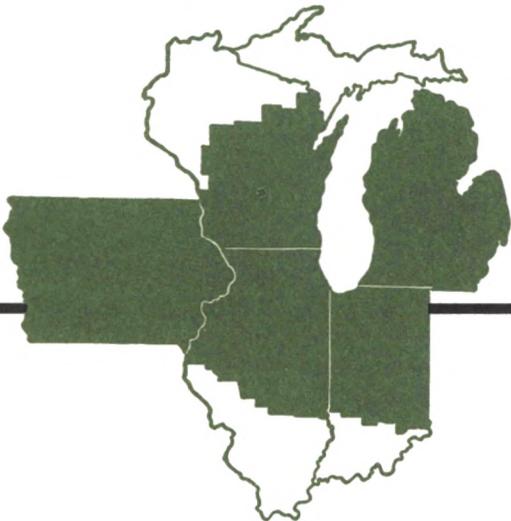


A review by the **Federal Reserve Bank of Chicago**

Business Conditions

1966 February



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THE Trend OF BUSINESS

For five years business activity has been moving closer to practical capacity. From 1961 to 1965 total output increased 5.2 per cent a year, compared with an average of 3.3 per cent in the earlier postwar period when the labor force was growing less rapidly. In 1965 unemployment averaged 4.5 per cent nationally—the lowest rate since 1957—and plant capacity in many basic industries was being utilized at or above optimal rates. As margins of unused resources narrowed, moderate, but persistent, upward price pressures became increasingly evident.

These developments have been particularly marked in the industrial Midwest which produces large shares of the nation's steel, motor vehicles, machinery and equipment and other durable goods. Unemployment in the five-state area of Illinois, Indiana, Iowa, Michigan and Wisconsin averaged only 3 per cent last year. Labor markets in many centers were tighter than at any time since World War II.

A widespread expectation in mid-1965 was that the uptrend in activity would moderate in the closing months of the year and in the early part of 1966. Three major reasons were offered. Steel inventories were being accumulated in excess of current needs because of the possibility of a strike, and sharp cutbacks in production were anticipated in the autumn. Second, motor vehicle sales and output were expected to decline from what was believed to be an "unsustainable" level. Third, social security taxes were scheduled to rise substantially after January 1.

Concern relating to the steel and auto industries proved to be exaggerated. Although steel output declined as expected after the wage settlement in September, the downturn was shorter and shallower than anticipated. By mid-January output had rebounded to an annual rate of 125 million tons, and incoming orders indicated further gains ahead. Auto and truck sales did not slacken appreciably during the second half of 1965, holding at a

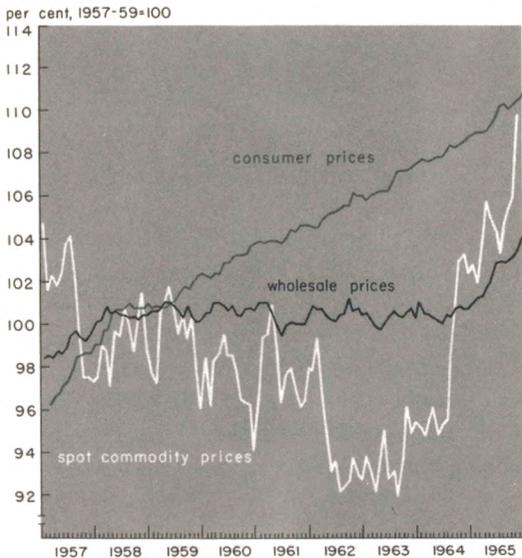
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Annual Report: The 1965 Annual Report of the Federal Reserve Bank of Chicago contains the Bank's financial statements, brief reviews of last year's developments in business, agriculture and banking, and a 30-page illustrated feature article "The Airlines: growth industry, credit aids expansion." Copies of the Annual Report may be obtained by writing to the Bank.

Nonferrous metals and meats led prices upward after mid-1964



combined annual rate of almost 11 million units. The impact of higher social security taxes has yet to be evaluated, but these increases now appear as a desirable dampening influence upon an ebullient economy.

Business and consumer demands rise

Demand for machinery and equipment has risen steadily during the past year and by a larger amount than had been expected by most. It is possible that this rise would have been sufficient to offset substantial weakness in steel or autos in the fourth quarter of 1965. As long as six months ago, pressures on capacity to produce certain capital goods such as machine tools, heavy trucks and railroad equipment already were causing a stretchout in promised delivery times and shortages of skilled metalworkers were hampering efforts to increase output. Backlogs of machinery and equipment firms increased

further in each succeeding month. In recent months, reports of delays in completing capital expenditure projects have become more and more frequent.

Construction put in place in 1965 exceeded the previous year's total by about 5 per cent. Industrial, commercial and public utility outlays were up about 15 per cent. Doubtlessly, construction activity would have been even larger, particularly in the Midwest, were it not for severe shortages of workers in the building trades.

Bids on new construction commonly exceeded estimates, and in some cases contractors refused to tender firm bids because of uncertainties regarding the cost and availability of labor and components. These problems were particularly significant for projects requiring the services of fabricators of structural steel. A Department of Commerce estimate published in November indicated that construction outlays would rise 6 per cent further in 1966, and private estimates indicate an even larger increase in the volume of construction work in the planning stage.

Some analysts anticipated a marked slowing, even a cessation of nonfarm business inventory accumulation in the fourth quarter of 1965. Reductions in steel holdings were largely offset by increases for most other items, however, and the fourth quarter rate of nonfarm inventory accumulation exceeded 5 billion dollars, down from earlier quarters but somewhat more than the long-term trend. Strength in sales and orders indicated an acceleration in the rate of inventory investment for many industries early in 1966.

Consumer disposable income rose throughout 1965 as a result of larger employment, higher wages and salaries, increased dividends and interest and, starting in September, larger social security payments. Purchases of consumer hard goods were encouraged by the

elimination or reduction of excise taxes in June. Instalment credit extensions were at a record high. For the year as a whole, consumption expenditures increased somewhat more than the 7 per cent rise in income with the result that the rate of savings declined to 5.3 per cent of after-tax income from 6 per cent in 1964. Surveys of family spending intentions taken late in the year suggested further increases in purchases of most consumer durables in 1966.

Vietnam—an added burden

Demands of consumers and private business and increases in Federal and state and local spending on civilian programs probably would have been sufficient to maintain the upward momentum of the economy during 1965. Superimposed upon these, however, were the measures—announced in July and

later amplified—to expand the United States military effort in Vietnam. Draft calls were increased sharply to 40,000 per month. Orders for a wide variety of military needs ranging from clothing and food to bombs, helicopters and ground vehicles gradually exerted additional pressure on available supplies, often under priorities.

Expansion of the personnel and equipment of the armed forces is continuing in early 1966. Unquestionably, the direct and psychological effects of the involvement in Southeast Asia were serving to encourage unrelated expenditures by those who feared possible price increases or shortages.

Credit demand exceeds supply

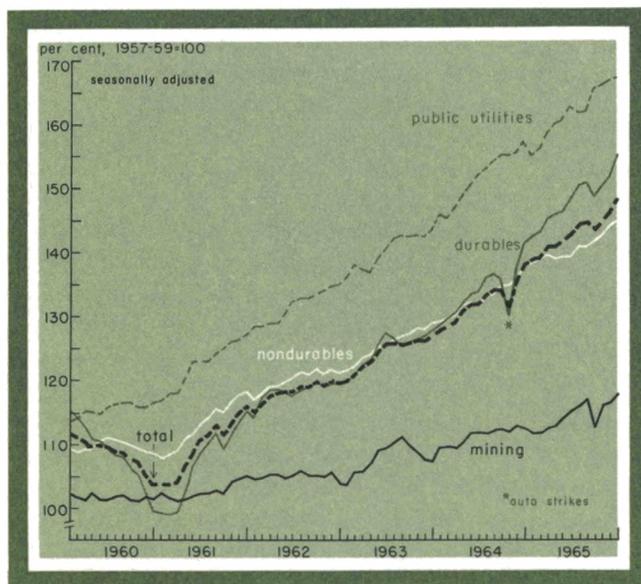
Expanding business activity last year was accompanied by heavier use of credit. Total loans and investments at commercial banks rose by 10 per cent, more than in any year since 1955. Total loans increased 15 per cent and commercial and industrial loans 20 per cent. (For Seventh District weekly reporting member banks, the increase in business loans last year was 23 per cent.)

Corporate securities issued for new capital totaled more than 15 billion dollars and exceeded the previous high of 1964 by 16 per cent. New municipal issues of 10.5 billion dollars also set a record high.

The money supply—demand deposits and currency—rose 4.8 per cent, faster than in any year since 1951. Time deposits rose 16.1 per cent, a rate exceeded only in 1962.

From the end of 1960 to the end of 1965, total bank credit rose

Industrial production continued rapid rise late in 1965 despite reduced steel output

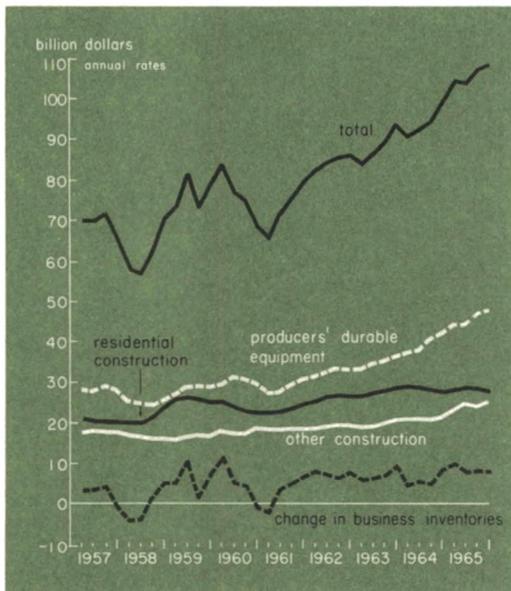


51 per cent with increases of at least 8 per cent each year. From 1947 through 1960, increases in loans and investments averaged 4 per cent a year. The money supply and time deposits also rose much more rapidly in the Sixties than the average for the earlier post-war period.

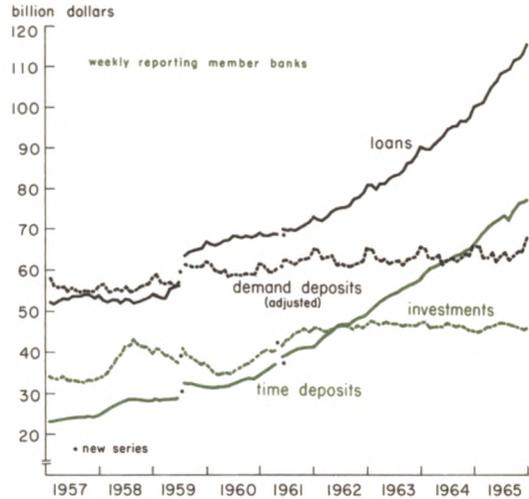
The rate of rise in bank credit was reduced appreciably in the third quarter of 1965, but in the fourth quarter it jumped to 11 per cent, slightly greater than for the year as a whole. Business loans increased at a particularly rapid rate in December.

On December 6 the Board of Governors of the Federal Reserve System approved decisions of the Directors of the Federal Reserve Banks of Chicago and New York to increase discount rates charged to member banks from 4 to 4.5 per cent. Identical increases were announced for the other 10 Federal Reserve Banks during the succeeding

Producers' durables—main factor in rise of private investment



Loans and time deposits of leading banks have risen sharply



week. Following the rise in discount rates, large commercial banks increased the prime rates charged to top-rated business firms from 4.5 to 5 per cent.

All classes of interest rates had been rising for several months prior to December 6. In the weeks that followed, these rates increased further and at year-end market yields were at or near the postwar highs of late 1959.

Most market interest rates were very stable in the first half of 1965, before a general uptrend began. By the end of November, yields on corporate, municipal and long-term Government bonds had increased approximately 20 basis points or 0.2 per cent. These rates increased further in December, but only about one-third as much as in the June-November period. Rates on Treasury bills, which rose 30 to 40 basis points between June and November, depending on maturity, moved up by a somewhat larger amount in December.

The increase in the discount rate in early December placed this rate in a more normal relationship with the market rates that already reflected the upward push of credit demands. At the end of November, the 90-day Treasury bill rate had been above the discount rate by as much as 12 basis points for two months.

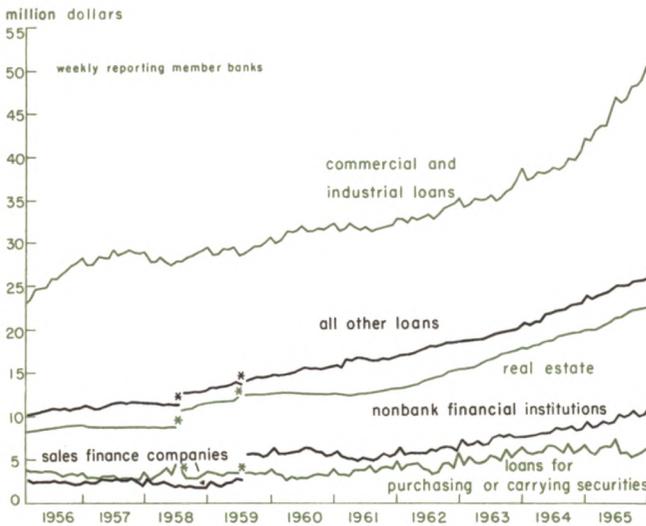
When interest rates rise, many observers suggest that money is getting "tighter" and, similarly, historically high rates are equated with "tight money." Interest rates, of course, are the price of the use of borrowed money. Like other prices, rising interest rates indicate an increase in demand relative to supply. During 1965 the supply of money and credit rose more rapidly than in past years, but demands for credit, particularly business loans, rose even faster.

Federal Reserve System purchases of Governments were sufficiently large during De-

cember that excess reserves of member banks exceeded member bank borrowings during a portion of the month. Thus, "free reserves" were positive. During most of the year, borrowings were greater than excess reserves. By the measure of free reserves, therefore, as well as by the measures of the rate of bank credit expansion or deposit growth, money and credit were easier, *not* tighter, in December despite the uptrend in short-term interest rates.

Additions to bank reserves in a magnitude sufficient to prevent the rise in interest rates that occurred during the second half of 1965 would have been accompanied by an even faster rate of growth of money and credit. In view of existing demand pressures upon resources of labor, materials and plant facilities, such a policy would have intensified the upward drift of prices and threatened the sustainability of economic growth.

Business borrowings led bank loan expansion



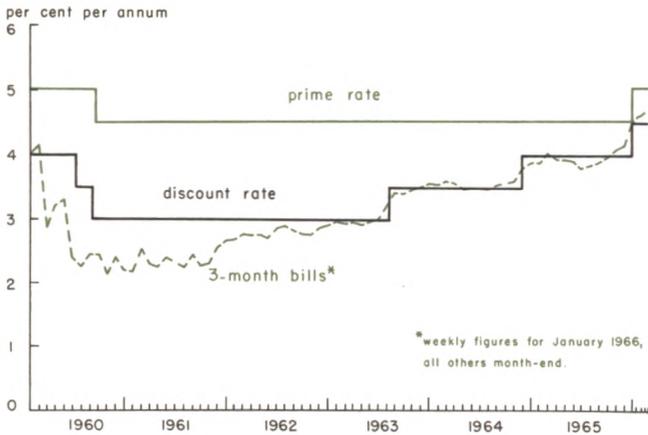
Capital outlays still strong

The latest survey of business plant and equipment spending in the United States—released in December—indicated that these outlays would exceed the total of the previous year by more than 15 per cent. Nine months earlier the increase was expected to be less than 12 per cent.

From 1961 to 1965, capital expenditures rose more than 50 per cent. Only once before in the post-war years did these outlays increase in four successive years. The period of 1949 to 1953, which included the Korean War, saw a rise of 47 per cent.

The capital spending boom of the Sixties is far from ended. In fact, it appears to have received

Interest rate increases reflect strong credit demands



additional impetus in recent months. A Government economist has suggested an increase in capital expenditures in 1966 of 12 per cent, and some private observers foresee a rise of 15 per cent or more, equaling the large gains in each of the past two years.

A recent Department of Commerce survey shows that managers of firms accounting for 49 per cent of all manufacturing assets believed in September 1965 that they needed more plant and equipment. Only 39 per cent had held this view a year earlier. For producers of durable goods, these proportions were 49 per cent and 36 per cent, respectively. It is likely that additional managements have made upward re-evaluations of their needs for facilities in recent months.

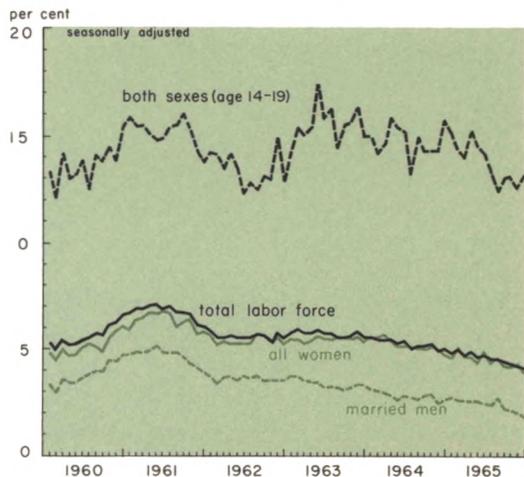
At the end of December, order backlogs of producers of durable goods amounted to 62.1 billion dollars, up 15 per cent from a year earlier. For machinery producers backlogs were up 21 per cent and equaled 3.2 months' shipments, compared with 2.9 months' a year

earlier. For certain long lead-time capital goods, delivery times have lengthened to the extent that some customers have been reluctant to place orders or have turned to second best choices, including used equipment.

Reduced availability is having a serious effect upon exports of some types of machinery and equipment. Domestic orders for machine tools rose 30 per cent in 1965, but export orders were down 27 per cent.

Purchasing agents have voiced concern in recent months over "shortages" of aluminum, zinc, brass and copper products, molybdenum, bearings, castings, forgings, certain chemicals and paper and cotton products. Electric, gas and telephone utilities have experienced an unexpected narrowing of their margins of operating capacity at peak loads.

Unemployment declined for all classes of workers in 1965



Under these conditions, it is understandable that business plant and equipment programs after five years of expansion are more vigorous than ever and that particularly large increases are projected by the utilities, chemicals, textiles, paper, and machinery and equipment industries.

In time, expansion and modernization programs now under way will serve to increase capacity and dampen inflationary pressures. While these programs are accelerating, however, they utilize manpower, materials and facilities that otherwise would be available for production for current consumption.

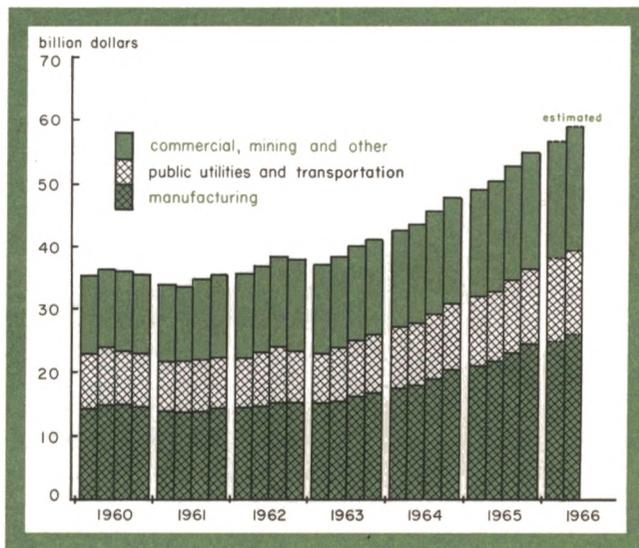
Manpower limitations

Nonfarm wage and salary employment averaged 60.4 million in 1965, 3.8 per cent more than in the previous year. This gain was exceeded only in the 1950-51 comparison. Manufacturing employment, averaging 18 million last year, was up 4.0 per cent from 1964 and for the first time exceeded the peak reached in 1953.

Employment gains in the five states of the Seventh Federal Reserve District were greater than for the nation from 1964 to 1965, with total employment increasing 4.1 per cent and manufacturing employment 5.3 per cent.

As 1965 drew to a close, it was clear that increases in output and employment in the Midwest were being limited by the availability of workers. Unemployment rates below 3 per cent were reported for many large centers. Rates of 2.3 per cent for Chicago and 2.1 per cent for Detroit in October were the lowest on record. Labor market analysts in both of these major areas considered de-

Rise of plant and equipment outlays is continuing in 1966



mands for workers to be the strongest since World War II, surpassing the situation existing in the mid-Fifties or the Korean War.

Manufacturers have been using substantial amounts of overtime. For the nation, workweeks in manufacturing averaged 41.2 hours in 1965, one-half hour more than in the previous year when average weekly hours equaled the postwar high reached in 1953 and 1955. Weekly hours of Michigan manufacturers averaged 44.5 last year, and averages for Illinois, Indiana and Wisconsin also exceeded the nation's by an appreciable margin.

The strength of demand for workers in the Chicago area in recent months has been highlighted dramatically by the trend of newspaper want ad linage. During the fourth quarter of 1965, an index of these ads in Chicago's papers was up 75 per cent from the

same period of 1964 and was two and one-half times the level of two years earlier. In addition, employers attempting to fill a variety of jobs have undertaken additional means of recruiting workers, including direct mail campaigns.

Complaints of higher labor turnover and labor pirating have become more common. Worker mobility is desirable and necessary if individuals are to move to the jobs for which they are best fitted. But each new employe must be trained and acclimated before achieving his full potential. Frequent job changes, of course, tend to reduce productivity.

To obtain adequate staffs many employers have lowered hiring standards for new workers. Meanwhile, more older employes, often the most skilled and productive, are taking advantage of opportunities for early retirement.

All of these factors tend to slow the gains in output per worker, made possible by new equipment and techniques, which have been so important in increasing output and in holding labor costs in check during the past

several years. The following table shows a steady slippage in the ratio of increases in output to increases in employment:

	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>
	(per cent increase)			
Total output	6.6	3.8	5.0	5.5
Nonfarm employment	2.8	1.9	2.8	3.8
Ratio	2.4	2.0	1.8	1.5

Last year the average civilian labor force, those working or actively seeking work, rose about 1.4 million. This required the addition of many workers—especially women and the elderly and teen-agers—whose attachment to the labor force is not strong. Another large labor force increase is anticipated in 1966, mainly because of the increased number of young people graduating from or leaving high schools and colleges. An added demand factor is anticipated, however, because the armed forces are expected to be enlarged. If the Council of Economic Advisers' forecast of a rise in total spending on goods and services in 1966 of 6.5 per cent is realized, it is probable that demands for workers will strengthen further relative to the supply.

Fertilizer

Big changes in production and distribution

Commercial fertilizer compounds, although developed a little more than a hundred years ago, did not come into widespread use until the early 1900s. The industry has shown a pattern of evolution familiar to the American scene—consisting of improving technology, better organization, more efficient transportation, rising demand and broadening markets—but with unusual clarity.

The demand for fertilizer materials has increased sharply during the period since World War II. Relatively high prices for agricultural commodities and Government restrictions on acreages of a number of the

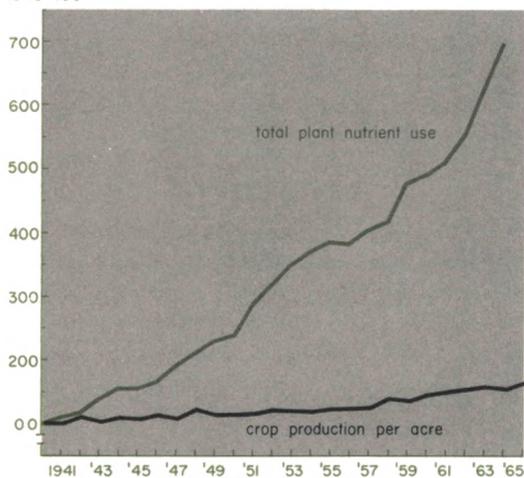
major crops resulted in more intensive farming and helped to boost fertilizer usage. Farmers have been able to boost production, in part, by applying larger amounts of plant nutrients. The demand has been boosted also by improvements in financing; fertilizer dealers, country banks and other lenders have extended a growing volume of credit for fertilizer purchases.

Concurrent with the increase in demand, important changes have occurred in the production and distribution of plant foods. Production capacity has been greatly expanded. New production processes have permitted development of fertilizers which are more concentrated, easier to handle and more effective in promoting growth of plants. Through mergers, acquisitions and construction of new facilities, the major firms in the industry have become increasingly integrated—both horizontally and vertically.

Producers have attempted to expand markets and improve operating efficiencies by broadening their lines to include all the primary plant nutrients—nitrogen, phosphate and potash. They have further attempted to strengthen their market position by extending their operations through several stages of the distribution channels. The traditional distribution channel included a number of distinct stages. Fertilizer materials typically moved successively from primary producers to wholesale distributors, to mixers, to retail outlets or local dealers and, finally, to farmers.

Efforts to boost yields result in expanded fertilizer demand

1940 = 100



As primary producers tended to develop their own distribution systems, often selling directly to farmers, the marketing chain was shortened and the linkage between manufacturers and farmers has become much closer. Furthermore, the development of bulk blending and liquid fertilizer facilities have improved efficiency and permitted the production of products adapted more closely to individual farmer's needs. The distribution of fertilizers also has been affected by the establishment of "farm service centers" which handle a variety of fertilizer materials as well as other farm supplies.

The major producers of petroleum products have contributed to many of the changes in the fertilizer industry in recent years. Virtually every major oil company has become a producer of anhydrous ammonia, an important nitrogenous material, utilizing their readily available supplies of natural gas as a raw material.

More than one-third of the ammonia production capacity in 1964 was controlled by companies commonly classified in the petroleum industry. Furthermore, these firms have complemented their production of nitrogenous materials by acquiring or merging with firms engaged in the production of phosphate and potash. Also, drawing upon their experience in the distribution of petroleum products, their impact upon traditional marketing practices in the fertilizer trade has been significant.

The "N"

Commercial fertilizer materials contain one or more of the basic plant nutrients—nitrogen, phosphorus and potash. Nitrogen is by far the most abundant and the only fertilizer material commonly occurring in the atmosphere. The earth's atmosphere contains about 75 per cent nitrogen by weight. How-

Higher analysis fertilizers have been developed

	Available plant nutrients*			
	Nitrogen	Phosphorus	Potash	Total
	(per cent)			
1945	4.0	10.3	7.5	21.7
1950	4.0	10.9	8.3	23.2
1955	5.2	11.9	10.8	27.9
1960	6.4	13.1	12.0	31.6
1963	7.2	14.5	12.5	34.3

*Average analysis of mixed fertilizers consumed in the United States.

ever, before nitrogen can be utilized by plants, it must be combined with other elements by either chemical or biological means. An example of a biological process is the transformation of atmospheric nitrogen by nodule bacteria which live on the roots of plants known as legumes (clovers, soybeans, etc.).

By far the most important commercial method for converting atmospheric nitrogen into forms usable by plants is the synthetic ammonia process, involving the reaction of pure nitrogen and hydrogen under high temperature and pressure to produce anhydrous ammonia. This compound may be injected directly into the soil or converted into other fertilizer materials. Although hydrogen, the more costly raw material, can be readily produced from several carbonaceous substances, as well as the electrolysis of water, the most important source is natural gas. Indeed, more than three-fourths of the commercial production is obtained from this source.

During the past two decades, the capacity to produce synthetic anhydrous ammonia has been increased about tenfold. Capacity was expanded greatly during World War II and

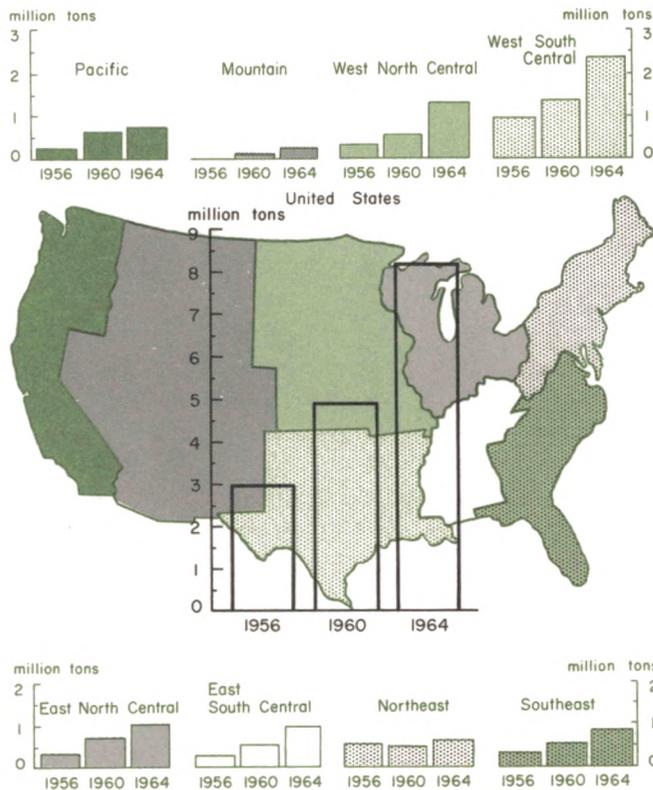
again during the Korean crisis to supply requirements for munitions. Capacity continued to grow in subsequent years largely because of the increasing demand for nitrogen as a plant food.

Production of anhydrous ammonia has increased at an average rate of about 12 per cent a year since the late Fifties. In 1958 there were 58 facilities in operation with an estimated annual capacity of 4 million tons. By mid-1964, capacity had been nearly doubled. Since then, announcements of new

facilities and expansions of existing plants indicate that capacity has continued to increase rapidly.

While the practice of applying anhydrous ammonia directly to the soil is becoming more widespread, most of the agricultural ammonia is still converted into derivatives, such as ammonium nitrate and urea. These have certain advantages because of complimentary production processes and also in ease of transportation, storage and application. Output of these products has been rising rapidly,

Nitrogen capacity increasing rapidly



SOURCE: Tennessee Valley Authority.

especially during the past five or six years. As of mid-1964, annual capacity for production of ammonium nitrate was estimated at 4.5 million tons. Several additional facilities are expected to be in operation by the end of 1966. Production capacity for urea rose to about 1.4 million tons in mid-1964 and was more than double the capacity in 1959.

The "P"

Phosphate mineral deposits are the primary source for commercial fertilizers. Bones, iron ores and phosphate slags (obtained as by-products in steel manufacturing) also have served as sources of phosphorous fertilizers but now are of minor importance. The mineral deposits are widely distributed throughout the world with important ones located in the southeastern and western parts of the United States. Although the largest deposits in this country are located in the West, most of the mining—about 70 per cent—is in Florida. Tennessee and the western states account for most of the remainder. Extensive phosphate reserves in North Carolina are being developed currently.

Almost all of the phosphate rock is produced by strip-mining; a small proportion of production in the western states is by underground mining. Consequently, preparation of the material requires elaborate screening, washing and flotation treatment to separate the phosphate from clay, sand and other impurities.

Some finely ground rock phosphate is applied directly to the soil, but most of the phosphate is converted by various chemical processes into forms that are more concen-

Phosphoric acid facilities widely dispersed



SOURCE: Tennessee Valley Authority.

trated and more readily utilized by plants.

In past years, most of the phosphate fertilizer has been manufactured by mixing ground phosphate rock with sulfuric acid to yield a relatively low analysis fertilizer called normal superphosphate. Later, as phosphoric acid became readily available, more concentrated fertilizers—such as triple superphosphate and ammonia phosphate—were developed.

Total production of phosphatic fertilizers has increased steadily during the past several years, but production trends of the three major compounds—ammonium phosphate, concentrated superphosphate and normal superphosphate—have been diverse. Normal superphosphate production has declined rather steadily during recent years, while production of ammonium phosphate has more than tripled since 1959 and production of concentrated superphosphate has increased about one-third. The latter two fertilizer products are cheaper to transport, handle and

apply per unit of plant food because of their higher analysis and this undoubtedly is an important reason for their relative gains in production.

Production capacity for both of these more concentrated phosphatic fertilizers continues to increase. As of mid-1964, there were 36 facilities producing ammonium phosphate with an estimated capacity of about 1.4 million tons annually and several new facilities were being constructed and others expanded. Similarly, several new plants and expansions were scheduled for production of concentrated superphosphate, further boosting the annual production capacity from the estimated 4.6 million tons as of mid-1964.

As a result of the expanded demand for the higher analysis phosphatic fertilizers, the production of phosphoric acid also has been increased rapidly. Since the mid-Fifties production of this product has more than doubled and scheduled construction of several new plants indicates that this expansion is continuing.

The "K"

Potash bearing rock is widespread throughout the world. Often, however, it is in the form of insoluble minerals unsuitable for agricultural purposes.

Potash fertilizer in the form of water soluble salts is obtained chiefly from underground deposits and secondarily from salt lakes and other potash brines. The most important recovery method is the crushing of the ore and separation from impurities by washing and flotation. In other cases, potash is recovered by solution and crystallization.

Potash expansion mainly in Canada



SOURCE: Tennessee Valley Authority.

While a small portion of potash is applied directly to the soil, most potash is applied in conjunction with nitrogen and phosphate. In 1963, for example, only about 14 per cent of the 2.5 million tons applied was used in direct application to the soil. Potassium chloride accounted for almost all of this material although potassium sulfate and other potassium products were utilized in limited amounts on plants such as tobacco that will not tolerate large amounts of chlorine.

Commercially important solid deposits of potash are found in New Mexico and Utah while brine sources are located in California and Utah. Substantial new potash deposits are currently being developed in Canada and are expected to contribute substantially to available supplies.

Within the current decade annual production capacity of potash in the United States and Canada is expected to more than double from the nearly 4 million tons estimated in 1964. While some of the expansion is sched-

uled in the United States, both in New Mexico and in Utah, about three-fourths of the expansion is scheduled in the province of Saskatchewan, Canada.

The quiet revolution!

Paralleling the striking changes in production, equally significant innovations have occurred in the marketing and distribution of commercial fertilizers. Traditionally, producers of nitrogen, phosphates and potash have sold these products almost exclusively to "independent" manufacturers of mixed fertilizers. These manufacturers combined the various materials to produce fertilizer suited to particular crops and regions. The products were distributed on a wholesale basis to retail outlets, such as feed and seed stores, that in turn sold to farmers.

Inventory and collection problems existed at each stage of the marketing chain and primary producers of fertilizer materials often had little impact on or control over the sales of the final fertilizer products. Furthermore, this system was adaptable to relatively few materials and only to standard grades which often did not meet individual farmer's needs satisfactorily. In recent years, efforts to reduce costs, improve financing, develop better control over sales and to produce and market materials adapted more closely to farmer's needs have resulted in many changes in distribution patterns. These changes were affected also by the rapid increase in volume of fertilizers utilized by individual farmers and their specific demand for ingredients, based on knowledge gained from soil test and other sources. It is currently estimated that well over one-half of the fertilizer materials are moved to farms through channels that are owned or controlled by producers of the basic fertilizer materials.

One of the most significant developments

in the marketing of fertilizer during the past decade has been the emergence of bulk blending and handling and the greater use of liquid fertilizer mixtures. Bulk blending is the simple mixing together of several dry fertilizer materials to provide the combination of plant nutrients desired. (Conventional fertilizer mixing normally involves combining liquid and dry materials which are then dried, ground and bagged.)

Bulk handling of fertilizer materials and the rapid growth in the number of bulk blending facilities have been possible because of the development and ready availability of high analysis and uniform granular fertilizer materials. These have less tendency to cake than fine materials and hence are free flowing and almost dustless. The rapid increase in the volume of fertilizer used by individual farmers also has contributed to the rise in bulk handling.

About 200 bulk blending facilities were in operation in 1959; by 1965 the number apparently had risen to more than 2,500. Most of the increase has occurred in the midwestern states where about three-fourths of the plants are located. However, during the past couple of years the number of bulk mixing facilities has increased rapidly also in the Southeast and West.

Liquid mixing plants, too, have increased rapidly. The availability of both phosphoric acid and liquid nitrogen compounds has improved, as have equipment for transporting, handling and applying liquid materials, all of which help to step up the acceptance of these materials by farmers. The number of facilities has increased rather steadily from about 335 in 1959 to well over 700. Like bulk mixing facilities, the greatest concentration of liquid mix plants is in the Midwest where more than half of the total number is located.

Because of the comparatively small invest-

ment required, blending facilities can be located close to fertilizer markets. The blended materials—both bulk and liquid mixtures—often are prepared to the precise specifications prescribed by farmers as indicated by soil test and often are custom applied.

The trend toward supplying fertilizer materials by these methods appears likely to continue. Estimates by the Tennessee Valley Authority indicate that about one-fifth of the fertilizer market is served by the bulk method while liquid mixtures account for about 5 per cent of the total. Within the next decade, bulk blending could account for nearly half of the market for solid fertilizers, according to the TVA, and with further development of high analysis liquids, it is indicated that liquid mixtures may account for 10 to 15 per cent of all fertilizers.

Paralleling and often associated with the expansion of bulk and liquid fertilizer blending facilities has been the establishment of agricultural or farm service centers. Many of these centers have taken on the appearance of a farm supply supermarket, providing fertilizers, petroleum products, plant and pest inhibitors as well as management services, including advice concerning soil fertility levels, plant populations, weed control and animal nutrition. The multi-line of products and services, many of which are highly seasonal, enable the operators of these centers to spread their overhead expense over a large volume of sales.

Moreover, such establishments are convenient for farmers, often enabling them to purchase a number of needed items from a single source.

The commercial fertilizer industry will undoubtedly continue to change and expand as new technologies become available and as the demand for plant nutrients increases further.

sion will be maintained or accelerated over the next few years is an open question—but there is little indication that the industry has stabilized.

The differential between fertilizer consumption and the estimated capacity to produce these materials would appear to be widening for some products. However, with further market expansion, normal plant obsolescence, and because of necessary seasonal swings in production, this differential may be more apparent than real. Certainly, the optimum levels of fertilization in the United States and especially in the underdeveloped regions of the world, have not been reached. Food shortages presently exist in many of the populous and lesser developed countries and with ever increasing populations it is possible that these shortages will increase. Along with other measures, expanded use of fertilizer materials could help to improve this situation.

In addition to the prospects for further expansion in the production and use of plant nutrients, other facets of the industry apparently will continue to experience rapid changes. Equipment and techniques for transporting, handling and applying fertilizers are being steadily improved. The addition of "micronutrients," "secondary" nutrients (such as copper, zinc and sulfur which are needed in some regions for optimum plant growth) and pest control chemicals to fertilizer mixtures may become widespread. Also, fertilizers that release plant nutrients at desired rates throughout the growing season or over even longer periods may become common. Scientists may be only on the threshold in the development of higher analysis fertilizers and plant nutrients that would be more readily available to crops. Development of plants that have greater capacity to utilize commercially supplied plant foods also may be in its early stages.