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Highway traffic and its regulation

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Iowa State College

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HIGHWAY TRAFFIC AND ITS REGULATION

A DISSERTATION

Submitted to the Graduate Faculty

in candidacy for the Degree of

DOCTOR OF PHILOSOPHY

By

SUE-HIN PAN

APPROVED:

Signature was redacted for privacy.

In charge of major work

Signature was redacted for privacy.

Head of Department

Signature was redacted for privacy.

Graduate Dean

June, 1926

DEDICATION

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T O

MY FATHER

TO WHOM I OWED MY NINETEEN
YEARS OF EDUCATION UP TO
THIS LAST DEGREE

ACKNOWLEDGMENT

****

THE AUTHOR WISHES TO EXPRESS HIS THANKS FOR THE

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PROFESSOR A. H. FULLER, HEAD OF THE CIVIL ENGINEERING DEPARTMENT; PROFESSOR T. R. AGG, IN CHARGE OF MY MAJOR WORK, AND PROFESSORS P. H. ELWOOD, JR., AND W. L. FOSTER, IN CHARGE OF MY VARIOUS MINOR COURSES.

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I N T R O D U C T I O N

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Any one who drives an automobile from a through highway into a large city center will at once realize the traffic congestion which needs to be relieved.

Traffic has become a regional as well as a local problem, and future growth must be met more frankly and scientifically than in the past. "Traffic" is like "mumps", simply a name, a disease. It is a result, not a cause. The disease, after accurate diagnosis, can be treated. But a cure requires scientific study, often a major surgical operation, and eventually a large bill for repairs. The longer the delay, the larger the bill.

So, in order to cure this traffic congestion it must first be examined by a doctor with careful and detailed analysis of its cause and development and then treated with medicines,--the laws, regulations and the physical devices.

This thesis is arranged in two parts: I. Highway Traffic; and II. Highway Traffic Regulation. The former includes the causes and development of highway traffic, and the latter includes highway traffic laws and regulations and physical traffic devices.

It is the intention of the author that concrete discussions and illustration of subjects are followed in this paper to secure the better and clearer understanding.

IOWA STATE COLLEGE
Ames, Iowa
1926

SUE-HIN PAN

HIGHWAY TRAFFIC AND ITS REGULATION

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HIGHWAY TRAFFIC AND ITS REGULATION

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PART ONE--HIGHWAY TRAFFIC

CHAPTER ONE. The Growth of Automobile Registration.

The traffic problem is not a problem recently developed but it has existed since the beginning of civilization. In Rome, "Caesar found it necessary to issue an order prohibiting the passage of wagons through the central district for ten hours after sunrise." * But the recent development of automobiles with the growth of the population concentrated in a limited area is the cause of traffic congestion the solution of which we now face.

The horse-drawn vehicle is rapidly disappearing. New York affords an interesting example. In 1918,13,387 public horse-drawn carts were licensed; in 1919 the number was 13,017; in 1920, 12,810; in 1921, 9,782; and in 1922 the number had decreased to 8,661. According to figures given out by the Bureau of Census, the city horses decreased by more than one half between the years 1910 to 1920.

With the cheaper production of automobiles and better living of the population, the uses of the automobile were increased. Table 1a shows the production and registration of motor vehicles registered up to 1924 with over seventeen millions of vehicles registered.

Table 1b shows the car and truck growth in production and registration compared, from 1895 to 1924, inclusive, which shows that trucks are increasing rapidly due to the development of the field of highway transport.

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*Munro, Municipal Government and Administration; pp 22, MacMillan Co., New York City, 1923.

Tab. 7a.

Production and Registration of Motor Vehicles 1895-1924

Year	Production	Per Cent Gain Over Preceding Year	Registration	Per Cent Gain Over Preceding Year
1895	4		4	
1896	25		16	
1897	100		90	
1898	1,000		800	
1899	2,500		3,200	
1900	5,000		8,000	
1901	7,000	40%	14,800	85%
1902	9,000	29%	23,000	55%
1903	11,235	25%	32,920	43%
*1904	22,830	100%	55,000	67%
1905	25,000	11%	78,000	42%
1906	34,000	36%	107,000	37%
1907	44,000	30%	142,000	33%
1908	65,000	48%	197,500	39%
*1909	130,986	100%	312,000	58%
1910	187,000	43%	468,500	50%
1911	210,000	12%	639,500	36%
1912	378,000	82%	944,000	48%
1913	485,000	28%	1,258,062	33%
*1914	569,054	18%	1,711,339	36%
1915	892,618	57%	2,445,666	43%
1916	1,617,708	81%	3,512,996	44%
§1917	1,868,949	15%	4,983,340	42%
§1918	1,153,638	—38%	6,146,617	23%
1919	1,974,016	71%	7,565,446	23%
1920	†2,205,197	12%	9,231,941	22%
1921	†1,661,550	—25%	10,463,295	13%
1922	†2,659,064	60%	12,238,375	17%
1923	†4,086,997	53%	15,092,177	23%
1924	**†3,617,602**	**—11%**	**17,591,981**	**17%**

*From U. S. Census Reports.

§Production figures compiled by Automotive Products Section, War Industries Board, from sworn statements by manufacturers.

†Includes motor vehicles of U. S. design made in Canada.

NOTE:—Registrations by States are given on pages 69-75, by Cities on pages 76-77.

Tab. 1b.

Car and Truck Growth in Production and Registration Compared

	PRODUCTION		REGISTRATION	
	Passenger Cars	Trucks	Passenger Cars	Trucks
1895.....	4	.....	4	.....
1896.....	25	.....	16	.....
1897.....	100	.....	90	.....
1898.....	1,000	.....	800	.....
1899.....	2,500	.....	3,200	.....
1900.....	5,000	.....	8,000	.....
1901.....	7,000	.....	14,800	.....
1902.....	9,000	.....	23,000	.....
1903.....	11,235	.....	32,920	.....
1904.....	22,419	411	54,590	410
1905.....	24,550	450	77,400	600
1906.....	33,500	500	105,900	1,100
1907.....	43,300	700	140,300	1,700
1908.....	63,500	1,500	194,400	3,100
1909.....	127,731	3,255	305,950	6,050
1910.....	181,000	6,000	458,500	10,000
1911.....	199,319	10,655	619,500	20,000
1912.....	356,000	22,000	902,600	41,400
1913.....	461,500	23,500	1,194,262	63,800
1914.....	543,679	25,375	1,625,739	85,600
1915.....	818,618	74,000	2,309,666	136,000
1916.....	1,525,578	92,130	3,297,996	215,000
1917.....	1,740,792	128,157	4,657,340	326,000
1918.....	926,388	227,250	5,621,617	525,000
1919.....	1,657,652	316,364	6,771,074	794,372
1920.....	1,883,158*	322,039*	8,225,859	1,006,082
1921.....	1,514,000*	147,550*	9,346,195	1,118,520
1922.....	2,406,396*	252,668*	10,864,128	1,375,725
1923.....	3,694,237*	392,760*	13,479,608	1,612,569
1924.....	**3,243,285***	**374,317***	**15,460,649**	**2,131,332**

*Includes Canadian Production. Canadian production table is on page 9.

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Growth of State Registration

Tab. 2a.

Total Motor Vehicle Registrations by States—1919-1924

(Figures from U. S. Bureau of Public Roads)

STATE	1918	1919	1920	1921	1922	1923	1924
Alabama	46,171	58,898	74,637	82,366	90,052	126,642	157,262
Arizona	23,905	28,979	34,601	35,611	38,034	49,175	57,828
Arkansas	41,458	49,450	59,082	67,408	84,596	113,300	141,983
California	407,761	477,450	583,623	680,614	861,807	1,100,283	1,319,394
Colorado	83,244	104,865	129,255	145,739	162,328	188,956	213,247
Connecticut	86,067	102,410	119,134	134,141	152,977	181,748	217,227
Delaware	12,955	16,152	18,300	21,413	24,560	29,977	35,136
District of Columbia	30,490	35,400	34,161	40,625	52,792	74,811	88,762
Florida	54,186	55,400	73,914	97,957	116,170	151,990	195,128
Georgia	104,676	137,000	146,000	131,976	143,423	173,889	207,688
Idaho	32,289	42,220	50,861	51,294	53,874	62,379	69,227
Illinois	389,620	478,438	568,924	663,348	781,974	969,331	1,119,236
Indiana	227,160	227,255	333,067	400,342	468,939	583,342	651,705
Iowa	278,313	364,043	437,378	461,084	500,158	571,061	616,128
Kansas	189,163	228,600	294,159	289,539	327,194	375,594	410,891
Kentucky	65,884	90,008	112,683	126,802	154,021	198,377	229,804
Louisiana	40,000	51,000	73,000	77,885	102,284	136,622	178,000
Maine	44,572	53,425	62,907	77,527	92,539	108,609	127,178
Maryland (2)	74,666	95,634	102,841	136,249	165,624	169,351	198,398
Massachusetts	193,497	247,182	274,498	360,732	385,231	481,150	570,578
Michigan	262,125	325,813	412,717	476,452	578,210	730,658	867,545
Minnesota	204,458	259,741	324,166	323,475	380,557	448,187	503,437
Mississippi	48,400	59,000	68,486	65,039	77,571	104,286	134,680
Missouri	188,040	244,363	297,008	346,437	392,523	476,598	540,500
Montana	51,053	59,324	60,650	58,785	62,650	73,828	79,695
Nebraska	173,374	200,000	219,000	238,704	256,654	286,053	308,715
Nevada	8,159	9,305	10,464	10,821	12,116	15,699	18,118
New Hampshire	24,817	31,625	34,680	42,039	48,406	59,604	70,932
New Jersey	155,519	190,873	227,737	272,994	342,286	430,958	504,217
New Mexico	17,647	18,082	22,100	22,559	25,473	32,032	41,680
New York	459,288	566,511	676,205	812,031	1,002,293	1,204,213	1,412,879
North Carolina	72,313	109,017	140,860	148,627	182,550	246,812	302,232
North Dakota	71,678	82,885	90,840	92,644	99,052	109,266	117,346
Ohio	412,775	511,031	621,390	720,634	858,716	1,069,100	1,241,600
Oklahoma	121,500	144,500	212,880	221,300	249,659	307,000	369,903
Oregon	63,324	83,332	103,790	118,198	134,125	165,962	192,615
Pennsylvania	394,186	482,117	570,164	689,589	829,737	1,043,770	1,228,587
Rhode Island	36,218	44,833	50,477	54,608	66,083	76,312	95,482
South Carolina	55,492	70,143	93,843	89,836	95,239	127,467	161,753
South Dakota	90,521	104,628	120,395	119,274	125,241	131,700	142,396
Tennessee	63,000	80,422	101,852	117,025	135,716	173,365	204,680
Texas	251,118	331,310	427,693	467,616	526,238	688,233	801,712
Utah	32,273	35,236	42,616	47,485	49,164	59,525	68,316
Vermont	22,553	26,807	31,625	37,265	43,881	52,776	61,179
Virginia	72,228	94,100	115,470	139,200	168,000	218,896	261,945
Washington	117,278	148,775	173,920	185,359	210,716	258,264	295,443
West Virginia	38,750	50,203	80,664	93,940	112,763	157,924	190,734
Wisconsin	196,253	236,290	293,298	341,841	382,542	457,271	525,221
Wyoming	16,200	21,371	23,926	26,866	30,637	39,831	43,639
Totals	**6,146,617**	**7,565,446**	**9,231,941**	**10,463,295**	**12,238,375**	**15,092,177**	**17,591,981**

[1] Maryland registrations prior to 1923 include non-resident registrations.

The recent increased use of busses and trucks, due to their economy and convenience are worth notice. Highway transport of today is not only a means to support other kinds of transportation, but it is an independent kind of transportation which has its own large field to serve. Tables 2b-e show the total motor vehicle registration for 1921, 1922, 1923 and 1924 with special classification into cars, trucks, busses, etc, tabulated by the Bureau of Public Roads. Notice the rapid increase of trucks and commercial cars from 965,241 in 1921 to 2,131,332 in 1924.

Table 2b. MOTOR VEHICLE REGISTRATION BY CLASSES

1921.

Tab. 2b. MOTOR VEHICLE REGISTRATION BY CLASSES 192

State	Total Car and Truck Registration	Passenger Cars	Trucks and Commercial Cars	Taxis and Buses	Trailers	Motor Cycles
Alabama	82,366	69,422	9,110	3,834	.....	810
Arizona	35,049	31,069	3,980	562	.....	440
Arkansas	67,408	66,480	928(b)	.....	4	174
California	663,251	645,522	17,729	.....	.....	35,092
Colorado	145,739	136,336	9,403	.....	45	2,868
Connecticut	132,804	108,692	24,112	1,337	.....	5,282
Delaware	21,413	21,413(a)	.....	.....	67	541
District of Columbia	40,625(d)	33,654	5,177	1,794	.....	1,101
Florida	97,957	83,111	14,846	.....	.....	1,296
Georgia	131,976	131,976(a)	.....	.....	.....	1,232
Idaho	51,294	46,935	4,359	.....	.....	744
Illinois	663,348	583,441	79,907	.....	.....	8,898
Indiana	400,342	357,025	43,317	.....	1,851	7,524
Iowa	461,084	430,118	30,966	.....	344	3,897
Kansas (j)	289,539	267,891	21,648	.....	.....	2,271
Kentucky	126,802	110,602	15,025	1,175	.....	.....
Louisiana	77,885	67,311	10,574	.....	.....	479
Maine	77,527	67,591	9,936	.....	.....	1,525
Maryland	136,249	120,231(l)	11,597(m)	4,421	.....	5,271
Massachusetts	360,732	305,471	55,261	.....	472	12,048
Michigan	476,452	426,687	49,765	.....	4,330	6,195
Minnesota	323,475(o)	299,100	24,375	.....	820	3,150
Mississippi	65,039	65,039(a)	.....	.....	.....	.....
Missouri	346,437	346,437(a)	.....	.....	.....	3,609
Montana	58,785	58,785(a)	.....	.....	.....	472
Nebraska	238,704	219,781	18,923(p)	.....	322	1,866
Nevada	10,821	10,000(q)	821	.....	.....	131
New Hampshire	42,039	36,994	5,045	.....	.....	2,358
New Jersey	272,994	248,477	24,517	.....	857	9,724
New Mexico	22,559	21,155	1,404	.....	.....	152
New York(r)	779,344	630,791	148,553	32,687	3,213	26,998
N. Carolina(i)	148,627	134,884	13,743	.....	.....	1,274
N. Dakota	92,644	90,221	2,423	.....	.....	811
Ohio	720,634(t)	622,044	98,590	.....	4,801	17,203
Oklahoma	221,300	221,300(a)	.....	.....	.....	1,013
Oregon	118,095	103,735	14,360(u)	103	290	3,164
Pennsylvania	689,589	632,541	57,048	.....	951	21,111
Rhode Island	53,355	43,662	9,693	1,253	41	1,751
S. Carolina	89,836	82,993	6,843	.....	59	.....
S. Dakota	119,274	110,997	8,277	.....	.....	.....
Tennessee	117,025	102,795	14,230	.....	.....	1,043
Texas	467,616	467,616(a)	.....	.....	.....	3,905
Utah	50,185	40,562	9,623	.....	.....	909
Vermont	37,265	33,778(v)	3,487	.....	.....	965
Virginia	139,200	122,000	17,200	.....	.....	2,100
Washington	185,359	154,239	27,739(w)	3,381	797	3,913
West Virginia	93,940	77,397	16,543	.....	.....	1,539
Wisconsin	341,841	320,577	21,264	.....	.....	6,423
Wyoming	26,866	23,966	2,900	.....	.....	322
Totals	**10,448,632**	**9,432,844**	**965,241**	**50,547**	**19,264**	**214,781**

(a) Includes motor truck registrations.

(b) Trucks registered since May 1, others included under passenger cars.

(d) Does not include 8,439 non-resident passenger cars and 1,023 non-resident trucks.

(i) For period July-December inclusive.

(l) Includes approximately 12,000 non-resident passenger cars.

(m) Includes approximately 2,000 non-resident trucks.

(o) Does not include 1,752 cars and trucks owned by States, cities and counties.

(p) Includes motor bus registrations.

(q) Does not include 179 cars owned by State and cities.

(r) 11 months, February-December inclusive.

(t) Does not include 2,800 cars and trucks owned by State, cities and counties.

(u) Includes 5,223 commercial vehicles of less than 1 ton cap.

(v) Does not include 490 cars and trucks owned by State and cities.

(w) Does not include 1,891 State vehicles.

Tab. 2c MOTOR VEHICLE REGISTRATION BY CLASSES 1922

STATE	Passenger Cars: Total Motor Cars and Trucks	Passenger Cars: Private Passenger Cars	Passenger Cars: Taxicabs Buses and Cars for Hire (m)	Motor Trucks and Commercial Cars	Trailers (u)	Motor Cycles
Alabama	90,052	77,473	2,710	9,869	.....	638
Arizona	38,034	33,774(x)	.....	4,260(x)	.....	424
Arkansas	84,596	76,696	.....	7,900	82	238
California	861,807	822,394	.....	39,413	4,861	16,301
Colorado	162,328	151,499	.....	10,829	62	2,770
Connecticut	152,977	124,608	2,447	25,922	117	4,386
Delaware	24,560	21,810(x)	.....	2,750(x)	85	427
Dist. of Columbia	52,792	43,509(a)	2,560	6,723(a)	.....	2,357
Florida	116,170	94,175	2,767	19,228	455	1,456
Georgia	143,423	126,498	.....	16,925	.....	1,136
Idaho	53,874	49,393	.....	4,481	.....	703
Illinois	781,974	682,250	.....	99,724	.....	8,156
Indiana	469,939	413,410	.....	56,529	2,508	6,598
Iowa	500,158	468,736	.....	31,422	100	3,570
Kansas	327,194	303,725	.....	23,469	.....	2,315
Kentucky	154,021	136,627	.....	17,394	.....	1,042
Louisiana	102,284	87,003	.....	15,281	.....	509
Maine	92,539	78,697	.....	13,842	499	1,321
Maryland	165,624	150,523(j)	3,225	11,876(j)	333	4,981
Massachusetts	385,231	325,307(d)	.....	59,924(d)	519	10,047(d)
Michigan	578,210	518,127	.....	60,083	5,305	5,160
Minnesota	380,557	341,322	.....	39,235	601	3,240
Mississippi	77,571	71,000	.....	6,571	.....	100
Missouri	392,523	352,929	.....	39,594	448	2,792
Montana	62,650	55,682	.....	6,968	.....	397
Nebraska	256,654	233,658	.....	22,996	414	1,856
Nevada	12,116	10,759(x)	.....	1,357(x)	.....	112
New Hampshire	48,406	42,270	.....	6,136	279	1,883
New Jersey	342,286	258,540	9,237	74,509	886	9,284
New Mexico	25,473	23,820(x)	.....	1,653(x)	.....	163
New York	1,002,293	781,070	35,365	185,858	3,417	25,175
North Carolina(i)	182,550	163,600	.....	18,950	.....	1,190
North Dakota	99,052	96,080	.....	2,972	.....	766
Ohio	858,716	740,384	.....	117,832	5,389	15,339
Oklahoma	249,659	221,697(x)	.....	27,962(x)	.....	952
Oregon	134,125	118,035	592	15,498(f)	237	3,206
Pennsylvania	829,737	763,916	.....	65,821	1,075	19,316
Rhode Island	66,083	51,804	1,503	12,776	52	1,431
South Carolina	95,978	88,757	.....	7,221	68	557
South Dakota	125,241	116,144	.....	9,097	.....	659
Tennessee	135,716	119,319	.....	16,397	.....	1,680(h)
Texas	526,238	467,299(x)	.....	58,939(x)	.....	3,401
Utah	49,164	41,942	.....	7,222	150	742
Vermont	43,881	41,241	.....	2,640	.....	856
Virginia	168,000	145,000	.....	23,000	200	1,850
Washington	210,716	176,074	2,701	31,941	980	3,846
West Virginia	112,763	101,301	6,352	5,110	96	1,361
Wisconsin	382,542	356,143	.....	26,399	.....	5,718
Wyoming	30,637	27,410	.....	3,227	10	304
Totals	**12,239,114**	**10,793,930**	**69,459**	**1,375,725**	**29,335**	**182,762**

(a) Does not include 19,926 non-resident cars nor 1,836 non-resident trucks.
(d) A total of 65,141 re-registrations deducted pro rata from cars, trucks, and motorcycles.
(f) Includes 4,763 commercial cars of less than one ton capacity.
(j) Includes approximately 12,000 non-resident cars and 2,000 non-resident trucks.
(m) For nine months, March 1 to December 31 inclusive.
(u) Where blanks occur no data could be secured as to the number of trailers in the State.
(x) Estimated division of passenger cars and trucks by N. A. C. C. State keeps no separate record.

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Tab. 2d. MOTOR VEHICLE REGISTRATION BY CLASSES, 1923

TABULATION BY STATES OF MOTOR VEHICLE REGISTRATION

(Figures from Bureau of Public Roads,

STATES	Grand Total Motor Vehicles	Private Passenger Cars	Motor Trucks	Taxis, Busses and Cars for Hire[1]	Motor-Cycles
Alabama	126,642	109,535	13,845	3,262	599
Arizona	49,175	42,176	6,565	434	392
Arkansas	113,300	102,000	11,300	.....	300
California	1,100,283	1,056,756	43,527	.....	14,694
Colorado	188,956	175,669	13,287	.....[2]	2,473
Connecticut	181,748	148,791	29,140	3,817	4,450
Delaware	29,977	24,709	5,268	.....	467
District of Columbia[3]	74,811[3]	65,681[3]	7,187[3]	1,943[3]	1,772
Florida	151,990	125,140	23,530	3,320	975
Georgia	173,889	151,325	22,469	95	1,011
Idaho	62,379	57,200	5,179	.....	655
Illinois	969,331	847,005	122,326	.....	7,611
Indiana	583,342	510,114	73,228	.....	6,042
Iowa	571,061	534,796	36,265	.....	3,044
Kansas	375,594	349,038	26,556	.....[5]	1,950
Kentucky	198,377	177,834	20,543	.....	844
Louisiana	136,622	116,003	20,619	.....	400
Maine	108,609	90,177	15,614	2,818	1,400
Maryland	169,351	153,661	11,609	4,081	4,846
Massachusetts	481,150	407,645	73,505	.....	11,033
Michigan	730,658	657,148	72,000	1,510	4,165
Minnesota	448,187	399,404	48,783	.....	3,220
Mississippi	104,286	93,846	10,440	.....[2]	114
Missouri	476,598	430,340	46,258	.....	2,570
Montana	73,828	65,449	8,379	.....	374
Nebraska	286,053	259,382	26,671	.....	1,608
Nevada	15,699	13,699	2,000	.....	112
New Hampshire	59,604	52,608	6,996	.....[6]	1,987
New Jersey	430,958	330,552	89,105	11,301	8,811
New Mexico	32,032	29,032	3,000	.....	215
New York	1,204,213	962,681	203,846	37,686	22,153
North Carolina[12]	246,812	225,488	21,324	.....[2]	1,300
North Dakota	109,266	105,958	3,287	21	645
Ohio	1,069,100	927,200	141,900	.....	15,000
Oklahoma	307,000	288,424	18,576	.....[2]	823
Oregon	165,962	152,135[14]	12,987	840	3,140
Pennsylvania	1,043,770	969,361[17]	74,409	.....	19,220
Rhode Island	76,312	60,620	13,930	1,762	1,575
South Carolina	127,467	115,892	11,575	.....	547
South Dakota	131,700	121,164	10,536	.....	471
Tennessee	173,365	154,181	19,184	.....	751
Texas	688,233	688,233[18]	.....[2]	.....	3,346
Utah	59,525	51,625	7,900	.....	766
Vermont	52,776	49,420	3,356	.....	839
Virginia	218,896	187,977	30,919	.....	1,813
Washington	258,264	218,580	37,100	2,584	3,560
West Virginia	157,924	143,548	7,456[19]	6,920	1,353
Wisconsin	457,271	422,718	34,553	.....[2]	5,645
Wyoming	39,831	35,294	4,537	.....[2]	291
Totals	**15,092,177**	**13,457,214**	**1,552,569***	**82,394**	**171,372**

[1]Where no data are given these vehicles are not registered as a separate class, but included with passenger cars or trucks. [2]Included with passenger cars. [3]Includes re-registrations but does not include non-resident registrations. [5]Included with trucks.

[14]Includes ambulances and commercial cars under 1 ton capacity. [17]Includes 88,650 commercial vehicles having a chassis weight of less than 2,000 pounds. [18]Includes motor trucks. [19]Solid tire vehicles only.

Tab. 2e. MOTOR VEHICLE REGISTRATION BY STATES, 1924

INDIVIDUALLY AND COMMERCIALLY OWNED

STATES	Grand Total Motor Vehicles*[1]	Passenger Cars[1]	Motor Trucks[1]	Taxis, Busses, and Cars For Hire	Official Cars and Trucks Owned by State, etc.[1]	Motor Cycles
Alabama	157,262	135,777	18,688	2,797	[2]	549
Arizona	57,828	50,233	7,595	[2]	903	372
Arkansas	141,983	125,368	16,615	[2]	458	295
California	1,319,394	1,125,381	[4]194,013	[4]	[2]	12,325
Colorado	213,247	197,361	15,886	[5]	[2]	2,226
Connecticut	217,227	180,542	33,776	2,909	1,110	4,211
Delaware	35,136	29,075	6,061	[3]	[2]	325
District of Columbia	88,762	78,846	9,916	[5]	1,351	1,889
Florida	195,128	157,519	34,192	3,417	[2]	733
Georgia	207,688	181,268	26,275	145	[3]	750
Idaho	69,227	61,600	7,627	[2]	930	619
Illinois	1,119,236	978,428	140,808	[2]	[2]	6,873
Indiana	651,705	566,736	84,969	[2]	[2]	4,822
Iowa	616,128	575,210	40,918	[5]	2,400	2,597
Kansas	410,891	370,951	39,940	[2]	1,947	1,632
Kentucky	229,804	206,064	23,275	[6]465	1,044	724
Louisiana	[7]178,000	[7]150,900	[7]27,100	[5]	1,000	510
Maine	127,178	105,040	19,001	3,137	854	1,288
Maryland	198,398	184,398	11,183	2,817	[2]	3,462
Massachusetts	[8]570,578	[8]486,952	[8]83,626	[5]	[9]900	10,778
Michigan	867,545	784,070	83,475	[2]	[2]	3,644
Minnesota	503,437	465,165	37,823	449	2,171	3,080
Mississippi	134,680	122,117	12,563	[5]	[3]	96
Missouri	540,500	489,356	51,144	[5]	1,203	2,139
Montana	79,695	69,824	9,871	[3]	979	293
Nebraska	308,715	277,449	31,266	[2]	[3]	1,342
Nevada	18,118	16,236	1,882	[5]	336	111
New Hampshire	70,932	63,662	7,270	[2]	[2]	1,750
New Jersey	504,217	393,785	99,288	11,144	[7]4,200	8,053
New Mexico	41,680	39,890	1,790	[3]	[3]	228
New York	1,412,879	1,136,678	236,012	40,189	8,910	19,837
North Carolina	302,232	272,552	27,480	2,200	[3]	1,029
North Dakota	117,346	112,664	4,682	[2]	[9]317	509
Ohio	1,241,600	1,076,800	164,800	[2]	5,400	15,000
Oklahoma	369,903	342,856	27,047	[2]	[2]	733
Oregon	192,615	177,558	15,057	[2]	[2]	2,764
Pennsylvania	1,228,587	1,043,692	178,122	6,773	[2]	17,540
Rhode Island	95,482	76,666	17,247	1,569	[2]	1,428
South Carolina	161,753	146,639	15,114	[2]	1,067	477
South Dakota	142,396	131,190	11,206	[2]	[2]	305
Tennessee	204,680	183,891	20,789	[2]	[2]	682
Texas	801,712	735,270	62,754	3,688	[2]	2,634
Utah	68,316	59,453	8,863	[2]	500	731
Vermont	[10]61,179	[10]57,072	[10]4,107	[2]	123	779
Virginia	261,945	220,000	41,643	302	[2]	3,000
Washington	295,443	251,466	41,555	2,422	3,701	3,164
West Virginia	190,734	163,907	22,171	4,656	[2]	1,407
Wisconsin	525,221	475,182	50,039	[2]	3,005	3,938
Wyoming	43,639	38,831	4,808	[2]	177	252
Totals	**17,591,981**	**15,371,570**	**2,131,332**	**89,079**	**44,986**	**153,925**

*—Does not include motor cycles and official cars and trucks.
[1]—Net number of cars and trucks shown when possible, excluding re-registrations and non-resident registrations. Federal, State, or other Government owned cars and trucks, not registered and not paying licenses, are also excluded in grand totals, unless noted.
[2]—Recorded in private cars and trucks.
[3]—Not separately recorded.
[4]—"Motor Trucks" includes solid and pneumatic types, also taxis, busses, etc.
[5]—Included with private passenger cars.
[6]—Stateownedcarsonly. [10]—Includes non-resident registrations.

THE GROWTH OF URBAN AUTOMOBILE REGISTRATION

In the following table the total automobile registration of large cities are shown.

Table 3.

TOTAL AUTOMOBILE REGISTRATION OF LARGE CITIES

CITY	1922	1923	1924
Albany, New York	16,282	23,768	
Baltimore, Maryland		77,276	82,650
Boston, Mass.	52,000	70,156	
Buffalo, New York	50,300	87,000	
Chicago, Illinois	210,500	265,233	310,838
Cincinnati, Ohio	45,822	64,205	81,210*
Cleveland, Ohio	98,670	165,477	191,580
Denver, Colorado	46,124	56,481	62,376
Detroit, Michigan	169,983	230,594	260,551
Indianapolis, Ind.	56,960	62,174	83,400
Kansas City, Mo.	62,650	59,950	81,281
Los Angeles, Cal.	196,710	426,935	
Milwaukee, Wis.	39,720	72,963	72,490
Minneapolis, Minn.	70,478	56,978	90,000
New York, N. Y.	300,972	363,590	430,842
San Francisco, Cal.	75,730	88,254	105,038
Seattle, Wash.	60,600		66,642
St. Louis, Mo.	91,777	108,425	
Washington, D. C.	52,792	101,986	

* 28 bus lines.

THE WORLD REGISTRATION OF AUTOMOBILES

In regard to the registration of automobiles in the world, it is interesting to note that the United States had 10,448,632 automobiles registered against the total registration of the world of 12,528,272 in January, 1922. This gives 83% of the total. At the end of 1922 the world registration was 14,507,588 and in the United States alone there were 12,239,114 or 84% of the total. In 1923 the world registration was 18,023,-584 and the United States had 15,092,177 or 88% of the total. In 1924, world registration was 21,264,752 and United States, 17,591,-981, or 83% of the total.

The following table gives the registration in some countries by years.

Table 4. THE WORLD REGISTRATION OF AUTOMOBILES

(From Bureau of Foreign Domestic Commerce.)

Country	Total Number by Year				
	1914@	Jan. 1922	Dec. 1922	1923	1924
Argentina	10,000	70,000	82,417	85,850	130,000
Belgium	10,000	18,500	36,000	57,000	92,700
Canada	46,600	469,310	509,670	642,571	638,794
China		8,150	8,421	8,847	10,102
Denmark	8,000	14,000	22,261	42,201	47,352
France	100,000	236,148	295,876	444,812	575,000
Germany	57,300	60,000	128,092	152,068	219,990
G. Britain & Ireland	245,900	497,532	498,271*	642,853*	770,839*
Italy	12,000	53,000	53,600	75,000	95,000
Japan		12,260	8,711	10,500	22,111
Mexico	4,000	25,000	20,734	24,485	35,000
New Zealand	8,000	37,500	37,500	44,864	60,600
Russia			13,000#	14,000	15,000
Spain	8,000	41,000	41,000	53,000	70,000
Switzerland		18,011	19,011	23,039	29,848
United States	1,300,000	10,448,632	12,239,114	15,092,177	17,591,981
The World		12,528,272	14,507,588	18,023,584	21,264,752

@From German Survey *United Kingdom #Plus trucks unknown

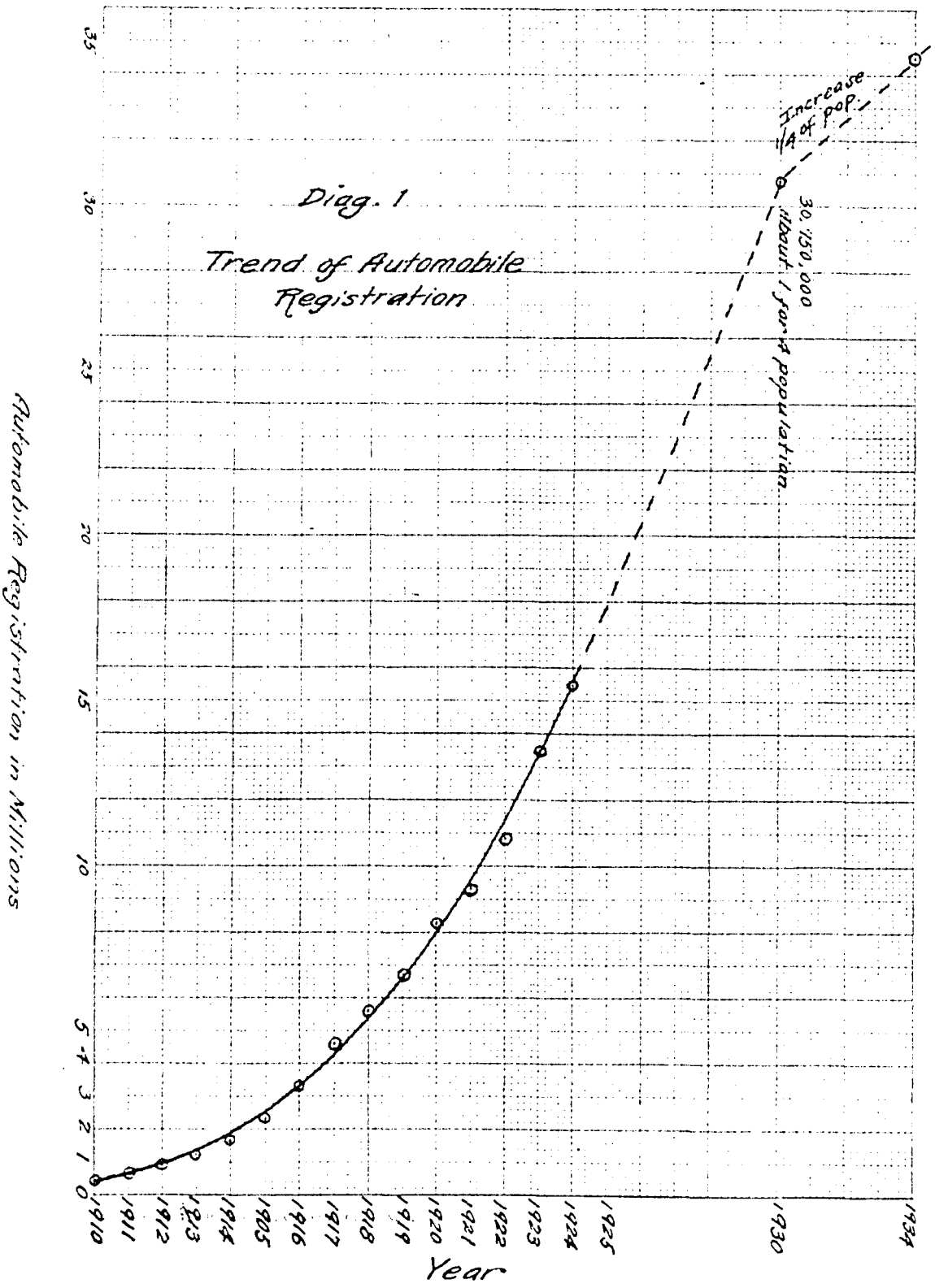
THE FUTURE REGISTRATION OF AUTOMOBILES

As you will see in the next diagram, the automobile registration seems to continue to increase for five or six years normally but as soon as the ratio reaches to one automobile for four persons then it will quite likely change its trend of growth and will be directly proportioned to the increase of population.

The estimation was set to follow the normal trend until 1930 and the registration was assumed to about 30,750,000, as the population in that time will be about 122,500,000. It gives about one automobile for every four persons for the United States.

After 1930 it will be likely to increase in registration directly proportional to the population; i. e., the yearly automobile registration will be one-fourth of the population of that year.

This will be discussed further in the chapter on "Automobiles, Highways and Population."


Diag. 1
Trend of Automobile Registration
Increase 1/4 of pop.
about 1 for 4 population
30,150,000
Automobile Registration in Millions
Year
0
1
2
3
4
5
10
15
20
25
30
35
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1930
1934

Chapter Two. The Development of Highways

The rural public roads of the forty-eight states; that is, the public roads located outside the limits of incorporated villages, towns, and cities, had on January 1, 1922, a total length of 2,941,294 miles and according to the latest survey by the United States Bureau of Public Roads in 1924 found that there were 259,721.3 miles of highways in the State system and 2,743,-195.2 miles of highways in the County and the Local Road Systems.

In 1904 the total mileage of rural roads amounted to 2,151,379 miles, of which 153,530 miles, or 7.14 per cent, were improved with some form of surfacing. By the close of 1921 the rural roads had increased to 2,941,294 miles, of which 387,760 miles, or 13.17 per cent, were surfaced. And in 1924 the rural roads had increased to 3,002,916.5 miles, of which 467,905.5 miles, or 15.58 per cent, were surfaced.

Table 5 shows the total mileage of all rural roads and total mileage surfaced as of 1904, 1909 and 1921. Table 6 shows the total miles of existing roads in state highway systems at the end of reported year, 1924. Table 7 shows the total mileage of existing county and local rural roads at the end of year 1924; and table 8 shows the federal aid road mileage as of January 31, 1926.

Some street conditions of typical cities are also shown in Table 9, with total mileage and different widths.

TABLE 5.—*Total mileage all rural roads and total mileage surfaced as of 1904, 1909, 1914, and 1921.*

States	Total road mileage				Miles surfaced				Percentage surfaced			
	1921	1914	1909	1904	1921	1914	1909	1904	1921	1914	1909	1904
Alabama	58,410	55,446.00	49,639.00	50,089	10,420	4,988.50	3,263.93	1,720.00	17.84	8.99	6.58	3.43
Arizona	21,227	12,075.00	5,987.00	5,987	1,233	253.43	273.00	217.00	5.81	2.09	4.56	3.62
Arkansas	74,866	50,743.00	36,445.00	36,445	3,871	1,097.50	1,085.25	236.00	5.17	2.16	2.97	.64
California	75,889	61,039.00	48,069.00	46,653	14,275	10,279.73	8,587.75	8,803.00	18.81	16.84	17.87	18.87
Colorado	48,143	39,780.00	29,693.00	30,214	4,598	1,193.87	320.50	178.00	9.55	3.00	1.08	.59
Connecticut	12,152	14,061.00	12,583.00	14,088	2,206	2,975.45	3,030.54	2,360.10	18.15	21.16	24.08	16.75
Delaware	3,933	3,674.00	3,000.00	3,000	448	243.50	186.44	66.00	11.39	6.62	6.22	2.20
Florida	27,643	17,995.00	17,579.00	17,374	6,438	2,830.47	1,752.35	885.50	23.29	15.72	9.97	5.10
Georgia	94,912	80,669.00	82,230.00	57,203	18,339	12,342.12	5,978.00	1,634.00	19.32	15.30	7.27	2.86
Idaho	31,099	24,396.00	18,403.00	18,163	2,982	679.00	510.50	212.00	9.59	2.78	2.77	1.16
Illinois	96,326	95,647.00	94,141.00	94,141	11,473	11,606.31	8,914.00	7,924.00	11.91	12.02	9.47	8.42
Indiana	76,246	73,347.00	67,996.00	68,306	39,857	30,962.40	24,955.75	23,877.00	52.27	42.20	36.70	34.96
Iowa	104,082	104,074.00	102,427.00	102,448	2,585	614.57	2,505.10	1,664.00	2.48	.59	2.45	1.62
Kansas	128,551	111,052.00	98,302.00	101,196	1,100	1,148.85	374.71	273.20	.86	1.03	.38	.27
Kentucky	68,704	57,916.00	53,744.00	57,137	15,436	12,403.28	10,114.95	9,486.00	22.47	21.40	18.82	16.60
Louisiana	39,803	24,563.00	24,962.00	24,897	2,771	2,067.62	329.50	34.00	6.96	8.42	1.32	.14
Maine	21,483	23,537.00	25,528.00	25,528	2,953	2,762.36	2,703.06	2,323.50	13.75	11.74	10.59	9.10
Maryland	14,772	16,459.00	16,773.00	16,773	3,663	2,489.26	2,142.30	1,570.00	24.80	15.10	12.77	9.36
Massachusetts	18,868	18,681.00	17,272.00	17,092	6,575	8,505.89	8,463.18	7,343.80	34.85	45.53	49.00	45.89
Michigan	77,283	74,190.00	68,906.00	69,296	17,186	7,828.51	6,900.54	7,025.50	22.22	10.55	10.01	10.14
Minnesota	107,103	93,517.00	79,323.00	79,324	16,905	3,967.83	5,416.85	6,247.50	15.78	4.24	6.83	7.87
Mississippi	53,085	45,779.00	39,619.00	38,698	5,744	2,133.35	342.25	149.00	10.82	4.66	.86	.31
Missouri	111,520	96,041.00	107,923.00	108,133	7,879	6,712.57	4,755.50	2,733.00	7.06	6.98	4.40	2.53
Montana	64,732	39,204.00	23,319.00	22,419	1,772	609.25	95.00	65.00	2.74	1.55	.41	.28
Nebraska	86,556	80,272.00	80,338.00	79,462	496	1,204.54	248.55	23.00	.57	1.50	.31	.03
Nevada	26,057	12,182.00	12,751.00	12,585	168	262.00	46.00	64.00	.64	2.14	.36	.51
New Hampshire	13,841	14,020.00	15,116.00	15,116	1,692	1,659.63	1,448.48	1,293.00	12.22	11.83	9.58	8.55
New Jersey	14,066	14,817.00	14,842.00	14,842	6,459	5,897.46	3,377.86	2,422.30	45.92	39.80	22.76	16.32
New Mexico	45,549	11,573.00	16,920.00	15,326	1,802	261.50	104.00	2.00	3.96	2.20	.61	.01
New York	81,878	79,398.00	79,279.00	73,798	18,566	15,635.90	12,787.36	5,876.00	22.68	19.60	16.13	7.96
North Carolina	68,204	50,758.00	48,285.00	49,763	16,755	6,063.75	2,313.00	1,259.00	24.57	11.82	4.79	2.53
North Dakota	106,523	68,796.00	61,593.00	59,332	710	955.00	140.00	212.00	.67	1.38	.23	.36
Ohio	84,219	86,354.00	88,801.00	69,439	36,068	30,569.17	24,106.00	23,460.00	42.83	35.16	27.13	33.79
Oklahoma	[1] 134,263	107,916.00	71,325.00	43,554	2,461	121.60	361.00		18.33	.11	.50	
Oregon	45,475	36,819.00	29,475.00	34,258	8,050	4,726.40	2,799.25	2,589.00	17.70	12.83	9.49	7.56
Pennsylvania	90,991	91,555.84	87,386.79	99,777	13,921	9,982.88	3,364.76	2,160.80	15.30	10.90	3.84	2.17
Rhode Island	2,274	2,170.00	2,120.75	2,361	754	693.42	1,042.07	1,021.50	33.15	31.95	49.14	43.27
South Carolina	61,850	42,226.00	32,075.00	41,830	6,908	3,270.50	3,534.75	1,878.00	11.17	7.74	11.02	4.49
South Dakota	115,485	96,306.00	56,354.00	59,295	548	363.00	286.00	151.00	.47	.37	.50	.25
Tennessee	62,546	46,050.00	45,913.00	48,989	9,878	8,102.00	5,353.50	4,285.00	15.79	17.59	11.66	8.75
Texas	167,685	128,960.00	128,971.00	121,409	14,883	10,526.79	4,896.00	2,128.00	8.88	8.16	3.80	1.75
Utah	23,047	8,810.00	8,320.00	7,090	2,544	1,153.75	1,018.00	608.00	11.04	13.09	12.23	8.57
Vermont	14,677	14,249.00	14,406.00	14,521	3,545	1,442.03	2,650.63	1,953.50	24.15	10.12	18.40	13.45
Virginia	59,080	53,388.00	43,399.00	51,812	7,260	3,909.57	1,902.75	1,600.00	12.29	7.32	4.38	3.09
Washington	45,816	42,428.00	34,283.60	31,998	12,062	4,922.09	4,520.68	1,976.50	26.33	11.61	13.19	6.17
West Virginia	35,173	32,024.00	32,109.00	26,178	1,367	1,064.97	591.40	254.50	3.89	3.30	1.84	.97
Wisconsin	78,679	75,707.00	61,090.00	63,593	19,714	13,399.47	10,167.33	10,633.20	25.09	17.60	16.64	16.72
Wyoming	46,528	14,797.00	10,569.00	10,447	440	468.50	416.00	153.00	.95	3.10	3.94	1.46
Total	2,941,294	2,445,760.84	2,199,645.14	2,151,379	387,760	257,291.54	190,476.32	153,530.40	13.17	10.52	8.66	7.14

[1] Includes about 26,000 miles of section lines declared Public Highways by law but which are not open to general traffic.

Tab. 6

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

TABLE M-4 (1924) — RURAL ROAD STATUS SURVEY, 1924 — B.P.R. - R.R.S.S. - A-1

TOTAL MILES OF EXISTING ROADS IN STATE HIGHWAY SYSTEMS,
AT END OF REPORTED YEAR, 1924

States	Year Report Ends	Grand Total Mileage In Systems	Unimproved, and Earth Partially Graded	Earth, to Established Grade, & Drained	Total Miles of Road Surfaced	Sand-Clay	Gravel, Etc., Untreated	Waterbound Macadam, Untreated	Surface-Treated Macadam & Gravel	Bituminous Macadam, By Penetration	Sheet Asphalt	Bituminous Concrete	Cement Concrete	Block Pavements: Brick	Block Pavements: Asphalt	Block Pavements: Wood	Block Pavements: Stone	States
Alabama	12/31	3,958.0	2,147.7	157.8	1,652.5	589.0	874.6	35.9	25.3	(1) 30.8	5.7	74.9	16.1	--	--	0.2	--	Alabama
Arizona	12/31	1,984.4	310.5	306.0	1,367.9	--	1,189.8	--	--	--	15.0	24.3	138.8	--	--	--	--	Arizona
Arkansas	12/31	6,718.0	2,248.0	1,606.0	2,864.0	--	2,065.0	183.0	48.0	144.0	32.0	261.0	131.0	--	--	--	--	Arkansas
California	12/31	6,400.0	2,618.8	(2) 550.0	3,231.2	--	(2) 750.0	39.4	--	378.6	--	332.9	1,730.3	--	--	--	--	California
Colorado	12/31	8,928.0	223.4	5,296.2	3,408.4	--	3,208.5	--	--	--	--	--	199.9	--	--	--	--	Colorado
Connecticut	6/30	1,821.7	--	153.9	1,667.8	--	75.1	--	1,030.5	193.4	--	125.2	241.9	1.7	--	--	--	Connecticut
Delaware	12/31	417.8	--	--	417.8	--	--	--	1.3	20.1	--	--	390.0	6.4	--	--	--	Delaware
Florida	12/31	3,508.5	1,409.3	44.7	2,054.5	385.0	23.0	142.3	604.4	175.0	192.0	25.8	112.0	337.0	58.0	--	--	Florida
Georgia	12/31	6,235.9	3,792.1	118.2	2,325.6	1,530.0	402.0	35.1	26.4	115.8	21.6	12.2	181.9	0.6	--	--	--	Georgia
Idaho	12/31	4,071.3	2,192.9	380.0	1,498.4	68.2	1,327.5	--	--	--	5.4	56.2	41.1	--	--	--	--	Idaho
Illinois	12/31	4,819.5	339.1	1,063.8	3,416.6	--	0.4	0.5	--	3.4	4.6	22.0	3,305.7	80.0	--	--	--	Illinois
Indiana	9/30	3,916.4	9.3	130.7	3,776.4	--	1,845.6	990.6	29.1	136.2	--	24.1	680.1	70.2	--	0.5	--	Indiana
Iowa	12/31	6,659.7	2,058.6	1,934.4	2,666.7	--	2,164.4	--	--	--	--	--	448.4	53.9	--	--	--	Iowa
Kansas	12/31	7,147.0	5,990.4	319.8	836.8	65.0	160.1	--	--	72.9	--	--	426.5	112.3	--	--	--	Kansas
Kentucky	12/31	8,000.0	5,315.3	435.7	2,249.0	--	545.1	481.2	875.0	(3) 217.1	--	13.8	111.6	5.2	--	--	--	Kentucky
Louisiana	12/31	7,000.0	3,598.8	--	3,401.2	--	3,256.6	--	87.1	20.2	--	12.4	9.9	15.0	--	--	--	Louisiana
Maine	12/31	1,455.5	271.0	--	1,184.5	7.3	643.5	--	304.5	176.1	--	--	53.1	--	--	--	--	Maine
Maryland	9/30	2,247.2	--	--	(4)2,247.2	--	(5) 383.1	--	1,004.2	--	56.0	28.2	768.0	7.7	--	--	--	Maryland
Massachusetts	11/30	1,515.5	--	12.8	1,502.7	2.7	--	--	(6) 533.7	640.3	--	177.6	145.7	0.8	--	0.1	1.8	Massachusetts
Michigan	12/31	(7)6,581.7	36.1	674.8	5,870.8	10.5	3,614.8	--	682.3	107.0	--	188.3	1,257.7	10.2	--	--	--	Michigan
Minnesota	11/1	6,982.4	183.2	1,328.3	5,470.9	191.1	4,691.1	14.8	--	10.6	--	66.2	473.9	10.7	--	12.5	--	Minnesota
Mississippi	12/31	5,398.9	2,679.3	346.0	2,373.6	2.5	2,079.3	10.7	49.4	4.7	6.7	13.8	187.3	19.2	--	--	--	Mississippi
Missouri	12/31	7,640.0	4,120.4	1,860.2	1,659.4	--	1,079.5	--	--	80.7	--	--	(6)499.2	--	--	--	--	Missouri
Montana	12/31	7,957.0	6,956.7	280.1	720.2	--	679.7	--	0.6	5.5	--	2.3	32.1	--	--	--	--	Montana
Nebraska	12/31	5,742.3	3,350.2	1,465.5	926.6	239.7	615.4	--	--	--	2.6	8.2	41.7	19.0	--	--	--	Nebraska
Nevada	12/31	2,704.3	1,931.6	182.2	590.5	--	509.6	--	(9) 10.2	24.0	--	1.6	45.1	--	--	--	--	Nevada
New Hampshire	12/31	(10)1,367.4	246.2	10.4	1,110.8	--	209.9	9.7	728.4	95.6	--	59.2	8.0	--	--	--	--	New Hampshire
New Jersey	12/31	(11)1,030.3	--	19.3	1,011.0	--	129.0	19.2	146.9	7.4	47.3	229.9	407.7	4.1	3.1	6.3	10.1	New Jersey
New Mexico	11/30	7,963.0	6,300.7	185.0	1,477.3	--	1,413.2	--	--	--	--	0.7	63.4	--	--	--	--	New Mexico
New York	12/31	11,260.0	1,973.5	6.7	9,279.8	--	119.4	--	2,399.1	4,080.6	--	188.6	2,189.9	264.5	23.4	0.6	3.7	New York
North Carolina	12/31	6,200.0	--	889.6	5,310.4	2,905.6	565.6	125.1	--	151.6	--	781.7	734.0	46.8	--	--	--	North Carolina
North Dakota	6/30	(12)6,174.0	4,057.2	1,544.0	572.8	--	568.0	--	--	--	--	--	4.8	--	--	--	--	North Dakota
Ohio	12/31	10,546.0	4,805.7	--	5,740.3	--	564.4	1,462.9	--	(13)1,122.2	39.9	193.1	1,113.5	1,244.3	--	--	--	Ohio
Oklahoma	12/31	5,589.0	4,173.5	47.0	1,368.5	--	885.5	--	--	--	--	80.0	383.0	20.0	--	--	--	Oklahoma
Oregon	12/31	4,464.0	1,319.0	318.0	2,827.0	--	1,949.0	--	--	--	--	684.0	194.0	--	--	--	--	Oregon
Pennsylvania (14)	12/31	10,768.0	--	3,913.6	6,854.4	--	592.7	--	2,681.1	332.2	206.1	283.5	2,373.3	371.3	6.1	3.4	4.7	Pennsylvania
Rhode Island	12/31	761.6	177.9	178.0	405.7	--	--	--	148.5	82.4	2.9	141.4	30.5	--	--	--	--	Rhode Island
South Carolina	12/31	4,740.0	1,616.6	33.5	3,089.9	2,637.8	186.9	14.9	13.5	16.8	65.3	41.7	113.1	--	--	--	--	South Carolina
South Dakota	12/31	(15)5,663.2	200.0	3,987.7	1,475.5	--	1,474.3	--	--	--	--	--	1.2	--	--	--	--	South Dakota
Tennessee	12/31	4,644.4	1,905.5	259.0	2,479.9	--	829.4	932.1	171.5	388.3	19.6	50.9	88.1	--	--	--	--	Tennessee
Texas	12/31	16,668.0	8,445.7	995.0	7,227.3	609.1	4,462.5	245.4	1,289.2	114.3	25.0	66.6	372.8	42.4	--	--	--	Texas
Utah	11/30	3,132.3	1,525.0	667.6	939.7	--	690.5	--	--	--	10.5	41.4	197.3	--	--	--	--	Utah
Vermont	12/31	4,453.0	1,584.6	--	2,868.4	--	2,728.8	9.0	75.8	22.9	--	--	31.9	--	--	--	--	Vermont
Virginia	9/30	4,621.6	1,335.8	847.7	2,438.1	(16)	750.5	--	923.4	388.9	10.7	7.6	356.1	0.9	--	--	--	Virginia
Washington	12/31	3,133.7	673.3	142.2	2,318.2	--	1,770.9	--	--	39.6	1.9	37.3	459.3	9.3	--	--	--	Washington
West Virginia	12/31	3,594.0	2,068.2	564.7	961.1	--	113.3	92.4	--	(17)287.3	0.7	57.3	291.6	128.5	--	--	--	West Virginia
Wisconsin	12/31	(18)10,000.0	--	1,500.0	8,500.0	800.0	5,500.0	500.0	--	--	--	--	(19)1,700.0	--	--	--	--	Wisconsin
Wyoming	12/31	(20)3,136.9	1,903.6	523.2	710.0	--	669.6	--	2.2	--	--	27.1	11.1	--	--	--	--	Wyoming
Totals		259,721.3	96,094.7	35,279.3	128,347.3	10,043.5	58,357.1	5,344.1	13,991.6	9,686.5	771.4	4,453.0	22,783.6	2,882.0	90.6	23.6	20.3	Totals

NOTES: (1) - Includes 2.4 miles of patent "Rawhide" road. (2) - Partly estimated. (3) - Includes Kentucky rock (asphalt) road. (4) - Includes 38.0 miles hard pavement in Baltimore.
(5) - Includes 73.6 miles of shell road. (6) - Includes 1'.5 miles of oil treated sand road. (7) - State trunk roads only. (8) - Includes 111.4 miles of road with combined 9' concrete and 7' gravel.
(9) - Oil treated sand road. (10) - Excludes 60.2 miles of road built by compact with towns of over 2,500 population.
(11) - Includes 94.8 miles taken over from county system. (12) - System increased by 1,319 miles of unimproved (or partly graded) road from state roads.
(13) - Includes 113.4 miles of Kentucky rock asphalt. (14) - Includes state aid system. (15) - 121.4 miles added to system of which 18 miles were county graded roads and 51 miles county gravel roads.
(16) - Included with gravel. (17) - Includes 22.7 miles of Kentucky rock (asphalt) road.
(18) - Approximate data: 2,500 miles of county road added to system. (19) - Includes bituminous concrete. (20) - Decrease in mileage by revision of roads in system.

8-1-1925

Tab. 7

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

B.P.R.-R.R.S.S.-A-1
A-1924-M-5

TABLE M5 (1924)

RURAL ROAD STATUS SURVEY 1924
TOTAL MILES OF EXISTING COUNTY AND LOCAL RURAL ROADS
(NOT ON STATE HIGHWAY SYSTEM)
AT END OF YEAR 1924.

STATES 1/	GRAND TOTAL MILEAGE RURAL ROADS, OTHER THAN STATE HWY. SYSTEM	UNIMPROVED, AND EARTH PARTIALLY GRADED	EARTH TO ESTABLISHED GRADE & DRAINED	TOTAL MILES OF ROAD SURFACED	SAND-CLAY	GRAVEL, ETC., UNTREATED	WATERBOUND MACADAM, UNTREATED	SURFACE-TREATED MACADAM AND GRAVEL	BITUMINOUS MACADAM, BY PENETRATION	SHEET ASPHALT	BITUMINOUS CONCRETE	PORTLAND CEMENT CONCRETE	BRICK	(a) ASSOC. (a) ASPHALT, (b) STONE, BLOCK	MISCELLANEOUS	STATES
ALABAMA	57,543.2	46,685.7	-	10,857.5	6,486.1	3,311.4	663.0	224.9	121.6	19.2	29.8	1.4	-	-	-	ALABAMA
ARIZONA	20,370.9	16,745.2	1,932.3	1,693.4	648.3	716.8	-	-	-	-	67.1	261.2	-	-	-	ARIZONA
ARKANSAS	68,147.0	63,972.5	1,200.0	2,974.5	150.2	2,434.9	162.2	29.4	102.7	9.4	35.9	50.8	-	-	-	ARKANSAS
CALIFORNIA	69,218.0	27,499.0	29,688.0	12,031.0	-	6,123.0	966.0	586.0	992.0	-	755.0	1,729.0	-	-	900.0	CALIFORNIA
COLORADO	58,692.4	25,643.9	27,707.1	5,341.4	2/	5,341.4	-	-	-	-	-	-	-	-	-	COLORADO
CONNECTICUT	10,396.9	7,277.9	2,376.1	742.9	-	8.4	111.5	471.3	87.4	4.0	17.7	42.6	-	-	-	CONNECTICUT
DELAWARE (1923)	3,993.0	1,923.5	1,790.0	279.5	-	50.0	30.0	152.2	19.5	-	20.5	6.8	0.5	-	-	DELAWARE
FLORIDA	24,905.0	17,960.6	-	6,944.4	2,786.5	1,432.6	537.1	687.4	159.2	593.2	38.9	145.3	427.2	(a) 87.0	-	FLORIDA
GEORGIA	92,128.7	49,186.5	26,080.6	16,861.6	12,599.4	3,151.8	194.5	114.3	231.9	33.7	70.0	477.0	-	-	-	GEORGIA
IDAHO	30,745.0	9,025.0	12,250.0	9,470.0	-	9,015.0	325.0	-	-	-	60.0	-	-	-	70.0	IDAHO
ILLINOIS	91,508.5	80,098.3	654.0	10,756.2	-	6,782.6	2,622.5	138.0	64.4	28.4	34.0	926.3	152.0	(a) 6.0	-	ILLINOIS
INDIANA	76,617.3	40,505.0	-	36,112.3	-	23,615.5	11,038.0	208.9	220.1	-	147.9	690.8	151.1	-	-	INDIANA
IOWA	97,964.5	85,076.1	827.6	2,060.8	-	2,058.8	-	-	-	+	-	2.0	-	-	-	IOWA
KANSAS	121,978.0	121,405.0	-	573.0	--	270.0	240.0	63.0	-	-	-	-	-	-	-	KANSAS
KENTUCKY	60,704.0	45,635.6	251.7	14,816.7	70.0	3,153.0	10,644.3	740.3	11.0	56.0	-	36.1	4.0	(a) 5.0	97.0	KENTUCKY
LOUISIANA	32,803.0	31,526.2	-	1,276.8	-	1,265.0	-	-	3.2	-	5.6	-	3.0	-	-	LOUISIANA
MAINE	19,484.3	16,695.6	8.9	2,779.8	0.9	2,113.3	505.4	43.1	7.5	3.8	1.5	4.3	-	-	-	MAINE
MARYLAND	12,639.0	8,722.0	1,807.0	2,110.0	414.0	785.0	189.0	415.0	70.0	-	-	48.0	-	-	189.0	MARYLAND
MASSACHUSETTS	17,582.5	11,775.4	-	5,807.5	-	3,126.5	98.2	1,485.6	917.6	-	140.6	41.0	-	-	-	MASSACHUSETTS
MICHIGAN	70,701.4	54,715.0	860.0	15,126.4	67.5	12,593.2	1,254.0	353.1	94.0	2.0	91.7	435.4	3.5	-	231.9	MICHIGAN
MINNESOTA	100,834.5	81,457.2	2,538.1	16,839.2	3,776.2	12,832.5	68.6	67.4	-	8.5	21.9	61.6	2.5			MINNESOTA
MISSISSIPPI	51,481.5	43,968.6	645.6	6,867.3	364.3	6,114.0	89.5	20.0	228.2	-	6.0	45.3	-	-	-	MISSISSIPPI
MISSOURI	104,460.1	95,384.8	1,200.0	7,975.3	1,755.3	4,457.5	1,213.8	56.0	79.2	1.0	5.6	257.9	10.0	-	-	MISSOURI
MONTANA	59,219.9	59,009.9	-	210.0	-	210.0	-	-	-	-	-	-	-	-	-	MONTANA
NEBRASKA (1923)	81,549.5	79,549.5	1,785.7	214.3	146.8	61.0	0.7	-	-	-	2.0	3.3	0.5	-	-	NEBRASKA
NEVADA	20,074.5	18,247.0	1,513.0	314.5	-	314.0	0.5	-	-	-	-	-	-	-	-	NEVADA
NEW HAMPSHIRE	11,720.6	11,605.0	-	115.6	-	113.0	-	-	2.6	-	-	-	(a) 3.2	-	-	NEW HAMPSHIRE
NEW JERSEY	16,689.2	74.9	10,173.9	6,440.4	-	2,709.5	1,323.2	592.4	719.4	244.1	476.9	256.4	38.8	(e) 75.5	-	NEW JERSEY
NEW MEXICO	39,067.7	37,638.4	495.7	933.6	731.0	202.6	-	-	-	-	-	-	-	-	-	NEW MEXICO
NEW YORK	70,613.0	54,912.8	440.7	15,259.5	-	5,110.4	3,484.4	3,637.4	2,408.6	16.5	17.3	515.9	55.0	-	-	NEW YORK
NORTH CAROLINA (1921)	61,706.7	48,867.4	-	12,839.3	9,610.1	2,726.3	275.2	119.9	35.0	12.0	20.6	20.0	19.3	(a) 0.5	0.5	NORTH CAROLINA
NORTH DAKOTA	100,324.4	99,842.3	-	482.1	-	482.1	-	-	-	-	-	-	-	-	-	NORTH DAKOTA
OHIO (1921)	73,986.1	45,861.8	283.8	27,840.5	501.0	13,184.1	11,650.9	951.8	516.5	4.6	25.2	314.9	276.5	-	414.7	OHIO
OKLAHOMA	128,673.0	124,801.8	3,571.7	299.5	-	-	29.7	267.8	-	-	-	2.0	-	-	-	OKLAHOMA
OREGON	45,306.0	30,945.0	7,068.0	7,293.0	-	6,837.0	-	-	-	-	235.5	50.5	-	-	130.0 3/	OREGON
PENNSYLVANIA (1921)	81,252.5	72,007.7	-	9,244.9	0.5	72.6	696.2	65.7	17.2	1.2	319.9	99.3	177.0	-	7,795.3	PENNSYLVANIA
RHODE ISLAND	1,558.0	1,313.2	-	244.8	-	60.5	47.9	49.5	78.5	5.0	0.5	-	-	(a) 3.0	-	RHODE ISLAND
SOUTH CAROLINA	59,668.5	46,422.1	7,255.4	5,991.0	5,489.1	401.9	19.1	5.0	-	1.0	28.1	48.9	-	-	-	SOUTH CAROLINA
SOUTH DAKOTA	110,142.2	109,603.7	-	538.5	-	538.5	-	-	-	-	-	-	-	-		SOUTH DAKOTA
TENNESSEE	60,082.3	39,632.6	10,596.6	9,853.1	-	4,769.0	3,933.7	659.3	99.6	343.6	17.0	30.9	-	(a) 1.0	-	TENNESSEE
TEXAS	151,017.0	137,345.4	1,850.0	11,821.6	1,500.0	9,495.8	325.8	130.0	243.2	81.4	45.4	-	-	-	-	TEXAS
UTAH (1921)	20,248.8	16,912.9	1,322.0	2,013.9	697.6	1,230.1	12.0	3.6	7.2	-	17.7	45.7	-	-	-	UTAH
VERMONT (1921)	10,408.0	8,241.0	554.0	1,613.0	-	1,613.0	-	-	-	-	-	-	-	-	-	VERMONT
VIRGINIA (1921)	55,250.7	50,227.2	100.0	4,923.5	2,528.8	993.7	762.4	419.7	129.2	-	-	89.7	-	-	-	VIRGINIA
WASHINGTON	45,750.0	22,126.0	9,417.0	14,207.0	-	12,435.0	-	-	112.0	20.0	229.0	1,198.0	53.0	-	160.0	WASHINGTON
WEST VIRGINIA (1921)	31,840.9	30,924.8	200.0	716.1	-	93.7	398.7	52.2	35.1	-	7.7	66.8	55.0	-	6.9	WEST VIRGINIA
WISCONSIN	88,964.2	20,456.3	32,570.7	15,937.2	3,315.8	11,415.9	889.7	-	-	-	-	315.8	-	-	-	WISCONSIN
WYOMING	43,182.4	43,168.2	-	14.2		14.2	-	-	-	-	-	-	-	-	-	WYOMING
TOTALS	2,743,195.2	2,202,621.5	201,015.2	339,558.5	53,638.4	185,926.0	54,890.6	12,789.1	7,852.6	1,488.6	2,990.6	8,362.8	1,437.4	137.0	9,996.3	TOTALS

1/ STATES NOT REPORTING 1924 DATA ARE LISTED WITH BRACKETS AND YEARS OF LATEST INFORMATION
2/ SAND-CLAY INCLUDED WITH GRAVEL.
3/ WOOD PLANK ROAD

LAA.
9-25-1925

11C

STATUS OF FEDERAL AID HIGHWAY CONSTRUCTION
(Bureau of Public Roads)
As of January 31,1926

States	Fiscal yrs.1917-25	Fiscal year 1926		
	Proj.comp.prior to July 1/25	Proj.comp.since June 30/25	Proj.under construc.	Proj.approv. for constr.
Alabama	611.9 mi.	473.7 mi.	355.6 mi.	28.2 mi.
Arizona	613.8	92.2	88.7	26.7
Arkansas	1048.9	189.5	371.6	44.9
California	894.8	72.4	356.0	6.3
Colorado	651.2	41.7	234.1	25.2
Connecticut	101.6	13.4	29.1	3.7
Delaware	107.1	12.3	22.7	10.5
Florida	96.3		295.5	13.8
Georgia	1478.3	181.5	691.7	71.5
Idaho	600.1	47.1	183.4	17.0
Illinois	1236.2	32.1	285.3	
Indiana	422.1	47.0	487.0	16.6
Iowa	1996.9	36.5	476.8	140.3
Kansas	831.4	233.9	500.3	152.5
Kentucky	584.9	84.6	313.6	9.0
Louisiana	927.6	68.9	160.4	25.5
Maine	281.4	9.8	66.2	8.3
Maryland	294.4	41.8	99.2	
Massachusette	300.6	20.4	80.4	14.6
Michigan	612.6	272.1	281.6	11.9
Minnesota	2721.2	397.0	522.4	37.9
Mississippi	803.4	156.9	427.8	65.0
Missouri	1118.9	190.3	698.6	29.1
Montana	921.6	71.2	175.2	119.0
Nebraska	1570.6	120.3	1079.6	40.7
Nevada	357.3	125.6	367.9	
NewHampshire	208.1	27.6	19.5	0.5
New Jersey	219.1	35.1	56.4	
New Mexico	1081.3	329.6	116.3	5.4
New York	831.5	175.5	621.7	148.6
North Carolina	1119.8	79.6	190.1	35.0
North Dakota	1917.5	164.5	533.0	131.0
Ohio	1191.1	129.7	306.3	57.5
Oklahoma	852.2	112.3	291.0	20.2
Oregon	794.6	75.3	144.2	42.8
Pennsylmania	850.3	80.9	663.7	44.7
Rhode Island	64.8	6.0	40.2	4.2
South Carolina	1235.9	58.6	345.2	78.1
South Dakota	1447.9	387.6	764.4	
Tennessee	497.9	122.7	316.8	58.7
Texas	3907.1	540.5	1168.4	248.5
Utah	423.1	10.5	251.9	16.0
Vermont	107.8	3.5	46.2	0.1
Virginia	676.2	241.3	195.2	52.1
Washington	526.7	137.0	26.7	1.2
West Virginia	328.7	12.8	185.7	11.3
Wisconsin	1451.7	54.5	272.1	19.2
Wyoming	982.0	102.8	208.8	0.1
Hawaii			6.5	
totals	41898.3	5920.1	15421.0	1893.4

Table 9. STREET CONDITIONS OF TYPICAL CITIES

City	Total miles within city limit	City Streets: Average width between property lines		
		Main Thoroughfare	Business	Residence
Buffalo, N. Y.	678	66-99	66	60-66
Chicago, Ill.	3,300	66-141	66	66
Columbus, O.		60-90	82.5	50-60
Davenport, Ia.	188	80	80	50-60
Denver, Colo.	900	80	80	60
Des Moines, Ia.	600	66-80	66-70	40-66
Kansas City, Mo.	1,350	60	70	50
Los Angeles, Cal.	3,543	80-100	90	50-60
Minneapolis, Minn.	881	80-100	80-102	60-80
Nashville, Tenn.	342	50	50	50
New Haven, Conn.	207	50-70	50-70	50-70
New York, N. Y.	4,000	100	60	60
Ogden, Utah	200	99-132	99-132	60-90
Reno, Nevada	41	80	80	60
St. Louis, Mo.	988	60*	60*	60*
Seattle, Wash.	342	50	50	50

* 80% of streets are 60 feet or less, other from 80 to 150, this applying to all classes of streets. (12)

HIGHWAY EXPENDITURES

Under the present system of highway finance, the operator and owner of motor vehicle bears its operating costs and the public, through state highway commissions or through local highway departments, bears the costs of constructing and maintaining the highway. One of the main problems of highway finance is to apportion this highway cost among those who, on the one hand, make a direct use of the highway and benefit thereby, and those, on the other hand, who benefit indirectly through the development of the highway system. Aside from general property taxes or special taxes, we now have motor-vehicle revenues which are raised either by the licensing of the motor vehicles and the exaction of a special fee in connection herewith; or by the taxation of gasoline. Through the use of these two methods the automobile is called upon to bear directly a part of the total cost of highway construction and maintenance. The average motor vehicle revenues for 1921 and 1923 can be compared thus:

	1921	1923
States in which average revenues were $20 and over	3	15
States in which average revenues were $10 to $19	34	28
States in which average revenues were $10 and less	11	5

Table 10 shows these in detail.

In discussing the subject of highway expenditures, the question is often raised as to the amount of money which the people of a state or a community can afford to spend for the improvement of the roads. The relationship which exists between the highway expenditures and the income of the people reduced to a per

capita basis furnishes one criterion which can be applied.

In thirteen states,--Alabama, California, Connecticut, Illinois, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont,--the per capita highway expenditures in 1921 amounted to less than 1 per cent of each person's income. In seventeen states,--Colorado, Florida, Georgia, Kentucky, Louisiana, Maine, Michigan, Nebraska, New Mexico, Ohio, Oklahoma, Tennessee, Texas, Utah, Virginia, Washington, and West Virginia,--the highway expenditures were between 1 and 2 per cent of the income. In eleven states,--Delaware, Indiana, Kansas, Minnesota, Montana, Nevada, North Carolina, North Dakota, South Carolina, Wisconsin, and Wyoming,--the highway expenditures were between 2 and 3 per cent. In seven states,--Arizona, Arkansas, Idaho, Iowa, Mississippi, Oregon, and South Dakota,--they were over 3 per cent. South Dakota, where the highway expenditures amounted to 6.84 per cent of the people's income, showed the highest ratio. In New York, where the ratio is the lowest, the highway expenditures were only 0.34 per cent of the income.

Tab. 10 TOTAL HIGHWAY EXPENDITURES AND MOTOR-VEHICLE REVENUES 1921 to 1923*

State	1921 Total highway expenditures, less interest and principal payments	1921 Total license fees and gasoline taxes: Amount	1921 Percentage of total highway expenditures	1922 Total highway expenditures, less interest and principal payments	1922 Total license fees and gasoline taxes: Amount	1922 Percentage of total highway expenditures	1923 Total highway expenditures, less interest and principal payments	1923 Total license fees and gasoline taxes: Amount	1923 Percentage of total highway expenditures
			Per cent			Per cent			Per cent
Alabama	$4,881,701	$1,147,265	23.5	$7,771,258	$1,252,800	16.2	$7,771,258	$2,674,103	34.4
Arizona	9,801,812	283,868	2.9	9,562,166	374,168	3.9	9,562,166	755,791	7.9
Arkansas	19,353,866	1,026,344	5.3	12,292,781	1,238,271	10.0	12,292,781	1,654,289	13.5
California	36,614,695	6,841,060	18.7	46,886,653	8,388,606	17.9	46,886,653	13,127,137	28.0
Colorado	8,903,278	1,465,542	16.5	10,334,618	1,636,542	15.9	10,334,618	1,972,572	19.1
Connecticut	8,445,716	2,300,350	27.2	9,118,182	4,246,901	46.6	9,118,182	5,259,675	57.0
Delaware	5,570,049	375,469	6.7	3,944,090	425,377	10.8	3,944,090	604,788	15.3
Florida	8,541,667	1,018,712	11.8	10,549,971	2,231,524	21.2	10,549,971	3,604,108	34.1
Georgia	14,371,514	2,108,022	14.7	8,878,320	2,569,265	29.0	8,878,320	3,658,910	41.2
Idaho	10,786,137	841,213	7.8	4,784,041	812,944	17.0	4,784,041	1,310,502	27.4
Illinois	37,639,731	6,804,556	18.1	50,496,350	7,882,482	15.6	50,496,350	9,654,796	19.1
Indiana	44,142,148	2,422,227	5.5	40,689,112	2,999,788	7.4	40,689,112	6,600,143	16.2
Iowa	39,321,554	7,719,128	19.6	33,401,849	7,923,388	23.7	33,401,849	8,827,063	26.5
Kansas	22,054,780	1,400,000	6.4	21,709,498	3,100,000	14.3	21,709,498	3,435,666	15.8
Kentucky	11,684,078	2,184,825	18.7	13,884,070	2,587,993	18.6	13,884,070	3,359,168	24.2
Louisiana	11,858,100	453,276	3.8	12,786,192	2,210,618	17.3	12,786,192	3,945,679	30.9
Maine	8,259,725	1,004,730	12.1	9,467,482	1,417,567	15.0	9,467,482	1,946,345	20.8
Maryland	8,968,584	2,400,162	27.4	7,497,713	3,220,387	43.0	7,497,713	4,225,259	56.2
Massachusetts	18,634,337	4,717,480	25.3	10,843,800	7,885,527	72.6	10,843,800	6,989,634	64.5
Michigan	50,708,404	6,751,925	13.3	55,516,404	8,305,022	15.0	55,516,404	10,500,786	18.9
Minnesota	37,144,902	5,672,424	15.3	33,644,891	6,544,685	19.5	33,644,891	7,316,772	21.8
Mississippi	17,256,426	751,946	4.3	18,078,341	1,444,512	8.0	18,078,341	1,545,472	8.5
Missouri	15,240,880	2,505,354	16.4	18,913,961	3,512,182	18.6	18,913,961	4,016,384	21.2
Montana	9,270,916	823,430	8.9	3,635,170	863,811	23.7	3,635,170	1,170,871	32.2
Nebraska	10,364,131	2,824,811	27.0	9,134,304	3,041,096	33.2	9,134,304	3,353,175	36.6
Nevada	1,971,895	102,800	5.2	2,240,623	120,947	5.4	2,240,623	269,731	12.0
New Hampshire	3,598,921	876,322	24.4	4,047,980	1,246,098	30.9	4,047,980	1,734,391	42.9
New Jersey	26,334,950	3,974,064	15.0	34,195,623	6,251,418	18.3	34,195,623	7,653,780	22.4
New Mexico	3,399,464	541,921	15.8	4,159,433	426,903	10.2	4,159,433	460,000	11.1
New York	50,913,712	10,288,878	20.2	48,952,729	12,736,364	26.0	48,952,729	19,862,442	40.6
North Carolina	25,617,735	2,765,258	10.8	24,949,161	3,493,827	14.0	24,949,161	6,637,909	26.6
North Dakota	7,212,241	684,054	9.5	5,417,705	698,941	12.9	5,417,705	1,221,904	22.5
Ohio	65,777,680	6,691,160	10.2	48,234,644	7,888,902	16.3	48,234,644	9,622,370	20.0
Oklahoma	13,941,478	2,619,714	18.8	10,721,964	2,729,109	25.5	10,721,964	3,816,771	35.5
Oregon	28,476,121	4,270,058	12.4	15,851,436	4,440,779	28.0	15,851,436	6,027,751	38.2
Pennsylvania	69,580,813	10,305,499	14.8	80,699,582	12,575,480	15.6	80,699,582	21,335,826	26.4
Rhode Island	2,694,544	848,724	31.5	2,414,704	1,139,742	47.2	2,414,704	1,286,629	53.2
South Carolina	9,414,868	741,115	7.9	9,840,778	1,501,888	15.3	9,840,778	2,414,061	24.5
South Dakota	13,752,165	720,587	5.2	12,116,778	1,242,252	10.2	12,116,778	1,755,652	14.5
Tennessee	12,046,753	1,387,870	11.5	11,659,311	1,592,250	13.7	11,659,311	2,862,010	24.6
Texas	15,747,452	[illegible]	8.3	56,022,344	4,264,488	7.6	56,022,344	6,657,132	11.9
Utah	4,564,260	441,304	9.7	3,909,295	729,475	18.7	3,909,295	844,191	21.4
Vermont	2,150,484	668,289	31.1	2,882,200	781,582	27.0	2,882,200	1,107,033	38.8
Virginia	14,380,422	2,021,146	14.0	15,143,391	2,467,446	16.2	15,143,391	4,757,083	31.5
Washington	22,229,060	3,612,278	16.2	17,564,039	4,215,700	24.1	17,564,039	5,123,747	29.2
West Virginia	9,130,841	1,256,526	13.7	12,546,208	1,930,079	15.4	12,546,208	2,974,508	23.7
Wisconsin	16,774,180	1,671,646	9.0	41,706,869	4,088,570	9.8	41,706,869	4,958,944	11.8
Wyoming	4,129,212	288,122	6.6	2,818,372	316,819	11.2	2,818,372	554,258	19.7
	947,302,856	127,771,344	13.4	931,886,835	160,851,584	17.2	931,886,835	225,427,013	24.2

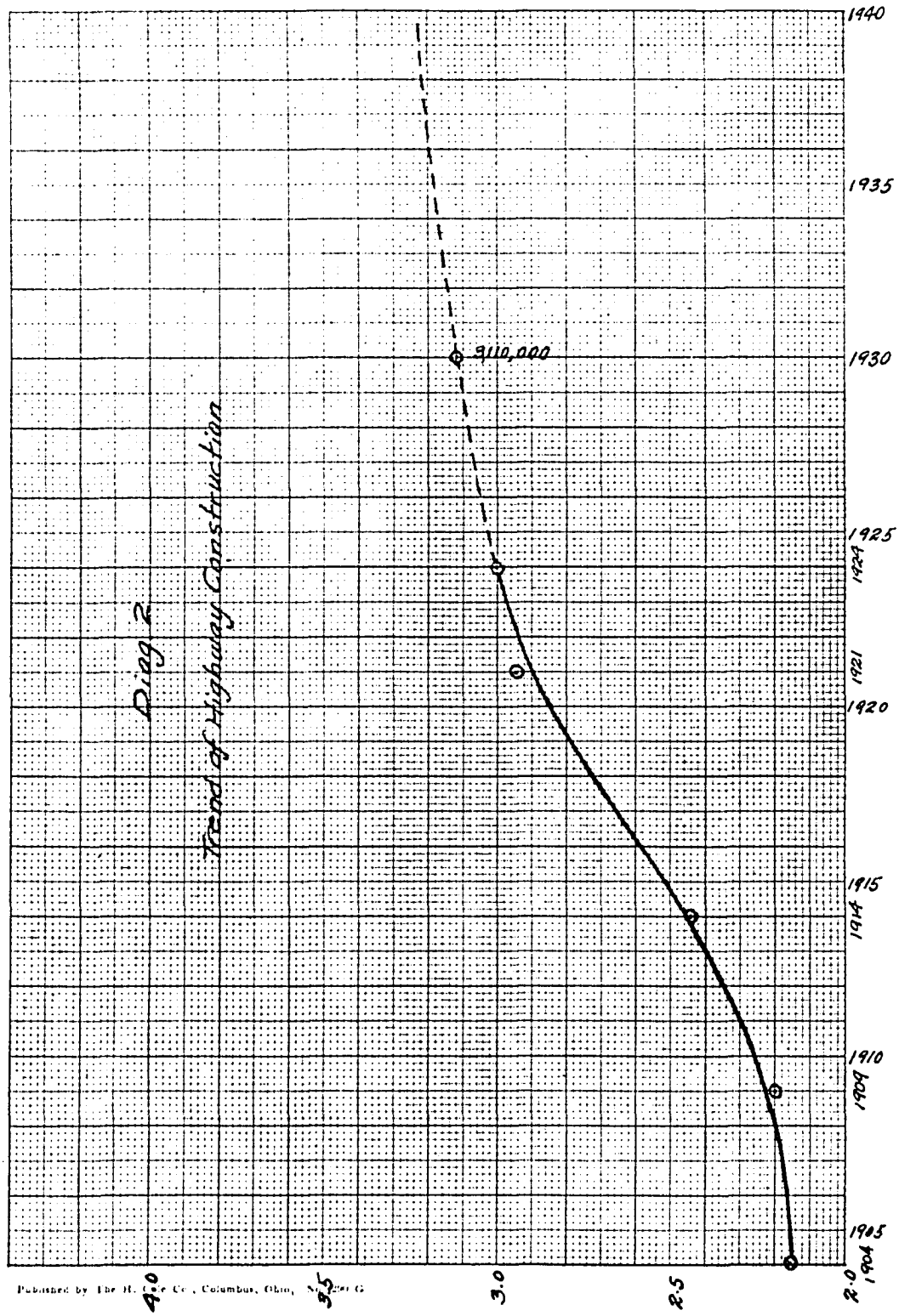
* 1923 Estimated

FUTURE HIGHWAY CONSTRUCTION

There is no doubt that more highways are needed, but as shown in diagram 2, the construction of highways has come to the saturating point where the trend of increase is about uniform.

As mentioned in the first part of this chapter, at the present only 15.58 per cent of the total road mileage was surfaced or improved. So in the future highway construction the new construction will be a minor problem but the improvement or surfacing of the present mileage will be a major and an important task for the highway engineers.

There is 94.42 per cent yet to be improved. This no doubt involves a great sum of money and takes time, but for the economic of highway transport and better traffic movement this is necessary to be done.



Diag 2

Trend of Highway Construction

Chapter Three. THE GROWTH OF POPULATION

The growth of population has a great deal to do with the increasing use of automobiles. It is interesting to know that the urban populations are gaining from year to year and this tends to cause congestion in the cities. Study of population and its distribution will assist in throwing light on the future traffic demand.

The population of the United States, exclusive of outlying possessions, from 1890 to 1920 was as follows:

Census Year	Population	Increase over preceding census	
		Number	Per cent
1920	105,710,620	13,738,354	14.9
1910	91,972,266	15,977,691	21.0
1900	75,994,714	13,046,861	20.7
1890	62,947,714	12,791,931	25.5

The new estimate of population by the Bureau of Economic Research in June 1924 was as follows:

January 1, 1920 105,711,000
January 1, 1921 107,575,000
January 1, 1922 109,298,000
January 1, 1923 110,883,000
January 1, 1924 112,826,000

Table 11 shows the growth of population in nineteen states and the District of Columbia. Table 12 shows the growth of urban and rural population of these states and the district.

Table 11. POPULATION OF NINETEEN STATES AND THE DISTRICT OF COLUMBIA--1900 to 1920

STATE	1920	1910	1900	INCREASE IN POPULATION 1910-20	1900-10	1910-20	1900-10
				Number		Per Cent	
California	3,426,861	2,377,549	1,485,053	1,049,312	892,496	44.1	60.1
Colorado	939,629	799,024	539,700	140,605	259,324	17.6	48.0
Florida	968,470	752,619	528,542	215,851	224,077	28.7	42.4
Illinois	6,485,280	5,638,591	4,821,550	846,689	817,041	15.0	16.9
Iowa	2,404,021	2,224,771	2,231,853	179,250	7,082	8.1	.3
Maryland	1,449,661	1,295,346	1,188,044	154,315	107,302	11.9	9.0
Mass.	3,852,356	3,366,416	2,805,346	485,940	561,070	14.4	20.0
Michigan	3,668,412	2,810,173	2,420,982	858,239	389,191	30.5	16.1
Missouri	3,404,055	3,293,335	3,106,665	110,720	186,670	3.4	6.0
New Jersey	3,155,900	2,537,167	1,883,669	618,733	653,498	24.4	34.7
New York	10,385,227	9,113,614	7,268,894	1,271,613	1,844,720	14.0	25.4
N. Dakota	646,872	577,056	319,146	69,816	257,910	12.1	80.8
Ohio	5,759,394	4,767,121	4,157,545	992,273	609,576	20.8	14.7
Penn.	8,720,017	7,665,111	6,302,115	1,054,906	1,362,996	13.8	21.6
Texas	4,663,228	3,896,542	3,048,710	766,686	847,832	19.7	27.8
Tenn.	2,337,885	2,184,789	2,020,616	153,096	164,173	7.0	8.1
Virginia	2,309,187	2,061,612	1,854,184	247,575	207,428	12.0	11.2
Washington	1,356,621	1,141,990	518,103	214,631	623,887	18.8	120.4
Wisconsin	2,632,067	2,333,860	2,069,042	298,207	264,818	12.8	12.8
District of Columbia	437,571	331,069	278,718	106,502	52,351	32.2	18.8

The urban population as will be shown in the next two tables has risen from 40% in 1900 to 51.4% in 1920 in the United States and there is no doubt that it will continue to rise for a certain time.

Table 12a. URBAN AND RURAL POPULATION OF U. S.-1900-1920

CLASS	1920	1910	1900
Total Number	105,710,620	91,972,266	75,994,575
Urban	54,304,603	42,166,120	30,380,433
Rural	51,406,017	49,806,146	45,614,142
Total Per cent	100.00	100.00	100.00
Urban	51.40	45.80	40.00
Rural	48.60	54.20	60.00

Table 12b. URBAN AND RURAL POPULATION IN NINETEEN STATES AND DISTRICT OF COLUMBIA--1900 to 1920

STATE	1920			1910		1900
	Total	Urban	Rural	Total	Urban	
California	3,426,861	2,331,729	1,095,132	2,377,549	1,469,739	
Colorado	939,629	453,249	486,370	799,024	404,840	
Florida	968,470	355,825	612,645	752,619	219,080	
Illinois	6,485,280	4,403,153	2,082,127	5,638,591	3,476,929	2,1
Iowa	2,404,021	875,496	1,528,526	2,224,771	680,054	1,5
Maryland	1,449,661	869,422	580,239	1,295,346	658,192	
Mass.	3,852,356	3,650,248	202,108	3,366,416	3,125,367	
Michigan	3,668,412	2,241,560	1,426,852	2,810,173	1,327,044	1,4
Missouri	3,404,055	1,586,903	1,817,152	3,293,335	1,398,817	1,8
New Jersey	3,155,900	2,474,936	680,964	2,537,167	1,907,210	
New York	10,385,227	8,589,844	1,795,383	9,113,614	7,185,494	1,9
N. Dakota	646,872	88,239	558,633	577,056	63,236	
Ohio	5,759,394	3,677,136	2,082,258	4,767,121	2,665,143	2,1
Penn.	8,720,017	5,607,815	3,112,202	7,665,111	4,630,669	3,0
Texas	4,663,228	1,512,689	3,150,539	3,896,542	938,104	1,7
Tenn.	2,337,885	611,226	1,726,659	2,184,789	441,045	1,5
Virginia	2,309,187	673,984	1,635,203	2,061,612	476,529	
Washington	1,356,621	748,735	607,886	1,141,990	605,530	1,3
Wisconsin	2,632,067	1,244,568	1,387,499	2,333,860	1,004,320	
District of Columbia	437,571	437,571		331,069	331,069	

. be shown in the next two

4% in 1920 in the United

.l continue to rise for a

'LATION OF U. S.-1900-1920

1910	1900
1,972,266	75,994,575
2,166,120	30,380,433
9,806,146	45,614,142
100.00	100.00
45.80	40.00
54.20	60.00

ULATION IN NINETEEN
MBIA--1900 to 1920

	1 9 1		0		1 9 0 0	
ral	Total	Urban	Rural	Total	Urban	Rural
,132	2,377,549	1,469,739	907,810	1,485,053	777,699	707,354
,370	799,024	404,840	394,184	539,700	260,651	279,034
,645	752,619	219,080	533,539	528,542	107,031	420,511
,127	5,638,591	3,476,929	2,161,662	4,821,550	2,616,368	2,205,182
,526	2,224,771	680,054	1,544,717	2,231,853	572,386	1,659,467
,239	1,295,346	658,192	637,154	1,188,044	591,206	596,838
,108	3,366,416	3,125,367	241,049	2,805,346	2,567,098	238,248
,852	2,810,173	1,327,044	1,483,129	2,420,982	952,323	1,468,659
,152	3,293,335	1,398,817	1,894,518	3,106,665	1,128,104	1,978,561
,964	2,537,167	1,907,210	629,957	1,883,669	1,329,162	554,507
,383	9,113,614	7,185,494	1,928,120	7,268,894	5,298,111	1,970,783
,633	577,056	63,236	513,820	319,146	23,413	295,733
,258	4,767,121	2,665,143	2,101,978	4,157,545	1,998,382	2,159,163
,202	7,665,111	4,630,669	3,034,442	6,302,115	3,448,610	2,853,505
,539	3,896,542	938,104	1,743,744	2,020,616	326,639	1,693,977
,659	2,184,789	441,045	1,585,083	1,854,184	340,067	1,514,117
,203	2,061,612	476,529	536,460	518,103	211,477	306,626
,886	1,141,990	605,530	1,329,540	2,069,042	790,213	1,278,829
,499	2,333,860	1,004,320				
	331,069	331,069	.....	278,718	278,718	.....

The New York Times told us that the population of the United States is about 115,000,000 in 1925. Probably 55% of all the people are in the cities and towns and the other 45% are engaged in agriculture. The changing rank of the largest cities from 1900 to 1925 is shown in the following table.

Table 13. POPULATION OF THE LARGEST CITIES OF THE UNITED STATES--1900 to 1925--BASED ON THE LATEST OFFICIAL ESTIMATES

CITY	1900	1910	1920	1925	Per Cent Increased
New York	3,437,332	4,766,883	5,620,048	6,103,384	77
Chicago	1,698,575	2,185,283	2,701,705	2,995,239	76
Philadelphia	1,293,697	1,549,008	1,823,779	1,979,364	52
Detroit	285,764	465,766	993,687	1,242,044	331
Cleveland	381,768	560,663	796,841	936,485	145
St. Louis	575,238	687,029	772,897	821,543	42
Baltimore	508,967	558,485	733,826	796,296	56
Boston	560,892	670,585	748,060	781,529	39
Los Angeles	102,479	319,198	576,673	727,102	609
Pittsburgh	451,512	533,905	588,343	631,563	39
San Francisco	342,782	416,912	506,676	557,530	62
Buffalo	352,387	423,715	506,775	539,016	53
Milwaukee	285,315	373,857	457,147	509,192	78
Washington, D. C.	278,718	331,069	437,571	497,906	78
Newark	246,070	347,469	414,524	452,513	85
Minneapolis	202,718	301,408	380,582	425,435	109
New Orleans	287,104	339,075	387,219	414,413	44
Cincinnati	325,902	363,591	401,247	409,333	25

THE FUTURE POPULATION

The population of the United States is quite regularly increasing. With a large area of land and the industrial development to gain better wealth, it is quite sure that this increment will be continued for a long time.

But the danger of increasing population of cities which will add more traffic in a limited area is not a good outlook from the traffic movement point of view. The extension of city area or decentralization of the city is a future problem of traffic circulation in relation to the growth of population.

Form E-3

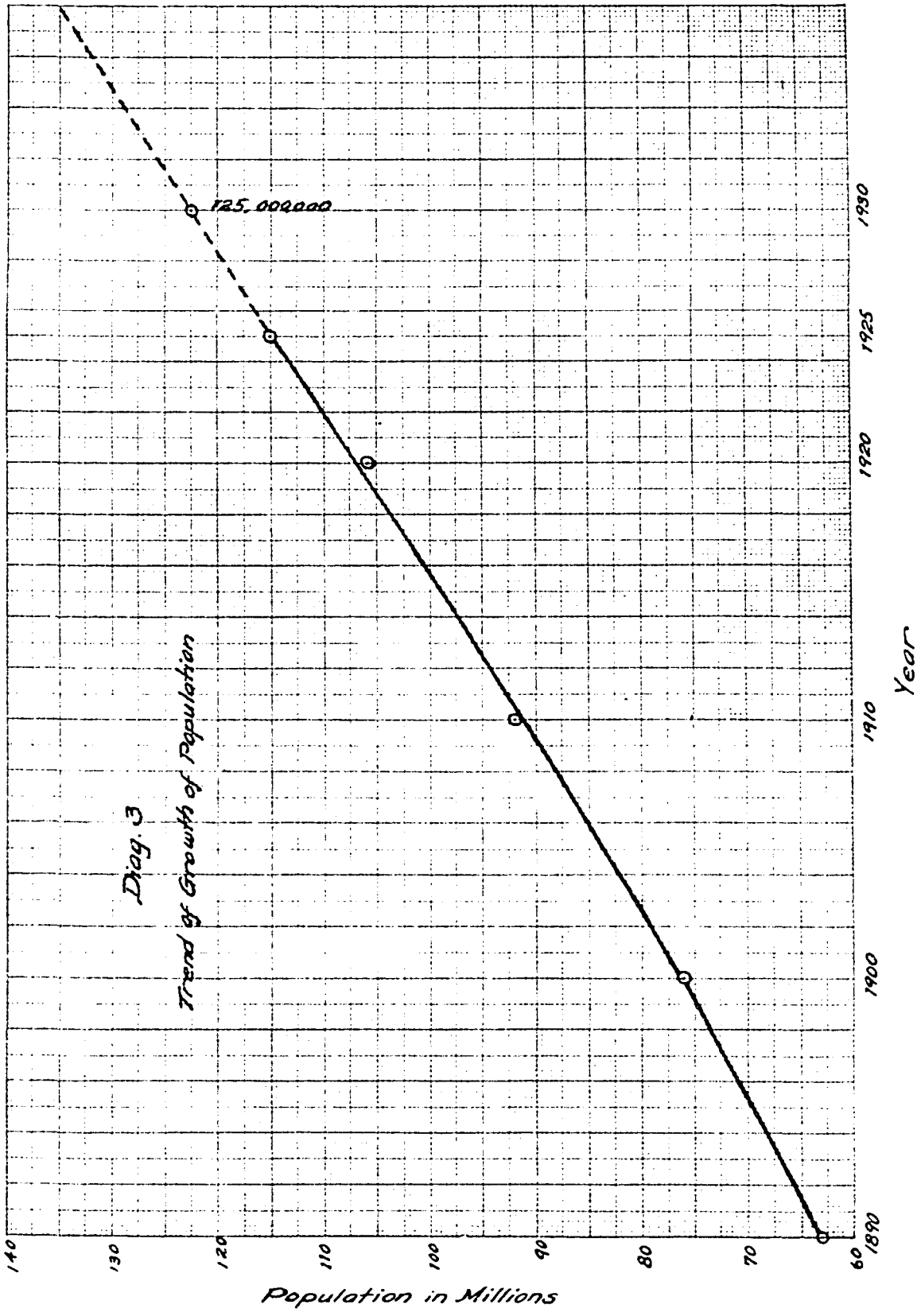


Fig. 3 Trend by growth of population

Chapter Four. AUTOMOBILES, HIGHWAYS AND POPULATION

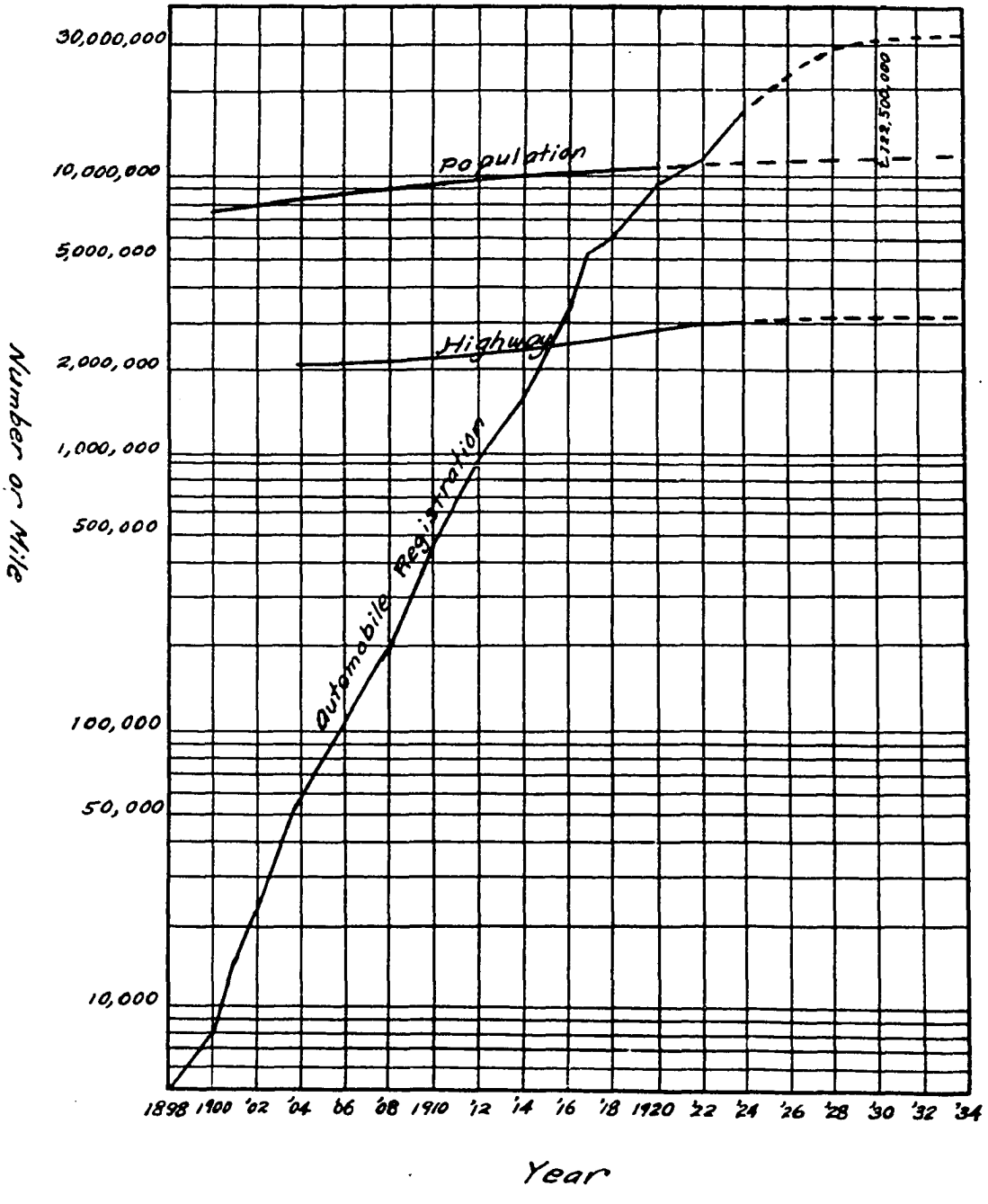
The relation of automobiles, highways and population is no doubt an important study which should be undertaken to find the future possible trend of the traffic development. In diagram 4 is shown the growth of automobile registration, the development of highways and the growth of population of the United States. It is interesting to note the rapid growth of the automobile registration up to the present time, but this will come to the saturating point after which it will increase normally and parallel to the growth of population and the development of highways, practically.

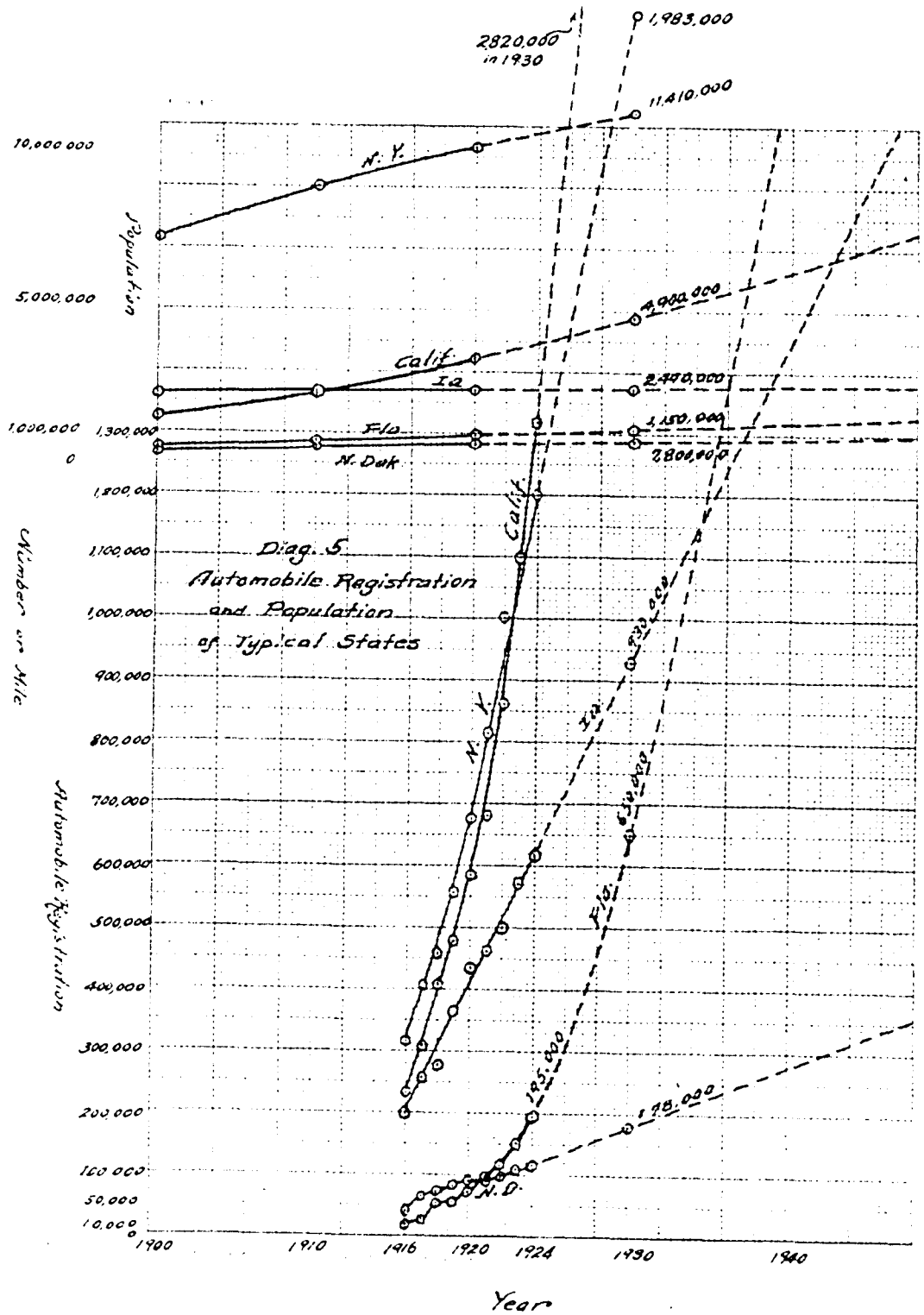
The population, of course, will grow more or less regularly and the highway mileage too will be increased directly proportional to the growth of the use of automobiles; i. e., to the growth of the traffic. But as said before, the future mileage of highways may not develop rapidly but the improvement and reconstruction will be a major problem as it has a great mileage of works to be done.

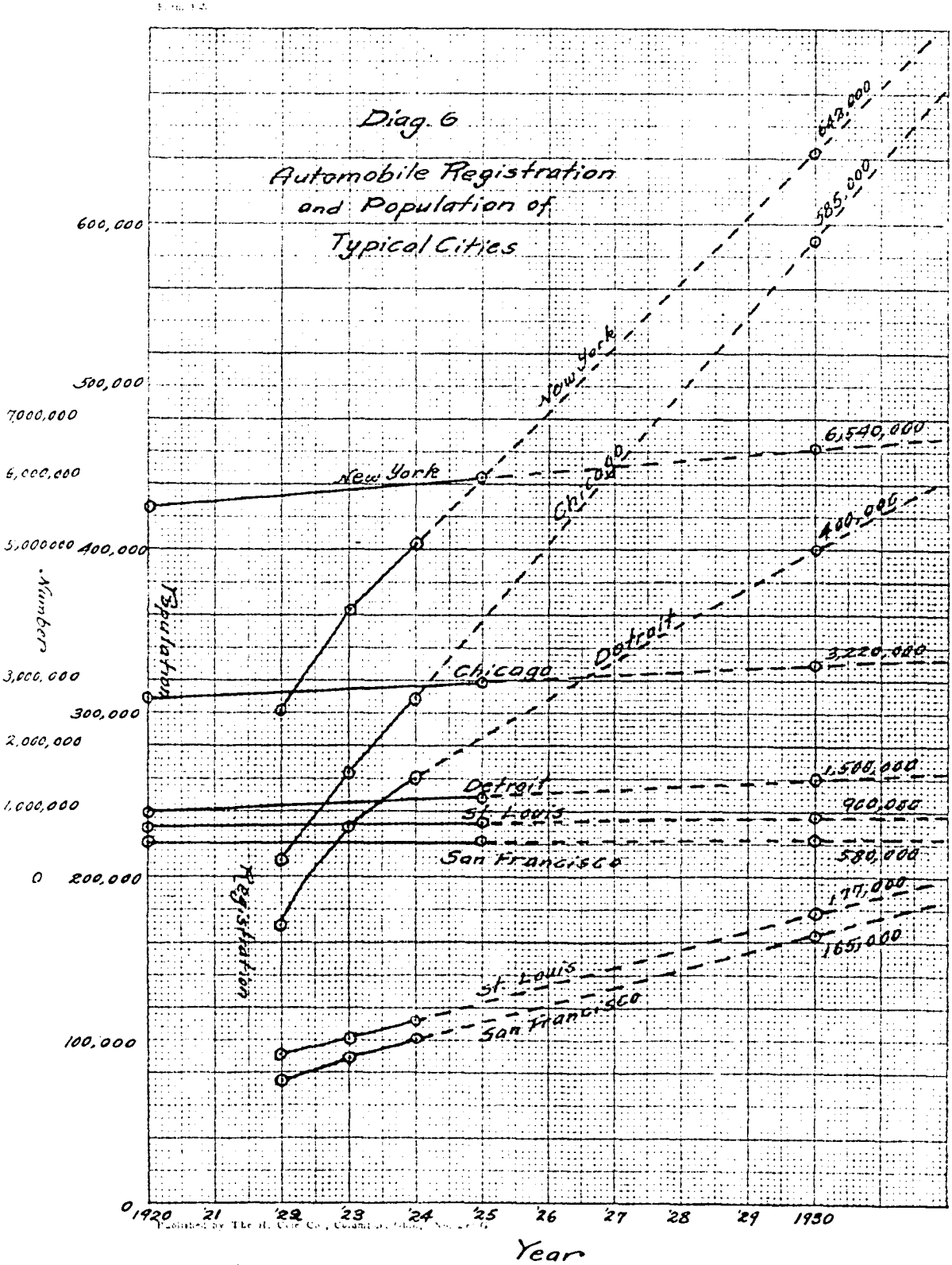
For further illustration, the relation of automobiles and population of typical states from different sections of the United States are shown in the Diagram 5, in which it is interesting to note that most of them are steadily growing and in Florida it shows quite rapidly growing in automobile registration in the past few years.

Diagram 6 shows the relation of automobile registration and population in some typical cities from different sections of the United States. The population is growing normally and the

Diag. 4 Automobiles, Highways, & Population




2820,000
in 1930
1,983,000
11,410,000
10,000,000
N. Y.
Population
5,000,000
4,000,000
Calif.
Ia
2,400,000
1,000,000
1,300,000
Fla
1,150,000
0
N. Dak
2,800,000
1,800,000
1,700,000
Diag. 5
Automobile Registration
and Population
of Typical States
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
50,000
10,000
0
Number on Mile
Automobile Registration
1900
1910
1916
1920
1924
1930
1940
Year


Diag. 6
Automobile Registration and Population of Typical Cities
600,000
500,000
7,000,000
6,000,000
5,000,000
400,000
3,000,000
300,000
2,000,000
1,000,000
0
200,000
100,000
0
Number
Population
Registration
New York
Chicago
Detroit
St Louis
San Francisco
6,540,000
400,000
3,220,000
1,500,000
900,000
580,000
165,000
1920
'21
'22
'23
'24
'25
'26
'27
'28
'29
1930
Year

automobile registrations are mostly straightly increasing, but Detroit seems to show the trend of slow growth although it is a rapid growing city if compared with Chicago and New York.

The following table shows some interesting facts of highways compared with other related data in years 1904,1909, 1914 and 1921.

TABLE 14—*Road mileage, road income, and other related data for the United States in 1921, 1914, 1909, and 1904*

	1921	1914	1909	1904
Total road mileage	2,941,294	2,445,761	2,199,645	2,151,379
Surfaced mileage	387,760	257,291	190,476	153,530
Percentage surfaced	13.2	0.5	8.7	7.1
Total income for all rural road purposes	$1,149,437,896	[1] $240,263,784	[2]	$79,623,617
State and local road and bridge bonds outstanding at end of year	$1,222,312,300	$344,763,082	[2]	[2]
Land area (square miles)	2,973,714	2,973,830	2,973,830	2,974,099
Population, total for United States	[3] 105,273,049	[4] 91,641,197	[4] 91,641,197	[5] 75,715,857
Rural population	[3] 51,406,017	[4] 49,348,883	[4] 49,348,883	[5] 45,197,390
Miles of road per square mile of area	0.99	0.82	0.74	0.72
Miles of road per 1,000 of rural population	57.2	49.5	44.6	47.6
Surfaced mileage per square mile of area	0.130	0.086	0.064	0.052
Surfaced mileage per 1,000 of rural population	7.54	5.21	3.86	3.39
Road and bridge income per mile of road	$390.79	$98.22	[2]	$37.01
Road and bridge income per square mile of area	$386.52	$80.79	[2]	$26.77
Road and bridge income per capita	$10.92	$2.62	[2]	$1.05

[1] Income considered as equal to expenditure.
[2] No data available.
[3] 1920 census.
[4] 1910 census.
[5] 1900 census.

PERSONS PER MOTOR VEHICLE

The number of persons per motor vehicle in the United States in the past few years decreased from 14 in 1919 to 6.2 in 1924. The following two tables show (1) the number of persons per motor vehicle in the United States, and (2) the number of persons per motor vehicle in different states.

Table 15. NUMBER OF PERSONS PER MOTOR VEHICLE IN THE U.S.

Year	Number of persons per motor vehicle
1919	14.00
1920	12.00
1921	11.00
1922	8.60
1923	7.40
1924	6.20
1925 (July 1)	6.47

Table 16. NUMBER OF PERSONS PER MOTOR VEHICLE IN DIFFERENT STATES.

STATE	1921	1922	1923	1924
Alabama	28.50	26.1	19.	17.49
Arizona	9.50	8.8	8	7.58
Arkansas	25.90	20.4	16	14.49
California	5.16	3.8	3	3.38
Colorado	6.40	5.8	5	5.02
Connecticut	10.39	9.0	8	8.05
Delaware	10.40	9.1	8	7.93
District of Columbia	10.80	8.3	6	5.55
Florida	9.88	8.3	7	6.46
Georgia	21.90	20.2	17	16.53
Idaho	8.40	8.0	7	7.63
Illinois	9.70	8.3	7	6.94
Indiana	7.30	6.2	5	5.30
Iowa	5.21	4.8	4	4.29
Kansas	6.10	5.4	5	4.85
Kentucky	19.00	15.7	12	11.92
Louisiana	23.10	17.6	14	12.26
Maine	9.90	8.3	7	7.19

Continued

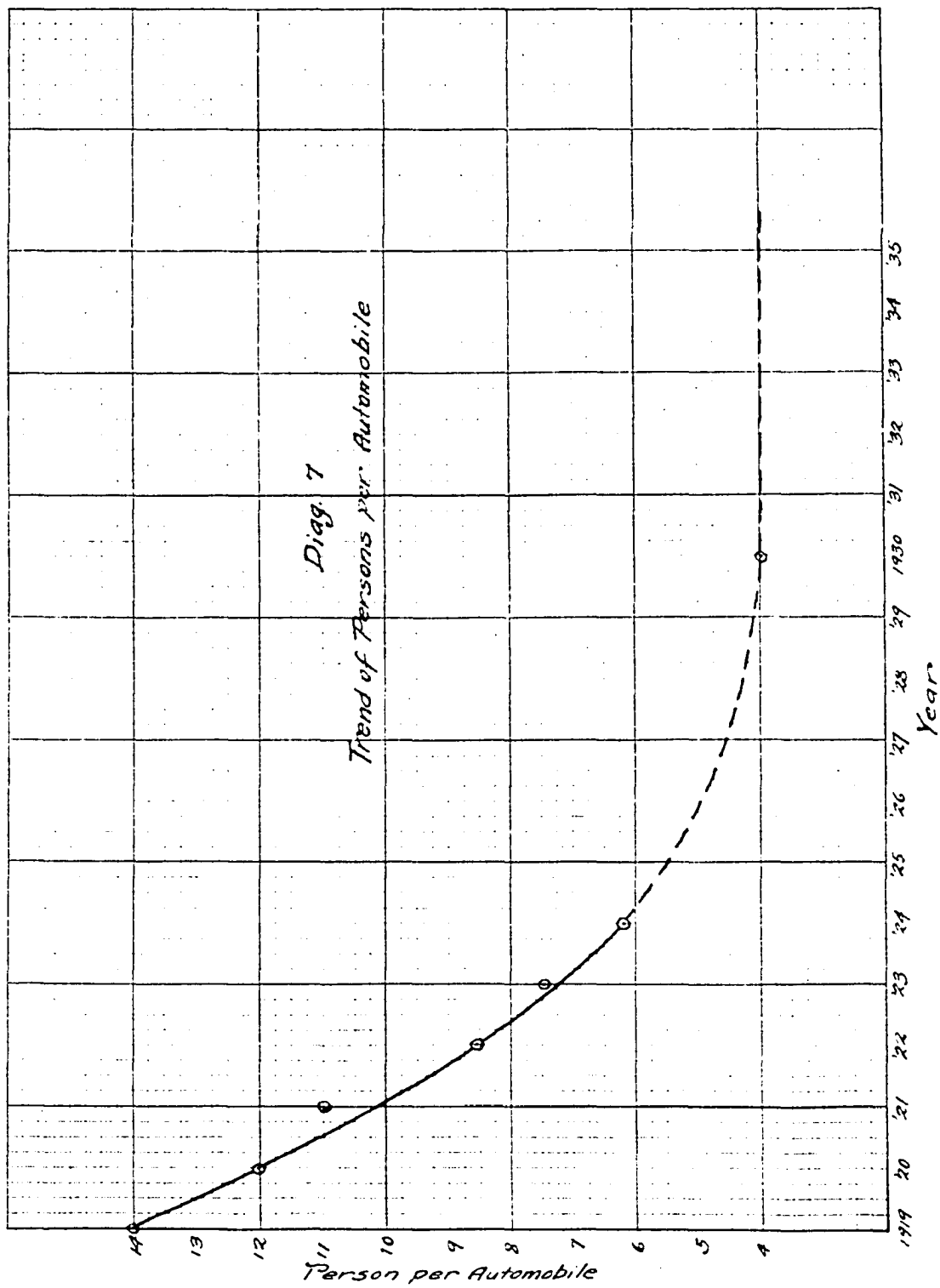
	1921	1922	1923	1924
Maryland	10.60	8.8	9	8.04
Massachusetts	10.70	10.0	8	8.28
Michigan	7.70	6.3	5	5.07
Minnesota	7.40	6.3	6	5.37
Mississippi	27.50	23.1	17	14.66
Missouri	9.82	8.7	7	7.04
Montana	9.30	8.8	8	8.75
Nebraska	5.40	5.1	5	4.80
Nevada	7.15	6.4	5	4.76
New Hampshire	10.50	9.2	8	7.03
New Jersey	11.56	9.2	8	8.34
New Mexico	15.90	14.1	12	9.33
New York	13.30	10.4	9	9.21
N. Carolina	17.20	14.0	11	9.78
N. Dakota	6.90	6.5	6	5.97
Ohio	7.90	6.8	6	5.69
Oklahoma	9.20	8.1	7	6.30
Oregon	6.60	5.8	5	4.64
Pennsylvania	12.60	10.5	9	8.66
Rhode Island	11.30	9.1	8	8.01
S. Carolina	18.70	17.7	14	11.89
S. Dakota	5.30	5.1	5	4.99
Tennessee	19.90	17.2	14	13.02
Texas	9.94	8.9	7	6.68
Utah	8.90	9.1	8	8.02
Vermont	9.40	8.0	7	6.18
Virginia	16.50	13.8	11	10.89
Washington	7.30	6.5	6	6.04
West Virginia	15.60	12.9	10	9.20
Wisconsin	7.70	6.9	6	5.77
Wyoming	7.20	6.3	5	5.45

In the above table you will notice that the number of persons per motor vehicle in 1924 runs from 3.38 in California and 4.29 in Iowa to 17.49 in Alabama.

The trend of number of persons per motor vehicle in the United States, as it will be seen in Diagram 7, is from 14 in 1919 to 6.2 in 1924, and within a few years--probably between 1928 and 1930--it will reach about four persons per motor vehicle in the United States. The number of persons per automobile has come to the saturating point if you look at the very slight increase of California and Iowa in the past two years in Table 16. Four persons per vehicle means the total population of the United States can ride on the automobiles at one time and have plenty of room. If over that is waste or have to put some dead cars in the garage and the actual use on the highways are not over four persons per one vehicle. After this year the increase will be likely around this four per one proportion and the number of vehicles in use will be increased one-fourth of the population of the United States as a whole.

As to the different states and cities, it will vary of course, due to their character of use of motor vehicles and the professions of the population. The possible increase of registration of automobiles and population had already shown in Diagrams 5 and 6 which can find a light to this question.

Form E-6


Diag. 7
Trend of Persons per Automobile
Person per Automobile
Year
14
13
12
11
10
9
8
7
6
5
4
1919
20
21
22
23
24
25
26
27
28
29
1930
31
32
33
34
35

THE AUTOMOBILE FATALITIES

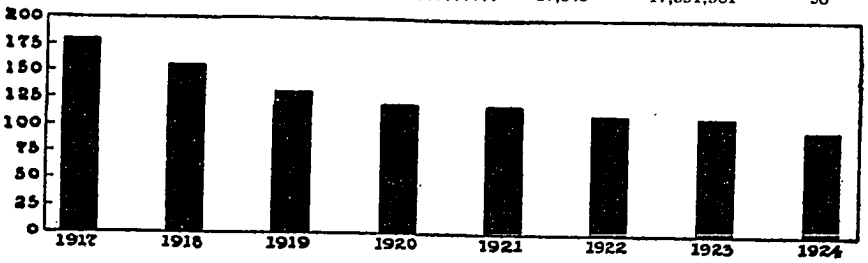
The automobiles have been taking thousands of lives every year which is a great menace to the human being and should not be allowed to grow any more, if not decreased at all. Here shows the automobile fatalities of the United States since 1916 up to 1924.

Table 17

Ratio of Motor Fatalities to Registration Declines

Year	Automobile Fatalities	Motor Vehicle Registration	Fatalities per 100,000 Registration
1917	9,097	5,104,321	178
1918	9,457	6,146,617	154
1919	9,825	7,565,446	130
1920	11,074	9,231,941	119
1921	12,370	10,463,295	118
1922	13,676	12,238,375	112
1923	16,452	15,092,177	109
1924	17,345	17,591,981	98

Fig. 1.



Bars illustrate the number of motor fatalities per 100,000 vehicles registered. See table above.

Table 18. AUTOMOBILE FATALITIES** IN 19 STATES

As to the states, following table shows the normal increase of the number of deaths in nineteen states.

STATE	NUMBER OF DEATHS						
	1918	1919	1920	1921	1922	1923	1924
U.S.Registration Area	7,525	7,968	9,103	10,168	11,666	14,411	15,528
California	545	647	734	876	960	1,239	1,254
Colorado	120	118	117	121	159	157	158
Florida	*	58	104	104	122	170	242
Illinois	466	522	728	887	1,003	1,031	1,065
Iowa	*	*	*	*	*	242	211
Maryland	167	153	142	177	224	243	246
Massachusetts	488	524	454	523	496	611	685
Michigan	257	318	419	441	574	738	863
Missouri	241	244	231	276	321	398	449
New Jersey	393	424	405	484	543	672	746
New York	1,251	1,354	1,410	1,632	1,788	1,930	1,985
Ohio	661	631	717	734	818	1,078	1,024
Pennsylvania	855	818	1,042	1,060	1,260	1,592	1,535
Tennessee	82	100	130	134	160	171	232
Virginia	103	116	97	140	137	200	240
Washington	158	148	184	202	173	240	265
Wisconsin	155	164	167	205	271	292	363
North Dakota	@	@	@	@	@	@	@
Texas	@	@	@	@	@	@	@

**Figures include deaths from accidents caused by motor vehicles except motorcycles; @not registration area; *not added to registration area until a later date.

URBAN AUTOMOBILE FATALITIES

The automobile fatalities in large cities by year are as the table follows which shows the trend of increase.

Table 19. AUTO FATALITIES** OF TWENTY-ONE LARGE CITIES

CITY	1918	1919	1920	1921	1922	1923	1924
Baltimore, Md.	104	106	97	100	130	131	129
Boston, Mass.	109	125	89	103	129	133	143
Buffalo, N. Y.	90	68	104	81	106	137	112
Chicago, Ill.	308	328	472	569	623	589	560
Cincinnati, O.	59	67	57	79	76	102	85
Cleveland, O.	168	126	155	148	142	203	220
Denver, Colo.	43	41	37	43	56	45	40
Des Moines, Ia.	*	*	*	*	*	18	17
Detroit, Mich.	125	139	175	133	176	252	305
Kansas City, Mo.	64	42	56	67	63	86	87
Los Angeles, Cal.	91	119	142	165	187	224	267
Milwaukee, Wis.	48	60	59	52	65	62	83
Minneapolis, Minn.	44	38	41	49	71	60	86
New Orleans, La.	29	36	50	43	46	68	84
New York, N. Y.	699	780	773	885	896	964	1,000
Philadelphia, Pa.	2,288	191	226	190	267	294	263
Pittsburg, Pa.	105	94	98	107	123	146	186
St. Louis, Mo.	95	105	104	119	134	168	197
San Francisco, Cal	74	85	88	94	118	107	113
Seattle, Wash.	40	50	41	44	44	55	53
Washington, D. C.	55	58	50	53	64	86	108

** Figures include deaths from accidents caused by motor vehicles except by motor cycles.

* Not added to registration area until a later date.

GRADE CROSSING FATALITIES

The grade crossing fatalities as you will see in the next table shows decrease in the year 1924.

YEAR	NUMBER OF PERSONS
1920	1,791
1921	1,705
1922	1,810
1923	2,268
1924	2,149

Chapter Five. TRAFFIC SURVEY

There are two types of traffic survey. One is highway transport survey which deals with the analysis of the commercial opportunity of highway transportation organization in certain locality and the other is to determine the volume, weight and kind of traffic on a highway, or a system of highways, and regional or local characteristics of the traffic.

Although a traffic survey is no more than a record of the traffic at the time the survey was made it is a basis of all computations in which traffic is concerned and is the starting point in all analyses of the possible trend of traffic on a specific highway or in an administrative area.

The following are some results of the traffic survey made by states and cities.

California.--A traffic census was started in June, 1924, to be continued until February, 1925. The traffic count being taken bimonthly, at stations distributed throughout the states, on Sunday and Monday nearest of the middle of the month. Record is being made of the number of passenger automobiles, heavy trucks, light trucks trailers, buses, tractors and horse-drawn vehicles during each hour from six o'clock in the morning until ten o'clock at night. The following map and table show the amount of traffic on Sunday, June 15, in the several parts of the state. This study indicates a general average increase at all stations throughout the state of 43% over 1922, during which time there has been an increase in automobile registration of 51.5%. It can be predicted that traffic on state highways in general follow with reasonable closeness the increase in motor vehicle registration.

Tab. 20.

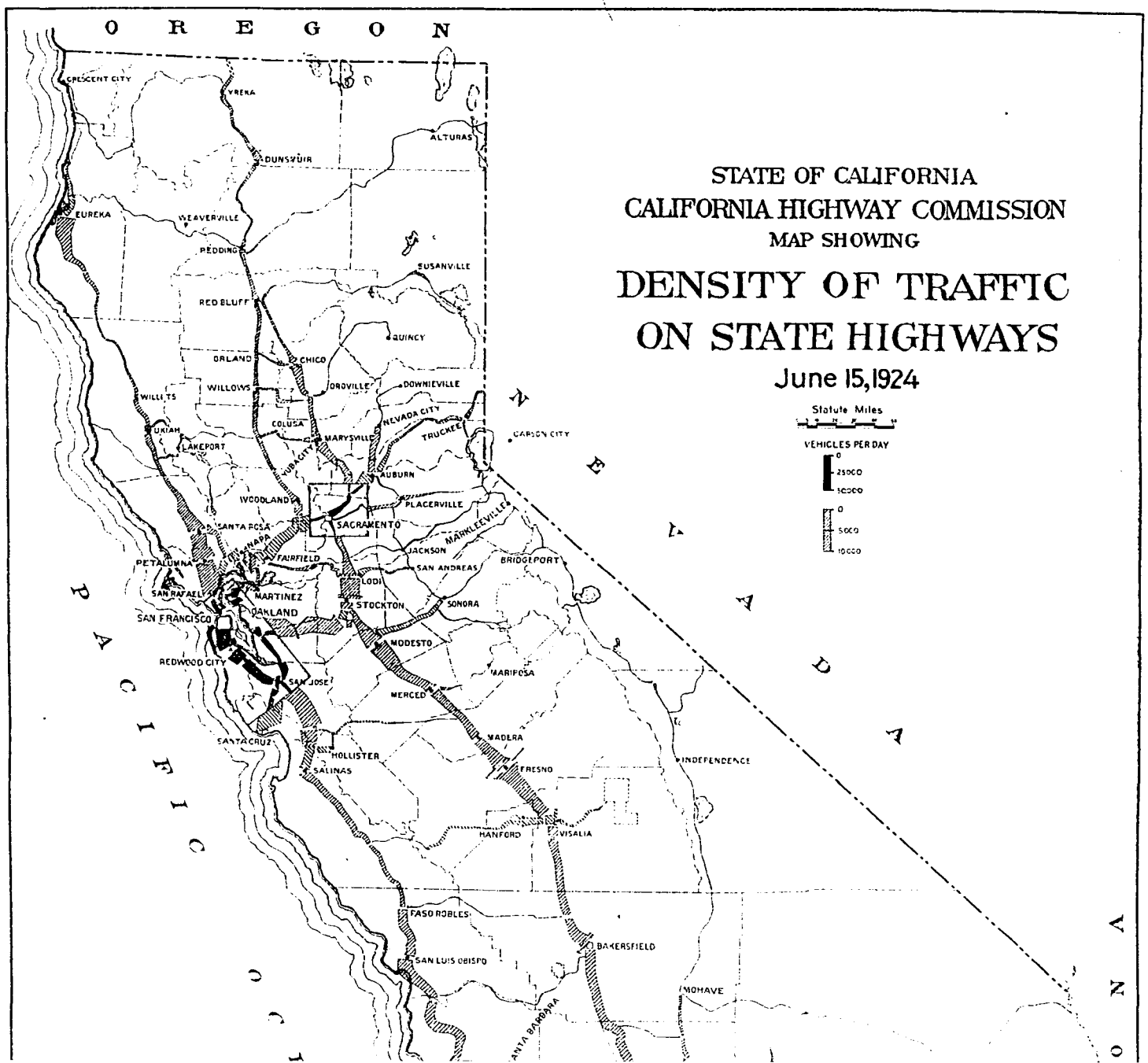
TRAFFIC COUNTS AT TWENTY SELECTED STATIONS ON HEAVILY TRAVELED SECTIONS OF STATE HIGHWAY SYSTEM.

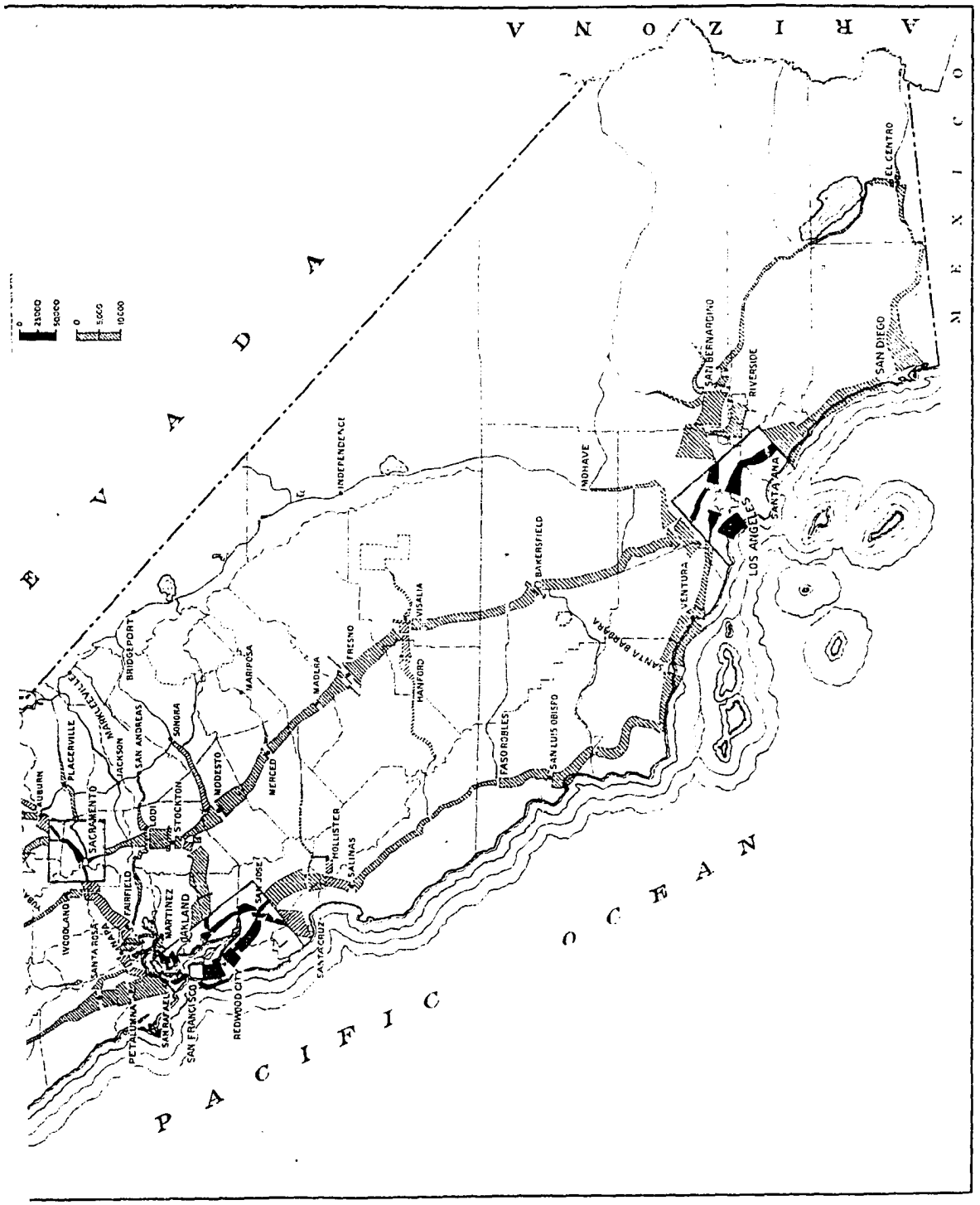
20

Sixteen-Hour Count, Sunday, June 15, 1924.

Route No.	Station	Count June 15, 1924	Peak count on other dates
1	Redwood Highway at junction Tiburon road	5,945	
1	Redwood Highway south of Eureka	4,189	
2	Peninsula Highway at San Bruno junction Bay Shore road	27,577	
2	Peninsula Highway at Stanford University entrance	14,995	
2	Coast Route, Santa Barbara south of city	5,858	
2	Coast Route, Hollywood at Laukershim Boulevard	19,348	20,347
2	Whittier Boulevard, east city limits of Los Angeles	21,763	27,873
2	Los Angeles-San Diego road at northerly city limits of Anaheim	12,416	15,700
2	Los Angeles-San Diego at San Juan Capistrano	4,578	
3	Sacramento, north of city at American River bridge	10,829	
3	Pacific Highway south of Yreka	1,421	1,526
4	Valley Route at Modesto, north of city	4,410	
4	Valley Route at Fresno, south of city	6,938	
4	Ridge Route, at maintenance station	1,854	2,371
5	Altamont Pass road, Altamont at R. R. station	3,829	
5	Dublin Canyon road at junction Niles road	5,149	
5	Los Gatos-Santa Cruz road southwest of Los Gatos	6,821	
9	Pasadena, east city limits	14,787	
9	Foothill road, San Bernardino, west of city	5,364	
14	San Pablo Avenue at Richmond junction	13,453	

Map I.- Density of Traffic on California State Highways.

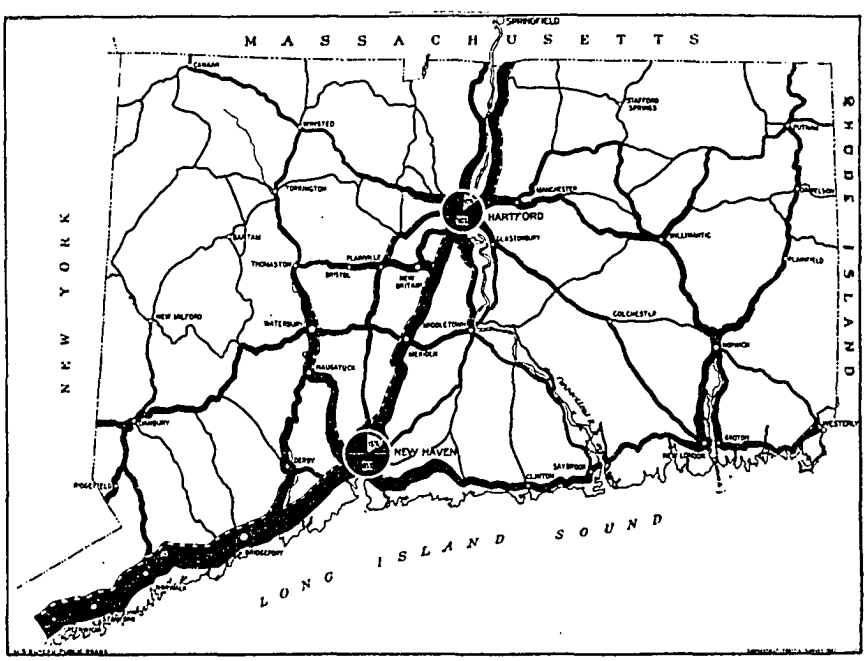



NEVADA
ARIZONA
MEXICO
PACIFIC OCEAN
0
25000
50000
0
5000
10000
INDEPENDENCE
MOHAVE
BAKERSFIELD
SAN BERNARDINO
RIVERSIDE
EL CENTRO
SAN DIEGO
LOS ANGELES
SANTA ANA
VENTURA
SANTA BARBARA
FRESNO
VISALIA
HANFORD
MADERA
MARIPOSA
MERCED
MODESTO
STOCKTON
LODI
SONORA
SAN ANDREAS
JACKSON
PLACERVILLE
NEVADA CITY
BRIDGEPORT
AUBURN
SACRAMENTO
WOODLAND
SANTA ROSA
NAPA
FAIRFIELD
MARTINEZ
OAKLAND
SAN RAFAEL
SAN FRANCISCO
PETALUMA
REDWOOD CITY
SAN JOSE
SANTA CRUZ
HOLLISTER
SALINAS
PASO ROBLES
SAN LUIS OBISPO

CONNECTICUT.--A highway traffic survey was made from September 11 to December 31, 1922, and 175,346 passenger cars and 40,613 trucks were analyzed. Map 2 and Fig. 2 and 3 show the analyses of this survey. The outstanding points are as follows:

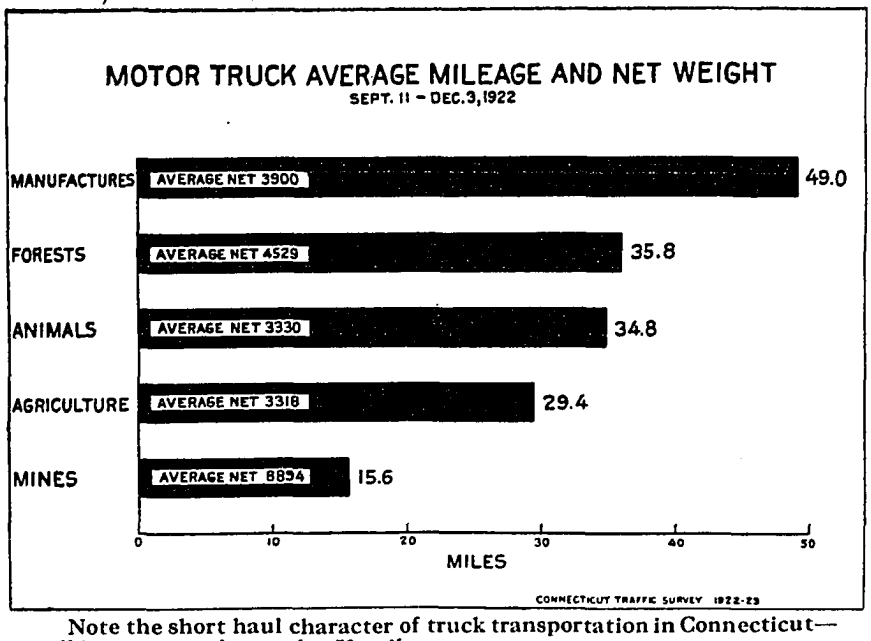
Average persons per car	2.5
Average car mileage per trip	45.1
Per cent car mileage for business	35%
Peak month of traffic	October
Per cent trucks averaging under 30 miles per trip	78.6%
Per cent total net tonnage hauled less than 30 miles	67.4%
Per cent of truck movement unloaded	33 %
Per cent of tonnage hauled on contract basis	75 %

Map 2. TRAFFIC DENSITY OF CONNECTICUT HIGHWAYS



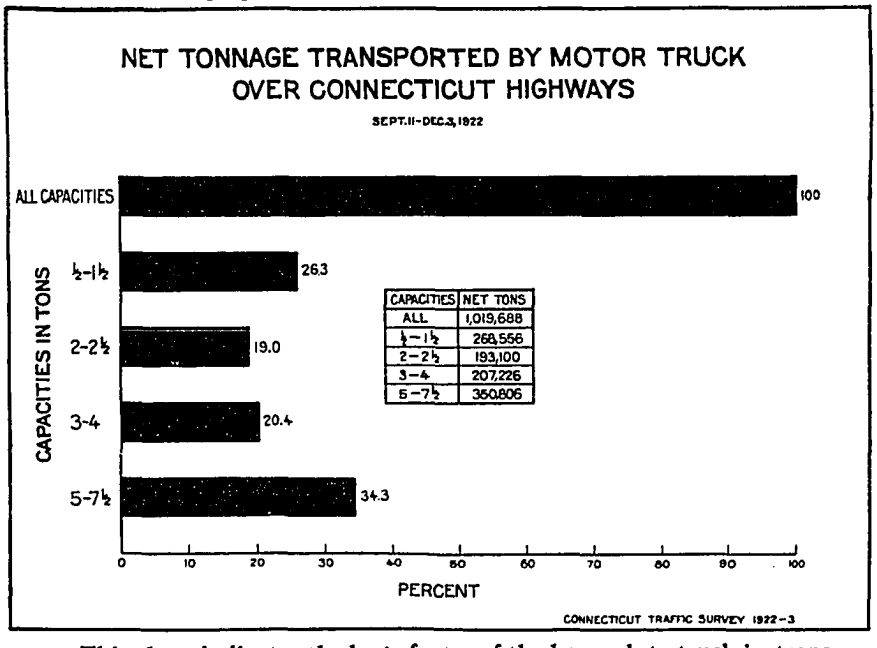
The thickness of the line in the above map indicates the density of passenger car travel, averaging 3,000 cars per 24 hours a day at the maximum. The black and white line indicates highways having motor truck travel averaging 1,000 motor trucks per 24 hour day. Truck traffic at New Haven is 15% and at Hartford 10% of the total.

Fig. 2



Note the short haul character of truck transportation in Connecticut—all items averaging under 50 miles.

Fig. 3



This chart indicates the large factor of the heavy duty truck in transportation of goods in Connecticut. The heaviest classification, though 15% of the total in number of hauling units, carries 34% of the tonnage.

IOWA.--A comprehensive traffic survey was made in Iowa in 1917. Figure 4 shows the relation between volume of traffic and weight of traffic at the weighing stations and Table 21 shows the classification of traffic at a number of stations resulting from that survey.

Some important points in the conclusion may be summarized as follows:

1. The tonnage of traffic on Iowa highways is considerably larger than has been generally supposed and the system of roads has been carrying what would be considered moderately heavy for a paved road.

2. Passenger automobiles overwhelmingly predominate in the present traffic and the saving in fuel and tires when surfaces of low tractive resistance are provided will aggregate a large sum annually.

3. The present highways, because of the extreme variations in the condition of surfaces, do not encourage the use of motor trucks.

Traffic count of the motor vehicles crossing the Okoboji bridge leading to Arnold's Park, Sunday August 10th, 1924, shows a total of 5,687 motor vehicles passing over this stretch of road at the famous Iowa summer resort.

The sunday counters tabulated cars from 89 counties, 23 states, and 2 foreign countries between the hours of 7 a. m. and 7 p. m. The weekday count carried out on four days averaged 2,187 vehicles, as follows:

Wednesday, August 13	2,219
Thursday, August 14.	2,987
Friday, August 15.	1,887
Saturday, August 16.	2,542

Fig. 4

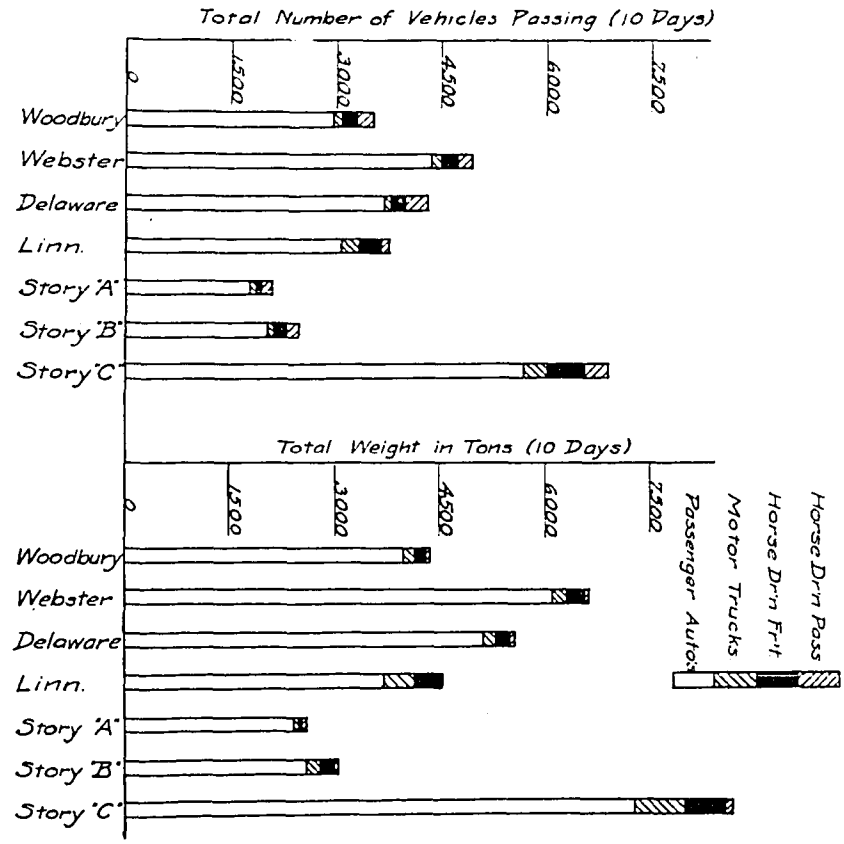


Fig. 4. Showing the relation between volume of traffic and weight of traffic at the seven weighing stations.

Tab. 21

CLASSIFICATION OF TRAFFIC ACCORDING TO ORIGIN AND DESTINATION

County	Farm-Town per cent	Inter-Urban per cent	Inter-County per cent	Inter-State per cent
Adams	75.0	16.7	1.0	7.3
Appanoose	57.9	34.0	4.6	3.5
Sioux	61.0	22.0	10.7	6.3
Wright	33.8	49.7	14.9	1.6
Winnebago	65.2	29.2	2.8	2.8
Howard	57.6	35.7	4.6	2.1
Des Moines	41.9	40.5	14.8	2.8
Clarke	34.7	29.9	18.3	17.1
Keokuk	55.6	21.6	6.2	16.6
Chickasaw	61.8	27.2	9.0	2.0
Palo Alto	47.7	18.0	25.6	8.7
Plymouth	21.1	28.6	43.5	6.8
Floyd	33.4	40.7	18.1	7.8
Wapello	79.8	12.5	5.3	2.4
Cass	43.6	32.8	14.4	9.2
Average	47.7	30.4	15.0	6.9

MAINE.--A preliminary analysis of the evidence obtained in the Maine highway transportation survey, conducted by the United States Bureau of Public Roads in cooperation with the Maine State Highway Commission, has developed a number of interesting and useful facts with regard to the traffic on the Maine highways, its growth over a period of years, present distribution over the state system, probable future density, and other matters of interest generally to all concerned with the planning and construction of highways. The evidence analyzed was recordsd in the course of the field study which was begun July 1, 1924, and lasted until October 31, 1924.

It is shown in the survey that the primary highway system which embraces only 7.1 per cent of the total highway mileage carries 53.4 per cent of the total daily vehicle mileage. Furthermore, 18.4 per cent of the primary system carries 38.7 per cent of the total daily vehicle mileage on the system. From this it follows that with respect to the entire highway system of the state, 1.3 per cent of the total mileage serves more than a fifth of the traffic, as measured in vehicle miles.

It is evident that the heavy concentration of traffic is confined to a relatively small percentage of the total highway mileage. For this reason, it is advocated that traffic zones should be created to bring together for construction and maintenance purposes those sections of the highway system which serve approximately the same amount and type of traffic.

The traffic importance of the primary system as compared with the secondary system appears even greater when considered from the standpoint of passenger car traffic. Practically

all of the trucks using the Maine highways have capacities between one-half and two and one-half tons, and the number of trucks of five tons capacity or over is practically negligible. Over 80% of the trucks observed were equipped with pneumatic tires, and from 55 to 67 per cent were loaded. Wheel loads in excess of 2,500 pounds were found to be very exceptional on trucks weighing less than 6,000 pounds gross, and the maximum wheel load for trucks of less than 12,000 pounds gross weight (three tons capacity) was found to be 5,000 pounds. Over 98 per cent of such trucks, however, have wheel loads less than 4,500 pounds.

The following tables and maps will show some interesting figures and the future traffic planning will show in the other special chapter.

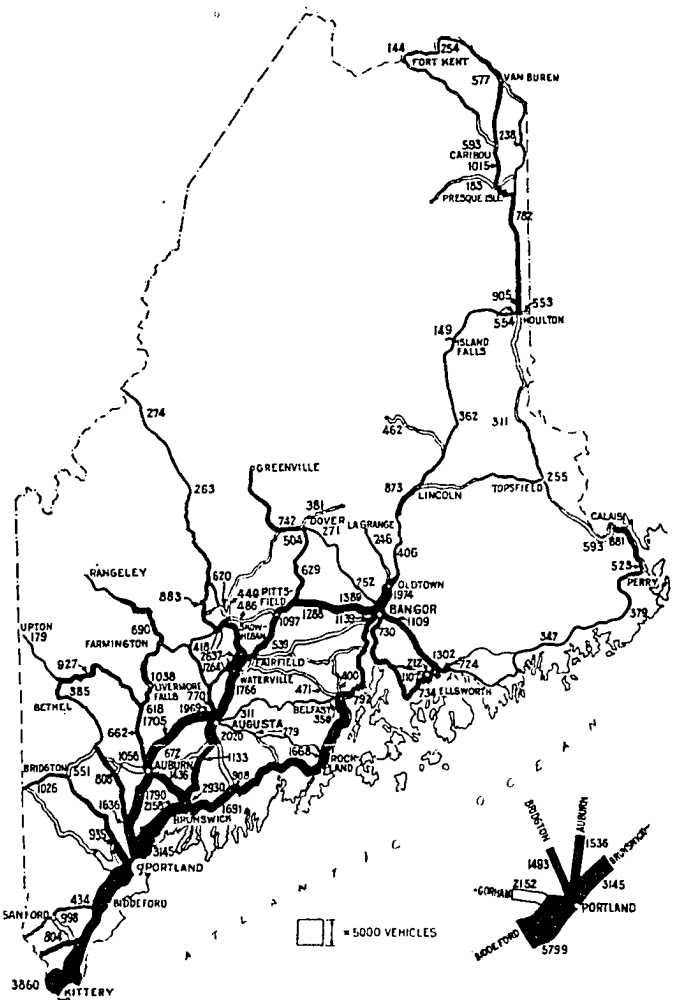
TABLE 22—*Average density of traffic on the primary, secondary, and third-class highway systems, July 1 to October 31, 1924*

Highway system	Average density of traffic	Index of relative density of traffic (third class=100 per cent)
	Vehicles per day	*Per cent*
Primary (1,630 miles)	1,044	3,600
Secondary (4,049 miles)	244	840
Third class (17,425 miles)	29	100

TABLE 23—*Average density of motor-truck and passenger-car traffic on the primary, secondary, and third-class highway systems, July 1 to October 31, 1924*

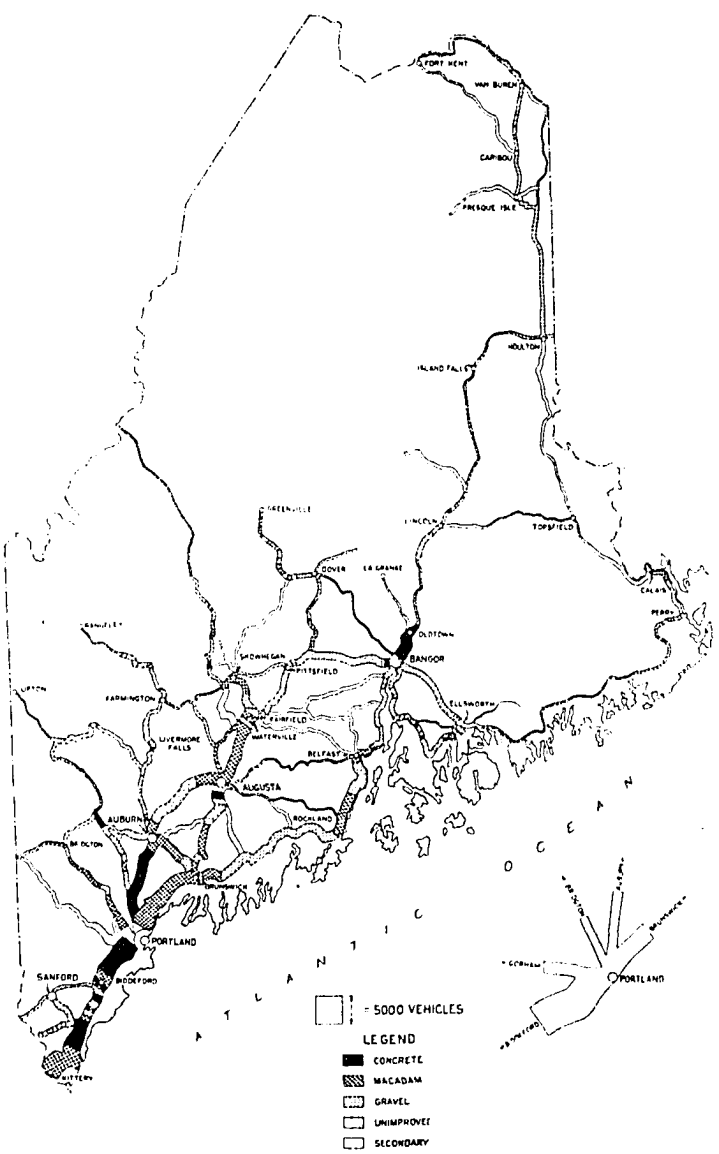
Highway system	Average density of passenger-car traffic	Index of relative density of passenger-car traffic (third class=100 per cent)	Average density of motor-truck traffic	Index of relative density of motor-truck traffic (third class=100 per cent)	Ratio of passenger-car to motor-truck traffic
	Vehicles per day	*Per cent*	*Vehicles per day*	*Per cent*	
Primary (1,630 miles)	950	3,520	94	4,700	10.2
Secondary (4,049 miles)	221	820	23	1,150	9.6
Third class (17,425 miles)	27	100	2	100	13.5

Map 3



—Average density of all motor-vehicle traffic on principal primary and secondary highways in Maine, July 1 to October 31, 1924

Map 4



—Average density of motor vehicle traffic and road types on the primary system of Maine

MARYLAND.--A traffic census was made in the state of Maryland by the Engineering Experiment Station of the University of Maryland in cooperation with State Road Commission and the United States Bureau of Public Roads from 1917 to 1920, inclusively.

The next traffic map shows the traffic density,and the daily average of traffic is shown in Table 24.

YEAR	ALL VEHICLES	TRUCKS	HORSE-DRAWN
1917	258	26	81
1918	277	42	57
1919	350	55	62
1920	439	80	65

MASSACHUSETTS. As early as 1909, the Massachusetts Highway Commission commenced recording by actual count the amount and character of traffic over the more important highways throughout the state.

The counts of 1921 and 1924 were made in the later part of August, covering a period of one week. Trucks and busses were not noted in 1909, but beginning in 1912 the records show that their use has increased until in 1924 they amount to 9% of the vehicles counted.

In 1909 the average number of vehicles per station per day was 270; in 1912, 430 vehicles; in 1915, 760 vehicles; in 1918, 1,180 vehicles; in 1921, 1,950 vehicles; and in 1924, 3,721 vehicles.

Some of the principal fagures of interest in the 1924 count are as follows:

Number of observation stations on state highways. . .76

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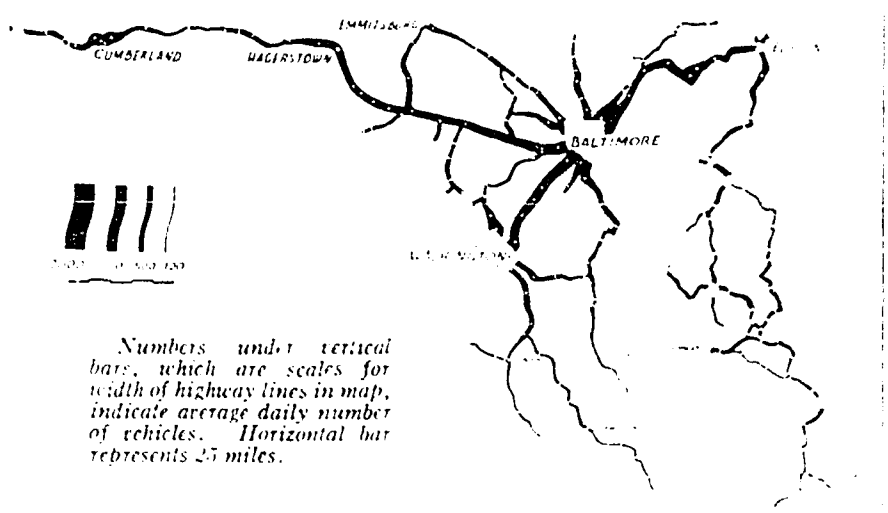
Map. 5

TRAFFIC MAP OF MARYLAND



Above map shows main highways of Maryland. The widths of the lines indicate volume of daily average traffic (see scale). It will be noted that on an improved road the traffic tends to become fairly stable throughout its length. For instance, the traffic between Hagerstown and Baltimore is virtually uniform. This map was compiled by the Engineering Experiment Station of the University of Maryland, A. N. Johnson, director, in cooperation with State Road Commission, J. N. Mackall, chairman, and the U. S. Bureau of Public Roads, T. H. MacDonald, chief

Total of the daily average number of vehicles passing all stations. 259,102

Classified as:

1. Automobiles 232,208
2. Trucks. 23,754
3. Motor busses. 896
4. Motor cycles. 2,244

Registration Classification:

5. Automobiles
   a. Massachusetts registration. 194,376
   b. Outside Massachusetts registration. . . 37,836
6. Trucks
   a. Massachusetts registration. 22,640
   b. Outside Massachusetts registration. . . 1,114

Maximum daily average number of vehicles passing a station (Fellsway, South of Revere Beach Parkway, Metropolitan Park Boulevard) 17,715

Daily average per station for the 18 like stations . 3,721

NEW YORK.--Some traffic counts on the New York State Highways are as follows:

NEW YORK STATE HIGHWAYS

Traffic during 12 hours (7 a. m. to 7 p. m.) on August Week Day.

	1909	1914	1919	1924
Albany Post Road at Peekskill. . .	135		2,816	5,734
Boston Post Road, Mamaroneck and New Rochelle		3,426	8,206	18,734
Nassau County, Little Neck-Old Westbury		187	944	6,200
Suffolk County, Amityville-Babylon	938	1,937		3,060
Rensselaer County, Albany Post Road near Albany.	477	3,542		5,036

These figures show that the traffic on these highways has increased from two to five or six times during the past ten years.

A count made on the Buffalo Niagara Falls main highway in October, 1924, shows that 24,000 vehicles passed in a single day, while the estimated capacity of this road for comfortable travel is not more than 10,000 per day.

Counts of the traffic using the Hudson River ferries were made by the Interstate Tunnel Commission, in order to estimate the possible future traffic which would come to the vehicular Tunnel. These studies indicate that the tunnels would have a traffic equal to a total of 6,770,000 vehicles per annum by the time they are opened for traffic in 1926, and that this will have doubled by 1934. By the later year the traffic will have reached the full capacity of the tunnel, namely, a maximum hourly traffic of 3,770 vehicles (46,000 per day or 15,640,000 per annum). Assuming further that traffic would increase at the rate as does the traffic on the ferries, namely 9.7% per annum (Bridge and Tunnel Commission report of 1924), the traffic desiring to use the new highway between New York and New Jersey by 1934 will have reached an hourly maximum of 5,933 72,380 per day or 24,610,000 per annum

NORTH DAKOTA.--A comparatively recent traffic survey was made in North Dakota in 1925 which resulted in many interesting points worth notice. The census showed that 22,875 cars passed in one day at all of the 30 points at which the counts were made, the most traffic being across Liberty Memorial Bridge between Bismark and Mandan, where 3,036 autos were counted on Sunday, July 19, 1925, and the next on Highway No. 3 west of Fargo,--2,243 cars on the

Tab. 25

1925 TRAFFIC OBSERVATION ON STATE HIGHWAYS

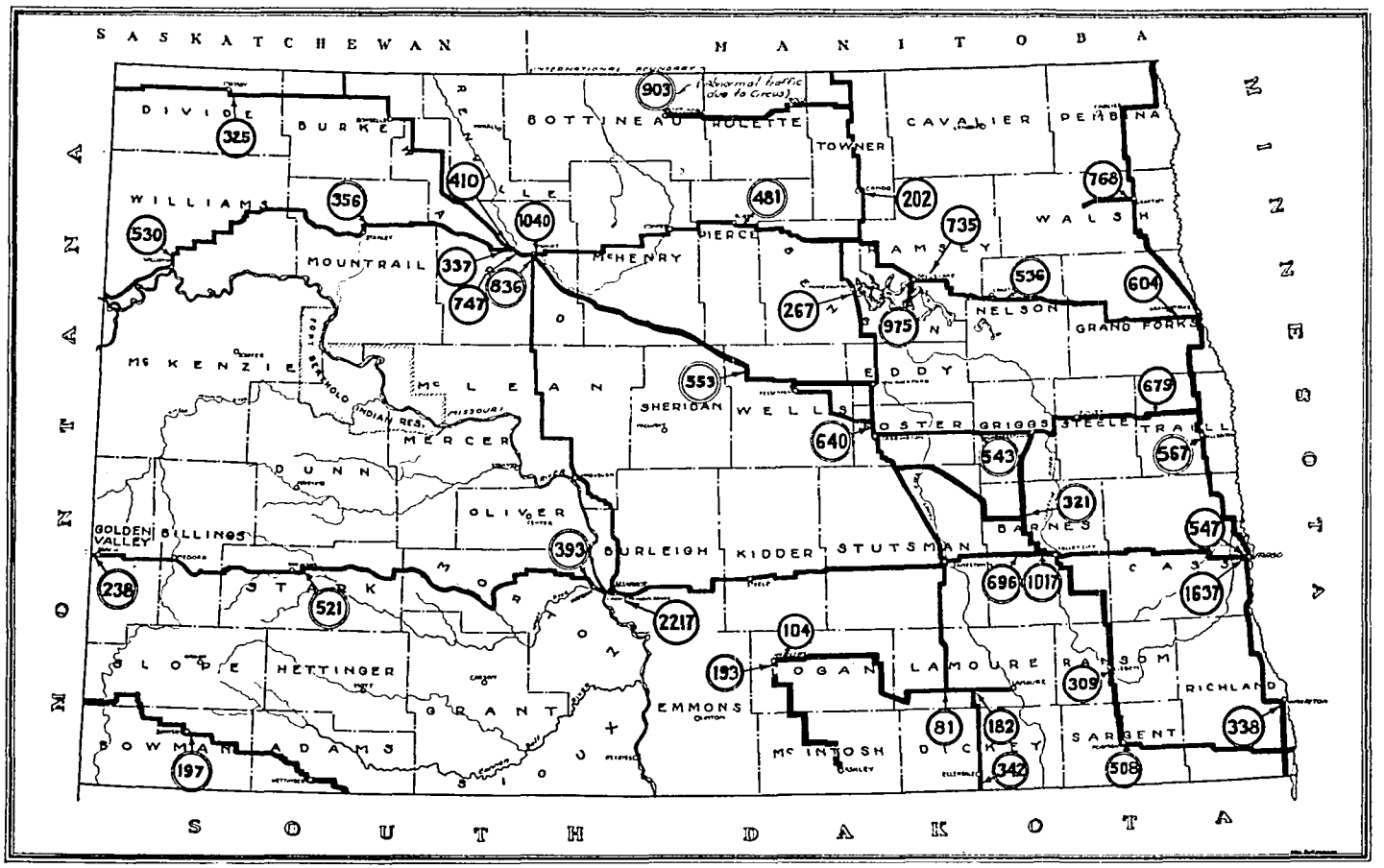
Average number of vehicles per day. Census Period—July 19-25 inclusive.

S. H.	Between	Observation Point	Passenger Cars		Transport Lines		Miscellaneous Trucks		Horse Drawn Vehicles	TOTAL
			N. D.	Foreign	Busses	Trucks	Under 2-ton	Over 2-ton		
1	Hillsboro and Fargo	1 mile south of Hillsboro	428	82		1	31	5	20	567
1	Fargo & S. D. St. Line	1 mile south of Wahpeton	227	79		4	17	3	8	338
3	Fargo and Valley City	S. W. Corner A. C. Campus	426	70			24	7	20	547
3	Fargo and Valley City	Co. Equipment warehouse	1157	343	2		63	61	11	1637
3	Valley City to Junction of S. H. No. 3-9-12	Junction: 12-4 Mi. W. of Valley City	772	210	2		22	4	7	1017
3	Junction S. H. No. 3-9-12 to Jamestown	Junction: 12-4 Mi. W. of Valley City	510	159	2		16	3	6	696
3	Bismarck & Mandan	Memorial Bridge over Missouri River	1905	206	34	24	38	3	7	2217
3	Mandan and Hebron	2 Mi. W. of Mandan	272	81			18	8	14	393
3	Hebron and Dickinson	At fair grounds 2 mi. E. of Dickinson	357	112			24	4	24	521
3	Beach and Mont. St. Line	1 Mi. west of Beach	86	127			11	10	4	238
4	Cando and Minnewaukan	1 Mi. South Cando	175	17					10	202
4	Minnewaukan & New Rockford	1 Mi. So. Minnewaukan	204	25	2	2	18	3	13	267
4-9	New Rockford and Carrington	1 Mi. N. Carrington	428	157	2	2	36		15	640
4	Jamestown and Ellendale	At Junction of 4 & 13 E. of Edgeley	28	52	1					81
4	Ellendale S. D. St. Line	1 Mi. So. Ellendale	151	171	6	2	4		8	342
5	Dunseith and Bottineau (Abnormal Traffic-Circus Day)	1 Mi. East Bottineau	827	27	2		11	3	30	903
5	Bowbells and Crosby	1 Mi. east Crosby	275	29			7		14	325
6	Bismarck and Minot	1 Mi. south Minot	702	46	7	1	52	17	11	836
7	Portland and Mayville	1 Mi. east Portland	619	32		1	21	2	4	679
7	Cooperstown and Carrington	Jct. 7 & 12 W. Cooperstown	445	64			23	3	8	543
8	Grand Forks and Larimore	4 Mi. W. Grand Forks	457	90		19	26	4	8	604
8	Larimore and Lakota	1 Mi. east Lakota	415	91			17	6	7	536
8	Lakota and Devils Lake	1 Mi. east Devils Lake	597	81		1	29	8	19	735
8	Devils Lake and Rugby	1 Mi. east Rugby	315	114			20	21	11	481
8	Rugby and Minot	1 Mi. east Minot	904	65			35	7	29	1040
8	Minot and Stanley	Jct. 8 & 2 7 Mi. W. Minot	275	49			11	1	1	337
8	Minot and Stanley	1 Mi. east Stanley	257	75			11		13	356
8	Stanley and Williston	1 Mi. east Williston	427	74			22		7	530
8	Minot to Jct. 8-9	7 Mi. west Minot	598	105	2		36	4	2	747
9	Minot and Kenmare	7 Mi. west of Minot	323	56	2		25	3	1	410
9-10	Harvey and New Rockford	1 Mi. south Harvey	337	133	2		33	14	34	553
9	Valley City and Carrington	Jct. 3-9-12 4 Mi. W. Valley City	262	51			6	1	1	321
9	Valley City and Forman	1 Mi. South Lisbon	246	32			13		18	309
10	Ashley and Napoleon	1 Mi. south Napoleon	146	5			13		29	193
11	Fairmont to Forman	1 Mi. east Forman	319	75		4	77	4	29	508
13	LaMoure and Edgeley	Jct. 4-13 W. of LaMoure	131	36	1	5	1	1	7	182
13	Edgeley to Napoleon	1 Mi. east Napoleon	83	10			7		4	104
16	Hettinger to Marmarth	1 Mi. east Bowman	95	93			2		7	197
17	Grafton and Park River	1 Mi. west Grafton	600	60	1		45	6	56	768
20	Devils Lake & Chautauqua Park	1 Mi. south Devils Lake	820	52	7		74	2	20	975
	Average Station		440	86	2	2	24	5	13	572
	Average Percentage		77.0	15.0	.3	.3	4.2	.9	2.3	100.00

Map 6

STATE MAP SHOWING TRAFFIC DENSITY

The circles show the average number of cars passing the point indicated by the arrow from the circle during a day according to the traffic census figures set out on the table below.



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same day. On the next page will be found a table showing the points where the census was taken, the kinds of cars and the daily average of cars passing the census-taking points during the period of counting. It also furnishes the averages for the entire 30 points, and the percentages of the various types of the vehicles. One of the surprises was the disclosure that the foreign or out-of-state passenger cars constituted 15 per cent of the total number of all vehicles,-cars, busses and horse-drawn. This fact can only be interpreted to mean a very heavy tourist traffic and perhaps also a large number of cars of foreign registry used by commercial travelers who reside in the state but are supplied with cars by their firms and which are registered by the home office. In Map 6 is given the average number of cars at each point placed in a circle with an arrow pointing to the exact spot where the count was made.

An analysis of the compilation or table discloses that the horse-drawn vehicle is fast disappearing and soon may become a curiosity on the main highways. The use of trucks on the highways, however, has not yet reached that volume found in other states, as about 5.2 per cent of them were noted. Passenger cars comprised 92 per cent of all the traffic and of this 15 per cent were found beyond the state. It must also be noted that the big majority of these passenger cars are of light construction and because of this fact do not tear up the roads as much as the heavier kind.

PENNSYLVANIA.--There were some interesting points found from the Pennsylvanie traffic survey in 1924 which may be

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Map 7.

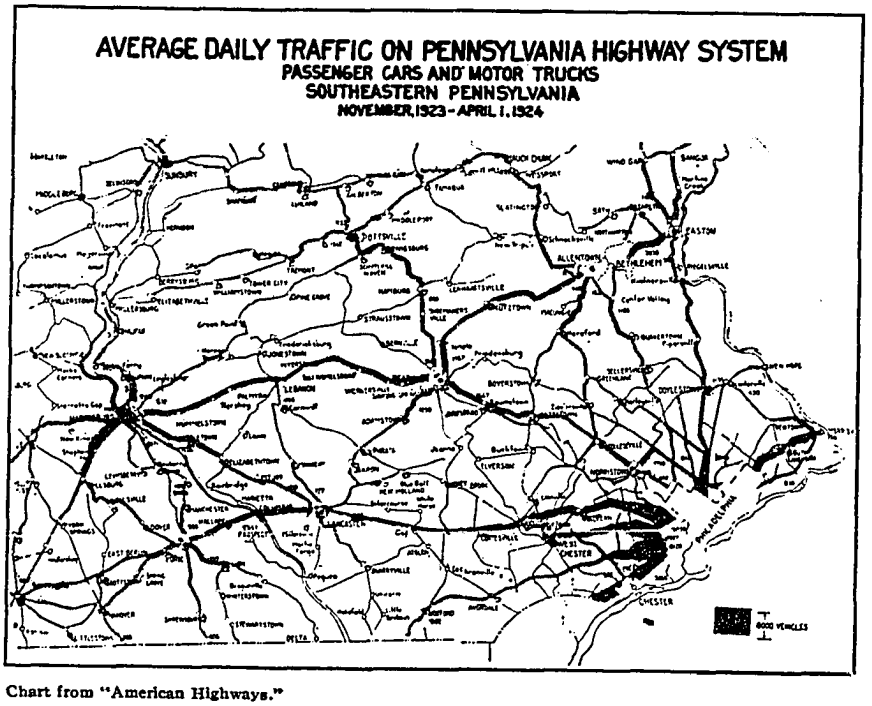


Chart from "American Highways."

summarized as follows:

A. Really heavy traffic only occurs within a ten mile limit of large centers of population.

B. 92% of the traffic is local and only 9% interstate.

C. 30-40% of the passenger car traffic is engaged on business.

D. Trucks average only ten per cent of the traffic.

Of the truck traffic, it is instructive to learn that only 9% of the vehicles are of gross weight of 18,000 pounds; while those of 24,000 pounds or over comprise but 1%.

Conditions also vary considerable along the same highway. That is why it would not be economically sound to lay down roads of a uniform type and size.

Map 7 shows the traffic density graphically.

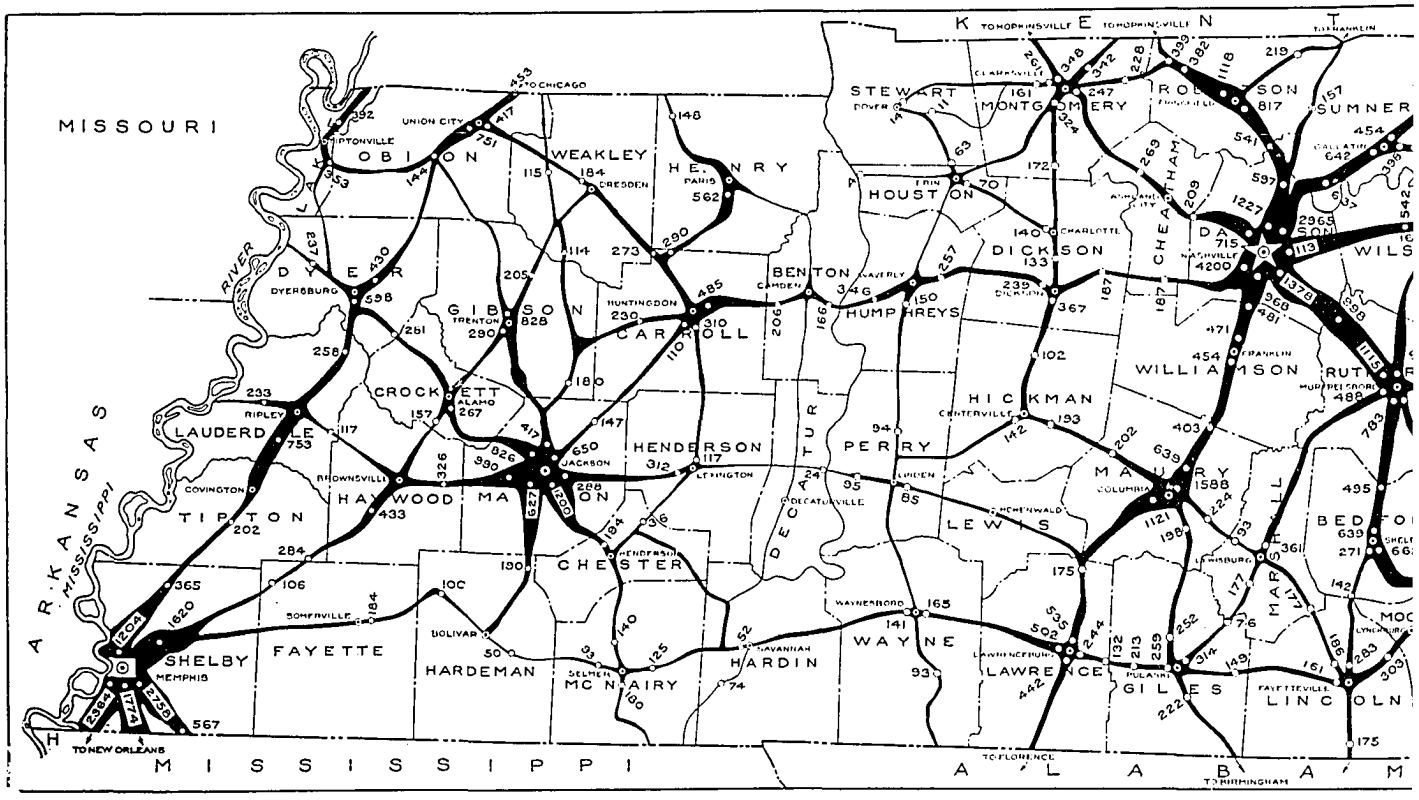
TENNESSEE.--Map 8, a traffic map, was made from a count taken Oct. 5 to 11, 1925, in the state of Tennessee. Near the larger cities many vehicles use the highways daily, while in the remote sections the traffic drops down to a very nominal amount. An estimate has been made of the total vehicle mileage on the state highway system. There are 4,650 miles of state highways under state maintenance. By averaging counts at adjacent points on the highways and multiplying by the distance between points, an estimate may be made of the total vehicular mileage on the road. Such an estimate shows a daily total of 599,600 vehicle miles on the primary system; 341,000 on the secondary system; and 189,500 on the state aid roads, making a total of 1,130,100 vehicle miles daily on the state and Federal system. This means 412,500,000 vehicle

miles throughout the year. It is estimated that a well maintained highway will save from 1 to 10 per cent per vehicle mile.

Map 8 [below]

WASHINGTON.--A comparative traffic census table for the years 1921 to 1924 will be found in the next table, and a density map showing the distribution of traffic in 1924 census will be found in the Map 9, which the state of Washington based upon these findings and planned a future highway program up to 1936. (See Map 16 in Chapter 10.)

Map 8



Traffic Distr

roughout the year. It is estimated that a well maintained will save from 1 to 10 per cent per vehicle mile.

Map 8 [below]

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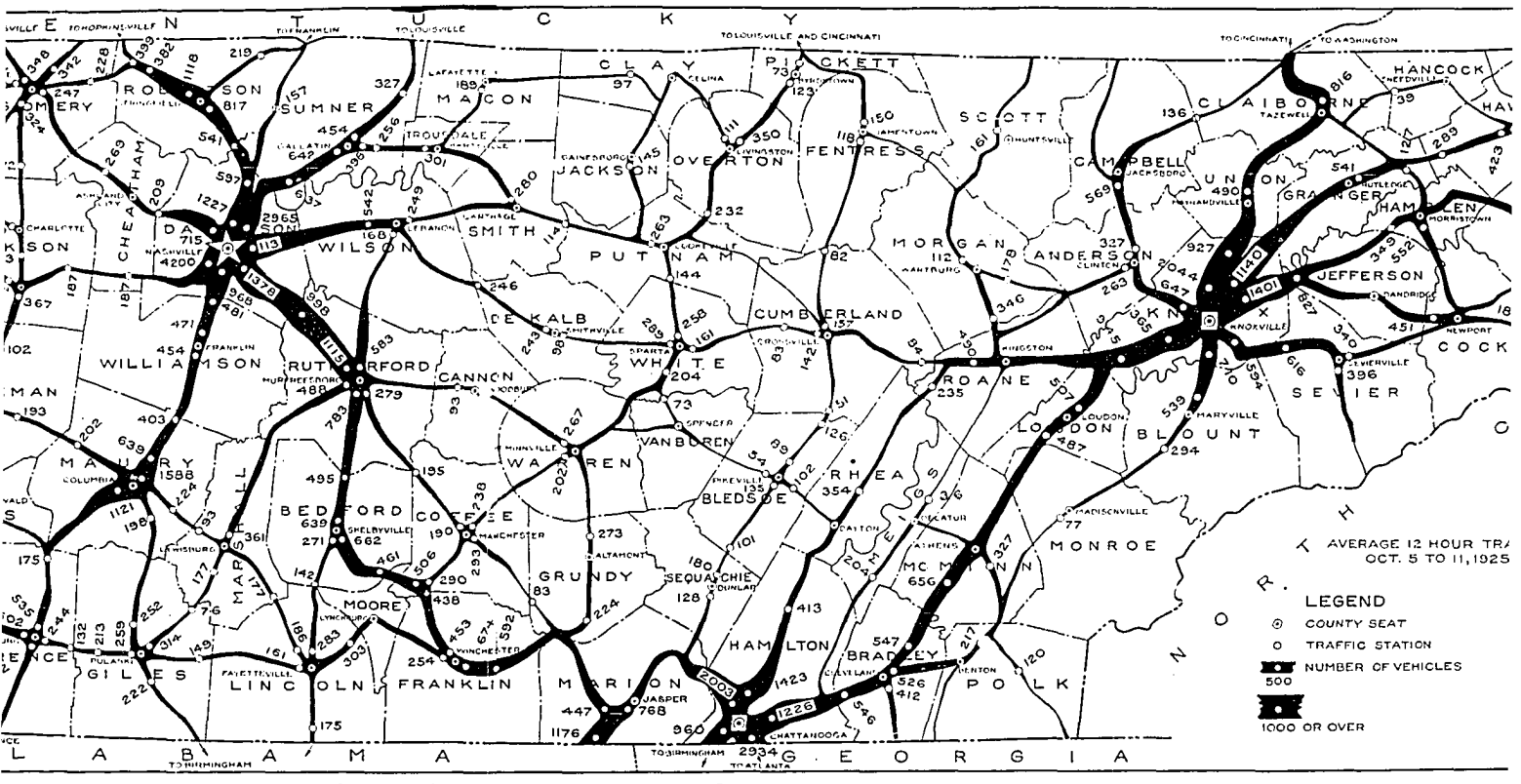
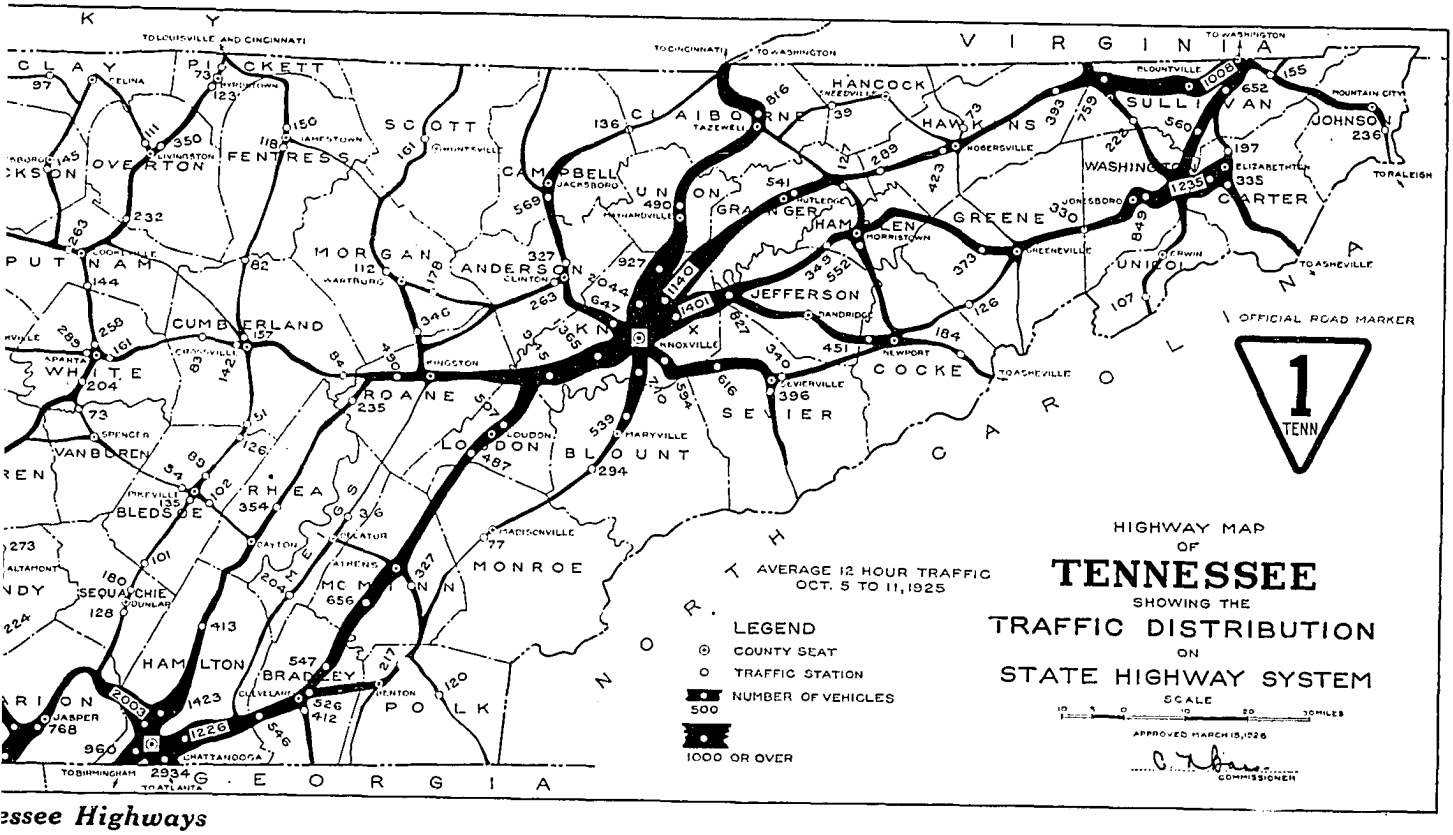


Traffic Distribution on Tennessee Highways

hroughout the year. It is estimated that a well maintained
will save from 1 to 10 per cent per vehicle mile.

Map 8 [below]

WASHINGTON.--A comparative traffic census table for the
1921 to 1924 will be found in the next table, and a density
owing the distribution of traffic in 1924 census will be
in the Map 9, which the state of Washington based upon these
gs and planned a future highway program up to 1936. (See Map
Chapter 10.)



essee Highways

Map 9. Traffic Map of Washington.

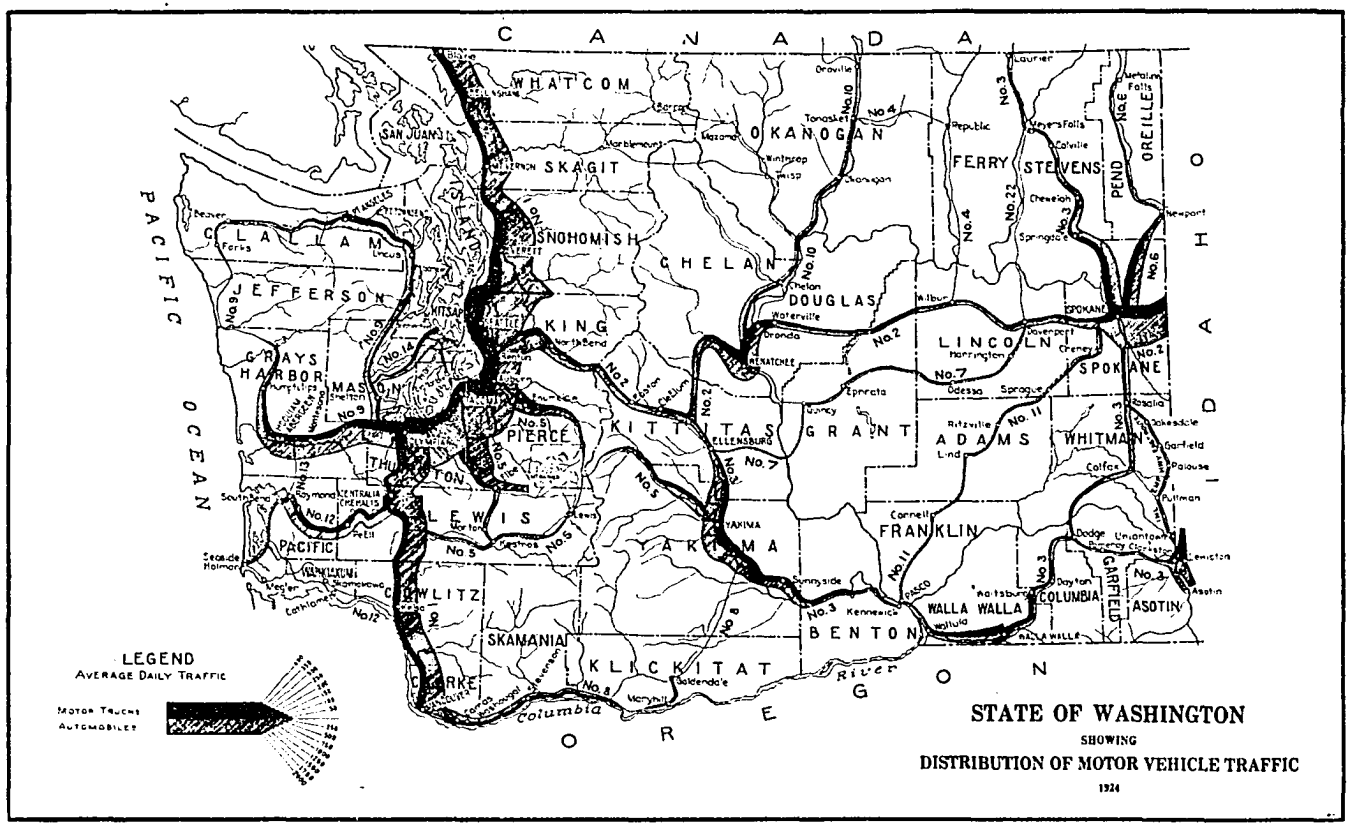


Table 26.

COMPARISON OF TRAFFIC CENSUS FOR YEARS 1921 AND 1924.

COUNTY	LOCATION OF TRAFFIC STATION	Average of All Daily Traffic		Percent of Increase in Traffic
		Year 1921	Year 1924	
	STATE ROAD NO. 1—			
Clarke	Vancouver-Salmon Creek	1,554	3,278	110.94
Cowlitz	Woodland-Kalama	501	2,303	371.66
Lewis	Chehalis South	726	2,679	269.01
	Chehalis-Centralia	2,087	4,050	94.06
	Centralia-Thurston County Line	833	2,976	248.89
Thurston	Olympia South	1,058	3,193	201.80
	Olympia East	1,929	5,539	187.14
Pierce	Lakeview	3,131	4,736	51.26
	Fife (South)	2,581	5,825	125.69
King	Bryn Mawr	2,802	4,520	61.31
	Morningside	3,474	7,180	107.83
Skagit	Snohomish-Skagit County Line	376	2,097	457.71
	Mount Vernon-North City Limits	1,295	3,613	179.00
Whatcom	Bellingham North	825	2,780	236.97
	STATE ROAD NO. 2—			
King	Fall City	1,382	2,037	47.40
Kittitas	Blewett Pass-Virden	96	486	406.25
	Cle Elum-Virden	506	838	65.61
Douglas	Columbia River Bridge	3,643	1,949	-46.50
Grant	Hartline	179	318	77.65
Lincoln	Davenport West	374	503	34.49
	Davenport East	469	625	33.26
Spokane	Junction with Central Washington Highway	685	829	21.02
	Spokane-East City Limits	4,373	4,472	2.26
	STATE ROAD NO. 3—			
Kittitas				
Yakima	Union Gap	1,886	2,351	24.66
Benton	Benton City	189	350	89.95
Franklin	Snake River Bridge	67	151	125.37
Walla Walla	Walla Walla West	1,609	1,974	22.68
Garfield	Dodge-Central Ferry	112	222	98.21
Spokane	Spokane North City Limits	664	1,470	121.39
Ferry	Laurier	31	45	45.61
	STATE ROAD NO. 5—			
King	Auburn East	1,248	1,418	13.62
Pierce				
Lewis	Riffe	78	304	289.75
Yakima	Nelson Bridge	770	1,086	41.04
	STATE ROAD NO. 6—			
Spokane	Hillyard North City Limits	1,263	1,608	27.32
Pend Oreille	Newport West	132	454	243.94
	STATE ROAD NO. 7—			
Grant	Ephrata East	281	293	4.27
	STATE ROAD NO. 8—			
Clarke	Vancouver East	796	1,546	94.22
Skamania	Stevenson-Carson	478	519	8.58
Klickitat	Maryhill-Goldendale			
Yakima				

COMPARISON OF TRAFFIC CENSUS FOR YEARS 1921 and 1924

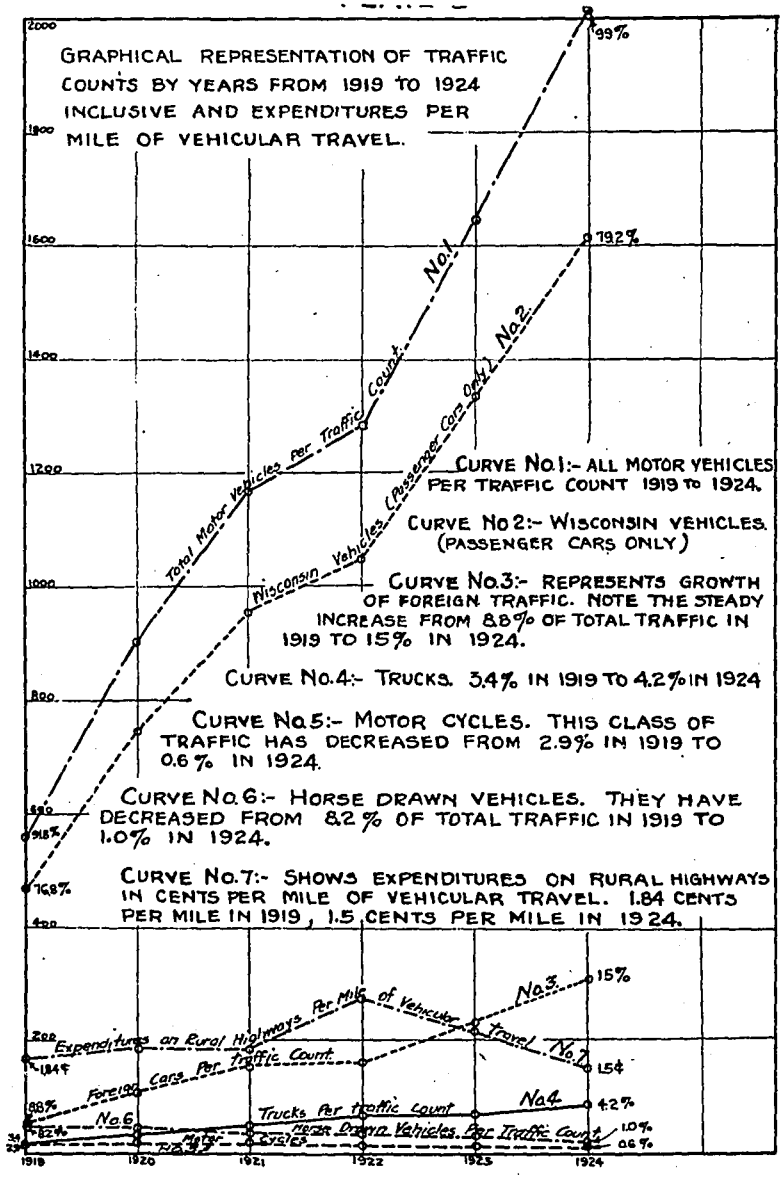
(Continued)

COUNTY		Average of all Daily Traffic. 1921	1924	Per cent of increase in the traffic
	STATE ROAD NO. 9.			
Thurston	Olympia West.....	1,141	2,439	113.76
Mason	Shelton North.....	292	995	240.75
Clallam	Port Angeles West.....	430	979	127.67
	Port Angeles East.....	485	1,159	138.97
	STATE ROAD NO. 10.			
Chelan	Chelan.....	265	454	71.32
Okanogan	Okanogan North.....	222	417	87.84
	STATE ROAD NO. 11.			
Lincoln	Sprague.....	209	260	24.40
Spokane	Junction with Sunset Hwy..	375	512	36.53
	STATE ROAD NO. 12.			
Lewis	Chehalis West.....	475	1,114	134.53
Pacific	Raymond East.....	705	1,396	98.01
	Raymond-South Bend.....	626	1,315	110.06
	STATE ROAD NO. 14.			
Mason	Union.....	238	470	97.48
	INLAND EMPIRE HIGHWAY, EASTERN ROUTE			
Whiteman	Palouse-Oakesdale.....	154	285	85.06

WISCONSIN.--A series of traffic surveys were made in Wisconsin from the year 1919 to 1924 and here is a graph which will tell the story.

Diagram 8. TRAFFIC COUNTS

OF WISCONSIN



Tab. 27. - Traffic Count of Wisconsin

Showing a summary of the traffic counts taken at various points on the State Trunk Highway System annually from 1919 to 1924, inclusive. It will be seen that in 1919

8.8% of the total traffic was tourist or out-of-state traffic.
3.4% was motor trucks.
2.9% was motorcyles.
8.2% was horse-drawn vehicles.

By following through the other years up to 1924 it may be noted that the foreign traffic has increased constantly from 8.8% in 1919, to 15% in 1924. The motor truck traffic has fluctuated but is higher in 1924 than in 1919; the motorcycles have decreased from 2.9% in 1919, to 0.6% in 1924; the horse-drawn vehicles have decreased from 8.2% in 1919, to 1% of the total in 1924. This table, while it does not show the total of any particular count, does show a general trend in the direction of heavy motorized traffic, and a steady increase in the percentage of out of the state cars.

1919 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
8-24	51	38,651	4,770	920	1,366	1,834	47,541
8-27	33	13,678	1,495	876	480	2,011	18,541
9-17	35	10,059	1,221	920	541	1,901	14,642
9-21	31	12,247	1,585	303	532	1,197	15,861
10-15	37	9,989	755	1,059	426	2,849	15,078
10-19	33	18,437	1,530	583	657	1,272	22,479
Total...	220	103,061	11,357	4,661	4,002	11,064	134,145
No. per	station.....	468	52	21	18	50	609
Per cent	of total.....	76.7	8.8	3.4	2.9	8.2	100.00

1920 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
7-25	55	52,242	7,542	1,052	1,248	1,682	63,766
8-11	48	23,530	3,466	1,853	694	2,221	31,764
8-22	50	44,992	5,475	925	1,260	1,586	54,238
9- 6	46	38,259	6,322	1,622	1,069	2,056	49,928
9-22	43	21,762	2,366	1,799	488	2,660	29,075
Total...	242	180,785	25,171	7,251	4,759	10,805	228,771
No. per	Station.....	748	104	30	20	45	147
Per cent	of Total....	79.0	11.0	3.1	2.2	4.7	100.0

1921 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
7- 4	62	87,258	15,306	2,732	1,498	1,640	108,434
7-20	62	41,714	5,805	3,711	669	2,424	54,323
8-10	65	37,511	6,245	3,386	421	3,182	50,745
8-21	69	69,516	10,947	2,170	1,103	1,862	85,598
9- 5	66	76,263	15,438	3,042	1,184	2,585	98,512
9-18	43	37,468	2,773	2,066	282	2,071	44,660
9-21	17	8,198	798	902	102	389	10,389
Total...	375	357,928	57,312	18,009	5,259	14,153	452,661
No. per	Station.....	955	153	48	14	38	1,208
Per cent	of Total....	79.1	12.7	4.0	1.1	3.1	100.0

1922 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
6-21	60	38,912	4,482	5,453	522	2,594	51,963
7- 4	62	99,192	14,821	3,126	1,115	1,281	119,535
7-19	67	48,413	7,782	5,315	459	2,463	64,432
7-30	66	90,336	11,981	2,968	990	1,210	107,485
8- 8	65	47,048	8,269	5,286	551	2,405	63,559
8-20	63	91,755	13,058	2,697	1,047	1,207	109,764
9- 4	63	79,510	15,990	4,158	936	2,235	102,829
9-20	62	39,292	4,160	4,583	450	2,647	51,132
Total...	508	534,458	80,543	33,586	6,070	16,012	670,699
No. per	Station.....	1,050	160	66	12	32	1,320
Per cent	of Total....	79.5	12.1	5.0	0.9	2.5	100.0

1923 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals

8-27	33	13,678	1,496	876	480	2,011	18,541
9-17	35	10,059	1,221	920	541	1,901	14,642
9-21	31	12,247	1,585	303	532	1,197	15,864
10-15	37	9,989	755	1,059	426	2,849	15,078
10-19	33	18,437	1,530	583	657	1,272	22,479
Total...	220	103,061	11,357	4,661	4,002	11,054	134,145
No. per	station.....	468	52	21	18	50	609
Per cent	of total.....	76.7	8.8	3.4	2.9	8.2	100.00

1920 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
7-25	55	52,242	7,542	1,052	1,248	1,682	63,766
8-11	48	23,530	3,466	1,853	694	2,221	31,764
8-22	50	44,992	5,475	925	1,260	1,586	54,238
9- 6	46	38,259	6,322	1,622	1,089	2,656	49,928
9-22	43	21,762	2,366	1,799	488	2,660	29,075
Total...	242	180,785	25,171	7,251	4,759	10,805	228,771
No. per	Station.....	748	101	30	20	45	947
Per cent	of Total....	79.0	11.0	3.1	2.2	4.7	100.0

1921 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
7- 4	62	87,258	15,306	2,732	1,498	1,610	108,434
7-20	62	41,714	5,805	3,711	669	2,424	54,323
8-10	65	37,511	6,245	3,386	421	3,182	50,745
8-21	69	69,516	10,947	2,170	1,103	1,862	85,598
9- 5	66	76,263	15,438	3,012	1,184	2,585	98,512
9-18	43	37,468	2,772	2,060	282	2,071	44,660
9-21	17	8,198	798	902	102	389	10,389
Total...	375	357,928	57,312	18,009	5,259	14,153	452,661
No. per	Station.....	955	153	48	14	38	1,208
Per cent	of Total....	79.1	12.7	4.0	1.1	3.1	100.0

1922 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
6-21	60	38,912	4,482	5,453	522	2,594	51,963
7- 4	62	99,192	14,821	3,126	1,115	1,281	119,535
7-19	67	48,413	7,782	5,315	459	2,463	64,432
7-30	66	90,336	11,981	2,908	990	1,210	107,485
8- 8	65	47,048	8,269	5,286	551	2,405	63,559
8-20	63	91,755	13,058	2,697	1,047	1,207	109,764
9- 4	63	79,510	15,990	4,158	936	2,235	102,829
9-20	62	39,292	4,160	4,583	450	2,647	51,132
Total...	508	534,458	80,543	33,586	6,070	16,042	670,699
No. per	Station.....	1,050	160	66	12	32	1,320
Per cent	of Total....	79.5	12.1	5.0	0.9	2.5	100.0

1923 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
6-23	66	57,762	7,210	6,055	575	2,250	73,852
7- 4	67	128,660	15,675	3,317	1,346	1,130	150,128
7-18	65	61,191	11,444	5,826	537	2,245	81,243
7-29	66	111,417	16,060	2,947	1,156	922	132,502
8- 9	63	57,023	12,962	5,581	433	2,609	79,208
8-20	66	110,158	20,946	2,994	1,025	887	145,010
9- 3	66	112,742	29,445	4,177	1,179	2,431	149,974
9-19	63	49,509	5,807	4,873	321	2,150	62,660
Total...	522	698,062	119,549	35,770	6,572	14,624	874,577
No. per	Station.....	1,337	229	69	13	28	1,676
Per cent	of Total....	79.8	13.7	4.1	0.7	1.7	100.0

1924 COUNTS

Date	No. of Traffic Stations	Wisconsin Cars	Foreign Cars	Motor Trucks	Motor Cycles	Horse drawn Vehicles	Totals
6-18	63	61,741	8,191	7,777	476	2,356	80,541
7- 4	66	160,825	31,870	3,875	1,236	698	198,504
7-16	65	65,770	12,907	7,440	554	1,607	88,278
7-27	65	147,953	22,884	3,233	1,207	587	175,864
8- 6	65	72,236	14,761	6,735	534	1,691	95,957
8-17	65	146,268	25,968	3,001	958	561	176,756
9- 1	65	117,016	33,181	5,041	659	1,313	157,210
9-17	63	63,396	7,976	7,158	374	1,891	80,795
Total...	517	835,205	157,738	44,260	5,998	10,704	1,053,905
No. per	Station.....	1,615	310	86	12	21	2,038
Per cent	of Total....	79.2	15.0	4.2	0.6	1.0	100.0

Most of the large cities are now making traffic surveys in order to plan and facilitate the traffic requirements. The table below shows the street traffic survey and widening in larger cities.

Table 28. STREET TRAFFIC SURVEY AND WIDENING IN LARGE CITIES

CITY	Has the city made traffic counts for street planning?	Has the city made special traffic studies?	Have any streets been widened because of traffic?
Buffalo	Yes	Yes	Yes
Chicago	Yes	Yes	Yes
Columbus	In progress	Will this year	Roadways
Davenport	No	No	---
Denver	No	No	---
Des Moines	Yes	Yes	Yes
Kansas City	Yes	Yes	Yes
Los Angeles	Some	Official & unofficial	Yew
Philadelphia	By Bureau of Highway	By several Bureaus	Yes
Providence	No	Police service engineer	Yes
Minneapolis	Yes	Yes	Yes
Nashville, Tenn	---	Street car rerouting; one way traffic.	One
New Haven, Conn.	Yes	Yes	Yes
New York City	Yes	Being made continuously	Yes
St. Louis	Yes	Yes	Yes
Seattle	Extensive	Extensive	Yes

BALTIMORE.--To determine accurately the amount of vehicular traffic entering and leaving the business district of Baltimore, a comprehensive check was made by the traffic department of the United Railways and Electric Company on a normal week day in the later part of October, 1922. The check began at 6 a. m. and continued until 12 o'clock midnight.

A total of 152,339 vehicle movements in and out of the business section, made up of:

Pleasure autos.....	76,234	or	50%
Commercial autos.....	37,024	or	24%
Street Cars.....	12,036	or	14%
Buses and taxi-cabs.....	4,224	or	3%
Horse-drawn.....	13,821	or	9%
TOTAL.....	152,339		100%

The heaviest point for each kind of traffic was:

Pleasure autos--Franklin & Cathedral St.....	6,311
Commercial autos, Pratt & Fallsway.....	3,058
Street cars, Baltimore & Fallsway.....	1,820
Horse-drawn, Pratt & Fallsway.....	1,457

The heaviest hour for each kind of traffic was:

Pleasure autos.....	5:00-6:00 p. m.	6,300
Commercial autos....	2:00-3:00 p. m.	3,941
Street cars.....	5:00-6:00 p. m.	1,926
Buses and taxicabs..	5:00-6:00 p. m.	361
Horse-drawn.....	2:00-3:00 p. m.	1,466

Baltimore is handicapped with narrow streets to the extent that all traffic movement is very seriously interferred with,

particularly during the congested rush hour periods. The only measure of relief that has been realized was through the passage of the ordinance which prohibits parking of vehicles on certain down town streets between 4:30 and 6:00 p. m.

CHICAGO.--A survey made in Cook County, Illinois, about two years ago found that approximately 125,000 vehicles pass the city limits every day through the thirteen entrances which are now paved. A through chart of total traffic shows that less than 20% of the traffic from the south used Halsted Street, while 80% of it enters the city over Western Avenue. It is due to the very poor condition of Halsted Street within the city limit and to the great delay caused to the traffic by the grade crossing with the Indiana Harbor Belt line just south of the city limit.

The cause of the traffic congestion is not the traffic from down state which but is the traffic which originates within this county. A traffic map is shown on the next page of Cook County.

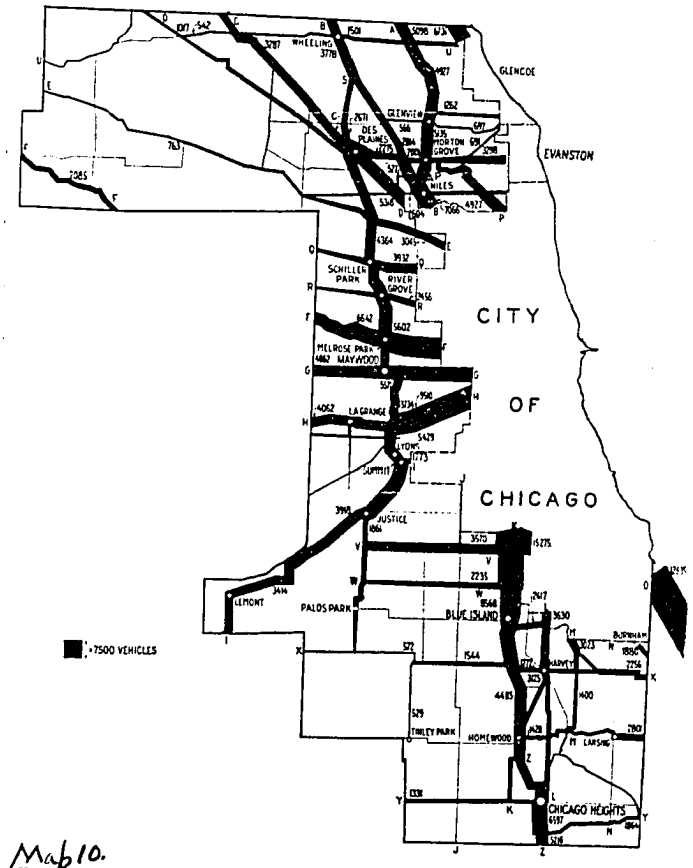
The following tables are some traffic counts in the city of Chicago.

Table 29. VARIATION OF VEHICULAR TRAFFIC ON A NORMAL WEEK-DAY AT DIFFERENT INTERSECTIONS OF SOME THOROUGHFARES.

On State Street 4 p. m.--5 p. m.	North and South	East and West	Total
At Lake	670	615	1,285
At Randolph	839	858	1,697
At Washington*	880	1,084	1,964
At Madison@	979	682	1,661
At Monroe	909	800	1,709
At Adams	993	405	1,398
At Jackson	994	1,005	1,949
At Van Buren	930	506	1,436
At Harrison	813	507	1,320

@ 30,000 pedestrians in the same hour
* 26,000 pedestrians in the same hour

Map 10.



Map 10.

FIG. 1.—Average daily density of vehicular traffic on Cook County highways, 1924

On Jackson Boulevard 4 p. m.--5 p. m.	North and South	East and West	Total
At Wabash	957	890	1,947
At State	775	839	1,614
At Dearborn	460	904	1,364
At Clark	620	1,242	1,862
At Wells	650	1,167	1,817
At Franklin	502	1,499	2,001
On Washington Street			
At Wabash	906	1,090	1,996
At State	880	1,084	1,964
At Dearborn	531	874	1,405
At Clark	709	967	1,676
At La Salle	740	1,074	1,814
At Wells	587	1,075	1,662
At Franklin	693	940	1,633

Los Angeles.--In 1925 a check showed 333,900 vehicles per day entering the central traffic district, an area in the business district approximately one mile square. Congestion, however, is not localized in the down town district. The survey indicated that the most heavy traveled intersection was two miles removed from the center of the city, at a point where two important arteries cross.

A check made of all traffic crossing the streets bounding the congested or metropolitan district the hours of 6 p. m. and 7 p. m. on a normal week day, shows that the automobile played rather a minor part in the delivery of passengers in the metropolitan district. These figures were as follows:

Table 30. COUNT OF STREET CARS, PASSENGER AUTOMOBILES AND COMMERCIAL AUTOMOBILES

	Figueroa street	Los Angeles	Temple & Market	Pico Street	TOTAL
Street cars	4,440	7,231	4,685	4,285	20,641
Passenger autos	92,047	64,370	41,584	63,946	261,974
Commercial Vehicles	14,272	21,825	6,701	9,500	51,298
	110,759	92,426	52,790	77,731	333,913

NEW YORK CITY AND ITS REGION.--A regional highway traffic was studied in New York City. The area being studied includes 5,528 square miles which in 1920 had a population of about 9,000,000.

The maximum hourly traffic occurs on the Boston and Albany Post roads near the New York City line and the Lincoln Highway in the City of Elizabeth, the traffic at these points reaching a total of 1,400-1,600 vehicles per hour. 1,300 vehicles per hour on the Marrich Road and other radial highways carried traffic varying from 1,035 to 1,105 vehicles per hour.

The motor vehicle registration in the environs was about seven persons per vehicle in 1923 in contrast with sixteen in the city itself. For the entire area this figure has decreased from about 35 in 1916 to 11.1 in 1923. An estimate of future registration indicates a total of 2,180,000 motor vehicles in 1930.

The congestion in New York City as the results obtained from an area during 24 hours indicate a total daily movement of persons into the area of 2,849,600 and a total daily movement of vehicles of 223,450. The traffic at Fifth Avenue and 42nd St., increased 30 per cent in the two years from 1921 to 1923.

ST. LOUIS.--In November, 1922, the department of streets and sewers checked the traffic entering and leaving the congested district on 39 arteries of travel for the 11 hour period from 7:30 a. m. to 6:30 p. m. and found as follows:

	Number	Percentage of vehicles	Percentage of Passengers carried
Street car	12,342	10	68
Automobile	69,509	59	25
Truck & Wagon	36,729	31	7

The total movement was 118,580 vehicles; average 10,780 per hour.

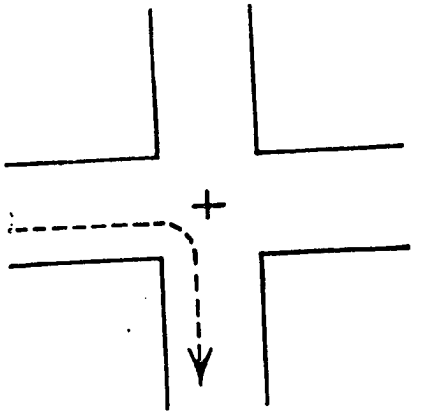


Fig. 5 Right turn

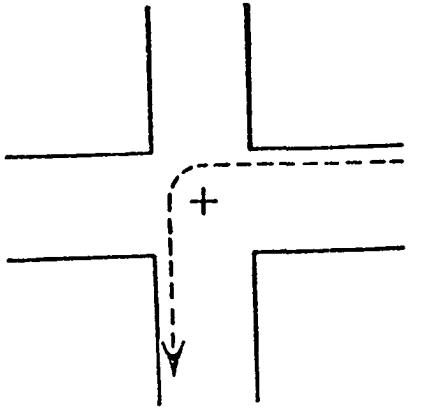


Fig. 6 Left turn

TRAFFIC INCREASES, SEATTLE , WWASHINGTON

Increased traffic adds to the cost of maintenance and it is apparent from the following table that traffic is increasing. The increases noted areproportionate in other parts of the city(Seattle).

Increase in Traffic in One Year,1923 to 1924

1st Ave. between University and Union Sts.	7.8 percent
2nd Ave. " " " " "	10.3
3rd Ave. " " " " "	53.
4th Ave. " Jackson and Main Sts.	20.
5th Ave. " " " " "	46.
Rainier, south od Dearborn " " "	19.
4th Ave. and Jackson St.	20.
Fremont Bridge	15.percent
University Bridge	22.
Eastlake, south of Harvard No.	12.1
Westlake,between Denny Way and John St.,	22.6
Ballard Bridge	32.7

PART TWO.--TRAFFIC REGULATION

Chapter Six. REGULATION OF MOVING VEHICLES

The First Traffic Ordinance Against Speeders.

Traffic ordinances against the "speed demon" had their beginning in 1878 in Rhode Island. This traffic ordinance was embodied in a resolution of the assembly of the colony of Rhode Island and was the result of the running down of a child in the street of the town of Newport. The resolution of the assembly as it appears in a recent article in the "American City" read as follows:

> "Whereas, there was very lately in the town of Newport on Rhode Island very great hurte done to a small childe by reason of exceeding fast and hard riding of horses in said town, this Assembly takeing the matter into serious consideration and being desirous for the future to prevent the like mischief, doe ordain, et cetera, that from and after the publication hereof, if any person or persons shall presume to ride on either horse, mare or gelding, a gallup or to run speed, in the street of Newport, said person shall for his offence pay unto the Treasurer of said towne 5 shillings in money on demand; 2 shillings of which shall be paid to any person or persons that shall give information thereof and the other three shillings to remain for the use of the said towne."

THE PRESENT TRAFFIC REGULATION

After the use of the automobile was introduced and with its rapid growth, it gives us at the present time a most difficult problem to solve on the highways. For the convenience of the motorist and the safety of the pedestrian, traffic laws were established from time to time in different states and cities. Up to the present time every state and large city has this kind of regulation which differ widely in detail if compared with one another. This causes the great trouble to the highway users throughout all the states and especially going from one state to another.

The subject of uniform laws and regulations as one of

the urgent needs for the better movement of traffic and easy use of highways is now under discussion. Perhaps the most up to date and best suggested model is the one by the committee on Uniformity of Laws and Regulations which was just completed and presented to the National Conference on Street and Highway Safety at Washington, D. C.

RESTRICTIONS ON MOTOR VEHICLE SIZES, WEIGHTS AND SPEEDS

The restrictions in all of the states of the United States will be found in the next tabulated table which was comprised by the Motor Vehicle Conference Committee and the uniform restriction suggested by the committee reported on the National Conference on Street and Highway Safety read as follows:

Tab. 30

Speed Restrictions	Special Powers to Lower Weight Restrictions	Special Powers to Raise Weight Restrictions	State
Open country, 30 miles per hour; within incorporated city or village, 15 miles per hour; where building more than 200 ft. apart, 20 miles per hour; through cemeteries, passing schools, hospitals, etc., 12 miles per hour; around curves, reasonable speed. Buses allowed same speed as passenger cars, but average speed for whole route must not be more than 25 miles per hour. TRUCKS More than 3 tons, less than 6, pneu. tires .....20 miles per hour With two or more solid tires .....16 miles per hour More than 6 tons with pneumatic tires .....16 miles per hour With solid tires.....12 miles per hour All vehicles more than 3 tons, equipped with steel tires, 6 miles per hour. State Highway Commission and cities, villages and towns may, by ordinance, designate certain highways and streets as through traffic routes and require all vehicles to come to full stop before crossing or entering upon such route.	Executive highway officers in charge of maintenance may prohibit the moving of any load over any highway when weight is over 400 lbs. per inch of tire in contact with surface, at periods of year when frost is coming out of ground and roads are in soft condition. Municipal authorities may reduce limits to not less than 7,000 lbs. gross in case of highways under their control.	The State Commission; County, State Road and Bridge Committees, may issue permits for operation of restricted vehicles on highways or bridges except those in municipalities. Municipal authorities have similar authority.	.....Wisconsin
Operate vehicle at a reasonable and proper speed (35 miles per hour evidence of unreasonable speed) having regard for other traffic and intended use and condition of road. Reduce speed to a reasonable rate at intersections, bridges, curves, descent, and on passing other vehicles or animals. Slow down to 15 miles per hour at railroad crossings if view is clear for 100 ft.; if view not clear come to full stop. All passenger carriers for hire and school buses must stop at railroad crossings outside municipalities.	.....X.....	Highway Department may issue special permits for operation of restricted vehicles on highways under their jurisdiction.	.....Wyoming
Commercial Vehicles Solid tires .....15 miles per hour Pneumatics .....18 miles per hour Tractors .....15 miles per hour *Other Vehicles* All highways except outlying districts where limits are posted .....22 miles per hour Alleys ..... 7 miles per hour Emerging from alleys 3 miles per hour	Director of Traffic, with the approval of the commissioners, has the power to change any of the regulations applying to motor vehicle traffic.	Director of Traffic may issue permits to operate vehicles heavier than 28,000 gross. Engineer Commissioner may issue written permits for operation of heavier vehicles over bridges.	.....Dist of Col.

RESTRICTIONS AS TO SPEED

(a) Any person driving a vehicle on a highway shall drive the same at a careful and prudent speed not greater than is reasonable and proper, having due regard to the traffic, surface and width of the highway and of any other conditions existing, and no person shall drive any vehicle upon a highway at such a speed as to endanger the life, limb or property of any person.

(b) Subject to the provision of the subdivision (a) of this section and except in those instances where a lower speed is specified in this act, it shall be prima facie lawful for the driver of a vehicle to drive the same at a speed not exceeding the following, but in any case when such a speed would be unsafe it shall not be lawful.

1. Fifteen miles an hour when approaching within fifty feet of a grade crossing of any steam, electric or street railway when the driver's view is obstructed. A driver's view shall be deemed to be obstructed when at any time during the last two hundred feet of his approach to such crossing he does not have a clear and uninterrupted view of such railway crossing and of any traffic on such railway for a distance of four hundred feet in both directions from such crossing.

2. Fifteen miles an hour when passing a school during school recess or while children are going to or leaving school during opening and closing hours.

3. Fifteen miles an hour when approaching within fifty feet and in traversing an intersection of highways when the driver's view is obstructed. A driver's view shall be deemed to be obstructed

when at any time during the last one hundred feet of his approach to such intersection he does not have a clear and uninterrupted view of such intersection and of the traffic upon all of the highways entering such intersection for a distance of two hundred feet from such intersection.

4. Fifteen miles an hour in traversing or going around curves or traversing a grade upon a highway when the driver's view is obstructed within a distance of two hundred feet along such highway in the direction in which he is proceeding.

5. Fifteen miles an hour in a business district, as defined herein.

6. Twenty miles an hour in a residence district, as defined herein.

7. Thirty-five miles an hour under all other conditions.

It shall be prima facie unlawful for any person to exceed any of the foregoing speed limitations, except as provided in subdivision (c) of this section. In every charge of violation of this section the complaint, also the summons or notice to appear, shall specify the speed at which the defendant is alleged to have driven, also the speed which this section declares shall be prima facie lawful at the time and place of such alleged violation.

(c) Local authorities in their respective jurisdictions are hereby authorized in their direction to increase the speed which shall be prima facie lawful upon through highways at the entrances to which vehicles are by ordinance of such local authorities required to stop before entering or crossing such through highways, but such increase in speed shall not be more than ten miles greater than the speed limits otherwise applicable under this section upon such highways.

SIZE OF VEHICLES AND LOADS

(a) No vehicle shall exceed a total outside width, including any load thereon, of ninety-six inches, except that the width of farm tractor shall not exceed one hundred-eight inches, and excepting, further, that the limitation as to size of vehicles stated in this section shall not apply to implements of husbandry temporarily propelled or moved upon the highways.

(b) No vehicle unladen or with load shall exceed a height of twelve feet, six inches.

(c) No vehicle shall exceed a length of thirty feet, and no combination of vehicles coupled together shall exceed a total length of eighty-five feet.

(d) No train of vehicles or vehicle operated alone shall carry any load extending more than three feet beyond the front thereof.

(e) No passenger vehicle shall carry any load extending beyond the line of the fenders on the left side of such vehicles nor extending more than six inches beyond the line of the fender on the right side thereof.

WEIGHT OF VEHICLES AND LOADS

No vehicle shall be operated on any highway with a gross weight concentrated upon any wheel in excess of 800 pounds per inch base width of tire, nor with a gross weight concentrated upon any axle in excess of 22,400 pounds.

PERMITS FOR EXCESSIVE SIZE AND WEIGHT

The State Highway Commission (or other proper state authorities) and local authorities in their respective jurisdistions,

may, in their direction, upon application in writing and good cause being shown thereof, issue a special permit in writing authorizing the applicant to operate or to move a vehicle of a size or weight exceeding the maximum specified in this act, upon any highway under the jurisdiction of and for the maintenance of which the body granting the permit is responsible. Every such permit shall be issued for a single trip and may designate the route to be traversed and contain any other restrictions or conditions deemed necessary by the body granting such permit. Every such permit shall be carried in the vehicle to which it refers and shall be open to inspection by any peace officer, and it shall be a misdemeanor for any person to violate any of the terms or conditions of such special permit.

REGULATION OF MOVING VEHICLES IN STATES AND CITIES

For further illustration of the regulation of moving vehicles, following are some typical and special features of many states and cities which are quoted from their respective traffic laws and regulations.

COLORADO.--"All vehicles shall be propelled along all public highways in a careful and proper manner, and with due regard for the safety and convenience of pedestrians and vehicles thereon.

"Vehicles shall travel upon the right side of public highways unless the road ahead on the left side is clear and unobstructed for at least 100 yards, except on mountain roads, where vehicles shall be under control at all times; vix, must be able to stop within the distance possible of view, and in all cases shall keep as far to the right as possible, leaving more swiftly moving vehicles and traffic to the left.

"All vehicles approaching an intersection of a public highway, with the intention of turning thereat, shall in turning to the right keep to the right of the center of such intersection, and in turning to the left shall run beyond the center of such intersection, passing to the right thereof, before turning such vehicle toward the left. These directions are illustrated in figures 5 and 6.

"Vehicles in proceeding in opposite directions shall pass each other to the right, each giving to the other one-half of the road as nearly as possible.

"Vehicles overtaking other vehicles proceeding in the same direction shall pass to the left thereof, and shall not again drive to the right until reasonably clear of the overtaken vehicle.

"Any vehicle travelling on a public highway which is divided longitudinally by a park-way or an isle of safety, shall keep to the right of such park-way, or isle of safety, unless otherwise directed by the provisions of any ordinance, rule or regulation of competent local authorities.

"As between vehicles meeting on mountain highways a grade of 10% or more, ascending vehicles shall have the way over descending vehicles, except where it is more pr for the ascending vehicle to return to a turnout."

FLORIDA.--"A person operating or driving a motor vehicle shall, at request or on signal by putting up the hand, from a person driving, riding or leading a horse or horses or other draft animals, ring such motor vehicle immediately to stop, and, if traveling in e opposite direction, remain stationary so long as may be reason-

able to allow such horse or animal to pass, and if traveling in the same direction, use reasonable precaution in thereafter passing such horse or animal; Provided, that in case such horse or animal appears badly frightened or the person operating such motor vehicle is requested so to do, such person shall cause the motor of such vehicle to cease running so long as shall be reasonably necessary to prevent accident and insure safety to others.

"When the operator of a motor vehicle desires to pass other vehicles going in the same direction and at the slower rate of speed, he shall give notice by sounding a horn or other device for that purpose at least one hundred (100) feet to the rear of the front vehicle, and the front vehicle upon such notice shall at once, when practicable, turn to the right sufficiently that the left hand wheel or wheels shall be at least eighteen(18) inches from the center of the road on the right hand side for a reasonable distance or time in which for the rear car to pass."

ILLINOIS.--"Except as hereafter provided, motor vehicles traveling upon public highways shall give the right of way to vehicles approaching along intersecting highways from the right and shall have the right of way over those approaching from the left.

"But motor vehicles entering upon or crossing (1) a highway which has been designated by law as one of routes 1-46 inclusive,.....(2) a street or other thoroughfare in cities, villages and towns which has been designated and marked by the Department of Public Works and Buildings to extend or connect such routes, shall come to full stop as near the right-of-way line as possible before driving on the paved portion and regardless of direction, shall give the right-of-way to vehicles upon said highway. At

all intersections of highways where, by the provisions of this paragraph, a stop is required before entering upon an intersecting highway,.....

"In all cases police vehicles, fire departments, vehicles transporting United States mail, and ambulances, shall have the right of way over other vehicles. In_corporated cities, having a population of more than 7,500 inhabitants, may designate certain streets or boulevards as preferential traffic streets, and prescribe rules regulating traffic upon, crossing over, or turning into such streets or boulevards, and like specifications regulating traffic may be enforced at points where traffic officers are stationed."

MASSACHUSETTS.--"Every person operating a motor vehicle, upon approaching a railway crossing at grade, shall reduce the speed of the vehicle to a reasonable and proper rate, and shall proceed cautiously over the crossing."

MICHIGAN.--"Slow moving vehicles shall keep as near to the right side of the highway as possible, allowing more rapidly moving vehicles free passage to their left.

"....the safety of the public demands the stopping of every vehicle, whether motor, horse-drawn, or otherwise, upon approaching and before passing over any crossing at grade of railroads, interurban and suburban railways with public streets, highways, alleys, private roads, private ways and crossings,...."

MISSOURI.--"In municipalities, no vehicles shall be driven from private property or from an alley onto a highway, or

from the side of a highway into a line of moving vehicles, unless the highway is sufficiently free from approaching vehicles to permit such vehicles to enter the line of moving vehicles without danger of collision, and the operator or driver of such a vehicle shall give warning of his intention to proceed into the line of moving vehicles by sounding his horn or whistle and by giving the signal required....."

NEW YORK.--"Except as herein otherwise provided, and except for the exercise by municipalities of the powers granted to them by the general highway traffic law relating to traffic and parking, local authorities shall have no power to pass, enforce or maintain any ordinance, rule or regulation requiring from any owner, operator or chauffeur to whom this article is applicable any tax, fee, license or permit for the use of the public highways,....."

"Upon approaching a pedestrian who is on the traveled part of the street and not upon a sidewalk, and upon approaching an intersecting street * or a curve or a corner in the street where the driver's view is obstructed and where a traffic officer is not on duty, every driver of a vehicle shall slow down the same and give a timely and sufficient signal with his voice, horn or other signaling device."

*Street shall include that part of the public highway or a bridge intended for vehicles.

PENNSYLVANIA.--"The operator of any motor vehicle shall stop upon request or signal of any constable, police officer, or members of the State Police Force, or designated officer of the State

Highway Department, who shall be in uniform or shall exhibit his badge or other sign of authority, and shall, upon request, exhibit his registration certificate or license, and shall write his name in the presence of such officer, if so requested, for the purpose of establishing his identity."

The most generally adopted method for formulating speed regulation in the city has been to differentiate rate for specified zones within the city, and in addition special regulation for various localities such as railroad crossings, schools and parks. Most of the states authorize their cities to make special speed regulations within their jurisdictions. Table 31 showing the speed limit in typical cities and some of the special regulations which are taken from their respective regulations for moving vehicles are as follows:

BALTIMORE.--"Vehicles shall keep to the right of the center of the streets.

"Vehicles meeting shall pass each other to the right.

"Vehicles overtaking others shall, in passing, keep to the left.

"A vehicle turning to the right into another street shall turn the corner as near the curb as practicable.

"A vehicle turning to the left into another street shall pass to the right of and beyond the center of the street intersection before turning.

"No vehicle shall stop, for the purpose of taking or setting down a passenger or loading or unleading freight, or for any other purpose, except in case of accident or other emergency, of when directed to stop by police, in such a way as to obstruct

any street or crossing.

"Except as provided in this article, no horse or vehicle shall be driven, backed, led or allowed to stand on any side-walk which has been curbed, except that wares or merchandise in process of loading and unloading, shipment or being received from shipment, may be transferred from truck or other vehicles over the sidewalk by the use of skids, provided a passageway be kept open for the free passage of pedestrians.

BOSTON.--"Vehicles must stop so as not to interfere with or prevent the passage of pedestrians at crossing or at intersections of streets.

"Except on Sundays and legal holidays, vehicles shall pass in but one direction as indicated in the following named streets: . . . . .

"Between the hours of 9 o'clock a. m. and 5 o'clock p. m. in the following named streets there shall be no delivery of coal, ice, barrels, kegs, cases or boxes, or the backing of vehicles to the curb, the collection of garbage, refuse or waste materials, barrels and boxes, the cleaning out of cesspools or the opening of manholes, except in an emergency, and then only on permit of the Board of the Street Commission....."

Table 31. SPEED LIMIT IN TYPICAL CITIES

CITY	Business District	Residence District	Open Country or Blvd.	Cross-ing	SCHOOL
Baltimore	12	18	25	..	..
Buffalo	20	25	..	15	..
Cleveland	15	20	..	..	10
Detroit	10	15	..	½ legal	..
D. of Columbia	18	18	..	12	..
Kansas City	15	25	..	10	..
New Orleans	15	20	25-30	8	..
Newark	12	..	..	6	6
Portland, Ore	15	20	..	½ legal	10
St. Louis	8	10	..	6	..
Seattle	20	20	..	12	12
Code of Motor Vehicle Conference Committee	15	20	30	..	..
Committee on National Conference of Street and Highway Safety	15	20	35	15	15

CHICAGO.--"In all instances where street cars are stopped for the purpose of loading and unloading passengers, automobiles must stop 10 feet behind the rear part of the street cars.

"On coming to boulevards or through streets with standard stop signs, all automobiles must come to a full and complete stop and not enter or cross boulevard or through street until traffic is clear."

DES MOINES.--"No driver of a vehicle or team shall over take and pass any vehicle or team at street intersections in the business district of the city;"

ST. LOUIS.--"The operators and drivers may drive the same along the street railway tracks, provided, however, they do not interfere with the use of the said tracks by street cars or violate other provisions of this Ordinance."

SAN FRANCISCO.--"It shall be unlawful for any person to so drive any wagon, cart or other vehicle on any street or any portion of any street, paved with bituminous rock, on which the rails of a street railroad are laid, that the wheel or wheels on one side of such wagon, cart or vehicle shall be run or operated on and along the outer rail of said street railroad, and the wheel or wheels on the other side thereof shall be run or operated on and along the bituminous pavement between the said outer rail and the sidewalk curb."

SEATTLE.--"No person shall drive or operate a vehicle

with a trailer between the hours of 8:00 a. m. and 6:00 p. m., the length of which exceeds 24 feet, upon those portions of the streets named and within the district described as follows:....."

Chapter Seven. REGULATION OF STANDING AUTOMOBILES

Although parking is a great problem of the city streets as it is necessary to regulate it in the cities, there is no reason for not providing parking spaces along the rural highways and regulate them where necessary. Few regulations regarding to the parking of automobiles can be found in the state codes but some are provided as follows:

COLORADO.--"No vehicle shall be stopped or permitted to stand on the traveled portion of any public highway for the purpose of making repairs, except such repairs as it may be necessary to make in order to remove it therefrom; and no vehicle shall be stopped permitted to stand, or be parked thereon for camping or any other purpose."

MICHIGAN.--"It shall be unlawful to park a vehicle on the beaten track or paved surface of any highway outside the limits of any village or city."

MINNESOTA.--"Ll1 vehicles on highways and not in motion shall be placed as near the right hand side of the highway as practicable and in such manner as not to obstruct public travel; provided, however, that any municipality may, by ordinance, require or permit parking elsewhere. No motor vehicle shall be permitted to stand unattended, and with the motor running, on any highway."

NEW YORK.--"....are authorized to designate by ordinance or regulation such safety zones, parking spaces and cab or taxicab

stands in the public streets as are, or shall be required, for the safety and convenience of the citizens and inhabitants of the city or village,.....

"Except at parking spaces or when authorized so to do by the ordinance or regulation no vehicle shall remain backed to the curb except it be actually loading or unloading and then for no longer time than the actual loading and unloading reasonably requires."

WISCONSIN.--"Parking in such a way as to interfere with the free passage of vehicles is forbidden; and free passageway of at least 18 feet between parked motor vehicles must be left in all instances."

Parking in the city is quite a big problem of today. There are three classes of standing vehicles in streets. In the first place there is the vehicle which has been stopped for the loading and unloading of merchandise. The second type of standing vehicle is that which may be said to be left in live parking. The third type of standing vehicle is that which has been left for an indefinite time, in what may be called dead parking, or storage.

The parking restriction in typical cities are shown in the next table and some interesting regulations from cities will follow.

Table 32. PARKING RESTRICTION IN TYPICAL CITIES

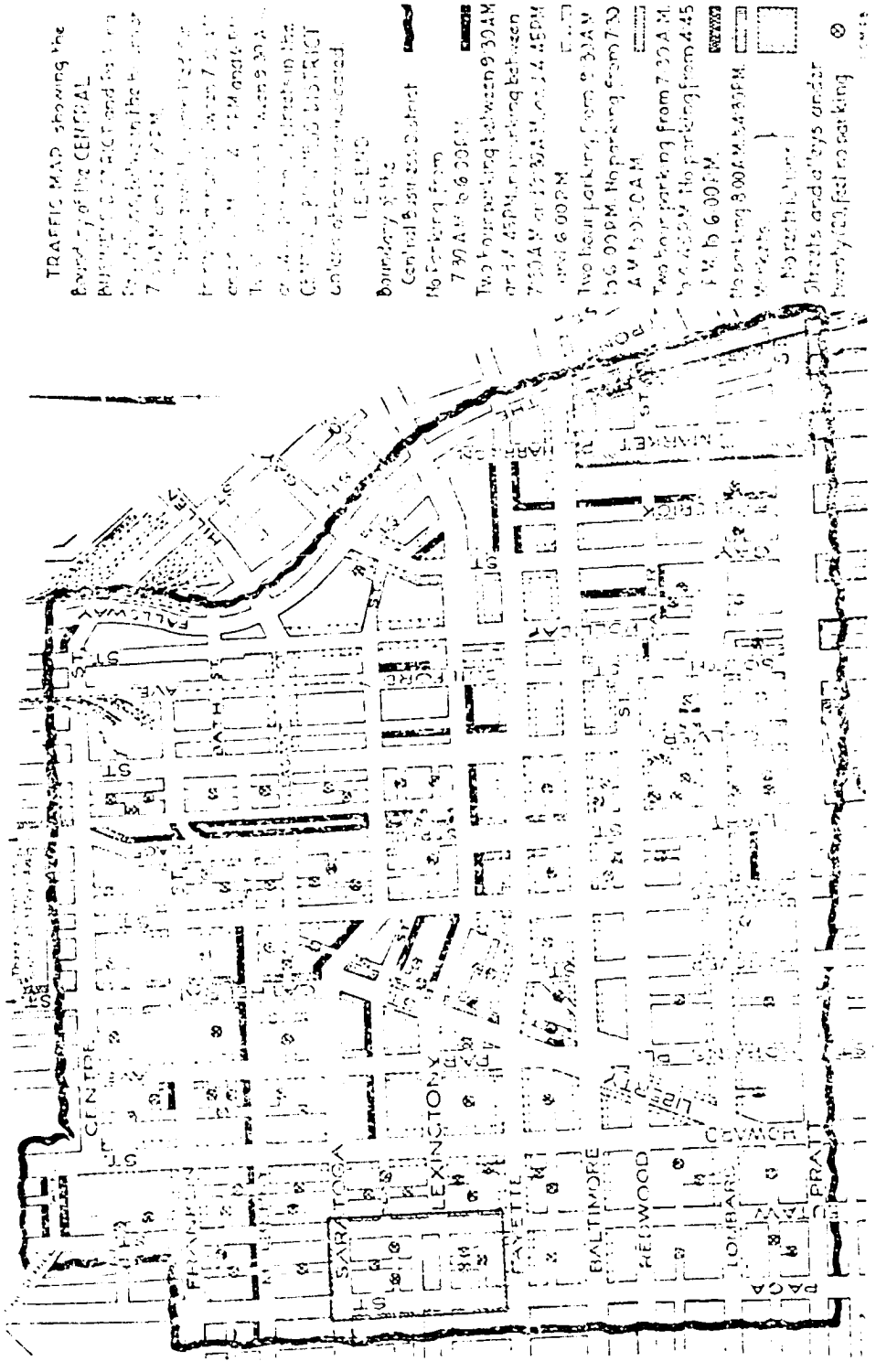
CITY	Prohibited parking in certain areas	15 minute zone	30 minute zone	40 minute zone	1 hour zone
Boston	..	..	X	..	X
Buffalo	X	..	..	..	X
Chicago	X	..	X	..	..
Cleveland	X	..	..	..	X
Kansas City	X	..	..	..	X
New Orleans	X	X	..	..	X
Philadelphia	X	..	..	..	X
Portland, Ore.	X	X	X	...	..
St. Louis	..	X	..	..	..
San Francisco	..	..	..	X	..
Seattle	X	..	..	..	X
Washington, D. C.	X	..	..	..	X

BALTIMORE.--A very clear map of Central Business District of Baltimore will be found in Map 11 which indicates the regulations of parking in different places of that district. Some general parking ordinances are read as follows:

"Excepting the limits of the several markets,.....and unless otherwise provided in this article, no wagon, cart, motor vehicle or other vehicle, or horse, mule, or other animal shall be permitted to stand on any of the following streets, lanes, or alleys of the city for a longer period than two hours between eight o'clock a. m. and four-thirty (4:30) o'clock p. m. of any day, Sundays and holidays excepted, to wit....; and, excepting aforesaid, no wagon, cart, motor vehicle or other vehicle, or horse, mule, or other animal shall be permitted to stand for a longer time than may be reasonably necessary to take on or discharge passengers, freight or merchandise, between the hour of four-thirty (4:30) o'clock p. m. and six-thirty (6:30) o'clock p. m. of any day, Sundays and holidays excepted, on any of the following streets, or portion of the streets, within the limits designated, to wit:.....at or near street intersections, signs indicating that the standing of vehicles within respective blocks covered by this Ordinance is prohibited between four-thirty (4:30) o'clock p. m. and six-thirty (6:30) p. m., nor shall any wagon, cart, motor vehicle or other vehicle or horse, mule or other animal be permitted to stand on any of the streets, lanes or alleys of the city for a longer time than six (6) hours between the hours of six-thirty (6:30) o'clock p. m. of any day and eight o'clock a. m. of the next day; except in that part of the city last annexed."

BOSTON.--"Except provided in...., no vehicle shall stop

Map 11. Traffic Map of Baltimore



with its left side to the curb.

"No vehicle shall remain backed to the curb except when actually loading and unloading and then for not more than five minutes at any time. Between 6 o'clock a. m. and 6 o'clock p. m. this rule shall not apply except that vehicles shall block surface cars for a longer than ten minutes at any one time.

"No vehicle shall stop or stand within the intersection of any street, nor within twenty feet of a street corner, nor within ten feet of a hydrant.

"Between the hours of 7 o'clock a. m. and 1 o'clock p. m. vehicles shall not stand in front of entrances to churches, hotels, theaters, schools or other places of public gathering except to let off or take on passengers."

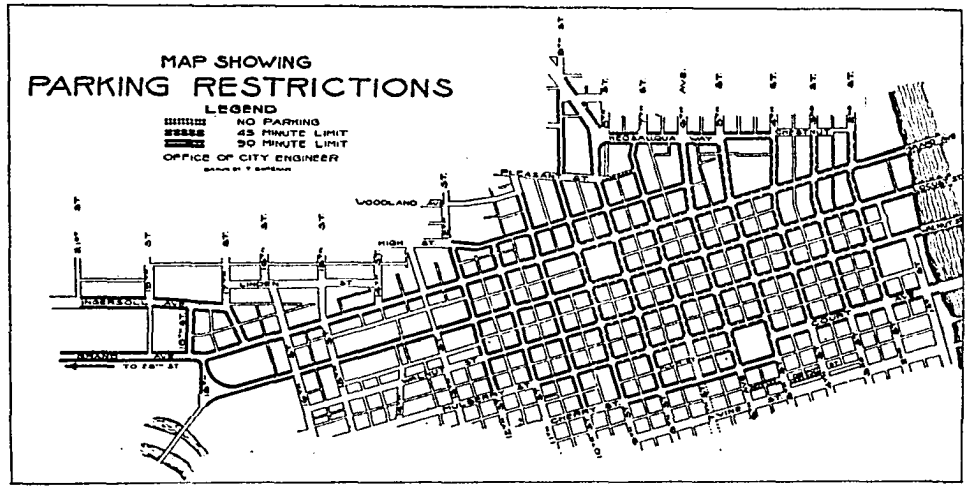
CHICAGO.--"Vehicles must not park on bridges or approaches thereto.

"Parking is prohibited within 50 feet of entrances, between 1:30 and 5:00 p. m., and between 8:00 and 11:00 p. m., except to load and unload passengers."

DES MOINES.--Here is another more simple parking map of Des Moines (Map 12) with longer period of parking limit in certain places. Parkings are prohibited in certain streets; limited to 45 minutes between 7:30 a. m. and 6:30 p. m. in certain streets; and limited to 90 minutes between the same hours in certain other streets. The manner of parking is given in the regulation as follows:

"Parking on West Court Avenue, from 1st St. to 5th Ave., shall be at right angles to the curb on both sides of the avenue; parking on the north side of the W. Locust St., from Second St. to

Map 12- Parking Restrictions in DesMoines



the alley west of Second Street shall be at right angles to the curb; and parking on East 5th Street, from Walnut Street to Grand Avenue, shall be at right angles to the curb on both sides of the streets; and all other places, parking shall be parallel to the curb and as near thereto as the condition of the street will permit."

DETROIT.--"Standing vehicles shall be parked parallel to the curb where not prohibited by rule of the Commissioner and shall be placed so that neither right wheel shall be further than 6 inches from the curb. Provided, that angle parking shall be permitted and required at such places as the Commissioner may designate by rule.

"Double parking is prohibited upon all the streets of the city."

SAN FRANCISCO.--"It shall be unlawful for any person operating vehicles described in Section 41* of this Ordinance to leave such vehicles standing on grade exceeding five (5) per cent with only the brake set, except when the front or rear wheels of such vehicles shall have been thrown in towards to curb in such a manner as to prevent such vehicle from running down the grade if the brakes should be released;.....

"The following are hereby designated as stands for licensed hacks, taxicabs, automobiles and sightseeing automobiles:

A. Around certain squares.
B. At the ferries.
C. Steamboat landings.
D. Railway depots.
E. In front of some hotels."

---

* All kinds of vehicles.

SEATTLE.--"It shall be unlawful to park a vehicle on any street on which street railway cars are operated; Provided, however, that vehicles, the length of which do not exceed twelve (12) feet, may be parked adjacent to the curb on Western Avenue, between Seneca Street and Yesler Way, between the hours of 6:00 a. m. and 9:00 p. m.

"No person shall stand a vehicle at any location designated as a location for parking, nor park a vehicle at any location designated as a location for standing."

Chapter Nine. REGULATION OF PEDESTRIANS

The traffic regulations are not only for the regulation of vehicular traffic, but also for the guidance and safety of the pedestrian.

Traffic regulations must govern the movement of pedestrians as well as motorists. Steps must be taken to make it as difficult as humanly possible for the pedestrian to get hurt.

In a number of cities ordinances have been passed making it an offense to run counter to traffic signals, whether the offender is a motorist or a pedestrian. When the signal instructs the motorist to go he must go and the pedestrian should remain on the sidewalk so as to insure the free and quick movement of both the vehicular and pedestrian traffics. Here are available regulations of pedestrians in two states.

STATE OF NEW YORK.--"Pedestrians walking upon the traveled part of a street and not the sidewalk shall, when meeting or passing vehicles, be subject to and comply with the rules governing vehicles as to meeting, turning out and passing, except as to signals."

STATE OF VIRGINIA.--"Pedestrian walking along state highways shall keep to the left hand side of the road."

Table 33 shows the pedestrian regulations in the larger cities of the United States and some of the details from their regulations may be copied as followed:

DENVER.--"Pedestrians in the district and on the streets named and described in Section 1993 thereof, shall cross

streets at a right angle at street intersections or designated crossing places, and at no other place. Where a traffic officer is stationed, pedestrians shall cross with the release of traffic.

A safety zone is set aside for the use of the pedestrians in which pedestrians may go as in passing over street crossing, and across which no vehicle shall pass and within which shall be, while the same is lawfully occupied by any pedestrian."

LOS ANGELES.--"In any crosswalk where traffic is not being directed by a police officer or by a traffic signal, pedestrians shall have the right of way over vehicles; provided that any pedestrian desiring the right of way shall give warning of his intention to cross by raising the hand, palm out, toward the approaching traffic. It shall be unlawful for the operator of any vehicle to drive into such crosswalk until such pedestrian shall have passed in front of said vehicle.

"It shall be unlawful for any person to stand or walk in the roadway other than in a safety zone or in the crosswalk, if such action interferes with the lawful movement of the traffic; provided that no pedestrian shall cross a roadway other than by a route at right angles to the curb, or by the shortest route to the opposite curb, and provided, further, that in the Central Traffic District no pedestrian shall cross a roadway other than by a crosswalk."

Table 33. PEDESTRIAN REGULATION IN LARGER CITIES

CITY	Must cross at the crossing.	No diagonal crossing.	Keep to the Right	Look before crossing	Obey Officer
Birmingham	X	X	X	X	..
Boston	X	X	X	X	..
Buffalo	X	X	..	X	X
Cincinnati	X	X	X	..	X
Cleveland	X	X	X	X	X
Indianapolis	..	X	..	..	X
Lincoln	X	..	..	..	..
Long Beach, Cal.	X	X	..	X	X
Los Angeles	X	X	..	..	X
Milwaukee	..	X	..	..	X
Portland	X	X	..	..	X
St. Louis	..	..	..	..	X
Salt Lake City	-- Pedestrians have the right of way at all places.				
Springfield, Mass.	X	X	..	X	X
Toledo	..	X	..	..	X
Washington, D.C.	X	X	..	X	X
Wilmington.	X	X	..	..	X

SAN FRANCISCO.--"The Police Department established pedestrian crossings or traffic lanes along and across Market St. from the Embarcadero to Ninth Street and all pedestrian traffic across such street shall be confined to such crossings as shall be thus established. Upon other streets where traffic is congested pedestrians shall cross only at street intersections and within the area bounded by the extension of the exterior and interior sidewalk lines. Pedestrians shall heed the directions of the traffic officers and all traffic signals shall apply to pedestrians as well as to vehicular traffic. Pedestrians on sidewalks shall keep to the right."

SEATTLE.--"Pedestrians shall not step into that portion of the street open to moving traffic at any point between intersections in the business district except to board a street car or to enter a safety zone at right angles.

"On paved streets at intersections pedestrians shall not cross intersections diagonally."

DISTRICT OF COLUMBIA.--"Pedestrians shall have the right of way between crosswalks and between street intersections.

"Persons walking on highways without sidewalks shall face in the direction of approaching traffic."

Chapter Nine. HIGHWAY SAFETY

The general conclusions were reached in the National Conference on Street and Highway Safety this year as to the causes of accidents are as follows:

"The appalling annual increase in automobile accidents is due in large measure to the tremendous increase in the number of vehicles upon our highways. It has not been possible, in the comparatively few years since the advent of the motor car, to alter streets and highways to meet the needs of this enormous growth of vehicular traffic. Nor have all the people who walk and drive been able to acquire the necessary skill and judgment to cope with the multiplicity of hazards which have resulted.

"These hazards must be reduced, and at the same time the level of competence must be raised. Provision must be made for the greatest possible improvement in cars, highways, and traffic systems; and the public must be brought by education and regulation to a point where it can be and will avoid as far as possible the dangers inherent in highway transportation.

"In accident prevention the lessening of human incompetence and of physical hazards are both of great importance. To this end the clear understanding of all the factors which cause or contribute to cause accidents is indispensable."

Following is a table showing twelve most fertile causes of fatal accidents for the period from January, 1924, through May, 1925, as analyzed from newspaper and other reports by the National Automobile Chamber of Commerce.

	CAUSE	Percentage of total accidents due to cause
1.	Adult jay walking.	25.1
2.	Children crossing against traffic rules or playing in streets.	14.0
3.	Too fast for conditions.	12.9
4.	Violating rules of the road.	8.3
5.	Intoxication.	4.9
6.	Fog, snow or rain.	4.5
7.	Pedestrians confused.	4.3
8.	Skidding.	3.9
9.	Inattention of driver	3.7
10.	Confusion of driver	3.7
11.	Defect in vehicle.	3.3
12.	Inexperience.	2.8
	All twelve causes.....	91.5

Number of different causes listed in complete analysis..... 22

Number of times all causes were involved in an accident.... 3,706

Judging from all points, the highway safety problem involves not only literary laws and regulations to prevent the accidents but also the physical regulations marking and signalling, are necessary to provide to make them physically impossible. Uniform signals and some marking systems and safety provisions which are practicing in some states may be interesting to illustrate in the next few paragraphs.

COLORS AND FORMS OF TRAFFIC SIGNALS

The following are some rules of the text of revised draft of the code of colors and forms suggested by a special committee of the American Engineering Standards Committee and the recommended symbols are illustrated in Figure 7.

Rule 30. Significance of Colors.

A. Red shall be used as an indication to stop and for other purposes where required by law.

B. Yellow shall be used as an indication to exercise caution.

C. Green shall be used as an indication to proceed.

Rule 31. Significance of Form.

"Where definite forms of luminous, nonluminous signs or signals are used either alone or in combination with colors to give the indications specified in Rule 30, the following will apply:

A. Stop shall be indicated by having the greatest dimension horizontal, as with a horizontal semaphore or a string of lights.

B. Caution shall be indicated by having the greatest dimension horizontal, as with a horizontal semaphore or string of lights.

C. Proceed shall be indicated by having the greatest dimension vertical, as with a vertical semaphore or string of lights.

Rule 33. Cautionary Signs for Drivers.

A. Highway signs and signals of a cautionary nature for the notice of drivers shall have letters and symbols black on a yellow background or yellow upon a black background.

B. For signs to be read from vehicles in motion symbols are recommended in place of, or supplementary to, words.

C. When symbols are used, those illustrated in Figure 7 are recommended for the situation indicated. Other or special symbols should be such as not to be confused with these.

Rule 34. Location Signs.

A. Traffic signs shall be erected with the top not more than 8 feet above the surface of the roadway.

B. Traffic signs shall be erected at the outer edge of the shoulder area and on the right hand side of the roadway where practicable.

Rule 40. Aspect of Railroad Grade Crossing Signal.

An electrically or mechanically operated signal used for the protection of highway traffic at railroad crossings shall present toward the highway when indicating the approach of a train the appearances of a horizontally swinging red light or disk.

Rule 41. Location.

The railroad standard highway crossing sign and the signal shall be mounted on the same post.

Rule 45. Approach Signal.

Advance warning signals which indicate the approach to a railroad crossing, and not the actual approach of a train, shall conform to the Rule 30.

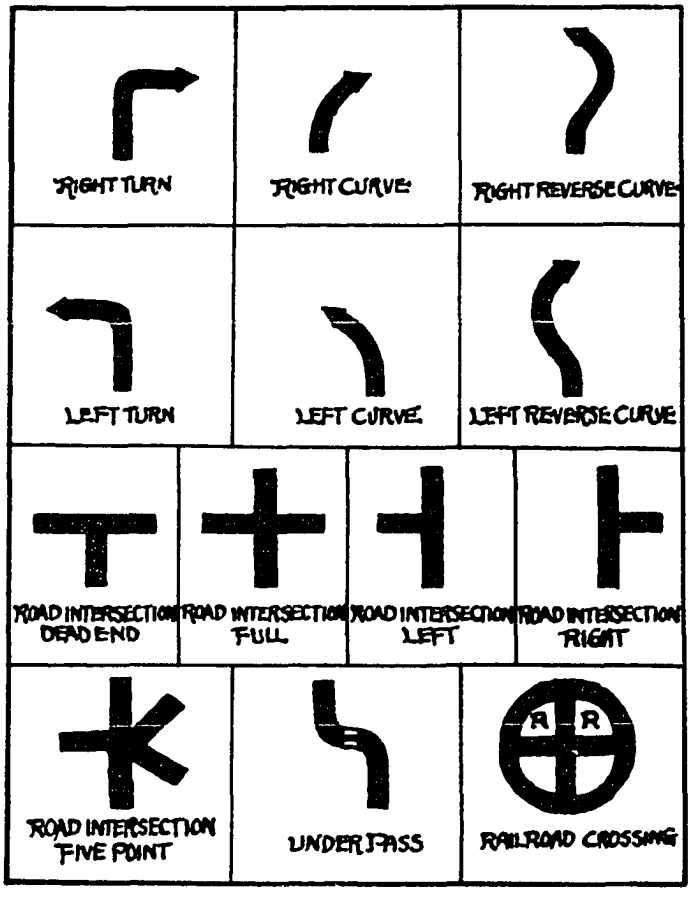


Fig. 7 Highway Symbols

UNITED STATES ROAD MARKERS

United States Road markers were adopted by the Joint Board appointed by the Secretary of Agriculture for this purpose in 1925.

For all route markers and directional signs, black lettering on white background; for all warning and caution signs black lettering on lemon yellow background.

The shapes of the different kinds of signs are as follows:

1. Railroad warning Sign: Round.
2. Danger or stop sign: Octagonal.
3. Caution or slow sign: Diamond shaped.
4. Look or attention sign: Square
5. Road Markers.

Some characteristic or conventional shape different from the above. Figure 8 is showing this class of marker which is to be used in the State of Iowa. They are 16 inches high and 16½ inches wide.

6. Directional and information sign: Rectangular.

Figure 8: U. S. Road Marker

HIGHWAY MARKING IN ILLINOIS

The Department of Public Works and Buildings has adopted a system of highway marking with the aim to make virtually impossible for the motorist who follows the marking to become lost. The system serves a two-fold purpose: First, to promote safety; and second, to furnish directory information to the traveling public.

The first purpose is accomplished by maintaining warning signs at all points of potential danger. These signs, which are placed 400 feet each way from the point of danger, are illustrated in Figure 9 to Figure 13.

At railroad grade crossings, the "Danger" sign is supplemented by a cautionary marking placed on the right hand side of the pavement. This marking consists of a series of diagonal stripes, alternately painted black and white. Series of stripes are placed at intervals of 100 feet, beginning 400 feet from the railroad crossing. Figure 14 illustrates this warning device.

MARYLAND.--Perhaps the best feature of highway marking in Maryland, as you will see in the next two pictures, is the signs of traffic information which give the motorist the necessary information as he crosses into the state and figures the route to follow

MICHIGAN.--Very simple and artistic warning signs were adopted in Michigan which show in the Figures 17 to 18. They are conformed closely in colors, size and design to the uniform standards which have been developed and approved by a group of midwestern states which include Michigan.

Fig. 9- Direction Sign

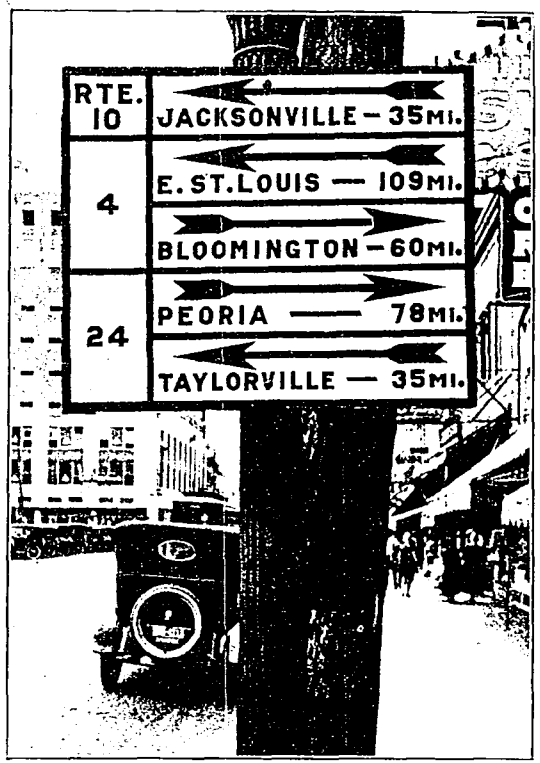


Fig. 10- State Marker.

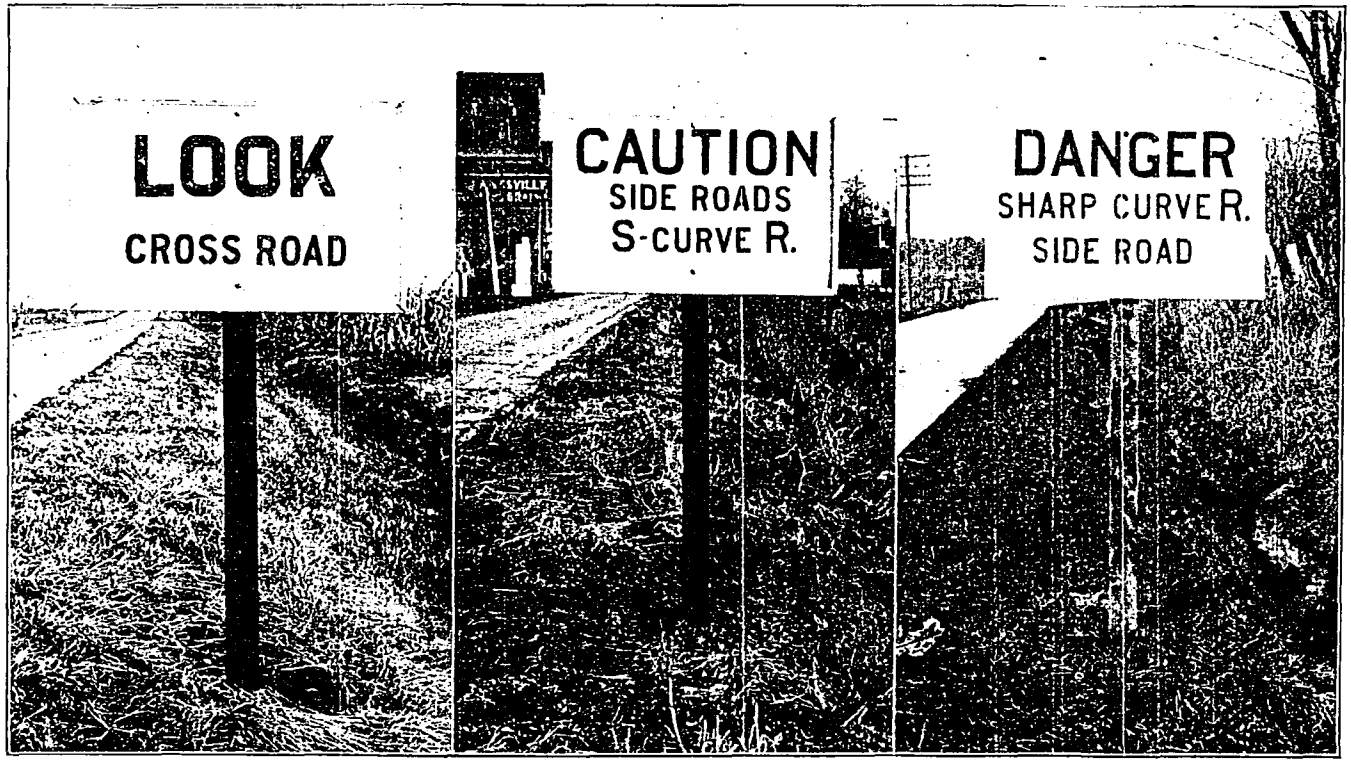


Figure 11. Figure 12 Figure 13

"Look" signs are erected where it is unnecessary to slacken speed, but where the driver should be on his guard.
"Caution" signs are erected where some slackening of speed and a greater degree of care are necessary.
"Danger" signs are erected only where there is imminent danger.

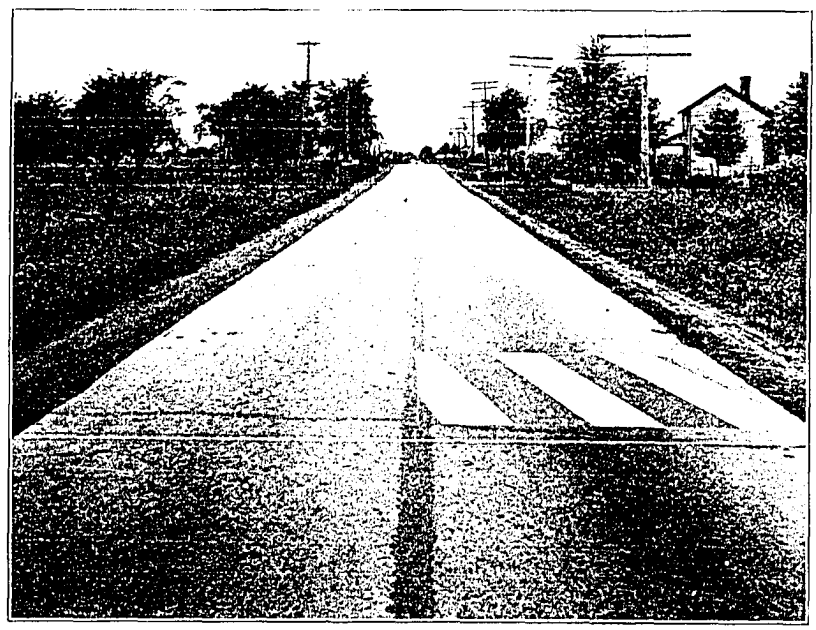


Figure 14—Railroad crossing warning stripes painted on pavement.

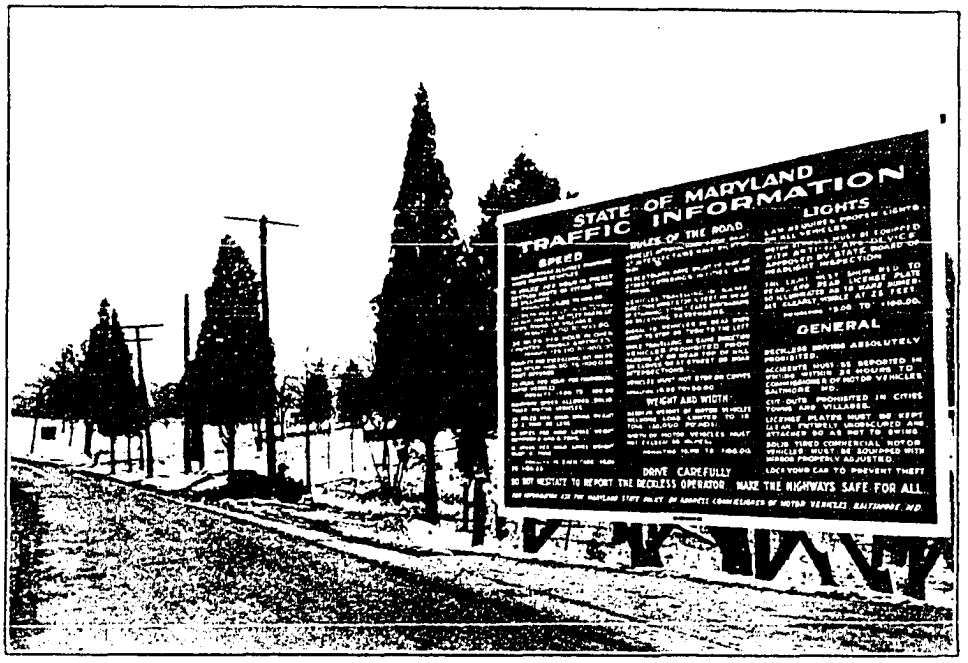
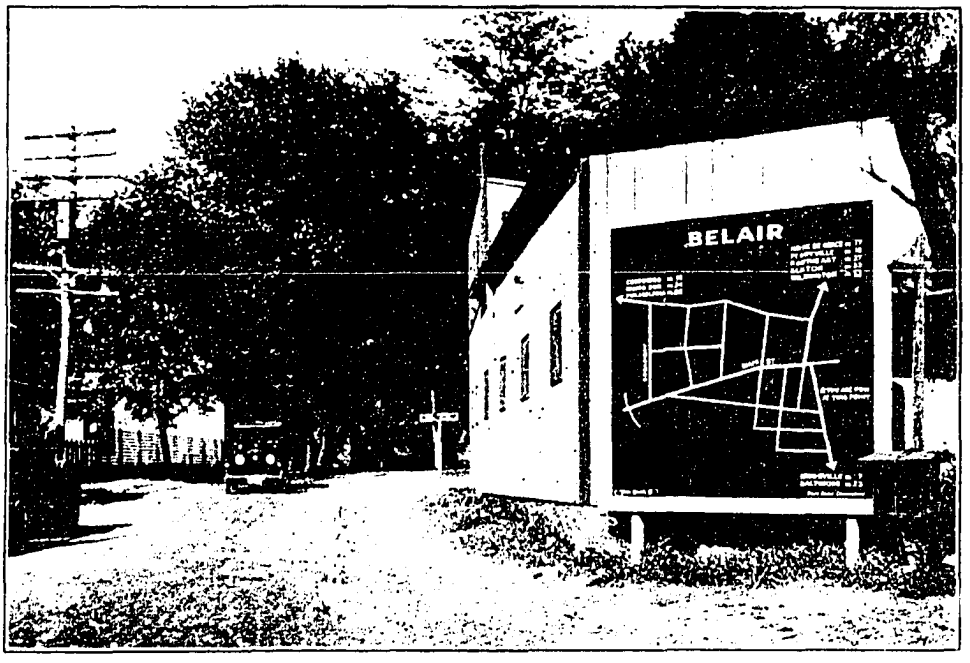


Fig. 15

15'x25' SIGN GIVING TRAFFIC INFORMATION TO THE TOURIST AS HE CROSSES INTO THE STATE.

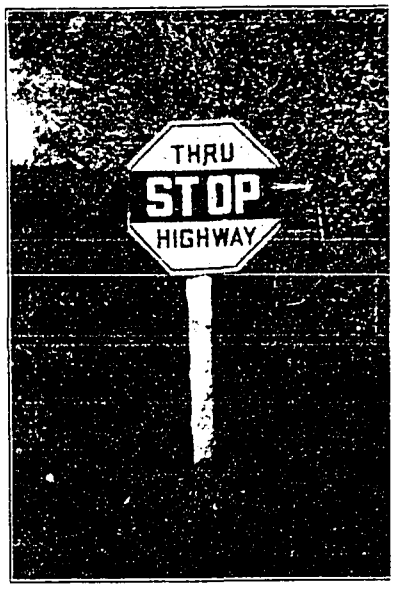


VIEW SHOWING TYPE OF ROAD MARKER AT ENTRANCE TO ALL LARGE TOWNS

Fig. 16

Figs 17 and 18.- Standard Warning Signs Used in Michigan

Fig. 19

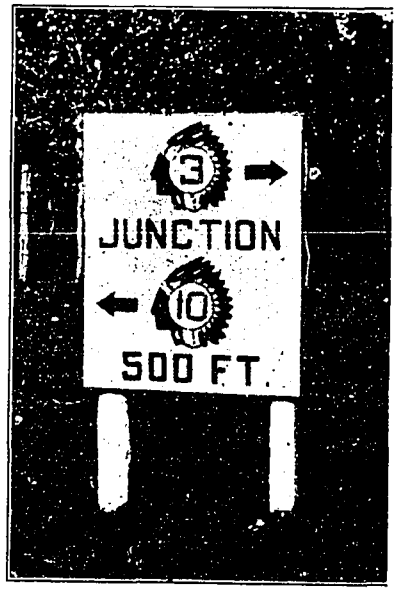


THRU STOP HIGHWAY

Fig. 20

BAD CURVE

Fig. 21



JUNCTION SIGNS
Markers of this type are placed at all highway intersections

NORTH DAKOTA.--North Dakota also has a remarkable system of highway marking and the outstanding markers will be found in Figures 19 to 21, inclusive.

TRAFFIC SIGNALS.

Traffic signs or signals should conform to the maximum visibility. They should denote their meanings as far as possible by their shapes and colors. The classifications of signals in use will be stated in the next few paragraphs and some typical illustrations of types of signals and their locations will be found in the pictures in the next pages.

1. Manual Controlled Devices. Standards, dummy cops, semaphores and certain types of mushrooms.

2. Automatically operated devices. Mushrooms, light houses and traffic towers.

3. Semi-automatic operated devices. Mushrooms, light houses, and traffic towers. They differ from 2 in that the latter is capable of being operated manually or automatically at will.

4. Synchronously controlled devices. Control traffic in large units than the single block by this device.

5. Plattoon control. By a carefully worked out scheme of progressively changing the traffic lights along the main thoroughfare, instead of synchronously changing them, traffic might move in plattoons, so that a vehicle once joined the plattoon would remain in that plattoon throughout the length of its journey.

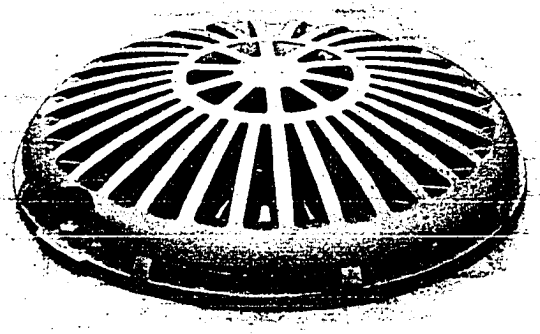
6. Master cross streets. Master cross-streets for busy crossings by progressive changing of the traffic signal.

The following table indicates typical signal practice in the large American cities.

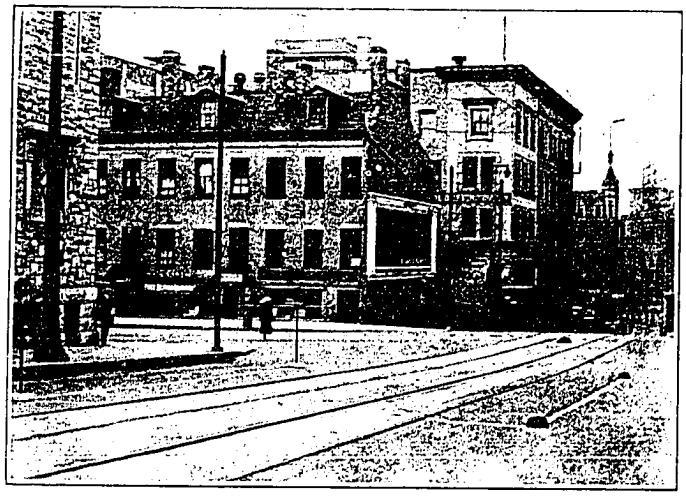
Table 34. SIGNAL PRACTICE IN TYPICAL LARGER AMERICAN CITIES

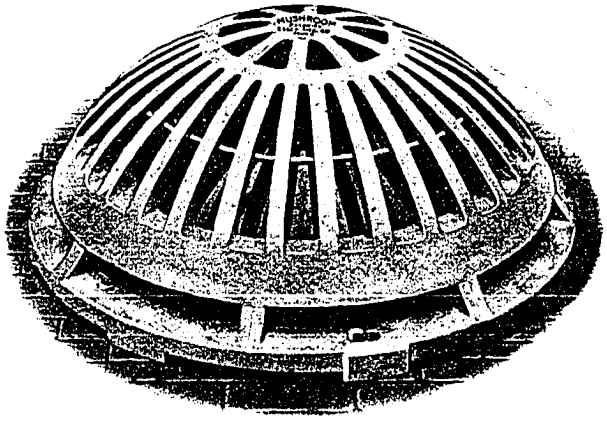
CITY	Manual Semaphore?	Manual lights?	Automatic lights?	Signal towers?
Baltimore	Yes	Yes	Yes	Yes
Boston	Yes	No	Yes	No
Cleveland	Yes	No	No	No
Chicago	No	No	Yes	Yes
Detroit	Yes	Yes	Yes	Yes
Kansas City	No	No	No	No
Los Angeles	No	No	Yes	No
Philadelphia	Yes	Yes	No	No
Pittsburgh	Yes	Yes	No	No
Portland, Ore.	Yes	No	No	No
St. Louis	No	No	Yes	No
San Francisco	No	Yes	No	No
Washington, D. C.	Yes	Yes	Yes	No

Figs. 22-24- Mushrooms



TYPE "L"





TYPE "H"

Figs. 25-28.--Location of Mushrooms

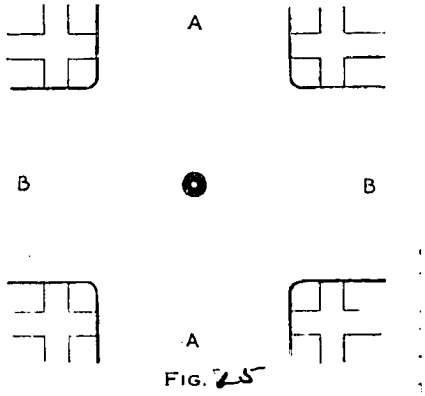


FIG. 25

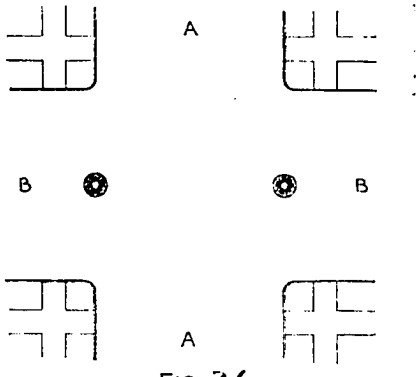


FIG. 26

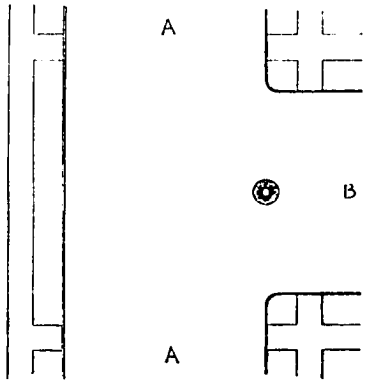


FIG. 27

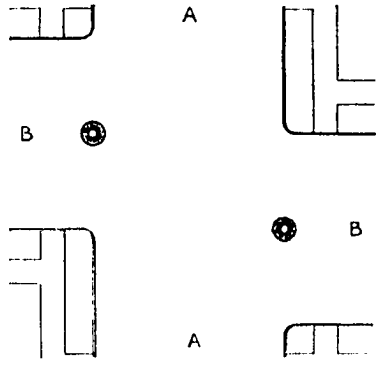


FIG. 28

Fig. 29.- Mast Arm Suspension

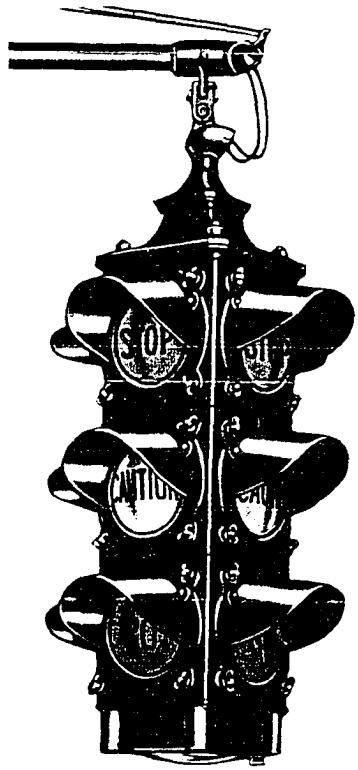


Fig. 30. Span-wire Suspension

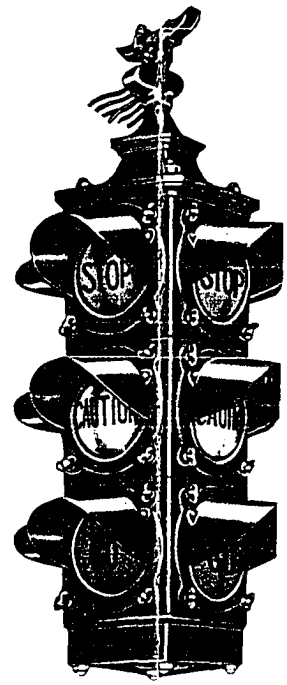
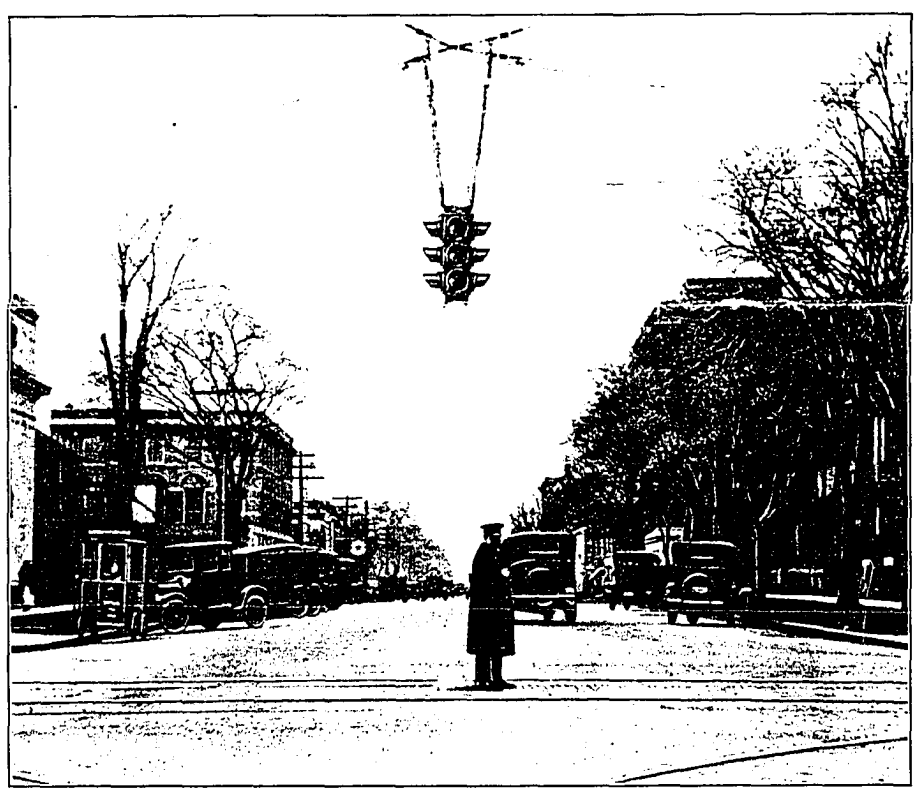
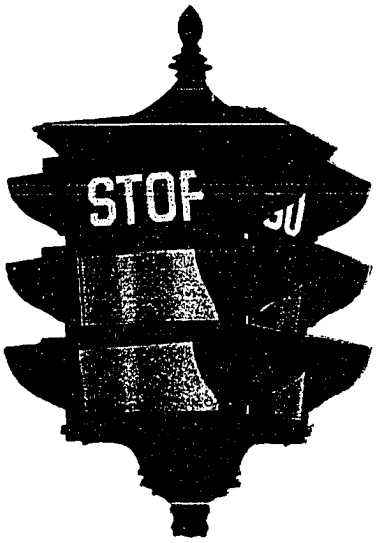


Fig. 30 Shown in Use.

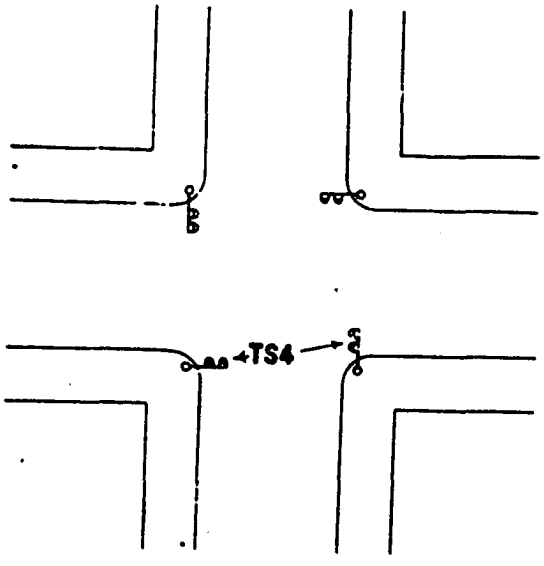


Figs. 31 & 32. Signals with Lettering.



Type W-4
Post Mounted

Type W-4
Suspended



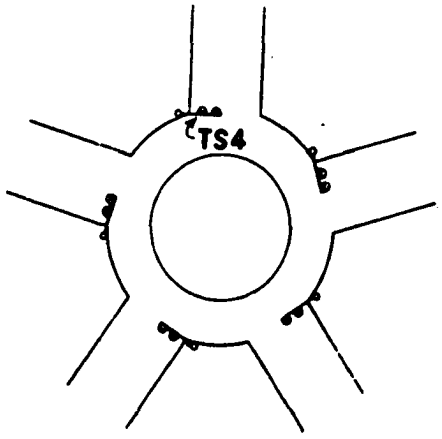


Fig. 33. Location of One Way Signals

Fig 38 Safety Crossing

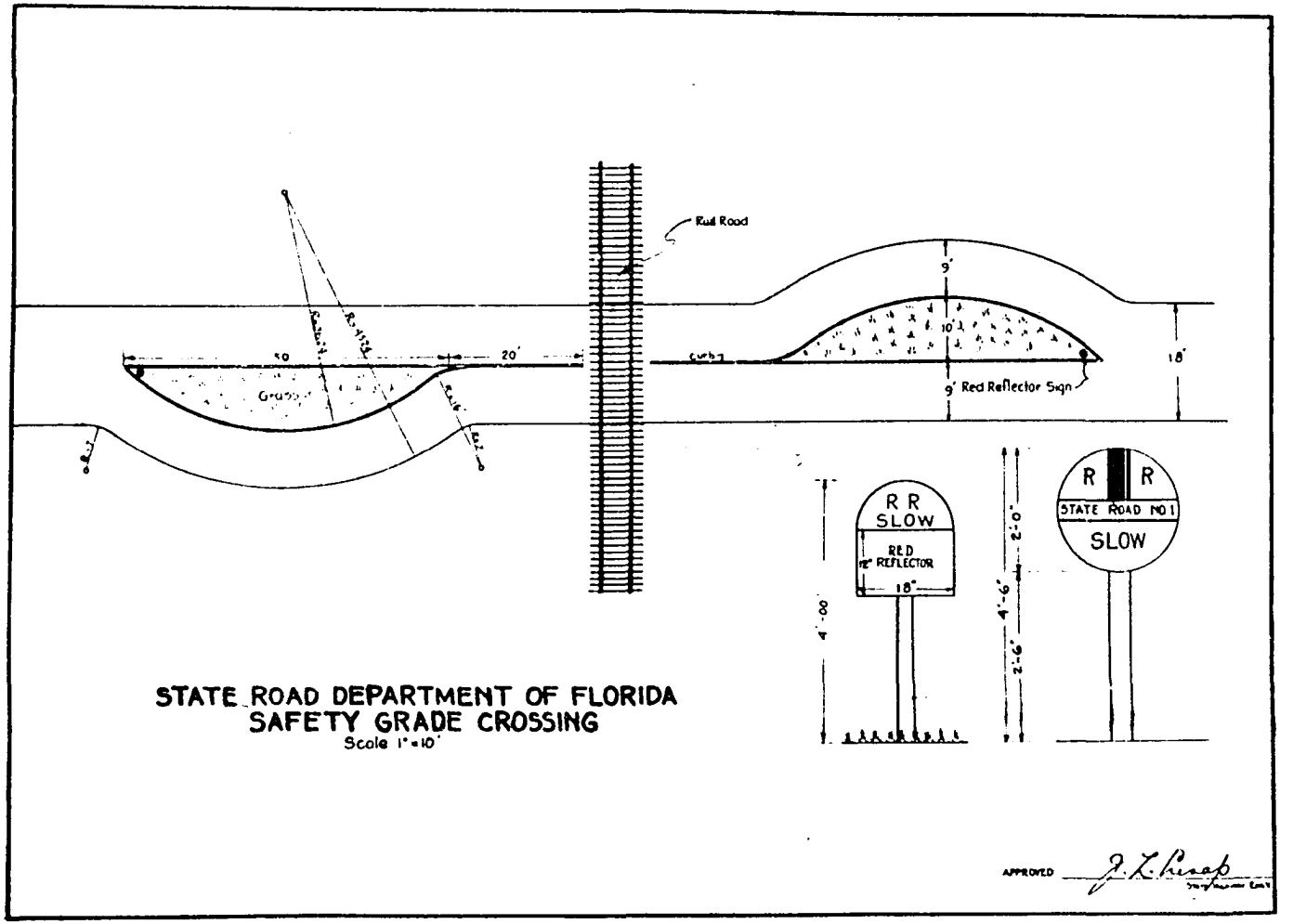
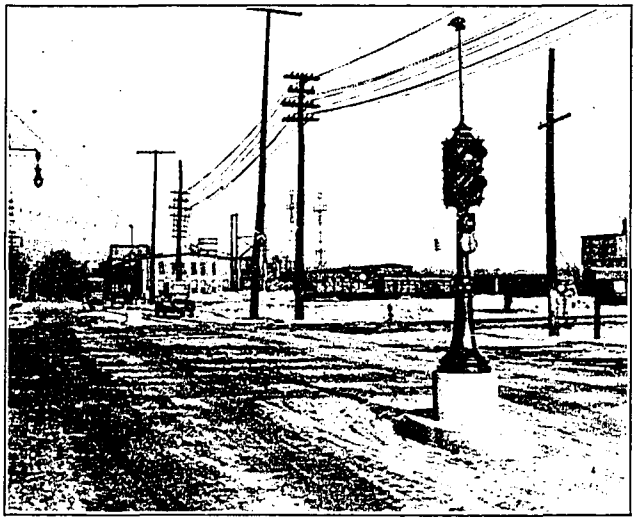


Fig. 39. Old Type of Grade Crossing Signal

Fig 40. New Type of Grade Crossing Signal



HIGHWAY GRADE CROSSING.

One of the most important problems of highway safety is the solution of highway grade crossing. Thirty per cent of all grade crossings on highway projects submitted to the Bureau of Public Roads are eliminated either by relocation or by the construction of underpasses or overhead crossings. The state of Washington has adopted the policy in 1919* that all the railroads and extensions of railroads hereafter constructed shall cross existing railroads and highways by passing either over or under the same, when practicable, and shall in no instance cross any railroad or highway at grade without authority first being obtained from the commission to do so. The solution of this problem in general may be stated as follows:

A. By means of grade separation with the highway either above or below the railroad.

B. By means of relocating the highway so that no crossing will be made.

C. By means of relocating the railway so as to avoid the crossing.

D. Protection at grade crossing.

1. Watchman with gates.
2. Watchman without gates.
3. Gates operated from control tower.
4. Automatic signal devices.

E. Warning signs before and at grade crossings on both sides.

F. Construction of obstruction to slow down the traffic before the crossing. Hump and dip or island with warning sign at the middle of the road.

---

* Highway Code of the State of Washington, 1919, pp. 179--

Figure 38 shows a plan of safety grade crossing which is practiced in the state of Florida. The approach to the railroad is on a curve or arc, so that the motorist must of necessity slow down before traversing the railroad track. This device so far has proved to be of benefit in that state.

Figures 39 and 40 illustrate the old type of signaling and the latest type of signaling at the railway crossing.

PAINT MARKING.

Paint marking is recognized to be most effective and simple and cheapest means of directing traffic on paved streets and thoroughfares. Following are some better practices in cities which were comprised by the Tropical Paint and Oil Company of Cleveland. The marking should be wide enough to give maximum visibility, say about four inches, and the yellow color is the most suitable color for the general use.

SAFETY ZONES.

There are four general types of safety zones:

1. The painted line zone.
2. The elevated platform.
3. The signalized zone.
4. The post or stancheon zone.

The painted line zone (Figures 23 and 47) is the simplest and by far the least expensive. The elevated platform type (Figure 46) is one which has gained considerable favor and

Fig. 41- Spaces for Parking.

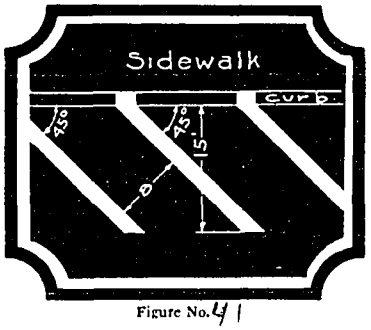


Figure No. 41

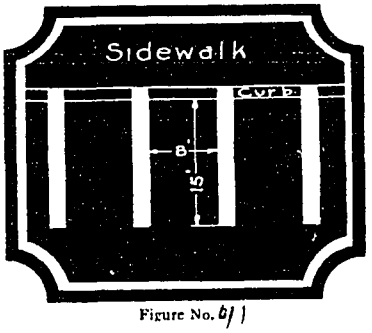


Figure No. 41

Fig. 42. Intersection Crossing.

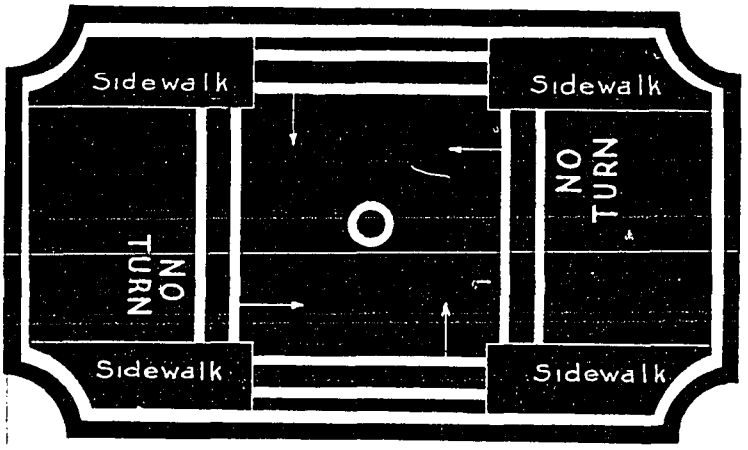


Figure No. 42

Fig. 43. Intersection

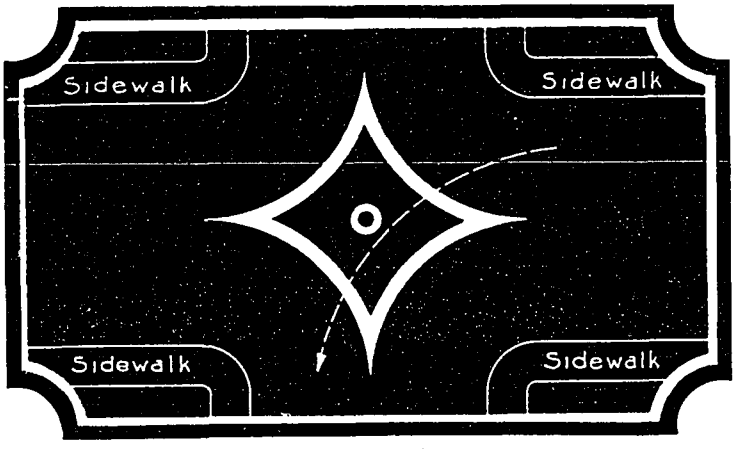


Figure No. 43

Fig. 44. Turning

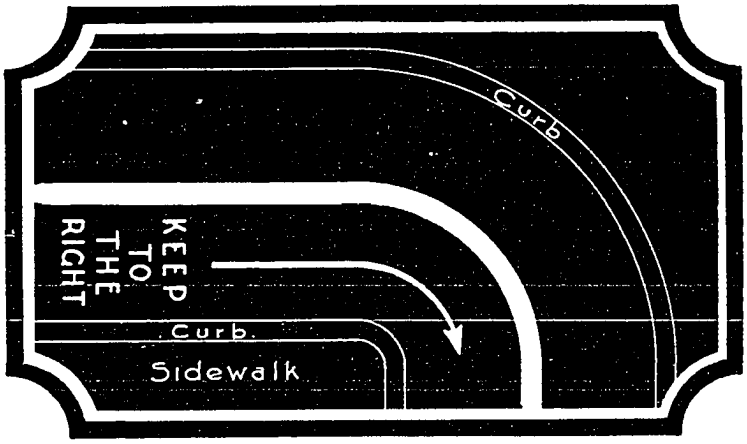


Figure No. 44

Fig. 45. Limited Parking Space

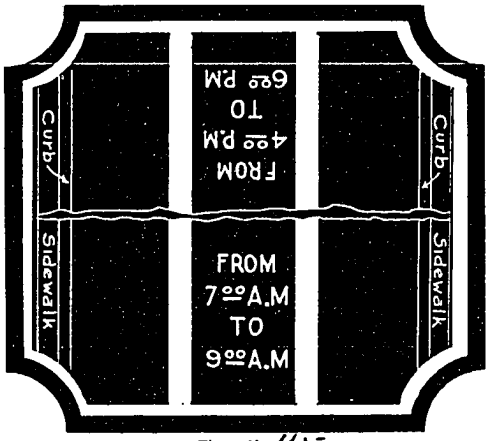


Figure No. 45

Fig. 46. No Parking Near Fire Hydrant

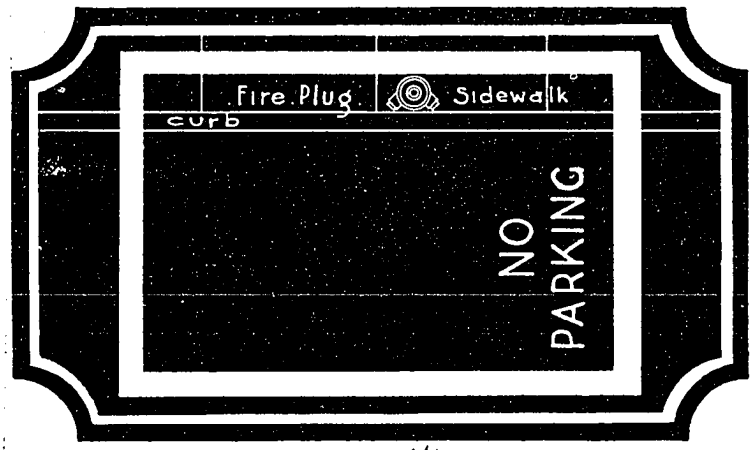
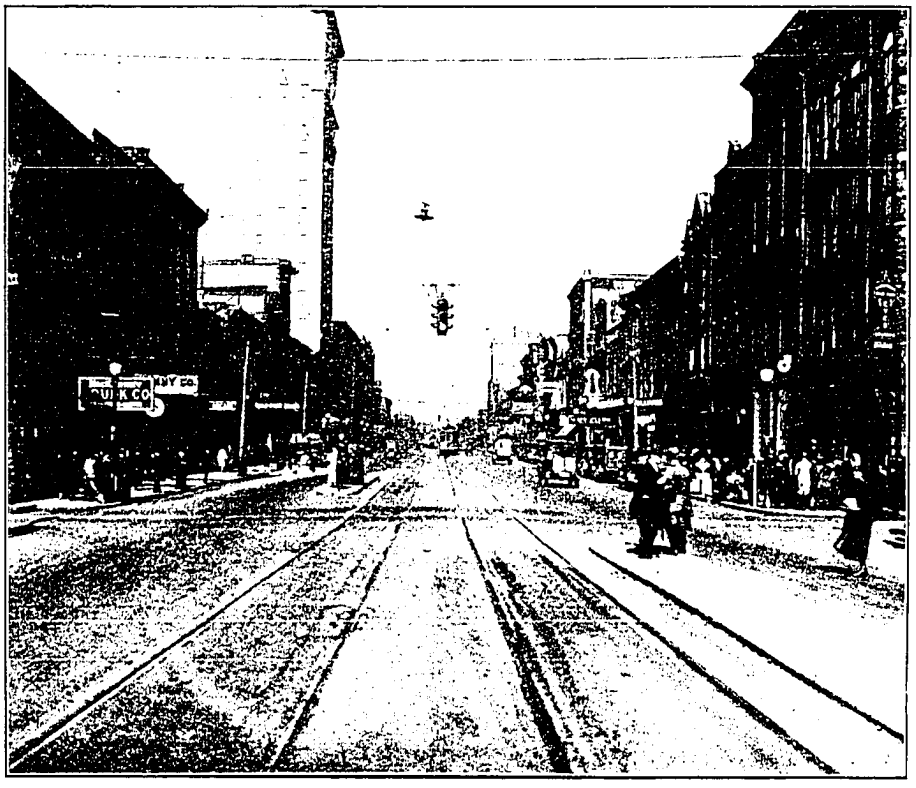


Figure No. 46

is now widely used. The signalized zone (Figures 42 and 46) is one which is created by the placing of a sign in the street indicating the nature of the area reserved. The post or stancheon zone is constructed by placing along boundaries of the reserved area with standards resting on the street surface or set into the pavement.

Fig. 47. Painted Line Zone

Fig. 48. Elevated Zone



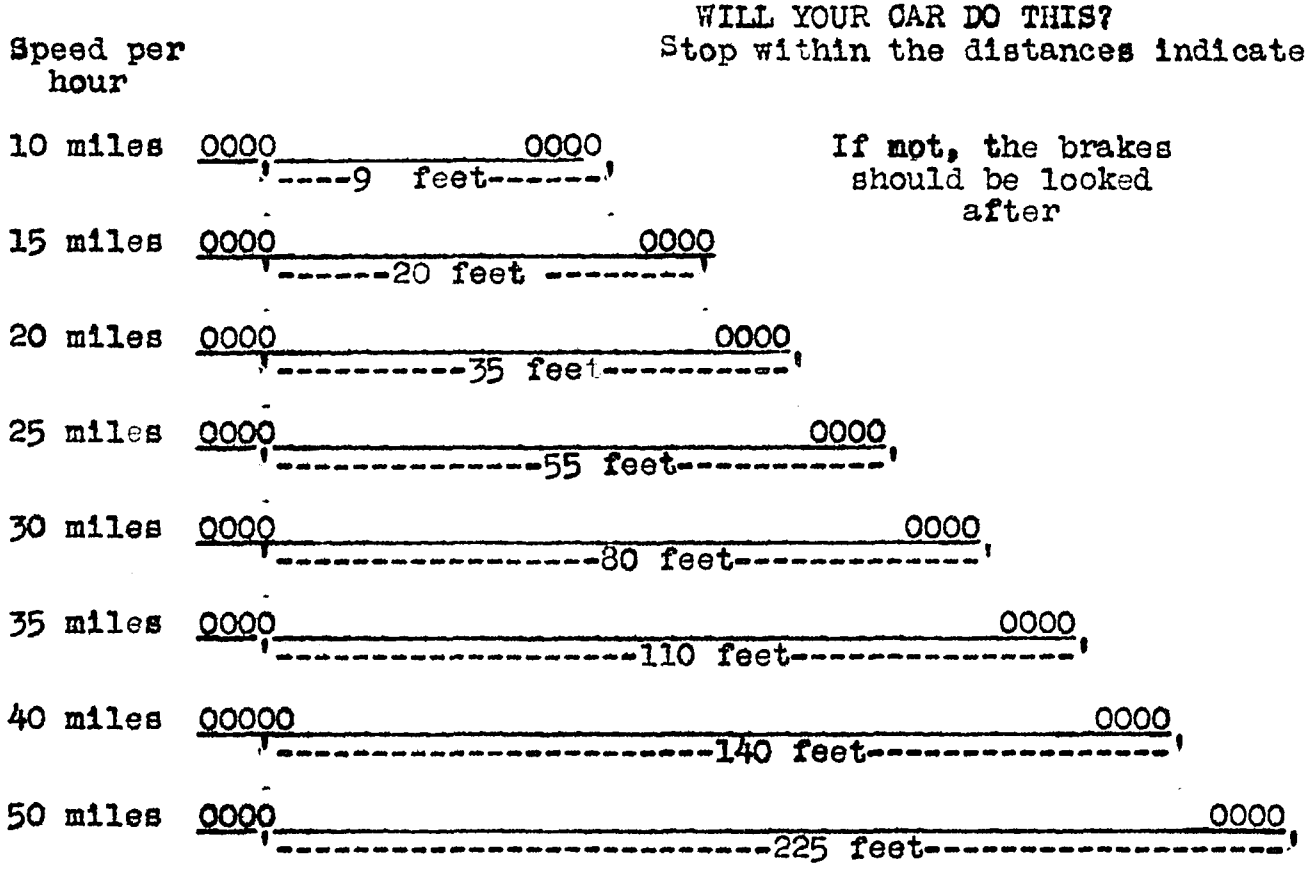


Fig. 49/ This chart shows the distances in which your car should stop, under average conditions, if your brakes are right.

Chapter Ten. TRAFFIC PLANNING

TRAFFIC CONGESTION. There are two different senses in this term "traffic congestion" as commonly used: 1. To indicate such a volume of traffic on the road as to reduce below its potential maximum the speed at which traffic moves, which may be called "retardation"; and 2. To indicate the presence on the road of so great a number of vehicles as to reduce the traffic capacity of the roads, whose consequences may be termed "suppression of traffic." So traffic congestion therefore has two phases: 1. The retardation of traffic, and 2. The suppression of traffic.

An increase in the number of vehicles on the road always tends to retard the rate of movement of the traffic. If the increase in the number of vehicles goes beyond a certain point it not only retards traffic but it reduces the amount of traffic which can be passed through the street per hour. Where the only speed restriction is that which is the automatic result of the number of vehicles on the road, reduction of speed retards traffic until a minimum of speed of about 14 miles per hour is reached, for beyond 14 or 15 miles per hour the traffic capacity decreases with increases in the speed of movement because of the increase in the safe braking space (Figure 49) between vehicles, but increases traffic capacity; further reduction of speed not only retards traffic but it also suppresses traffic by reducing traffic capacity.

From Dean A. N. Johnson's observation of the traffic capacity of the general built two-lane road can be closely ascertained.

In considering the question of the number of vehicles

that may pass a given point in a single file, or what may be designated as the total discharge of a single lane of traffic. It is evident that this number is depending on the velocity and the spacing or intervals between the vehicles; the vehicles to be considered as practically of a fixed length, which for the present purpose, may be taken as 15 feet. Expressing the velocity in miles per hour as V, and the clear distance between vehicles in feet as C, the total number of vehicles that will pass a given point in one hour is given by the relation:

$$N = \frac{5,280\ V}{15+C}$$

in which 15 represents the average length in feet.

It is known from observation that as the velocity of the fehicles increases, the spacing is varied. Whether this variation is directly as the velocity, or some other function of the velocity, is difficult to determine with any precision. There is some evidence, however, to indicate that the spacing between the vehicles varies approximately as the square of the velocity.

The causes of congestion may be stated as follows:

A. Concentration of population due to business.

B. Concentration of population due to social activities

C. Terminal and focal congestion.

D. Motorization of the population.

E. Poor highway construction.

F. Irregularity in highway system.

G. Bottle necks.

H. Improper direction and regulation.

I. Peak demands at certain times.

J. Community habit in using certain streets.

K. The mingling of fast and slow vehicles.

L. The mingling of rail and free wheel vehicles.

M. Crowded pedestrians.

N. Cruising taxis and cabs.

O. Unnecessary obstructions in highways.

The methods proposed by traffic engineers for the relief of traffic congestion fall into five classes:

1. Traffic restriction, including rules and regulation of all kinds of traffic.

2. Improved traffic guidance, including signs and signals.

3. Minor improvements, including street alterations and removal of obstructions.

4. Major extensions of highway facilities, including highway system and street system planning.

5. Zoning and decentralization of business, including regulation of buildings and creation of new sections.

HIGHWAY CONSTRUCTION. The first and most important development for the circulation of traffic is the better highway system. Among the things in the future highways which should be mentioned are these:

1. Highway exclusively for motor vehicles; broad roads, smooth surface, adequate safeguards, channels for classes of traffic

and safe exits and entrances.

2. The extension of these highways in a net-work across the country, going, for example, from New York to Boston without having to negotiate any congested sports and without any sharp turns or other speed-attacking factors.

3. Elevated thoroughfares in the larger cities with entrance and exits and channels for fast and slow and truck traffic

4. Vehicular tunnels or adequate bridges over waterways and other similar obstructions.

5. Most important of all, the building of roads that will stay built. This means scientific roadbeds and proper surfacing, of which we have thus far had but little.

There are three types of wearing surface which are in use at the present time for the heavy traffic highways:

1. Bituminous mixtures.

2. Concrete.

3. Granite block.

Bituminous is sufficiently strong for light loads, but is slippery in wet weather. Concrete must be laid monolithically with the base and is not renewable, but will last for 15 to 20 years; For the heaviest traffic, granite blocks are the best.

Perhaps the best recommendation for the construction of highways is the one reported by the committee to the Conference on Street and Highway Safety in 1925. The important points from its conclusion read as follows:

"The roadway of every improved rural highway should be

wide enough for at least two lines of traffic. Every pavement in a city street should be wide enough for at least three lanes of traffic without street cars or four lanes with street cars. Those for streets of heavy traffic should be wider. Street and highway pavement widths should be in multiples of widths of traffic lanes; i. e., 9 feet minimum for motor vehicles and 10 feet for street cars

"Right-of-way for parking space, for clear view at curves and intersections, and for future roadway widening should be provided before the cost of the land becomes prohibitive. Parkways and sidewalks should be so placed as to facilitate future widening.

"To make it feasible to prohibit parking or stopping on the traveled roadway, improved rural highways should be provided, either continuously or at intervals not exceeding 300 feet, with reasonable hard and level parking spaces entirely outside of the traveled way.

"Safety as well as economy requires that grades in excess of 6% be avoided where feasible in laying out or improving the thoroughfares of primary importance, whether in country village or in the city.

"Highway of primary importance should not have curves of less than 300-foot radius. Heavy grades and sharp curves should not be combined.

"The cross section of the pavement or roadway should be as flat as drainage conditions will permit. Curves should be widened and banked, and provided with transition curves to effect an easy transition between straight sections of the roadways and the curves.

"A clear view of approaching vehicles for at least 300

feet should be provided at all points on highways of primary importance.

"At street intersections the grades of each street should be maintained if possible, particularly those of main arteries of traffic. Curb radii should ordinarily not be less than 15 feet, and 20 feet in special cases.

"Every bridge on an improved highway or street should be at least 22 feet wide, to enable two lines of traffic to pass without difficulty."

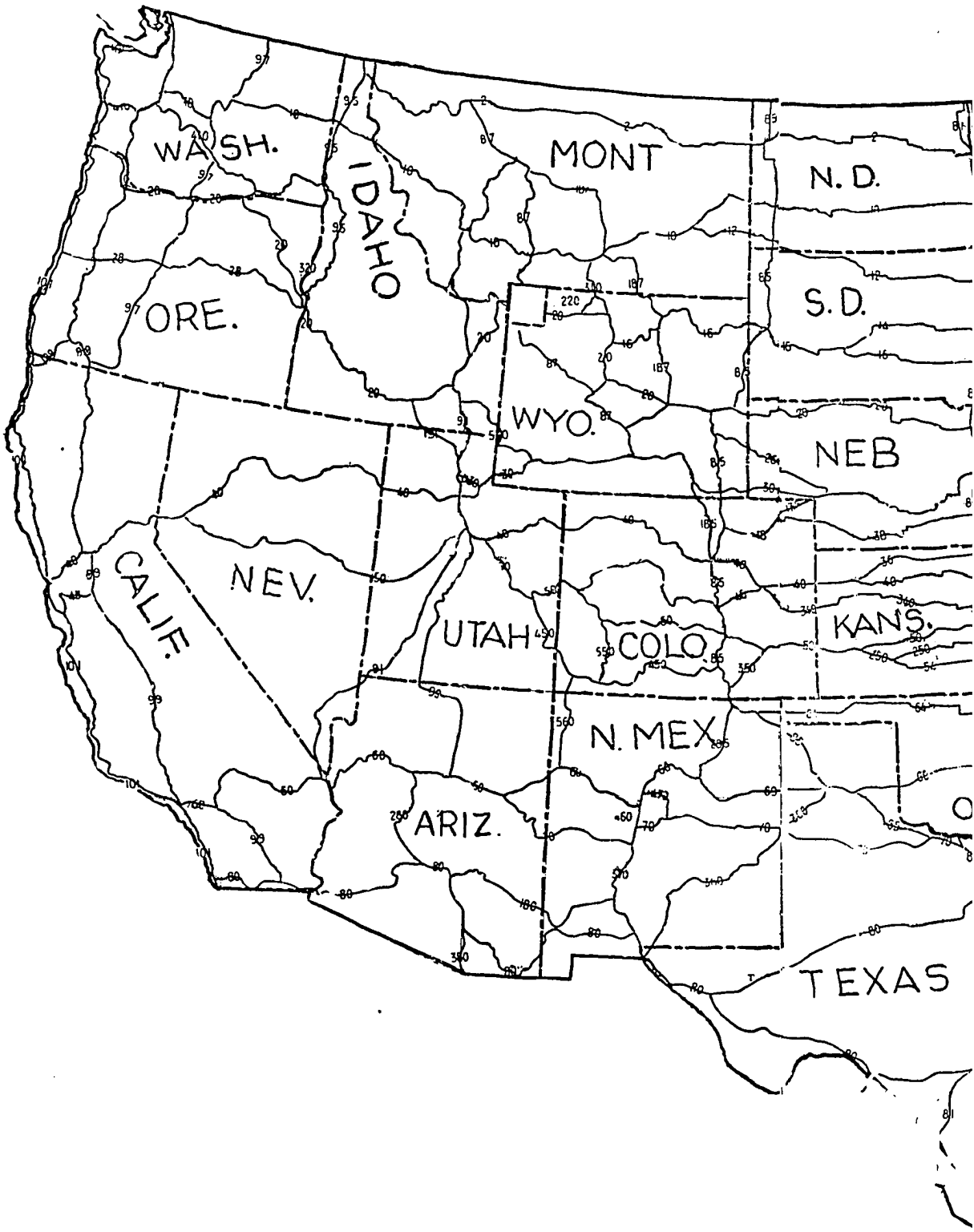
The United States has now selected a comprehensive system of national highways consisting of 75,884 miles of roads which is shown in Map 12. This is no doubt a great advancement in the circulation of traffic for the country and it also means an unestimable benefit to the people as a whole.

Many states and some larger cities have also their definite highway or street construction programs in which the better circulation of traffic is aimed.

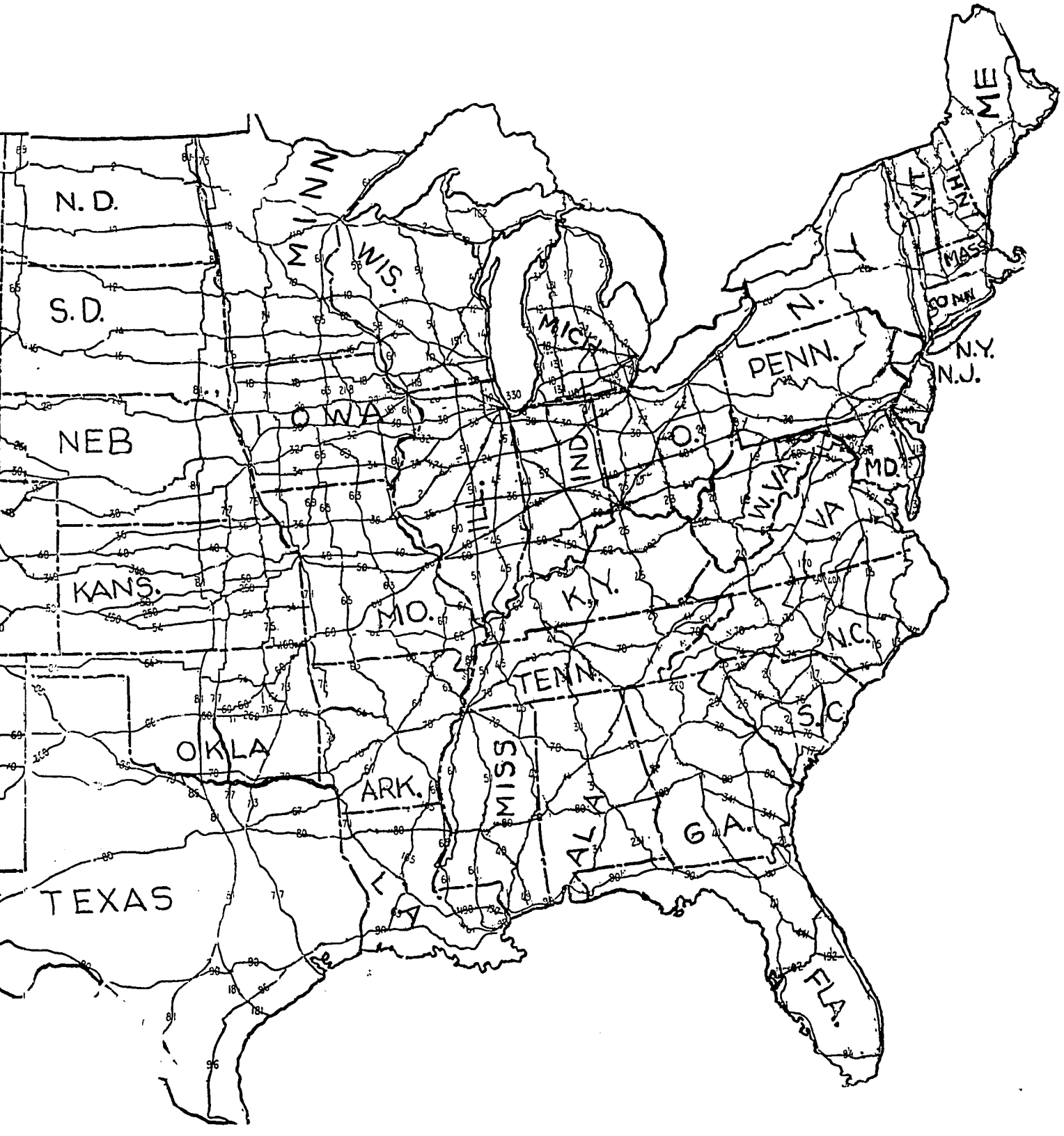
Map 12. U. S. Road System

Map 12.

MAP OF U. S. ROADS AS OFFICIALL



FICIALLY DESIGNATED BY JOINT BOARD



CALIFORNIA.--The varying importance of the roads in the California state highway system from the standpoint of state wide necessity and use has shown the need for a classification in order to establish relative importance and provide for a proper rate of progress on the construction of the various parts of the system. They have chosen the functional use of the routes, rather than present traffic, as a basis of classification as follows:

The primary system to consist of:

Class A:

1. Intercity highways.
2. Major interstate connections.

Class B:

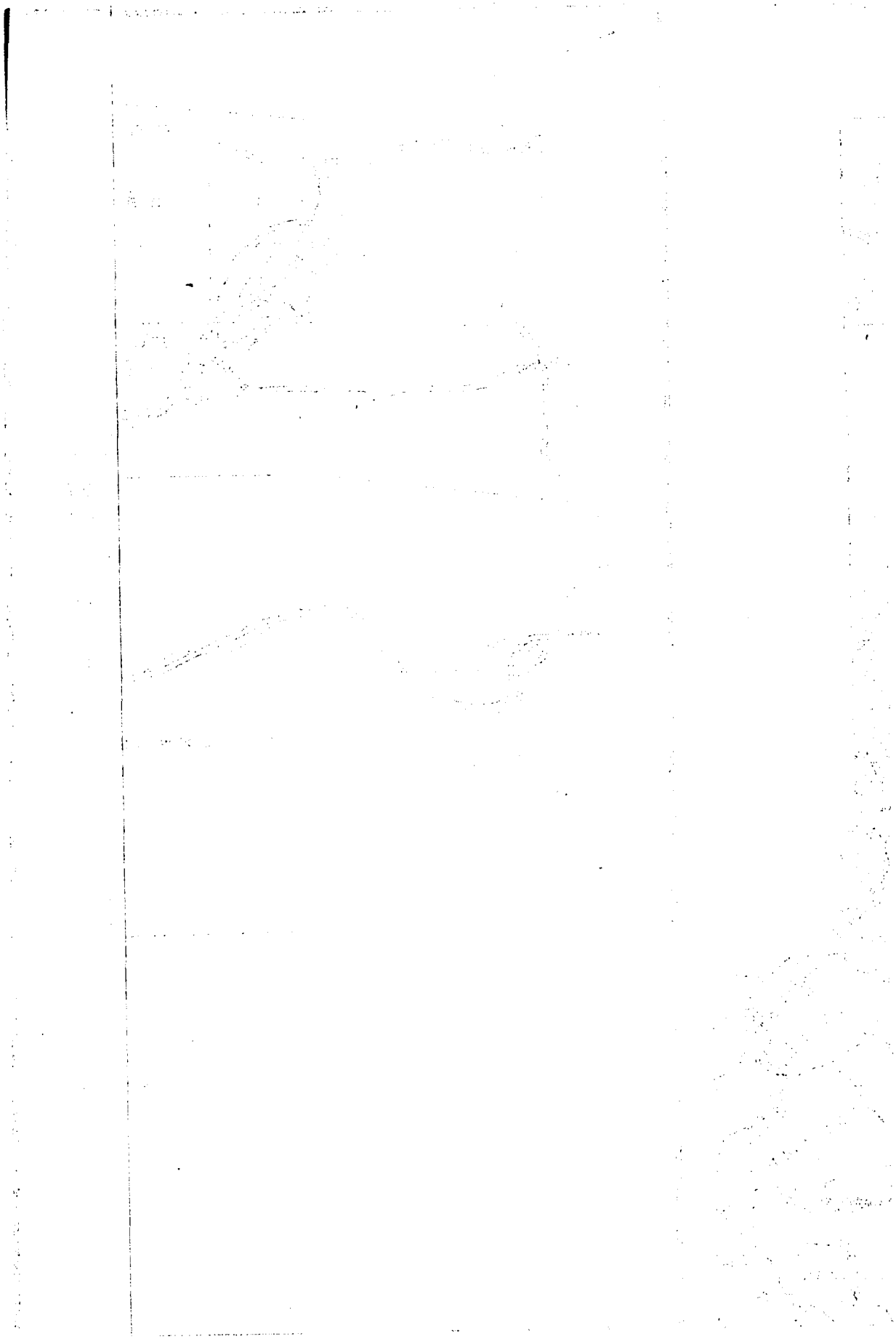
3. County seat laterals.
4. Other important lateral connections.
5. Major recreational highways.

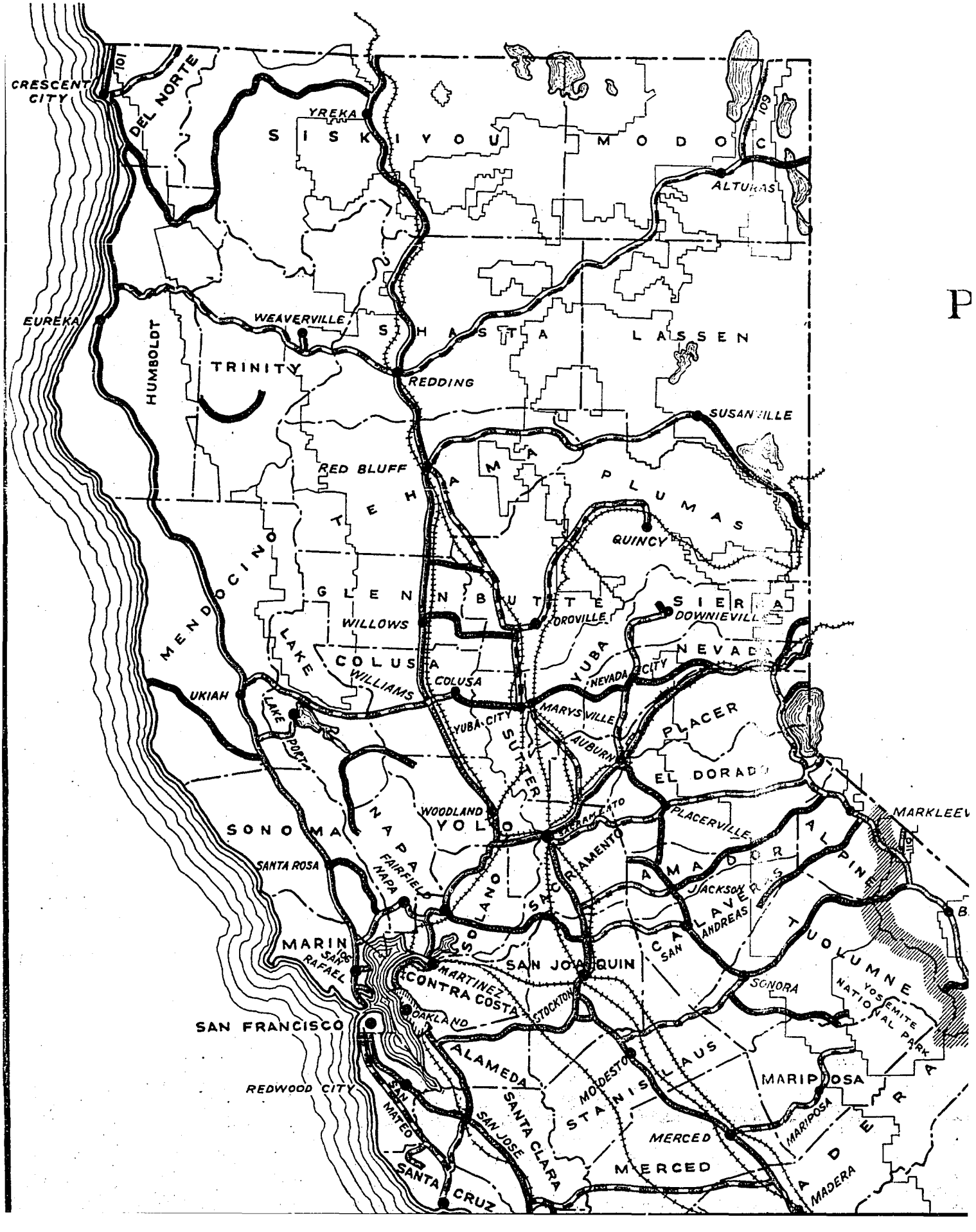
The secondary system to consist of:

6. Minor interstate connections.
7. Minor recreational highways.
8. Local development highways.

The next map shows the complete plan of the above classifications which has a traffic planning value for the future.

Map 13.- California Highway System




CRESCENT CITY
DEL NORTE
101
YREKA
SISKIYOU
MODOC
109
ALTURAS
EUREKA
HUMBOLDT
WEAVERVILLE
TRINITY
SHASTA
LASSEN
REDDING
SUSANVILLE
RED BLUFF
TEHAMA
PLUMAS
QUINCY
MENDOCINO
GLENN
BUTTE
SIERRA
WILLOWS
OROVILLE
DOWNIEVILLE
LAKE
COLUSA
YUBA
NEVADA
NEVADA CITY
UKIAH
WILLIAMS
COLUSA
MARYSVILLE
YUBA CITY
SUTTER
AUBURN
PLACER
EL DORADO
LAKEPORT
WOODLAND
YOLO
SACRAMENTO
PLACERVILLE
MARKLEEV
SONOMA
NAPA
SANTA ROSA
FAIRFIELD
NAPA
SOLANO
AMADOR
ALPINE
JACKSON
MARIN
SAN RAFAEL
MARTINEZ
CONTRA COSTA
SAN JOAQUIN
CALAVERAS
ANDREAS
TUOLUMNE
SONORA
YOSEMITE NATIONAL PARK
STOCKTON
SAN FRANCISCO
OAKLAND
ALAMEDA
MODESTO
STANISLAUS
MARIPOSA
REDWOOD CITY
SAN MATEO
SAN JOSE
SANTA CLARA
MERCED
MARIPOSA
MADERA
SANTA CRUZ

STATE OF CALIFORNIA

HIGHWAY ADVISORY COMMITTEE

MAP SHOWING

CLASSIFICATION OF PRESENT STATE HIGHWAY SYSTEM AND RECOMMENDED ADDITIONS

COMMITTEE

ARTHUR H. BREED (Chairman)

ELMER P. BROMLEY	LOUIS EVERDING
R.M. MORTON	A.E. LODER
E.E. EAST	J.B. GILL
J.H. NEWMAN	GEO. G. RADCLIFF

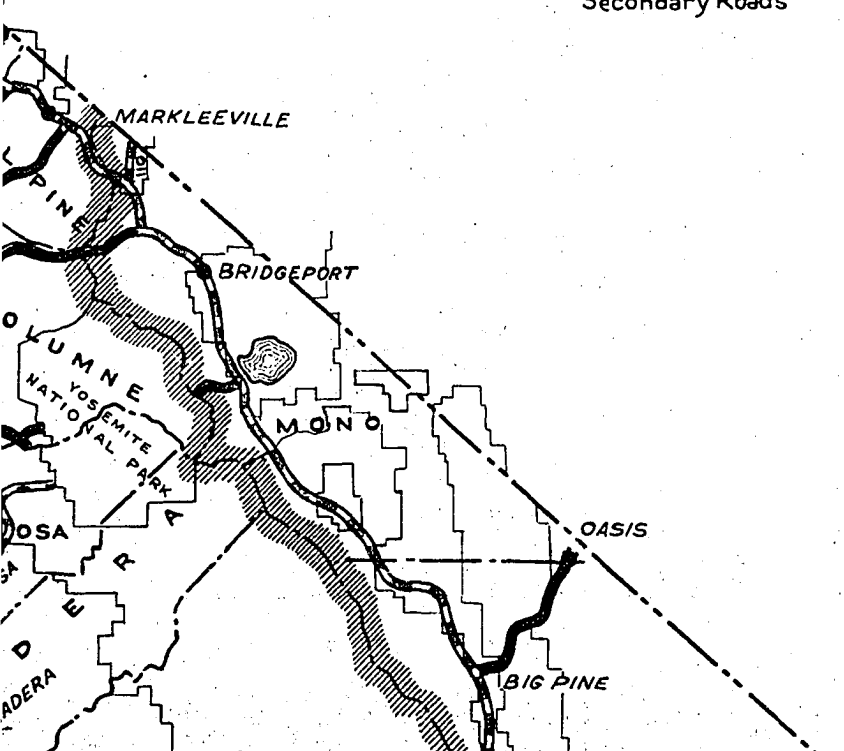
Statute Miles

5 10 20 30 40 50

LEGEND

Primary Roads — Class A, Class B

Secondary Roads — Class C



STATE OF CALIFORNIA

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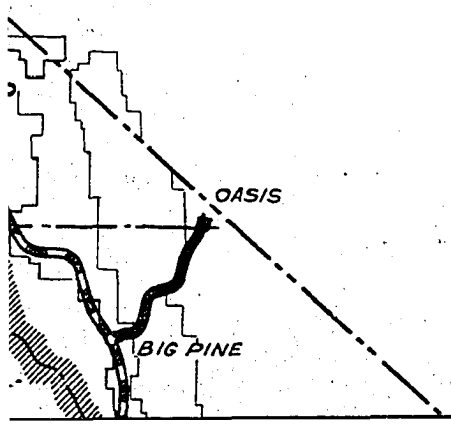
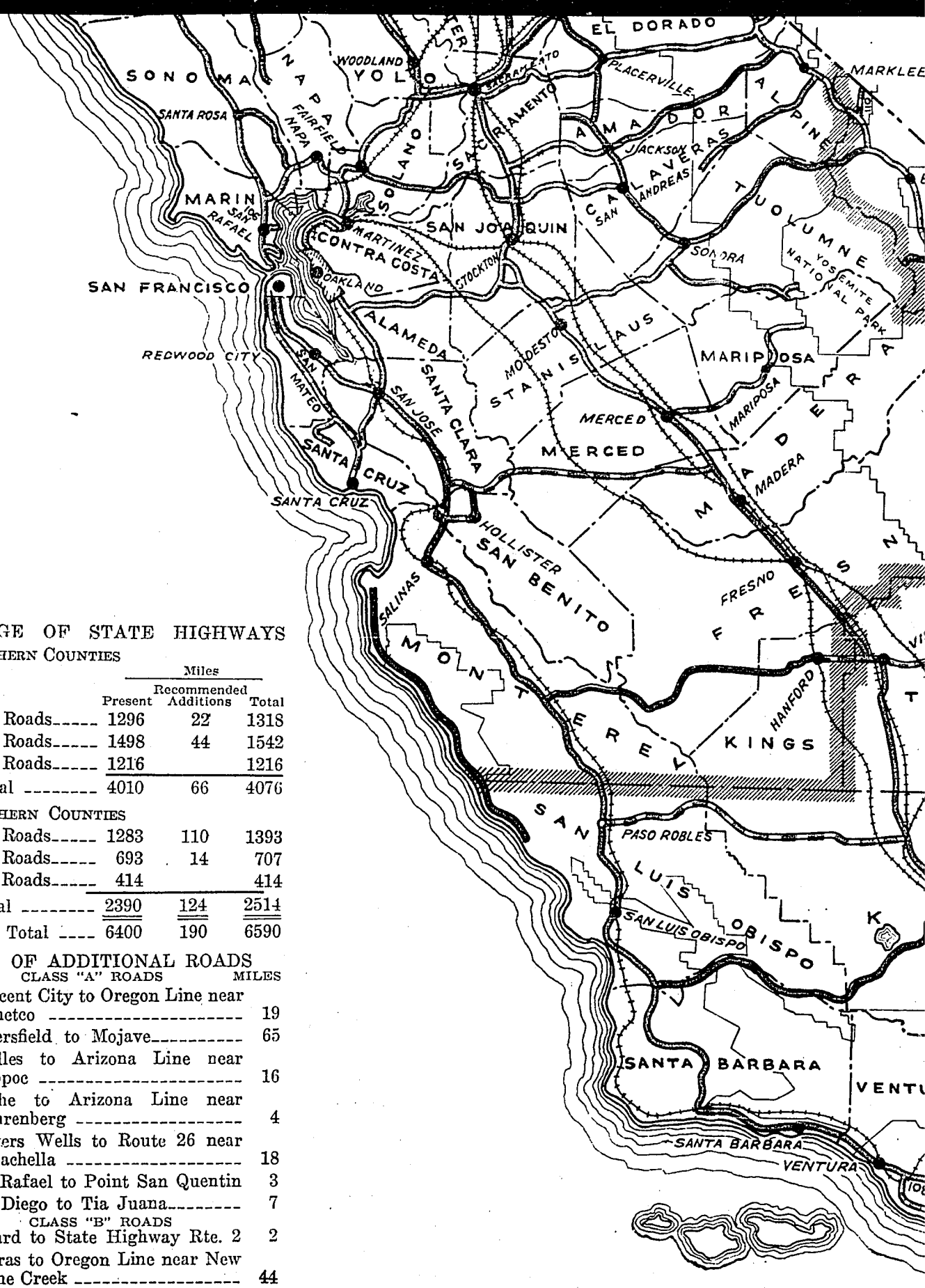




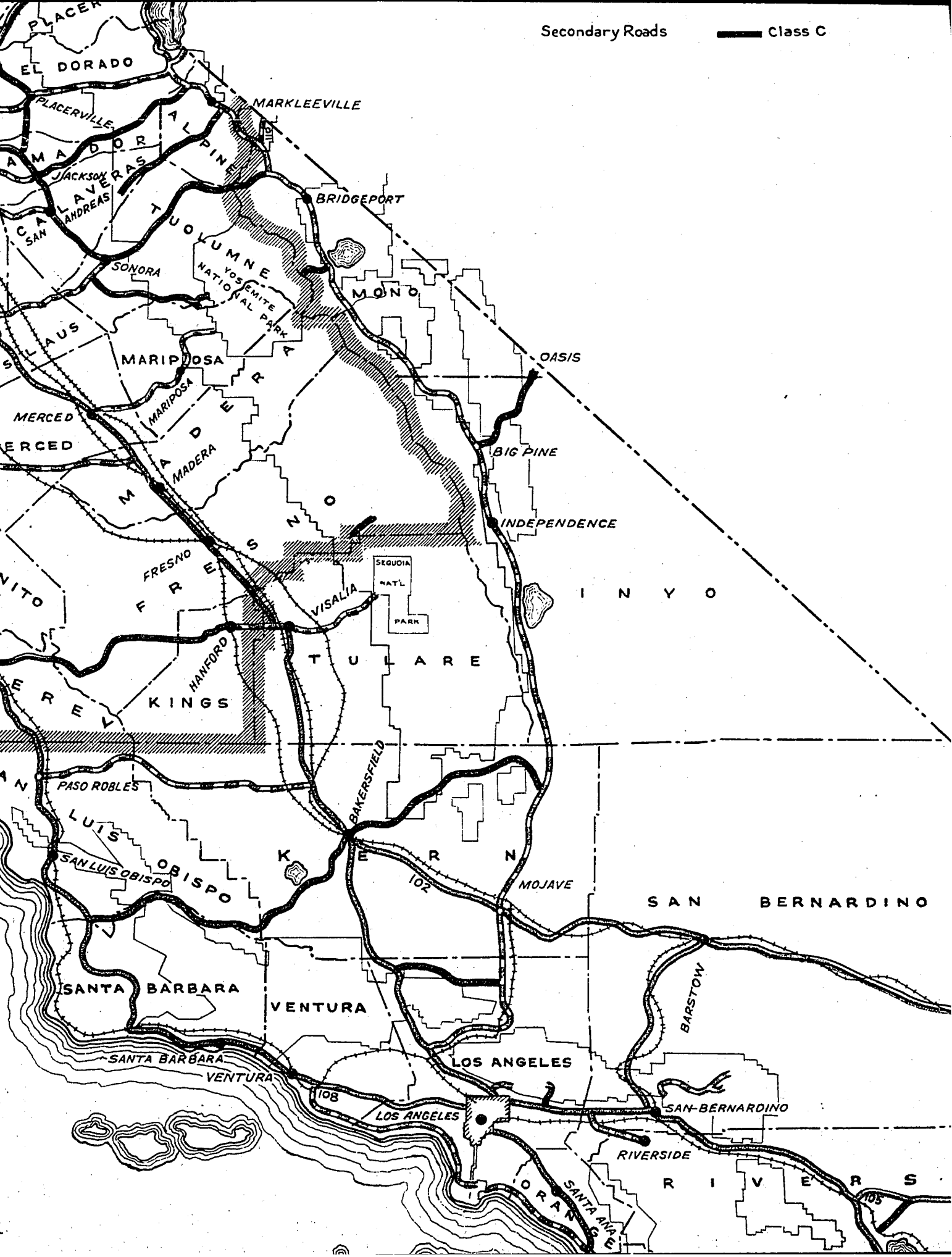
MILEAGE OF STATE HIGHWAYS

45 NORTHERN COUNTIES

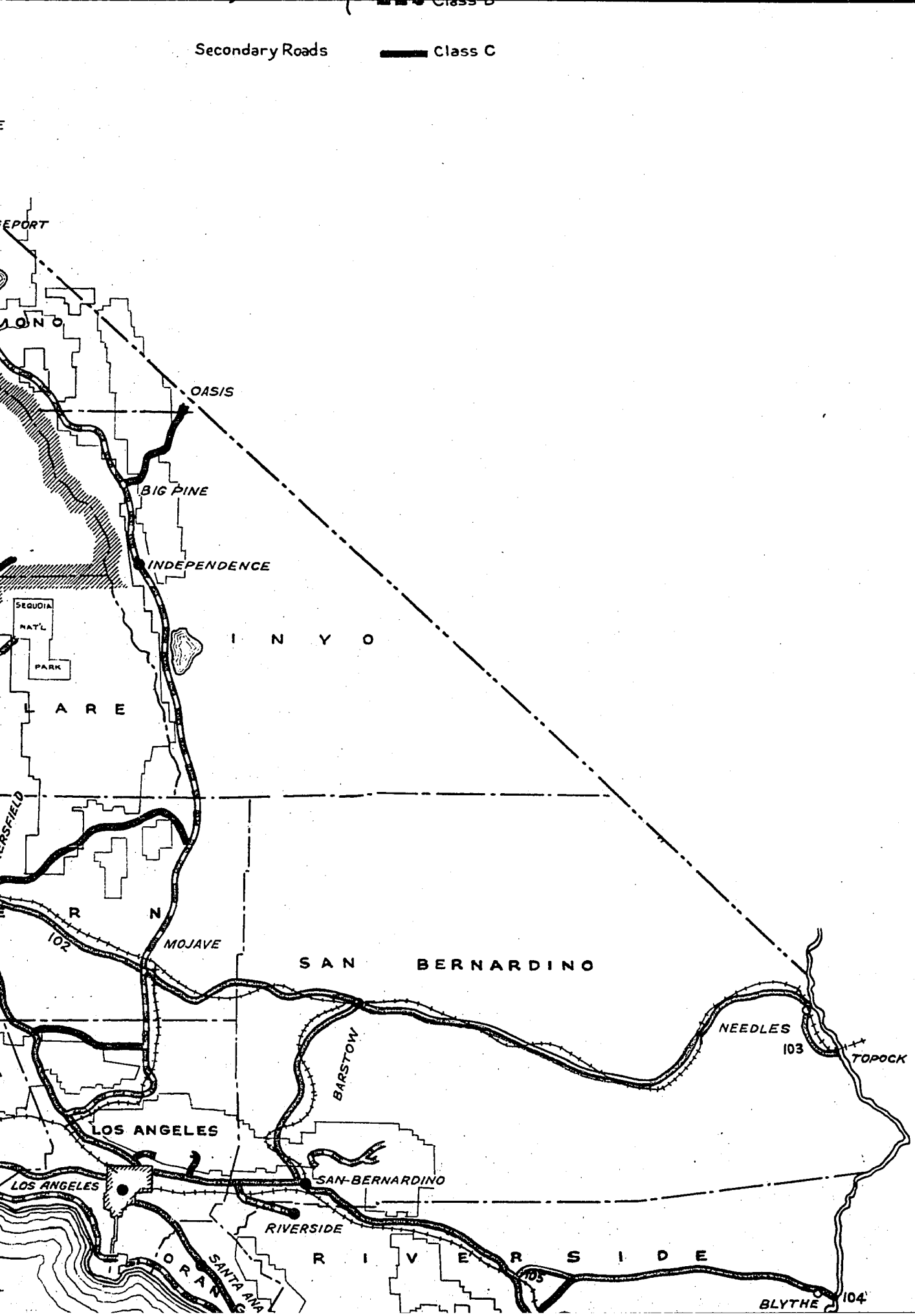
	Miles		
	Present	Recommended Additions	Total
Class A Roads	1296	22	1318
Class B Roads	1498	44	1542
Class C Roads	1216		1216
Subtotal	4010	66	4076
13 SOUTHERN COUNTIES			
Class A Roads	1283	110	1393
Class B Roads	693	14	707
Class C Roads	414		414
Subtotal	2390	124	2514
Grand Total	6400	190	6590

LIST OF ADDITIONAL ROADS

NO.	CLASS "A" ROADS	MILES
101	Crescent City to Oregon Line near Chetco	19
102	Bakersfield to Mojave	65
103	Needles to Arizona Line near Topoc	16
104	Blythe to Arizona Line near Ehrenberg	4
105	Shavers Wells to Route 26 near Coachella	18
106	San Rafael to Point San Quentin	3
107	San Diego to Tia Juana	7
	CLASS "B" ROADS	
108	Oxnard to State Highway Rte. 2	2
109	Alturas to Oregon Line near New Pine Creek	44
110	Route 23 near Coleville to Nevada State Line	12


Secondary Roads
Class C
PLACER
EL DORADO
PLACERVILLE
MARKLEEVILLE
AMADOR
ALPINE
JACKSON
CALAVERAS
SAN ANDREAS
BRIDGEPORT
TUOLUMNE
SONORA
YOSEMITE NATIONAL PARK
MONO
STANISLAUS
MARIPOSA
SIERRA
OASIS
MERCED
MARIPOSA
MADERA
BIG PINE
INDEPENDENCE
FRESNO
SEQUOIA NAT'L PARK
VISALIA
INYO
TULARE
HANFORD
KINGS
PASO ROBLES
BAKERSFIELD
SAN LUIS OBISPO
KERN
102
MOJAVE
SAN BERNARDINO
SANTA BARBARA
VENTURA
BARSTOW
SANTA BARBARA
VENTURA
LOS ANGELES
108
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
SANTA ANA
RIVERSIDE
105

Secondary Roads — Class C



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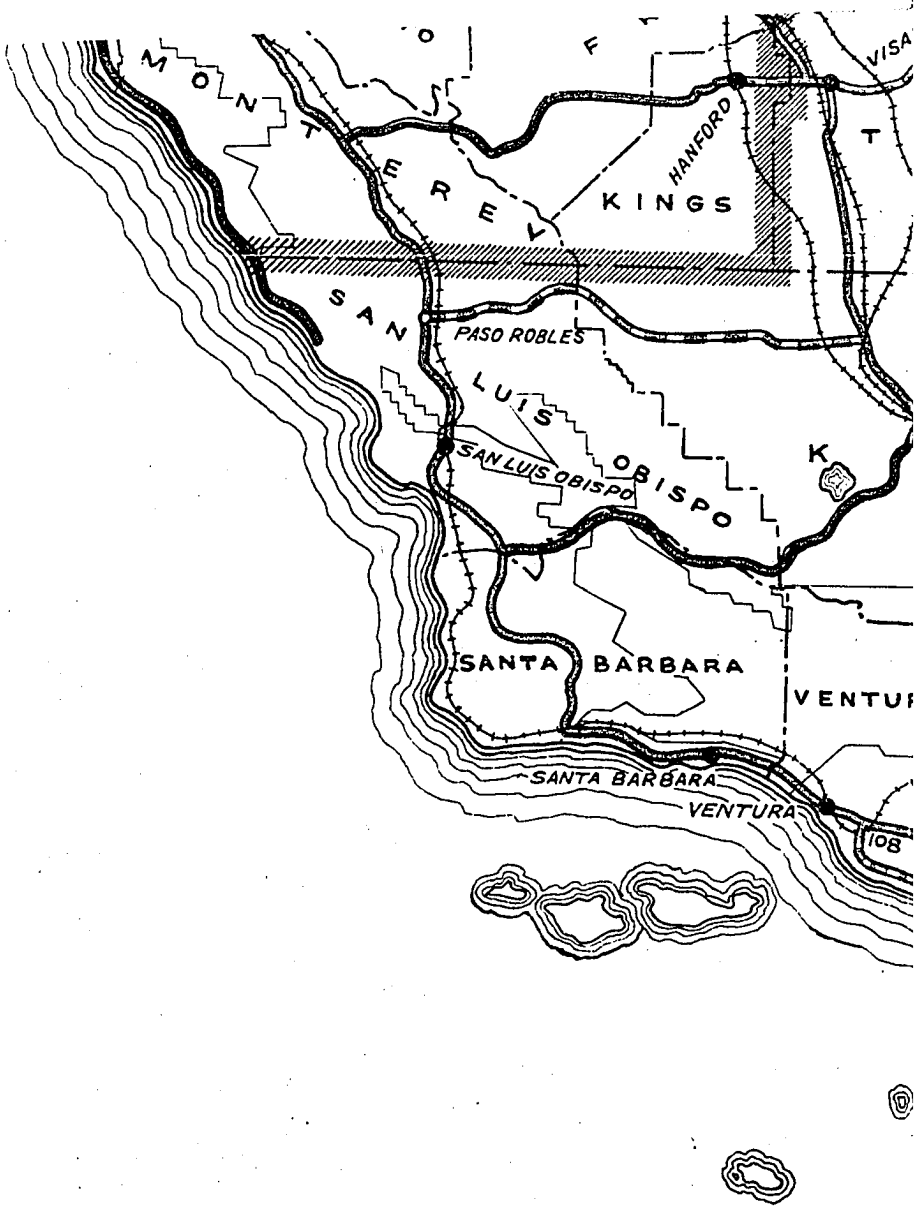
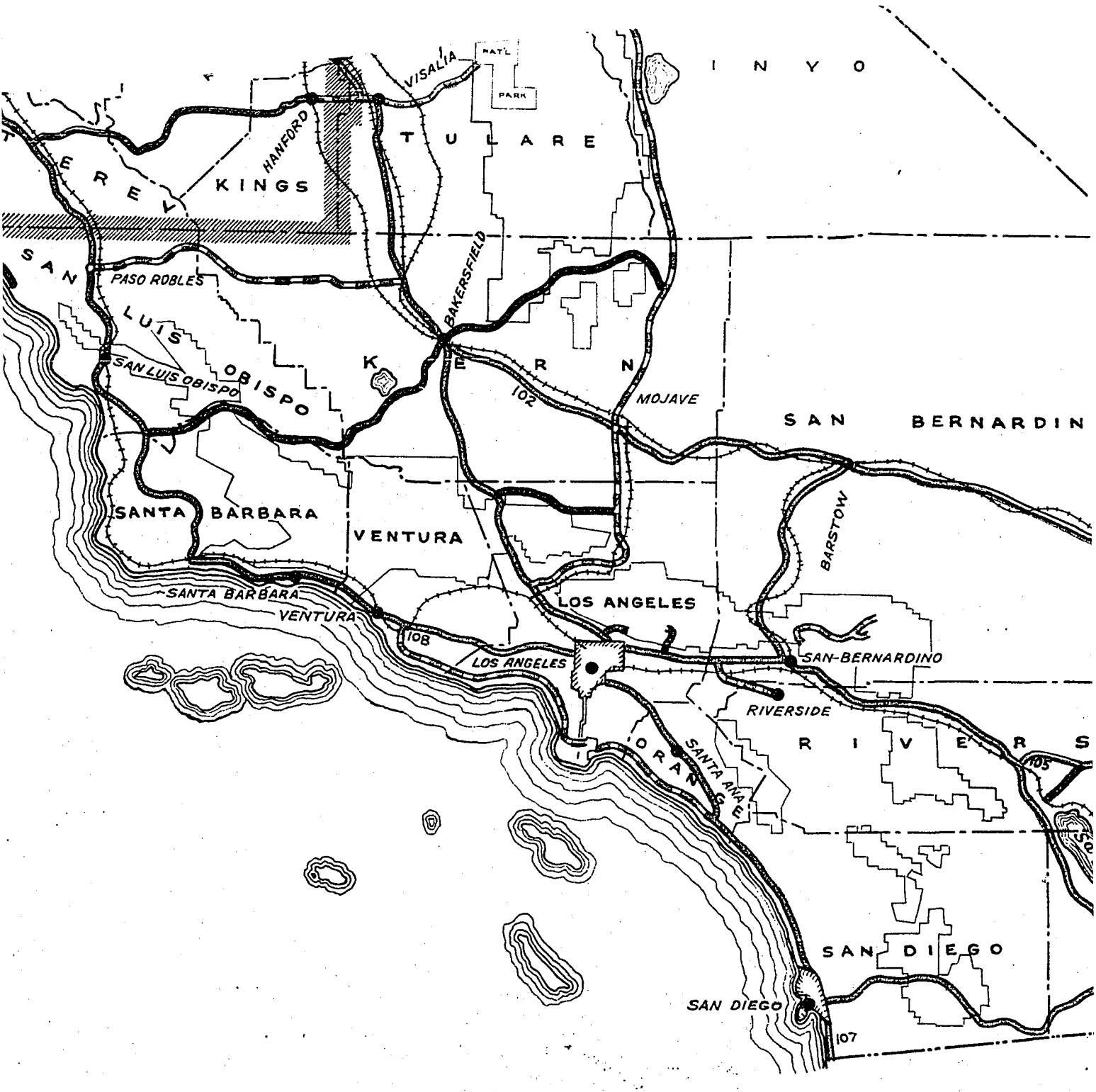



INYO
TULARE
KINGS
HANFORD
VISALIA
PAT'L
PARK
BAKERSFIELD
SAN LUIS OBISPO
PASO ROBLES
KERN
MOJAVE
102
SAN BERNARDIN
SANTA BARBARA
VENTURA
SANTA BARBARA
VENTURA
LOS ANGELES
108
LOS ANGELES
BARSTOW
SAN-BERNARDINO
RIVERSIDE
ORANGE
SANTA ANA
105
SAN DIEGO
SAN DIEGO
107


INYO
ULARE
PARK
BAKERSFIELD
102
MOJAVE
SAN BERNARDINO
NEEDLES
103
TOPOCK
BARSTOW
LOS ANGELES
LOS ANGELES
SAN-BERNARDINO
RIVERSIDE
RIVERSIDE
105
ORANGE
SANTA ANA
BLYTHE
104
Salton Sea
SAN DIEGO
IMPERIAL
EL CENTRO
SAN DIEGO
YUMA
107

CONNECTICUT.--From the observation made in Connecticut in 1922, it was found that many trucks were loaded with over 25,000 pounds. Of the number of over-loads exceeding 25,000 pounds 87.8 per cent were over-loads per capacity; 88.7 per cent were by trucking companies. Thirty-nine out of forty-one cases were loaded from 846 to 1,560 pounds per inch of tire width on the rear axle. Only 4.2% of the trucks observed were five-ton capacity.

The least width of truck body observed was five feet; the greatest width was nine feet six inches.

The recommendations were made based on overloading analysis as follows:

1. Classification of highways.
2. Seasonal restriction of loads.
3. Prohibition of overloads per capacity, and restriction of tire to 800 pounds per inch width.
4. Maximum body width of 7 feet six inches.
5. Maximum axle loads to be determined for each make and class of trucks and placed in conspicuous place on the vehicle.

MAINE.--A definite betterment of the method of planning future highway improvements is represented by Map 15 and Table 34 which show a forecast of the average daily traffic on the principal primary and secondary routes during the period July to November 1930

Map 14.

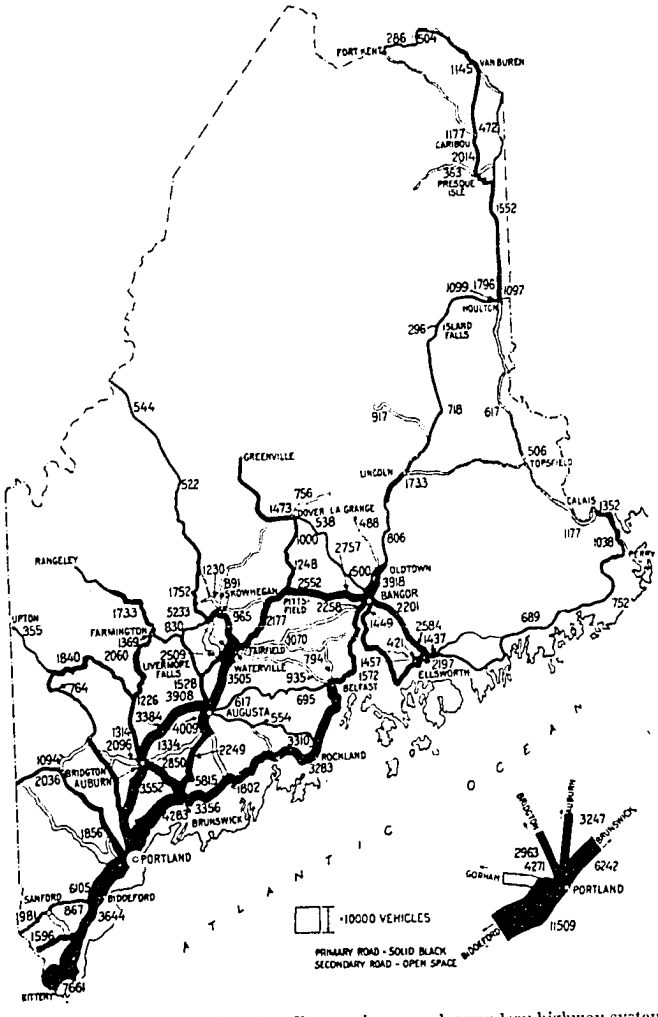


Fig. 7.—Anticipated density of traffic on primary and secondary highway systems of Maine, July to November, 1930

Table 34. TOTAL DAILY TRAFFIC AT 26 STATIONS

Year	Total Daily Traffic
1916	7,316
1919	14,468
1923	39,569
1930	60,527*

* Estimated

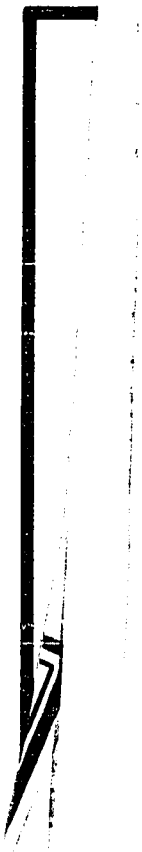
The forecast of the expected traffic is of particular importance at the present stage of highway development in Maine. The state has reached the second critical stage in its highway improvement program. The first stage may be called the gravel-road stage. The second stage of a highway improvement program may properly be called the reconstruction and high-type improvement stage.

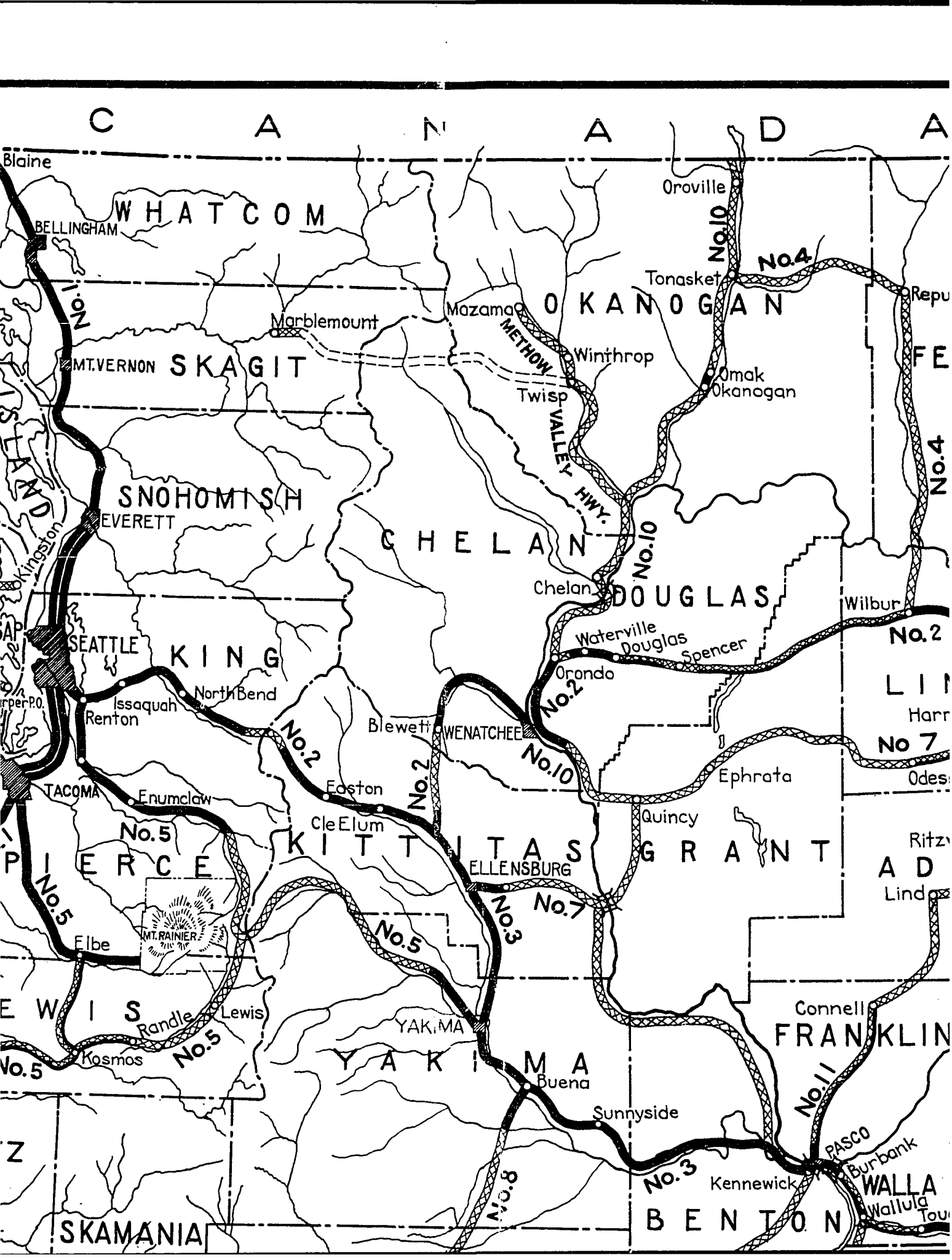
Even estimating 1,000 vehicles per day instead of 500 as the capacity of a gravel road, reference to the 1930 forecase map will indicate that a considerable mileage of gravel roads on the Maine primary system should be reconstructed with more durable surfaces within the next six years.

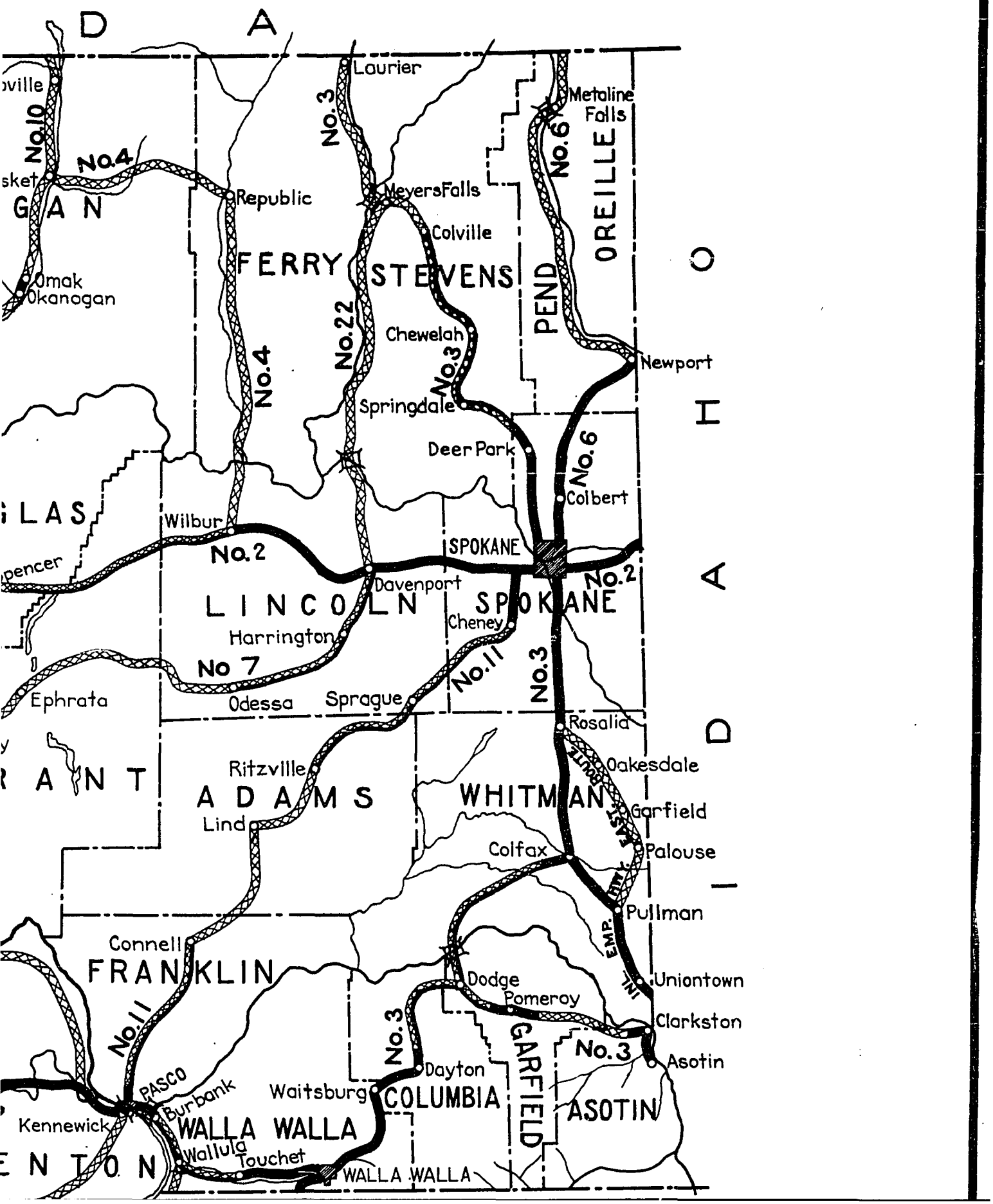
On the basis of a maximum capacity of 1,000 vehicles per day for gravel-surfaced highways, it was suggested that the construction of high-type pavements on the heavy traffic routes and the heavy traffic routes included in the suggested improvement program, are divided into three groups based on density of traffic, the type of traffic on each highway, and the urgency of the need for immediate improvement for the period 1925 to 1930.

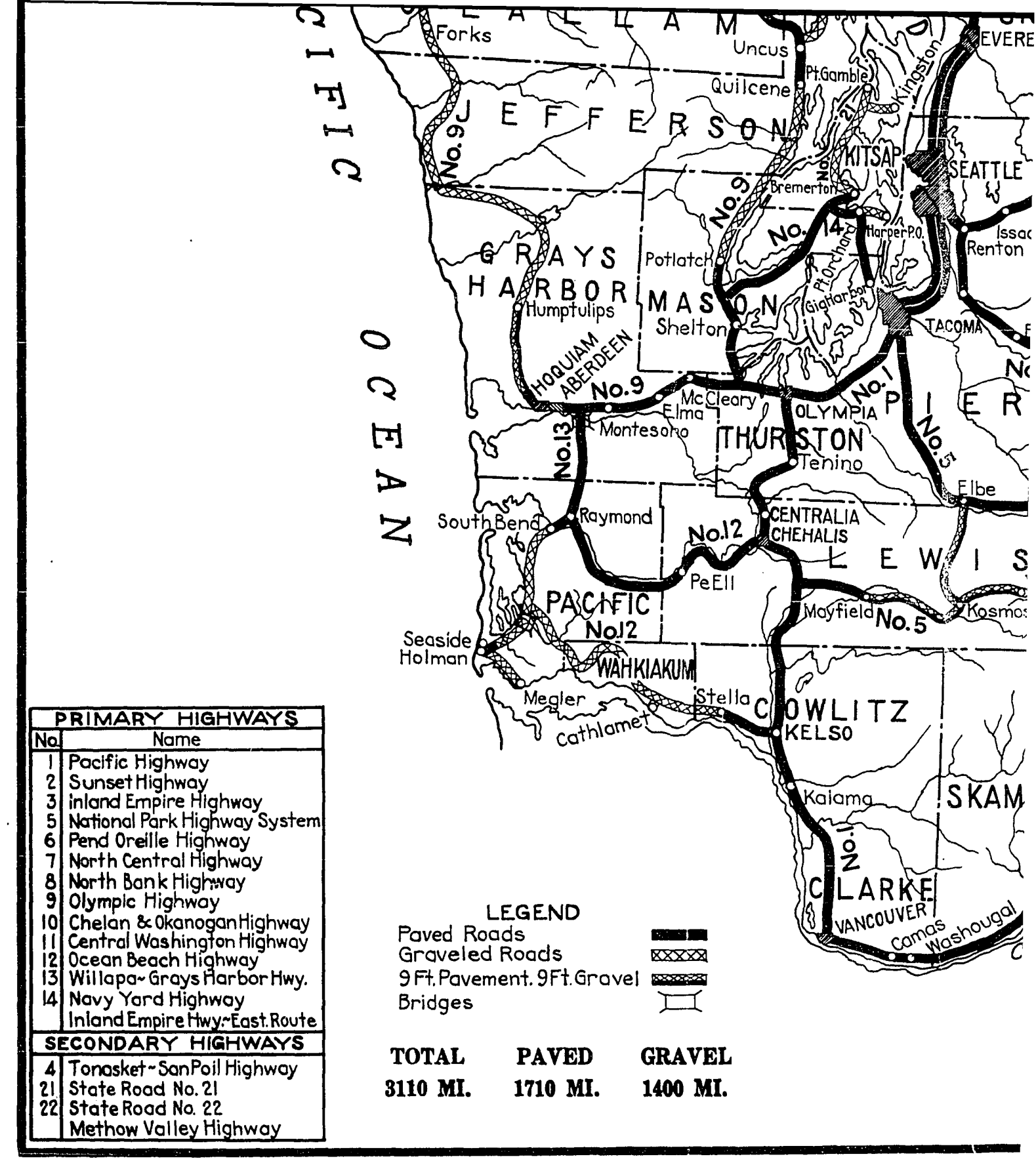
WASHINGTON.--The State Highway Committee has approved a tentative program to be completed during the next ten years up to 1936, based upon the present revenue for state highway purpose. A map showing the system to be completed by 1936 is shown in the next page--Map 16.

Map 15: Highway Program of Washington



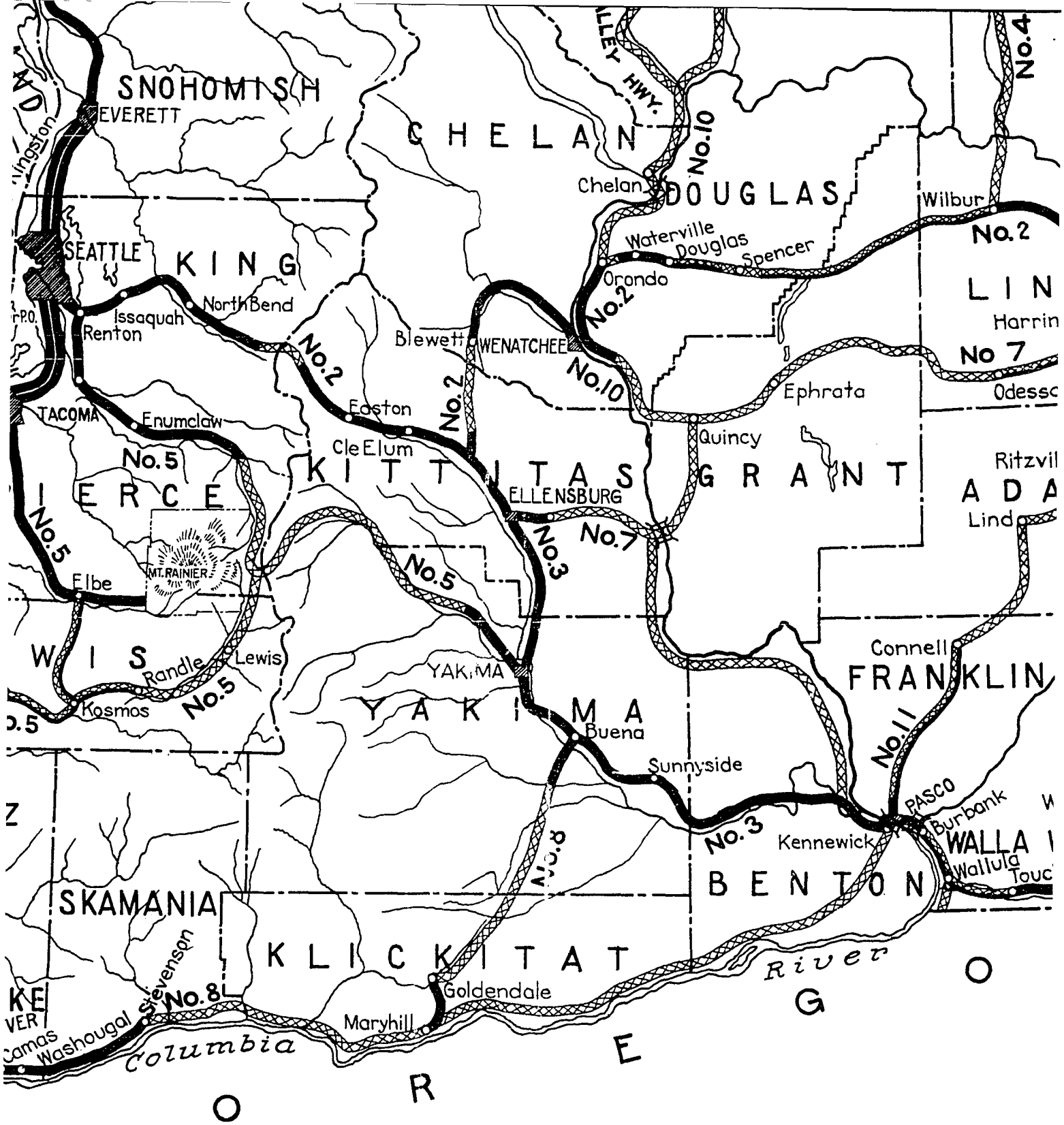

C A N A D A
Blaine
WHATCOM
BELLINGHAM
I-5
MT. VERNON
SKAGIT
Marblemount
Mazama
METHOW
Winthrop
Twisp
VALLEY HWY.
OKANOGAN
Oroville
No.10
No.4
Tonasket
Omak
Okanogan
SNOHOMISH
EVERETT
Kingston
CHELAN
No.10
Chelan
DOUGLAS
Waterville
Douglas
Spencer
Orondo
Wilbur
No.2
SEATTLE
KING
North Bend
Issaquah
Renton
Blewett
WENATCHEE
No.2
No.10
Ephrata
Quincy
GRANT
TACOMA
Enumclaw
Easton
No.2
Cle Elum
No.5
KITTITAS
ELLENSBURG
No.7
No.3
PIERCE
MT. RAINIER
Elbe
No.5
Randle
Lewis
Kosmos
LEWIS
YAKIMA
Buena
Sunnyside
Connell
FRANKLIN
No.11
PASCO
Burbank
Kennewick
No.3
No.8
WALLA
Wallula
BENTON
SKAMANIA


D A
H O
A D
Laurier
Metaline Falls
No.3
No.6
No.10
No.4
Republic
MeyersFalls
Colville
FERRY
STEVENS
PEND OREILLE
Omak
Okanogan
No.4
No.22
Chewelah
No.3
Newport
Springdale
Deer Park
No.6
Colbert
Wilbur
SPOKANE
No.2
No.2
Davenport
LINCOLN
SPOKANE
Cheney
Harrington
No 7
No.11
No.3
Ephrata
Odessa
Sprague
Rosalia
Ritzville
Oakesdale
ADAMS
WHITMAN
Garfield
Lind
Colfax
Palouse
Pullman
Connell
FRANKLIN
Dodge
Pomeroy
Uniontown
Clarkston
No.11
No.3
No.3
Asotin
Dayton
PASCO
Burbank
Waitsburg
COLUMBIA
GARFIELD
ASOTIN
Kennewick
WALLA WALLA
Wallula
Touchet
WALLA WALLA



PRIMARY HIGHWAYS	
No.	Name
1	Pacific Highway
2	Sunset Highway
3	Inland Empire Highway
5	National Park Highway System
6	Pend Oreille Highway
7	North Central Highway
8	North Bank Highway
9	Olympic Highway
10	Chelan & Okanogan Highway
11	Central Washington Highway
12	Ocean Beach Highway
13	Willapa~Grays Harbor Hwy.
14	Navy Yard Highway
	Inland Empire Hwy.~East. Route
SECONDARY HIGHWAYS	
4	Tonasket~San Poil Highway
21	State Road No. 21
22	State Road No. 22
	Methow Valley Highway

TOTAL	PAVED	GRAVEL
3110 MI.	1710 MI.	1400 MI.



Approved by State Highway Committee April 1, 1924

STATE OF WASHINGTON

SHOWING

PROGRAM OF STATE HIGHWAY DEPARTMENT
STATE AND FEDERAL AID SYSTEM
TO BE COMPLETED BY
1936

mittee April 1, 1924

SCALE 0 10 20 30 40 50 MILES

J.W.H.

COOK COUNTY, ILLINOIS.--The analysis of traffic upon the present highway system and consideration of the area and the population of the area to be served has developed certain fundamental principles after the traffic survey of 1924 which must be incorporated in the plan of highway improvement. These principles may be summarized as follows:

1. The plan must be a regional plan.

2. It must provide for permanent improvements.

3. It must efficiently serve present and expected future traffic. To accomplish this, it is essential that all important sources of highway traffic be connected by direct through routes, involving:

A. The construction of arterial highways between Chicago and principal centers of population of the county.

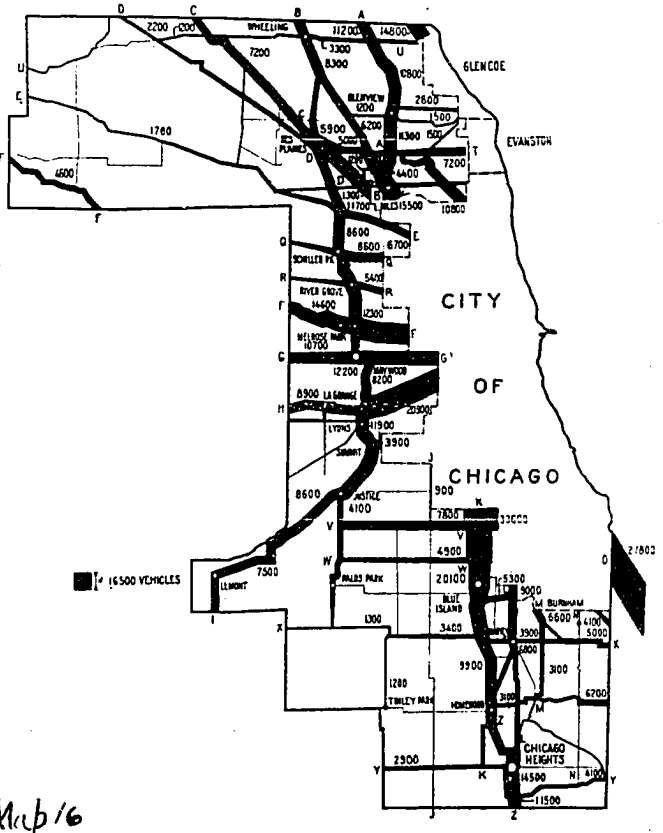
B. The connection of the highways in the area surrounding the city with through city streets, which will permit traffic to move rapidly and directly to its destination.

C. The construction of the routes connecting important cities and villages in the county exclusive of the city of Chicago. These routes will also serve as "by-pass" routes for traffic desiring to avoid the city and as a traffic-sorting route in the present congested areas.

D. The elimination of obstructions to the free and rapid movement of traffic. This involves the elimination of congestion points such as rail and highway intersections at grade, traffic "bottle-neck", and sections of inadequate width.

4. The plan must provide for the acquisition of right-of-way required for future routes.

Map 16



Map 16

FIG. 1.—Forecast of average daily density of vehicular traffic on Cook County highways, 1930

5. The present construction of the sections of highways must as far as possible be utilized as the basis for the propcsed plan.

Map 17 is a traffic map showing the forecast of average daily density of vehicular traffic on Cook County highways, 1930, from which the future program is laid.

DES MOINES.--The traffic problem of Des Moines drew some interesting solutions from many engineers of the country and the suggestions are as follows:

CONTINUOUS MOVEMENT

1. Ernest P. Goodrich, New York Consulting engineer, offers the idea of cintinuous movement on one-way streets, north and south streets as well as east and west. While movement on the main streets is uninterrupted, that on the cross streets is made to alternate after every block, so that a machine crossing east and west would have to wind in and out of traffic, up one street and back another.

2. Goodrich has another idea of the platoon or progressive system, by which autos may move continuously along any street, but as part of a group and at a definite speed. These groups, or platoons, cross at regular intervals, keeping traffic moving all the time under control of a definite traffic control system.

3. Another idea, presented by Goodrich and other authorities, is that of speed highways, elevated from cross streets, to which ramps lead and on which autos are permitted to travel at a

maximum speed.

WANT "STEP SYSTEM"

4. Since congestion is greatest at quitting time for offices and factories, New York authorities are considering the idea of a step system by which large buildings or firms alternate in dismissing their employes.

5. Clarence R. Snethen of the Los Angeles traffic commission suggested smaller cars of improved design, permitting two cars to operate where one does now, as a solution. Cars must fit present streets, he says, instead of trying to widen streets for the present large cars.

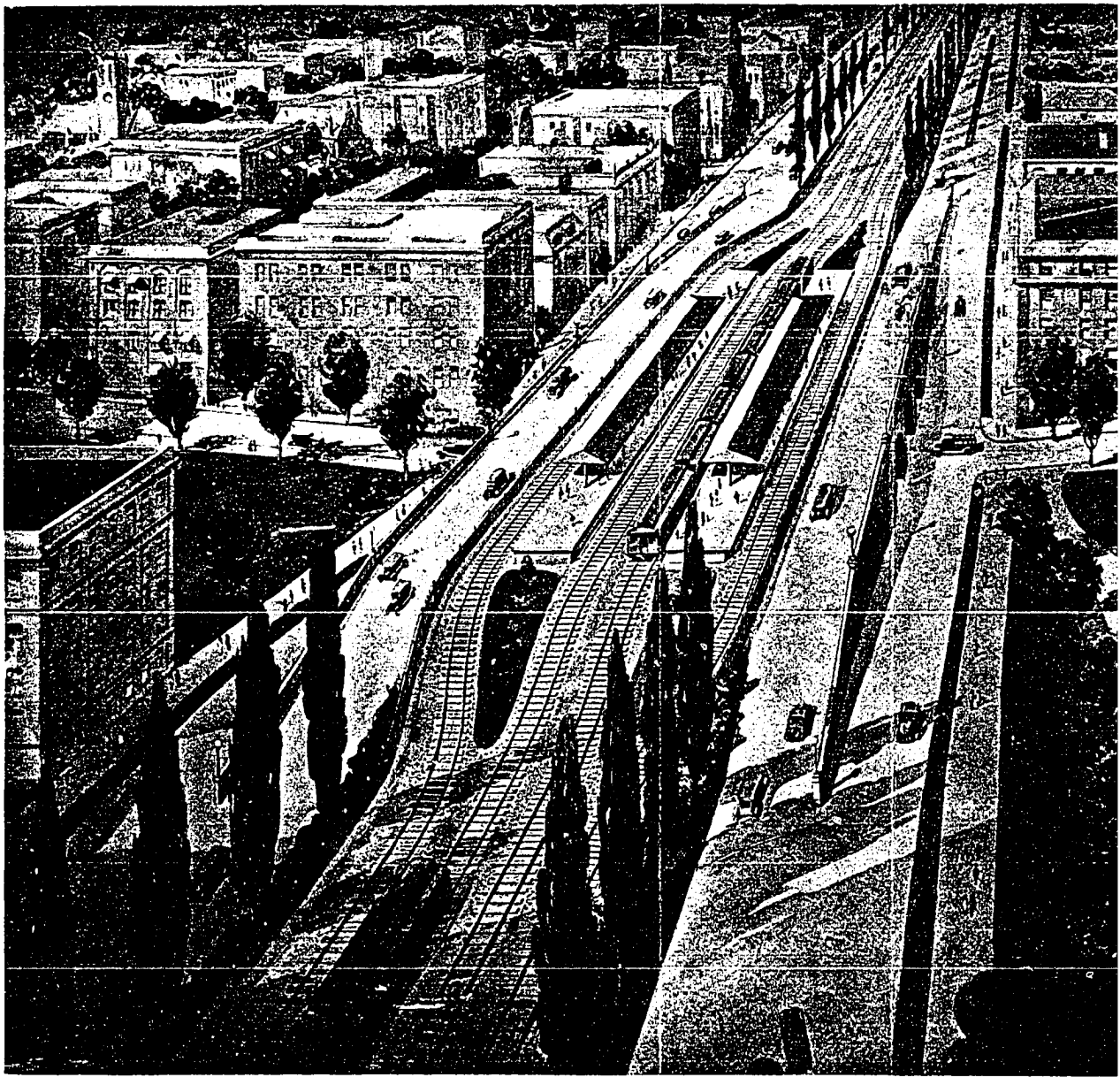
6. Hexagonal blocks have been suggested by a Canadian engineer, with a system by which traffic can be speeded up with greater safety on the same level.

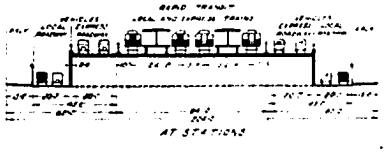
All of these ideas, except the last two, are already on trial or at least are being seriously planned.

SUPER-HIGHWAY OF DETROIT.--In the plans for Detroit's future transportation requirements the automobile, representing the individual's rapid transit on rubber, and electric trains, giving rapid mass transportation on rail, have been considered together.

The automobile is recognized as the pioneer transportation agency in developing remote sections, with busses and street cars following, to carry the major load. Ultimately any section, or all sections, may readh a condition of population density requiring the fullest development of trains operated rapid transit, with its natural complement of street car and bus line feeders. To

Fig. 50



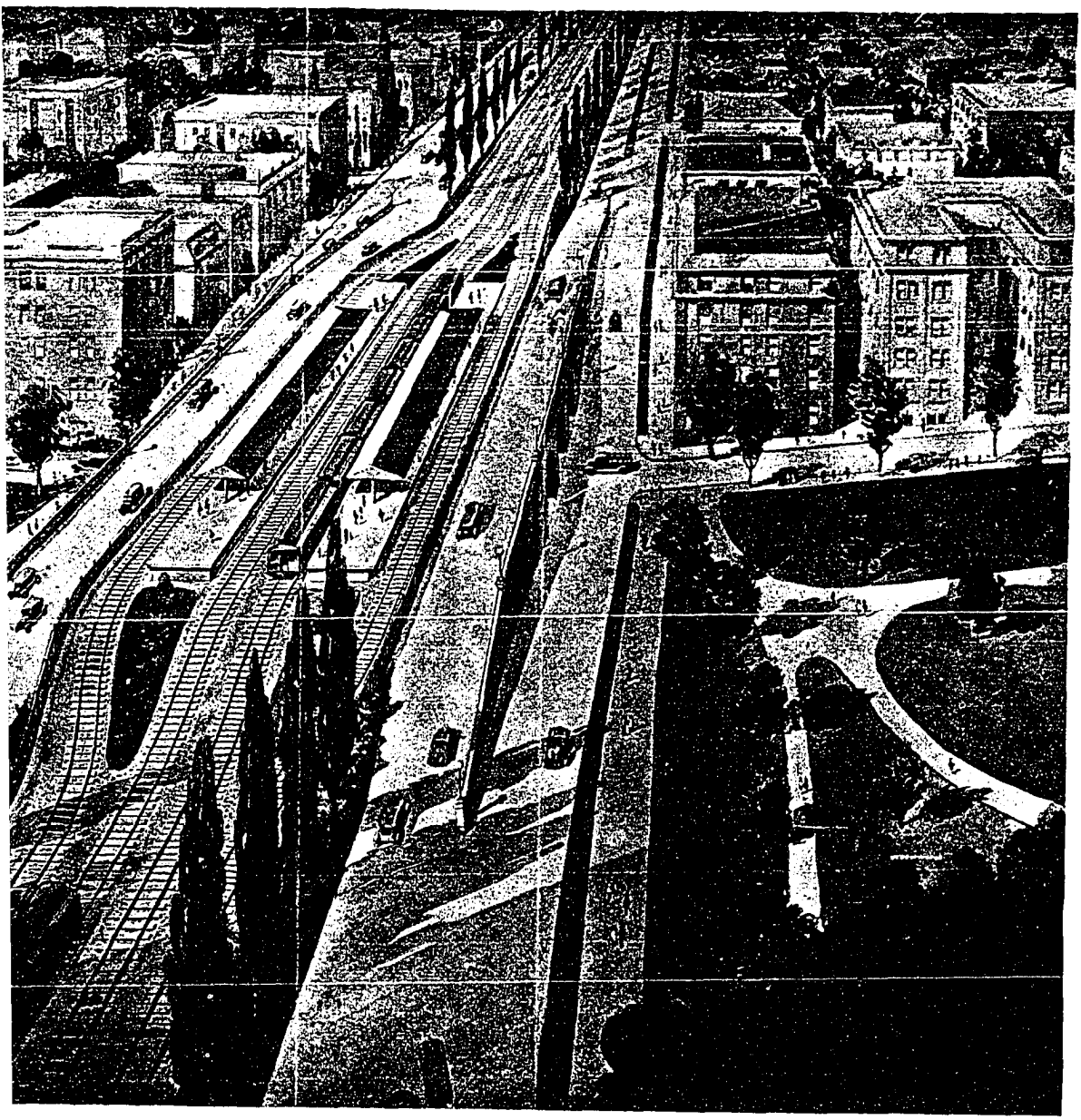


PERSPECTIVE VIEW OF HIGHWAY 204 FT WIDE SHOWING PROPOSED ARRANGEMENT AT INTERSECTING THOROUGHFARES AND A FOUR TRACK RAPID TRANSIT SURFACE RAILWAY

RAPID TRANSIT COMMISSION DETROIT AUGUST 1923

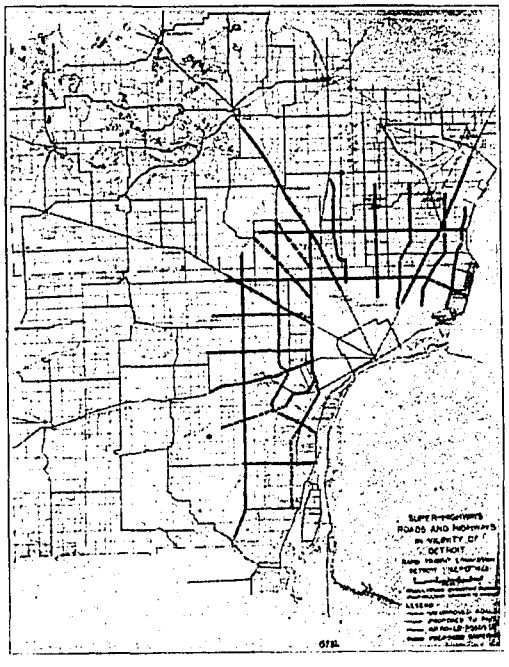
DANIEL L. TURNER CONSULTING ENGINEER

JOHN P. HALLIHAN ENGINEER IN CHARGE



PERSPECTIVE VIEW OF HIGHWAY 204 FT. WIDE SHOWING
ROPOSED ARRANGEMENT AT INTERSECTING THOROUGHFARES AND A
FOUR TRACK RAPID TRANSIT SURFACE RAILWAY

RAPID TRANSIT COMMISSION — DETROIT AUGUST 1923
DANIEL L. TURNER — CONSULTING ENGINEER
JOHN R. HALLIMAN — ENGINEER IN CHARGE



Super-Highways and Roads in Vicinity of Detroit

Map. 17

provide for this ultimate development necessitates the making of a comprehensive plan of routes extending to the limit of the Metropolitan Area and so designed as to serve all the sections equally.

The standard width of the super-highway is 204 feet. When the four tracks are brought up onto the surface, at the edge of the present built-up area, and sewers, etc, are still left below ground, only 84 feet is required for the rapid transit facilities. Placing 60 feet upon each side for street space makes the 204 feet, which has been adopted as the standard super-highway width.

The basis of the suburban portion of the master plan has been to grid the area extending from the 6 to 15 mile circles with radial, east and west and north and south super-highway routes approximately 3 miles apart. Beyond this outer limit the state is extending the radials and trunk line roads to the next town or city. In this manner several cities 25 to 30 miles away will have continuous 204 feet double track super-highways, making direct connection between those cities and the so called Detroit system, which itself comprises 217 miles.

The main objects of the 204 foot roadways are as follows:

1. To permit a variety of treatment in pavements, tree planting and the like, depending upon the requirements of the territory traversed.

2. To give increased capacity with increased safety and speed for motor vehicle transportation.

3. By proper spacing of motor vehicle roadways, the center may be left free for future train-operated rapid transit at a saving of almost one-half of the cost per mile of an underground system.

4. When surface rapid transit is provided with grade separation at the station points at half-mile intervals, the express motor vehicle roadway can be carried about the same intersecting streets and provide a facility not now available to motorist anywhere.

5. The wide right-of-way will have capacity to handle the circulation and transportation of the occupants of the tallest structures. Being wide, the super-highway will not only attract these structures, but will provide them maximum light and air and a splendid setting.

6. Regardless of how the width of the super-highway may be utilized, it will permit the planting of trees and shrubbery in places along its route where there will be not be disturbed by the successive steps in the evolution of its development.

NEW YORK.--The Advisory Committee on Traffic Relief which was formed as the result of a resolution adopted by the Board of Estimate and Appointment of New York City on December 22, 1924, made its report on December 28, 1925, at the same time asking that it be relieved from further responsibility in the manner of traffic relief.

The committee held seven meetings and gave consideration to the practicability of obtaining relief through further regulation of traffic, to certain specific improvements designed to open up new and needed traffic arteries, and to incidental problems bearing upon the subject. Some of the matters more particularly considered and the recommendations made were:

1. More stringent traffic laws and ordinances than those now in force, in the opinion of the corporation counsel, could be enacted by the municipal assembly or the Board of the Aldermen.

2. Traffic counts should be made at carefully selected points throughout the city. A map of arterial streets showing upward of 300 points where such counts should probably be made accompanied the report.

3. Roadway and sidewalk width should be modified by increasing the roadway width of streets 60 feet wide from 30 feet as heretofore provided, to 34 feet, the added width to be withdrawn from the sidewalk with corresponding changes in streets from 50 to 75 feet wide.

4. Subway kiosks should be removed from the curb and placed either alongside the building line or preferably within an adjacent building. Material relief would result from the removal of elevated railroad columns from the roadways and of surface railway cross overs and turnback switches, all of which impede traffic.

5. It was not believed by the committee that the length of time during which vehicles remain stationary (i. e. parked) is an important element of traffic problem in general because any stoppage whatever largely destroys the usefulness to moving traffic of the particular lane in which the vehicle is standing. Recommendations considered but not made definite where the limiting of some of the north and south arterial streets, to prohibit the loading and unloading of traffic during certain hours, and to require that trucks be constructed so as to permit both side and end unloading.

6. Increased restriction of the height of buildings was pointed out to be a method of relieving the steadily increasing traffic load upon the streets. Re-zoning would be difficult, but traffic ordinances which would have the effect of imposing upon builder the necessity of providing accomodations within the building

for the parking incident to its use might automatically help in the restrictions to building height. The introduction of arcades should be encouraged as offering the most available method for increased street capacity without serious invasion of land values or destruction of valuable property.

7. Use of containers for the delivery of merchandise was recommended as a means to decrease and eventually to discontinue the use of the public thoroughfare for loading or unloading purposes during the hours of maximum traffic congestion.

8. A public campaign should be instituted with a view to encouraging the construction of parking garages.

9. The time has arrived when apportionment of roadway width should be definitely based upon traffic lanes, these in turn being regulated by the size of the vehicles using them. A study was made to regulate the maximum dimension of vehicles.

10. An express street of adequate width should be built along the west water-front in the boroughs of Manhattan and the Bronx with an extension along the city line to connect parkways in Westchester County.

11. The relief to be obtained from the alternation of the rapid transit structure on the line of Broadway across the Manhattan valley to provide for a vehicular roadway over West 125th St. would not be commensurate with the cost of the work.

12. In regard to the development of the Hell Gate bridge to serve as a portion of a tri-borough bridge to connect the borough of Queens with the borough of Manhattan and the Bronx, Dr. Gustav Lindenthal stated that the arch span of the bridge is strong enough to carry an upper or highway deck and that no additions are

needed on the arch span for sidewalks since the unused space outside the arches on the railroad can be devoted to this purpose.

13. An interborough parkway improvement is proposed to afford a connection between Eastern Parkway in Brooklyn and Forest Parkway in Queens.

ST. LOUIS, MO.--Major street plans (Map 14) were adopted to provide continuous and wider traffic routes to the business district from all sections of the city.

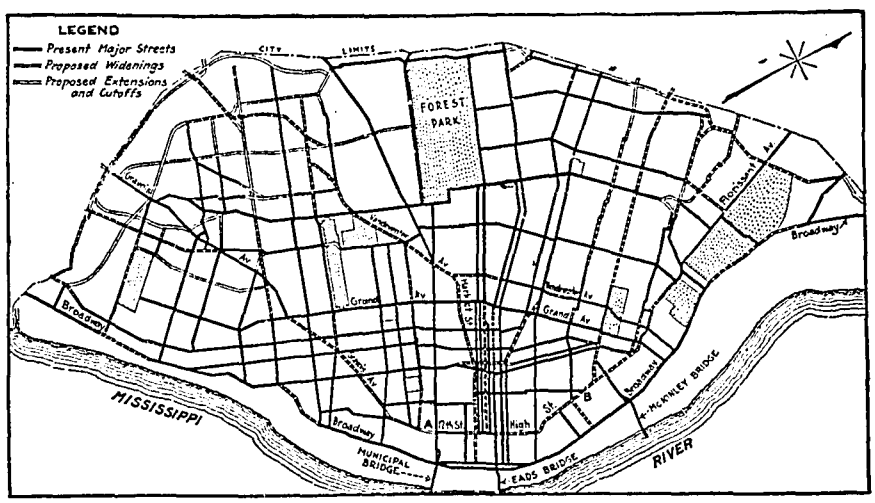
In 1914 in St. Louis there were 9,869 licensed motor vehicles; in 1920 there were 60,473. It is predicted that in 1926 there will be 200,000 licensed vehicles.

The plan will relieve as of present traffic, in two ways: 1. The two radial routes will be made continuous and widened and paved to offer desirable direct routes to the business district from both north-west and south-west; and 2. The present narrow east and west streets will be widened and paved to accomodate more vehicles.

CITY PLANNING.--The program for improvement of traffic facilities may be part of a general city paln or metropolitan area plan or, if no such plan has been established, a traffic program may be developed in advance of a more comprehensive plan. The traffic program should be inclusive of the following:

A. A transit plan, covering facilities for the mass movement of population by vehicles of all classes, including rapid transit, steam railraod commuter service, street car lines, bus lines, private automobiles and other means.

St. Louis Plans for Future Motor Traffic



Courtesy of Engineering News-Record

MAJOR STREET PLAN OF ST. LOUIS, MISSOURI

More road space for a larger number of vehicles is the common-sense plan which St. Louis is adopting for the relief of traffic congestion. The map above indicates the extent of the widenings, extensions and cut-offs which have been authorized. The city has voted a $67,000,000 bond issue for municipal improvements, of which $8,650,000 will be expended for establishing, opening and widening streets. The present motor vehicle registration of St. Louis is 108,425, and the municipal authorities estimate this will total 200,000 by 1926.

B. A street and highway plan, providing for main thoroughfares, by-pass and interconnecting thoroughfares, secondary streets, business and industrial streets, and local residence streets, with any necessary enlargements and improvement required to carry the traffic with expedition and safety.

C. A traffic control plan, to provide for the orderly improvement of facilities and measures for the safe and efficient utilization of street and highway capacity.

In arranging streets or highways for the circulation traffic, there are four points which should be considered, as follows:

1. Grade crossing. At peak points of congestion and danger it is desirable and sometimes practicable to separate grades so as to carry the through traffic of one street over or under the other street. This permits a feww flow of vehicular traffic across the intersection on both streets and lessens the difficulties and dangers of the pedestrian as well.

2. Classification of traffic. The most serious traffic difficulties result where there is a great mixture of all kinds of traffic, especially on a narrow roadway. Where there are three parallel narrow streets with mixed traffic as above, great relief can be secured by confining street car operation to one street and reserving another primarily for the slow moving trucks and teams and the third for the faster moving motor cars.

3. Arrangement of traffic arteries. Through traffic of all kinds should be confined to main thoroughfares while traversing residence districts and outlying areas and these main thoroughfares should be so arranged that they will form natural boundaries to homogeneous districts, as residentail areas, large enough to support neighborhood facilities such as store, schools and recrea-

tion places.

In laying out the minor streets in the unbuilt areas the number of intersections with or crossing a main thoroughfare should be minimized.

4. By-passes and belt highways. Often traffic congestion is created not so much by the vehicles of persons who have business in the congested district as by the vehicles of those whose business or pleasure takes them through the congested district. In such cases the opeing of convenient by-passes routing traffic around the congested district will unquestionably give relief.

In peplanning of street system for the traffic relief, it may be found that the existing streets are so arranged that even with exclusive widenings they will not serve the purpose, in which case it is necessary to consider the cutting of new streets by the method of widening by taking from abutting lots or by taking from sidewalks or by building line set-back as condition sees fit.

The construction of double-decked streets in the congested area is now practicing in some large cities for the relief of traffic. However, in New York, Boston and Chicago, the inconvenience of having elevated structures in the streets is well understood.

The vehicular tube or tunnel is another method whereby the area available for traffic can be increased. The Hudson River tube which is connecting New York City with the New Jersey shore is one of the best examples.

Still another method for increasing roadway is by the

use of the arcaded sidewalk. By this plan as shown in Figure 51 the roadway is extended to the full width of the existing street, and the sidewalks are placed in arcades in the abutting buildings.

The physical changes or minor alterations of streets as they will be stated in the next paragraphs will also increase the street capacity and accomodate the traffic.

A. Removal of physical obstructions, like hydrants, mail-boxes, post, etc.

B. Changes in street construction: The surface of all streets where traffic is heavy should be provided with a type of pavement adopted to traffic demands.

C. Cutting back curbs at intersections.

D. Building traffic squares and circles at intersections of several streets, at bridge heads, docks, railway stations, etc. (See Figure 52.)

E. Separate lanes for street cars, fast traffic and slow traffic.

F. Separating vehicles and pedestrians by fences or subways or elevated walks or safety zones.

G. Designation of one-way streets.

Street intersections are the congested points in cities due to many lines of traffic come to this one point. Relief to intersections may be afforded in various ways:

1. Curb corners may be around off with greater radii.

2. Corners may be cut off and additional land included within intersections.

3. Building lines may be established to keep buildings back of street lines.

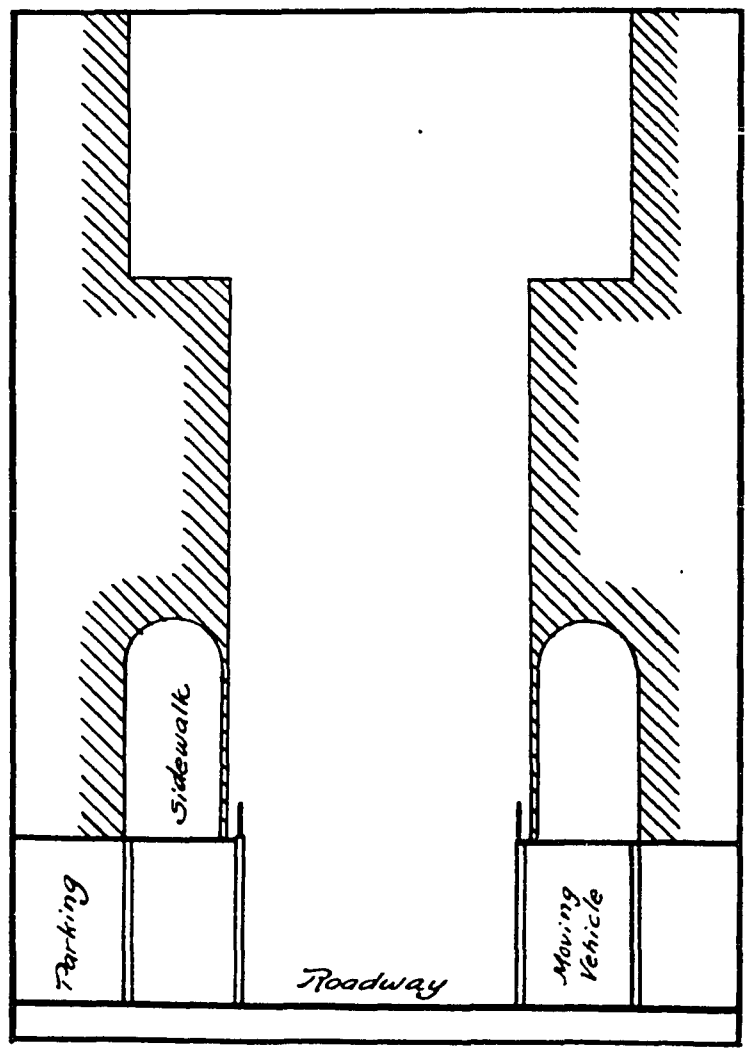
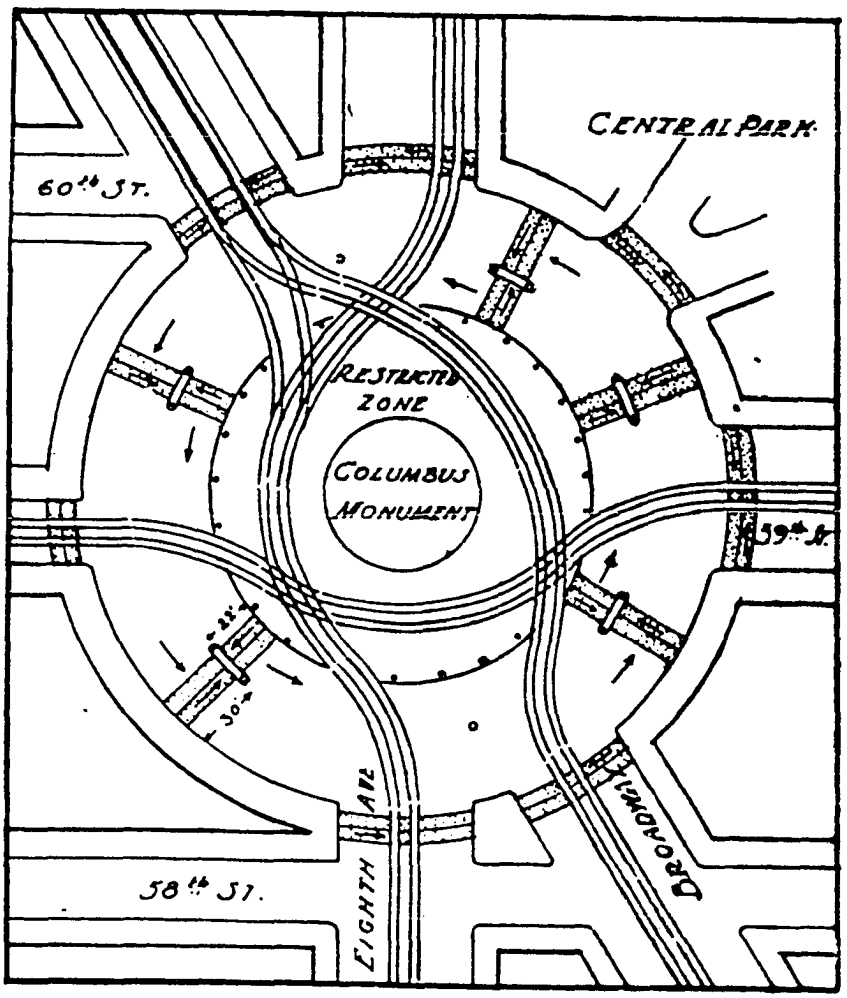


Fig. 51 Arcaded Street



—Improved Rotary Traffic for Columbus Circle, showing crosswalks and Safety Zones to canalize traffic as well as to assist pedestrians.

Fig. 52

4. Streets may be sprayed out near intersections.

5. Vehicular paths around corners may be marked upon pavements.

6. Parking may be prohibited near intersections.

7. Standards may be elected to guide traffic.

8. Traffic may be rerouted.

9. One way street may be established and left-hand turns prohibited.

10. Cross streets may be opened and closed synchronously.

11. Fast and slow traffic may be separated.

12. Grades of intersecting may be separated.

Zoning and Decentralization.

As mentioned before, the zoning and decentralization is one of the practical methods to solve the congestion problem in the city. The down-town or business section of a city is usually crowded with both vehicular and pedestrian traffic, especially in the rush hours near the opening and after the close of the office time. To avoid such abnormal traffic in a limited street capacity the zoning or decentralization of business should be introduced. Zoning is to limit and regulate the height and the use of buildings in the congested area so as to avoid the congestion and decentralization of business means to remove business from a crowded area to an open area or spread the business of a crowded area to different placed of a city so as to secure more even distribution of workers and hence to minimize the congestion.

A. Regulation of Height. Tall buildings will add congestion by pouring out their employees to the streets at one time. So the regulation of heights of buildings to their minimum heights will result the better street traffic condition.

B. Regulation of Use. Industries and big business are undoubtedly employing more workers and at the same time have more customers to call on. This makes the congestion at certain times due to the coming and leaving of the workers and add more traffic due to buyers and delivery of commodities. The regulation of the use in a city is also important for the better distribution of business and avoiding the congestion.

C. Alternation of Working Hours. Another way to avoid the rush traffic at one time in an already built-up crowded area is by means of the alteration of working hours. The office hour is generally begun at 9 a. m. in the morning, and closes at 12 at noon, then reopens at 1 p. m. and closes at 5 p. m. in the evening. To alternate this in one office or in one building or even in one kind of business or industry, it needs only arrange in shifts so that certain workers come at this time and the other group comes at the other time. For instance, first group comes to start at 8:30 a. m., out for lunch at 11:30 a. m., back for work again at 12:30 p. m. and closes at 4:30 p. m.; second group starts at 9 a. m. in the morning and closes at 5 p. m. in the evening; and third group starts at 9:30 a. m. in the morning and closes at 5:30 p. m. in the evening, etc.

D. Removal of Business to the Open Section. This has three-fold advantage:

1. To the business and the industry owners, who can

secure better and cheap land and allows easy extension.

2. To the workers of course, since they can have better sanitary provision and save the traveling time and expense if they live near to them.

3. To the buyers since they can secure what they want much nearer and save the time and expense to secure what they want much nearer and save the time and expense to the down-town. And, to the traffic problem, it will no doubt be that this reduces a great volume of traffic which would crowd in one section.

PARKING FACILITIES. Parking for unlimited time results in the exclusion of all persons desiring to do business who arrive after the parking spaces are filled but on the other hand, if parking is limited in too short a period the drivers in order to conform with time limits either have to move a short distance or jockey for places at the curb and obstruct the movement of traffic. The parking problem in the cities has become a difficult problem of traffic regulation. The parking facilities are varied according to the conditions of cities, but some of the solutions may be stated as these:

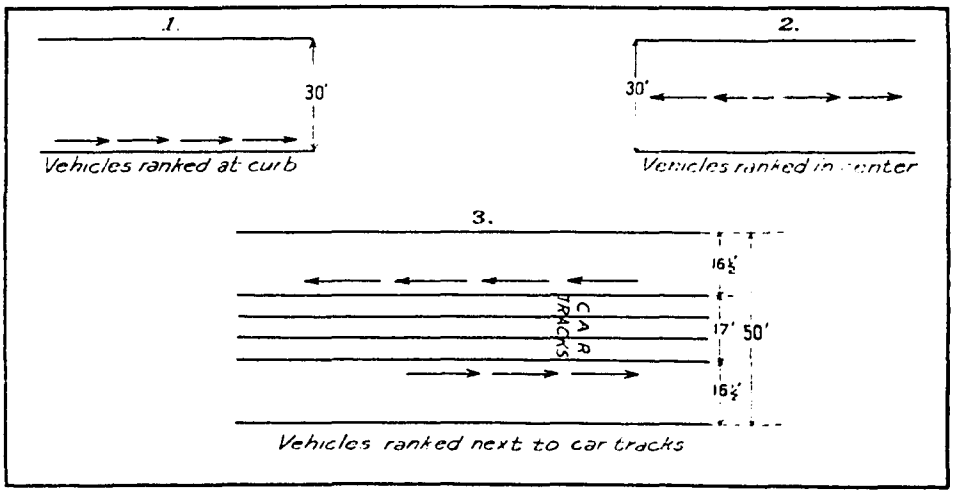
A. Basement garage. One of the pioneers in this field is the Pacific Mutual Building of Los Angeles, on the two lower floors of which 140 cars can be accomodated.

B. Land in transition for parking. Pittsburgh has one of the largest garages of this kind in America, located within a few blocks of the business center.

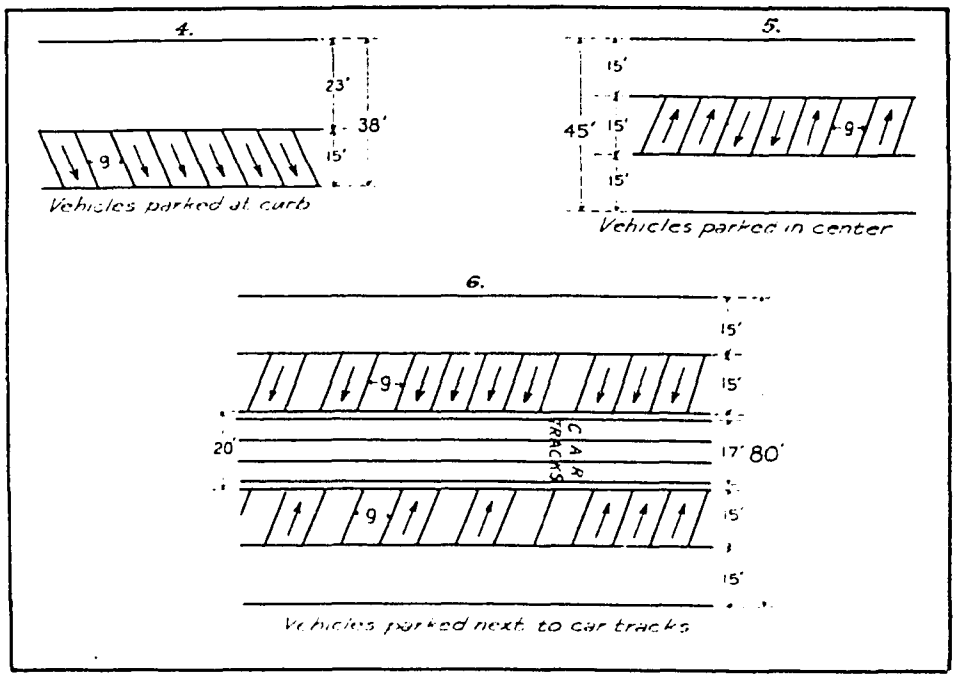
C. Automobile Hotel. An automobile hotel, eight stories in height, with accomodations for 800 vehicles, is being

Fig. 53 Parking and Ranking Provisions

"Ranking—Standing vehicles behind one another parallel to the curb."



"Parking—Standing vehicles alongside one another at an angle to the curb."



planned in Washington, D. C.

D. Sub-surface garages in parks. A proposed plan for Chicago whereby 7,000 cars would be cared for in sub-surface garages in Grant Park, and the remaining 24,000 vehicles which enter Chicago daily would be stored in regional garages. Another plan in New York has been also proposed to provide for 30,000 vehicles under central Park and 4,000 in Bryant Park with electric mummon system for the owner to call.

E. Public land for parking. Cleveland publicly owned land has been made available for parking.

F. Parking in arcades. Double arcaded streets may be used in the lower arcade for parking purposes.

G. Parking on roofs of the buildings. Parking on the roofs of buildings with automobile elevator has been planned in Washington, D. C.

H. Parking Tower. Parking tower has been worked up at Purdue University in which a series of platforms mounted between endless chains provides space for parking automobiles one above the other.

The ranking and parking facilities for the vehicles on the streets should be provided for at least as Figure 53, and the width of parking space located in the middle of a street, where vehicles are to be parked at an angle of:

90^{0} should be at least 15 feet
45^{0} should be at least 15 feet
$37\frac{1}{2}^{0}$ should be at least 14 feet
30^{0} should be at least 13 feet

When a parking space is next to the curb these widths can project over the curb about that much. Six feet side line is

required for ranking.

Chapter Eleven. APPLICATIONS AND RECOMMENDATIONS

TRAFFIC SURVEY

In order to apply a suitable system of traffic regulation, the traffic condition of a particular city must be known so that it will furnish the basic requirement for the determination of the regulations. Of course, cities of larger sizes and the cities of smaller sizes are different in their traffic conditions and their requirements of regulation, but the importance of the traffic survey is just the same for both large and small cities. Large cities have their complicated traffic problems and small cities, too, have their necessary traffic problems.

Even in a small city there are certain business streets where the people do their shopping usually concentrated traffic in certain hours of a day and especially on Saturdays. To know this actual condition and its necessary provision, traffic counts in such streets on a normal week day and one week ends are advisable. A small city may grow up to a larger size in the near future and the future problem of traffic regulation must be planned right in its early days so that the city will not suffer any traffic congestion in the future is vitally important. This is also meant that the traffic count is necessary for the planning of the future traffic circulation.

One of the greatest problems in the larger cities of present time is the traffic problem, solve the traffic congestion. Due to the neglect of far-sighted policy to plan an adequate street plan and the rapid increase in the use of automobiles, most of the

large cities of today are having traffic congested streets. The need of drafting comprehensive traffic regulations through the light of traffic survey is apparent.

In a large city, business streets, through streets, and intersections or focal points are places of congestion. The traffic survey of a large city should consider not only the traffic within the city but also it should cover the neighboring region as well. And, to make a complete survey for the whole city rather than to pick just a few points in the congested area. Of course, more careful attention should be paid to the congested areas.

After the proper points, evenly in the city and more attention in the congested areas, are selected, the next question will be the proper time to be counted. As the traffic of normal week days are different from the week-end and the traffic of certain hours are different from other hours of the same day, so it is necessary to take counts throughout the whole week to record the variation of daily traffic in a week and to take counts throughout the whole day to show the variation in different hours of a day. Week-end has the peak traffic in the recreational area for the week and before and after office hours occur the most congested conditions in the business section for the day. Before starting a traffic survey, it must be remembered that the local general condition must be clearly in mind in order to arrange the location and time of traffic survey properly suited to that city in question.

In recording the traffic counts, different kinds of traffic, car traffic, truck traffic, bus traffic, street car traffic motor cycles and other car traffic and pedestrian traffic, must be clearly entered in the list. In the case of car traffic number of passenger in each car should be stated and in case of truck traffic

kind of commodity carried, its capacity, weight, make, etc, are necessary to keep for each truck. Busses and street cars are particularly important to note their schedules, capacities, percentage of loads carried and general conditions of their bodies.

The traffic circulation problem is not only confined to a city but the highway system of good circulation for a state or a nation is also should be sought. It is through traffic survey, the only practical means, that the actual traffic condition can be found and to provide for its needs if any. The improvement of highway systems for a state or for the nation is best to plan and to replan from its actual condition and its possible development in the future through the traffic survey. Many states of the Union have been taken or are undertaking this kind of traffic survey and I hope that this will continue until every state is succeeded then the real requirement of the traffic circulation of the nation will be found.

The method of traffic survey is practically identical to the method that has been mentioned for the large cities except, in addition, origins and destinations of traffic from state to state and the seasonal or monthly variation of traffic should be figured to give the interstate relation and the peak traffic of the year.

Traffic survey is not a job of once for all, but must keep on from time to time as the traffic condition varies and the new requirement arises. So, in short, the traffic data must be kept up to date and improved as soon as it finds condition warrant to do so.

TRAFFIC REGULATION

Uniformity and simplicity of laws and regulations throughout the country will give the most important effect of traffic circulation. They mean easy and quick circulation.

Stop before grade crossings, speed of 15 miles an hour in the business district and cautionary area, 20 miles an hour in the residential area and 35 miles an hour in the rural highway are recognized as the suitable speed regulations which should be adopted throughout the country.

Maximum width of 96 inches, maximum height of 12½ feet, maximum length of 85 feet and maximum load of 800 pounds per inch base width of tire or maximum concentration upon one axle of 22,400 pounds should also be adopted throughout the country. The uniform system is not only the easy means for motorists to follow, but also means easy enforcement of regulations to assure maximum obedience by the regulator.

In the regulation of moving traffic, definition of traffic lanes, keeps to right, must be provided in any case whether for a city or for a state. Then come to turning at the intersection with keeping to the right when turning to the right and pass beyond the center point when turning to the left. Passing should be noticed by sound signal; reduce speed and stop before grade crossings; slow up when nearing schools, hospitals and other public buildings; stop for pedestrians to cross at intersections are all essential to be provided in the traffic code.

Some special provisions, as in the mountainous district, certain regulations like the ascending traffic has the right of way over the descending traffic; in cities due to congestion certain

streets may be designated as one-way streets; and also materially relieve in the congested street if certain traffic is prohibited in certain hours are all adoptable if the condition requires it.

In the regulation of standing traffic, in the rural highway, parking spaces along it either in the highway or preferably in an area outside and next to the highway should be provided for parking of automobiles. But the free passage of moving traffic must be insured so that not to interfer with them by parking.

Parking in the city is quite a problem to be solved today. In general, the parking provision may be created as follows:

1. Space for Parking. Where necessary, the parking spaces must be provided for the convenience of the people, such as in the business district, in the park and playground, near to the theatre, in railroad stations, in steamer wharf, and so forth.

2. Manner of Parking. According to the traffic condition and the width of the street, different manners of parking may be permitted. Perpendicular parking as for wide street and is necessary for the loading and unloading of trucks in the wholesale business district. Angle parking may be employed when streets are not very wide and is primarily for passenger car parking. If parking must be provided and the street is very narrow, the only solution is the parallel parking either on both sides or on one side only according to the width of the street available for this purpose.

3. Time of Parking. Parking may entirely be restricted for the movement of rush hour traffic during the rush hours, usually

usually before and after the office hours and shopping hours, which will give more space for the moving traffic and by this the quick movement is secured. In sedtions where traffic is heavy but parking must be provided, then the short period of time allowance for the parking during certain hours is applicable.

4. No Parking. Dangerous points, intersections, safety zones, near the fire hydrants and in front of certain public buildings and grounds where parking will interfere with the free movement of traffic or endanger the traffic or for the sake of public safety, it is necessary to prohibit parking by creation of zones and not allow parkings within these specified areas.

To insure the quick movement and safety of both vehicular and pedestrian traffic, the regulation of pedestrian in accordance with the vehicular traffic is essential. In rural highways few pedestrians are using the roadway, but yet it is logical to define this usage as keeping the pedestrian to the left hand side of the road and crossing at the intersection.

Pedestrian traffic in the city is no doubt involving a hard problem especially at the intersection of the congested area. Alternative movement of vehicular and pedestrian traffic at the intersection by creating safety zones and allowing pedestrians to cross safely with vehicular traffic stopped beyond the zone, is the present good practice. However, this is applicable only for cities of not up to very congested traffic condition, but for very congested traffic condition, like in the city of New York or Chicago, it is economically loss to stop a continued line of traffic stream at the intersection. In this case separation of vehicular traffic from pedestrian traffic by either construction of subways or by bridges is strongly advocated. (1\3)

HIGHWAY SAFETY

The physical regulation by signs and signals is a valuable means of traffic regulation and to secure the highway safety. Highway accidents have caused many losses to lives and property every year and is still unfortunately showing an increase. It is the duty of the traffic engineers to make this loss at least to stop from increasing if not decreasing at all.

The color of a sign has a great psychological significance. Some colors give you a soft feeling and no attention, while others give you a sharp feeling and you will notice it. Red color has long been used in general as a danger color; yellow or orange as caution colors; and green and blue as safe colors. So far for the most satisfactory system of highway signalling, the red should be used as a danger color for signs and light signals of denoting danger and stop character; the yellow as caution color for signs and light signals of denoting cautionary and slow-up character; and the green as safe color for signs and signals of denoting safe and proceed character.

Symbols to represent various road conditions on signs of different shapes are very effective in telling the motorist while he is driving along the highway. Perhaps the best every recommended set of symbols was the one by American Engineering Standard Committee which had been described in the last chapter and I hope this will be universally adopted.

Shapes of signs should be adapted to their necessary spaces for their letters and symbols. Different shapes have been used in different states with some good and some reverse, but the best set through careful consideration adopted for the United

States road system is here I like to mention. In which round shape for railroad warning sign, octagonal for danger or stop sign, diamond-shaped for caution or slow sign, square for look and attention sign and rectangular for directional and informational sign. It must be noticed that the sign with angles will draw attention easily and the rectangular shaped sign will give better space for lettering.

In cities, various traffic equipments are used to regulate the traffic. Mushrooms are usually placed at centers of street intersections and outer corners of safety zones with red lights. Traffic signals with red, green and yellow lights suspended above the middle or posted at corners of street intersections to direct traffic movements automatically are applicable in congested intersections. Bells are sounded as these lights are changed so as to notice the traffic to move or stop. In small cities with not heavy traffic at intersections, semaphores operated by officers can be substituted. Semaphores are also good equipments for the traffic regulation of temporary natures even in a big city. Dead ends or jogs or danger points, flashing beacons are advisable to place so as to alarm the danger and to insure the safety. Traffic towers are suitable for sections of a big city, where heavy traffic is to be handled. The tower can easily be seen from far distance by motorists and the traffic officer is safer and can see clearer on the tower to handle the traffic. Synchronous control or plattoon control are applicable when only in a large city with tremendous traffic to be handled. These are so far the available means for the control of large fleets of traffic.

Painted lines are the cheapest form of traffic regula-

tion. The yellow paint should be used since it gives better visibility and distinction. Painted center line serves very effectively the separation of traffic lanes. Painted crossing zone keeps motors from entering into injure pedestrian. Other painted parking zones with specified time and area to be used are also well and simple means of traffic regulation.

A word in regard to the safety zone which I would like to mention here. Although safety zones have four kinds as stated in the previous chapter, the painted line zone is the best to be used in crossings at general intersections for it does not obstruct the motor traffic and at the same time gives clear boundary for the pedestrian. And, for large squares and circles and street car loading zones, the best is the elevated type which serves good purpose and is much safer at a congested crossing.

TRAFFIC PLANNING

The width of highways of today are generally provided for by two lanes of traffic except in some boulevards and city thoroughfares. For the continuous growth of traffic, it is sure that the present two-lane highways are too narrow to serve the adequate movement of traffic in some parts of the country at the present and most parts of the country in the future. Therefore, the logical improvement of this condition will be called for more lanes and hence separation of fast and slow traffic. This must be developed and it is likely to be followed in regions of large population centers.

The economic of highway transport has great to do with the types of a highway. The gain from the highway improvement is evidently higher than what it paid for and is generally recognized

as a good investment. The business of highway engineer is thus to introduce better and economical type of highway improvement. Replanning of the whole highway system to the best for the easy and direct transportation; relocation of routes to avoid unnecessary travel; elimination of grade crossing to insure safety; surfacing of raodways to accomodate the need of neavy traffic; widening highways to permit more lanes of traffic; changing grades to secure better movement. These are all questions and aims for the future construction and improvement of highways which should bear in minds of highway engineers.

As mentioned in the first part of this chapter, the traffic survey is a real valuable means by which we can find the actual traffic condition and its tendency so that the possible need of the future accommodation can be laid down. States or cities can easily plan out the possible future traffic density map from the result of the traffic survey and highway improvement can be determined to meet its future need. This is a very important step for any state or city to follow if they want to solve the traffic problem from a practical method. Moreover, it is a sound step for traffic planning.

Unplanned streets of cities of today caused greater part of the traffic congestion which required to improve in almost every aged city of this country. City planning is vitally important for the solution of traffic problem. Major streets which for carrying the through traffic should be planned to form as the "backbone" of the street system. They must be well connected and built wide enough to take care of the quick and easy movement of traffic. Traffic arteries are included in this class. In cities of already

built-up type when their major streets are incapable to serve the new traffic, by-pass routes can be provided so as to take care of the through traffic and at the same time to avoid the unnecessary traffic from entering in the city to cause congestion. Minor streets are then planned to connect these major streets and thus form the complete street system of a city.

Many streets are now found that they are too narrow to serve the traffic and some way of improvement are condisered. Cut back sidewalks to give wider roadways is a general practice, but the introduction of arcade is worth taking for it is a practical and cheapest method to provide wider streets in a built-up area without causing serious damage to the buildings. This has great significance in the down-town district of a large city.

Another solution of traffic problem bringing about by the city planning is the practice of zoning. It is through zoning that the regulation of heights and uses of buildings in a city are defined. Hence the even distribution of population and decentralization of congested area are resulted to better the traffic condition. Every city, large or small, should have their city plans for the correction of past mistakes and the development of the future requirements. This is not only helps to solve the traffic problem alone, but has its important object of promotion and betterment of wealth and living of the city deserves emphasis.

C O N C L U S I O N

HIGHWAY TRAFFIC.

1. The growth of automobile registration shows increasing rapidly until not later than 1930 the ratio of one vehicle to about four persons of the population of the United States will be reached. But after this point the growth will likely change to directly proportional to about one-fourth of the population.

2. The future development of highways should be planned and built in accordance with the requirement of the traffic and the present highways should be improved and surfaced as soon as possible to accommodate the traffic of the present and of the future.

3. The concentration of population or workers in one limited area is one of the important causes of traffic congestion. The decentralization by zoning is necessary for the better and more even distribution of population or workers of the future in a state or a city.

4. Traffic survey is the only method by which the traffic condition can be found and from which to plan for the relief of the traffic movement of the present and of the future. Every state, city or rural district should have this kind of survey continuously for its determination of future traffic accommodation.

TRAFFIC REGULATION

5. The uniform traffic laws and regulations as proposed by the special committee of the Second National Conference

on Street and Highway Safety should be adopted throughout the country so that the easy and economic traffic circulation can be secured.

6. A well organized traffic bureau should be established in every state and city to control the traffic and to enforce the laws and regulations rigidly under the technical traffic engineer.

7. Separation of classes of traffic,--fast moving, slow moving, standing and pedestrian,--with more lanes in a highway and given their definite lanes, spaces, or walks without interfering each other.

8. Physical regulation with signs, signals and other devices should be uniformly and properly provided at the necessary points for the safety and the direction of the traffic.

9. National, regional and city planning of traffic with scientific construction of highway and street systems to the best accommodation for the different classes of traffic and with the provision for the future development.

10. To regulate the production of uneconomical sizes of vehicles and to produce vehicles of minimum size with maximum capacity.

11. To limit the use of the number of vehicles in one state or one city or one district according to its real necessity of the people.

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****

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