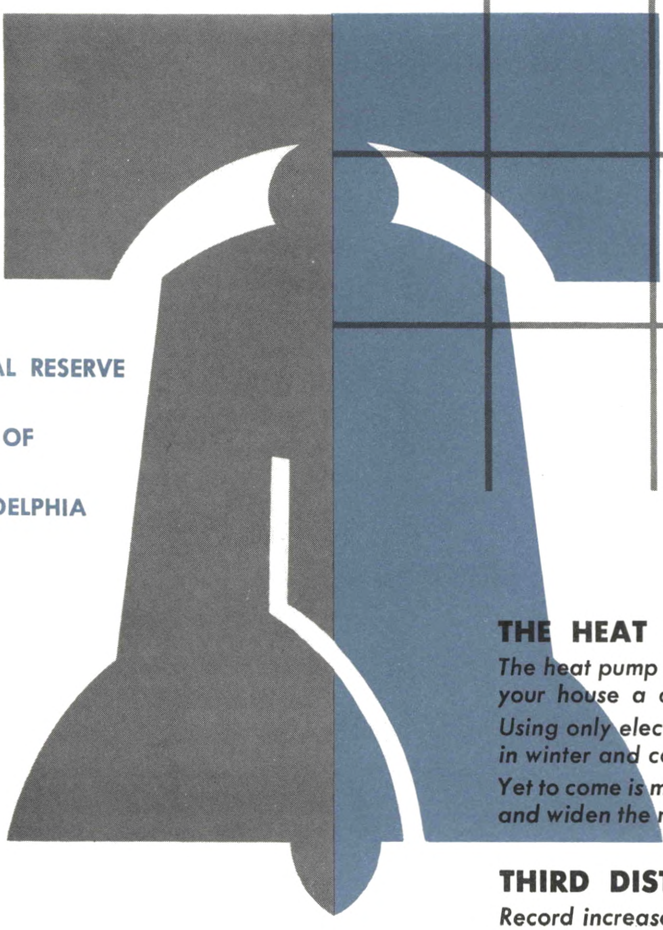
FEBRUARY 1956

business review



FEDERAL RESERVE BANK OF PHILADELPHIA

THE HEAT PUMP

The heat pump is a climate machine that automatically makes your house a comfortable home through all kinds of weather. Using only electricity and air or water, it warms your house in winter and cools it in summer. It's safe, clean, and reliable. Yet to come is mass production needed to cut the cost and widen the market.

THIRD DISTRICT BANKING—1955

Record increase in bank loans partly offset by reduction in investments. Current earnings higher, but net profits decline.

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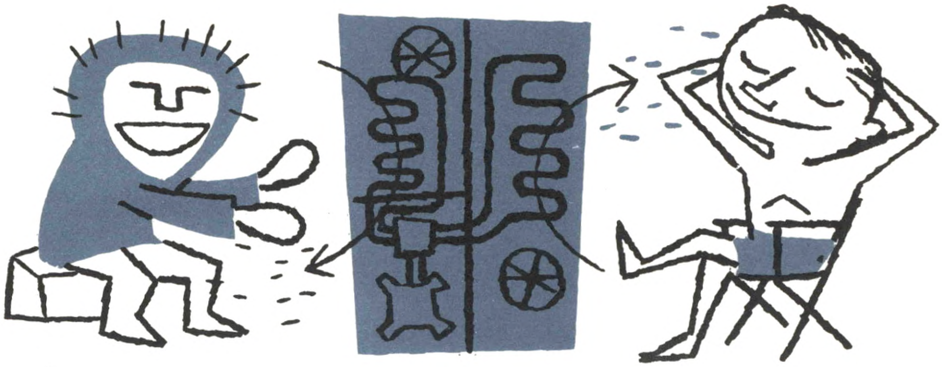
THE HEAT PUMP



A hundred years ago the heat pump was just an idea. Today it is a reality. Within a decade it may be a big industry.

The heat pump is a device that pumps heat into your house in winter and out of your house in summer. It burns no fuel and requires no chimney. It uses only electricity and air or water. The electrical connections are as simple as those for an electric range or dryer. In size the heat pump is comparable to the modern oil- or gas-fired furnace and just as sleek. Manufactured by the best-known electrical appliance manufacturers in the country, it can be installed in any house—old or new. The heat pump is a climate machine that diffuses perpetual comfort throughout the entire house. It is automatic.

When we first heard about the heat pump we thought it was one of the latest tales right out of a science-fiction publication. On further inquiry we found a number of people already living in heat-pump luxury in Southern New Jersey. So to Jersey we went and called at the homes of a number of heat-pump users. Seeing is believing.

At the very first call in a home located just a few minutes' walk from the beach in a suburb of Atlantic City the hostess graciously conducted us through her new home. It was a warm day in August. The doors and windows were kept closed. The heat pump was running, and so was the electric washer because it was Monday.

In answer to one of the doubting-Thomas type of questions about the heat pump the hostess said: "The only complaint I have with the heat pump is that the home is so comfortable that my weekend guests do not want to go home but want to stay with me all week. I can't even get them out of the house to take a walk on the boardwalk."

Deep in January we called upon more residential heat-pump users to find out how they fare in cold weather. All of them were keeping warm and all were apparently happy except the owner who put a thermometer in every room to test the heat-pump salesman's promise of uniform heat throughout the house. When one of the seven rooms was found to be out of line by two degrees he squawked.

Safe, clean, and compact, the heat pump can be installed almost anywhere in the house—in the basement, the utility room, or attached garage. In cold weather, warm air flows through metal ducts into every room of the house and the same ducts also circulate cool air through the house in summer. Thus, a house with a heat pump has no use for a furnace, fuel tank, or flue. Neither does it need any other form of air conditioning. The heat pump is a combination heating and cooling mechanism all in one package.

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On a centrally located wall of the house equipped with a heat pump is a conventional-looking thermostat with an unconventional feature. It has two controls instead of one. The "heat" control is set at 75 degrees if the temperature of the house is not to fall below that point; and the "cool" control may be set at 79 degrees if the temperature is not to go above that point. You simply set it and forget it. Thereafter you are never cold and chilly in winter or hot and sweaty in summer.

What goes?

The "works" of a heat pump are much like those of a refrigerator. In fact, the refrigerator in your home is a one-way heat pump. It sounds crazy but it's true. It pumps heat out of the food compartment into your kitchen. By placing your hand on the outside coil, you can feel the heat being thrown off. If you remove the door of the refrigerator and push the open side up against a hole cut in the wall of your house, you have a small-scale heat pump. It would take heat from the atmosphere outside and warm your house. On reversing the position of the refrigerator so that the open side faces indoors, the machine would cool the house by removing the heat from the indoor air and rejecting it through the condenser to the outdoor air. Basically, all that is needed to convert a refrigerator into a full-scale heat pump is to install a bigger motor, a larger pump called a compressor, a thermostat, and a set of valves to reverse the cycle automatically instead of physically turning the box around.

Operating on the principle of a refrigerator, it is easy enough to see how the heat pump cools a house in summer; but how in the world does it heat in winter?

Now, heat is a peculiar thing. It is hard to define; but anybody knows when he has too little or too much. Strange as it may seem there is always some heat in the atmosphere, even though it may be so cold that your teeth chatter. It is only simple logic that air at 32 degrees Fahrenheit is warmer than air in zero weather. The same reasoning tells us that air at zero is warmer than air at 50 degrees below zero or even colder temperatures. All we need is a method of extracting this heat, and with the new refrigerants available today the heat pump can accomplish this task easily. Perhaps the accompanying illustration helps to clarify how the heat pump works.

Heat is where you find it

Heat pumps of the so-called air-to-air type are designed to extract heat from the atmosphere. The heat so extracted is stepped up by the compressor which supplements the heat taken from the air by the heat equivalent of electricity used to run the compressor. Naturally, the lower the outside temperature the harder the heat pump must work to warm the house. Heat pumps come with built-in electric resistance units to supply additional heat and defrosting required in areas where the winter temperature occasionally drops very low.

The big advantage of the air-to-air heat pump is that there is no place without air. But the atmosphere is not the only source of heat; there are also ground-to-air and water-to-air heat pumps.

The earth itself is a good source of heat. In the ground below the frost line is a great reservoir of heat at practically constant temperature. This natural heat sink can be tapped with a ground-to-air heat pump. The way this works is to circulate a refrigerant through a system of copper pipes buried four or five feet below the surface. The liquid refrigerant circulates through

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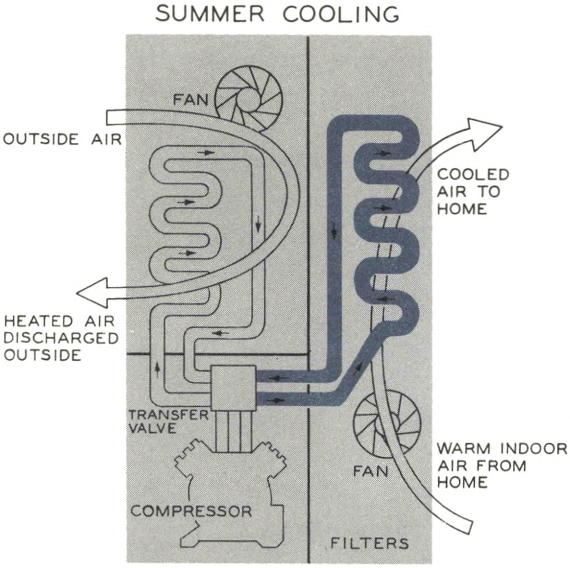
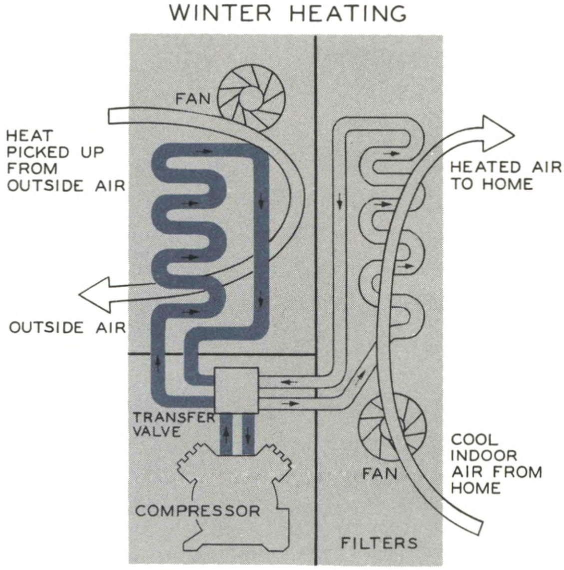
HOW THE HEAT PUMP WORKS





the underground pipes where it picks up the ground heat. In so doing the refrigerant changes into a gas which is made still hotter on going through the compressor. Upon entering the condenser the hot gas gives up its heat to the house heating system and in the process reverts to a liquid and returns to the ground to pick up more heat. So it goes—round and round, and the process is reversed for cooling.

The water-to-air type of heat pump gets its heat from a natural body of water such as a river, lake, or well. Well water is an excellent source of heat which seldom falls below 45 degrees Fahrenheit in this country. The water is pumped from a well into a condenser where the refrigerant coil absorbs heat from it to warm the house. The water from which the heat has been extracted may be discharged down the drain or in areas where water is scarce it may be returned to an adjacent well so that the water table is not affected. In the latter instance, the water is merely borrowed for a few minutes to get its heat and then returned.

All three types of heat pump are in use today. The water-to-air pump is, of course, limited to sections of the country where there is an abundance of good, clean water. Many such pumps have been installed in Florida where it is necessary to dig wells only 15 or 20 feet to get the required water. The ground-to-air type of heat pump has some drawbacks; it is costly to buy and bury several hundred feet of copper pipe in the first instance and it is expensive to dig up the pipes in case of needed repairs. Much engineering talent has gone into improvements on the air-to-air pump, which seems to be in the ascendancy. According to a 1955 survey of heat-pump installations, both residential and commercial, over half were of the air-to-air type and most of the remainder used water as the source of heat. In residential installations, the preference of air over water as the heat source is more

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pronounced than in commercial installations. Some commercial and industrial enterprises utilize the waste heat of processing water to supply their heat pumps.

No matter what the source of heat, all heat pumps are based on a simple law of thermodynamics—heat flows from a substance at a higher temperature to a substance at a lower temperature, just as water flows from a higher to a lower level. Also like water, heat must be pumped from a lower to a higher level. By inference, the temperature of Hades is uniform throughout for if it were not, some enterprising engineer would install a heat pump and make a corner of the kingdom comfortable.

History of the heat pump

The heat pump is very young so its history is short. Like many other inventions, the heat pump had its origin in Europe where it appeared shortly after World War I. There the early installations were industrial applications, especially in certain chemical industries, in paper mills, and in sugar refineries where compressors were used to generate heat for drying purposes.

The use of mechanical devices to heat or cool buildings had to await the arrival of low-cost electricity. Initial efforts were directed at summer air conditioning, and unit air conditioners cooling one room only made their appearance in the 1920's. In the early thirties, engineers in cooperation with electric utilities, began experimenting with heat pumps for heating and cooling both homes and offices. In this country the first two heat-pump installations for year-round comfort air conditioning were installed in late 1934 and early 1935 in the Salem, New Jersey, office of the Atlantic City Electric Company and the Riverside, California office of the Nevada California Power Company.

As improvements and refinements were made throughout the thirties, a limited number of heat-pump installations were made in various places throughout the country from Connecticut to California. During this period of trial and error there was a predominance of commercial installations. Progress was temporarily retarded during World War II, when heat-pump manufacturers were busy on war work. After the war, big money went into the improvement of heat pumps for residential use. They now come in package units with a choice of horsepower for different size houses. The leading manufacturers, including several blue-chip companies, are busy enlarging production facilities and building up dealer organizations to bring the heat pump to the attention of the public.

Precisely how many heat pumps are being produced or how many are now in use, no one really knows. One reason is the comparative youth of the product which still has no established channels to collect reliable statistics, and another reason is the rapidly growing acceptance of the product. Prior to 1954 it was a simple matter to keep track of the relatively few installations; most of the companies knew where they were and followed them closely. However, with the tremendous expansion of sales during the past two years it was no longer possible to do this. Such records as there are show that almost two-thirds of them are in private homes and the others in commercial establishments. Of the six or eight companies already in the business, the leading manufacturer is currently reported to be turning out heat pumps at the rate of 4,000 units a year. Although some of the estimates of output and installations are pardonably optimistic, it cannot be denied that the market for the heat pump is getting "hot."

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Geography of the heat pump

Most of the heat pumps are in the South. This is plainly shown on the accompanying map, based on 2,076 installations for which exact locations are known. Florida had the greatest number of known installations, followed by California, Tennessee, and Texas, in that order. At the time of the survey there were only nine states without any heat-pump installations.

Generally speaking, the heat pump is more attractive and economical in the milder climates of the South, Southwest, and Pacific Coast. Florida, for example, has been an excellent market for the heat pump where it serves as a cooling agent throughout the long hot summers and it dispels the chill during the comparatively few cold days in winter. Indeed, many homes in that area have no heating facilities of any kind.

Although the heat pump originally found its best market in the South, it is no longer restricted to the area below the Mason-Dixon Line. With a great deal more heating capacity built into the latest models, heat pumps are steadily expanding their market northward. South Jersey may be cited as an example of how the heat pump moves into and captivates an area. The electric utility serving that region reported one heat pump on its lines in 1953, eight more in 1954, and 78 more last year.

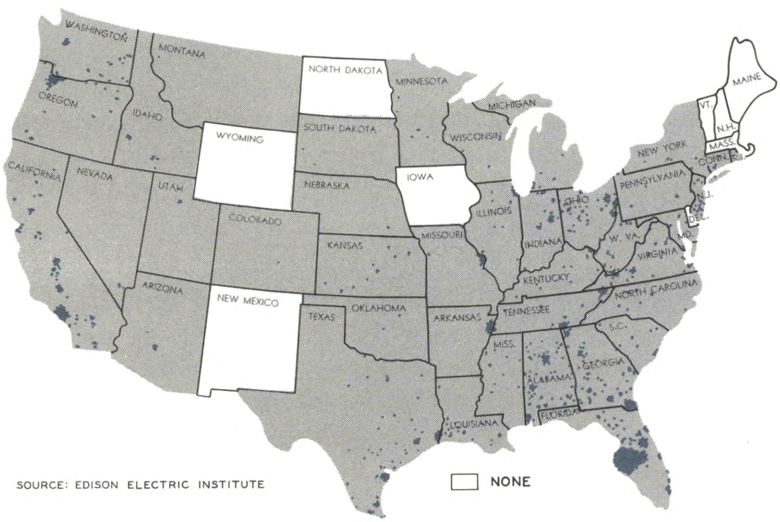
Economics of the heat pump

Like all good things, heat pumps cost money. Both the original cost and the upkeep depend upon a number of things—the size of the house, the type of construction and insulation, the location, the prevailing climate, and the cost of electricity. It also depends upon the size and type of heat pump installed.

First, let us consider the cost of installation. The installed cost of a heat pump ranges from $2,700 to $3,100 for a house in the $15,000 to $20,000 price class. That includes not only the heat pump itself but also the necessary wiring and duct work for an air-to-air type of installation.

In Florida, where water-cooled heat pumps predominate, an installation for a small home costs only $1,700 including the well. They cost less down there because smaller units with less heating capacity are adequate for the short, mild winter and also because of the ready supply of water as a source of heat.

HEAT PUMP INSTALLATIONS



SOURCE: EDISON ELECTRIC INSTITUTE

NOTE—Map includes 2,076 installations for which exact locations have been received by Joint AEIC-EEI Heat Pump Committee as of May 1955.

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The cost of a heat pump is obviously much greater than that of a conventional gas, coal, or oil heating system; but such a comparison is invalid. Since the heat pump furnishes both heating in winter and cooling in summer, its cost should be compared with the cost of both a heating and central air-conditioning system. On that basis, the cost of a heat pump is estimated to run only 15 to 20 per cent higher. Users of the heat pump are willing to pay the added cost for the added comfort and convenience.

The heat pump supplies a more steady, even flow of heat instead of periodic blasts. In addition to heating when it is cold and cooling when it is hot, the heat pump cleans and filters the air, automatically removes excess moisture from the air, and can ventilate the year round. Incidentally, in a seashore home with a heat pump the salt shakers always work no matter how humid the weather, and fishing boots never collect mildew. Another feature especially appreciated by the housewife is the fact that there is no dust or smudge inevitably associated with a fuel-burning system. The heat pump feeds on electricity and there is nothing so clean as a kilowatt.

The cost of operating a heat pump is determined largely by the climate. Generally, the farther north or the longer the winter the greater the cost of operation. Instead of speaking of an average cost, which nobody pays or a range of cost which only two people pay, let us take a specific case from nearby South Jersey.

The owner has a two-story residence exposed on all four sides. The house, in the $22,000 price class, has about 1,600 square feet of floor space and is approximately 13,000 cubic feet in content. It is equipped with a five horsepower air-to-air type of heat pump. During the 1953-1954 season the owner spent $485.33 for electricity for all purposes. Of that the heat pump consumed $261.49 of electricity—$197.73 for heating from October through June and $63.76 for cooling from July through September. The 80-gallon water heater consumed $116.18 of electricity, and the remaining $107.66 went for other purposes such as the range, electric clothes dryer, lighting, etc. From the description it is apparent that the owner has an all-electric home in which the cost of operating the heat pump was just slightly over 50 per cent of the total electric bill.

In the 1954-1955 season, when the winter was considerably colder and the summer was somewhat kinder, the cost of operating the heat pump was only $203.79—of which $187.88 was for heating duty and $15.91 for cooling duty. Naturally, the cost of electricity is an important element in the cost of operating a heat pump. In the case just cited, where the owner's total electric bill for the 1954-1955 season was $458.29, he consumed 24,748 kilowatt hours of electricity. That is 1.85 cents per kilowatt hour. At an average rate of 2 cents a kilowatt hour, his bill would have been $494.96 and at an average of 2½ cents it would have been $618.70. So the rate structure of the company that supplies your electricity is one of the first things to consider before installing a heat pump. It has been said that the heat pump operates at a competitive disadvantage when electricity costs more than 2 cents a kilowatt hour, but that depends on the cost of competitive fuels. What interests the customer most is the total cost of air conditioning his house, and this is bound to decrease as heat pumps are improved in efficiency.

Future of the heat pump

"Cool as a mountain breeze in summer and warm as a South Sea island in winter," says the an-

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nouncement of one of the heat-pump manufacturers and the copy is illustrated with a scene that looks like lovely Lake Louise in the Canadian Rockies and another that portrays breakers gently lapping a palm-studded beachfront embellished with tropical cheesecake. The overleaf is full of figures about B.T.U.'s, belts, horsepower, and a blueprint—all of which would delight the heart of an engineer.

Advertising has its place, and so does engineering, but what is the future of the heat pump? The heat pump is a delight and a joy to the 4,000 or 5,000 owners who have them. Manufacturers know they have a good product, and on the basis of rapidly increasing sales they are enthusiastic about the future. Heat pumps have already been approved by the Veterans Administration and the Federal Housing Administration. In the present state of the art, the biggest obstacle is the first cost. The industry today stands about where the automobile did in 1915. Basic principles have been mastered, but the cost still restricts sales to the luxury market.

Yet to come is the mass production needed to cut the cost and widen the market. Heat-pump manufacturers cite the example of the household refrigerator which in 1920 had an average price of $600 and decreased over 70 per cent to an average price of $172 in 14 years as public acceptance of the product increased and the mass market was developed. In anticipation of a decrease in the cost of production of 50 per cent or more, simplification of components, increase in efficiency, smaller physical dimensions, and more attractive exteriors, manufacturers expect the sale of heat pumps to rise to 75,000 units a year by 1960 and 250,000 by 1964. Market acceptance of the heat pump is expected to outstrip any electric consuming device except television.

Another factor to be reckoned with in appraising the outlook for the heat pump is the attitude of the utilities. Reference here has already been made to the fact that the sale of heat pumps is predicated on low-cost electricity. Moreover, they use a tremendous amount of it. When a heat pump is installed the household consumption of electricity jumps from an average of about 2,500 kilowatt hours a year to approximately 20,000. Should growth of the heat pump turn out to be anything like that expected by their manufacturers, it would give a tremendous boost to the sale of electricity.

One of the most amazing things about our post-war economy is the huge amount of money already spent by the electric utilities to expand their capacity for the generation and distribution of electric power. Equally amazing is the large amount of money they have earmarked for future expansion. Entering into these expansion plans are devices like the heat pump which feeds solely on kilowatts and feeds heavily.

Many utilities welcome the addition of heat pumps on their lines, not only as an increased outlet for the sale of kilowatt hours but also to help balance their load. As a result of the phenomenal growth of room air conditioners during the past few years, the summertime load of the utility goes very high so that something is needed to bring up the winter load. The heat pump is an ideal instrument for that purpose. Owing to the difficulty of storing electrical energy, the peak power requirements must be available at all times and it is costly to allow equipment to stand idle awaiting peak summer requirements. Anything that helps to smooth out the peaks and valleys in the production of power increases the efficiency of utility operation.

Electric utilities live on the sale of power but some of them also sell gas. Naturally, those that sell electricity only are likely to be most en-

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thusiastic about taking heat pumps on their lines and some of them offer special heat pump rates. Ordinarily, it is the manufacturer that designs and builds a new household appliance who gets the utility interested to put the new device on their lines, but in the case of the heat pump it has been the reverse. Here, the utilities are pushing the manufacturers of heat pumps.

In appraising the market for heat pumps, emphasis has been placed upon residential installations. The producers, however, are not overlooking the commercial market. Unlike a residential heat pump which sells on the basis of comfort and convenience, the installation of a commercial heat pump in an office building, factory, store, or theater is looked upon as a business proposition. In such cases the heat pump easily pays its cost and keep in greater efficiency of output or expanded volume of sales.

By all appearances the heat pump is here to stay and it could easily revolutionize residential and commercial space heating. Its progress is being scrutinized very carefully by those whose fortunes may be affected. Manufacturers of air-conditioning equipment are interested because the heat pump is right up their alley and offers double-barreled service. Electric utilities are interested because the heat pump has potentialities for greatly expanded output of electric power and better balanced loads. Gas and oil companies are concerned because the heat pump may do to them what they did to coal.

THIRD DISTRICT BANKING — 1955

The annals of business for 1955 are sprinkled with references to new high points achieved. In part this is matched by the records of banking becoming available with the filing of year-end reports.

Heavy borrowing from the banks was to be expected and was very much a part of the banking picture in 1955. Preliminary tabulations covering member banks in the Third Federal Reserve District show the greatest increase in loans ever reported in a twelve-month period, a rise of nearly $600 million or 18 per cent to a record $3,818 million. Demands came from many sectors of the economy. Reports in detail from a group of large banks indicate that a sharp rise in advances to commerce and industry reflected heavier borrowings by manufacturers, sales finance companies, utilities, mortgage dealers and others. Real estate loans moved up considerably in 1955 and the volume of instalment credit granted to consumers expanded rapidly.

The growth in total bank credit was much less than the increase in loans. Investments were drawn down considerably to help meet the persistent demand for loans. Sales and redemptions reduced holdings of United States Treasury issues by $327 million to $2,496 million. And investments in other securities, chiefly the obligations of states and local governments, were reduced materially, falling $130 million to $802 million.

In percentage, the increase in loans and the

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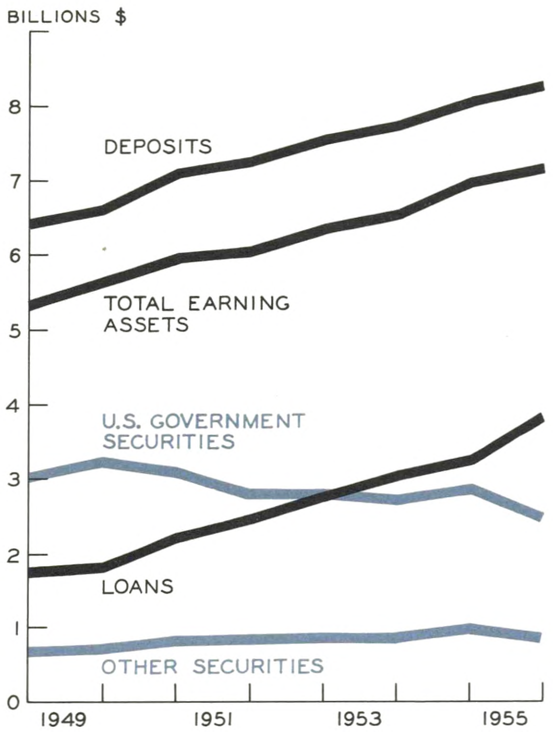
MEMBER BANKS—THIRD DISTRICT



decrease in holdings of Federal Government securities at member banks in the Third District were in line with member banks throughout the country, judging by figures for the year ended December 28, 1955. But the decline locally in other securities contrasted with a small increase in the national figures.

To help maintain reserve positions, borrowing by Third District banks from the Federal Reserve Bank was definitely more active than in 1954. Semi-monthly averages show that such borrowings were consistently larger than excess reserves in the last half of the year. In the closing month of 1955 the Reserve Bank's discounts and advances to member banks averaged over $60 million daily as against $18 million a year earlier.

With loans in record volume, the gross earnings of Third District member banks reached a new high point. Preliminary tabulations, adjusted for bank mergers, show total income of $293 million, 8 per cent more than in 1954. More than half of this increase was absorbed by rising expenses—salary and wage payments, interest on deposits, and other items of outgo—but a sufficient amount remained to add materially to current earnings after expenses.

Consistent with developments during the year, profits on securities were much smaller than in 1954 and valuation reserves on loans were built up substantially by transfers out of earnings. These and other changes more than offset higher net current earnings and a decline in income tax payments. Accordingly, the preliminary figures show a decline of nearly $8 million to $53 million in net profits available for distribution. Cash dividends increased and absorbed three-fifths of net profits.

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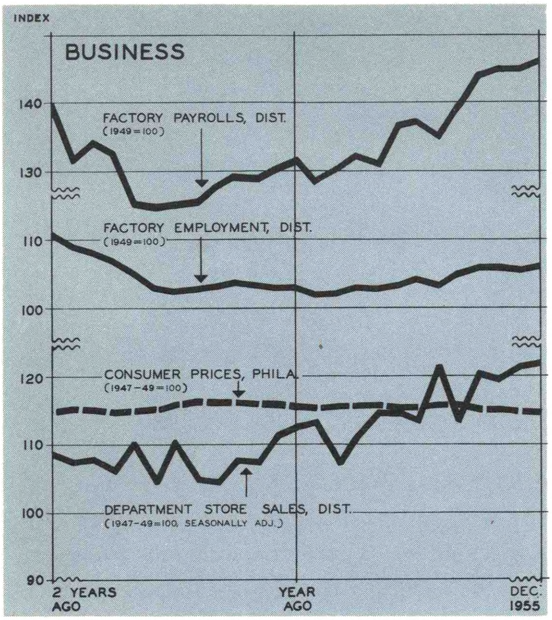
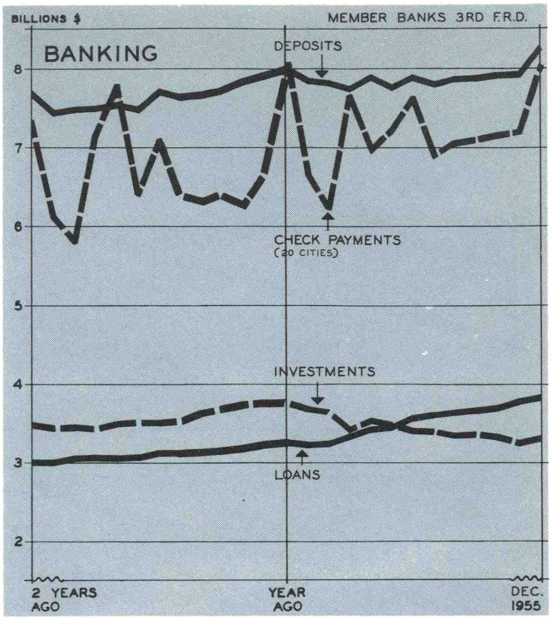
FOR THE RECORD...





SUMMARY	Third Federal Reserve District, Per cent change: December 1955 from mo. ago	December 1955 from year ago	12 mos. 1955 from year ago	United States, Per cent change: December 1955 from mo. ago	December 1955 from year ago	12 mos. 1955 from year ago
OUTPUT						
Manufacturing production	0	+ 7	+ 3	− 3	+11	+11
Construction contracts*	− 4	+ 9	+12	0	+16	+21
Coal mining	+ 6	+ 7	+12	+ 5	+21	+19
EMPLOYMENT AND INCOME						
Factory employment (Total)	0	+ 3	0	− 1	+ 6	+ 4
Factory wage income	+ 1	+12	+ 7	...	...	...
TRADE**						
Department store sales	0	+ 7	+ 7	0	+ 5	+ 7
Department store stocks	+ 3	+ 8	...	+ 3	+ 8	...
BANKING (All member banks)						
Deposits	+ 2	+ 1	+ 3	+ 2	+ 3	+ 4
Loans	+ 2	+18	+13	+ 2	+17	+13
Investments	+ 1	−12	− 4	0	−10	− 1
U.S. Govt. securities	+ 1	−12	− 5	+ 1	−12	− 3
Other	0	−14	− 1	− 1	0	+ 8
Check payments	+12†	0†	+ 7†	+16	+ 8	+ 8
PRICES						
Wholesale	...	...	...	0	+ 2	0
Consumer	0‡	− 1‡	0‡	0	0	0

*Based on 3-month moving averages.
**Adjusted for seasonal variation.
†20 Cities
‡Philadelphia

LOCAL CHANGES	Factory* Employment: Per cent change December 1955 from mo. ago	year ago	Factory* Payrolls: Per cent change December 1955 from mo. ago	year ago	Department Store Sales: Per cent change December 1955 from mo. ago	year ago	Department Store Stocks: Per cent change December 1955 from mo. ago	year ago	Check Payments: Per cent change December 1955 from mo. ago	year ago
Allentown	0	+ 9	+1	+31	...	...	...	...	+ 5	+ 6
Harrisburg	0	+14	0	+37	...	...	...	...	+ 7	+ 5
Lancaster	−1	+ 7	−1	+18	+40	+ 8	−24	+ 5	+ 4	+11
Philadelphia	0	0	+1	+ 6	+23	+ 7	−21	+10	+10	− 1
Reading	+1	+ 6	−1	+16	+48	+ 9	−21	+ 5	+ 6	+ 9
Scranton	0	+ 2	−1	+10	+58	+ 5	−23	+ 3	+14	− 1
Trenton	−1	+ 8	−2	+15	+52	− 4	−19	−8	+16	+15
Wilkes-Barre	−1	+ 4	0	+ 5	+55	+ 5	−22	+ 5	+ 7	− 3
Wilmington	+1	+13	−1	+21	+37	+ 6	−25	+ 8	+46	−13
York	+2	+ 4	+4	+14	+50	+13	−24	+13	+ 7	+11

*Not restricted to corporate limits of cities but covers areas of one or more counties.

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