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**EMPLOYMENT AND UNEMPLOYMENT SERIES**

**TECHNOLOGICAL CHANGES AND EMPLOYMENT  
IN THE UNITED STATES POSTAL SERVICE**



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## Acknowledgment

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**TECHNOLOGICAL CHANGES AND EMPLOYMENT  
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**Recent Innovations in the Postal System**

A study of the recent history and present status of the postal system by the United States Bureau of Labor Statistics shows that it has been undergoing a series of changes which, although more continuous and therefore less noticeable, are probably no less radical in character than the changes that have revolutionized many other American industries. One needs to go back no more than a quarter of a century to discover that the system has been transformed in regard to the nature and variety of services rendered; the use of mechanical methods; the introduction of administrative changes; the adaptation of the physical plant to changing conditions and needs; and the increased productivity of labor.

Since 1908 (the first year included in the present study) the vast and complicated system of parcel post has been developed. Connected with parcel post has been the introduction of the collect-on-delivery system, the insuring of parcels, and special-handling arrangements. Among the other additions to the services rendered are the Postal Savings System, village delivery, and extensions of the delivery system in both city and country.

In smaller offices and with regard to some phases of the work in larger offices, mechanical methods are not economically applicable; but for handling a wide variety of activities, such methods have been devised and extended in recent years to an extent that is seldom realized by patrons of the system. Improved canceling and post-marking machines are used in all offices large enough to justify their adoption. In preparing letters for the canceling machine, mechanical facing tables are used. Many varieties of automatic conveyors have been devised and put into use. An important factor in the development of motor vehicles and airplanes has been the extensive patronage of these industries by the postal system. Large firms and institutions have been encouraged to make use of such devices as metered postage machines. In the handling of finances and accounts, many kinds of the most efficient types of bookkeeping and calculating machines are in extensive use.

There has been an even greater variety of administrative changes for the purpose of promoting efficiency. Among these may be included a definite budgeting of funds for encouraging invention and for buying or renting and maintaining labor-saving devices. A division of cost ascertainment has been established for carrying on a continuing study of the various phases of income and expenditure as a basis for conducting the financial affairs of the postal system according to sound economic principles. The handling of the accounts of smaller offices has been decentralized in what is known as the district post-office accounting system. Remarkable economies have been effected in the money-order accounting system. Surveys have been conducted for the purpose of discovering the most efficient methods, formulating plans for standardized procedures, and making available to the entire system the best methods found anywhere in the system. An administrative reorganization has coordinated the mailing and finance divisions in the various larger offices. In order to avoid slack time and to make possible a full utilization of the labor facilities of the system, postal employees perform a variety of functions and thus the advantages of specialization are combined with the economies of interchangeability of labor. An important illustration of recent coordination of labor for greater efficiency is the unit system for facing, canceling, and separating letters in the larger offices. The development and general application of a system of efficiency ratings has characterized recent postal history.

In the adaptation of the physical plant to changing conditions and needs the principal problems have been created by the development of the Parcel Post System. During the first decade of the present century an extensive program of construction was undertaken and the buildings put up were remarkably efficient for the handling of the classes of mail then authorized by law. With the development of the Parcel Post System during the second decade of the century, the existing plant proved to be extremely inadequate. Its inadequacy was accentuated by the halting of construction programs as a result of the World War. With the working out of experimental methods for handling parcel post and the new special services, and with the further improvement of the technique of handling other kinds of mail and the older special services, a new program of construction was recently undertaken and is now well advanced.

The various changes thus briefly outlined have been accompanied by a remarkable increase in the productivity of labor. On a conservative basis of calculation (conservative in the sense that the change in the volume of output is underestimated and the change in the volume of labor is overestimated) the productivity of labor in the postal system increased from a base of 100.0 in 1908 to 171.8 in 1930, declining, because of the falling off in business, to 163.4 in 1931.

In regard to these changes and the methods used by the Postal Service in handling its business, there is very little published information. The general lack of knowledge, although no doubt in part attributable to the relative lack of self-advertising on the part of the post offices, is in a measure a result of the high degree of efficiency and adaptability of the system. An institution or an organization which comes into such intimate contact with the lives and interests of the people generally as does the post office would inevitably be subjected

to extensive and critical scrutiny unless it found means of performing its functions efficiently and with a smoothly operating adaptation to changing needs and conditions.

## Problems of the Postal Service

Post-office employees carry on their work under a remarkable variety of conditions and find it necessary to meet and solve a great diversity of problems. These conditions and problems range all the way from the crossroads country post office to a metropolitan postal system.

A more or less typical office of the more remote kind is supplied by a star-route contractor who brings the mail once daily from a town a dozen miles away. This town in turn is reached, not by railway nor by public conveyance, but by star-route from the nearest railroad station 25 miles away. All the work of the post office, handling the mail of the various classes, performing the various special-service transactions (for example, insuring parcels), keeping books and making reports, and serving as a central agency for community information—all of these varying activities are required of the postmaster virtually without assistance.

In contrast is a metropolitan post office 150 miles away with many hundreds of employees, millions of dollars in revenue, millions of special-service transactions (as the issuing of money orders), and hundreds of millions of pieces of mail per year.

Varying conditions and problems are illustrated by the types of buildings and of material equipment. In many places the work of the postal employees is carried on in rented structures, as, for example, in an outgrown mercantile establishment taken over by the Post Office Department in one of the larger cities, pending the completion of a publicly owned building. A large proportion of the structures now in use were built many years ago under the influence of the so-called monumental ideal of public architecture. Even in some of the larger cities where the volume of postal business is so large as to make mass handling economical, there are buildings of the monumental type with interior columns and other arrangements which seriously interfere with the use of modernized mechanical facilities and efficient grouping of equipment and of employees. This condition is the principal cause of the recent adoption of an extensive building program.

The problems confronting postal employees are not confined to those of meeting the needs of individual patrons. There are many specialized needs that require ingenuity and adaptability. These are illustrated by the mass of parcels issuing from mail-order houses; the vast quantity of periodicals, the bulk of which has rapidly increased, due to modern advertising; the handling of money orders for firms whose receipts are largely in that form; and the irregular influx of circulars in large quantities from big firms which, in recent years, have made increasing use of circulars for advertising purposes.

Another phase is illustrated by the transfer and transportation of mail. One of the most important matters in this connection is concerned with conveying mail from one operation to another—for ex-

ample, from the canceling machines to the primary separating cases. Another aspect of the problem of transportation is to be found in conveying mail from one floor to another, while still another is found in the transfer of mail from outside conveyances, as motor vehicles, to the post office and vice versa. Of course, the larger aspect of transportation is found in the conveying of mail from one post office to another. Trunk-line railway connections, as between Washington and Baltimore, simplify the problem, but even here the economical utilization both of space and of the time of postal employees requires constant study and adaptation to changing conditions. When the two post offices are as widely separated as Baltimore, Md., and Burnt Woods, Oreg., for example, transportation is obviously a complicated process. It is sufficient here to enumerate some of the principal modes of transportation of mail from one point to another in an office or in a given city and between the more remotely located offices. Among these methods are conveyance by hand; by floor trucks of many kinds; by a great variety of mechanical conveyors; by chutes and floor wells; by tractor trains; by pneumatic tubes; by horse-back; by horse-drawn vehicles, dog sleds, etc.; by motor vehicles; by trains, both steam and electric; by steamboats and other water craft; and by airplanes and airships. In connection with transportation there is the vitally important problem of choosing between direct handling by employees of the Government and conveyance by others under contractual arrangements.

Not the least of the problems of an organization which has such varied activities and contacts with virtually everyone in the country is the problem of personnel. In 1931 the regular, full-time employees numbered about a quarter of a million, and the system afforded part-time, contractual, and indirect employment to many others. The range of activities carried on by the organization is probably unequaled by any other business enterprise in the country. There are innumerable problems of routine character connected with time keeping, pay rolls, retirement deductions, efficiency ratings, transfer from one type of work to another in order to avoid slack time, etc. In general the problem of personnel involves in its most significant aspect the maintenance of morale and efficiency without resort to the virtually absolute power that is commonly vested in the administrative heads of private business enterprises.

The most fundamental problem of the postal system—one which permeates and determines the character of all its activities—arises out of the universality and variety of the services rendered. These are illustrated by the occasional letter or parcel handled for a farm laborer in a remote country district reached only by rural carrier or star-route contractor, and the millions of pieces of mail and special-service transactions handled in the course of a year for a large mail-order house. The extensive and increasing range of services rendered and the universality of contacts required on the part of postal employees give rise to the basic problem of constant adaptation of the means at the disposal of the post office—often far from adequate—to meet the widely divergent demands of a public which is likely to be by no means uncritical.

In the study of the Postal Service undertaken by the United States Bureau of Labor Statistics the aim is to arrive at a statistical esti-

mate of changes in the productivity of labor and of the effects of these changes on the volume of employment. In connection with this primary purpose of the study it is necessary to know how the postal system works in its main features, and to analyze the principal technological changes which have influenced the productivity of labor and the volume of employment.

## Administrative Changes

### Departmental Organization

Under the Postmaster General as executive head there are four main divisions of the Post Office Department, each under an assistant postmaster general.

The First Assistant Postmaster General is in charge of services and personnel connected directly with the handling of mail in the post offices throughout the country, and the delivery of mail to patrons of the post office in city and country alike. The Second Assistant Postmaster General is concerned primarily with transportation facilities; arrangements with railroads and other transportation agents; the Railway Mail Service, which is in charge of the transfer of mails in terminals and of the handling of mails in transit; the air mail service; and the international aspects of the Postal Service. Financial matters, money orders, classification of mail, stamps, registered mails, postal savings, and cost ascertainment are among the more important aspects of the work assigned to the Third Assistant Postmaster General. To the Fourth Assistant Postmaster General have been assigned, in general, such matters as pertain to the supervision, upkeep, and improvement of the physical plant, including buildings and equipment. Under him is also the Division of Engineering and Research, which has a very important part to play in the process of technological improvement.

In addition to the four main branches of the Post Office Department there are various officials with specialized duties, as the solicitor, the chief inspector, the comptroller, and others who are directly responsible to the Postmaster General. The final auditing of accounts is in charge of the General Accounting Office, which is not under the jurisdiction of the Post Office Department.

### Fact-Finding Surveys

The recent history of the administration of the postal system has been marked by a series of important surveys, which have been carried on in part by congressional committees, in part by special commissions, and in part by officials of the Post Office Department.

The post-office appropriations act for the fiscal year 1906-7 created a joint commission of Congress on second-class mail matter. The chairman of this commission was Senator Penrose and the vice chairman, Representative Overstreet. The commission reported that because of lack of adequate cost data it was unable to make definitive recommendations regarding changes in rates. It therefore recommended in the first place a series of special weighings of the mails and in the second place the appointment of a special commission to

study the whole question of cost ascertainment and business methods in the postal system.

As a result of the recommendations of this commission, Congress provided for extensive special weighings of the mails to extend over a period of six months during the fiscal year 1907-8. A new commission, known as the Joint Commission on Business Methods of the Post Office Department and the Postal Service, was also created by act of Congress of March 2, 1907. The chairman and vice chairman of the former commission (Senator Penrose and Representative Overstreet) were in charge of the new commission. A little later, in 1911, another commission on second-class matter was appointed; it was known as the Hughes Commission because it was headed by Charles Evans Hughes.

On the basis of the information resulting from the special weighings and special counts and from the investigations of the Penrose-Overstreet and Hughes commissions, rapid progress was made toward a more efficient administration of the department and toward the introduction of labor-saving devices.

During the years 1913 and 1914 four commissions, consisting of post-office inspectors and representatives of the Division of Post Office Service, made extensive studies of principal post offices, and on the basis of their recommendations numerous changes were made. Equipment was rearranged to economize floor space. Carrier routes were reorganized for a fuller utilization of the 8-hour day prescribed for letter carriers. A more careful coordination of work in the post offices with train schedules was undertaken. Efforts were made to reduce the amount of slack time on the part of employees by shifting them from one kind of work to another in accordance with the varying amounts of work required. A beginning was made in the coordination of the different divisions of postal administration by combining the various departments under the two main divisions of mails and finance.

During the period of the World War, progress in connection with buildings and the physical plant was checked by war-time needs. At the same time the growth of the Parcel Post Service and of other special services made increasingly urgent a program of adaptation of the plant to the growing volume and variety of services rendered. The seriousness of the problem led to the establishment in 1920 of the Joint Commission on the Postal Service, composed of certain members of the Senate and House Post Office Committees. The commission chose an advisory council of business men and engineers for carrying on detailed investigations of conditions and needs. The purpose of the commission is indicated by the following quotation from the law creating it: "The commission shall investigate all present and prospective methods and systems of handling, dispatching, transporting, and delivering the mails and the facilities therefor; and especially all methods and systems which relate to the handling, delivering, and dispatching of the mails in the large cities of the United States."

The work of this commission, which extended over a number of years and which was made public in the form of numerous official documents, formed the basis of outstanding changes in the methods of carrying on the Postal Service since that time. One of the out-

standing results of its investigations was the establishment of the Division of Cost Ascertainment. Closely connected with the commission's investigations was the extensive building program authorized by Congress in 1926 and still in process of execution.

Another series of important surveys of the postal system was carried on by officials of the Post Office Department during the years 1929 to 1931. Extensive surveys were made of 55 principal offices, and detailed analyses made of various operations. There was a comparison of time, labor, and cost per unit of output at principal offices. Efforts were made to discover the causes of variations in efficiency and to extend throughout the system the methods in use in the more efficient offices.

### Miscellaneous Administrative Changes

The problem of the most efficient internal organization of the larger post offices gave rise as early as 1909 to an experimental consolidation of all work having to do with the handling of the mails under one superintendent and of all work having to do with financial matters under another superintendent. In 1911 it was reported that some of the larger offices were undergoing such a reorganization, with two instead of five main divisions, and that as a result the "same amount of work" was being done by "a relatively smaller force." As a result of the work of commissions of postal experts, beginning in 1913, the 2-division plan of organization was developed and extended practically throughout the Postal Service. At that time it was reported that post offices handling 75 per cent of the country's mail had been reorganized in such manner as to conform to standard principles of business management. By the merging of the mail, city, carrier, parcel-post, registry, money-order, postal-savings, finance, stamps, and second-class sections and divisions (all of which had been more or less independent) into the two large divisions of mails and finance, it was found that a large amount of slack time on the part of employees was eliminated and that at the same time the work of the various divisions was accelerated by a ready interchange of labor under the new system of organization.

The coordination and interchangeability of labor was further promoted by the development of forms for use by foremen, supervisors, and superintendents. These forms have been developed at the principal offices in such manner as to meet local needs and conditions. They include such data as enable postal officials to keep a constant check on the number of hours and the amount of work done in the various divisions and subdivisions of the Postal Service. In one of the larger offices, for example, a monthly statement is prepared showing the number of employees and the hours consumed in handling all mails. The statement classifies both the personnel and the work done so as to have instantly available a record showing the trend of the productivity curve. In a word, the post offices have adopted methods of plant management such as are in use in the more efficient industrial establishments in private enterprises.<sup>1</sup>

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<sup>1</sup> An instance of plant management methods is the unit system, described on pp. 15, 18, and 19.

## Improved Methods of Accounting

One of the more important changes in postal administration has been the inauguration of improved methods of accounting. The annual report of the Postmaster General for 1909 pointed out the need of more effective supervision of the more than 60,000 offices throughout the country. A plan was then proposed which was later developed into the system of district post-office accounting. It was reported in 1917 that under congressional authorization the country was divided into districts with central offices therein for the distribution of supplies and the administrative examination of accounts. Under this arrangement the smaller district offices obtained their supplies and rendered their accounts through a central accounting postmaster. Recommendation was made for a further extension of the system on the ground that not more than 25 per cent of the possible savings were being realized by the limited extent of the district post-office accounting system, which recommendation was later carried out. Particularly important was the extension of the system in 1922. It was reported in 1923 that in accordance with recent changes all postal receipts and money-order funds were made immediately interchangeable and available for all authorized post-office expenses; that the auditing of 600,000 money-order accounts annually in Washington was eliminated; and that other significant improvements and economies were effected. In 1928 it was reported that "a new system of postal accounting has been inaugurated at 45,000 third and fourth class offices, under which postal and money-order accounts were merged. This eliminated the rendition and auditing of 540,000 money-order accounts annually."

### Procedure in a Representative Central Accounting Office

The nature of the work done and the principal recent changes in the methods of the central accounting offices may perhaps best be described by means of an illustration. The office chosen as an illustration handles the accounts of about 870 third-class and fourth-class offices.

There is in use a cash-accounting machine introduced about two years ago. This machine audits daily the various forms of post-office remittances, also requisitions for stamps and supplies. Three forms are used by the district post offices for (1) money orders, (2) district-office deposits of surplus funds, and (3) requisitions for stamps and supplies.

Corresponding to these three forms are three types of record index cards for filing. The machine combines three operations (except for requisitions, in which there are only two): (1) Posting on the record index card; (2) printing a receipt for the remitting postmaster (in connection with a money-order remittance or surplus-fund remittance); and (3) printing a tape record for the bookkeeper's use in checking the transaction. Each of these operations was formerly done by hand. The present method of mechanical operation, combining all three, saves time and also reduces the chances of error. The machine also adds any desired total during the day; and the bookkeeper who has the key to the machine adds the day's grand total.

As the remittance and requisition letters are received, the items are added on an ordinary adding machine. The operator of the cash-accounting machine has these sums. If the two machines agree, the handling of the accounts is correct. As a check against the actual amounts received, the bookkeeper, who controls the making of the grand total by the machine, takes this total, removes the tape record, and checks it against the actual receipts.

The remittance form, or letter, contains a blank postal-card receipt. This receipt is filled out by the cash-accounting machine as one of its three combined operations. A bundle of these forms is put into a mechanical cutter to remove the postal-card receipts, which are returned to the remitting postmasters. This process replaces the old method of writing out the receipt on thin paper and sending it in an envelope. Those receipts were often lost, and the present method saves much time and trouble incidentally in avoiding duplication of work.

Another accounting device is a bookkeeping machine, in use since about 1920, but recently adapted to new functions. Its main use is for auditing quarterly reports of postmasters in the central accounting area. There is an abstract, or itemized list, of receipts and payments for each office. Offices are known by numbers. On a single line the bookkeeping machine records the number of a particular office and all items of receipts, together with the payments. The receipts are added, and the payments are subtracted, and at the end of the line a balance is struck.

The cash-accounting machine mentioned above is also used for the daily bookkeeping of the local post office, including the handling of transactions with district offices. The particular form now used was originated locally. The machine lists the receipts at the top of the page and adds them; then, below the receipts, it lists and sums up the expenditures. Expenditures plus the bank balance should equal the receipts. The machine is so designed as to be adaptable to the handling of different forms.

The bookkeeping machine described above as being used for auditing quarterly reports of district postmasters has also been used locally for keeping a check on the daily disbursements from the Post Office Department's allotment of funds for overtime and substitute services. In order to conserve the allowance it is important to know the extent of its use from day to day. The record of expenditures has been reduced to simple forms filled out mechanically on the bookkeeping machine and thus a great deal of time is saved in handling records of variable expenditures. The method has been adopted by other offices.

The work done by the bookkeeping and the cash-accounting machines was formerly done by hand in the now fast-disappearing books and forms used by the old-fashioned expert manual bookkeeper.

There are also in use check-writing machines, signature devices, machines for computing the complicated rates on second-class matter, time recorders, and various other mechanical or semimechanical appliances.

Combined with mechanical devices is the more systematic method of utilizing labor to effect still further economies. The pay roll is an instance. Formerly one day was required in the office being described to enter the time on the books and to compute the amounts

due on the basis of the scale of pay for regular time, overtime, night work, etc. The next day the checks were written. On the third day employees came to the office, signed vouchers, and were given their checks. Now the entire process consumes about one-half of one day, without extra help, except for four clerks from the mailing division who were given special training and are transferred to this work one-half a day twice a month.

Another innovation at the same central accounting office is a system for a cumulative index record of deductions from salaries for the retirement fund. Contrary to a widely held idea, this fund is not derived from the Public Treasury but is formed by deductions from the pay of Government employees. This of course means added accounting, which, unless systematized, would become intricate and expensive.

The system of dividing the offices of the country into districts with central accounting offices through which the business of the smaller offices is transacted results in many economies and a considerable net reduction of time on the part of postal employees. (1) Regional handling of supplies and accounts makes possible the economies of mass handling from Washington to the central accounting offices as distributing centers; (2) increase in variety and volume of work at the central accounting offices tends to flatten out their peak loads and to promote interchangeability of labor; (3) officials of the central accounting offices, knowing local conditions and needs, can often more intelligently handle the problems of the post offices in their districts than could the officials at Washington.

### Efficiency Ratings

Another administrative change which approximately coincides with the early portion of the period included in the present study is the system of efficiency ratings applied to employees of the Postal Service. A beginning was made in 1909, and considerable extensions were made in 1911. The system was gradually improved and applied throughout the Postal Service and placed on a basis which combines the advantages of comparative security for the worker and efficiency for the system.

### Modernizing the Physical Plant

Probably the most significant features of postal administration in its relation to the productivity of labor are to be found in the adaptation of the physical plant to the needs of the service. To this end, all branches of the postal administration have contributed, but the office of the Fourth Assistant Postmaster General has been charged in a distinctive sense with responsibility for the maintenance and improvement of buildings and equipment. In recent years the Division of Engineering and Research in the office of the Fourth Assistant Postmaster General has been particularly active in this connection.

Many rewards have been paid to employees for labor-saving devices. Extensive and rapidly increasing appropriations have been made for the purchase and maintenance of mechanical equipment. Extensive experimentation has been conducted in the devising, testing, and improving of equipment. The principal problem has been concerned with the adapting of older buildings to changing needs (as

the handling of parcel post) and the planning of new buildings in such manner as to make them attractive as public buildings and at the same time adapted to the rapidly expanding needs of the service.

A few years before the Parcel Post System was introduced in 1913, an extensive building program had been undertaken. A new building in Chicago, which was occupied in 1905, was equipped with belt conveyors, automatic elevators, facing tables, and other up-to-date facilities. It became a model for other offices, notably the new buildings at St. Louis and Washington.

This building program of the earlier years of the century was halted by the inauguration of the Parcel Post System, which necessitated many changes in the arrangement and equipment of post-office buildings. Before an extensive plan for the adaptation of the physical plant to the new conditions created by the Parcel Post Service and other special services could be fully formulated and carried into effect, the war intervened, and this in turn was followed by a period of reconstruction and excessive building costs. The annual report of the Postmaster General for 1920 stated that there had been no public-building legislation since the act of March 4, 1913, and that an acute problem had arisen in some of the larger cities. Succeeding annual reports of the Postmaster General called attention to the acuteness of the problem and described the temporary arrangements that were being made, together with the studies and experiments that were under way for the purpose of meeting the situation as soon as Congress might authorize a construction program.

One of the results of the survey undertaken by the Joint Commission on Postal Service established by act of Congress of April 24, 1920, was the formulation of plans for modernizing the physical plant. No comprehensive program was adopted by Congress, however, until 1926. By an act of May 25 of that year the Postmaster General and the Secretary of the Treasury were made jointly responsible for the execution of the program. These officials appointed five representatives, including a secretary, who formed a public-buildings committee. This committee, on the basis of a nation-wide survey, formulated explicit plans for the extensive building program which was soon to be undertaken. The detailed work of planning the buildings and their equipment was carried on by the Division of Engineering and Research, which in 1931 checked and revised plans for 290 publicly owned buildings and drew up plans for 87 leased buildings.

Reconstructing practically the entire physical plant of a nation-wide enterprise was a problem of such magnitude that progress was necessarily slow if mistakes were to be avoided and the program was to be adapted most satisfactorily to the varying needs and conditions of different parts of the country. The last year included in the tables following is the fiscal year ending June 30, 1931. During that year the Postal Service in all of the larger cities was still being carried on under the twofold disadvantages of older and temporary buildings and of projected or actual transition to the new plants. The extensive reductions in labor and other costs of operation expected from the reconstructed physical plants do not, therefore, appear in the tables. On the contrary, it is likely that the upward trend of output per employee has been retarded by construction, transition, and readjustment.

A sample of the country-wide program of modernizing the buildings and equipment of the Postal Service is to be found in the new post-office building at Chicago. This building is described in a public announcement by the Post Office Department made in January, 1931. In this announcement it was stated that "when completed and ready for occupancy, which it is estimated will be within a year and a half, the structure will contain approximately 2,309,000 square feet of floor space, covering an area of practically 50 acres." It is claimed that post-office employees will find at their disposal in this building "every convenience and detail for handling the mails which it has been possible for human ingenuity to provide." The length of the building is 800 feet, the width 350 feet, and the height 200 feet, with 12 stories in front and 9 stories in the rear. Forty elevators are provided, 18 for conveying mails, and 22 for passengers. Provision is made for 74,000 linear feet of mechanical conveyor belts and for 2,000 linear feet for the loading and unloading of mail from motor vehicles.

Although the building is designed with a view to the utmost degree of efficiency for the transaction of business, artistic effects have not been ignored. At the base of the main façade with the principal public entrances are piers in harmony with the commodious interior public lobbies. The exterior walls are of stone. At the four corners are pylons, 200 feet high and 100 feet by 500 feet in area. Thus a balanced composition of the façades is obtained. Setbacks at the top story of the corner structures tend to emphasize their effects. The long wall surfaces between the pylons are cut by vertical piers. There is little of the merely ornamental. The artistic effect is primarily derived from a sense of proportion and from a careful and scientific adjustment of the structure to the uses for which it is designed. There is in this way a radical departure from the older monumental type of public building.

It was estimated in January of 1931, in the statement describing the new building, that an ordinary day's business in Chicago includes the handling of approximately 6,500,000 letters, 250,000 out-bound parcel-post packages, and 80,000 sacks of paper and parcel-post mail for delivery at Chicago. The number of letters handled in a single day has run as high as 11,000,000. "The plans in the building for handling mail are so designed that the raw material will come into the building, go to the upper floors and travel by gravity through the building, and be a finished product ready for dispatch from the city or to delivery to the patrons of the several offices in Chicago when it reaches the ground floor."

In addition to the various classes of mail there are the special services and the auditing of the accounts of post offices in the Chicago district. The receipt of remittances, the handling of postage stamps, and the various other operations of related nature require vaults, cages, storage rooms, and facilities in general such as any large financial institution must have. "The first and second floors in the front half of the building will be devoted entirely to financial matters dealing with the public, the supplying of stamps and money orders, furnishing facilities for the registration of mail matter, handling of large C. O. D. and insured mail, and receiving parcels direct from the public for dispatch." Facilities are furnished for

many of the activities of employees, including a cafeteria. "Space is also provided for the benefit of the employees for what is known as their credit union, where they take care of their own associates in case financial assistance is required. The executive offices are all located in the front of the building above the first floor. There are assembly halls and recreation rooms; in fact, everything that is possible to be carried on in a post office will be conducted in the building."

## Handling Letters at Offices of Origin

When the Federal Postal Service was established, and for a long time afterwards, its purpose was to enable the people of different sections to carry on communication. Handling letters still remains its most important function. Letters, letter-size circulars, and postal cards are handled in substantially the same way. The ordinary patron of the postal system writes a communication and deposits it and is likely to give it no further thought. This fact in itself is a tribute to the efficiency of postal employees, for if communications were not handled safely and with little delay, patrons would quickly become conscious of the failure and would take the trouble to learn the nature of postal operations, if for no other reason than to discover the cause of failure.

The method used in handling a communication depends on the place of origin and on the destination. A letter coming from the country or a town or small city is handled in the early stages of transit in a radically different manner from a letter originating in a large city. Similarly the methods of delivery vary with rural, town, small-city, and large-city destinations.

The first stage in the journey of a letter after it leaves the writer is its deposit for collection. The postal system affords a variety of arrangements for the convenience of patrons, ranging from a box on a rural delivery route to the drop window in an urban office with automatic belt conveyor running to a special-handling section.

Letters, when collected from the various places of deposit, are handled in all offices, except those large enough to justify specialized and mass handling, by methods not varying in essential respects from those used many years ago. Letters must be faced (arranged with the stamps all facing the same way), canceled, and postmarked; classified according to their destination; pouched, labeled, and dispatched. These various processes are more or less specialized, depending on the size of the office and the amount of mail. After a letter leaves the office of origin it is transported to a point where it merges with the main stream of postal traffic. If the office of origin is on a railway post office (a division of a railroad which is handled by a particular crew of Railway Mail Service employees as, for instance, between Pittsburgh and Washington), there is a direct transfer of mail to the Railway Mail Service, usually either by motor-vehicle operators employed by the Government or by mail messengers working under contract. If the office of origin is not on a railway post office, any one of several methods of transport may be used for conveying mail to the point where it merges with the main traffic stream. Among these methods are rural carrier, star-route carrier, and mail messenger, by means of horseback, buggy, automobile, steamboat, bus line, or other conveyance.

The larger cities are of course on the main traffic stream and their quantity of mail is such as to make possible a higher degree of specialization and a larger use of mechanical methods.

Although details of handling mail in the larger cities vary with the size of the city and the nature of the physical plant, there are certain clearly defined stages characteristic of all of the larger post offices. These stages include—(1) Collection of letters from various places of deposit and transfer to the post offices; (2) transfer from street to work floor; (3) facing at the facing or pick-up tables (arranging the letters so that the stamps all face the same way); (4) canceling and postmarking; (5) classification according to region of destination at the primary separating cases; (6) more detailed classification according to destination at the secondary separating cases; (7) tying out, labeling, pouching, and dispatching; and (8) transfer to motor vehicle or other conveyance.

Not all mail goes through these various stages and some mail goes through additional stages. "Special handlings" of various kinds are necessary in the case of special-delivery letters, air mail, registered letters, odd sizes and weights, precanceled and metered-postage mail, and large quantities of circulars.

### Procedure in a Representative Large Office

In order that the discussion of methods of handling outbound letters may be consecutive and may avoid the confusing differences of detail to be found in different offices the account will be confined, for the present, to the more or less typical methods used in one of the larger offices.

Mail collected from the various places of deposit is brought to the post-office building by motor vehicles and fed directly from the street into chutes which terminate near a belt conveyor in the basement. The pouches and sacks are placed on this conveyor, which carries them to a bucket elevator similar in operation to the kind used to lift coal from mines. There is an electrically operated endless chain of trough-shaped "buckets" into which the belt feeds the mail. The only manual control is by a man who is stationed at the terminus of the belt to space the pouches and to keep them from jamming. This elevator takes the pouches to a mezzanine over the second floor and deposits them on a metal slide, and laborers (not the more highly paid postal clerks) empty the pouches into traveling hoppers. These hoppers move mechanically above the facing tables on the second floor, and by a tripping device are made to feed the mail as desired onto the facing tables.

At the facing tables letters unsuited for machine cancellation, and also special-delivery and air-mail letters, are held out. Ordinary mail is handled by the so-called unit system. A unit without the mechanical facing table consists of (a) 2 manual facing tables 8 feet by 12 feet; (b) 4 canceling machines; (c) 1 table for two hand stamps (for canceling pieces not suited to mechanical cancellation); and (d) 36 separating tables, each with 30 pigeonholes for the primary separation. Such a unit is operated at the peak of traffic by 55 men handling about 55,000 pieces of mail per hour.

Some of the units have mechanical facing tables. The mechanism is not used for automatically facing the letters but for conveying the

faced letters from the table. Such a table has a troughlike groove, slot, or runway around the edges. On one side of the partition which divides this groove are placed the long letters and on the other side the short letters. At the base of this partitioned groove is a motor-driven belt conveyor taking the letters to two mechanical stackers, one for long letters and one for short letters, with the stamps all facing the same way. Because of this facing process the tables are called facing tables although other names are used, as pick-up tables and set-up tables. From the stackers the letters are fed automatically into machines which automatically cancel and postmark them at the rate of about 600 per minute per machine. When canceled the letters are taken to the primary separating cases.

Letters which are unsuited for cancellation and postmarking by machine are picked out from the others at the facing table and placed on a small shelf in front of the employees at the facing table. Such letters are canceled manually with a steel hand stamp and are then taken to the primary separating section, where they are merged with the ordinary letters and separated to States or groups of States according to destination.

Special-delivery and air-mail letters also receive special handling, and are placed on a flat metal shelf above the facing table. From this shelf they are automatically collected by a series of baskets with brush attachments, the whole forming an endless cable, which carries them to a central location where they are automatically deposited on a slide by a tripping device on the bottom of each basket. From the slide they are deposited automatically on the table for cancellation and postmarking and immediate handling to insure connection with the next outbound train.

Letters from the drop window in the lobby of the post office are also given special handling. They are sent from the first floor in boxes on a vertical conveyor or "finger lift" operated by chain drive to the second floor where the finger lift passes by a metal chute or inclined plane. The fingers of the lift on which the boxes rest pass by the chute but deposit the boxes on the chute. The chute in turn conveys the boxes to the special-handling section.

Ordinary letters and cards, when sent through the facing process and stacked either by hand in the case of nonmechanical tables or automatically by the mechanical tables, are taken from the facing-table stacks to the adjacent canceling machines. A bundle of letters, faced and stacked, is placed in contact with a canceling machine in such manner that the letters feed automatically through the machine. It is possible to cancel about 1,500 letters per hour by hand. The speed of the machine varies with the type, but the speed commonly attained is 600 per minute. The canceling machine not only combines the canceling and postmarking processes but automatically re-stacks the letters. The stacker arrangement attached to the canceling machine permits an accumulation of about 2 feet of stacked letters. These are distributed to the primary separation cases by employees assigned to this detail.

The canceled letters, whether manually or mechanically canceled, are next put through the process known as the primary separation. In each of the units there are about 36 primary separating cases. Each individual primary separating case has 30 pigeonholes of a convenient size for letters—6 holes across and 5 holes in height—and

these are labeled for the "throwing" of mail by States or groups of States. There are also usually a few "directs" (larger cities to which the volume of mail is large enough to justify separate pigeonholes in the primary cases). Uncanceled, nondeliverable, and damaged mail is held out for special handling.

The letters, after being placed in the primary separating cases, are regularly "cleaned out" and sent to the secondary separating cases. The transfer is in part manual and in part mechanical. The "clean out" from a particular pigeonhole is put into a pan. There are 30 of these pans, corresponding to the 30 primary separations (for example, letters for Illinois are put into one pan, letters for Ohio into another, etc.). An employee detailed to the "clean-out" work starts at one end of a unit of primary cases and collects from each case the mail for a particular State or group of States, as, for instance for Ohio. Thus all Ohio mail is placed in one of the pans and the pan placed on a belt conveyor. Each pan has a tripper attachment adjustable to 14 stations. The tripper on the pan containing Ohio mail is set to the station number corresponding to the Ohio station of the secondary separating section, and the pan moves along the belt to its proper station where it is automatically tripped, removed from the belt and placed on a slide. At the bottom of the slide the pan is removed, the mail is emptied, and the pan placed on a second belt to be returned to the primary section. Each of the 30 separations of the primary section is dispatched to the secondary section in the same manner, but because of the limited number of belt-delivery stations more than one of the pans are routed to the same station. Large letters ("lumber") are worked through the primary units in the same manner as the small letters, but on account of their size the pan conveyor can not be satisfactorily used for transferring them from the primary to the secondary sections and they are, therefore, conveyed in "gurneys" (canvas baskets on castors).

The primary separation is to a large extent alphabetical according to States or groups of States. When letters destined to a particular State reach the secondary separating cases a much more complicated system of distribution is necessary. The larger post offices in a particular State are represented alphabetically in the pigeonholes of the secondary cases. These are known as "directs," and mail is distributed to them alphabetically as in the case of the primary units. Letters to other post offices are distributed to trains in accordance with an elaborate "scheme." Distributors are required to memorize the train connections for all post offices in the State to which their particular scheme applies, and must be able to choose the appropriate train connection available at any given time during their time or "tour" of duty. The scheme of distribution includes, of course, the smaller offices not on railroads and the distributor must know through what office these other offices not on railroads receive their mail.

Before each train departure the letters in the various pigeonholes of the secondary cases must be "tied out," labeled with the appropriate train connection, and pouched. In the larger secondary sections the pouches are arranged on racks in such manner as to permit direct pouching from the secondary cases, thus avoiding the sending of packages of letters to one central point for pouching. Pouches for a particular train are numbered and the last pouch is marked

with a suffix "X" following the number. Suitable records are made and the pouches are sent by spiral chute to the loading platform in the basement, whence they are dispatched on Government motor vehicles to appropriate railroad stations.

In order to adapt the cases to different distribution schemes, the distributing cases are ingeniously provided with reversible square labels. Otherwise it would be necessary to have a separate set of cases for every distribution scheme. Some of the cases also have movable partitions for varying the sizes of the pigeonholes and, on occasion, doubling the number of holes in a given case. The labels are painted, thus avoiding the frequent renewal necessary when the old-fashioned pasted labels were used.

One of the units at the office now being described has a device for feeding letters from the facing table directly into the canceling machines—one for canceling long letters and the other for short letters. This eliminates the intermediate manual process of removing the letters from the facing-table stackers to the feeding devices of the canceling machines.

There is also in experimental operation an arrangement, which is to be used in the office under construction, for automatically conveying letters from the primary to the secondary separating cases. This was devised by a local post-office employee. The pigeonholes of the primary separating cases are provided with hinged bases which can be automatically thrown back so that letters, when put into the holes, instead of having to be taken out by hand (cleaned out) for transfer to the secondary cases, will slide down onto a belt conveyor. For each pigeonhole in the several cases which is used for a particular destination (Illinois, for example) there is a belt conveyor, so that all letters for that destination will automatically converge onto that particular belt. The large number of belts that will be required gave rise to a problem of conserving space. This problem is being solved by putting the belts through the floor below the primary separating cases and running them along the ceiling of the room below. Then they are to be brought back through the floor to the appropriate secondary distributing centers. The letters borne along these belts will be automatically stacked and then distributed in the secondary distributing cases for tie-out and pouching. In order to send the letters upward by belt conveyor from the ceiling of the room below back to the mailing floor, an ingenious "tail-drive" device has been invented. In order to maintain an even, constant, upward movement of mail, a second belt with a certain amount of slack is placed above the belt conveyor so that when a piece of mail begins its upward journey the upper belt presses flexibly against it and keeps it from sliding backward. The flexibility of the second belt also permits the movement of different sizes of mail matter. In various new post offices it is proposed to add this remarkable feature (the mechanical transfer of mail from the primary to the secondary separating cases) to the various other mechanical refinements of the unit system for facing, canceling, and distributing letters.

It should be noted that the unit system is more than a mechanizing of mail handling. It involves constant study and correlation of the labor force in such manner as to assign to each stage of the process the number of men called for by the most efficient operation of the unit as a whole.



(*c*) 2 carriers taking the canceled letters from the stackers to the primary separating cases across the aisle; and (*d*) 16 men at the primary cases—a total of 28 men.

There are two rows of primary cases placed at right angles to the aisle, one row for long and one for short letters.

One man is in charge of the facing tables, another in charge of the various primary separating tables, etc.

Each primary case has 18 holes for separations, which include (*a*) "directs" to a few large cities, (*b*) States, (*c*) groups of States, and (*d*) foreign mail. Mail originating locally for local delivery is sent over in hampers unpouched to a branch office which specializes in the handling of inbound mail.

To the north on the same floor is a section for handling "slugs." Beyond, and to the east of the primary cases, is an aisle parallel to the aisle between the facing tables and the primary cases. Beyond this second aisle are cases, running at right angles to the aisle, for handling the secondary separations, the special-delivery mail, the air mail, and the "directs" (mail distributed at the primary cases to five principal cities). These "directs" are merely checked for errors from the primary separation, tied out, pouched, and dispatched.

Special-delivery mail and air mail, separated at the facing tables, is brought every 5 or 10 minutes to the special-handling cases, canceled, distributed, tied out, and dispatched on the earliest trains.

All mail from a particular pigeonhole in each of the primary separating cases (Ohio mail, for example) is regularly removed from the primary cases ("cleaned out") and taken to the appropriate secondary separating cases across the aisle from the primary cases. The degree of distribution in the secondary cases varies with the region to which the mail goes. This secondary separation, except in the case of State mail (that is, mail addressed to offices in the State of the post office now being described), is according to railway post-office distribution schemes.

State mail coming from the primary cases is brought across the aisle to what is called, not a secondary separating section, but the "State primary." Most of the State mail is here distributed alphabetically by towns ("directs"). The "residue" of State mail, which is destined to smaller offices, and which amounts to about 35 per cent, is separated alphabetically by groups of towns (towns beginning with the letters A to J, and towns beginning with the letters K to Z). Then the "residue," thus broken up into these two separations, is taken to what is known as the "State secondary." Here it is distributed to railway post offices, including "dis" offices ("dis" offices being offices through which other offices, usually not on a railroad, receive their mail, by star routes, mail messengers, buses, electric lines, steamboats, or other conveyance).

All distributors of State mail, except those who handle the "residue," make use of the alphabetical system. They merely need to know the arrangement of the pigeonholes in the separating cases, somewhat as a typist automatically strikes the right key without looking at it or consciously aiming at it. Distributors also tie out and pouch their mail, but they are supplied with a constantly revised list by dispatchers. For State mail this alphabetical arrangement simplifies and facilitates distribution, because the individual

distributor no longer is required to keep in mind as he throws his mail into the holes the intricate systems of railway post offices, trains, and dispatching. But distributors of the State "residue," and other distributors at secondary cases, "must know their tie-outs," that is, must be acquainted with the general distribution scheme for the mail they are handling.

Each distributor is required to master at least one distribution scheme, but in the case of the State directs, the actual handling of the distribution, as far as the dispatching scheme is concerned, is done by the dispatcher. The making of the dispatcher's pouching lists and the handling of pouches are duties which require much training and alertness. One small town alone, for example, receives mail in the course of 24 hours by 7 different trains, and the tie-out of letters for dispatch must be governed accordingly.

Beyond the cases for handling the various secondary distributions, the State secondary, the "residue," etc. (that is, beyond the cases where letters are finally "tied out" for pouching), are located the pouch racks, labeled appropriately for dispatch. The dispatcher and his assistant keep the labels in order, maintain the pouching lists, lock the pouches, make entries of pouches dispatched, and check off the dispatches as they are completed.

Much of the mail is put through only a portion of these processes. This is true especially of unstamped mail, both metered and unmetered. Such mail usually arrives from the sender in large quantities, with a statement accompanying each lot. It is dumped onto a table at the south end of the mailing room and checked for irregularities. In the case of unmetered mail (the amount of which is not limited mechanically, as is true of mail from users of metered-postage machines) there must be a check-up to see that the sender has a deposit large enough to cover the lot. Some unstamped mail can be sent direct to the dispatching section. A part of it must be put through the secondary separating cases. None of it goes through the facing tables and canceling machines, and little goes through the primary separating cases. Metered-postage machines materially reduce the amount of labor in handling mail.

Letters when finally pouched and made ready for dispatch are sent by hand trucks and elevators to the loading platform at the opposite end of the building from the unloading platform, after having passed in an orderly and consecutive forward movement through the various processes necessary for transfer to transportation agencies.

## Handling Letters Between Offices

Letters originating at any one of the more than 48,000 post offices, at their branches, or on tributary routes are merged in one of the numerous main streams of postal traffic, directly or indirectly, as indicated in the preceding account. These larger streams of traffic between the more important centers consist of railroad routes known as railway post offices, and of air-mail routes.

The air-mail routes are used almost entirely for letters. The rapid growth of the air-mail service is indicated by the fact that in 1927 the amount of air mail carried was less than 500,000 pounds, while

in 1931 it was more than 8,500,000 pounds. Miles flown increased from less than 3,000,000 to more than 21,000,000. The handling of the mail at terminal points is by methods not radically different from the methods used in handling mail at railroad terminals. On account of the relatively small quantities of mail by weight, ordinary motor-vehicle service affords facilities adequate for speedy transmission to and from post offices.

Although air-mail routes have grown rapidly in numbers and in amount of business handled, the main streams of postal traffic remain largely with the trunk-line railroads. The transfer of mail between motor vehicles and trains is under the supervision of postal clerks in transfer offices. In addition to transfer offices there are terminal railway post offices where mail distributors work what is known as "lay-over" mail (mail held at the terminal for some time before it can be dispatched). They also distribute what is known as "stuck" mail (first-class mail from railway cars which the mail clerks on the cars were unable to distribute). A relatively large proportion of the work of the Railway Mail Service in terminals consists of the handling of classes of mail other than letters. This is because of the bulk of parcels, periodicals, etc., and because of the fact that many of the post offices of the older type were constructed in such a way as not to be adaptable to the handling of large quantities of parcel post. In the case of letters as well as other classes of mail, however, the transfer and terminal offices of the Railway Mail Service perform the vitally important functions of (1) supervising the safe and speedy transfer of mail between motor vehicles or other local transportation facilities and trains; (2) the distribution of such portions of mail as can be more economically handled and more speedily forwarded in terminal offices than in post offices or in railway mail cars; (3) the adjustment of facilities (for example, the number and types of railway mail cars) to changes in the kinds and quantities of mail passing through the transfer and terminal offices; and (4) the arrangement of distribution schemes and constant readjustment of the routing of mail to points throughout the country in such manner as to avoid needless expense in transportation and, at the same time, to make sure of the speedy handling of mails, especially of letters, daily papers, and other kinds of mail requiring special handling.

Mechanical devices (chutes, conveyors, hand trucks, trackless trains of floor trucks driven by electric batteries, etc.), although used for letter mail, are important mainly in connection with the handling of the more bulky kinds of mails, and will be described in that connection.

When letter pouches are finally placed in the railway mail cars they leave the jurisdiction of the transfer clerks, and the railway mail clerks in the postal cars become responsible for them. In these cars, letters, daily newspapers, and a few parcels are distributed. The nature of the mail matter handled, as well as the extent of its distribution, depends on such factors as the time elapsing between the receipt of letters at the post office and the time of departure of trains; the facilities available in the post offices for handling mail; the problem of making connections at distant terminals; and the amount of time intervening between the arrival of the mail at its destination and the first possible delivery by carrier. Intricate and

constantly changing schemes of distribution are used. A high degree of skill and accuracy in the "throwing" of mail is required. In spite of the recent decline of business and of the tendency to increase the proportion of air mail, the railway postal clerks in 1931 are credited with 10,496,298,615 distributions and redistributions of pieces of first-class mail and 6,202,295,782 distributions and redistributions of pieces of second, third, and fourth class mail. During the same year the number of pieces of registered mail handled amounted to 84,951,637. Much first-class mail, as well as most of the mail of other classes, is carried in storage cars and in "closed pouch" cars, and is merely transferred and not otherwise handled on trains.

Under the jurisdiction of the Railway Mail Service are transfer offices, terminal railway post offices, railway post offices in transit, and the closed-pouch service. The latter refers particularly to the transportation of mail in closed pouches on trains or other conveyances between offices not supplied by regular railway post-office service.

A further explanation of the nature of the work done by railway postal clerks in mail cars is afforded by an illustration—the case of the Kansas City, Fort Madison, and Chicago Railway Post Office, operating between Kansas City and Chicago. Clerks in this car, eastbound, distribute mail originating at Kansas City or transferred there from other points and destined to offices served directly or indirectly by this car, including, of course, offices to the eastward of Chicago. On the westbound trip the process is merely reversed. The crew of the car must include clerks acquainted with the distribution schemes of Kansas City and Chicago and of Missouri, Illinois, and adjacent States and also familiar with the routing of mail for more distant points.

One of the important functions of these clerks is to distribute city mail either to carrier stations or, in some cases, even to carrier routes diverging from carrier stations. The clerk assigned to the distribution of Chicago mail must know to which of about 55 carrier stations every street number in Chicago is assigned. Also, on dividing streets between carrier-station areas, he must know which side of the street has the odd and which the even numbers. On the westbound car, distribution of letters is made to carrier routes for certain downtown areas of the city, and the clerk must know to which of 72 carrier routes every street number, large building, and prominent firm in down-town Kansas City belongs.

## Handling Letters at Offices of Destination

An effort has been made, in the above account, to follow the course of letters from their various places of origin through the offices of origin and along the lines of transportation to the places of destination. The handling of letters at the places of destination varies in much the same manner as the handling of letters at the places of origin, the method depending on whether the destination is a country office, a town, a smaller city, or a metropolitan center.

The method of handling mail in rural, town, and small-city destinations depends on whether or not the destination is on the main traffic stream. If it is on such a stream, letters are handled from a

railway post office directly from the train to the post office either by motor-vehicle operators employed by the Government or by mail messengers working under contract or by employees of the railroad or other contracting carrier. If the place of destination is a "dis" office (not on a railway post-office route, but supplied through an office on such a route) various means of transportation are used for conveying letters to their final destination. These methods are similar to those used for conveying letters originating at the same offices. Final delivery of the letter may be by general delivery, by private post-office box, by rural delivery, by star-route carrier, or by village or city carrier. The village delivery service was originated for the purpose of furnishing smaller places with carrier service when such places were not served by rural carriers and were not large enough for city delivery service. Whether the carrier is a member of the village, city, rural, or star-route delivery system, the letters destined to addressees on his route are separated, usually in the post office though occasionally by the Railway Mail Service, from letters destined to addressees on the other routes supplied from the same post office. Having received an allotment of mail, he separates it in the order of delivery to his patrons, and proceeds to cover his route in the prescribed maner, on foot in town, by carriage (usually automobile) if in the country, making final transfer of mail from the postal system to its patrons on his route.

In the case of offices in larger cities the volume of mail makes possible not only a considerable degree of specialization but the economies of mass handling. Transfer from the railroad station or air-mail station to the post office is usually by motor vehicles owned and operated by the Government.

Much of the inbound mail for larger cities is distributed, as has already been seen, by the Railway Mail Service, usually in mail cars, though sometimes in terminal railway post offices. Such mail may go to the appropriate carrier station without being unpouched en route. In some cases it is sent to the main post office and there either forwarded without being unpouched, or else distributed in the central office to carrier routes under the supervision and by means of the mass-handling facilities of the central office.

Mail not worked by the Railway Mail Service goes through a series of processes which are the reverse of the processes to which outbound mail is subjected.

The handling of inbound letter mail, circulars, and small parcels in larger offices varies with the nature of the building and the equipment, as does the handling of outbound mail. The underlying principles of mail handling, however, are similar in the various offices and may be illustrated by the case of one of the larger offices. In the office in question temporary facilities are in use pending the completion of the new post-office building. The methods, nevertheless, are in large measure typical.

All inbound mail except parcel post for this office is distributed on the second floor. This includes mail trucked in from other depots, the main office, the branch offices and the box collections, and brought by elevators on hand trucks to the second floor. There are primary and secondary distributing centers for each of the three main types of foot-carrier mail: (1) Letters; (2) letter-size circulars; and (3)

tray mail (flats, small parcels, and paper mail). These three distributing centers are arranged conveniently so as to facilitate forward movement of each class of mail from primary distributing centers onward and downward to the loading platform.

The cases for tray mail must be much larger than those for letters and letter-size circulars. In order to make all holes in a particular case accessible to the distributor, the case is broken into sections and arranged in horseshoe shape. This saves much time and reduces lost motion formerly required by the distributor in going back and forth to reach the various holes in his case. Tray mail is brought to these cases in trays on hand trucks.

The primary distribution is mainly to station sections. A station section may include only one carrier station, if the station has a large number of carrier routes, but it may combine several carrier stations.

Mail for each station section is taken to the secondary distributing cases and distributed to the carrier routes of each carrier station.

The separating cases are arranged in long rows. A crew is assigned to each row, each member of the crew handling a complete case. The members of the crew are given approximately the same amount of mail to "throw." As soon as this amount is distributed they move to the opposite side of the case, and if a particular distributor is repeatedly the last to change sides, it is apparent that he is below the average in speed. There is thus an automatically operative impulse to "keep up with the procession," and an automatic check on the work of the slower members of the crew. To relieve the strain, crews stand on one side and sit on the other side of the cases.

In order to check the amount of time spent and the volume of output on a given operation and to see that the output per unit of time is maintained, a set of forms has been devised.

The primary separations are simple. The distributor merely needs to know to which of the station districts a particular address belongs. The secondary separation requires familiarity with a much more elaborate distribution scheme. The distributor must know to which of the various carrier routes of the station section that he is handling a particular address belongs. Each distributor must know the primary scheme and at least one of the secondary distribution schemes. The distributors are thus interchangeable and slack time is reduced. Since circulars and tray mail are handled by the same scheme of distribution that applies to letters, clerks are changed from one type of mail to another as the volume of mail demands. Interchangeability of employees is possible also in connection with some other types of work. Distributors, for instance, may be shifted to the canceling machines for canceling such mail as is not canceled at the main office, or to the special-delivery section, or to various other types of work. Interchangeability, with a corresponding reduction of slack time, is also brought about by shifting men from the main office to a branch office and vice versa. This is possible because the peak of inbound mail comes at a different time from the peak of outbound mail.

Formerly the regular crew went on in the early morning and in the late afternoon and peaks in the volume of mail were handled by

substitutes and auxiliary employees. By changing the hours of the regular crew, the peaks were handled almost entirely by regular employees and auxiliary help has been largely eliminated.

There was formerly much lost motion and idle time due to crews changing at different times during the day. This has been reduced by means of timing the "trips" (the periods on duty) so as to make only one major "clean-up" between the shifting of crews.

At times there is not enough work for full crews, and in order to reduce the amount of slack time, "compensatory" time is granted as far as possible during the slack periods. That is, men are given time off to make up for Sunday duty or other special work.

Due to night differential pay rates, papers (except daily papers) and circulars are handled in the daytime unless there is slack time at night when men would be on duty with no urgent mail to handle.

Letters, circulars, and small parcels are distributed to carrier routes throughout the city in the manner described above, or in a similar manner, varying with local conditions. When distribution to carrier routes is made at the carrier station (the station from which the carrier operates), mail goes direct to the carrier's desk. If the advantages of mass handling cause distribution to be centralized, either at a single office or at district offices which supply a number of carrier stations, the mail must of course be dispatched by motor vehicles from the distributing center to the appropriate carrier station.

A considerable part of the letters, circulars, and small parcels, such as carriers handle, is delivered to the addressees through general delivery, private boxes, and special delivery. In the larger cities, however, the letter carriers handle the bulk of these classes of mail. After the mail for a particular city, originating both locally and throughout the world, has been put through the various processes briefly described above, it finally reaches the desks of the letter carriers. These desks contain separations for use by the carriers in the distribution of their mail. At regularly scheduled periods (the number of periods varying with the city and with the area in a particular city to which a carrier is assigned) a carrier collects his mail from the distributing cases into which the distributing clerks have placed it. If distribution is made at a central office other than the carrier's own station, his mail is brought to his desk from a motor vehicle. At his desk he takes charge of his "hand" and sets it up for delivery. The setting-up process is simply the arrangement of the mail by streets and street numbers in the order of its delivery to the addressees. Each "hand" is then made up into convenient bundles, each bundle is tied with a strap specially adapted to the purpose, the bundles are placed in a carrier satchel, and the carrier is then ready to proceed over his route.

The routes of letter carriers are kept in a flexible condition. Records are kept as to the length of time necessary to cover the different routes, the varying amounts of mail carried, the time required for the distribution of the mail by the carriers in the office, the strapping of bundles, and other duties. By such methods the amount of work done by letter carriers is standardized and average output per carrier is maintained, whether the volume of mail fluctuates or not.

## Handling Parcels at Offices of Origin

Before 1913 fourth-class mail was limited to small bundles which ordinarily were delivered by foot carriers, and which created no serious problem of mail handling in the office or out of it. Periodicals classed as second-class mail were then far less bulky than in more recent years when the amount of advertising, as well as of reading matter, has tended to increase. With the gigantic increases in the average size per piece and in the total volume of second and fourth class mail, revolutionary changes in methods of mail handling were introduced.

As in the case of letters and circulars, the methods of handling vary at the places of origin and at the places of destination, depending on the location and, particularly, the size of the places. Irrespective of the places of origin and of destination, the handling of these classes of mail, as well as of letters and circulars, along the main streams of traffic is standardized to a considerable degree.

For places of origin which are too small to afford a volume of mail large enough for mass handling there are two main methods. In the smaller offices there is an unspecialized handling of these classes of mail, as well as of all other postal services, by the postmaster with occasional clerical assistance. In offices of moderate size the amount of work and the number of employees make specialization possible, but not mechanized mass handling. A clerk may be assigned, for example, to the handling of insured parcels. Various other specialized functions prove economical in such offices. It is apparent, however, that unless there is some special circumstance, such as the existence of a mail-order house in a small city, the amount of bulky mail would not justify the expense of mechanical handling, such as by belt conveyor, spiral chutes, etc.

In rural, town, and small-city offices the process of transportation to stations and, in general, the merging of these classes of mail with the main traffic stream are substantially the same as in the case of letters and circulars. Much of the handling is done at terminal railway post offices under the supervision of the Railway Mail Service. The city post offices in many cases are not adapted to the handling of bulky mail and in other cases they are not large enough to meet the requirements of a rapidly expanding volume of mail and special services. These and other considerations (for example, the problem of routing bulky mail) account for the larger proportion of second-class and fourth-class mail which is partly distributed in terminal railway post offices.

The most significant developments of recent years in connection with the Postal Service, so far as technological improvements are concerned, are probably those that have grown out of the problems of handling the rapidly expanding volume of parcel-post mail in the larger cities. In these localities mechanized equipment has proved to be practicable and has already been installed in many offices. It is to be provided extensively in the numerous larger post-office buildings now under construction. Early in the history of the Parcel Post System, experience indicated the desirability of separate buildings located near railroad stations and equipped with mechanical mail-handling facilities.

The methods of handling outbound bulky mail may be illustrated by an urban office of moderate size, but large enough to justify a considerable degree of mechanization. The heavier paper mail and the "flats" (large flat pieces of third-class mail), as well as parcel-post mail, are handled in a separate building specially equipped for the purpose.

Parcels deposited at the main office and the various branches, and parcels transferred from railroad stations for handling here, come in by motor vehicles and are unloaded in one end of the building. The other end is used for loading after the mail has been handled in the post office. Fragile pieces, loose parcels, etc., are moved on elevators to the basement. Ordinary parcels are sent to the second floor by belt conveyor and dumped onto a big central separating table in the center of the room. On one side of this table where parcel-post mail is handled, parcels for the State in which the post office is located are distributed, and on the other side, all others.

On the State side of the table, State parcels are taken to the distributing racks (rows of sacks held open on metal racks, with labels indicating railway post offices). The distributor must know the whole State scheme of distribution (the proper routing throughout the day for reaching every post office, and the distributing centers for reaching all post offices not on railways). Parcels are thrown or placed in the appropriate sacks with great precision and skill.

On the opposite side of the separating table mail is distributed to railway post offices for three adjacent States. For other regions mail is sent to the appropriate terminal railway post offices (for example, for Pennsylvania, to Pittsburgh for distribution; for New Jersey, to Philadelphia for distribution; for Virginia, West Virginia, North Carolina, and Ohio, to Cincinnati for distribution).

Distributors must know all railway post offices in the States for which distribution is made and all the offices receiving mail through each one; the post offices through which all post offices not on railroads receive their mail; and the railway post offices by which all "directs" are to be dispatched.

Men on the unloading platforms make primary separation to the extent of picking out mail for the State in which the office is located, and also segregating articles unsuited to sacking ("outsides") to be sent to the basement for direct handling and transfer to trucks.

In a larger office, which numbers important mail-order houses among its patrons, the handling of outbound mail is more extensively mechanized, there being in a separate building a postal station specializing in parcel-post mail. For receiving outbound parcel-post mail there are three chutes from the street into which the mail trucks unload, and one chute from the lobby for packages mailed at this particular station. The trucks bring parcels and papers from other postal stations or branch offices and from the main office for handling here.

These four chutes lead into the basement. Here a separation is made of large parcels and others not to be sacked ("outsides") and then the mail is put on hand trucks and taken by elevators to separating platforms or tables on the fourth floor, where the primary separation breaks it up into seven parts, by main sections of the

country. State parcels (that is, parcels for other offices in the State in which this post office is located) are sent by belt conveyor to another part of the floor. For the rest of the country there are six chutes into which the parcels are separated, to be sent to the third floor for further handling. State parcels are separated alphabetically by towns into six parts, for example, towns beginning with the letters C to E, and also sent, by six additional chutes, to the third floor for distribution. The alphabetical separation is so adjusted as to give each chute approximately the same amount of mail.

On the fourth floor, circulars and periodicals (other than those that are distributed in the publishing houses and firm offices and sent direct to trains) are distributed and sacked and dispatched by elevators from the fourth floor to the loading dock.

On the third floor there are two distributing centers. On one side (near the terminals of the six chutes carrying State mail) are distributing tables and sack racks for State parcels. For these there are 600 "directs"—that is, offices to which mail is distributed alphabetically and sent direct without further handling. The "residue" of mail goes to small offices, some on railways and some inland. Towns not on railways receive their mail through junction towns and are known as "dis" offices. The distribution of the "residue" mail, therefore, requires knowledge of the distribution scheme of the entire State, so that mail for a particular town will be put in the appropriate sack and dispatched on the proper train.

On the other side of the third floor a similar distribution is made for the rest of the country, except that there are fewer "directs," about 80 for a neighboring State, for example, and the "residue" is correspondingly larger. The "residue," instead of being distributed at the post office, is sent to the terminal railway post office in the same city for distribution, where mail is distributed to 14 States.

As the sacks are tied out for dispatch they are put on a belt conveyor which empties into a spiral chute leading to the loading dock or platform. For mail not adjacent to the conveyor, there is a second chute not connected with the conveyor.

Insured and C. O. D. parcels, which are handled on hand trucks instead of conveyors and chutes, are sent to the fourth floor for special handling and are then merged with the ordinary mail.

Large quantities of outbound parcel post are handled at the mail-order houses. Each of the two main mail-order houses has about 20 Government clerks making distribution there instead of at the post office. This mail is sent by the mail-order houses direct to the trains, instead of to the post office. This arrangement not only speeds up the mail for the mail-order houses but also saves the post office the labor and cost both of hauling the mail from the post office to the trains and of handling it at the post office.

### The Van Buren Annex

One of the most interesting illustrations of the mechanized mass handling of parcel-post and other bulky mail is the system used at the Van Buren annex of the Chicago post office. The physical plant of the postal system of Chicago, as of many other cities, is under-

going reconstruction. This, however, has not prevented the continued use of a truly remarkable system of mail handling.<sup>2</sup>

The Van Buren annex is a building located near the Union Station and was designed for the use of a mechanical belt system primarily for the handling of parcel-post mail.

Mails reach the Van Buren annex in various ways, from different sources, and in several conditions:

(1) From the main post office parcel post is brought unsacked in nondamage parcel dump trucks, six of these trucks being placed in a single motor vehicle. The trucks are unloaded from the motor vehicles at the north receiving platform, elevated section, and emptied onto feed belts by an automatic tripping device. These trucks are the invention of an employee of the Chicago post office.

(2) Mail from branch offices and from private mailers is brought to the receiving dock partly sacked and partly loose. These mixed loads must be handled in several different ways as will be indicated later.

(3) Sacked mail from Union Station railroad lines is transferred directly by means of belt conveyors.

(4) Sacked mail from other depots than the Union Station is brought by Government motor vehicles to the north section of the receiving dock on the first floor and placed on hand trucks for further handling.

Mail received at the Van Buren annex from these several sources reaches the primary distributing centers in the following ways:

(1) Mail from the main post office brought in dump trucks is emptied onto an elevating belt conveyor at about 16 degrees pitch, terminating at the south end of the third floor. This belt empties onto a main feed belt. If mail traffic is heavy two sets of belts are used.

(2) Mails received from private mailers in their own vehicles and from city stations are of all classes and must, therefore, be handled in different ways. A single motor-vehicle load may include ordinary canceled parcel post; ordinary uncanceled parcel post; C. O. D., insured, special-delivery, and special-handling parcel post; outside parcels, that is, such as can not be sacked (eggs in crates, automobile tires, broom handles, etc.); and, in addition, periodicals, catalogs, circulars, and letters. Ordinary canceled parcel post in sacks or in bulk is sent by hand trucks to the elevating belts on the first floor, where the sacks are emptied and loose parcels deposited and mechanically transferred to the third floor for primary separation. Circulars, catalogs, and periodicals, after appropriate special handlings, are sent to the fourth floor by elevators for primary separation, unless already made up in sacks to trains and "directs" (a particular sack containing mail to one post office exclusively), in which case sacks so made up are sent by chutes to train platforms for car-door and depot separation. Outside parcels received from all sources are always handled on hand trucks and elevators and are sent to the fourth floor for distribution. All first-class mail received at the Van

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<sup>2</sup> The Bureau of Labor Statistics is indebted to the post-office authorities at Chicago and particularly to Mr. E. A. Goodrich, assistant superintendent of mails, for a large part of the data contained in the following description of the Van Buren annex.

Buren annex is sent at hourly intervals to the main post office for proper treatment and dispatch.

(3) Parcel post from Union Station railroad lines is handled, in the first place, by portable belt conveyors operated electrically from special sockets. A belt is long enough to extend from the car openings to the platform about 15 feet away. Mail dumped onto one of these belts is deposited in turn by the belt, through floor openings in the platform, onto a connecting belt conveyor 1,400 feet in length and in continual operation. This belt is divided into two units, the south half running north and the north half running south, which meet at about the center of the building and deposit their mails onto a cross belt operating on the ceiling of the basement level. This cross belt connects, in turn, with an elevating belt leading to a break-up point or separating unit on the track floor. Here the mail brought by crossover belts is separated and deposited through chutes onto belts for dispatch to its several destinations, including the Van Buren annex. Mail for the annex is then taken by elevator to the fourth floor, where the sacks are emptied into holes in the floor leading to the separating centers below.

(4) Parcel post from depots other than the Union Station, is delivered by Government motor vehicles to the north section of the unloading platform on the first floor, where it is removed from the vehicles, placed on hand trucks, and sent by elevator to the fourth floor for treatment such as is given to parcel post received from Union Station lines—that is, sent through floor chutes to the appropriate separating centers.

Movement of mail is generally from the unloading platforms upward to the primary distributing centers, mainly to the northward on the third and fourth floors. From these points gravity and electrically operated distributing belts are used to carry the mail to the secondary distributing centers, from which, in turn, the movement is mainly southward and downward to the first floor and the train levels for dispatch. Thus there is a continuous forward movement of mail with the handling of the mail being carried on, as far as possible, while it is in motion.

Mail from the several sources, as has been seen, converges (either by elevating belt conveyors to the third floor or by elevators to the fourth floor and thence through chutes to the third floor) in the third-floor primary separating centers. The primary separation is made from two main feed belts. Paralleling this center tier of two feed belts are two separating units of eight belts each. Of the eight belts for each of the two units four are on each side of the center tier of feed belts, and are used in each case only by one of the two groups of postal clerks assigned to the primary separation; and four belts are in the center and are used in common by the two groups of separators. If the volume of mail is not too large, one unit of belts only is used. In this primary section, with its two 8-belt separating units, 70 employees can be used. Their duty is to take the parcels from the moving feed belts and to place each parcel on its appropriate belt in one of the 8-belt separating units.

Seven of the eight belts of each of the two separating units go direct to secondary separating tables, taking to these tables parcels destined to States or groups of States which receive the larger por-

tion of this class of mail originating at Chicago. These seven belts (or 14 if both units are used) carry about 65 per cent of the mail from the feed belts. The eighth belt, carrying about 35 per cent of the mail, leads upward to the fourth floor and there becomes a feed belt for another system of belts for separating the 35 per cent of the mail. This mail is for more than 30 States, mainly the remoter areas to which the volume of mail is light. Thus the eighth belt becomes a feed belt for a second primary distributing center which handles mail for the more distant areas; the reason for this is that the building now used is not adapted to the installation of enough belts accessible to separators for the requisite number of separations. The 15 primary separations (7 from the main feed belt and 8 from the auxiliary feed belt) would require 15 belts accessible to any particular separator. In the new post-office building the belting will be so simplified that all of the primary separations can be made from one feed belt direct to the various destinations included in the primary scheme of distribution. Then 100 per cent instead of 65 per cent of the mail from the feed belt will be distributed to belts leading directly to the secondary distributing centers.

Each of the 15 primary separations is followed by a secondary separation at the terminus of the appropriate primary separating belt. At the secondary tables an alphabetical separation to floor trucks (gurneys) is made for the purpose of distributing parcels to direct sacks, each such sack containing nothing but mail for a particular post office and requiring no further handling en route. This direct distribution for the six nearby States serves to send without additional handling approximately 94 per cent of all parcels received for these States. The residue, about 6 per cent, is sent to the Railway Mail Service for further distribution.

In the case of towns in some of the more distant States it is relatively difficult to make a direct distribution at Chicago to these towns. In such cases the mails for some of the larger offices in these States are sent direct, but the residue is dispatched to a railway-mail terminal or post office located at a point convenient for distribution to these towns. Such terminals or post offices are usually railroad centers from which an entire State may be served without difficulty, and often the center to which mail is sent for distribution lies outside the State to be served. For example, it has been found that all parcel post for the State of Arkansas can most economically be sent to the terminal at St. Louis, Mo., for distribution to direct for Arkansas. In other cases it is necessary to subdivide the mails in a number of ways in order to speed up the servicing of sections of larger States. Instances are to be found in the case of parcel post for California and for Texas. California mails are divided by a scheme of post offices according to which some of the California mail is sent to the Los Angeles terminal and the remainder to the Sacramento post office, and from these two points all of the State of California may be serviced. Texas is divided into three parts, one section being served from the terminal at Texarkana, Ark., one from the terminal at Fort Worth, Tex., and the third from the Kansas City, Mo., terminal.

The problems involved in the choice of such centers of distribution as St. Louis for Arkansas mail are among the most important of the

Postal Service. It is desirable to maintain, as far as possible, a continuous forward movement of mail and, at the same time, there must be a concentration at strategic points for the "fanning out" of the mail from distributing centers to tributary points. Choice of a particular distributing center requires careful and extensive study of the district to be served and of the available railroad accommodations.

In the movement of parcel-post mail through the Van Buren annex the parcels received in each of the 15 secondary separating centers (located at the terminals of the 15 primary separating belts) are handled in one of two ways. Either they are made up into "directs" which require no further handling till they arrive at the office of destination, or parcels to different offices are combined in such manner as to call for further distribution en route.

Methods in use at the secondary distributing centers may be illustrated by the case of one of the 15 centers—the one for the handling of mail for the States of Missouri, Kansas, Arkansas, Nevada, and Texas. It will be recalled that mail sent to the fourth floor (the 35 per cent of the mail taken from the primary feed belts described above) is separated onto eight primary separating belts. One of these belts contains mail for the five States mentioned above. From this belt it is emptied into a chute leading to a secondary distributing table on the third floor. Mail for Kansas is sorted out from the rest and mail for Kansas offices beginning with the letters A to L is put into one sack and mail for offices beginning with the letters M to Z is put into another sack. When full, or at the time for dispatch, the sack is locked and labeled "Kansas City, Mo., Terminal, Kansas PP No. 1 (D4) from Chicago, Ill." and the second sack is labeled the same way with the exception of "No. 2" instead of No. 1. Nevada and Arkansas mails are "sent solid" and "tagged out" to the proper terminal railway post office. Missouri and Texas parcels are separated, loaded on gurneys, and worked again by principal towns with a "residue" of miscellaneous parcels.

It will be recalled that in connection with the distribution of letters and circulars, distributing cases are used with pigeonholes into which the letters are put before being tied out and pouched. For pouching, the sacks are placed on racks in such manner as to hold the sacks open in a position for receiving the packages of letters as they are thrown from a central point by the distributor. In the case of parcel post it is obvious that distributing cases can not be used. The conveyor belts for the primary separations correspond to the primary separating cases. At the secondary separating tables used for parcel post, small floor trucks or gurneys are used for such parcels as require further distribution. When parcels are finally ready to be sacked, sack racks resembling pouch racks are used; but since the parcels and the sacks are of larger size, the process of sacking is necessarily slower and more difficult than the process of pouching.

Parcels for a particular destination (whether for a single post office, for a region, or for a number of post offices) when finally distributed and sacked are sent by floor wells or chutes to belts on the floor below. These belts in turn feed into spiral chutes which lead to the loading levels. A particular route must be chosen because the several spiral chutes feed into different sections of the Union Station

and into different loading areas for depots other than the Union Station. It will be recalled that the Kansas mail referred to above contained on the label the symbol "D4." This symbol indicates the floor well, the belt, and the spiral chute to be used for that particular sack. The symbols U1, U2, U3, and U4 denote the Union Station mail platform. Mail for Union Station trains is delivered by spiral chutes direct to track level, where a car-door separation is made. About 35 mail cars may be loaded at one time. Symbols other than U1 to U4—as, for example, D4—on sack labels indicate other stations. Delivery to these stations is by spiral chutes to the motor-vehicle loading platform, where separation is made onto hand trucks for motor vehicles which carry mail to stations other than the Union Station. The placing of mails in the cars is done by railway employees under the supervision of transfer clerks of the Railway Mail Service.

In addition to the distributing center just described for the States of Missouri, Kansas, Arkansas, Nevada, and Texas, there are 14 other secondary distributing centers. Some of these have separations which are mainly alphabetical; for example, Illinois mail is distributed directly to nearly 1,100 post offices out of a possible 1,550 offices. The "residue" in this case (the mail which railway post-office trains would receive as miscellaneous) is approximately only 5 per cent of all Illinois parcel post handled. In other cases, especially when the destination is more remote, the proportion of mail which requires additional handling en route is much larger.

The Van Buren annex is by no means limited in its operations to the handling of parcel-post mail. If we return, for a moment, to the main feed belt on the third floor and observe the stream of mail on this feed belt we see considerable quantities of first-class mail, circulars, periodicals, and small miscellaneous items. These various classes of mail are not removed from the main feed belt but are allowed to ride to a table at the end of the belt, where they are placed in gurneys and sent by elevators to the fourth floor for further handling. First-class mail is sent each half-hour to the main post office to be merged with the main stream of letters handled there.

Special-delivery and other parcels requiring special handling are held out on the first floor when possible, otherwise at the primary separation from the feed belt, and are sent to special-handling sections, mainly on the fourth floor. Foreign mail is also handled on the fourth floor.

Much of the parcel-post mail can not be put into sacks without special handling. Parcels that can not be sent by belt to the sack racks and that can not be placed in sacks while the sacks are on the racks are sent to the fourth floor and sacked separately in order to take advantage of the lower transportation rate for sacked mail.

Even with special handling there are many parcels which can not be sacked and which are known as "outsides." These are conveyed on hand trucks and elevators to the fourth floor, where they are distributed to depots and returned by hand trucks and elevators for dispatch. All outside parcels received are separated on the same schedule as mails which are sacked, and are included in the same trains as sacked parcels.

A large variety of paper mail is handled at the Van Buren annex. Included under this general heading are catalogs, advertising matter, periodicals, calendars, samples of no commercial value, and transient newspapers. Second-class mail is received principally in sacks, weighed by lot, and zone-inspected, and recorded in the name of the mailer before being sent by hand trucks and elevators to the fourth floor. Various other kinds of paper mail are also sent to the fourth floor. Here 60 separations to sacks are made. Mails for a few of the large cities are labeled direct to these cities. The rest of the paper mail is distributed to Railway Mail Service terminals in other cities, with the exception of mail for the States of Illinois, Iowa, Indiana, Michigan, Wisconsin, Ohio, and California, which is sent to the Chicago terminal railway post office for further distribution. The division of labor between the Railway Mail Service and the Van Buren annex is determined by such factors as economy of labor, speed of delivery, and facilities available. Paper mails are sent from the fourth floor to loading levels and dispatched in a manner similar to the method outlined for parcel post.

The various spiral chutes which feed the trains of the Union Station and the other outlets terminate on the track level or adjacent to the motor-vehicle loading platform southward of the unloading docks. There is room within the building's boundaries for loading about 15 cars. By means of stubs or spurs beyond the building's boundaries north and south, about 20 additional cars can be accommodated.

For the purpose of hauling trains of trucks to car doors for loading at points beyond the south and north ends of the building, where hand movement is difficult or too laborious, tractors driven by electric batteries are used.

A superficial view of the operations at the Van Buren annex gives the impression of a confused maze of belt conveyors, chutes, trucks, tractor trains, and other facilities. Further observation reveals an orderly arrangement and movement of the various kinds of mail from the places of ingress upward to the appropriate centers for necessary handling and then forward and downward to the places of dispatch to trucks or trains. There is a prodigious amount of motion but a remarkably small amount of lost motion.

## Handling Parcels Between Offices

The account so far given concerns the collecting of parcel post and the placing of it in a position to be transported along the main streams of traffic toward its destination. As has been seen, there are two main classes of mail from the point of view of its preparation for transit: (a) "Directs," which require no distribution en route and which require a minimum of transfer, relabeling, and redispaching; and (b) other mail, which is not assorted by post offices and which, therefore, requires additional distribution before reaching the post office of destination.

In the case of parcel post, such mail as requires distribution en route is not handled ordinarily in railway mail cars. Because of the relatively high cost of space and of transportation facilities in railway mail cars, these are reserved largely for letters and daily papers

and small quantities of mail of other kinds requiring special handling. The distribution of parcel post en route is usually in terminal railway post offices.

The uses of terminal railway post offices were mentioned in connection with letter mail,<sup>8</sup> but their functions are more vital in the handling of other classes of mail.

A relatively simple illustration of the work of terminal railway post offices in the handling of parcel post is to be found in the case of the terminal at Kansas City, Mo. Terminal post offices are located at railroad terminals, or at least in such manner as to facilitate the distribution and dispatch of mail in a forward direction. The Kansas City terminal post office is operated in connection with the railroad terminal. Mail to be transferred from one train to another and not to be worked in the terminal post office is brought from the mail cars on hand trucks to a chute and sent by chute to a platform in the sub-basement to be redispached. Mail originating in Kansas City is brought to an unloading dock on motor vehicles and sent through four chutes to the sub-basement, where the transfer mail from the train floor is also received by chute. From the terminal post office on the floor above the sub-basement six chutes bring mail worked in the terminal post office for similar separation to trains. "Outsides" in great variety are handled by means of hand trucks and elevators and these also are sent to the sub-basement.

Thus transfer mail, together with mail from Kansas City (both sacks and outsides), is conveniently assembled in the sub-basement. As it comes into the assembling center it is distributed, while being worked backward toward the train sheds, for convenient transfer to appropriate trains. Sack mail comes down the four chutes from the unloading dock and is dumped onto a separating table. Also, the chute leading from the train unloading floor terminates on a separating platform near the terminus of the four chutes used for mail from Kansas City. Near the separating platforms are six belt conveyors moving backward toward the train sheds. The mail on the separating platforms is separated to railways and placed on the six belt conveyors, each of which leads to a dispatching platform. "Outsides," as they are distributed, are handled on hand trucks.

Thus mail of these various kinds and from these several sources (transferred from trains, sent by chute from the terminal post office, and trucked in from the Kansas City post office and its branches) is moved backward, distributed, and prepared for dispatch. It is then sent through a tunnel underneath the train floor on hand trucks and raised by elevators to the various tracks, each hand truck going to the track of the train for which its load is dispatched.

Due to the fact that the main terminal railway post office does not have sufficient room, there is an overflow distributing center known as the annex, which is chiefly used for working mail for Oklahoma, Texas, and Nebraska. The same system of distribution is used and there are no distinctive mechanical devices in the annex.

The scheme of distribution used in terminal railway post offices is essentially the same as in general post offices; but it involves more extensive knowledge of train schedules and connections and of the country-wide system of terminal railway post offices, and the em-

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<sup>8</sup> See pp. 21 and 22.

phasis is on routing and dispatching rather than separating and distributing.

A terminal railway post office resembles in many ways a city post-office building which specializes in the handling of parcel-post mail and paper mail, as does the Van Buren annex or the Quincy station at Chicago. A terminal railway post office, however, functions not so much in the handling of parcels to or from the city in which it is located as in the routing, transfer, and economical "fanning out" of mail from a strategic center to its tributary areas.<sup>4</sup>

The actual movement of ordinary parcel mail along the main traffic stream to the point of its diversion for transfer to the office of destination is in storage cars or in cars in which storage space is reserved at contractual rates.

### Handling Parcels at Offices of Destination

Parcel mail has now been followed from the office of origin into the main traffic stream and along the stream to the point where it must be diverted from the stream for transfer to the office of destination. As in the case of transfer from the office of origin to the main traffic stream, the methods used for diverting parcel mail from the stream to the office of destination depend (1) on whether or not the office of destination is in a city through which a main stream of postal traffic flows, and (2) on whether or not the office of destination is large enough to justify specialized modes of handling mail. Much of the transfer work is done by employees of transportation companies having mail contracts. Generally, in smaller places, mail messengers working under contract are employed. In larger places Government employees convey the mail in publicly owned motor vehicles. Bus lines, electric railroads, steamships, and various other modes of transportation are often found necessary, as in the case of the transportation of mail from the point of origin to the main traffic streams.

When parcel mail has finally reached its office of destination, the methods of delivery to addressees also vary substantially as do the methods of collecting parcel mail from the addressors and conveying it to the offices of origin. In smaller places there is not even specialized handling. In offices of moderate size there is a varying degree of specialization of labor, but very little mass handling by mechanized methods. In the larger cities and, in general, in places having a volume of mail sufficient to justify mechanized handling, various devices are used similar in general nature to the devices used for handling outbound parcel post in the offices of origin.

In the largest cities the specialization goes so far as to include the use of separate buildings for handling inbound and outbound parcel mail. In Chicago inbound parcel post, together with similar mail, is handled at the Quincy station and outbound parcel mail, as already seen, goes through the Van Buren annex. The Quincy station is the distributing center for all parcel-post and paper mail for city delivery. At this station are received (1) parcel-post and paper mail in sacks from all Chicago railroad depots; (2)

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<sup>4</sup> See pp. 31 and 32.

parcel post, papers, and special delivery matter in sacks or pouches from all city postal stations; (3) parcel post, both ordinary and special delivery, unsacked from the Van Buren annex in nondamage dump trucks, and also paper mail in sacks; (4) paper mail in sacks direct from publishing houses for city delivery; and (5) a certain amount of first-class mail, the delivery of which can be advanced by transfer from railroad depots to the Quincy station instead of to the main post office. Each of the special containers bringing unsacked parcel-post mail from the Van Buren annex has a capacity equaling 12½ sacks, and each automobile has room for 6 containers. This container was invented at the Chicago post office, and is there known as the Madigan nondamage dump truck. It can be quickly unloaded and, by means of a tripping device, emptied in one movement. The use of this container eliminates the necessity of filling and emptying mail sacks, reduces motor-vehicle loading and unloading time, and speeds up the movement of mails.

The various kinds of mail from the several sources mentioned are sent by hand trucks and elevators to a mezzanine above the fourth floor. Here the mail is dumped from sacks, or, in the case of the parcel-post mail from the Van Buren annex, emptied directly from the Madigan trucks onto a belt conveyor feeding a belt separating unit on the fourth floor.

Men along this feed belt remove the large parcels and put them onto separating belts running parallel to the feed belt. Of these separating belts seven lead to tables which serve parcel-post delivery districts of the city. The eighth belt serves as a feed belt for a second break-up. From this eighth belt C. O. D. parcels and parcels being returned to the large mail-order houses are sent to special-handling sections. The parcels delivered by the belts terminating at the tables which serve the parcel-post delivery sections of the city are separated by employees in accordance with the Chicago delivery scheme to parcel-post carrier routes and placed in sacks. The sacks are labeled to indicate these routes, and are then dispatched to the platform used for outgoing mails to be loaded on Government motor vehicles for delivery to the appropriate city postal station. At the station a parcel-post delivery man for each route receives the sacks for his route, arranges the parcels upon the tailboard of his automobile roughly in the order of delivery, and proceeds to cover his route in a manner analogous to the way in which letter carriers cover their routes. Formerly parcels were arranged in the post office by postal clerks in the order of delivery by streets and street numbers. It was found that this consumed a great deal of time without speeding up the delivery in a corresponding degree. The sorting of the mail by the motor-vehicle operator on the tailboard of his truck saves a great deal of time on the part of postal employees without materially slowing up the delivery of mail.

In addition to parcel post delivered by motor-vehicle operators in the manner just described, other classes of mail are handled at the Quincy station. The large feed belt on the fourth floor carries small parcels and paper mail as well as ordinary parcel post. Small parcels and paper mail are allowed to travel to the end of the main feed belt, where they fall into a chute leading to second-floor outlets. Separation to city postal stations is made on the second floor. In

addition to the small parcels and paper mail received from the main feed belt on the fourth floor, there are large quantities of second-class mail, particularly periodicals, brought to the receiving platform by local publishing and printing concerns. This mail of local origin is sent to the second floor for distribution along with the paper mail and small parcels received from the main feed belt on the fourth floor, and is then distributed to appropriate postal stations, to which it is dispatched and from which it is delivered to addressees by the regular district foot carriers.

Special-delivery parcels are handled separately and sent by elevator to the second floor, where the time of receipt is postmarked on the parcels. Delivery tickets are drawn up and parcels are turned over to a squad of special-delivery messengers for delivery. These messengers buy and maintain motor vehicles with bodies conforming to the general construction and appearance of the regulation Government mail truck.

First-class mail handled at the Quincy station consists largely of pouches of letters received from various city postal stations for transfer to other stations. Distribution of this mail to appropriate stations for delivery in the city is performed on the second floor. Letters are pouched and the pouches labeled, and locked and dispatched by motor vehicle at scheduled intervals for delivery to appropriate stations. There is also a quantity of first-class mail received from railroad stations to be handled at the Quincy station in order to facilitate delivery. This mail is usually distributed on railway mail cars and the special service of delivery to city stations by way of the Quincy office instead of the main post office results in advancing the delivery of a considerable body of first-class mail.

Outside parcels received from all sources are separated to parcel-post delivery districts on the receiving platform of the first floor and are dispatched by automobile, with the sacked parcels, to the appropriate parcel-post delivery station.

The larger buildings in the Quincy station district are served by a special time-saving arrangement. Owners or managers of these buildings were solicited and, after a thorough explanation, their cooperation was obtained in the form of rooms being set aside at no cost to the post office for the delivery of parcels to these buildings, and for the separation of parcels in the buildings instead of in the post office. Under this system carriers and motor-vehicle employees are supplied with keys to these rooms. One truck driver can serve nine buildings and one carrier can serve three buildings. While the carrier is delivering parcels, the truck driver does nothing but haul mail to the storage rooms. There are two deliveries instead of one as formerly, and this makes unnecessary the emergency trips formerly made on Monday to handle accumulated week-end mail. This arrangement, besides giving better and more frequent service, reduces the number of deliverymen from 68 to 56, eliminates 3 motor cars, and reduces the amount of space required at the post office.

From the account so far given relating to the intricacy and the magnitude of the problems of mail handling it is apparent that the traditional type of building, sometimes described as the monumental type, is far from adequate for the present-day work of the postal system. In addition to the requirements for the speedy and eco-

nomical ingress and egress of mail and for the handling of the various types of mail through the several stages required for both inbound and outbound mail, the special services of the post offices (some of which, as, for instance, the postal-savings division, have no immediate connection with handling the mails) have grown in number and volume till they also call for highly specialized facilities which are rarely available in the older types of buildings.

## Special Services of the Postal System

Originally the postal system was limited almost entirely to the handling of letters. Now there are many special services in addition to the handling of the various kinds of mail.

In 1908 (the first year which is included in the present study) there were three special services, namely, registrations, money orders, and special deliveries. The registering of letters was authorized in 1855; the money-order system was instituted in 1865; and 20 years later came the beginning of the special-delivery system.

Of the more recent special services, three—insurance of mail, the collect-on-delivery arrangement, and special handling—are all connected primarily with the Parcel Post System, which was inaugurated at the beginning of 1913. Still another special service is the handling of private funds by the postal-savings division of the post offices.

As will be seen later from the statistical portions of this study, the special services have grown with great rapidity in recent years until they constitute a considerable portion of the total services rendered. Most of the special services are of such nature that there can be only a very limited use of mechanical methods. The principal technological changes, therefore, have been in the nature of administrative rather than mechanical improvements. One of the most important of these has been the reorganization of postal administration for coordinating the various forms of post-office work under the two main divisions of mail handling and finance. This has made possible a reduction of slack time and a relatively complete utilization of the labor forces. To this end one of the more important changes has consisted of a greater interchangeability of labor, by which an employee is shifted from one class of work to another as his qualifications make possible and as occasion may demand.

## Mechanizing of the Money-Order Accounting System

A notable exception to the statement that the special services have not been adapted to the use of mechanical methods is to be found in the handling of money orders. It is true that in the writing of money orders and in the final stage of cashing them there are no significant mechanical arrangements, but in the money-order accounting system there is a remarkable degree of mechanization. The methods were developed during the past two decades by Government auditors at Washington for the Post Office Department and were gradually extended to field offices. A clear account seems to call for a description of the system in a typical field office, such as that of Kansas City.

The Kansas City office audits in a preliminary manner the paid money orders of an extensive area, including the third-class and fourth-class offices of western Missouri—about 800 in all; and it handles the index cards (to be explained later) of Denver, Omaha, Topeka, and Oklahoma City, in addition to its own, but without auditing the accounts of these offices.

The system of auditing paid money orders is by means of the punched-card-index method. There is a key punch operated by hand. Of this type there are about 20 in use in Kansas City. So expert do the operators become that they can punch about 10 cards a minute, and errors have been reduced to as low a ratio as 1 wrong finger movement out of 340,000 movements. The average number of finger movements in punching a single card is 17. These key punches are operated electrically by means of a magnet on the principle of the telegraphic circuit.

The cards contain printed figures for (1) the paying-office number; (2) the year (the last digit only with the figures 0 to 9); (3) the months, numbered 1 to 12; (4) the date paid; (5) the file number (representing a bundle or file of about 200 orders cashed by a particular office or bank); (6) the issuing-office number; (7) the serial number of the money order; (8) the month of issue of the money order; (9) the amount; and (10) the fee.

The key punch operated by hand is used only for punching numbers that are variable (items 6 to 10 in the list given above) in a particular file of paid orders.

The cards of the file for which a balance is being sought (ordinarily about 200 orders) are then put through a gang punch. Every money order in each file has the same paying-office number, year, month, date of payment, and file number (items 1 to 5 above); the gang punch is therefore set for these fixed numbers. The cards representing the entire file are placed in position and a releasing device automatically feeds the cards through the punch. The gang punch has a capacity of 100 cards per minute, at least ten times that of the key punches, and the two gang punches in use do as much as 20 to 25 key punches could do.

The cards are then placed in a printing and adding mechanism—a tabulator. The punched cards pass over brushes, and through the holes in the cards electrical contacts are established. The resulting circuit in turn operates the armature of a magnet, and this sets in motion a printing mechanism, which prints a tabulation or list (a file run) of the money orders contained in the file. The machine also has an adjustable adding device and the amount of the money orders in a particular file is added and the sum printed on the tabulation.

The tabulated list or file run thus becomes a balance sheet. If there is an error a check-up is made. This can be done by comparing the items in the file with the items in the printed list (file run). If the file balance or file run is correct, the cards of the file have served their purpose as far as balancing the file is concerned.

A great many files of money orders are thus put through for establishing cash balances. Complaints and inquiries, however, are received concerning particular money orders with no reference to the file number, which is purely an auditing record. The problem

then is, how to locate a particular money order concerning which inquiry is made, the inquiry perhaps naming only the date and office of issue, serial number of money order, and amount.

In order to establish an index for making any money order in the vast number of files accessible, all of the punched cards of a particular date for each of the larger paying offices (Kansas City, Denver, Omaha, Topeka, and Oklahoma City) are put through an electric sorting machine to arrange them numerically by the numbers of issuing post offices (every post office being assigned a number). The rate of sorting is about 400 per minute.

The cards of each paying office, thus sorted, are then put separately through the same electric tabulator which is used to print the balance sheets of the separate files. This second list is printed in duplicate in the sequence of numbers of the issuing offices. One copy is sent to Washington for use in final audit and for reference. The printing mechanism has a keyboard which uses numbers corresponding to the numbers on the cards. As the cards are automatically fed into the machine the numbers that are punched on the cards set up electrical contacts which actuate the printing mechanism (as in the case of the printing of the balance sheet); thus is printed a record of all orders paid during a particular day in the numerical sequence of the numbers assigned to the issuing offices. The sheets (known as index files or runs) contain the numbers of the issuing post offices and also the serial numbers of the money orders, month of issue, amount paid on each order, and the number of the file corresponding to the file numbers on the original balance sheet.

Each of these sheets lists about 200 money orders and the sheets afford a consecutive record of the daily business of each office. They are filed in numerical sequence of the issuing offices. Thus in case of inquiry concerning a particular money order the number of the office, the date of issue, the serial number of the money order, and (a particularly important item) the original file number can be readily located in the index file. Then, by referring back to the appropriate file of canceled money orders, information is readily available for answering inquiries.

Copies of the index files of orders paid at the larger offices (Denver, Omaha, Topeka, and Oklahoma City) are sent to these offices for similar use in enabling them to answer inquiries.

The portion of the money order containing the signature of the payee goes to Washington. In order to avoid writing to Washington in case of disputed payment, the Kansas City office developed a method of having large firms and institutions mark the coupon (the part of the money order retained at the post office) with the firm's ledger or file number in such way as to enable them by reference to their record to satisfy themselves that they had received the money. This reduced the number of requests for photostatic copies about 50 per cent, with a great saving of labor and time. This method has been adopted for use in other post offices.

Money orders issued by a particular office (Wichita, Kans., for example) are paid not only at Kansas City but at various other offices. Kansas City's preliminary audit covers only the orders paid in Kansas City and the district subject to its accounting supervision. In order that the Washington office may audit all offices and have a check on

both the issuing and the paying of money orders, the punched index cards, the canceled money orders, and the index runs or lists are sent to Washington. The lists are abstracts of the orders for which Kansas City claims credit, and the paid orders themselves are the vouchers. Thus the Kansas City office and the third-class and fourth-class offices in the Kansas City district are subjected at Washington to a final audit of paid money orders; the same is true of all the paid orders handled at all of the various electrical accounting offices in the field.

There remain the money orders for which cards are not punched at the electrical accounting offices in the field. Many first-class and second-class offices do not submit their paid orders to electrical accounting offices in the field but send them direct to Washington. There are also a few central accounting offices<sup>5</sup> which handle the general accounts of third-class and fourth-class offices, but which do not have electrical accounting machinery for perforating cards. Some of these send the paid money orders of their offices and of the third-class and fourth-class offices in their accounting districts to Washington and not to the electrical money-order accounting office in the field. There is therefore still a considerable amount of card punching at Washington. One type of key punch in use is equipped with an automatic feeding device and an automatic stacker, which do away with the handling of cards individually before and after punching. The cards when punched are automatically fed into an electrical tabulator which automatically sums up the amounts of the orders. Thus the claims of the paying offices are verified or corrected.

Whether the cards are punched in field offices or in Washington, the Washington authorities are able by means of the perforated cards, the paid orders, and the abstracts or lists submitted by the paying offices, to audit all paid orders with remarkable speed and accuracy.

When the cards (whether punched in field offices or in Washington) have served their purpose for auditing paid orders they are used for auditing the amounts charged by the issuing postmasters who issued the orders and who received the money. For this additional audit the cards punched at Washington and the cards sent in from field offices are assembled and again put through the sorting machine and sorted by post offices of issue in numerical sequence. The cards are then sent to the electrical tabulators for audit in a manner similar to the method used for auditing the accounts of paying offices.

The electrical money-order accounting machinery has also been adapted to the auditing of delayed-payment money orders, territorial and (in part) international money orders, and postmaster's drafts. In connection with delayed-payment orders the system is particularly serviceable in finding whether or not duplicate orders have been issued and in avoiding a second payment.

Some system of checking up on orders is essential for discovering alterations, forgeries, attempts at second collections on duplicate orders, and other forms of fraud. The amount of labor involved in

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<sup>5</sup> See p. 8.

any nonmechanical method of indexing and auditing would be incalculably greater than the amount now necessary. The electrical accounting method not only is rapid and economical but offers an almost perfect proof that all money orders have been accounted for at the issuing and paying offices in the amounts intended by the remitters.

## Measuring Output

### Mail Handling

Any business enterprise that is conducted according to prevailing economic standards finds it necessary to devise methods for measuring its output. In the case of the post offices, such measurement is essential for sound accounting, budgeting, fixing of rates, assignment of revenues and expenditures, and testing of efficiency alike of labor and of the physical plant. For the purpose of the present study, the measurement of output is essential for ascertaining changes in the productivity of labor and in the number of employment opportunities afforded by the Postal Service.

The period chosen for the study of changes in the output of the postal system has been determined by several factors. A practical consideration is the availability of essential data. It was found that the years immediately preceding the introduction of the Parcel Post System were marked by successful efforts on the part of the Post Office Department to measure the productivity of the system as a whole. This is particularly true of the years 1908, 1910, and 1912. Then followed a long interval characterized by the extension of the Parcel Post System, beginning in 1913, and by the war years and the period of reconstruction, when the methods of measurement worked out earlier were no longer applicable and when the urgency of war-time demands presumably prevented the development of new methods. As a result of the work of the Commission on Postal Service authorized by Congress in 1920, the Division of Cost Ascertainment was organized in 1923. Since 1926 this branch of the Postal Service has functioned regularly and comprehensively in a remarkably successful measurement of the output of the entire system.

Changes in the productivity of labor are obviously affected most vitally by technological changes, either mechanical or administrative. The most significant technological changes in the postal system have occurred since the beginning, in 1908, of dependable measurement of the output of the postal system. The Joint Commission of Congress on Business Methods of the Post Office Department stated in its preliminary report, published in 1908, that "there is a lamentable lack of labor-saving devices practically throughout the whole Postal Service."<sup>6</sup>

This commission was appointed in the first place for the purpose of studying the problem of improving administrative methods. Its investigation revealed the fact that not only was the Postal Service poorly equipped with respect to mechanical devices but that the

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<sup>6</sup> United States. Congress. Joint Commission on Business Methods of the Post Office Department. Preliminary report, 1908, p. 77. (60th Cong., 1st sess., Senate Report No. 201.)

management of labor, the measurement of efficiency, and the business methods in general afforded opportunities for extensive improvement.

The period chosen for studying the output of the postal system begins, therefore, with the years immediately preceding the introduction of the Parcel Post System, when relatively few technological improvements had affected the productivity of labor and when the measurement of output was first put on a dependable basis. The years from 1913 to 1925 are omitted because of the complications of the rapidly extending Parcel Post System and of the war and reconstruction periods when dependable measurement is impossible. The years 1926 to 1931 are included by virtue of the successful work of the Division of Cost Ascertainment in making possible measurement on a basis comparable to the years immediately preceding the introduction of the Parcel Post System.

Obviously the principal output of the postal system consists of the various kinds of mail. The classification adopted for the fiscal year 1907-8, and still used by the Division of Cost Ascertainment, includes first-class mail (chiefly letters), second-class mail (periodicals), third-class mail (predominantly circulars), fourth-class mail (now parcel post), franked mail, and penalty mail. One additional classification now used is called "free-for-the-blind."

The Penrose-Overstreet Commission on Second-Class Mail Matter reported to Congress in January of 1907 that "the Post Office Department is not now able and has never been able to furnish statistics as to the cost of various classes of mail."<sup>7</sup>

As a result of the commission's recommendations, arrangements were made for a special weighing of the mails during the six months' period from July 1 to December 31, 1907, and also for special counts of the number of pieces by classes and subclasses of mail. Various other records were secured for the fiscal year 1907-8. For succeeding years additional information was secured from time to time. As a result of these investigations it was possible for the first time to arrive at a reasonably accurate estimate of the number of pieces of mail by classes. For 1910 and 1912 the results based on the special weighings and counts of 1907-8 were utilized, corrections being made where possible.

With the introduction of the Parcel Post System in 1913, it is, however, obvious that the ratios used during the years immediately preceding were no longer valid. Not until 1923 was any considerable effort made to measure the output of the system. In that year investigations by the post-office committees of the two houses of Congress and the joint commission on postal service (the Hughes Commission) culminated in the undertaking of a comprehensive survey by the Post Office Department for the purpose of ascertaining the cost of carrying on the various activities of the postal system. The first report was for the year 1923. During the next two years the work was allowed to lapse, but in 1926 and in each succeeding year surveys similar to that of 1923 were carried on and detailed

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<sup>7</sup> United States. Congress. Postal Commission on Second-Class Mail Matter. Report (1907), pp. xlv-1. (59th Cong., 2d sess., H. Doc. 608.)

reports were issued. The method used is indicated in a general way by the following quotation from the report for 1931 (p. 2):

The theory of this cost ascertainment has been to credit as accurately as possible to each of the classes of mail matter, and to each of the special services, its earned proportion of revenue from each of the several general sources, and to charge against each the computed proportion of the expenditures made from the several sums appropriated by the Congress for the maintenance of the Post Office Department and the Postal Service by allocating to each class, where the classes are handled separately, and to each service, the direct cost for labor and transportation. Where two or more classes are handled jointly a division of such cost is made by processes of apportionment, based upon ratios established by elaborate tests involving time, number of pieces, weight, volume, and average haul of mail. \* \* \*

Incidental to the accomplishment of the above object it was essential that there be computed and taken into consideration the number of pieces, the weight, the volume, and the average haul of each of the classes of mail matter and the number of transactions in each of the special services. It being wholly impracticable to count, weigh, and compute the volume and haul of each of 26,000,000,000 pieces of mail matter and to maintain records in such form as to charge directly to each of the classes of mail matter and special services its exact share of the expenditures from each of the 71 appropriations made for the conduct of the Postal Service, it was necessary to employ methods of ratio and apportionment based upon tests.

The periods for collecting statistics on which the reports are based are illustrated by the fiscal year ending June 30, 1931. For this year statistics were taken during seven consecutive days in four separate periods as follows: September 15 to 21, 1930; December 8 to 14, 1930; March 23 to 29, 1931; and June 1 to 7, 1931. The periods chosen are in recognition of the seasonal variations in the movement of mails, and they form as nearly as possible a complete cycle of the days of the month.

On the basis of the methods thus briefly described, the Post Office Department has been able to analyze with a considerable degree of accuracy the amount of mail handled by classes during the fiscal years ending June 30, 1908, 1910, 1912, and 1926 to 1931. The results are incorporated in Table 1.

TABLE 1.—*Estimated number of pieces of domestic<sup>1</sup> mail handled, by classes of mail, in specified fiscal years*

Fiscal year	First-class mail	Second-class mail	Third-class mail	Fourth-class mail
1908 <sup>2</sup> .....	7, 102, 704, 806	3, 805, 584, 029	1, 720, 964, 103	145, 306, 026
1910 <sup>4</sup> .....	8, 310, 164, 623	4, 336, 259, 864	2, 013, 528, 001	170, 008, 050
1912 <sup>5</sup> .....	9, 159, 648, 117	4, 934, 002, 770	2, 219, 355, 307	239, 982, 313
1926 <sup>7</sup> .....	15, 265, 624, 116	4, 658, 267, 730	3, 962, 462, 729	770, 360, 696
1927 <sup>7</sup> .....	16, 283, 564, 220	4, 753, 291, 005	4, 061, 604, 835	742, 589, 397
1928 <sup>7</sup> .....	16, 706, 197, 518	4, 678, 023, 212	3, 837, 689, 374	751, 980, 239
1929 <sup>7</sup> .....	17, 169, 597, 132	4, 833, 738, 538	4, 341, 142, 570	770, 397, 277
1930 <sup>7</sup> .....	16, 901, 204, 170	4, 968, 371, 363	4, 324, 939, 431	837, 308, 320
1931 <sup>7</sup> .....	15, 911, 567, 916	4, 856, 857, 633	4, 100, 020, 837	765, 661, 536

<sup>1</sup> Foreign mail is omitted because there is no adequate basis for comparing the earlier and later periods. The amount is relatively small, and the ratio of change in the quantity of foreign mail is probably not radically different from that of domestic mail.

<sup>2</sup> United States Post Office Department. Cost of transporting and handling the several classes of mail matter. Washington, 1910, p. 5.

<sup>4</sup> United States Post Office Department. Second-class matter, by J. J. Britt. Washington, 1911, pp. 3, 4.

<sup>5</sup> United States Post Office Department. Annual report, 1912. Washington, 1912, p. 307.

<sup>7</sup> Data are from the annual cost-ascertainment report of the Post Office Department.

TABLE 1.—Estimated number of pieces of domestic mail handled, by classes of mail, in specified fiscal years—Continued

Fiscal year	Penalty matter	Franked matter	"Free-for-blind" mail	Total
1908 <sup>1</sup> .....	231, 716, 587	9, 007, 574	( <sup>2</sup> )	13, 015, 283, 125
1910 <sup>4</sup> .....	281, 647, 268	( <sup>5</sup> )	( <sup>5</sup> )	15, 111, 607, 806
1912 <sup>6</sup> .....	310, 437, 878	( <sup>5</sup> )	( <sup>5</sup> )	16, 863, 426, 385
1926 <sup>7</sup> .....	456, 104, 444	32, 733, 617	195, 007	25, 145, 748, 339
1927 <sup>7</sup> .....	438, 590, 586	50, 487, 129	111, 949	26, 330, 239, 121
1928 <sup>7</sup> .....	471, 911, 383	46, 989, 467	390, 758	26, 493, 181, 951
1929 <sup>7</sup> .....	448, 909, 071	37, 178, 342	391, 696	27, 601, 354, 626
1930 <sup>7</sup> .....	459, 606, 087	41, 405, 009	538, 220	27, 533, 372, 600
1931 <sup>7</sup> .....	511, 993, 883	38, 843, 177	1, 192, 143	26, 186, 137, 125

<sup>1</sup> United States Post Office Department. Cost of transporting and handling the several classes of mail matter. Washington, 1910, p. 5.

<sup>2</sup> No separate estimate made.

<sup>4</sup> United States Post Office Department. Second-class matter, by J. J. Britt. Washington, 1911, pp. 3, 4.

<sup>5</sup> Included under penalty matter.

<sup>6</sup> United States Post Office Department. Annual report, 1912. Washington, 1912, p. 307.

<sup>7</sup> Data are from the annual cost-ascertainment report of the Post Office Department.

Most of the classes of mail increased in number of pieces up to 1929 and since that date the number has somewhat declined. Since 1908 the number of pieces of first-class mail have considerably more than doubled, increasing from slightly more than 7,100,000,000 in that year to almost 17,170,000,000 in 1929, and declined to about 15,900,000,000 in 1931. The number of pieces of second-class mail increased much less rapidly, from approximately 3,800,000,000 in 1908 to more than 4,850,000,000 in 1931. The outstanding fact regarding second-class mail is the comparatively slight difference in volume in 1912 and 1926 to 1931. This is due mainly to changes in rates and regulations, notably in 1918 and 1919.<sup>8</sup> The increase in the amount of third-class mail was from about 1,721,000,000 in 1908 to somewhat more than 4,100,000,000 in 1931.

In the case of fourth-class mail, consisting mainly of merchandise, the introduction of the Parcel Post System in 1913 led to a tremendous expansion in number of parcels, from 145,306,026 in 1908 to 765,661,536 in 1931. But even more significant than the increase in number of pieces was the increase in the size and in the variety of articles. In the case of penalty matter (consisting largely of departmental mail) and franked matter (made up in the main of congressional mail) the combined increase corresponds quite closely to the rate of increase of first-class and third-class mail, although the quantity is of course relatively slight—about 240,000,000 pieces in 1908 and 550,000,000 pieces in 1931.

It is apparent that from the point of view of the amount of work necessary for the handling of mail there are great differences between the various classes of mail. If these different classes are to be combined into a total volume of mail handled, it is necessary in comparing changes in volume of output with changes in volume of labor to weight the classes of output by means of labor-weighting factors. Particularly is this true of fourth-class mail. If the classes of mail increased in the same ratio and if the average size and weight per piece (or other qualities affecting the amount of labor required for

<sup>8</sup> United States Post Office Department. Annual report, 1919. Washington, 1919. pp. 17-22.

handling) remained approximately the same throughout the years included in the present study, the weighting would not be so essential because the derived ratios would remain relatively constant. In the case of second-class and third-class mail and of franked and penalty mail the changes in the number of pieces and in the average weight and bulk per piece have not been so great as in the case of fourth-class mail, although when these classes of mail are not weighted the result, from the point of view of the amount of labor required, is an underestimate of the combined volume of output.

The principal problem of weighting is in connection with fourth-class mail. Because of the introduction of the Parcel Post System there was a great change not only in the number of parcels but also in the average size and weight per piece. Even in the years 1908, 1910, and 1912, before the introduction of the Parcel Post System, the handling of fourth-class mail required considerably more labor per piece than did the handling of first-class mail per piece. Fortunately, a weighting factor is available. On the basis of extensive tests made by the Post Office Department it was reported in 1909 that "ordinary letters and circulars can be handled in about one-third the time required for newspapers and packages."<sup>9</sup>

From this investigation it is apparent that a considerably larger amount of time was required for handling periodicals as well as parcels than for handling letters. The present problem, however, is the weighting of fourth-class mail. On the basis of the authority quoted above, it appears desirable to multiply the number of pieces of fourth-class mail by three as a labor-weighting factor for the years 1908, 1910, and 1912.

After the introduction of the Parcel Post System in 1913, this weighting factor was no longer applicable because of the great increase in the size and weight of parcels. For the more recent period there is available the information secured by extensive surveys carried on by post-office inspectors. Careful records were kept of the number of pieces handled, the number of man-hours, and the average number of pieces handled per hour, in the letter section and in the parcel-post section of the mailing division of large offices throughout the country. The records covered a variety of conditions.

The number of pieces handled in the mailing division of typical offices was totaled for first-class mail (348,664,195 pieces) and for parcels (14,168,406 pieces); and the amount of time required was also totaled. By dividing the total amount of time for handling the first-class mail by the total number of pieces of first-class mail, the average amount of time per piece was derived. In the same way, the average time per piece for parcel-post mail was computed. A comparison of the average time per piece results in a ratio of 1 for first-class mail to 8.2 for parcel-post mail. The basic data are admittedly far from comprehensive; but there is evidence that the ratio of 1 to 8.2 is a conservative estimate of the difference in amount of time per piece required for handling the two classes of mail.

The change in the estimated ratio of 1 to 3 in 1908 to 1 to 8.2 at present is explained by the great increase in the size and weight of

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<sup>9</sup> United States Post Office Department. Cost of transporting and handling the several classes of mail matter and of conducting the registry, money-order, and special-delivery services. Washington, 1910, p. 13.

parcels. During the years 1908, 1910, and 1912 the limit of weight for ordinary parcels was 4 pounds. After March 15, 1918, the limit of weight for zones 1 to 3 was 70 pounds, and for zones 4 to 8, 50 pounds. The combined length and girth of parcels might be 84 inches. In 1908 the average weight per parcel of fourth-class mail was 6.5 ounces; in 1926, 85.8 ounces; and in 1931, 79.3 ounces.

The results of applying the above weighting factors to fourth-class mail are indicated in Table 2.

TABLE 2.—Changes in number of pieces of domestic mail handled in specified fiscal years with fourth-class mail weighted on basis of relative amount of labor required

Fiscal year	Fourth-class mail			Number of pieces of all other classes	Total number of pieces (including fourth-class weighted)	Index numbers of change in volume (1908=100.0)
	Number of pieces unweighted	Weighted on basis of relative labor required <sup>1</sup>				
		Number of pieces	Index numbers (1908=100.0)			
1908.....	145,306,026	435,918,078	100.0	12,869,977,099	13,305,895,177	100.0
1910.....	170,008,050	510,024,150	117.0	14,941,599,756	15,451,623,906	116.1
1912.....	239,982,313	719,946,939	165.2	16,623,444,072	17,343,391,011	130.3
1926.....	770,360,696	6,316,957,707	1449.1	24,375,387,643	30,692,345,350	230.7
1927.....	742,589,397	6,089,233,055	1396.9	25,587,649,724	31,676,882,779	238.1
1928.....	751,980,239	6,166,237,960	1414.5	25,741,201,712	31,907,439,672	239.8
1929.....	770,397,277	6,317,257,671	1449.2	26,830,957,349	33,148,215,020	249.1
1930.....	837,308,320	6,865,928,224	1575.1	26,696,064,280	33,561,692,504	252.2
1931.....	765,661,536	6,278,424,595	1440.3	25,420,475,589	31,698,900,184	238.2

<sup>1</sup> Weights used were 3 for 1908, 1910, and 1912; and 8.2 for 1926 to 1931.

It will be seen from Table 2 that, weighted as described above, the number of units of fourth-class mail increased from 435,918,078 in 1908 to 6,278,424,595 in 1931. All other classes of mail are included without weighting, although it is apparent that the handling of periodicals, especially the more bulky journals, and of a considerable portion of third-class mail, which includes merchandise up to 8 ounces and "flats" or larger circulars and printed matter not coming under the parcel-post classification, requires much more work per piece than does the handling of letter mail per piece. There is also a considerable portion of franked and penalty mail that has much bulk and weight. Mail classed as "free-for-the-blind" is also relatively very bulky, but the number of pieces is not large. That there has been an increase in the average amount of labor per piece required for handling second-class mail is indicated by the increase in the average weight per piece. In 1908 it was only 3.3 ounces per piece; while for the years 1926 to 1931 the average weight per piece was more than 5 ounces.

The total number of pieces of mail, including fourth-class mail weighted and other classes unweighted, increased from about 13,300,000,000 in 1908 to about 33,562,000,000 in 1930, and declined in 1931 to about 31,699,000,000. The index of change in volume ran from a

base of 100.0 in 1908 to 252.2 in 1930 and 238.2 in 1931. This estimate of the change in the volume of mail matter, although decidedly conservative because of the inclusion of all classes except fourth-class mail without weighting, is nevertheless as close an approximation of the change as available weighting factors make possible.

### Special Services

Since 1912 the special services rendered by the Post Office Department have increased rapidly in variety and in the number of transactions. The special services were long confined to registrations, money orders, and special deliveries. After 1912, all of these increased rapidly in number of transactions. The first year in which statistics relating to postal-savings accounts appear was 1912. After 1912 the collect-on-delivery system and the insuring of parcels rapidly swelled the volume of special transactions.

Table 3 shows the growth of the special services during the years covered in Tables 1 and 2 (1908, 1910, 1912, and 1926 to 1931). There was a doubling of the number of registrations between the years 1908 and 1931, in spite of the considerable decline during the year 1931. The number in 1908 was 40,151,797, and in 1931, 80,740,703. The number of money orders issued increased considerably more, from 68,576,210 in 1908 to 205,263,380 in 1930, from which high point the number declined to 192,584,774 in 1931. The number of special-delivery transactions increased still more rapidly, from 13,734,514 in 1908 to more than 100,000,000 in 1930, with a decline during 1931 to 94,072,832.

Due to changes in postal regulations and to recent business conditions, the number of collect-on-delivery transactions (one of the services introduced after 1912) declined from 51,083,653 in 1926 to 40,555,435 in 1931. The number of insurance transactions also shows a decline. The number in 1926 was 137,857,693; in 1930, 126,673,256; and in 1931, 112,312,231. In regard to the Postal Savings System, it is impossible to include the number of transactions (that is, the number of deposits and withdrawals), but it is likely that for a period of years the average number of deposits and withdrawals per depositor remained approximately constant. The number of depositors in 1912 was 243,801. The prevailing confidence in the Postal Savings System during a period of bank failures led to a large increase in the number of depositors. The number in 1931 was 770,841.

Table 3 also includes the results of the use of labor-weighting factors in connection with special-service transactions. The method used for deriving these labor-weighting factors is indicated by Table 4.

TABLE 3.—Changes in number of special-service transactions, unweighted, and weighted on basis of approximate differences in amount of labor involved,<sup>1</sup> Postal Service, in specified fiscal years

Fiscal year	Registrations, paid and free		Money orders		Special-delivery transactions	
	Unweighted	Weighted <sup>2</sup>	Unweighted	Weighted <sup>3</sup>	Unweighted	Weighted <sup>4</sup>
1908.....	40, 151, 797	614, 322, 494	68, 576, 210	555, 467, 301	13, 734, 514	92, 021, 244
1910.....	42, 053, 574	643, 419, 632	81, 417, 639	659, 482, 876	15, 440, 033	103, 448, 221
1912.....	42, 235, 000	646, 195, 500	88, 995, 153	720, 860, 739	18, 366, 377	123, 054, 726
1926.....	82, 011, 928	1, 254, 782, 498	195, 687, 918	1, 585, 072, 136	92, 243, 473	618, 031, 269
1927.....	82, 162, 947	1, 257, 093, 089	196, 962, 507	1, 595, 396, 307	93, 725, 425	627, 960, 348
1928.....	83, 486, 646	1, 277, 345, 684	198, 945, 390	1, 611, 457, 659	95, 416, 666	639, 291, 662
1929.....	89, 144, 845	1, 363, 916, 129	202, 430, 322	1, 639, 685, 608	99, 046, 407	663, 610, 927
1930.....	92, 668, 468	1, 417, 827, 560	205, 263, 380	1, 662, 633, 378	101, 769, 753	681, 857, 345
1931.....	80, 740, 703	1, 235, 332, 756	192, 584, 774	1, 559, 936, 669	94, 072, 832	630, 287, 974

  

Fiscal year	C. O. D. transactions		Insurance transactions		Postal-savings accounts (number of depositors)		Total number (weighted)	Index numbers of change (1908=100.0)
	Un-weighted	Weighted <sup>5</sup>	Un-weighted	Weighted <sup>6</sup>	Un-weighted	Weighted <sup>7</sup>		
1908.....							1, 261, 811, 039	100.0
1910.....							1, 406, 350, 779	111.5
1912.....					243, 801	38, 032, 956	1, 528, 143, 921	121.1
1926.....	51, 083, 653	638, 545, 663	137, 857, 693	716, 860, 004	339, 305	52, 931, 580	4, 866, 223, 150	385.7
1927.....	49, 820, 640	622, 758, 000	133, 378, 223	693, 566, 760	411, 394	64, 177, 464	4, 860, 951, 968	385.2
1928.....	49, 297, 283	616, 216, 038	132, 034, 024	686, 576, 925	412, 250	64, 311, 000	4, 895, 198, 968	388.0
1929.....	49, 600, 219	620, 002, 738	130, 939, 801	680, 887, 433	413, 990	64, 582, 440	5, 032, 685, 275	398.9
1930.....	46, 187, 859	577, 348, 238	126, 673, 256	658, 700, 931	463, 827	72, 357, 012	5, 070, 724, 464	401.9
1931.....	40, 555, 435	506, 942, 938	112, 312, 231	584, 023, 601	770, 841	120, 251, 196	4, 636, 775, 134	367.5

<sup>1</sup> See Table 4.

<sup>2</sup> Weight used was 15.3.

<sup>3</sup> Weight used was 8.1.

<sup>4</sup> Weight used was 6.7.

<sup>5</sup> Weight used was 12.5.

<sup>6</sup> Weight used was 5.2.

<sup>7</sup> Weight used was 156.0.

It is apparent that the amount of labor per transaction varies greatly with the different classes of special services and that the amount of labor required for the special-service transactions is not the same as for the handling of mail. Tables 1 and 2 show the results of an effort to reduce the different classes of mail to a common denominator in terms of the average amount of labor per piece for handling first-class mail. In order to reduce the special-service transactions to the same common denominator, it is necessary to compare them with first-class mail in respect to the amount of labor required.

There has been no adequate record of the amount of time required per transaction and it is therefore necessary to approach the problem indirectly. This can be done on the basis of the studies made by the Division of Cost Ascertainment, the results of which are expressed in terms of expense, rather than in terms of amount of labor, but in regard to first-class mail and the several special services the predominant element of cost is labor. This is true particularly of the special services, for with them the element of transportation plays virtually no part as compared with the handling of first-class mail. Because of the great importance of transportation as an element of cost in the

handling of classes of mail other than letter mail, the cost of handling can not be used as a labor-weighting factor for the different classes of mail. In respect to first-class mail and the special services, the costs other than labor are slight and tend to cancel out, with the exception of cost of transportation, which applies to the handling of letters but not to the special-services transactions. The method, therefore, is a conservative one and in all probability gives an underestimate of the total weighted volume of output.

Table 4 gives the average expense per piece for first-class mail and per transaction for the several special services for the years 1926 to 1931, the cost ranging from 1.68 cents per piece of first-class mail to 262.65 cents per depositor in the Postal Savings System. Expressed in the form of an index with the cost per piece for first-class mail being represented by 1, the cost per transaction of the special services ranges from 5.2 for insurance transactions to 156.0 for each depositor in the Postal Savings System. It is this index that is used for weighting the several special-services transactions and reducing them to a common denominator with the various classes of mail.

TABLE 4.—Comparative expense per piece of first-class mail and per transaction, special services, in the Postal Service, 1926-1931<sup>1</sup>

Kind of service	Average expense, 1926-1931		Kind of service	Average expense, 1926-1931	
	Amount	Index number		Amount	Index number
	<i>Cents</i>			<i>Cents</i>	
First-class mail.....	1.68	1.0	C. O. D. transactions.....	20.98	12.5
Registrations.....	25.83	15.3	Insurance transactions.....	8.73	5.2
Money orders.....	13.57	8.1	Postal-savings accounts (cost		
Special-delivery transactions..	11.25	6.7	per depositor).....	262.65	156.0

<sup>1</sup> Based on data in appendix to the annual cost-ascertainment report of the U. S. Post Office Department for fiscal years 1926 to 1931.

The total volume of services rendered, including the several classes of mail and the several kinds of special services, weighted as already indicated, is presented in Table 5.

The volume of mail handled (weighted) increased from about 13,306,000,000 in 1908 to almost 33,562,000,000 in 1930, and declined to about 31,699,000,000 in 1931. The volume of special-service transactions (weighted) increased from 1,262,000,000 in 1908 to 5,071,000,000 in 1930, and declined to 4,637,000,000 in 1931. The total volume of output (weighted) increased from 14,568,000,000 in 1908 to 38,633,000,000 in 1930, and declined to 36,366,000,000 in 1931. The index of change runs from a base of 100.0 in 1908 to 265.2 in 1930, and to 249.4 in 1931.

It is apparent that the figures are approximations only. Fortunately, however, there is available a method of checking the validity of the weighting factors used. On the basis of its extensive studies of the entire postal system, the Division of Cost Ascertainment has been able to compute the approximate proportion of time of all postal employees devoted to the handling of first-class mail.

TABLE 5.—Changes in estimated number of units of output of the Postal Service in specified fiscal years weighted on basis of estimated differences in amount of labor required

Fiscal year	Number of pieces of mail handled (weighted) <sup>1</sup>	Number of special-service transactions (weighted) <sup>2</sup>	Total units of output	
			Number	Index numbers of change (1908=100.0)
1908.....	13,305,895,177	1,261,811,039	14,567,706,216	100.0
1910.....	15,451,623,906	1,406,350,779	16,857,974,685	115.7
1912.....	17,343,391,011	1,528,143,921	18,871,534,932	129.5
1926.....	30,692,345,350	4,866,223,150	35,558,568,500	244.1
1927.....	31,676,882,779	4,860,951,968	36,537,834,747	260.8
1928.....	31,907,439,672	4,895,198,968	36,802,638,640	252.6
1929.....	33,148,215,020	5,032,685,275	38,180,900,295	262.1
1930.....	33,561,992,504	5,070,724,464	38,632,716,968	265.2
1931.....	31,698,900,184	4,636,775,134	36,335,675,318	249.4

<sup>1</sup> See Tables 1 and 2.

<sup>2</sup> See Tables 3 and 4.

Table 6 indicates that during the years 1926 to 1931 the per cent of time of all postal employees devoted to first-class mail ranged from 42.401 in 1926 to 43.773 in 1928. These figures are of course approximations, but are based on remarkably detailed and comprehensive data, projected by carefully tested methods of ratio and apportionment.

The number of pieces of first-class mail handled in 1926 was 15,265,-624,116. The per cent of time of postal employees devoted to the handling of first-class mail was 42.401. On the basis of the amount of time devoted to all other services of the postal system (57.599 per cent), all other forms of output of postal employees, equated in terms of first-class mail, amount to 20,737,357,184 units. This means a total of 36,002,981,300 units of output. Reference to Table 5, which is based on the methods of weighting used in this study and previously described, shows 35,558,568,500 units for the same year (1926). A further comparison of Tables 5 and 6 shows a remarkably close correspondence of figures. The labor-weighting factors used herein give a somewhat smaller output for each of the years 1926 to 1931, and this fact bears out the statement made above that the factors used might be expected to give conservative results.

TABLE 6.—Changes in number of units of output of the Postal Service, fiscal years 1926 to 1931, estimated on basis of per cent of time of postal employees devoted to first-class mail<sup>1</sup>

Fiscal year	First-class mail		Other classes of mail and special-service transactions		Total number of units of output
	Number of pieces	Per cent of total time of postal employees	Per cent of total time of postal employees	Number of units of output (calculated on basis of per cent of time required)	
1926	15,265,624,116	42.401	57.599	20,737,357,184	36,002,981,300
1927	16,283,564,220	43.772	56.228	20,917,304,380	37,200,868,600
1928	16,706,197,518	43.773	56.227	21,469,332,582	38,165,530,100
1929	17,169,597,132	43.555	56.445	22,250,899,068	39,420,496,200
1930	16,901,204,170	43.232	56.768	22,192,994,930	39,094,199,100
1931	15,911,567,916	43.394	56.606	20,756,100,184	36,667,668,100

<sup>1</sup> Compare Table 5. The per cent of total time of postal employees devoted to first-class mail was derived by the Division of Cost Ascertainment from basic data collected during its quarterly surveys of the postal system.

The use of the amount of labor required per piece and per transaction as weighting factors may be criticized on the ground that the amount of labor varies with technological changes and that one of the objects in view was the measurement of the effects of technological changes on volume of labor. As to this, it may be said that the inclusion of the various classes of mail and special-service transactions without weighting would give results so extremely inaccurate as to be misleading. Since it may be safely assumed that technological changes have tended to reduce the amount of time required per unit of output, there is additional basis for the statement that the estimates of output are conservative. While it is desirable to have as accurate an estimate as possible of the effects of technological changes on volume of employment, it seems desirable to underestimate rather than to overestimate the effects.

One reason, then, for considering that the weighted estimates of the increase in output are conservative is the nature of the labor-weighting factors already discussed. Another reason is the fact that the estimates of output do not include various intangible elements of output. These elements include, for instance, extensions of the direct delivery of mail in place of requiring patrons to come to the post office to secure their mail. This is illustrated both by the city delivery service and the rural delivery service. In 1907 the number of city delivery offices was 1,240 and the number of regular carriers was 24,577; and in 1931 the figures were 3,098 and 53,387, respectively. In 1907 the number of regular rural delivery carriers was 37,582, and the number in 1931 was only 42,412; but the estimated number of miles traveled by rural delivery carriers increased from 268,569,000 in 1907 to 412,382,000 in 1931. The Postmaster General reported in 1926 that since March 4, 1921, the rural delivery service had been extended over 130,439 miles of road, and that such extension, together with the increase of frequency of service from three to six times per week on many routes, "brought new and improved service to 982,158 families, or approximately 3,339,000 individuals."

Another element of output not included in the estimates consists of special-handling facilities of various kinds to promote safety and speed. Special handling was authorized by law in 1925. The increase in the variety, size, and shape of mailable articles constitutes a further intangible extension of service. Improved collection facilities have been inaugurated in the form, for instance, of additional branch offices and safer and more convenient boxes. There has been a remarkable speeding up of the service by means of motor vehicles; air mail; improved arrangements by the Railway Mail Service for transfer and routing of mail; speedier distribution and dispatch of mail by detailing postal clerks for such work in publishing houses and mail-order houses, and sending the mail of such establishments direct from their offices to trains; and the use of metered postage, which provides economies alike for the Government and the user of postal facilities.

In brief, the mathematical statement of increased output is a conservative computation, and omits entirely many improvements and extensions which add to the quality of service but which can not be reduced to quantitative terms permitting inclusion in the mathematical estimate of changes in volume of output (Table 5). This fact must be remembered in connection with the problem of comparing changes in volume of labor with changes in volume of output. Quality of output is not measurable in terms of quantity of output and is therefore omitted from Table 5; but the amount of labor devoted to improving the quality of service can not be separated from the amount of labor utilized for increasing the quantity of output and must therefore be included in estimates of changes in the volume of labor. The result is an unavoidable underestimate of changes in volume of output as compared with changes in volume of labor.

## Classes of Labor and Volume of Employment

It has been seen that the problem of measuring the output of the postal system entails many difficulties. Measuring the changes in the volume of labor is a problem no less difficult. The vastness of the system, with its ramifications throughout the country; the use both of direct Government employees and of workers under various contractual arrangements; the use of permanent and full-time employees, and also of temporary and part-time labor; and the great variety of types and classes of work—these are some of the conditions which complicate the problem of the exact measurement of changes in the volume of labor.

The main groups of postal employees are the following: Postmasters and assistant postmasters; clerks and supervisory force in first-class and second-class offices; city carriers; rural carriers; watchmen, messengers, and laborers in first-class and second-class offices; railway mail clerks; and departmental employees, mainly in Washington. There are various lesser groups and groups of an irregular nature, together with workers who are on a contractual basis. Among these may be mentioned star-route carriers, mail messengers, clerks in third-class and fourth-class offices, motor-vehicle personnel, village carriers, and clerks in contract stations.

Changes in the number of employees in the principal groups during the fiscal years 1908, 1910, 1912, and 1926 to 1931 are indicated in Table 7.

TABLE 7.—Changes in number of employees in the Postal Service, in specified fiscal years, by principal groups classified as regular and temporary and equated on a full-time, annual man-power basis

Fiscal year	Postmasters		Assistant postmasters		Clerks and supervisory force, first and second class offices				Departmental employes, inspectors, and clerks at headquarters		Railway Mail Service employes			
	Number	Index numbers	Number	Index numbers	Number			Index numbers	Number	Index numbers	Number			Index numbers
					Regular	Temporary	Total				Regular	Temporary	Total	
1908.....	60,704	100.0	1,862	100.0	28,211	365	28,576	100.0	1,741	100.0	15,295	(1)	15,295	100.0
1910.....	59,580	98.1	2,095	112.5	31,825	444	32,269	112.9	1,729	99.3	16,795	(1)	16,795	109.8
1912.....	58,729	96.7	2,329	125.1	33,714	471	34,185	119.6	1,733	99.5	17,075	(1)	17,075	111.6
1926.....	50,601	83.4	2,723	146.2	67,071	7,027	74,098	259.3	2,067	118.7	20,411	1,994	22,405	146.5
1927.....	50,286	82.8	2,745	147.4	68,708	7,754	76,462	267.6	2,088	119.9	20,550	2,045	22,595	147.7
1928.....	49,944	82.3	2,756	148.0	69,818	8,315	78,133	273.4	2,090	120.0	20,854	2,046	22,900	149.7
1929.....	49,482	81.6	2,776	149.1	70,987	10,012	80,999	283.5	2,111	121.3	21,229	2,156	23,385	152.9
1930.....	49,063	80.8	2,781	149.4	72,015	10,429	82,444	288.5	2,112	121.3	21,185	2,127	23,312	152.4
1931.....	48,733	80.3	2,782	149.4	71,621	9,762	81,383	284.8	2,143	123.1	20,945	2,120	23,065	150.8

  

Fiscal year	City carriers				Rural carriers				Watchmen, messengers, and laborers, first and second class offices				Grand total	
	Number			Index numbers	Number			Index numbers	Number			Index numbers	Number (equated)	Index numbers
	Regular	Temporary	Total		Regular	Temporary	Total		Regular	Temporary	Total			
1908.....	26,352	1,388	27,740	100.0	39,143	1,336	40,479	100.0	1,072	(1)	1,072	100.0	177,469	100.0
1910.....	28,715	1,440	30,155	108.7	41,079	1,497	42,576	105.2	1,200	(1)	1,200	111.9	186,399	105.0
1912.....	29,962	1,379	31,341	113.0	42,199	1,559	43,758	108.1	1,330	(1)	1,330	124.1	190,480	107.3
1926.....	48,238	6,724	54,962	198.1	45,315	2,245	47,560	117.5	4,071	473	4,544	423.9	258,960	145.9
1927.....	50,117	7,163	57,280	206.5	44,790	2,218	46,998	116.0	4,312	613	4,925	459.4	263,309	148.4
1928.....	51,293	7,735	59,028	212.8	44,288	2,247	46,535	115.0	4,536	637	5,173	482.6	266,559	150.2
1929.....	52,719	8,894	61,603	222.1	43,840	2,396	46,238	114.2	4,741	705	5,446	508.0	272,040	153.3
1930.....	53,762	9,357	63,119	227.5	43,278	2,268	45,546	112.5	4,890	747	5,637	525.8	274,014	154.4
1931.....	53,387	9,131	62,518	225.4	42,412	2,260	44,672	110.4	4,876	743	5,619	524.2	270,915	152.7

<sup>1</sup> No data available. Work now done by temporary employees was then handled largely by regular employes by means of longer hours, overtime, and Sunday work without extra compensation.  
<sup>2</sup> Not including 989 appointed as a result of the 44-hour work week law effective July 1, 1931.

As may be seen from Table 7, the number of postmasters decreased considerably, from 60,704 in 1908 to 48,733 in 1931, the index of change dropping from a base of 100.0 in 1908 to 80.3 in 1931. This decline in the number of postmasters corresponds, of course, to the decline in the number of post offices, which in turn has been largely the result of the extension of Rural Delivery Service, combined with the improvement of transportation facilities and the readier maintenance of contacts by country people with towns. The number of

assistant postmasters increased approximately 50 per cent, from 1,862 in 1908 to 2,782 in 1931.

Clerks in third-class and fourth-class offices are not employees of the Government and are not ordinarily on a full-time basis. Clerks and supervisory employees in first-class and second-class offices are classified in Table 7 as regular and temporary employees. The number of temporary employees actually on the pay rolls is considerably larger than the number shown in the table. In order to put them on a basis comparable with that of regular employees it is necessary to ascertain the total amount of time worked by temporary employees and to divide this total by the normal number of man-hours worked by regular full-time employees. This can be done because of the fact that temporary employees are paid at regular statutory rates of pay and the total amounts paid to temporary employees of the different classes and wage-rate groups are matters of record. The number of regular clerks and supervisory employees in first-class and second-class offices increased from 28,211 in 1908 to 71,621 in 1931. The number of temporary employees computed on an equivalent full-time annual basis increased from 365 in 1908 to 9,762 in 1931. The index of change for both groups combined ran from a base of 100.0 in 1908 to 288.5 in 1930, with a slight decline in 1931. The increase was mainly due to the expansion of the special services and of parcel-post mail. (See Tables 2 and 3.) For all groups in which there is an appreciable amount of temporary employment the number has been reduced to an equivalent full-time annual basis.

The group of departmental employees, inspectors, and clerks at headquarters includes in general the employees at Washington and certain field agents with headquarters at Washington. The number of temporary employees has been negligible. The total number increased from 1,741 in 1908 to 2,143 in 1931, with an index of 100.0 in 1908 and 123.1 in 1931.

The Railway Mail Service, which in general has charge of the interoffice transfer, handling, and transportation of mail, employs principally the classes known as railway-mail clerks and transfer clerks. In this general group also there are no records of the number of temporary employees during the years 1908, 1910, and 1912. The total number of employees increased from 15,295 in 1908 to 23,065 in 1931, with the index changing from a base of 100.0 in 1908 to 150.8 in 1931.

City carriers increased, as indicated by Table 7, from 26,352 regular and 1,388 temporary, or a total of 27,740 carriers, to 53,387 regular and 9,131 temporary, or a total of 62,518 carriers in 1931. In this group, as in most others, there is a slight decline in 1931 from the number in 1930. The index of change rose from 100.0 in 1908 to 225.4 in 1931.

The number of rural carriers increased from 39,143 regular and 1,336 temporary, or a total of 40,479 carriers, to 42,412 regular and 2,260 temporary, or a total of 44,672 carriers in 1931. The index of change rose from 100.0 in 1908 to 110.4 in 1931.

In regard to watchmen, messengers, and laborers in first-class and second-class offices, official records fail to reveal the number of temporary employees during the years 1908 to 1912. The number was probably negligible because of the fact that work now done by

temporary employees was then done largely by regular employees by means of longer hours and overtime and Sunday work, without extra compensation. The total number of watchmen, messengers, and laborers in first-class and second-class offices (including temporary employees on an equivalent annual basis from 1926 to 1931) increased from 1,072 in 1908 to 5,619 in 1931, the index of change rising from 100.0 in 1908 to 524.2 in 1931. This exceptionally large increase is due in part to the fact already mentioned, namely, the employment of temporary laborers to handle the work formerly done by means of longer hours, overtime, and Sunday work. Another reason for the increase is the fact that the Parcel Post System requires a relatively large amount of work which falls under the general classification of ordinary manual labor.

The grand total of these various groups of employees, including the temporary employees on an equated basis, increased from 177,469 in 1908 to 274,014 in 1930, from which high point it declined to 270,915 in 1931, the index of change being 100.0 in 1908 and 152.7 in 1931.

The increase in the number of employees in the groups included in Table 7 is unavoidably overestimated. During the years 1908, 1910, and 1912 most of the groups included in Table 7 put in much overtime and Sunday work; and since they were not given extra compensation for overtime and Sunday work, there is no means of computing the amount of extra time. On the basis of laws in operation during 1926 to 1931, much temporary labor was used and paid for at regular statutory rates, and, as stated above, it is therefore possible to calculate the temporary hire during these years on an equivalent full-time basis.

The effects of the laws mentioned are indicated by a statement made in the annual report of the United States Post Office Department for 1908: "City carriers are limited by law to 8 hours daily duty for the 6 working-days of the week and such number of hours on Sunday, not exceeding 8, as the exigencies of the service require. In the case of clerks, however, there is no statutory provision as to their hours of labor, and \* \* \* it is not possible to fix an absolute 8-hour schedule for them without increasing the allowance for clerk hire far in excess of the needs of the office."

The reduction in the amount of Sunday work was initiated in 1910 at Detroit and gradually other offices, even without statutory sanction, followed the example of Detroit. In 1912 Congress passed a law, effective March 4, 1913, providing for a reduction in the amount of Sunday work and for compensatory time off duty for employees who were required to work on Sunday. The same law provided for 8 hours in 10 and no overtime except in case of emergency or if the needs of the service required it; and when overtime was exacted of employees, they were to receive extra compensation. The Postmaster General reported in 1913 that the readjustment of schedules necessitated by this law led to the use of a considerable amount of temporary labor. Later extensions and applications of the law materially increased the amount of temporary labor. It is apparent, therefore, that if the volume of employment in the form of overtime and Sunday work of the years 1908, 1910, and 1912 could be calculated on the same basis as has been done for the volume of auxiliary,

substitute, and other forms of temporary labor of the years 1926 to 1931, the estimate of the number of labor units for the earlier years would be considerably increased.

Incidentally, it may be said that during the years 1908, 1910, and 1912, when overtime and Sunday work were required without extra pay, there was probably a tendency on the part of the employees to speed up their work in order to reduce, as far as possible, the amount of Sunday and overtime work. This factor, although intangible and not subject to computation, probably accentuates the underestimate of the number of labor units for the years 1908, 1910, and 1912.

The various other groups of workers, both direct employees and those on a contractual basis, can not be reduced to an equivalent annual basis in terms of man-hours, but in respect to most of these groups the evidence indicates that there has been either a decline or a relatively small increase in number since 1908.

One of the largest of these irregular groups consists of clerks in third-class and fourth-class offices. The decline in the number of smaller post offices has been accompanied by a decline in the amount of clerical assistance required. The work formerly done by clerks in these offices is now done in part by employees in the groups included in Table 7, especially by rural carriers and by clerks in larger offices from which rural carriers operate.

Another group of employees not appearing in Table 7 is composed of clerks in contract stations. Contract stations are branches of post offices and are usually located in department stores and other private establishments. The clerical force of a contract station is employed by the contractor. In 1908 there were 3,814 contract stations; in 1931, 5,783.

The amount of labor required for the transporting of mails is not included in Table 7 for the obvious reason that such labor is incidental in most cases to the general transportation of goods and passengers.

The local transfer or carriage of mails is usually a distinct operation handled by workers who confine their attention to this work while they are actually in charge of the mails, but the amount of time required per employee ranges from a few minutes per day to full-time employment. In 1908 the work was done almost entirely by employees of public carriers having mail contracts (especially the railroads) or by special contractors—mail messengers, screen-wagon contractors, regulation-wagon contractors, etc. In larger cities the transfer of mails was in part by pneumatic tubes operated on a contractual basis. In 1909 there were pneumatic-tube routes in New York and Brooklyn, Chicago, Philadelphia, Boston, and St. Louis. The total mileage was 64,6086. Star-route contractors formed a clearly distinct group, to be discussed later.

Recently, and especially since 1920, when a ruling by the Interstate Commerce Commission reinterpreted the obligations of public carriers, there has been a marked increase in the number of mail messengers. There has also been a tendency toward the employment of operators of Government-owned motor vehicles to take the place of employees of public carriers for the local handling of mails, especially between post offices and their branches and in the delivery of parcel-post mail.

As early as 1907 an experimental collection service by automobiles was established in Milwaukee, and it was reported that twice as many collections were made as could be done by horse-drawn vehicles. Experiments were also made in other cities, the motor-vehicle operators being on a contractual basis, as were operators of wagons. In 1911 it was reported by the Postmaster General that mail was being collected by automobiles in 15 cities, "and in practically every instance one carrier with an automobile will do the work of two carriers with horse-drawn vehicles." Government owned and operated motor-vehicle service was authorized in 1914 and was first established in Washington in the same year. By January 1, 1918, the service had been extended to New York and Brooklyn, Chicago, Philadelphia, Detroit, Boston, St. Louis, Pittsburgh, Indianapolis, Buffalo, and Nashville.

The local carriage of mails is thus a function performed in part by mail messengers and other special contractors, in part by employees of public carriers having mail contracts, and in part by Government employees operating motor vehicles. The relative numbers of the three classes have changed from time to time, but the ratio of amount of labor required for performing this particular postal function to the total amount of labor represented in Table 7 may be assumed to have remained comparatively constant. The validity of Table 7 for the purpose of the present study is, therefore, not affected by the omission of mail messengers, operators of Government motor vehicles, and other workers connected with the local carriage and transfer of mails.

An interesting group long connected with the Postal Service is the group known as star-route carriers. These are almost entirely on a contractual basis. In 1908 there were 14,032 such routes, and the total mileage was 182,287. In 1931 there were 12,089 routes, with a total mileage of 226,370. It is apparent, therefore, that the star-route service has tended to decline, so far as the number of carriers is concerned. There is no means of knowing the average amount of time spent by star-route contractors, but the decline in the number of routes, combined with improved roads and methods of transportation, indicates clearly a decrease in the total amount of labor by star-route carriers. The decline has been accompanied by a transfer of their work to rural delivery carriers, who are included in Table 7. In 1931, for example, the work of 25 star routes was transferred to rural delivery carriers.

There is one other group of employees not included in Table 7—village delivery carriers. Village delivery service was not inaugurated until 1913. The number of carriers increased from 101 in 1913 to 859 in 1926, and thereafter tended to decline. This group of employees is not included in Table 7, because their work represents an added service not rendered by the Post Office Department during the years 1908, 1910, and 1912. Since the service rendered by these employees does not appear in the computation of output for these years, obviously the labor units represented by village carriers should not be included in the estimate of volume of employment.

So large an organization as the Postal Service requires a vast amount of work by persons who are not in the direct employ of,

nor in a direct contractual relationship to, the Post Office Department. Such workers are generally, for obvious reasons, beyond the scope of the present study. There is in this general classification, however, one group which must be mentioned, although not included in the statistical analysis. This group consists of the employees of the post-office division of the General Accounting Office, an independent establishment. Its post-office division now does substantially the same work as was formerly done by the office of the Treasury Department's auditor for the Post Office Department.

In 1908 the office of the auditor for the Post Office Department had 756 employees. There was a gradual decline in number until in 1931 the post-office division of the General Accounting Office had only 452 employees. This reduction was caused in part by the transfer of some of the work (especially the punching of cards in field offices in connection with the electrical money-order accounting system).<sup>10</sup> Certain other work has similarly been transferred to employees of the Post Office Department. This means that the estimated number of employees, as shown in Table 7 (p. 55), includes for the later years certain postal employees whose work was formerly done outside of the Post Office Department and who therefore do not appear in the estimated number of employees for the earlier years. There is added reason, therefore, for the statements previously made,<sup>11</sup> to the effect that the change in the volume of labor since 1908 has been appreciably smaller than is indicated by the figures in Table 7.

A more significant cause of the decline in the number of employees engaged in the final audit of the finances of the Post Office Department is to be found in the use of labor-saving devices such as the electrical-accounting machinery connected with the money-order accounting system.<sup>10</sup>

We are now in a position to compare the change in the volume of output with the change in the volume of employment during the fiscal years 1908, 1910, 1912, and 1926-1931. When reduced to an index basis, the volume of output rose from the base of 100.0 in 1908 to 265.2 in 1930, and dropped to 249.4 in 1931. (See Table 5.) Volume of employment, on an index basis, increased from 100.0 in 1908 to 154.4 in 1930, and decreased to 152.7 in 1931. (Table 7.)

As has been stated,<sup>12</sup> the change in the volume of output is underestimated because of the difficulty of adequate weighting of certain elements of output and because of the addition, during the period under study, of various intangible elements of output which can not be included in the computations. On the other hand, the change in the volume of labor is overestimated, as has already been explained.<sup>11</sup> In the first place, overtime and Sunday work (without extra compensation and therefore not subject to computation) formerly took the place of temporary work, which has been reduced for the years 1926 to 1931 to an equivalent full-time basis. In the second place, the change in the volume of employment has been less than is indicated by Table 7 because of the tendency to dispense with irregular

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<sup>10</sup> See pp. 39-43.

<sup>11</sup> See pp. 57, 58, and 60.

<sup>12</sup> See pp. 49-54.

and contractual work (for example, the clerks in third-class and fourth-class offices, star-route contractors, etc.), and to transfer the work of these groups to the classes of employees which are included in Table 7.

## Changes in Number of Employment Opportunities

It is desirable to ascertain the changes in productivity and in number of employment opportunities for each of the several groups of postal employees. However, when a particular group (e. g., the city-carrier group) is considered, it is found that a number of circumstances make impracticable a satisfactory analysis of changes in productivity or of changes in number of employment opportunities for the group. It is true that extensive studies and tests have been carried on for measuring the efficiency of different groups, as, for instance, of city carriers. The work of this group is carefully supervised. Each route is inspected regularly by a foreman or the assistant superintendent of mails, or, in smaller offices, by the assistant postmaster or postmaster. The time spent by carriers in performing their various tasks is carefully checked and reported. The supervisors make every effort to ascertain the amount of time needed for sorting different classes of mail, withdrawing mail from distribution cases, strapping mail in bundles and placing bundles in satchels, marking changes of address, handling collect-on-delivery parcels, obtaining postage due, and for the various other items of the carrier's daily routine. Careful checks are made for ascertaining the average number of letters handled and the average volume of work under each of the items of the daily routine. Thus the work is standardized as far as possible in accordance with the generally accepted principles of "scientific management."

On the basis of such studies routes are rearranged in such manner as to give to each carrier approximately the amount of work that can be done within the statutory 8-hour day.

Since conditions vary widely at different offices and on different routes in the area of a single office, there is no uniformly applicable standard. Each office, indeed each route, becomes, to a certain extent, a case study. In regard to a particular office, and especially a particular route, there are records indicating changes in productivity, but these records do not suffice for a comprehensive computation for the entire system over a period of years.

There are several difficulties in the way of a comprehensive study of changes in productivity and in number of employment opportunities for a particular group. Mail handling involves contributions from practically all groups. Particular processes undergo changes. For example, the primary separation of mail matter is not consistently the same in different offices and at different times in the same office. Records of particular processes, except for a limited period of time for purposes of standardization and of increasing the output per man-hour, are not available. The special services also involve contributions from several groups. A money order, for

example, includes issuing, filing, paying, and auditing, and the several items of work connected with a money-order transaction involve many employees of different classes in widely separated post offices. The general adoption of interchangeability of labor for the purpose of reducing slack time has meant that a single employee may devote part of his time within a single day to the handling of more than one class of mail and to sharing the work of a number of special-service transactions.

For the entire postal system, however, it has been possible to estimate the total number of units of labor and the total number of units of output. These estimates, embodied in the preceding tables, are summarized in Table 8.

TABLE 8.—Changes in estimated volume of output and number of employees, Postal Service, in specified fiscal years

Fiscal year	Units of output		Employees	
	Number <sup>1</sup>	Index numbers	Number (on equivalent full-time basis <sup>2</sup> )	Index numbers
1908.....	14,567,706,216	100.0	177,469	100.0
1910.....	16,857,974,685	115.7	186,399	105.0
1912.....	18,871,534,932	129.5	190,480	107.3
1926.....	35,558,568,500	244.1	258,960	145.9
1927.....	36,537,834,747	250.8	263,309	148.4
1928.....	36,802,638,640	252.6	266,559	150.2
1929.....	38,180,900,295	262.1	272,040	153.3
1930.....	38,632,716,968	265.2	274,014	154.4
1931.....	36,335,675,318	249.4	270,915	152.7

<sup>1</sup> Computed on basis of comparative time required for different kinds of output; see Tables 1-5.

<sup>2</sup> See Table 7.

Table 8 indicates a change in number of units of output (computed on the basis of the comparative time required for different kinds of output) from approximately 14,568,000,000 in 1908 to 38,633,000,000 in 1930 and 36,336,000,000 for 1931. The index of change shows an increase from 100.0 in 1908 to 265.2 in 1930, but a drop to 249.4 in 1931. The number of employees, placed on a comparable basis as far as possible for the earlier and later periods and reduced to an equivalent full-time annual basis, increased from 177,469 in 1908 to 274,014 in 1930, but fell to 270,915 in 1931. The index of change runs from 100.0 in 1908 to 154.4 in 1930, and to 152.7 in 1931. On the basis of these estimates a computation has been made of changes in productivity of employees for the years 1908, 1910, 1912, and 1926-1931. The results are shown in Table 9.

TABLE 9.—Changes in productivity of postal employees in specified fiscal years, measured by the volume of mail handled and of special-service transactions

Fiscal year	Pieces of mail (weighted) <sup>1</sup>		Special-service transactions (weighted) <sup>1</sup>		Total output		Employees <sup>2</sup>		Average output per employee	
	Number	Index numbers	Number	Index numbers	Number of units (weighted)	Index numbers	Number (on equivalent full-time basis)	Index numbers	Number of units (weighted)	Index numbers
1908.....	13, 305, 895, 177	100. 0	1, 261, 811, 039	100. 0	14, 567, 706, 216	100. 0	177, 469	100. 0	82, 086	100. 0
1910.....	15, 451, 623, 906	116. 1	1, 406, 350, 779	111. 5	16, 857, 974, 685	115. 7	186, 399	105. 0	90, 440	110. 2
1912.....	17, 343, 391, 011	130. 3	1, 528, 143, 921	121. 1	18, 871, 534, 932	129. 5	190, 480	107. 3	99, 074	120. 7
1926.....	30, 692, 345, 350	230. 7	4, 866, 223, 150	385. 7	35, 558, 568, 500	244. 1	258, 960	145. 9	137, 313	167. 3
1927.....	31, 676, 882, 779	238. 1	4, 860, 951, 968	385. 2	36, 537, 834, 747	250. 8	263, 309	148. 4	138, 764	169. 1
1928.....	31, 907, 439, 672	239. 8	4, 895, 198, 968	388. 0	36, 802, 638, 640	252. 6	266, 559	150. 2	138, 066	168. 2
1929.....	33, 148, 215, 020	249. 1	5, 032, 685, 275	398. 9	38, 180, 900, 295	262. 1	272, 040	153. 3	140, 350	171. 0
1930.....	33, 561, 992, 504	252. 2	5, 070, 724, 464	401. 9	38, 632, 716, 968	265. 2	274, 014	154. 4	140, 988	171. 8
1931.....	31, 698, 900, 184	238. 2	4, 636, 775, 134	367. 5	36, 335, 675, 318	249. 4	270, 915	152. 7	134, 122	163. 4

<sup>1</sup> See Tables 1 and 2.

<sup>2</sup> See Tables 3 and 4.

<sup>3</sup> See Table 7.

The estimated number of units of output (weighted) for 1908 is 14,567,706.216, and of employees (on equivalent full-time basis) is 177,469. The average number of units of output per employee for 1908 is therefore 82,086. The average output per employee by 1912 had grown to 99,074 units. As stated previously, it is not possible to measure in a satisfactory manner the output after 1912 and before the establishment of the work of the Division of Cost Ascertainment of the Post Office Department. It is known, however, that in the interval many changes, both in methods of management and in mechanical equipment, were introduced. These changes, which have already been described, account for the increase in average output per employee from 99,074 in 1912 to 137,313 in 1926. From 1926 to 1930 there was a relatively small increase in average output, the figure for the latter year being 140,988. Business conditions, of course, account for the decline to 134,122 units in 1931. The change in average output per employee is more easily visualized by the index figures in the last column of Table 9. The index rises from 100.0 in 1908 to 120.7 in 1912, to 167.3 in 1926, to 171.8 in 1930, and drops to 163.4 in 1931.

The relatively slight change in average output per employee since 1926 is due mainly to three facts. (1) The extensive and continuous efforts of congressional committees and commissions and of post-office officials to increase the efficiency of postal employees had already resulted in a remarkable increase of productivity for so vast and varied an enterprise as the postal system. (2) The output of the postal system had become relatively stabilized by 1926, probably on account of the development of telegraphic and telephonic communications and of private motor-vehicle trucking, and, therefore, an increase in productivity per employee was not stimulated by a rapid expansion of business. Then came the downward trend of output in 1931, and an increased average output per employee could be had only at the expense of material reductions in the number of postal employees. (3) The period since 1926 has been marked by the inau-

guration of far-reaching and highly significant improvements in the management, and particularly in the physical plant, of the postal system. But these changes, with rare exceptions, have not as yet been completed, and have, therefore, not found expression in the statistics of average output per employee. On the contrary, the extensive work of construction and of transition probably retarded average productivity in terms of final output.

On the basis of the statistical data embodied in the preceding tables, it is possible to make an estimate of the technological displacement of labor and of the effects on the number of employment opportunities for the entire postal system for the fiscal years 1908, 1910, 1912, and 1926 to 1931. Such a computation is embodied in Table 10.

TABLE 10.—Actual changes in number of employees, Postal Service, in specified fiscal years as compared with the numbers necessary on basis of output per employee in 1908

[Based on changes in the productivity of labor as measured by amount of mail handled and volume of special-service transactions]

Fiscal year	Total units of output <sup>1</sup>	Number of employees (on equivalent full-time basis) <sup>2</sup>	Productivity of employees		Number of employees necessary on basis of output in 1908	Decrease of employment opportunities (1908 base)	
			Average output per employee	Index numbers (1908=100.0)		Number	Per cent
1908.....	14,567,706,216	177,469	82,066	100.0	177,469	-----	-----
1910.....	16,857,974,685	186,399	90,440	110.2	205,370	18,971	9.2
1912.....	18,871,534,932	190,480	99,074	120.7	229,900	39,420	17.1
1926.....	35,558,568,500	258,960	137,313	167.3	433,187	174,227	40.2
1927.....	36,537,834,747	263,309	138,764	169.1	445,117	181,808	40.8
1928.....	36,802,638,640	266,559	138,066	168.2	448,342	181,783	40.5
1929.....	38,180,900,295	272,040	140,350	171.0	465,133	193,093	41.5
1930.....	38,632,716,968	274,014	140,988	171.8	470,637	196,623	41.8
1931.....	36,335,675,318	270,915	134,122	163.4	442,654	171,739	38.8

<sup>1</sup> Weighted number of pieces of mail handled plus weighted number of special-service transactions (shown in Table 9).

<sup>2</sup> See Table 7.

The average output per employee for the year 1908 was 82,086 units. This figure was derived by dividing 14,567,706,216, the total number of units of output, by 177,469, the total number of employees (part-time employees being reduced to an equivalent full-time annual basis). If this average output per employee for 1908 (82,086 units) had continued to be the average output per employee for the succeeding years included in Table 10, with the total output increasing as is indicated, it will be seen that the number of employees during these succeeding years would have been much greater. By dividing the total number of units of output for each succeeding year by the average output per employee in 1908, we derive, for each succeeding year, the number of employees which would have been necessary if the average output per employee for each succeeding year had remained the same as in 1908. On the basis of this assumption the number of employees would have increased from 177,469 in 1908 to 229,900 in 1912, 433,187 in 1926, and 470,637 in 1930, from which high point the number would have declined to 442,654 in 1931.

In other words, these numbers of employees, based on the average productivity per employee in 1908, are estimates of the number of employment opportunities which would have been available on the basis of the average output per employee in 1908.

By subtracting from these numbers based on the average output in 1908 the number of employees actually in the service of the postal system during each succeeding year included in the table, we arrive at estimates of technological displacement, or of the changes in the number of employment opportunities resulting from the various technological changes, which have been the principal causes of increased average output per employee. With the exception of the years 1928 and 1931, there has been a decline in potential employment opportunities as compared with each preceding year included in Table 10.

These figures of decrease in the number of employment opportunities are presented in the form of per cents of decrease in the last column of Table 10. The decrease, which is in reality the extent of technological displacement, amounted to 9.2 per cent in 1910, as compared with 1908; to 17.1 per cent in 1912; and to 40.2 per cent in 1926. From this point the per cent of decrease rose to 41.8 per cent in 1930 and declined to 38.8 per cent in 1931, 1908 being the base throughout.

For reasons already indicated,<sup>13</sup> and consisting essentially of the fact that the change in the volume of output is unavoidably underestimated and the change in the volume of labor overestimated, these estimates of the increase in the average output per employee and of technological displacement are conservative and do not indicate the full extent of the changes in question.

The estimates of displacement in Table 10 are based on the assumption that the services rendered by the postal system from 1908 to 1931 would have expanded substantially as indicated, even if the average output per employee had not materially increased. It is probable that in the case of the parcel-post business, expansion would have been somewhat smaller without an accompanying increase in the average output per employee. Without such an increase other agencies would probably have been able to absorb a portion of the parcel-post business. The extent to which the increased output of the postal system has depended on the increased productivity of labor is a problem which, unfortunately, resists solution in exact statistical form. It seems likely, however, that this factor is substantially counteracted by the decidedly conservative nature of the estimates in Table 10, due to the underestimate of increase in output and the overestimate of increase of labor units.

## Communication Versus Other Postal Services

It is desirable for more than one reason to distinguish between the work of the postal system in furnishing facilities for communication and its various other activities. Communication was the original, and is still the principal, work of the Postal Service. Economic activities, when viewed functionally, fall into main headings of such a

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<sup>13</sup> See pp. 49-54, 57, 58, and 60.

nature as are related to the satisfying of certain outstanding human needs. One of these needs is connected with communication. The postal system, however, is not the only agency which serves to meet the need for communication. It is desirable to bring together as far as possible related information regarding the functioning of the various agencies which satisfy this basic need for communication.

In order to facilitate the ascertaining of the general trends of productivity and of employment in the field of communication generally, an effort has been made to differentiate the communications activities of the postal system from its other functions. The basis of this differentiation, as far as output is concerned, is found in the classification of mail matter. The handling of first-class mail is almost exclusively the handling of communications. The handling of most of the mail of the other classes can hardly be classed under the heading of communication. To be sure the differentiation depends in a measure on the definition of the term "communication." For practical purposes of classifying economic activities, a communication is a message; and nearly all messages which are handled commercially consist of letters and post cards, telegrams, telephone conversations, and radiograms. It may be said with substantial accuracy that the communication function of the Postal Service consists of the handling of first-class mail.

The basis of differentiation between communication and other functions, as far as labor is concerned, is complicated by the fact that the work of relatively few postal employees is limited to the handling of first-class mail. It is obviously impossible, therefore, to segregate postal employees who handle first-class mail from those who perform other postal functions. Fortunately, however, the extensive tests and records of the Division of Cost Ascertainment of the Post Office Department in recent years have made it possible to assign to first-class mail the approximate per cent of the total time of all postal employees given by them to this form of postal service.

In Table 11 appear estimates of the number of units of first-class mail and of other forms of output of the Postal Service; and also estimates, based on data collected by the Division of Cost Ascertainment, of the the per cent of the total time of postal employees devoted to first-class mail and to all other forms of postal service.

**TABLE 11.**—*Comparative amount of time of postal employees devoted to communication or message handling (first-class mail) and to other principal forms of output, fiscal years 1926 to 1931*

Fiscal year	First-class mail			Other output of Postal Service		
	Number of pieces	Per cent of total output	Per cent of total time of postal employees <sup>1</sup>	Number of units <sup>2</sup>	Per cent of total output	Per cent of total time of postal employees
1926.....	15,265,624,116	42.9	42.401	20,292,944,384	57.1	57.599
1927.....	16,283,564,220	44.6	43.772	20,254,270,527	55.4	56.228
1928.....	16,706,197,518	45.4	43.773	20,096,441,122	54.6	56.227
1929.....	17,169,597,132	45.0	43.555	21,011,303,163	55.0	56.445
1930.....	16,901,204,170	43.7	43.232	21,731,512,798	56.3	56.768
1931.....	15,911,567,916	43.8	43.394	20,424,107,402	56.2	56.606

<sup>1</sup> Based on data collected by Division of Cost Ascertainment, U. S. Post Office Department.

<sup>2</sup> See Tables 1-4.

It will be seen that for the years 1926-1931 first-class mail ranged in per cent of the total output from 42.9 to 45.4, while the per cent of total time of postal employees given to first-class mail varied somewhat more slightly, ranging from 42.401 to 43.773. The estimates of output other than the handling of first-class mail are based on the labor-weighting factors previously discussed. Using the data contained in Table 11 as a point of departure, it is possible to estimate the effects of technological changes on the number of employment opportunities afforded by the communications work or message handling of the postal system as embodied in the handling of first-class mail. The results are incorporated in Table 12.

**TABLE 12.**—*Estimated change in number of employment opportunities afforded by the communications work or message handling (first-class mail) in specified fiscal years*

Fiscal year	Output			Employees		Decrease in employment opportunities	
	Total units <sup>1</sup>	Message handling (first-class mail)		Total number <sup>2</sup>	Number required for first-class mail <sup>3</sup>	Total displacement (on basis of output per employee in 1908) <sup>4</sup>	Number applicable to first-class mail <sup>3</sup>
		Number of pieces	Per cent of total output				
1908.....	14,567,706,216	7,102,704,806	48.8	177,469	86,605	0	0
1910.....	16,857,974,685	8,310,164,623	49.3	186,399	91,895	18,971	9,353
1912.....	18,871,634,932	9,159,648,117	48.5	190,480	92,383	39,420	19,119
1926.....	35,558,568,500	15,265,624,116	42.9	258,960	111,094	174,227	74,743
1927.....	36,537,834,747	16,283,564,220	44.6	263,309	117,436	181,808	81,086
1928.....	36,802,638,640	16,706,197,518	45.4	266,559	121,018	181,783	82,529
1929.....	38,180,900,295	17,169,597,132	45.0	272,040	122,418	193,093	86,892
1930.....	38,632,716,968	16,901,204,170	43.7	274,014	119,744	196,623	85,924
1931.....	36,335,675,318	15,911,567,916	43.8	270,915	118,661	171,739	75,222

<sup>1</sup> See Tables 1-4.

<sup>2</sup> See Table 7.

<sup>3</sup> Approximate; based on per cent first-class mail forms of total output.

<sup>4</sup> See Table 10.

In 1908 the total number of units of output of the Postal Service was 14,567,706,216. The number of pieces of first-class mail was 7,102,704,806, or 48.8 per cent of the whole. In the same year the total number of employees was 177,469. The approximate number of employees required for the handling of first-class mail, based on the per cent of total output included in first-class mail (48.8 per cent), was 86,605. By a similar process estimates are derived regarding the number of employees required for the handling of first-class mail for the years 1910, 1912, and 1926 to 1931. Carrying out the ratios, Table 12 assigns to the handling of first-class mail (communications) the appropriate proportions of the total displacement.

Of course, it can hardly be shown that the changes in methods of handling first-class mail have had exactly the same effect on average output per employee as have changes in methods of handling other forms of postal service. It seems likely, however, that for the period included in Table 12 the changes have had a sufficiently close approximation to make valid the use of the results found in the table as an indication of the general trend. There seems to be some reason for

believing that the changes in the handling of letters have led to a relatively large increase in the average output per employee. Letter handling lends itself to mechanized and standardized mass-handling methods. Projected changes in postal methods probably apply most significantly to the handling of first-class mail.

## Trend of Employment

Several conditions have recently retarded the upturn of the productivity curve. With the growth of the Parcel Post System and of some of the special services, the lack of building facilities adapted to the use of improved methods has become increasingly restrictive of the efficiency of postal employees. The general decline of business has been accompanied by a large reduction in the amount of business handled by the post offices. This would have meant a decline in the average output per employee, even with a reduction of the labor force to a minimum. In many private enterprises there has been a curtailment of employment approximating the decline of output. The Post Office Department has, however, consistently avoided reducing its labor force to a minimum. The amount of part-time employment has been reduced and vacancies have rarely been filled, but the regular employees of the Post Office Department and of the individual post offices have enjoyed a relative security of tenure. This is based on generally accepted public policies of conserving the human assets as well as the physical plant and of maintaining a trained personnel regardless of temporary fluctuations in output. The policy, however, has of course adversely affected the average output per employee.

Assuming a return to business activity approximating that of the years immediately preceding 1929, there are several factors which indicate a decided upward trend of the curve of productivity and a corresponding downward trend of the curve of employment opportunities, as measured by productivity, when output returns to normal.

One of these factors is the new building program which is in an advanced stage and which will soon provide the principal cities of the country with facilities of the best available type. Equipment that has proved to be most efficient and most productive will be extended throughout the larger post offices of the country and will be operated in buildings especially designed for the use of such equipment.

Another factor operating in the same direction consists of the recent intensive study of labor management and administrative organization and methods. Surveys carried on between October, 1929, and April, 1931, in 55 of the largest offices of the country afford an outstanding illustration of the trend. The annual report of the Post Office Department for 1931 states that these surveys "indicate that an estimated annual saving of \$4,500,000 will be effected when the ascertained surplus man power can be absorbed through the policy of absorbing vacancies occurring in the service due to normal casualties such as deaths, retirements, resignations, or removals."

If a revival of business restores to the postal system a large and growing volume of output, the curve of average output per employee

may be expected to rise rapidly. In other words, on the basis of production facilities afforded by the reconstructed physical plant and by the administrative reorganization of the system, the Post Office Department will be able to handle not only its former maximum production but a much larger output with a smaller volume of labor than has previously been required.

If the smaller total output of 1931 should prove to be permanent or long continued, the curve of average output per employee will naturally rise less rapidly and will depend on the relatively slow working out of the department's policy of allowing vacancies to remain unfilled and of taking up the slack by interior readjustments.

In either case (whether or not total output returns to its earlier high level) indications point to a resumption of the upward trend of the curve of output per employee; to a further decline of opportunities for employment in proportion to volume of output; and to a further increase in the volume of surplus man power attending the completion of the contemporary programs of construction and reorganization.



## LIST OF BULLETINS OF THE BUREAU OF LABOR STATISTICS

*The following is a list of all bulletins of the Bureau of Labor Statistics published since July, 1912, except that in the case of bulletins giving the results of periodic surveys of the bureau only the latest bulletin on any one subject is here listed.*

*A complete list of the reports and bulletins issued prior to July, 1912, as well as the bulletins published since that date, will be furnished on application. Bulletins marked thus (\*) are out of print.*

### **Conciliation and arbitration (including strikes and lockouts).**

- \*No. 124. Conciliation and arbitration in the building trades of Greater New York. [1913.]
- \*No. 133. Report of the industrial council of the British Board of Trade on its inquiry into industrial agreements. [1913.]
- \*No. 139. Michigan copper district strike. [1914.]
- \*No. 144. Industrial court of the cloak, suit, and skirt industry of New York City. [1914.]
- \*No. 145. Conciliation, arbitration, and sanitation in the dress and waist industry of New York City. [1914.]
- No. 191. Collective bargaining in the anthracite coal industry. [1916.]
- \*No. 198. Collective agreements in the men's clothing industry. [1916.]
- No. 233. Operation of the industrial disputes investigation act of Canada. [1918.]
- No. 255. Joint industrial councils in Great Britain. [1919.]
- No. 283. History of the Shipbuilding Labor Adjustment Board, 1917 to 1919.
- No. 287. National War Labor Board: History of its formation, activities, etc. [1921.]
- \*No. 303. Use of Federal power in settlement of railway labor disputes. [1922.]
- No. 341. Trade agreement in the silk-ribbon industry of New York City. [1923.]
- No. 402. Collective bargaining by actors. [1926.]
- No. 468. Trade agreements, 1927.
- No. 481. Joint industrial control in the book and job printing industry. [1928.]

### **Cooperation.**

- No. 313. Consumers' cooperative societies in the United States in 1920.
- No. 314. Cooperative credit societies (credit unions) in America and in foreign countries. [1922.]
- No. 437. Cooperative movement in the United States in 1925 (other than agricultural).
- No. 531. Consumers', credit, and productive cooperative societies, 1929.

### **Employment and unemployment.**

- \*No. 109. Statistics of unemployment and the work of employment offices in the United States. [1913.]
- \*No. 172. Unemployment in New York City, N. Y. [1915.]
- \*No. 183. Regularity of employment in the women's ready-to-wear garment industries. [1915.]
- \*No. 195. Unemployment in the United States. [1916.]
- \*No. 196. Proceedings of Employment Managers' Conference, held at Minneapolis, Minn., January 19 and 20, 1916.
- \*No. 202. Proceedings of the conference of Employment Managers' Association of Boston, Mass., held May 10, 1916.
- No. 206. The British system of labor exchanges. [1916.]
- \*No. 227. Proceedings of Employment Managers' Conference, Philadelphia, Pa., April 2 and 3, 1917.
- \*No. 235. Employment system of the Lake Carriers' Association. [1918.]
- \*No. 241. Public employment offices in the United States. [1918.]
- \*No. 247. Proceedings of Employment Managers' Conference, Rochester, N. Y., May 9-11, 1918.
- \*No. 310. Industrial unemployment: A statistical study of its extent and causes. [1922.]

**Employment and unemployment—Continued.**

- No. 409. Unemployment in Columbus, Ohio, 1921 to 1925.
- No. 542. Report of the Advisory Committee on Employment Statistics. [1931.]
- No. 544. Unemployment-benefit plans in the United States and unemployment insurance in foreign countries. [1931.]
- \*No. 553. Fluctuation in employment in Ohio, 1914 to 1929.
- No. 555. Social and economic character of unemployment in Philadelphia, April, 1930.

**Foreign labor laws.**

- \*No. 142. Administration of labor laws and factory inspection in certain European countries. [1914.]
- No. 494. Labor legislation of Uruguay. [1929.]
- No. 510. Labor legislation of Argentina. [1930.]
- No. 529. Workmen's compensation legislation of the Latin American countries. [1930.]
- No. 549. Labor legislation of Venezuela. [1931.]
- No. 554. Labor legislation of Paraguay. [1931.]
- No. 559. Labor legislation of Ecuador. [1931.]
- No. 569. Labor legislation of Mexico. [1932.]

**Housing.**

- \*No. 158. Government aid to home owning and housing of working people in foreign countries. [1914.]
- No. 263. Housing by employers in the United States. [1920.]
- No. 295. Building operations in representative cities in 1920.
- No. 545. Building operations in the principal cities of the United States in [1921 to] 1930.

**Industrial accidents and hygiene.**

- \*No. 104. Lead poisoning in potteries, tile works, and porcelain-enameled sanitary ware factories. [1912.]
- No. 120. Hygiene of painters' trade. [1913.]
- \*No. 127. Dangers to workers from dusts and fumes, and methods of protection. [1913.]
- \*No. 141. Lead poisoning in the smelting and refining of lead. [1914.]
- \*No. 157. Industrial accident statistics. [1915.]
- \*No. 165. Lead poisoning in the manufacture of storage batteries. [1914.]
- \*No. 179. Industrial poisons used in the rubber industry. [1915.]
- No. 188. Report of British departmental committee on the danger in the use of lead in the painting of buildings. [1916.]
- \*No. 201. Report of the committee on statistics and compensation insurance cost of the International Association of Industrial Accident Boards and Commissions. [1916.]
- \*No. 209. Hygiene of the printing trade. [1917.]
- \*No. 219. Industrial poisons used or produced in the manufacture of explosives. [1917.]
- No. 221. Hours, fatigue, and health in British munition factories. [1917.]
- No. 230. Industrial efficiency and fatigue in British munition factories. [1917.]
- \*No. 231. Mortality from respiratory diseases in dusty trades (inorganic dusts). [1918.]
- \*No. 234. The safety movement in the iron and steel industry, 1907 to 1917.
- No. 236. Effects of the air hammer on the hands of stonecutters. [1918.]
- \*No. 249. Industrial health and efficiency. Final report of British Health of Munition Workers' Committee. [1919.]
- \*No. 251. Preventable death in the cotton-manufacturing industry. [1919.]
- No. 256. Accidents and accident prevention in machine building. [1919.]
- No. 267. Anthrax as an occupational disease. [1920.]
- No. 276. Standardization of industrial accident statistics. [1920.]
- \*No. 280. Industrial poisoning in making coal-tar dyes and dye intermediates. [1921.]
- \*No. 291. Carbon monoxide poisoning. [1921.]
- No. 293. The problem of dust phthisis in the granite-stone industry. [1922.]
- No. 298. Causes and prevention of accidents in the iron and steel industry, 1910-1919.
- No. 306. Occupation hazards and diagnostic signs: A guide to impairments to be looked for in hazardous occupations. [1922.]
- No. 392. Survey of hygienic conditions in the printing trades. [1925.]

**Industrial accidents and hygiene—Continued.**

- No. 405. Phosphorus necrosis in the manufacture of fireworks and in the preparation of phosphorous. [1926.]  
No. 427. Health survey of the printing trades, 1922 to 1925.  
No. 428. Proceedings of the Industrial Accident Prevention Conference, held at Washington, D. C., July 14-16, 1926.  
No. 460. A new test for industrial lead poisoning. [1928.]  
No. 466. Settlement for accidents to American seamen. [1928.]  
No. 488. Deaths from lead poisoning, 1925-1927.  
No. 490. Statistics of industrial accidents in the United States to the end of 1927.  
No. 507. Causes of death, by occupation. [1929.]

**Industrial relations and labor conditions.**

- No. 237. Industrial unrest in Great Britain. [1917.]  
\*No. 340. Chinese migrations, with special reference to labor conditions. [1923.]  
No. 349. Industrial relations in the West Coast lumber industry. [1923.]  
\*No. 361. Labor relations in the Fairmont (W. Va.) bituminous-coal field. [1924.]  
No. 380. Postwar labor conditions in Germany. [1925.]  
No. 383. Works council movement in Germany. [1925.]  
No. 384. Labor conditions in the shoe industry in Massachusetts, 1920-1924.  
No. 399. Labor relations in the lace and lace-curtain industries in the United States. [1925.]  
No. 534. Labor conditions in the Territory of Hawaii, 1929-1930.

**Labor laws of the United States (including decisions of courts relating to labor).**

- \*No. 211. Labor laws and their administration in the Pacific States. [1917.]  
No. 229. Wage payment legislation in the United States. [1917.]  
No. 285. Minimum wage laws of the United States: Construction and operation. [1921.]  
No. 321. Labor laws that have been declared unconstitutional. [1922.]  
No. 322. Kansas Court of Industrial Relations. [1923.]  
No. 343. Laws providing for bureaus of labor statistics, etc. [1923.]  
No. 370. Labor laws of the United States, with decisions of courts relating thereto. [1925.]  
No. 408. Laws relating to payment of wages. [1926.]  
No. 548. Decisions of courts and opinions affecting labor, 1929-1930.  
No. 552. Labor legislation, 1930.

**Proceedings of annual conventions of the Association of Governmental Officials in Industry of the United States and Canada. (Name changed in 1928 from Association of Governmental Labor Officials of the United States and Canada.)**

- \*No. 266. Seventh, Seattle, Wash., July 12-15, 1920.  
No. 307. Eighth, New Orleans, La., May 2-6, 1921.  
\*No. 323. Ninth, Harrisburg, Pa., May 22-26, 1922.  
\*No. 352. Tenth, Richmond, Va., May 1-4, 1923.  
\*No. 389. Eleventh, Chicago, Ill., May 19-23, 1924.  
\*No. 411. Twelfth, Salt Lake City, Utah, August 13-15, 1925.  
\*No. 429. Thirteenth, Columbus, Ohio, June 7-10, 1926.  
\*No. 455. Fourteenth, Paterson, N. J., May 31 to June 3, 1927.  
\*No. 480. Fifteenth, New Orleans, La., May 21-24, 1928.  
No. 508. Sixteenth, Toronto, Canada, June 4-7, 1929.  
No. 530. Seventeenth, Louisville, Ky., May 20-23, 1930.  
No. 563. Eighteenth, Boston, Mass., May 18-22, 1931.

**Proceedings of annual meetings of the International Association of Industrial Accident Boards and Commissions.**

- No. 210. Third, Columbus, Ohio, April 25-28, 1916.  
No. 248. Fourth, Boston, Mass., August 21-25, 1917.  
No. 264. Fifth, Madison, Wis., September 24-27, 1918.  
\*No. 273. Sixth, Toronto, Canada, September 23-26, 1919.  
No. 281. Seventh, San Francisco, Calif., September 20-24, 1920.  
No. 304. Eighth, Chicago, Ill., September 19-23, 1921.  
No. 333. Ninth, Baltimore, Md., October 9-13, 1922.  
\*No. 359. Tenth, St. Paul, Minn., September 24-26, 1923.  
No. 385. Eleventh, Halifax, Nova Scotia, August 26-28, 1924.  
No. 395. Index to proceedings, 1914-1924.  
No. 406. Twelfth, Salt Lake City, Utah, August 17-20, 1925.  
No. 432. Thirteenth, Hartford, Conn., September 14-17, 1926.

**Proceedings of annual meeting of the International Association of Industrial Accident Boards and Commissions.—Continued.**

- \*No. 456. Fourteenth, Atlanta, Ga., September 27–29, 1927.
- No. 485. Fifteenth, Paterson, N. J., September 11–14, 1928.
- No. 511. Sixteenth, Buffalo, N. Y., October 8–11, 1929.
- No. 536. Seventeenth, Wilmington, Del., September 22–26, 1930.
- No. 564. Eighteenth, Richmond, Va., October 5–8, 1931.

**Proceedings of annual meetings of the International Association of Public Employment Services.**

- No. 192. First, Chicago, December 19 and 20, 1913; second, Indianapolis, September 24 and 25, 1914; third, Detroit, July 1 and 2, 1915.
- \*No. 220. Fourth, Buffalo, N. Y., July 20 and 21, 1916.
- No. 311. Ninth, Buffalo, N. Y., September 7–9, 1921.
- No. 337. Tenth, Washington, D. C., September 11–13, 1922.
- No. 355. Eleventh, Toronto, Canada, September 4–7, 1923.
- No. 400. Twelfth, Chicago, Ill., May 19–23, 1924.
- No. 414. Thirteenth, Rochester, N. Y., September 15–17, 1925.
- No. 478. Fifteenth, Detroit, Mich., October 25–28, 1927.
- No. 501. Sixteenth, Cleveland, Ohio, September 18–21, 1928.
- No. 538. Seventeenth, Philadelphia, September 24–27, 1929; Eighteenth, Toronto, Canada, September 9–12, 1930.

**Productivity of labor.**

- No. 356. Productivity costs in the common-brick industry. [1924.]
- No. 360. Time and labor costs in manufacturing 100 pairs of shoes, 1923.
- No. 407. Labor cost of production and wages and hours of labor in the paper box-board industry. [1926.]
- \*No. 412. Wages, hours, and productivity in the pottery industry, 1925.
- No. 441. Productivity of labor in the glass industry. [1927.]
- No. 474. Productivity of labor in merchant blast furnaces. [1928.]
- No. 475. Productivity of labor in newspaper printing. [1929.]
- No. 550. Cargo handling and longshore labor conditions. [1932.]

**Retail prices and cost of living.**

- \*No. 121. Sugar prices, from refiner to consumer. [1913.]
- \*No. 130. Wheat and flour prices, from farmer to consumer. [1913.]
- \*No. 164. Butter prices, from producer to consumer. [1914.]
- \*No. 170. Foreign food prices as affected by the war. [1915.]
- No. 357. Cost of living in the United States. [1924.]
- No. 369. The use of cost-of-living figures in wage adjustments. [1925.]
- No. 495. Retail prices, 1890 to 1928.

**Safety codes.**

- No. 336. Safety code for the protection of industrial workers in foundries.
- No. 350. Rules governing the approval of headlighting devices for motor vehicles.
- \*No. 351. Safety code for the construction, care, and use of ladders.
- No. 375. Safety code for laundry machinery and operations.
- No. 382. Code of lighting school buildings.
- No. 410. Safety code for paper and pulp mills.
- \*No. 430. Safety code for power presses and foot and hand presses.
- No. 447. Safety code for rubber mills and calenders.
- No. 451. Safety code for forging and hot-metal stamping.
- No. 463. Safety code for mechanical power-transmission apparatus—first revision.
- No. 509. Textile safety code.
- No. 512. Code for identification of gas-mask canisters.
- No. 519. Safety code for woodworking plants, as revised 1930.
- No. 527. Safety code for the use, care, and protection of abrasive wheels.
- No. 556. Code of lighting: Factories, mills, and other work places. (Revision of 1930.)
- No. 562. Safety codes for the prevention of dust explosions.

**Vocational and workers' education.**

- \*No. 159. Short-unit courses for wage earners, and a factory school experiment. [1915.]
- \*No. 162. Vocational education survey of Richmond, Va. [1915.]
- \*No. 199. Vocational education survey of Minneapolis, Minn. [1917.]
- No. 271. Adult working-class education in Great Britain and the United States. [1920.]
- No. 459. Apprenticeship in building construction. [1928.]

## Wages and hours of labor.

- \*No. 146. Wages and regularity of employment and standardization of piece rates in the dress and waist industry of New York City. [1914.]
- \*No. 147. Wages and regularity of employment in the cloak, suit, and skirt industry. [1914.]
- No. 161. Wages and hours of labor in the clothing and cigar industries, 1911 to 1913.
- \*No. 163. Wages and hours of labor in the building and repairing of steam railroad cars, 1907 to 1913.
- \*No. 190. Wages and hours of labor in the cotton, woolen, and silk industries, 1907 to 1914.
- No. 204. Street-railway employment in the United States. [1917.]
- No. 218. Wages and hours of labor in the iron and steel industry, 1907 to 1915 :  
With a glossary of occupations.
- \*No. 225. Wages and hours of labor in the lumber, millwork, and furniture industries, 1915.
- No. 265. Industrial survey in selected industries in the United States, 1919.
- No. 297. Wages and hours of labor in the petroleum industry, 1920.
- No. 356. Productivity costs in the common-brick industry. [1924.]
- No. 358. Wages and hours of labor in the automobile-tire industry, 1923.
- No. 360. Time and labor costs in manufacturing 100 pairs of shoes, 1923.
- No. 365. Wages and hours of labor in the paper and pulp industry, 1923.
- No. 407. Labor cost of production and wages and hours of labor in the paper box-board industry. [1926.]
- \*No. 412. Wages, hours, and productivity in the pottery industry, 1925.
- No. 416. Hours and earnings in anthracite and bituminous-coal mining, 1922 and 1924.
- No. 484. Wages and hours of labor of common street laborers, 1928.
- No. 499. History of wages in the United States from colonial times to 1928.
- No. 502. Wages and hours of labor in the motor-vehicle industry, 1928.
- No. 504. Wages and hours of labor in the hosiery and underwear industries, 1907 to 1928.
- No. 513. Wages and hours of labor in the iron and steel industry, 1929.
- No. 514. Pennsylvania Railroad wage data. From Report of Joint Fact Finding Committee in wage negotiations in 1927.
- No. 516. Hours and earnings in bituminous-coal mining, 1929.
- No. 523. Wages and hours in the manufacture of airplanes and aircraft engines, 1929.
- No. 525. Wages and hours of labor in the Portland cement industry, 1929.
- No. 532. Wages and hours of labor in the cigarette-manufacturing industry, 1930.
- No. 533. Wages and hours of labor in woolen and worsted goods manufacturing, 1910 to 1930.
- No. 534. Labor conditions in the Territory of Hawaii, 1929-1930.
- No. 535. Wages and hours of labor in the slaughtering and meat-packing industry, 1929.
- No. 537. Wages and hours of labor in the dyeing and finishing of textiles, 1930.
- No. 539. Wages and hours of labor in cotton-goods manufacturing, 1910 to 1930.
- No. 546. Wages and hours in rayon and other synthetic manufacturing, 1930.
- No. 547. Wages and hours of labor in the cane-sugar refining industry, 1930.
- No. 551. Wages and hours of labor in the boot and shoe industry, 1910 to 1930.
- No. 577. Wages and hours of labor in the men's clothing industry, 1911 to 1930.
- No. 560. Wages and hours of labor in the lumber industry in the United States. 1930.
- No. 566. Union scales of wages and hours of labor, May 15, 1931.
- No. 567. Wages and hours of labor in the hosiery and underwear industries, 1907 to 1930.
- No. 568. Wages and hours of labor in the manufacture of silk and rayon goods, 1931.
- No. 570. Wages and hours of labor in foundry and machine shops, 1931. (In press.)
- No. 571. Wages and hours of labor in the furniture industry, 1910 to 1931.
- No. 573. Wages and hours of labor in metalliferous mines, 1924 to 1931. (In press.)

## Welfare work.

- \*No. 123. Employers' welfare work. [1913.]
- No. 222. Welfare work in British munition factories. [1917.]

**Welfare work—Continued.**

- \*No. 250. Welfare work for employees in industrial establishments in the United States. [1919.]
- No. 458. Health and recreation activities in industrial establishments, 1926.

**Wholesale prices.**

- \*No. 284. Index numbers of wholesale prices in the United States and foreign countries. [1921.]
- No. 453. Revised index numbers of wholesale prices, 1923 to July, 1927.
- No. 572. Wholesale prices, 1931. (In press.)

**Women and children in industry.**

- \*No. 116. Hours, earnings, and duration of employment of wage-earning women in selected industries in the District of Columbia. [1913.]
- \*No. 117. Prohibition of night work of young persons. [1913.]
- \*No. 118. Ten-hour maximum working-day for women and young persons. [1913.]
- No. 119. Working hours of women in the pea canneries of Wisconsin. [1913.]
- \*No. 122. Employment of women in power laundries in Milwaukee. [1913.]
- \*No. 160. Hours, earnings, and conditions of labor of women in Indiana mercantile establishments and garment factories. [1914.]
- \*No. 167. Minimum-wage legislation in the United States and foreign countries. [1915.]
- \*No. 175. Summary of the report on condition of woman and child wage earners in the United States. [1915.]
- \*No. 176. Effect of minimum-wage determinations in Oregon. [1915.]
- \*No. 180. The boot and shoe industry in Massachusetts as a vocation for women. [1915.]
- \*No. 182. Unemployment among women in department and other retail stores of Boston, Mass. [1916.]
- No. 193. Dressmaking as a trade for women in Massachusetts. [1916.]
- No. 215. Industrial experience of trade-school girls in Massachusetts. [1917.]
- \*No. 217. Effect of workmen's compensation laws in diminishing the necessity of industrial employment of women and children. [1918.]
- \*No. 223. Employment of women and juveniles in Great Britain during the war. [1917.]
- No. 253. Women in the lead industries. [1919.]
- No. 467. Minimum-wage legislation in various countries. [1928.]
- No. 558. Labor conditions of women and children in Japan. [1931.]

**Workmen's insurance and compensation (including laws relating thereto).**

- \*No. 101. Care of tuberculous wage earners in Germany. [1912.]
- \*No. 102. British national insurance act, 1911.
- No. 103. Sickness and accident insurance law in Switzerland. [1912.]
- No. 107. Law relating to insurance of salaried employees in Germany. [1913.]
- \*No. 155. Compensation for accidents to employees of the United States. [1914.]
- No. 212. Proceedings of the conference on social insurance called by the International Association of Industrial Accident Boards and Commissions, Washington, D. C., December 5-9, 1916.
- \*No. 243. Workmen's compensation legislation in the United States and foreign countries, 1917 and 1918.
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