



MONTHLY REVIEW

TWELFTH FEDERAL RESERVE DISTRICT

MARCH 1950

FEDERAL RESERVE BANK OF SAN FRANCISCO

REVIEW OF BUSINESS CONDITIONS

THE record of the District economy improved in many respects in the first two months of the year. After making allowance for seasonal declines, few segments could be considered weak, and many gains continued into early March. Except for the effects of the coal strike, which had little influence on developments in this District, events in the District paralleled those in the United States.

Department store trade improves

District department store trade during most of 1949 was characterized by a relatively weak position in comparison with the previous year. Even though the dollar volume improved during the second half of 1949 in relation to 1948, the gap was not closed at any time. In January of this year this pattern appeared likely to continue. During the first five weeks of the year department store sales were off 9 percent from 1949. With the return of moderate weather, however, after severe January conditions, sales picked up markedly in most parts of the District. Omitting the first five weeks of the year, dollar volume through early March was 3 percent ahead of 1949. Including the first five weeks, sales were off 3 percent from 1949, a smaller gap than that which existed most of last year. During the early weeks of the year the District lagged behind the nation. Sales in this area each week since early February, however, placed the District ahead of the country for the year to date.

District construction activity increases

According to preliminary indications, in both January and February, the dollar volume of new construction authorized may have set records for those months. In the last quarter of 1949 construction activity began to show signs of improvement. By January, the dollar volume authorized had gained more than 20 percent over the same month last year. Reversing the normal seasonal pattern, the volume was also slightly ahead of December. February authorizations went up more than 10 percent over January and about 35 percent over a year ago.

Employment declines less than last year

Even the employment situation looked better in January and February. This is true in spite of somewhat lower employment and higher unemployment this February than a year ago. The significant factor is that the year-

period changes for February 1950 in employment and unemployment were markedly smaller than for the year period ending February 1949. A more striking difference is apparent in the changes evident between November and February in 1948-49 and 1949-50. In the 1948-49 period nonagricultural employment dropped 5 percent and unemployment increased 120 percent. From November 1949 to February 1950, however, nonagricultural employment fell a little more than 1½ percent and unemployment rose about 45 percent. Labor market reports from various areas in this District do not indicate any significant further declines in nonagricultural employment, and a few areas reported much improved conditions in late February and early March.

Bank loans decline only fractionally, instalment credit rises

Further evidence of the relatively good position of the District economy is available from the changes in bank loans to business and agriculture. During the early part of 1949 the decline in activity, the liquidation of inventories, and the hesitancy of business intensified the usual winter decline in loans to business and agriculture. Between the beginning of the year and the first week in March 1949, the dollar volume of commercial, industrial, and agricultural loans outstanding in weekly reporting member banks fell more than 6½ percent. This year it declined less than 0.5 percent in the same period. Last year loans outstanding in the District declined more rapidly than in the country as a whole; this year District loans declined slightly less than did the national total.

Consumer instalment loans outstanding at District commercial banks have continued to rise during the early part of this year. Last year the sharp decline in retail

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trade during the early months of the year tended to force down the amount outstanding. The pressure was strengthened somewhat by the reinstatement of regulation of instalment credit in the preceding fall. The moderate decline in the volume outstanding in early 1949, however, appears to have been related more to the decline in sales than to the stringency of regulation.

Inflow of Treasury funds

A point of interest in recent developments is the inflow of Treasury funds to the District. Normally tax payments at this time of the year more than offset Federal expenditures in the District, resulting in small Treasury withdrawals of funds. From January through the first two weeks of March this year, however, the payments by the Treasury exceeded collections. This reflects almost entirely the effect of paying the veterans' insurance dividends, a non-budget item.

Farm situation reflects variety of conditions

Preliminary reports indicate that cash receipts from farm marketing may have been somewhat below last year

during January and February. The cotton crop, however, found an unusually good market. California growers disposed of almost all of their crop before harvesting was complete, and the small remainder was expected to be sold within a very short period. This is in marked contrast with a year ago. In 1949, almost 400,000 bales, about 40 percent of the crop, were disposed of by transfer to the Government under the price support program. The success of the cotton crop reflects in part high quality and in part the effects of damage to the Mississippi Valley crop by late rains. Harvesting of the California crop was unusually early, however, and the workers released have not found other employment. As a result, California agricultural employment declined more than usual.

Weather played a prominent part in other segments of District agriculture. Early winter rains were very timely, but were offset in part by cold January weather which retarded growth on ranges. Range conditions are considered fairly good and are appreciably better than last year. Frost in January damaged the citrus crop, though not so severely as last year.

MEMBER BANK EARNINGS AND EXPENSES—TWELFTH DISTRICT, 1949

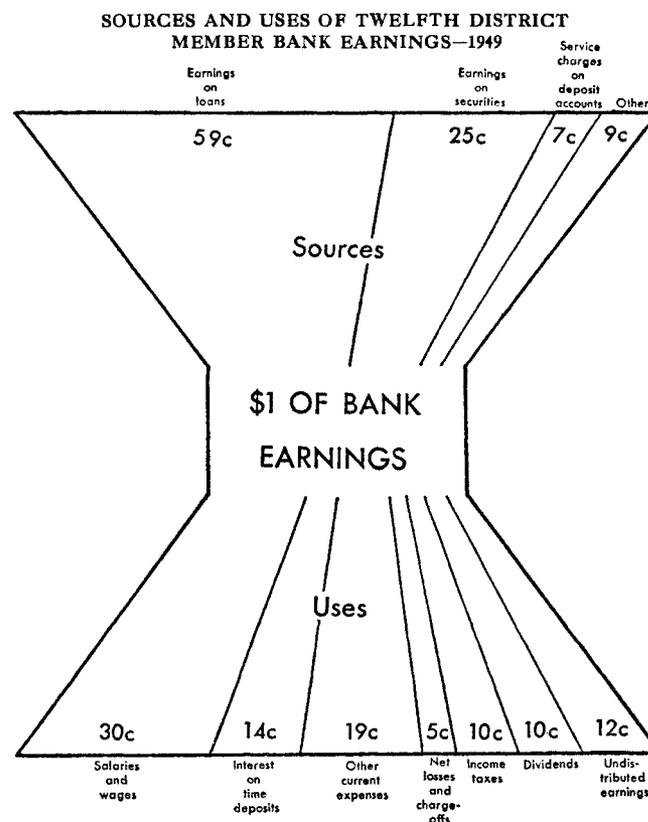
IN 1949 as in 1948, aggregate earnings of Twelfth District member banks rose to a new record figure. Despite the early-year business recession, earnings from loans averaged 8 percent higher than in 1948, while the decline in income from Government securities was largely checked when reductions in legal reserve requirements led banks to increase their holdings of short-term Governments. Corresponding very closely with the experience of member banks in the country as a whole, Twelfth District net current earnings increased by 6 percent, and net profits after taxes were up 11 percent, passing the hundred mil-

lion dollar mark for the first time. However, a large part of the District's improved earnings and profits picture must be attributed to the relatively profitable operations of the few very large banks; the combined figures for all other banks showed comparatively little change from 1948.

EARNINGS AND EXPENSES OF DISTRICT MEMBER BANKS				
	(millions of dollars)			Percent change
	1947	1948	1949 ^p	1948-49
Earnings on loans	210.5	264.5	284.7	+ 8
Interest and dividends on				
Government securities	111.2	105.0	103.0	- 2
Other securities	18.2	18.3	20.3	+11
Service charges on deposit accounts	22.4	27.5	32.7	+19
Trust department earnings	12.9	13.6	13.9	+ 2
Other earnings	26.2	29.0	27.7	- 4
Total earnings	401.5	458.0	482.3	+ 5
Salaries and wages	127.1	141.2	146.9	+ 4
Interest on time deposits	54.1	62.2	65.6	+ 5
Other expenses	77.4	86.7	91.3	+ 5
Total expenses	258.6	290.1	303.8	+ 5
Net current earnings	142.9	167.9	178.4	+ 6
Net recoveries and profits (losses —)				
On securities	6.6	- 0.5	1.7	—
On loans	-13.9	-22.5	-22.5	—
Other	- 0.9	- 0.6	- 1.0	—
Total net recoveries and profits	- 8.2	-23.6	-21.8	—
Net profits before income taxes	134.7	144.3	156.6	+ 9
Taxes on net income	42.2	48.0	49.4	+ 3
Net profits after taxes	92.5	96.3	107.2	+11
Cash dividends declared	37.5	42.1	46.8	+11
Undistributed profits	55.0	54.2	60.4	+11

^p—preliminary.

Note: Because of rounding, component items may not add to totals exactly; percent changes are based on the original unrounded figures.



PERCENT CHANGES, 1948-49, IN SELECTED EARNINGS AND EXPENSE ITEMS OF TWELFTH DISTRICT MEMBER BANKS, BY SIZE GROUP AND BY AREA

	Banks in					
	All banks	15 largest banks	Other banks	Calif.-ornia	Ore. and Wash.	Ariz. Idaho Nev. and Utah
Earnings on loans...	+ 8	+ 9	+ 3	+ 7	+ 9	+11
Interest and dividends on Government securities	- 2	0	- 8	- 1	- 6	- 2
other securities ...	+11	+12	+ 5	+14	+ 5	+ 8
Total earnings	+ 5	+ 6	+ 1	+ 6	+ 5	+ 7
Salaries and wages...	+ 4	+ 4	+ 3	+ 3	+ 7	+11
Total expenses	+ 5	+ 5	+ 4	+ 4	+ 7	+13
Net current earnings.	+ 6	+ 9	- 4	+ 9	+ 1	- 2
Profits before taxes..	+ 9	+ 8	+11	+ 8	+ 9	+13
Taxes on net income.	+ 3	+ 2	+ 8	+ 1	+ 4	+ 9
Net profits	+11	+11	+12	+11	+11	+16
Cash dividends	+11	+14	- 8	+14	+10	+ 6

Lower reserve requirements increased earning assets

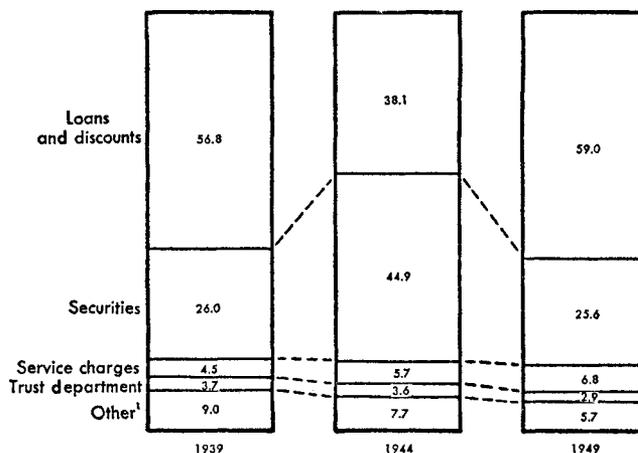
The reduction of legal reserve requirements was certainly an important factor in the rise in bank earnings. Reserve requirements were reduced by stages during the summer, and these reductions enabled member banks to increase the proportion of earning assets to total assets from 76 percent at the end of 1948 to more than 80 percent at the end of 1949. After declining very slightly during the first half of 1949, bank holdings of Government securities rose by 11 percent in the latter half as large acquisitions of short-term Government issues absorbed newly-created excess reserves. The spring business recession, magnified by the normal seasonal effect, caused a 6 percent contraction in total loans and discounts by the end of July, followed by recovery almost to the December 1948 volume by the close of 1949.

Consumer and real estate loans up over 1948

A change in the composition of earning assets was also a significant factor in the upward trend of aggregate District member bank earnings. For the year as a whole, the average volume of loans outstanding was 4 percent higher than in 1948, while average holdings of Governments were 4 percent lower. This relative increase in loans, from 41 to 44 percent of the average volume of earning assets, occurred despite the loan contraction which accompanied the spring recession and the large purchases of Governments for bank portfolios after June. Bank earnings were further fortified by the fact that the loan decline of the first half occurred in lower-yield commercial and industrial loans, while the higher-yield real estate and consumer credit loans increased throughout the year.

Both average holdings of securities other than U. S. Governments and interest and dividends on such securities were up 11 percent over 1948. The average rate of interest on loans was slightly higher than in 1948 as banks, particularly the larger ones, expanded loans to consumers. Rates of return on Governments for the year as a whole showed no significant change from 1948, despite the decline in market yields in the latter half of 1949 following the modified support plan announced in June by the Federal Open Market Committee.

PERCENTAGE DISTRIBUTION OF TWELFTH DISTRICT MEMBER BANK EARNINGS, BY SOURCE—PREWAR, WARTIME, AND POSTWAR



¹ Service charges and fees on loans included in other earnings in 1939, in earnings on loans in 1949.

Earnings and expenses show parallel rise

Reflecting these changes in the composition of their assets, Twelfth District member banks' earnings on loans were up 8 percent over 1948, while earnings on Governments declined 2 percent. The average volume of demand deposits in 1949 was 3 percent lower than in the previous year. Although the dollar amount of bank debits was 2 percent smaller than in 1948, there is some evidence that the number of debit items may have risen slightly. Perhaps an increase in items, lower average balances, and higher rate schedules all contributed to the 19 percent increase in revenues from service charges on deposit accounts. Gross earnings were up 5 percent.

Total salary and wage payments were up 4 percent, as bank staffs and average salaries were both 2 percent larger than in 1948. Reflecting a 3 percent increase in the average amount of total time deposits, accruals of interest on such deposits were 5 percent higher; based on dollar totals, the rate of interest paid on time deposits was 1.06 percent, compared with 1.03 in 1948. Total expenses, like total earnings, rose 5 percent.

Combined net profits at new high

Net current earnings were up 6 percent and, as a percent of capital accounts, were fractionally higher than last year. Although net losses and transfers to reserves were only slightly smaller than in 1948, and net income taxes were up 3 percent, net profits of Twelfth District member banks were 11 percent higher than in 1948. Forty-four percent of net profits was distributed in dividends, the same percentage as in the preceding year.

Close conformity of Twelfth District earnings experience with that of System member banks as a whole is indicated by the fact that in both cases total earnings and total expenses were up 5 percent, net current earnings 6 percent, and net profits after taxes 11 percent. Income taxes were 18 percent higher than in 1948 for all member banks compared with a 3 percent rise for District banks.

This difference was offset by a relatively larger drop in net losses and transfers to reserves of District banks, resulting in a similar increase in net profits after taxes. Ratios of net current earnings and net profits to capital accounts of member banks continued to be much lower for the nation than for the Twelfth District, however. For the nation, these ratios were 12 and 8 percent, respectively, or 14 and 9 percent if New York and Chicago are excluded. For the District, these ratios were almost 20 and 12 percent.

Earnings increased in largest banks primarily

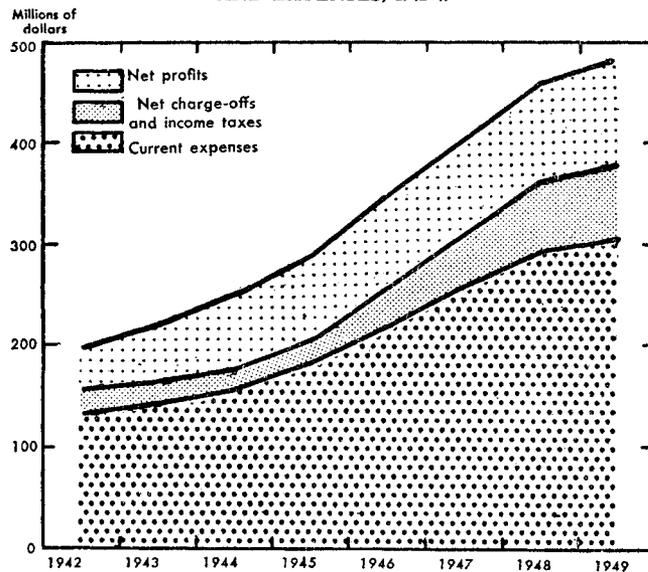
Comparison of the performance of the fifteen largest banks with that of District member banks as a whole reveals some marked differences. Both loan earnings and net current earnings of the fifteen largest banks were up 9 percent; in contrast, all the rest of the District's member banks raised their combined gross earnings only 1 percent over 1948 and saw their net current earnings decline 4 percent. It is true that net profits after taxes provided an even more favorable comparison for these than for the larger banks—12 percent above 1948. But it should be borne in mind that the smaller banks had made relatively larger net transfers to reserves in 1948 to establish or build up bad-debt reserves to allowed levels, the larger banks having generally made greater use of loan reserves in previous years. In 1949 net losses and charge-offs (including transfers to loan reserves) by the smaller banks dropped over 50 percent, while such losses and transfers by the fifteen largest banks increased. Thus the 12 percent increase in the smaller banks' net profits may be contrasted with a 9 percent decline in their net *current* income after taxes (not shown in table). As in 1948, rates

RATIOS TO CAPITAL ACCOUNTS AND RATES OF RETURN ON EARNING ASSETS—TWELFTH DISTRICT MEMBER BANKS

Ratios to capital accounts		
	1948	1949
Net current earnings		
All banks	19.7	19.8
15 largest	20.4	20.6
Other	17.5	16.8
Net profits after taxes		
All banks	11.3	11.9
15 largest	12.1	12.4
Other	8.7	9.9
Rates of return on		
Loans		
All banks	4.7	4.8
15 largest	4.6	4.8
Other	5.0	4.9
Government securities		
All banks	1.6	1.6
15 largest	1.6	1.6
Other	1.5	1.5

Note: Ratios computed from dollar totals, not by averaging individual bank ratios. Balance sheet items used are averages of amounts reported as of beginning, middle, and end of year.

TWELFTH DISTRICT MEMBER BANK EARNINGS AND EXPENSES, 1942-49



of return on capital were significantly higher for the large banks as a group.

Among the large banks themselves notable disparities existed. While all but two reported increased income from loans, the percentage increases ranged from 2 to 27. Income from Government securities declined as much as 18 percent in one bank, yet rose in six of the fifteen banks. Total earnings were up in all but one instance, yet five reported varying drops in net current earnings.

Levelling-off of earnings and expense trends

For all District member banks combined, 1949 represented a continuation of trends in earnings and expenses more or less clearly apparent since the war's end, but there were strong indications that these postwar changes are levelling off. Each component item analyzed evidenced a shift in the same direction from 1948 figures as these had from the 1947 data, but in most cases the shift was smaller both absolutely and percentagewise. The only exceptions were income from non-Government securities and service charges on deposit accounts, both of which increased more, dollarwise, than in 1947-48. Income from Governments declined less than in 1947-48, while earnings on loans increased less, indicating a tendency toward stabilization of the general pattern of bank assets after large postwar readjustments. The upward momentum of salaries and other expense items was clearly diminished, in response to the weakening of inflationary forces.

RETAIL CREDIT SURVEY—TWELFTH DISTRICT, 1949

EVER since the end of the war, consumers in the Twelfth District have been relying more and more upon the use of credit. In 1949, they spent less money at retail stores than in 1948, but they made a greater proportion of their purchases through their charge accounts or on an instalment basis than they had the year before. These

facts were brought to light in the eighth annual Retail Credit Survey conducted by the Federal Reserve System, in which over 1,000 credit-granting stores in this District participated.¹

¹ A report covering the nine lines of businesses surveyed, with details by size and by geographic area, will be available on request.

RETAIL SALES BY TYPE OF PAYMENT—TWELFTH DISTRICT, 1948-49

Kind of store	No. of stores reporting ¹	Total sales	Cash sales		Regular charge sales		Instalment sales				
			Percent change	Percent of total sales 1949	Percent of total sales 1948	Percent change	Percent of total sales 1949	Percent of total sales 1948	Percent change	Percent of total sales 1949	Percent of total sales 1948
Automobile dealers	121	+11	-3	44	50	-3	16	18	+41	40	32
Auto tire and accessory	221	-14	-24	45	52	-11	30	29	+10	25	19
Department ²	141	-6	-11	46	48	-2	45	43	-2	9	9
Furniture	167	-15	-24	15	17	-21	30	33	-8	55	50
Hardware	54	-11	-15	43	45	-9	52	51	+22	5	4
Household appliance	60	-14	-18	21	22	-17	30	31	-10	49	47
Jewelry	61	-13	-24	31	36	+5	12	10	-10	57	54
Men's clothing	100	-9	-16	47	51	-2	50	46	+1	3	3
Women's apparel	61	-9	-12	30	31	-7	69	68	-24	1	1

¹Includes credit-granting stores only. ²Not including national chains.

Total sales decline in all lines except automobiles

The decline in total retail sales last year is attributed to the slower pace of business activity in general, and to some extent the small declines in retail prices. In all the nine lines surveyed except automobile dealers, total dollar sales fell behind their 1948 volume. Automobile dealers increased their sales by 12 percent, though not without increased advertising efforts. Retailers handling principally hard goods reported declines averaging as much as 15 percent.

Even the automobile dealers experienced a decline in cash sales, though in their case the decline was small. In the other lines cash sales fell considerably below their level of 1948, and in every case made up a smaller proportion of total sales than the year before.

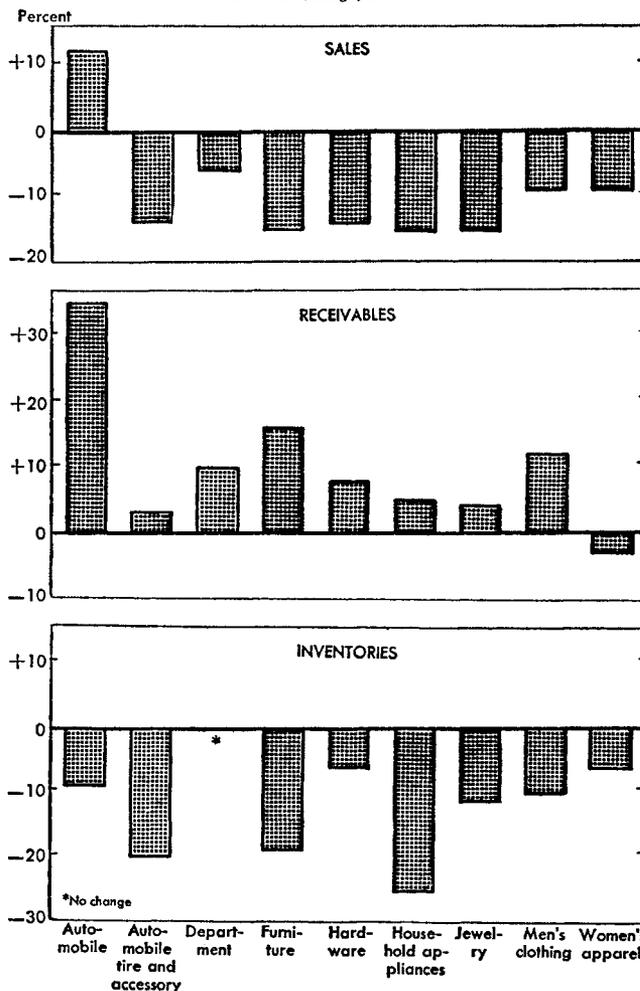
Credit sales gain in importance

Total dollar amounts of credit sales were down from 1948 levels, though to a smaller extent than cash sales, at all lines except automobile dealers. Four of the lines, however, made a larger volume of instalment sales (including trade-in allowances). As a proportion of total sales, credit sales gained in all lines surveyed. In 1948, 50 cents of each dollar spent at automobile outlets covered by the survey was on a credit basis. In 1949, credit sales had increased to 56 cents per dollar spent. Similar increases took place at reporting automobile tire and accessory stores, jewelry stores, and men's clothing stores.

Accounts receivable increase

Consumers found it harder to save and easier to obtain credit in 1949 than in 1948. Easier credit terms included smaller down payments, smaller instalment payments, and a longer period over which to pay; even so, some found

RETAIL SALES, RECEIVABLES, AND INVENTORIES—TWELFTH DISTRICT
Percent change, 1948-49



ACCOUNTS RECEIVABLE OF RETAIL ESTABLISHMENTS—TWELFTH DISTRICT, 1948-49

Kind of store	Number of stores reporting ¹	Percent change in total receivables	Regular charge receivables		Instalment receivables			
			Percent change	Percent of total receivables 1949	Percent of total receivables 1948	Percent change	Percent of total receivables 1949	Percent of total receivables 1948
Automobile dealers	115	+37	-1	20	27	+52	80	73
Auto tire and accessory	220	+3	0	88	91	+33	12	9
Department ²	137	+10	+5	68	71	+23	32	29
Furniture	78	+16	-3	17	20	+20	83	80
Hardware	49	+8	+5	89	91	+31	11	9
Household appliance	56	+5	+1	18	19	+6	82	81
Jewelry	58	+4	+1	8	8	+5	92	92
Men's clothing	97	+12	+13	95	95	+2	5	5
Women's apparel	61	-3	-3	97	97	-8	3	3

¹Includes credit-granting stores only. ²Not including national chains.

it more difficult to meet their payments than in 1948. As a result of these factors, total accounts receivable, or the amount of retail credit outstanding, increased in seven lines whose total sales declined. In all lines, receivables increased relative to total sales. In general, the dollar amounts of instalment receivables increased more than regular charge receivables. Five of the nine retail lines reported increases of 20 percent or more in their instalment receivables. In most of the lines instalment receivables increased as a proportion of total accounts receivable.

Inventories down

Retailers, wary of the business situation, allowed their inventories to decline. Only department stores registered no change in inventories at the end of the year as compared with the end of 1948. Monthly figures show an increase in department store inventories toward the end of the year after declining considerably during the first sev-

RETAIL SALES AND INVENTORIES—TWELFTH DISTRICT
1949 compared with 1948

Kind of store	No. of stores reporting ¹	Percent change in total sales	Percent change in inventories	Inventory turnover ²	
				1949	1948
Automobile dealers	132	+12	— 9	10.9	8.8
Auto tire and accessory	220	—14	—20	3.2	3.0
Department ³	150	— 6	— 0	4.6	4.9
Furniture	193	—15	—19	3.0	2.9
Hardware	57	—14	— 6	3.0	3.3
Household appliance	79	—15	—25	3.9	3.4
Jewelry	71	—15	—11	1.5	1.6
Men's clothing	102	— 9	—10	2.8	2.8
Women's apparel	63	— 9	— 6	4.3	4.4

¹ Includes credit-granting stores only.

² Sales during year divided by inventories at end of year.

³ Not including national chains.

eral months. Five of the retail lines reduced their inventories (at retail prices) by 10 percent or more over the year-period. Inventories at household appliance stores declined the most, but this decrease reflected an upturn in appliance sales toward the end of the year as well as the cautious buying policy of the retailers. Inventory turnover did not change markedly in any of the lines.

WESTERN POWER AND FUEL OUTLOOK—III. PETROLEUM

THIS article is the third in a series dealing with the fuel and power resources of the West. Discussions of electric power and natural gas appeared in the *Monthly Review* for November 1948 and May 1949, respectively. The present article on petroleum will be followed by a discussion of western coal and shale oil resources.

Growing importance of petroleum in the total energy supply

It has often been pointed out that the dynamic factors in the American fuel situation over the past 30 years have been petroleum and natural gas, while coal has remained the static element. During the period from about 1890 to 1918, production of coal in the United States expanded fairly rapidly, particularly bituminous coal, which finds its largest use in industrial applications. Since 1918, coal output has fluctuated considerably from year to year but, except during the war, increased only slightly over the levels attained 30 years earlier. The production of petroleum and natural gas, on the other hand, has grown enormously. Petroleum output has been multiplied five-fold and natural gas output seven-fold since 1918. These two fuels have supplied a steadily larger share of the nation's energy requirements, rising from about 10 percent of the total mineral fuel and water power consumption of the United States in the years 1901-10 to well over 50 percent in 1949.

Because of the relatively scanty deposits of high grade coal in the West, petroleum and natural gas are much more important in the economy of this region than in the country as a whole. Estimates of petroleum economists indicate that in recent years oil and natural gas have accounted for close to 90 percent of the total energy supplied by mineral fuel and water power in the Pacific Coast states, some 60 to 70 percent being contributed by liquid petroleum.

Since the early part of this century petroleum has sustained the basic industrial development of California by providing abundant and relatively cheap supplies of fuel in the form of oil and its associated natural gas. Petroleum products from California have also contributed importantly to the economy of neighboring areas, including British Columbia, Alaska, and Hawaii, as well as the Pacific Coast and intermountain states. Motor fuel for automobiles, trucks, and tractors throughout this whole region, and aviation fuel as well, have been supplied predominantly by California refineries, often with substantial surpluses for shipment to the Atlantic Coast and export markets. The industrial growth of the Los Angeles area in particular was greatly stimulated by local supplies of cheap oil and natural gas.¹ Industries in which the cost of fuel is an important item were enabled to locate successfully in the western region and maintain themselves against competitors located in areas where fuel costs were higher. Such by-products of oil refining as asphalt and road oils have facilitated highway construction and maintenance throughout the West. Oil has also supplied a convenient and economic fuel for domestic and commercial heating in many western areas beyond the reach of natural gas supplies. In a very real sense it may be said that much of the Pacific Coast region is essentially an oil- and gas-based economy.

The problem of future supplies

Concern is expressed from time to time, however, as to the adequacy of Western petroleum resources to meet the expanding needs of the rapidly growing regional population and its industries. Except during the two war periods, 1915-20 and 1942-45, the production of crude oil and refined petroleum products in the Pacific Coast

¹ Joe S. Bain, "War and Postwar Developments in the Southern California Petroleum Industry," The Haynes Foundation, Los Angeles, California, 1944.

area has generally exceeded local requirements by a fairly wide margin, leaving a substantial surplus for accumulation of stocks and for export. The great increase of population and industry incident to and following World War II has considerably changed this situation. Local demand, especially for gasoline and the other more highly refined products, now tends to absorb a constantly larger fraction of the total output as compared with the prewar situation. Also in the background lurks the possibility of suddenly expanded demands resulting from military emergency, complicated by potential enemy threats to waterborne supplies for certain parts of the area.

Petroleum is a non-replaceable resource, and it is becoming increasingly difficult and costly to find. In spite of intensive exploratory efforts and heavy financial outlays in recent years, relatively few oil fields of substantial importance have been discovered in the Pacific Coast and intermountain areas since the mid-thirties. The decline in new discoveries up to about 1948, together with the narrowing margin between current production and local consumption, tended to give some support to those who took a dim view of the outlook for continued abundant and cheap petroleum supplies in this region. On the other hand, the lack of sensational new discoveries was offset to a considerable degree by the finding of numerous smaller fields and by the extension of older fields, both in area and depth. The discovery in 1948 of a large new field in the Cuyama Valley in Central California, with consequent stimulus to exploration generally, coming at a time when current production has been outrunning market demand, has given comfort to those who are more optimistic as to the adequacy of Western oil resources.

The present article cannot explore this basic problem in detail but will be limited to a factual account of the petroleum demand and supply situation in this area as it has developed over the years, together with some comments on certain factors which seem pertinent in appraising the future outlook.

Western Petroleum Supply and Demand, 1900-45

Although crude petroleum has been discovered in widely scattered locations in the United States, it is produced in important quantities in only about 20 states, with six of these accounting for nearly seven-eighths of the total output in recent years.¹ In the Twelfth District important oil resources have been discovered and developed only in California. That state has accounted in recent years for between one-sixth and one-fifth of the total United States output of both crude oil and refined products. The relative position of California in comparison with other important crude producing areas at various times since 1920 is shown by the following statement which indicates the percentage of total crude output produced in each area.

Since about 1914 California oil production has supplied the basic petroleum requirements of the Pacific Coast

	Midcontinent-Gulf region (7 states)	California	Eastern region (8 states)	Rocky Mountain region (3 states)
1920	63	23	10	4
1929	63	29	5	3
1941	67	16	14	3
1946	71	18	7	3
1948	71	17	6	4

region,¹ and in addition has regularly provided a substantial surplus for shipment to Hawaii, British Columbia, and Alaska, to trans-Pacific areas, and in some years to the Atlantic Coast. The volume of outside shipments was relatively small before World War I but averaged close to 12 million barrels per year from 1914 to 1922 when the equivalent of about one-eighth of all crude oil produced in California was shipped out, largely in the form of fuel oil. Most of the California crude production before 1920 came from the San Joaquin Valley, much of which was of heavy grade yielding relatively little gasoline and other light distillates, but a high proportion of residual or heavy fuel oil. Some of this heavy crude was not even run through refineries, but was used directly as fuel or mixed with residual fuel oil and marketed in that form.

Great increase in production, shipments, and stocks in the 1920's

With the discovery of large new fields in the Los Angeles basin in the early 1920's, notably at Santa Fe Springs, Huntington Beach, and Long Beach, there came a great increase in crude oil production, much beyond the capacity of local or regional markets. The average annual output of California crude oil more than doubled during the decade 1921-30 as compared with the period 1911-20. Whereas during the earlier period annual output ranged between 85 million and 105 million barrels, production jumped in 1923 to 264 million and in 1929 reached a peak of 293 million barrels when deeper zones were tapped in the Santa Fe Springs and Long Beach fields. Over the whole decade 1921-30, California crude oil output averaged about 218 million barrels per year as against 96 million barrels in the decade 1911-20.

Shipments of all petroleum products to points outside the Pacific Coast area, which had gradually climbed to a peak of 16 million barrels in 1922, shot up suddenly to 90 million barrels in 1923 when the flood of new production came in. More than 60 million barrels of crude oil were shipped out in that year, some 52 million barrels to the Atlantic Coast alone. Outside shipments of all petroleum products during the years 1923-30 averaged over 84 million barrels a year, equivalent to about one-third of total California crude oil production during that period.

The output of the new fields in the Los Angeles area was of much higher average gravity—light crudes as contrasted with the heavy San Joaquin Valley crudes of the earlier period. Hence a higher proportion of gasoline and other light distillates could be obtained. This was re-

¹These states, in order of production in 1949 are Texas, California, Louisiana, Oklahoma, Kansas, and Illinois. Source: U. S. Bureau of Mines.

¹ Defined by the U. S. Bureau of Mines as California, Oregon, Washington, Arizona, and Nevada. This term will be used throughout as meaning the states specified.

flected in the rapid increase in gasoline production, which was stepped up from around 12 million barrels in 1920 and 1921 to 42 million barrels in 1925 and to over 92 million barrels in 1929, a level not again approached until the war years. These quantities were greatly in excess of local market requirements; the gasoline surplus found its outlet chiefly on the Atlantic Coast. Total gasoline shipments jumped from less than a million barrels in 1920, a year of actual gasoline shortage in California, to 16 million barrels in 1925 and to an all-time peak of 44 million barrels in 1929. This quantity exceeded the total consumption of gasoline within the entire Pacific Coast area and represented nearly one-half of the year's petroleum shipments of all kinds. Fuel oil shipments reached their maximum in 1927, at approximately 43 million barrels. Shipments of kerosene, a product not specially favored by California refineries and relatively little used in the Pacific Coast region, attained their peak in 1928, at 6 million barrels.

Notwithstanding the large volume of outside shipments and the continuous growth of regional demand for petroleum products, California oil production expanded so rapidly during the 1920's that huge storage stocks were built up, particularly of heavy crude and residual fuels. Total crude and residual inventories increased from less than 40 million barrels at the end of 1921 to over 150 million barrels by the end of 1929, of which more than two-thirds consisted of low gravity crude and heavy residual oil. Gasoline-bearing crude, which had never been in excess supply until the high gravity discoveries of the early 1920's, accounted for around 40 million barrels of all crude stocks at the end of the decade. Total producers' inventories of all petroleum products reached a

peak early in 1930 in excess of 188 million barrels, a figure never since approached.

Slowing down of activity in the 1930's

Much less hectic conditions marked the California oil industry during the 1930's and development was more orderly than during the feverish activity of the preceding decade. This slowing down was in part a consequence of the general economic depression and in part a specific reaction from the condition of flooded oil markets and unstable prices of the prior period. Production of crude oil declined sharply from the 1929 peak and remained at a considerably lower level as the previous chronic over-production was brought under fairly effective control. A considerable number of producing wells were shut in, while output of others was curtailed. Total annual output in 1931-35 averaged about 185 million barrels, rising in 1936-40 to around 230 million.

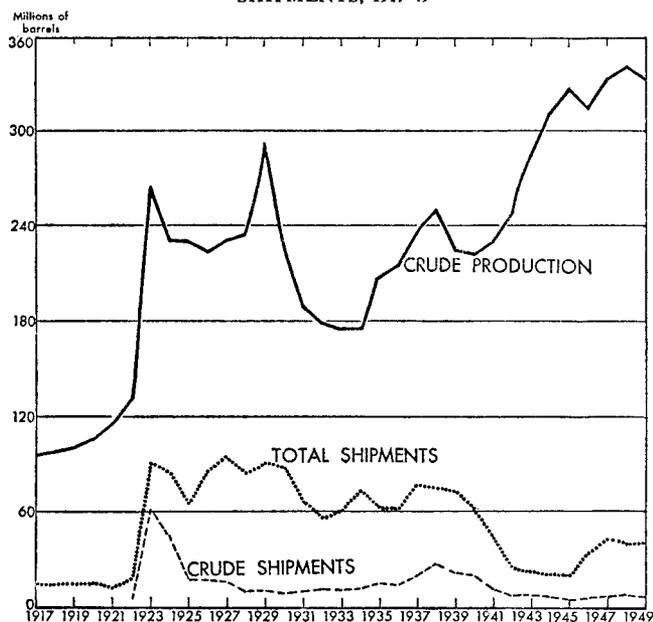
Except for the large Wilmington field, few outstanding new oil discoveries were made in California during this period, a situation in marked contrast with that in Texas where enormous new fields were being opened up. The rapidly expanding Texas output tended to depress prices and to limit the market outlet for California oil in the Atlantic area. Shipments to points outside the Pacific Coast region declined to around 66 million barrels per year for the period 1931-40, as compared with an average of some 84 million barrels during the eight years ending in 1930. Japan became a heavy buyer of California oil during this decade, however, and took especially large quantities of crude and fuel oil in the years 1935 to 1939. Meanwhile regional population and industry were growing and the domestic market for the higher grade products, especially motor fuel, became increasingly important. The burden of unwieldy inventories with which the decade began was appreciably reduced, being about one-fourth less at the end of the decade.

The war and California's petroleum resources

World War II put a severe strain on the productive capacity of the California oil industry; it also took a huge bite out of the area's raw material resources. The geographical position of California with respect to the Pacific war area made this region a logical center for the supply of military fuel and motor oil requirements of all kinds, while the rapid growth of defense industries throughout the Pacific Coast region and the extra burden on railroads and shipping caused by the war gave an enormous impetus to the demand for fuel oils. These several forces combined to stimulate the production of crude oil in California to a rate previously unknown and required the operation of refineries and oil transport facilities at capacity levels.

Fortunately, large accumulated stocks were available to draw upon during the early war years. In spite of the general reduction in inventories during the preceding decade, very substantial stocks, especially of crude and heavy fuel oil, remained on hand at the date of Pearl

CALIFORNIA PETROLEUM PRODUCTION AND SHIPMENTS, 1917-49



Shipments include foreign exports and domestic shipments to points outside California, Washington, Oregon, Arizona, and Nevada.
Source: United States Bureau of Mines.

Harbor. Approximately 142 million barrels of petroleum and oil products were held by Pacific Coast oil companies at December 1, 1941, of which about 63 million barrels were heavy crude or residual fuel oil and about 55 million barrels were gasoline-bearing crude or gasoline. These stocks were worked down, at first gradually and then more rapidly, under the impact of growing military and industrial requirements to a level of around 75 million barrels by mid-1945, with the bulk of the reduction falling in the heavy classifications.

War demands concentrated at first on fuel oil, reflecting enlarged transportation and naval activity, but with the progressive increase in air warfare in the Pacific area, requirements for gasoline also shot upward. Demand for heavy fuel oil, which had averaged around 250,000 barrels per day in the period 1936-40, reached a peak of nearly 600,000 barrels per day early in 1945; gasoline consumption over the same time increased from around 210,000 to about 400,000 barrels per day. To meet these huge requirements crude oil production was raised from a pre-war level of around 630,000 barrels per day to a peak of about 942,000 barrels in May 1945. Supplementary supplies of both crude and refined oil were obtained by rail from Texas and Rocky Mountain producing areas. Considerable additional refinery capacity was installed, notably for the production of aviation gasoline and other special war needs, including constituents for the manufacture of synthetic rubber.

Difficulty of obtaining increased output

The great increase in California crude oil output required to meet the war demand was obtained chiefly by stepping up production from existing wells, a considerable number of which, especially in the San Joaquin Valley, had been shut in during the curtailment program of the 1930's, and in part by drilling new wells, largely in already proven fields. In spite of material and equipment

shortages, nearly 6,000 new producing oil wells were completed during the five years 1941-45, as compared with about 4,600 in the preceding five-year period.

Among the new wells drilled were some 300 in the Elk Hills Naval Reserve, where an extensive area had been proved at an earlier date but not developed. An intensive drilling campaign succeeded in raising the total output of the Elk Hills field, including wells privately owned as well as those in the Naval Reserve, from a daily average of about 13,000 barrels in early 1943 to a peak figure of 65,000 barrels per day in July 1945. Following the war, the Naval Reserve wells were promptly shut in and the field's production was cut back to about the 1943 level.

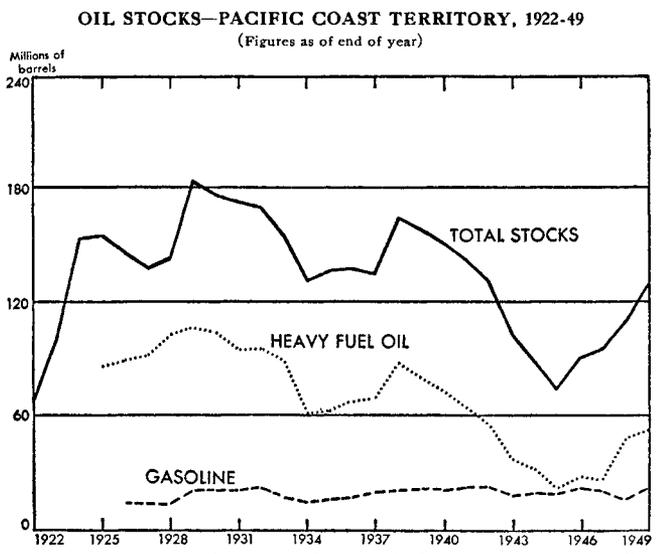
Generally speaking, the results of the war-time drilling in producing additional oil were none too reassuring. The new wells were less productive, on the average, than those completed in the prewar years. While the number of active producing wells increased between the end of 1940 and mid-1945 by nearly 50 percent—from about 15,000 to around 22,500—the average output per well declined by roughly 10 percent between the period 1936-40 and the five war years, 1941-45. In fact, the total output of all the fields in the Los Angeles basin was actually less during the latter period than in the preceding five years, in spite of the large contribution from the recently developed Wilmington field. The entire increased output of the state's oil fields during the war came from the San Joaquin and Coastal districts, each of which had sufficient reserve capacity to permit the necessary expansion in output.

The forced draft under which the industry operated during the war, while abundantly justified from the standpoint of its vital contribution to national defense, was inevitably at the expense of basic raw material resources. It is true that exploratory and drilling effort more than offset the drafts made for war purposes, with the result that the industry's proved reserves were actually higher at the war's end than at its beginning. None the less, many fields were operated during the war at rates above their maximum efficient rates, with consequent acceleration of their eventual depletion and with probable loss of otherwise recoverable oil.

The Postwar Period

The previous section has outlined briefly some of the main developments in the Pacific Coast petroleum situation up to 1945. New conditions have arisen since the war and the oil industry is in process of adjusting itself to the changed situation. Shifts in demand occur so rapidly, however, that any far-reaching plans for the future must be flexible and subject to more or less drastic revision.

Even within the brief period since the end of the war the Pacific Coast petroleum situation has experienced a pronounced cycle. Following a condition of temporary easing in demand and reduction of output in 1945-46 came the business boom of 1947-48 which stimulated the industry to another high pitch of activity. Something approaching an actual shortage of fuel oils and heating oils



Note: Heavy fuel oil stocks include residual fuel oil and non-gasoline bearing crude. Total stocks include all other products in addition to those shown.
Source: United States Bureau of Mines.

appeared in 1947 for almost the first time in some parts of the area. Industrial demand for heavy fuel oil again became an important factor, stimulated by increasing shortages in California natural gas supplies available for industrial use. Public utility consumption of fuel oil set a new record in the Pacific Coast states in 1947 as abnormally low rainfall cut down the generation of hydro-electric power and put an extra load on steam plants. Gasoline demand grew apace as population continued its rapid growth, and new cars and trucks began to appear in appreciable numbers. More lubricating oil was wanted; even the demand for kerosene spurted.

Under this combination of pressures the industry experienced in 1948 its banner year. Prices of major refined products advanced sharply, in the case of heavy fuel oil to the highest levels in more than 20 years. Exploration and drilling activity were intensified, and in spite of strikes among refinery operatives late in the year new records were established in both crude oil production and refinery output. Some disturbing factors began to appear, however, which pointed to impending changes in the demand outlook. One of these was a prolonged waterfront strike which caused a sharp drop in deliveries of bunker oil in the second half of the year. The railroads were also turning increasingly from heavy fuel oil to Diesel oil, while deliveries of natural gas from the newly completed Texas pipe line restricted further expansion of the industrial fuel oil market. Partly in consequence of these factors, but also reflecting the increased rates of output, aggregate inventories were built up by the end of 1948 to levels approximately half-way between those existing at the dates of Pearl Harbor and V-J Day, with the bulk of the increase coming in heavy fuel oil and crude petroleum.

Expanding civilian demand for gasoline, Diesel oil, and light heating oils—the latter stimulated by unusually cold weather—carried the industry into new high ground early in 1949, but demand for heavy fuel oil still dragged while its production continued to increase. In spite of sharp price cuts both in fuel oil and in low gravity crude, inventories kept on accumulating. The end of 1949 found the industry with approximately 10 percent of its producing wells shut in and crude oil production back to a level of around 870,000 barrels per day as compared with about 950,000 barrels per day twelve months earlier.

The extent of the change in the industry's outlook between 1947 and 1949 may be indicated by a single comparison. While as recently as 1947 leaders in the industry were actively discussing plans for the construction of a pipe line to bring Texas oil to California, before the end of 1949 large tanker shipments of heavy fuel oil and of light distillates were being made to the Atlantic Coast—probably at unremunerative prices—in order to relieve the pressure of burdensome inventories.

Discounting short-run changes in the supply and demand situation, the basic contrast between prewar and postwar conditions is the more or less inevitable transformation of the regional economy from a position of sub-

stantial oil surplus to one more nearly approaching balance between supply and demand, with some indication that a condition of local oil deficit may not be very far distant if the search for new oil is permitted to lag. It has already been pointed out that regional petroleum consumption accounted for about two-thirds of all California crude oil production in the period 1926-30. By 1946-49 domestic demand had grown to the point where it absorbed nearly nine-tenths of the total output. The basic explanation, of course, is the continued large population growth and industrial expansion of the area. These developments, together with rapidly increasing per capita consumption of many petroleum products, have generated a total volume of demand which tends to take an ever larger fraction of the available supply.

But while the demand for petroleum products in the aggregate has grown more rapidly than the aggregate local supply, the composition of the over-all demand has changed very markedly and continues to change. Pronounced shifts have occurred in the character and volume of demand for individual petroleum products, reflecting new types of use, changes in industrial processes, and basic technological developments. It is the impact of these changes in demand which is causing or at least accentuating some of the current difficulties within the industry and which emphasizes the necessity for continued flexibility and adaptation of industry processes to meet the new situation.

The demand for petroleum products

Crude petroleum is not a simple or uniform substance, but is rather a general term for a highly complex mixture of what the chemist calls hydrocarbons, including liquids, gases, and solids. No two types of crude petroleum are precisely alike; the various types of crude vary greatly in their chemical and physical characteristics. Hence they yield the several component products of the distillation process in quite different proportions, depending upon their specific composition. They also differ greatly in their relative ease of treatment by the techniques of the refining process.

Similarly the demand for petroleum is not homogeneous, but is a composite of demand for a wide variety of products, the chief of which are gasoline, fuel and heating oils of various grades, kerosene, and lubricants. These are all "joint products" of simple distillation and are obtained in varying proportions from practically all types of crude petroleum. The miscellaneous end-products of the more complex refining processes extend to literally hundreds of items. The proportions in which the major refined products can be obtained from a given grade of crude oil are not rigidly fixed but can be varied somewhat according to market requirements, as refining processes are sufficiently flexible to permit more or less variation in the yield of the several products. The ultimate limiting factor is, of course, the specific characteristics of the crude oil available to the refinery, although the various "cracking" processes—stages in refining procedure following simple

distillation—permit an important additional recovery of the more volatile and hence more valuable products from those of lower grade.

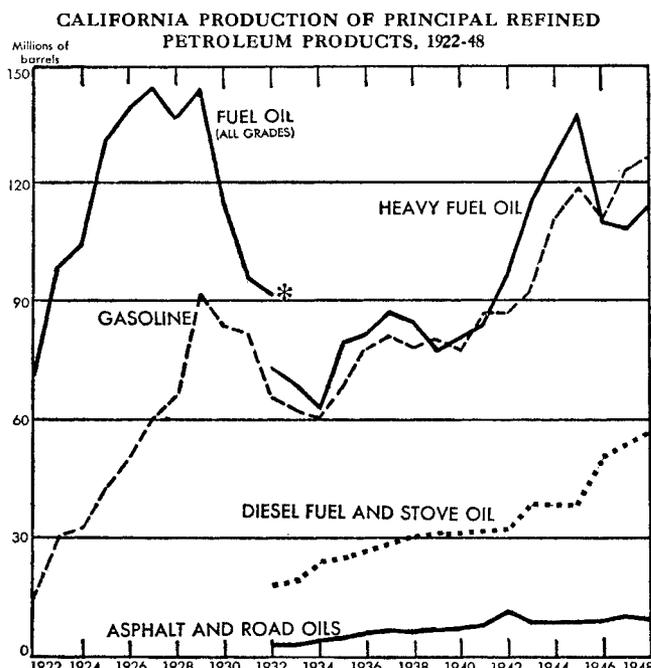
As compared with other principal refining areas of the United States, the output of Pacific Coast refineries runs to a much higher proportion of residual fuel oil and a somewhat lower proportion of gasoline than elsewhere. This has been due in part to the special characteristics of California crudes, in part to the fact that a ready local market existed for heavy fuel oil at prices relatively higher than in other sections of the country. Kerosene and lubricants also represent much smaller fractions of total refinery output in the West, while the production of Diesel fuel and light heating oils, and of asphalt and road oils, is relatively larger than in other areas. Because of the preponderance of low gravity crudes in California, that state is the leading producer of heavy fuel oil. This condition has played an important part in the development of the industry in this region and has given rise to some of its distinctive problems.

In the United States as a whole the output of all fuel oils, including light fuels such as heating oil and Diesel oil, exceeded that of gasoline up to about the year 1929. Since that time gasoline production, except during the war years, has surpassed the output of all fuel oils combined and in most years has accounted for around 44 percent of the total refinery output of the United States, as compared with around 27 percent for residual fuel oil and from 10 to 14 percent for light fuel oils. This shift reflected the increased demand for motor fuels, resulting from the great expansion in use of automobiles, trucks, and tractors. It was made possible by constant improvements in refining technology, such as wider use of the cracking process, and by the increasing availability of higher grades of crude oil.

In California, the use of the more advanced type of cracking techniques—as represented by the catalytic process—has not been as general as in other parts of the country. Hence the shift toward higher recoveries of gasoline and other light distillates has lagged somewhat behind the national trend. In the early twenties, gasoline production in California represented only about 20 percent of total refinery output, as against a national figure of at least 30 percent. In each case the relative importance of gasoline in the total reached its approximate peak in the early thirties and except during the war has remained fairly constant. As compared with the national yield of around 44 percent, however, gasoline production in California has seldom exceeded around 37 or 38 percent of total refinery output, while heavy fuel oil production has generally run somewhat higher. Including the light fuel distillates (heating and Diesel oils), fuel oil production in California has continued to represent well over half the total output of all petroleum products.

The Pacific Coast domestic market

Almost nine-tenths of the total domestic demand for refined petroleum products in the Pacific Coast region is



normally for motor fuel—gasoline and Diesel oil—and the various types of fuel oils, including heating oil. The proportions in which these several major products are wanted in the regional market have changed very greatly over the past 25 years. Heavy fuel oil was long the dominant product in a quantitative sense, yielding first place to gasoline only as recently as 1948. In 1923 regional consumption of heavy fuel oil was around 250,000 barrels per day, or more than two-thirds of all refined products consumed in the whole area, while in 1949 the daily average consumption of 288,000 barrels represented only about one-third of the total domestic demand. Gasoline consumption of less than 50,000 barrels per day in 1923 was less than one-eighth of the total regional market for refined products at that time. By 1949, with an average daily consumption of 332,000 barrels, gasoline had become the leading product in terms of volume—a position it had long held in terms of value—and accounted for nearly 40 percent of the total quantity of refined products sold in the domestic market.

Other fuel oils, including Diesel engine fuel and heating oils, which represented less than 2 percent of all sales in the regional market in 1923, had increased to nearly one-seventh of the total physical volume in 1949, with an average daily consumption of 115,000 barrels. Taking the demand for all refined products together, the domestic market in the Pacific Coast area grew from about 365,000 barrels per day in 1923 to about 848,000 in 1949. During the war, of course, demand soared much higher and reached an annual peak in 1945, at 976,000 barrels per day, of which military consumption, about equally divided between gasoline and other products, represented nearly one-third.

The fuel oil market

Beginning in 1924 the United States Bureau of Mines has made an annual survey of fuel oil distribution in the five western states known as District 5, including California, Washington, Oregon, Arizona, and Nevada.¹ Sales of fuel oil by the reporting companies are classified by principal type of use or ultimate market, e.g., railroads, ships, utilities, industries; since 1936 aggregate sales are broken down to show the various types or grades of fuel going to each major use. These data show that demand from railroads and vessels has long constituted the backbone of the market for fuel oils in this area; their requirements usually represented well over half the total—taking all types of oil together—until the postwar period when their proportion fell below 40 percent. The next most important segment of the market is the mining, smelting, and manufacturing group, whose takings ranged between 10 and 20 percent of the total. Sales of heating oils show the most consistent gain over the entire period, and have risen from about 4 percent of the total in the mid-twenties to nearly 18 percent in the years 1946 to 1949. The electric utilities are sometimes important consumers of heavy fuel oil, particularly when shortages in hydro-electric power necessitate increased steam generation. The gas utilities also utilize heavy fuel oil in the manufacture of artificial gas in areas such as the Pacific Northwest which lack natural gas or cheap coal. During the postwar years the gas and electric utilities have accounted for nearly 11 percent of total fuel oil sales in District 5. The oil companies themselves consume about 5 percent of all fuel oil used in the domestic market. The remainder of the total domestic demand, varying from 7 to 15 percent in different years, is represented by such miscellaneous uses as trucks, tractors, dredges, road oils, orchard heating and spraying, and by the requirements of the national defense forces.

The special problem of heavy fuel oil—handicap or challenge?

A significant clue to the problems and prospects of the Western petroleum industry is to be found in the important place of heavy fuel oil in relation to total refinery output in this region, and in the marked shifts in market demand for this product as compared with the relative stability and more constant growth in demand for gasoline and light oils. While the trend in regional consumption of these latter products has long been consistently and strongly upward, except for the temporary recession in 1946 which marked the transition from war to peace, demand for heavy fuel oil has not increased correspondingly and in recent years, as already indicated, has actually declined. This condition has created a major problem for the industry.

Consumption of heavy fuel oil in this region reached its peak in 1945 with total domestic deliveries in that year of about 170 million barrels, 49 million barrels of which

were for military use and 121 million for civilian use. By 1949 domestic deliveries had fallen to about 105 million barrels; military demand shrank 75 percent—from 49 to 12 million barrels, while civilian consumption fell off from 121 million to 93 million barrels, a decline of around 23 percent. The principal factor accounting for the drop of about 28 million barrels in civilian demand was a 25 million barrel reduction in railroad use—from 47 million barrels in 1945 to about 22 million barrels in 1949—the lowest figure since 1935. A decline in maritime demand from 31 million barrels in 1945 to about 17 million barrels in 1949 was offset, however, by an increase from 34 to 48 million barrels in combined use by industries, utilities, and oil companies. The latter figure was the highest, except for that of 1947, yet recorded.

The heavy shrinkage in railroad consumption is perhaps the most serious aspect of the fuel oil situation in this region, and most of this promises to be permanent. The railroads have been continuously losing freight traffic to highway truck transport and are rapidly replacing their steam motive power by Diesel-electric locomotives. The net efficiency of the Diesel engine is so much greater than that of the steam locomotive that one gallon of Diesel engine fuel does the work of nearly 5 gallons of heavy fuel oil used in generating steam. Hence the increased use of more expensive Diesel fuel by the railroads is far overbalanced by their reduced buying of heavy fuel oil.

Competitive fuels

Any considerable extension of local Pacific Coast markets, either for heavy fuel oil for industrial consumption or for the intermediate oils used for space heating, appears likely to be limited by the increasing availability of natural gas. Substantial imports of oil-well gas from Texas and New Mexico are already being made into California, and present contracts call for a considerable increase in these supplies within the next few years. Plans for the importation of natural gas from Alberta into British Columbia and the Pacific Northwest also seem due to be realized in the not distant future. Such imports might result in some loss of markets in those areas for California fuel oils. Continuing large imports of foreign oil into Atlantic and Gulf coastal areas, particularly of crude petroleum from Venezuela, which runs to a high proportion of heavy fuel oil, would also tend to restrict the profitable shipment of California residual oil to the East Coast market, an area which it does not ordinarily serve.

Little comfort from the California crude oil producers' standpoint can be derived from the trend of demand for heavy fuel oil in recent years. Under the impact of sharply falling fuel oil prices in 1949, drastic adjustments were made in posted prices for California crudes which marked down those grades yielding relatively little gasoline and light distillates, while offering better prices for higher gravity crudes. These adjustments forced a large reduction of output from fields producing lower grade crude. The large integrated companies controlling considerable oil field acreage have also curtailed their own output of

¹District 5 comprises the Pacific Coast territory as that term has been used in this article.

the heavier grades of crude. Unless these trends are reversed and some significant and permanent increase occurs in the market demand for heavy fuel oils—a contingency which currently appears remote—the outlook for utilization of the heavier grades of low gravity California crude reserves seems increasingly discouraging.

Excessive supplies

While the story of demand has thus been one of diminishing consumption, with little indication of probable improvement, no corresponding reduction has occurred in refinery output of heavy fuel oil, which of necessity must be produced, by current refining methods, in the normal process of distillation of crude oil in order to obtain gasoline and other "fractions" which are in greater demand. In spite of constant improvements in refinery techniques and the development of cracking processes to derive a larger proportion of gasoline and other light distillates from each barrel of crude, the average yield of residual oil in California refineries is still relatively high—not far short of 40 percent of crude input in recent years.

The consequence has been a build-up in stocks of heavy fuel oil, including cracking stocks, from a postwar low of about 16 million barrels in March 1947 to 50 million barrels in September 1949. During the ensuing six months no less than 120 tankship cargoes of heavy fuel oil were dispatched by Pacific Coast refiners to the Atlantic Coast, or an aggregate movement of some 12 million barrels—more than at any time since 1934. While these shipments were no doubt stimulated in part by the bituminous coal shortage during the winter of 1949-50, they were probably motivated chiefly by the desire to reduce burdensome inventories. According to trade reports they were made for the most part at unremunerative prices. They can hardly be regarded as offering any permanent solution to the persistence of excess residual stocks arising to some degree, at least, from the relative backwardness of current refinery practice.

New refinery procedures imperative

The problem of dealing with the continuing over-supply of heavy fuel oil has become essentially an engineering and capital investment problem rather than one of retrieving lost markets. This calls for the installation of technological processes for increasing still further the percentage yield of gasoline and distillates and for the conversion of surplus residual oil into salable products. Some procedure more effective than mere dumping at unremunerative prices will have to be found for disposing of excess residual materials.

Only a few of the larger integrated companies in this area have begun to attack the problem from this angle, which is the only way that seems to promise a really constructive and permanent solution. One company has invested heavily in coking facilities designed to secure the maximum possible extraction of higher grade derivatives from residual oil, leaving solid coke as a final end product for which there is a ready though limited market. Others

are planning a general revamping of their existing refinery equipment and techniques in order to "dig deeper into the barrel" and secure more high grade products and less of residual materials. The very heavy capital investment required is probably the basic reason why more California refiners have hesitated to embark upon such costly programs, to which the pressure of events is now apparently forcing them. An important collateral benefit from this general type of approach is its probable contribution to petroleum conservation through limiting the withdrawal of crude oil from underground reserves to quantities more nearly in line with demonstrated economic demand.

The Trend of Reserves

The term "reserves" as applied to the petroleum industry is a somewhat flexible one and its use has not been entirely understood or even consistent. It refers primarily to oil resources that have been proved by adequate drilling, although some allowance is also given to undrilled reserves where conditions give reasonable basis for sound estimates. By proved reserves is meant that fraction of the total discovered crude oil supply now known to exist below ground that can be recovered by present producing methods and under current economic conditions. This recoverable proportion is often surprisingly low for individual fields; it probably averages considerably under 50 percent of the original underground oil supplies. Improvements in current production practices, such, for example, as unitization and pressure maintenance of an entire field, could greatly increase the estimated recoverable volume of reserves and the total ultimate recovery, even without additional new discoveries.

More complete recovery of the oil in underground structures can sometimes be effected by what are known as secondary recovery methods. As the initial energy present in the form of natural gas—which is responsible for driving the oil to the well bore—is gradually exhausted, the flow of oil declines and eventually ceases. This may result in leaving a large quantity of oil in the sand and rock structures which cannot be recovered by ordinary methods and hence is permanently lost. Under certain appropriate conditions, however, the underground pressure can be maintained or restored by means of gas or water injection. Such secondary methods have been adopted in an increasing number of fields in the United States and have made notable progress in California in recent years. They have made possible the recovery of large additional quantities of oil that would otherwise be left in the ground.

Limitations as to inferences concerning reserves

The industry committees who are responsible for making the annual estimates of crude oil reserves are careful to point out that newly discovered oil fields are seldom fully developed, i.e., proved, for several years following the original discovery. Hence the quantity of additional oil estimated as proved through new discoveries in any one year is comparatively small. On the other hand, the

volume of oil in already existing reserves in older fields can be more precisely estimated and revised year by year as more wells are drilled and more information becomes available. Hence the quantity of oil credited to reserves in any one year by the extension of existing fields and the revision of previous estimates is comparatively large. To a certain extent, therefore, the significance of new discoveries is likely to be understated, at least in the initial stages, as the original or first-year estimates of additional oil brought in by such discoveries necessarily represent but a part and often only a small part of the reserves that may ultimately be assigned to these same fields in succeeding years.

This contrast may be illustrated by taking the data on new oil blocked out for any representative period. During the 13 years 1937 to 1949, for example, the total new oil added to the proved reserves of the United States averaged close to 2.4 billion barrels per year. Of this quantity slightly more than 19 percent, on the average, was represented in any one year by the discovery of new fields or new pools within the year, while nearly 81 percent was represented by the revision of previous estimates or the extension of previously discovered fields. In California, during the same period, the proportion of new oil represented by original discoveries was only 15 percent, by subsequent revisions and extensions 85 percent.

It should also be noted, as the estimating committees point out, that only incorrect and misleading conclusions as to the probable life of existing reserves and their rate of depletion can be obtained by dividing the estimated volume of reserves by the current or projected annual rate of production. The physical factors of the underground reservoirs control the rate at which oil can be obtained from any particular pool and the oil in existing reserves can be recovered only over a period of many years and at gradually declining annual rates. Hence current estimates of proved reserves can give no reliable basis for measuring the *rate* at which these reserves can be "produced" in actual practice.

In point of fact, the estimated crude oil reserves of the United States have shown a practically continuous growth over a long period of time, despite the great increase in annual rate of production. During the 31-year period from 1918 to 1949 there were only six years in which annual output exceeded the total of new oil found by first-year discoveries and by the extension and revision of reserves found in previous years. Total crude oil output during this period aggregated nearly 34.3 billion barrels, an average of over 1 billion barrels a year; but new discoveries, extensions, and revisions aggregated nearly 53 billion barrels, an average of 1.7 billion barrels a year. For every barrel of oil produced, on the average over this 31-year period, more than one and a half new barrels were found. Total proved reserves increased from 6.2 billion barrels in 1918 to over 24.6 billion at the end of 1949. In short, discoveries of new oil reserves have more than kept pace with production withdrawals.

Growth in reserves relatively smaller in California than in United States as a whole

The California record since 1918 runs in much the same general terms, although there were more years in which current production exceeded replacement of oil in reserves—13 years out of 31, as against six for the country as a whole. Total new oil found in California between 1918 and 1949 amounted to 8.8 billion barrels as against total output of 7.2 billion barrels, while proved reserves rose from 2.2 billion barrels to 3.82 billion. The net increase in reserves over the whole period from 1918 to 1949 was relatively much less in California, however, than in the country as a whole, only about 72 percent, as against a nearly three-fold rate of increase for the United States. The great bulk of the increase in California's reserves came before 1930, since which time a small net decline occurred until 1948, when the trend turned sharply upward and continued into 1949. As a consequence of the high postwar rate of exploratory and development effort culminating in those years, a much larger net addition was made to California reserves in 1948 than in any year since 1928.

Important new fields discovered in the Cuyama Valley in 1948 were under intensive development in 1949, and, while not yet fully proved, are expected to add substantially to the oil resources of the state, particularly in high gravity crudes. These discoveries have given additional impetus to renewed exploration in other areas not previously tested by modern methods. As a rule, periods of relatively high prices for oil are marked by a stepping up in the rate of exploration and development. The postwar period supplies an excellent illustration of this principle, with high incentive prices stimulating the search for new oil and resulting in this case, at least, in large additions to reserves. Exploratory efforts since the war have been greatly aided by the increased availability of materials and manpower, as contrasted with conditions prevailing during the war when frozen prices and shortages of essential materials restricted discovery efforts.

It seems to be the general practice in the petroleum industry to keep proved reserves at a level about 10 to 15 times the current annual rate of production in order to assure the necessary margin of safety. When reserves, relative to production, drop toward a 10 to 1 backlog, discovery efforts are speeded up; when reserves approach a 15 to 1 supply, geological and exploration activity slackens somewhat. By this standard, the California backlog of reserves in recent years has been none too high. Except during the depression years of the early thirties, the ratio of annual output to existing reserves has been steadily creeping up, with the result that since about 1943 proved reserves have averaged less than 11 times the current rate of withdrawal.

The production of oil 10 or 20 years hence must come in substantial measure from fields that have not yet been discovered. Hence the adequacy of future supply depends on a continuing and persistent discovery effort. This, in

turn, depends on price levels for crude oil which will provide the incentive to risk the large expenditures necessary in modern drilling, and on public policies which encourage the sound development of the industry. A momentary production surplus, such as exists at present, should not, therefore, be allowed to slow down discovery effort even temporarily, since there is no current over-supply of undrilled locations and proved reserves are only about 11 times current production.

Conservation and Control

An important factor, both in the maintenance of adequate crude oil reserves and in the basic conservation of petroleum resources, is the exercise of a reasonable degree of restraint on the rate of production or withdrawal of oil from the underground reservoirs, especially in newly developed fields. It is physically possible, within fairly wide limits, to produce or "flow" the oil from any particular field either rapidly or slowly—on the one hand by drilling additional wells and operating them at flush rates; on the other by curtailment or shut-in of existing wells. It may make an appreciable difference, however, both in the total ultimate recovery of oil and in the life of the field, which method is used, as excessively high rates of output in the early stages make it more difficult and costly—in extreme cases impossible—to obtain the maximum recovery of the oil remaining underground.

In the early days of unrestricted rates of flow in practically all oil-producing areas, as illustrated by the experience of the 1920's in Southern California, many oil fields were prematurely depleted, at least in part, to the permanent detriment of the potential ultimate recovery. This followed from the excessive reduction in underground pressures through exhaustion of the associated natural gas produced along with the oil.

Even as recently as 1949 a flagrant example of uneconomic and wasteful oil production occurred in California—the over-rapid exploitation of the newly discovered Placerita Canyon field. Within a few months of its original discovery this relatively small field, estimated to contain 60 million barrels of oil, was rapidly drilled by competitive "town-lot" methods, encouraged in part by a recent court decision which held invalid a California statute designed to limit the close spacing of oil wells in order to restrain precisely this type of wasteful competition. The result at Placerita was a brief period of flush production followed by a quick decline in rate of output due to the premature reduction of the underground pressures which might otherwise have prolonged the productive life of the new field indefinitely. Coming at the particular time it did, when crude oil markets were already surfeited and thousands of wells were being shut in, this new flood of oil contributed to further price unsettlement and general market instability. More important, however, is the con-

sideration that only about 25 percent of the oil contained in this formation, according to industry estimates, is expected to be ultimately recovered, to say nothing of the large wastage of natural gas blown to the air.

This episode, which may be duplicated on a larger scale in the future unless some form of control is imposed, gives point to the proposals currently being advanced in the industry to secure legislation for the more effective conservation of oil in California. Among the important oil producing states, California and Wyoming stand practically alone in not having conservation laws. Although some degree of voluntary conservation has been practiced more or less consistently for the past 20 years in California, no sanctions can be enforced on individual operators and concerted action by industry members to limit market supply may invite anti-trust proceedings by the Department of Justice. Hence there is increasing insistence within the industry on the need for compulsory conservation measures, similar in general terms to those in force in practically all other important oil producing states. These laws, some of which date back more than 20 years, usually provide for regulation of spacing, drilling, and operation of wells so as to prevent waste; cooperative development of fields for the protection of individual interests and unitized operation of pools in connection with pressure maintenance projects to increase ultimate recovery; limitation of output of oil and gas to reasonable market requirements and allocation of the restricted output among pools and individual producers on an equitable basis. Administration is usually lodged in some form of state commission clothed with adequate power to compel compliance with its orders, but subject to appropriate court review. The vital features of regulation are the authority to establish the total current allowable volume of production, usually after public hearings to determine existing and prospective market demand, and the pro-rata allocation of the allowable output among the various producers.

This type of public regulation and control, while not universally popular among all producers, seems to be reasonably acceptable to the industry. While limitation of output might theoretically be subject to abuse, there is no evidence that deliberate restriction of supply designed to hold prices at unduly high levels has ever been authorized by any of the state commissions. There appears to be fairly general agreement that the existing state conservation laws have worked well in practice and have safeguarded the public interest by checking the over-rapid development of new fields and reducing wasteful operating practices. In so doing they have contributed to the maintenance of more stable conditions in the industry and to the basic conservation of oil and gas resources. They have thus tended to encourage the search for new oil and the maintenance of adequate reserves.

BUSINESS INDEXES—TWELFTH DISTRICT¹

(1935-39 average = 100)

Year and Month	Industrial production (physical volume) ²								Total mfg employment ⁴	California factory payrolls ⁴	Car-loadings (number) ²	Dep't store sales (value) ²	Dep't store stocks (value) ⁵	Retail food prices ³
	Lumber	Petroleum ³		Cement	Lead ³	Copper ³	Wheat flour ³	Electric power						
1929	148	129	127	110	171	160	106	83	.....	111	135	112	134	132.0
1931	77	83	90	74	104	75	101	82	.....	73	91	92	110	104.0
1932	46	78	84	48	75	33	89	73	.....	54	70	69	86	85.8
1933	62	76	81	54	75	26	88	73	.....	53	70	66	78	86.8
1934	67	77	81	70	79	36	95	79	.....	64	81	74	83	83.2
1935	83	92	91	68	89	57	94	85	88	78	88	86	88	99.6
1936	106	94	98	117	100	98	96	96	100	96	103	99	96	100.3
1937	113	105	105	112	118	135	99	105	112	115	109	106	108	104.5
1938	88	110	103	92	96	88	96	102	96	101	96	101	101	99.0
1939	110	99	103	114	97	122	107	112	104	110	104	109	107	98.9
1940	120	98	103	124	112	144	103	122	118	134	110	119	114	97.6
1941	142	102	110	164	113	163	103	136	155	224	128	139	137	107.9
1942	141	110	116	194	118	188	104	167	230	460	137	171	190	130.9
1943	137	125	135	160	104	192	115	214	306	705	133	203	174	143.4
1944	136	137	151	128	93	171	119	231	295	694	141	223	179	142.1
1945	109	144	160	131	81	137	132	219	229	497	134	247	183	146.3
1946	130	139	148	165	73	109	128	219	175	344	136	305	238	167.4
1947	141	147	159	193	98	163	133	256	184	401	142	330	300	200.3
1948	144	149	162	211	107	153	116	284	189	430	134	353	346	216.1
1949	138	147	167	202	103	140	104	303	186	425	126	332	323	209.6
1948 December	134	153	171	196	111	104	122	298	190	444	131	358	320	216.5
1949 January	115	151	174	176	112	108	128	300	185	430	105	342	321	217.9
February	115	152	170	173	107	129	118	297	185	423	103	314	327	214.1
March	131	153	176	195	120	169	102	295	187	412	118	329	342	213.3
April	141	152	169	212	124	167	82	303	189	412	126	335	331	215.6
May	143	149	170	215	126	159	100	304	189	415	134	340	320	211.0
June	146	148	174	219	118	138	104	315	188	419	139	335	313	209.9
July	136	146	162	217	98	131	108	299	186	423	120	329	302	206.3
August	135	144	165	209	93	121	109	310	186	429	138	333	309	205.7
September	140	144	166	208	84	136	108	308	185	437	138	326	333	207.3
October	139	141	158	200	77	136	104	306	185	435	124	337	330	205.2
November	147	140	161	200	89	145	101	299	183	421	129	319	331	205.7
December	150	140	156	196	105	140	89	306	182	424 ^r	128	339	315	202.4
1950 January	123 ^p	140	161	178	124	168	104	322	179	417	96	316	323	206.4

BANKING AND CREDIT STATISTICS—TWELFTH DISTRICT

(amounts in millions of dollars)

Year and month	Condition items of all member banks ⁷				Bank rates on short-term business loans ⁹	Member bank reserves and related items ¹⁰					Bank debits index 31 cities ^{11,12} (1935-39 = 100) ²
	Loans and discounts	U.S. Gov't securities	Demand deposits adjusted ³	Total time deposits		Reserve bank credit ¹¹	Commercial operations ¹²	Treasury operations ¹²	Coin and currency in circulation ¹¹	Reserves	
1929	2,239	495	1,234	1,790	.....	- 34	0	+ 23	- 6	175	146
1931	1,898	547	984	1,727	.....	+ 21	- 154	+ 154	+ 48	147	97
1932	1,570	601	840	1,618	.....	- 42	- 175	+ 234	+ 30	142	68
1933	1,486	720	951	1,609	.....	- 2	- 110	+ 150	- 18	185	63
1934	1,469	1,064	1,201	1,875	.....	- 7	- 198	+ 257	+ 4	242	72
1935	1,537	1,275	1,389	2,064	.....	+ 2	- 163	+ 219	+ 14	287	87
1936	1,682	1,334	1,791	2,401	.....	+ 6	- 227	+ 454	+ 38	479	102
1937	1,871	1,270	1,740	2,187	.....	- 1	- 90	+ 157	- 3	549	111
1938	1,869	1,323	1,781	2,221	.....	- 3	- 240	+ 276	+ 20	565	98
1939	1,967	1,450	1,983	2,267	.....	+ 2	- 192	+ 245	+ 31	584	102
1940	2,130	1,482	2,390	2,360	.....	+ 2	- 148	+ 420	+ 96	754	110
1941	2,451	1,738	2,893	2,425	.....	+ 4	- 596	+ 1,000	+ 227	930	134
1942	2,170	3,630	4,356	2,609	.....	+ 107	- 1,980	+ 2,826	+ 643	1,232	165
1943	2,106	6,235	5,998	3,226	.....	+ 214	- 3,751	+ 4,486	+ 708	1,462	211
1944	2,254	8,263	6,950	4,144	.....	+ 98	- 3,534	+ 4,483	+ 789	1,706	237
1945	2,663	10,450	8,203	5,211	.....	- 76	- 3,743	+ 4,682	+ 545	2,033	260
1946	4,068	8,426	8,821	5,797	.....	+ 9	- 1,607	+ 1,329	- 326	2,094	298
1947	5,358	7,247	8,922	6,006	.....	+ 302	- 443	+ 630	- 206	2,202	326
1948	6,032	6,366	8,655	6,087	.....	+ 17	+ 472	- 482	- 209	2,420	355
1949	5,926	7,014	8,596	6,221	3.20	+ 13	- 931	+ 378	- 65	1,924	350
1949 January	6,009	6,382	8,664	6,082	.....	+ 2	- 101	- 58	- 54	2,329	356
February	5,910	6,306	8,330	6,097	.....	- 4	- 7	- 19	- 4	2,308	344
March	5,899	6,208	8,147	6,102	3.27	- 15	- 34	+ 6	- 31	2,299	364
April	5,811	6,230	8,157	6,109	.....	+ 6	- 127	+ 109	+ 11	2,264	354
May	5,738	6,357	8,154	6,112	.....	- 8	- 202	+ 94	+ 37	2,128	345
June	5,762	6,330	8,006	6,179	3.24	0	- 53	- 5	0	2,063	351
July	5,707	6,548	8,139	6,179	.....	+ 20	- 213	+ 130	- 16	1,997	344
August	5,729	6,846	8,221	6,170	.....	- 30	- 194	+ 40	+ 1	1,832	332
September	5,853	6,863	8,273	6,186	3.14	+ 13	+ 41	- 37	+ 9	1,837	336
October	5,860	6,933	8,353	6,186	.....	+ 2	- 95	+ 92	+ 7	1,831	351
November	5,919	6,944	8,511	6,157	.....	- 12	+ 21	- 2	- 16	1,854	349
December	5,926	7,014	8,596	6,221	3.16	+ 40	+ 32	+ 30	- 8	1,924	376
1950 January	5,901	7,123	8,620	6,244	.....	- 48	- 92	+ 5	- 62	1,892	354
February	5,893	6,999	8,311	6,262	.....	+ 5	- 34	- 7	+ 10	1,848	360

¹ All monthly indexes but wheat flour, petroleum, copper, lead, and retail food prices are adjusted for seasonal variation. Excepting for department store statistics, all indexes are based upon data from outside sources, as follows: Lumber, various lumber trade associations; Petroleum, Cement, Copper, and Lead, U.S. Bureau of Mines; Wheat flour, U.S. Bureau of the Census; Electric power, Federal Power Commission; Manufacturing employment, U.S. Bureau of Labor Statistics; and cooperating state agencies; Factory payrolls, California State Division of Labor Statistics and Research; Retail food prices, U.S. Bureau of Labor Statistics; and Carloadings, various railroads and railroad associations. ² Daily average. ³ Not adjusted for seasonal variation. ⁴ Excludes fish, fruit, and vegetable canning. Factory payrolls index covers wage earners only. ⁵ At retail, end of month or year. ⁶ Los Angeles, San Francisco, and Seattle indexes combined. ⁷ Annual figures are as of end of year; monthly figures as of last Wednesday in month or, where applicable, as of call report date. ⁸ Demand deposits, excluding interbank and U.S. Gov't deposits, less cash items in process of collection. Monthly data partly estimated. ⁹ New quarterly series beginning June 1948. Average rates on loans made in five major cities during the first 15 days of the month. ¹⁰ End of year and end of month figures. ¹¹ Changes from end of previous month or year. ¹² Minus sign indicates flow of funds out of the District in the case of commercial operations, and excess of receipts over disbursements in the case of Treasury operations. ¹³ Debits to total deposit accounts, excluding interbank deposits. ^p—preliminary. ^r—revised.