Highway Research in Ohio

By

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By THOMAS H. MAC DONALD,
Chief, United States Bureau of Public Roads

This article by Mr. MacDonald, the chief highway builder of the nation, covers the scope and purpose of the traffic and transport survey that is now in progress in Ohio. The survey is nine months under way and will be completed December 14, 1925.

The survey is carried forward cooperatively between the U. S. Bureau of Public Roads and the Ohio Division of Highways and the cost for the same is met on a 50-50 basis. The work is conducted under the supervision of J. G. McKay, Chief Division of Highway Economics, U. S. Bureau of Public Roads, who is represented in Ohio by Major B. P. Root as field manager. The Ohio Division of Highways is represented by Harry E. Neal traffic Engineer who, with Major B. P. Root, select the personnel and purchase equipment and supplies. Supervision over the general plan is in charge of Mr. MacDonald, Mr. McKay and Director Schlesinger.

The result of this work will serve as guide in determining character of future improvements, also methods of reconstruction and maintenance. It will likewise be of much value to legislators and other officials in providing legislative data as to traffic density and control.—Editor.

THE improvement of a highway system increases the public welfare through the production of highway transportation service. The justification of an improvement program depends upon the amount and quality of transportation service produced. There is no difference in principle between the public business of producing highway transportation facilities and a private business engaged in the production of commodities.

The same basic principles of management govern public and private production. Applied to the public business of producing highway transportation service the first of these principles is an analysis of the public demand for highway service and a determination of the mileage and type of highway improvements to be produced in order to serve traffic needs.

The second basic principle, following the determination of the amount and type of highway improvements necessary for present and expected future traffic, is a financial analysis of the funds necessary to carry out the required betterment program.

The third principle is the engineering and business management of the physical production of the improvement.

The highway engineer as the director of the public business of producing transportation service is responsible for the analysis (1) of the demand for his product, (2) a financial analysis of the revenues available and the establishment of a budget for the period of the improvement and (3) the business management of the improvement program.

The following discussion deals primarily with the first of these functions.

The demand for improved highway service has grown with the increase in motor vehicle registration and completion of improved highway mileage. Highway traffic in Maryland, Maine, Michigan and Wisconsin has been found to increase approximately in proportion to motor vehicle registration. Motor vehicle registration has doubled and redoubled during the past eight years. In 1916 the registration of motor vehicles in the United States was 3,512,996; in 1920 it was 9,231,941 and in 1924 it had increased to 17,591,981, an increase of 400 per cent during the eight year period. In the state of Ohio, motor vehicle registration has increased at approximately the same rate; in 1916 the registration was 252,431, in 1920, 621,390 and in 1924, 1,241,600.

This tremendous increase in the number of transportation units has revolutionized highway traffic and highway transportation. It has made the provision of highway service one of the important industries of the country. Each year since 1920 the expenditures for rural highways in the United States have approximated one billion dollars. Ohio, with over 84,000 miles of rural roads has each year expended large sums in construction, maintenance and improvement of this net work of highways. The cost of providing highway service is paid by the people of the state. The administration of this great industry in the most efficient manner, the manner which will give the people of Ohio the most efficient highway service for the expenditures of public funds, is accompanied by economic and engineering problems of great importance. These problems are grouped under three headings—where to build, how to distribute the cost of the improvement, and how to build. A satisfactory solution of these problems can be found only as the result of comprehensive economic and engineering studies.

The state of Ohio, realizing the need for such researches, has entered into a co-operative agreement with the Bureau of Public Roads, United

States Department of Agriculture for the conduct of a state wide investigation of highway problems. These investigations were begun in December 1924. Credit is due L. A. Boulay, recently Director of the Ohio Department of Highways and public Works, G. F. Schlesinger, the present Director and H. J. Kirk, State Highway Engineer, for the initiation of these investigations in an earnest endeavor to arrive at a sound basis for future highway planning, construction, maintenance, and regulation in Ohio.

The general purpose of these investigations is to secure and develop facts and principles which will aid in the planning and construction of the most economical and serviceable highways, the best design of highways to serve traffic requirements, and the further advance of the science of highway development.

One of the important research projects inaugurated under this co-operative agreement is the "Ohio Highway Transportation Survey." This research deals particularly with the economic phases of the formulation of a scientific and economical plan of highway development.

Traffic counts have been made in previous years at selected points on the highways of Ohio. These counts have yielded valuable information and indicate the historical trend of highway traffic without which the accurate prediction of the future trend of traffic becomes more difficult.

A count of vehicles, however, does not disclose all the important facts necessary for the economic and engineering development of a highway system. The use of some highways by motor truck freight lines and heavy units of transportation makes the daily tonnage and frequency of truck and bus traffic as important a factor as the daily number of vehicles. In order to obtain more complete traffic information, the traffic count has been extended to include the recording of vehicles weights and additional data.

Data obtained during the present survey include (a) the number and type of vehicles; (b) the rated capacity and gross, axle and wheel loads of motor trucks; (c) principal commodities transported by motor trucks; (d) towns of origin and destination of passenger cars and motor trucks; (e) the type of usage of passenger cars and (f) the number of out-of-state vehicles. Figures 1 and 2 show the data sheets used in recording motor truck and passenger car information.

The first step in the organization of the Ohio survey was the selection of the highways, and later of the points of these highways, where traffic information is now being recorded. The location of principal industries, population of cities and towns, and other economic factors which affect highway traffic in the different areas of the State were given careful consideration in the selection of the 354 traffic survey stations. Motor truck weights, as well as all other traffic information, are recorded at 156 of these stations; at the remaining stations all information, with the exception of motor truck weights, is recorded. A sufficient number of operations are made at each station during the period of the survey to insure an adequate sample of traffic.

In addition to the regular operation of the 354 survey stations, statewide counts of vehicles on the highway system are taken during each season of the year. These counts of vehicles are made on the same day and at the same hours at over 1000 selected points on the State Highway System and are made possible by the help of the Boy Scouts of the State. These simultaneous counts at over 1000 stations supplement the data recorded at the 354 survey stations and make possible an analysis of traffic on the entire state system under practically the same traffic conditions.

The completition of this investigation will make available to the State of Ohio a large volume of valuable data regarding highway utilization in the State. The present density and distribution of traffic on the highways of the State will be accurately determined. A graphic presentation of the density and distribution of passenger car traffic on the principal highways of the State is shown in Figure 3. This figure presents, superimposed on the State highway map, the relative density of passenger car traffic on the various highways. As the investigation is still in progress the data here presented must of necessity be based upon records obtained to date. The final analysis of traffic on each route will be computed for a 24 hour day. The passenger car traffic densities shown are the average of several observations at each survey station between the hours of 10 A. M. and 4 P. M., during the period December 15, 1924 to June 15, 1925. As this period does not include the maximum traffic season of the year, and as the results are based upon only six or seven counts, and a period of six hours per day, the final results will vary materially from the data shown in Figure 3.

Upon the completion of the investigation, complete data for the entire year for total vehicles and motor trucks as well as for passenger cars, and maximum traffic as well as average traffic will be available. Figure 3 does, however, indicate the great variation in traffic upon the various highways. The most important routes in the state are clearly indicated.

Route 2, extending from the Pennsylvania state line through Ashtabula, Cleveland, Elyria, Fremont, Toledo and Bryan, to the Indiana state line is one of the heaviest travelled routes in the state. Along this route was observed the following average number of passenger cars for the six hour period:

On Route 1, the National Road, passenger car traffic, for the six hour period, averages about 325 vehicles at all points as far as Zanesville. West of Zanesville to Springfield, this average increases to over 500. From Springfield the traffic passes west to Brandt, leaving the National Pike at this point, passing south to Dayton over route 201, and west out of Dayton over route 11 to Eaton, and thence northwest back to the National Road.

Another important east and west route is the Lincoln Highway extending from Salem through Canton, Massillon, Wooster, Mansfield, Bucyrus and westward along Route 5. This route carries an average density of nearly 500 passenger cars as far as Bucyrus. Upon the unimproved section west of Bucyrus an average of less than 40 cars for the six hour period was observed. The greatest density of traffic on the state system was recorded on the section between Canton and Massillon on Route 5, an average of 1778 passenger cars during the six hour period.

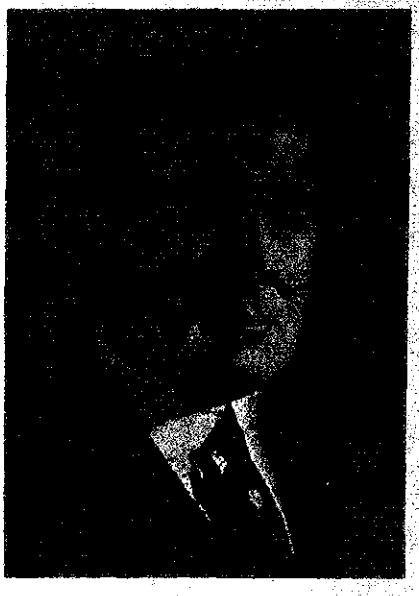
The heavily travelled north and south routes are not as well-defined. One extends from Cincinnati north to Hamilton, Dayton, Piqua, Lima and Findlay.

The longest north and south route traverses the whole state, beginning at Portsmouth, thence to Chillicothe, Columbus, Delaware, Marion, Findlay and Toledo. The average six-

Federal and State Officials Cooperating in Traffic Survey

J. G. McKay,
Chief Division of Highway Economics, U. S. Bureau Public Roads.

G. F. Schlesinger,
Director Ohio Department of Highways and Public Works.



L. A. Boulay,
Former Director, Ohio Department of Highways and Public Works.

Leading participants in the traffic and transport one-year survey now in progress on the state highway system.

Harry J. Kirk,
State Highway Engineer.

The field forces, consisting of four divisions operate at 354 stations and are grouped into seventeen parties as follows: Three weight parties, eleven recording parties, two density parties and one night party.

Harry E. Neal,
State Traffic Engineer.

George E. Carr,
Chief Engineer of Maintenance.

Major B. P. Root,
Field Manager, Transport Survey Bureau, U. S. Bureau of Public Roads.

hour densities observed along this route were:

Station location	Average Number of Passenger Cars 10 A.M.—4 P.M.
North of Portsmouth	278
South of Chillicothe	331
North of Chillicothe	338
South of Columbus	400
North of Columbus	1085
North of Delaware	332
North of Marion	292
South of Findlay	257
North of Findlay	405
North of Bowling Green	676

Another well travelled north and south route passes from Dennison to New Philadelphia, Massillon, Akron and Cleveland. This route has a minimum traffic density of 419 passenger cars north of New Philadelphia and 756 south of Massillon.

Route 16, from Youngstown to Cleveland, has a minimum traffic of 502 cars for the six hour periods. Traffic is heavy on the improved routes in the densely populated and highly industrialized areas surrounding Canton, Akron and Cleveland, particularly between Akron and Cleveland.

The greater density of traffic in the areas surrounding important centers of population is also very apparent. This relationship of traffic to population is an important factor in highway planning.

The map clearly indicates the variation in passenger car traffic upon the highways of the state system. The average daily passenger car traffic varies from a maximum of 1778 to a minimum of less than 10 passenger cars during the six hour period. This large variation in traffic density on different highways demonstrates clearly the need for traffic information as a guide to efficient and economical planning of a highway system.

The completion of the survey will make available not only detailed information regarding the average and maximum present density of various types of traffic on all highways but will also make possible the prediction of future traffic upon these highways with reasonable accuracy. The earlier traffic counts made by the State Highway Department are of particular value as indices of the rate of growth of highway traffic over a series of years. Without such indices it is more difficult to make an accurate prediction of future traffic.

Present and expected future traffic density are among the important factors in determining the location, type of improvement and width of highway betterments, and the logical order of improvement of the various routes in the system. The type of traffic, however, is frequently as important a factor as the daily density of traffic. The proportion of heavy duty motor trucks to total truck traffic and the passenger bus traffic upon a highway are frequently the determining factors in the proper selection of the type and design of a highway to serve traffic needs.

The distribution of motor trucks by rated capacities is a reliable index of the present and expected type of truck traffic on a highway. A partial analysis of the traffic at two points on the Ohio State Highway System has been made from data available to date as an illustration of one of the types of information which will be available upon the completition of the investigation. The first of these points is Station No. 508 located on the main road between Youngstown and Warren, about 2 miles north of Girard and 3 miles east of Niles, at the Junction of State Routes 16 and 169. The second is Station No. 812 on State Route 2, about 5 miles east of Toledo. Both of these stations are on important highway routes but the variation between them is significant. Up to June 15 each of these stations has been operated seven ten-hour periods. The number of the various types of vehicles recorded at each station during 70 hours is: see Table A.

The total traffic at Station 508 is approximately 60 per cent higher than at Station 812, but truck traffic at Station 508 is 129 per cent higher than truck traffic at Station 812. Passenger bus traffic which is quite important at Station 508 is not important at Station 812.

The composition of traffic by types of vehicles at the two stations is: see Table B.

The greater importance of truck traffic at Station 508 is again indicated by the following tabulation of loaded trucks by capacity groups.

TABLE A

Station	Passenger Cars	Motor Trucks	Passenger Buses	Horse Drawn Vehicles	Total Vehicles
508	14,386	2,231	548	65	17,230
812	9,820	974	6	1	10,801

TABLE B

Station	Passenger Cars Per Cent	Motor Trucks Per Cent	Passenger Buses Per Cent	Horse Drawn Vehicles Per Cent	Total Vehicles Per Cent
508	83.5	12.9	3.2	0.4	100.0
812	90.9	9.0	0.1	0.0	100.0

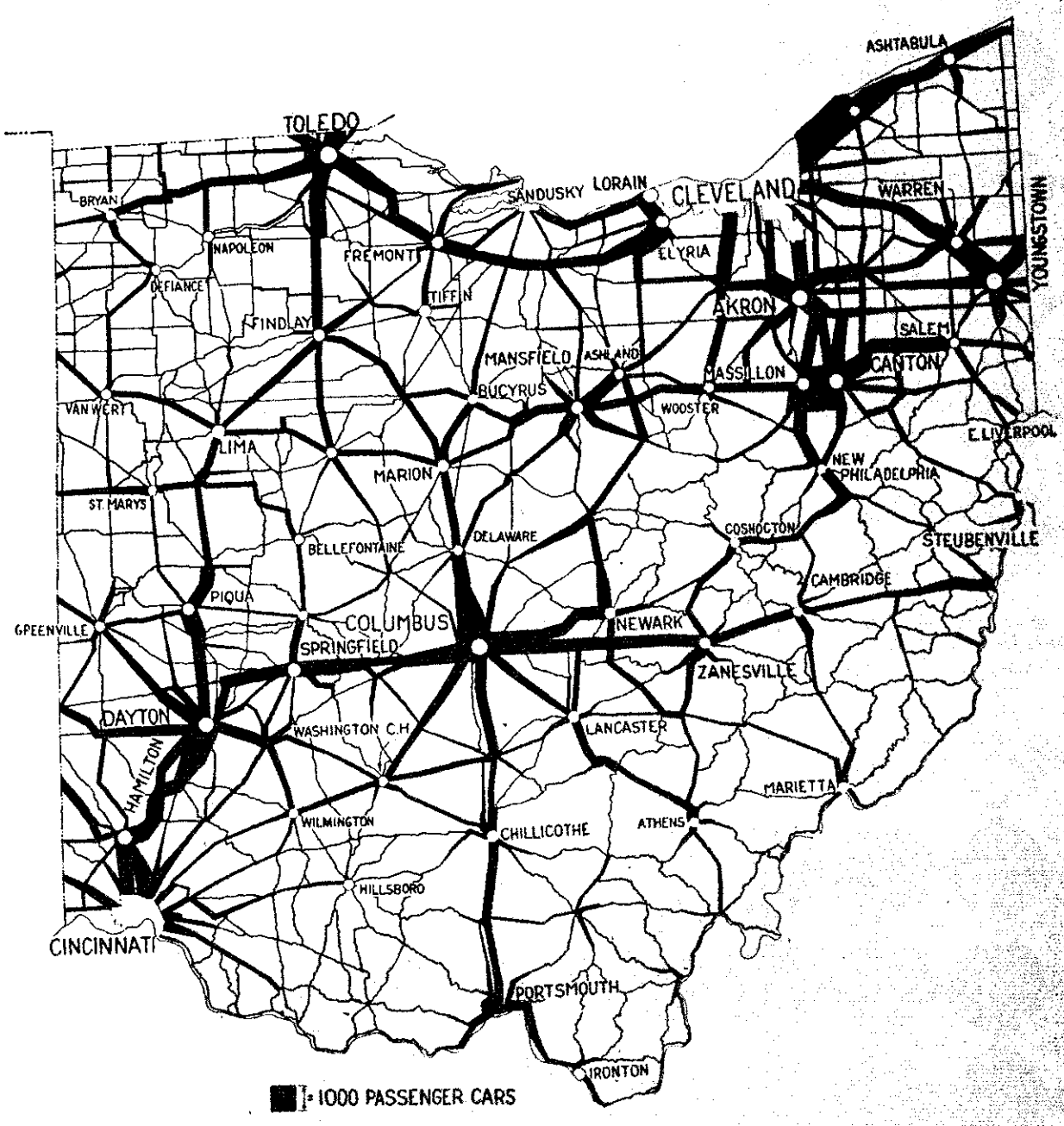
TABLE C

Capacity Groups (tons)	STATION 508		STATION 812	
	Number	Per Cent	Number	Per Cent
½—1½	923	64.6	452	73.4
2—2½	255	17.8	102	16.5
3—4	192	13.4	49	7.9
5—5½	59	4.2	12	2.0
6—7½	0	0.0	1	0.2
TOTAL	1,429	100.0	616	100.0

TABLE D

Gross Weight Groups (pounds)	STATION 508		STATION 812	
	Number	Per Cent	Number	Per Cent
5,000 and under	388	45.6	134	41.0
5,100—10,000	236	27.7	120	36.7
10,100—15,000	110	12.9	36	11.0
15,100—20,000	74	8.7	23	7.0
Over 20,000	43	5.1	14	4.3
TOTAL	851	100.0	327	100.0

Passenger Traffic Flow Map



Empty trucks are in approximately the same ratio to total trucks at both stations, being 35.9 per cent of total trucks at Station 508, and 36.8 per cent at Station 812, and can therefore be eliminated without affecting the comparison of the two stations.

The distribution of loaded trucks by rated capacity groups is: see Table C.

Not only has Station 508 the greater number of trucks but it also has the greater proportion of large capacity trucks. Trucks of 3 ton and larger capacities are 17.6 per cent of total loaded trucks at Station 508 as compared with 10.1 per cent at Station 812. During similar periods Station 508 has 251 trucks of 3 ton and larger capacities as compared with 62 at Station 812.

The gross weight of motor trucks is quite closely correlated with the rated capacity. Some variation does exist due to differences in the commodities transported, loading practices and the maximum legal gross loads in different areas but the correlation is generally quite close. In the State of Maine it was found that the number of trucks on any highway weighing less than 12,000 pounds agreed very closely with the number of trucks of less than 3 ton capacity. An analysis of the gross weight of loaded trucks at Stations 508 and 812 is as follows: see Table D.

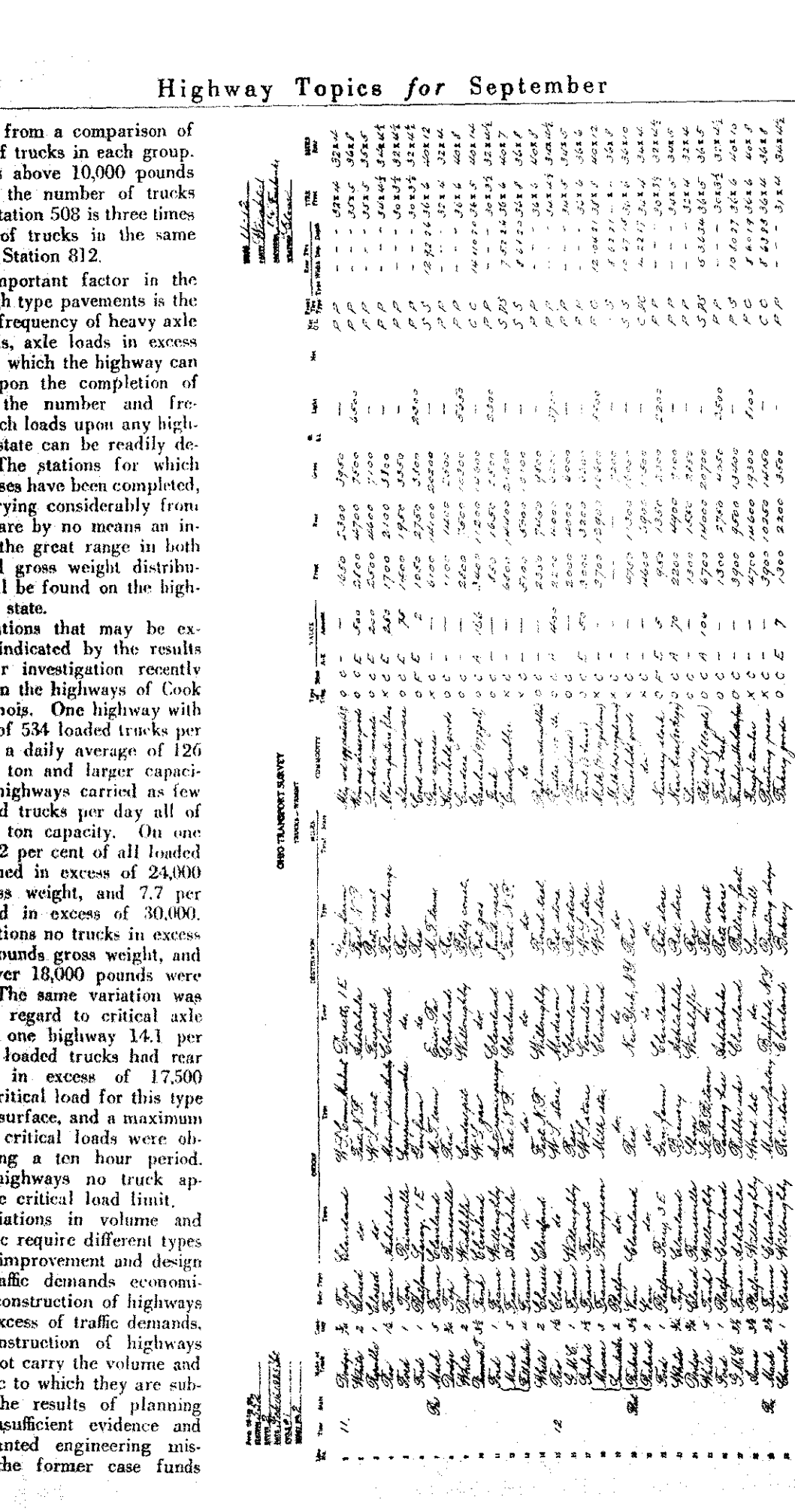
Station 508 exceeds Station 512 in the percentage of trucks in each gross weight group above 10,000 pounds. The greater importance of the highway upon which Station 508 is located for heavy duty trucks is even

more evident from a comparison of the number of trucks in each group. In all classes above 10,000 pounds gross weight the number of trucks observed at Station 508 is three times the number of trucks in the same class than at Station 812.

A very important factor in the design of high type pavements is the number and frequency of heavy axle loads; that is, axle loads in excess of safe loads which the highway can support. Upon the completion of the survey the number and frequency of such loads upon any highway in the state can be readily determined. The stations for which partial analyses have been completed, although varying considerably from each other, are by no means an indication of the great range in both capacity and gross weight distribution that will be found on the highways of the state.

The variations that may be expected are indicated by the results of a similar investigation recently completed on the highways of Cook County, Illinois. One highway with an average of 534 loaded trucks per day carried a daily average of 126 trucks of 5 ton and larger capacities; other highways carried as few as 10 loaded trucks per day all of less than 5 ton capacity. On one highway 15.2 per cent of all loaded trucks weighed in excess of 24,000 pounds gross weight, and 7.7 per cent weighed in excess of 30,000. At other stations no trucks in excess of 24,000 pounds gross weight, and very few over 18,000 pounds were observed. The same variation was observed in regard to critical axle loads. On one highway 14.1 per cent of all loaded trucks had rear axle loads in excess of 17,500 pounds, a critical load for this type of highway surface, and a maximum of 97 such critical loads were observed during a ten hour period. On other highways no truck approached the critical load limit.

Such variations in volume and type of traffic require different types of highway improvement and design to serve traffic demands economically. The construction of highways greatly in excess of traffic demands, and the construction of highways which will not carry the volume and type of traffic to which they are subjected are the results of planning based on insufficient evidence and are unwarranted engineering mistakes. In the former case funds



Sample Field Record—Truck Data

which could be used more advantageously on other highways are expended for the improvement of a highway beyond the present and expected future traffic needs; in the latter high maintenance costs and the necessity of early reconstruction will result in a total cost greatly in excess of the cost of providing an adequate type of highway in the first place.

The transportation survey will provide valuable information regarding serviceable types of improvement for various highways in the state. The volume, composition and type of traffic on highways will be compared with the construction and annual maintenance costs of the present type of improvement upon these routes. As a result of these comparisons the most economical types of highway improvement for various amounts and types of traffic will be established.

Highway traffic is predominantly short distance movement. This is particularly true of motor trucking but is also generally true of the passenger car movement. Long passenger car trips are quite common but are small in number as compared with the local movement. The results of the Connecticut Transportation Survey indicate that 55.7 per cent of all passenger cars have an average trip mileage of less than 20 miles, and 72.0 per cent less than 40 miles. In the same state it was found that 81.1 per cent of the motor trucks traveled less than 30 miles per trip. In Cook County, Ill., the corresponding percentage was 75.8 per cent.

The similarity between these data and Ohio conditions is indicated by the fact that in the preliminary analysis of Stations 508 and 812 it was found that approximately 88 per cent of the trucks travel less than 25 miles per trip. At Station 812 only approximately 46 per cent travel less than 25 miles per trip. This station has an unusual amount of long distance traffic due to its location on the main highway from Cleveland to Toledo and Detroit.

The predominance of the local or short haul movement necessitates the careful study of each section of the highway system. Traffic conditions may be very different on sections of the same route a few miles apart.

Figure 3 indicates the rapid increase in passenger car traffic as a route approaches the larger cities. Investigations in other states have demonstrated that this condition is equally true of trucks. In Cook County, Ill., it was found that a highway with a total traffic of over 6,600 vehicles per day near the City of Chicago had less than 2,100 vehicles at a point approximately 20 miles further distant from the city. Another highway having over 15,000 vehicles per day at the Chicago city limits had less than 4,500 vehicles per day at a point approximately 9 miles from the city line. Truck traffic decreased from 405 trucks to

OHIO TRANSPORT SURVEY

PASSENGER CAR DATA

Time										ORIGIN	DESTINATION	Total Miles	State Miles
1	7 00	Ford		2			x			Ashland	Bellaire		
2		Ford					x			do	do		
3		Ford		1		x				Zanesville	Columbus		
4		Ford					x			do	Hopewell, 16		
5		Dodge			x		x			Columbus	Zanesville		
6		Nash								Zanesville	Columbus		
7	Mich	Ford				x			x	Pittsburgh, Pa	Tulsa, Okla		
8		Dodge			x		x			Zanesville	Hopewell		
9		Ford					x			do	Columbus		
10		Ford		2	x		x			Springfield	Zanesville		
11	Pa	Chevrolet		2			x			Washington, Pa	Newark		
12		Ford		2	x			x		Hopewell 16	Zanesville		
13	Calif	Chev		2		x	x		x	Baltimore, Md	Los Angeles, Calif		
14		Buick		1	x		x			Cambridge	Ashland		
15		Dodge			x			x		Zanesville 3W	Zanesville, 19		
16	Ind	Olds				x	x			Zanesville	Indianapolis, Ind		
17		Nash		2	x			x		do	Zanesville, 6W		
18	Conn	Nash				x	x		x	Bridgeport, Conn	Peoria, Ill		
19	Me	Nash		1		x	x		x	Milo, Me	Sidney		
20		Ford		2		x	x		x	do	do		
21	W Va	W W		2		x	x			Zanesville	Columbus		
22		Dodge		2		x	x		x	Niagara Falls, N Y	Cincinnati		
23		Ford		1		x	x			Cambridge	Columbus		
24		Ford		2	x		x			Coshocton	do		
25		Ford		1	x			x		Zanesville 3W	Zanesville		
26	Pa	Stud		2		x	x		x	Columbus	Philadelphia, Pa		
27		Stud		2		x	x			do	Zanesville		
28		Buick		2	x		x			Byesville	Columbus		
29	Ky	Marmon		1		x	x		x	Mt Clemens, Mich	Washington, D C		
30	8 00	W Va	Ford		6		x	x		x	Wheeling, W Va	Birmingham, Ala	
31			Star		1	x		x			Zanesville	Zanesville 5W	

HOURS 7-8

WEATHER Clear

PARTY CHIEF E. F. Fairbanks

Sample Field Record—Passenger Car Data

66 trucks per day on the former highway, and from 543 trucks to 238 trucks on the latter highway.

Although it is doubtful if such great variation in actual traffic density will be found upon highways in the proximity of cities in Ohio the tendency is present and the proportional changes in traffic volume are probably equally pronounced. This means that a highway which is badly congested at one point may be of ample capacity to serve the traffic using it at a point only a few miles distant. In order to be able to provide the necessary highway service at these points of varying traffic it is necessary to analyze the sources of traffic upon the highways. Whether the most efficient way of relieving congestion at certain points is the widening of the present route or the provision of a parallel route must depend upon the principal sources of traffic upon the route. Traffic, within certain limits, will follow an improved highway even though an indirect route in preference to a more direct but less highly improved route. It is quite possible that the improvement of an additional highway route may not only relieve congestion on a present route but may also provide a more direct route for a considerable part of the traffic. A knowledge of the sources of traffic is also of great assistance in the selection of routes to be improved.

Let us take for example the case of two centers of population served at present by two unimproved routes. Traffic may not warrant the improvement of both routes. An analysis of the sources of traffic may demonstrate that the improvement of one route may provide improved service to the traffic now using both routes without compelling any considerable part of this traffic to use an indirect or longer route. The improvement of the second route may not provide economical service to the traffic now using the alternative route, or may provide service to this traffic only at additional cost caused by the necessity of using a longer and more indirect route. One route may provide improved service to a large volume of local traffic as well as to through traffic between the centers of population. The alternative route may be so located as to serve very little local traffic. A knowledge of the source of traffic is necessary to estimate the total traffic which will be served by a proposed improvement.

Upon completion of the Ohio Survey information regarding the origin and destination of the traffic upon the various highway routes of the state will be available and will provide data regarding the important sources of traffic which must be considered in the solution of problems of highway planning.

In order that highway funds may be economically and equitably distributed over the entire system of highways in the state the relative traffic importance of the various highways of the state must be determined. The highways of the state may be divided into four classes—national interstate routes, state, County, and township highways. This classification is based upon the area of influence of the highway, whether a highway is predominantly of local significance, of importance to the entire county, state, or is national in importance.

In the state of Maine it was found that the primary highway system, comprising 7.1 per cent of the total highway mileage in the state, serves 53.4 per cent of the total traffic of the State, measured in terms of vehicle mileage, also that 300 miles of the primary system, comprising only 1.3 per cent of the total highway mileage in the state serves 20.7 per cent of the total traffic in the state.

The actual percentage of the total traffic which is served by each of the four classes of highways will vary among the several states depending upon the amount of mileage included in each classification. The transportation survey will make possible an accurate determination of the highways which should be included in each classification as well as supplying information which is necessary for an equitable distribution of highway funds among the various classes of highways.

It is generally accepted as a sound rule of highway planning that no highway should be improved beyond the earning power or service of the improvement. In terms of private industry this rule is that an investment is not justified which will not earn a fair rate of return. As a corollary of this rule it may be stated that the investment which yields the greatest return on the investment should be made first. To follow this rule scientifically it is necessary to determine the service value of the highway system and of each highway route.

A survey of highway transportation in Connecticut revealed the fact that the State Highway System, comprising slightly over 1100 miles, during a period of one year carried approximately 414,000,000 vehicle miles, approximately 58,000,000 net ton miles of freight and approximately 974,000,000 passenger miles. In Cook County, Illinois it was found that 418 miles of highway carried a daily total of approximately 991,000 vehicle miles.

Although there exists no accurate method of measuring the value of this service and expressing it in monetary terms a conservative estimate of the annual service value of the Connecticut State Highway System reaches a total of over $5,000,000, or a return of over 20 per cent on the estimated replacement value of the system.

The completion of the present survey will also make available to the State of Ohio similar data for the various highway systems of the state and for individual highway routes within the State.

This type of information will also be of value in determining the extent to which various types of highway improvement such as re-locations, grade reductions, the elimination of railway crossings and highway intersections at grade, and the elimination of traffic congestion points and "bottle necks" are economically justified.

The survey will also furnish information which is essential to the scientific regulation of highway traffic, particularly the establishment of weight regulations which will permit the greatest freedom of highway use that is consistent with highway safety and the preservation of the highway investment.

It will also make available general economic data regarding the relation of highway transportation to other forms of transportation and the coordination of the various types of transportation.

These various types of information which are being produced by the survey will enable the state of Ohio to establish a scientific plan of highway improvement for a period of several years. It will permit the traffic classification of Ohio roads into the various highway systems, and an equitable distribution of highway funds among these systems in proportion to traffic use. It will permit the selection of the most

conomical types of highway improvement for various highways ased on (1) the density of present nd future traffic, (2) the ratio of ucks to total vehicles, (3) the proortion of large, medium, and small apacity trucks and resulting gross oads, (4) maximum wheel loads, 5) the frequency of critical gross oads and wheel loads, (6) probable aintenance costs on various types f highway surfaces and (7) probble variation in the transportation osts with various types of highway urface.

It will also permit the selection f the order of improvement of vaious highway routes in order to rovide for the State the greatest ossible highway service at the low-st practicable cost. Finally it will ermit the establishment of a defiite highway budget based upon resent and expected future highay needs.

An investigation dealing more articularly with the financial phase f highway planning will shortly be ndertaken in the state of Ohio under the co-operative agreement between the Ohio Department of Highways and Public Works and the United States Bureau of Public Roads.

The primary objective of this investigation is to determine the effect of various types of highway improvement upon the value of agricultural land. Such information is necessary to a scientific distribution of highway costs among the various classes which derive benefits from the improved highways.

The general plan of the investigation includes a farm to farm survey in selected areas of the state. Information regarding the value of these farms and measurements of the factors affecting such values will be obtained from farm operators, county records and other supplementary sources of information.

An investigation of this nature is particularly valuable in Ohio due to the quite general use of the special assessment method of obtaining funds for highway improvement.

The survey is expected to provide valuable data to highway officials in the establishment of sound and equitable principles of highway finance. The results obtained regarding land values and the factors influencing these values will also be of service to farm operators in the establishment of fair tax assessments and in the valuations of agricultural lands for loan purposes.

The highway transportation survey and the investigation into the effect of highway improvements upon rural land values will give the state of Ohio the benefit of the most recent developments in highway research methods and will make available to the state essential data necessary for the efficient and economic development of its highway system.

The Bureau of Public Roads desires to express its appreciation of the co-operation it has received from the Ohio Department of Highways and Public Works, especially from Mr. Boulay, Mr. Schlesinger, Mr. Kirk, Mr. Neal and members of the Department staff who are assisting in these investigations.