

9. In the previously published study on uphill speeds, the truck crawl speeds could be easily ascertained since the gradients imposed limits which the trucks could not exceed. However, in this downhill study, the speeds encountered were apparently those which the individual driver considered proper.

10. It was found that acceleration rates of trucks on downhill grades seldom approach the maximum acceleration inherent in a truck.

11. The average truck speeds on downgrades and level road are nearly the same and are approximately equal to the national average speed of free moving vehicles traveling level 2-lane roads of modern design. No appreciable delay was caused the average passenger vehicle following the truck.

12. If a separate lane for passing trucks on the upgrade is provided when necessary, the problem should be solved, since speeds observed in this study indicated no justification for an extra lane for trucks on downgrades. The exception to this is the idea that it might be well to continue the uphill truck lane over the crest of the hill to a point where the

truck reaches a speed of say 50 mph. From data collected in this report the distance required to do this is roughly 0.4 mi. beyond the summit.

#### ACKNOWLEDGEMENT

Photographs were taken by Mr. Norman G. Wallace, Chief Locating Engineer, Arizona Highway Department, Mr. John M. Nutter and Mr. H. D. Sines of the Arizona Highway Department and Mr. Eddie Deuel, Photographer, Phoenix, Arizona. Mr. J. W. Dewey was project chief in charge of field operations.

#### REFERENCES

- There seems to be almost no published material on this type of a study. However, considerable use was made of the following works during the period of processing the field data.
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## SPEEDS ON RURAL HIGHWAYS, PAST AND PRESENT

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### SYNOPSIS

Of the many respects in which automotive vehicles have been improved in the past 50 years, none has affected our lives so profoundly as the tremendous increase in speeds. The record for the fastest mile has risen from 39 mph. in 1898 to 394 mph. at the present time, while even the cheapest of the standard American cars can now be driven faster than 80 mph.

The speeds at which people drive on the highways are important for at least three reasons: (1) speed is what makes automobiles useful, and anything which reduces actual driving speeds takes away a part of their usefulness; (2) speeds are related to accidents, making it essential that safety officials pay attention to speed trends; (3) driving speeds are important to the designers of new highways, whose job it is to satisfy the desires of most drivers without going to unnecessary expense.

Continuous records of speed trends before World War II are scarce. A number of states made "one-shot" speed surveys of a fairly intensive character during the depression years of the 1930's, but these studies were not repeated in a way which would have permitted year-to-year comparisons. It was only in 1942, with the restrictions on gasoline and rubber, that the states began to make continuing large-scale speed studies.

The earliest usable speed-trend information comes from Rhode Island, where the average speed showed a steady increase from 22 mph. in 1925 to 34 mph. in 1934. A second state where pre-1940 figures can be used is New York, in which seven of the locations studied intensively by the Bureau of Public Roads in 1935 were restudied in 1950. The results show a slight drop in the average speed,

from 43.5 mph. in 1935 to 41.7 mph. in 1950, accompanied by a noticeable increase in the concentration of speeds around their central values. Traffic volumes were about the same for the two sets of speed data.

The studies conducted more or less continuously by a large number of states since 1941 show a sharp decline in the middle of 1942 to a wartime low of 36 mph. in the fall of 1942. There has been a gradual recovery since that time to a level slightly higher than prewar. From a prewar value of 47 mph. the national average speed on main rural highways dropped to 36 in the fall of 1942, was back to 40 by the end of 1943, reached 45 in the middle of 1946, and leveled off at about 48 in 1948.

Speeds in the central and western regions of the country are consistently higher than in the East. Of the different vehicle types, busses are consistently a little faster than passenger cars, with trucks some distance behind. While busses and passenger cars have returned approximately to their prewar speeds, trucks are now averaging about 3 mph. faster than they did before the war. There is little reason to expect much change in highway speeds in the next few years unless there should be new restrictions on the consumption of rubber and gasoline.

Speed is the essential characteristic of the modern motor vehicle. While there are many respects in which today's cars and trucks differ from earlier types of vehicles, none has affected our lives so profoundly as the great increase in speed which we now take for granted.

The speeds at which people drive are important for at least three reasons. The first, as we have already noted, is that speed is what

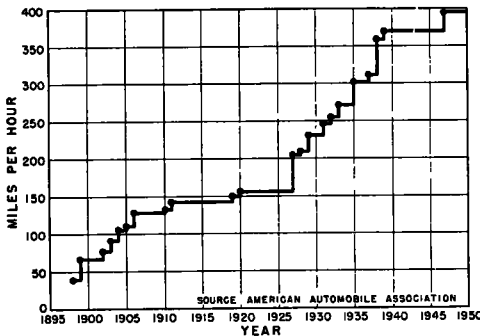


Figure 1. Speed Record for the Fastest Mile

makes automobiles useful. Anything which reduces speeds, be it traffic congestion or a man-made speed limit, deprives the automobile of a certain part of its usefulness, though restrictions are sometimes necessary for the safe and orderly movement of traffic. Secondly, speeds are related to accidents. There is no desire to take sides here in the controversy over whether or not speed is a "cause" of accidents, but it is undeniable that the severity of accidents tends to increase with

higher driving speeds. And third, the speeds at which people like to drive are important to highway designers. It is frustrating for a 50-mph. driver to travel on a 30-mph. road, while it is a waste of public funds to build 80-mph. roads if only a handful of drivers are interested in going that fast.

Actual driving speeds are related, of course, to the speeds of which the vehicles are capable. It is of interest to examine the way in which the speed potentiality of the motor vehicle has advanced in the years since the automobile was first invented.

Figure 1 shows how the speed record for the fastest mile has increased from 39 mph. in 1898 to 77 mph. in 1902, over 100 mph. in 1904, over 200 mph. in 1927, over 300 mph. in 1935, and finally in 1947 to 394 mph., which is the current record.<sup>1</sup> The vehicles which have made these records are special racing cars, not ordinary automobiles, but these speeds do show the progress which has been made in vehicle design. They represent an upper limit to the speeds at which self-powered motor vehicles can run on level ground.

Somewhat more like the ordinary automobile is the type of vehicle used in the annual 500-mi. race at the Indianapolis speedway. The average speed of the winner of this race (see Fig. 2) has increased from 75 mph. in 1911 to about 100 mph. in 1925 and 124 mph. in 1950. The speed at Indianapolis has not increased anywhere nearly as fast as the one-mile record. The 40 years in which the Indi-

<sup>1</sup> The data in Figures 1 and 2 are based on information obtained from the Contest Board of the American Automobile Association.

anapolis record went up by two-thirds saw the one-mile record go up by a factor of almost three.

Finally, let us look at the top speeds of American stock cars (Fig. 3). Here we see a rapid increase up to the mid-1930's with little change since that time. Almost any car today can be driven as fast as 80 mph. Since there are few highways on which a sustained speed of this magnitude is possible and almost no drivers are competent to drive safely at such speeds, there is little reason to expect much increase in the speed capabilities of standard American cars.

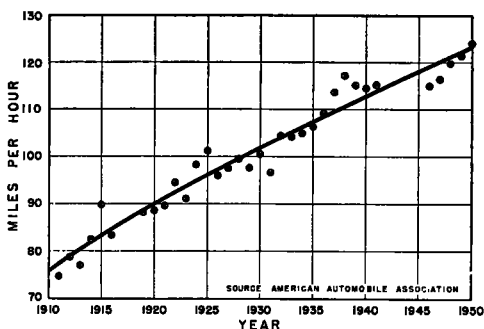


Figure 2. Average Speed of Winner at Indianapolis 500-Mile Race

With these top speeds in mind, let us now look at the actual driving speeds on the highways. It is impossible, unfortunately, to show the trends in highway speeds over a long period like 30 or 40 years, because there are no states in which speed studies have been carried on year after year for any such length of time. Continuous speed trends are available only for the past 10 years, during which there has been wide interest in the effects of the various restrictions which were introduced in World War II. Before discussing the nationwide trends of the past 10 years, however, we shall consider a few studies that do go back to an earlier period.

Rhode Island was the first state to conduct speed studies from which valid year-to-year comparisons can be made. The early studies, in the four years 1925-1928, were rudimentary, in that: (1) vehicles were simply timed with stop watches as they crossed fixed lines, without even using mirror boxes to assure accurate sighting of the vehicles; (2) no speed

distributions were published—only the lowest speed, the highest speed, and the average; (3) no information was obtained about traffic volumes or about the distribution of vehicle types. On the other hand, care was taken to see that the studies were made in the same months of successive years, and the balance among the various stations received careful attention from the people conducting the study.<sup>2</sup>

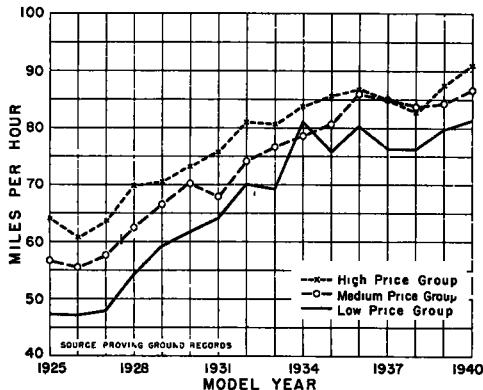


Figure 3. Average Top Speeds of American Stock Cars

TABLE 1  
RESULTS OF STATE-WIDE SPEED SURVEYS  
IN RHODE ISLAND

Year	Months	Average Speed
		<i>mph</i>
1925	May-July	19.1
	October-November	25.8
1926	April-June	21.7
	October-November	29.2
1927	April-June	24.3
	October-November	31.4
1928	April-June	27.3
	October-November	35.1
1934	August-September	34.1

The 1934 study in Rhode Island was a broader survey in which the Federal Emergency Relief Administration and the Bureau of Public Roads cooperated with the State Board of Public Roads.<sup>3</sup> A considerably wider

<sup>2</sup> Harry C. Burnham, "Summary of Traffic Observations Covering Period of Three Years, May 1925-December 1928." Mimeographed. Issued by the State of Rhode Island, State Board of Public Roads, Motor Vehicle Department. No date.

<sup>3</sup> "Rhode Island Highway Traffic Survey," published by Board of Public Roads, 1934.

range of information was obtained, but the only valid comparison that can be made with the studies going back to 1925 is in the average speeds. This comparison is presented in Table 1.

Two things are brought out by this table. The first is that speeds were slower in the spring months than in the fall. In every one of the four years, 1925-1928, the average speed for October and November was at least 6

price group rising from 47 mph. in 1925 to 81 mph. in 1934—it seems likely that the increases observed in Rhode Island reflect the substantial improvement in the automobile during those years.

A second place where pre-1940 speeds can be compared with recent observations is the state of New York, where intensive studies were conducted by the Bureau of Public Roads in 1935. Seven of the locations which were

TABLE 2  
SPEED DISTRIBUTIONS AT SELECTED LOCATIONS IN THE STATE OF NEW YORK IN 1935 AND 1950

Location	Direction	Total Hourly Traffic Volume		Percent Trucks		Vehicles Studied		Average Speed		Percentage of Vehicles Exceeding Various Speeds					
		1935	1950	1935	1950	1935	1950	1935	1950	40 mph.		50 mph.		60 mph.	
		<i>vph</i>	<i>vph</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Number</i>	<i>Number</i>	<i>mph.</i>	<i>mph.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>
2J	Northbound				4										0
	Southbound				5										0
	Both	684	661	2		1,904		45.4	41.6	75.8		29.7		5.7	5.4
2K1	Northbound				4		282	43.4	43.6		75.9		13.7		0
	Southbound				5		136	42.4	40.2		54.8		4.8		0
	Both	448	502	8		978				65.1		15.6		0.9	0
2K2	Northbound				2		298	46.4	44.0		79.0		12.1		0.3
	Southbound				2		245	46.4	41.3		58.6		5.7		0
	Both	610	543	4		800				79.4		32.0		3.6	0
2L1	Northbound			7	3	522	283	42.1	41.6	60.0	60.6	12.6	7.1	2.4	0.7
	Southbound			10	1	325	339	37.8	40.4	44.9	61.8	8.4	3.4	0.3	0
	Both	430	622												
2L2	Northbound			6	15	707	201	41.7	45.5	57.0	75.6	15.4	22.6	2.2	11.5
	Southbound			7	14	769	209	38.8	44.7	44.1	68.3	6.0	20.9	1.0	5.7
	Both	430	205												
2M1	Northbound			8	6	300	247	45.5	45.1	71.7	76.5	29.7	25.1	5.1	2.2
	Southbound			10	16	600	218	44.2	43.7		65.7		20.7		1.4
	Both	414	177												
2M2	Northbound			5	2	300	338	45.5	35.3	77.4	15.5	31.3	0.3	1.1	0
	Southbound			6	3	513	355	43.6	36.0		18.7		0.8		0
	Both	520	924												
All locations (each location weighted equally)		505	519	6	6	7,718	3,812	43.5	41.7	67.5	59.3	21.5	10.5	2.7	1.6

mph. faster than in the months of May and June. It is not known whether this is due to a difference in traffic volumes or to a difference in the amount of pleasure and tourist travel.

The second point, the important one, is that there was a steady increase in the average speed throughout the period from 1925 to 1934. If we may assume that the average speed in summer is halfway between the spring speed and the autumn speed, we get average summer speeds of 22 mph. in 1925, 25 in 1926, 28 in 1927, 31 in 1928, and 34 in 1934. Since this was a period in which the speed capabilities of American cars were increasing sharply—the average top speed for the low-

used in that year were restudied in the summer of 1950.<sup>4</sup> Detailed comparisons have been made for each location of the distribution of speeds in each direction, the traffic volumes, and the distribution of vehicle types. By choosing appropriate figures from the 1935 studies, it has been possible to compare speeds in 1935 and 1950 for closely comparable volumes of traffic at most of the locations. In looking at these figures it should be kept in mind that the locations are all on main rural

<sup>4</sup> The results of these studies will be published by the Bureau of Highway Planning in the New York State Department of Public Works.

highways of a type which was considered excellent in 1935 but is not in a class with the limited-access expressways that are being built at the present time.

The detailed comparison of the seven locations is given in Table 2, which shows that on the average there has been little if any net change in speeds at these locations during the past 15 years. The average of the average speeds at the seven locations has actually dropped from 43.5 in 1935 to 41.7 mph. in 1950. The comparability of traffic conditions can be judged from the fact that the average hourly volumes were 505 in 1935 and 519 in 1950. Six percent of the vehicles were trucks in each of the two years.

age of drivers in the speed groups between 40 and 50 miles per hour has increased."<sup>5</sup>

A comparison of the same two studies shows that the average speed increased from 40 mph. in 1933-1934 to 44 mph. in 1939, but it is not known whether the traffic conditions and the choice of locations are sufficiently alike to give the comparisons any validity. This is the usual difficulty when an attempt is made to compare independently made speed studies with one another.

So we come at last to the nationwide speed studies which have been made more or less continuously from 1941 to the present time. These studies are made on a really large scale

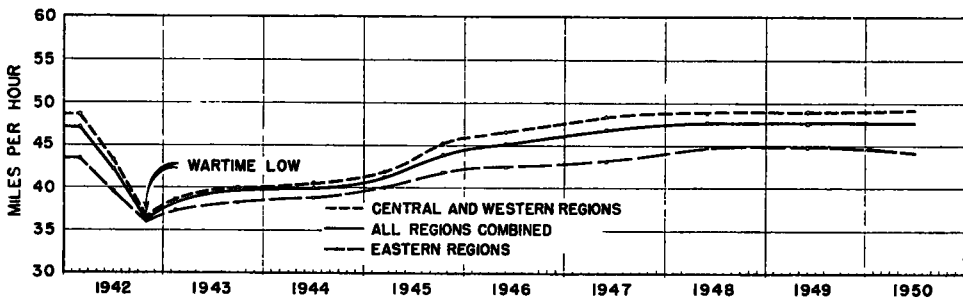


Figure 4. Average Speed on Main Rural Highways, by Region

While the average speed changed little in the 15 years, the dispersion has decreased somewhat. Where 21.5 percent of the speeds were over 50 mph. in 1935, there were only 10.5 percent in this group in 1950. Similarly, the percentage of speeds under 30 mph. has dropped from 5.5 to 3.8. Six of the seven locations show an appreciable drop in the standard deviation of the speed distribution, while the seventh had about the same amount of variation in both study years.

There are other states, like Connecticut, Maryland, and South Carolina, where intensive speed surveys have been made during one or two years, but there has not been the repetition at regular intervals which would permit the drawing of conclusions about speed trends over a period of years. The report of one such study, made in Connecticut in 1939, contains the statement that:

"A comparison between the speed distribution found in this study and a 1933-1934 speed study in Connecticut shows that the percent-

by the highway departments of more than half the states and are reported regularly to the Bureau of Public Roads. They give an excellent picture of the changes that have occurred and are occurring in speeds on main rural highways.<sup>6</sup>

Figure 4 shows the changes in average speed, broken down by regions. The average speed in the central and western regions of the country has been consistently higher than in the eastern region. Both these curves—and

<sup>5</sup> Quoted from Harry R. de Silva, "A Study of Motor-Vehicle Drivers and Speed in Connecticut." *Public Roads*, Vol. 21, No. 5, p. 90 (1940). The earlier study referred to is C. J. Tilden, D. L. Morris, T. M. C. Martin, and E. W. Russell, "Motor Vehicle Speeds on Connecticut Highways," a book published in 1936 by the Committee on Transportation, Yale University.

<sup>6</sup> Results of these studies are published at irregular intervals by the Bureau of Public Roads in a bulletin entitled "Traffic Speed Trends."

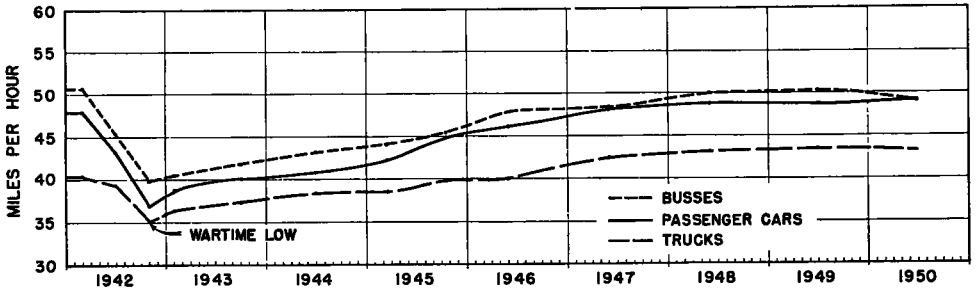


Figure 5. Average Speed on Main Rural Highways, by Vehicle Type

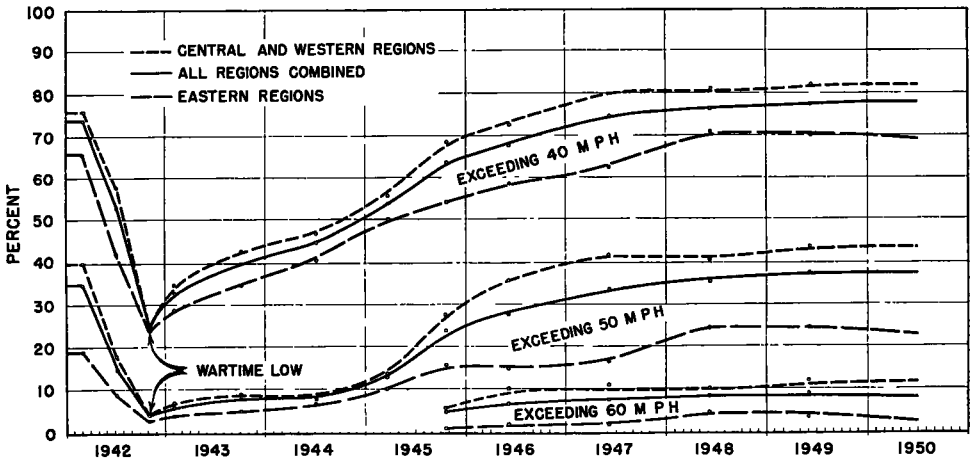


Figure 6. Percentage of All Vehicles Exceeding Various Speeds on Main Rural Highways, by Region

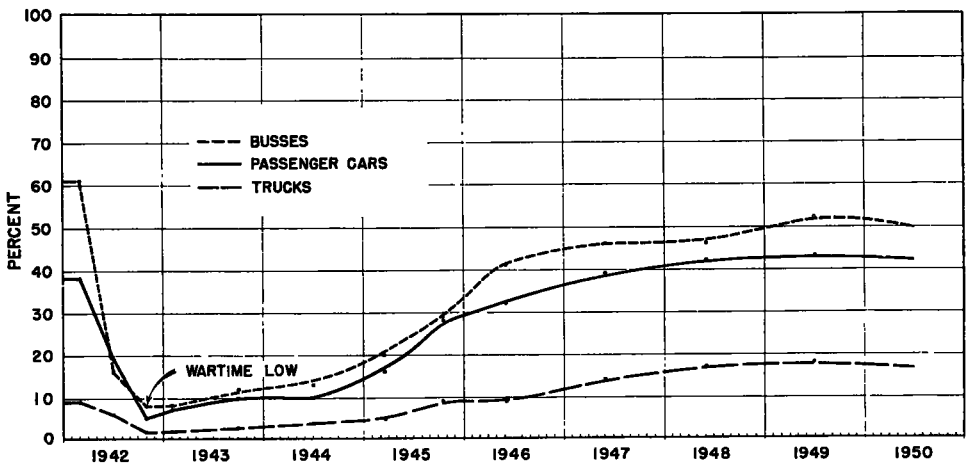


Figure 7. Percentage of Vehicles Exceeding 50 Miles per Hour on Main Rural Highways, by Vehicle Type

also, therefore, the curve representing the national average—show a sharp drop during early 1942 from the prewar level to a minimum in the fall of 1942, from which there has been a gradual recovery to a level slightly higher than that of 1941. The national average was 47 mph. at the beginning of 1942, dropped to 36 in the fall of 1942, returned to 40 by the end of 1943, reached 45 in the middle of 1946, and leveled off at about 48 in 1948.

Not only are there differences between one region and another, but even within a single region there is considerable variation from one station to another. In the central region, for example, the statewide average speeds in 1949 ranged from 44.8 in Oklahoma to 51.3 in Iowa. Individual locations vary even more widely; two Indiana stations reported 1950 average speeds of 56 mph. (including trucks), while one Oklahoma station had a 1949 average as low as 36 mph. In looking at the graphs it is well to keep in mind the large amount of variation which exists.

Figure 5 shows the trend of the national average speed, broken down by vehicle types. Here we see that busses are consistently a little faster than passenger cars (except in the preliminary results for 1950), while trucks are noticeably slower. On the other hand, it is the trucks which have made the greatest net gain since before the war; the small increase in the national average speed on main rural highways is due mainly to the 3-mph. rise in the average speed of trucks. From the point of view of interference with other traffic, it is interesting that the performance of trucks is being maintained and even improved at a time when loads are increasing at an unprecedented rate.<sup>7</sup>

Figure 6 shows that the percentages of vehicles exceeding 40, 50, and 60 mph. have followed a pattern very much like that of the average speeds. Here again the central and western regions show more fast drivers than the eastern region, and here again it appears that speeds leveled off around 1948 at a rate slightly higher than prewar. Where the prewar national average showed 74 percent of all vehicles driving over 40 mph. and 35 percent driving faster than 50, the corresponding 1948

figures are 77 and 36 percent, respectively. There has been no appreciable change in the percentage of vehicles traveling between 40 and 49 mph., but the proportion traveling between 50 and 59 has risen from 19 percent in 1945 to 29 percent in 1950. Finally, we have the break-down by vehicle types of the percentages of vehicles exceeding 50 mph. (Fig. 7). As before, the busses have the most, followed closely by the passenger cars, with the trucks some distance behind. However, the busses have not returned to their prewar level, while the percentage of the trucks going faster than 50 mph. is about twice what it was before the war. For passenger cars the percentage is a little higher than before the war, but not much.

It should be emphasized that these nationwide speed figures are taken mainly from two-lane roads, many of which are not of advanced design. Since there is some evidence to indicate that people drive faster on modern types of roads, especially on divided highways with limited access, it is to be expected that average speeds will increase somewhat as new roads are constructed. It will be many years, however, before any substantial fraction of the travel on existing obsolete roads is transferred to roads of really advanced design. Hence there is not likely to be any sharp increase in the national average speed during the next few years.

To sum up, the speed potentialities of the motor vehicle, as demonstrated by specially designed vehicles operated on special race tracks, have risen rapidly and steadily throughout the automobile's history. The top speeds of standard American cars rose dramatically until the mid-1930's, since which time they have remained fairly steady. Speeds on our main rural highways have followed a similar course, rising sharply until the mid-thirties, remaining steady until the sharp drop in 1942 following America's entry into World War II, and returning slowly since that time to a level which is slightly higher than prewar. If recent trends are any guide, and if there are no new restrictions on the use of gasoline and rubber, the expectation for the next few years is for a very gradual increase in average speeds. It seems quite clear that the period of rapid increases in highway speeds has long since come to an end.

<sup>7</sup> See, for example, J. T. Lynch and T. B. Dimmick, "Axle-Load and Gross-Load Trends," in *Proceedings*, Highway Research Board, Vol. 29 (1950).