

EMPLOYMENT AND CHANGING OCCUPATIONAL PATTERNS IN THE RAILROAD INDUSTRY

1947-60



Bulletin No. 1344

Cover picture: The rapid shift from steam to diesel-electric locomotives exemplifies technological change on the railroads.

Courtesy of Erie Railroad

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UNITED STATES DEPARTMENT OF LABOR
W. Willard Wirtz, Secretary

BUREAU OF LABOR STATISTICS
Ewan Clague, Commissioner

PREFACE

Shifts in the relative importance of industries and occupations are inevitable in an economy typified by constantly changing markets, technology, resources, and other structural characteristics. The railroad industry is a prime example of the effects of such change. Once an industrial giant exemplifying a pioneering and expanding America, railroads have not kept pace with general economic growth in the post-World War II period. Railroad employment has fallen sharply and, in the process, many occupations have been severely affected.

This bulletin analyzes employment trends and occupational changes in the railroad industry in the 1947-60 period. The study is part of the continuing program of research on the changing industrial structure and occupational composition of the American economy conducted by the Bureau of Labor Statistics.

The Bureau is grateful for the cooperation of railroad industry and union officials and representatives of government agencies who cooperated generously in reviewing and commenting on the draft of the study. The photographs included in this bulletin were supplied by the Association of American Railroads. This bulletin was prepared by Bernard Yabroff and William Kelley with the assistance of Catherine F. Delano, of the Bureau's Division of Manpower and Occupational Outlook, under the supervision of Sol Swerdloff, Chief, under the general direction of Harold Goldstein, Assistant Commissioner for Manpower and Employment Statistics.

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Employment and Changing Occupational Patterns in the Railroad Industry 1947-60

Changes in the relative importance of occupations within an industry occur not only in industries in which employment is expanding, but also in those in which employment is declining. Nowhere is the latter situation more dramatically illustrated than on the Nation's railroads, where the occupational structure has changed during a time of severely declining postwar employment resulting from widespread technological developments and changing

patterns of transportation and production. Employment fell substantially in many railroad occupations and dramatically in others, showed little change in some, and even increased in a few. As a result of these changes, the relative importance of major railroad occupational groups has shifted. This study is concerned principally with employment changes that occurred in railroad occupations between 1947 and 1960, and their underlying causes.

Postwar Employment Decline

The employment decline on the railroads in the postwar period was an acceleration of a longrun trend. From an alltime peak of about 2 million in 1920, railroad employment fell to 1.4 million in 1947. By 1960, employment was down to about 790,000,¹ a decline of approximately 600,000, or more than

40 percent, in little more than a decade (chart 1). (Preliminary data from the Interstate Commerce Commission indicate that by 1961, railroad employment had fallen to about 730,000.)

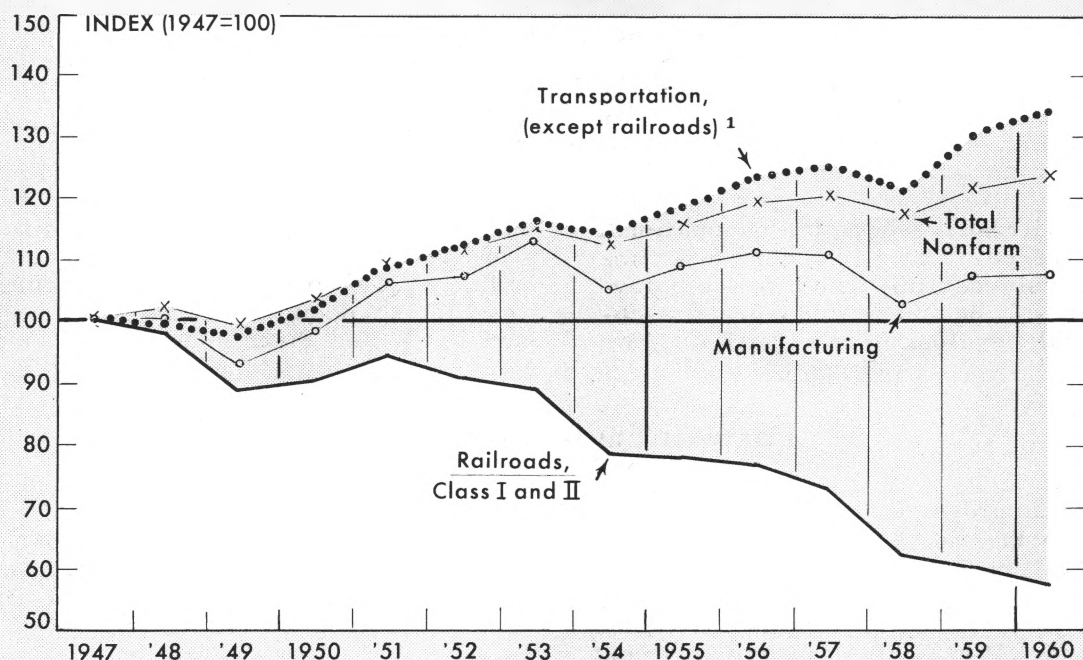
The 1947-60 decline on the railroads was numerically much greater than in any other industry.² Nevertheless, because of the widespread geographical dispersion of the railroad work force, the extent of the employment decline on the railroads generally has not received as much national attention as that of other industries with substantial, but less extensive, employment losses. There has been, of course, intense local concern over the impact of declining railroad employment in particular communities largely dependent on railroad operations.

Postwar employment decline on the railroads mainly resulted from extensive developments in railroad technology (chart 2) and the loss of business, mainly passenger, to other modes of transport. Competition from other common carriers (trucks, buses, pipelines, and airlines), private truckers, and passenger automobiles stimulated the introduction and improvement of machines and equipment, materials, and methods of operation on the railroads.

¹Employment data, 1920-60, are for Class I and Class II railroads. Transport Statistics in the United States, 1960 (Interstate Commerce Commission, Bureau of Transport Economics and Statistics), Pt. I, table 155, p. 107. Occupational employment data from 1947 to 1960 analyzed later in this article are for Class I line-haul railroads, which account for more than 90 percent of all railroad employment. These data, covering 128 occupational divisions (classifications) for which the Commission collects employment information, are available annually in the source cited above, table 69. Typical occupational titles under each of these classifications are listed in Rules Governing the Classification of Railroad Employees and Reports of their Service and Compensation, prescribed by the Interstate Commerce Commission, effective Jan. 1, 1951, and published by the Association of American Railroads, Washington, D. C., Aug. 1951.

²In the two industries with the next largest employment declines between 1947 and 1960--textiles and bituminous coal mining--the numbers of workers fell about 390,000 (29 percent) and 260,000 (60 percent), respectively.

Chart 1. Wage and Salary Workers Employed in All Nonfarm, Manufacturing, Railroad, and Transportation (Except Railroad) Industries, 1947-60



¹ Includes employment in local and suburban transportation; intercity and rural buslines; motor freight transportation and storage; air transportation, common carriers.

Source: Railroads, Class I and II employment, Interstate Commerce Commission; other: Bureau of Labor Statistics.

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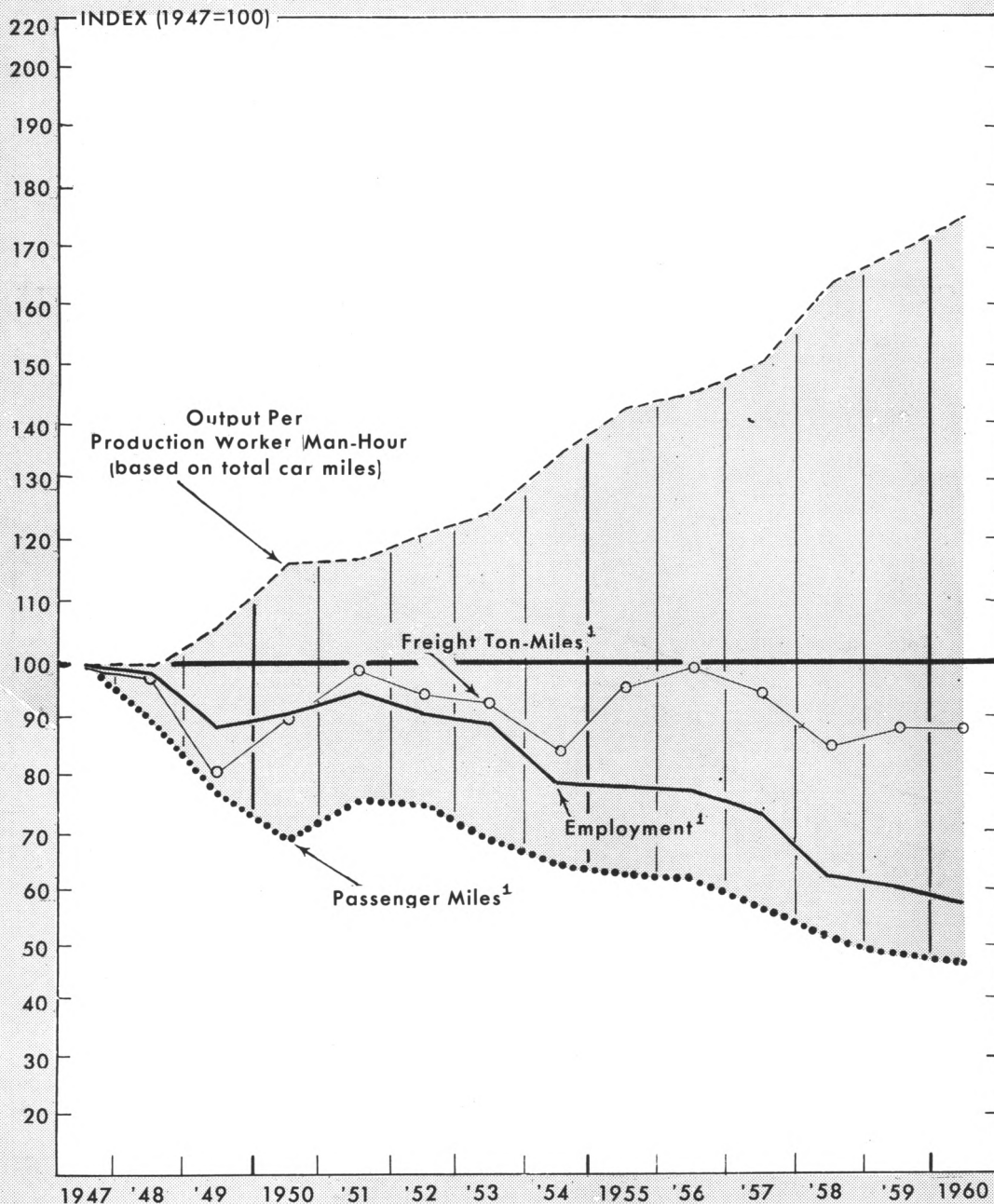
The pressure to introduce labor-saving innovations has also been attributed, in part, to increasing railroad wage rates and other labor costs.³ One of the factors that contributed to increased labor costs was a reduction in the standard workweek for railroad employees. However, the reduction in the workweek of nonoperating employees to 40 hours in 1949, followed by increased railroad activity in 1950 and 1951, helped to stem the downward trend in railroad employment in this period. The 40-hour workweek for yard operat-

³ William Haber, "Technological Innovation and Labor in the Railroad Industry," Technological Change and the Future of the Railways. Selected papers from a 3-day conference conducted by the Transportation Center at Northwestern University, Evanston, Ill., 1961, p. 112.

ing employees was negotiated in 1952 on an optional basis; by 1960, it covered most terminal operating employees.

The effects of growing competition were evident in sharply declining railroad passenger traffic and a lack of growth in freight movement. In railroad passenger traffic, a downward trend began as far back as the early 1920's with the increasing use of the private automobile. The decline in traffic was reversed during World War II as a result of dependence on railroads for mass troop movements, curtailment of automobile production, and rationing of tires and gasoline; after the war, the decline resumed. Between 1949 and 1960, intercity passenger traffic carried by railroads shrank from 36 billion passenger-miles to about 22

Chart 2. Employment, Revenue Traffic, and Output Per Man-Hour,
Class I Railroads, 1947-60

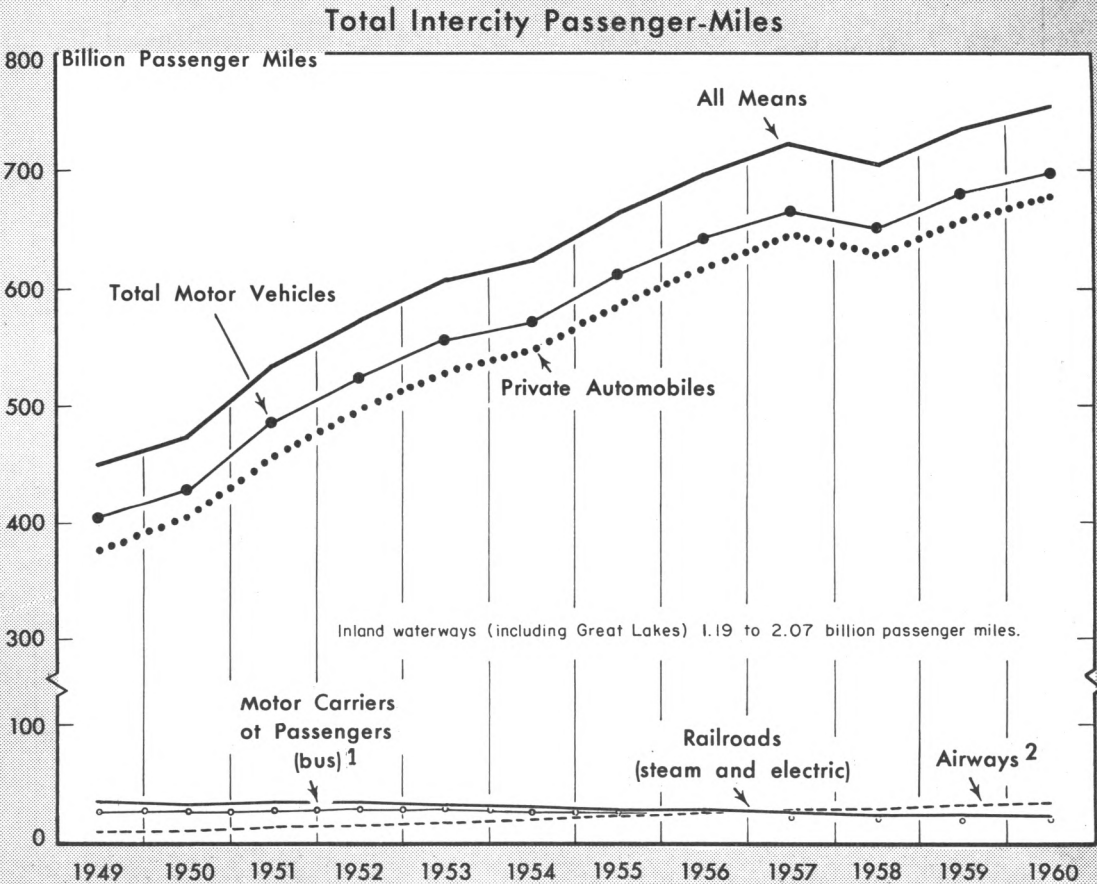
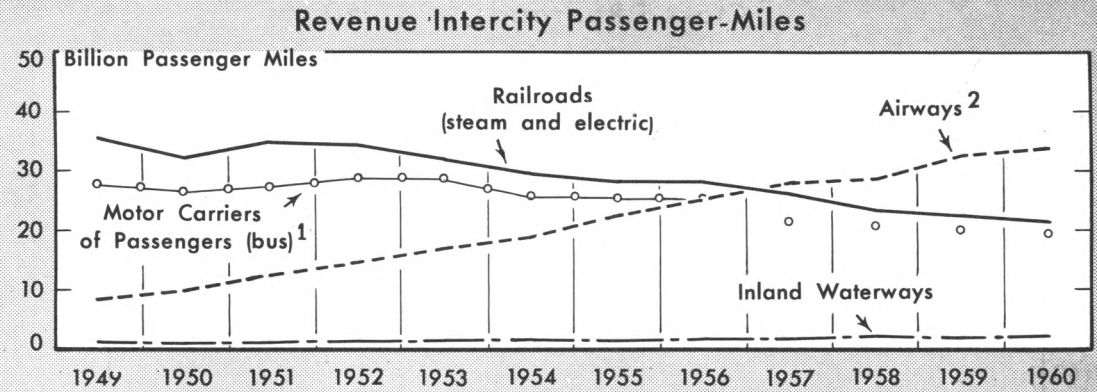


¹Class I line-haul railroads only.

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Source: Interstate Commerce Commission; Bureau of Labor Statistics.

Chart 3. Intercity Passenger-Miles, 1949-60



¹ Schoolbus data are excluded. Data for motor carriers, 1957-60, are not comparable.

² Includes domestic commercial revenue, pleasure, and business travel.

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Source: Interstate Commerce Commission; Bureau of Labor Statistics.

Estimated volume of intercity freight traffic, public and private, by transportation agency, 1947, 1950, 1955, and 1960

Type of carrier	Ton-miles (billions)			
	1947	1950	1955	1960
Total	1,018.6	1,062.6	1,274.8	1,330.9
Railway revenue ton-miles (including electric railways, express, and mail) ¹	664.5	596.9	631.4	579.1
Motor vehicles ²	102.1	172.9	223.3	299.4
Inland waterways, including Great Lakes ³	146.7	163.3	216.5	223.0
Pipelines ⁴	105.2	129.2	203.2	228.6
Airways (domestic revenue service), including express, mail, and express baggage ⁵2	.3	.5	.8

¹ Ton-miles of revenue freight, express, and mail of all classes of line-haul railroads and electric railways are covered. Switching is not included. Data are based on reports of carriers to the Interstate Commerce Commission, plus some data from the Post Office Department.

² The highway ton-miles cover all operations, for-hire and private, common and contract, between cities and between cities and rural areas, but not between rural areas without passing through cities and not city delivery or city movements to and from contiguous suburbs. Turnpike movements are included beginning with 1940 (the year of the opening of the Pennsylvania Turnpike). Highway ton-miles estimated on the basis of Bureau of Public Roads data for main and local rural roads, mileages of routes in rural and urban areas, and on Department of Agriculture data on farm consumption. Passenger-miles in private automobiles estimated on basis of data from the Bureau of Public Roads on rural and intercity travel and from average load data. As processing of certain data is not complete, highway estimates herein for 1960 should be regarded as preliminary. Alaska and Hawaii are included in 1960, therefore, these figures are not comparable with data for previous years. Schoolbus data are excluded.

³ All ton-miles on the Intracoastal Waterways, Great Lakes, inland rivers, etc. are included, but no deep-sea cargo movements except those portions moving within domestic waters of the United States enroute to overseas ports. In 1948, 1951, 1953 and 1954, there were additions of ton-miles on waterways not previously covered, which produced a relatively small lack of comparability in coverages.

For various reasons, including the extreme circuitry, these figures do not include deep-sea coastwise or intercoastal movements of domestic traffic.

⁴ Oil movements through pipelines are included whether or not these pipelines are regulated by the Interstate Commerce Commission. Crude, product, and gathering lines are covered. Data are from reports to the Interstate Commerce Commission, from the Bureau of Mines, and from other sources.

⁵ Based on Civil Aeronautics Board statistics, Federal Aviation Agency Surveys, and other data. Ton-miles by airway are limited to those in domestic revenue service of certified and noncertified and/or supplemental carriers, except movements over international waters or foreign countries. Movements by private plane are not included, nor are such "local delivery" operations as crop dusting.

Alaska and Hawaii are included in 1960, therefore, these figures are not comparable with data for previous years.

Note: Because of rounding, sums of individual items may not equal totals.

Source: Intercity Ton-Miles, 1939-1959 (Interstate Commerce Commission, Bureau of Transport Economics and Statistics), April 1961, table 1; 75th Annual Report of the Interstate Commerce Commission, fiscal year ended June 30, 1961, p. 15.

billion (chart 3) and as a share of total intercity passenger-miles, from 8 percent to less than 3 percent. Meanwhile, the share carried by private automobiles increased from about 84 percent to more than 90 percent and by air carriers, from 2 percent to more than 4 percent.⁴

In contrast with the longrun rise in the volume of railroad freight traffic since the turn of the century (excluding the 1930's), freight traffic leveled off following its peak in World War II but has continued to fluctuate cyclically.⁵ The trend in the volume of freight traffic carried by railroads and other modes of transport is indicated in the preceding tabulation of data prepared by the Interstate Commerce Commission.

Railroad employment in the 1947-1960 period was also affected by various operating economies introduced by management. Employment was reduced by measures such as lower expenditures for roadway and structures maintenance, abandonment of branch lines in some areas and closing of small freight stations in others, and introduction of centralized traffic control on lines carrying dense traffic. On some lines, passenger service was curtailed or discontinued. In a few instances railroads were merged.

A major factor affecting employment in railroad occupations was the widespread inauguration of many tech-

nological changes. One of the most radical developments was the almost complete replacement of the steam locomotive by the diesel-electric locomotive. The nature of diesel locomotive service requirements permitted lower equipment maintenance employment. Reduced locomotive maintenance contributed to the consolidation of repair facilities which resulted in reduced structures maintenance. Diesels also hauled longer, heavier trains, thus affecting employment in train and engine service and, to a lesser extent, in other activities related to train movement. Extensive mechanization, as well as improvements in materials and in methods of utilizing mechanical equipment and manpower in road and track maintenance occupations, drastically curtailed unskilled and semiskilled labor requirements. Clerical employment was reduced by increasing use of a variety of modern office machines and equipment and, in recent years, the application of electronic data-processing methods to railroad accounting and statistical systems. The rapid spread of radio, teletype, Centralized Traffic Control (CTC), and other advanced signaling and communication equipment affected railroad employment generally. Labor savings were also achieved through the consolidation of station accounting functions, increasing use of production-line methods of equipment maintenance, relocation of track to minimize roadway grades and curves (thereby reducing the number of locomotives needed on particular runs, and track maintenance requirements), more efficient freight handling and shipment, and other major improvements in operating methods. Other innovations which contributed to changes in manpower requirements included welded rails, automatic car-weighting devices, quick-drying and spray paints, increased capacity of freight cars, and more powerful locomotives.

The postwar spread of technological innovations on the railroads entailed a high annual level of real capital investment from 1946 to 1960, a level significantly higher than in the preceding

⁴Intercity Passenger-Miles, 1949-1956, (Interstate Commerce Commission, Bureau of Transport Economics and Statistics), Jan. 1958, table 1; and 75th Annual Report of the Interstate Commerce Commission, fiscal year ended June 30, 1961, p. 15. Comparable data prior to 1949 are not available.

⁵For a discussion of the historical trend of railroad freight and passenger traffic, see National Transportation Policy, Report of the Committee on Commerce, U.S. Senate, special Study Group on Transportation Policies in the United States, 87th Cong., 1st sess., pt. II, ch. 4. June 26, 1961.

two decades.⁶ In current prices, capital expenditures by Class I railroads between 1946 and 1960 averaged more than \$1 billion annually.⁷

The effects of technological change, and a number of other interrelated in-

fluences, such as employee and management skills and effort, on railroad operations were indicated in the more than 70 percent increase in output per production worker man-hour in railroad transportation between 1947 and 1960; this gain was larger than in most other industries.⁸

Changes in Occupational Structure

The postwar decrease in railroad employment affected all major railroad occupational groups, although some were affected much more severely than others (chart 4). For example, the large number of employees engaged in maintenance operations fell by more than half over the 1947-60 period as a whole. In contrast, the relatively small numbers of executives, officials, and staff assistants dropped only slightly and the number of professionals, sub-professionals, and agents declined moderately.

Differences in the postwar rate of employment declines among railroad occupational groups resulted in some shifting in their proportional distribution. For example, train, engine, and yard (operating) employees became the largest single occupational group, moving up from 22.7 percent of all Class I line-haul railroad employees in 1947 to 27.1 in 1960. Employment in the white-collar group rose from about 16 percent to 20 percent over the same period. On the other hand, the proportion of railroad employment in maintenance occupations dropped from 47 percent to less than 39 percent.

Employment trends among the occupational groups were varied (chart 5). There was a fairly steady decline from 1947 to 1960 among freight and passenger terminal employees and other railroad employees classified in the occupational group "Transportation (other than train, engine, and yard)." Among maintenance employees, the decline accelerated during the latter years of the period. In contrast, employment of executives, officials, and staff assistants increased slightly through the mid-1950's, but then declined.

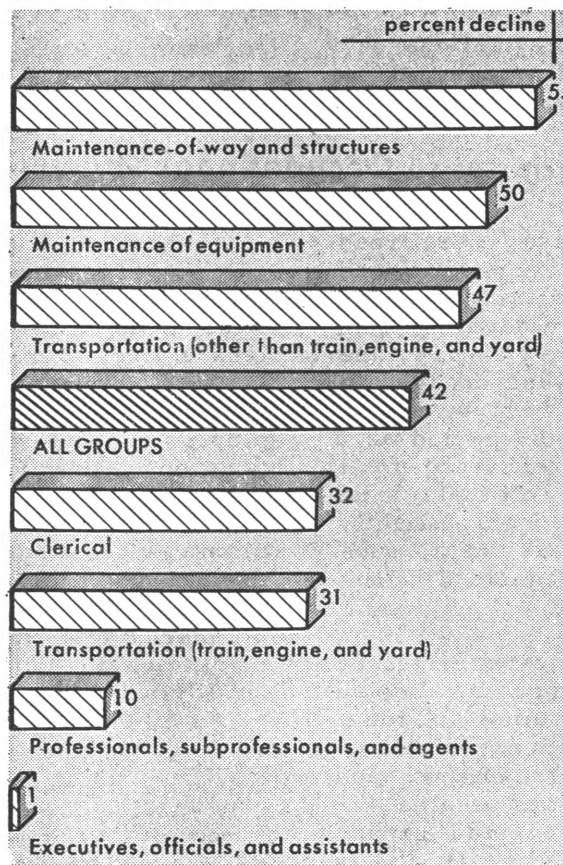
Cutbacks in railroad employment generally were most severe among those persons in jobs requiring relatively little skill or training. Thus, the less skilled workers such as gangmen, laborers, truckers, and loaders, as well as helpers, apprentices, and employees engaged in routine clerical functions generally experienced proportionately much greater employment declines than craftsmen, supervisors, managers, and professionals. This disparity was largely due to the widespread replacement of less skilled labor by mechanical and electronic equipment, and the consolidation of railroad facilities.

⁶Capital expenditures from 1925 through 1949, Association of American Railroads, Bureau of Railway Economics, subsequent years, (Interstate Commerce Commission, Bureau of Transport Economics and Statistics). Real value of capital expenditures obtained by deflating expenditures with The Railroad Construction Index compiled by the Interstate Commerce Commission, Bureau of Accounts.

⁷More than \$16 billion was spent on railroad capital equipment over this period. Approximately \$5.5 billion was spent for new freight cars, \$4.2 billion for new motive power, \$900 million for new passenger-train cars, \$700 million for modern traffic control and communications systems, and the remainder for new roadway machines, improvements to stations and track, and other modernization projects. Background on Transportation, News Service, Association of American Railroads, May 19, 1961.

⁸Output measured both in terms of total revenue traffic and car-miles, on Class I railroads and Class I switching and terminal companies. Indexes of Output Per Man-Hour for Selected Industries, 1939 and 1947-60, Annual Industry Series, (U.S. Department of Labor, Bureau of Labor Statistics, Dec. 1961).

Chart 4. Decline in Major Railroad Occupational Groups, 1947-60



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Source: Interstate Commerce Commission

Occupational group ¹	Employment (in thousands)						Percent change ²		
	1947		1955		1960		1947-60	1947-55	1955-60
	Number	Percent	Number	Percent	Number	Percent			
Total employees	1,352	100.0	1,058	100.0	781	100.0	-42	-22	-26
Maintenance of equipment and stores	370	27.4	273	25.8	184	23.6	-50	-26	-33
Maintenance-of-way and structures	265	19.6	197	18.6	119	15.2	-55	-26	-40
Transportation (other than train, engine, and yard)	172	12.7	127	12.0	91	11.7	-47	-26	-28
Transportation (train, engine, and yard)	307	22.7	250	23.6	212	27.1	-31	-19	-15
Clerical	163	12.1	138	13.0	111	14.2	-32	-15	-20
Professionals, subprofessionals, and agents	36	2.7	35	3.3	32	4.1	-10	-3	-9
Executives, officials, and staff assistants	15	1.1	16	1.5	15	1.9	-1	+6	-6
Miscellaneous services	24	1.8	22	2.1	17	2.2	-27	-7	-22

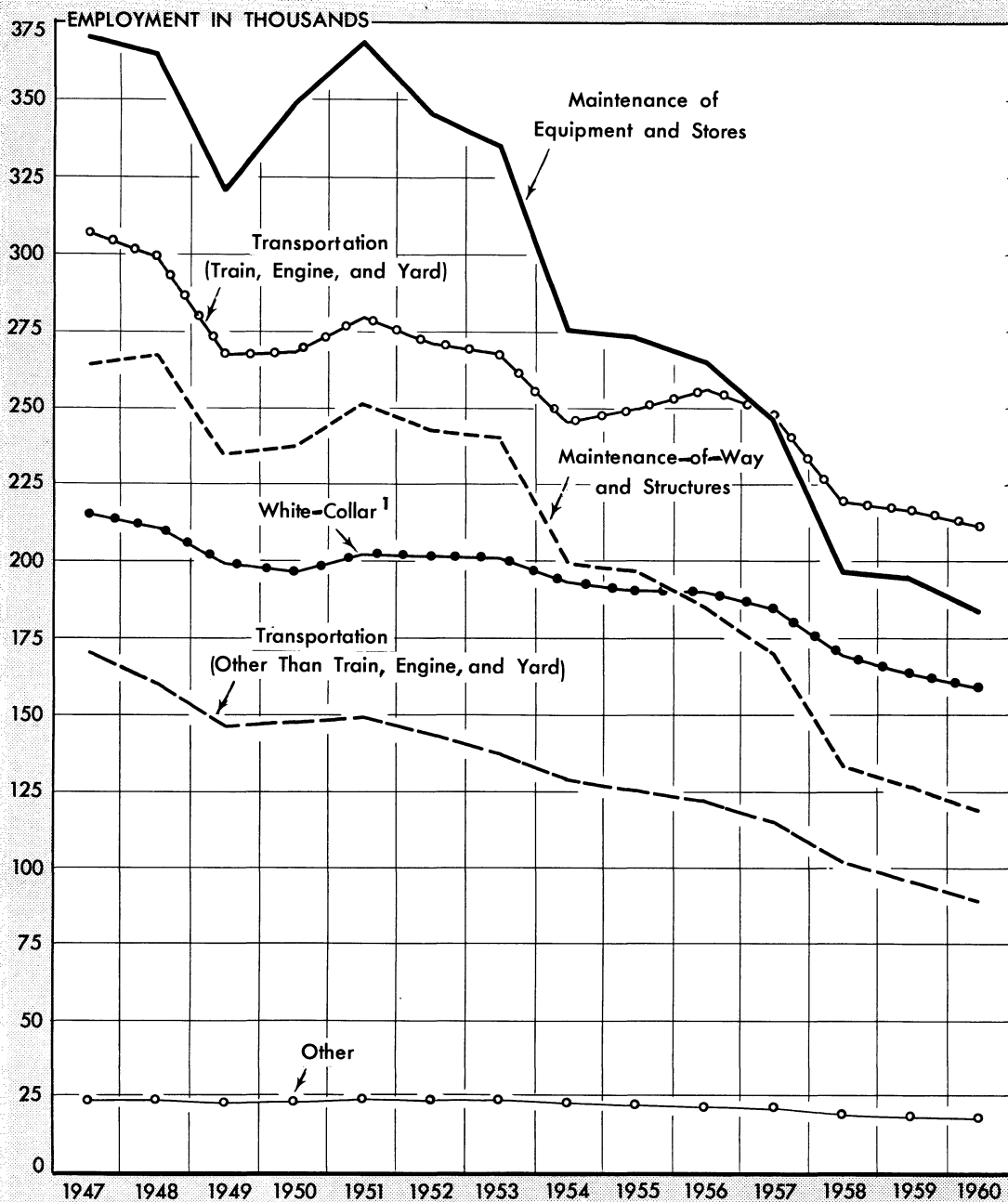
¹ Interstate Commerce Commission occupational divisions (classifications) were grouped by Bureau of Labor Statistics.

² Percentage changes computed from unrounded numbers.

Note: Because of rounding, sums of individual items may not add to totals.

Source: Transport Statistics in the United States, 1947, 1955, and 1960, (Interstate Commerce Commission, Bureau of Transport Economics and Statistics), Pt. I, table 69.

Chart 5. Railroad Employment in Selected Occupational Groups, 1947-60



¹ Includes the following occupational categories: executives, officials, and staff assistants; professionals, subprofessionals, and agents; and clerical personnel.

Source: Interstate Commerce Commission; Bureau of Labor Statistics.

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Although persons with more skill and training generally were less affected by technological developments and changes in the volume of railroad activity, employment was substantially reduced in some skilled occupations such as boilermaker, blacksmith, machinist, painter, and carpenter. On the other hand, skilled electrical workers (A);⁹ masons, bricklayers, and plasterers; and chief telegraphers and some other supervisory classifications were among the few railroad occupations that had higher employment in 1960 than in 1947.

Maintenance Employees

More than half of the postwar decline in railroad employment occurred among maintenance personnel, whose numbers dwindled from 635,000 in 1947 to 303,000 in 1960. Of these, about 3 out of every 5 were engaged in the maintenance of equipment and stores, which includes the upkeep and repair of locomotives, freight and passenger cars and other wheeled vehicles, and related equipment; and the warehous-

⁹Occupational titles for electrical workers as well as for carmen and clerical personnel include the alphabetical designations A, B, C, or D to indicate differences in types of work performed or in levels of skill in these classifications. Most workers classified as Electrical workers (A) are skilled equipment maintenance personnel. Electrical workers (B) primarily are employed in power stations and substations in skilled occupations such as load dispatcher and station operator. Electrical workers (C) work mainly as operators of electric hoist or conveyor equipment at coal, ore, or grain docks and storage facilities. Carmen (A and B) work principally on passenger car equipment and Carmen (C and D) principally on freight car equipment. Personnel classified as Clerks and clerical specialists (A) mainly have professional or supervisory responsibilities; Clerks (B and C) mainly do routine work.

¹⁰The number of passenger-train cars in service (Class I and II railroads and switching and terminal companies) dropped from about 39,000 in 1947 to 26,000 in 1960; the number of freight-carrying cars generally was about 1.75 million through 1958 but, by 1960, had declined by almost 70,000. Transport Statistics in the United States, op. cit., table 155, p. 103.

The analysis that follows deals with changes in employment in the 128 standard ICC railroad occupational divisions (classifications). To permit more meaningful discussion of these changes, the classifications were grouped into five broad categories of railroad employment: Maintenance employees; transportation employees (other than train, engine, and yard); transportation employees (train, engine, and yard); white-collar employees and miscellaneous service employees.

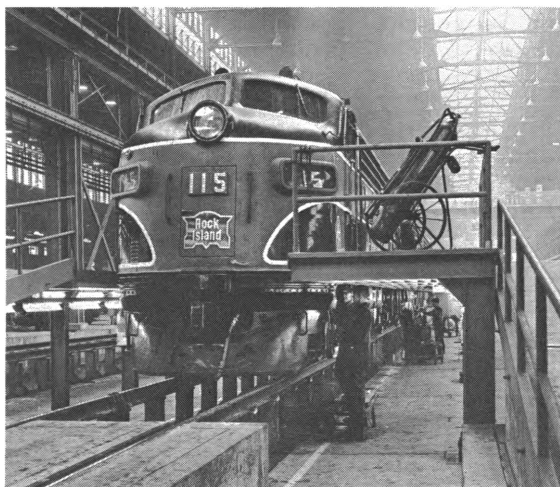
ing of parts and supplies. The remainder were maintenance-of-way and structures employees who maintain roadways, bridges, buildings, and other structures and install and maintain signal and communications systems and related control devices.

Equipment and Stores

In 1960, the number of employees engaged in maintenance of equipment and stores was only half that in 1947. Although reductions in the number of cars in service¹⁰ played an important part in the vast curtailment of equipment maintenance employment, the conversion from steam to diesel-electric locomotives was the key factor. "Not only did the diesel-electric locomotive require less service but as the result of its greater availability [because of lower service requirements], fewer units were required to handle the same amount of traffic."¹¹ The

¹¹Statement of Michael Fox, President, Railway Employees Department, AFL-CIO, in Impact of Automation on Employment, Committee on Education and Labor, House of Representatives, 87th Cong., 1st sess., 1961, p. 294.

The number of locomotives in service declined 30 percent from 1947 to 1960. In 1947, 84 percent of locomotives were steam driven and 14 percent were diesel powered. In 1960, 97 percent of the locomotives were diesel and less than 1 percent were steam driven. Yearbook of Railroad Information, 1961 edition, Eastern Railroad Presidents Conference, Jersey City, N.J., p. 8.



COURTESY OF CHICAGO, ROCK ISLAND
& PACIFIC RAILROAD

Layout of modern diesel maintenance shop facilitates work of machinists, electricians, and other equipment maintenance employees.

lower service requirements of the diesel also permitted the consolidation of shop facilities and the application of production-line methods to equipment servicing.¹² In recent years, equipment maintenance employment has also been affected by the practice of some railroads of sending diesel engines requiring major overhaul back to the manufacturer for rebuilding or exchange for more highly powered new, or rebuilt, units.

Part of the decline in equipment maintenance employment may also be traced to many diverse, relatively small, but cumulatively significant im-

¹² One example of the impact of lower service requirements on maintenance employment is the experience of the Santa Fe Railroad which, in 1946, maintained 26 shops for repairing locomotives and cars, 7 for wheel repair, and 4 for repairing passenger cars. By 1961, repair facilities had been reduced to one major diesel shop and five diesel shops for minor repairs, one shop for passenger car and equipment repair, one wheel shop, and one major freight car repair shop, with three other locations serving as minor car repair depots. "Springfield Becomes Shop Center," Modern Railroads, Chicago, Nov. 1961, pp. 80-81.

provements in maintenance equipment, materials, and methods. These included specialized paints and spray painting methods; improved bearings and bearing lubrication; better inventory control and materials-handling methods; improved manual and automatic welding techniques; and ultrasonic, isotopic, spectrographic, and other advanced analytical techniques to determine metal wear or fatigue. The use of automatic machines to perform specialized operations, such as machining and assembling of car wheel sets, also has cut man-hour requirements.

Changing technology not only contributed importantly to employment declines in almost every skilled equipment maintenance occupation but, in the process, often altered job content and skills. Changes in the number employed in these occupations from 1947 to 1960 are shown in the following tabulation:

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-6
	Total	169,858	145,185	111,205	-35	-15	-23
54	Blacksmiths	5,841	3,375	1,956	-67	-42	-42
55	Boilermakers	13,128	4,310	2,341	-82	-67	-46
56	Carmen (A and B)	20,341	18,212	12,425	-39	-10	-32
57	Carmen (C and D)	56,181	58,786	46,006	-18	+5	-22
58	Electrical workers (A)	10,423	15,430	11,602	+30	+48	-12
59	Electrical workers (B and C)	3,079	2,415	1,893	-39	-22	-22
60	Machinists	47,357	31,621	24,699	-48	-33	-22
61	Molders	569	171	106	-81	-70	-38
62	Molders	569	171	106	-81	-70	-38
63	Sheet-metal workers	11,259	9,298	7,156	-36	-17	-23
73	Stationary engineers	1,680	1,567	1,021	-39	-7	-35

¹ Includes an indeterminate number of gasoline motor-car repairmen.
² Electrical workers (C) include an indeterminate small number of semiskilled electrical equipment operators. The "C" group as a whole had only a few hundred employees.

Rapid replacement of locomotive steam power by diesel-electric power was central to the very large reduction in boilermakers' employment. The number of blacksmiths also declined, partly because of the industry-wide use of replacement parts for diesel locomotives, in contrast with the practice of repairing or reconstructing components for steam locomotives. Improvements in heat-treating, welding, and forging methods, and in related equipment, were also important factors contributing to the decrease. Technological change also contributed to the sizable reduction in employment of machinists, one of the largest of the skilled railroad shop trades. These changes included different and lower maintenance requirements for diesels compared with steam locomotives, the

introduction of production-line servicing methods, and improvements in machine shop equipment, including some with automatic controls. The extent of the employment decline among machinists would have been even greater had it not been for an increase in maintenance work resulting from the very large amount of track and roadway equipment purchased by the railroads since World War II. Reduced employment of stationary engineers reflected the introduction of automatic controls on shop boilers, although the drop in the total number of shop facilities was also important. The number of electrical workers (B), a group which includes power station and substation operators and load dispatchers, declined as diesel-electric locomotives were substituted for "straight-electric" locomotives, which depend on externally generated power.

Electrical workers (A) comprised the only classification in equipment maintenance to show an increase in employment over the 1947-60 period as a whole. All of this increase, however, was due to the large expansion through the early 1950's in the number of these employees needed to maintain the extensive electric power and control equipment on the mushrooming fleet of diesel-electric locomotives.¹³ In recent years, employment of electrical workers (A) has dropped somewhat because of the decline in the number of trains run, the growing experience with diesel maintenance, lower maintenance requirements of later model diesels,

¹³ From 1947 to 1955 the number of diesels increased more than fourfold--from 5,772 to 24,786; between 1955 and 1960, the increase was only 14 percent. Yearbook of Railroad Information, op. cit., p. 8.

¹⁴ Advancing technology in roadway and structures' operations on the railroads generally paralleled developments in the construction industry, notably in highway construction. "Increasing use and efficiency of roadbuilding equipment, particularly in grading and surfacing, was the prime cause of the 47-percent decline in on-site labor requirements for highways from 1947 to 1958." "Labor Requirements for Highway Construction," Monthly Labor Review, Aug. 1961, p. 859.

and increased specialization of work in larger, consolidated maintenance facilities.

Employment of carmen, the largest occupational classification among equipment maintenance employees, was affected generally by technological changes such as improved welding and new joining and fastening techniques, and modernized materials-handling equipment. The severe drop in passenger traffic relative to freight traffic from 1947 to 1960, however, affected occupations within the carmen group differently. Thus, the number of carmen (A and B), most of whom maintain railroad passenger cars, fell 39 percent--more than twice the decline for carmen (C and D), most of whom maintain freight cars.

Those in unskilled and semiskilled equipment maintenance jobs--laborers, helpers, and apprentices--had much greater employment declines than craftsmen, foremen, and other skilled equipment maintenance employees, as shown in the following tabulation:

ICC Div. No.	Occupational group	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	370,287	373,155	184,006	-50	-26	-33
50,51	General, assistant general, and department foremen.	9,323	8,296	7,150	-23	-11	-14
52,53	Gang foremen, leaders, and inspectors.	13,655	11,494	8,573	-37	-16	-25
54-63	Skilled trades journeymen ¹	169,858	145,185	111,205	-35	-15	-23
64-66	Skilled trades helpers and apprentices	98,877	56,052	26,006	-74	-43	-54
67	Classified and general laborers	78,574	52,128	31,072	-60	-34	-40

¹ Includes an indeterminate small number of semiskilled electrical equipment operators in ICC Div. No. 60, Electrical Workers (C).

Way and Structures

Postwar employment of personnel who maintain railroad way and structures dropped by 55 percent, the greatest relative decline among major railroad occupational groups.¹⁴ As the

ICC Div. No.	Occupational group	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	264,816	196,980	118,516	-55	-26	-40
27	Roadmasters, general foremen, and assistants.	3,147	3,359	3,366	+7	+7	+(¹)
28	Inspectors	1,132	1,004	879	-22	-11	-12
35-38	Roadway maintenance workers	207,439	143,345	78,355	-62	-31	-45
39-42	Bridge and building workers	30,366	27,311	17,764	-42	-10	-35
44-49	Signal and telegraph workers	18,875	19,429	16,848	-11	+3	-13
50,51	Laborer crews (bridge and building, signal and telegraph).	3,857	2,532	1,304	-66	-34	-49

¹ Less than 1 percent.

preceding tabulation shows, almost nine-tenths of the decrease was among roadway maintenance employees, who comprise the great majority of all way and structures employees.

Roadway maintenance. Employment in this occupational category fell principally because of two factors: (1) the volume of maintenance decreased as track mileage was reduced and as the recurring cycle of rail and tie renewal and other major maintenance operations were lengthened through technological

¹⁵ Transport Statistics in the United States, op. cit., 1947, 1960, tables 92 and 93.

¹⁶ "The transition from 112 pound rail [per yard] to 131 pound rail reduced the annual maintenance man-hours per mile per year from 1,103.4 to 902.6, or 18 percent [from 1943 to 1950]." William Haber, et al, op. cit., p. 40. With the shift toward heavier rail, the average weight of rail in main tracks on Class I line-haul railroads increased from 100 pounds per yard in 1947 to 106 pounds per yard in 1960. Transport Statistics in the United States, op. cit., 1960, table 7.

¹⁷ According to an article in Railway Age, the declines in rail and track renewals in recent years indicate that minimum replacement has occurred in the light of expected rail and tie service life. "M/W: Moderate Increase" M. H. Dick, Engineering Editor, Railway Age, Jan. 16, 1961, pp. 30-32. See also, "B and O - C and O Officers Stress Deferred-Maintenance Peril," Railway Age, July 17, 1961, pp. 14-18.

¹⁸ "We have four new push-button classification yards; four yards that replace as many as 25 others..." "The Importance of Technological Change to the Railway Industry," Alfred E. Pearlman, President, New York Central Railroad, in Technological Change and the Future of the Railways, op. cit., p. 52.

¹⁹ The installation of CTC increased from about 10,000 track miles controlled in 1947 to 28,000 in 1955 and 36,000 track miles controlled in 1960. Transport Statistics in the United States, op. cit., 1947, 1960, table 8. With the installation of CTC between Cleveland and Buffalo (distance—163 miles), the New York Central Railroad was able to eliminate two tracks of a four-track system. New York Times, Feb. 17, 1957, Sec. 3, p. 1. CTC also contributed to the paring away of 1,800 miles of track on the Pennsylvania Railroad between late 1953 and 1957. "Slimming the PRR," The Pennsy, Pennsylvania Railroad Co., Philadelphia, Jan.-Feb., 1958, p. 10.

improvements; and (2) manpower requirements, principally for gangmen, were reduced by the widespread introduction of mechanized equipment.

The decline in roadway maintenance from 1947 to 1960 is clearly apparent in the 69-percent drop in the number of miles of replacement rail laid by Class I line-haul railroads and the 62-percent decline in the number of replacement crossties put in place.¹⁵ The service life of rail was lengthened by increasing use of heavier rail¹⁶ and of better designed rail; heat-treated, end-hardened, and special alloyed rail; and continuous welded rail in place of bolt-joined rail sections. The period between installation and replacement was extended by the use of better methods of welding to repair battered rail ends and other worn rail surfaces. Rail and tie damage was reduced by improved roadway surfacing and drainage which created a more shock-absorbent roadbed. Greater use of longer service "treated" ties contributed to the decrease in tie renewals. Improved tie plates, pads, and sealants extended tie life by providing better distribution of rolling weight on the tie, and reduced tie rot and wear. Also, it is reported in a leading railroad industry magazine, that some railroads did not effect adequate roadway maintenance programs.¹⁷

Elimination of track and roadbed also reduced roadway maintenance requirements. Trackage and roadway on abandoned branch lines were uprooted, miscellaneous trackage was eliminated in areas of declining traffic and trackage was eliminated in many freight yards made obsolete by new yards using more automatic car classification systems.¹⁸ (For a description of operations in modern electrically controlled car classification yards, see p. 21.)

Retirement of trackage has also been accomplished by the increased installation of Centralized Traffic Control (CTC).¹⁹ With this system, a single train dispatcher, aided by remote control devices and a continuing view of train movements provided by an illuminated track diagram, is able to operate

signals and switches which direct the movement of trains over hundreds of miles of railroad. The improved control over train movements provided by CTC permits closer spacing of trains and results in fewer delays arising out of the meeting and passing of trains, thus increasing the capacity of specific track area to handle trains.

Mechanization was the most important factor in the sharp postwar reduction in roadway maintenance employment. The use of roadway machines for railroad track work is not new--many early versions of machines now in use were developed in the late twenties or early thirties--but major changes have been made since the end of World War II. Substantial investment in roadway equipment²⁰ has provided machines which replace manpower in practically all labor-intensive areas of roadway upkeep. "Included in the equipment of a modern track gang are machines to pull and replace ties, drive spikes; gather up and clean track ballast, return it to the track; and tamp it firmly to provide a smooth-riding surface. Still other machines spray chemicals for the control of vegetation along the right-of-way, and use the science of electronics to inspect and detect flaws in rails before they can break and cause an accident."²¹ Motor vehicles are being used increasingly to carry maintenance crews, equipment, and machines on highways from one track location to another, although rail motor cars are still widely used. When rail vehicles are used, delays are frequent because

tracks must be cleared for oncoming trains. Off-track earth-moving equipment such as bulldozers, graders, power shovels, and cranes have become increasingly available for ditching or other excavation or fill work. The rapid spread of radio communication enables supervisors quickly to check with foremen on work progress, and minimizes delays in track work by keeping crews posted on the location of moving trains.

The effect of mechanization on roadway employment has accelerated since the end of World War II. Although single-purpose machines used early in the postwar period made possible faster-than-manual operation and greatly reduced human effort, improvements in machines, the introduction of multipurpose machines, and the increasing efficiency of machine operators permitted even greater labor-savings in roadway maintenance work. Certain operations, such as taking out and inserting ties and raising, tamping, and lining track, when performed manually, commonly required gangs of 100 men and, at times, as many as 300. Today's mechanized work gangs, combined for production-line handling of these operations, may number between 25 and 35 men making use of 8 to 11 power machines.²² "One railroad found that a single multipurpose machine operated by 1 man, could replace 6 single-purpose machines and eliminate about 15 trackmen."²³

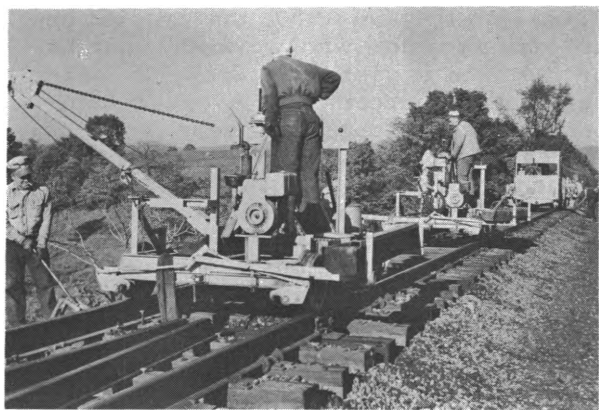
In addition to its impact on the number of employees in roadway maintenance, mechanization has changed the character of employment in such operations by stimulating the reorganization and more efficient utilization of the roadway work force. Before the use of machines and equipment became widespread, track and roadway upkeep was performed by the section gang or crew, frequently numbering 30 or more men. Such a group, equipped with manually and pneumatically operated hand tools, had full responsibility for a limited area of roadway. Extra gangs were employed for heavy roadway construction and repair jobs, such as major rail- and tie-laying or replace-

²⁰Net investment in roadway machines by Class 1 line-haul railroads increased from \$62.5 million at yearend, 1947, to \$200.5 million at yearend, 1960 (current dollars). *Transport Statistics in the United States*, op. cit., 1947, 1960, table 138.

²¹Curtis D. Buford, Vice President, Operations and Maintenance Department, Association of American Railroads, "New Concepts in Railroading," address before the Annual Transportation and Logistics Forum, National Defense Transportation Association, Denver, Colo., Sept. 19, 1961.

²²"Now Most Maintenance Operations Are Mechanized," *Railway Age* (Centennial Issue), Sept. 1956, pp. 230-234.

²³"Revolution on the Steel Highway," *Modern Railroads*, Chicago, May 1959, p. 79.



COURTESY OF ASSOCIATION OF AMERICAN RAILROADS AND WESTERN MARYLAND RAILWAY

The size of roadway maintenance crews has been reduced sharply with the widespread use of specialized equipment.

ment and surfacing or resurfacing large sections of roadway. With mechanization, the trend has been to use specialized gangs in roadway maintenance. Large gangs may operate over an entire railroad or a very large section of track. One group may replace ties, reline rail, and resurface track, while others perform ditching operations at the sides of the roadbed, or weld rail and lay welded rail. Smaller "floating" mechanized gangs of 8 to 12 men assigned to railroad divisions or subdivisions do necessary maintenance between major roadway renewals, such as tamping low spots in the roadbed, relining rail, and repairing (welding) rail joints or other worn rail surfaces. "Floating" gangs may be supplemented by patrol gangs of two to four men who inspect rails, ties, and roadbed, tighten rail bolts, and perform other miscellaneous light work. The changing structure of roadway maintenance employment, particularly as reflected in the sharp decline of section workers and the rapid growth of portable equipment operators, is shown in the following tabulation:

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	207,439	143,345	78,355	-62	-31	-45
40	Gang or section foremen	24,603	19,658	10,784	-56	-20	-45
42	Section gangmen	123,667	84,585	38,248	-69	-32	-55
38	Gang foremen (extra and work train)	4,095	2,912	3,152	-23	-29	+8
41	Extra gangmen	47,663	28,743	18,467	-61	-40	-36
35	Portable equipment operator#	4,880	6,291	7,182	+47	+29	+14
36	Portable equipment operator helpers	687	738	381	-45	+7	-48
37	Pump equipment operators	1,844	418	141	-92	-77	-66

The proposition that mechanization has also affected the character of roadway maintenance employment by upgrading the average skill level in these jobs is "widely recognized" according to a definitive study of maintenance-of-way employment.²⁴ The study points to the greater time needed by untrained workers to learn roadway maintenance jobs requiring operation of machines and equipment. Evidence of higher skill requirements is also cited in terms of the large increase between 1948 and 1955 in the number of portable equipment operators in roadway maintenance work.

Although the roadway maintenance work force was cut drastically, continuity of employment improved for those who remained, partly reflecting railroad efforts to maximize the use of expensive capital equipment. For example, the average months of service of extra gangmen, whose employment is particularly erratic, rose from about 4.6 months in 1947 to 6.4 months in 1959.²⁵

²⁴ William Haber, et al, Maintenance of Way Employment on U.S. Railroads, 1957, p. 52.

²⁵ Annual Report, Railroad Retirement Board, 1949, Table E-5, p. 244; 1959 data computed from Compensation and Service of Railroad Employees, Statistical Tables, 1959, U.S. Railroad Retirement Board, 1961, p. 75. A month of service is defined by the Board as any calendar month in which an employee has earnings, no matter how little, creditable under the Railroad Retirement Act.

Between 1954 and 1959, the proportion of extra gangmen who worked 9 months or more in a year rose from 25 percent to 38 percent.²⁶ Average compensated man-hours for these workers increased from 1,637 in 1947, with a 48-hour workweek, to 1,840 in 1960,²⁷ despite a reduction in the workweek to 40 hours.

Structures maintenance. Employees engaged in maintaining bridges, buildings, tunnels, towers, and other railroad structures, constitute another major group of railroad maintenance employees. Contraction of the railroad plant that accompanied improvements in methods and equipment and the abandonment of stations largely accounted for this group's sharp employment decline, as shown in the following tabulation:

IGC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	34,223	29,843	19,068	-44	-13	-36
29	Gang foremen of skilled labor	4,018	3,818	2,695	-31	-5	-29
30	Carpenters	13,805	11,754	7,144	-48	-15	-39
31	Ironworkers	964	819	585	-39	-15	-29
32	Painters	2,093	2,066	915	-56	-1	-56
33	Masons, bricklayers, and plasterers	1,996	2,554	2,750	+38	+28	+8
34	Helpers and apprentices ¹	7,490	6,300	3,675	-51	-16	-42
39	Gang foremen of laborers (bridge and building; signal and telegraph)	258	142	90	-65	-32	-37
43	Laborers (bridge and building; signal and telegraph)	3,599	2,390	1,214	-66	-34	-49

¹ Includes unknown number of maintenance-of-way welders.

² Includes unknown number of maintenance-of-way welders' helpers.

Uneconomical railroad structures were eliminated, to reduce maintenance costs and to save State or local property taxes. Many passenger trains were discontinued and many passenger stations were abandoned.²⁸ Many small freight stations were closed, or consolidated to serve larger areas,²⁹ partly because improved highways permitted shippers greater accessibility to many locations. With dieselization, the number of major equipment repair terminals was reduced, fewer structures for locomotive maintenance were required, and the extensive facilities that provided fuel and water for steam locomotives were eliminated. Many small train control towers were eliminated as centralized traffic control systems were applied to thousands of miles of heavily traveled rail routes.

Structures maintenance operations and employment were reduced in still other ways. Increased use was made of brick, steel, and other durable materials in constructing or altering railroad structures, such as diesel locomotive shops, freight depots, and office buildings. The development of high-capacity earth-moving equipment made it economical to eliminate many bridge trestles which needed extensive renewal, by earth-filling ditches or streams and using steel or concrete culvert pipe to carry the water through the fill. The practice of reinforcing bridges to carry the constantly increasing weight of larger and more powerful steam locomotives declined with the widespread use of diesel locomotives. Jointed aerial booms mounted on highway trucks reduced labor requirements involved in the erection of bridge or building scaffolds or other rigging. Bridge and building crews were equipped with portable electric generators and air compressors which enabled them to use portable electric tools such as chain and circular saws, drills, and grinders, and portable pneumatic tools such as impact wrenches, jack-hammers, and bolt-pullers. Employment of ironworkers was affected by the increasing substitution of welding, bolting, and other improved methods in place of riveting, for joining structural

²⁶Data for 1954 from William Haber, et al, op. cit., table 5-1(e), p. 135; 1959 data computed from Compensation and Service of Railroad Employees, *ibid*.

²⁷Transport Statistics in the United States, op. cit., 1947, 1960, table 69. Average man-hours per year obtained by dividing annual compensated hours for extra gangmen by the annual average of "during-the-month" employment.

²⁸A total of "1,244 [passenger] trains were discontinued by State commissions during the years 1951-56, and 2,466 stations were abandoned in the same period." National Transportation Policy, op. cit., p. 350.

²⁹"From 1955 to July 31, 1961, 160 [mainly freight] stations were closed by...[The Southern Pacific Company] --about 140 of them since Jan. 1958." Report to the President by the Emergency Board (Board No. 138), Washington, D.C., Sept. 15, 1961, p. 14.

members of bridges and buildings. Fewer painters were needed as improved paints and spray-painting equipment decreased painting time and provided longer lasting, protective coatings.

Masons, bricklayers, and plasterers were the only occupational division (classification) to show increased employment. The rise can be traced partly to the more extensive use of masonry as a substitute for wood in railroad structures, but it may also reflect the inclusion of maintenance-of-way welders in this occupational classification.³⁰ Welders have become increasingly important in track laying and repair operations.

Signal and telegraph. These employees constitute a third group of maintenance-of-way and structures employees. Employment declines in this group were much less severe than in other occupational groups in maintenance-of-way and structures operations. In four of the six signal and telegraph classifications, employment actually showed moderate gains until the mid-1950's, but then declined. Employment in the less-skilled assistants and helpers classifications declined throughout the 1947-60 period, as shown in the following tabulation:

ICG Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	18,875	19,429	16,848	-11	+3	-13
44	General foremen and assistants and inspectors	1,342	1,547	1,551	+16	+15	+1
45	Gang foremen	1,468	1,624	1,581	+8	+11	-3
46	Signalmen and signal maintainers	8,244	8,754	7,889	-4	+6	-10
47	Linemen and groundmen	2,232	2,863	2,462	+10	+28	-14
48	Assistant signalmen and signal maintainers	2,447	2,403	1,776	-27	-2	-26
49	Helpers, signalmen, and signal maintainers	3,142	2,238	1,589	-49	-29	-29

¹ Less than 1 percent.

Group employment data for signalmen and signal maintainers and their assistants and helpers indicate decreases in employment between 1947 and 1960. These data, however, apparently mask divergent trends within these groups. Employment of signalmen--those engaged in installing railroad signals and control devices--probably increased through the mid-1950's and then tapered off, largely because of the greater growth in CTC systems during the earlier years of the 1947-60

period. Their employment was also favorably affected by increased installation of automatic light signals, gates, and other warning devices at highway crossings, and of electronic control equipment in major freight yards, which permit more automatic and speedier classification of freight cars.³¹

The number of signal maintainers, on the other hand, probably decreased over the entire 1947-60 period. Elimination of many miles of second and other main tracks through installation of CTC led to the elimination of signals which controlled movement over these tracks and to elimination of interlockings³² at the occasional junctions of two or more parallel main tracks. With the expansion of CTC and the abandonment of branch lines, the number of miles of track (primarily single track) controlled by nonautomatic block signals was reduced considerably. In addition, there was a growing use of electrically actuated switches and signals, using relatively few moving parts, and a sharp reduction in the number of mechanical switch and signal controls which had complicated linkage requiring much greater maintenance.

The number of linemen and groundmen rose over the postwar period as a whole. These men, who string and lay power cable and communications lines at and between railroad terminals, shops, power-generating and switching stations, and other railroad facilities, were needed for new installations and modifications of existing ones as railroads modernized their plant and operations. For example,

³⁰ Rules Governing the Classification of Railroad Employees, etc., op cit., p. 21.

³¹ According to 1 tabulation, 32 electronically controlled freight classification yards were in service between 1949 and 1959 and 2 others were slated to be put into service by 1960. See Frank E. Shaffer, "Rundown on Automation," Trains Magazine, March 1961, pp. 22-23.

³² An interlocking is a complex of switches and signals governing the movement over switches arranged to avoid conflicting train movements.

there was widespread consolidation of equipment maintenance facilities and installation of various types of communications equipment. In recent years, however, employment of line-men and groundmen has been declining with the contraction of railroad plant and improvements in technology. Examples of such technological developments are "carrier" equipment which

permits the sending of many messages over a single wire, the aerial boom which facilitates work on overhead construction, the truck-mounted power auger which speeds the digging of holes for line poles, and microwave radio transmission equipment which displaces telephone, telegraph, and other wired communications systems.

Transportation Employees (Other Than Train, Engine, and Yard)

The number of employees at freight and passenger terminals, train control and communication centers, signal control towers along the right-of-way, and aboard dining and parlor cars of passenger trains declined from 172,000 to 91,000--or 47 per cent--between 1947 and 1960. More than half of the reduction in this group occurred among railroad employees who load and unload cars and weigh, check, and inspect freight at freight stations, and who operate barges, ferries, and tugboats. Employment reductions among employees at freight stations and aboard vessels are shown in the following tabulation:

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	89,643	59,885	43,013	-52	-33	-28
78	Station agents (supervisory, major stations)	2,288	2,164	1,970	-14	-5	-9
79	Station agents (nontelegraphers, smaller stations)	4,957	4,350	3,225	-35	-12	-26
80	Station agents (telegraphers and telephoners)	14,100	13,067	10,738	-24	-7	-18
88-89	General foremen and assistants (freight stations, warehouses, docks, and grain elevators)	587	578	471	-20	-2	-19
90	Gang foremen (freight stations, etc.)	3,027	2,798	2,196	-27	-8	-22
91	Callers, loaders, scalers, and perishable-freight inspectors	17,375	12,742	9,139	-47	-27	-28
92	Truckers (stations, warehouses, platforms)	34,009	12,997	7,018	-79	-62	-46
93-94	Laborers (coal and ore docks, stations, warehouses, platforms, and grain elevators)	6,906	6,033	4,764	-31	-13	-21
98	Officers, workers and attendants on barges, ferries, towing vessels, etc.	6,394	5,156	3,492	-45	-19	-32

¹ Includes some station agents at passenger stations.

Employment at small freight terminals fell and many terminals were closed with the drastic decline in less-than-carload freight traffic (from 22.6 mil-

lion tons in 1947 to 3.2 million tons in 1960),³³ and the considerable shift in handling of mail to competing modes of transportation.

Substantially reduced numbers of truckers, loaders, checkers, and other employees at freight terminals also reflected such developments as the reorganization of workflow; the widespread use of chain and belt conveyor systems and lift trucks and other powered vehicles; and the increasing installation of communications equipment. The introduction of mechanized mail-sorting systems in some terminals also reduced employment needs.

Personnel who provide services to railroad passengers also suffered severe reductions in employment, mainly because of the steep drop in postwar railroad passenger travel. Other reasons were the introduction of snackbar food service on passenger trains and the installation of electronic passenger reservation systems on some roads. Employment declines were especially large for laundry workers and for waiters, chefs, stewards, and others working on dining and parlor cars, as shown in the following tabulation:

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	37,714	27,780	18,723	-50	-26	-33
84	Station masters and assistants	430	408	296	-31	-5	-27
85-86	Supervising baggage agents and assistants	481	496	356	-26	+3	-28
87	Baggage, parcel room, and station attendants	9,035	9,016	6,080	-33	-(¹)	-33
12	Ticket agents and assistants	1,274	1,076	692	-46	-16	-36
95	Stewards and dining car supervisors	1,857	1,366	880	-53	-26	-36
96	Chefs and cooks	5,610	3,481	2,276	-59	-38	-35
97	Waiters	13,975	7,875	4,910	-65	-44	-38
100-101	Parlor car conductors and train attendants	4,422	3,596	2,979	-33	-19	-17
104	Laundry workers and foremen	623	466	254	-60	-26	-45

¹ Less than 1 percent.

³³ Transport Statistics in the United States, op. cit., 1947, 1960, table 46.



COURTESY OF NEW YORK CENTRAL SYSTEM

One train dispatcher, operating a centralized traffic control board, guides the movement of trains over many miles of railroad.

The telegraphers (other than chief telegraphers), telephoners, towermen, dispatchers, and other workers directly engaged in controlling train movements and handling communications at and between terminals were other nonoperating transportation employees whose numbers decreased, as shown below:

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	29,976	28,557	22,577	-25	- 5	-21
75	Chief train dispatchers . .	994	1,094	997	+(1)	+10	- 9
76	Train dispatchers	3,210	3,105	2,536	-21	- 3	-18
77	Train directors	152	210	374	+146	+38	+78
81	Chief telegraphers	925	1,111	1,156	+25	+20	+ 4
82	Clerk telegraphers and telephoners	10,029	9,053	6,555	-35	-10	-28
83	Telegraphers, tele- phoners, and towermen . .	14,666	14,004	10,959	-25	- 5	-22

¹ Less than 1 percent.

to operate "at-site" switch and signal controls.

The extensive introduction of CTC had its greatest employment impact among train-control employees with lower levels of responsibility. Thus, the rate of employment decline among telegraphers, telephoners, towermen, and clerk telegraphers, who make up the great majority of all train-control personnel, was significantly greater than that for train dispatchers. In some instances, train dispatchers were assigned to the handling of remotely controlled switches and signals,³⁴

With the widespread introduction of automatically controlled and of remotely controlled switches and signals (including those remotely controlled under CTC systems), fewer train-control workers were employed to provide written orders to train personnel and

³⁴ "...the carrier [Southern Pacific Company] has consistently manned these CTC systems with train dispatchers and progressively abolished telegrapher positions in CTC territory where trains no longer move under train orders." Report to the President by the Emergency Board, op. cit., p. 11.

whereas under the decentralized system displaced by CTC, telegraphers or towermen controlled switch-signal layouts or issued train orders under the direction of dispatchers.

At railroad communications centers, employment of telegraphers and telephoners declined because of the expanded use of improved communications equipment, such as teletype and carrier systems. On the other hand, there was an increase in the number of chief telegraphers (wire chiefs), who supervise activities at communications centers.

Dieselization and declining train miles were other factors in the downward trend in train control employment. Because higher powered diesel locomotives permitted the hauling of longer, heavier trains without the need for helper engines, related train control activities were reduced. Also, diesel-powered trains did not need to stop for refueling or for taking on water, or for setting and releasing retaining valves (auxiliary braking devices) on steep slopes, "thus reducing the number of train orders required and permitting the closing of intermediate telegraph offices which were maintained mainly for train order purposes."³⁵ Drastic

reduction in the number of mail-carrying trains and "establishment by the United States Post Office Department of a metropolitan distribution system, which brought about elimination of intermediate passenger train stops between the centralized mail distribution centers," resulted in the elimination "at intermediate stations [of] a number of station duties of telegraphers."³⁶

Reductions in employment also occurred among employees who generally assist in the movement of freight and passenger traffic.

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
99	Transportation and dining service inspectors . . .	806	778	666	-17	-3	-14
102	Bridge operators and helpers	1,016	1,049	939	-8	+3	-10
103	Crossing and bridge flagmen and gatemen . .	12,996	8,559	4,647	-64	-34	-46

The number of crossing and bridge flagmen (watchmen) and gatemen was considerably reduced by widespread installation of automatic gates, signal lights, and other warning devices at highway crossings. Fewer flagmen were needed also because of the drastic decline in the number of highway crossings without gates but with watchmen protection.

Train, Engine, and Yard Employees

The decline in the number of operating employees--those engaged in train and engine service over the road and at terminals--was closely linked not only to reductions in the number of passenger and freight trains, but also to technological developments. The most important development was the diesel-electric locomotive. In addition, faster movement and fewer delays of cars and trains resulted from better signal and control devices, extensive use of communications equipment, and improvements affecting freight car components such as roller bearings, bearing lubrication pads, and structural framework.

³⁵Report to the President by the Emergency Board, op. cit., p. 12.

³⁶Ibid.

Despite the fact that the engine crew (engineer and fireman) and the train crew (conductor and brakeman) generally work together as an operating unit, engine service employees had a greater relative employment decline.

ICC Div. No.	Type of service	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
111-120	Train service	172,287	146,072	124,540	-28	-15	-15
121-128	Engine service	117,733	89,469	74,982	-36	-24	-16

The disparity may be traced to the rapid replacement of the steam locomotive by the diesel. Because of its greater pulling power, the diesel could more easily get a train moving and move it more efficiently at low speed. In addition, a diesel locomotive could be coupled into multiple units operated from a single cab, whereas each steam locomotive required a separate engine

crew. As a result of these advantages, "pusher engines," which were used to assist steam locomotives in moving heavy trains out of terminals and up steep slopes, were seldom needed when diesel-powered locomotives were used on the head end of the train. Because diesel engines could be coupled and operated by a single engine crew, longer and heavier freight trains were more economical to run compared with trains powered by steam engines.

Terminals

More than half of all operating employees in 1960 were engaged in operations at terminals--"making-up" and "breaking-up" trains, transferring cars from one railroad to another, and placing and removing cars at industrial sidings and other tracks used for loading and unloading. A small proportion of these employees handled the movement of passenger equipment at terminals. Another small group (hostlers) moved locomotives around engine maintenance areas and delivered locomotives to engine crews in yards and at train departure points. Employment of all terminal operating employees has decreased, particularly during the late 1950's, as shown in the following tabulation:

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	133,981	124,089	110,206	-18	-7	-11
105-106	Yard masters and assistants	6,080	6,098	5,889	-3	(1)	-3
119	Yard conductors and foremen	20,793	20,739	18,918	-9	(2)	-9
120	Yard brakemen and helpers	54,783	51,662	45,434	-17	-6	-12
124	Yard engineers and motormen	19,918	18,279	15,803	-21	-8	-14
128	Yard firemen and helpers	21,374	19,213	17,969	-16	-10	-6
107	Switchtenders	3,177	2,839	1,976	-38	-11	-30
108-110	Hostlers and helpers	7,856	5,259	4,217	-46	-33	-20

¹ A plus quantity of less than 1 percent.
² A minus quantity of less than 1 percent.

The decline in employment among operating employees at terminals was generally much less severe than among those in road freight and passenger service, in part resulting from the negotiation in 1952 of a basic 40-hour workweek for yard operating employees. Although acceptance of the agreement was optional, by 1960 it covered most terminal operating employees. Another factor that contributed to the lesser employment declines

among yard operating personnel is the "stand-by" character of some terminal work. While labor requirements for some terminal operations, such as car classification, can be approximated on the basis of past experience, employment allowances must be made at terminals for the less predictable demands of shippers for services and for the early or late arrival of freight trains. In contrast, most road crews work or are called for work only when schedules dictate or it is known that trains will be ready to roll.

Declining train movement, particularly passenger, caused a reduction in terminal employment generally. Technological changes, too, had widespread effects on terminal employment, but some developments particularly affected certain yard occupations. For example, the installation of radio equipment in yard offices and on locomotives affected yard operating employment generally by permitting continuous communication between yard masters and switching crews. On the other hand, the use of automatic devices in freight car classification yards to speed operations and reduce costs reduced employment of yard labor in general, but had much greater impact on brakemen (switchmen) and switchtenders.

In the modern, huge car classification yard which handles great traffic volume, strings of cars are pushed to the lip of a declining slope, "cut" (separated) according to destination, and permitted to roll down to one track in the classification yard. In the past, brakemen (switchmen) rode these "cuts" of cars and controlled their speed by tightening or loosening handbrakes. Switchtenders stationed along the "lead" track threw switches which diverted cars to appropriate classification tracks. The application of controls--first remote, then automatic--to retard the speed of cars and to throw switches eliminated the need for brakemen and switchtenders for this type of work. Today, in a modern car classification yard, the entire operation is monitored by an operator seated at a control panel. The operator, merely



COURTESY OF NEW YORK CENTRAL SYSTEM AND SOUTHERN PACIFIC CO.

In many large freight car classification yards, most hand braking of freight cars has been eliminated by automatically and remotely controlled car retarding systems.

by pushing a button on the panel, actuates this system which automatically controls the retarders and switches to classify all cars in an entire train. The development of such controls has been an evolutionary process--early retarding equipment dates back to the mid-twenties--but improvements have accelerated rapidly during the postwar period and such control equipment has been widely adopted. According to one assessment of the employment effect of remote and automatic controls in car classification yards, such equipment "has cut operating manpower requirements from an average of 18 or 20 crews of four to eight men, to 1 crew of five men or less."³⁷

Road Freight Service

Only 3 out of every 5 operating employees in road freight service in 1947 were so employed in 1960.

³⁷ Arthur B. Shenefelt, "Automation on the Railroads," p. 7, reprinted from a series published in the Journal of Commerce, New York, April and May 1957.

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	130,302	94,256	79,157	-39	-28	-16
113-114	Road freight conductors	20,953	16,007	13,734	-34	-24	-14
117-118	Road freight brakemen	51,105	39,293	33,379	-35	-23	-15
122-123	Road freight engineers	27,834	18,898	15,573	-44	-32	-18
126-127	Road freight firemen (helpers)	30,410	20,058	16,471	-46	-34	-18

Fewer freight trains were operated because of greatly increased train length and higher average tons per car of carload revenue freight. Total freight train miles (revenue and non-revenue), and train miles for work trains declined sharply. Among developments which helped to eliminate train delays and otherwise improve train operations were the vast postwar expansion of CTC; the introduction of radio communication between locomotive, caboose, and train control personnel; and the increasing use of detection devices to call attention to hot bearings and dragging equipment on cars of trains en route.

Road Passenger Service

Only about half as many operating employees were engaged in passenger service in 1960 as in 1947, primarily as a result of the 50 percent decline in the number of passenger-train miles. The declines in employment of these workers are shown in the following tabulation:

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	42,850	31,392	22,241	-48	-27	-29
111	Road passenger conductors	7,678	5,686	4,082	-47	-26	-28
112	Assistant passenger conductors and ticket collectors	3,379	2,784	2,283	-32	-18	-18
115-116	Road passenger brakemen and baggagemen	13,596	9,901	6,710	-51	-27	-32
121	Road passenger engineers	9,534	6,849	4,841	-49	-28	-29
125	Road passenger firemen (helpers)	8,663	6,172	4,325	-50	-29	-30

White-Collar Employees

Among major white-collar groups, only the clerical group had a proportionately large reduction in employment. The percentage decline among professionals, subprofessionals, agents, storekeepers, and buyers fell moderately, and there was slight overall change in the employment of executives, officials, and staff assistants.

was much greater than for supervisors and the more skilled clerical personnel, as the following tabulation shows:

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	162,701	138,140	111,229	-32	-15	-19
4-5	Supervisory clerks, chief clerks, and assistants	14,340	14,320	13,455	-6	-(¹)	-6
9	Stenographers and secretaries (A)	3,950	3,995	3,767	-5	+1	-6
8	Mechanical device operators	8,451	8,232	7,047	-17	-3	-14
7	Clerks (B and C)	114,947	94,192	73,805	-36	-18	-22
10	Stenographers and typists (B)	16,183	13,704	10,394	-36	-15	-24
14	Switchboard operators and office assistants	4,830	3,697	2,761	-43	-23	-25

¹ Less than 1 percent.

Clerical Personnel

The flow and storage of information on railroads present a particularly complex problem because of the extensive geographical areas over which most carriers operate. Many different kinds of reports, correspondence, and records are prepared in connection with the boarding and alighting of passengers, loading and unloading of freight cars, interchange of cars between carriers, and arrival and departure of trains at points all over the country. Also, voluminous internal accounts and records, such as payroll, purchasing and inventory accounts, and equipment performance records must be kept up to date. Concentrations of clerical personnel are found in the general offices of railroads, but substantial numbers work in thousands of freight stations and in division offices, passenger terminals, freight yards, and offices and parts storerooms of railroad maintenance shops.

Clerical employment fell about a third between 1947 and 1960. However, the drop in the number of clerks, stenographers, typists, and other employees engaged in routine operations

The drop in clerical employment was due to various causes. For example, many passenger and freight stations were eliminated. Clerical rolls were also reduced because of the centralization of many equipment-maintenance facilities and reductions in the purchase and inventory of parts and supplies. Many different types of office machines were introduced to keep pace with the enormous volume of paperwork. Improved indexing and filing equipment and systems speeded the storage and retrieval of information. Information transmitted by teletype, facsimile, and other methods was duplicated by machines at the receiving end, eliminating the need to copy manually.

Installation of modern data-processing equipment also affected clerical employment. In 1947, most railroads were using bookkeeping, accounting, and other business machines along with punch-card equipment to process mass data. The installation of electronic data-processing equipment on many

major railroads since the mid-1950's³⁸ permitted the establishment of more centralized accounting systems. The immediate employment impact of the introduction of electronic data processing was slight. Both the old and new methods of processing data were carried on simultaneously for extended periods to develop satisfactory programs and to train personnel to operate the new equipment. However, with complete conversion to the new systems, labor and time savings were realized.

The rate at which clerical employees were displaced was programmed to occur over a number of years on some railroads, as a result of collective bargaining agreements between carriers and the union which represents these employees. One such agreement provided that the abolishment of positions owing to changes in work caused by conversion to electronic data processing would be accomplished through normal attrition, not to extend beyond 4 years from the effective date of each such change.³⁹

Professionals, Subprofessionals, and Agents

The role of the engineer and scientist, technician, market analyst, and other highly specialized railroad personnel was increasingly emphasized in the postwar period as carriers sought to reduce costs and compete more effectively by modernizing plant, equipment, and operating methods. As a result, despite the substantial drop in railroad employment, the number of professional and subprofessional personnel (ICC Div. Nos. 3 and 6) fell moderately.

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	35,981	35,399	32,348	-10	-2	-9
3	Professional and subprofessional assistants	8,169	8,145	7,777	-5	-(²)	-5
6	Clerks and clerical specialists (A) ¹	11,600	11,505	10,487	-10	-1	-9
13	Traveling auditors or accountants	1,297	1,207	1,015	-22	-7	-16
11	Storekeepers, sales agents, buyers	2,381	2,275	1,771	-26	-4	-22
19	Traffic and other agents	11,015	10,725	9,843	-11	-3	-8
20-22	Claims agents	1,519	1,542	1,455	-4	+2	-6

¹ Mainly professional personnel.
² Less than 1 percent.

Except for lawyers and legal specialists, employees classified as "professional and subprofessional assistants" were in scientific and technical occupations such as engineers and chemists and their assistants, architects, and draftsmen.⁴⁰ The group of clerks and clerical specialists (A) mainly includes professional personnel, such as accountants, statisticians, and market analysts. The relatively greater drop in employment of these employees compared with scientific and technical personnel probably reflected the greater centralization of accounting functions that became possible with the introduction of more efficient data-processing equipment. Declining passenger traffic was an important reason for the reduction in employment of traveling auditors and accountants, many of whom audit and check passenger transportation.

Several factors contributed to the employment decline among storekeepers, sales agents, and buyers. With the adoption of the diesel-electric locomotive, many maintenance facilities were eliminated. Fewer locomotives and cars in service resulted in reduced purchase and storage of replacements parts, petroleum products, and other equipment and supplies. Purchases of rails and ties decreased

³⁸ The rapid growth in the number of such installations in recent years is indicated by the estimate that "there are currently some 31 railroads which have approximately 64 computers installed." Robert S. Gillett, Opportunities for Computers in Land Transportation, p. 3. Paper presented at the Railroad Computer and Automation Conference, sponsored by the American Institute of Electrical Engineers, Land Transportation Committee, (Cleveland, Ohio), June 6, 1961.

³⁹ Agreement between the Union Pacific Railroad Co. and the Brotherhood of Railway and Steamship Clerks, Freight Handlers, Express and Station Employees, Sept. 26, 1958, Sec. 6.

⁴⁰ Unpublished data from a Bureau of Labor Statistics survey of scientific and technical personnel indicate that in the railroad industry about 9 out of 10 technical professional personnel were engineers, and 1 of every 3 technicians was a draftsman. About 1 of every 6 scientists and engineers was engaged in management or administrative activities.

as roadway maintenance operations contracted.

Executives, Officials, and Staff Assistants

Employment in this relatively small group increased through the midfifties, reflecting the need for management personnel to adapt railroad operations to meet extensive technological change and growing competition from other

carriers. Since then, however, employment in the group has dropped steadily. By 1960, employment approximated the 1947 level.

ICC Div. No.	Occupational group	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total	15,194	16,074	15,043	- 1	+ 6	- 6
1	Executives, general officers, and assistants	6,767	7,319	6,760	-(¹)	+ 8	- 8
2	Division officers, assistants, and staff assistants	8,427	8,755	8,283	- 2	+ 4	- 5

¹ Less than 1 percent.

Miscellaneous Service Employees

The large group of railroad employees who perform miscellaneous services declined by about a fourth between 1947 and 1960.

radio and other intercommunication equipment between offices, installation of automatic elevators, elimination of many passenger and freight stations, and widespread consolidation of facilities for equipment maintenance, accounting, and car classification switching. Motor vehicle operator made up the only occupational classification in which employment increased, reflecting a very great rise in the number of highway vehicles used by Class I line-haul railroads. A large proportion of these vehicles were trucks in nonrevenue service, many of which were used in place of rail hand cars and motorcars to move railway maintenance crews and equipment from one track location to another.

ICC Div. No.	Occupation	Employment			Percent change		
		1947	1955	1960	1947-60	1947-55	1955-60
	Total ¹	23,690	22,103	17,182	-27	- 7	-22
15	Messenger and office boys	3,609	2,606	1,727	-52	-28	-34
16	Elevator operators and attendants	1,026	818	518	-50	-20	-37
17-18	Lieutenants and sergeants of police, patrolmen, and watchmen	7,258	6,266	4,767	-34	-14	-24
23	Miscellaneous trades workers ²	882	838	370	-58	- 5	-56
24	Motor vehicle operators	4,676	6,225	5,880	+26	+33	- 6
26	Janitors and cleaners	6,239	5,350	3,920	-37	-14	-27

¹ Excludes small number of teamsters and stablemen (ICC Div. No. 25).

² Includes such employees as printers, photographers, bookbinders, and ships' carpenters.

Factors which contributed to the overall drop in employment in this group included the extensive use of

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