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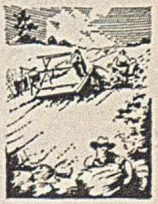
WHAT'S AHEAD FOR CHEMICAL ENGINEERING?

This issue is concerned largely with the present prospects for the group of industries that depend upon chemical engineering technology. It recognizes the limitations of prophecy, especially at a time when basic readjustments are still being made in our political and economic structure. But it proposes to look critically and squarely at the future, first from the immediate viewpoints of those several fields in which chemical industry now finds its major market and second, from the longer range view of chemical engineering opportunities in newer and more rapidly changing phases of industrial activities. This approach in itself outlines the two directions in which we can look for further progress. In other words, full prosperity must inevitably depend upon general recovery of the basic industries of the country, but in the meantime chemical engineers can literally lift themselves by their own boot-straps if they can produce new products and processes for fields that have not yet felt the stimulating influence of chemical technology.

First place is given to the textile industry, not only because it is the largest user of chemicals, but also because it offers the most promising opportunity for the chemist and chemical engineer. Research, now slowly getting under way, is likely to prove an entering wedge for a new technology in this oldest of manufacturing industries. And, fortunately, immediate prospects also look unusually good. Our commentator predicts, with a fair degree of confidence, that this year will show an increase of 7 to 10 per cent over 1932. Let us hope he is right, for that means more business in dyes, soap, oils, starches, alkalis and the many other textile chemicals.

Agriculture—our largest industry in point of employment and our most basic as a producer of raw materials—suffers from the lowest farm prices in thirty years. With it suffer directly the fertilizer and insecticide industries, but indirectly every chemical business that depends on the purchasing power of the ultimate consumer. Therefore, we are all concerned with the plight of the farmer for unless his prices are restored to a reasonable level, those for industrial products are likely to fall even lower than they are today. Chemical industry has demonstrated the investment value in commercial fertilizers, even in times like these. But it hasn't yet found a way to pay for them out of the farmer's dwindling profits.



Iron and steel, operating at a fifth or a sixth of capacity, finds immediate and disturbing effect on coke production with its ammonia, gas, tar and benzol byproducts, in sulphuric and muriatic acids for pickling, zinc for galvanizing, in magnesite and chrome for refractories. It is not widely known, but even before 1929 there was a decline in steel pro-

LOOKING FORWARD INTO 1933 WITH PROCESS INDUSTRIES

An Editorial Interpretation and Summary of Major Economic Trends as Revealed by Data Presented Here and Elsewhere in This Issue

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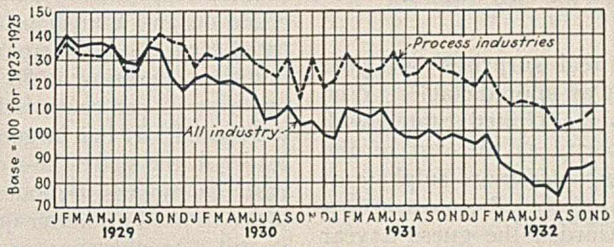

PROCESS industries, as a group, parted company with "All Industry" in September, 1929, and so far during this depression have operated at a relatively higher level of activity as gaged by their consumption of electrical energy. The reason for this divergence is first of all a highly diversified market for their products and an inherent flexibility in makeup that permits them to adapt themselves quickly to changing conditions. Furthermore, as industries go, many of the process group are relatively new and still in the growing stage of their development. As we go farther into the depression—or come nearer to its end—there is a lagging tendency on the part of some of the so-called "heavier industries" that serve iron and steel, construction and agriculture while the "lighter industries" that produce consumer goods continue to resist the general downward trend. In 1933, therefore, we must expect a mixed trend but the group as a whole should continue to operate well above the average for "All Industry." Most prices are somewhat lower but economies that have been effected through plant improvements and modernization assure the maintenance of fair earnings except in a few sorely tried industries.

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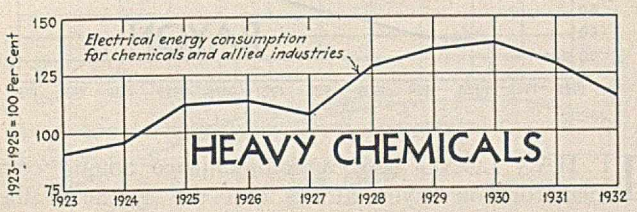
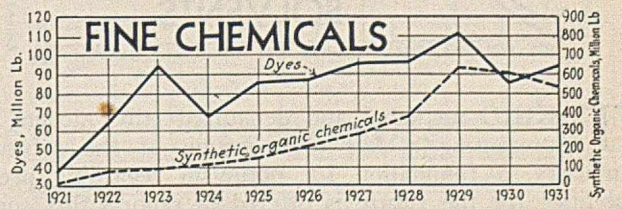
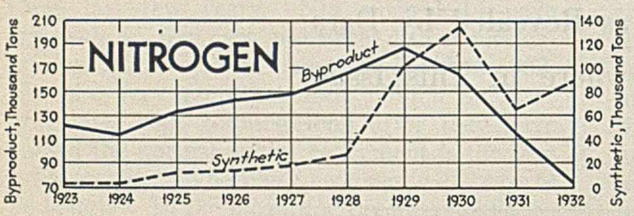


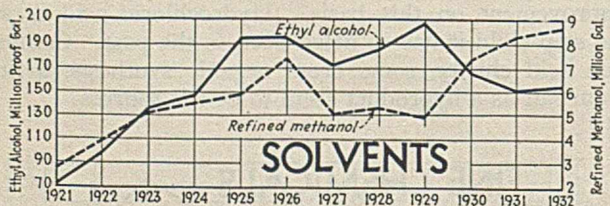
WHERE their markets lie, there lie the 1933 fortunes of the heavy chemical industries. Sulphuric acid, so largely dependent on agriculture through its intermediary, fertilizers, can expect no quick improvement in that line. Nitric acid, likewise hinges to a considerable extent on fertilizers and explosives but here the situation is somewhat better if we can continue to export synthetic sodium nitrate in competition with the natural product. What effect the liquidation of Cosach may have on such exports, only the future can tell. Principal markets for alkalis have been well maintained, everything considered. Some of them, notably glass containers, are in a fair way to improve. Salt, both raw material and consumer goods, finds its first-quarter shipping prospects some 7 per cent below the same period of 1932. Shippers of heavy chemicals in general, on the other hand, anticipate a 7 per cent improvement on this basis. Hydrochloric acid is still the step child it has so often been in the past. Combustion acid chiefly, some from organic synthesis, a little from salt as a byproduct seem to be the sources.



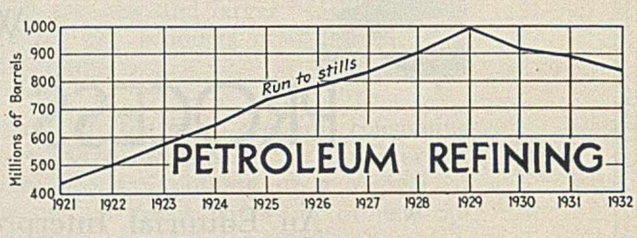
FINE CHEMICALS interpreted here to mean dyes and organic synthetics, had a fairly good year in 1932 and look forward to business increased by perhaps 5 to 10 per cent in 1933. Last summer's resumption of activities in textile mills marked the turning point for the dye industry which closed the year at a better rate of production than at any time since 1929. Depression demand for cheaper merchandise, not only in textiles but in leather, paper and rubber goods, seems to have called for an increasing use of chemicals as fillers and extenders, weighting agents, etc. Synthetics, such as plastics, used in consumer goods, were also favorably influenced by this demand for lower priced merchandise. New solvents and refrigerants came into large use in 1933. Research and development being more active in this field than any other, assures continuous growth since new and non-competitive uses will always supplement the existing highly diversified market for synthetic organic chemicals.



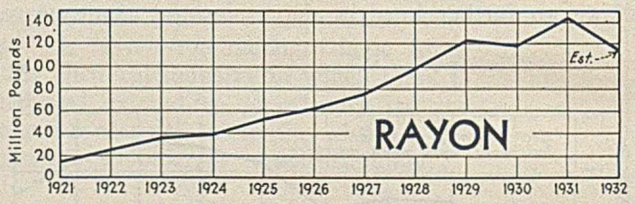
NITROGEN sprang some real surprises last year and 1933 continues almost as unpredictable. Who would have ever thought that the United States with almost as much coke-oven capacity as the rest of the world combined, should have *imported* more sulphate of ammonia than it *produced?* And even the most ardent advocate would never have hazarded the guess a year ago that we would *export* more synthetic sodium nitrate than our total *imports* of the natural product from Chile! Nor would it have seemed probable that agriculture would substitute large quantities of ammonia for nitrate nitrogen even with the abnormal price relations which prevailed. Yet that's just what we did in 1932. Slight stiffening of prices with no indication of excessive stocks of ammonium sulphate would seem to lend encouragement to the view that profit prospects are at least better than a year ago. On the other hand, with Cosach in liquidation and complete capital reorganization certain, it would be hazardous to predict anything more than a year of uncertainties with the depression as likely to favor the natural as the synthetic producer of nitrates.



TAKING methanol and denatured ethyl alcohol as representing a fair cross-section of the solvents industry, a foundation for optimism regarding probabilities for the future is offered in reports that some of the largest consumers of solvents are working into a more favorable position. Rayon started the year at a high rate of production, automotive schedules are laid out on a broader basis than was attained in 1932; and chemical production for the first quarter of the year is estimated at an increase of 7.5 per cent over the corresponding period of last year. New solvent-consuming outlets were opened up last year and new solvents attained commercial importance. Progress in that direction may assume a trend which will be important in shaping future production.

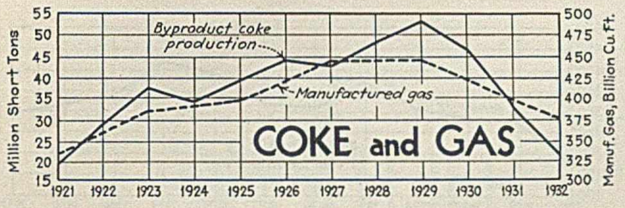


PETROLEUM run to stills in 1932 was down less than 10 per cent from the preceding year—a favorable record compared with the decreases in most industries. And since consumption of about 870,000,000 bbl. exceeded production by some 80,000,000 bbl., the industry improved its statistical position largely as a result of crude oil production curtailment. But lower prices for crude oil and a flush production at the year's end, indicated that the problem is still pressing. The refining industry operating at 55 to 70 per cent of total capacity but over 95 per cent of the capacity of its cracking units were used. It has largely maintained personnel, being a leader in the share-the-work program and it has used the past few months to modernize manufacturing facilities in order to produce better quality of products. Distribution is still a troublesome problem. Bootlegging of cheaper grades of gasoline is demanding corrective attention. Prospects for 1933 are for a slight decline in sales due in the earlier months to the general expectation of colder weather and for the year as a whole to the indicated fall in registration and use of motor vehicles.



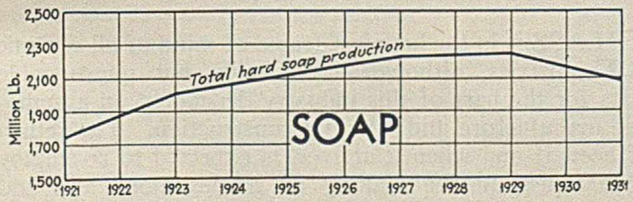
IT HAS LONG been a commonplace among commentators on rayon affairs that the synthetic fiber industry could, if it would, control its production and, in distinction to the fortuitous nature of natural fibers, avoid the misfortunes of the fat and the lean years. This the industry attempted for the first time during 1932 when a summer shut-down followed a fall in price which slid producers to new depths of unprofitableness. When textile demand suddenly awoke in the late summer, plants reopened to better prices and almost capacity activity which continued to the end of the year. With the advent of 1933 the industry is hopeful, at least for the first six months which is as long a period as prognosticators care to think about. During this time, it is anticipated that the present rate, or something near it, can be maintained.

Technically, trends are at present hazy. During the past year acetate and cupra silk increased, nitro about held its own while viscose bore the brunt of the 18 per cent decrease from record 1931. New rayons are not near, although crease-proofing of fabrics is a fact and probably an important one. A little increase for viscose, and larger percentage increases for acetate and cupra seem to be in the stars for 1933.

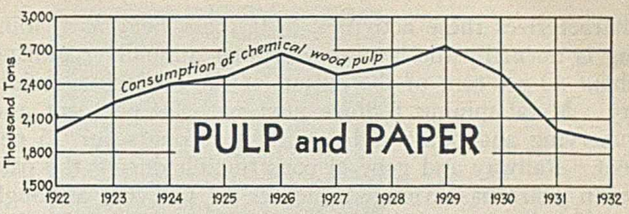


COKE and other coal products made in byproduct oven depend primarily on the iron blast-furnace requirements of the country, and only secondarily on city-gas demands. Production in 1932 was, therefore, at the lowest ebb since pre-war, with the exception of 1921, which year about equaled 1932. Renewed upward trend in production of coal products depends on further recovery in steel demand. No shortage of coal products has resulted because of balance-wheel influences elsewhere in industry. Use of coke as a gas-making fuel continues to shrink as water gas is supplanted by other manufactured gas types or by natural gas. Household use of coke as solid fuel has apparently been well maintained, despite keen competition of bituminous and anthracite coal; oil for house heating has proved a more successful competitor.

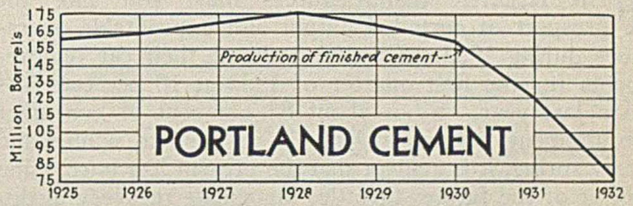
City gas requirements have declined less than almost any other division of industrial activity. Household and commercial use has declined less than 5 per cent, and industrial use only a little more than this in the case of manufactured gas, but as much as 15 per cent in the case of natural gas from city supplies. Demand for city gas in 1933 is prospectively somewhat greater than in the past year, probably nearly equaling the peak demands for all time.



BECAUSE its distribution depends very largely upon the direct consumer, soap products have been but little affected by the decline in industrial operations. The position of domestic markets does not indicate any material change in consuming demand from that of 1932. The export outlook points to some curtailment. The industry has been favored with a wealth of unusually low-priced raw materials but the finished product also has been subjected to price revisions and the new year opened with an announcement of a further reduction in price for some of the larger tonnage items. Lower sales prices will be largely offset by reduction in costs.

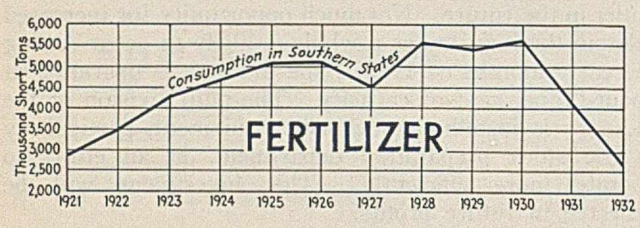


PULP AND PAPER as an industry parallels general business very closely. Newsprint depends on advertising, boxboard on commodity shipments, and wrapping paper on retail sales of general merchandise. Newsprint, book and writing paper have developed a slightly better trend, but the specialty goods are proving to be the "best sellers." Much more consideration will be given this outlet in the future. Not much opportunity for increased sales in the industry as a whole is likely to occur during the early months of 1933. The industry is operating at about 60 per cent of capacity. The pulp division of the industry is installing much new equipment, particularly in the stock preparation department, in an effort to operate more efficiently. This investment will be reflected in future profits.

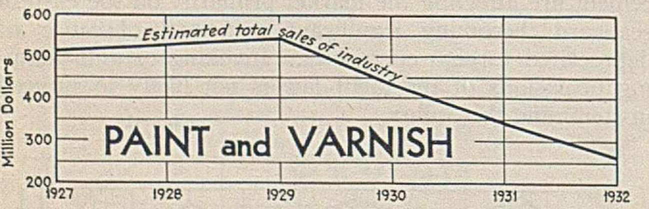


CEMENT consumption varies most importantly as highway construction rises or falls. Public opinion regarding new bond issues or new taxes for highways therefore becomes of foremost concern to the cement manufacturer. Since the average citizen is becoming extremely tax conscious, much further expansion in highway building even as a measure of unemployment relief can not be expected and material curtailment of this important cement market may result. Other engineering construction, in which cement is important, gives greater promise of renewed vigor in 1933. Imports of foreign cement are affecting the market primarily on the eastern seaboard, becoming significant principally because of depreciated foreign currencies. Invoking of anti-dumping provisions of the tariff law is not likely to succeed in stemming this influx.

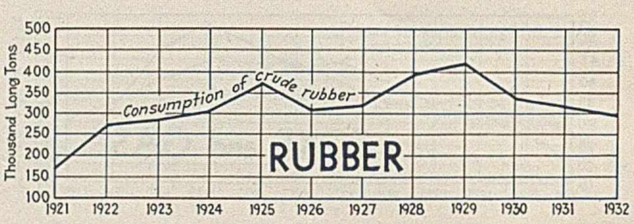
EXPLOSIVES serve primarily the basic fields of coal and ore mining and construction. The output since 1929 has faithfully reflected the abrupt decline that characterizes these activities. Of these fields coal mining is normally the largest consumer annually requiring about 40 per cent of the output of the explosives industry. Metal mining follows next with 20 per cent and quarrying and non-metallic mining accounts for 15 per cent. Railway and general construction during the past seven years has averaged another 15 per cent although in 1932 almost a third of the output was so used. During the past year the explosives industry as a whole operated at approximately 50 per cent of the average for the past ten years. It hit a low spot in the middle of 1932, gained steadily in the last quarter of the year, entering 1933 with every indication of maintaining the usual seasonal increase during the early months. What happens after that depends upon industry in general.



FERTILIZER manufacturers must still face the prospect of curtailed output and unprofitable operations during 1933. Shippers estimate their car requirements for the first quarter of 1933 at 10 per cent less than last year. Since about 85 per cent of consumer requirements are normally sold in the late winter and early spring, it is evident that the present low purchasing power of the farmer throttles immediate recovery in this industry. If the domestic allotment plan or other form of farm relief should be adopted the fertilizer industry would not be benefited until the following year, if at all. In depression, nitrogen usually suffers first but low prices have helped it to resist this trend. Large-scale development of new domestic potash sources forecast an intensely competitive situation. Already, phosphate problems made acute by abnormal imports of Russian, Canadian, Moroccan and Japanese phosphate are receiving official study; but no "relief" to the domestic industry can offset the trouble which come from pinching the pocketbook of the farmer.

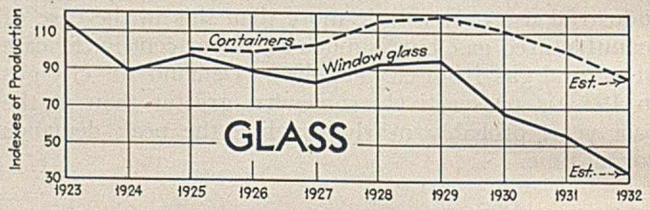


DURING the past year, most people have merely paid for taxes, food and the absolute essentials of life, and as a result, the automobile, building construction and furniture industries, all important consumers of paints, varnishes and lacquers, have passed through a period of greatly reduced production. Further, repairs and paintings have been delayed. As a result, the quantity of painting that must ultimately be done is growing rapidly and, therefore, when business has definitely revived, it is conceivable that the paint industry will be one of the busiest. Traffic men in the East estimate that 8.6 per cent fewer cars will be required to handle the shipments of paint, varnish and lacquer products in the first quarter of 1933 than were used in the corresponding quarter of last year. However, the general outlook for the year is fair. There has already been an increase in production activity and retail trade has shown some improvement.



INVENTORY of automobile tires is at least a million units lower than a year ago. It has been estimated that, in addition to new car equipment, about 30,000,000 tires will be sold for replacement in 1933 against 32,000,000 in 1932. With the return of confidence, which is generally expected, the volume of tire sales in the new year, should come somewhere close to 50,000,000. Producers confidently feel that their industry will be among the first to respond to the general economic improvement.

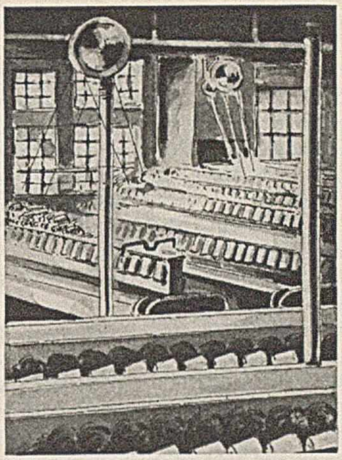
The mechanical goods division of the industry will probably continue to give a fairly good account of itself. While the tennis shoe production has felt the effects of foreign competition, the boot and shoe division as a whole should continue the success it has had in the year just ended. The outstanding feature in the rubber industry is the prospects for increased prices for raw material, rubber and cotton during the next few months.



GLASS is in the happiest frame of mind of all ceramic industries, although 1933 holds but questionable gifts for the part of this industry dependent on automobile manufacture and building construction. The return of beer, if and when it arrives, is expected to re-employ 24,000 men in the making of bottles alone and add many cars to the railroads' traffic. Industrial glassware makers are gleeful in anticipation of the tubing they will sell to breweries. Chemical manufacturers who supply the container industry are hopeful but not fully convinced that the estimates are sufficiently sanguine. Makers of the new architectural glassware are evolving new products—and waiting.

Refractories, depending both on new construction and on maintenance, are in the doldrums. The maintenance outlook, fortunately, is improving with each passing day. One bright spot in heavy ceramics is in chemical stoneware which, of course, moves with the chemical industry. Here the situation has recently improved and the makers anticipate a much better year than 1932.

An authority appraises the immediate prospects for improvement in one of chemical industry's best customers



WHITHER TEXTILES?

By DOUGLAS G. WOOLF

Editor, Textile World
New York City

TO GET IT over with, I shall take the plunge into the realm of prophecy in the first paragraph of this article. If I were selling to the textile industry, and wanted to budget sales for 1933, I would base my estimate upon an expectation of approximately 7½ per cent increase in textile mill activity over 1932. Moreover, I would feel that I was taking the conservative side—and would be prepared for the pleasant surprise of, say, a 10 per cent increase.

Readers who expect a forecast to be accompanied by a diagrammatic explanation will be disappointed. This is not that kind of prediction. True, it is not merely a hunch; but, on the other hand, neither is it the result of a straight statistical calculation. It is rather the product of a "picture-puzzle" method—being based upon a study of the industry's performance over a period of years, a knowledge of current trends in textile markets, and an estimate of the course of general business during 1933. Naturally, the latter factor is the x in the equation.

After arriving at a definite estimate, we checked it with other observers in the industry and found some vindication of our unscientific procedure in the fact that their opinions coincided closely with ours, but mostly tended toward the higher percentage increase. An additional check, of interest to those who are statistically minded, is the fact that, according to one theory, the textile industry shows a two-year cycle and a "peak" is in the cards for 1933. Following this thought further, textile business is better during the first half of a "peak" year than during the last half. This, too, checks with our own opinion for this year.

The Background

In order to get a picture of what this 1933 estimate means in relation to recent years, it is necessary to indulge in a few statistics. First, let's see what has happened during the depression. Taking 1929 textile activity, based on fiber consumption, as 100, the depression years—including our estimate for 1933—rate as follows:

1929	100	1931	80
1930	77	1932*	72
1933†	77		

Extending the comparison to include a longer period, the eight-year average 1924-31 is taken as 100 and may be regarded as a "normal" year for the period under review. On this basis, recent years—including our estimate for 1933—would rate:

8-yr. av.	100		
1924	88	1929	113
1925	101	1930	87
1926	104	1931	91
1927	115	1932*	81
1928	104	1933†	87

In other words, if our estimate of a 7½-per cent increase for 1933 proves to be correct, the year will be about on a level with 1930, and only 13 per cent under what we have been rash enough to term a "normal" year. If the higher estimate of a 10-per cent increase proves accurate, 1933 will be on nearly as high a level as 1931—and only 11 per cent below a "normal" year. Either one would not be so bad for any industry under present conditions.

*Based on incomplete data.
†Estimated.

Unfortunately, however, the textile improvement of recent months has been publicized in newspaper headlines so blatantly that these figures may appear anti-climactic. The public has gained the impression that the textile industry is breaking all activity records. Here is what actually happened last year: In August, textiles experienced probably the most abrupt and most decisive transition in the history of the industry. Almost complete stagnation was replaced by a demand which, for a while at least, necessitated practically 100-per cent operation. As an indication of the change it might be mentioned that raw material consumption in October was approximately 75 per cent greater than in July. The average monthly consumption of raw material during the last five months, based on incomplete data but with the possible margin of error a narrow one, was 28 per cent greater than the average during the first seven months. This improvement did not enable the industry to break any records for the year but it transformed what threatened to be a thoroughly disastrous year into a period of activity only 11 per cent under the previous year and only 19 per cent under the average for the preceding eight years.

The causes of this turn-about are important in so far as they affect the outlook for 1933. Like most industrial movements, this one was not the result of any one factor. The combination of circumstances producing it included, among others, a critical need for replacement buying, a rise in raw material prices, and at least a psychological improvement in the outlook in business in general.

Of these, the first is probably the most important one affecting the immediate future. No matter how bad business is, people still have to wear clothes under present standards of modesty. Then, too, the depreciation limit in apparel cannot be disregarded as it often is, unfortunately, in machinery, for example. The old saying that a depression lasts as long as the seat of a man's trousers has an element of truth in it. That is why, of course, the so-called consumer-goods industries lead the way out of periods of business prostration. That is what has been happening during the last six months—and what may be expected to continue to happen during the months immediately ahead.

Despite the active buying of textiles from first hands in the summer and fall, and despite the fact that this demand partly anticipated, rather than responded to, a call from ultimate consumers, there is a good amount of textile buying still to be done. The absence of excessive stocks, by and large, in any of the channels of trade means that the industry will be sensitive to this continued demand.

Hen or Egg?

The part which advances in commodity prices played in the improvement is, in a sense, the old story of the hen and the egg. It is impossible to say just to what extent increased demand strengthened raw material quotations, and to what extent firmer prices induced covering of requirements. Nor can any blanket statement be made for all textiles. The advance in raw cotton in August, for example, was undoubtedly due to the Government estimate of a much smaller crop this year; the rayon price advance in September, on the other hand, was the result of a temporary sold-up condition. However, it is reasonably safe to say that present textile raw material prices are not inflated and that comparative firmness, with its resultant buoyant effect upon the markets, may be anticipated for the next several months.

Coming to the third factor, the outlook in general business, we have no desire to compete with authorities in that field. For our own purposes, however, we have proceeded on the assumption that the tendency toward improvement may be expected to continue—and that 1933, taking the year as a whole, should develop a higher rate of general activity than 1932.

Since the textile industry is, in a sense, a group of industries, and since chemical manufacturers are interested in the prospects in the individual branches, it is in order to comment briefly upon the outlook for the products of each of the major fibers.

Outlook in Each Branch

Cotton—The most important factor in cotton goods is the job which the industry is doing in balancing production with demand. This is best demonstrated by the reduction in stocks of goods carried by the mills. At the end of October, stocks on hand amounted to only 167,000,000 yd., as against 256,000,000 yd. on the same date last year, and an average of 341,000,000 yd. carried on Oct. 31 during the four preceding years. Actual *shipments* of goods from mills during the first ten months of 1932 were approximately 5½ per cent greater than the *production* for the same period. This element of control is the best form of insurance against market degeneration. The leadership of the Cotton-Textile Institute has been a potent factor in this direction.

Activity in the cotton industry, based on fiber consumption, was approximately 8 per cent less in 1932 than in 1931, and 20 per cent less than the eight-year average, 1924-1931.

The raw material outlook has been improved by the prospect of a sharp decrease in the crop this year as against last, but the existence of a large carry-over means that the industry is faced with a greater supply than ever before in its history. This fact is in itself the most important argument against any sharp advance in cotton prices, irrespective of the trend of demand. Such an advance, whether due to speculative manipulation or to artificial respiration supplied by some such governmental action as the much-discussed Harriman plan, or "domestic allotment act," would retard rather than advance the rate of recovery in the cotton industry.

On the consumption side, the ingenuity which has been injected into the styling of cotton goods during recent years is a decidedly favorable factor, so far as use for apparel purposes is concerned. The trend of consumption of cotton products for industrial purposes depends of course upon the trend in general business and, as indicated previously, we anticipate an increase there.

Wool — Activity in the woolen and worsted industry suffered a more acute contraction in 1932 than any other branch of textile manufacture. Based on fiber consumption, last year's operations were approximately 25 per cent less than the previous year and 27 per cent under the eight-year average, 1924-1931. However, this was due largely to a period of unprecedented stagnation in the spring. Sharp recovery was noted in the latter part of the year and the outlook for the next few months, at least, is encouraging.

In this branch, there is no such oversupply of raw material as that which faces cotton mills. In fact, there is much talk of an imminent wool scarcity. Although this is not to be taken too literally, there is every reason to expect a firm raw material market as a basis for next year's operations in the wool industry.

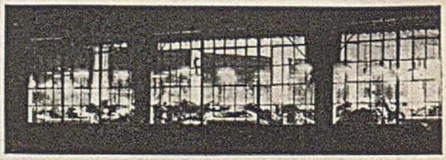
Unfortunately, this division has been handicapped by a lack of cooperation among its members. The failure of the Wool Institute left the industry largely without leadership. A movement started recently, under the auspices of the National Association of Wool Manufacturers and other organizations, offers some hope of a remedy for this situation.

Silk—Statistically, the silk branch of the textile industry did remarkably well last year. Rate of activity, based on fiber consumption, was only 6 per cent lower than the previous year, and 3 per cent *higher* than the eight-year average, 1924-1931. Unfortunately, collapse of the raw-silk market in the spring, due to conditions in the Far East, made it a difficult year, as a whole, for manufacturers. The subsequent recovery in raw material prices helped greatly, but the outlook in Japan is still too uncertain to permit any predictions on this phase. However, disregarding the uncertainty in raw silk prices, the prospect is for continued activity.

Rayon Comes Back

Rayon—Synthetic fibers staged one of their come-back acts, for which they are now famous. Their market had almost completely dried up in the spring —and radical curtailment, including complete plant shut-downs for a month or more, was put into effect. In the early summer the picture changed almost over-night, and during the last five months of the year 100 per cent operation was warranted; producers were in the pleasant position of refusing orders.

In September, the writer estimated a domestic rayon production of 115,000,000 lb. in 1932, approximately 20 per



cent less than 1931. Since this estimate was made after the improvement set in, and took its effects into account, there seems no reason to make any radical change in it at this time. Consumption may run somewhat higher, as stocks were liquidated during the rush for yarn in the summer and fall. In fact, a consumption of 120,000,000 lb., or even a little higher, is not beyond the realm of possibility. We believe that the development of synthetic fibers is still in its infancy and that it is impossible to set any limit to its future expansion. Incidentally, the increasing use of acetate yarn is worth noting—and watching.

On the price side, restricted demand in the first half of the year, in conjunction with the collapse in raw silk, led to two price cuts in June and July, bringing 150 denier viscose from 75 to 65, and then to 55 cents. In late August, the price was advanced to 60 cents. On the whole, 1932 was not a particularly profitable year for rayon producers.

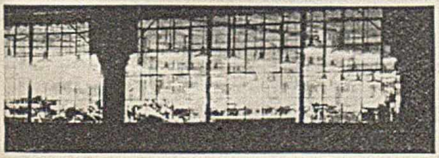
The immediate outlook in this field, so far as consumption is concerned, is favorable.

Broader Movements at Work

Thus far, we have been considering largely the immediate factors affecting the outlook in textiles. No one interested in the future of these markets, however, can afford to ignore certain fundamental forces now at work, because those forces promise to have more effect than any temporary shift in the supply-demand relationship, or any transient fluctuation in textile activity.

On the economic side, there has been developing—haltingly at times, and imperfectly at all times—a movement toward coördinated solution of the many problems facing the industry. This movement has of course been a defensive one—an attempt to counteract the inherent weakness of a highly decentralized industry. The cooperative defense has taken the form of associational effort. This is best exemplified in the work of the Cotton-Textile Institute. Formed in 1926, this organization has played an outstanding part in preventing complete collapse during the depression years.

Its activities have included the compilation and dissemination — in collaboration with the Association of Cotton Textile Merchants—of statistics on production, sales, shipments and stocks of the various types of cotton goods; the encouragement of individual and voluntary attempts to bring those several factors into balance; the development of sound and uniform principles of cost determination; the promotion of new and extended uses for cotton products; and the achievement of more satisfactory relationships among the various divisions of the industry.



As previously indicated, the most important single accomplishment to date has been a sane production-demand balance. In achieving this end, the industry has taken two constructive moves which have had social ramifications and one of which, particularly, has gained for the industry public prestige and confidence. These were, first, the limitation of maximum hours per week to 55 on the day shift and 50 at night; and second, the elimination of night employment of women and minors in cotton mills.

Adoption of the latter policy may be regarded as the most significant single step ever taken by the industry. It is true that two important groups, the print cloth and narrow sheetings industries, have broken away from the night-work policy, and we are aware of the incongruity of the maximum-hour scales adopted when other industries are discussing a 40-hour week and organized labor goes on record as favoring a 30-hour week. However, everything is relative and what improvement has been made in social policies is a major step in advance for the textile industry.

Nor has this spirit been restricted to the cotton industry. As stated previously, the wool division has made one abortive attempt toward cooperation—and is certain to try again. The associations in the silk, knitting, and finishing branches have extended their activities to include constructive plans for the correction of fundamental weaknesses.

Better Merchandising Arrives

By no means the least important trend in textiles has been the development of a merchandising consciousness. Here, too, the movement grew out of necessity but the result has been none the less encouraging. The move has taken two forms: cooperative and individual. In the former category, there are the studies in marketing of cotton, wool, silk and rayon goods now being conducted under the auspices of the Textile Foundation. In the latter, there is a new merchandising aggressiveness apparent in the activities of an increasingly large number of textile mills.

Finally, on the economic side, there are such encouraging signs as the strengthening of the large selling organizations, and the gradual elimination of a very considerable quantity of productive equipment.

Technically, the industry has also made progress. During the last few years, the improvements made in equipment and processes have been greater, in the aggregate, than in probably any other similar period. Unfavorable business conditions have prevented widespread utilization of these improvements, but they represent an important potential influence for the future.

It is possible merely to mention a few of these: the development of long-draft spinning; of single-process picking; of range finishing; of full-fashioned hosiery production in one operation; of scientific pre-shrinking and crease-proofing of fabrics; of continuous rayon manufacture; and of the use of plastic compounds in the production of textile materials. In connection with the latter item, its significance is indicated by the production of a pile fabric without the use of a loom!

Those who sell to the textile industry and who wish to keep in touch with factors influencing its future will do well to study each of these technical trends.

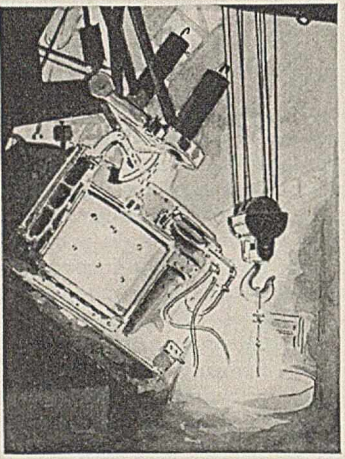
The Industry's Price Policy

Lest readers may imagine that, as a protagonist for the industry, we are attempting to give it too clean a bill of health, we hasten to admit that it is still far from a profitable field of endeavor. This is due partly to the depressed conditions prevailing in business generally, partly to the difficulty of adjusting an old industry to new conditions, and partly to the lack of a sane price policy. Textile manufacturers have indulged in more than their share of price-cutting tactics. Even during the months of satisfactory demand in the last half of 1932, the least sign of abatement would lead to price-panic. The fact that such abatement may have been seasonal, and easily predictable, counted for little. A defeatist attitude still prevents the industry from capitalizing on a relatively large call for its products.

So long as it is not legally possible to restrain price-cutters, the only answer is education. There have been signs, recently, of a more general realization of the futility of such tactics. Until those signs become unmistakable, we are unable to make any such definite prediction regarding textile profits as we were bold enough to make concerning textile activity. Fortunately, we sense a growth of mental flexibility among textile manufacturers which encourages us to anticipate a decade of greater prosperity than characterized that through which they have just passed.

By ERNEST E. THUM
Editor, Metal Progress
Associate Editor, Chem. & Met., 1917-1923

What Is the Outlook for IRON and STEEL



ONE ACCEPTS the task of writing on this subject with much trepidation. One guesses that the reader is anxious to know what to expect in the immediate future—1933, and even first quarter 1933—and is only mildly interested in the trend for the next generation. But it is clear that any pronouncement for the next few months is mere speculation; information on which any reasonably sound prediction can be made is only applicable to long-time tendencies, and then only in the absence of unheralded revolutions in society. Our present industrial stagnation seems to be the result of a number of causes whose relationships are so obscure that no economist or statesman, either here or abroad, has been able to point a clear way out (or at least be plausible enough to attract a large and enthusiastic following). Yet our immediate future depends upon how well and quickly this tangle of influences is unlaced. Consequently, almost the only safe short-time prediction is that changes are inevitable, since our world is not static, and since numerous historical precedents show that great masses of people will not long endure want when necessities are within reach.

In order to prove the unreliability of short-time forecasts based on recent statistics, glance at the first curve (*The Iron Age's* record of daily production of steel ingots in the United States) and imagine yourself back in the early spring of 1930. "The collapse of stock-market quotations last November was quickly reflected in a sharp fall in steel production," you would say, "but the winter improvement in business (so prominent in 11 out of these 13 years) seems to have erased the losses. The lines drawn along the peaks and the valleys are undoubtedly converging. Can I not draw the conclusion from these statistics that the industry is becoming more stabilized? If so, the year 1930 appears to be destined to be a very good year—not so good as 1929, with its record 55,000,000 tons, yet very good, nevertheless—and should produce the country's normal needs, on the order of 47,500,000 gross tons."

The cold fact is that in 1930 we produced 39,600,000 gross tons. The statistical predictor was off about 17 per cent, the difference between a very good year and a moderately poor one.

Suppose we tried our predicting propensities again in the spring of 1931. We were then a little older and a little wiser, and the production curve had stretched itself out another year (Fig. 1). Again an imaginary conversation with ourselves: "Well, it seems we have been through more than a stock market flurry—it's more like the depression in 1921, perhaps even worse, for the production curve has already had a downward trend for more months and has slid further down from the peak than ten years ago. But at last the turn has come, for we can't get much worse."

Again, the cold fact is that 1931, instead of being better than the disappointing 1930, produced one-third less, or 25,200,000 tons, and it didn't even stop there, for in 1932 we will be lucky if the output reaches 13,000,000! The statistical predictor in the spring of 1931 was off just about 100 per cent, the difference between up and down.

A statistician would hasten to point out that extrapolation of production curves for a single industry is especially hazardous for the near future; trends only may be indicated. If activity in the steel industry could be related to that of other industries, perhaps errors in one prediction would cancel errors in another. This supposition also can readily be tested, for the steel industry has acquired a considerable mass of data about the consumption of its product.

Late in 1929 the present writer made such an estimate for 1930. It was published in *The Iron Age*, Jan. 2, 1930, p. 106. It considered various industries which consumed steel.

Railroads bought about 11,000,000 tons annually from 1923 to 1926; 1926 to 1929 the average was 8,800,000. However, late in 1929 unusually large contracts for rails and cars were let, so the anticipated railroad consumption for 1930 was 10,000,000.

Automotive industry had taken fluctuating amounts of steel, but some figuring disclosed that the purchases for the five previous years amounted to about 1.6 tons of steel for each car or truck built. A respected personage in the industry had predicted 4,500,000 cars for 1930, which meant about 7,200,000 tons.

Machinery used 1,900,000 tons in 1926; since then the amount had steadily declined to 1,600,000; assume this figure in 1930. Containers for food took a steadily increasing tonnage "and there is no reason to suspect that this trend will be halted. Assume 1,800,000 tons."

Agriculture appeared to be on a declining cycle, so 1930 was guessed at 2,700,000 tons. (In 1929 it was 3.0.)

Exports fluctuated about 2,800,000 tons since 1923, and this figure was assumed for 1930. Oil, gas, water and mining (3.7 in 1927, 4.8 in 1928, 5.8 in 1929) appeared to be on the bulge, but the crest of pipe-line tonnage seemed to have been passed, so 1930 was guessed at 4.7 tons.

Building and construction had used around 9,000,000 tons annually since 1926. 1930 was expected to be less, despite the programs recommended by President Hoover. Guess 8,000,000. Unclassified was taken at the average since 1923, 8,400,000.

The total comes to 47,200,000 tons, almost exactly what the "normal needs of the country" were, as estimated by another editor by an entirely independent route. This close check did nothing but prove both of us wrong; note the following tabulation:

	Estimate Million Tons	Actual Million Tons
Machinery	1.6	1.2
Containers	1.8	2.4
Agriculture	2.7	1.6
Exports	2.8	2.2
Oil, etc.	4.7	4.6
Building	8.0	7.4
Railroads	10.0	5.9
Automobiles	7.2	6.1
Unclassified	8.4	8.2
	47.2	39.6

It is apparent that the errors in the estimate for 1930 came in through the depleted purchasing power of the farmer, the automobile buyer, and the railroads. In 1931 and 1932 these effects were further intensified, and the artificially stimulated building industry also collapsed.

To help those who will try their hand at a similarly detailed prediction for 1933, Fig. 2 shows the curves of consumption for the various industries since 1922. The reason such an estimate is not attempted here is that it appears to me to be just as easy and just as accurate to guess once for the entire steel industry as to guess eight times for the principal outlets.

This article may be progressing backward, for so far it has shown that near-by prediction is impossible either from one output curve or eight consumption curves. Before passing on to a consideration of longer trends another point can be made.

Glance through the following tabulation:

Year	U. S. Steel Production Million Tons	U. S. Automobile Production Million Tons
1923	43.5	4.2
1924	36.8	3.7
1925	44.1	4.4
1926	47.0	4.5
1927	43.8	3.6
1928	50.3	4.6
1929	54.8	5.6
1930	39.6	3.5
1931	25.2	2.4
1932	13.0	1.4

You don't need to have a slide rule to see the remarkably close ratio, year after year, of about ten tons of steel for each car. That doesn't mean that the automobile is the dog wagging the steel-industry tail, or vice versa. It means that when we have the money to buy automobiles we also have the money to buy steel bridges and shingle nails, fertilizer, and shoe blacking. This broad relationship is the only one which has yet become apparent; when we're up, all of our industries are up. This fact has been driven home during the past two or three years, but a careful consideration of the curves already given indicates that they are roughly parallel to what we remember about the general course of trade in all the industries—that is to say, the desire and ability of Tom, Dick, and Harry to buy things.

"Recovery" in the steel industry in 1933 therefore has no connection to the average production in any preceding year or group of years, nor to the "trend" line which is shown in Fig. 1. It awaits the returning desire and ability of the ultimate consumer to buy the things he thinks he needs. (He will always get the things he really needs, somehow or other.)

Now desire is a matter of psychology; ability has some relationship to economics. Neither are exact sciences, so they give us little help in solving our immediate problem. Predictions for better business in 1933 must therefore be based on the knowledge that the American nation has been doing far, far less business that it is accustomed to, and that its present level of activities is so low that there is no other way to go but up. Also, that unless someone finds some fresh bogeymen to frighten the timid (that is, all of us), we will before long pluck up courage enough to say Boo! to those we now have with us.

It may be said with considerable confidence that production statistics can be used only to indicate broad trends, and then only when the effect of temporary influences is suppressed or allowed for. (In passing it may be remarked that this is only another contrast between economics and science. A "trend" is a long-time extrapolation adjusted by a very human observer, but physicists would put no trust in anything more than a very slight extension beyond observed values, and only in values washed free of the personal equation.)

Let us now look at some curves for longer times—say pig iron, for there are data for pig iron for many years back. Before accepting pig iron as an indicator, we should do it with our eyes open to its limitations.

Production of pig iron would not indicate industrial activity in the 17th century, even if the term "industrial activity" means anything as of 1650 A.D. When there were no wars to use up cannon, the early blast furnace owners were hard put to find an outlet for their product, and the foundries attempted to popularize art objects, such as stove fronts, monuments, and memorial plaques. About 150 years ago, when a method of changing pig iron into tough weldable wrought iron was invented, there began to be some relationship, yet only in the 40-year period (roughly 1870 to 1910 when the bessemer process of steel making was in its hey-day) was cast iron ubiquitous. Its production then was a real measure of prosperity, since it was almost the sole raw material for steel, wrought iron, and cast iron articles of every description.

This condition did not endure, and the importance of cast iron during the last generation has been gradually suppressed. Whereas one ton of steel was made for every ton of pig iron just before the War, now the ratio of steel to iron is 1¼ to 1. This is because open-hearth steel is favored over bessemer because it consumes any amount of scrap that can be had cheaply, and all manner of substitutes for gray iron castings have appeared—high strength cast iron, alloy steel castings, die castings, molded condensation products, non-ferrous articles, welded steel, stampings. All these things disturb the supremacy of cast iron, and its relationship with general industrial activity.

With these gradually changing conditions in mind, look at the figures for world production of pig iron since 1870 (Fig. 3). It is a curve that is capable of many interpretations. For instance, in 1905 Sir Robert Hadfield told the Faraday Society that the pig iron then being produced was consumed by about 200,000,000 people, only a small fraction of the total population of the globe, and a future increase equal to the

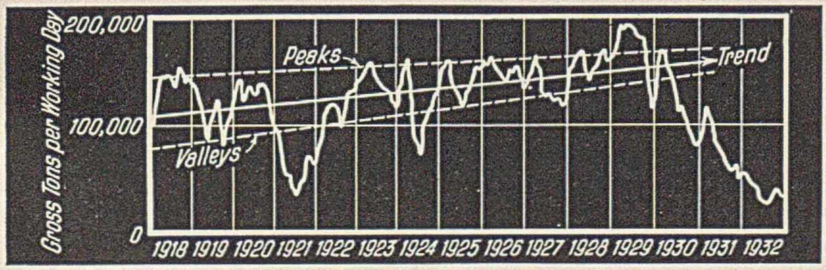


Fig. 1—Early in 1930 it appeared that the steel industry was becoming more stabilized. Early in 1931 we appeared to have been through a depression like that of 1921. In 1933 we don't know where we are

average for the period 1870-1900 could be expected as civilization spread into the darker areas. Such a straight line, calling for about a million tons increase a year, is drawn on the coordinate sheet. It appeared to be much short of actualities for about 15 years. As a matter of fact, the curved line *A* represented the trend better—iron was actually produced at an ever-increasing rate. The 1900 to 1915 period coincided with the rise of the automobile and the mass-production idea, and none doubted the intimate connection between the two, and few could see an end to the process.

Then came the War, and its immediate after-effects (especially staggering to civilized Europe) to knock the production line down below Sir Robert's prediction. However, things started to boom in a big way after 1922, and for a considerable period of time it appeared that the new production curve *B* was paralleling the pre-war trend. Such a 12-year set-back was suggested by the present writer five years ago, and the prediction was fairly accurate for 1928 and 1929. But this new curve failed to take into consideration—well, whatever started the trouble in 1929, and now even Sir Robert appears to be a rosy-eyed optimist!

One thing is sure, and that is that any estimate of the rate of expansion in the iron and steel industry based on pre-war conditions is worthless. The dizzy climb has been checked. Instead of making the 120,000,000 tons of pig iron in 1932 called for by curve *A* (and probably producible by existing blast furnaces) or the 100,000,000 tons called for by curve *B*, the world's make will actually be less than 40,000,000 gross tons. One wonders, indeed, if the production line will regain Sir Robert's forecast and make 80,000,000 by 1940!

For there are more reliable indications than Fig. 3 that the consumption per capita in America, at least, is growing much less rapidly than in the 1900-1920 period.

First is a profound change in our methods of transportation. Prior to the War many miles of new line were being built in the Central and Far West. Since the War the desire has been to economize on operating labor by longer trains. Both these movements are complete, yet both (while they lasted) required huge quantities of iron and steel for rails, bridges, signal systems, locomotives, and cars. Competition from automobiles and airships, pipe lines and electric transmission lines will prevent any further large expansion of the rail system; from now on it will require metal principally for maintenance—obviously only a portion of its consumption in the recent years when the railroads were the steel industry's best customers.

Associated with this are the changes in the nature of the metals brought about by the automotive industry. In the new "rolling stock" weight is a great consideration. (The power plants on four sections of the 20th Century Limited are comparable with that in the frail racing craft, Miss America X!) This means that the bulky cast iron, machine steel, and boiler plate are replaced by aluminum, strong alloy steels, and sheet. Chilled iron wheels and steel tires give way to wood and rubber. In the permanent way, heavy rails are superseded by wire concrete reinforcement, and massive trusses by spidery suspension bridges.

This change from the bulky and impressive to the light and sleek is also to be observed in all our modern machines, household equipment, and tools. Design is being continually refined, not only to improve portability, but to reduce first cost of raw material. Hence an ever-increasing amount of sheet and strip is being made into stampings, pressings, weldings, and casings, replacing more bulky forgings and castings. For this reason production of sheet and strip during the last four years jumped to 20 per cent of the entire steel output in this country, as compared to 12 to 13 per cent for the previous decade. (An accelerating cause, of course, has been large improvements in the production technique for flat rolled steel products.)

One might think that the tonnage lost to the changed transportation and mechanical industries would be regained by sales to other rapidly growing ones, such as the process industries. This is in line with the fallacy that every man put out of work by a machine can find a job made by another machine. The real truth is that such sales of metal (except the remarkably steady, "depression-proof" outlet for containers, shown on Fig. 2) comprise an increasing proportion of special alloys, more or less corrosion-proof. The ideal now is to put in equipment that will stay put. While only a little stainless steel is now being made, relative to the enormous amount of common steel which is rust-

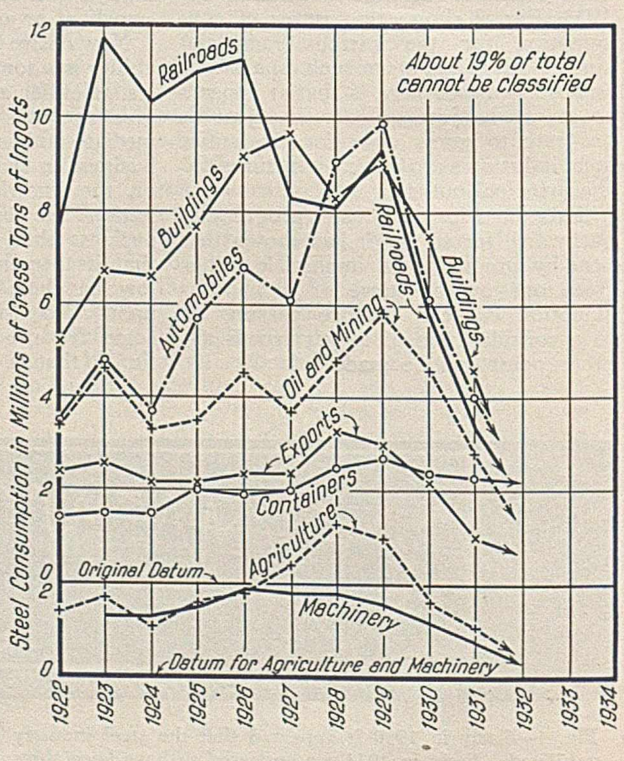
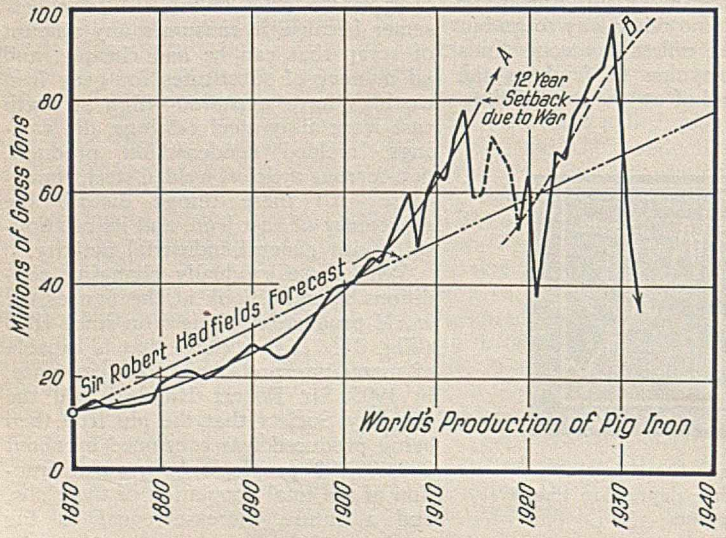


Fig. 2 — About the only depression proof outlet for American steel is for containers

Fig. 3—Production of basic commodities violently disturbed by unforeseen external causes



ing away each year, yet the tonnage is growing rapidly, as well as that larger tonnage of steel with low alloy content markedly resistant to corrosion. This means that, on the average, the steels now being made are lasting longer than ten years ago.

One last important factor will contribute to this slackening demand for steel we are discussing, namely stagnant building and construction, ordinarily consuming 15 to 20 per cent of the American output. Despite all the propaganda that our trouble is "under-consumption, not over-production," it is becoming abundantly clear that we have developed so much power and invented so many labor-saving machines that the entire country's wants can be supplied

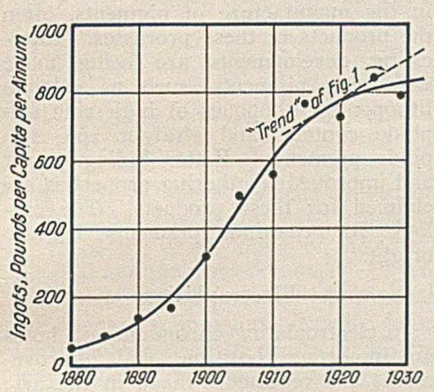


Fig. 4—U. S. steel production appears to take the S curve of a wasting asset, when 5-year averages are figured to consumption per capita

when the entire population is working at a fraction of the standard 8-hr. working day. Existing and enormous debts already owed America by other nations will effectively prevent any outlet by exporting products beyond those consumed within the States. America will therefore be in no position to expand its existing factories (except for newly discovered specialties) until such time as the work day can be drastically cut, and the mass of our people again happily and gainfully employed. Lacking powerful and militant labor unions, which in the past have forced such evolutionary changes, willy-nilly, this necessary and inevitable change will probably be unduly delayed.

With the above factors in mind, namely, stagnation in railroad and factory construction, the replacement of massive machinery by lighter, the development of rust and corrosion-resistant metals, and the impossibility of export, we can see ample reasons for the so-called S curve of steel production in America. Reproduced herewith as Fig. 4 is one drawn by W. W. Macon (*The Iron Age*, Sept. 15, 1932) wherein the dots represent five-year averages. Such a system of plotting smooths out the precipitous fluctuations characteristic of Fig. 1 and gives an entirely different idea of the trend line. (Note the "trend" of Fig. 1 indicated by arrow. Macon's curve indicates that the maximum annual production per capita will be about 850 lb. of steel ingots; Hadfield in 1905 thought the corresponding figure for civilized nations would be 400 lb. of pig iron per inhabitant. In our present mood we would be inclined to the view that the true value is somewhere between the two figures.

The S curve of Fig. 4 is one which has appeared over and over again in the recorded history of metals. It is the production curve of every mine, of every mining district, and of every industrial nation. Copper producers in America are familiar with it—we dominated the world in copper not so long ago, as did England before us, and as did Spain before England. Just because we were the leaders once is no reason why we should continue to be indefinitely. On the other hand, the United States will never reach a place where its copper production is unimportant.

Shortage of High Iron Ore

Production from a gold mine takes an S curve because the deposit is exhausted more or less rapidly. The S curve of steel in America is a product of changing demand rather than of a lack of iron ore or coke, either real or in prospect.

Much concern is felt in the Lake Districts over the impending shortage of high iron ore; the so-called independent producers having no more than a ten-year reserve. But it should be remembered that the Lake deposits are true bonanzas, soon to be exhausted. It will then be necessary for the industry to mine lower grades, to revise smelting processes, or to concentrate the ore by mechanical or chemical means. Rest assured that these things will be done—in fact are being done, for one-third the Missabe ore is now given a crude concentration process whereby some of the clay or soft gangue material is washed out. Only by a judicious mixing of high grade and washed ore is it possible to keep the average iron content above 50 per cent (55 per cent was the figure before the War).

As the iron content of workable ore is reduced by these improvements, the tonnage of available material increases in geometric ratio to astronomical figures. Remember that the earth's crust contains 5 per cent iron and that its core is an enormous meteorite. What man needs he gets! He will get iron and steel as long as he remembers how to dig the paint rock, char the wood, and harness the waterfall.

It may be concluded from all this that even though our recovery from the present depression may be slow, we can look forward for a long, long time to come to an American steel industry that will produce metal for local consumption at a rate somewhere in the neighborhood of 600 lb. per capita annually. While this is not an especially attractive outlook for the steel industry, calling as it does for a production of about 40,000,000 tons in 1940, the chemical industries can draw comfort from the assurance that their products will be consumed by the steel industry in increasing quantity. In return the process industries will consume an increasing amount of new and special alloys, and must count on more byproducts from the coke and steel plants.

Those very changes already noted, which are cutting down on the per capita consumption of steel, are responsible for an increasing consumption of chemicals and chemical products. Consider the increasing proportion of thin material. Ten years ago one out of every four tons of ingots eventually was marketed as sheet, strip, tin plate, and wire. Now the proportion is one of three. All of it requires pickling acid and much of it is fluxed and coated with metal or oil. In its fabricated form for ultimate consumer it will be polished or colored, thus consuming abrasives, cleaners, glazes, enamels, lacquers, and electroplates.

Based on figures given by J. M. Camp to American Iron and Steel Institute in 1920, it may be predicted that the 40,000,000 tons of steel produced in America in 1940 will consume chemicals on the following order: 400,000 tons sulphuric acid (50 deg. Bé.) for pickling, 40,000 tons hydrochloric acid and ammonium chloride for fluxing coated sheets, and 10,000 tons palm oil for tin plate.

A large amount of acid and oils will also be used in plants making coke for iron blast furnaces. Byproduct plants will continue to shoulder the beehive into oblivion, and the 30,000,000 tons of pig iron produced in America in 1940 will undoubtedly require on the order of 300,000 tons of sulphuric acid to fix the ammonia, 7,000,000 gal. of straw oil for absorption of light fractions, and 1,250 tons of caustic for neutralization of acid washes.

Growth of Alloy Division

All this activity will involve the production of corresponding amounts of ammonium sulphate, benzol, waxes, and tar, which will enter the market in competition with similar materials produced in other industries.

Growth of the alloy part of the steel family has frequently been remarked. In 1902, 2 per cent of the total steel ingots and castings were alloy; the proportion is steadily climbing and has now reached 6 per cent. (Collected statistics give a conservative picture, owing to the lack of an accepted boundary between plain steel and alloy steel.) Unquestionably, the causes for this movement are continuing, and a constantly increasing proportion of the output will be low-alloy steels, heat-treated to improve their physical properties. Each one of these will consume its proportion of the various ferro-alloys — chromium, vanadium, molybdenum, tungsten, silicon, manganese, titanium, and zirconium—and the pure metals nickel, aluminum, copper, and cobalt.

An especially important phase of the future steel industry is the corrosion, rust, and heat resisting steels. These have only lately been discovered, but no words of mine are needed to remind readers in the chemical industry of the importance of stainless iron to nitric acid plants, to those in the oil industry of high-alloy preheater and exchanger tubes, to readers in the paper industry of high chromium-nickel castings for handling sulphite liquors, and to those in the chemical industry of reaction chambers of high-nickel alloys, to those in the food industries of the stainless steels. These established uses will undoubtedly grow. The most spectacular advances are being made in the high chromium-nickel alloys, which have proven so enduring against hot gases that all manner of furnace parts are being made of them (even for high temperatures in the ceramic industries) such as containers, muffles, heat exchangers, conveying mechanisms, resistors, and burner parts. The enthusiast pictures the ovens, kilns, and furnaces of the future as made of a little brick, but mostly of metal and insulation materials.

Will Depend on Chemicals

There are already a great number of alloy analyses available, and the end will never be in sight, for continued contact between producer and consumer will bring forth special alloys for special purposes. Some of them will have so little iron in them they cannot be called steel, but the production will be so exacting that only the best steel-making technique and equipment will be equal to the task. All of them will in turn require larger and larger amounts of the less common metals and the ferro-alloys, produced only by chemical means or by smelting in electric furnaces.

So much for the near future—say the next generation. Soon thereafter the steel industry will lean heavily on the chemical to help it with its problem of low-grade ore. For it is not to be doubted but that the iron industry will follow the copper or zinc industry—first high-grade ore smelted direct; then low-grade ore concentrated by gravity; next flotation (using acid, oils, and complex chemical reagents) before smelting; lastly, the leaching of low-grade rock or fine concentrates and recovery of metal by electrolysis. We in the iron industry are still working our high-grade iron ores and just beginning gravity concentration. Our children will see us descending the scale; perhaps our grandchildren will work with electrolytic iron.

CHEMICALS USED IN METAL WINNING AND TREATMENT

EDITORIAL STAFF REVIEW

UTILIZATION of the latest concepts of physics and chemistry, application of thermodynamics to the study of processes, and a rapid progress in the development of scientific methods of control are some of the trends in modern metallurgy. To this must be added an increasing demand for products of the highest purity, with specifications becoming more and more rigorous. These facts assure continuation and even broadening of the present fruitful interchange of ideas, processes, and equipment, between the metallurgist and the chemist.

Intense activity in the production of gold was the outstanding feature of the past year, and indications point to an even higher output in the coming year. Many interesting problems in the metallurgy of gold are still waiting for their solution; most important among these is probably the recovery of cyanide from waste solutions. This is already accomplished for the stronger solutions used in the cyanidation of silver ores, and successful application to the weaker solutions used for gold may be expected in the near future. Retreatment of old waste dumps and efficient milling of certain refractory ores also present problems of a chemical nature. With material reductions in treatment costs the life of many gold fields, notably the Rand, should be prolonged for many years. Application of the flotation process to gold metallurgy has become an accomplished fact, and further development in this direction may be expected.

Chemicals Used in Flotation

Flotation is another branch of metallurgy in which the chemical engineer is vitally interested. The delicate reactions involved, the multiplicity of available reagents, and the exacting supervision required to maintain proper conditions in the circuit call for careful chemical control. No other single factor in the process approaches in importance the proper selection and control of reagents. Among future prospects in this field is a wider use of the process in the treatment of gold ores, increased application in the non-metallic field, and possible utilization in certain chemical processes.

A steadily increasing grade of the flotation concentrates produced suggests a wider application of hydro-metallurgy in the extraction of metals. The process of preparing the metallic solutions and of maintaining them at the proper concentration and purity involves problems familiar to the chemical engineer. New uses may be found for ammonia in this field. Now one of the cheapest of the alkalis, ammonia is being used successfully in leaching flue dust, and its application in certain flotation circuits has already been predicted.

Treatments of flue dust and secondary metallurgical products, and the rapidly increasing recovery of scrap and waste metals usually present involves chemical problems. Much progress is reported in the manufacture of pigments, often the products of these processes. Interesting developments are being made with zinc pigments, such as calcium lithopones, lithopones of high zinc sulphide content, and straight zinc sulphide pigments. Better hiding power and improved weathering properties are claimed for these products. The outlook for titanium pigments is also bright.

Electroplating

In electroplating chromium still holds an important position, and improvements are repeatedly made in the art; use of cadmium plating is also making rapid advance. Tungsten plating, recently added, may offer interesting possibilities, although its development has not yet progressed to a stage where definite predictions can be made. Recent improvements in nickel plating include work at high temperatures and the use of solutions with low pH. An interesting attempt to produce non-tarnishing silver involves plating of the silver with palladium, followed by a flash of rhodium. One objection raised to this method is the somewhat different color imparted to the silver.

The metallurgy of the rare metals offers many problems to the chemist, in production as well as in application. Several new metals have recently advanced to the commercial class, such as rhenium, indium, gallium, zirconium, and titanium. Much publicity has lately been given to recent discoveries of radium in Canada, and to the improvements in the chemical process used in extracting the metal, said to be superior to prevailing methods. Great activity is being displayed to create new outlets for this interesting metal, especially along industrial lines.

An alloy coating for steel has been found that is resistant to hydrochloric acid. It is reported that a perchlorate solution of lead and bismuth will give a deposit of an alloy of these two metals highly resistant to muriatic acid corrosion. The plate is ductile and practically free from pinholes and other objections.

Process Industries as Purveyors to the MOTOR CAR

By T. A. BOYD

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ALMOST every material going into the modern motor car is a product of one or the other of the metallurgical and the process industries. And if the latter may be considered to include the former group, which, broadly, is not unreasonable, then the process industries may be seen behind practically every item that goes into the automobile. Furthermore, with petroleum refining a division of the process group, it is evident that the motor car is also operated almost entirely on process industries products. Every single part of the automobile, except perhaps the padding in the cushions, some of the wooden pieces, and the water in the radiator, is either directly a product of some one of the process industries or else these industries contribute in a large way to its supply or to its fabrication. Even the water in the radiator has to be chemically treated in the winter time to keep it from freezing. For the latter purpose there is required each winter a total of around 40,000,000 gal. of ethyl alcohol, methyl alcohol, glycerine, and ethylene glycol.

Metallurgical Products Lead

By far the greater part of the motor car is constructed of the various products of the iron and steel industries. Between 2,500 and 3,000 lb. of iron and steel on the average went into each automobile manufactured during the five years, 1927 to 1931 inclusive. And so it is that of recent years the motor car has been the largest single consumer of some of the products of the iron and steel industries, notably of steel strips, bar, and sheets; of alloy steels; and of malleable iron. It has also been the largest consumer of nickel, of lead, of plate glass, of rubber, of upholstery leather, of gasoline and of lubricating oils. And it has been a very large user as well of aluminum, copper, tin, zinc, coated fabrics, paints, and lacquers. These facts are illustrated graphically in Fig. 1. Table I shows the actual consumption of these materials by years, in comparison with consumption by all industries.

Elsewhere (Table II) there is listed a large group of the basic chemical and metallurgical products which are used by the motor-car industry. This list, although large, is naturally not a complete one, for in reality the automobile is an integration of almost every available material. It would perhaps be simpler to make a list of materials which do *not* contribute to the making and operating of motor cars than of those which do. Some of the items listed in the table are consumed in large amounts and some only in small quantities, of course. The amount of a material that is used is not always a measure of its importance, however. But, all in all, the motor car constitutes one of the largest and most important outlets of the process industries.

As a consumer of the materials mentioned, the automobile has not, of course, maintained its customary rate during the depression years since 1929. With the exception of those materials which are consumed chiefly in the operation and maintenance of cars, there has been a large reduction in demand, and a reduction which has increased further in amount with each succeeding one of the three years just past. During 1932 the automobile manufacturing industry operated at a rate which was less than 40 per cent of the average for the five years 1927 to 1931.

Now, statistics collected over a period of many years have shown that the average life of automobiles has for a long time been about seven years ("Facts and Figures of the Automobile Industry," 1932 Ed., p. 11). The magnitude of the decrease in number of cars manufactured during the past three years has been so great as to make the number built each year smaller than that needed to replace the cars which, during that year, had reached the age of seven years. As a consequence of this condition, there has been accumulating each year since 1929 a deficiency of automobiles. This is true even if it be assumed that the number of cars in service in 1929 represented the maximum demand of the country, which it probably did not.

Deficiency Mounting Rapidly

How much this deficiency in the number of cars produced during the past three years amounts to is estimated in an approximate way in Table III, some of the data for which are shown graphically in Fig. 2. The simple basis on which the resulting figures have been arrived at is that the domestic sale of cars in the United States seven years prior to the year under consideration represented the number that needed replacement during that year.

The figures tabulated show that already, on this simple basis, there is an accumulated deficiency of nearly 4,500,000 cars. Furthermore, this is true when the automobile business is considered as now being simply one of replacing those cars worn out in service. And, even if the deficiency is to be held down to the figure given, the automobile industry will need to make nearly

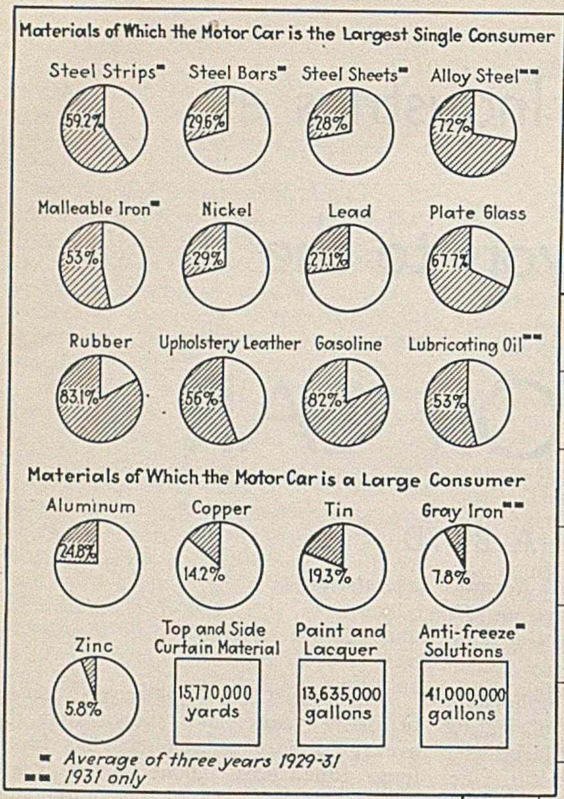
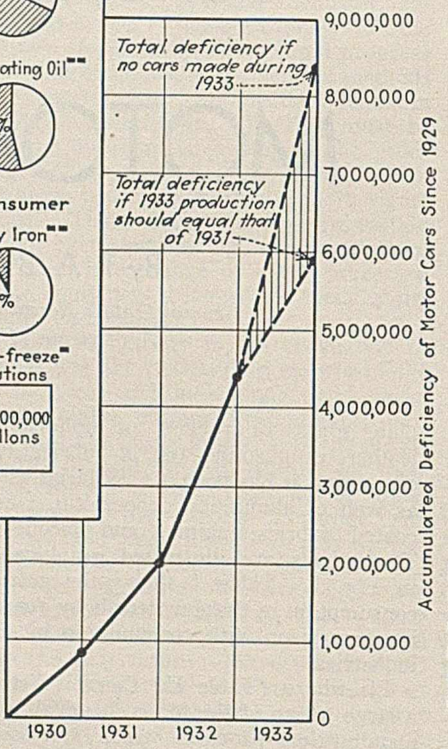


Fig. 1—Percentage of total U. S. production of principal commodities consumed in automobile manufacture

Fig. 2 — Accumulated deficit of motor cars in U. S. since 1929, based on replacement alone



4,000,000 cars during 1933. This arises from the fact that the nearly 4,000,000 cars made in 1926 will become seven years of age during 1933. It appears scarcely probable that, unless conditions improve considerably, such a large number of cars will be manufactured during 1933, for it is larger than the number of cars sold in the United States in any one of the years past, with the single exception of 1929. Hence, it seems likely that by the end of 1933 the number needed to put motor car drivers back on the 1929 basis of ownership will have mounted still further, perhaps to about 6,000,000.

Registration Drop Relatively Small

It is true that decreases in registrations since 1929, although considerable, have not been nearly as large as the figures given in the previous paragraph. But that does not mean that these figures on cars normally needing replacement are not valid. It means rather that a great many cars are being kept in operation longer than used to be the case.

The sole purpose of the discussion and analysis just given has been to show that there has been and is still being built up a deficiency of new automobiles, or what may be considered as a potential demand for cars; and that this is true even when the automobile business is viewed simply as a replacement one, without any regard to possible future increases in the number of cars that may be required by the American public. Here it is emphasized that this analysis is not intended to contain anything in the way of a definite forecast as to what the demands of the automobile industry for process products may be at any given time in the future. The magnitude of that demand will naturally depend upon the ability and willingness of people who now have cars to replace those which are now apparently in need of replacement, coupled with the ability of people who do not now have cars to buy new ones. And just what that purchasing ability may amount to is beyond the scope of this paper to estimate, even if such an estimate could be made. But the analysis does show that the potential demand for cars has now become very large.

Population Increase Adds Demand

In respect to the possible demand for cars by people who have not previously had them, it may be mentioned, also, that the normal increase in population during the four years 1930-33 should amount to about 6 per cent. So, even if the number of cars in actual service in 1929 (about 25 million) should be

Table I—Quantities of Principal Process Materials Used in Making, Repairing and Operating Automobiles*

(Percentages represent per cent of total production used in automobile industry)

Material	Unit	1927	1928	1929	1930	1931	Average†
Steel	Tons	4,485,000	6,700,000	7,239,000	4,600,000	2,950,000	5,194,800
	Per Cent	14	18	18	15.5	16	16.3
Malleable iron	Tons	....	....	490,000	343,000	210,000	347,666
	Per Cent	....	....	52	53	54	53
Gray iron	Tons	....	....	....	....	466,450	466,450
	Per Cent	....	....	....	....	7.8	7.8
Rubber	Long Tons	305,472	441,000	392,772	307,790	282,782	345,963
	Per Cent	82	85	84.2	82.6	81.6	83.1
Plate glass	Sq.ft.	70,470,000	97,422,801	110,500,000	72,710,000	52,200,000	80,660,560
	Per Cent	63	74	73	68.7	60	67.7
Upholstery leather	Sq.ft.	37,785,000	31,500,000	27,595,900	14,380,000	14,425,000	25,137,180
	Per Cent	60	60	57.8	51.4	51	56
Aluminum	Tons	21,000	25,000	37,000	20,000	14,000	23,400
	Per Cent	26	27.7	37.4	17.4	15.7	24.8
Copper	Tons	110,000	135,000	160,000	102,000	73,600	116,120
	Per Cent	11.6	14.6	15.7	14.8	14.2	14.2
Tin	Long Tons	16,000	19,000	21,000	11,000	8,000	15,000
	Per Cent	22	24.1	23.6	14.1	12.6	19.3
Lead	Tons	135,000	160,000	215,000	160,000	147,000	163,460
	Per Cent	16.7	25.6	31.2	26	35.8	27.1
Zinc	Tons	20,000	27,000	34,000	33,000	27,000	28,200
	Per Cent	3.4	4.5	5.5	6.5	9.0	5.8
Nickel	Pounds	9,880,000	14,000,000	16,150,000	10,900,000	8,000,000	11,786,000
	Per Cent	29	28	26	30	32	29
Top and side curtain material	Yards	16,000,000	18,600,000	21,500,000	13,500,000	9,250,000	15,770,000
Paint and lacquer	Gal.	12,880,000	15,270,000	18,270,000	11,746,000	9,560,000	13,545,200
Gasoline	Gal.×10⁶	10,010	11,048	12,500	14,130	14,400	12,417
	Per Cent	80	80	80	85	85	82
Lubricating oil	Gal.	405,000,000	415,000,000	450,000,000	495,000,000	450,000,000	443,000,000
	Per Cent	....	....	....	....	53	53
Antifreeze solutions	Gal.	....	....	43,000,000	45,000,000	35,000,000	41,000,000
U. S. production cars and trucks	....	3,401,326	4,358,748	5,358,420	3,355,986	2,389,738	3,772,843

*Data from "Facts and Figures of the Automobile Industry," 1928-1932 editions
†For years shown

Table II—Partial List of Process Products Used Directly or Indirectly in Motor Car Industry

Acetic acid
Acetylene
Alcohol
Alloy steels
Aluminum
Aluminum hydrate
Aluminum oxide
Aluminum sulphate
Ammonia
Ammonium sulphate
Amyl acetate
Amyl alcohol
Animal fat
Antioxidants
Antimony
Arsenic
Asbestos
Asphalt
Baking enamel
Barium
Barium carbonate
Barium chloride
Barium sulphate
Basic lead carbonate
Basic lead sulphate
Benzene
Beta naphthol
Boric acid
Borax
Butyl acetate
Butyl alcohol
Butyl propionate
Cadmium
Cadmium cyanide
Cadmium oxide
Cadmium sulphide
Calcium carbide
Calcium carbonate
Calcium chloride
Calcium sulphate
Carbon
Carbon black
Carbon dioxide
Carbon steel
Castor oil
Caustic soda
Celluloid
Cellulose acetate
Ceramic materials
Charcoal
China wood oil
Chromic acid
Chromium
Chromium oxide
Chromium sulphate
Chlorine
Chloroform
Citric acid
Clay
Coal tar
Coated fabrics
Cobalt
Coconut oil
Coke
Copper
Copper cyanide
Copper sulphate
Cottonseed oil
Cresol
Dextrin
Dibutyl phthalate
Disodium phosphate
Dyes
Emery
Ether
Ethyl acetate
Ethyl alcohol
Ethyl butyrate
Ethyl lactate
Ethylene bromide
Ethylene chloride
Ethylene glycol
Ferric chloride
Ferric sulphate
Ferrous sulphate
Fluorspar
Formaldehyde
Fuel oil
Gas
Gasoline
Glass
Glue
Glycerine
Gold
Graphite
Gray iron
Hydrochloric acid
Hydrofluoric acid
Hydrogen
Hydroquinone
Iron oxide
Isobutyl acetate
Isobutyl alcohol
Isopropyl acetate
Isopropyl alcohol
Lacquers
Lead
Lead acetate
Lead oxides
Lead sulphide
Lead sulphate
Lead tetraethyl
Lime
Limestone
Linseed oil
Litharge
Lubricating oils
Magnesia
Magnesium
Magnesium carbonate
Magnesium phosphate
Malleable iron
Manganese
Manganese chloride
Mercury
Methyl alcohol
Mica
Molybdenum
Molybdic oxide
Monel metal
Mono sulphonic acid
Nickel
Nickel ammonium sulphate
Nickel carbonate
Nickel chloride
Nickel sulphate
Nitric acid
Nitrocellulose
Nitrogen
Oleic acid
Organic accelerators
Ortho toluidine
Oxalic acid
Oxygen
Paint
Paper and pulp products
Paraffin
Para nitraniline
Petrolatum
Petroleum naphtha
Pig iron
Phenol
Phosphoric acid
Phosphorus
Plaster of Paris
Platinum
Polish
Porcelain
Potassium chromate
Pumice stone
Reclaimed rubber
Rosin
Rouge
Rubber
Salt
Salt cake
Sand
Shellac
Silica
Silicon
Silicon carbide
Silver
Silver cyanide
Soap
Soda Ash
Sodium
Sodium acetate
Sodium bichromate
Sodium carbonate
Sodium chlorate
Sodium chloride
Sodium cyanide
Sodium disulphite
Sodium ferrocyanide
Sodium hydroxide
Sodium nitrate
Sodium nitrite
Sodium perborate
Sodium peroxide
Sodium phosphate
Sodium silicate
Sodium stannate
Sodium stearate
Sodium sulphate
Soldering fluxes
Stannous chloride
Starch
Stearic acid
Strontium chloride
Sulphur
Sulphuric acid
Synthetic resins
Talc
Tallow
Tannic acid
Tanning materials
Tar
Tartaric acid
Thorium
Tin
Tin chloride
Titanium
Titanium oxide
Toluene
Top material
Tricresyl phosphate
Trisodium phosphate
Tungsten
Tungstic acid
Turpentine
Upholstery leather
Vanadium
Waxes
White lead
Whiting
Xylene
Zinc
Zinc cyanide
Zinc oxide
Zinc stearate
Zinc sulphate
Zinc sulphide
Zirconium

considered as representing the saturation point for the population of that year, the saturation point on the same basis will by this current year be 1,500,000 cars higher. This figure would, of course, be in addition to the large deficiency in replacements as estimated above.

New Materials Needed

Here it may be appropriate to suggest that there are some needed extensions in the process materials available for the fabrication and operation of motor cars. In doing so, it may first be said that the essential difference between a process industry and a mechanical one is this: whereas for the most part a mechanical manufacturing industry changes simply the *form* of materials, process industries change not only the form but also the *properties* of materials. Thus, one of the metallurgical industries purchases iron ore and coke and produces from them pigs of metallic iron, ingots of steel, or bars or sheets or strips. In the same form it may produce a carbon steel with a tensile strength of 40,000 lb., or one with a tensile strength as high as 400,000 lb.

The need of the automobile industry is not altogether for improved mechanical forms, but also for new and better materials, and for the cheapening of some of the valuable materials now available as well. So it is that the process industries can have a large place in the further improvement of automotive transportation, just as they have played an outstanding role in advancing automotive transportation to its present important place, and in keeping it there.

Demand for Cheaper Light Metals

In metallurgy there is, for instance, need, among other things, for cheaper light metals. It is a striking fact that, in spite of the automobile having been considered as a large consumer of aluminum, the average weight of aluminum that went into each automobile made during the five years, 1927 to 1931, was really only about 12.5 lb. Compare that amount with the 2,500 to 3,000 lb. of iron and steel used per car during the same period. Less than one-half of one per cent of the average car has been constructed of aluminum. There is, in fact, several times as much rubber as aluminum in automobiles. The reason for the small quantity of aluminum used in each car is not that its potential usefulness is small but that its cost is too high. And that situation is a most unfortunate one; because, as a material for making motor cars, a metal with the lightness of aluminum is very desirable indeed. And so it is that the cheapening of aluminum would widen a great deal its availability as a material for use in fabricating motor cars, and thereby make it a much more useful material.

Then there are the immense possibilities that appear to be latent in the still lighter metal, magnesium. Much further development will have to be accomplished, of course, before magnesium can fulfill the promise that it seems to offer for the future. And the possibilities of beryllium, the lightest metal of all, are hardly known and have scarcely been scratched as yet.

Better Rustproofing Required

Needed especially are more perfect means for the rust-proofing of iron and steel. If it is to be useful in making motor cars, such a means of rust prevention, whatever else it may be, must be cheap enough to have wide application. There is also need for a better understanding of lubrication in general, and particularly for lubricants which will permit higher bearing pressures. Needed as well is a great deal more knowledge of the chemistry of hydrocarbons, and especially of the application of such knowledge in adjusting the chemical constitutions of the hydrocarbons in gasoline to those forms which the automobile engine has signified that it likes, and so to eliminate the hampering difficulty of "knock" right at its source. The solution of these, and other, problems would extend considerably the already very large service of the process industries to the motor car, and thus would be expected to increase to a corresponding degree the demand for their products.

Table III—Analysis of Accumulated Demand for Motor Cars on Replacement Basis Alone*

Year	U. S. Domestic Sales	Replacement Deficit†
1923.........	3,799,788	
1930.........	2,950,980	848,808
1924.........	3,310,018	
1931.........	2,148,917	1,161,101
1925.........	3,837,841	
1932.........	1,400,000(estimated prod.)	2,437,841
Total.........................		4,447,750
Add 1926 domestic sales, due for replacement in 1933.....................		3,908,854
Total number of cars in need of replacement during 1933....................		8,356,604

* Data chiefly from "Facts and Figures of the Automobile Industry," 1932 edition.
† Failure of sales to replace cars sold seven years earlier.

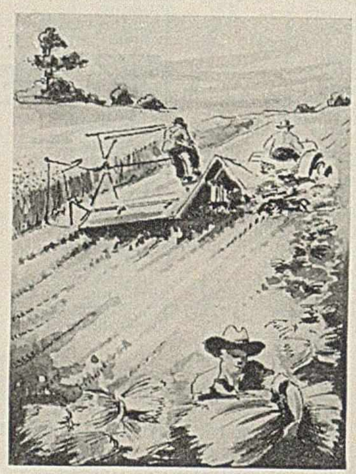
INFLUENCE OF

AGRICULTURAL PROSPECTS ON CHEMICAL INDUSTRY

By CHARLES J. BRAND
Executive Secretary and Treasurer
The National Fertilizer Association
Washington, D. C.

EVERY DOLLAR spent in a business enterprise should produce more than a dollar of return. Even with recent low prices of farm products, chemical fertilizers have made a true dollar return for the farmer. Under normal price conditions that return averaged about $3.54 per $1.00 spent, according to the testimony of some 48,000 farmers who were interviewed by representatives of The National Fertilizer Association. Even with present depressed farm prices, adequate and intelligent fertilizing would probably pay back an additional dollar for each one spent. Unfortunately, the farmer's income has become so low and his credit resources so nearly exhausted that he has been forced for three years progressively to reduce his fertilizer applications. It makes little difference how useful a thing is, without money or without credit, you cannot buy it.

Despite the additional wealth produced by fertilizers, the manufacturer has too often since 1920 profited little or not at all. This has been true even in years when the total farm income, though not the purchasing power of farm products, was fairly large. Intense competition with profitless sales, high fixed charges, and excessive sales costs due in part to the highly seasonal demand, partly explain this. The chief reason, however, has been the low buying power of the farmer, caused generally by lack of net, not gross, income. This arose both from the low exchange value of farm products and from a catastrophic decrease in total income. The latter dropped $8,000,000,000 between 1919 and 1921. Beginning with 1922 there was some moderate recovery but another drop of almost $6,700,000,000 has taken place between 1929 and 1932. The total drop between 1919 and 1932 was nearly $11,700,000,000, a 70 per cent decrease. If I had the poker player's superstition about figures, I



might feel there was some relation between this loss and the war debts, as funded, of nearly $11,600,000,000. What wouldn't a reasonable restoration of the income and purchasing power of American agriculture do, not only for farming itself, but also for our whole national economy.

Fig. 1 shows the intimate relation between farm income, cotton and cottonseed income and fertilizer sales. The most disastrous drop in receipts American agriculture ever experienced began in 1919 and culminated in 1921. The average farm price of wheat dropped from $2.58 a bushel in June, 1920, to $0.92 in December, 1921. Now it is $0.33. Cotton fell from $0.29 a pound in July, 1920, to $0.08 in December, 1920. Now it is $0.059. The farm price of hogs dropped from $19.30 a hundred in August, 1914, to $6.52 in December, 1921. Now it is down to $3.05.

Table I—Relation Between Farm Income, Cotton and Cotton Seed Income, and Fertilizer Sales

Year	Gross Income of Agriculture	Income from Cotton and Cottonseed	Year	Fertilizer Consumption (Tons)
1919	$16,935,000,000	$2,375,886,000	1920	7,176,754
1920	13,566,000,000	1,070,692,000	1921	4,862,931
1921	8,927,000,000	748,874,000	1922	5,670,000
1929	11,911,000,000	1,418,363,000	1930	8,212,076
1930	9,403,000,000	795,092,000	1931	6,339,501
1931	6,955,000,000	529,000,000	1932	4,250,000
1932	5,240,000,000	397,000,000	1933	

Cotton price declines are especially disastrous to the fertilizer industry, as over 31 per cent of the fertilizers consumed is applied to cotton. The drop in farm income between 1925 and 1926 was due largely to the low price of cotton with a consequent effect upon fertilizer sales. Farm income between 1919 and 1920 dropped nearly $3,400,000,000. Fertilizer consumption fell over 2,300,000 tons. Similarly disastrous drops in consumption occurred in 1931 and 1932.

A few of the salient figures on which Fig. 1 is based are compiled in Table I:

Between 1923 and 1929 gross farm income ranged from $11,040,000,000 to $11,911,000,000. Although exchange values were adverse to farm products during this period (see Fig. 3), there was a tendency toward stability of which farmers tried to take advantage. They adapted themselves to their adverse price relation and tried to meet the problems by an increasing use of commercial plant food and other efficient practices. Their achievement in increasing consumption of fertilizer from less than 4,900,000 tons in 1921 to over 8,200,000 tons in 1930 is noteworthy, particularly in the face of the shifting of crops from the fertilizer-using territory of the East to the non-fertilizer-using territory of the West, discussed later.

The chemical industry has a great interest in agriculture. Under normal conditions agriculture consumes in excess of 2,000,000 tons of sulphuric acid; great tonnages of phosphoric acid; hundreds of thousands of tons of potash salts, sulphate of ammonia, and nitrate of soda, both natural and synthetic, quantities of calcium cyanamide, sulphur, calcium arsenate, copper sulphate, and many other chemicals. Indirectly the industry has an even greater interest in agriculture, for without agricultural prosperity we have apparently learned—after three years of general depression, the culmination of eight years of prior agricultural depression—that general prosperity hinges on agricultural prosperity to an extent that few have understood and many have denied.

The farm market is the largest single sales outlet in the country. Even with the depression of agriculture, which began in 1921 and which has continued with varying severity until now, farm purchasing power still controls general domestic prosperity. That this should be so is not surprising, as will be seen below. We may ignore the changes of the last two years and consider the census figures for 1930.

At that time of a total population less than 123,000,000 persons, almost 30,500,000 actually resided on farms. Nearly 22,000,000 additional were classed as rural non-farm, living in towns and villages, and in the open country, but not engaged in farming. A large fraction of this population is in a real sense a part of the farm market. When we add to this total of more than 52,000,000 those persons in every walk of life, including manufacture, transportation, commerce, and the professions, some part of all of whose economic effort impinges on agriculture, we may well cease to doubt that general prosperity depends upon agricultural prosperity.

The depression has induced a back-to-the-land movement of such great proportions (approximately 1,500,000 persons) that by Jan. 1, 1933, farm population promises to be about 32,000,000. The all-time peak of Jan. 1, 1910, was only 32,077,000. Agriculture is, and probably forever will be, the residual occupation of man. This one fundamental fact demands for this super-basic industry a peculiar consideration adapted to its unusual problems.

National prosperity requires a proper balance between agriculture and industry. The best measure of this balance is whether a proper ratio exists between the purchasing power of farm products and the purchasing power of the products of industry and the services of commerce. How unbalanced the present situation is may be seen from Table II, presenting the index numbers of present prices and costs, compared with pre-War figures.

These figures portray the main features of the agricultural problem. How can we expect the farmer to survive with a decent standard of living in the face of such odds? The index numbers given are the latest readily available. Those for fertilizer and farm machinery are as of Sept. 15 at the farm; those for taxes, industrial wage rates, prices paid by farmers, food at retail, wholesale price of all commodities, farm wages, and prices of farm products at the farm, are as of Nov. 15, 1932, issued by the U. S. Department of Agriculture.

Table II—Index Numbers of Costs Affecting Agriculture and Industry

(1910-14 = 100)

Farm taxes	266
Industrial wage rates	177
Urban fuel and light costs	157
Freight rates	155
Food distribution costs	154
Farm machinery (excluding automobiles)	154
Living costs	135
Prices paid by farmers for commodities required in production and living	106
Prices of food at retail	104
Wholesale price of all commodities	94
Fertilizer	92
Farm wages	84
Wholesale prices of farm products	65
Prices of farm products at the farm	54

The five pre-War years were not a period of extraordinary agricultural prosperity; in fact, a long period of peace with relative freedom of international trade and progress throughout the world had produced unusual equilibrium throughout the economic structure. Every year from 1890 to 1908 inclusive showed "all commodities" enjoying an excess purchasing power over farm products. All commodities, of course, always include farm commodities which have usually been a pulling-down factor. The index numbers from 1909 to 1914, inclusive, of the Bureau of Labor Statistics, given in Table III, show how well-balanced conditions were.

In emphasizing the necessity for agricultural restoration, I do not wish to leave the impression that other factors, both domestic and international, are not of great importance in the present situation. Foreign debts, loss of foreign trade, over-speculation, high tariff walls, continued high freight rates, depreciated currencies, mechanization, high distribution costs, excessive government expenditures expressed in heavy taxation, and many other factors have played their part in bringing us where we are.

The purchasing power of the farmer depends upon his income. His income depends upon the number of units of

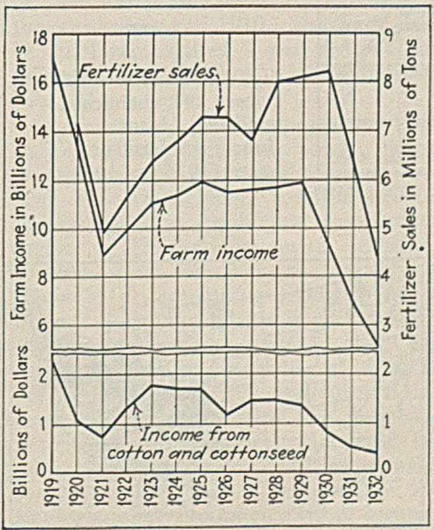


Fig. 1—Gross farm income and cotton income vs. fertilizer sales one year later

commodities he produces and sells and the price per unit. Taking the 1919 to 1929 average, a bale of cotton was worth more than $100 at the farm. Today it is worth less than $30. It takes just as many acres and as much work to earn $30 now as it did $100 then.

Because of the immense number of competing units engaged, and the inevitable dependence upon weather and other conditions beyond control, agriculture is in a weak trading position in exchanging its commodities for the commodities and services of others. Farming is both a mode of living and a business. The farm is both a factory and a home. The farmer is both a manufacturer and a consumer. These facts have deep significance, too often ignored or not understood. A modern farm family buys much the same things, with exception of a few food products, as a city family. The weak exchange position of agriculture is reflected in the balance sheets of every class that does business with it. It affects not only the fertilizer, machinery, seed and feed businesses, but the grain dealer, the miller, the cotton spinner, and the packer. It does, however, affect those who sell to the farm and those who buy from it in profoundly different ways. Industries that supply the necessities of life and operation to agriculture know how farm purchasing power has almost vanished.

Fig. 2 shows for the period from 1913 to November 15, 1932, by charting of index numbers, the relative behavior of prices of chemicals, fertilizer, farm products and farm machinery, using the year 1926 as basis. A comparison with pre-War conditions would be more illuminating and, in the light of the long period of depressed prices in which we now find ourselves, more useful.

The shifting of the Bureau of Labor Statistics base from 1913 to 1926 and the inclusion of several hundred new commodities make impossible a direct comparison of the years, following 1927 with earlier years. The effect of the change can best be shown by listing some of the index numbers for 1926, using a value of 100 for 1913 as the base, and placing the numbers for 1927 side by side, on both bases, as given in Table IV.

When 1926 was made the base period, the effect, of course, was to level all index numbers of that year to 100. The new base was favorable to fuels, clothing and building materials, and the like, and unfavorable to chemicals and fertilizers. Those that were highest on the 1913 scale now enjoy a more favorable comparison when adjustment to the new price levels now prevailing is under consideration.

The low 1926 index number of the chemical group was due to low prices of anhydrous ammonia, sulphur, denatured alcohol, copper and ferrous sulphate, white arsenic, and practically the whole acid group, particularly sulphuric and hydrochloric. The low number of the miscellaneous group was due to rubber, jute, burlap, cottonseed meal, and wood pulp. The low metals index was due to low prices of pig iron, structural steel, aluminum, and copper. The moderately satisfactory index number of farm products, 9 per cent below "all commodities," was due chiefly to good prices of wheat, potatoes, tobacco, and wool.

Fertilizer materials prices were high during the whole period of the War, largely because Germany was practically our only source of potash salts. Prices of these rose over 300 per cent, but they were almost unobtainable. Imported nitrate of soda, another fertilizer product of unusual weight at that time, was a high-priced war material.

In articles and addresses I have for years emphasized the fact that agriculture has been suffering acute depression that began in 1920 and which may not yet have reached bottom.

Fig. 3 shows the disadvantage at which the farmer is operating with respect to the exchange value of his products. In 1913, when the average wholesale price of the most used cotton fertilizer (3 per cent nitrogen, 8 per cent phosphoric acid, 3 per cent potash) was $20.31 a ton, it took 166 lb. of cotton to buy a ton of fertilizer; in 1931, although the price of this particular fertilizer had receded about 6 per cent, it took 335 lb. The farmer had to carry to market 110 per cent more cotton in 1931 to buy a ton of fertilizer than he did in 1913. (Average experience, confirmed thousands of times, has shown that each pound of fertilizer applied may be counted on to produce an extra pound of seed cotton.)

Cultivators are important implements in cotton production. In 1913 a riding cultivator cost $21.85; in 1931 a riding cultivator—no doubt a better one—cost $39.42. In the former year it required 179 lb. of cotton to buy the machine, in the latter 691 lb. Stated in another way, in 1913 it took about one-third of a bale to buy the cultivator, and in 1931 it took over a bale and a third. The chief reason was that cotton dropped from an average price of 12.2c. a pound in 1913 to 5.7c. in 1931.

Gradual exhaustion of farm resources of money and credit in the end expressed itself in such a loss of purchasing power as to contribute heavily to the grave break-down in our national economy that came after we stopped lending to foreign countries, in effect in order that they might buy our commodities. As long as our loans were sufficiently generous, the demand for our raw materials and manufactured products held up and we appeared able to enjoy a continuing prosperity despite agricultural adversity. When we ceased to play banker to the world normal economic forces took charge. Within the short space of two years we were plunged into the deepest commercial, financial, and industrial depression in our history.

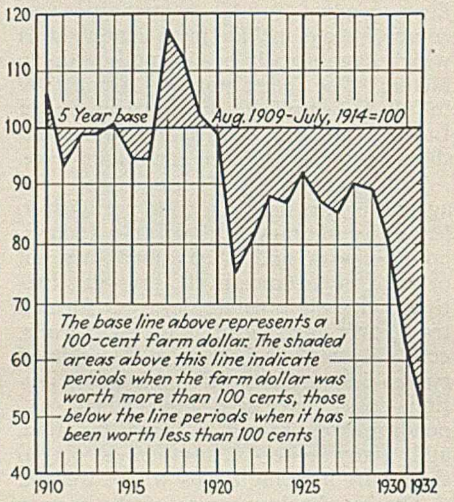


Fig. 3 — Value of farm dollar. Farm products sold vs. commodities bought

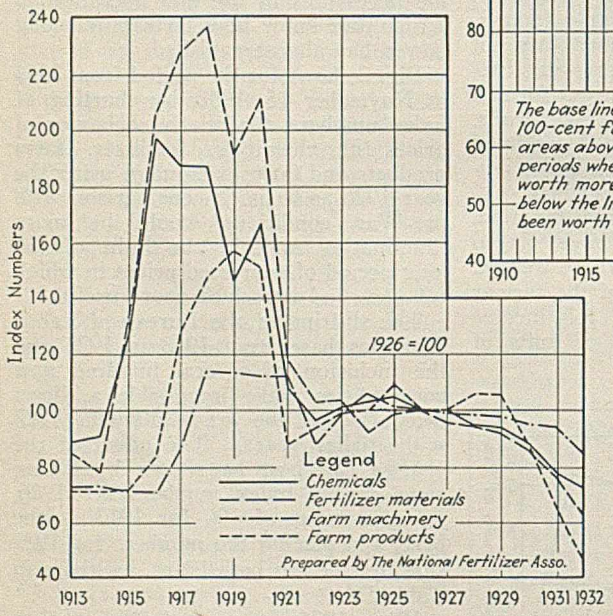


Fig. 2 — Wholesale prices of chemicals, fertilizer, farm machinery vs. farm products (1926 = 100)

Fig. 3 can leave no doubt as to the duration of the depression in agriculture. The farmer has been working for the nation at far less than a fair wage.

Agriculture is so diverse in its activities that it is really not a single industry but a group of many industries. At a given time some of these may be prosperous, while others are depressed. The high index number of farm products in 1925 was to a large extent due to the fact that the index number of the value of cotton and cottonseed was 177, while the combined index number of the 27 chief farm commodities including cotton was 147. On the other hand, the relatively high index numbers of 1928 and 1929, as shown on Fig. 2, were due to relatively high average prices for all farm commodities, excepting only the grains.

We might dismiss the more formal and conventional methods of expressing the idea that the purchasing power of the farmer's product is low, and merely recite a few facts and a few price comparisons. On his farm in South Dakota, my nephew in September sold his oat crop for 8c. a bushel, less than required to buy three first-class postage stamps.

In Ohio during November, farmers told me that corn had sold as low as 15c. a bushel for thoroughly useful grades. That is the price of a package of any one of a number of well-advertised brands of cigarettes.

On Nov. 15, 1932, the average price of cotton was 5.9c. a pound. Average for Nov. 15 in the five pre-War years, 1910-1914 inclusive, was 12.1c., or more than twice as much. In 1929 cotton was grown on 1,987,000 farms. Imagine the economic misery in these farm homes as a culmination of three successive years of disastrous prices.

On Nov. 15, 1932, the average price of wheat was 32.8c.; the pre-War five-year Nov. 15 average was 87.3c. More than 1,258,000 farms grow wheat.

Hogs represent an important source of farm income. In 1930 they were kept on nearly 3,619,000 American

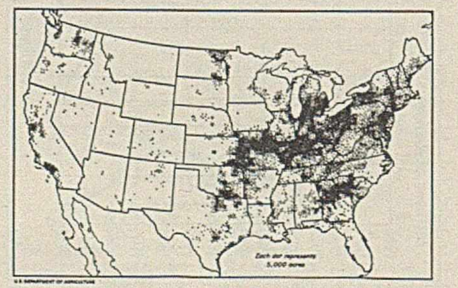


Fig. 4—Decrease in acreage, 1919-1929

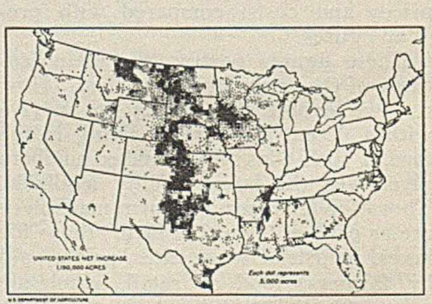


Fig. 5—Increase in acreage, 1919-1929

farms. The 1910-1914 average price of hogs, Nov. 15, was $7.25 per 100 lb. On Nov. 15, 1932, the average price at the farm was $3.05. Hogs have a double usefulness, as they are also the chief market for corn. In 1929 corn was grown for grain on 4,148,791 farms.

The average price of corn on Nov. 15, 1932, was 19.4c. a bushel. The Nov. 15 average for the five pre-War years was 59.4c. In other words, corn at the farm is bringing one-third as much as the five-year pre-War average.

The overwhelming importance of these four farm products has considerable bearing on the present discussion of farm-aid legislation, particularly the emergency domestic allotment bill now on the calendar, introduced last session by Senator Peter Norbeck and Congressman Henry T. Rainey. The facts given in this article call for constructive and conscientious efforts to solve some of the problems of the American farm if general prosperity or an approximation of it is to be restored. Many, including the writer, believe that some form of the allotment plan will start a real recovery in business.

The chemical fertilizer industry has a big interest in the shift of crops from fertilizer-using to non-fertilizer-using territory that occurred between 1919 and 1929. A similar trend is in progress now. In the eastern half of the United States there was a decrease of 32,000,000 acres of all crops harvested, while the acreage of crops harvested in the western half of the country increased about 33,000,000 acres.

Figs. 4 and 5 clearly show this startling shift. Acreage decreased in 1,940 counties. In the southeast the outstanding decline was in Georgia and So. Carolina, where cotton area alone decreased almost 2,000,000 acres, while it increased 5,291,000 acres in non-fertilizer-using Texas. Fig. 5 shows the increase in acreage in 1,130 counties. Obviously the great majority of these counties are located in the non-fertilizer-using territory in the Great Plains region. The shift really involved a decrease of about 17,200,000 acres in the fertilizer-using territory and an increase of 24,152,000 acres in the non-fertilizer-using territory.

In the face of this loss of market, the fertilizer industry sold over 8,000,000 tons of fertilizer in 1930. This increased demand pays high tribute to the farmer's appreciation of the economic value of commercial plant food.

Fig. 6—Expenditure for fertilizer, 1929

It is not generally known that over 95 per cent of our fertilizer consumption is normally applied to ten crops, as follows: cotton, 31.4; corn, 22.5; potatoes, 10.3; wheat, 10.2; tobacco, 7.0; oats, 4.9; citrus fruits, 3.6; hay, 2.7; sweet potatoes, 1.7; tomatoes, 1.2; all other crops, 4.5 per cent.

Fig. 6 shows geographically where fertilizer is used and how much is expended. In 1929, 2,324,090 farms reported the expenditure of $271,058,673 for fertilizer of all kinds. A total of 2,239,546 farms reported the purchase of 7,535,022 tons of commercial fertilizer. To visualize the loss of market experienced by the fertilizer industry, Figs. 4 and 5 should be compared with Fig. 6.

To put the case with great restraint, agricultural prospects are not encouraging. Together with loss of income and purchasing power, the value of the farm plant has decreased, while mortgage and other debts have increased enormously. Fig. 7 shows the situation for specific years.

In 1910 capital value was nearly $35,000,000,000 and the mortgage debt $3,320,000,000, as shown in Table VI. In 1920 capital value was $66,000,000,000 and mortgage debt $7,857,000,000. By 1930 capital value had dropped to $47,880,000,000, but mortgage debt had gone up to more than $9,241,000,000.

The estimated 1932 value of the farm plant is $37,000,000,000. Estimates of mortgage debt for this year are not yet available. It probably exceeds $9,000,000,000 and should certainly be less than in 1930. Between 1920 and 1930 over 450,000 farmers lost their properties through foreclosure proceedings. The 1932 value of the farm plant receded to a figure approximating that of 1910 but the mortgage debt is nearly three times that of 1910. Mortgage debt in 1910 represented 9 per cent of the value of the farm plant. In 1932 it was over 24 per cent.

Agricultural prospects involve not only income, purchasing power, taxes, mortgage debt, and similar items, but also domestic demand, foreign demand and competition, credit and many other factors. Domestic demand depends heavily upon whether the nation is ready to do something likely to be of direct help to agriculture itself. Foreign demand usually represents an outlet for farm products to the value of over 18 per cent of our gross agricultural income. This percentage has not been reached recently. Foreign demand for non-agricultural commodities usually represents less than 6 per cent of the total national non-agricultural income. In other words, loss of foreign trade is of far greater consequence to agriculture than to industry.

If domestic demand is rehabilitated through effective farm aid, foreign demand will be less essential, though still exceedingly important. The income and spending of nations are not unlike that of individuals—they cannot eat their cake and have it too. If the countries that buy our exports spend more for our automobiles, gasoline, lubricating oils, agricultural machinery, and copper, they will have less to spend for our chemicals or our cotton, wheat, lard, and tobacco.

Credit will be exceedingly scarce and expensive, driving many farmers off the farms. The experience of 1932 proved to hundreds of thousands of cotton growers that it is practically a waste of time to attempt to make a cotton crop in the old Cotton Belt without commercial plant food. They did a full season's hard work and bore all of the costs of production, and in hundreds of

Table III—Pre-War Index Numbers
(1913 = 100)

Year	All Commodities	Farm Commodities
1909	97	97
1910	101	103
1911	93	93
1912	99	101
1913	100	100
1914	98	103

Table IV—Index Numbers of Commodity Groups for 1926 and 1927, When 1913 = 100 and for 1927 When 1926 = 100

	1926 (1913 = 100)	1927 (1913 = 100)	1927 (1926 = 100)
Fuels	180	162	87
Clothing materials	176	221	96
Building materials	173	163	93
House furnishings	162	158	98
Foods	153	149	97
All commodities	151	147	95
Farm products	142	144	99
Agricultural implements	137	135	99
Metals	127	120	100
Miscellaneous	124	121	100
Chemicals	118	118	100
Fertilizer materials	109	102	96

Table V—Wholesale Prices

Index Numbers
(1926 = 100)
Bureau of Labor Statistics

Year	Chemicals	Fertilizer Materials	Farm Machinery	Farm Products
1913	89.4	85.5	72.9	71.5
1914	91.0	78.3	73.1	71.2
1915	127.8	133.7	71.2	71.5
1916	196.9	205.2	71.0	84.4
1917	187.6	228.0	86.3	129.0
1918	187.3	236.9	114.0	148.0
1919	145.8	191.8	113.8	157.6
1920	166.5	211.6	111.9	150.7
1921	108.9	117.9	111.4	88.4
1922	97.2	102.3	88.2	93.8
1923	100.6	102.5	98.8	98.6
1924	102.2	92.6	105.7	100.0
1925	104.1	98.8	100.4	109.8
1926	100.0	100.0	100.0	100.0
1927	100.0	96.2	99.2	99.4
1928	95.5	94.6	98.8	105.9
1929	94.4	92.1	97.9	104.9
1930	88.7	85.6	95.1	88.3
1931	78.0	76.8	94.0	64.8
1932 (Oct.)	72.7	63.4	84.7	46.9

Table VI—Relation of Capital Value To Mortgage Debt

Year	Value of Plant* ($1,000)	Mortgage Debt ($1,000)
1910	34,801,126	3,320,470
1920	66,316,003	7,857,700
1930	47,879,838	9,241,390
1932	37,000,000	9,000,000†

* Land and buildings.
† Approximate — estimate for 1932 not yet available.

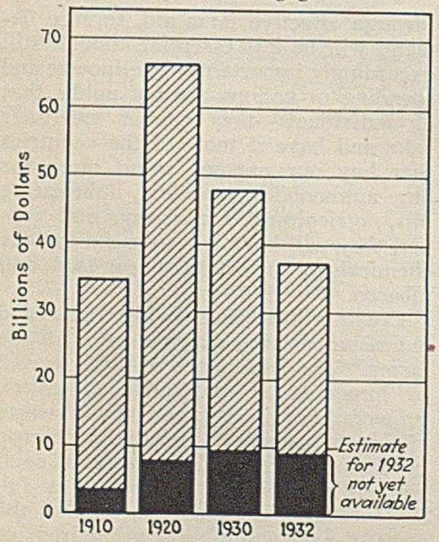
thousands of cases had almost nothing to show for their expense and effort. Many of these farmers, if they cannot obtain reasonable credit between now and March, may become public charges.

The agricultural credit corporations erected under the Reconstruction Finance Corp. are authorized by law to make loans only upon adequate security. Throughout the United States there are now thousands of farmers who can no longer give adequate security. One of our greatest needs, therefore, is what might be termed relief credit. Farmers to whom such loans are extended will pay back all they can, depending upon the crops they make and their prices, and make some kind of living.

The years 1930-32 inclusive will be remembered in the history of American agriculture as a time when farmers fought with courage and tenacity, an unequal and losing contest, without receiving due consideration from the standpoint of economic justice.

Such encouragement as there is in agriculture at present lies chiefly in the dairy, poultry, and certain specialized industries, but if agriculture is to contribute, by its production of new wealth from the soil, to the genuine rehabilitation of American business, there will have to be more "tug" and less "hold-back" work on the part of large groups of American citizens. Agriculture has contributed more than any other industry to American life. Raw cotton alone has brought to us from foreign countries more than $20,000,000,000 out of the $120,000,000,000 represented by our export trade for the past 38 years. Definite, constructive policies covering the whole field of agriculture and its balance with industry in our national life, both for the immediate and the more distant future, must be evolved and put into effect, utilizing and promoting individualism in its proper sense without permitting it to destroy or to be a drag upon national progress.

Fig. 7 — Relation of farm value to mortgage



Fertilizer Industry Feels Foreign Competition

ABOUT mid-October a cargo of phosphate rock from the tundras near the Arctic Circle in Soviet Russia was unloaded in Baltimore. Presumably labor and exchange conditions and the cheapness of ocean freights make it possible to transport this material to the United States and sell it successfully in competition with our home production. When we recall that the known phosphate rock deposits of the United States are estimated to exceed eight billion tons, this situation should provoke deep thought and constructive action.

The Russian material comes from the Khibiny district on the Kola peninsula, near the border of Finland, about 180 km. from Murmansk. The Khibiny deposit is estimated to contain a minimum of 500,000,000 tons of apatite. We have been told by Dr. Vavilof, an outstanding Russian agriculturist, that although Russian domestic agricultural requirements call for every ton of phosphate rock that can be converted into superphosphate, shipments by rail southward into Russia is impossible after winter closes in. On the other hand, the proximity of the Gulf Stream makes possible ocean transportation to and from the Khibiny district throughout the winter. This suggests that Soviet shipments will seek a Russian market throughout the rail-shipping seasons of spring, summer, and autumn, and a world market with low marine freights during the winter months. It is reported that the plant at Khibinogorsk uses the patented flotation process but without license from the owners of the patents. The rights to this process, which is also used in Florida are owned in the United States. Annual capacity of the plant is said to be about 250,000 tons. The rapidity of development in the Khibiny district is shown by a population increase from a few families to about 40,000 persons in less than three years.

Russian Output on Increase

Already one of the two atmospheric nitrogen fixation plants built by the Soviet Government is located in this district. When Dr. Giacomo Fauser, of Italy, the inventor of the Fauser process, was in Washington a few weeks ago, he stated that a third plant, in which his process is to be used, is under immediate consideration.

The annual capacity of the present mining operation has been estimated at from 250,000 tons per annum to as much as 1,000,000 tons, and it is understood that work is under way to complete a superphosphate plant for production of normal and concentrated superphosphate and of ammonium phosphate for domestic and export trade. It is worth remembering that 250,000 tons of rock makes 500,000 tons of normal superphosphate. This is nearly one-quarter of the total amount that will be used in the United States this year.

In past years small shipments of North African phosphate rock have entered our ports. It is understood that this trade may in the near future be renewed on a larger scale. Our foreign trade in phosphate rock dropped from over 1,300,000 tons two years ago to about 800,000 in the year that closed July 31, 1932.

Imports of Ammonium Sulphate

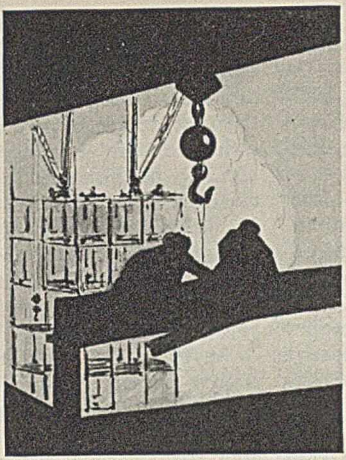
The situation with reference to shipments of ammonium sulphate is well known to all. Large quantities of this material have been coming in during the past year and a half, from Germany, England, Poland, Belgium, Holland, and Japan, with small quantities from other countries. During the first half of 1932 no less than 165,000 tons of ammonium sulphate were imported, compared with 34,000 tons in 1931 and 3,000 tons in 1930. In the twelve-month period between July, 1931, and July, 1932, the price of sulphate dropped nearly 44 per cent. Concomitantly our foreign market has almost vanished. While in the fertilizer year of 1930-31 we exported over 125,000 tons, in 1931-32 we shipped less than 25,000.

Comparing the same periods, imports of nitrate of soda dropped from 688,000 to 210,000 tons. During August and September, 1932, only 517 tons of nitrate came in, compared with almost 84,000 tons in August and September, 1931.

Speaking of "carrying coals to Newcastle," over 12,000 tons of superphosphate was brought into the United States in the year ended July 31, 1932. Not enough had been imported in previous years to warrant separate classification. The same was true of 6,350 tons of phosphate rock. More than this quantity of rock has already come this year from Russia alone.

To add to the perplexity of the situation, Japan has begun to ship mixed fertilizers to Pacific Coast ports. And it is reported some European countries are considering the shipment of normal mixed fertilizers to the fertilizer ports on our eastern coast. It is rather difficult to assess what effect the development of this trade may ultimately have on our mixed goods trade.

From an address, National Problems Affecting the Fertilizer Industry, by Charles J. Brand, executive secretary and treasurer before the Southern Convention, National Fertilizer Association, Atlanta, Ga., Nov. 1, 1932.



CONSTRUCTION CHALLENGES CHEMICAL ENGINEERING TALENTS

By F. E. SCHMITT
Editor, Engineering News-Record

Two mutually dependent arts have up to now exerted little influence on each other. Development of the products of chemical technology to meet more fully the needs of building and engineering construction and fuller adaptation of chemical engineering processes hold promise of leading to extensive changes in the civil engineer's technique.

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PARALLELING the profound changes which the development of chemistry and chemical engineering technology has wrought in the agencies of civilized life during the past century, equally profound change has resulted from the expansion of building and civil engineering skill. Each of the two arts has created marvels in improved service to humanity. Moreover, they are closely interrelated, and both are dependent quite directly on the well-being of the community's economic organization. Yet we find, strangely enough, that construction has been but little influenced directly by chemical advance.

When we seek for the reasons back of this condition we are apt to recognize as chief among them the ancient lineage of the major construction materials—the brick, stone, wood, mortars and iron products with which the constructor mainly works. Their production technology has been refined and modernized in many ways; developed by research and by the inventive and productive skill of many thousands of technologists, they have been made better, cheaper and more adaptable. But in the main they are the same materials known to the ancients and used by them with admirable skill.

We have to consider also the essential simplicity of the mechanical processes of construction as a factor in rendering the art relatively stable toward the revolutionizing, modernizing and altering influences which chemical discoveries and their industrial application on a grand scale have brought to bear on virtually every other field of modern production. The really significant changes in engineering construction in modern times are few in number, and the chemical art has played only a secondary part in them. The invention of portland cement, roughly a century ago, the development of high-power explosives, and initiation of mass production of ductile iron by the invention and commercial perfection of cheap steelmaking processes, may be ranked as the dominant factors of change in materials by which the powers of construction have been extended. The wide utilization of bituminous materials which followed the exploitation of petroleum and the development of gas and coke technology also had no inconsiderable influence on the growth of construction. In these instances the influence of the chemical engineering art is apparent. On the other hand, such far-reaching changes as the perfection of bridge-building practice, the creation of the skyscraper, and the conception and large-scale development of reinforced concrete, are examples of outstanding factors of progress in construction in which the chemical industry played no part.

Superficially viewed, then, the field of construction might appear to have but little contact with the field of chemical production. Seen in more detail, however, every phase and operation of civil engineering activity is found to be pervaded by the influence of chemistry and its products. Metallurgy and the various fields of non-metallic production employ chemical products and processes at every turn. In ferro-alloys, wood preservatives, the extensive range of the paint and varnish arts, wallboards, cement, ceramic products, everywhere in greater or lesser degree the practices of construction rest vitally on what chemical engineering practices have contributed. The improvements made through these contributions have helped construction to raise its quality and cheapen its cost.

Obviously, large future possibilities of chemical engineering influence lie dormant in the requirements of the construction field, and it is timely to consider a few of these. Before doing so, however, it will be helpful to have a rough quantitative estimate of the dimensions of the field.

A Seven-Billion Dollar Market

In normal times construction represents an annual market of seven to eight billion dollars, its amount increasing with the growth of the country and the increasing complexity of its demands. In 1928 and 1929 the total passed ten billions. Roughly one-third of the total expenditure goes into public works, these being mainly the improvements built by states and cities, such as streets and roads, waterworks, sewerage systems, bridges, markets and docks, institutions and other facilities that form the equipment necessary for well-ordered community existence. Another third goes into utility and industrial plant construction. The remainder represents housing.

These are operations of substantial size. They employ several millions of men directly and consume four or five billions of dollars worth of material, something like half of which consists of products of chemical engineering or of metallurgical processes.

It is clear from these facts alone that in an economic sense the chemical industry has a strong interest in construction. A substantial part of the latter market is controlled by engineers and contractors. In addition, the workers in the construction field form no small element of the general consumer market for manufactured products upon which the remainder of the chemical industries subsists. And finally the expansion of chemical plant forms part of construction's market. Thus the chemical engineer or manufacturer is quite directly concerned with the volume of construction activity and the sound, progressive character of its operations. In so far as he can contribute to its advance by improving its materials or processes he may help to make construction more efficient and cause it to flourish.

Revive Construction

When, as within the past two years, construction declines to a third of its normal amount, the chemical industry also suffers. The severe check that was imposed upon engineering construction and building by the deflation of business activity and later by the throttling of public credit reacted doubly on the producing and process industries, on the one hand by curtailing the market for the supplies which construction uses, and on the other hand by decreasing general consumer purchasing power through the unemployment of some millions of construction workers. It is the direct interest of every industry to assist in bringing about rapid revival of construction in order to rebuild these markets.

Since chemical products and processes enter largely into the work of the constructor and into the subsequent operating processes with which the civil engineer is concerned, it is to be expected that many opportunities are open to the chemical engineer to improve construction practice. Chemistry has made few fundamental contributions to the civil engineering art up to now, and as a result it is not far from the truth to say that construction has experienced little of that powerful reviving and recreating influence with which chemical technology has transformed most other fields of creative effort. True, explosives gave the constructor a tool without which many of his modern achievements would be all but impossible, and the creation of portland cement and concrete supplied him with a new constructive material which extended his powers in almost marvelous degree. But, keeping in mind such isolated exceptions, if we look at almost any modern piece of construction, be it house, office building, wharf or dam, we will discover little trace of modern chemical industry. The near future is bound to change this condition.

Relation to Chemical Industry

The powers of chemical creation and commercial production are so great that it is merely a matter of time before chemistry will affect the arts of construction as extensively as it has affected other human arts. This may not be accomplished tomorrow, for the necessary close contact between the chemical engineer and the civil engineer which must precede their effective cooperation has in general not yet been established. Only at individual points does chemical technology come into direct touch with the needs of construction and in general the stimulus to invention and technological development which comes from definite realization of practical needs is still lacking. However, the relation of chemical industry to construction is becoming rapidly more intimate. Many problems of the civil engineer are coming to have obvious chemical relationship or to call upon chemical methods and thought for their analysis and solution.

If the materials of the constructing engineer are viewed in the aggregate, it will be found that, in many respects, they exhibit shortcomings in quality, type, diversity, appeal of convenience or appearance, or in several of these attributes. This is in part due to their ancient origin, but the strong drift toward standardization of types, qualities and sizes which has been noticeable for the past decade or two has also been of influence, in tending more toward rigidity of practice than toward free and inventive progress. Standardization is highly useful, but it would unquestionably be vitalized and its stagnating tendencies corrected were chemical skill now actively impinging on construction engineering problems.

Anything approaching a complete survey of the possibilities thus offered to the chemical industry by the construction field is impossible in reasonable space. Only a few fields can be touched, and these in a suggestive way only. But such a brief glance at what the future may bring is enough to indicate what we may expect.

The Building Field

Consider the ordinary building. Imagine it stripped of its items of service equipment (contributed mainly by the electrical and machine industries) and look upon the structure itself. Substantially every part, from frame to finish and glazing, is obviously composed of old materials. If building is to be improved and cheapened, to be made more permanent and at the same time more adaptable, change in the materials handed down from past centuries, and the addition of new materials, are almost essential. Here lie primary opportunities for the creation of new possibilities by the chemical industries. Opportunities may be found in both structural and finish materials.

As to the framework of the building, we may think first of wood, oldest of all materials and still the builder's material of widest range of usefulness. Valuable because of strength, lightness and ready workability, it is subject to decay and shrinkage. When the chemical art discovers means of making lumber proof against decay and shrinkage, a vast improvement will be at hand and building methods will undergo radical change. The same or an added treatment might conceivably render wood immune to destruction by fire, for the reduction of flammability accomplished by present wood-fireproofing treatments is quite inadequate to give the degree of fire protection that safety demands in building framework.

Solid fireproof compounds or units for building construction, of lighter weight than those used today, offer another field for radical improvement in practice. Many valuable qualities are available in brick, stone, tile, concrete and gypsum units, but each of these has its individual shortcomings: excessive weight, lack of strength, inadequate weather and wear resistance, or fragility. Chemical synthesis may make available better materials to replace them, with advantages comparable to those which followed the replacement of many metal parts by molded composition. A skillful builder recently commented on the fact that virtually every building when closely examined is found to be more or less extensively cracked, because the inherent brittleness of its materials fails to provide resistance against the inevitable movements to which every building is subject. New materials possessing a reasonable "give" would resist these cracking actions and increase the permanence of buildings.

Decorative Finishes

In finish there is wide range of opportunity to develop better floor surfaces and improved facing materials or units for walls and ceilings. Plaster surfacing, one of the most ancient elements of building practice, is at the same time one of its weakest and most costly elements, and its elimination would constitute a vital simplification of building. External wall surfaces offer an opportunity almost as great, for the possibility of the application of light and adaptable plastics appears most attractive. Let us bear in mind that only within a few years past have light aluminum plate castings and stainless steel begun to diversify our building exteriors, and still more recently enameled steel sheets in an experimental way. There can be little question that architect and builder are ready for new and improved materials to form the exterior skin of their building structures as soon as such materials are made available by the chemical industries. And cost will not set narrow limits here, for weight, weather resistance, permanence and appearance are of commanding importance. New chemical discoveries may have to be awaited before many of these possibilities become tangible, but new discoveries are precisely what we should expect of the chemist as a matter of almost daily occurrence, if the history of the last few decades is a reliable guide.

Trim also offers possibilities of improving the materials now used. Solid, void-free, sanitary construction of the room enclosure is needed most of all in house construction, a field in which the defects of present day materials and the losses due to the cost and inefficiency of traditional building practices appear in most burdensome form.

Road Construction

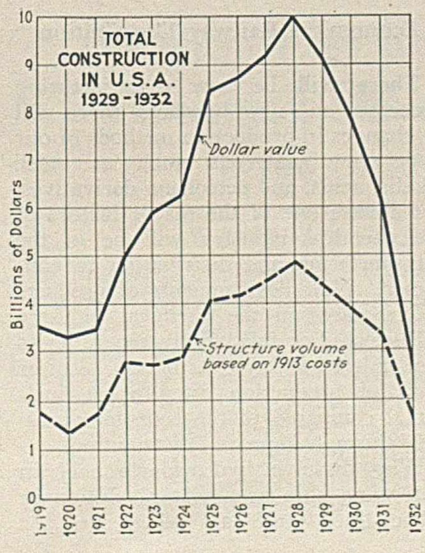
Asphalt, tar and portland cement have made the modern road possible. Without these substances the automobile could never have been developed to its present importance or highway transportation been raised to its new significance. These products of chemical industry, together with another, the rubber tire, are directly responsible for the creation of billions of dollars of new wealth, and the corresponding development of vast new productive power throughout the world. But perhaps the chemist can go still farther.

Methods of treating earth and stone to produce more permanent surfaces, possessing greater stability and wear resistance and of readier adaptation to different forms of base, afford a wide prospect for new advances. Low-cost construction methods for minor roads are now in the center of interest, but they present problems as yet unsolved.

In the field of high-cost pavements, rubber has been tried, but as yet has penetrated but little into practice. Street and sidewalk surfaces, and such special roadways as those of bridges, might be greatly improved over the best that can be produced with materials now available.

If we go below the surface we encounter the problem of the road subgrade, to which engineers and with them a few chemists have devoted much study in recent years. We still lack for the attainment of satisfactory skill in rendering subgrade soils sufficiently stable and strong to bear the loads imposed upon them by the pavement surface regardless of weather and moisture conditions. And the subgrade problem in turn is merely one phase of the larger problem of controlling the character of soil so that it may be maintained in one definite physical state or at will changed from its natural state to another.

The same problem is encountered in connection with the construction of earth dams, the stability of fills and levees, and the control of landslides. The mysteries of those peculiar states of material which are studied in physical chemistry seem to be involved, as also the obscure effect of the interaction of moisture and earths. This phase of soil research is as yet a science barely in the stage of infancy, but it well may lead to results of unsuspected scope. Its development is sure to involve chemical engineering processes very directly.



Waterproofing and protective coatings—paints, varnishes, lacquers and whatnot—form one of the most highly developed fields of chemical industry as applied to construction. Their antiquity alone should assure this, for did not Noah waterproof the outer surface of his ark and probably also paint its interior? Yet the actual facts of present-day practice are none the less disappointing. The leaking cellar, the costly building penetrated by rain water to the destruction of costly trim and finish, the continual trouble and expense of renewing paint coatings, are all too well known to permit us to look on this art as being in a satisfactory state. The chemist still has much work to do in furnishing better materials and methods to the constructor by which he may assure the exclusion of water and obtain durable, protected surfaces.

Chemistry in Sanitation

Advances in water and sewage purification and in associated branches of sanitary engineering are among the leading contributions which the civil engineer has made in recent decades to the security and convenience of living. In this field he has close contact with chemical engineering at nearly every turn, not alone in the sedimentation and softening of water and its sterilization by chlorine, but also in the disposal of the vast volumes of sewage which issue from the modern city. Most sensational of the developments of the last year or two has been the re-entrance of chemical treatment processes into the field of sewage disposal. There is a promising outlook for the successful adaptation of these processes to large-scale use, though much remains to be done before present experimental developments can claim to have attained practical success.

In water treatment developments of practice are going on which tend constantly toward shaping a purification plant on the pattern of a chemical process plant, using its equipment and plan of arrangement extensively. Chemical engineering skill here has wider opportunities than have yet been realized, to reduce the cost and complexity of plant and process.

Refuse disposal has been touched least by the chemical influence. The tendency of the day is strongly toward reliance on incineration where direct disposal by dumping or burial is not feasible. But here, too, since the fundamental task is to transform a perishable, objectionable material into stable form, it is by no means beyond the bounds of possibility that chemical procedure may bring new solutions to what is today a vexatious and costly undertaking.

If the concept of sanitation is carried a step beyond present day levels, still further possibilities appear. For, beyond all else, the modern city is dirty—as dirty as it is noisy. Chemistry can contribute little toward a solution of the noise problem, but is it too much to expect that it may find ways of combating the pollution of air, streets and houses with dirt and odors? We still have before us the problem of sanitation of the atmosphere which we breathe and in which we live. It may be that this must remain something for the mechanical engineer to deal with, by removing dirt from the air as it enters our houses. But if chemical technology has been able to contribute so much to other fields of sanitary advance—eradication of water-borne diseases, mosquito control, elimination of the offense and hazards attending waste disposal—it may also find a way of controlling or minimizing atmospheric pollution.

Better Knowledge Ahead

What has been said is intended to suggest that the chemical engineer is destined to play a much larger part in contributing to the art of construction than he has yet found opportunity to do. But it would be unjust to fail to keep in mind the extensive influence which chemists and chemical engineers are exerting upon civil engineering progress in less obtrusive manner.

Both in placing manufacturing processes upon a modern basis and in furnishing the means by which the construction engineer can examine, verify and test his materials and the results of his processes, chemistry has already brought about a profound transformation in the results attained by construction as well as in the certainty and speed of construction operations. Out of such studies in turn grows a better qualitative and quantitative appraisal of properties and performance, through the aid of which it will be possible to seek for new materials in definite directions.

The same effect that chemistry has already exerted toward placing construction upon a higher scientific level is continuing at the present time and will continue to be active. Cooperation of chemical engineering with construction is steadily increasing, and as their technical relation becomes closer they will also come into more intimate economic dependence upon each other.

What's Ahead in the Transportation Of Chemicals?

By L. A. BELDING

General American Tank Car Corp. New York

ONE of the things ahead for chemical industry is greater economy in the distribution of its products. Why should a producer of liquid caustic soda ship it as a 50 per cent solution, paying one half of the freight on water, when hot and more concentrated solutions can just as readily be shipped in newer, insulated tank cars? Why should sulphuric acid, a major chemical, be handled in small lots of 40 to 50 tons when tank cars now regularly handle as much as 85 tons of this acid in a single shipment? Why should consumers of bromine, buy sodium bromide and then treat with sulphuric acid to get the required bromine, when liquefied anhydrous bromine may shortly be shipped in a new type of tank car at great savings.

Hydrogen peroxide is now going over the rails in 8,000 gal. packages in contradistinction to carboy shipments of 12 gal. each of a year or two ago.

We may reasonably expect that before long lime and soda ash will not be shipped in barrels or in bulk in box cars with all the attendant hazards to workmen of loading and unloading, but will be handled mechanically in and out of special dust-tight, weatherproof tank cars. Wheat, flour, peanuts, rice, sugar, cornstarch, will also be handled so as to eliminate package costs, and at lower labor costs; while chemicals such as fuller's earth, talc, arsenic, and a host of other dry commodities, will be handled entirely by mechanical means, eliminating barrel, box, or bag, and effecting greater economy in their distribution.

Economical Railway Distribution

There will be new manufacturing processes and new products, there will be changes in production methods of our basic raw materials such as steel, alkalis, acids, and petroleum derivatives, but always one of the major factors of the chemical industry will be in the transportation and distribution to consumer. New developments of products or processes in the chemical industry will succeed or fail largely according to economical railway distribution. Lower costs of production often prove incidental compared to the economies possible through improved distribution.

Why dissolve hydrochloric acid in water and ship as a water solution in rubber-lined tank cars when cars are now being designed to ship anhydrous hydrochloric acid? Why ship portland cement in bags when it can be carried cheaper and more efficiently in bulk? Why, in many instances, go to the expense of producing granulated sugar when sugar syrups are applicable in many food processes and can be shipped with far greater economy. Insulated tank cars will maintain temperature of lading in zero weather and solubility of sugar at 100 deg. C. is 100 per cent greater than at 20 deg. C. Ship hot and save freight. There will be less of the unnecessary cooling and drying, and unnecessary finishing operations in the chemical industry of the future.

Trends Among Chemical Users

Textiles will be consuming more hydrogen peroxide for bleaching and small packages such as the glass carboy cannot be used economically in the tonnage required. Rayon products call for hydrogen sulphide, but the petroleum refiner looks upon this refinery byproduct as a nuisance. There must be means developed for successfully and economically transporting this waste hydrogen sulphide from the petroleum refinery to the rayon factory where it can become one of the important raw materials. Textiles can use hot concentrated caustic soda solutions and the very manufacture of caustic soda economically produces a hot solution. The transportation facilities provided for carrying this caustic soda from producer to consumer must be such that there will be no expensive cooling and finishing by the producer, and no expensive processing and heating by the consumer.

Iron and steel will always demand tonnages of sulphuric acid and transportation facilities now available permit refinement of manufacture and provide greater economies for the steel mill. It is unnecessary to solidify the tars now sold by steel mills. They may be loaded at a temperature of 900 deg. F. and delivered to consumer hot and molten.

Construction projects of the chemical industry will have their share of benefits through the bulk delivery of portland cement. Weatherproof, dust-tight cars carrying as much as one hundred tons of cement in bulk will effect savings of $2.00 per ton in distribution costs, and such a saving is more than any cement mill is making as a profit right now.

New Fields of Opportunity

CHEMICAL ENGINEERING, if it is to grow as a profession and prosper as a profitable contribution to industry, must broaden the base of its operations. It must extend its influence to older fields that have never accepted chemical technology in their production processes and it must turn to new industries that involve problems of a chemical character. In this Year I of Technocracy, it is perhaps treason to admit that rule of thumb still reigns in several important industries, yet we know of many plants where the authority of the little red book of formulas or its modern successor, the "Official Works Manual" can never be questioned. Here the entree for the chemical engineer is difficult and progress must of necessity be slow and painstaking.

But in newer industries—such as aviation, air-conditioning or electronics,—which are themselves the products of science, there is no such obstacle of tradition in the path of the chemist or the chemical engineer. There are plenty of problems to be solved and rich rewards await their solution. The only hitch is that the newer industries often fail to recognize the fact that their problems are of a chemical character and unless there is a closer association on the part of chemical engineers with these fields, the inter-relations do not become apparent. As a step in that direction, *Chem. & Met.* has assembled a brief symposium of opportunities in the newer fields of aviation, air-conditioning and electronics, in the new-old industry of brewing, and, finally, in food manufacture and sanitation, where there are evident trends toward the acceptance of chemical engineering practice.

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Brewing—A Fertile but Difficult Field For Chemical Cultivation

By ROBERT SCHWARZ

President The Schwarz Laboratories, Inc.
New York

IT IS NOT the purpose of this brief article to arouse false hopes on the part of the chemist or chemical engineer who may envision the brewing industry as a tremendous new field shortly to be opened up for chemical exploitation. Years upon years of experience in this country before prohibition and in Germany and England even before that, have demonstrated that brewing is first of all an art, and secondly a science. A plant may brew a theoretically perfect beer only to find that the public won't buy it. In other words, the chemist in the brewing industry must begin with the art and work back to the science—must begin with the product that meets with popular demand, and work back to perfecting plant operations and production technique.

One other factor that cannot be overemphasized is the fact that beer is a perishable commodity, that involves biological considerations quite uncommon to most chemical operations. Therefore I should say that as the old brewing industry gradually re-opens its doors, it will be the biological and control chemists who will first find their work cut out for them. The research and development chemists will follow later, but I believe that some time will elapse before other than the largest breweries organize their own control laboratories and research departments.

The chemical engineer, too, will enter the industry perhaps through the door of new equipment that will introduce precise and automatic control of operations as well as new materials of construction. Tradition will still hold sway in many respects, but the modern technique of engineering operation is bound to find more general acceptance. Chemical engineers will have much to learn from the master brewer before they are ready to assume any major responsibility in this important industry. To sum it up in a sentence, I would say that the brewing industry must eventually offer a fertile field for chemical cultivation but one requiring a great deal of detailed knowledge of the art as well as the fundamentals of the sciences of chemistry and biochemistry and chemical engineering.

Aviation Has Real Need for Chemical Developments

By EDWARD P. WARNER

Editor of "Aviation," Former Assistant Secretary of the Navy for Aeronautics

CHEMICAL ENGINEERING makes direct contact with the aeronautical world at two principal points,—protective coatings of materials and fuels for engines. Great headway has been made in the past few years in the development both of paints and of purely chemical means of safe-guarding alloys against corrosion, and also in the improvement of protective coatings for fabrics, especially in the development of fast-color lacquers. Work still continues on improved lacquers, dopes and "doping schemes," but the problem of fabric protection is no longer a critical one.

In the use of light alloys, most notable recent trends have been to an almost universal use of anodic treatment for protection of duralumin and other alloys of that type, and a growing use of Alclad. Stainless steel is making headway in highly specialized types of construction. Improvement in the art of drawing stainless steel tubes would be very welcome, and would make it possible to replace chrome-molybdenum and other alloys now much used in aircraft structures with the stainless material without basic redesign of the structure. British manufacturers are moving in that direction.

The use of magnesium in American aircraft grows rather slowly, largely because of corrosion dangers. There again the responsibility for making it possible to secure an important weight economy falls upon the metallurgist or the chemist. Beryllium continues the subject of academic discussion, and attracts much less attention than it did a couple of years ago. A more immediate and practical need is for light alloys substantially non-corrosive in themselves, and there seems to have been much progress in that direction in Germany within the past year.

Of even greater current importance is the chemistry of fuels, for the efficiency of all aircraft operations depends upon the type of fuel that can be used. To improve the fuel, especially in respect of its anti-detonant quality, is to increase the permissible compression ratio of the engine and to cut down the engine weight, the frontal area and air resistance, and the weight of fuel consumed for a given power. It has been conclusively demonstrated that there are conditions under which it is good economy to increase the amount paid for fuel by as much as three or four cents a gallon (and it is quite imaginable that in some cases the differential of advantage might run to eight or ten cents a gallon), as compared with the price previously paid for what had seemed a perfectly satisfactory gasoline. The attempts to produce better fuels and to control their properties more narrowly of course run along several alternative lines. There are straight-run fuels from selected crudes, from the California field and others of similar properties; there are fuels made by vapor-phase cracking from crudes of lesser native merit; there are the products of the hydrogenation process (which have the added advantage of having a very high flash point, and being exceptionally safe against accidental ignition); and there is the final added possibility of the use of various anti-knock compounds, such as tetra-ethyl lead. All that lies within the field of the petroleum chemist and his immediate automotive ally.

When our research becomes really far-flung, however, it is possible to go on to a considerable variety of other sources for fuel, and particularly to investigate various blends of petroleum products with benzol and alcohol (ethyl and methyl), both of which have exceptional possibilities in raising the octane number, now generally accepted as the quantitative measure of anti-detonant quality. The fuel used in the engine of the seaplane which holds the world's air speed record of 408 miles an hour, in fact, contained no petroleum product at all, being a blend composed principally of benzol and alcohol. It is preeminently due to fuel research that it has been possible to raise the normal output of large air-cooled aircraft engines from about .28 hp. per cu.in. of piston displacement to about .40. There is every reason to hope for a further increase to at least .50 in the near future, but if it is to be achieved the chemist will have to carry much of the burden.

What's Ahead for Air Conditioning In Chemical Industries?

By S. B. LINCOLN

Lockwood-Greene Engineers, Inc., New York

PRACTICALLY all manufacturing processes have a tendency to become much more exacting as industry develops. Standards of quality and uniformity are continually being carried to higher levels by the most progressive manufacturers in their respective fields. In the present period, competition is keener than ever before, and manufacturers must be prepared to consider all possible methods of improving their product.

Air conditioning has already been an important factor in improving quality and rate of production in many industries. The first application of air conditioning was made approximately 30 years ago in the printing industry, but the textile industry was the first large industry to apply air conditioning throughout most of its processes. Therefore, the advantages of air conditioning are probably better appreciated in this industry than in any other. Recent years have seen a wide application of air conditioning to those industries making cellulose products such as rayon, transparent wrappings, and photographic films. Large installations have been made in some departments of printing plants, and in plants for the manufacture of candy, food products, tobacco, and pharmaceutical products.

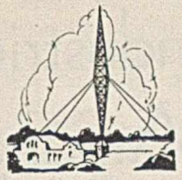
It is well known that in any manufacturing operation there will be a number of variable conditions. In the chemical industry where chemical reactions are involved and where elements of time, temperature, humidity and even air currents affect the finished product, air conditioning provides a means for eliminating at least two variable conditions. This industry must have many operations where uniformity of product can be greatly improved by the aid of air conditioning.

In all those chemical processes which involve drying operations, air conditioning offers an opportunity for improvement of product. Many existing dryers provide an approximate but not an exact control of humidity, but for any product it will be found possible to develop by experiment the exact cycle of varying temperature and humidity which will produce the best results. The proper apparatus for controlled air conditions then provides a means for reproducing this exact cycle continuously.

There are many industries which have never given a thought to the possibilities of air conditioning. It seems probable that the manufacture of sheet glass, for instance, could be greatly improved by maintaining exact control of air supplied to furnaces for combustion. Sudden weather changes, and even changes in wind direction now affect furnace control and cause serious difficulty in making glass of uniform quality. Another critical point in this process is in the forming of the sheet which is now done without any control of room temperature and humidity and without control of direction or intensity of air currents. This is an excellent example of an industry where the quality of the finished product depends upon a number of variable conditions and where, so far as we know, no application of air conditioning has been made.

Some discoveries of the benefits of air conditioning, as applied to certain processes, have been made in an accidental manner, but it seems probable to us that many other such opportunities now existing will have to be discovered by men within the chemical industries themselves. This field covers a wide variety of plants and processes, and offers every opportunity for the exercise of initiative and originality on the part of chemical engineers.

Electronics—New Hybrid of Chemistry and Electricity



By O. H. CALDWELL

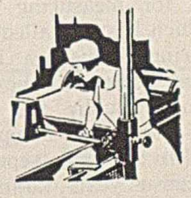
Editor of Electronics
Former Federal Radio Commissioner

A NEW MARKET for special chemical products is developing in the very rapid expansion of the uses of electronic tubes and photo-cells in industry. Electrodes for these tubes employ special materials and metals which create new demands for products that formerly were produced only on a laboratory scale. Meanwhile the new trend to gaseous illuminants of increased efficiency, such as the sodium-vapor lamp and the quartz-mercury tube, involves further calls on the chemical industry for supply of raw materials.

On the other hand, these thermionic and photo-sensitive devices offer the chemical engineer valuable new tools for the control of his own chemical processes by automatic indicators that never wink, never sleep, and never fail. Processes can be governed so as to operate valves, produce mixes, or turn heat on or off, when the color, density or other property reaches a predetermined value. Indeed, with the photo-electric cell there is no degree of delicacy of control which cannot be based upon the slenderest change in properties on the one hand, and yet made to operate electrical circuits involving tremendous horsepower, on the other. At last the chemical engineer has a dependable robot-giant who can be put to work in any remote part of the plant, and made to effect control as if human agency intervened at that point. With the unlimited power of amplification of the electronic tube, the designer need only write the specifications of the ideal automatic control function, and electronic devices can be found to perform the task, accurately, unfailingly, and tirelessly.

In the new field of electronics the chemical engineer finds himself in a familiar background of electrons, ions, cathodes, and chemical phenomena. For electronics is the hybrid of electricity and chemistry, a new art of untold potentiality in which the most rapid progress will come as engineers understand the two basic sciences from which electronics has grown.

Breaking Into the Food Industries



By LAURENCE V. BURTON

Editor of Food Industries

TO THE CHEMICAL ENGINEER with the proper training, the food industries offer the largest undeveloped field of endeavor in the country. Food manufacturing operations are essentially chemical engineering unit operations but with the distinction that rigid sanitary control is necessary throughout. Foodstuffs are all of biological origin and may be easily decomposed by bacteria, molds, and yeasts. Hence to fit into the food plant organization best, the chemical engineer needs to know his biological chemistry and microbiology.

Unfortunately, however, very few but the largest food manufacturers understand the chemical engineer and what he can do for them. There is seldom a place in the organization table for him and hence it is difficult for him to gain a foot-hold as a chemical engineer in a food plant. *Food Industries* has been steadily developing a consciousness of the importance of the chemical engineer in the food field by popularizing the term "food engineer."

With the passage of time it is certain that food manufacturers will develop a clearer understanding that their businesses are largely an adaptation of chemical engineering, and when that time arrives we can expect to see the trained food engineer in charge of the production division of the better food manufacturing establishments.

To secure employment as such, however, is an extremely difficult task, particularly in 1933. If the advice of one who has gone through the mill is worth anything, it is that, until the food industries recognize chemical engineering as a valuable professional attribute, the chemical engineer must get into the plant in whatever guise he can—researcher, development engineer, operator, or what not—and then show his talents cautiously after he has made a place for himself.

Chemical Engineering Trends In Sewage Treatment

By F. W. MOHLMAN

Director of Laboratories, the Sanitary District of Chicago

CONSUMPTION of chemicals in sewage treatment will probably be extended markedly in the next few years. Many studies are being made of the application of iron compounds, chlorine, lime, and other materials for precipitation of sewage and as filter aids to improve the rates of vacuum filtration of sewage sludge. So far, ferric chloride has proved to be most effective as a filter aid, but the cost is quite a large percentage of the total cost of disposal of sludge. At Baltimore the cost of ferric chloride was more than 50 per cent of the total cost of sludge disposal.

New equipment is needed for sludge incineration. Large projects seem to be turning to disposal of sludge by filtration and incineration. Digestion of sludge is still the most widely used procedure, followed by drying on sand beds and dumping.

The activated-sludge process is now preeminent for complete treatment. The chemical processes under investigation apparently fall into lower ranges of efficiency, with the possible exception of the ferric sulphate-zeolite process, which so far has been tested only on a very small scale.

The trend toward chemical engineering processes and equipment is a challenge to chemical and mechanical engineers to find cheaper and more efficient equipment, new chemicals and simplified processes for sewage treatment and sludge disposal. This challenge has resulted in the launching of a variety of chemical and biochemical processes, most of which are too expensive for the results obtained, or deficient in degree of treatment. The conservative sanitary engineer does not admit that the well-established processes of sewage treatment, such as activated sludge or trickling filters, are destined for the scrap heap; their use can be simplified and cheapened by the application of chemical engineering equipment.

Process Industries Attain Higher Rating Among Manufactures

In the almost universal curtailment to which manufacturing operations have been subjected in the last three years, a wide variation is shown in the degree of decline recorded for the individual industries. The process industries which comprise a well defined group of producers followed the downward trend to a lesser degree and now hold a more prominent place in our industrial set-up than ever before.

THROUGH the figures for production emanating from the Census of Manufactures is offered a medium for measuring the rate of activity which has prevailed in domestic manufacturing industries in alternate years. The Bureau of the Census has recently made public the returns for 1931 and interesting comparisons are to be found in the totals reported for the last three census years, taking in as they do, a period prior to the abnormal expansion of 1929, and going through 1931 with its downward trend for manufacturing operations.

Analysis of the census figures indicates that the rise in production in 1929 as compared with 1927, while large, was not so extensive as the decline in output in the two-year period succeeding 1929. Under the lure of broader consuming demand, the productive capacity of manufacturing plants was increased. The census figures do not definitely record changes in plant capacities but the number of establishments engaged in manufacturing in 1929 represented a gain of more than 9 per cent over the total for 1927. Cost of materials in 1929 likewise increased more than 9 per cent over those used in manufacture in 1927. Value of finished products rose to an even higher degree, the comparison giving 1929 a gain of more than 12 per cent over 1927.

Passing to consideration of 1931 figures, the curve takes a decided reverse direction and the respective group totals not only fell far below the 1929 levels but also were appreciably lower than they were in 1927. The number of establishments dropped more than 17 per cent compared with 1929 and more than 9 per cent compared with 1927. For the same periods the decline in cost of materials was more than 44 per cent and more than 10 per cent respectively and the value of products decreased upwards of 41 per cent and 34 per cent.

In the case of cost of materials and value of products the drastic reductions in 1931 not only reflect the slower rate of manufacture but also accentuate the lower price levels which were reached in that year. To reduce the decline in 1931 to a purely volume basis, it would be necessary to take into consideration the difference in unit values in the different years.

The Process Industries

Naturally the same influences which depressed manufacturing in general from 1929 through 1931 affected to a greater or less degree the progress of the process industries during those years. The accompanying tabulation enumerates the group of manufactures which make up the process industries and the detailed statistics relate the position of these industries one to another and trace the progress of the group in comparison with general manufacturing.

On the basis of number of establishments expansion in the process industries from 1927 to 1929 was not so marked as it was in general industry. Census figures credit the process industries with the operation of 16,579 establishments in 1927 and 16,600 establishments in 1929 or an increase of only a fraction of 1 per cent. Due to the prevalence of mergers and to the consuming markets the number of establishments had declined to 14,371 in 1929 and in this respect

What the New 1931 Census of Manufactures Shows for Process

	Number of Establishments 1931	1929	1927	Number of Wage Earners 1931	1929	1927	Wages — Dollars 1931	1929	1927
Chemicals	2,225	2,508	2,372	100,368	132,758	119,684	102,361,709	152,875,427	132,005,413
Ceramics, Brick and Clay Products	1,558	2,113	2,218	78,725	129,632	138,687	72,596,345	151,780,650	168,512,372
Coke-Oven Products	112	153	171	14,383	20,552	21,082	22,134,487	33,389,425	34,167,692
Drugs, Medicines and Cosmetics	2,337	2,792	2,385	34,428	40,908	36,331	36,826,569	45,836,942	40,395,166
Explosives and Fireworks	113	145	136	6,075	7,425	7,367	6,662,903	10,418,485	9,526,258
Fertilizers	590	638	621	14,803	20,926	18,612	12,314,429	17,883,925	17,649,661
Glass and Glassware	230	263	269	48,830	67,527	65,825	57,543,436	87,795,111	81,352,734
Glue, Gelatin and Adhesives	137	158	141	2,836	3,407	3,728	3,670,542	4,783,018	5,203,700
Leather, tanned	412	471	494	42,096	49,932	52,924	49,594,294	63,413,707	67,887,231
Lime and Cement	369	411	421	30,996	41,922	47,225	35,883,320	58,325,410	65,301,663
Gas, manufactured	638	754	828	35,726	43,065	48,497	51,001,333	61,060,382	68,356,448
Oils and Greases, Animal and Vegetable	1,007	1,153	1,073	21,309	28,091	30,382	20,332,649	29,178,038	32,019,991
Paints and Varnishes	1,010	1,063	1,006	22,300	29,211	28,061	29,122,000	42,244,695	40,184,732
Paper and Pulp	846	883	929	107,901	128,049	123,360	126,395,657	173,077,781	162,002,097
Petroleum Products	358	390	354	67,936	80,596	71,234	106,815,307	131,176,993	113,716,705
Rayon and Allied Products	32	29	19	38,732	39,106	26,341	38,220,094	44,697,129	28,649,441
Rubber Goods	439	525	516	98,087	149,148	141,997	111,513,369	207,305,857	198,073,743
Soap and Cleaning Prep.	579	711	597	16,146	17,076	15,835	20,273,251	22,350,817	22,714,361
Sugar	154	173	153	20,007	23,727	22,369	23,900,522	29,513,699	28,056,380
Other Products	1,225	1,267	1,876	39,119	53,474	80,036	44,619,841	71,947,550	105,608,289
Total for Process Industries	14,371	16,600	16,579	840,805	1,106,532	1,099,577	971,782,057	1,439,055,041	1,421,384,077
Total for All Industries	174,136	210,959	191,866	6,511,647	8,838,743	8,353,977	7,225,587,464	11,620,973,254	10,848,802,532
Per Cent of Total by Process Industries	8.2	7.9	8.7	12.9	12.5	13.2	13.4	12.4	13.1

the group declined more relatively from 1927 than did general manufacturing.

The cost of materials used in the process industries further bears out the contention that these industries were not unduly inflated in 1929 as the totals were $7,179,452,461 in 1927 and $7,350,-827,748 in 1929 or a gain of little more than 2 per cent. The drop from 1929 to 1931 however was severe topping 38 per cent but still under the percentage decline registered for all industry.

From the standpoint of value of products the process industries again made a relatively good showing. Restricted markets and a steadily dropping price level for commodities could not fail to draw down the total value of finished products and the group had an output in 1931 of approximately 31 per cent under that reported for 1927.

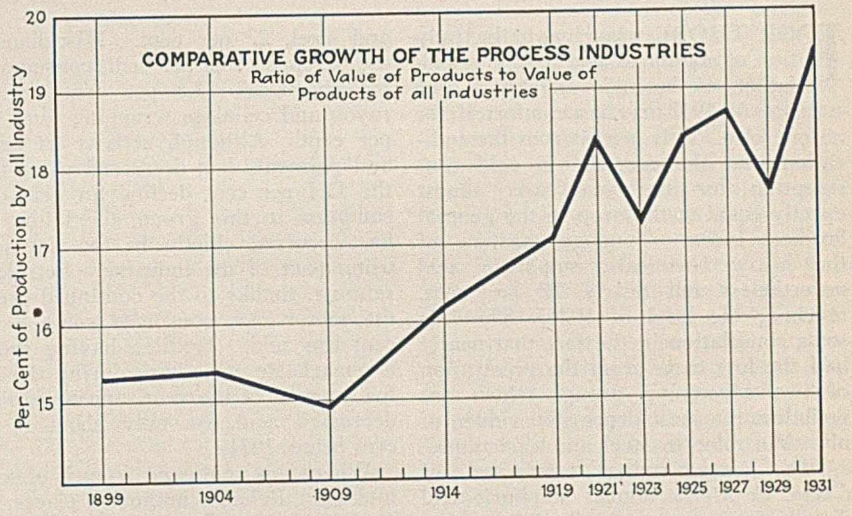
The showing of the process industries is all the more commendable when it is considered that the group includes some lines of manufacture which are largely dependent upon industries which have been most adversely affected by the depression. Steel operations, for instance, have been directly reflected in the output of coke-oven products. The slump in building has slowed up consumption of lime and cement and the same reason plus the drop in automotive production restricted demand for paints and varnishes. The situation in agriculture was distinctly unfavorable to consumption of fertilizer chemicals.

Rayon Output Increased

Reversing the general order, production of rayon reached a higher valuation in 1931 than it did in 1927, the percentage of gain running in excess of 17 per cent. The output of drugs, mēdicines, and cosmetics in 1931 fell less than 6 per cent below the value placed on the 1927 production. Soap makers apparently were but little affected by slower business conditions as their products, disregarding declines in sales prices, were less than 8 per cent down from the total valuation given for the 1927 production. The manufactured gas industry valued its outturn in 1931 at but little more than 9 per cent under its valuation for 1927 and the value of chemicals, which find a consuming outlet in practically every manufacturing line fell off in value about 14 per cent in the same interval.

Perhaps the most interesting and most enlightening comparison to be drawn from the figures given in the accompanying table is to be found in the changing relationship which the process industries bear to industry as a whole. The percentage which these industries contribute to our total manufactures has steadily risen in recent years and the trend is still upward.

This growing importance of the process industries may be largely accounted for by the fact that they include the production of materials which find almost universal application and thus directly share in the progress which is being made in other lines of manufacture. Chemical engineering research and the development of new products and of new uses for old products, however, must be given their full meed of recognition.



Among new products which have quickened the rate of growth of the process industries are included rayon, plastics, cellulose wrapping film, and pyroxylin lacquers.

All of which is in line with the views just expressed by 150 leaders of American life in the fields of research, industry, engineering, economics, education, and finance which state that uninterrupted development of research, invention and labor-saving devices as means of improving production and creating new needs and industries with enlarged employment opportunities is the road out of the depression toward a new prosperity.

Industries As Compared With 1929 and 1927 Compilations

Cost of Materials, Supplies, Fuel and Power Dollars			Value of Products — Dollars			Value Added by Manufacture — Dollars		
1931	1929	1927	1931	1929	1927	1931	1929	1927
329,058,440	508,152,499	422,090,030	760,429,942	1,090,930,252	884,976,741	431,371,502	582,777,753	462,886,711
55,073,061	110,686,054	135,380,584	196,440,118	411,472,613	436,103,772	141,367,057	300,786,559	300,723,188
162,793,117	281,592,430	286,728,701	226,509,038	416,348,458	382,012,617	63,715,921	134,756,028	95,283,916
151,765,002	202,519,777	183,589,308	525,951,881	646,795,185	559,002,970	374,186,879	444,275,408	375,413,662
20,908,303	34,228,924	39,517,248	49,951,956	79,123,226	78,374,607	29,043,653	44,894,302	38,857,359
106,899,718	159,801,195	138,142,925	155,150,562	232,510,936	190,384,890	48,250,844	72,709,741	52,241,965
73,080,234	103,293,943	109,911,464	214,811,484	303,818,560	282,394,330	141,731,250	200,524,617	172,482,866
17,334,581	22,646,734	23,492,745	31,091,137	39,096,406	39,141,210	13,756,556	16,449,672	15,648,465
172,399,689	337,597,868	331,984,736	271,070,432	481,340,299	494,255,838	98,670,743	143,742,431	162,271,102
64,854,848	109,150,257	137,281,492	170,934,487	303,324,918	335,152,751	106,079,639	194,174,661	197,871,259
152,579,762	188,416,183	211,785,523	467,751,449	512,652,595	516,705,170	315,171,687	324,236,412	304,919,647
259,280,827	470,996,141	438,481,066	342,803,530	601,308,320	563,848,596	83,522,703	130,312,179	125,367,530
192,593,000	334,132,065	307,724,370	348,855,000	568,975,838	519,009,842	156,262,000	234,843,773	211,285,472
494,108,610	723,360,707	724,110,963	851,530,240	1,206,114,305	1,138,089,666	357,421,630	482,753,598	413,978,703
1,200,918,204	2,031,341,408	1,752,997,043	1,511,597,675	2,639,665,001	2,142,648,503	310,679,471	608,323,593	389,651,460
36,206,576	33,334,753	25,747,792	132,783,559	149,546,107	109,888,336	96,576,983	116,211,354	84,140,544
251,501,898	578,677,681	660,370,209	610,120,806	1,117,460,452	1,225,077,114	358,618,908	538,782,571	564,706,905
135,916,182	199,752,025	187,463,765	302,556,478	360,971,162	328,294,401	166,640,296	161,219,137	140,830,636
408,264,984	521,582,617	636,441,459	494,956,767	634,267,635	710,381,336	86,691,783	112,685,018	73,939,877
226,318,327	399,564,487	426,211,038	405,241,076	683,646,247	792,499,557	178,932,744	284,081,760	366,288,519
4,511,855,363	7,350,827,748	7,179,452,461	8,070,537,617	12,479,368,515	11,728,242,247	3,558,692,249	5,128,540,567	4,548,789,786
21,420,124,017	38,549,579,732	35,133,136,889	41,333,108,998	70,434,863,443	62,718,347,289	19,912,984,981	31,885,283,711	27,585,210,410
21.0	19.0	20.2	19.5	17.7	18.7	17.9	16.1	16.5

Sulphuric Acid Production Mirrors Industrial Conditions

EDITORIAL STAFF

FOR THOSE who cling to the tradition of sulphuric acid as the grandfather of business indicators, the statistics of 1932 may be a comfort, if for no one else. This arises from the indication that the decrease in acid consumption for the year was almost exactly equal to the drop in the general business index. Tonnage capstone of the heavy chemicals, sulphuric acid nevertheless fell nearly 27 per cent, reaching the level of 1921. There is some consolation in the fact that nearly half the loss came from the prostration of two consuming groups which are doubtless the most depression ridden of all. We refer to steel and agriculture.

The accompanying tabulation of *Chem. & Met.'s* annual sulphuric-acid distribution estimate shows clearly what happened. With agricultural income cut to the bone and fertilizer production, of consequence, at an abnormally low level, fertilizer consumption of acid dropped over 46 per cent. Iron and steel plants, operating for the year at less than 20 per cent of capacity, consumed another 46 per cent less acid than in 1931. Dependent very largely on the production of pig iron, the acid used in the manufacture of coal products—chiefly ammonium sulphate—declined 36 per cent.

Other using industries, in the aggregate in their effect on sulphuric acid, were hardly more of a factor than the groups already mentioned. Use in the manufacture of explosives declined slightly more than 30 per cent and for metallurgical products other than iron and steel, 27 per cent. Miscellaneous uses dropped 18.5 per cent, consumption for chemicals, 13.8 per cent and for rayon and cellulose wrapping film, 11.4 per cent. Although activity in paints and pigments has decreased more than the 11.1 per cent decline for acid consumption in this group, the falling off has occurred chiefly in the non-acid-using part of the industry. Petroleum refining, thanks to the continued use of the motor car, consumed some 8 per cent less acid. Textiles, having shown a remarkable come-back during the last five months of the year, appear to have decreased acid use only about 7 per cent below 1931.

Where this acid came from is of some interest. Reliable authority places the total acid from sulphur, expressed as 50 deg. Bé., at 2,520,000 short tons, including acid made from sulphur in metallurgical byproduct plants. This corresponds to a sulphur consumption for acid of about 456,000 long tons, as compared with total sulphur shipments to domestic users totalling in the neighborhood of 800,000 long tons. Sulphur mining during the year fell far below the 1931 production of 2,129,594 long tons to an estimated 890,000 tons, a decrease due only in part to the falling off in demand. Increased production taxes late in 1931 made it then seem likely that the producers would for some time subsist to a considerable extent on stocks, which at the end of 1931 had reached the unprecedented total of 3,250,000 tons. With a fall in exports from the 407,586 long tons of 1931 an estimated 375,000 tons in 1932, the apparent decrease in stocks as of Jan. 1, 1933, is 285,000 tons.

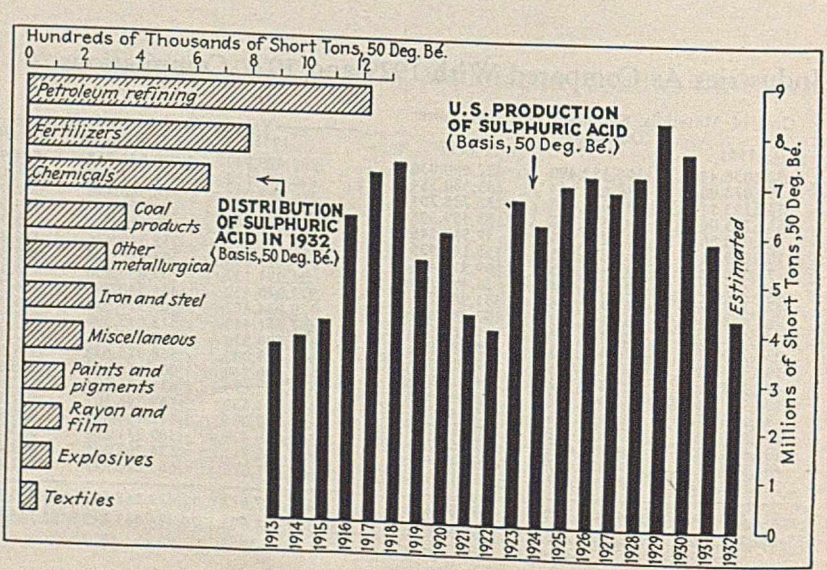
According to the Bureau of Mines, 1931 byproduct acid production at metallurgical plants totalled 1,078,000 short tons as 50 deg. Estimates for 1932 are necessarily sketchy but it is believed that some 600,000 tons of acid was produced from metallurgical gases. Another 110,000 tons is believed to have come from concentrates and pyrrhotite. Use of pyrites in non-metallurgical plants held up fairly well. Consumption of imported pyrites to the extent of an estimated 235,000 long tons, plus a probable 35,000 tons from stock, brings the acid total from this source to 700,000 tons. Another 400,000 tons is believed to have been produced from domestic pyrites. Total pyrites imports of 352,066 tons in 1931 compare with an estimated 246,000 tons in 1932. Domestic pyrites production in 1931 was 330,848 tons, in comparison with an estimate of 235,000 tons in 1932.

It is believed that 43 per cent of the acid produced came from contact plants.

New sulphur developments of the year may hold potentialities for the future. Texas taxes sent sulphur prospectors to Louisiana, looking into the possibilities for new supplies. Jefferson Lake Oil Co. started production in a small way at the Jefferson Island salt dome in Iberia Parish, La., while the Freeport Sulphur Co. announced its intention of constructing shortly a sulphur mining plant in the tidewater marsh region of Plaquemines Parish at Lake Grande Ecaille.

Estimated Distribution of Sulphuric Acid Consumed in the United States
(Basis, 50 deg. Bé.)

Consuming Industries	1930 Short Tons (Revised)	1931 Short Tons (Revised)	1932 Short Tons
Fertilizers	2,477,000	1,455,000	780,000
Petroleum refining	1,420,000	1,348,000	1,240,000
Chemicals	820,000	760,000	655,000
Coal products	800,000	570,000	365,000
Iron and steel	660,000	480,000	260,000
Other metallurgical	560,000	410,000	300,000
Paints and pigments	200,000	180,000	160,000
Explosives	177,000	175,000	120,000
Rayon and cellulose film	145,000	175,000	155,000
Textiles	78,000	81,000	75,000
Miscellaneous	330,000	270,000	220,000
	7,667,000	5,904,000	4,330,000



Recent Technical Aspects of Sulphuric Acid

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WITH the high-pressure production schedule of the late 'twenties interrupted by a breathing spell, technical progress in the sulphuric acid industry has not ceased. No epoch-starting discoveries have been announced recently, but it is evident that research and experimentation for the improvement of methods, yields and costs continue.

From 1927 to 1929, there was in the United States a veritable stampede among acid manufacturers for the erection of vanadium-mass contact-process plants. In December, 1931, A. Paul Thompson, in a paper read before the American Institute of Chemical Engineers (*Trans.* A.I.Ch.E., 27, 1931, pp. 264-309) for the first time presented a carefully prepared comparison between platinum and vanadium pentoxide as catalysts in the contact process.

An important patent decision of the year was that in the suit of the General Chemical Co. vs. Monsanto Chemical Works over alleged infringement of the Slama and Wolf vanadium catalyst patent owned by General. The suit was dismissed at the costs of the plaintiff, the court finding claims 1 to 6 and 8 valid but uninfringed, and claim 7 invalid. (See *Chem. & Met.*, 39, 1932, p. 408.)

Acid Capacity Overbuilt

Too much acid-plant construction during the boom years resulted in a great excess of sulphuric acid capacity for the United States and there was no occasion for new plant construction in 1932. It is understood, however, that in England plans were under way, in the fall of 1932, for a new Mills-Packard chamber plant to be erected at Ipswich; and that during 1932 the capacities of three chamber plants were substantially increased by redesigning, with introduction of Gaillard turbo-dispersers. It is reported that two new contact plants of American design, to be erected in China under American supervision, have been contracted for.

The new contact plant (four units, aggregate capacity 375 tons per day) of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail, B. C., has been described in detail by W. M. Cobleigh (*Ind. Eng. Chem.*, 24, 1932, pp. 717-21). A contribution on contact-process converters, describing Grillo, Mannheim, internal heat-exchange and multipass converters, and comparing internal and external heat-exchange converters, has been presented by DuBois and Harney (*Ind. Eng. Chem.*, 24, pp. 1091-6). Here it is pointed out that since installations of 100 tons daily capacity in a single two-pass system are already an accomplished fact, the tendency in the United States has been toward converters of larger size. It is felt that if the cost of chromium steels could be somewhat reduced, such alloys would find application in the construction of heat-exchange tubes. One large company has abandoned cast-iron in favor of steel for the construction of converter shells.

Bacon (*Paper Trade J.*, 94, 1932, pp. 31-5) has described a new sulphur burner capable of producing a gas containing up to 20 per cent SO_2 with no SO_3 content. In its operation molten sulphur is fed into the burner by means of compressed air.

Methods for the production of elemental sulphur from sulphide ores appear to be making headway, particularly in Norway, where sulphur is produced by blast-furnace methods, developed over a series of years by the Orkla Grubeaktiebolag. A 40-ton plant, erected in 1927 at the Lökken mine, is reported by Ridgeway ("Mineral Resources of the United States," 1931, Part II, p. 151) to have been followed by a much larger plant with a capacity of 200,000 tons of pyrite annually (75,000 tons of sulphur), erected on the Orkdal Fjord, at Thamshavn late in 1931. The sulphur produced is reported to be of high quality, containing but 0.01 per cent ash and no oil.

A sulphur development of some importance in the foreign situation was the dissolution of the Sicilian Sulphur Consortium, primarily a sales organization, which had been in existence for the past 12 years. It ceased to operate on July 31 (*Chem. & Met.*, 39, 1932, p. 465), according to reports to the Department of Commerce.

The tariff of four cents a pound on copper, imposed by Congress in 1932, effectually prevents the importation of cupreous pyrite. Non-cupreous, or washed pyrite may still be imported, however, and this variety of Spanish pyrite will no doubt continue to be used to some extent in the United States for the manufacture of sulphuric acid. Calculations indicate that in coast regions, acid can be made more cheaply from pyrite than from brimstone, while at interior points, brimstone is the cheaper raw material.

Some are inclined to paint a dark picture for the future of the sulphuric acid industry, citing such trends as the manufacture of superphosphate by nitric acid and by furnace methods, the manufacture of nitric acid from ammonia and the smaller consumption of acid by the petroleum and the iron and steel industries. What the immediate future holds for sulphuric acid depends on the measure of prosperity that the fertilizer, petroleum, iron and steel, general chemical and textile industries, etc., are destined to enjoy. Letting alone speculation as to immediate prospects, a careful consideration of the long term outlook leads me to the conclusion that sulphuric acid, despite inventions tending to diminish its consumption in certain fields, will continue to be used in large quantities.

Soils Need Sulphur

In the matter of fertilizers, for example, Lipman and McLean (*Chem. & Met.*, 38, 1931, p. 394) presented figures on the annual loss of sulphur from the soil, and emphasized the importance of sulphur as a plant food. However successful superphosphate made by a nitric acid or a furnace method may eventually become, such products will not restore to the soil the sulphur that is indispensable. The use of ammonium phosphate instead of ammonium sulphate as a fertilizer ingredient also seems a minor threat to sulphuric acid since phosphate restores none of the needed sulphur to the soil; while the phosphoric acid used is itself made, in the main, by the use of sulphuric acid.

Production of gasoline by the hydrogenation of heavy or asphaltic oils has been cited as a menace to the consumption of acid by the petroleum industry. This has been refuted by Bacon, who maintains that on account of high capital costs, hydrogenation will only come into general use when the supply of medium-boiling point oils becomes exhausted.

Finally, while researches in some directions tend to displace sulphuric acid, it is equally true that researches in other fields develop new uses for the acid, as witness the recent rise of the rayon and cellulose-film industries—non-existent a few years ago, but now consumers of sulphuric acid in large quantities.

Alkalis Fare Better Than Business in General

EDITORAL STAFF REVIEW

DECREASING its production considerably less than the decline in general business, the alkali industry showed a high grade of resistance during the third and most acute of the depression years. Its sticking powers were, in fact, a trifle better than those of the average process industry. Operating at about 70 per cent of capacity the ammonia soda industry produced in the neighborhood of 1,925,000 tons as compared with 2,189,351 tons in 1931 and 2,586,304 tons in 1929. Thus, while the rate of general business activity, as shown by the averaged indexes of the *Business Week,* declined 24.7 per cent from 1931 to 1932, and 47.3 per cent from 1929 to 1932, soda ash production fell 12.1 per cent in the last year and 25.6 per cent since 1929. Comparable to the 70 per cent operating rate of the parent industry, lime-soda caustic production is estimated at from 70 to 80 per cent of capacity and electrolytic caustic at about 70 per cent also.

In total soda ash sales, as is shown in the accompanying tabulation, a decline of 14.3 per cent seems to have taken place. In the individual using groups, the chemicals are estimated to have fallen off only about 1.3 per cent. The uses embraced by this classification include sodium nitrate, silicate and phosphate, none of which suffered particularly. A considerable increase in synthetic sodium nitrate production coupled with the stability of the use of sodium silicate as an adhesive in paper carton manufacture was largely responsible for the excellent showing in this division. Soap, also a relatively stable industry, used some 8.6 per cent less ash than in 1931. Cleansers and modified sodas declined an equal amount. Soda for water softening, of which the railroads are the largest users, declined a probable 10 per cent. Other losses include: petroleum refining, 11.1 per cent; miscellaneous uses, 11.9 per cent; textiles, 12.9 per cent; pulp and paper, 17.3 per cent; glass, 25.3 per cent; and exports, 50 per cent. Adding in the ash used for exported $NaNO_3$, however, would show an export increase of nearly 100 per cent.

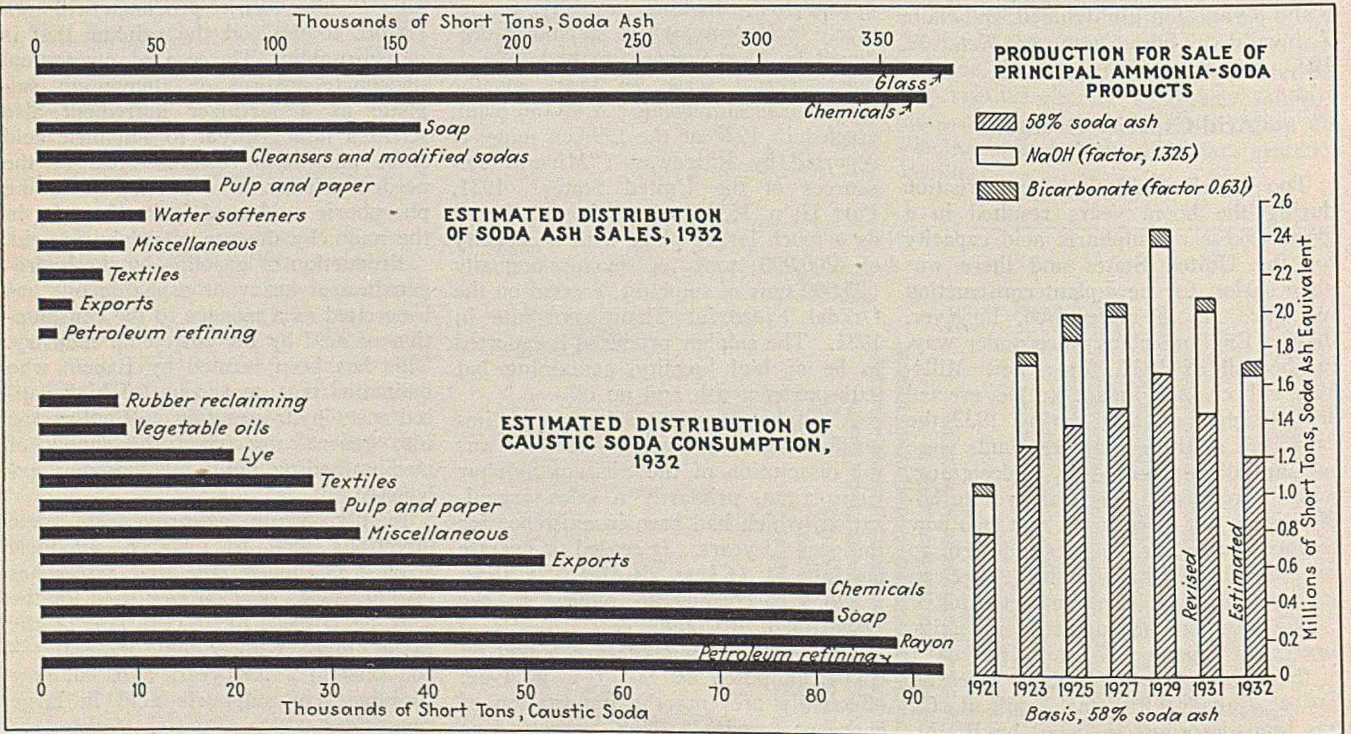
The decreases in caustic soda consumption were not dissimilar. With a total decline of about 15.3 per cent, the

Estimated Distribution of Soda Ash Sales in the United States

Consuming Industries	1930 Short Tons (Revised)	1931 Short Tons (Revised)	1932 Short Tons
Glass	561,000	508,000	380,000
Soap	200,000	175,000	160,000
Chemicals	350,000	375,000	370,000
Cleansers and modified sodas	112,000	95,000	87,000
Pulp and paper	100,000	87,000	72,000
Water softeners	55,000	50,000	45,000
Petroleum refining	16,000	9,000	8,000
Textiles	30,000	31,000	27,000
Exports	36,000	28,000	14,000
Miscellaneous	40,000	42,000	37,000
Totals	1,500,000	1,400,000	1,200,000

Estimated Distribution of Caustic Soda in the United States

Consuming Industries	1930 Short Tons (Revised)	1931 Short Tons (Revised)	1932 Short Tons
Soap	100,000	90,000	82,000
Chemicals	100,000	98,000	81,000
Petroleum refining	117,000	103,000	93,000
Rayon	110,000	108,000	88,000
Lye	22,000	22,000	20,000
Textiles	63,000	32,000	28,000
Rubber reclaiming	30,000	14,000	8,000
Vegetable oils	20,000	8,500	9,000
Pulp and paper	10,000	36,500	31,000
Exports	42,000	66,000	52,000
Miscellaneous	38,000	42,000	33,000
Totals	652,000	620,000	525,000



use for vegetable oil refining showed an increase of 5.9 per cent. Soap again was a light loser with 8.9 per cent decline. Consumption for lye fell about 9.1 per cent, for petroleum refining, 9.8 per cent and for textiles, 12.5 per cent. Pulp and paper consumption of caustic appears to have been off 15.3 per cent, rayon, 18.4 per cent and exports and miscellaneous uses, each 21.3 per cent.

Technical developments were not spectacular. To meet the need for lower operating cost the efficiency of manpower was materially increased. Several of the ammonia-soda plants abandoned the time-honored reciprocating compressor for CO_2 in favor of turbine-driven centrifugal blowers which, at a speed of 10,000 r.p.m., handle six to eight times as much gas as the old compressors and do it more cheaply. No further capacity was added during the year in any part of the industry nor were either of the Southern soda and caustic projects carried farther toward completion.

No important trends in the consumption of soda products appeared during the year with the exception of the increase in synthetic sodium nitrate production at Hopewell, Va., which is shown by the jump in exports from 73,700 tons in 1931 to an estimated 185,000 tons last year. There is probably a tendency toward slightly reduced requirements for petroleum refining while the future loss (largely as sodium silicate) on account of the increase in the Canadian tariff may amount to as much as 300 tons of ash per month. Viscose rayon, of course, is veering toward caustic recovery but this practice is still negligible and would amount to only about 20 per cent with the theoretical maximum recovery. Users continued to discover the advantages of bulk shipment during the year and it is reported that some ash is now being shipped to consuming plants in the Dry-Flo tank car.

Production of Caustic Soda in the United States

Year*	Lime-Soda (Short Tons)	Electrolytic (Short Tons)	Total (Short Tons)
1921	163,044	75,547	238,591
1923	314,195	122,424	436,619
1925	355,783	141,478	497,261
1927	387,235	186,182	573,417
1929	524,985	236,807	761,792
1931 (revised)	455,832	203,057	658,889
1932 (estimated)	350,000	180,000	530,000

*Figures for 1921-31 are from the U. S. Bureau of the Census. Electrolytic caustic soda figures do not include that made and consumed at wood-pulp mills, estimated at about 30,000 tons in 1927 and 1929, at about 24,000 tons in 1931 and 20,000 tons in 1932.

Coke and Coal Products Reach New Lows in 1932

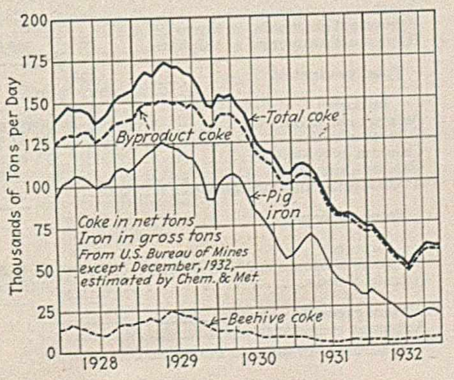
COAL PRODUCTS were manufactured at byproduct coke ovens during 1932 at a much lower rate than during any year preceding for more than a decade. This was a natural reflection of the lowered rate of metallurgical activity in the United States. The production during 1932 is estimated as follows:

Byproduct coke	21,000,000 tons
Tar	285,000,000 gal.
Ammonium sulphate or equivalent	730,000,000 lb.
Crude light oil	80,000,000 gal.
Gas	335,000,000 M cu.ft.

The coal used in making these products was 30,000,000 tons. During this same year the production of beehive coke was only approximately 750,000 tons and the pig iron production in the United States 8,750,000 tons.

The low production of coal products, about 64 per cent of that in the preceding year, did not occasion any shortage in the domestic markets. Since a very large part of the coal tar made is burned as fuel, that usage served as a balance wheel in the tar markets. The low price of gasoline and improved petroleum technology made the use of motor benzol for blended motor fuels less essential than formerly; this of course prevented any tendency toward shortage of light oil products. The decreased production of ammonium sulphate was apparently one of the major causes of an unusually large import of that chemical during the year. Thus a very definite trend away from nitrate nitrogen in fertilizers and toward ammonia nitrogen was made possible by importations. (See *Chem. & Met.*, Aug., 1932, pp. 421 and 467.)

United States coke and pig iron production



Gas from byproduct ovens continued a major factor in city-gas supply during the year. The decline in this usage was approximately equal in percentage to the decline in the total quantity of gas produced or purchased by manufactured-gas companies. Only in the case of refinery and natural gas used in mixtures was there an increase in the quantity from 1931 to 1932; in the case of practically all other types of gas the quantities used declined by 10 to 15 per cent. The following tabulation indicates the percentage contributed by each source of supply during 1932 to the total of the send-out of these concerns (data based on ten months' reports of American Gas Association):

	Per Cent
Water gas	41
Coke-oven gas	36
Retort coal gas	8
Oil gas (Western processes)	2
Refinery oil gas and natural gas	13
	100

City-gas sales by manufactured-gas companies declined 4.8 per cent while revenues from such sales declined 5.1 per cent from the 1931 figure, according to preliminary estimates of American Gas Association. The only exception to the general downward trend was in the use of gas for house heating in which there was an increase of 2.7 per cent during 1932 as compared with the preceding year.

Natural gas sold for household and commercial purposes declined by 5.4 per cent, but the sales for industrial purposes registered a much greater decline, about 15 per cent. Still greater percentage decline occurred in the use of natural gas for non-utility purposes with the result that the total marketed consumption of natural gas during 1932 was approximately 16 per cent below that which was reported duirng the preceding year.

The greater declines in natural gas use than in manufactured gas do not indicate that the natural product was in any sense supplanted by the manufactured. Actually, during the year the area receiving natural gas increased slightly and the further developments during 1933 are expected still further to continue the invasion of manufactured-gas territory by extension of natural-gas supplies. These changes are, however, at the present time having little effect on the operation of byproduct-coke ovens or the production of coal products. The variation in activity of the steel industry is so much more important in this latter particular as to be altogether dominant.

Unexpected Developments in 1932 Nitrogen Production

By CHAPLIN TYLER

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NITROGEN PRODUCERS, whether in the synthetic, byproduct, or Chilean nitrate branch of the industry, have passed through a year of drastic deflation and readjustment. For the producers of synthetic nitrogen products, operations continued at low levels, with no prospects of substantial increased demand for at least a year to come. There has been an increasing realization that new construction has been overdone; and yet, in some parts of the world, plant expansion is being continued. This action is of course in line with the intention of all important world powers to become wholly self-sustaining as regards supplies of nitrogen. Whatever the reasons, the result cannot improve the present world situation of gross over-capacity. For producers of byproduct nitrogen, there has been a further contraction in both sales and price, with resultant inevitable loss. However, much of the idle byproduct capacity has been more or less depreciated, and to that extent is a smaller fixed charge than is borne by most synthetic ammonia producers. For producers of Chilean nitrate, the past year has been more critical than any other in history. The technical improvements and "rationalization" now appear to have placed a terrific burden upon the industry, a burden that seemingly cannot be lifted without complete or nearly complete repudiation of bonded indebtedness to say nothing of loss to holders of junior shares.

As regards the conditions in the United States, a few of the changes in trend and important events of 1932 are brought out clearly by the accompanying table. In 1932, synthetic ammonia production was well in excess of that of the previous year, probably by 35 per cent. However, the gain in volume was offset by a price decline of from 10 to 20 per cent.

Byproduct ammonia production, both as liquor and as sulphate, showed another severe decline, due largely to integration with steel production. Very roughly, the synthetic ammonia industry operated at 28 per cent of capacity in 1932, whereas the byproduct ammonia operations were at 37 per cent of capacity. For the first time on record, imports of sulphate of ammonia exceeded domestic production, and concurrently, exports of sulphate fell to a very low figure. It is probable that most producers of byproduct sulphate secured only $14 to $17 at the ovens for their sulphate, at which prices none can show a profit, at least at prevailing rates of operation, and assuming also that the ammonia in the gas is assigned no value.

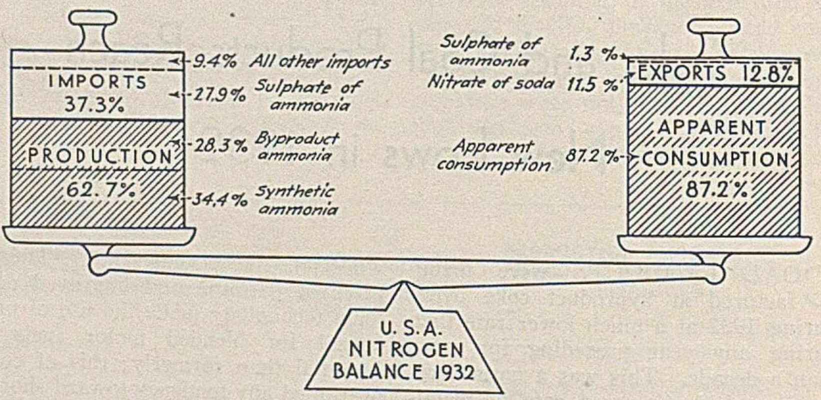
Sulphate consumption in 1932 appeared to be at least 600,000 tons, allowing for some accumulation of stocks; a figure larger than for 1931, and about the same as the probable consumption in 1930. This is surprising, in view of a decline of between 50 and 55 per cent in tonnage of fertilizer sales since 1930. Clearly, the preference for nitrate nitrogen is not sufficient to overcome the former widespread in price between the ammonia and nitrate forms of nitrogen.

Change in the nitrate of soda situation has been even more striking than would have been imagined several years ago. Prices have been forced down, and even at present reduced levels are high as compared with ammonia forms of nitrogen; consumption has fallen off at an alarming rate, as witness the situation in such rich markets as the U. S. A.; stocks in Chile are said to be sufficient for at least two years' demand at current levels.

Importation of nitrate from Chile declined abruptly from 616,000 tons in 1931 to about 50,000 tons in 1932. On the other hand, exports of nitrate of soda increased from 73,700 tons in 1931 to a probable total of 185,000 tons in 1932. This means that for the first time on record, exports of nitrate of soda exceeded imports, and this fact indicates that synthetic nitrogen is able to compete in world markets with the natural product, even when sold in same chemical form.

Imports of calcium cyanamide increased by a good margin over imports in 1931; but even so, the quantity imported in 1932, probably about 70,000 tons, represents only 20 per cent of the estimated capacity of the plant of origin in Ontario.

Calcium nitrate, which in former years seemed destined to have a permanent place in American agriculture, has declined in use quite sharply. Whereas 49,130 tons was imported in 1930, and 32,200 tons in 1930, only 5,000 tons was imported in 1932. Rel-



Inorganic Nitrogen Balance U. S. A.

Data are in part estimates, and cover only major items of inorganic nitrogen. All quantities are expressed in short tons

	1932		1931		1930	
Production	Product	Nitrogen Equivalent	Product	Nitrogen Equivalent	Product	Nitrogen Equivalent
Synthetic ammonia	108,000	89,000	80,000	66,000	164,000	135,000
Byproduct ammonia, as liquor	......	11,700	......	18,000	......	26,000
Byproduct ammonia, as sulphate	300,000	61,800	471,000	97,000	671,000	138,250
Total production	......	162,500	......	181,000	......	299,250
Imports*						
Sulphate of ammonia	350,000	72,200	125,700	25,900	37,840	7,790
Nitrate of soda	51,500	8,240	616,000	98,550	637,000	102,000
Calcium cyanamide	69,600	15,300	57,500	12,660	162,000	35,650
Calcium nitrate	5,040	780	32,200	5,000	49,130	7,620
Ammonium sulphate-nitrate	84	22	5,890	1,530	9,120	2,370
Total imports	......	96,542	......	143,640	......	155,430
Exports*						
Sulphate of ammonia	16,800	3,460	74,900	15,430	91,400	18,830
Nitrate of soda	185,000	29,700	73,700	11,800	28,630	4,580
Total exports	......	33,160	......	27,230	......	23,410
Apparent consumption	......	225,882	......	297,410	......	431,270

* Includes Hawaii and Porto Rico.

atively, the decline in importation of ammonium sulphate-nitrate has been even greater. German nitrogen, therefore, is becoming unimportant to American agriculture, and especially should it be noted that "high-powered" mixtures carrying upwards of 60 per cent plant food have not made significant headway.

The apparent consumption of inorganic nitrogen in 1932 is estimated to have been 226,000 tons, which is roughly half of the 1928-30 "normal." In many respects this total is satisfactory, as for example, when compared with present performance in the steel and other "heavy" industries. Nitrogen at least tends to be absorbed at a rate which indicates fully its essential nature in the pursuits of agriculture and industry.

While this strength in consumption is gratifying, the price situation, at least as regards the various forms of agricultural nitrogen (and some forms of technical nitrogen) is not reassuring. In removing the import duty of $5 per short ton which applied to sulphate of ammonia from 1922 to 1930, Congress may have thought that such an act was the height of wisdom. But $5 per ton of sulphate, which is one cent per pound of ammonia, happens to be the difference between profit and loss to the nitrogen industry.

It is plainly evident that the American nitrogen industry (which involves not only the chemical industry, but the steel industry, gas industry and coal industry) is being penalized by the present "open-door" policy. So flagrant have been the tactics of some foreign producers that cases for dumping were found by the Treasury Department against Germany, Poland and Belgium. These findings no doubt will have some good effect in the immediate future, in tending to lessen destructive competition from abroad.

It should not be forgotten that the home industry is competing against a foreign nitrogen industry that in large part has received government loans or subsidies, not to mention the advantage accruing to foreign producers from present rates of money exchange.

Cosach to Liquidate

A DECREE for the liquidation of the Nitrate Corp. of Chile, Cosach, large $325,000,000 producing and marketing concern, was signed Jan. 2, 1933, by President Arturo Alessandri of Chile. The decree, in effect, cancels the presidential mandates of March and April, 1931, which granted the legal existence of the company.

A liquidating committee will be made up of Aureliano Burr, former manager of the Central Bank, and named government liquidator, a supreme court judge and a representative of Cosach. The latter two to be named within the next 30 or 40 days.

The presidential decree liquidating the nitrate company is effective immediately and is equivalent to placing it in receivership. Two years may be required to complete liquidation. In the interval the committee previously mentioned will conduct the regular business of the company with regular powers of liquidators in addition to other powers which are expected to be granted that body when the extraordinary session of Congress begins on Jan. 5.

A statement from Santiago issued jointly by the liquidating commission and M. G. B. Whelpley, president of the Cosach, gave the assurance that the reorganization of the Nitrate Corp. of Chile, will not have the effect of disturbing marketing conditions at least during the present season which ends June 30, 1933. The statement said, "The state of liquidation in which Cosach now is will not affect the situation of nitrate, iodine, or other byproduct markets during the present season.

"The liquidators and the board of directors formally declare that the nitrate and iodine market will be maintained in an orderly manner and that sales will continue to be on a centralized basis. The liquidators declare that all previous sales contracts and new contracts entered into during the season will be complied with."

The significance of the statement is said to be the indication that upon completion of the reorganization plans for the corporation it will be able to market nitrates and other products at lower prices than now prevail. An important portion of the selling price in the past few years has represented either an export tax before the industry was concentrated in the one organization, or later, the sums necessary for service on the company's bonds.

Organic Chemicals in 1931

THE production of organic chemicals reported by the Census of Manufactures for 1931 includes for the first time certain chemicals that were previously given in the census of dyestuffs. It is interesting to note that production quantities and values of products are supplied for plastic materials in the new census. Among the plastics for which information is included are pyroxylin, rubber substitutes, phenol resins, urea-formaldehyde, cellulose acetate, and casein. The rubber substitutes, the census shows, were particularly badly affected between 1929 and 1931, production falling from 9,923,231 lb. to 3,397,886 lb.

Production of Organic Chemicals Reported by the Census of Manufactures, 1929-1931

	1931	1929
Acetone, lb.	26,055,552	*
Value	$1,818,520	*
Alcohols:		
Amyl and fusel oil, gal.	103,884	
Value	$100,342	
Methanol, synthetic, gal.	7,766,592	$11,840,877
Value	$1,462,272	
Other alcohols, not including ethyl, nor wood distillation methanol, value	$4,790,874	
Amyl acetate, gal.	494,468	181,203
Value	$495,891	$312,898
Butyl acetate, gal.	3,311,272	4,523,863
Value	$3,491,729	$5,680,155
Butyl propionate, lb.	1,117,809	*
Value	$204,097	*
Carbon bisulphide, lb.	83,045,219	71,009,798
Value	$3,199,896	$2,859,584
Carbon tetrachloride, lb.	34,095,802	32,712,749
Value	$1,719,796	$1,728,034
Chloroform, lb.	2,134,451	3,081,920
Value	$322,656	$595,759
Ether, lb.	6,981,845	6,463,552
Value	$1,431,735	$1,897,194
Ethyl acetate, gal.	7,283,441	10,932,225
Value	$3,219,735	$9,006,914
Ethyl chloride, lb.	828,500	*
Value	$170,468	*
Geraniol, lb.	74,908	94,743
Value	$129,796	$244,650
Glycerin, crude, lb†	25,918,319	28,789,974
Value	$1,577,965	$2,358,031
Refined, lb.†	102,341,183	113,140,075
Value	$10,299,482	$12,715,641
Methyl acetone, lb.	1,899,142	4,675,140
Value	$123,812	$574,736
Plastics, pyroxylin, lb.	14,820,767	21,847,427
Made and consumed in the same establishments, lb.	3,001,330	4,856,625
For sale, lb.	11,819,437	16,990,802
Value	$11,113,618	$17,266,323
Finished articles of pyroxylin made in the producing establishments, value	$6,545,486	$10,522,214
Rubber substitutes, lb.	3,397,886	9,923,231
Value	$366,908	$1,003,371
Phenol resins, lb.	41,946,352	$10,942,518
Value	$8,057,620	
Other—urea-formaldehyde, cellulose-acetate, casein, etc., value	$657,837	
Vanillin, lb.	171,669	317,355
Value	$775,724	$1,858,228

* Withheld to avoid disclosing approximations of data for individual establishments.
† Production for sale by chemical and soap-manufacturing establishments only. Total production of crude glycerin, 80 per cent basis was — 1931, 140,001,604 lb.; 1929, 140,079,568 lb.

Domestic Potash Production Holds Well in 1932

POTASH production in the United States during 1932 nearly equalled that of the best previous year despite a much lower requirement for fertilizer consumption. Imports of potash suffered heavily, amounting in most classes to less than half the tonnage brought in during 1931.

Production of potash salts by the U. S. Potash Co., Carlsbad, N. M., became during the past year for the first time an important factor in the country's supply. The enlarged and improved facilities of the American Potash & Chemical Co., at Searles Lake, Calif., continued as the major domestic source. It is now estimated that the combined production facilities of these two firms and several minor enterprises that produce potash as byproducts could readily furnish between 200,000 and 250,000 short tons of K_2O per year. The domestic production from these sources was about 60,000 tons of K_2O equivalent during 1932, or approximately 30 per cent of the current United States need. The available production capacity exceeds last year's actual consumption, and is well over 50 per cent of the maximum consumption of potash at any time in a period of peak usage as a fertilizer material.

Dependence on Agriculture

The trend in potash supply is necessarily dependent on the changes in purchasing power of agriculture since 80 to 90 per cent of the potash consumed in the United States is used as a fertilizer raw material. Fertilizer sales declined from 8.2 million tons in 1930 to 6.3 million tons in 1931, and further to 4.25 million tons in 1932. Apparently the consumption of potash in fertilizers declined a little less rapidly, indicating the continuation of the trend toward higher plant food concentration in mixed fertilizer.

Efforts to revive agriculture and restore farm purchasing power must ultimately have some beneficial influence on fertilizer. Further expansion in domestic potash production, then, will presumably follow to the extent that successful competition between domestic and imported potash can be achieved. Expansion in domestic production can occur in several ways: (1) Enlarged production without further increase in capacity is possible at Searles Lake; (2) much larger production at the present Carlsbad mine can readily be accomplished; (3) digging of another mine shaft not far from Carlsbad is being seriously considered by a group, said to be headed by Denver interests (this project has passed the stage of extensive core drilling but the shaft sinking has not begun); (4) further production of byproduct potash at portland cement plants is indicated by the successful experiments which have been made at the North American Cement Corp.'s plant at Security, Md.

Results at this plant clearly indicate the practicability of potash recovery from the fine cement mill "fume," with the production of potassium sulphate a probable economic achievement. It is estimated that the successful application of this process in all portland cement plants with recoverable potash would add to the United States output approximately 50,000 tons of K_2O equivalent per year. The development in only half the cement capacity of the country, a very conservative forecast, would therefore supply more than 10 per cent of the United States potash needs at the present rate of consumption.

Production of potash from green sand, wyomingite, or other potash minerals has proved to be technologically feasible. Semicommercial-scale experiments in the blast furnace at the Fixed Nitrogen Research Laboratory conclusively demonstrate the practicability of volatilization and recovery in this manner. But it appears too early to permit a reliable conclusion as to the prospective costs and probable competitive relations between blast-furnace potash and that from other sources. Even greater uncertainty as to the economic prospects surrounds the various proposals that have been made for the manufacture of other potash salts by wet processes or from polyhalite. This latter possibility is being further investigated by the Bureau of Mines at its New Brunswick station. Chemical engineering forecasts should await further data from that source.

Freight Favors Imports

Domestic production at present sources must compete with imported potash under some disadvantage in the cost of transportation from the point of production to the Eastern and Gulf ports from which it goes to fertilizer companies. The transatlantic freight rate for potash is approximately $3 per ton in contrast with $8 from Carlsbad to corresponding Atlantic and Gulf ports. Hence the freight differential unfavorable to domestic production amounts to nearly $10 per ton of contained K_2O even with high-grade muriate shipments. Low cost of domestic production has thus far been successful in offsetting this disadvantage. Further U. S. development depends largely upon the extent to which domestic producers are willing to sacrifice a further portion of their profit margin in order to secure an increased share of the total business. They are being materially aided by the produc-

Production of Potassium Compounds, 1931 and 1929*

(These figures refer to production for sale and do not include data for amounts made and consumed in the same establishments)

	1931	1929
Total value	$7,972,000	$9,998,054
Bitartrate (cream of tartar)		
Pounds	6,971,444	7,852,559
Value	$1,572,337	$1,930,577
Citrate		
Pounds	139,935	151,074
Value	$72,451	$80,701
Iodine		
Pounds	380,047	443,557
Value	$1,290,565	$1,487,166
Hydroxide		
Tons	†4,818	†7,191
Value	$580,765	$637,977
Acetate		
Pounds	80,119	$5,861,633 (Acetate and Other combined)
Value	$22,816	
Other (chloride, xanthate, Rochelle salt, etc.), value	$4,433,066	

* U. S. Census of manufactures.

† For 1931, basis 88 to 92 per cent; for 1929, as reported, regardless of strength.

Production, Foreign Trade and Consumption of Potash*

(Short tons of contained K_2O)

Year	U. S. Production	Imports	Exports†	Change in Stock	Apparent Consumption
1922	11,714	201,415	3,119	—982	210,992
1923	20,215	209,950	2,000	+710	227,455
1924	22,903	200,365	961	—1,593	223,900
1925	25,448	258,217	1,078	—494	283,081
1926	23,366	266,280	840	—1,276	290,082
1927	43,510	244,155	982	—6,500	293,183
1928	59,910	330,493	1,310	—400	389,493
1929	61,590	324,638	7,766	+4,100	374,362
1930	61,270	342,454	8,521	+4,800	390,403
1931	63,880	214,785	16,230	—500	262,935
1932‡	60,000	120,000	1,000		180,000

* Based on U. S. Government data with 1932 estimates by *Chem. & Met.*

† Calculated on assumption of 50 per cent K_2O in salts exported; data before 1929 for chemicals only; later years include all potash fertilizer materials.

‡ *Chem. & Met.* estimates.

tion of chloride salts of more than double the potash content of the 26-per cent product which has hitherto been shipped from Carlsbad.

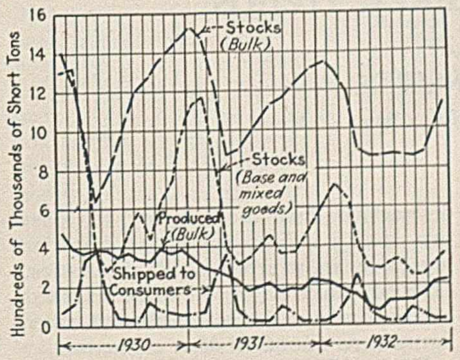
The price of potash chemicals for fertilizer use has not changed significantly during the year despite the curtailment in demand. This shows a belief on the part of the producers that consumption of potash depends on general agricultural conditions primarily, and only slightly on its price.

It has been the belief in some quarters that European producers or American importers would lower the United States price on their goods in order to meet American competition and restrict the development of American producing plants. This is in some measure prevented by the anti-dumping regulations of the tariff law. Foreign producers are not at liberty to lower the price for potash in the United States below the price prevailing in the country of origin without incurring severe penalties. Since the consumption of potash in Europe is very great, it is difficult for European producers to lower the prices at home sufficiently to permit legal imports into the United States at prices much below those which have prevailed here in the recent past. To this extent, therefore, domestic producers are protected against unbridled foreign competition; but there is no corresponding protection for the American industry against the serious effect of depreciated foreign currencies which may occasion a very low price in terms of the American dollar.

Phosphate Problems Dominated by Agricultural Troubles

PHOSPHATES are primarily fertilizer chemicals. Their use, therefore, varies directly with fertilizer consumption and is largely dependent on farm income or farmer buying power. The parallelism during the last four years between these factors is shown clearly in Table I.

Since purchasing power, and the probability of fertilizer purchase, lags at least one year behind income it may reasonably be expected that 1933 will also be a poor year for fertilizer and hence for phosphates. Resumption of normal activity in this industry apparently can come only when some of the natural economic or artificial political corrective measures talked of in Congress and elsewhere become effective.



Production, stocks and shipments of superphosphates

(From Bureau of the Census except the last three months, estimated by *Chem. & Met.*)

International trade in phosphates has been an important matter affecting the welfare of the industry during the past year. Import and export figures appear in Table II. Imports from four sources have demanded attention both of the industry and of the Federal government's administrative or legislative bodies. All these matters came to a head during December. An anti-dumping order against imports of Moroccan phosphate was confirmed in the Court of Customs and Patent Appeals. Formal charges of unfair competition through unauthorized use of patents was charged before the U. S. Tariff Commission in an effort to prevent entry of Soviet phosphates. By Senate resolution the Tariff Commission was instructed to investigate the cost of production of phosphates in the United States and in competing areas of Canada and Japan from both of which low cost imports have been received in western states. These threats of successful import have been added to the industry's difficulty in securing the usual markets abroad for United States exports; exports have in fact this year amounted to less than half the tonnage of two years before.

Technical developments during the past year have necessarily been limited by the curtailed activities of the industry and the influence of the general business situation. Production of phosphoric acid by furnace processes was continued in only two of the existing furnace plants, the Florida furnace being idle. There has been considerable discussion but no official announcement of any other new furnace enterprises. Triple superphosphate has been produced in somewhat smaller quantities, partly because of business conditions directly affecting the industry, and partly because of curtailed metallurgical activity in plants which commonly have used this fertilizer chemical as an outlet for their surplus byproduct sulphuric acid.

Ammoniation of superphosphate has continued to grow in popularity, particularly stimulated by the newly authorized official methods for determining available P_2O_5. These methods now

Table I—Phosphate Production Compared With Fertilizer Consumption and Farm Income

	Bulk Superphosphate Production (Millions of Tons of 16 Per Cent Equivalent)	Consumption of All Fertilizers (Millions of Tons)	Gross Income From Farm Production, Billions of Dollars
1929	4.2	8.1	12
1930	4.4	8.2	9
1931	3.2	6.3	7
1932	1.9	4.2	5

Table II—International Trade in Phosphates
(Thousands of Short Tons)

	U. S. Imports			U. S. Exports		
	1930	1931	*1932	1930	1931	*1932
Bone phosphate	66.8	54.9	33	......	......	...
Phosphate rock	†	†	8	1,372.8	1,065.5	660
Superphosphate	†	†	22	125.2	91.6	28
All other	41.0	24.3	12	......	4.5	2
Totals	107.8	79.2	75	1,498.0	1,161.6	690

* 1932 partly estimated. † Not separately reported.

Fertilizer Production, 1929 and 1931
(U. S. Census of Manufactures, 1931)

	1931	1929
Fertilizers made in all industries, total value..	$141,110,845	$222,731,116
Made in the fertilizer industry, value......	$134,989,638	$201,751,371
Made as secondary products in other industries, value.......	$6,121,207	$20,979,745
Complete fertilizers		
Tons................	4,547,603	5,991,780
Value................	$110,819,321	$168,838,463
Superphosphates, including concentrated phosphates		
Total production, tons	*3,521,889	4,133,134
For sale—		
Tons............	*1,997,386	*2,531,230
Value............	$21,048,370	$28,375,184
Made and consumed, tons............	*1,524,503	†1,601,904
Potash superphosphate		
Tons...............	146,186	211,293
Value...............	$2,964,027	$4,854,365
Fish scrap		
Tons	44,062	84,711
Value................	$1,367,807	$3,244,632
Bone meal		
Tons................	34,745	39,548
Value................	$927,284	$1,544,054
Other fertilizers		
Tons................	189,439	461,667
Value................	$3,984,036	$15,874,418

* Basis 16 per cent available phosphoric acid.
† Strength not reported.

recognize as available some of the reverted phosphates which have been demonstrated to be useful plant foods, though formerly not credited as such. Aggressive marketing of ammonia-urea mixtures began on a substantial scale during the year. (See *Chem. & Met.*, Oct. 1932, p. 540.) Other mixtures for similar use have been proposed by others. Late in the year the Department of Agriculture suggested that ammoniation of peat be developed for the production of fertilizer material having high organic nitrogen value. Use of superphosphate with manure in dairy farm fertilization has also been relatively more active recently than in former years.

An outstanding corporate development of the year was the proposed merger of the Armour Fertilizer Works with the Virginia-Carolina Chemical Co. That merger was not consummated, evidently as the result of opposition by substantial minor stockholders. Hence, even the pressure of restricted or totally absent profits has not been sufficient to accomplish any apparent improvement in the industry's corporate setups. Competitive methods have, it is charged, been continued in many cases in an unwarranted manner contrary to the industry's code of ethics, which has seemed just now to be so urgently needed. There has been much talk about this but no important corrective measures have been announced. Future profits, in fact the very life of companies, apparently more than ever now depend upon the ability to accomplish mixing and marketing of manufactured and purchased chemicals with the narrowest possible margin above actual materials cost. In other words, the internal problems of the industry remain larger than those of distribution.

Wood Chemicals Respond to Changing Market Trends

By R. S. McBRIDE

Editorial Representative, Chem. & Met.

Editor's Note—This is the fourth and last of a series of articles on the problems and technology of the hardwood distillation industry. Originally announced for publication in February, the present article discusses the factors affecting the marketing of hardwood distillation products other than charcoal.

MANUFACTURE of wood chemicals varies almost directly with the current demand for charcoal. Hence the production of methanol, acetic acid, calcium acetate, acetone, and other chemical derivatives of wood was much curtailed during 1932. The trend in this industry in the future will be governed particularly by the development of household uses of charcoal and by the magnitude of the renewed demand for charcoal iron. (See *Chem. & Met.*, Dec., 1932, p. 667.) Fortunately for the users of wood chemicals, synthetic supplies are available in abundant quantity to meet any deficiencies in production from wood. And in every use except for denaturing of industrial alcohol, these synthetic supplies could, if competitive conditions warranted, supplant altogether the wood chemicals without causing any difficulty for the users.

Production of hardwood products by destructive distillation during the past two years is indicated in the accompanying table, in which the 1931 statistics, except for acetic acid, are those reported by the Bureau of the Census; all other figures are *Chem. & Met.* estimates.

During 1931 the production of acetone, all by synthetic methods, was in excess of 26,000,000 lb. as reported by the Census of Manufactures. During the same year the methyl acetone production of the country was recorded as 1,900,000 lb., all from the wood distillation industry; but there has been produced during 1932 a considerable quantity of synthetic methyl acetone made by blending in the desired proportions methanol, methyl acetate, acetone, and other wanted constituents. To a considerable extent this synthetic product, the composition of which can be controlled in accordance with the wishes of the purchaser, has begun to compete with the natural wood distillation product of the same name.

Hardwood Products From Destructive Distillation

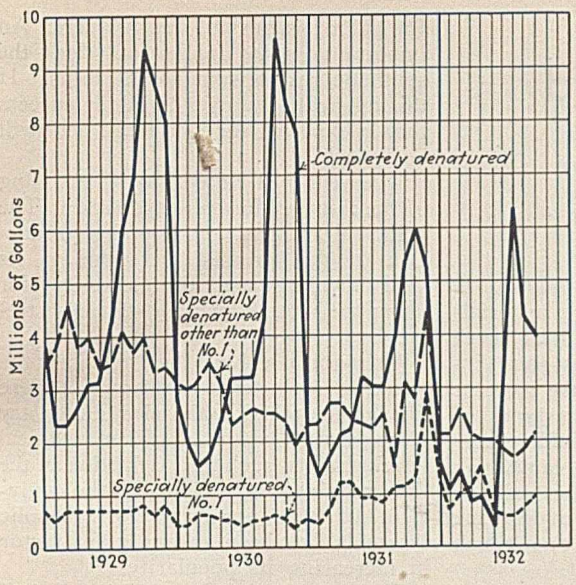
	1931*	1932†
Charcoal (bu.)	22,000,000	14,500,000
Crude methanol (gal.)	4,140,000	2,300,000
Refined methanol (gal.)	2,760,000	1,750,000
Methyl acetone (lb.).	1,900,000	1,000,000
Acetate of lime (tons)	26,000	19,500
Acetic acid (tons)...	13,500†	7,000

*U. S. Census.
†*Chem. & Met.* estimates.

Methanol production, shipments, and stocks on hand from both wood distillation and synthetic operations are shown on the accompanying charts. It will be noted there that synthetic production has been greater in 1932 than in the last preceding year, amounting to nearly five times the output of refined methanol from wood. The abnormally low rate of operation at wood-distillation plants during the summer was accounted for by the inability of the industry to utilize charcoal in blast furnaces. During the summer months there was, therefore, a very low total demand for charcoal and practically all plants of the industry closed down because charcoal storage facilities were completely filled. The upturn in production rate which occurred in October indicates primarily a renewal of the movement of charcoal into the household-fuel market. The stocks of charcoal iron still on hand in the furnace division of the industry indicate little need for early resumption of furnace operations.

Production of acetic acid or calcium acetate, and of methyl acetone as a by-product of methanol refining, conforms closely to the trend curves for crude methanol. The output of all these wood chemicals is inevitably in about a constant ratio, one to another, since little change can be made in the production of any one of them from a cord of wood by any feasible variation in distillation-plant operating methods. Only failure to make reasonably complete recovery of one or more such products could account for any large change in the ratios. (In this connection it should, of course, be understood that it is optional with a producer of wood chemicals whether he makes calcium acetate or acetic acid, assuming that facilities for both chemicals are available at his plant. Hence only the total acetic acid equivalent of the two chemicals should be considered in estimating the industry's trends.)

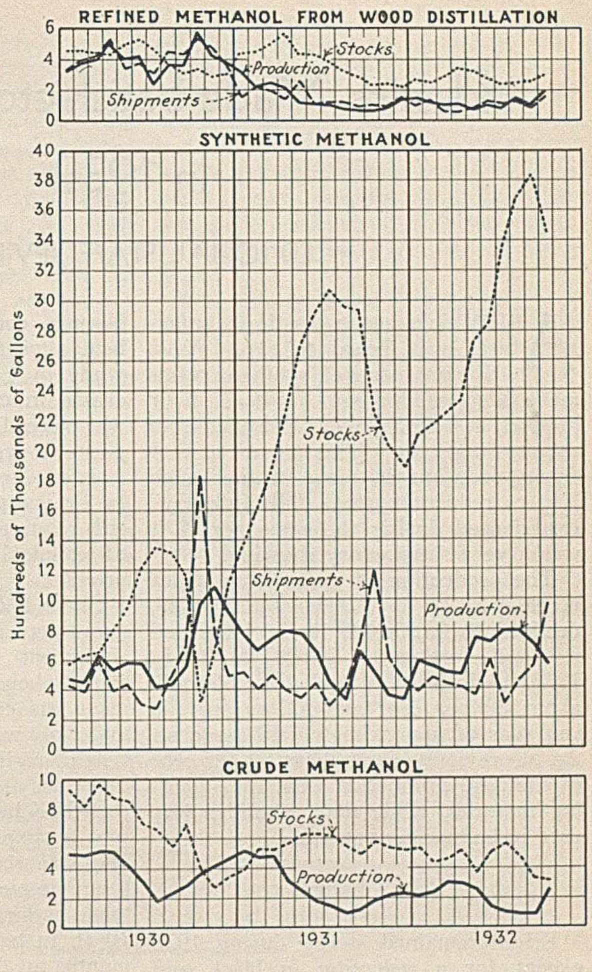
Until quite recently substantially all acetic acid found in the crude pyroligneous liquor from wood distillation was converted into calcium acetate. That product was formerly used for the manufacture of acetone and acetic acid, largely because it was the most convenient form in which to store and transport the acetic radical. Now nearly 20 per cent of the workable capacity of the industry is equipped to produce acetic acid by direct processes. In addition there are three other plants of substantial size which make secondary chemicals, methyl acetate, ethyl acetate, or acetic anhydride, for use in affiliated works; their capacity is about 15 per cent of the industry total. And one other plant makes acetate, but at once



Left: Denatured alcohol withdrawals, 1929-32

Right: Methanol trend curves

(From figures of the Bureau of the Census covering reports from about 80 per cent of the wood distillation and 92 per cent of the synthetic industries)



converts it into acetic acid before marketing. Hence approximately 40 per cent of the total producing capacity of the industry no longer markets acetate. Acetic acid and its derivatives, thus, have become almost equal in importance to calcium acetate as a product of the wood-distillation industry itself. Further change in this direction is contemplated by others in the industry, making it possible that calcium acetate will largely disappear as a major product of the wood-chemicals business.

Industrial Needs Control Acetates

Use of acetic acid and acetates is very largely affected by the industrial requirements in the field of lacquers, rayon and the other plastics which include as constituents or as intermediate products some organic acetate. Much of the decline in acetic acid demand during the early part of 1932 can be traced directly to the very restricted activity of the automobile business, which uses in body finishes very large quantities of these acetates. Later in the year renewed activity of the rayon industry was a helpful compensating factor. In this connection forecasting of trends necessitates consideration of the competition between acetate rayon and the other types of synthetic fiber.

In considering the markets for acetic acid as a whole, one should also give careful attention to other textile industries which use from 10 to 15 per cent of the total production of the country, to the manufacture of white lead, and to chemical, drug, and dye manufacturers making such things as indigo, acetanilide, and several other important pharmaceuticals.

Refined methanol, whether made synthetically or from wood, is now largely used as an anti-freeze for automobile radiators. This highly seasonal usage accounts for the sharp drop in stocks on hand shown each fall by the curves given here. In order to create an almost unlimited market for methanol, it has been proposed seriously during the past year that this material be used as a constituent of automobile motor fuel. It adds highly desirable anti-knock characteristics to the fuel. Apparently at the present price level it is not an economic constituent even when given credit for this superior performance. Those who propose this development are, however, contemplating huge producing plants many times as large as the greatest now in existence, permitting low production costs per gallon. There appears to be a definite economic opportunity for this development if and when gasoline prices should again rise to levels comparable with those of ten years ago. Such opportunity probably will not exist in any large way so long as the wholesale tanker price for gasoline on the Eastern Seaboard remains near to 6 cents per gallon.

Only as a denaturant does wood methanol find a market from which it can exclude its synthetic competitor. By Federal requirement the methanol which is used in special formulas for denaturing industrial alcohol must be natural wood alcohol prepared by straight distillation and containing appropriate percentages of the pyroligneous impurities natural to this product. The specifications for denaturing-grade alcohol have, during the past year, been made much more severe in this particular, in order to prevent the supply of methanol too highly purified to be satisfactory to Federal authorities. The chart of denatured alcohol withdrawals shows the influence of recent economic conditions and changed official formulas on the consumption of completely and specially denatured industrial alcohol. It will be noted that although the total use of denatured alcohol has declined there has recently been a very much smaller decline in consumption of special formulas and actually an increase in the consumption of SDA No. 1 which contains methanol as the principal denaturant.

New Formula Authorized

Just before the close of the year a new special solvent formula was authorized by the Bureau of Industrial Alcohol, permitting a still higher percentage of methanol in order better to satisfy the requests of some manufacturers of paints, varnishes, and other industrial materials. The new formula adds five parts of methanol to 100 parts by volume of SDA No. 1, with a resulting composition closely resembling the old completely denatured alcohol No. 1, the formula which was suspended just two years ago.

Plastics Made Satisfactory Record In 1932

EDITORIAL STAFF REVIEW

A FEW days ago a plastic manufacturer was heard to say, "As a whole producers of synthetic resins made a splendid record in 1932; their production fell off only 12 per cent from the previous year." This remark at first seems odd, but in view of the much larger reduction that "all industry" experienced during the same period it was a very satisfactory showing.

The production of phenolic resinoids reached a high of 33,000,000 lb. in 1929, declined to 25,500,000 lb. in 1931, and fell still further to 23,000,000 lb. in 1932, indicating a total loss of only about 30 per cent and a loss for the last year of approximately 10 per cent. As in previous years, about 80 per cent of the total production went into molding material, while the remainder was used in laminating varnish.

Price Changes

Prices remained steady during 1932 except for a reduction in black and brown molding material early in the year to a minimum level of 15 cents. Previously the price had been 17c. per lb. Later in the year prices of laminated materials also were reduced through the resin manufacturers' ability to supply the varnish at lower prices. Just as we go to press a leading producer announces a reduction in molding material prices for 1933. A price of 12c. per lb. minimum for general purpose black and brown and greatly reduced prices of large quantities of colored molding materials have been made. For example, formerly 3,000 lb. of a specially made colored resin sold at from 26c. to 34c. per lb., while during 1933 it is planned to sell such a quantity at from 18c. to 25c. per lb. for the great majority of colors. This manufacturer believes that the lower prices will assist in expanding largely the applications for phenolic resins. In view of the fact that all industry shows a reduction of from 30 to 60 per cent during 1932, the fact that the production of phenolic plastics fell off only 10 per cent indicates, of course, that there has been an increase in the applications of these materials to industry in general.

In England and on "the continent" the situation in phenolic resinoids has been better than it has in America. German consumption of such materials held almost even with the 1931 level, while in England there was some increase in consumption. This increase was spread over the various types of phenolic products such as molding materials, varnish resin, and laminated. In France the use of phenolic resins is still relatively small because of the lack of technical developments in the French product.

Since 1925, a German firm has been manufacturing large acid resistant equipment for the process industries from phenolic resins. This development has combined asbestos as a base material with a phenol-formaldehyde type of resin. After a thorough mixing the mass is placed in molds and subjected to heat and pressure to form it into a simple, solid piece of the shape and size required. Up to the present time one piece seamless tanks have been made as large as 10 ft. in diameter and 10 ft. in height. During the past few months an American company has commenced the production of this type of equipment. Incidentally, this development will probably result in another large outlet for the phenol-formaldehyde resins.

The cast phenol-formaldehyde industry is one of a very small group of industries that has been able to laugh at the word "depression." Since 1930 cast phenolic resins have made a large gain. In 1932, approximately 1,500,000 lb. were produced, a gain of 40 per cent over the previous year. This plastic owes much of its increasing popularity to its ease of machinability, and to the flexibility in colors. About 60 per cent of this resin is used for casting so-called industrial articles, such as clock cases, cutlery, and handles for household electrical equipment, and the remainder for novelty goods. During the year the price of the cast phenolic resin has been reduced from about 67c. to about 55c. per lb. for most colors.

It is estimated that approximately 15,000,000 lb. of synthetic resins were used in the production of protective coatings in 1932. The phenol-formaldehyde and glycerol-phthalic acid resins continue to lead all other types for industrial finishes. But much experimental work is being done that will probably result in increasing consumption of the other resins as raw material for paints, varnishes, and lacquers. An important new application for the synthetic resins is in house paints. If this application proves to be the success that is expected for it, a large field will be opened.

The year just closed, saw the passing of the thiourea-formaldehyde resin. The principal reasons for stopping production of this product were due to its slow molding and the necessity for using the more expensive stainless steel molds.

Urea-formaldehyde has replaced the thiourea resin and has become more firmly intrenched in the plastic industry of the United States. Further technical developments, such as a reduction in the time required for molding to the equivalent of that necessary for phenolic resinoids, has been an important factor in increasing its popularity.

The patent situation in the United States remains complicated, and as a result the number of companies producing this type of plastic has been reduced from four to three. The output, which was about 800,000 lb. in 1931, was increased to approximately 2,500,000 lb. in 1932, representing a 300 per cent growth over the previous year. Most of the urea-formaldehyde resin is marketed in powder form for molding purposes. Large quantities go into the china and glass industry, especially in the gift or premium class of ware. Cereal manufacturers employ large quantities of the ware as premiums. A small quantity is now being consumed in laminated material by two producers. The laminated product goes to the building trade for trimming building interiors.

Urea Resin Prices

The price has remained unchanged at 35c. per lb. for standard colors. The granular resin in single color lots sells at 31c. per lb. and the finely ground in single color lots, at 29c. There is no immediate prospect of lower prices.

A close relative of the molding urea-formaldehyde resins is the cast material. It has been on the market in France for several years, but has not as yet been produced on this side of the Atlantic.

The casein-formaldehyde industry has felt the effects of the difficult year in business, and as a result several of the manufacturers have consolidated into one organization. However, there are still two smaller concerns that did not join the combination. About 95 per cent of the resin is molded in the form of sheet stock and the remainder as rod. The most important outlet of the product is in the button trade, which consumes 90 per cent of the production in the manufacture of buttons, buckles, and slides. The remainder is employed in making parts for the electrical trade, lip sticks, and jewelry novelties. Production during 1932 was about equal to that for 1931, largely due to the increased use of buttons and other fasteners on ladies clothing, an economical method of dress making.

The styrol resin industry has been rather quiet in recent months. The company sponsoring this plastic has made further improvements in the process and product, but has not been particularly active in increasing its applications. It is being used for high-frequency radio equipment—coils, panels, and the like. This plastic is available in molding powder and in standard shapes.

Nitrocellulose Plastics

The nitrocellulose plastics experienced a further curtailment in demand. In 1931, 14,644,000 lb. in the form of sheets, rods, and tubes, but exclusive of film, were produced. This compares with a production estimated to have been 11,300,000 lb. in 1932, representing a reduction of 23 per cent.

Fountain pen barrels and safety glass remain the important outlets for this plastic. The use of safety glass in automobiles is on the increase, and it is expected that eventually all glass used in the construction of cars will be of the safety type. Both cellulose nitrate and cellulose acetate are being used in the manufacture of safety glass. The quality of the nitrocellulose has been improved in an effort to hold its own. At the same time the difficulties encountered with the acetate have been overcome. Its stability to light has increased its use. The nitrate is still the lower priced, although the price difference is rapidly disappearing. In connection with safety glass, it is interesting to note that an American manufacturer has recently developed a new process which is now being used for commercial production of safety glass. Although the prices for nitrocellulose vary greatly due to color and quantity, the average price is slightly under $1 per lb.

Cellulose Acetate

Cellulose acetate is increasing in importance due chiefly to its being less flammable. Its 1931 production, exclusive of film and yarn, was about 100,000 lb., representing a value of about $150,000. The 1932 production was probably nearly 500,000 lb., while the price has been reduced from $1.50 per lb. to approximately 75c. per lb. for large quantities.

The acetate product has been further improved by the use of more suitable plasticizers which have resulted in the elimination of buckling and warping. Recently this material has been used for combs and phonograph records for broadcasting purposes. The records are made of either solid cellulose acetate or a core of some other material with cellulose acetate veneering on both sides. Due to the higher cost this plastic does not now compete with the established record materials, but since it permits much better quality of tones, it is justified for broadcasting purposes. Manufacturers of translucent lamp shades, for which celluloid is obviously unsuitable, are using increasing qualities of the acetate. It is also used for certain types of electrical insulation.

To a somewhat less important extent, cellulose acetate is used for injection molding. This particular method is only suitable when the number of articles to be molded does not justify the expensive molds used in the customary method.

Just as the new year began the announcement was made of a new producer of cellulose acetate molding composition. The new product is made in colors, of course, principally the lighter shades, translucent and transparent, and in plain, pearl, and mottle effects. Its outstanding characteristic is its strength.

During 1931, wrapping material of cellulose acetate made its appearance, offering high-moisture resistance, clarity, and heat-sealing as chief advantages. However, this development did not made the progress during 1932 that had been expected, for it was held back by the great amount of static generated when it was tested for use in automatic wrapping machinery. Solution of this problem will greatly increase its use in 1933.

The film business corresponded with the general trend of business last year. Yarn ran along with all industry until the second half of the year, when demand picked up, and at the close of the year plants were operating at capacity. All of which points to increased production and lower costs, hence probably lower prices for 1933.

For the past couple of years there have been many rumors to the effect that other cellulose esters would soon make their appearance on the market, but there have been no particular new developments of importance, probably because of the higher price of the raw materials. From England comes the announcement that benzyl cellulose, an ether of cellulose has made its appearance in industry. Its resistance to water and to chemical attack is said to be excellent and it is reversibly thermoplastic. However, it is more expensive than the acetate and therefore will probably not make very rapid progress at this time.

What's New in Pigments?

EVEN in years of depression such as those we are passing through, there are interesting developments. This is true in the pigment industry where, with exception of the titanium group and zinc sulphide, pigments have experienced an important reduction in demand. In the case of white lead, red lead, zinc oxide and leaded zinc oxide, and lithopone, the falling off has been estimated as amounting to 20 to 25 per cent. The titanium pigments probably held their own in tonnage produced and are unique in that they are one of the few industries whose plants are operating at capacity. The trend toward high hiding pigments has increased the importance of titanium oxide, antimony oxide, and zinc sulphide which have been used in a limited quantity for several years.

Probably due to the fact that pigments are a raw material for the manufacture of capital as well as consumer goods, the production figures for the important ones, from a tonnage standpoint, show a falling off from the peak year of 1928 and 1929 of from 40 to 50 per cent. Lithopone made the best showing.

The gravity of the decline in prices, so general in the whole industrial sphere, has been felt in the pigment industry. Zinc oxide, after resisting the downward trend, received its first price reduction in March when it was lowered ¾c. per lb. In January calcium base titanium pigments were reduced ½c. per lb. The last days of December, 1932, witnessed a sweeping reduction in the prices of the lead pigments as follows: dry white lead, basic carbonate and basic sulphate in casks, ½c. per lb.; white lead in oil, 1c. per lb.; dry white lead in kegs, 1c. per lb.; red lead in oil, 2c. per lb.; dry red lead and litharge in kegs, 2½c. per lb.; dry red lead in casks, ¼c. per lb.

Sales of Pigments by Domestic Manufacturers
(Short Tons)

	White Lead (dry and in oil)	Red Lead	Zinc Oxide and Leaded Zinc Oxide	Lithopone
1928......	154,000	40,500	185,000	200,500
1929......	147,000	43,000	187,700	206,300
1930......	102,140	32,940	136,420	164,000
1931......	97,370	25,850	114,280	151,800
1932......	76,000	20,000	89,500	118,000

As might be expected the newer pigments are the center of most attention. Antimony oxide, a high hiding power, white pigment has received much interest during recent months. And the calcium base "high strength" lithopone offers a low price hiding power which is growing in popularity.

Rayon Essays Production Control To Aid Its Position

PROBABLY more important than any other development of the past year in rayon was the industry's discovery of a sure cure for overproduction. It was a heroic measure—but it worked—and doubtless justified its means. During the slack of the summer the industry simply shut up shop for periods ranging from one to two months. As a result, it was possible to reduce stocks so fully that when demand suddenly revived with the late summer textile renaissance, difficulty was encountered in filling orders. Since the resumption of operation, production has been at near capacity rates.

Were it not for the breakdown in natural silk prices, which dragged rayon to hitherto impossible figures—a base price as low as $0.55 for several months and only $0.60 at present—the year would have been an excellent one, considering the business situation. According to figures supplied by the entire industry to the *Textile Organon,* and released to us at the moment of going to press, 1932 production totaled 131,000,000 lb., a drop of only 9.5 per cent from 1931 and better than any other earlier year. Consumption by the same authority, reached 149,500,000 lb. as compared with 151,000,000 lb. in 1931. As production figures for individual companies are closely held, any estimate of the breakdown by types of rayon is frankly only an estimate. From apparently reliable information, it seems that viscose, always the heavy tonnage product, accounted for about 106,000,000 lb. or 80.8 per cent. Acetate continued its increase to some 14,000,000 lb. while cupra-ammonium rose slightly to perhaps 3,500,000 lb. Nitrocellulose held its own at a figure variously estimated at from 7.5 to 8.5 million lb.

Imports for the year approached the vanishing point at about 159,000 lb. Exports are estimated at 579,000 lb. Stocks at the end of the year declined to about three weeks' supply as compared with seven weeks' supply at the beginning of the year. World rayon production, as forecast in September by *Textile World,* continued its uninterrupted climb to about 483,000,000 lb. with viscose estimated at 87.5 per cent in comparison with 7.7 per cent for acetate, 3.2 per cent for cupra and 1.6 per cent for nitro.

What of the year's technical developments? Considerable grist for the Technocracy mill was supplied by the Furness Corp.'s new and highly mechanized cupra plant which went into actual production during the year. Generally described by the exponents of "metrical" economics as a "one-man" plant, it nevertheless employs a respectable complement of labor. What its minimum requirements are to be is not yet known but present indications point to a productivity per operator of three to four times that attained in viscose.

Rayon Production and Imports, 1921-1932

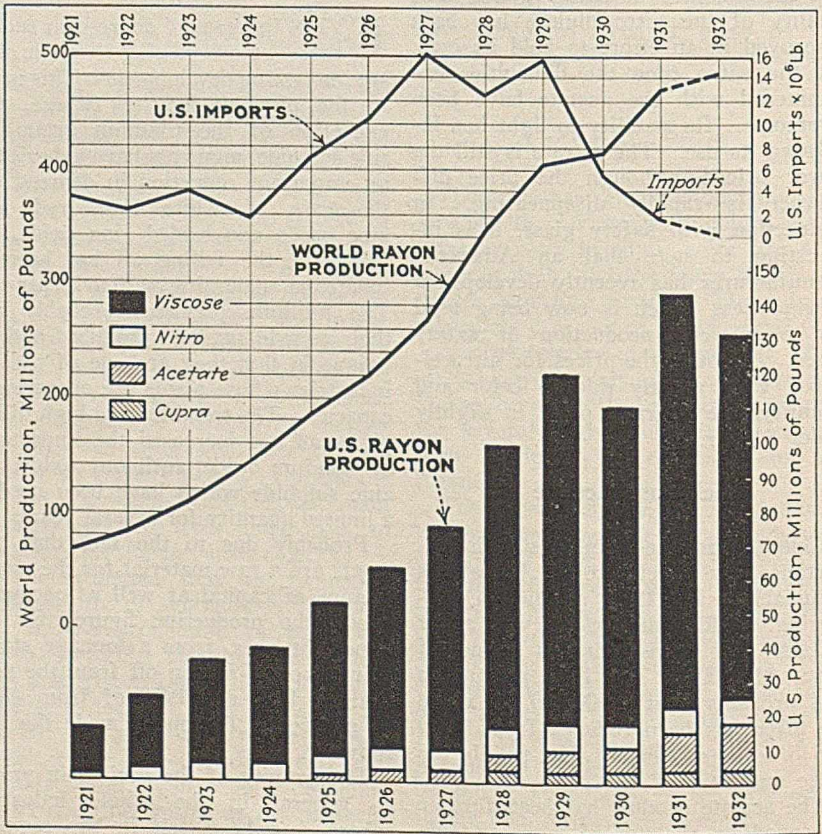
	U.S. Production (Thousands of Pounds)	U.S. Imports (Thousands of Pounds)	World Production† (Thousands of Pounds)
1921	15,000*	3,276	......
1922	24,406†	2,088	80,894
1923	35,400†	3,906	108,800
1924	38,750†	1,712	141,164
1925	52,200†	7,001	182,984
1926	62,575†	10,127	219,080
1927	75,050†	16,223	266,868
1928	98,650†	12,754	347,400
1929	119,500*	15,902	404,155
1930	110,000*	5,810	416,775
1931	144,800*	1,883	470,000
1932	131,000*	159‡	483,000

* From *Textile Organon,* Tubize Chatillon Corp.
† From *Textile World.*
‡ Estimated on basis of imports for first ten months. Includes only yarns and filaments.

As for other technical trends, they were largely predicated on the need for lower operating cost. Increases in spinning speeds will probably swing favor from the pot spinning machine back to the bobbin. Renewed talk about artificial wool has revived interest in hollow filaments. The increasing use of acetate and the successful subduing of its luster are developments of the first magnitude.

Successful exploitation in England of a brace of new crease-proofing processes, suitable for regenerated-cellulose rayons as well as cotton fabrics, may have far-reaching consequences. The processes consist in the formation in the fiber, after weaving, of a synthetic resin of urea-formaldehyde or phenol-formaldehyde which increases the dry strength of rayon by 30-50 per cent and the wet strength as much as 100 per cent.

Cellulose and cellulose acetate wrapping film appear to have prospered again during 1932 although accurate production statistics cannot be obtained. In 1931 the production was in the range between 31,000,000 and 38,000,000 lb., probably nearer the higher figure. The past year is generally believed to have witnessed an increase, perhaps to 40,000,000 lb. The two viscose-film producers continue to account for nearly all the production. The two acetate plants are getting under way but were probably responsible for less than 2,000,000 lb. of film during the year.



How Process Industries Face 1933 In the Far West

By PAUL D. V. MANNING

Pacific Coast Editor, Chem. & Met.

ALTHOUGH chemical manufacturers on the Pacific Coast did not make large profits during the last year, most of them operated with some profit. A few enterprises are running plants at full capacity but the majority are carrying on with a reduced production schedule.

The process industries in this section were not so fortunate in general. Pulp and paper makers of the Pacific northwest especially are feeling the effect of stimulation of low priced imports due to depreciated foreign exchange. With a few of the mills operating on full schedule, many shut down entirely, and the majority on reduced production, it is estimated that the output of this industry was only 40 to 50 per cent of rated capacity. With manufacturers having plants both in the East and in the Pacific northwest, there is a tendency to shut down the latter plants or operate at a very low rate.

The oil industry is likewise on a greatly reduced schedule and the five-day week has found much favor. During the year, the Richfield Oil Co. brought the Lachman vapor phase process of oil refining into successful operation. This process uses zinc chloride as the active agent.

Practically all companies have continued research work, some with reduced personnel while others have increased their endeavors. There has been a decided effort to bring out new products and to diversify manufacturing activities.

Additions to plant and apparatus, modernization and new processes have been or are being installed by the Stauffer Chemical Co., Great Western Electrochemical Corp., American Potash & Chemical Corp., Pacific Coast Borax Co., Shell Chemical Co., Marine Chemicals Co. and many others. Considerable research is under way on the chlorination of natural gas and other hydrocarbons. One company expects to bring into production by the middle of 1933, a new plant for the production of carbon tetrachloride.

The Great Western Electrochemical Corp. has rebuilt its hydrochloric acid plant and is again manufacturing this commodity. This company has also just brought to a successful conclusion, a six months operating test on the use of ferric chloride in sewage disposal, a 25,000 gal. pilot plant having been in operation at Palo Alto, California. Ferric chloride is now being shipped as a solution. The same company has also begun to produce ammonium chloride recently.

Alkali manufacturers are not having an easy time. This is especially true of those working on natural brines and deposits. The Rhodes Alkali and Chemical Co. has enlarged its Mina, Nevada, plant and is now producing and shipping considerable quantities of anhydrous sodium sulphate.

Summarizing the work of the past year, it may be concluded that the chemical and process industries of the Far West have cut costs and bettered their position, holding losses at a minimum and, excepting in a few specialized lines, have been able to retain most of their technically trained personnel. While it was certainly not a very good year but, could have been a lot worse and the industry finds itself in a stronger position to bid for national and world markets.

Steady Volume Forecast For Leather

LEATHER enters 1933 in the expectation of reasonably steady volume and price at present levels. Shoe production, of course, will set the pace for most of the industry and shoes now appear to be on a necessity rather than a desire basis. Which means that there is the possibility of a slight firming in prices since it is believed that the distress selling and cheap bargain hunting of 1930-31 have spent their force to a large extent. Sole leather deliveries for the first 11 months of 1932 were given as 5.8 per cent below the same period of 1930. Belting leather, on the other hand, showed a decrease of 42 per cent, apparently a serious blow to the industry until it is recalled that the volume normal to belting is only about 4 per cent of that of sole leather. Its fall, therefore, is less important to the industry than the drop in sole leather. Shoe upper leathers are expected to follow the trend of soles. A concerted effort is at present being made to launch goat-skin uppers for men's summer shoes. In the glove, upholstery, clothing, and novelty leather fields, trends are too uncertain to warrant a forecast. Undoubtedly, 1933 will be another "survival-of-the-fittest" year.

Production of Acids—1931-1929

Where no figures are given for amounts made and consumed in the same establishments the quantities and values relate to production for sale.

	1931	1929
Total value of production for sale	$66,062,978	$98,619,871
Acetic:		
Dilute, basis 100 per cent[1]—		
Pounds	48,846,511	52,914,807
Value	$2,761,237	$5,487,427
Glacial[1]—		
Pounds	13,739,589	13,449,259
Value	$776,251	$1,402,984
Boric (boracic):		
Pounds	18,128,529	26,055,132
Value	$970,383	$1,541,360
Carbonic (carbon dioxide):		
Pounds	[2]151,673,997	136,930,311
Value	$6,222,426	$6,931,735
Chromic:		
Pounds	3,024,854	4,211,605
Value	$423,069	$710,272
Citric:		
Pounds	8,381,441	10,755,798
Value	$3,060,185	$4,832,984
Hydrochloric (muriatic):		
Total production, tons	172,672	257,854
Made and consumed in the same establishments, tons	44,122	61,379
For sale—		
Tons	128,550	196,478
Value	$2,422,439	$3,195,415
Production according to strength, tons—		
20° Baumé	136,618	214,728
18° Baumé	30,093	40,753
Other strengths	5,961	2,376
Hydrofluosilicic:		
Pounds	3,734,000	....
Value	$68,739	[3]
Mixed sulphuric and nitric—		
Total production, tons	100,596	184,163
Made and consumed in the same establishments, tons	63,011	120,442
For sale—		
Tons	37,585	63,721
Value	$1,800,480	$4,214,433
Nitric, basis 100 per cent—		
Total production, tons	116,275	143,454
Made and consumed in the same establishments, tons	84,889	110,493
For sale—		
Tons	31,386	32,961
Value	$3,349,099	$3,494,577
Oleic—		
Pounds	29,918,146	56,947,501
Value	$1,870,722	$5,374,587
Phosphoric—		
Pounds	[4]20,463,677	[4]34,673,982
Value	$761,354	$2,073,066
Stearic—		
Pounds	24,868,407	39,153,726
Value	$2,056,964	$5,488,320
Sulphuric, basis 50 deg. Baumé—		
Total production, tons	6,014 542	8,491,114
Made and consumed in the same establishments, tons	1,764,744	2,674,949
For sale—		
Tons	4,249,798	5,816,165
Value	$33,202,098	$45,573,245
Sulphuric, reclaimed, basis 50 deg. Baumé—		
Total production, tons	830,068	980,626
Made and consumed in the same establishments, tons	519,821	599,470
For sale—		
Tons	310,247	381,156
Value	$1,319,653	$1,389,340
Tannic—		
Pounds	667,212	1,449,375
Value	$250,874	$503,567
Tartaric—		
Pounds	5,181,020	4,906,479
Value	$1,462,529	$2,059,680
Other acids, value	$3,284,476	$4,346,879

[1] Total quantity of dilute and glacial acetic acid made and consumed in same establishments was—1931, 13,815,839 lb.; 1929, 19.822,964 lb. (dilute only). [2] Includes approximately 80,000,000 lb. piped to plants making dry ice but does not include 26,896,186 lb. made and consumed in such plants. [3] Included in value of other acids. [4] For 1931, basis 50 per cent; for 1929 as reported, regardless of strength.

Consuming Trend Toward S. D. Alcohol

PRODUCTION of ethyl alcohol for the year ended June 30, 1932, amounted to 146,950,912 proof gal., or a decrease of 19,063,433 proof gal. from the total produced in the preceding fiscal year. For the calendar year 1931 production was 151,463,000 proof gal. of which 123,377,000 proof gal. was produced in the first ten months. The output for Jan.-Oct., 1932, was 116,-150,000 proof gal. About 18.54 per cent of the 1931 output resulted from operations in the last two months of the year and if this percentage held good the 1932 total would be approximately 142,000,000 proof gal.

Withdrawals for denaturation in the last fiscal year were 132,578,234 proof gal., compared with 149,303,438 proof gal. in the preceding fiscal year. Total withdrawals for the calendar year 1931 were 140,070,000 proof gal. Of this amount 105,205,000 proof gal. was withdrawn in the first ten months so that about 24.8 per cent of the year's total was withdrawn in the last two months of the year. In the first ten months of 1932 withdrawals amounted to 93,565,000 proof gal. and if the percentage established for Nov.-Dec., 1931, was maintained, the twelve month total for 1932 would be 124,500,000 proof gal.

The volume of denatured alcohol produced in the last fiscal year was reported at 78,329,517 wine gal., of which 34,-298,235 wine gal. was completely denatured and 44,031,282 wine gal. was specially denatured. In the twelve months of 1931, 81,639,000 wine gal. of denatured alcohol was produced. Of this amount 60,750,000 wine gal. was turned out in the first ten months of the year or a little more than three-quarters of the year's output. On that basis, the ten-month output of 1932, 56,349,000 wine gal. would represent a production of 75,700,000 wine gal. for all of last year.

Of the completely denatured alcohol removed from denaturing plants in the last fiscal year 32,622,384 wine gal. was denatured in accordance with the provisions of Formula No. 5, only 13,040 wine gal. using Formula No. 1, which specifies methanol as a denaturant. Nearly all the permissible formulas were used in the specially denatured grades. First in importance was No. 1, which designates methanol as the denaturant. Next in order of importance was No. 2-B with benzol as the denaturant; No. 18, with vinegar as the denaturant; No. 23-A, with acetone the denaturant; No. 29, with acetaldehyde the denaturant; and No. 40, with either acetone or isopropyl alcohol and brucine sulphate the denaturants.

Effective July 1, 1932, completely denatured alcohol, Formula No. 5 was revised and two new formulas, No. 5-A and No. 10, were made effective. The revision of No. 5 substituted calorite for alcotate. Calorite is a petroleum product and its use was preferred to that of alcotate because it imparts less odor to the denatured product.

Of the new formulas No. 5-A uses as a denaturant, pontol, which was developed for that purpose. It is a synthetic product and consists principally of a mixture of primary and secondary aliphatic higher iso-alcohols. No. 10 designates another new product, tecsol, as the denaturant. Tecsol is free from wood alcohol and contains a definite proportion of pyroligneous bodies produced by the destructive distillation of wood.

The regulations pertaining to the distribution of completely denatured alcohol also were amended in the interest of greater supervision and control. All packages exceeding five gallons in capacity must now be shipped in one-way steel drums with embossed serial numbers and symbols identifying the producer.

The amount of specially denatured alcohol used in manufactured products in the year ended June 30, 1932, was considerably higher than the total used in the preceding year, the figures being 75,465,367 wine gallons for 1932 and 67,074,438 wine gallons for 1931. The discrepancy between these figures and those reported for production or distribution of specially denatured alcohol is explained by the fact that large amounts of alcohol are recovered at consuming plants. A very large increase in use of specially denatured alcohol was reported in solvents, and chemicals and food products, as well as rayon showed gains of more than 61 per cent. Ethyl acetate accounted for a gain of more than 19 per cent.

Six states, New Jersey, West Virginia, Maryland, Pennsylvania, Massachusetts, and New York, in that order, accounted for more than 70 per cent of all the specially denatured alcohol used in the last fiscal year.

Products Manufactured With Specially Denatured Alcohol

Year ended June 30, 1932

Products	Denatured Alcohol Used Wine, Gal.
Antiseptic solutions	888,221
Artificial silk	3,358,654
Barber-supply preparations	59,259
Bathing alcohol	1,526,091
Bay rum	274,442
Candy galze	34,581
Cement	39,501
Chemicals and food products	12,106,251
Dentifrices and tooth paste	39,860
Deodorants and disinfectants	37,833
Drugs and medical supplies	3,431,993
Dyes and dye intermediates	506,869
Electrical supplies	27,323
Ether	1,265,568
Ethyl acetate	4,339,489
Ethylene	305,519
Fungicides and insecticides	18,768
Hair tonics	686,296
Hats	19,476
Hydraulic brake fluid	167,500
Lacquers and solvents	8,327,734
Leather and leather solutions	314,986
Liniments and lotions	1,031,265
Nitrocellulose	5,701,906
Perfumes	170,555
Petroleum oils	1,334,760
Photographic supplies	1,166,308
Polishes and cleaning fluids	80,155
Pyroxylin and plastics	4,266,119
Resin and synthetic resin	604,540
Shellac, varnish, and paint	3,885,229
Soaps	210,407
Solvents	8,564,369
Tincture of iodine	58,015
Tobacco and solutions	1,218,988
Toilet preparations	782,256
Toilet water	586,945
Vinegar	7,766,130
Miscellaneous	261,206
Total	75,465,367

Materials Used in Alcohol Production

Year Ended June 30, 1932

Rye, lb.	23,792
Corn, lb.	265,703,148
Malt, lb.	15,023,085
Wheat, lb.	19,865,419
Potatoes, lb.	148,715
Pomace, lb.	124,500
Chemicals, lb.	20,103,526
Molasses, gal.	159,858,062
Liquids containing one-half of 1 per cent of alcohol, gal.	14,967,482
Mixed sulphate, gal.	11,146,057
Pineapple juice, gal.	4,235,380
Wine and lees, gal.	104,134

Alcohol Produced at Industrial Plants and Withdrawals for Denaturing

Fiscal Year	Alcohol Produced, Proof Gal.	Ethyl Alcohol Withdrawn for Denaturation, Proof Gal.	Denatured Alcohol Produced		
			Completely, Wine Gal.	Special Wine Gal.	Total, Wine Gal.
1922	79,906,101.50	59,549,919.6	16,193,523.60	17,152,224.31	33,345,747.91
1923	122,402,849.81	105,819,404.9	27,128,229.54	30,436,913.14	57,565,142.68
1924	135,897,725.83	121,576,196.1	34,602,003.72	33,085,292.04	67,687,295.76
1925	166,165,517.81	148,970,220.9	46,983,969.88	34,824,303.28	81,808,273.16
1926	202,271,670.32	191,670,107.2	65,881,442.43	39,494,443.80	105,375,886.23
1927	184,323,016.97	170,633,436.7	56,093,748.16	39,354,928.48	95,448,676.64
1928	169,149,904.83	159,689,378.2	46,966,601.28	45,451,424.28	92,418,025.56
1929	200,832,051.08	182,778,966.1	52,405,451.92	54,555,006.15	106,960,458.07
1930	191,859,342.42	181,601,420.3	58,141,740.88	47,645,796.84	105,787,537.72
1931	166,014,346.15	149,303,438.5	49,136,200.64	37,172,740.71	86,308,941.35
1932	146,950,812.76	132,578,234.7	34,298,235.54	44,031,281.80	78,329,517.34

Molasses continued to hold the leading place as a raw material for production of ethyl alcohol, as is shown by the fact that during the last fiscal year about 84.75 per cent of the alcohol was made from molasses. Synthetic production accounted for nearly 10 per cent of the total production, with an output of 14,242,270 proof gal., of which 14,238,801.50 proof gal. was made in West Virginia and 3,468.50 proof gal. in Maryland.

The decline in the use of denatured alcohol last year was due to the drop in general business activities, which affected the distribution of practically all materials. Demand for completely denatured alcohol was adversely affected by smaller sales for anti-freeze purposes and because a number of manufacturers formerly using completely denatured changed to specially denatured as better suited for their requirements. This trend was more noticeable in the second half of 1932. New uses for specially denatured also were reported during the year, in the manufacture of special proprietary solvents.

Larger Supplies of Synthetic Methanol

PRODUCERS of synthetic methanol cut down their output in November to 531,635 gal. but for the first 11 months of last year production was 6,989,906 gal. which compares with 6,679,776 gal. and 6,671,937 gal. for the corresponding periods of 1931 and 1930 respectively. Shipments of synthetic methanol from producing plants, however, were slightly below those for the preceding year.

Production of crude methanol in the wood distillation industry for the first 11 months of last year was reported at 2,178,258 gal. compared with 3,069,895 gal. for the 11-month period of 1931. These totals, however, do not include the entire industry and are issued with the qualifying statement that in 1929 the monthly statistics represented only 79 per cent of the total output. Likewise the monthly production totals for refined methanol from wood distillation are not 100 per cent inclusive and in 1929 included but 92.1 per cent of total production. The figures for Jan.-Nov. production last year may be interpreted in that approximation. The figures as reported are 1,352,636 gal. for 1932 and 1,557,070 gal. for 1931.

The production figures for crude and refined methanol from wood distillation clearly portray the position of the industry in the last year. Not only was there a recession in demand for methanol in the ordinary channels but unusually slow call for some wood distillation products forced a general reduction in output in order to prevent large accumulations of some selections. The fact that the proportion of products, obtained in the distillation of a given quantity of hard wood, remains practically constant places the industry in a position of disadvantage whenever one or more of the finished products fails to find a receptive market.

Methyl acetone which was produced to the extent of 1,889,142 lb. by the wood distillation industry in 1931 is estimated to have fallen to an output of about 1,000,000 lb. in 1932. Offerings of synthetic methyl acetone came on the market last year and the new competition thus presented may cut into the future demand for the older product.

Butyl Alcohol

Official figures for production of butyl alcohol have not been included in any of census compilations on chemicals or dyes. Activities at producing plants were reported to have held up well last year and it is believed that unsold stocks were increased. Competition among sellers was keen and the price trend for the year was downward.

Data for butyl acetate production were added to the 1931 census report and the quantity produced was given at 3,311,272 gal. which represents a considerable decline from the 1929 total of 4,523,863 gal.

The marked drop in output of lacquers had a direct bearing on the distribution of other acetates and in fact of different solvents in general. The increase in automobile production and enlarged rayon activities in the latter part of the year stimulated demand and gave hopes for improvement for the first quarter of 1933.

Chemicals Take Larger Part of Lime Output

LIME is used for building purposes, in agriculture, and in a group of chemical industries. Formerly building took more than half, but during recent years chemical usage has become most important. During the last three years more than 50 per cent of the lime consumed in the United States has gone to chemical process industries, an increase from about 40 per cent in 1925. Agriculture continues to use about 10 per cent and the building trades now take about 35 per cent of the total output. Renewed activity of the lime industry can be expected first through a resumption of building and to a lesser degree as chemical industry becomes more active. Variation in the use of agricultural lime is not of sufficient importance greatly to affect the United States total consumption.

BYPRODUCTS OBTAINED FROM COKE-OVEN OPERATIONS IN 1931[a]

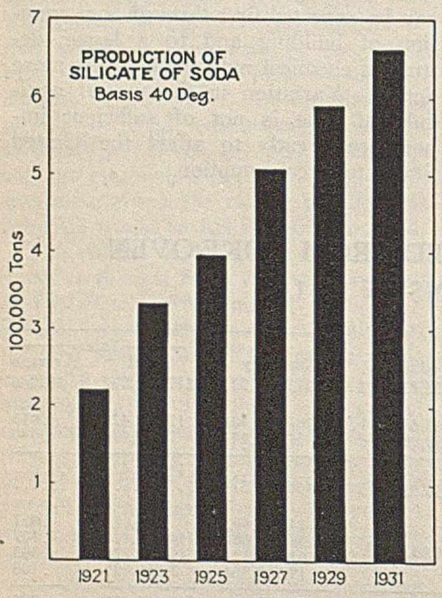
Product	Unit	Production	Sales: Quantity	Sales: Value: Total	Sales: Value: Average
Tar	Gallons	450,856,092	273,164,573	$12,440,567	$0.046
Ammonia:					
Sulphate	Pounds	983,614,651	1,007,561,803	12,812,422	.013
Ammonia liquor (NH_3 content)	Pounds	39,089,088	37,347,144	1,465,998	.039
		....	....	14,278,420	......
Sulphate equivalent of all forms		1,135,971,003	1,156,950,379	....	......
Gas:					
Used under boilers, etc.	M.cu.ft.	524,097,485b	14,274,493	810,673	.057
Used in steel or affiliated plants	M.cu.ft.		132,761,886	14,243,420	.107
Distributed through city mains	M.cu.ft.		161,881,123	49,023,725	.303
Sold for industrial use	M.cu.ft.		19,989,961	3,352,095	.168
		....	328,907,463	67,429,913	.205
Light oil and derivatives:					
Crude light oil	Gallons	122,529,148c	8,739,202	710,106	.081
Benzol, crude and refined	Gallons	14,772,297	14,267,081	2,209,839	.155
Motor benzol	Gallons	61,960,025	61,471,006	7,209,157	.117
Toluol, crude and refined	Gallons	11,832,932	12,693,294	3,099,452	.244
Solvent naphtha	Gallons	3,772,025	3,463,950	591,628	.171
Xylol	Gallons	2,028,729	2,074,126	444,850	.214
Other light oil products	Gallons	4,163,028	2,007,860	124,928	.062
		98,529,036d	104,716,519	14,389,960	.137
Naphthalene, crude and refined	Pounds	7,622,929	7,360,309	78,946	.011
Tar derivatives:					
Creosote oil, distillate as such	Gallons	13,740,196	13,686,594	1,218,227	.089
Creosote oil in coal-tar solution	Gallons	2,551,402	2,141,073	144,402	.067
Pitch of tar	Net tons	78,983	4,951	30,247	6.109
Other tar derivatives		....	....	55,032	......
Phenol	Gallons	94,097	110,352	29,783	.27
Other products		....	....	97,595	......
Value of all byproducts sold		....	....	110,193,092f	......

(a) Includes products of tar distillation conducted by coke-oven operators under same corporate name, excepting, however, phenol, and other tar acids produced at Clairton, Pennsylvania. (b) Includes gas wasted and gas used for heating retorts. (c) Refined on the premises to make the derived products shown, 117,625,416 gallons. (d) Total gallons of derived products. (e) Carbolate, crude products, cyanogen, sodium prussiate and sulphur. (f) Exclusive of the value of breeze production, which in 1931 amounted to $6,637,976.

Production of Silicate of Soda Shows Steady Growth

STANDING out as one of the few sodium products whose production in 1931 was increased over that for 1929, silicate of soda directs attention to the steady growth which has distinguished that branch of the industry in recent years. Exports also were of an expansive nature through 1929 but have taken a declining trend from that year to date. Deducting the increase in exports from 1925 to 1927, a gain of more than 102,000 tons is indicated for the domestic trade. On the same basis the apparent gain in domestic demands from 1927 to 1929 was approximately 80,000 tons and from 1929 to 1931 it is represented at about 69,000 tons.

New uses for silicates and a greatly increased demand from some of the old consuming industries, especially in the



manufacture of paper cartons and in adhesives is reported to account for the wider distribution of this chemical.

Export trade, while extensive, has been largely restricted to nearby countries. In 1931 of total exportations, more than 86½ per cent was consigned to Canada. Next in importance came Cuba and Mexico.

Another exception to the general rule for production in 1931 is found in the case of phosphates of soda but the rise in output over that for 1929 was not so marked as was that for silicate. Production of phosphates in 1929 was reported at 146,179 tons valued at $8,964,538 compared with 146,303 tons valued at $8,145,619 in 1931. Production of phosphates in 1932 was reported to have changed but little from the 1931 total but the output for some time has been running ahead of the amounts which the market could absorb although the uses for phosphates are said to have been considerably extended.

Hypochlorite of soda was the third sodium product to make a better showing in 1931 than in 1929, the totals being 26,772 tons valued at $2,015,817 in 1929 and 32,323 tons valued at $2,561,628 in 1931.

Niter cake and salt cake, on the other hand stand out because of the extent to which production declined in 1931 and demonstrate the degree to which changes in acid manufacture have affected the outputs of these byproducts.

Exports of Silicate of Soda

	Lb.	Value
1925	40,517,037	$353,944
1926	48,344,537	396,496
1927	54,986,118	432,062
1928	59,307,272	641,907
1929	66,734,993	617,265
1930	60,494,346	571,695
1931	58,577,134	522,577
1932	46,864,829	372,933

Silica of Soda Production Basis 40°

	Tons	Value
1921	221,550	$4,641,754
1923	331,309	5,060,719
1925	394,884	5,717,426
1927	504,518	6,826,099
1929	590,277	7,179,397
1931	663,434	7,460,105

Domestic Production of Sodium Compounds

Census years 1929-1931

Where no separate figures are given for amounts made and consumed in the same establishments, the quantities and values relate to production for sale.

	1931	1929
Total value	$104,885,620	$137,654,863
Benzoate—		
Pounds	688,248	868,141
Value	$249,039	$349,318
Bichromate and chromate—		
Tons	24,745	39,301
Value	$3,162,482	$5,137,346
Borate (borax)—		
Tons	80,004	92,250
Value	$2,432,172	$3,279,640
Carbonates—		
Bicarbonate, refined—		
Tons	127,981	140,234
Value	$3,730,716	$4,062,074
Sal soda—		
Tons	48,480	57,850
Value	$1,302,583	$1,522,895
Soda ash, basis 58%—		
Total production, tons	2,275,416	2,682,216
Made and consumed in the same establishments, tons	766,737	868,360
For sale—		
Tons	1,508,679	1,813,856
Value	$22,492,943	$34,648,657
By process—		
Ammonia soda—		
Total production, tons	2,189,351	2,586,304
Made and consumed in the same establishments, tons	766,737	868,360
For sale—		
Tons	1,422,614	1,717,944
Value	$21,079,187	$32,540,942
Natural and electrolytic soda—		
Tons	86,065	95,912
Value	$1,413,756	$2,107,715
Caustic (hydroxide), basis 76%—		
Primary production—		
Total tons*	658,889	761,792
Made and consumed in the same establishments, tons	24,676	37,118
For sale—		
Tons	634,213	724,674
Value	$26,565,202	$36,089,264
By process—		
Lime-soda, tons	455,832	524,985
Electrolytic, tons	203,057	236,807
Repacked caustic (purchased in bulk)—		
Tons	22,515	17,474
Value	$3,857,411	$3,611,573
Citrate—		
Pounds	1,370,561	1,432,482
Value	$409,124	$544,570
Hypochlorite—		
Tons	32,323	26,772
Value	$2,561,628	$2,015,817
Iodide—		
Pounds	47,658	49,796
Value	$194,526	$214,960
Phosphates—		
Total tons	146,303	146,179
Total value	$8,145,619	$8,964,538
Tribasic—		
Tons	82,954	82,045
Value	$4,675,085	$5,008,815
Dibasic—		
Tons	61,238	
Value	$2,887,390	64,134
Monobasic and pyro—		$3,955,723
Tons	2,111	
Value	$583,144	
Salicylate—		
Pounds	393,199	......
Value	$145,906	†......
Silicate, basis 40 deg.—		
Tons	663,434	590,277
Value	$7,460,105	$7,179,397
Silicofluoride—		
Tons	1,357	2,278
Value	$115,169	$228,093
Sulphates—		
Anhydrous, refined—		
Tons	7,299	......
Value	$169.717	†......
Glauber's salt—		
Tons	51,117	61,953
Value	$875,263	$1,112,267
Hyposulphite (thiosulphate)—		
Tons	23,512	25,020
Value	$969,206	$906,369
Niter cake (bisulphate)—		
Total production, tons	34,908	111,522
Made and consumed in the same establishments, tons	5,019	28,839
For sale—		
Tons	29,889	82,683
Value	$543,231	$1,023,136
Salt cake—		
Total production, tons	121,366	206,612
Made and consumed in the same establishments, tons	20,672	36,136
For sale—		
Tons	100,694	170,176
Value	$1,571,451	$2,014,838
Sulphide—		
Tons	25,056	33,032
Value	$1,199,506	$1,406,606
Sulphite—		
Tons	4,649	5,970
Value	$402,197	$462,072
Tungstate—		
Pounds	354,205	......
Value	$215,147	
Other sodium compounds, value	$16,115,277	$22,881,433

* Not including caustic soda made and consumed in wood-pulp and textile plants.
† Included in items for "Other sodium compounds."

Curtailment of Production of Naval Stores

With consuming industries cutting down their requirements and with a period of low prices prevailing, there has not been much incentive to the naval stores industry to produce turpentine and rosin at full capacity. Reports emanating from the gum and wood branches of the industry agree that outputs have been held down because of the position of the consuming market.

Receipts at the three principal distributing ports, while not representing 100 per cent of gum rosin and gum turpentine movements, nevertheless represent a very large total of the industry and may be used safely as a basis for calculating the rate of activity of the industry. For the first 10 months of 1932 receipts of gum rosin at the three principal ports amounted to 704,259 bbl. compared with receipts of 1,175,943 bbl. for all of 1931 and 986,321 bbl. for the first 10 months of that year. This is a decline of more than 280,000 bbl. in receipts for the 10-month period or a drop at a rate of more than 28 per cent. Allowing for the difference in stocks on hand at the close of October, apparent consumption of gum rosin in the first 10 months of the year was 834,424 bbl. in 1932 and 980.443 bbl. in 1931 or a decline of less than 15 per cent.

Production figures for wood rosin are available for the first 11 months of last year and are reported at 312,724 bbl. This compares with 312,458 bbl. for the corresponding period of 1931. In other words the output of wood rosin last year was slightly higher than it was in 1931. With an adjustment for the differences in stocks on hand, apparent consumption of wood rosin in the first 11 months of 1931 was 321,634 bbl. compared with 306,934 bbl. for the like period of 1932.

Both from the standpoint of production and apparent consumption, wood rosin made a much better relative showing in 1932 than did the gum product.

Receipts of gum spirits of turpentine at the three principal ports in the first 10 months of 1932 amounted to 186,167 bbl. in comparison with 287,981 bbl. in the Jan.-Oct. period of 1931. This drop of more than 100,000 bbl. in receipts or of more than 35 per cent bore out predictions that the crop for the 1932-1933 season will be at least 30 per cent below the total for the crop of the preceding season. From Jan. 1, 1932 to Oct. 31, stocks were reduced by 38,450 bbl. so that apparent consumption was 224,617 bbl. From Jan. 1, 1931 to Oct. 31, 1931 stocks increased by 36,042 bbl. making apparent consumption 251,939 bbl. This would indicate a drop in consumption in 1932 of less than 11 per cent from that of 1931.

For the first 11 months of last year, the output of wood turpentine was reported at 50,884 bbl. and for the corresponding period of 1931 the total was 52,389 bbl.

Differences in stocks of wood turpentine on hand Jan. 1 and Oct. 31 were indicated by an increase of 4,600 bbl. in 1932 and a decrease of 10,656 bbl. in 1931. Hence apparent distribution to consumers was 46,284 bbl. in 1932 and 63,045 bbl. in 1931 or a drop of more than 26 per cent last year.

Export trade is highly important in the naval stores trade and the following comparisons are offered in outward shipments for the first 10 months of 1931 and 1932: 1931—gum rosin, 767,266 bbl.; wood rosin, 124,596 bbl.; gum spirits of turpentine, 10,057,761 gal.; wood turpentine, 625,194 gal. 1932—gum rosin, 808,057 bbl.; wood rosin, 129,571 bbl.; gum spirits of turpentine, 9,313,089 gal.; wood turpentine, 747,774 gal. Total exports of rosin for the 10 months, therefore, were 937,628 bbl. in 1932 and 891,862 bbl. in 1931. Total exports of turpentine were 10,682,955 gal. in 1931 and 10,060,863 gal. in 1932.

Average prices for B rosin in the New York market in January, 1932 were represented by $3.30 per bbl. In November, 1932 the average price was $3.44 per bbl. The New York price for gum spirits of turpentine in January, 1932 was 40c. a gal. compared with 45c. a gal. in November. Prices fluctuated frequently but the net change was in favor of sellers with fair prospects of an enhancement in values in the early part of 1933 because of probable small receipts of gum rosin and gum spirits of turpentine over the remainder of the current crop year.

Production of Turpentine

	Gal., Crop Year 1931–1932	Gal., Crop Year 1929–1930
From crude gum	24,341,824	31,320,871
From wood distillation	*3,141,094	*4,619,253

*Production for calendar years, 1929 and 1931.

Stocks of Turpentine

	Gal. Mar. 31, 1932	Gal. Mar. 31, 1930
At crude gum stills	495,522	642,429
By industrial consumers	871,439	1,247,333
At wood-distillation plants	*324,636	752,858
At ports and distributing points	5,366,821	3,731,659
Totals	7,058,418	6,374,279

*Includes data for stocks at sulphate wood pulp plants.

Production of Rosin

	Barrels of 500 Lb. Crop Year 1931–1932	Barrels of 500 Lb. Crop Year 1929–1930
From crude gum	1,570,885	1,975,631
From wood distillation	*333,512	*478,555

*Production for calendar years 1929 and 1931.

Stocks of Rosin

	Barrels of 500 Lb. Mar. 31, 1932	Barrels of 500 Lb. Mar. 31, 1930
At crude gum stills	128,503	87,259
By industrial consumers	365,446	200,963
At wood-distillation plants	90,540	91,498
At ports and distributing points	449,828	229,674
Totals	1,034,317	609,394

	Receipts at Southern Ports: Gum Rosin 1932 Bbl.	Gum Rosin 1931 Bbl.	Gum Turpentine 1932 Bbl.	Gum Turpentine 1931 Bbl.	Production: Wood Rosin 1932 Bbl.	Wood Rosin 1931 Bbl.	Wood Turpentine 1932 Bbl.	Wood Turpentine 1931 Bbl.
January	28,614	41,345	5,234	7,228	23,196	24,488	3,626	4,757
February	29,539	27,322	3,808	5,354	20,006	32,322	3,121	5,634
March	31,705	38,977	6,190	9,511	26,187	33,544	4,329	5,740
April	64,070	88,741	17,018	26,102	26,443	35,585	4,415	6,344
May	91,527	120,819	27,410	37,026	30,597	33,593	5,151	5,996
June	96,115	165,500	26,841	52,345	29,483	34,747	4,827	5,675
July	104,904	156,810	29,723	53,459	30,076	28,495	4,878	4,370
August	99,148	129,018	27,770	37,112	31,141	17,074	4,861	2,607
September	83,484	116,632	22,811	28,995	31,155	25,058	5,020	3,797
October	75,153	101,157	19,362	30,849	33,132	26,102	5,202	3,922
November	......	95,642	......	23,147	31,308	21,440	5,454	3,547
December	......	93,980	......	19,844	......	23,242	......	3,733
Totals	704,259*	1,175,943	176,167*	330,972	312,724‡	335,690	50,884‡	56,122

* Total for 10 mo. ‡Total for 11 mo.

Production of Aluminum Compounds and Alum

Census years 1929-1931

	1931	1929
Aluminum sulphate—		
Tons	304.767	344,962
Value	$6,565,016	$8,038,730
Sodium aluminum sulphate—		
Tons	15,944	14,947
Value	$901,529	$848,299
Ammonia alum—		
Tons	4,472	5,720
Value	$233,556	$286,772
Potash and chrome alums—		
Tons	2,596	3.447
Value	$162,243	$214,646
Aluminous abrasives—		
Tons	7,401	33,246
Value	$1,151,586	$3,446,116
Aluminum chloride*—		
Tons†	1,099	1,521
Value	$161,786	$225,184
Aluminum stearate—		
Tons	1,065	1,066
Value	$341,083	$440,180
Other aluminum compounds, Value	$1,136,446	$2,448,846
Total value	$10,653,245	$15,948,773

* Total production, including amount made and consumed in the same establishments, as reported by the Bureau of Mines, was as follows:—For 1931, 7,121 tons, valued at $620,860; for 1929. 16,551 tons, valued at $1,600,826.

†Quantities representing solutions calculated on basis of 100 per cent.

Values for Vegetable Oils Make New Low Records

DEVELOPMENTS in the market for vegetable oils last year were largely bound up with the movement of prices. To gain a proper perspective of the oil market it must be remembered that cottonseed oil because of its very large tonnage is the biggest single factor in the market. Whenever prices for cottonseed oil are high all the competitive vegetable oils—and this includes all except the quick drying oils used in paints, etc.—move upward in price accordingly. Conversely, when cottonseed oil goes down in price, the other oils are quick to follow suit. At the beginning of last year, there was a heavy carryover of cottonseed oil either in the form of oil or of seed, hence the stage was set for a low-priced period even though other markets were not conducive to price declines. Then came a large supply of seed from the new cotton crop and the statistical position was definite so far as it indicated the direction in which values would go.

Plentiful supplies of other vegetable oils were on hand and with consuming demand affected by the general industrial situation a new low price record was established for some of the oils.

Statistics covering production of vegetable oils for last year are not yet available but in the first three quarters of the year the output of crude oils was 1,581 million pounds compared with 1,507 million pounds for the like period of 1931. Cottonseed oil was responsible for the larger total last year as production of the other oils with the exception of soya bean was lower than it was in the preceding year.

Production of linseed oil was materially lower last year. Drastic cuts also were made in producing coconut, castor, and sesame oils.

Factory consumption of crude vegetable oils for the Jan.-Sept. period last year amounted to 1,949 million pounds in comparison with 1,904 million pounds for the comparable period of 1931. These totals include the amounts of crude oils which passed to refineries. Again cottonseed oil was the influence which increased the 1932 total. A moderate gain was recorded in consumption of corn oil but the rest of the list fell decidedly from the 1931 totals. Sesame, palm-kernel, and linseed oils were especially noted in the downward trend.

With larger stocks of crude oil to draw upon, the output of refined vegetable oils for the first three quarters of last year amounted to 1,170 million pounds which topped the total of 955 million pounds produced in the nine-months period of 1931. Cottonseed and corn oils were the only ones refined in larger volume last year as the other selections lost considerable ground.

Factory consumption of refined vegetable oils failed to keep pace with production and for the nine-month period last year reached a total of 957 million pounds in comparison with a consumption of 1,053 million pounds in the corresponding period of 1931. In the case of each oil the 1931 totals exceeded those for 1932 although the decline for cottonseed and corn oils was not large.

As factory consumption does not include the amount of oils that pass into direct consumption, the difference between the tabulated production and consumption figures does not mean that corresponding variations are to be found in the stocks carried over at the end of the periods under consideration. Among the crude oils larger stocks were on hand on Sept. 30, 1932 than on Sept. 30, 1931 in the case of cottonseed, castor, and palm oils with reduced stocks for the other oils. Refined oils in larger supply last year at the same period were cottonseed, peanut, corn, and soya bean.

The accompanying table gives detailed statistics for factory production, consumption, and stocks for the various oils.

In the fish oil group, menhaden oil has attracted considerable attention because fishing operations in the Chesapeak Bay district were quite successful last season and the yield of oil was reported to have amounted to close to 50,000 bbl. This compares with approximately 28,000 bbl. for the preceding season and was the largest amount produced in at least five years. While the catch and yield last season was most encouraging it came at a time when competing materials were offered at unusually low prices and the result was that in order to dispose of a good part of menhaden production it was necessary to put prices down to a level lower than they had been in 25 years.

Consumption of whale oil was off about 20 per cent in first 9 months of last year. An important decision determined that whale oil made on the high seas and shipped direct to this country was subject to import duty.

Factory Production, Consumption, and Stocks of Vegetable Oils

	Production		Consumption		Stocks 1932		Stocks 1931	
	Jan.-Sept., 1932 Lb.	Jan.-Sept., 1931 Lb.	Jan.-Sept., 1932	Jan.-Sept., 1931	Jan. 1 Lb.	Sept. 30 Lb.	Jan. 1 Lb.	Sept. 30 Lb.
Cottonseed, crude	993,337,047	651,605,175	987,953,186	700,164,054	126,564,368	103,099,856	114,498,245	69,526,523
Cottonseed, refined	900,150,472	633,541,836	727,727,051	751,516,962	491,035,350	503,198,511	429,575,506	173,264,701
Peanut, crude	8,247,643	10,409,835	8,482,007	10,107,378	5,046,040	1,144,874	7,888,443	9,991,349
Peanut, refined	6,657,115	8,757,997	4,794,329	9,162,496	1,530,640	1,731,232	4,631,880	3,166,493
Coconut, crude	193,259,792	234,732,313	392,640,676	415,112,923	188,351,946	145,338,966	158,845,543	201,035,992
Coconut, refined	169,061,099	202,300,980	185,877,363	232,324,029	14,796,579	13,003,572	21,993,329	17,374,655
Corn, crude	77,750,085	82,922,345	86,488,767	86,097,866	10,386,337	8,288,899	7,881,891	10,639,449
Corn, refined	74,421,395	73,799,310	19,070,433	19,410,993	12,871,030	7,837,780	8,881,799	8,769,182
Soya bean, crude	29,290,481	28,473,146	19,764,708	27,752,760	13,635,137	11,001,906	12,283,984	11,373,556
Soya bean, refined	9,559,705	18,591,775	9,208,574	12,610,879	4,714,218	5,344,972	2,720,440	4,349,265
Olive, edible	616,110	1,509,164	1,172,124	1,341,306	4,050,525	5,332,847	8,389,928	2,839,965
Olive, inedible	....	5,250	4,899,510	5,966,076	1,376,512	1,387,196	1,744,373	1,576,479
Olive foots	....	....	23,829,928	31,100,602	8,981,149	12,492,442	28,272,840	12,638,344
Palm kernel, crude	....	13,592,465	12,732,904	42,977,721	8,016,911	7,335,398	13,956,333	10,862,254
Palm kernel, refined	9,820,466	18,455,813	10,133,300	18,319,978	1,663,305	1,114,584	2,003,796	2,013,795
Rapeseed	....	....	4,861,797	6,737,204	3,866,570	2,691,034	5,380,276	4,203,857
Linseed	234,049,685	390,256,792	175,994,098	240,139,810	154,484,399	97,495,599	113,422,640	107,501,243
China wood	....	....	52,688,673	65,646,601	33,410,550	30,819,445	49,894,404	38,323,544
Castor	27,106,695	38,029,880	10,673,592	13,505,852	11,886,830	12,710,394	8,375,322	9,534,297
Palm	....	....	147,577,392	191,568,636	89,073,994	83,972,431	93,819,571	75,082,768
Sesame	5,167,173	54,253,680	9,122,793	43,203,951	10,703,864	6,022,904	2,713,107	14,185,287
Sunflower	....	....	6,101,078	17,802,282	338,830	1,860,400	....	2,704,131
Perilla	....	....	3,763,376	....	....	6,680,351	....	....
All other	11,694,698	857,827	1,173,258	4,297,878	7,463,778	1,229,335	7,802,608	7,882,659
Totals	2,750,189,661	2,462,095,583	2,906,730,917	2,946,868,257				

Better Prospects for Synthetic Organic Chemicals

IN RESPONSE to a request by Roy D. Chapin, Secretary of Commerce, for a statement giving the outlook for 1933, C. A. Mace, secretary, Synthetic Organic Chemical Manufacturers Association of the United States, has submitted the following statement concerning the chemical industry:

"It must be borne in mind that, generally speaking, the consumption of synthetic organic chemicals is represented by a very small aggregate increase each year, principally due to two factors, first, the replacing of natural products by synthetic products and two, the normal increase in the consumption of synthetic products themselves, that is, the products already well-known in the various fields of consumption. This normal increase is further complicated by seasonal and style trends particularly applicable to the textile industry.

"A general survey of the whole synthetic organic chemical industry would be meaningless since so many of our products are consumed in totally unrelated industries. Therefore it would seem that a more particular survey of individual product groups would be more informative.

"The dyestuffs industry experienced a very peculiar development. Business was fair during the first two months of the year, fell off to a very low point during the spring and early summer and then picked up during the early fall to a very satisfactory business, entirely due to a resumption of textile operations which in turn receded again during November and December.

"Medicinals experienced on the whole a generally unsatisfactory condition. Providentially for our common welfare the past year has been a very healthy one and the result has been that such business as was procurable has been conducted on a constantly lowering price condition due undoubtedly to the desire on the part of all producers to procure the business that was in existence.

"In the synthetic flavoring and perfumery materials business it seems apparent that they have been confronted with about the same condition as the medicinal manufacturers.

"So far as price is concerned, regardless of the fact, it seems well recognized that in general you do not stimulate the consumption of these products by cutting prices. The smaller demand incidental to the economic condition of the times stimulates an effort on the part of each producer to procure a larger and larger proportion of the market for each of his products by price reductions, all of this in total disregard of the fact that generally speaking there is a definite limit to the consumption of each of the products of our industry at any given time and that also generally speaking price reductions can only have a very limited effect in increasing consumption.

"One of the important trends well worth mentioning is the change in the buying habits of our consumers. More and more buying has been done on a hand-to-mouth basis and this pervades the whole field of synthetic organic chemicals, thus making production planning very difficult.

"So far as the outlook for 1933 is concerned, it is about evenly divided among the following three propositions: About one-third of the manufacturers anticipate no better business than in 1932, about one-third anticipate better business, and the remaining third can see no outlook for anything better in the coming year. Summarizing the outlook, it would appear to be the general impression that we are about at the bed-rock of production and consumption and that any change would be one for the better rather than for the worse."

Hydrofluoric Acid

In the figures released by the Bureau of the Census in reporting domestic production of acids returns were not given for hydrofluoric acid. For 1927 and 1929 the output was as follows:

	1927	1929*
No. of plants	5	....
Tons produced	4,596	3,687
Tons for sale	3,338	....
For sale value	$614,125	$561,283

*Preliminary report.

While hydrofluoric acid was omitted in the 1931 returns, the preliminary reports show a production of 1,867 short tons of hydrofluosilicic acid valued at $68,379. Some idea of the hydrofluoric acid situation in 1931 may be gained from reports to the Bureau of Mines on fluorspar on hand and consumed at plants for hydrofluoric acid manufacture, as follows:

	1930 Short Tons	1931 Short Tons
Imported fluorspar	3,643	6,556
Domestic fluorspar	9,834	4,386
Consumed for hydrofluoric acid and derivatives	12,600	12,000
In stock — hydrofluoric acid and derivatives	15,000	14,000

Larger Distribution of Chemicals Forecast

According to reports submitted at the meeting of the Atlantic States Shippers Advisory Board, held Dec. 15, 1932, car requirements for the movement of commodities during the first quarter of 1933 indicate a drop of 1.9 per cent in distribution of goods for that period in comparison with the actual movement for the first quarter of 1932.

Estimates submitted for the individual groups include:

	Per Cent Increase	Per Cent Decrease
Chemicals	7.5	....
Coke	...	8.8
Fertilizer	...	10.0
Glass containers	...	17.0
Hides, leather, and tanning materials	6.0	....
Lime	Same	
Non-ferrous metals	...	2.5
Paints, oils and varnishes	...	8.6
Paper and pulp	1.2	....
Petroleum	Same	
Salt	...	7.1

Production of Nitrogen and Fixed-Nitrogen Compounds— 1931 and 1929

The figures in this table refer to production for sale and therefore do not include data for amounts made and consumed in the same establishments

	1931	1929
Total value[1]	$32,503,860	$38,336,799
Ammonia, aqua and liquor:		
Pounds (NH_3 content)	18,830,923	30,200,074
Value	$1,031,748	$1,784,212
Ammonia, anhydrous:		
Pounds	127,100,718	173,349,355
Value	$8,043,679	$10,673,234
Ammonium iodide:		
Pounds	4,888	7,840
Value	$25,724	$40,592
Ammonium sulphate:		
Pounds	24,100,732	11,852,867
Value	$263,474	$240,391
Ammonium molybdate:		
Pounds	24,792	$3,225,600 (Ammonium molybdate, Ammonium nitrate and Other ammonium compounds combined)
Value	$22,371	
Ammonium nitrate:		
Pounds	20,558,372	
Value	$844,502	
Other ammonium compounds, value	$1,680 142	
Cyanogen compounds:		
Ferric ferrocyanide (Prussian blue)—		
Pounds	3.502,912	4,803,419
Value	$1,134,364	$1,446,456
Other cyanides and hydrocyanic acid, value	$4,590,336	$6,336,719
Nitric acid:		
Tons, basis 100 per cent	31,385	32,961
Value	$3,349,099	$3,494,577
Nitrous oxide:		
Gallons	94,607,000	109,812
Value	$922,626	$1,196,392
Other nitrogen compounds and gaseous nitrogen, value	$10,595,795	$9.898,626

[1]Not including value of ammonia and ammonia products made in the coke and manufactured-gas industries.

Moderate Drop in Chemical Prices Last Year

WHILE net changes in the average price for chemicals taken collectively did not indicate any drastic revision during the last year, the market was far from being free of disturbing factors and the undertone was weak throughout the period. Different influences were at work to undermine price stability. Of prime importance was the fact that production of numerous selections was geared too high to harmonize with the contraction in consuming markets and surplus stocks overhung the market with the almost inevitable result of encouraging selling pressure. In the case of some of the more important chemicals, large consumers had covered their requirements for the year on contracts and the easier price tone applied only to trading in the spot market. In the latter part of the year when contract business for 1933 was in order, producers in many cases disregarded the open quotations and private terms formed the basis of transactions between producer and consumer.

Alkali prices were announced at figures which represented an advance over the previously prevailing prices. Contracts were placed, however, at about the same levels as in the year before. Mineral acids were difficult to sell for forward positions and the average price level for 1933 deliveries will be lower than it was for 1932. Bichromates, both potash and soda, fell off considerably in the tonnage moved in the last two years and competition for 1933 business was unusually keen, so keen, in fact, that buyers were able to cover needs at prices lower than they had been able to obtain in a number of years. Production of sodium phosphates was maintained at a higher level than the consuming market warranted and sporadic price cutting was common during the year.

Zinc oxide which had held an unchanged price course for a long time was offered at lower prices over a good part of last year, the influence of lower production costs and greater competition from other pigments finally effecting the revision. Producers of white lead never have made frequent changes in their sales quotations. At the close of 1931 a reduction was announced and the newly established figure held good over the year. In line with the movement of the metal market, a further decline was put into effect at the beginning of this year and probably the new figure will be a medium of sales for the entire year.

Variations in price movements for chemicals and for vegetable oils and fats as represented by the average monthly weighted indexes of *Chem. & Met.* are indicated in the following table which shows that in both cases the average level for 1932 was the lowest for the years enumerated:

	Chemicals	Vegetable Oils and Fats
1923	116.91	103.43
1924	103.88	109.31
1925	104.41	117.12
1926	104.42	112.98
1927	100.00	100.00
1928	99.51	96.43
1929	100.10	97.55
1930	95.78	86.62
1931	87.61	61.90
1932	85.00	43.60

The United States Department of Labor index for all commodities showed a monthly average of 100.6 for 1923 and for 1931 it had declined to a monthly average of 73.0. For the first 11 months of 1932 the average was 65.2.

A second factor on the general price structure of chemicals consisted in the lower prices at which raw materials could be secured. This meant a considerable change in cost of turning out the finished products and thus chemical prices were able to be lowered without disturbing the equilibrium between cost and margin of profit. In addition to the advantage afforded by lower priced raw materials, the majority of manufacturers had reduced overhead charges and put into effect numerous measures of economy which had a direct bearing on production costs.

On the other hand, there were price adjustments which resulted in bringing about higher prices. For instance, price cutting had brought sales figures for denatured alcohol in 1931 to such low levels that the possibility of profit was removed. This situation was rectified last year with a satisfactory result to producers even in the face of a reduced volume of business.

Unsettlement in foreign exchange and the low rates reached gave an advantage to foreign producers who were seeking to unload surplus offerings in our market. Taken as a whole, imported chemicals did not figure prominently in our trade but where import trade was pushed it had a demoralizing effect on domestic values. Sulphate of ammonia was typical of the chemicals which were brought into this country and gained a considerable part of domestic business purely because of price advantages. Record imports of sulphate not only forced down the price for the domestic product but also restricted its distribution. Anti-dumping charges were found unwarranted and no satisfactory solution was found for overcoming the handicap of depressed foreign currency.

Carbonate of ammonia was another item which figured prominently in the import trade and which because of the prices at which it was offered came under official scrutiny because of dumping charges. A treasury decision rendered in the last two weeks disposed of that charge as not justified.

Phosphate rock is another material in which importers have scored heavily in the last year because of price considerations. This material because of its wide use in agriculture is on the Free List and consequently no protection can be obtained by the domestic industry through the invocation of the flexible provisions of the Tariff Act.

The U. S. Court of Customs and Patent Appeals in December offered some grounds for encouragement when it handed down a decision upholding the Treasury Department's order that in 1928 barred importation of phosphate rock from Morocco on the ground that the purchase price to Baltimore brokers was less than its foreign market value. Morocco, Soviet Russia, Canada, and Japan have been mentioned in connection with the invasion of foreign phosphate rock.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	84.54
Last month	84.81
January, 1932	85.77
January, 1931	89.68

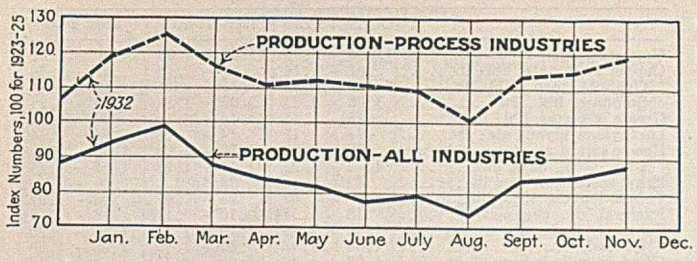
The most important price change in the last month was a reduction in the schedule for white lead. Lead oxides also were lowered. An easy tone prevailed for mineral acids and contracts are being made on private terms. Chlorine was moved up in price but most consumers are covered by contracts. Sodium phosphates have been under sales pressure.

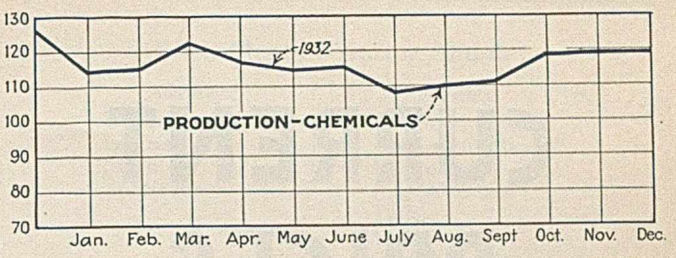
Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	42.46
Last month	40.27
January, 1932	47.33
January, 1931	70.65

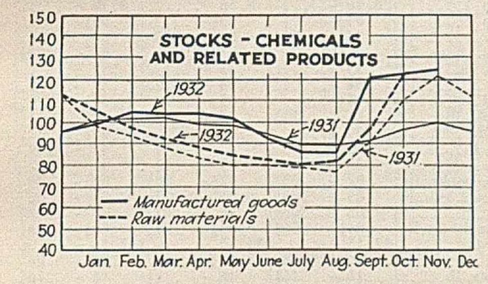
Values for linseed oil gained appreciably under the influence of smaller prospective seed supplies. Crude cottonseed oil also closed at an advance with a strong market ruling in the latter part of the period. Palm oil was lower during the month and the same was true for coconut, corn, and soya bean oils. Tallow and animal fats were lower.

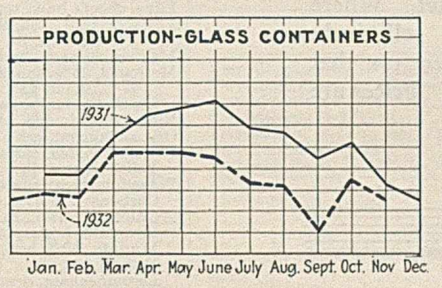


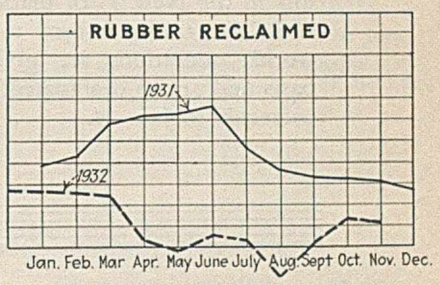


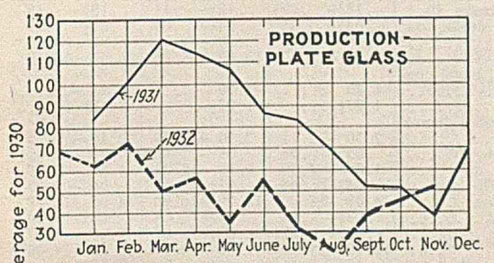
Based on electrical power consumption, data supplied by Electrical World

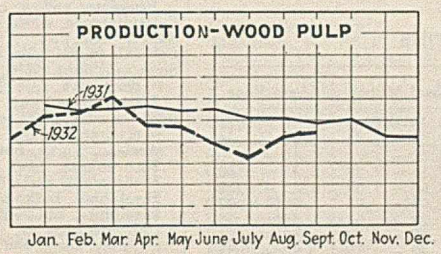
TRENDS OF PRODUCTION AND CONSUMPTION

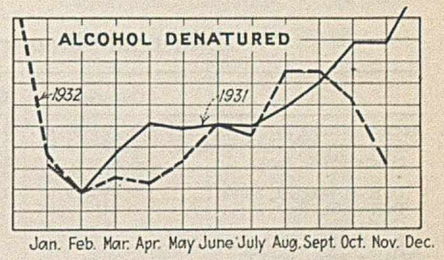


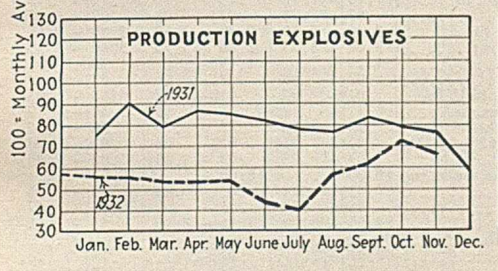


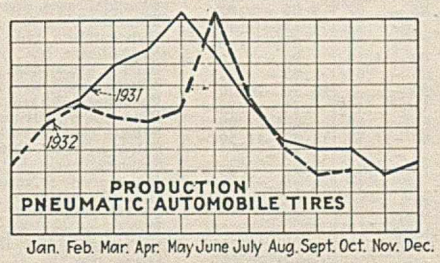


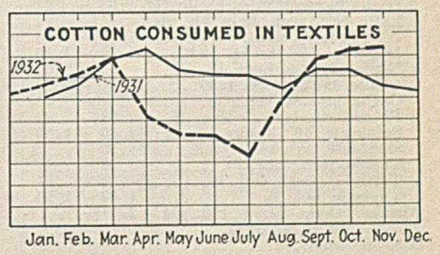


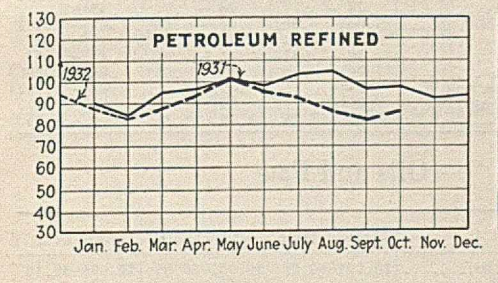


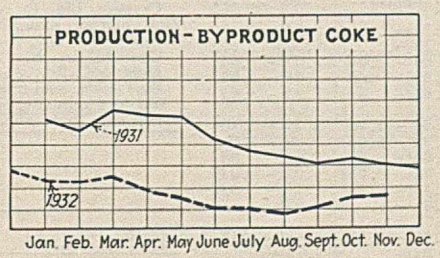


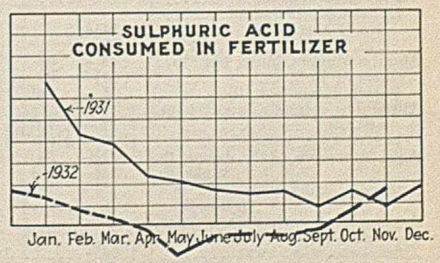


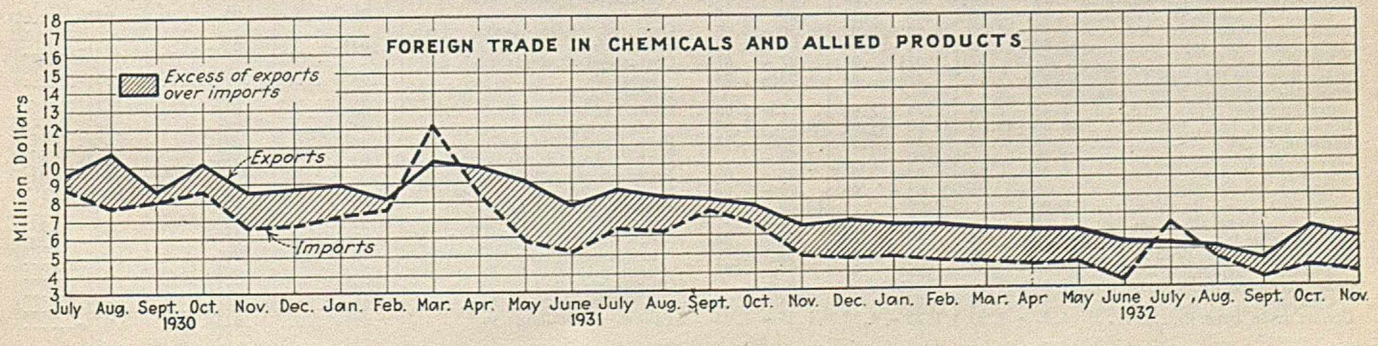












CURRENT PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Jan. 14.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.10 -$0.11	$0.10 -$0.11	$0.10 -$0.11
Acid, acetic, 28%, bbl., cwt	2.65 - 2.90	2.65 - 2.90	2.40 - 2.65
Glacial 99%, tanks	8.89	8.89 -......	8.10 -......
drs	9.14 - 9.39	9.14 - 9.39	8.35 - 8.60
U. S. P. reagent, c'bys	9.64 - 9.89	9.64 - 9.89	8.85 - 9.10
Boric, bbl., lb	.04¾- .05	.04¾- .05	.06¾- .07
Citric, kegs, lb	.29 - .31	.29 - .31	.33½- .35
Formic, bbl., lb	.10 - .11	.10 - .11	.10 - .11
Gallic, tech., bbl., lb	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb., lb	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18° tanks, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05¼	.05 - .05¼	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -......	15.50 -......	15.50 -......
Tannic, tech., bbl., lb	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb	.20 - .21	.20 - .21	.25½- -.26
Tungstic, bbl., lb	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.53½-......	2.53½-......	2.53½-......
Alcohol, Butyl, tanks, lb	.113 -......	.113-......	.143-......
Alcohol, Amyl	......-......	......-......	......-......
From Pentane, tanks, lb	.182-......	.182-......	.203 ......
Denatured, 190 proof			
No. 1 special dr., gal	.34½-......	.34½-......	.34½-......
No. 5, 188 proof, dr., gal	.38½-......	.38½-......	.35½-......
Alum, ammonia, lump, bbl., lb	.03 - .04	.03 - .04	.03 - .04
Chrome, bbl., lb	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb	.03 - .04	.03 - .04	.03 - .04
Aluminum sulphate, com., bags, cwt	1.25 - 1.40	1.25 - 1.40	1.25 - 1.40
Iron free, bg., cwt	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.02¾- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb	.15¼- .15½	.15¼- .15½	.15¼- .15½
tanks, lb	.05 -......	.05 -......	.05⅝-......
Ammonium carbonate, powd. tech., casks, lb	.10 - .11	.10 - .11	.10½- .11
Sulphate, wks., cwt	1.025-......	1.025-......	1.10 -......
Amylacetate tech., tanks, lb., gal.	.16 -......	.16 -......	.16 ......
Antimony Oxide, bbl., lb	.07 - .08	.07 - .08	.06½- .08
Arsenic, white, powd., bbl., lb	.04 - .04½	.04 - .04¼	.04 - .04½
Red, powd., kegs, lb	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	63.00 -65.00
Nitrate, cask, lb	.07¼- .07½	.07¼- .07½	.07 - .07½
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.03¾- .04
Bleaching powder, f.o.b., wks., drums, cwt	1.75 - 2.00	1.75 - 2.00	1.75- 2.00
Borax, grain, bags, ton	40.00 -45.00	40.00 -45.00	50.00 -57.00
Bromine, cs., lb	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	2.50 -......	2.50 -......	2.00 -......
Arsenate, dr., lb	.05½- .06½	.05½- .06½	.06 - .07
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	18.00 -......	18.00 -......	18.00 -......
flake, dr., wks., ton.	21.00 -......	21.00 -......	21.00 -......
Phosphate, bbl., lb	.07½- .08	.07½- .08	.08 - .08¼
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb	.06¼- .07	.06¼- .07	.06¼- .07
Chlorine, liquid, tanks, wks., lb.	.01¾-......	.0165-......	.01¾-......
Cylinders	.05½- .06	.05½- .06	.04 - .06
Cobalt oxide, cans, lb	1.25 - 1.35	1.25 - 1.35	1.35 - 1.45
Copperas, bgs., f.o.b. wks., ton.	13.00 -14.00	13.00 -14.00	13.00 -14.00
Copper carbonate, bbl., lb	.07 - .16	.07 - .16	.07 - .16
Cyanide, tech., bbl., lb	.39 - .44	.39 - .44	.39 - .44
Sulphate, bbl., cwt	3.00 - 3.25	3.00 - 3.25	3.10 - 3.25
Cream of tartar, bbl., lb	.15½- .16	.16 - .16½	.20¼- .22
Diethylene glycol, dr., lb	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.70 - 2.00
Imp., tech., bags, cwt	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb	.09½-......	.09½-......	.10 -......
Formaldehyde, 40%, bbl., lb	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal	1.10 - 1.20	1.10 - 1.20	1.10 - 1.20
Refined, dr., gal	1.80 - 1.90	1.80 - 1.90	1.80 - 1.90
Glaubers salt, bags, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.10¼- .10½	.10¼- .10½	.11¼- .11¾
Lead:			
White, basic carbonate, dry casks, lb	.06 -......	.06½-......	.06½-......
White, basic sulphate, sck., lb.	.05½-......	.06 -......	.06 -......
Red, dry, sck., lb	.06½-......	.06¾-......	.06¾-......
Lead acetate, white crys., bbl., lb.	.10 - .11	.10 - .11	.10 - .11
Lead arsenate, powd., bbl., lb	.09½- .14	.09½- .14	.10 - .14
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk, lb	.05½-......	.05¾-......	.05¾-......
Lithophone, bags, lb	.04½- .05	.04½- .05	.04½ .05
Magnesium carb., tech., bags, lb.	.05¾- .06	.05¾- .06	.06 - .06½
Methanol, 95%, tanks, gal	.33 -......	.33 -......	.33 -......
97%, tanks, gal	.34 -......	.34 -......	.34 -......
Synthetic, tanks, gal	.35½-......	.35½-......	.35½-......
Nickel salt, double, bbl., lb	.11 - .11½	.10½- .11	.10½- .11
Orange mineral, csk., lb	.09 -......	.09¼-......	.09¾-......
Phosphorus, red, cases, lb	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb	.28 - .32	.28 - .32	.31 - .32
Potassium bichromate, casks, lb.	.07 - .08	.07½- .08½	.08½- .09
Carbonate, 80-85%, calc. csk., lb	.05 - .05½	.05 - .05½	.05¼- .06
Chlorate, powd., lb	.08 - .08½	.08 - .08½	.08 - .08½
Hydroxide (c'stic potash) dr., lb.	.06⅛- .06⅜	.06⅛- .06¾	.06⅛- .06¾
Muriate, 80% bgs., ton	37.15 -......	37.15 -......	37.15 -......
Nitrate, bbl., lb	.05¾- .06	.05¾- .06	.05¾- .06
Permanganate, drums, lb	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.18½- .19
Sal ammoniac, white, casks, lb	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	16.00 -18.00
Soda ash, light, 58%, bags, contract, cwt	1.20 -......	1.20 -......	1.15 -......
Dense, bags, cwt	1.22½-......	1.22½-......	1.17½-......
Soda, caustic, 76%, solid, drums, contract, cwt	2.50 - 2.75	2.50 - 2.75	2.50 - 2.75
Acetate, works, bbl., lb	.05 - .06	.05 - .06	.05 - .05½
Bicarbonate, bbl., cwt	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb	.04½- .05	.04¾- .05	.06 - .07
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb	.03⅜- .04	.03⅜- .04	.03½- .04
Chlorate, kegs, lb	.05¾- .07½	.05¾- .07½	.05¾- .07½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb	.15½- .16	.15½- .16	.15½- .16
Fluoride, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., lb	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt	3.60 - 3.75	3.60 - 3.75	3.60 - 3.75
Nitrate, bags, cwt	1.295-......	1.295-......	1.77 -......
Nitrite, casks, lb	.07¼- .08	.07¼- .08	.07¼- .08
Phosphate, dibasic, bbl., lb	.018- .02	.018- .02	.0265 - .03
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (40° dr.) wks. cwt	.70 - .75	.70 - .75	.70 - .75
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, cyrs., bbl., lb	.03 - .03¼	.03 - .03¾	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr., lb	.03½- .04	.03½- .04	.05 - .06
Dioxide, cyl., lb	.06½- .07	.06½- .07	.06½- .07
Flour, bag, cwt	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb	nom.-......	nom.-......	nom.-......
Oxide, bbl., lb	.27½-......	.27½-......	.24½ ......
Crystals, bbl., lb	.24 -......	.24 -......	.23½-......
Zinc chloride, gran., bbl., lb	.06½- .06¾	.06½- .06¾	.06½- .06¾
Carbonate, bbl., lb	.10½- .11	.10½- .11	.10½- .11
Cyanide, dr., lb	.38 - .42	.41 - .42	.41 - .42
Dust, bbl., lb	.04½- .06	.04½- .05	.05½- .06
Zinc oxide, lead free, bag, lb	.05¾-......	.05¾-......	.06⅝-......
5% lead sulphate, bags, lb	.05½-......	.05½-......	.06⅛-......
Sulphate, bbl., cwt	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb	$0.08¾-$0.09	$0.08¾-$0.09	$0.09½-$0.10
Chinawood oil, bbl., lb	.05 -......	.05½-......	.07⅛-......
Coconut oil, Ceylon, tanks, N. Y. lb	.03 -......	.03⅛-......	.03⅝-......
Corn oil crude, tanks, (f.o.b. mill), lb	.02¾-......	.03 -......	.03⅛-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.03 -......	.02⅝-......	.03⅛-......
Linseed oil, raw car lots, bbl., lb	.074-......	.062-......	.067-......
Palm, Lagos, casks, lb	.03 -......	.03¾-......	.04⅛-......
Niger, casks, lb	.02¾-......	.03½-......	.04 -......
Palm Kernel, bbl., lb	.04½-......	.04½-......	.05¼-......
Peanut oil, crude, tanks (mill), lb.	.03 -......	.03½-......	.03¾-......
Rapeseed oil, refined, bbl., gal	.31 - .32	.31 - .32	.39 - .41
Soya bean, tank (f.o.b. Coast), lb.	nom.-......	nom.-......	nom.-......
Sulphur (olive foots), bbl., lb	.04⅜-......	.04⅜-......	.04½-......
Cod, Newfoundland, bbl., gal	.22 - .24	.23 - .26	.25 - .27
Menhaden, light pressed, bbl., gal.	.27 - .28	.27 - .28	.33 - .34
Crude, tanks (f.o.b. factory), gal.	.10 -......	.09½-......	.20 -......
Grease, yellow, loose, lb	.02¼-......	.02⅜-......	.02⅜-......
Oleo stearine, lb	.03⅛-......	.04¼-......	.05½-......
Red oil, distilled, d.p. bbl., lb	.06⅛-......	.06⅛-......	.07¼-......
Tallow, extra, loose, lb	.02¼-......	.02⅝-......	.02⅛-......

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb..	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb..............	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb..	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb....	.14½- .15	.14½- .15	.14½- .15
Aniline salts, bbl., lb...........	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb....	1.10 - 1.25	1.10 - 1.25	1.10 - 1.25
Benzidine base, bbl., lb..........	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.....	.48 - .52	.48 - .52	.48 - .52
Benzyl chloride, tech., dr., lb....	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal..	.20 - .21	.20 - .21	.20 - .21
Beta-naphthol, tech., drums, lb..	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb..........	.10½- .11	.10½- .11	.12½- .14
Cresylic acid, 97%, dr., wks., gal.	.42 - .45	.49 - .52	.54 - .58
Diethylaniline, dr., lb...........	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb..........	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb...........	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal............	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb.........	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb................	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb.....	.04¾- .05	.04¾- .05	.03¾- .04¼
Nitrobenzene, dr., lb...........	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb........	.51 - .55	.51 - .55	.51 - .55
Para-nitrotoluine, bbl., lb.......	.26 - .28	.26 - .28	.29 - .31
Phenol, U.S.P., drums, lb........	.14¼- .15	.14¼- .15	.14¼- .15
Picric acid, bbl., lb.............	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., gal...............	.90 - .95	.90 - .95	1.50 - 1.80
R-salt, bbl., lb..................	.40 - .44	.40 - .44	.40 - .44
Resorcinal, tech., kegs, lb.......	.65 - .70	.65 - .70	.70 - .80
Salicylic acid, tech., bbl., lb.....	.40 - .42	.40 - .42	.33 - .35
Solvent naphtha, w.w., tanks, gal.	.26 -......	.26 -......	.26 -......
Tolidine, bbl., lb................	.86 - .88	.86 - .88	.86 - .88
Toluene, tanks, works, gal......	.30 -......	.30 -......	.30 -......
Xylene, com., tanks, gal........	.26 -......	.26 -......	.26 -......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton...	$22.00-$25.00	$22.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb...........	.07 - .10½	.06 - .10½	.07½- .14
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb...	.02¾- .20	.02¾- .20	.03 - .20
Prussian blue, bbl., lb.........	.35 - .36	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.......	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb........	.26 - .27	.26 - .27	.27 - .30
Carmine red, tins, lb..........	3.90 - 4.50	3.90 - 4.50	5.00 - 5.40
Para toner, lb................	.80 - .85	.75 - .80	.75 - .80
Vermilion, English, bbl., lb.....	1.10 - 1.20	1.25 - 1.50	1.55 - 1.60
Chrome yellow, C. P., bbl., lb.	.15 - .15½	.16 - .16½	.16½- .17
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb......	.06 - .08	.06 - .08	.06 - .08
Manila, bags, lb............	.16 - .17	.16 - .17	.16 - .17
Damar, Batavia, cases, lb.....	.16 - .16½	.16 - .19	.16 - .16½
Kauri No. 1 cases, lb.........	.45 - .48	.45 - .48	.48 - .53
Kieselguhr (f.o.b. N.Y.), ton...	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton...........	40.00 -......	40.00 -......	40.00 -......
Pumice stone, lump, bbl., lb....	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb..........	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.................	3.90 -......	3.80 -......	3.95 -......
Turpentine, gal................	.44 -......	.42 -......	.39¾-......
Shellac, orange, fine, bags, lb....	.20 - .25	.20 - .25	.37 - .38
Bleached, bonedry, bags, lb...	.18 - .19	.18 - .19	.28 - .30
T. N. bags, lb................	.09½- .10	.09½- .10	.13 - .14
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton..	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b Ga.), ton....	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton..	13.75 -....	13.75 -.....	13.75 -.....
Wax, Bayberry, bbl., lb.........	.16 - .20	.16 - .20	.16 - .20
Beeswax, ref., light, lb..........	.20 - .30	.20 - .30	.25 - .27
Candelilla, bags, lb...........	.11 -......	.12 -......	.14½-.....
Carnuba, No. 1, bags, lb........	.22 - .24	.22 - .24	.27 - .28
Paraffine, crude			
105-110 m.p., lb.............	.03½- .03¾	.03½- .04¼	.03¼- .03¾

Price Changes During Month

Advanced	Declined
Chlorine	Cream of tartar
Linseed oil	Lead pigments
Rosin	Bichromates
Turpentine	Vegetable oils
	Tallow
	Platinum
	Candelilla wax
	Manganese ore

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.......	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton....	68.00-.....	68.00-.....	80.00-85.00
Ferrochrome, 65-70%...........	.09½-....	.10-.....	.11-.....
Spiegeleisen, 19-21% ton........	25.00-.....	25.00-.....	30.00-.....
Ferrosilicon, 14-17%, ton........	31.00-.....	31.00-.....	31.00-.....
Ferrotungsten, 70-80%, lb.......	.94- 1.00	1.00- 1.10	1.00- 1.10
Ferrovanadium, 30-40%, lb.......	2.60- 2.80	3.05- 3.40	3.15- 3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb...........	$0.05 -......	$0.05¼-......	$0.07½-......
Aluminum, 96-99%, lb...........	.229-......	.229-......	.233-......
Antimony, Chin. and Jap., lb.....	.05½-......	.05¾-......	.06⅝-......
Nickel, 99%, lb.................	.35 -......	.35 -......	.35 -......
Monel metal blocks, lb..........	.28 -......	.28 -......	.28 -......
Tin, 5-ton lots, Straits, lb........	.23 -......	.22¼-......	.20⅝-......
Lead, New York, spot, lb........	.03 -......	.03 -......	.03¾-......
Zinc, New York, spot, lb.........	.0342-.....	.035-......	.0345-.....
Silver, commercial, oz...........	.25⅜-......	.24⅞-......	.30 -......
Cadmium, lb...................	.55 -......	.55 -......	.55 -......
Bismuth, ton lots, lb............	.85 -......	.85 -......	1.50 -......
Cobalt, lb......................	2.50 -......	2.50 -......	2.50 -......
Magnesium, ingots, 99%, lb......	.30 -......	.30 -......	.30 -......
Platinum, ref., oz..............	28.00 -......	30.00 -......	40.00 -......
Palladium, ref., oz.............	17.00 - 18.00	17.00 - 18.00	19.00 - 21.00
Mercury, flask, 75 lb............	48.00 - 49.00	48.00 - 49.00	65.00 - 67.00
Tungsten powder, lb............	1.45 -......	1.45 -......	1.45 -......

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.......	$6.50 -$8.25	$6.50 -$8.25	$6.50 -$8.25
Chrome ore, c. f, post, ton........	16.50 -19.00	16.50 -19.00	17.00 -20.00
Coke, fdry., f.o b. ovens, ton......	3.25 - 3.75	3.25 - 3.75	3.25 - 3.75
Fluorspar, gravel, f.o.b. Il., ton...	17.25 -20.00	17.25 -20.00	17.25 -20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit...........	.19 -......	.23 - ...	.25 - .27
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb..............	.45 -......	.45 -......	.45 -......
Monazite, 6% of ThO_2, ton..,.....	60.00 -......	60.00 -......	60.00 -......
Pyrites, Span. fines, c.i.f., unit....	.13 -......	.13 -......	.13 -......
Rutile, 94-96% TiO_2, lb..........	.10 - .11	.10 - .11	.10 - .11
Tungsten, scheelite, 60% WO_3 and over, unit...............	8.00 -10.00	7.50 - 9.75	10.50 -12.00

INDUSTRIAL NOTES

The Bristol Company, Waterbury, Conn., has established a plant at London, England under the name of Bristol's Instrument Company Limited, incorporated under the Companies Act 1929.

Agash Refining Corp. has completed a 10,000 sq.ft. addition to its vegetable oil refinery in Bush Terminal, Brooklyn, N. Y. Offices of the corporation have been moved from 99 Hudson St., New York to Bush Terminal.

The Brown Instrument Co., Philadelphia, Pa., has appointed Nelson E. Chance assistant sales manager with headquarters at Philadelphia. Mr. Chance formerly acted as district manager of the Houston, Texas office of the company.

Advance Pressure Castings, Inc., Brooklyn, N. Y., has appointed as sales representatives: F. X. Morris, Drexel Park, Pa.; L. E. & L. Sales Engineers, Highland Park, Mich.; W. R. McDonough & Co., Cleveland, Ohio; B. J. Steelman, Chicago, Ill.; and A. G. Werner, St. Louis, Mo.

Link-Belt Company, Chicago, Ill., has named Moore-Handley Hardware Co., Birmingham, Ala., as distributors of Link-Belt products in that territory.

The Prest-O-Lite Storage Battery Co., Ltd., has installed additional machinery in its plant at Toronto, Canada and will enter upon the manufacture of lead oxides.

Leach-Lobaugh Laboratories, Inc., Scio, N. Y., will manufacture industrial chemicals, specializing in chemicals for processing and treating leather.

Virginia-Carolina Chemical Co. has closed its offices in New York and transferred the personnel to the offices in Baltimore with C. F. Sims as manager.

E. I. du Pont de Nemours & Co., Wilmington, Del., has developed a new dyestuff designated as Pontamine Fast Orange 7 R, a direct color slightly redder than Pontamine Fast Orange ER.

Davison Chemical Co., Baltimore, Md., has appointed Chester A. Fulton director of sales. Mr. Fulton is a director of the Davison company and is president of its subsidiary, the Southern Phosphate Co.

NEW CONSTRUCTION

Where Plants Are Being Built in Process Industries

	This Month		1932 Totals	
	Proposed Work and Bids	Contracts Awarded	Proposed Work and Bids	Contracts Awarded
New England	$125,000	....	$1,820,000	$395,000
Middle Atlantic	628,000	$75,000	4,287,000	5,856,000
Southern	145,000	181,000	8,760,000	1,182,000
Middle West	203,000	....	2,154,000	2,468,000
West of Mississippi	100,000	390,000	41,353,000	2,795,000
Far West	116,000	178,000	12,486,000	931,000
Canada	620,000	25,000	11,303,000	8,120,000
Total	$1,937,000	$849,000	$82,163,000	$21,747,000

PROPOSED WORK BIDS ASKED

Cardboard Mill—Eaton Dikeman Paper Co., Lee, Mass., plans the construction of a mill here for the manufacture of cardboard and tissue paper. Estimated cost $125,000.

Chemical Plan—Chemical Ltd. of Montreal Que., Can., plans the construction of a chemical factory at Pointe aux Trembles, Que. Estimated cost $200,000.

Liquid Chlorine—Central Board of Purchase, J. W. Nicholson, Purch. Agt., Milwaukee, Wis., will receive bids until Jan. 20. for furnishing 90,000 lb. liquid chlorine.

Liquid Chlorine — F. S. Gram, purchasing agent, Minneapolis, Minn., takes bids until Jan. 20. for furnishing 300,000 lb. (about 10 cars) of liquid chlorine for filter plant. F. Paul is city engineer.

Cotton Oil Mill—Southern Cotton Oil Co., J. H. Westbrook, Plant Mgr., Rocky Mount, N. C., plans rebuilding seed house and replacing machinery destroyed by fire. Estimated cost $50,000.

Electrolytic Plant Equipment — Luis Guillo, Mexican chemical engineer, c/o Mexican Minister, Mexican Embassy, Woodward Bldg., Washington, D. C., is receiving bids for supply of electrolytic plant equipment. Estimated cost is $250,000.

Gas Plant—Liquified Natural Gas Corp., 1209 Foshay Tower, Minneapolis, Minn., granted franchise to construct gas plant at Wisconsin Rapids, Wis.

Gas Plant—City of Perry, Okla., plans the construction of a gas plant and distribution system. V. V. Long, Colcord Bldg., Oklahoma City, Okla., is engineer.

Gas Plant—City of Corsicana, Tex., plans the constructing of a gas plant and distributing system. Will apply to Reconstruction Finance Corporation for loan.

Gas Plant—Canada Gas & Electric Co., Ltd., Pointe Aux Trembles, Montreal, Que., Can., plans the construction of a plant here. Estimated cost $50,000.

Glass Manufacturing Plant — Owens Illinois Glass Co., 965 Wall St., Toledo, O., plans alterations and repairs to its glass plant at Evansville, Ind. Work will be incidental to plant reopening. Estimated cost $28,000.

Glass Making Plant Remodeling — Anonyme des Manufactures, des Glaces et Produits de St. Gobain, Chauncey & Cirey, Paris, France, purchased plant of Standard Plate Glass Co., Butler, Pa., at receivers sale for $406,000 and plans completely remodeling plant by expansion and installation of latest glass making machinery. Committee of creditors has been operating plant to continue for 6 months more, while St. Gobains, complete plans for remodeling; they to be permitted free access to plant. Saint Gobain Co., E. Gentil, Paris, France, chief engineer, represented by C. E. Frazier, Washington, Pa.

Testing Laboratories—Indiana State Highway Commission, Indianapolis, Ind., is having plans prepared for testing laboratories. H. Barnhart, Indianapolis, is director.

Warehouse—C. Beelman, 1019 Union Bank Bldg., archt., Los Angeles, Calif., is receiving bids for 1 story, 180 x 250 ft., warehouse, East Pico Blvd., for Acme White Lead & Color Works, c/o architect.

Refinery—Union Oil Co. of California, Union Oil Bldg., Los Angeles, Calif., plans the construction of a pressure distillate sterilizer at its plant at Longview, Wash. Estimated cost $58,000.

Refinery Alterations — Cedar Grove Refinery Co., Shreveport, La., plans refinery alterations and repairs. Estimated cost is $35,000.

Soap Factory—Carman & Co., 629 West 27th St., New York, plans soap factory at Boonton, N. J. Bids in, project held up pending permit. Estimated cost is $28,500 including equipment.

Soap Factory—Colgate-Palmolive Peet Co., Jeffersonville, Ind., plans to remodel and install new equipment in its soap factory here. Estimated cost $100,000.

Refinery—Mexican Petroleum Co., Wagners Point, Baltimore, Md., (Pan-American Co.), has filed plans on first unit of refinery incl. cracking units, etc., Wagners Point, Baltimore, Md. $500,000.

Beet Sugar Factory—Corporation, c/o Simpson & Mitchell Investment Co., Winnipeg, Man., Can., plans the construction of a beet sugar factory. Estimated cost $300,000.

Salt Refining Plant—Simpson Oil Co., Simpson, Sask., Can., plans the construction of a salt refining plant. Estimated cost $50,000.

Caustic Soda Ash Plant—Japan Bemberg Co., Tokyo, Japan, plans construction of 150,000 kilos daily capacity, caustic soda ash plant 150,000 kilos daily capacity. Address U. S. Commercial Attache, Halleck A. Butts, Tokyo, Japan, for additional information.

Vegetable Oil Plant—Internationl Vegetable Oil Co., Greenville, Miss., plans alterations to cotton seed storage plant. Estimated cost $60,000.

Vanadium Ore Mill—Utah Vanadium Corp., c/o R. J. Evans, Salt Lake City, Utah, plans to develop its mining property south west of Green River, Utah, and construct concentration mill. Esimated cost $30,000.

Wax Plant—Old Victorian Products, Ltd., Glencoe, Ont., Can., plans the construction of a plant for the manufacture of waxes and polishes. Estimated cost $20,000.

CONTRACTS AWARDED

Fertilizer Storage Building, etc.—Erie R.R. Co., 50 Church St., New York, plans by H. Smith, Archt., 63 Sherman Pl., Jersey City, N. J., for storage building and equipment at Jersey City, N. J. Estimated cost is $28,500. Owner builds by separate contracts. Lessee New Jersey Fertilizer and Chemical Co., Tonnele Ave., Jersey City.

Laboratory—D. Wortman, architect, 116 Lexington Ave., New York, awarded general contract for 55 x 55 ft. laboratory, 47th Ave. and 5th St., Long Island City, to Perlman & Wortman, 109 East 9th St., New York, for Max B. Miller Co., 501 5th Ave., New York. Estimated cost is $28,000.

Lime Plant—Louisiana Lime Products Co., c/o Warren G. Gray, Alexandria, La., plans to develop its property here including the construction of lime kilns. Work will be done by day labor and separate contracts. Estimated cost $35,000.

Linoleum Factory—Paraffine Companies, Inc., 475 Brannan St., San Francisco, Calif., awarded contract for addition to linoleum factory at Emeryville, Calif., to Lindgren-Swinerton Co., Inc., 1723 Webster St., Oakland, Calif. Estimated cost $50,000.

Cracking Unit—Marathon Oil Co., Thompson Bldg., Tulsa, Okla., and Fort Worth, Tex., awarded contract for construction of a cracking unit at Fort Worth, Tex., to M. W. Kellog Co., 225 Bway., New York. Estimated cost $40,000.

Petroleum Refining — Argentine Government, Buenos Aires, Argentina, awarded contract for construction of petroleum refining plant (cracking unit), La Plata, Argentina, to M. W. Kellogg Co., 225 Bway., New York. Estimated cost is $600,000 or more. Owner will expend $400,000 additional on reconstruction of other cracking units in this plant.

Storage Tank, Oil Refinery—Hi-Way Oil Co., Ltd., 911 Yorkshire Bldg., Vancouver, B. C., awarded contract for construction 17,500 bbl. storage tank, on site of new oil refinery (now under construction), Vancouver, B. C., to Dominion Bridge Co., Ltd., 275 West 1st Ave., Vancouver, B. C.

Refinery—Charles Knox, Enid, Okla., will construct a refinery for the manufacture of gasoline, lubricating oils and by-products. Work will be done by day labor. Estimated cost $250,000.

Refinery—Union Oil Co. of California, Union Oil Bldg., Los Angeles, Calif., awarded the contract for pressure distillate sterilizer at Wilmington, Calif., to Consolidated Steel Corp., Eastern Ave., Los Angeles. Esimated cost $28,000.

Soap Factory—Colgate-Palmolive Peet Co., Berkeley, Calif., and Kansas City, Mo., plans to remodel and install new equipment ni its soap factories at Berkeley, Calif., and Kansas City, Mo. Work by day labor and separate contracts. Estimated cost to exceed $100,000 each.

Sulphur Plant—R. S. Alshire Oil Co., New Orleans Bank Bldg., New Orleans, La., awarded contract for three 1 story, 70 x 140 ft. buildings at its sulphur mining plant at New Iberia, La., to Ingalls Iron Works Co., AmericanTraders Bank Bldg., Bilrmingham, Ala. Estimated cost $146,000.