

MONTHLY

Business Review

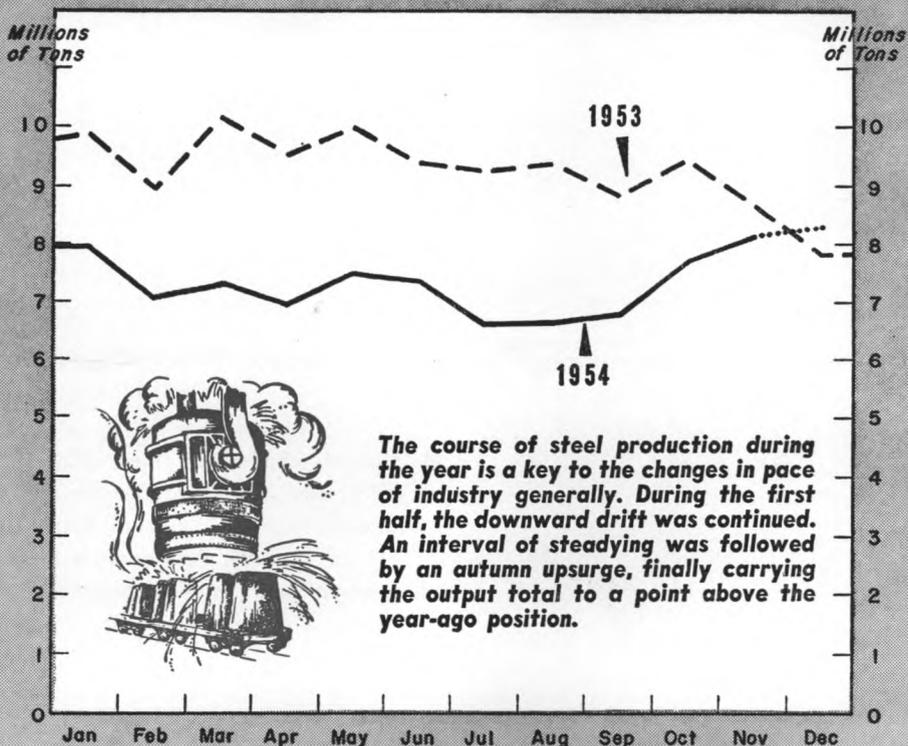
FEDERAL RESERVE BANK of CLEVELAND

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IN THIS ISSUE

Industrial Summary for 1954 . . .	3
The Year in Fourth District Banking . .	8
Review of Department Store Trade . . .	12
Putting Radioactivity to Work . . .	15
Announcements	7, 11

STEEL PRODUCTION



The course of steel production during the year is a key to the changes in pace of industry generally. During the first half, the downward drift was continued. An interval of steadying was followed by an autumn upsurge, finally carrying the output total to a point above the year-ago position.

Dec. '54 partly estimated

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Industrial Summary for 1954

BUSINESS SENTIMENT in the Fourth Federal Reserve District during the year 1954 may be said to have roughly paralleled the course of steel ingot production as depicted by the cover chart of this *Review*. Confidence that the recession of early 1954 would not be very deep, or prolonged, reached its lowest level during the midsummer doldrums. From then on, optimism began to strengthen as the steel industry charted a course of swift recovery. By year end, only expressions of optimism by the business community for the coming year were being voiced.

The close connection between business optimism and the steel operating rate in the Fourth District has a very real foundation. About 40 percent of the nation's steel ingot capacity is concentrated in the area and the primary metals and fabricated metals industries provide jobs for 30 percent of all manufacturing workers of the District.

Activity in Iron and Steel

From the record high levels of the first half of 1953, production of steel drifted downward until it reached a bottom in July and August of 1954. On a national basis, output in each of the latter two months amounted to only 6.6 million tons of ingots, or an operating rate of 63 percent of capacity. The subsequent steady advance, as shown in the chart, lifted steel production to 8.1 million tons in November and close to an estimated 8.3 million tons in December. The latter represented an operating rate of nearly 80 percent of capacity. Thus in the final four months of the year, steel ingot production rose by about 25 percent.

The abrupt turnabout in the steel industry can be traced to two main factors. The first was the general completion reached by the beginning of the fourth quarter, of the wave of steel inventory liquidation that had been under way since early in the year, and the resumption of purchasing in line with current consumption requirements. It is conservatively estimated that inventories of raw steel in the hands of fabricators had been drawn down by about 7 to 8 million tons in the first three quarters of the year.

The second important stimulating factor was the unprecedented year-end surge of production by the automobile industry which, in recent years, has consumed close to 20 percent of total steel shipments. Output in November of 509,000 cars more than doubled the previous month's total; December schedules called for a further increase to more than 630,000 units. If this number should be confirmed by the final tabulation, it would be the largest for any month since October 1950, and the highest December on record.

The vigorous year-end demand for automotive steel—particularly for cold rolled sheet and strip — had the immediate effect of lengthening steel-mill delivery dates and thereby automatically raising inventory requirements of consumers of these products. This, in turn, further stimulated advance ordering by a large range of customers.

For the entire year, steel ingot production in the United States is estimated at close to 88.3 million tons, or about 21 percent below the record 1953 output, and about equal to the outturn in the boom year of 1948.

The sharp reduction in steel mill activity had an even greater impact upon shipments

of Lake Superior iron ore from Upper Lake ports. Shipments dropped to 60.8 million gross tons, a drop of 37 percent from 1953, and the lowest since the strike-impeded year of 1946.

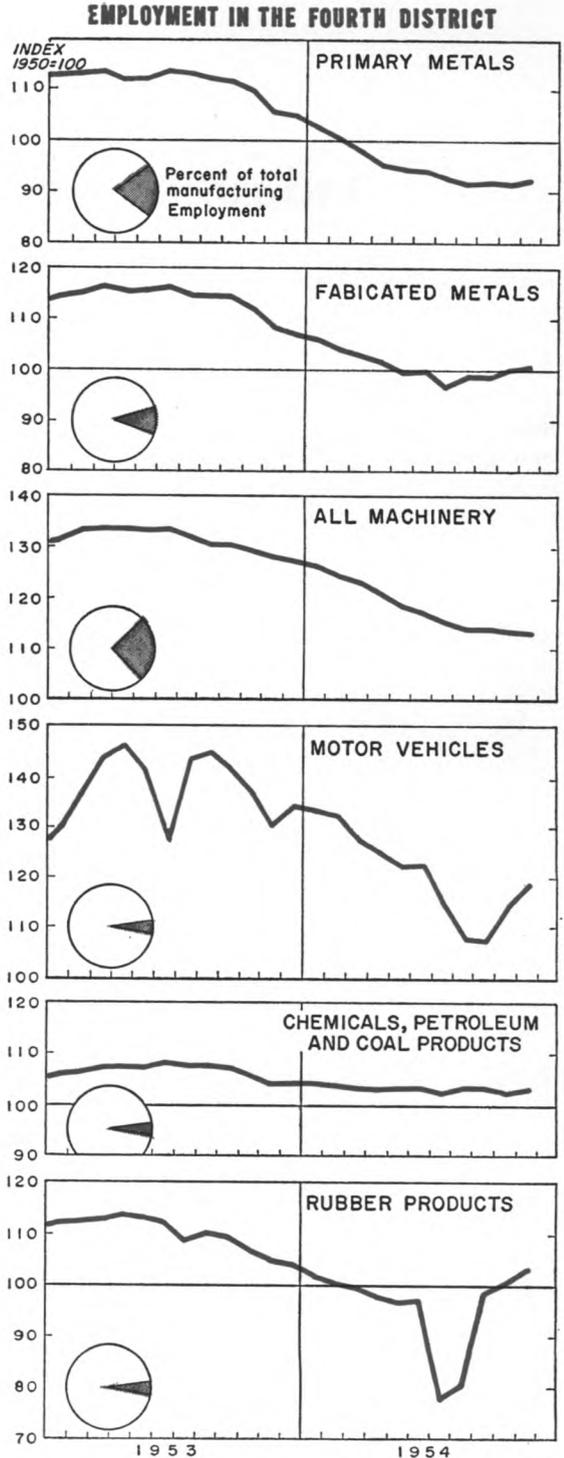
Stocks of Lake Superior iron ore at docks and furnaces on December 1, however, totaled 49.9 million tons, only 9 percent less than a year ago. At the November rate of consumption, this represented nearly a 9-month supply for blast furnaces, as compared with a year-ago supply of 8 months.

For the first time in history, District supplies of iron ore were augmented by rather liberal imports of foreign ore, chiefly from Liberia and from the new Labrador field, which began shipping in late summer. About 1,750,000 tons of iron ore were shipped out of Labrador, and of this, 145,000 tons came up the St. Lawrence river to the Great Lakes. Altogether, about 1,250,000 tons were consigned to District steel-making centers, chiefly via Atlantic coast docks. This tonnage is not included in the Lake Superior stocks noted above.

Employment by Industries of the District

Steel. Employment in the steel industry of the District, as shown in an accompanying chart, declined steadily through the first 10 months of 1954, and in October was only 91 percent of the 1950 average monthly level. A near 2 percent increase in November took place and a further upturn undoubtedly was registered in December. The initial increase in steel output in September and October apparently was achieved by a lengthening of the work week and the use of the most efficient equipment rather than by calling back laid-off crews. The steel industry alone had accounted for one-quarter of the employment losses suffered by District manufacturing industries during the first three quarters of 1954.

Fabricated Metals. The decline in employment in the fabricated metals industries was not as sharp as that experienced by primary metal producers and reflected a smaller re-



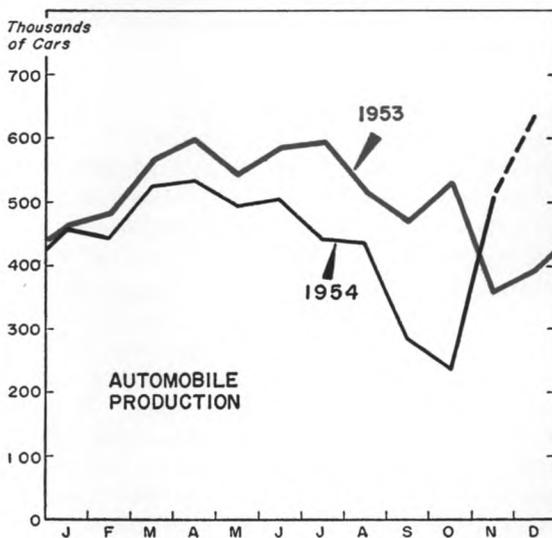
duction in steel consumption while inventories were being worked off. It should also be noted from the chart that metal fabricating employment reached a bottom at mid-summer and since has shown small but steady gains.

Machinery. The earlier phases of the recession of 1953-54 had relatively small effect upon District producers of electrical and nonelectrical machinery when measured by changes in employment. However, the downturn persisted all through the first 11 months of 1954 so that by November, employment was 15 percent below the peak of March 1953. The slide-off was directly related to similar trends in expenditures by business for new plant and equipment and a reduction of business inventories of household durable goods. However, at most recent report, the number of workers in the machinery industries (which account for 25 percent of all manufacturing employment of the District) was still 14 percent above the 1950 monthly average, thus making one of the best showings among major industries.

New orders for machine tools continued to drift downward during most of the year. The new order index of the National Machine Tool Builders Association stood at 119 in November (1945-47=100) or 19 percent below the year-ago level. Shipments, too, have steadily dropped off, with the third-quarter rate 30 percent lower than in the same 1953 period. Order backlogs were down to only 3 months of the demonstrated production rate, or about one-half the year-ago level. The 1954 revisions of the Internal Revenue Code, which liberalized depreciation allowances and made it easier for small business to retain earnings, have failed to stimulate new business to the degree anticipated by the machinery industry. The machine tool industry apparently faces a major educational job in convincing producers and their financial agencies of the high cost of retaining obsolete tools in the shop.

Autos and Parts. The 1954 pattern of automobile production, as shown by an accompanying chart, had a decided effect upon

Auto production was sharply cut during early autumn months; output of new models brought a surge of production during November and December.



District employment in the motor vehicle and parts industry. Production was progressively cut by the industry in a successful attempt to reduce new car stocks in the hands of dealers before the launching of the new 1955 models. By the end of October, cumulative new car outturn trailed the comparable 1953 period by 19 percent, but dealer stocks were at the lowest level since production was cut by the 1952 steel-labor dispute.

The effect of this slash in auto production can be seen in the chart of employment in the District's motor vehicle and parts industry. From the fourth quarter of 1953 through September 1954, manufacturing employment dropped 20 percent, the most unfavorable showing of any major District industry. By October, however, payrolls began to expand as suppliers stepped up the production of parts and components for the new models. This uptrend undoubtedly continued through the end of the year as auto schedules were progressively raised to record levels. For the entire year, passenger car assembly is estimated at 5.5 million units, or 10 percent below the high 1953 total.

Rubber Tires. The slowdown in the passenger car industry was almost a direct measure of the drop in the rubber industry's shipments of passenger car casings. Through the first 10 months of 1954, sales of replacement tires were on a par with the previous year, but original equipment tires were down 5.4 million units. This may be compared with a drop in production of about 1,020,000 passenger cars for the same period. In addition, account should also be taken of the decreased production of trucks, many of which are equipped with standard passenger car tires.

Production of passenger car casings in the first 10 months dropped 7.4 million units (or somewhat more than shipments) chiefly because of extended labor disputes among major manufacturers during July and August. Stocks of tires, however, were more than ample to meet current requirements and these were drawn down to supply the market. Sharply stepped-up output in September and October brought inventories up to the year-ago level by November 1.

Production of all types of pneumatic casings during 1954 is estimated to be about 9 percent below the large 1953 total.

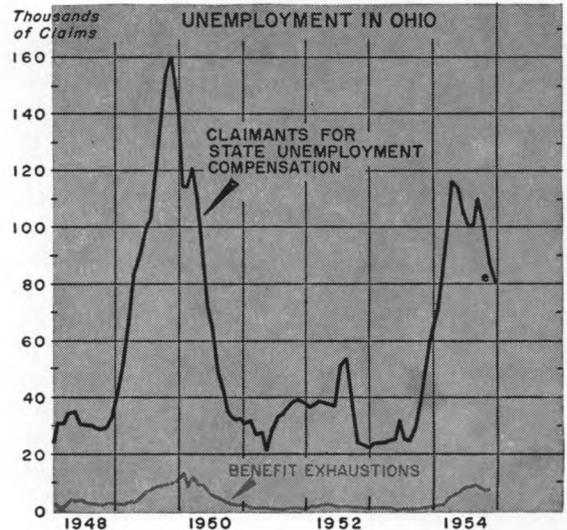
The outstanding development in the rubber industry in 1954 was the general introduction of the tubeless tire. The latter was adopted by all car manufacturers for 1955 models; also, it is expected to be aggressively sold in the replacement market since it can be used on the standard wheel without any material modifications.

The effects of decreased production and midsummer strikes are readily apparent in the chart of employment in the rubber industry of the District. Of particular interest is the fact that although total output of tires in September and October was about equal to the year-ago performance, District employment averaged about 8 percent less.

Trend of Unemployment

The accompanying chart shows the trend of continued claims for unemployment compensation during the past year, and also

The high point of unemployment in Ohio reached in the spring of 1954 was lower than the 1949 peak; by year end, seasonally adjusted unemployment was dropping rapidly.



e Dec. '54 partly estimated.

NOTE: Average weekly number of continued claims (seasonally adjusted by months) and total monthly benefit exhaustions are based on data reported by the Division of Research and Statistics, Ohio Bureau of Unemployment Compensation.

allows comparison with the 1948-50 experience. Despite an increase of over 10% in the number of persons covered by the unemployment compensation program, the number of claims filed was considerably smaller in 1954 than in 1949. Much of this difference can be traced to the effects of the coal and steel strikes, which occurred in the fall of 1949 just as unemployment was reaching a cyclical peak. Also important, however, was the fact that in 1954 the volume of claims began to recede after only eight months of rapid increases, while five years ago a full year passed before the rising trend of claims was reversed.

In the summer of 1954, after unemployment had reached a peak, there was a leveling period of several months' duration when the small decline in claims could largely be accounted for by the growing volume of benefit exhaustions, i.e., cases where benefits had been drawn for the maximum period allowable under the law and where the claimants

were thus automatically ineligible for further payments. By October, however, employment was expanding and unemployment began to ease. At the year end (on a seasonally adjusted basis) the number of unemployment compensation claims appeared to be dropping as fast as they had risen early in the year. A pattern similar to that of late 1949 and early 1950 seemed to be taking shape.

The key to the industrial revival which was taking hold during the fourth quarter of 1954 appears to lie within the motor vehicle and equipment industry. The auto and auto parts industry, as indicated in the chart on employment, directly employs only a small percentage of the District's labor force. It is important, however, because the industry as a whole, most of which lies outside the Fourth District, is a major buyer of District products. Thus the upsurge in auto output

directly influences such major industries as steel, iron foundries, metal fabricating, non-ferrous metals, machinery, plate glass, paint, rubber, coal, chemicals, transportation, and such service industries as finance and retailing.

As the year 1954 drew to a close there was no question that activity and employment had entered an expansionist stage. The upturn had been widespread and not wholly dependent upon the surge of production and ordering by the auto industry. Yet if auto production should seriously falter some time before mid-1955, much of the steam would be taken out of the recovery which at year end was very much in evidence. This observation applies with special force to the industry of the Fourth District, but it probably has some applicability, also, to the nation-wide trend of business.

Announcement

Following is the text of the statement made by the Board of Governors of the Federal Reserve System announcing the change in margin requirements effective January 5, 1955:

“The Board of Governors of the Federal Reserve System today amended Regulations T and U, relating respectively to margin requirements of brokers and banks, by increasing margin requirements from 50 percent to 60 percent, effective immediately. The increased requirements apply to both purchases and short sales. No other change was made in the regulations.”

The Year in Fourth District Banking

THE TWO most pervasive factors that affected banking in 1954 were the general sag in business activity during a considerable part of the year, and Federal Reserve policy designed to help counteract that decline. The business recovery in evidence toward year-end points to a different banking climate for the coming year.

The most pronounced features of the recent recession were the downturn in industrial production and the liquidation of inventories, particularly in durable goods. Because of the importance of durable-goods production and heavy industry in the Fourth District, the decline in business activity was somewhat more pronounced in the District than in the nation as a whole. Correspondingly, total loans of Fourth District member banks failed to expand during the year, in contrast to a substantial rise in the nation. Loans here declined until summer, and by the end of 1954 they had recovered only to about the year-ago level.

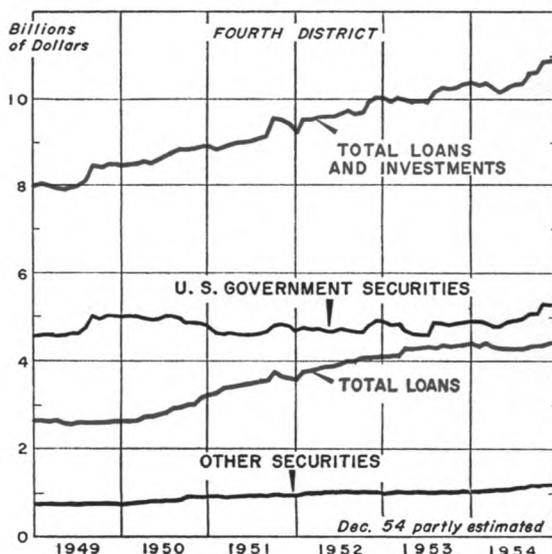
On the other hand, Federal Reserve policy had an expansive impact on the total volume of banks' earning assets, both in this District and nationally. During 1954, the Federal Reserve System, through coordinated use of its monetary instruments, aimed at promoting recovery and further growth in the economy by actively maintaining monetary ease. Specifically, member banks were provided with additional excess reserves at various times throughout the year, both through open-market operations and through a lowering of reserve requirements. In the absence of an active loan demand, new reserves were utilized by member banks to expand holdings of U. S. Government securities, as well as municipal

and corporate securities. As a consequence, total earning assets and deposits of member banks in the District, as well as the U. S., expanded significantly during the year.

Total Loans and Investments Rose

The trend of earning assets of Fourth District member banks in recent years is shown in an accompanying chart. Total loans and investments rose by nearly 5 percent in 1954. With the exception of 1952, the growth was the largest in the past six years.

Holdings of Government securities by Fourth District member banks were considerably enlarged during 1954, while total loans held practically steady.



Total Loans. The growth of earning assets of Fourth District banks occurred despite the failure of loans to show any net expansion for the year. The last previous period in which that had been the case was the recession year of 1949. However, the relative stability of total loans in 1954, as shown on the chart, fails to bring out widely divergent patterns in various types of loans, which is discussed at a later point.

U. S. Government Securities. To a large extent, the rise in total loans and investments of District banks in the past year was the result of expanded holdings of U. S. Government securities. Despite a moderate drop through April, these holdings rose by about \$400 million for the year as a whole. U. S. security portfolios of member banks had generally declined during the period of economic expansion from 1950 to mid-1953. The reversal of this movement during the recession of 1953-54 brought U. S. security holdings of District banks above the 1949 level for the first time.

Experience in the Fourth District conforms to an important national pattern that has emerged in recent years. There is a tendency for the Federal debt to move in an opposite direction to the business cycle and for bank loans and holdings of U. S. securities to move in a partially offsetting manner, both in periods of economic expansion and contraction. As a result, total earning assets show a more stable rate of growth than in earlier periods, and consequently bank deposits (the principal part of the money supply) display the same tendency.

Other Securities. Holdings of municipal and corporate securities by Fourth District member banks rose moderately during 1954, in contrast to their virtual stability during the previous three years. Expenditures by state and local governments on schools, roads, and other public works continued to expand during 1954, with member banks supplying a part of the funds, both in the District and nationally. In this District, however, almost all of the increase in municipal as well as corporate securities occurred in the holdings of member banks in large cities.

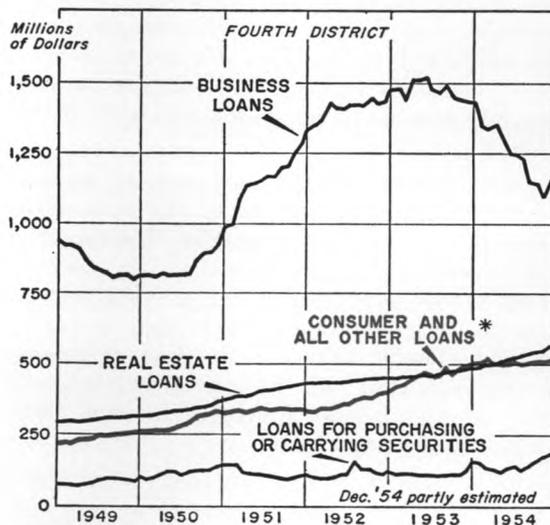
Loan Trends Mixed

Loans of District member banks displayed several contrasts in 1954. First, there were conflicting patterns in different types of loans, as brought out in the accompanying chart.⁽¹⁾ Partially as a consequence, there was also a difference in the trend of total loans as between large city banks and banks in other centers.

Business Loans. The decline in business loans of Fourth District banks started earlier, lasted longer, and went further than in the nation as a whole. The District decline began in mid-1953 and lasted through October of 1954. In contrast, the drop in business loans of member banks nationally began early in 1954 but was reversed by August.

To a large extent, the relatively unfavorable experience in the Fourth District stems from the importance in the District economy of manufacturing and mining—especially the metals and metal products lines. It was in

The decline in business loans during most of 1954 was largely offset by rises in other types of bank loans.



* Excluding interbank loans.

(1) The chart on loans applies to 17 weekly-reporting member banks, located in 6 cities, and holding about 53% of the total resources of all member banks in the District. Data on individual types of loans of all member banks are available only for call-report dates. Business loans include commercial, industrial, and agricultural loans.

such types of business that inventory liquidation and the decline of Federal defense spending had the greatest impact. Consequently, large loan repayments were made by firms engaged in manufacturing and mining until the final month of 1954.

In addition, large net repayments of business loans were made until late in 1954 by sales finance companies and public utilities. At the same time, the seasonal expansion that occurred nationally in the second half of the year in loans to food processors, to commodity dealers, and to wholesale and retail trade, was delayed in the Fourth District. (For a more detailed analysis of business loans in 1954, see this *Review* for December, 1954).

It was not until November that an upturn occurred in business loans of District banks, and even then, much of the rise came from purchases of certificates of interest sold by the Commodity Credit Corporation, representing a pool of price-support loans on farm commodities.

Because of the relatively greater importance of business loans to large city banks in the District as compared with country banks, total loans of the former registered a decline for the year, despite partially offsetting gains in all other types of loans. On the other hand, total loans of country banks rose for the year, mainly because of an increase in agricultural loans.

Real estate loans. Construction, particularly residential, was one of the most active sectors of the economy in 1954. The construction boom has been sustained in large part by easy credit terms and a ready availability of funds from lending institutions, including banks. Member banks in the Fourth District participated in this financing activity with one of the largest increases in real estate loans in recent years.

Other loans. After fluctuating within a relatively small range for most of the year, loans for purchasing or carrying securities displayed a rapid rate of increase in the final quarter of 1954. This development was an accompaniment of the unusual strength displayed in the stock market. Relatively, how-

ever, such loans represent only a small portion of member bank assets.

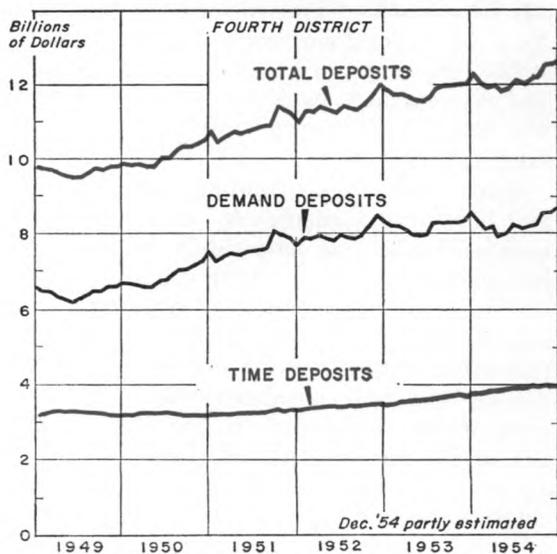
Consumer and all other loans showed little growth for the year as a whole. For the most part, this outcome reflects the stalemate that developed between new extensions and repayments of consumer instalment credit after March. Further growth seems to be in prospect for consumer credit in the near future, however.

Deposits Grew

Deposits of commercial banks vary largely, but not entirely, with changes in loans and security holdings of banks. A net increase in loans and investments of the commercial banking system as a whole results in newly created deposits, while deposits are reduced by a net decline in earning assets.

Since total loans and investments of Fourth District member banks expanded during the year, total deposits also rose, as shown in an accompanying chart. The growth of deposits, however, was only about 70 percent as large as that of earning assets. Total assets of mem-

During the second half of 1954, a rise in demand deposits of Fourth District member banks pushed total deposits to a new high.



ber banks did not rise as much as loans and investments, since there was an offsetting decline in cash assets. While total deposits rose by almost 3 percent for the year, the gain was not as large as recorded in the previous two years.

Demand deposits. Throughout the first four months of 1954, the seasonal decline in demand deposits roughly paralleled that of 1953. A gain in demand deposits during the balance of the year, reflecting both seasonal forces and an expansive monetary policy, produced a modest increase for the year as a whole. The increase, however, was smaller than in any year since 1949.

Time deposits. By way of contrast, the growth of time deposits at Fourth District member banks during 1954 was larger than any recent year except 1953. Personal saving continued at a high level in 1954, particularly in the first half, and this was reflected in a substantial growth in savings accounts. After mid-year, however, the rate of increase in time deposits slowed down noticeably, with the usual decline setting in near year-end.

In addition to the effect of seasonal forces,

the trend after mid-year was influenced by competition from other forms of liquid saving as well as by a tendency for the rate of personal saving to decline. For the year as a whole, however, the growth in time deposits was nearly twice that of demand deposits.

Outlook

The business recovery that began late in 1954 provides a more promising outlook for banking in 1955. In the Fourth District, the banking climate will be particularly influenced by developments in the steel and auto industries, both of which were recovering rapidly near year-end.

The outlook for 1955 includes a prospective recovery of commercial, industrial, and consumer loans, and continued growth in the demand for real estate and agricultural loans. In that event, however, the expansive effect on the deposits of commercial banks would probably tend to be moderated by some decline in security holdings. Nevertheless, the earnings position of banks would tend to improve, because of the higher rate of return on loans as compared to investments.

1954 ANNUAL REPORT

It is expected that this bank's *Annual Report* for 1954 will be published before the end of January. The report will carry a review of monetary and business developments during the past year, including the role of Federal Reserve policy.

Copies may be obtained by writing to the Research Department, Federal Reserve Bank of Cleveland, Cleveland 1, Ohio.

Review of Department Store Trade

DEPARTMENT STORE trade in the Fourth Federal Reserve District during 1954 fell short of the record volume of the preceding year. Nevertheless, sales during the latter months of the year showed marked improvement, on a seasonally adjusted basis, from the low first-quarter position.

The year-to-year decline in sales by Fourth District department stores during 1954 was larger than that shown for the nation as a whole. Through the middle of December, 1954, the latest period for which data are available at press time, department store sales trailed the year-ago volume by 8 percent in the Fourth District as compared with a decline throughout the nation amounting to only one percent.

This showing was in considerable part a reflection of the lower level of over-all business activity which prevailed during the greater part of the year. The Fourth District, with its concentration of durable-goods industries, was appreciably affected by the recession. Another factor in the somewhat disappointing trade totals for the Fourth District was the year-long labor-management dispute involving the Pittsburgh department stores.

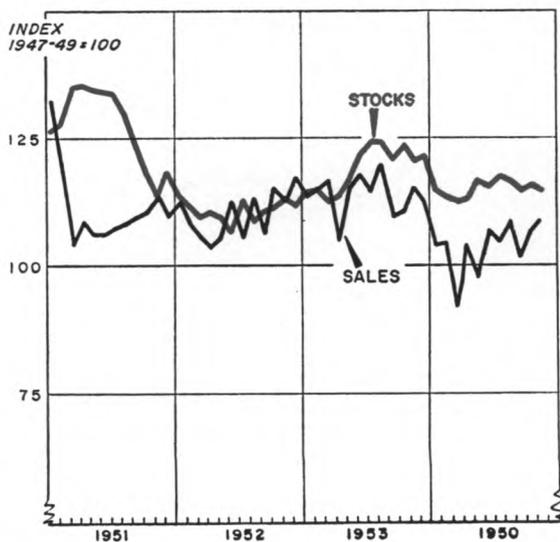
Total Sales and Stocks

Month-to-month movements in seasonally adjusted sales and end-of-month stocks for Fourth District department stores are shown on an accompanying chart. During the early months of 1954, department store sales (indicated by the black line on the chart) continued the downward movement begun in late 1953. By March, adjusted sales had dipped to a three-year low, caused at least in part by

prolonged and unusually severe snowstorms over much of the District. After March, seasonally adjusted sales rose hesitatingly, and by November, the latest month for which complete data are available, had reached a level equal to 109 percent of the 1947-49 average. Partial data for the month of December indicate a further increase over the November pace; the Christmas season was apparently a shade better than a year ago.

In spite of the rising trend exhibited by sales in the District throughout most of last year, adjusted sales were below the average for 1953 in each month of 1954 except December. It is likely that when the final results for December are available, they will show a

Department store sales in this District rose during the year from a reduced position; stocks held quite steady.



sales level for the month slightly above the year-ago position. The recent rise in business activity generally, and the agreement reached between labor and management in the Pittsburgh department stores, are factors which would seem to favor further improvement in the department store sales picture for this District.

Department store end-of-month inventories, as shown by the colored line on the accompanying chart, declined slightly on a seasonally adjusted basis during the first quarter of 1954. During the second quarter, however, inventories rose to about 116 percent of the 1947-49 average and remained virtually unchanged at this level throughout the remainder of the year. Such stability in the end-of-month inventory position suggests a buying policy on the part of District department stores closely attuned to monthly sales; if anything, it would be on the conservative side, insofar as the sales trend was generally upward.⁽¹⁾

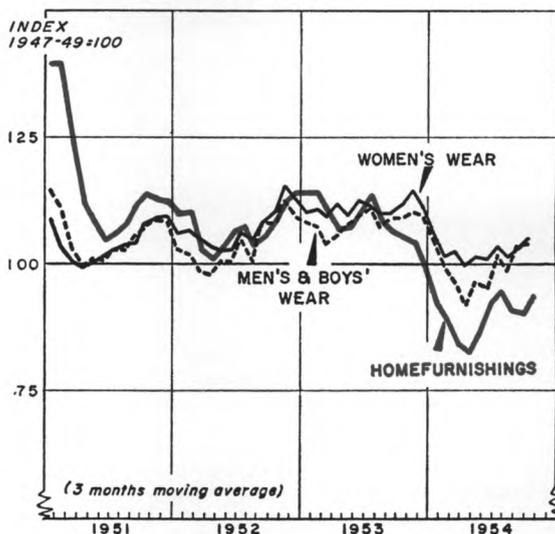
Lines of Goods

A second accompanying chart traces the course of sales over the past several years by three of the major departmental groups within Fourth District department stores. (The data plotted on this chart are three-months moving averages of seasonally adjusted sales indexes.) Sales of women's wear, both apparel and accessories, are shown by the solid black line on the chart, while the broken black line represents sales of men's and boys' wear, and the colored line indicates sales by the homefurnishings departments.

As the chart indicates, sales by each of the three major departmental groups fell off considerably during the latter part of 1953 and early 1954. Each of the three groups, however, has experienced a rising sales trend since the second quarter of 1954, after seasonal adjustment.

(1) The fact that the inventory line during 1954 is running at a higher level than the sales line simply indicates that the general relation between stocks and sales differs from that of the 1947-49 base period. Inventories during the latter period were not necessarily "normal", and in many respects were not a good guide to today's requirements.

Sales of homefurnishings have shown wider swings than sales of apparel.



Although sales by all three of the groups of departments shown on the chart have presented marked similarity in the direction of month-to-month changes, they have differed considerably in the *magnitude* of change since the second half of 1953. During 1952 and early 1953, the lines representing each of the three groups were fairly close together, indicating a similarity in both direction and magnitude of change. Between July 1953 and April 1954, however, adjusted sales by the homefurnishings departments fell off much more rapidly than was the case for the other two departmental groups. Correspondingly, a sharper rise in sales by the homefurnishings group was evident by mid-1954.

Of all the individual departments within Fourth District department stores for which separate sales data are available, only two posted an increase in sales between the years 1953 and 1954. The two were the *records, sheet music, and instruments* department, with a 3 percent gain, and the *cotton yard goods* department which posted a 1 percent margin. Year-to-year sales losses by the other departments ranged from 1 percent for *corsets and brassieres* to 39 percent for *linoleum*. The following table lists the five



Putting Radioactivity to Work

By G. D. CALKINS, *Battelle Memorial Institute*

INDUSTRY is giving increasing attention to the use of radioisotopes for improving on existing materials processing techniques and for making products that are impossible by present-day technology. Recent studies, for example, show that radiations from these atomic-energy by-products may be particularly useful in facilitating chemical or physical reactions that are vital to the development of better synthetic chemicals and rubber materials, new plastics, and improved methods of preserving foods, drugs, and medical supplies.

It has been shown by a number of investigators that the chlorination of organic materials may be readily initiated by irradiations. The insecticide, benzene hexachloride, has been produced in the laboratory by irradiating benzene and chlorine with the gamma rays from radioisotopes. Toluene and xylene have also been chlorinated by this means. Chlorinated toluene and xylene are used in making such end products as insecticides, perfumes, pharmaceuticals, and dyes.

Other research has indicated that a wide variety of organic materials may be polymerized with radiation. The polymerization may be conducted at low temperatures and pressures. The conventional plastics such as polyethylene and polystyrene have been made with the aid of radiation. More important, however, is the possibility that entirely new plastics may be produced through radiation-activated reactions. Research in this field is currently under way.

Another interesting effect of radiation on organic materials like plastics and rubber is the production of cross linkages between the large chain-like molecules. In the case of rubber, the formation of these cross links is known as vulcanization. This is currently accomplished by the addition of sulfur-containing compounds to the rubber. By irradiating rubber with radiation from radioactive materials, it appears possible to vulcanize rubber without addition of sulfur compounds. The end result of this research may prove to be the development of better rubber materials.

Cross links are also produced when previously polymerized plastics are irradiated. The physical properties of the plastics are modified in a very interesting manner. In general, the temperature at which they soften is increased markedly and their solubility in organic solvents decreases. In the case of polyethylene, irradiation produces a plastic that essentially will not soften. Polystyrene is affected in the same manner. The use of radiation extends the possible applications of plastics to higher temperatures and

enhances their ability to contain solvents with which they were previously not compatible. For example, irradiated plastic bottles might be used in applications requiring high-temperature sterilization prior to packaging of a product. Plastic pipe might be used for the transport of organic solvents.

Radiation can also increase the hardness of plastics. With beta radiation that is capable of penetrating only a short distance into the plastic, the scratch resistance of plastic sheet materials might be improved. This effect could make better plastic windows.

There are many promising studies under way on the use of radiation in the food and pharmaceutical industries. The majority of these are based on the fact that radiation is capable of killing or retarding the growth of microorganisms or rapidly growing biological materials. This sterilizing effect is produced without elevating the temperature of the irradiated material. It has been found that many meats, vegetables, fruits, and other foods and beverages may be effectively sterilized at room temperature with radiation. The major problem has been that, in many cases, the foods develop an off-flavor. Methods of counteracting this problem are being investigated. Other studies indicate that a wide variety of drugs may be sterilized with radiation. In many cases this is a difficult task by the conventional heat-sterilization methods because the drugs are heat sensitive.

Also of interest in the food industry is the possible use of radiation to retard the growth of sprouts that develop on vegetables such as potatoes. Through the use of radiation it appears possible that the quality of stored vegetables can be improved.

There are a wide variety of industrial problems that may be solved through the use of radiation. Further research and development will be required before the practicality of these applications will be proved. Part of this must consist of the development of a source of radiation suitable for industrial use. One possibility is that the fission products from nuclear reactors could be removed from time to time, placed in suitable containers, and utilized by industry. The problem of handling the highly radioactive fission products and placing them in suitable containers is not easy. The cost of this operation may make the general utilization of fission-product radiation impractical. Another possibility would be the use of a small nuclear reactor as the source of radiation. In this case, a reactor utilizing a liquid fuel would be used. The liquid fuel would flow continuously through the reactor where the nuclear reaction would occur producing the radioactive fission products. The radioactive fuel would then flow through pipes to an irradiation chamber where products could be treated with the radiation.

Editor's Note — While the views expressed on this page are not necessarily those of this bank, the *Monthly Business Review* is pleased to make this space available for the discussion of significant developments in industrial research.

FOURTH FEDERAL RESERVE DISTRICT

