CHEMICAL
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ENGINEERING

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S. D. KIRKPATRICK, *Editor*

PREPAREDNESS AND THE ENGINEER

DURING WORLD WAR I, Woodrow Wilson said that the sinews of war were men, money and munitions. They still are, but perhaps we now rate them in a slightly different order of importance. Poland's tragic failure first proved to the world the inability of mere man-power to resist a highly mechanized and motorized army. Mere money, which we have lately seen appropriated in the billions in this country, cannot buy preparedness in the open market. We cannot protect our shores with airplanes or destroyers "on order". So, we must add to President Wilson's interesting alliteration several more M's, before we get to the vital subject of *munitions*. There must be a *mobilization* of *manufacturing*. There must be *materials—metals* and *minerals*. And it takes the *methods* of *modern management* to make all these work effectively. Topping all this is *morale*, the *motive* power behind any great endeavor such as the one we face today.

Gradually during the past six months we have come to the realization that preparedness is, temporarily we hope, America's No. 1 industry. We are suddenly superimposing on our peace-time economy a great ten or twelve billion dollar industry. This heavy but necessary burden of non-productive enterprise must be carried by all of us. It bears heaviest, however, on the engineer because munitions manufacture is a highly technical field of industry — one that requires trained judgment and skill as well as resourceful knowledge of science and technology.

Lloyd George in writing of his early experiences as British Minister of Munitions in the World War said: "It soon became evident to clear eyes that the war would be fought and ultimately decided in the work shops and laboratories." Germany learned that lesson all too well. For six years her work shops and laboratories have been concentrated in a single tremendous effort. It is significant, too, to realize that at the beginning her program was delayed for many months because of a shortage of technically trained men and skilled mechanics. Then she started intensive training courses and as far as we can learn, that is still an essential part of the German war machine. It is something, of course, which we are not going to overlook in this country. And to a large measure that responsibility is up to our leaders in engineering education.

In England there is compulsory registration of engineers. The order signed by the Minister of Labor and National Service on July 14, 1940 applies to all engaged in the engineering profession, whether in a consultant, technical, research or supervisory capacity. We are now seeing the beginning of some of these same trends in Washington. The National Roster of Scientific and Specialized Personnel corresponds on a voluntary basis with the compulsory scheme now in effect abroad. In our defense organization in the Advisory Commission in Washington, and in the procurement and technical departments of the armed forces, it is significant that many of the key jobs are held by engineers. These men are in positions of increasing responsibility because they think in terms of production, rather than of politics.

So, getting back to Woodrow Wilson's "Men, Money and Munitions," perhaps he was right after all in putting man-power first in that important trinity. But we would qualify it with this reservation: Today's wars are being fought by men in factories rather than by men in trenches. This means that preparedness is primarily an engineering function — to convert to war use all the advances of science and technology that will make for mass production of the munitions we need so badly and, if necessary, for their effective use in protecting these United States of America.

CHEMICALS' FORWARD MARCH!

Again America is mobilizing its resources for a great re-armament program. Men and money, machinery and materials are being called for national service. Quietly and efficiently, chemical industry is moving into a position of strategic importance to the nation. Fortunately, it can and will supply the chemicals now so vitally needed for our defense.

In the similar emergency of 25 years ago, much of what is now the American chemical industry came into being. In its uncertain infancy it faced devastating competition from abroad as well as ignorance and misunderstanding at home. During those trying days the chemical societies and trade associations of the industry pooled their strength in supporting the fight to keep chemistry alive in the minds and hopes of the American public. Beginning in September, 1915, the annual and later the biennial chemical expositions attracted popular interest and attention — thus serving as a focal center for all educational and promotional activities on behalf of the American chemical industry.

In more recent years we have not always felt so keenly about the necessity for public interest and support. The dyestuff tariff was no longer a national issue. Chemicals had become established as commodities of commerce and sought to broaden their markets outside of their own industry. The chemical expositions gradually changed in character and purpose. They became the marketing places for machinery and engineering services needed by a stable but expanding industry. Major emphasis on chemicals as such shifted to the means for their efficient production. The exhibits became of more interest to chemical engineers and production men.

Now it seems that the pendulum is beginning to swing back. Materials are once more the center of attention. The nation is looking to the chemical industry to supply many of the munitions that are sorely needed for the defense program. Peace-time requirements are expanding as many chemical consuming industries approach capacity production.

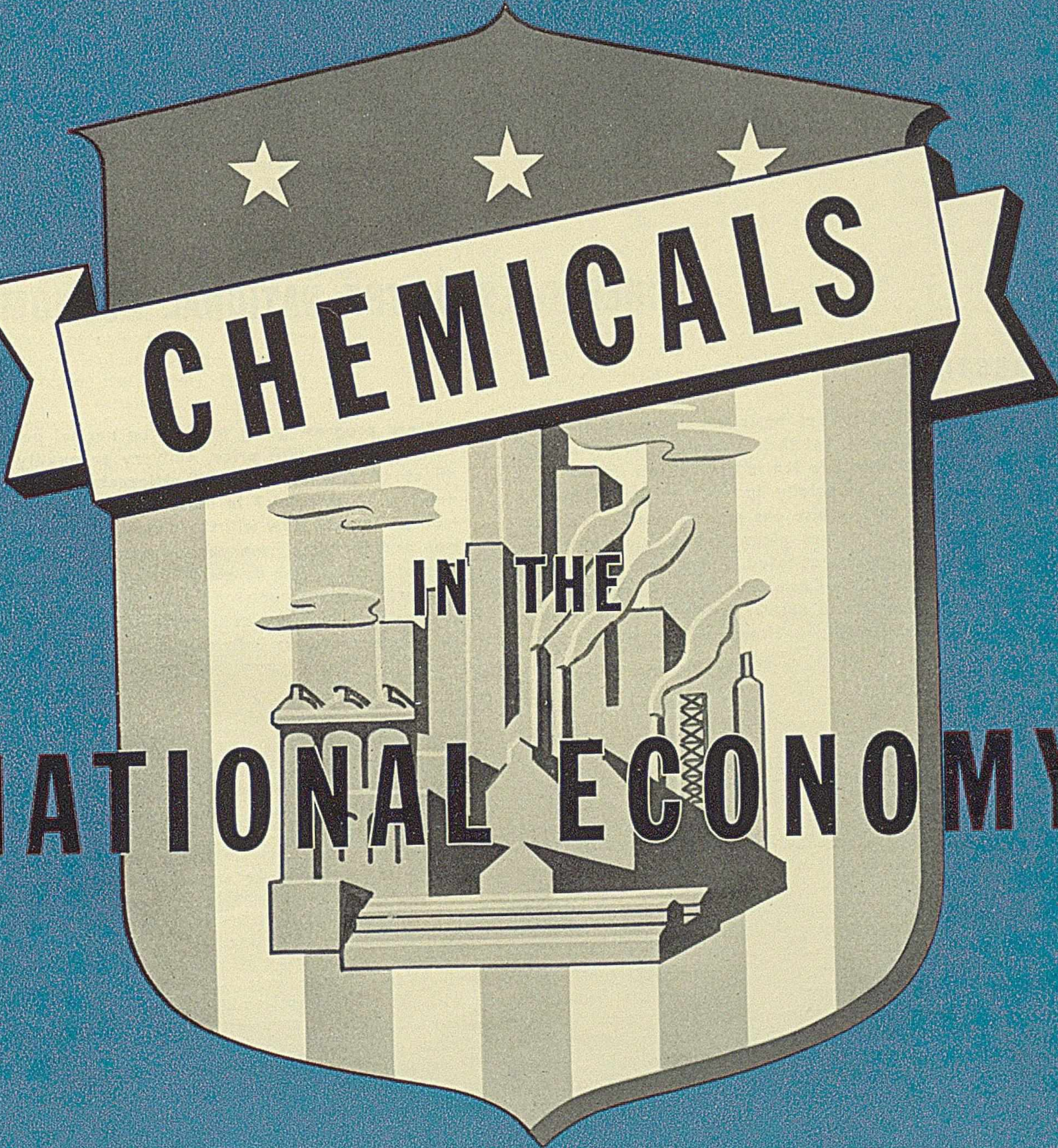
So it is natural that Chicago chemists who have been responsible for so many progressive ideas and practices in the profession should lead in organizing another approach to the industry's problems. The National Chemical Exposition, sponsored as a not-for-profit project of the Chicago Section of the American Chemical Society, is trying to return emphasis once more to "Chemicals." More than 40 per cent of the space in the great Exposition Hall of the Stevens Hotel has been taken by chemical companies, 35 per cent by machinery manufacturers and 25 per cent by the suppliers of laboratory apparatus. Several chemical conferences and a series of educational and scientific exhibits will help to spotlight chemical progress in many different directions. To provide inspiration for new ideas has been the guiding motive of the exposition committee under the chairmanship of Dr. Roy C. Newton, chief chemist of Swift & Co.

And it is in such an atmosphere and amid such surroundings that really new ideas are born. Here is the opportunity to see what is new and different, what is being done in one field that can find profitable application in another. There is no better way of stimulating chemical progress than through the exchange of ideas—nor is any transaction more profitable for all concerned.

All who can are urged to attend this exposition in Chicago during the week of December 11. The chemists who are behind it have freely given a great deal of their time and energy to this effort to stimulate interest and growth in the American chemical industry. It comes at an opportune time. Chemicals are starting their forward march to a new and greater place in the national economy.

CHEM & MET REPORT ON

CHEMICALS IN THE NATIONAL ECONOMY



CHEMICAL & METALLURGICAL ENGINEERING

NOVEMBER, 1940

TITLE OF REPORT Chemicals in the National Economy

TO Plant Managers, Superintendents and Chemical Engineers

FROM Chem. & Met. Editors

DATE November 1940

CHEMICALS IN THE NATIONAL ECONOMY

INTRODUCTION

CHEMICALS are of basic importance to the national economy, yet their true status is not always appreciated within the industry itself. Hence it is worthwhile, especially in such critical times as these, to re-appraise our present position and determine how future plans and developments are most likely to be affected. The purpose of this report—eleventh in *Chem. & Met.*'s 1940 series—is to help the reader to answer such ever-present questions as the following: How seriously is the national defense program going to bear on normal peacetime demands? Will price, delivery or quality be affected? Are there any "bottlenecks" likely to develop in materials? In labor? In equipment? In transportation? How will the diversion of research men and facilities from peace- to war-time affect normal growth and development of the industry? In short, where do we stand "chemically" and what can we do about it—as a nation, as an industry, as corporations, as individuals?

SYNOPSIS

1. Nothing in the defense program,—as far as we have been permitted to see it—is likely to place any impossible burdens on chemical industry. The direct demands for chemicals in munitions and the indirect demand as processing materials for other industries are all within the range of present possibilities. We have the knowledge and experience and, for the most part, the plants, to take care of an army of 2,000,000 men. If and when that number is to be greatly enlarged, we must look forward to the necessity for considerable expansion in production facilities.

2. Chemicals affect the production of billions of dollars worth of American goods and the jobs of millions of American wage earners. Liebig's classic use of sulphuric acid as a barometer of industrial progress can readily be extended to many other basic chemicals. It is obvious, therefore, that we can ill afford to curtail peace-time chemical applications in order to take care of war-time demands.

3. As long as chemical industry continues as No. 1 patron of research, we can expect to see growth and development. But if through conscription or otherwise our laboratories are robbed of their personnel, or their facilities are diverted entirely to defense problems, technical progress will surely be retarded. If through governmental edict or subsidy, we are persuaded to "freeze" many of these research developments in their present status, we cannot hope for the continued improvement in efficiency that comes normally with private enterprise.

4. The price policy of the industry is in the public interest. There has been a consistent trend toward more and better goods at ever lower prices. Even in the face of shortages resulting from the present war in Europe and increased cost of certain raw materials, the chemical industry has generally been able to resist the pressure for higher prices. Its leaders are convinced that we must avoid the inflation and the almost disastrous deflation that characterized the World War years and those that immediately followed.

5. In periods of emergency, every user of chemicals, including Uncle Sam, is thinking in terms of *delivery* as well as *price* and *quality*. Fortunately, chemical industry draws its chief raw materials from almost inexhaustible sources. Its manufacturing processes are comparatively flexible and can usually be expanded readily to meet any reasonable demands. Transportation facilities by rail, truck or barge, are adequate. Given fair warning, the industry is sufficiently resourceful to take care of reasonable deliveries promptly and efficiently.

6. Competition between commodities and processes within chemical industry is such that there are few if any chemicals that are absolutely irreplaceable. Substitutes are available or can be made to serve the great majority of chemical applications. From the viewpoint of the user, this is often his best insurance against inordinately high prices or threatened shortages of necessary supplies.

CONSUMPTION TRENDS

Consumption of chemicals in the United States is approaching an all-time high record. For the most part, this increased demand has come from industries that are engaged in peace-time operations—fertilizers, pulp and paper, petroleum, glass, rayon and textiles. In some of these fields, there has been some expansion to make up for loss of imports, but as yet there have been no extraordinarily heavy demands directly for defense purposes. They will come later, but in the meantime more chemicals are being used indirectly as the textile mills produce more uniforms and military goods, as glass, plastics, rubber and paints go into airplanes and motorized army equipment, as steel and non-ferrous metal plants reach peak capacity on military as well as private orders.

An interesting measure of the trend of chemicals consumption since 1932 is shown in the accompanying chart. This weighted index reflects the monthly requirements for chemicals from the 13 most important consuming industries, namely, fertilizers, pulp and paper, petroleum refining, glass, paint and varnish, iron and steel, rayon, textiles, coal products, leather, explosives, rubber, and plastics. The curve, it will be noted, has reached three successive peaks in recent years—in March, 1937, October, 1939 and October, 1940. The drastic decline that followed the 1937 peak brought us back to 1935 levels within less than a year. It took 20 months to climb back to the high point of 1939 only to fall off again slightly before entering the high ground represented by the 1940 average of approximately 140 per cent of 1935. There is ample reason now to believe that the final quarter of this year will mark a new high from both production and consumption standpoints.

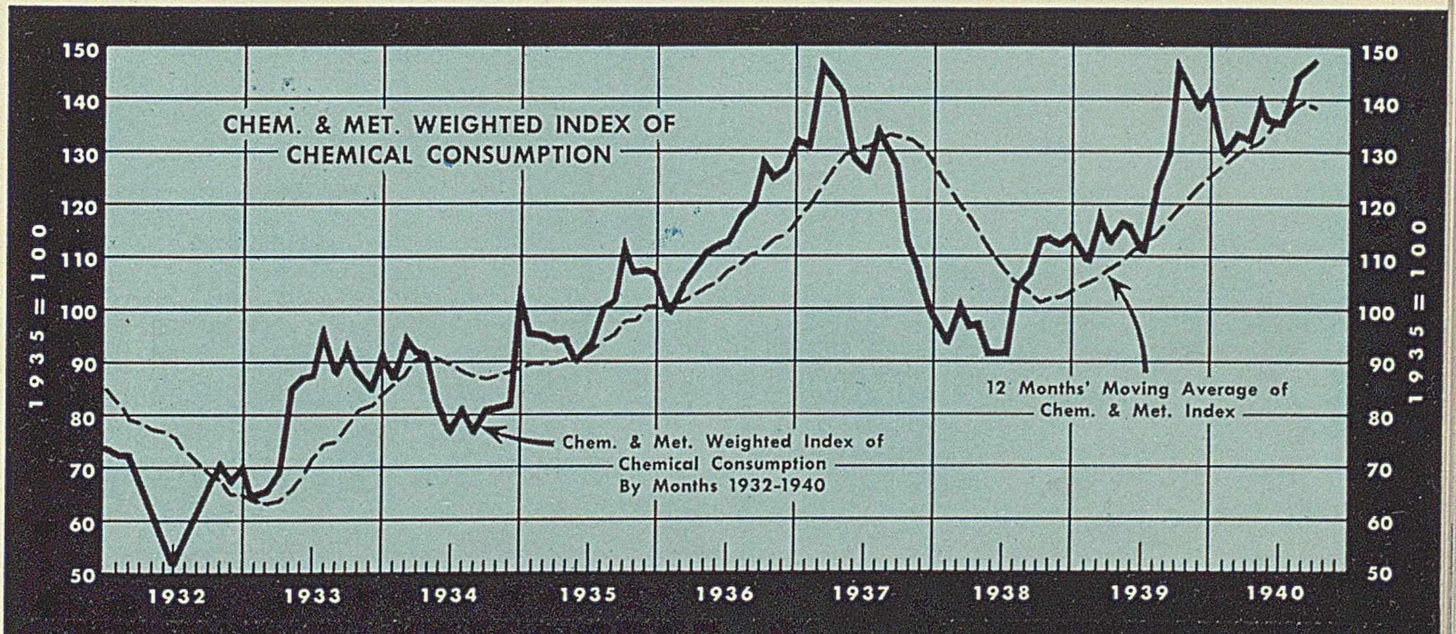
PRICE TRENDS

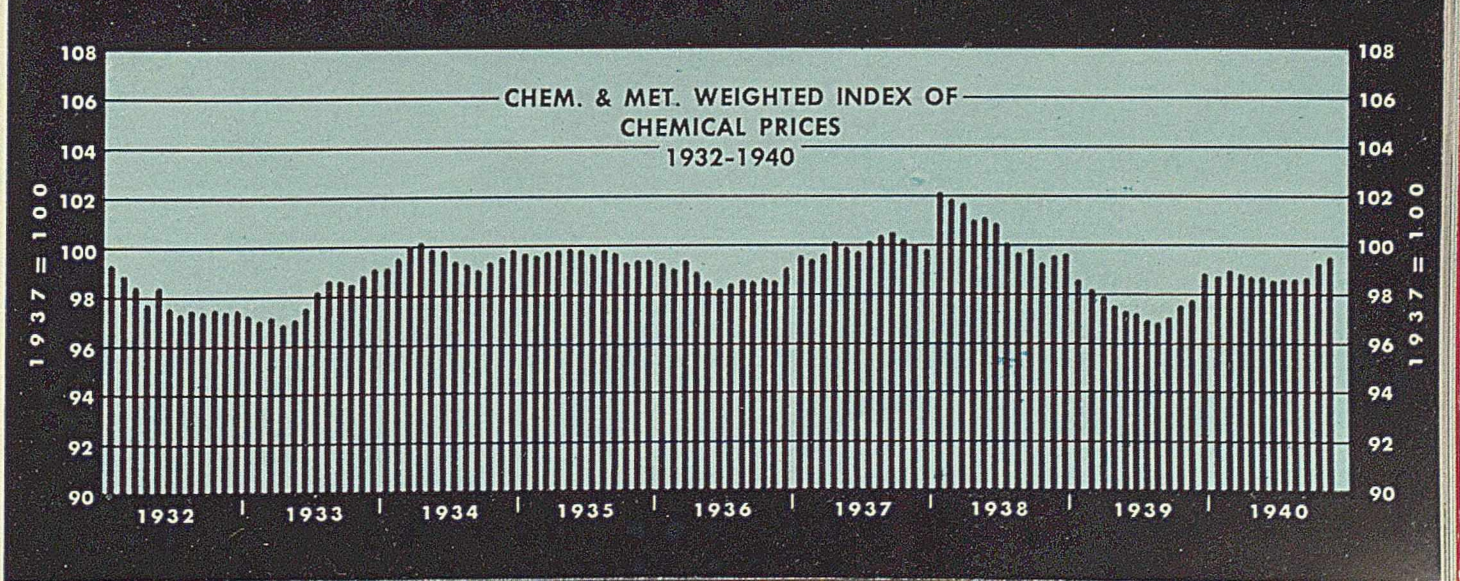
While values for chemicals have been affected somewhat by changes in general industrial activity, the trend over a long period has been downward—principally because improvements in process, technique, and management have resulted in lower production costs. Development of new chemicals with a consequent increase in competitive selling has also contributed to the downward movement. The low point for the last ten years was reached in 1933 and while this was followed by a reversal in the trend through part of 1937, the average price level from 1932 to date has fluctuated within a 3 per cent radius.

The outbreak of war in Europe last year was followed by a sharp rise in export demand for chemicals with higher prices entering into many such transactions. Yet domestic consumers received monthly deliveries at unchanged levels with the exception of a very few chemicals of foreign origin. At present the market is in a firm position which may be intensified as the defense program gathers headway but quotations for many of the large tonnage chemicals already have been extended to cover deliveries in 1941 so it is evident that no widespread fluctuations are in prospect.

WHAT OF THE FUTURE?

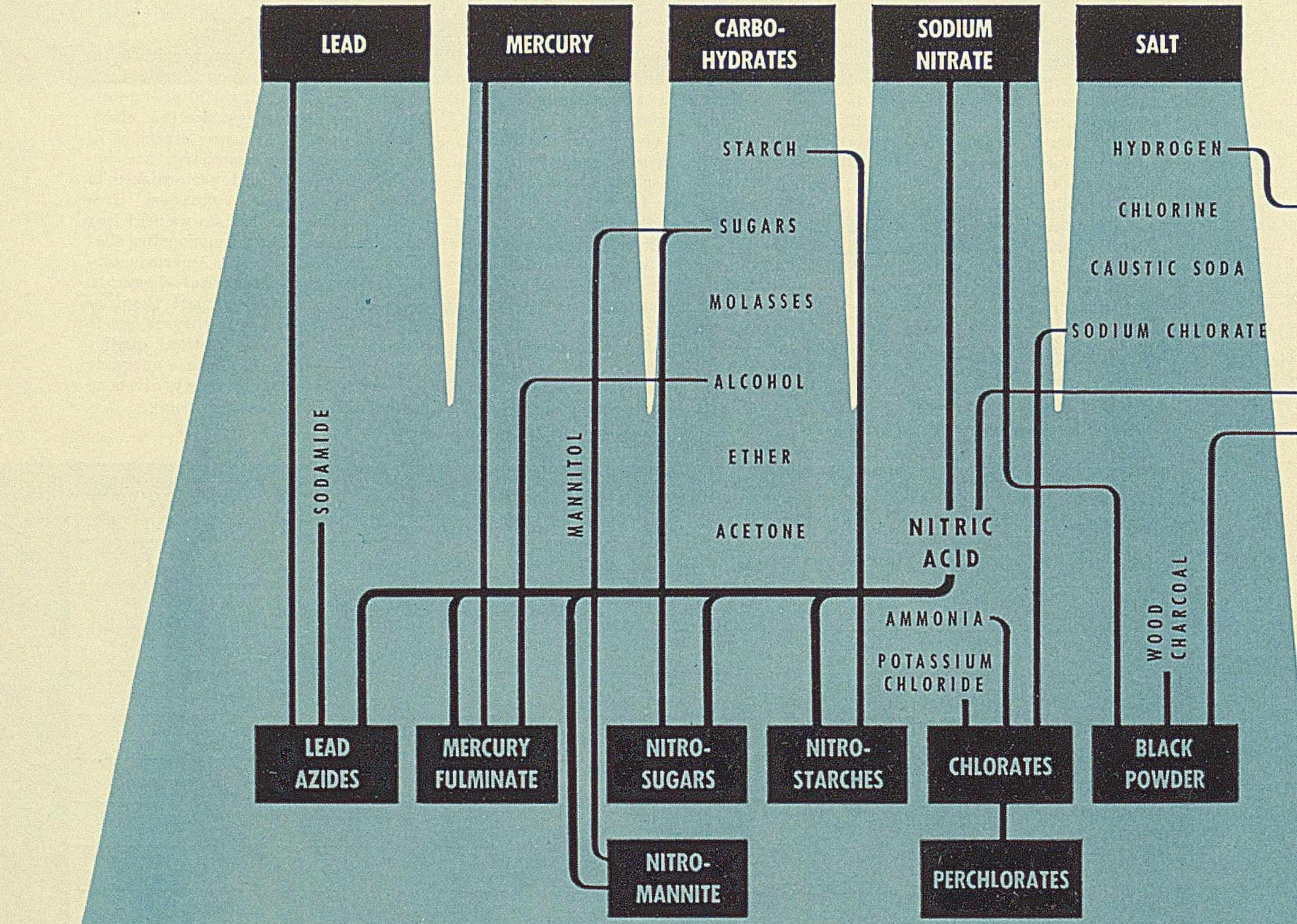
Chemicals face the future with confidence. There is no conceivable limit to the quantity of their production. There is conclusive evidence that chemicals, especially the many creations of synthetic organic chemistry, are superior in quality and performance to those man formerly obtained from natural resources. Nor do we need fear any longer the foreign monopolies that once dictated the prices American consumers must pay for vital chemicals. In the language of the airport, the price ceiling is low but visibility is good! Finally, all these—quantity, quality and price—combine to assure adequate supply and prompt delivery of chemicals for our national economy.

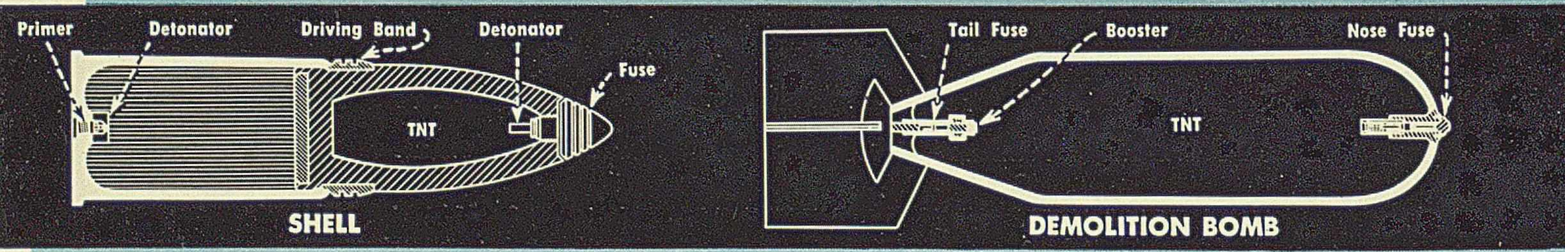




HOW CHEMICALS SERVE

THE NATIONAL DEFENSE TO MAKE





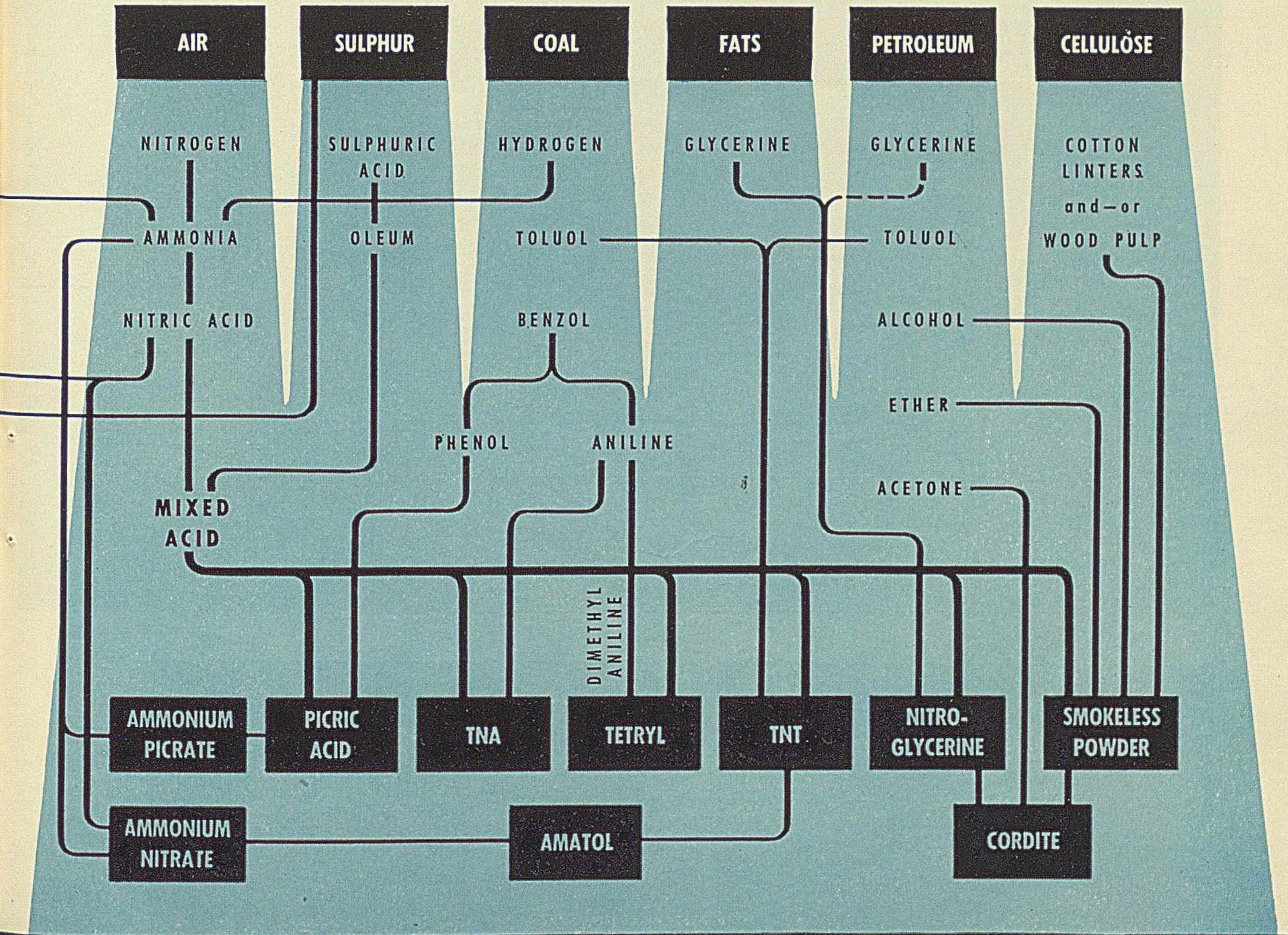
Military explosives may be divided into three general classifications: detonators and fuses, propellants, and high explosives. These are used in a combination known as an explosive train, which is merely a chain of explosions, each one larger than the one before.

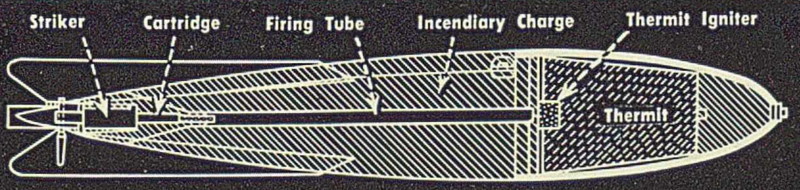
Explosives used as primary detonators include LEAD AZIDE, FULMINATE OF MERCURY and NITROMANNITE. BLACK POWDER is the principal fuse powder. SMOKELESS POWDER and CORDITE are the only important propellants, though "ammon" powder (ammonium nitrate and charcoal) was used by the Central Powers in World War I.

Intermediate detonators, or boosters, are: TETRYL, (tetranitromethylaniline), PICRIC ACID, TNA (tetranitroaniline) and hexyl (hexanitrodiphenylamine). Among the high explosives or bursting charges, the following are most important: TNT (trinitrotoluol), DNT (dinitrotoluol), AMATOL (mixture of ammonium nitrate

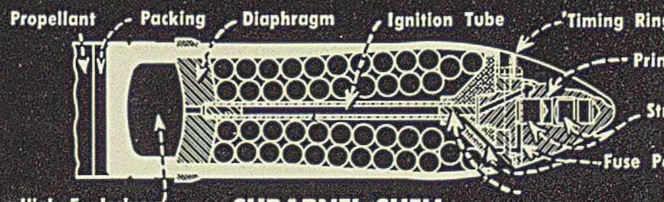
CHEMICALS

MILITARY EXPLOSIVES





INCENDIARY BOMB



SHRAPNEL SHELL

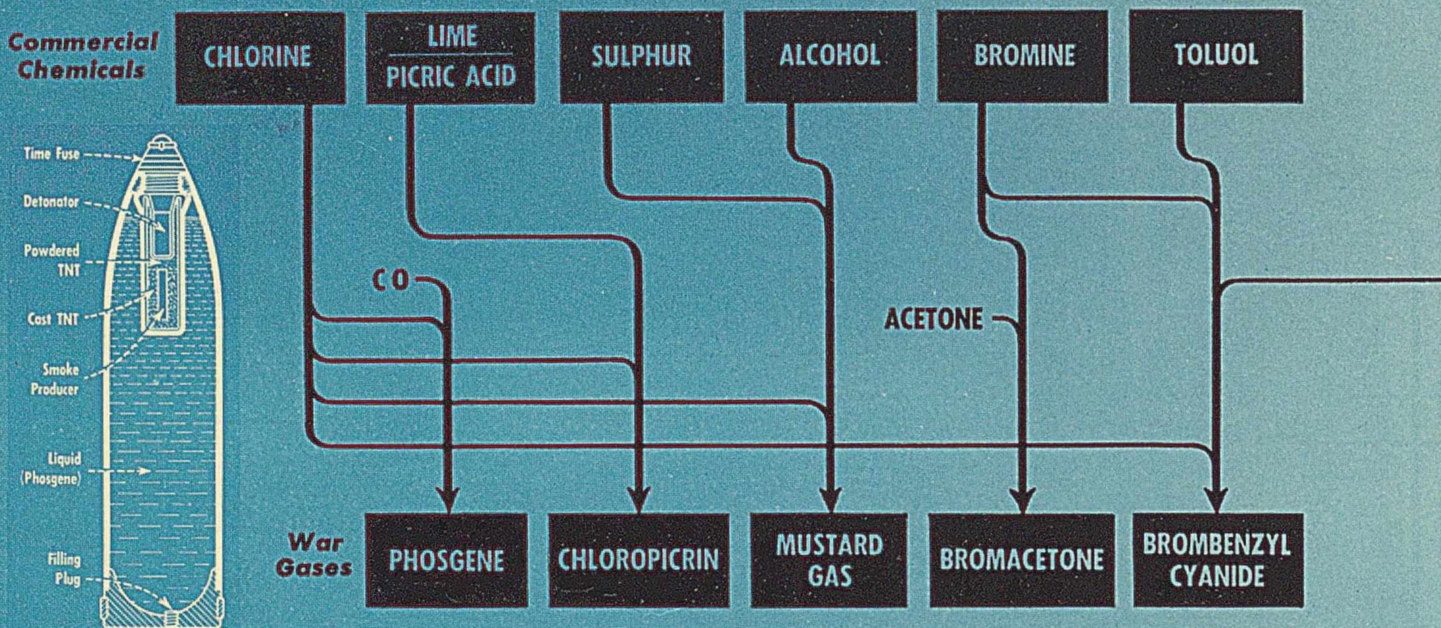
with TNT), PICRIC ACID mixed with AMMONIUM PICRATE (Explosive D), trinitroanisol, and penthrite (pentaerythrite tetranitrate). The last-named is the most important of the newer explosives. It can be made from acetaldehyde and formaldehyde in large quantities. NITRO-STARCH is used principally in trench warfare as a filler for hand grenades and mortar shells.

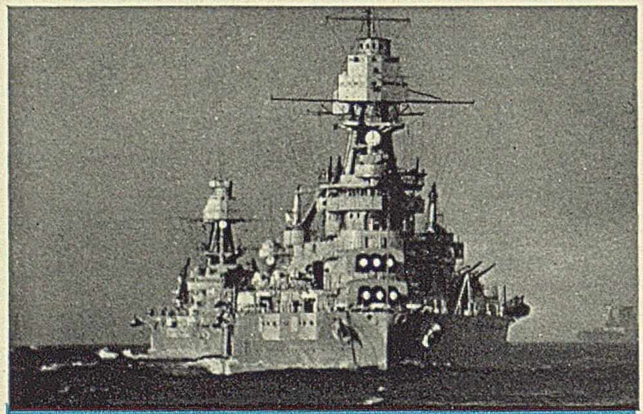
Demolition bombs have a similar explosive train to that of shells but they contain much more explosive—usually about 60 per cent of their weight in TNT. Incendiary bombs are filled with thermit (a mixture of powdered aluminum and iron oxide), an incendiary charge such as kerosene or oil emulsion, and explosive.

Shrapnel (named after Lt. Shrapnel, the inventor) contains lead balls packed in a sulphur, rosin or black powder matrix. The shell casing has a weak point near the nose and when exploded opens at that point ejecting the balls fanwise.

HOW CHEMICALS SERVE THE NATIONAL DEFENSE THROUGH

CHEMICAL WARFARE





U. S. Navy Recruiting Bureau

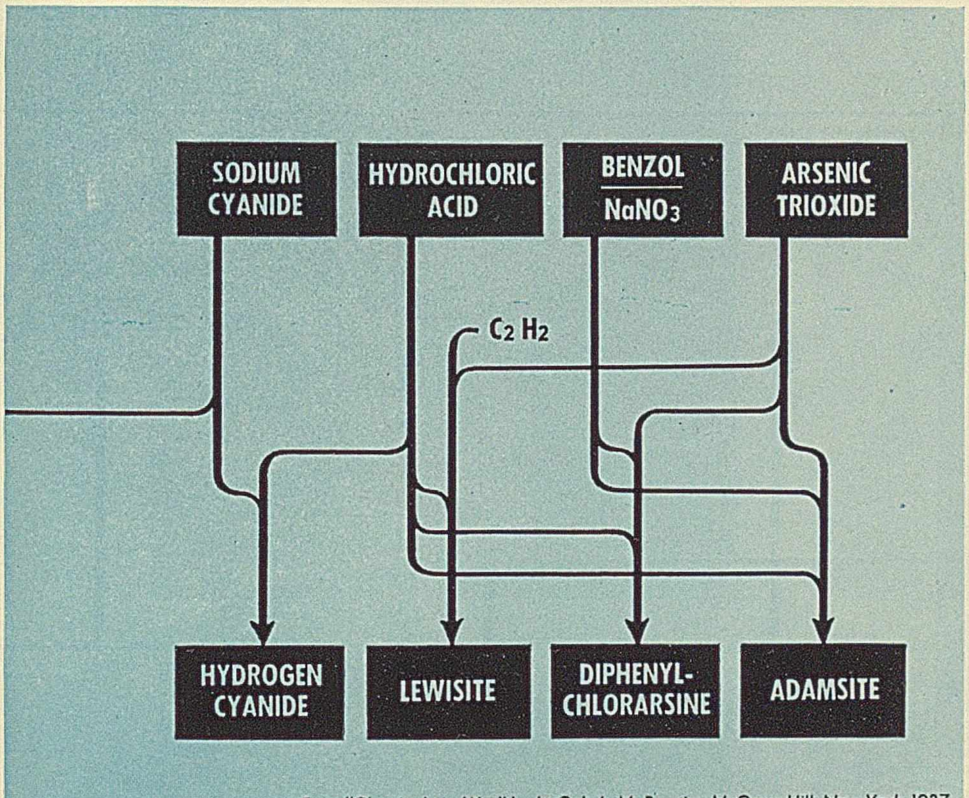
U.S. NAVY

Chemicals are used in: Special alloy steels, Lubricants and fuels, Synthetic rubber and plastics, Explosives, Flares and smoke screens, War gases and masks, Paint and finishes, Optical glass, Medicinals and dyes, Refrigerants, Cleansing compounds

AIR FORCE

Chemicals are used in: Metals and alloys, Lubricants and fuels, Rubber and synthetic rubber, Molded plastics, Explosives (bombs and shells), Flares and smoke screens, War gases, Paints and finishes, Coated fabrics, Synthetic fibers, Cement

THE ARMED FORCES



From "Chemicals in War" by Lt. Col. A. M. Prentiss. McGraw-Hill, New York, 1937

U. S. Army Signal Corps

MECHANIZED FORCES

Chemicals are used in: Special alloy steels, Lubricants and fuels, Synthetic rubber, Molded plastics, Explosives, Flares and smoke screens, War gases and masks, Fuel for flame-throwers, Coated fabrics, Anti-freeze solutions, Synthetic fibers

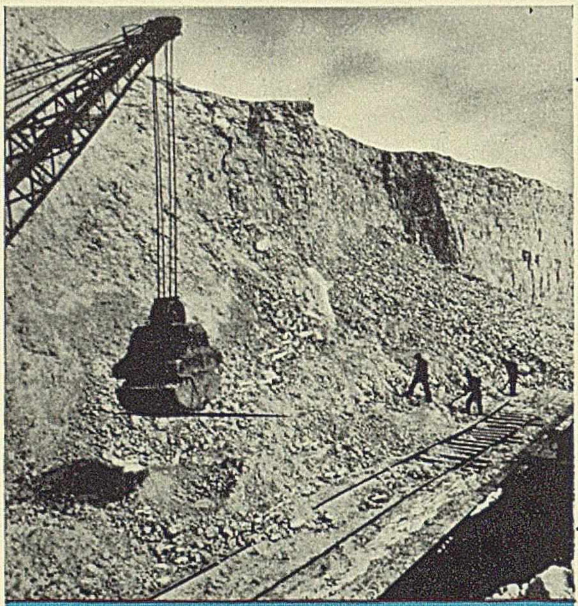
U. S. Army Signal Corps

U.S. INFANTRY

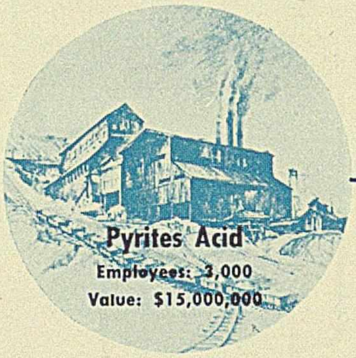
Chemicals are used in: Textiles, Coated fabrics, Leather goods, Gas masks, Dyes, Ammunition, Medicinals, Metal coloring materials, Food, Plastic buttons, Cleansing compounds, Synthetic rubber

HOW CHEMICALS SERVE

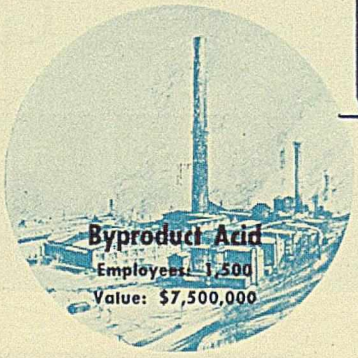
OUR PEACETIME ECONOMY



SULPHUR
Employees: 2,000
Value of Product: $29,000,000



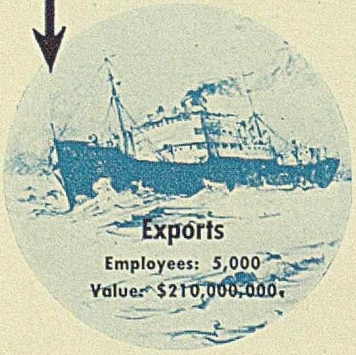
Pyrites Acid
Employees: 3,000
Value: $15,000,000



Byproduct Acid
Employees: 1,500
Value: $7,500,000

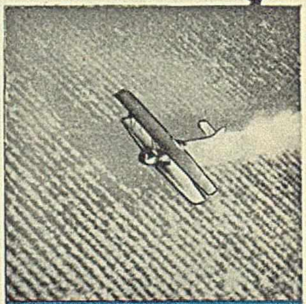
SULPHUR AND SULPHURIC ACID

affect the production of $17,250,000,000 of goods and the employment of 2,800,000 workers in American industries



Exports
Employees: 5,000
Value: $210,000,000

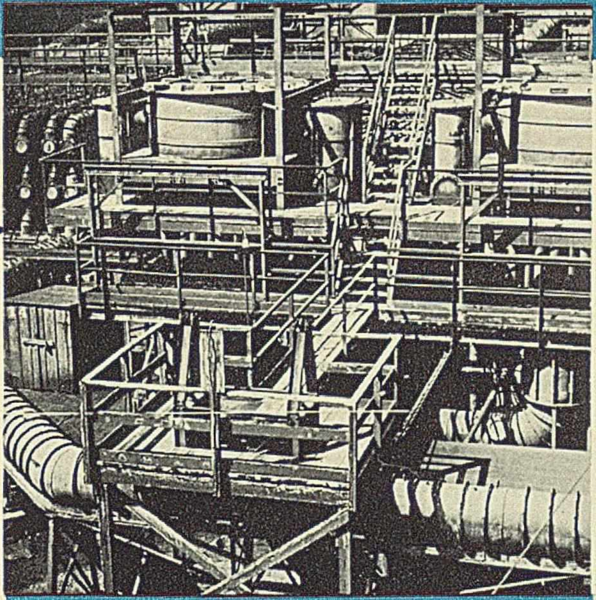
Rubber
Employees: 130,000
Value: $890,000,000



Insecticides
Employees: 4,000
Value: $70,000,000

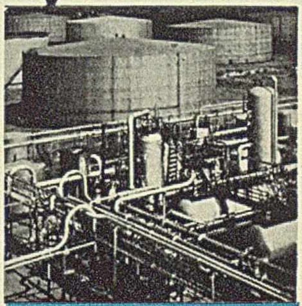
CHEMICALS

A. SULPHUR AND SULPHURIC ACID

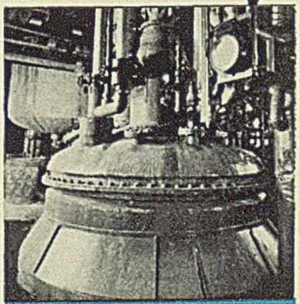


SULPHURIC ACID
Employees: 7,000
Value of Product: $39,000,000

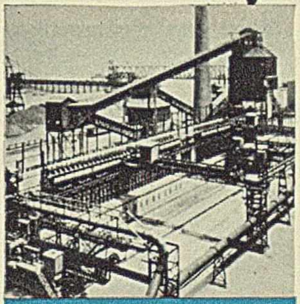
Fertilizers
Employees: 21,000
Value: $200,000,000



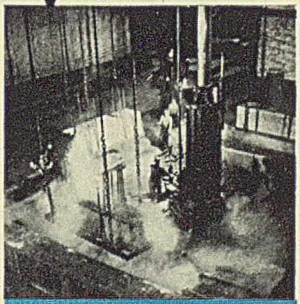
Petroleum Refining
Employees: 85,000
Value: $2,500,000,000



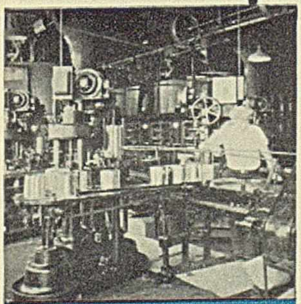
Chemicals
Employees: 125,000
Value: $1,500,000,000



Coal Products
Employees: 20,000
Value: $400,000,000

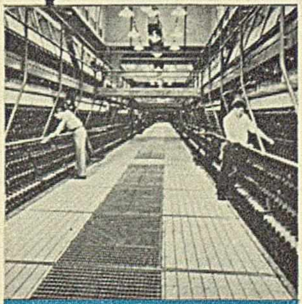


Iron and Steel
Employees: 500,000
Value: $3,500,000 000



Paint and Pigments
Employees: 30,000
Value: $550,000,000

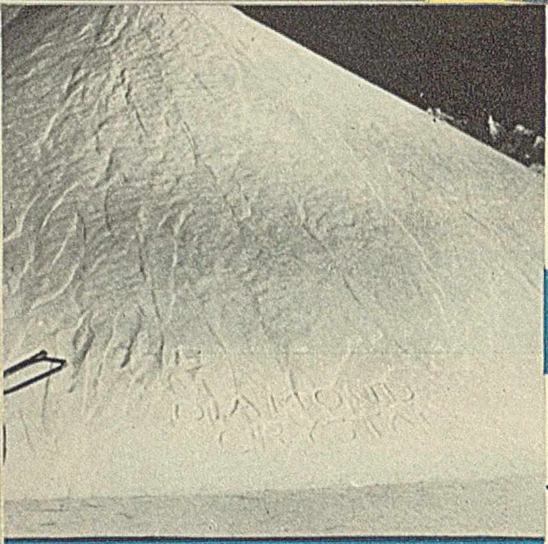
Explosives
Employees: 6,000
Value: $80,000,000



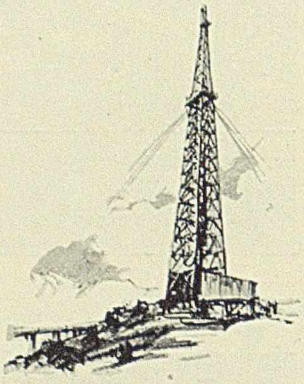
Rayon and Textiles
Employees: 1,875,000
Value: $7,350,000,000

HOW CHEMICALS SERVE

OUR PEACETIME

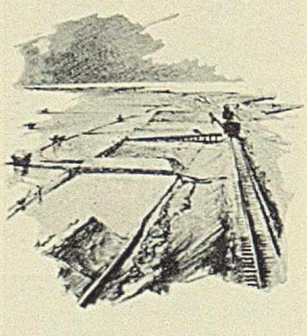


SALT
Employees: 5,000
Value of Product: $25,000,000



From Brine

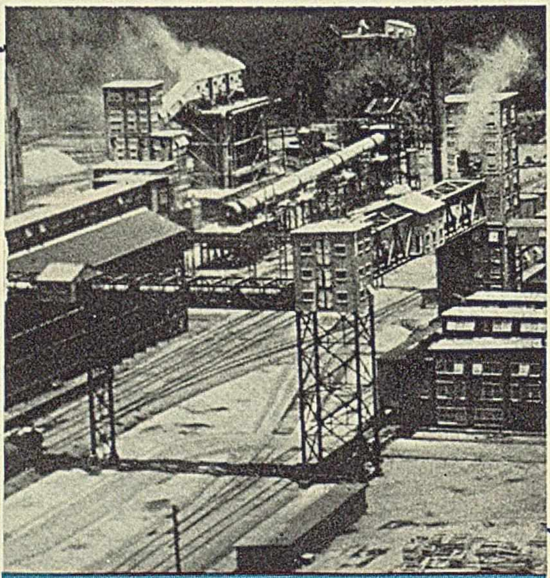
From Mine



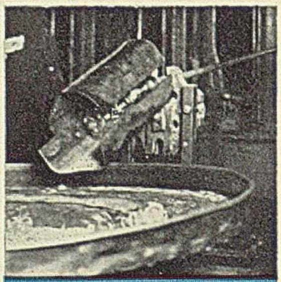
From Sea

SODA ASH AND CAUSTIC SODA

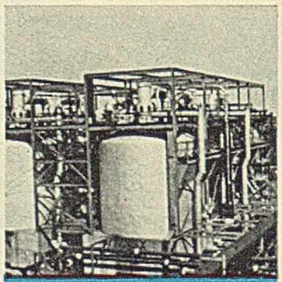
affect the production of $14,820,000,000 of goods and the employment of 2,500,000 workers in American industries



SODA ASH
Employees: 5,000
Value of Product: $43,000,000



Glass
Employees: 80,000
Value: $400,000,000

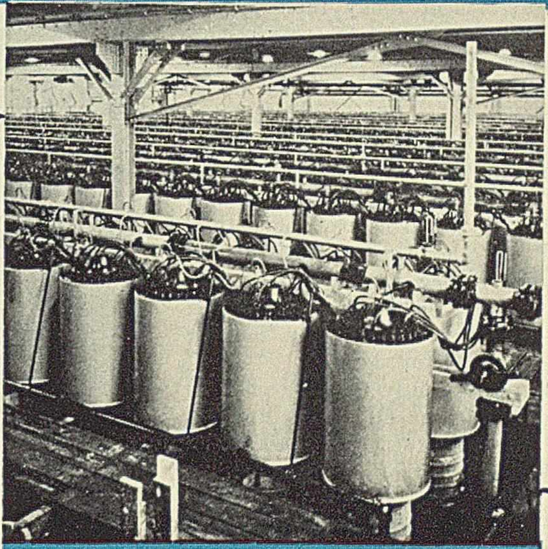


Water Softeners
Employees: 1,000
Value: $3,000,000

Cleansers, Modif. Sodas
Employees: 2,000
Value: $7,000,000

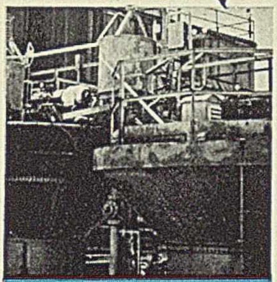
B. SODA ASH AND CAUSTIC SODA

ECONOMY

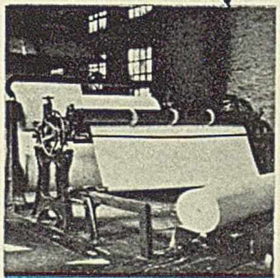


CAUSTIC SODA
Employees: 4,000
Value of Product: $36,000,000

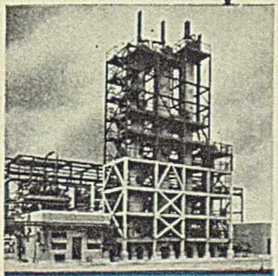
Soap
Employees: 15,000
Value: $310,000,000



Chemicals
Employees: 125,000
Value: $1,500,000,000



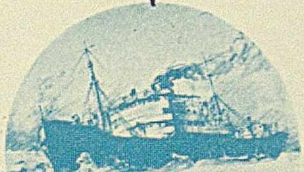
Pulp and Paper
Employees: 110,000
Value: $1,350,000,000



Petroleum Refining
Employees: 85,000
Value: $2,600,000,000

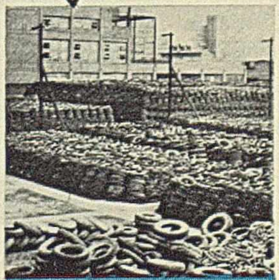
Rayon and Film
Employees: 60,000
Value: $275,000,000

Lye
Employees: 1,000
Value: $2,000,000

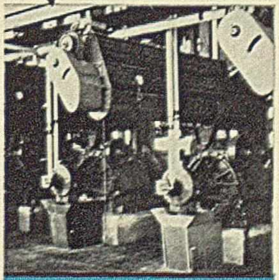


Exports
Employees: 5,000
Value: $210,000,000

Textiles
Employees: 1,815,000
Value: $7,100,000,000



Rubber
Employees: 130,000
Value: $890,000,000



Vegetable Oils
Employees: 20,000
Value: $173,000,000

WORLD WAR I vs TOTAL

THAT AMERICAN chemical industry is better prepared to meet the demands of its government today than during World War I is known to every school boy. We have built a tremendous and resourceful arm of service that is of as vital importance to this country in war as in peace. Our plants are staffed with a higher proportion of technically trained men and are equipped with better and more efficient machinery than those of any other nation. Their active, progressive management prefers peace to war but will not shirk its patriotic duties and responsibilities in helping America re-arm for defense.

So we courageously face the problem of accelerating our operations and enlarging our manufacturing facilities to meet the demands of defense. Unfortunately, a part of this program relates to destruction—to nonproductive enterprise that must be saddled on the backs of productive industries. With thoughtful planning and an eye to future growth and development, however, it may be possible at this stage to build many of these new facilities that will have permanent peace-time value.

From 1914 to the peak of war activity in 1918, there was a stupendous growth in most divisions of the heavy chemical and organic chemical industries. It was not alone the explosives business that expanded. Sulphur and sulphuric acid, caustic soda and soda ash, ammonia, chlorine, toluol, potash, dyes and synthetic organics and a score of other chemical products are now made in tonnages far in excess of the highest rate of World War I. This is fortunate.

But the new demand for chemical munitions, particularly explosives, requires even greater effort than was needed during World War I. At the moment, of course, one of the most pressing problems is to know what our defense needs will prove to be. We do not even know definitely how great a number of men in uniform must be served. At this time the official figures plan for 2,000,000 men in the army, but it is no secret that this number might be doubled in the comparatively near future. It is not expected that so many men would be in uniform at one time, unless there is actual fighting. However, preparations for mechanical equipment, goods and services to support the larger army must be made in peace-time if the military forces are to have proper backing.

In making the estimates of explosives

1914 U. S. PRE-WAR PRODUCTION	1918 PEAK OF WAR CAPACITY
SULPHUR 400,000 tons	SULPHUR 1,500,000 tons
SULPHURIC ACID 3,800,000 tons (50°)	SULPHURIC ACID 9,500,000 tons (50°)
SYNTHETIC AMMONIA None	SYNTHETIC AMMONIA None
OTHER AMMONIA 21,000 tons	OTHER AMMONIA 73,000 tons
NITRIC ACID 80,000 tons	NITRIC ACID 500,000 tons
CAUSTIC SODA 215,000 tons	CAUSTIC SODA 330,000 tons**
SODA ASH 935,000 tons	SODA ASH 1,507,000 tons**
TOLUOL 1,500,000 gal.	TOLUOL 14,100,000 gal.
PHENOL 8,000,000 lb.	PHENOL 145,000,000 lb.
AMM. NITRATE 58,000,000 lb.	AMM. NITRATE 240,000,000 lb.
TNT 7,200,000 lb.	TNT 192,000,000 lb.
PICRIC ACID 7,200,000 lb.*	PICRIC ACID 140,000,000 lb.
SMOKELESS POWDER 1,800,000 lb.	SMOKELESS POWDER 513,000,000 lb.
BLACK GUN POWDER 8,000,000 lb.	BLACK GUN POWDER 10,000,000 lb.
TETRYL 104,000 lb.*	TETRYL 1,920,000 lb.
MERCURY FULMINATE	MERCURY FULMINATE 600,000 lb.
CHLORINE 6,000 tons	CHLORINE 45,000 tons**
POTASH (as K_2O) None	POTASH (as K_2O) 54,805 tons
COAL-TAR DYES 7,000,000 lb.	COAL-TAR DYES 66,000,000 lb.
BROMINE 50,000 lb.	BROMINE 210,000 lb.
IODINE None	IODINE None

*As of Nov. 1917. **1919 Census. †See text.

DEFENSE (CHEMICALLY SPEAKING)

CHEMICALS

1940 NEEDS

	PRESENT PEACE-TIME OUTPUT	TOTAL DEFENSE (Est.)
SULPHUR	2,500,000 tons	3,000,000 tons
SULPHURIC ACID	9,400,000 tons (50°)	12,000,000 tons (50°)
SYNTHETIC AMMONIA	260,000 tons	550,000 tons†
OTHER AMMONIA	135,000 tons	150,000 tons
NITRIC ACID	200,000 tons	1,000,000 tons
CAUSTIC SODA	1,000,000 tons	1,250,000 tons
SODA ASH	3,000,000 tons	3,500,000 tons
TOLUOL	25,000,000 gal.	65,000,000 gal.
PHENOL	70,000,000 lb.	85,000,000 lb.
AMM. NITRATE	100,000,000 lb.	250,000,000 lb.†
TNT	10,000,000 lb.	600,000,000 lb.†
PICRIC ACID	....	25,000,000 lb.
SMOKELESS POWDER	30,000,000 lb.	800,000,000 lb.
BLACK GUN POWDER	3,000,000 lb.	15,000,000 lb.
TETRYL	....	2,500,000 lb.
MERCURY FULMINATE	....	350,000 lb.†
CHLORINE	485,000 tons	700,000 tons
POTASH (as K_2O)	350,000 tons	375,000 tons
COAL-TAR DYES	140,000,000 lb.	145,000,000 lb.
BROMINE	38,000,000 lb.	50,000,000 lb.
IODINE	300,000 lb.	500,000 lb.

required for "Total Defense," *Chem. & Met.* has used the very simple procedure of figuring one pound per day of high explosives and one pound per day of propellent powder for each man in uniform in the army. That "round number" estimate gives an approximate basis for beginning the calculations from which the accompanying table of "needs" has been prepared. But a number of other assumptions have also been necessary. For example, it is assumed that all of the propellent powder is to be of the smokeless type—an assumption not quite in line with the facts. It is also assumed for the first 2,000,000 men, about 80 per cent of the high explosives will be TNT and only 20 per cent ammonium nitrate and other specialties. Undoubtedly the proportion of ammonium nitrate will increase markedly, especially in preparing for a 4,000,000-man army.

It will also be noted that nitrogen requirements have been presented in terms of ammonia which calls for practically doubling our present synthetic capacity and slightly increasing byproduct recovery. During World War I, according to Major C. G. Storm, Chief of the Explosives Section of the Ordnance Department, we used 886,530,000 lb. of sodium nitrate and 900,000,000 lb. of sulphuric acid merely to produce our requirements of nitric acid. Were we, in the present emergency, to revert to such practice and import sodium nitrate from Chile, the ammonia, sulphur and sulphuric acid figures given here would have to be adjusted accordingly. During World War I, we used 260,000 lb. of mercury for fulminate production, but today lead azide and other products may be called on to replace a considerable share of our requirements for detonators. Similar instances of new technology which cannot now be foreseen will undoubtedly call for additional adjustments.

A final word of explanation and warning seems warranted. These estimated "Needs for Total Defense" are *annual* totals or *annual rates* of production and include the normal civilian as well as the extraordinary military requirements. Nothing is indicated as to how soon these rates will or must be attained. That depends upon national policies yet to be decided. But it is hoped that this general picture of the magnitude of these problems will help *Chem. & Met.* readers in planning to meet the serious responsibilities that the chemical industries must assume.

WHAT CHEMICALS HOLD FOR THE

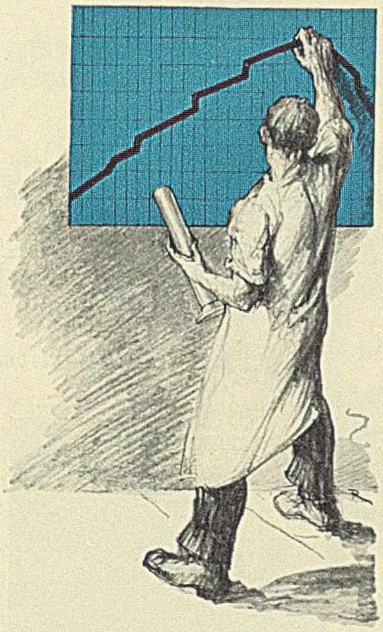
QUANTITY—UNLIMITED!

Because chemical industry is based primarily on almost inexhaustible sources of supply for its principal raw materials—coal, air, water, limestone, salt, petroleum hydrocarbons, cellulose and agricultural products grown in the United States—there is no conceivable limit to the quantity of its output. When we add to this the interchangeability of raw materials made possible by chemical engineering technology, American consuming industries need have no concern about "bottlenecks" developing along the chemical supply lines. To the American public and to the national economy this means that chemical industry may be expected to grow in size and service just as rapidly as we can advance our standards of living in this country. There is no better index of our progress in that direction than can be found in the use we make of the many products of synthetic organic chemistry, especially those created to meet the new and changing needs of mankind. Thus it would seem that the quantity of chemical production in the future depends upon: (1) The size of the consuming market; (2) the advances in technology in the application of chemicals for new services to humanity, and (3) the preservation of a system of free enterprise where men, money, materials and machinery are permitted to find profitable employment in building a greater future for America.

QUALITY—SUPERIOR!

Chemical industry has, for all time, exploded the popular fallacy that "Man cannot improve on Nature!" We need but to put to test the many creations of synthetic organic chemistry to find conclusive proof that these products are superior in quality and performance to those man formerly obtained from natural sources. New synthetic fibers and fabrics will give Milady gowns and costumes that will outwear and outmode the finest of silks and satins. The same materials, when applied to industrial uses in filter fabrics, belting and mechanical textile goods, show even more startling improvement on comparable materials made of cotton, flax and wool. Plastics have advanced so far beyond anything found as such in nature or derived from it by ordinary chemical processes that comparison is difficult. Synthetic rubbers have continued to sell for several times the price of natural rubber primarily because they may be used in many places where the latter is not satisfactory. What then are the things we can expect by way of quality in the products of the future? (1) Because chemical products are man-made and controlled, uniform quality is assured; (2) because such products are tailored for the use to which they are put, chemicals can be modified to meet stringent requirements as to strength, concentration, appearance and other desired properties; and (3) because research is a continuous process, always newer, always better products are the normal expectation in chemical industry.

FUTURE ?

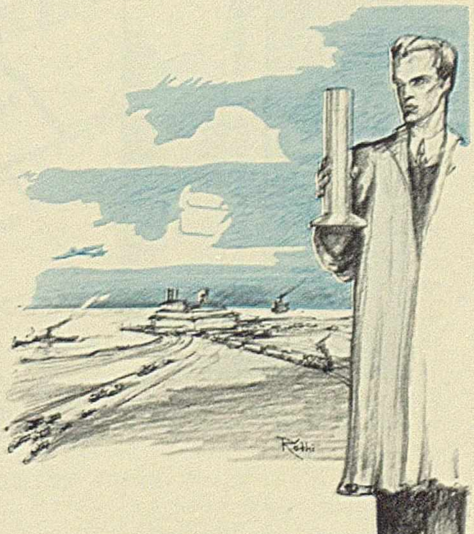


PRICE—RESTRICTED!

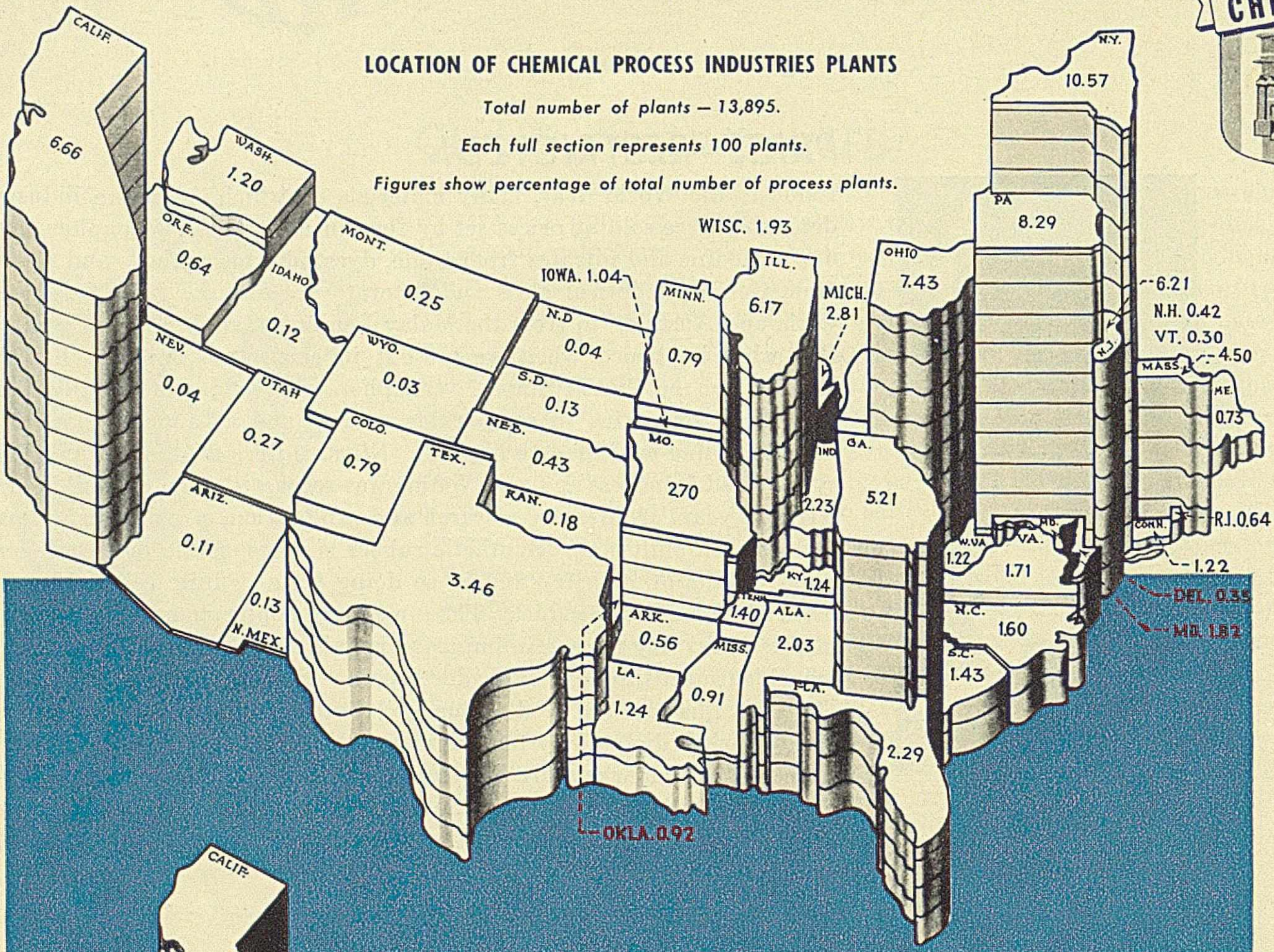
Prior to the World War, many materials on which American industry depended were sold at prices set by foreign monopolies. Camphor from Japan, iodine and nitrates from Chile, dyes, pharmaceuticals and potash from Germany, optical glass and laboratory glassware from Czechoslovakia and Austria, tin from the Malay Peninsula, rubber from Sumatra. But what happened when we set out in earnest to build a chemical industry in the United States? Camphor was made synthetically from American turpentine in comparable quality and at a price that set a definite ceiling on Japanese imports. Nitrates were made from ammonia synthesized from coal and air. Iodine was recovered from oil-well brines. After 20 years of intensive research and exploration, a real potash industry has been built here. Synthetic rubber is now made to meet stringent requirements of industry and in so doing set a definite ceiling for the price of the natural product. The same story applies to optical glass and in a modified way to certain imported metals and other critical materials for which substitutes are being developed. "Prices—restricted!" means: (1) That this country need no longer be subjected to unfair and unreasonable prices dictated by foreign monopolies; (2) as lower prices result from research, markets are broadened and luxuries are brought within the reach of all, and (3) wholesale competition between commodities and processes makes certain that the consumer gets what he wants at the lowest possible price.

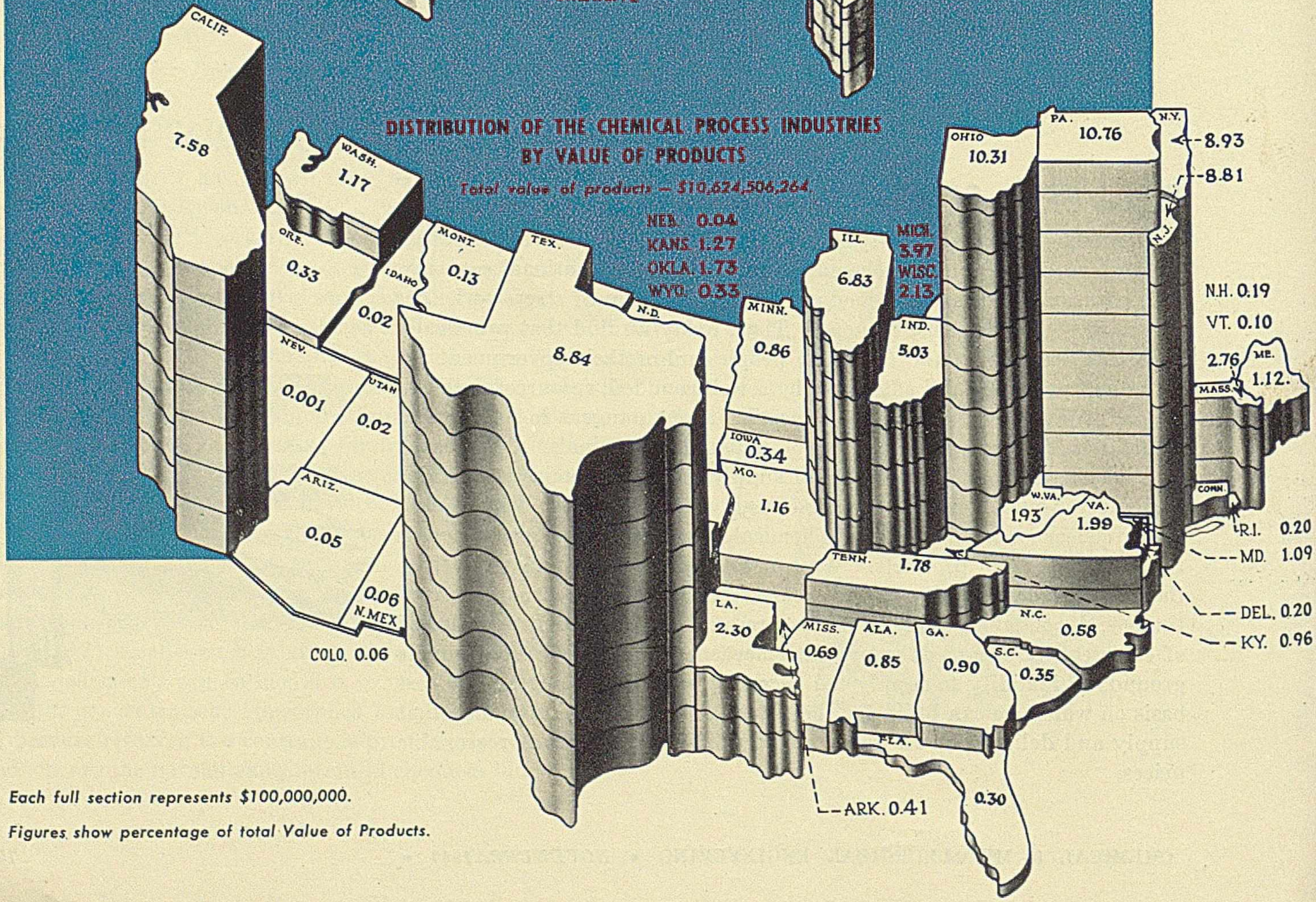
DELIVERY—SURE!

All these—quantity, quality and price—combine to assure the future supply and delivery of the chemicals we need for our national economy. This assurance becomes extremely important in times of stress—whether due to war- or peace-time economy. Thus, today we find that practically all of the demands of the American people and of their government are being met promptly and efficiently by a well-rounded, resourceful chemical industry. There need be no question about dangers to health that would result if we were deprived of imported medicinals. There need be no concern about interruption of supply of basic chemicals on which agriculture—and therefore our food supply—is dependent. There need be no concern about the heavy chemicals that enter into such a wide range of industrial products. We can confidently say that: (1) Given the need and opportunity to serve, chemical industry can produce a continuous, dependable supply of all its products; (2) no service demanded of chemical industry in the present emergency has been refused on the grounds of inability to supply the necessary materials, and (3) the best basis on which we can build for the future is the certain knowledge that supply and delivery of all important chemicals is assured at reasonable prices.



WHERE ARE THE PLANTS THAT MAKE CHEMICALS?





Each full section represents $100,000,000.

Figures show percentage of total Value of Products.

RESEARCH

Our First Line of National Defense

MELVIN E. CLARK *Assistant Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

American Cyanamid Co.'s four-year-old research Laboratory at Stamford, Conn., (shown above) provides an outstanding example of the security afforded by organized research effort. In time of war and in time of peace new products and processes to satisfy changing human requirements pour out of thousands of American laboratories. This one is unique because it started out as an experiment in a new research philosophy. Proper organization, coordinated group effort and liberal employee policies have made the experiment a success as evidenced by important new products described in this article.—*Editors.*

MANY AND VARIED are the demands made upon chemical research in time of war. Aside from the articles of war themselves, there are the chemicals of commerce no longer available because of the disrupted economy. In the latter category are numerous chemicals and raw materials previously imported from Germany, England or elsewhere. Research laboratories in the United States have been forced to step quickly into the breach, to develop new processes and products to supply domestic markets.

Fortunately, the Stamford (Conn.) Laboratory of American Cyanamid Co. has already become sufficiently well established to take an active part in this defense effort. In the early thirties Cyanamid executives began thinking about a broader more centralized research organization than then existed in the company. It was thought that such an organization should be set up apart from manufacturing and sales operations. The development of this idea continued through the next few years and in 1936 the first small technical group started work in the laboratory in Stamford, Conn. At that time they probably had no inkling of the character of service they might render to the public in 1940. They were thinking rather of a concerted peacetime policy based particularly on the development of cyanamide as a raw material.

THEN CAME THE WAR

Both the pace and direction of this research program have been varied, however, by wartime requirements. Synthetic rubber as an ingredient of automobile tires and mechanical rubber goods is an example. In 1936 large-scale production of synthetic rubber in the United States was considered a myth—possible but not probable, at least for many years. Today, because of the war in Europe and the threat to our rubber supplies, trucks are now rolling on synthetic tires made in part from acrylonitrile, a product of Cyanamid research. A large-scale plant for this cynamide derivative was placed in operation July 1; plans are already afoot to double its capacity.

Another example is thiourea, $(NH_2)_2CS$, which has been used for many years as a raw material in the manufacture of corrosion inhibitors, synthetic resins and photographic chemicals. It used to be imported from Germany and England, and because the market was not large, there was little reason to establish a plant here. The war changed all that. The market which is now growing because of other cyanamide developments (for example, sulphathiazole) must be supplied from domestic sources.

Cyanamid's Stamford laboratory had seen the handwriting on the wall. The company had been making this compound on a small scale for use in its own resins. Additional pilot plant work was all that was required to establish the process on a large-scale basis. Formerly, thiourea had been made by isomerization of ammonium thiocyanate, which in turn was derived from coal-tar sources.

By the new method calcium cyanamide is reacted with hydrogen sulphide in a reaction entirely analagous to that of calcium cyanamide and water. Both raw materials are cheap; calcium cyanamide, a powder resembling coal dust, is made at Cyanamid's Niagara Falls (Ont.) Plant, and hydrogen sulphide is a nuisance byproduct in the manufacture of rubber accelerators, sulphur dyes and mining chemicals. The new product made in this way is of higher quality than the old. It contains better than 99 per cent thiourea and no ammonium thiocyanate. Previous products often contained as much as 5 per cent of the latter chemical.

Thiourea is now being made on a plant scale at The Calco Division of Cyanamid in Bound Brook, N. J.

RED PRUSSIATE OF POTASH

Still a third example of a chemical that came into commercial production in this country because of the war abroad is red prussiate of potash. For many years potassium ferricyanide, $K_3Fe(CN)_6$, has been a necessary chemical in the blueprinting and photoengraving industries. More recently it has found a market in color photography. Formerly all requirements were imported from abroad, chiefly Germany and the Netherlands. Inasmuch as Cyanamid has been supplying about 85 per cent of the American market with this imported product and because of its position in the field of cyanide chemistry, it decided to produce the chemical domestically.

Preliminary work on the problem was carried out to detemine the most satisfactory method of production. When this had been decided, a definite research program was initiated involving the physics research staff and the pilot plant division. This problem serves as an excellent indication of the value of physical methods applied to chemical problems. In this instance the analyses of complex mixtures of the many ferri- and ferrocyanides were carried out much faster and more accurately by means of photometric methods worked out by the physics staff than could have been possible by standard chemical analyses. As a result of these tests it was established that the double salt $K_2NaFe(CN)_6$ would be more satisfactory than the red prussiate itself.

Laboratory experiments were carried out to determine proper conditions for preparation of the salt from sodium ferrocyanide, a product which is manufactured in large quantities by the Cyanamid company. The yellow prussiate of soda is first oxidized and then treated with potassium chloride. Under the proper conditions the double salt $K_2NaFe(CN)_6$ crystallizes out and sodium chloride is produced as a byproduct. Data on the temperatures, pressures, concentrations, catalytic agents, phase equilibria and other conditions of the reaction were collected in this small-scale apparatus.

PILOT PLANT PRODUCTION

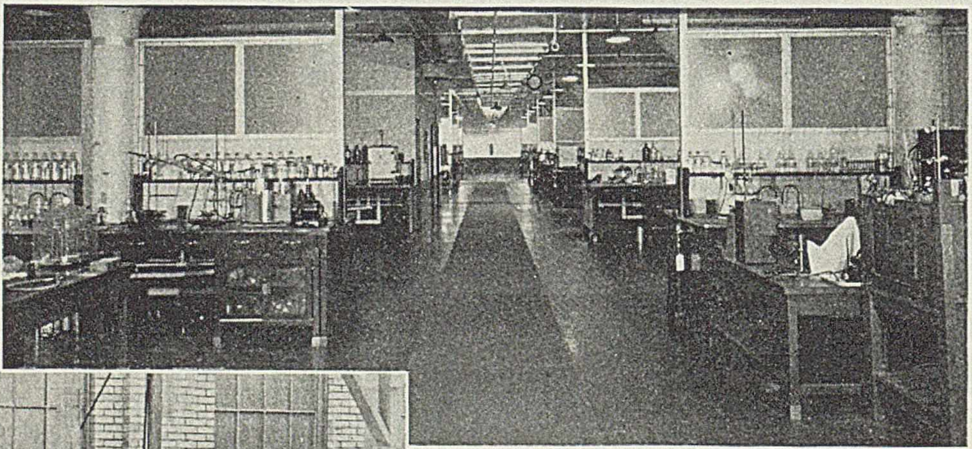
The next step was the building of a pilot plant to produce 300 lb. a day. Naturally, a good many problems were introduced at this point, the solutions of which made necessary some changes in the process. Two of these problems were of paramount importance—selecting materials of construction and determining the rate of cooling to obtain proper crystal size. The solutions handled were extremely corrosive, so much so that only three materials of construction were found to be suitable—glass, rubber and tantalum. It was not only a question of wearing out the equipment, because oftentimes a certain amount of corrosion can be tolerated, but in this case it had been determined by research that even minute quantities of certain impurities would render the product useless for its intended markets.

Tantalum was immediately excluded by the size of the units contemplated. Even glass-lined, jacketed kettles could not be used because they were not obtainable in sizes needed (although glass-lined kettles were used in the pilot plant). The problem was finally solved by using a rubber-lined tank and heating with live steam introduced directly into the solution. Following this step the heat was immediately removed by evaporation in a rubber-lined vacuum crystallizer.

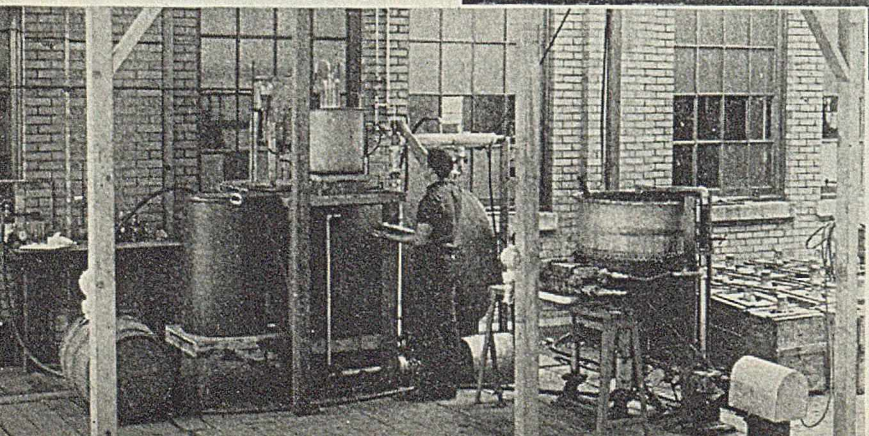
Following a second purification and crystallizing step, the crystals had to be centrifuged, transported in hopper-shaped rubber-lined buggies, and dried in an atmosphere from which reducing gases had been scrubbed. Fortunately, the dry salt is not hygroscopic; so it can be packaged in Fiberpak containers but even here investigation proved that it was necessary to tape the top edges of these drums with cambric to avoid contamination.

HIGH QUALITY PRODUCT

It already has been intimated that the product is extremely pure. In addition, its crystal size is adjusted for dustless handling and quick solubility by regulating conditions in the crystallizer. To the average eye, the

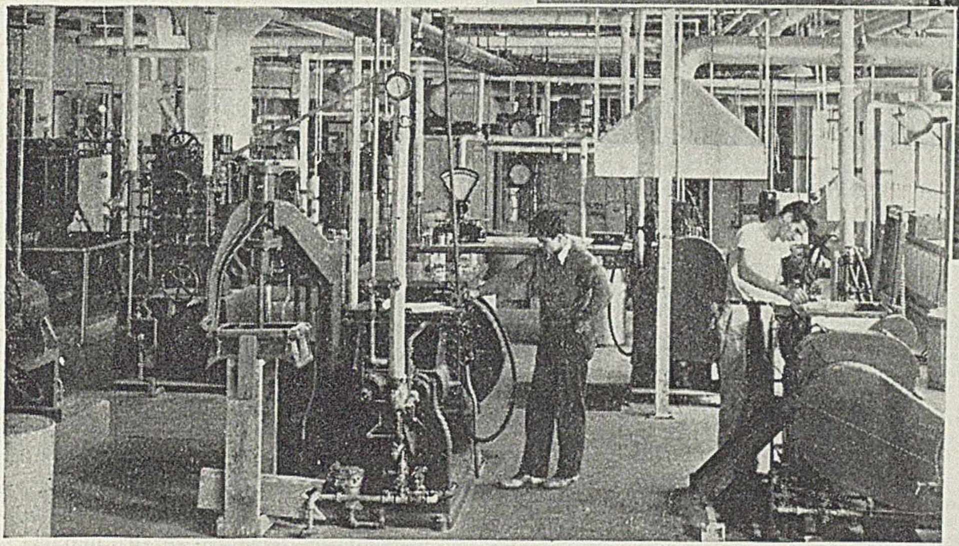


Research as the layman pictures it. This large laboratory with its racks of bottles, flasks and beakers is the chemist's realm. It's open bays inviting group effort contrast sharply with the locked doors characterizing much of chemical industry research



Chemical engineering research is typified in this pilot plant where thiourea is made from cyanamide. Design of a full-scale plant now operating at Bound Brook, N. J. was based on the results of experiments conducted here

Specialized pilot plant equipment in the wet end of Cyanamid's chemical engineering division is shown at right. A multiplicity of controls, ease of assembly, portability and materials of construction are important factors here



Standard equipment also has its place in the pilot plant. Tests conducted on these small-scale replicas form the basis for specifying their large-scale counterparts when designing a plant

product is about the same color as the potassium ferricyanide previously imported. After four months of pilot plant operation a full-scale plant was built for this process.

OTHER NEW DEVELOPMENTS

Aside from the importance of these developments in themselves, they are important because they reflect the resourcefulness of American research workers. It must be remembered that all these processes were perfected within a year, and yet they were far from the only projects of this Stamford laboratory during that period. Actually the chemical engineering division alone worked on 65 different products whose production ranged from 10 lb. on the smallest-scale project to 20,000 lb. on the largest.

Many new products are attributable to the laboratories in the past two years. Dicyandiamide has proved an interesting new intermediate, useful for making dozens of compounds. Certain of the guanidine compounds and melamine are available commercially. They are used in pharmaceuticals, explosives, dyestuffs, resins and other industries. Melamine, the trimer of cyanamide, has unique properties which promise to make it an important addition to both molding and finishing types of resins.

Other new products are a leather bate (an enzyme for digesting the proteins on hides during tanning) and Aero Ac-50, a delayed action accelerator for rubber. Sulphanilamide and sulphapyridine have become important Cyanamid products in recent years. All these are in addition to the products and processes developed to cope with wartime requirements. They are the more orthodox developments for which the Laboratory was built.

ORGANIZING FOR RESEARCH

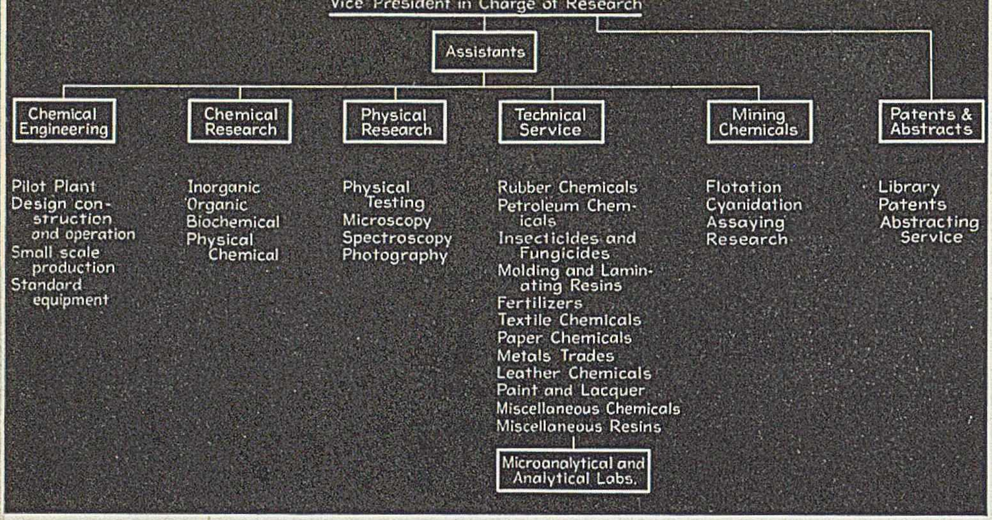
As might be expected, the pilot plant stage (represented here in the chemical engineering division) is really the goal of all research endeavor. It is the final clearing house through which all processes must pass. Here they must prove their worth or be forgotten. Cyanamid's chemical engineering division is on the ground floor of the 5-story modern building and overflows into a small auxiliary building in the rear. Dry operations such as mixing, grinding, drying, rubber compounding and pressing and controlled atmosphere rooms are all in the main building. The auxiliary building, because of its concrete floor and adequate draining and ventilation, is suited for wet operations and processes involving noxious odors.

Equipment used in this department is of two types—standard and special. By standard equipment is meant small-scale replicas of all kinds of standard unit operations equipment such as filters, kettles, mixers, grinders, and stills. Special equipment consists of pieces which have been designed for a specific process or purpose. One day a jacketed stainless steel kettle may be serving as a reactor for some resin, operating at high temperature and pressure. The next day, the same kettle might be chilled with brine to act as a crystallizer in an entirely different process. Much of the equipment is mounted on wheels so that it can be easily moved. Other, larger pieces, are set up as permanent installations. The larger developments are generally carried out in small separate plants designed for specific operations.

Objectives of the pilot plant have been defined by G. H. Foster, who is associated with A. S. Fromholz in directing the work of the chemical engineering division, as the following:

PILOT PLANT OBJECTIVES

1. Development of new processes and products
   a. Establishment of expected yields
   b. Establishment of expected costs
   c. Determination of materials of construction
   d. Provision for adequate control tests
   e. Cooperation with the engineering department in designing new plants
   f. Cooperation with production department in bringing new plants into operation
   g. Observation of health and property hazards
   h. Disposal of waste products
2. Improvement of existing processes
   The sub-classes in this type of project are similar to the above, probably more emphasis being put on materials of construction where newer materials are often capable of substitution for



Organization chart for a research department as used by American Cyanamid Co.

those available when the original plant was built and on the control by instruments of similar more recent development.

3. Production of adequate samples for field evaluation. This is a necessary part of the program for the introduction of a new product. Such samples may be of small poundage or may run into ton lots.
4. Production of sufficient quantities for sale to bridge over the gap between successful field trials and start of production units.
This phase of the operation is also of prime importance and in many cases involves the time of a considerable proportion of the personnel. It often permits a training period for the operators who will subsequently handle the process in the plant.
5. Production of specialty items which never attain a volume justifying installation of plant facilities.

CHEMICAL RESEARCH

So much for the chemical engineering division. But that is only a small part of the Stamford organization. As noted on the accompanying chart there are five major divisions. Chemical research, headed by Dr. L. C. Jones, is the department in which investigations are related to the purely chemical aspects of a problem. Inorganic, organic, biochemical and physico-chemical are the principal classifications into which the work is divided. Also a pre-pilot plant group is a part of this division. Its job is to operate new processes on a large laboratory scale primarily for the purpose of making large enough quantities of the product for further investigations, field tests and other uses. Upon request this group also supplies organic preparations of compounds not available from outside sources, needed by other groups for continuation of their work.

It is in chemical research that new projects are most often initiated. The workers are mostly chemists with only a few engineers, working in groups in large open bays. This fact is significant because it is a marked contrast to some research laboratories where group effort at this stage is strictly taboo and all investigations are conducted behind locked doors.

The physics department, headed by Dr. R. B. Barnes, has two main divisions—physical research and physical testing. The physical testing unit can be considered a small sized Bureau of Standards for the company to carry out all routine physical testing. This involves the use of all tests recognized by the American Society for Testing Materials applicable to the products of interest to the company and new methods of testing which the group is continuously developing. Also in this department are the laboratories for spectroscopy, microscopy, photography and physical testing.

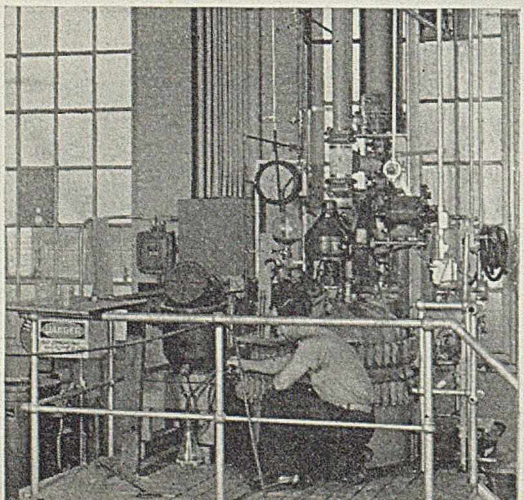
In any chemical manufacturing company technical service plays an important part. A knowledge of the requirements of the industries served and a willingness to conduct research in their behalf aids in promoting good will and oftentimes points the way to new and better products. Cyanamid has chosen to coordinate its technical service with other types of research, but to have it done by a separate organization. The work is divided among twelve laboratories which represent many chemical-consuming industries (see chart). In most cases group leaders for these laboratories have been chosen from the industry served so that they may have first-hand information about that industry's problems. Dr. Norman A. Shepard, head of this department, is a good example. Before coming with Cyanamid, he was for many years director of chemical research for Firestone Tire & Rubber Co. He is assisted by Mr. W. H. Harding, who was for years connected with the paper chemicals division of Cyanamid.

From 25 to 50 per cent of the work of this technical service department arises from customers' problems. The rest is initiated by the staff itself, comes from manufacturing operations or from other divisions of the Laboratory. Technical service maintains analytical and microanalytical laboratories for all the Stamford research organization.

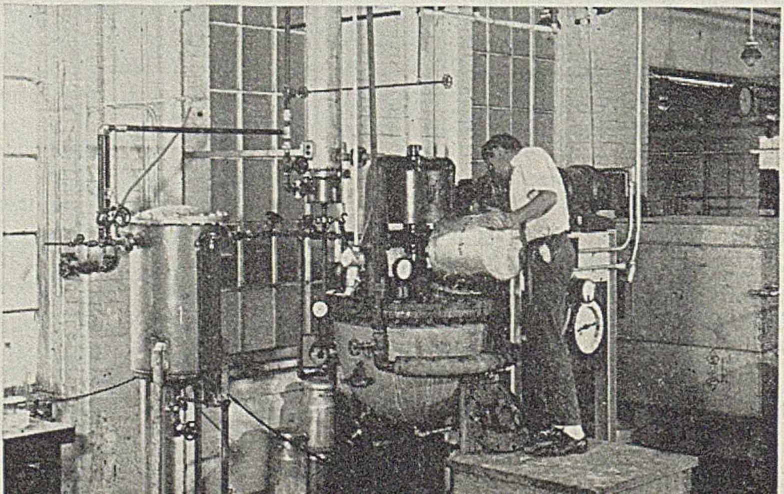
MINING CHEMICALS

A fifth division of the Stamford facilities is concerned chiefly with problems pertaining to the mining industry and is headed by Dr. L. J. Christmann. The history of this group goes back almost to the beginning of the American Cyanamid Co. Experience gained through its years of operation has made Cyanamid undoubtedly one of the largest producers of mining chemicals in the world. Because of its unique experience in this field, the group com-

This glass-lined reaction kettle has many control devices for adaptability to various processes



Resins are cooked in a stainless steel autoclave with water-cooled agitator, quick-opening release valve and automatic controls



bines its own technical service and research work. Problems of milling, flotation, cyanidation, assaying and development of new mining chemicals occupy its attention. Its contacts extend to all parts of the world covering mineral problems as widely diversified as the recovery of gold and the manufacture of cement. This group also spends time on other problems involving cyanamide chemistry but not concerned with mining.

In addition to the above described five divisions, the Stamford Laboratory also houses Cyanamid's patent and abstract division. Strictly speaking this unit is not a part of the Laboratory organization but is rather a unit of the parent company. However, it can readily be understood that because of the relationship between research and patent work, it is highly desirable to have these groups working closely together and this has been accomplished by the utilization of space in the Laboratory building. Literature searches are conducted in the vast library, finer than the libraries of many municipalities. Abstracts of current literature are prepared by a competent staff and circulated to all departments. Legal advice in regard to patents is made available. And finally, the patents themselves are drawn and applied for by lawyers and technologists working together—again a group project. Appropriately, the department is headed by a competent and experienced chemical engineer, Cyril B. Clark.

RESEARCH PHILOSOPHY

But underneath all this physical organization is the one thing that makes the Stamford project what it is. That is its philosophy. It was organized in such a way as to be set apart from the demands and influences of manufacturing operations. That philosophy is carried still further in that its chemists, physicists and engineers are often instructed *not* to consider too much the ever-present dollar sign. They should find out *first* whether a thing can be done, *secondly,* how much it costs. A second part of this policy is that adequate equipment be supplied to each researcher. This means that individual workers find little resistance to their requests for the latest type of equipment or a new kind of raw material. There is no false economy here.

This unique form of organization together with its underlying philosophy has been evolved largely through the genius and foresight of Dr. M. C. Whitaker, the chemical engineer who serves as vice-president in charge of research and development. Dr. Whitaker has always been an advocate of strong organization. Seventeen years ago when he received the Perkin Medal his acceptance address was "Organization—The Keynote of Successful Chemical Production." In referring to the necessity for establishing proper direction and policy for an organization of this kind he said then:

"An organization without proper and carefully defined policies is like a ship without a rudder. It may gyrate around without going anywhere in particular or may, in close quarters, do a great deal of damage both to itself and to its neighbors. Furthermore, a policy should be carefully worked out in the beginning and must 'stay put' . . . If research is to be a part of organization at all, it is entitled to the full benefits of cooperative support of every man in that organization from overhead to office boy."

At the time Dr. Whitaker made this statement he was not connected with Cyanamid, but he must have had in mind that organization's remarkable president William Brown Bell, eminent lawyer and executive, when he said:

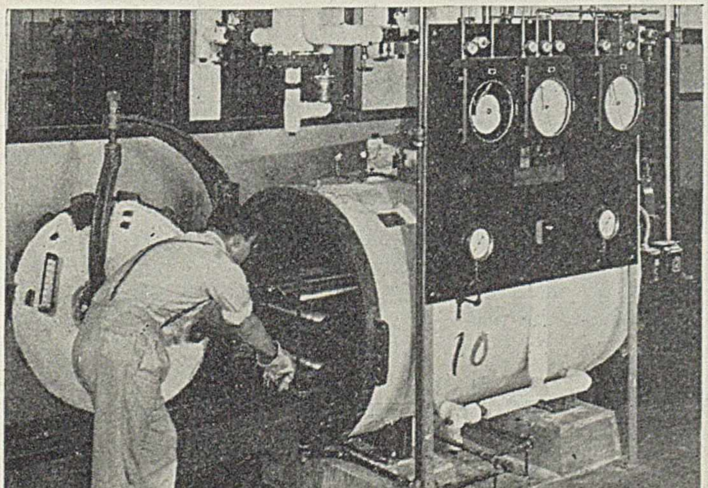
"A president of a corporation or a chairman of a board who reads and understands the research reports, knows and follows the progress of work of every chemist and engineer in the organization, who champions the fellow who is down and encourages the fellow who is up and who interprets these results to his directors, may be a rarity in some programs for the development of chemical production, but in our experience he has been the inspiration. We attribute these conditions to the care we have exercised in the selection and training of our bosses. They doubtless will ascribe it to other reasons."

And in these remarks we find the key to another Stamford policy, one *Chem. & Met,* has touched on many times—group effort. In addition to encouraging free discussion of problems among different research groups, the company has a system for correlating irrelevant ideas, which illustrates the practical application of the policy. Any employee may jot down on a card an idea or suggestion for research that he has no time or facilities to follow. These suggestions are studied, classified and routed to interested departments. If no existing group has jurisdiction over a given suggestion, it goes to a special projects department for analysis and preliminary research. Many of these suggestions later blossom into real research projects.

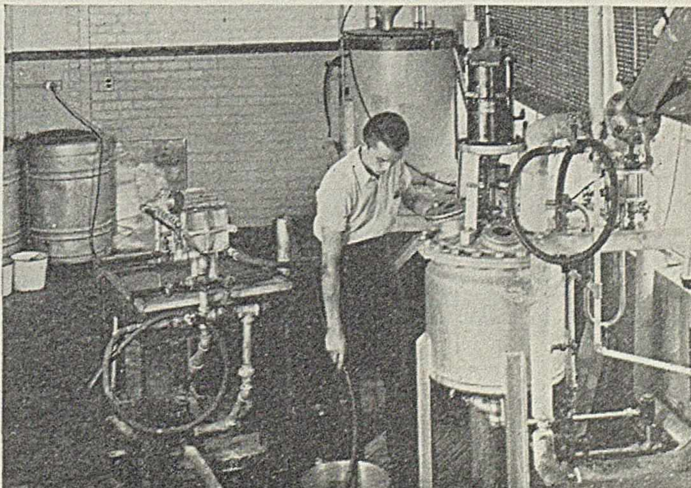
FREEDOM OF THOUGHT

Perhaps the purpose of some of these liberal policies is to free Cyanamid's millions of dollars worth of brains of all extraneous thoughts so that they may concentrate without interruption upon their important scientific problems. If so, there is small wonder that these 400 chemical-minded people, many of them outstanding authorities in specialized fields, have banded together in this gigantic research effort. These men are typical of the thousands of research workers who form America's *real* first line of defense. We look to them to stand ready to marshall their forces for defense just as they have always marshalled their forces for peace.

A recent acquisition at Stamford is this small-scale rubber vulcanizer for testing the effects of various rubber chemicals



Pilot plant reactor for Beetle resins. Note that the kettle is a permanent installation while the filter press is portable



Operation and Management in Making War-Time Chemicals

Plant executives discuss difficulties that management is up against in the great drive for production as plants are mushrooming. New men must be trained quickly to take new responsibilities. New equipment and processes must be made to function effectively. Health of all concerned must be preserved.

No Deviation Advisable

VICTOR L. KING
Technical Director
Calco Chemical Div.
American Cyanamid Co.
Bound Brook, N. J.

America is threatened by serious and determined enemies. While the remainder of our country is busily engaged in setting its various houses in order, it is well that we pause calmly and examine our own manufacturing chemical industries so that we, too, shall not be found wanting.

Perhaps our industry has an advantage in that it was born a generation ago during a similar period that emanated from the same sources. Those undertakings that have survived that ordeal, and still exist, have in that process burned off the barnacles of inexperience and are generally humming with well-organized activity.

We believe that the best service we can give our country now, or in fact at any time, is that of being energetically efficient, thoroughly thrifty, and by doing a good job of making the products we know best how to make. To be all these things is exacting, but the manufacturing of chemical products is an exacting business and no one should be engaged in it who is not prepared to live and act a life of accuracy and precision.

The problems, therefore, that confront those engaged in operating and managing chemical manufacturing undertakings in these times of heightened stress are, for well organized undertakings, not greatly different than they have been.

If we are precise and accurate and are in the habit of studying continuously to develop and perfect manufacturing controls, then we shall be thrifty and not wasteful. Neither time nor materials nor men can be wasted or used extravagantly. Equipment out of order, spoiled lots, inferior quality, wasteful usages of materials, power, or steam was never permissible, but now becomes treason. The chemical engineer's job is clear. It is to maintain steady and uniform output and vigilantly to ferret out sources and causes of interruption, deviation and failure. He should never relax or give up in the effort to devise and develop methods of control. Straws must be on hand to stick in every cake in order to tell when it is done. Throttles must be on every stream of materials. Our life and atmosphere of accuracy and precision must be maintained. There never was a process of chemical manufacturing that could not be speeded up by an indefatigable and open-minded study of time cycles, but unless the habit of adequate, precise and relentless control has been developed and is maintained, the percentage of errors, accidents and inaccuracies is liable to increase.

In the non-technical field, however, new problems or rather old ones in more acute form do now present themselves. Management must be farsighted enough and wise enough to insure adequate and timely supplies of materials and equipment.

The training of operators to replace the men we lend to the draft is a problem of paramount importance. At best we must lose no time at this job because an integral component of the make-up of a good operator is experience and experience takes time; but good men need more than experience—they need enthusiasm. Good training systems will acquaint them with the necessary technical knowledge, but to arouse their enthusiasm is even more important and this should receive the careful attention of all those in executive authority. Men just naturally want to be enthusiastic; and if they are given honest treatment and made to feel they are a part of the team, great dividends in enthusiasm result.

Every chemical company will be asked to make certain materials in a hurry. Most of us remember the wild period 25 years ago when almost everybody who had the boldness called himself a chemical engineer and was gambled on by those with the money to risk. Many were the casualties caused by lack of knowledge, woeful lack of manufacturing experience, and disgraceful lack of honesty, purpose or integrity. We all remember the ghosts of idle and rusting plants that besmirched our land for years afterwards, nearly all of them representing failures of one kind or another.

An important course for management today is to profit by that experience; in carefully sifting the many opportunities and really helping the government and the country by undertaking to make only those things in which one is competent. Greater speed and greater service will result.

The place of the chemical industry in the scheme of adequate national defense does not require or justify any real deviation on account of new problems from the sound principles that have been the basis of good chemical production in peace times. An even stricter adherence of the tenets of good management is in fact needed.

Give Adequate Training

J. L. BENNETT
Manager, Chemical Operations
Hercules Powder Co.
Wilmington, Del.

MANY CHEMICAL PLANTS are operated continuously, so that greater production during periods of emergency or other sudden increased demands for the product, cannot be obtained by operating two or three shifts instead of one.

On account of the value of raw materials and finished products, every reasonable effort is made to obtain and to maintain the highest practical yield of product from the raw materials used. With well trained operators and adequate supervision, American chemical plants are operated at a high standard of chemical and operating efficiency.

During periods of increased demand for the product, and particularly when the demand is urgent, and additional equipment cannot be provided, several problems are posed. To what extent can production be increased by sacrifice in yield or by the use of additional operators? What will be the effect on cost of maintenance? Can the higher rate of operation be established and maintained with the same degree of safety as in more normal operations, and without any new hazards? Can additional operators, foremen and supervisors be adequately trained quickly enough for effective use during the period of greater demand?

It is relatively easy to determine the increase in production that can be obtained at lowered chemical efficiency and to determine the extra cost of operation due to lowered efficiency or by the use of more operators. It is more difficult to appraise the effect on maintenance charges, but careful study during a gradual increase in production rate will guard against excessive maintenance charges or "break down" that might nullify the advantage of the higher rate of operation.

Higher production rates should not be started until and unless every possible increase in hazard has been studied and guarded against. Particular attention should be given to new hazards that might be developed.

New operators, foremen and supervisors should be given adequate training before they are assigned to control chemical operations. In many cases, after preliminary instruction to acquaint them with the more obvious parts of the work, it is preferable to complete the training on the job. This training should be under the guidance of experienced operators, who generally are found to be not only willing, but glad to teach the new man the many details of the operating process. In most chemical operations, a high standard of efficiency is maintained only by continuous and conscientious effort of the operators. It should be recognized that they are actively interested in the work and the efficiency of the operation.

Training of new operators can be very simple. The average American workman is an intelligent person who not only wants to know how to do things, but wants to know how to do them properly. He wants to know the "why" as well as the "how", and he should be told the "why" as well as the "how". Supervisors in direct charge of chemical operations will find their own work much easier and their parts of the plant operating much more satisfactorily, if they respond to the intelligent interest of the operators.

American chemical industry includes an operating personnel which has demonstrated that it is competent to cope with emergency conditions, and in which we can have the utmost confidence.

Increasing Production

T. R. HARNEY
Manager, Engineering Sales Div.
Monsanto Chemical Co.
St. Louis, Missouri

THE PRINCIPAL USE of sulphuric acid in an armament program is as mixed acid for the manufacture of explosives. For this reason the need for acid may be considered secondary to the need for plants in which to use it.

In 1917 there was in the United States a definite shortage of strong acid for munitions manufacture and the Government, as well as private concerns, had to build "war time" plants to meet the deficiency. To the best of my knowledge few of these hastily erected plants survived the war period and the boom immediately following.

In 1940 the situation is somewhat different. There is now a considerable supply of contact acid in the United States and while most of it is being used in peace time operation certain shifts—such as the starting of plants of obsolete types—can probably be made to set free appreciable quantities.

Present activities consist principally of studies to determine the feasibility of installing oleum manufacturing equipment in contact plants now having no oleum production. Also, plants now producing 20 per cent oleum are being studied to determine what, if anything, can be done to produce higher strengths.

Some thought is being given to the possibility of increasing production in existing plants, with or without physical expansion. Also, the question of location of acid supplies with reference to proposed explosives plants is being given some attention.

The general attitude of the industry might be summed up as willingness to render any service needed without eagerness to expand unreasonably beyond peace-time needs.

Preserve Health

H. B. MELLER
Director
Air Hygiene Foundation
Pittsburgh, Pa.

"EMERGENCY" programs are "hurry" programs. With the push for production there may be a temptation to hurry over details of preparation and health protection. The health of workers who produce munitions is as important as the health of those who use them.

It was demonstrated during the last war that increased output is gained through conserving the health and strength of workers by increasing the working force, not by instituting a system of overtime. Increased hours of work—except for short emergency periods—results in a reduced rate of output.

The individual skilled worker is of more than usual importance to industry just now, since he cannot be replaced as readily as in a period of normal production. Problems of fatigue, exposure to potential occupational disease hazards, sick absences from any cause therefore are of greater concern and should receive more than usual attention.

Protective system for control of occupational disease hazards should be checked frequently to see that efficiency is maintained under added burden. Many installations that formerly were adequate will need to be increased in capacity to carry the greater load.

A program of plant expansion is now under way as a result of increased output demands. While buildings and additions are in the planning stage, precious time and money can be saved by giving thought to the necessary health protective devices. Choice of location of machines and men, provisions for protective exhaust systems, substitution of harmless for harmful materials wherever possible are factors which can be determined while building plans are being perfected.

If it is important to maintain the health and strength of workers at a high level, it is of even more importance that foremen and higher executives should similarly protect themselves. These individuals have heavy responsibilities and would be most difficult to replace. It is of highest importance in the interest of the defense program that executives take that periodic rest which is essential to the maintenance of health and energy. Not all occupational diseases are caused by toxic dusts, fumes and gases; among executives, overwork and strain are important causes of heart diseases.

Train Workers

C. R. DOOLEY
Director of Training
National Defense Advisory Commission
Washington, D. C.

THE Advisory Commission to the Council of National Defense has established the "Training Within Industry" service to defense industries in meeting their increasing need for capable workers and supervisors.

The underlying purpose of this activity is: to assist defense industries to meet their man-power needs by training within the industry each worker to make the fullest use of his best skill up to the maximum of his individual ability.

Based upon types of requests for assistance which have been received from industry, the problem of increasing all kinds of skill as needed divides itself into three parts: (1) inventory of present skills, (2) training outside of industry, (3) training within industry.

Conclusions of various recent conferences confirm experience that this training includes three phases: (a) the development of production workers, (b) establishment of trade apprenticeship, (c) the development of supervisors through careful selection.

It is the intention of this organization to render specific advisory assistance to defense industries in inaugurating programs which they will carry on within their own plants at their own expense. The availability of this service will be made known, but will not be compulsory. There will be no authority to go into a plant on any basis other than at their request.

Four general types of assistance will apply in most cases and will be adapted to fit the various conditions in each specific plant.

1. Help in the analysis of the training needs.
2. Aid in setting up a program within the plant to meet its needs.
3. Make available the experience of other employers who have met similar problems through headquarters and field clearance.
4. Acquaint plant management with the availability of the services of tax-supported government agencies, such as the state and federal employment service, vocational and trade schools, engineering colleges, N.Y.A., C.C.C., W.P.A., so that the fullest use may be made of them. Only through the closest coordination and interpretation of the needs of industry to these agencies can they furnish the most effective pre-employment education and experience, as well as related instruction for employed workers.

This field service can be most effectively rendered by representatives of "Training Within Industry" working continuously in local areas of the district in which defense industries are located. Their activities will be carried on under the general direction of a small staff at Washington headquarters, so that the experience in each district will make a contribution to the program as a whole.

The field organization will be set up in some 22 districts: New England, So. New England (Conn. & R. I.), Upstate New York, Greater New York City, New Jersey, Eastern Pa. and Delaware, Maryland, Virginia, N. & S. Carolina, South Eastern States, Ohio Valley, Western Pa. & N. West Virginia, Northern Ohio, Michigan, Indiana, Greater Chicago and Illinois, North Central States, Mo., Ark., Okla. and Kansas, Texas & Louisiana, Colorado & Wyoming, S. Calif., Ariz., N. Mexico, N. Calif., Nev., & Utah, Pacific Northwest.

Design and Construction in Periods of Emergency

Experienced engineers tell of the new problems that must be met in successfully designing chemical plants and equipment under emergency conditions. Simple designs which specify readily obtainable materials help. Advanced welding technic makes for speed. The available supply of brains must be utilized with a minimum of waste.

Sense of Proportion

GUY N. HARCOURT
Vice President
Buffalo Foundry & Machine Co.
Buffalo, N. Y.

WE MUST RESERVE a sense of proportion in this emergency and take steps to prevent allocation of materials and labor to more spectacular defense industries in excess of their ability to use them promptly and effectively, thus causing a shortage in other important industries. Our people will need foods and medicines which are prepared in equipment built of stainless steel or other materials. Equipment manufacturers should not be deprived of these materials or made to wait too long for them to be delivered while they accumulate in warehouses in anticipation of their use in more warlike machines.

If a demand for large numbers of skilled mechanics is anticipated, steps should be taken by those responsible for our defense to train as many men as will be required so that private industry will not be depleted of the mechanics which have been trained in private industry.

We are being made to realize by each succeeding day's news bulletins from Europe, that wars today are between peoples and not armies. If the strength of the people is to be maintained at its highest pitch, provisions must be made to keep them supplied with those things which are necessary for their health and well-being.

Simplify Designs

T. C. GARY
Manager, Design Div., Engineering Dept., E. I. du Pont de Nemours & Co. Wilmington, Del.

SUCCESSFUL design of chemical plant and equipment under the emergency conditions must conform to basic principles and should use all available knowledge. Opportunity for experimental work to prove new ideas will be limited or absent. A sudden call to design in an emergency, after designing under normal conditions, necessitates an immediate and abrupt change in customary attitudes and methods. The difficulty of changing habits of long standing must be fully recognized. In normal times the designer strives for the maximum effectiveness which can be justified at reasonable cost. Time is paramount in an emergency. "Let well enough alone" should be the constant guide.

Standard parts or pieces of equipment, constructed of the most readily obtainable materials, perhaps unacceptable under normal conditions, should be given every consideration. Modifications in standard designs should be made only when unavoidable and special designs prepared only when unquestionably necessary.

The minimum number of the simplest drawings should be made for conveying necessary information to the shop and construction forces in the field. When proper care is exercised to avoid errors in basic design, the small extra cost which may be incurred for field alterations and additions resulting from use of abbreviated drawings, will usually be found negligible when the advance in time of commencement of shop and field constuction and hence completion of the plant for operation is realized. This is particularly true of chemical plant equipment in comparison with that used in the mechanical industries. Piecemeal issue of drawings in the sequence required by shop and field is essential to maximum speed.

The size of the engineering organization available when an emergency occurs need not determine the relative volume or complexity of work which may reasonably be undertaken, nor the degree of performance to be expected. The volume of work handled by a group of engineers may be materially increased by relieving the experienced men of the last vestige of unimportant routine.

Capable engineers and designers recently added to the group and unfamiliar with the methods and practices of the organization should, whenever possible, be given assignments of a specialized nature requiring a minimum of broad coordination so that their greatest value may become immediately effective. Customary rules and regulations should be, whenever possible, temporarily discontinued.

Simple designs which specify readily obtainable materials will influence early completion of construction more than any factor which may be entirely within the control of the shop and construction forces. Frequent visits by the designers to shop and field during construction increases in importance during periods of emergency.

It may be expected that those called upon for responsible direction of design in an emergency will have made reasonably complete tentative plans in advance. Such plans should provide for adequate working facilities; elimination of all unessential refinements in design which have no place in an emergency program; relief of experienced designers of routine work; and lastly, when other means have been exhausted, an extension in hours of employment but then only after careful consideration of the probable increase in total effectiveness which may be obtained, particularly when it is probable design under emergency conditions may continue for any length of time.

Welded Structures

ALBERT S. LOW
Vice President
The Austin Co.
Cleveland, Ohio.

IN THE FACE OF NECESSITY for speedy expansion of production facilities, recent steps toward simplifications of building design and advanced welding technique are particularly significant. With so many of the elements in total defense dependent upon increased production of basic chemicals and chemical products, any steps which will help meet the demand for record construction speed warrant attention.

The large proportion of shop fabrication now obtainable in welded structures suggests one way to meet this situation. While field work is subject to delays caused by unfavorable weather—fabricating shops can operate 24 hours a day whenever necessary.

Welding makes it possible to keep buildings entirely free of inaccessible surfaces which, in most chemical plants, would be subject to corrosive attack and could not be protected without great difficulty and expense. The various sections used in welded construction can be joined by continuous welds so that even the space usually existing between lapping members is completely eliminated.

Eliminate Restrictions

C. L. EMERSON
Vice President
Robert and Co.
Atlanta, Ga.

PROBLEMS now arising in construction are largely correlated with speed of production, which will undoubtedly be affected by the setting of priorities by the federal government. It is incumbent upon the industry to watch carefully, and make it plain to the authorities establishing these priorities the importance of heavy chemicals and specialized products in national defense, to the end that restrictions be not put upon the industry which would hamper or cripple it in meeting the immediate demands of the program, or development of new benefits to this program and to future welfare of the nation.

It is, of course, vital that expansion of chemical facilities should be done in a careful manner, but at the same time, industry can not afford to lose a day in effecting such expansion. While it is true that thorough planning for an adequate volume is a grave necessity, it is equally true that an intensive and energetic effort must be made to formulate and carry out these plans in the shortest time possible.

Conserve Brains

W. F. RYAN
Stone & Webster Engineering Corp.
Boston, Mass.

AT THIS juncture money is about the most plentiful commodity. Time seems woefully inadequate but there are still 24 hours in a day. The number one scarcity is brains, and the available supply must be utilized with a minimum of waste. Organizations which have been wise enough to train and retain a large number of experts during the less prosperous years are in a fortunate position. Plaintive ads for "experienced engineers" receive no answers.

Effective use of our limited supply of brains requires sane planning. We must face the facts that manufacturers can not be rushed either for quotations or deliveries, and set up our design and construction schedules accordingly. We must be satisfied with good solutions to our problems and not strive endlessly for perfect ones. We must utilize existing designs for equipment wherever feasible, even when a new design might, if it works, increase yield or reduce cost by a fraction of a per cent. We must not load upon process engineers structural and electrical designs which require specialized training in a particular industry, or burden them with problems of steam, water and power supply. We must not waste their time on office routine that can be handled adequately by non-technical help, and thought should be given to greater utilization of technically trained women. Also, we should appreciate that this emergency will be of long duration, and time must be taken to train our junior engineers for greater responsibilities, even though this procedure may appear to be costing time in the months immediately ahead.

Money, materials, man power, even time, are available to meet all requirements of national defense if we conserve our brains.

Avoid Specialties

J. R. ALTHER
Vice President
Universal Oil Products Corp.
Chicago, Ill.

SPEED IS A PRIME NECESSITY for construction of plants to meet emergency conditions—speed, coupled with extreme carefulness. To promote speed it is most desirable that specifications for materials of construction be as few and as simple as possible.

Units must be built rapidly for essential processes. The ideal materials are not always at hand when needed. Steel mills prefer to concentrate on the more common commercial lines, quantity production lines, rather than on specialties which require changing over equipment.

The ingenuity and resourcefulness of process, design and construction engineers are called into play to make use of materials which, though not ideal, are immediately available and which can be used at once, speeding up the work without creating hazards.

Under emergency condition, it is advisable to use standard valves and pumps instead of designing special equipment which may be better but for which new dies, castings and tools must be made. Good judgment and experience will indicate where specifications may be safely relaxed and material substituted to save time.

The following will greatly speed construction of equipment and getting it into operation:

1. Quick decisions as to the most practical and serviceable processes.
2. Commercialization of new processes from laboratory to plant operation whenever possible without going through pilot plant stage to obtain engineering factors for design, even at some sacrifice of results.
3. Revising normal strict specifications in order that greater quantities of products may be produced sooner.
4. Improvement of information on properties of alloys required for special service—and possible substitute materials.
5. Increasing number of skilled designing engineers and draftsmen for efficient plant layout and mechanical details.
6. Encouraging engineers and technologists to stay at the work in which they are experienced and skilled rather than transfer to other fields where valuable time must be taken to train them.

New Equipment

WALTER GEIST
Vice President
Allis-Chalmers Manufacturing Co.
Milwaukee, Wis.

IN SPITE OF increased production schedules now being required at the Allis-Chalmers Co's. various plants, every effort is being made to maintain reasonable delivery for equipment orders. This is being done not only by increased personnel and more shifts where feasible, but also by making maximum use of machine tools now in operation. While no unusual increase in plant facilities has taken place, a normal program of plant expansion over a period of years now makes a greater flow of production possible.

In spite of its increased activity, engineers are developing new and improved equipment to better meet the increased needs of the country in this time of emergency. One recent development of particular interest is a new design of motor driven centrifugal pump. Another development has to do with the welding of thin gage, stainless steel sheets and other alloys which hitherto could not be welded satisfactorily without destroying many of their vital properties. This month a junior size low-current electronic arc welder is being added.

Problems of Industry

HAROLD K. FERGUSON
President
The H. K. Ferguson Co.
Cleveland, Ohio

MOST of these recent developments in the chemical industries have been for peace-time products. However, many are even more valuable for the defense program. As a result, the chemical industry, with the exception of explosives, is in generally good condition at this time. But, several outstanding problems now confront it:

1. Granting delay and great expense incidental to rush design and construction of new chemical plants at this time, how can the need for such work be kept to a minimum?

Part of the answer seems to be by stepping up existing facilities to greater capacities, by quickly accomplished changes and improvements. This method involves a careful survey of the possible allotment of increasing amounts to government requirements, with proportionate reductions to private industry for the period of emergency.

2. All the above is necessary if the chemical industry is to solve its second problem, i. e., avoidance of heavy increases in numbers, and wider variation in products, of government owned and operated plants.

3. Once a decision has been reached that new plants are required, there arise added problems.

(Please turn to page 784)

Chemical Munitions Plants

A Lesson in Economic Geography

A. ROBERT GINSBURGH *Lt. Col., War Department, Washington, D. C.*

Chem. & Met. INTERPRETATION

Power needs, transportation facilities, labor requirements, availability of raw materials, waste disposal problems—all of the factors involved in the selection of a site for any chemical plant must be taken into consideration in locating a munitions plant. But in addition, as the author points out, there are numerous special requirements which must be fulfilled and problems to be solved before munitions will be available in sufficient quantities to meet the needs of an army of two million men.—*Editors.*

"Here is $750,000,000. Go out and get yourself some munitions plants and get them in a hurry. You must produce enough guns, enough tanks, enough planes, enough powder and enough other military ingredients to meet the wartime needs of an army of two million men as soon as possible."

Quite an order! But that in substance is what the American people through the President and their duly elected representatives in Congress have given the War Department.

Munitions plants, however, are not available in American markets. We have neither Krupps, nor Schneiders; neither a Skoda Works nor a Vickers Armstrongs Limited. We have no munitions industry in the European sense at all. What few civilian plants we have already have more orders from Great Britain and our own armed forces than they can fill with their present capacity. As for our arsenals they are primarily laboratories, and even now on a 24-hr. basis are unable to meet even ten per cent of the munitions load of a major emergency. Moreover, unlike 1917-18, we can not buy munitions abroad.

We are compelled, therefore, to build from the ground up. By converting ploughshare factories into spear plants, America's ingenious industrial system can meet a great part of the present demand in armaments. There are some critical items, however, for whose production there is little or no counterpart in the American industrial pattern for which new facilities will have to be created. Where should these new plants be located?

To help its own officers in their quest for satisfactory sites and American communities in their efforts to interest the government in their localities, the War Department recently drew up a guide outlining the factors that must be taken into account.

Paramount is the consideration of speed. The location should be such, other factors being equal, as to assure earliest possible production. In the selection of the Detroit area, for instance, for the tank factory to be built and operated by the Chrysler Corporation for the War Department, the promise of greater speed in delivery outweighed every other consideration.

The site must include not only available space for initial construction but room for possible future expansion. Who can foretell what we may be in for? What may be sufficient to meet our program in spite of its magnitude today may prove inadequate at some tomorrow. Better always to expand existing facilities than to search for sites for new ones!

The area should be reasonably secure from long range bombing operations. The prospects of an air attack upon American cities to some people may seem rather remote, but what of tomorrow? No one who has followed the dynamic development of aviation would venture to rule out such a possibility; and now that we have set out on an armament program for the first time in the peacetime history of our country, we do well to think of tomorrow. In the selection of factory sites, the War Department, therefore, has given great consideration to the geographical factor and has placed it second only to the paramount matter of speed. It has ruled out an area of 200 to 250 miles from the geographical boundaries of the United States. Within this restricted zone, new government plant construction will be kept down to a minimum.

New plants will be distributed geographically so as to avoid adding any more than is necessary to the existing concentration in limited areas of industry essential to the national defense. In 1917-18, munitions production was concentrated chiefly in an area resembling a triangle extending from Boston to Pittsburgh to Wilmington. As a result, critical problems of power and transportation developed which threatened to upset the whole armament program. The plan today is not only to get new plants outside of this industrial triangle, but to minimize the danger of setting up similar congested triangles in other parts of the country. The idea is to distribute the load as far as possible throughout the country as a whole.

In the interests of safety, it is extremely important to avoid congested areas for certain types of munitions factories; and in the selection of sites for ammunition plants, this factor must be watched carefully.

The War Department is anxious to avoid wholesale migrations of labor with the loss of time and effort that they entail. Officers looking for sites are therefore advised to take into consideration the availability of unemployed labor in the vicinity.

The availability of raw materials at not too great a distance is another factor; not only to minimize the expense of their moving but to keep down the needs for the transportation of the finished products.

As for transportation, the War Department requires ample rail facilities connecting with at least two independent systems, and the availability of good roads for heavy trucks and passenger traffic.

In every area, special care must also be taken to see that it is free of gas, oil and water lines, as well as mineral deposits, and assigned mineral rights.

In addition to the above factors that should apply universally to all munitions plants, there are others peculiar to the nature of the item that must be given additional consideration. Let us consider first those pertaining to chemical ordnance sites.

SMOKELESS POWDER PLANTS

Sites for smokeless powder plants require a space of approximately 6,000 acres, of which 2,000 must be on level ground. They call for supplies from nearby sources of cotton linters or wood pulp, nitric acid, alcohol, ether, and other solvents. There is a need for coal and water in great abundance. The latter is needed not only for manufacturing purposes but for fire fighting. They should have at least one extra source of water supply in case the primary system breaks down. The availability of sufficient electric power is another important factor.

Spent acids, wash liquors and other waste materials in large quantities result from the operation of smokeless powder plants, and facilities for their disposal also must be considered.

The demand for labor in such plants is principally among the semi-skilled and unskilled. They should be available within a reasonable commuting distance, within a radius of about twenty-five miles. Metal workers, lead burners and those engaged in subsidiary trades in smaller numbers should also be available in the vicinity of the plant.

At the time of this writing, two smokeless powder plant sites have been selected. Twelve miles from Louisville, Kentucky, near Charlestown, Indiana, E. I. DuPont de Nemours and Company has broken ground on a project that will cost more than $50,000,000. Near Radford, Virginia, a similar project running to about $35,000,000 is under way with the Hercules Powder Company in charge.

Both projects are on a cost plus fixed fee basis. The company builds the plant, operates it and is reimbursed for the cost. It receives a fixed fee for each job which can not exceed seven per cent of the cost. Title to the property vests in the Federal Government.

EXPLOSIVE PLANTS

Except for the raw materials, the requirements of explosive plants in general follow those of smokeless powder manufacture. The special needs at not too great a distance are for toluol, diphenylamine, phenol, natural gas or other hydrocarbons; nitric and sulphuric acids. Sites selected so far are:

1. Wilmington, Illinois, for TNT, DNT, and tetryl plants. The job of constructing one of the explosives plants has been awarded to the Stone and Webster Engineering Company at approximately $10,863,000. Contracts for construction of the other explosive plants had not been signed at the time of this writing. The DuPonts have been awarded the production contracts, which will run to about $17,670,000. The financial arrangements follow the same pattern as noted before.

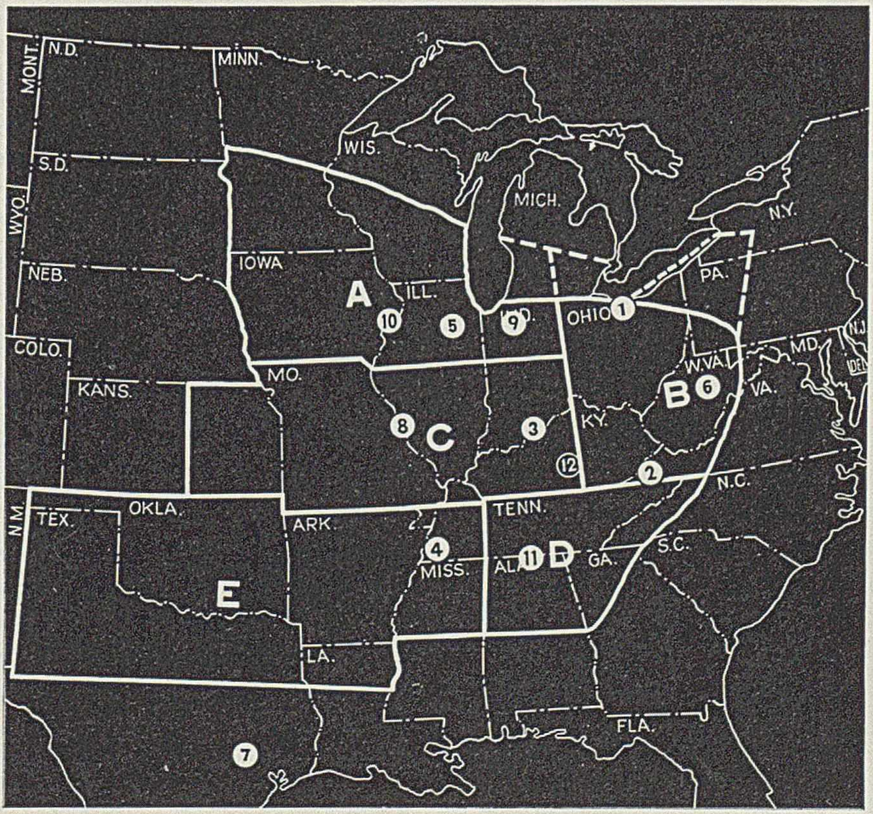
2. At Welden Springs, near St. Charles, Missouri, a TNT plant to be operated by the Atlas Powder Company at a cost of approximately $6,390,000. Negotiations for the construction of the plant were in progress at the time of this writing. The financial arrangements are the same as for the Wilmington plants.

3. At Baytown, near Houston, Texas, a toluol plant to be constructed by the Humble Oil and Refining Company, at an approximate cost of $10,760,000 on a cost plus

(Please turn to page 784)

Sites of 15 Government Defense Plants

(1) Ammunition loading, Ravenna, O. (2) smokeless powder; bag loading, Radford, Va. (3) smokeless powder; bag loading, Charlestown, Ind. (4) smokeless powder (British Commission), Memphis, Tenn. (5) TNT-DNT; ammunition loading, Wilmington, Ill. (6) ammonia, Morgantown, W. Va. (7) toluol, Baytown, Tex. (8) TNT-DNT, St. Charles, Mo. (9) ammunition loading, Union Center, Ind. (10) ammunition loading, Davenport, Ia. (11) ammonium nitrate, Muscle Shoals, Ala. (12) ammonia, Ky. Additional TNT and tetryl plants are expected



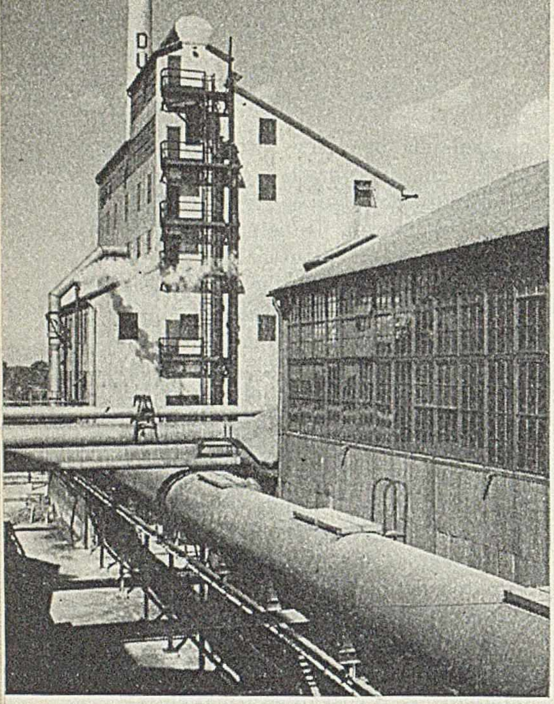


Fig. 1—Durez distillation building in the rear, first stage converter building at the right

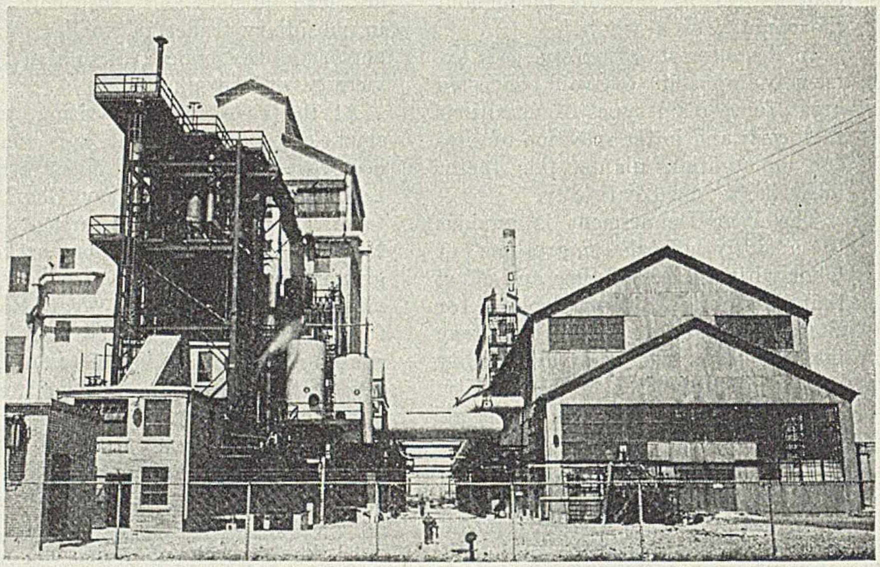


Fig. 2—General view of new Durez synthetic phenol plant, with benzene converter building at the right and extraction building at the left

Phenol Made by Vapor Phase Regenerative Process

THEODORE R. OLIVE

Associate Editor, Chemical & Metallurgical Engineering

SYNTHETIC PHENOL made by a new process so efficient that it yields less than one-tenth pound of byproducts for each pound of phenol is now being produced at the rate of over 15,000,000 lb. per year in a new plant recently put into operation by Durez Plastics & Chemicals, Inc. Situated at North Tonawanda, N. Y., the company has been engaged since 1921 in the manufacture of phenol-formaldehyde plastics and is now the country's largest independent producer of such materials. Successful synthesis of better than U.S.P. phenol by the new process assures Durez of its supply of this most important of the raw materials required. Further than this, the possibility of pushing the plant to considerably more than its rated capacity promises availability of phenol for munitions use, if a shortage should later develop.

The process, which employs hydrochloric acid as an intermediate in what is virtually the direct oxidation of benzene to phenol with air, is one that "couldn't work." Nevertheless it *did* work as was shown in 1934 at the Dr. F. Raschig G.m.b.H. of Ludwigshafen am Rhein, Germany, where it was put into successful operation by its inventors, Drs. W. Prahl and Wm. Mathes. Offered in the form of an exclusive United States license to Durez in 1937, the process was thoroughly investigated at Lugwigshafen by Robert M. Crawford, Durez production manager, who became convinced of its feasibility and recommended its adoption. Despite the slump of 1938, the company decided to go ahead with the $2,000,000 program which would be involved, and design and construction started early in that year with the assistance of one of the inventors, Dr. Prahl. As finally completed this last Spring, the plant has approximately four times the capacity of the German installation and improves on it in many respects. Entirely without assistance other than from the inventor, the complete job of design of both equipment and buildings was carried through by the Durez staff, with results which fully justify the com-

Chem. & Met. INTERPRETATION

With the successful operation by Durez Plastics & Chemicals, Inc., of the vapor phase regenerative chlorination process for phenol production, this material is now being made in the United States by three different syntheses. Contrasted with the older sulphonation and liquid phase chlorination methods, which make 2 to 5 lb. of byproducts per pound of phenol, the new process produces less than 0.1 lb. As described here the steps in oxidizing benzene to phenol by the Raschig method make an illuminating story of chemical engineering accomplishment.—*Editors.*

pany's pride in the new achievement.

Lest it be assumed that a process which oxidizes benzene to phenol with air is a simple one, it should be stated here that the carrying out of the two principal reactions is decidedly complex. Opportunities for loss exist at numerous points and the entire process consists of a series of overlapping cycles which made it all the more difficult to devise a simple and flexible method of control. Nevertheless this was done by unique design and with the help of numerous automatic instruments. In normal operation the yield is almost phenomenal, and there is little work to be done by the seven operators and one supervisor per shift who run the entire plant.

In this connection an ingenious expedient was to select the 12 critical points of operation where trouble might most quickly originate, and install at each such point an automatic signalling alarm which calls the operator and at the same time registers on a panel board in the laboratory. Provision of complete toilet facilities at each such critical operating point leaves the operator no excuse for being away from his station. At the same time, the laboratory alarm system, shown in Fig. 4, assures him of immediate help from the supervisor in authority who goes to the point of trouble when the alarm sounds.

Another striking difficulty in the design problem, as would be expected in a process employing HCl in both the liquid and vapor states, was that of averting severe corrosion. To the solution of this problem went large amounts of chemical porcelainware in the form of pipe, valves and raschig rings, together with Pyrex glass tubing and chemical stoneware tower linings and packings. Copper pipes and condensers were used at one point, high-temperature-resistant chrome alloy tubes at another, and nickel for the handling of pure phenol from the final condenser to the point of use. Several glass-lined tanks were required and 32 tantalum bayonet heaters. Pumping of acid solutions was handled by centrifugal pumps of both glass and Hastelloy B. Fortunately, however, a large part of both the piping and equipment could be of steel, all of which is welded.

As will be evident from the detailed description which follows, most operations of the process, including fractional condensation, distillation and extraction, are carried out in large towers packed with chemical stoneware or porcelainware raschig rings. Where protection from corrosion is required, the towers are lined with chemical brick, set in silicate cement. New methods of distribution of the small amount of liquid put over most of the towers, made the packed type efficient even for the distillation, thus avoiding corrosion problems and the great heights that would have been required with bubble tray towers. One incidental advantage was that this made feasible the housing of the entire plant, a necessity with the low melting materials in the process, especially in the severe climate of northern New York.

The process is in two stages, in the first of which monochlorbenzene is produced by the action of a catalyst according to the reaction:

$$C_6H_6 + HCl + \tfrac{1}{2}O_2 = C_6H_5Cl + H_2O$$

In the second stage, the monochlorbenzene is catalytically hydrolyzed with steam to yield phenol and regenerate the HCl according to the reaction:

$$C_6H_5Cl + H_2O = C_6H_5OH + HCl$$

Thus, neglecting losses, all HCl used in the first stage is recovered in the second, and the combined reactions may be expressed as:

$$C_6H_6 + \tfrac{1}{2}O_2 = C_6H_5OH$$

High as the efficiency of the process is, there is still some byproduct production. In the first stage something less than 1/10th lb. of polychlorbenzenes is produced per pound of phenol, together with small quantities of CO_2 and CO. Decomposition in the second stage yields traces of diphenyl compounds in addition to the regenerated HCl which is returned to the process. Operating on a closed cycle, the HCl in the process of course picks up impurities and so must be purged continuously, resulting in a small loss of acid from this source, as well as from that which is carried out in the polychlorbenzenes formed.

To facilitate an understanding of the detailed process, the accompanying "flow map" of Fig. 5 has been devised to emphasize the interlocking cycles of which the process is composed. Actually, several minor operations and cycles have been omitted from the map in an effort to simplify it, but these omissions do not seriously affect the discussion. The map comprises a number of different operations, all of which are identified in the key to the drawing. Connecting the various operations are five kinds of coded lines representing the principal reacting materials and their products, as is also

Fig. 3—Chemical porcelainware valves play an important part in the process, with more than one hundred in about a mile of porcelain pipe

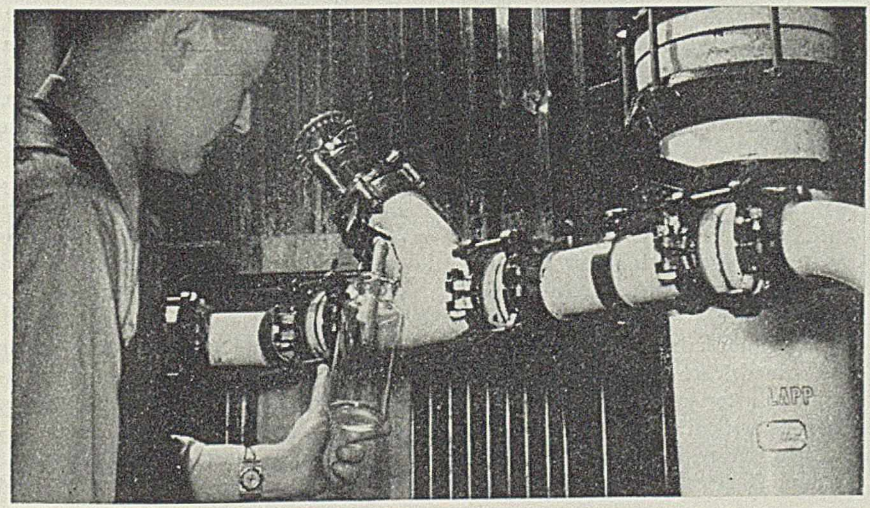
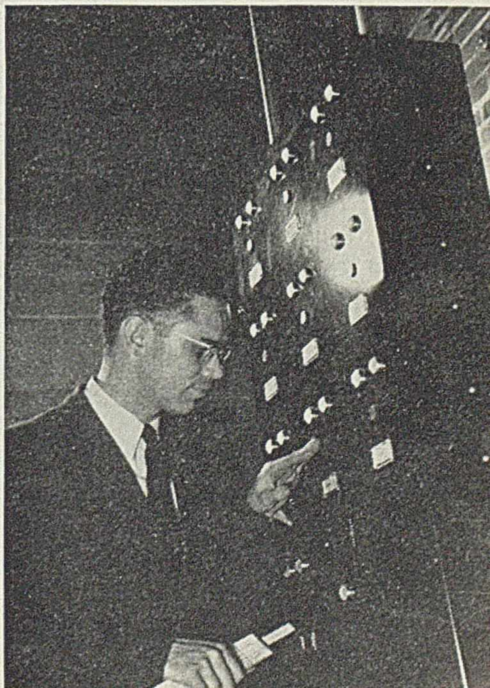


Fig. 4—Central panel where troubles at critical points are signalled to the supervisor



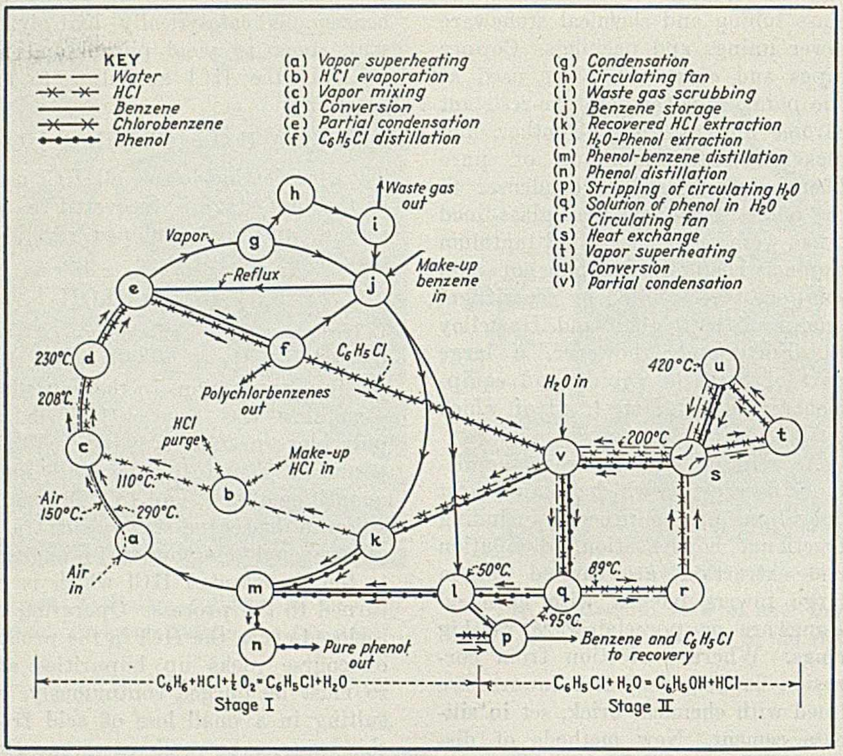


Fig. 5—"Flow map" of new Raschig regenerative synthetic phenol process (for illustrated flow sheet see pages 789 to 792.)

shown in the key. Not shown are such materials as N_2, CO, CO_2 and traces of diphenyls formed, but the paths of these components can readily be inferred. The left portion of the diagram, as indicated by the equation below it, is the first stage of the process in which the intermediate material, monochlorbenzene, is formed. Similarly the right portion of the diagram is the second stage where phenol is produced and HCl regenerated for return to the first stage. The principal cycles are the first stage benzene cycle and the second stage chlorobenzene cycle. Connecting the two stages is what might be called the "chlorine" cycle in which the chlorine sometimes appears as HCl, sometimes as C_6H_5Cl.

(Note: For a pictorial type of flow sheet with accompanying views of much of the equipment used in this process, see this month's *Chem. & Met.* Pictured Flow Sheet insert, pp. 789 to 792, this issue.—*Editor.*)

STAGE I PROCESS

Owing to the cyclical nature of the process, a description of its various steps might start equally well at any one of several points. Perhaps the most convenient, however, is the point designated (*a*) on the flow map. This is an oil-fired vapor superheater which is also used in Stage II and will be described completely at a later time. Here some 42,000 lb. per hr. of benzene vapor is heated to 290 deg. C. Air to the extent of about 3,000 c.f.m., drawn in by fan (*h*), is heated in another section of the superheater to 150 deg. C. and the two streams enter a vapor mixer (*c*) where they meet and mix with hydrochloric acid vapor from a group of four acid evaporators shown at point (*b*). These evaporators (Fig. 6) are acidproof-brick-lined steel vessels about 6 ft. in inside diameter by 5 ft. high, each provided with eight tantalum bayonet type steam heating elements. The evaporators handle about 8,000 lb. per hour of recovered 15 per cent HCl to which some 400 lb. per hour of 33 per cent make-up acid is added. Acid flows in series through the four, with the vapor from each discharging through a rubber-lined pipe into the top of the vapor mixer. The average vapor concentration from the four evaporators is slightly less than the 20 per cent of the constant boiling HCl mixture. To purge the acid system of accumulated impurities a small stream of acid from the fourth evaporator flows continuously to a storage tank, to be neutralized once a day and discarded.

The vapor mixer (*c*) is a vertical brick-lined steel shell about 4 ft. in inside diameter and 15 ft. high, packed with helical tile and discharging near its bottom to an insulated steel line running to an adjacent department where the first stage converters are located. The converters (*d*), of which there are five (one a spare), are of novel construction designed to carry away the heat of the exothermic reaction in air which is later used to heat the second stage reaction materials in (*s*). The converters are of steel, of a cellular construction in which the alternate cells are packed with a granular inorganic catalytic material. Air passages between the packed cells are connected into a closed cooling-air circuit containing a large fan. If the air leaving the cooling passages did not go above the desired operating temperature of about 230 deg. C., the air would simply circulate through the fan and back to the cooling passages. A temperature controller is provided, however, to admit a portion of outside air to the fan suction if the temperature should tend to increase. Hence outside air is always drawn in, in proportion to the cooling demand of the process, while an equivalent amount of heated air leaves the converter for second stage heating.

In the converters about 10 per cent of the benzene reacts to form monochlorbenzene, while a small amount forms polychlorbenzenes or is oxidized to CO and CO_2. To insure against excessive oxidation, CO_2 indicators are provided for each converter, each equipped with alarm contacts. The mixture of C_6H_5Cl, N_2, CO, CO_2, H_2O and polychlorbenzenes leaves the converters at the top and passes through large insulated steel ducts to a partial condenser (*e*), refluxed with liquid benzene and water, where the chlorobenzenes are condensed, while the unreacted benzene passes on to a series of final condensers (*g*). The partial condenser (*e*) is a steel tower equipped with a brick lining and raschig ring packing, 10 ft. 6 in. in inside diameter and 45 ft. high. At the top are a copper vapor offtake and copper distributing pipes for the benzene which is used to reflux the tower. At the bottom a porcelain line discharges the condensate, consisting of about equal parts of benzene and chlorobenzene, plus water containing a little acid. This mixture is gravity separated to remove the acid water, and the crude chlorobenzene layer is washed with NaOH and water, and distilled at (*f*) for the separation of benzene, monochlorbenzene and polychlorbenzenes. The first returns to the benzene circulating system at (*j*), the second is stored prior to use in Stage II, and the third is stored for eventual sale as a byproduct. Two stages of distillation are employed for this operation, the stills being raschig-ring-packed steel towers equipped with external steam-heated evaporators.

The final condensers (*g*) for the unreacted benzene are of copper shell-and-tube construction, six in number, arranged in two parallel rows of three in series, as shown in Fig. 7. All of the cooling water for the plant goes first through these condensers to secure the lowest possible condensing temperature. The benzene condensate flows to the benzene circulating tanks (*j*). The tail gas, still containing considerable benzene, is exhausted by the 4,000 r.p.m., 36-in. fan (*h*), which holds the preceding equipment under subatmospheric pressure, maintaining a suction of 50 in. w.g. at its intake, and is delivered to a recovery system (*i*) consisting of a wash oil scrubber (Fig. 7), close-circuited with a continuous still for recovery of the hydrocarbon wash oil and return of the recovered benzene to storage at (*j*).

The remainder of Stage I can only be described on the assumption that the products of Stage II, namely phenol and regenerated HCl, have already been accounted for. From the acid recovery tower (*v*) in Stage II, a 15 per cent HCl solution is recovered, containing about 5 per cent of the total make of phenol. The balance of the phenol make is separated as a water solution in scrubber (*q*) and both products are extracted with benzene in the countercurrent extractors (*k*) and (*l*). The recovered acid with its small burden of phenol passes in series through three extractors (*k*), each 36 in. inside diameter and 36 ft. high, built of brick-lined steel and packed with raschig rings. Each is supplied with benzene near the bottom, which is drawn off with its dissolved phenol near the top. The acid, discharging near the bottom, flows in at the top of the next lower extractor in the series. To guard against the possibility of acid getting into the benzol extract of phenol, a conductivity alarm is provided to sound a warning if the electrical conductivity of the extract outlet stream should become appreciable.

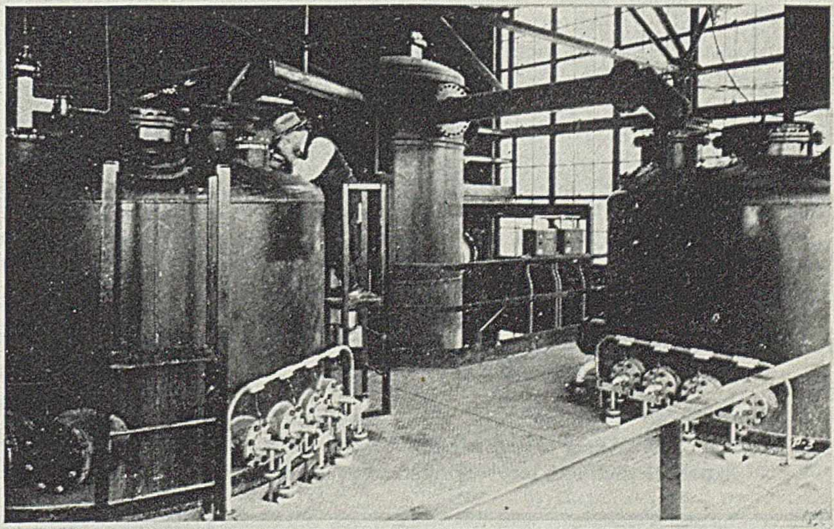
Separation of the main stream of phenol from the water solution flowing from scrubber (*q*) is accomplished similarly by benzene extraction in (*l*), except that HCl is not present here. The two all-steel extractors, 80 in. inside diameter and 59 ft. high, are connected so that each is supplied near the bottom with benzene while the water solution enters near the top of one, gravitates to the bottom, and enters the second at the top. The two overflows leave at the top and are combined as a solution of 50 grams of phenol per liter of benzene, while the water underflow from the second extractor is treated to strip its dissolved benzene at point (*p*) and is then recycled to Stage II.

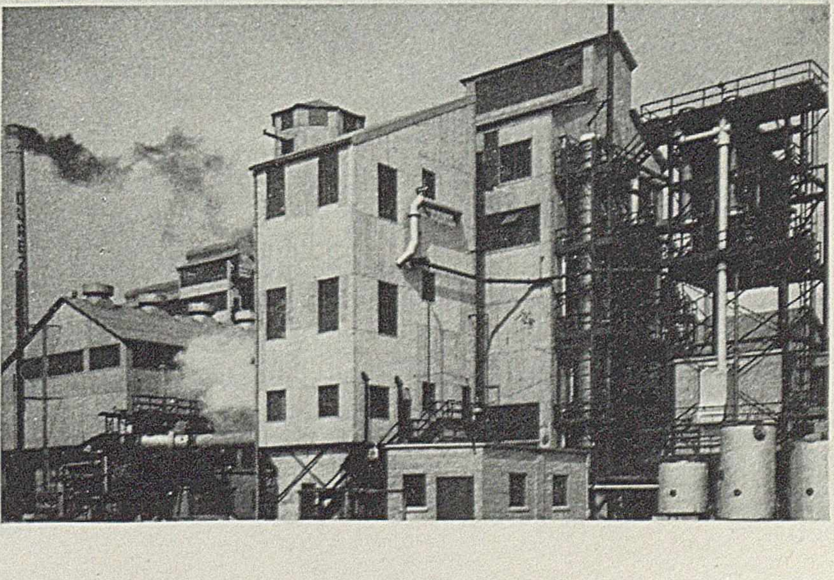
PHENOL DISTILLATION

The benzene solution of phenol from (*k*) and (*l*) not only carries the total make of phenol, but also provides the benzene needed for the first stage reaction. It flows to still (*m*) where a crude 97 per cent phenol is separated for final purification, and the benzene is vaporized to re-enter the first stage process at (*a*). This still consists of a single all-steel fractionating column 75 in. in inside diameter and 47 ft. high, packed with raschig rings. Heat is supplied by vaporizing part of the inflow of mixed benzene and phenol in three shell-and-tube steam-heated evaporators, all approximately 54 in. in diameter and 7 ft. high. The liquid passes from one evaporator to the next in series, the vapor from each entering at an appropriate level in the still column. The first is heated with 15-lb. exhaust steam from the second stage turbine-driven fan (*r*), and the others on high pressure steam, the last operating at about 170 deg. C. The outflow from the third evaporator contains 97 per cent phenol and is sent to the final phenol stills (*n*), of which there are two as shown in Fig. 8, both working under vacuum. In the secondary phenol still the condenser tubes and all parts from there on, which are in contact with the phenol, are of

Fig. 6—Two of the four HCl evaporators flanking the vapor mixer

Fig. 7—Benzene condensers and wash oil scrubber at the right, with extraction building at center and second stage converter building at left





nickel to avoid contamination. The resulting phenol, which has a solidifying point above 40.7 deg. C., is said to be the purest obtainable and to be much superior to U.S.P. requirements.

An interesting feature of the phenol stills is the use of rotary vacuum pumps for removing non-condensables from the condensers. The primary still employs a single-stage Nash Hytor pump inclosed in a steam-heated box, and the secondary, a two-stage Hytor pump, similarly steam heated, for production of 29.5 in. vacuum. Both pumps are sealed with molten phenol.

PHENOL PRODUCTION

Stage II of the Raschig phenol process can probably best be considered as starting directly after water scrubber (*q*) in which the phenol produced by the process is dissolved in water and removed to Stage I. In studying Stage I, it was noted how the water solution of phenol from scrubber (*q*) is extracted with benzene in (*l*) and the water recycled to (*q*). This water contains benzene which must be stripped off at (*p*) before recycling. The process here is somewhat involved, but consists roughly in bringing the water into contact in a column with a small quantity of the monochlorbenzene-water azeotropic vapor mixture at 89 deg. C. This vapor is bled from the system to remove non-condensables. With the help of live steam it strips the benzene, which is then separated from the monochlorbenzene vapor by fractional condensation. The water, heated to 95 deg. C., returns to scrubber (*q*) to dissolve further phenol.

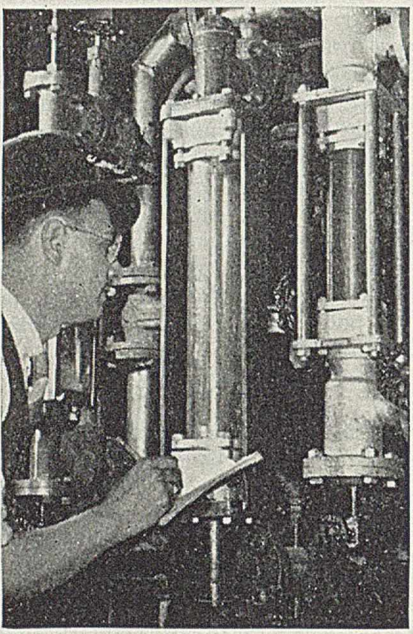


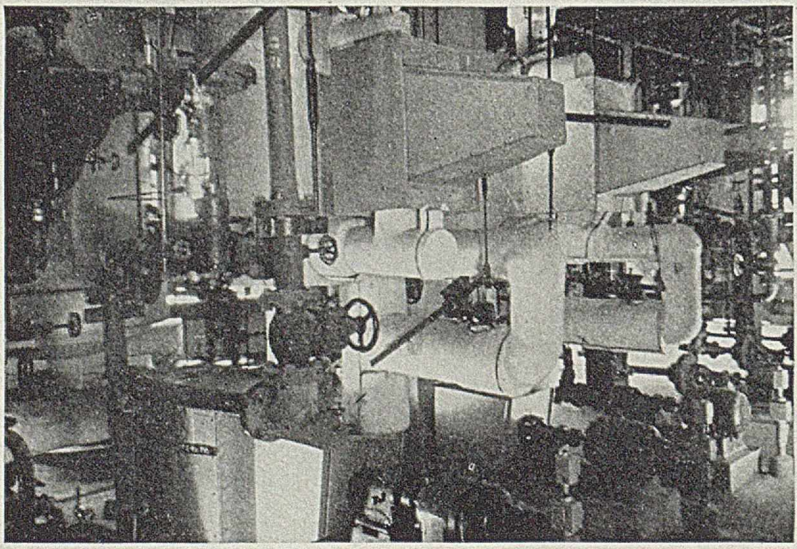
Fig. 9—Nickel rotameters used to indicate the flows of purified phenol

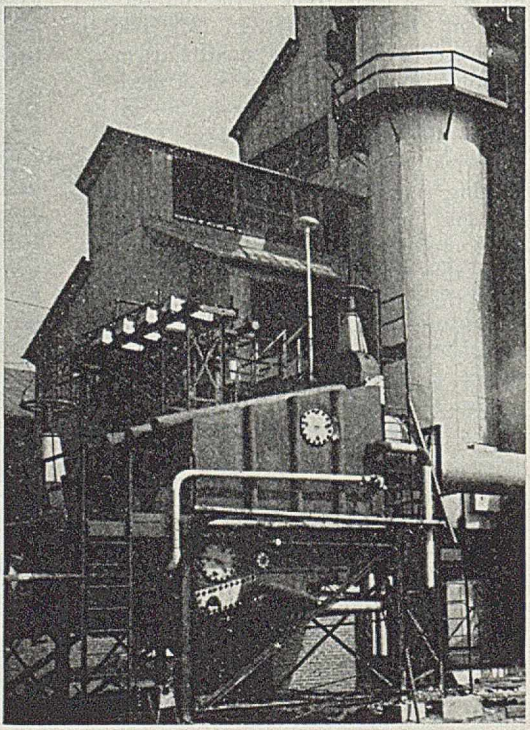
Scrubber (*q*) is an all-steel tower, 10 ft. 10 in. inside diameter and 50 ft. 8 in. high, packed with stoneware raschig rings and equipped with steel distributing pipes at the top. Entering the bottom of the tower is some 95 per cent of the phenol make, plus a mixture of steam and monochlorbenzene vapor of azeotropic composition (three parts C_6H_5Cl and two parts H_2O). The phenol, as noted, is dissolved in the circulating water while the temperature of operation is such that the azeotropic mixture passes through unchanged and discharges at about 89 deg. C. to the fan (*r*). This 40-in. fan is driven at 3,800 r.p.m. by a 200 hp. back-pressure turbine exhausting at 15 lb. to one of the evaporators of still (*n*). It maintains a suction of 60 in. w.g. and forces the vapor mixture on toward the converter.

The second-stage reaction is endothermic and requires the relatively high temperature of about 420 deg. C. To reach this temperature, the azeotropic mixture is first heated with steam (Fig. 10), and is then passed into a two-stage heat exchanger indicated at (*s*). The second-stage reaction is carried out in four converters (*u*), three of which operate simultaneously while the fourth is being regenerated. Therefore there are four two-stage heat exchangers, one for each converter, and four superheating sections in the vapor superheater (*t*). The heat exchange units each consist of two vertical steel shell-and-tube exchangers having 22 ft. tubes 1½ in. in diameter. The first exchanger is heated by 220 deg. air from the first-stage converter cooling system (*d*), while the second is heated by the products of the second stage conversion at 420 deg. C. The vapor mixture needs still further heating, however, and so passes through the chrome alloy

Fig. 8, Below—Base of the crude phenol stills, showing steam heated level controllers and reflux pumps

Fig. 10, Right—Preliminary steam heater for second stage materials, with extraction and acid recovery building in the background

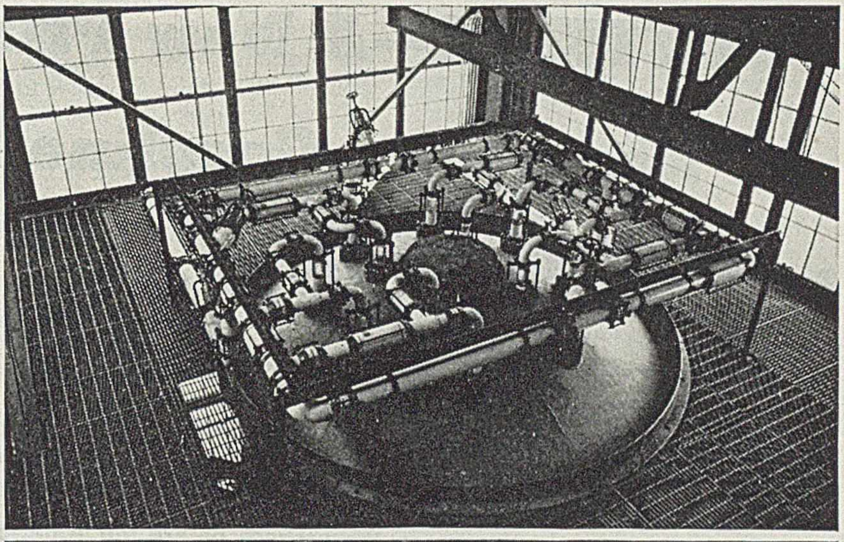




tubes of an oil-fired superheater (t) where the 420 deg. conversion temperature is reached.

The vapor superheater (t) is of interesting construction, designed for accurate temperature control without danger of overheating the tubes. The oil burner fires into a combustion chamber and against a bridge wall containing passages through which recirculated combustion gases may be introduced for lowering the hot-gas temperature. The diluted gas then passes through three of the four tube sections for heating the azeotropic mixture, then in series through the benzene vapor and air superheaters (a) of the first stage. Exiting from the last coil, the flue gas enters a fan, part being discharged from a stack and part recirculated as required by the temperature control equipment, to mix at the bridge wall with the gases directly from the burner.

Hydrolysis of the monochlorbenzene with steam is a catalytic reaction and is accomplished in all-steel converters (u) by passage through a 36-in. bed of a granular inorganic material which requires regeneration once in eight hours. Regeneration must be preceded and followed by purging with steam, so that the complications of cycling four converters, with their trains of heat exchangers and vapor superheaters, were sufficient to justify automatic cycle control. A master clock operates four trains of five electric time switches, each of which through relays and electric valves controls the operation of dampers and hydraulically operated valves so as to cut out the proper converter for two hours out of each eight, steam it and carry out the required regeneration.



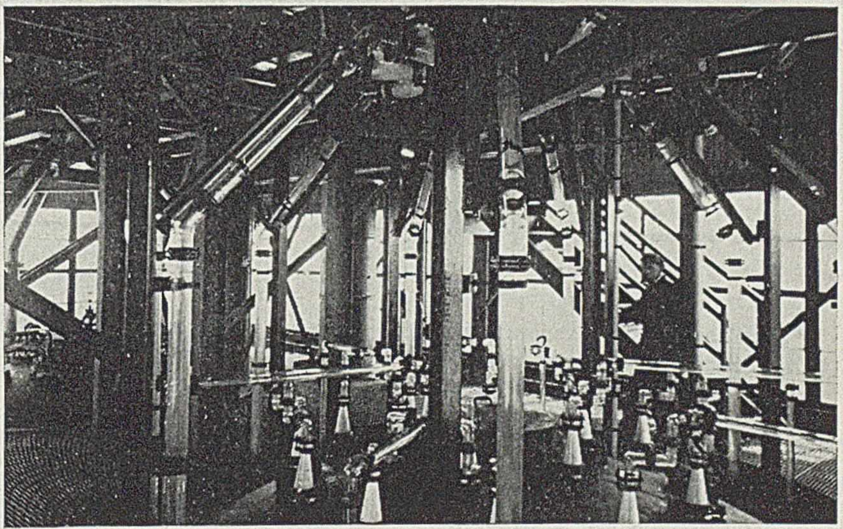


Fig. 11—Top of the desuperheating tower, showing Lapp porcelainware acid distribution piping, and its method of support

Fig. 12—Complex Pyrex distribution piping at the top of the acid recovery tower, with top of first stage partial condenser at the left

During conversion in converters (u) about 10 per cent of the monochlorbenzene in the azeotropic mixture is hydrolyzed to phenol and HCl, the remainder recycling in the process. The mixture is first cooled to 200 deg. C. by passage through the secondary heat exchanger (s), as noted above, then enters the first of two acid recovery towers (v). Although acid recovery is actually accomplished in two towers in series, it may be considered as in one, with the first tower the lower section of the second, as indicated in the diagram. The first, known as the desuperheating tower (Fig. 11), has as its function the concentration to 15 per cent of the weak HCl condensed in the second tower. This brick-lined steel tower is 10 ft. 6 in. in diameter and 20 ft. high, packed with raschig rings and equipped with porcelain distributor pipes through which about 170 g.p.m. of acid is constantly pumped. Weaker acid condensed in the second tower is added to the stream and concentrated in the desuperheater by heat from the gases entering from the heat exchangers (s). A part of the circulating load of acid is diverted to Stage I, entering at extractor (k) where its small amount of phenol is removed. Uncondensed vapors, consisting of the greater part of the phenol, the unreacted C_6H_5Cl, steam and some HCl, pass into the bottom of the second acid recovery tower (v), another brick-lined, ring-packed tower appearing in Fig. 12, which is 10 ft. 6 in. inside diameter and 45 ft. high, and equipped with a Pyrex glass distributor. Here the vapors are further cooled in contact with the entering monochlorbenzene from Stage I, plus a quantity of acid water from the first stage partial condenser, which is added at this point. Part of the water is vaporized, together with the C_6H_5Cl, to form the azeotropic mixture which passes from the tower along with the phenol vapor to the water scrubber (q), while the remainder condenses and leaves with the HCl. Thus the second stage cycle is completed.

It is unfortunate that lack of space prevents the description of many novel, although less important, features which inspection of the plant disclosed. In conclusion, therefore, the author wishes to express his appreciation for the cooperation which the Durez management afforded him, especially that which was given by Harry M. Dent, president, and Robert M. Crawford, production manager, in permitting the inspection and in assistance with the preparation of the article.

SOLUTIZER—A New Principle Applied to Gasoline Sweetening

L. E. BORDER *Shell Oil Co., Inc., Wood River, Ill.*

Chem. & Met. INTERPRETATION

For more than two years it has been known that the Shell Oil Co. was working on a process for sweetening gasoline by extracting the mercaptans with an organic "solutizer." D. L. Yabroff and L. E. Border presented a paper on the process before the American Petroleum Institute on May 18, 1939. Until now there has been no information available about the commercial application of the process. But with the successful operation of a new 15,000 bbl. per day unit at Wood River, Ill., we are privileged to present the essential facts about how and why the process works.—*Editors.*

Raw gasolines in general have a disagreeable odor because they contain mercaptans. The oil industry has, in the past, been able to satisfy the public demand for a product with an improved odor by taking advantage of the relative ease with which mercaptans can be oxidized to odorless compounds. By the Solutizer process, however, the mercaptans are not oxidized but are extracted from the gasoline. The underlying principle[1] is that by the addition of a suitable "solutizing agent" to a strong base such as sodium or potassium hydroxide solution, the solubility of mercaptans in the solution is so markedly increased that complete sweetening of full boiling range gasolines can be effected. For example, by solutizer treatment of a 200-400 deg. F. West Texas straight run naphtha, its mercaptan sulphur content can be reduced from 0.10 per cent by weight to less than 0.0005 per cent by weight, whereas, concentrated caustic soda treatment will effect a reduction to only 0.075-0.085 per cent by weight.

Sweetening of a gasoline by the Solutizer process meets the demand of an improvement in odor and obviously reduces the sulphur content of the stock by an amount equivalent to the mercaptan sulphur content of the untreated material. However, these two advantages are insignificant compared to the improved octane number and tetraethyl lead susceptibility which results from the complete elimination of the mercaptans.[2b,3g] It is common knowledge to refiners[3] that mercaptans contribute knocking characteristics to a gasoline and that their oxidation products such as disulphides and polysulphides are even worse. The advantage of the Solutizer process over oxidation processes is, therefore, readily apparent.

FIRST INSTALLATION

The first treating plant employing this process was erected by Shell Oil Co., Inc., at its Wood River (Ill.) refinery and placed in operation on May 17, 1940. This unit, now treating 15,000 bbl. per day, has operated without interruption since that time and the predicted profitability which was founded on a complete laboratory study[1] and two years of pilot plant operation[2] has been most satisfactorily realized.

The gasoline treated is a blend of 30 per cent cracked and 70 per cent straight run with an approximate end point of 250 deg. F. The treating solution employed is six normal in potassium hydroxide and three normal in potassium isobutyrate. With a solution to gasoline ratio of 1.5:10, the treatment reduces mercaptan sulphur content from 0.10 per cent by weight to 0.0004 per cent by weight which effects an increase in octane number of 0.5-0.7 units. In addition, the tetraethyl lead requirement is reduced 50-60 per cent. The tetraethyl lead saving combined with the low operating costs which will be evident from the following discussion have resulted in reducing the finishing costs for this gasoline by approximately 5.0 cents per barrel as compared to conventional combined caustic soda and doctor treatment.

The process embodies an extraction system and a regeneration system with the working inventory of solutizer solution recycled indefinitely. A simplified flow diagram of the Wood River treater is shown herewith. Raw gasoline containing 0.10 per cent by weight mercaptan sulphur flows directly to the unit from three stabilizing columns thus preventing any oxidation of mercaptans in intermediate storage. In this manner the pressure head at the source of production is utilized although it must be supplemented by a booster pump to overcome pressure drops across the treater. The charging rate is automatically controlled by a combination of a recording flow controller at the treater inlet and a pressure regulator on the transfer line which maintains constant pressure on the booster pump suction by diverting peak flows to untreated storage.

H_2S REMOVAL

Traces of hydrogen sulphide are removed from the sour gasoline in a pretreater employing dilute caustic soda. The sour gasoline is cooled to 85 deg. F. before entering the extraction tower because solutizer extraction is more efficient as the treating temperature decreases. Traces of caustic soda entrained from the pretreater are removed by a coalescer filled with steel wool.

The extraction system consists of a tower 5 ft. in diameter by 58 ft. high containing a 36-ft. bed of 1 in. x 1 in. carbon ring packing, baffled to prevent channeling. From pilot plant experience this tower has the effectiveness of nine or ten extraction stages. The gasoline is introduced and dispersed over the cross section of the tower through an orifice distributor located just beneath the packing bed. The treating solution is injected in a similar fashion immediately above the packing and since it is almost twice as dense as the gasoline it flows down over the packing countercurrent to the rising gasoline. Its injection rate is maintained constant by a recording flow controller. Since the two phases are quite intimately mixed in the packing the gasoline contains about 0.02 per cent by volume of solutizer solution in the form of a hazy suspension as it flows from the top of the tower. About 90 per cent of this settles out in a 10 ft. x 20 ft. settler and the remainder is removed in a steel wool coalescer on the rundown stream. This coalescer is so effective in removing the last traces of entrainment that further settling is unnecessary and the treated product is pumped continuously from a single rundown tank to finished gasoline blending tanks.

FAT SOLUTIZER SETTLER

The fat solution containing about 1 per cent of suspended gasoline flows from the bottom of the extraction tower to a 10 ft.x20-ft. settler from which the separated gasoline is pumped back to the tower inlet. The solution also contains about 0.5 per cent of dissolved gasoline, which would subsequently be lost overhead in the regenerator if it were not for the fact that the solubility of gasoline in diluted solutizer is negligible. To prevent its loss the total aqueous overhead from the regenerator is pumped into the settler to dilute the spent solution.

This solution settler is bulkheaded into two compartments so that the inlet compartment, in which gasoline separates, floats on tower pressure and the other serves as a surge chamber at atmospheric pressure. The rate of release of solution to the surge compartment is governed by an automatic valve which is actuated by a duogravity float at the phase interface in the top of the extraction tower.

REGENERATING THE SOLUTION

Diluted, spent solution is pumped to the regenerating column where the diluent is vaporized in the reboiler to supply the stripping medium. It is charged at a constant rate controlled by an automatic recording controller and is preheated to 255 deg. F. by heat exchange with the column overhead and the stripped solution. The column, which is 6 ft. in diameter and 48 ft. high, contains fourteen bubble trays and one sump tray. Preheated solution enters on the eleventh tray from the bottom. Steam is used in the tubes of a kettle-type reboiler to vaporize the diluent.

All overhead from the column, water vapor and mercaptans, is condensed and flows to an accumulator from which the aqueous portion containing about 0.025 per cent by weight of mercaptan sulphur is pumped with automatic control to tray No. 15. It is stripped free of mercaptans in the three top trays and collected on tray No. 12, from which it is pumped to the spent solution settler for "springing" dissolved gasoline. The practice of diluting the spent solution has a two-fold advantage.[2b] In addition to practically eliminating gasoline losses it also reduces the stripping steam consumption.

Condensed mercaptans, which collect in the accumulator, are burned in the refinery power plant and those not condensed are vented to a nearby topping unit heater. Since the unit is entirely enclosed the treater area is free of mercaptan odors. There is no disposal problem for the accumulator water because it is 100 per cent recycled within the system, that is, to the top of the column to be freed of mercaptans, from there to the spent solution settler as diluent and back to the regenerator again.

Concentration of the regenerated solution is maintained constant by means of a temperature recorder controller which automatically governs the amount of steam supplied to vaporize the diluent in the reboiler by holding the temperature at 285 deg. ± 1 deg. F. The stripped solution after heat exchange with the column charge is cooled to 85 deg. F. for further use.

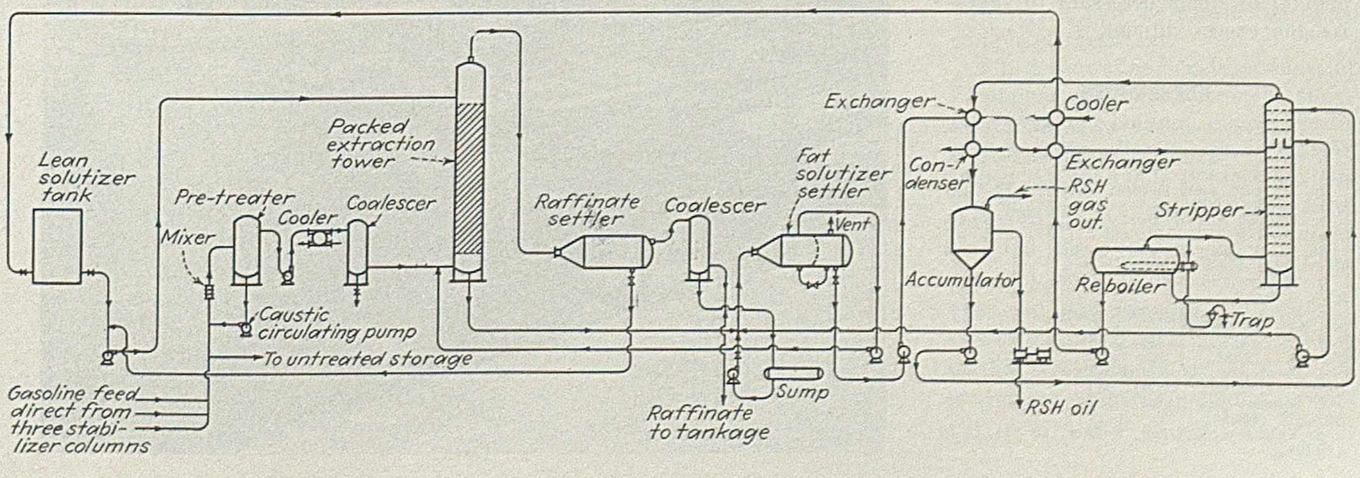
Tube bundles in the reboiler and the stripped solution-to-charge exchanger are constructed of a 70 per cent copper-30 per cent nickel alloy which is not attacked by solutizer solution at 285 deg. F. Pilot plant experience proved steel exchanger bundles to be subject to "hydrogen attack" in solutizer service at this temperature. The remainder of the equipment, towers, vessels, pumps, lines, etc., are all constructed of steel. All vessels are designed to meet the API-ASME code and are equipped with relief valves. All of the automatic control valves are air actuated.

FEATURES OF TREATER DESIGN

Several outstanding features of the treater design which have resulted in low operating costs are as follows:

1. By employing a packed extraction

Simplified flow diagram of 15,000 bbl. per day Solutizer treater installed at Wood River, Ill.



tower a multiplicity of stages are incorporated in one vessel, thus effecting low pumping and maintenance costs in the extraction system.

2. Mechanical losses of treating solution have been eliminated by coalescing and recovering the last traces of suspended solution from the treated gasoline. A system of drains from all pump bleeders and sample lines also prevent losses of both gasoline and solvent at these sources.

3. Gasoline losses have been almost eliminated by diluting the spent solution before regeneration, thus "springing" the dissolved oil. Actual hydrocarbon loss to fuel has averaged less than 0.05 per cent; the total volumetric depreciation to fuel is approximately 0.25 per cent of which about 80 per cent is pure mercaptan.

4. This practice of diluting the spent solution also permits an appreciable saving in the steam required for regeneration because the mercaptans are stripped from a dilute solution much more easily than from a concentrated one.

5. The water which is used as a diluent is the overhead from the regenerator. By stripping it free of mercaptans in the upper section of the regenerator the steam requirements are further reduced. The steam consumption has averaged 15 lb. per bbl. of gasoline.

SIMPLICITY OF OPERATION

Since the process permits operation to a large extent by automatic controls the unit requires only part time of one operator. The proportion of solutizer solution required to produce a doctor sweet product is determined by routine checking of the treated product by the doctor test. The optimum amount of steam to be used in the regeneration of the spent solution is determined by shaking a sample of the stripped solution with mercaptan-free gasoline and testing this gasoline by the doctor test. If the operator finds this test positive the rate of pumping diluent into the spent solution is increased, and when the more dilute solution reaches the reboiler the automatic temperature controller supplies the additional amount of steam necessary to vaporize the excess diluent.

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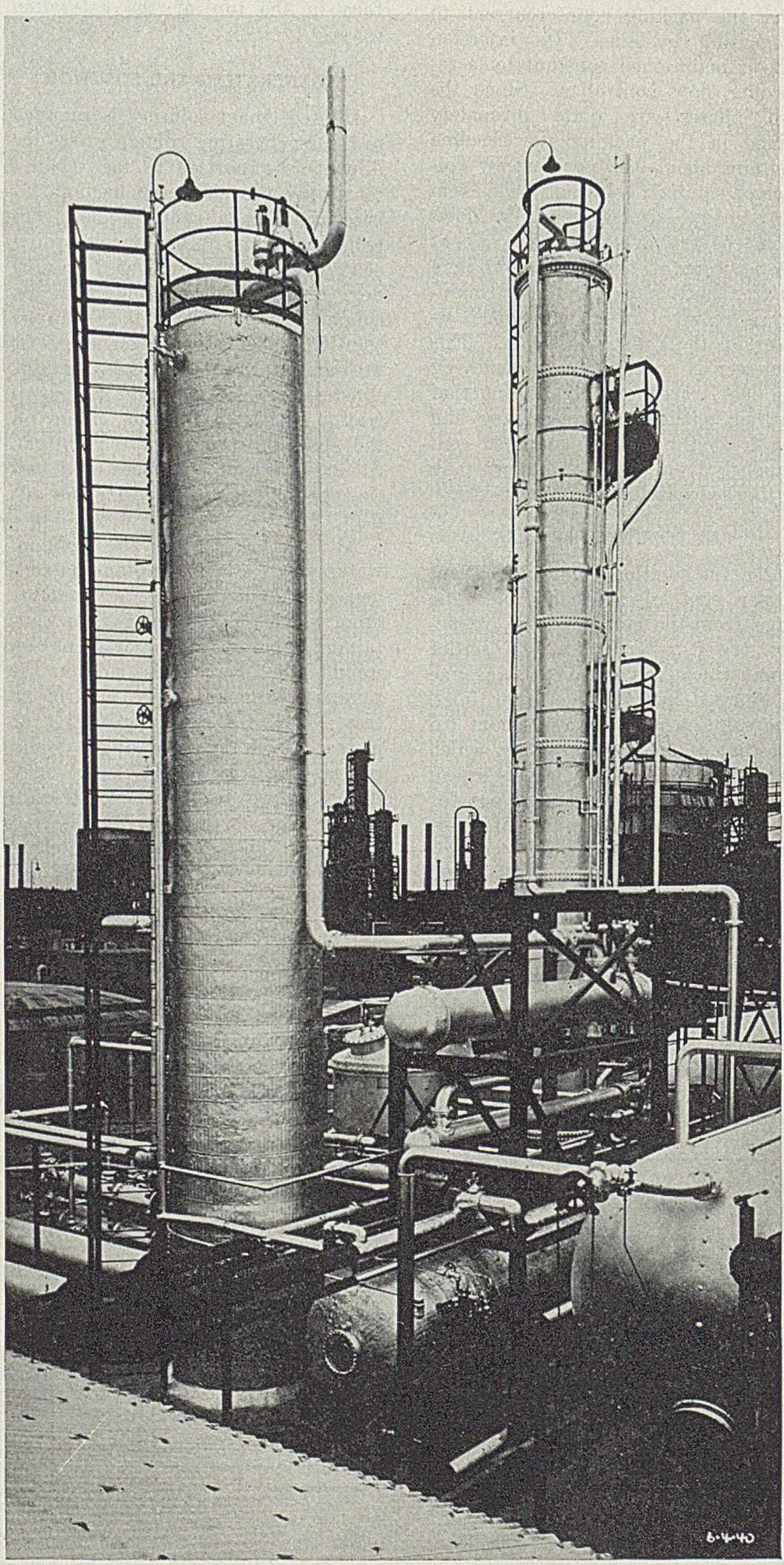
This 15,000 bbl. per day gasoline treater installed at Shell Oil Co.'s Wood River, Ill., refinery removes unwanted mercaptans by a new process. With a "solutizer" solution of potassium hydroxide and potassium isobutyrate, these knock-producing sulphur compounds are removed leaving a sweetened gasoline. The unit shown below is the first commercial installation



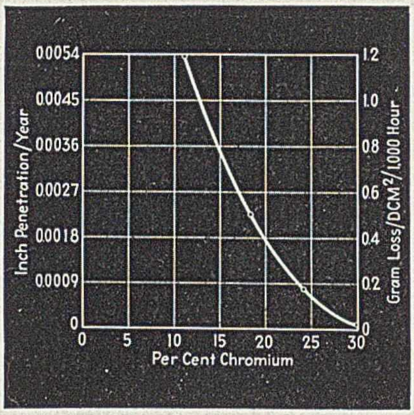


Fig. 1—Corrosion of chromium-iron alloys in boiling concentrated acetic acid

What Metals to Use With Acetic Acid

FRANK PAVLIS and F. A. ROHRMAN, *Student and Associate Professor respectively, Dept. of Chemical Engineering and Chemistry, Michigan College of Mining and Technology, Houghton*

Chem. & Met. INTERPRETATION

Results of the numerous tests made by the authors are: (1) Hot, concentrated acetic acid behaved as an active corroding medium against most metals. (2) Dry, or anhydrous, acid had the greatest corrosive effect, (3) Silver, tantalum, platinum, and a 26 per cent chromium-4 per cent molybdenum alloy proved to be most resistant to acetic solutions at all temperatures, (4) Straight chromium irons increased in resistance to this acid as the chromium content was increased. Any increase in nickel encouraged an increase in the corrosion rate. (5) The 18 per cent chromium-8 per cent nickel alloys showed a wide range of resistance depending upon carbon content, mode of manufacture, chromium-nickel ratio, molybdenum content, etc. The low carbon and molybdenum-containing 18-8 proved most resistant under all conditions. (6) Any 18-8 alloys showed a variable resistance to acetic solutions depending upon the length of time the metal was exposed to air between immersions. (7) Aluminum was corroded but slowly except in very dilute and concentrated acid. One-half per cent acid was quite destructive as was dry or anhydrous acid.—*Editors.*

Acetic acid ranks as our most important organic acid. The 1939 production exceeded 215,000,000 lb., and all indications point to an increase in its consumption. Due to the extensive use its corrosive action is of great importance. The purpose of this paper is to report the results of over 2,000 corrosion tests of this acid upon several hundred metals and alloys.

The behavior of acetic acid upon most metals is quite unpredictable. On some metals it exerts a slow solvent action which is sufficient to contaminate products as well as to destroy equipment. On other metals, it acts with avidity. Acetic is classed as a weak acid in the usual chemical sense. The fact that the salts of this acid are generally soluble makes it potentially a destructive acid upon most metallic equipment. It is known that the acid is much more corrosive at the boiling point and in the concentrated state than at the lower concentrations and temperatures.

The acetic acid used for the tests was the common glacial acid of commerce. In general, the tests were conducted in 1,000 cc. beakers containing 800 cc. of the acid. Most of the tests were made with strong, hot acid because dilute and cold solutions rarely demonstrated sufficient corroding action to be measurable.

Metals tested for their resistance to boiling glacial acid could be grouped into three classes: (1) those severely corroded and unfit for use with the acid, (2) those slightly attacked and reasonably secure for most purposes, and (3) those not affected to any measurable extent. In the first class must be placed magnesium, iron, zinc, lead, copper, brasses, bronzes, cupro-nickels, nickel, Monel, Inconel, Duriron, and the high-carbon stainless steels and irons. Among those slightly attacked are the following, with their average inches penetration per year of exposure:

Alloy	*In. penetration yr.*
18 Cr—8 Ni (low carbon)	0.000095
24 Cr (low carbon)	0.000770
30 Cr (low carbon)	0.000130
Elcomet-K	0.000020
G–60	0.000030
Pioneer metal	0.000300
Illium–G	0.000061
Hastelloy–C	0.000150
18 Cr—8 Ni—Mo	0.0000057
24 Cr—12 Ni—Mo	0.000018
35 Cr— 5 Ni—Mo	0.0000044

In this slightly affected group it was found that similar alloy types, of either higher carbon or nickel contents, invariably resulted in higher corrosion rates. It is evident that small molybdenum additions are of value in fortifying the resistance of the 18Cr—8Ni—low carbon alloy. The newer types of 18–8, containing silver, were also tested but showed little improvement over the 18Cr—8Ni—low carbon.

Only four metals could be classed as completely resistant to the boiling glacial acetic acid. These four are platinum, silver, tantalum, and a new alloy, Midvale 2024 (26Cr, 4Mo, balance Fe). Gold was not tested; however, it may be considered to be completely resistant.

Fig. 1 shows the beneficial effect of chromium additions to iron as alloys for resisting boiling, glacial acetic acid. All the alloys represented contained less than 0.07 per cent carbon. The sharp slope of the curve proves conclusively that chromium additions are of value in reducing the corrosion.

Fig. 2 demonstrates the effect of different boiling acid concentrations of this acid upon 18 Cr—8 Ni alloys containing different amounts of carbon. Curve *H* is of the high carbon (over 0.20 per cent C.), curve *M* of the medium carbon (0.12 per cent C), and curve *L* of the low carbon (0.06 per cent C). It can be readily seen that the influence of carbon is considerable. It is well to mention here that slight differences in the compositions and in the physical treatments of the "18-8" metal often resulted in enormous differences in corrosion rates.

It was found that between 40 per cent and 75 per cent acid consistent results were difficult to obtain. The corrosion rates under apparently identical conditions often fluctuated considerably. This "temperamental" range of concentration was later found to be largely due to the differences in time that the samples had been exposed to air between tests. After a test the samples would be washed, dried, weighed, and resubmitted to the solution. Often the times between acid exposure would be several hours greater than between other exposures.

It is known that these metals are resistant to attack by virtue of their resistant surface oxide films. It is also known that the formation of this film is a function of several factors, of which time is one. As the passive metal is exposed to a corroding medium, such as acetic acid solution in this case, the film is slowly dissolved at a rate faster than it can be formed in the solution. When the metal is exposed to air again the oxide builds up rapidly. Undoubtedly the formation of this film approaches asymptotically a definite thickness with time. For short periods of time, however, differences in time should have an important bearing upon the corrosion resistance or corrodibility of these alloys in other media as well as acetic acid.

This theory was proved by experimentation to be correct. Twelve specimens of the same "18-8" stainless steels were exposed to the same acetic acid solution.

The plot of corrosion rate against acetic acid concentration shows a drift toward a maximum at about 50 per cent acid, followed by a drop to about 90 per cent acid. What causes this definite trend is debatable. This tendency was noted with the other metals as well.

The dry, glacial acid has a pronounced corrosive action upon metals and alloys. The addition of a drop or two of water to the acid had the immediate effect of stopping this violent action. Of all the metals studied, only platinum, silver, and tantalum were able to resist the avid action of dry, concentrated acetic acid. Mixtures of acetic acid and acetic anhydride behave as does the dry acid.

The peculiar behavior of aluminum in acetic acid has been reported from time to time. It has been known that aluminum is resistant to all concentrations of this acid except in the very dilute and the dry, glacial states. Fig. 3 gives the corrosion rate of pure aluminum (99.9 per cent) in a boiling acetic acid solution. Most of these samples were exposed to the acid solutions for 24-hour periods. All samples were completely immersed during the entire period of test.

It was found that the greatest corrosion occcurred when the metal was in contact with the dry, glacial acid. The next most destructive concentration is that of about 0.5 per cent acid. The reason for this can probably be explained by the hydrolysis of aluminum acetate. All concentrations of acetic acid cause some corrosion, resulting in aluminum ions being formed. The aluminum and acetate ions combine to form aluminum acetate, which quickly hydrolyzes to form aluminum hydroxide. In the dilute solution—that is, in those less than 0.5 per cent acid—the hydroxide precipitates out of solution, while in the more concentrated solution of acid this hydroxide is dissolved. According to the Nernst theory of solution potentials, as the ion concentration of a metal in solution increases, the solution potential of that metal becomes less negative; therefore, as the aluminum hydroxide which is formed dissolves in stronger acid solution, the Al^{+++} concentration increases and the corrosion falls off. In acid solutions less than 0.5 per cent, the precipitated hydroxide tends to cling to the metal and partially protect it from further corrosion. A corrosion maximum occurs then at the concentration where precipitation of hydroxide occurs and where the precipitate does not adhere to the metal. The following tests of one series of aluminum samples in boiling dilute acetic acid solution demonstrates this action:

Acetic acid concentration per cent	In. penetration per yr.
10	0.0066
5	0.010
1	0.016
0.5	0.024
0.2	0.00058

These results show that there may be danger in employing aluminum equipment in regions where hot, dilute concentrations of acetic acid may be encountered.

Fig. 2—Corrosion of 18Cr-8Ni alloys in acetic acid solutions

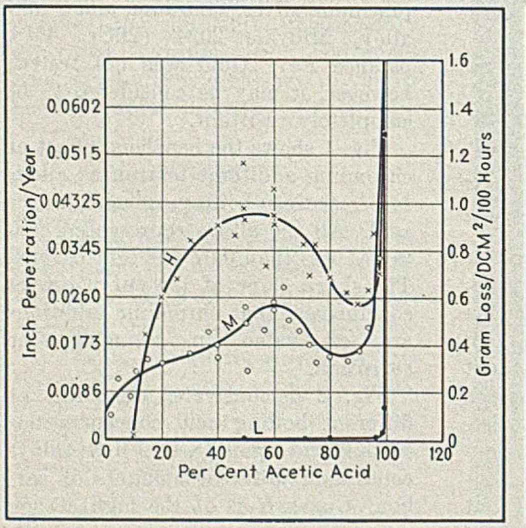
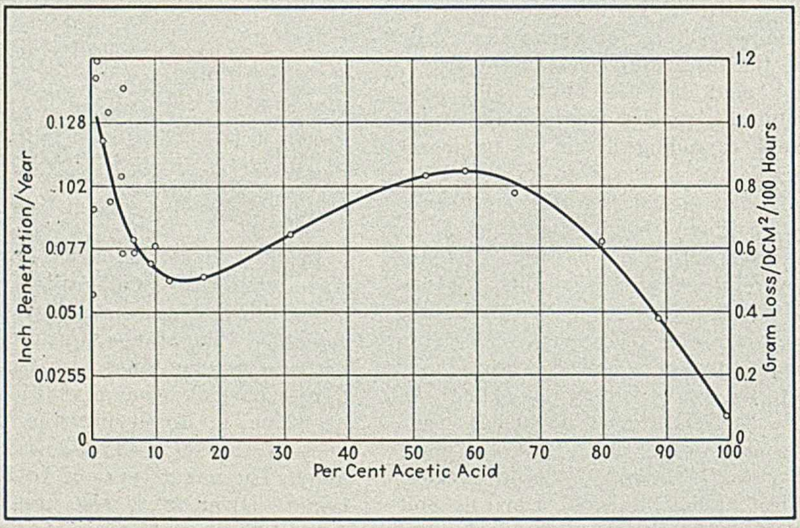


Fig. 3—Gives the corrosion rate of pure aluminum (99.9 per cent) in a boiling acetic acid solution



Going Into Business For Yourself

ARTHUR R. MAAS *A. R. Maas Chemical Co., Los Angeles**

Chem. & Met. INTERPRETATION

Young chemical engineers often have the ambition to go into business for themselves. In a conversational style, A. R. Maas relates how his small company started by making photographic chemicals for Hollywood and expanded to supply heavy chemicals for the Pacific Coast. His reminiscenses and observations should prove interesting to our younger readers and valuable to those among them who contemplate establishing their own businesses.—*Editors.*

The young chemical engineer with ideas and ambitions to be in business for himself is often deterred by the size of established concerns and by the requirements for capital. It does take money, but that is not the number one essential. Ability is the prime requisite; ability of more kinds than are ever found in one man. And if it is located and set to work, there are excellent chances that money for the start can be located somehow and the enterprise will continue and grow.

Suppose the chemical industry followed the legal profession in corporate names. Then our company, instead of its present title, would have a letterhead reading, "Maas, Jones, Smith and Brown." These individuals would represent the four outstanding types of abilities with which our company started. These were:

1. Organization, management, sales.
2. Chemical engineering, product design.
3. Management of plant and personnel.
4. Accounting, credits, collections.

When you have an air castle, Thoreau said, build foundations under it. The foundations for an ambitious chemical engineer's own business would be the search for these different types of ability, to work in association or for hire.

Reasoning from our own experience, the greatest handicap on this ambitious young man is not lack of capital, but his technical viewpoint. It concentrates his interest upon the making of things to the neglect of the business viewpoint which wants to know what can be done with the things that are to be produced, who are the potential customers, and what charges will be made.

Through 25 years as a consulting chemist, I have learned to regard the chemist without business experience as a very dangerous fellow. Again and again, excited business men have come to our laboratory saying that they have found a chemist who can make this, or that; that the chemist has found a mountain of raw material and that they propose backing a company, after we have checked up the chemist's process. Such business men are generally in the shoe or lumber business. They know that no such opportunities for sudden wealth are to be found in their own industries. But they have been led into a wonderland by a perfectly honest chemist who has gone through the looking-glass with Alice and believes that the mere ability to make something is all that is needed for success in the chemical industry.

His mountain of raw material may be nearby, but when he comes to production, the molehill of raw material available to a distant competitor may be nearer or purer. And he will find it impossible to compete because freight rates were not figured.

If he really succeeds in making standard products, then the shoe manufacturer and the lumberman will find that chemical industry presents the same old problems of costs and selling.

Having started as a technical man, I know how the fellow with that type of experience is apt to overlook, under-rate or disregard the necessity for salesmanship. I once believed firmly that ability to make things was all-sufficient. Later I discovered that it was just as necessary to tell people about the things you make. Keeping the makers and the tellers on an even keel is one of the problems of the chemical industry. Each has his superiority complex.

My first boss gave me a few lessons in selling. I was a boy in his drug store, and he would open the case where hairbrushes were kept, from fifty cents to five dollars, and show me how fine the bristles were, and how beautiful the back, of the five dollar brush. When a customer came for a fifty-cent brush I would show him in the same way, and to my astonishment, sometimes sold a five-dollar brush.

But it was the mystery of the prescription counter that made the deepest impression. I went to the University of California and studied pharmacy. I afterwards obtained a position teaching that subject and toxicology and at Southern California I studied chemistry and became chemist for a chemical company and later for wholesale drug house. In

* As told to James H. Collins.

1913 opened a little consulting laboratory.

My ideal then was the late Arthur D. Little's laboratory in Boston. He published a "house organ" giving chemical facts for business men. I started one of my own, a four-page leaflet called *Chemistry & You* to tell my public what a consulting chemist did. In Los Angeles at that time he was supposed to be chiefly an assayer of ore samples.

But it was not until I had a manufactured product to sell that the real importance of selling, as well as making, came home.

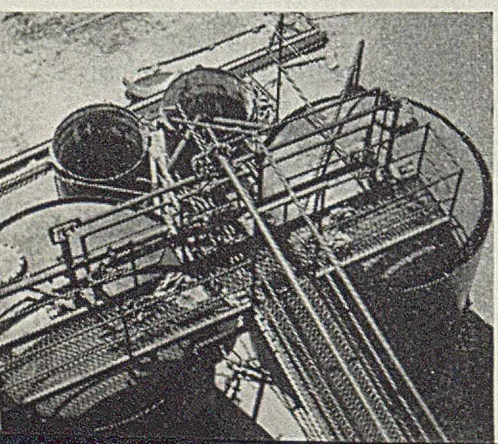
Hollywood was growing, I had motion picture clients and the first World War, cutting off German chemicals, led D. W. Griffith to retain me to help contrive a developer for his big picture "Intolerance." That gave me the idea of manufacturing chemicals for Hollywood laboratories. I decided that something simpler than a developer would be best, and decided on photographer's "hypo" for which the California deserts furnished some of the material. My first evaporator was a secondhand bathtub, selected as the cheapest vessel which would prevent metal contacts, and my first batch of hypo was sold to a photographic supply house for six dollars.

For me, it was a hard sale for I was shy and lacked all the confidence that arouses the customer's interest, gives him desire and conviction, and gets his signature on the dotted line.

For the wholesale dealer, it was just a small purchase—"You bring your hypo in," he said, "and if it's good, we'll buy it." He sold me a keg to put it in.

That led, in the next five years, to building a nice little manufacturing business in photographic chemicals, as well as handling those we didn't make. I joined the Los Angeles Ad Club to learn more about selling and gained experience through contacts with laboratory directors. For when I went in to see how much hypo they would need next month, they usually had problems, fogged and spotted film and so on, and in seeking the causes, one forgot selling in talking chemistry. Also, this trouble shooting enabled us to make improvements in our chemicals.

Part of the newly constructed phosphate plant of the Maas Company



Until the mid-1920's, such chemical industries as California had were mostly around San Francisco where the industrial demand was larger. Southern California had developed borax, agar, cement and a few other staple products, but the bulk of its chemicals came from the East. At that time, a chemical engineer gave his opinion that opportunities for the research and manufacturing chemist were meager and that the best opportunities lay in selling.

This is still true. The first yardstick we have to apply to any contemplated product—and we are constantly measuring them—is, "How much will our market take yearly?" Below $10,000 worth, it must be ruled out, no matter how attractive technically—unless it is an overlooked product such as sodium pyrophosphate for which a rapidly growing market is assured.

If we can sell it, then the salesman is just as important as the chemical engineer who is to make it at a competitive cost. So young chemical engineers in our region may well turn their attention to learning how to sell, which they will find useful anywhere if they like it.

PERSONNEL

Through the expansive 1920's our factory and laboratory had the balance in personnel needed by the kind of business that it was. The factory was managed by a man who had spent ten years working in the desert borax and soda plants adjacent to Los Angeles, as master mechanic and superintendent, with additional experience in power plants and mining. He could build and operate plants, and had done so, for trona, bicarbonate of soda, soda ash, borax, potash, salt, or whatever was wanted. He had come to us in 1924 and built our hypo and sulphite plant.

Mrs. Georgia Dwight looked after the office. She had come in early in the laboratory days and made her place as an efficient business housekeeper.

That left to me the selling and the product planning, but the latter was limited to products and product refinements in the photographic chemical field. We had made our place there, sold more than half the chemicals used by Hollywood laboratories, held our own against accomplished competition, and grown as Hollywood grew, but no faster.

What we needed was an experienced chemical engineer but we didn't clearly realize this until one dropped out of the clouds.

Fred C. Bowman often says that his family has been in chemical industry for three generations. He was Prince of Wales first proficiency scholar at the University of Toronto where he studied mineralogy as well as chemistry. After that he was engaged in mining as prospector, surveyor and chemist. He had worked in three chemical laboratories and eight chemical manufacturing concerns doing research, plant construction and operation. He was truly an experienced hand when he came to Southern California in 1924. After research work for the Carnegie Institution at Santa Barbara, he came with us in 1929 and immediately applied his knowledge to the development of our business.

Until that time our competition had been less on price than in active selling, with laboratory service. We were near and handy if Hollywood wanted technical assistance.

PROMOTION

Any glib promoter could have made a splendid stock prospectus from the facts laid before us by Mr. Bowman but costs were his chief concern. The plant had to be built with the least amount of money. And he figured the production costs so grudgingly that when the general trend of prices was downward, his margin for that gave us "livingroom."

Mr. Bowman's first specific proposal after studying markets and costs, was that we make trisodium phosphate. It was coming down in cost and becoming known as a superior cleaner and water softener. Our local market took about 4,000 tons a year, and perhaps 10,000 tons were sold on the Pacific Coast.

In the East, TSP was made of soda derived from salt, and phosphoric acid secured from Tennessee. Our soda had been laid down in the desert ages ago. It needed only purification and calcination. The acid was obtainable from Montana, a byproduct of copper smelting.

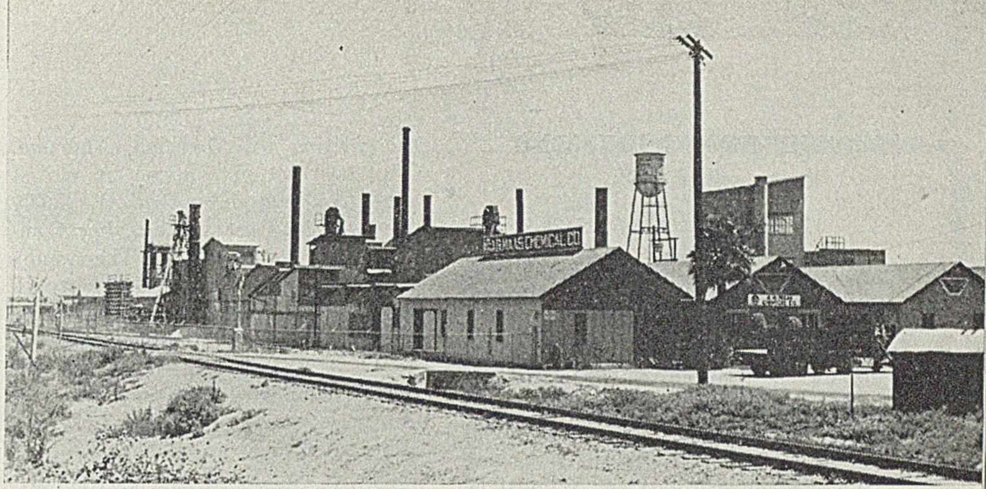
Investment capital was not available for many such enterprises had failed and we had still to show investors and bankers that we were able to stay in business and make profits.

So, about $25,000 needed was raised by mortgaging real estate, limited investments by people who knew us, and out of profits. It came hard and was spent after much comparison of second hand equipment. What he installed had been little-used or never set up.

We had some advantages in the climate, for lighter construction than is needed in colder regions is satisfactory for buildings and some of the plant needed no housing at all.

We couldn't run continuously, but the batch system, shutting down nights and Sundays, made it easier to adjust our production to our market.

Now that we had a product for which a market existed up and down the Pacific Coast and in states west of the Rockies instead of just in Hollywood, the "teller" was needed.



Looking south at the A. R. Maas Chemical Co. plant at South Gate, Calif.

PUBLICITY

The little leaflet *Chemistry & You* had been devoted chiefly to laboratory affairs with succinct stories of troubles shot, out-of-the-way analyses made, and so on. Its circulation was about 1,200 copies in and around Los Angeles.

TSP soon began to yield interesting episodes. Within a year a car of our TSP left our plant the day it was ordered. It reached nearby customers in 24 hours and those in the Northwest in five or six days, this was in contrast with the 30 days needed to bring a car from the East. We developed a patented non-caking grade called TSP "N" for package cleaners. In our second year, we shipped our first car to Australia, later developed as a market by a personal visit.

The circulation of *Chemistry & You* was extended over the Western states, to jobbers and large industrial purchasers. And on sales trips, our representative was often greeted by the buyer saying, "Why, I know your concern—I read your little paper!"

Most of the selling was done by myself in order to get acquainted with the trade and to establish jobbing connections. There is a distinct advantage for the small manufacturer in personal contacts because people like to meet and do business with principals. Also, such trips can be combined with some very good fishing.

Naturally, our business will not support a large research staff. Yet in proportion to size, we give as much attention to research as the large chemical companies. It became our policy to bring out a new product once a year, or to improve a process or product. In a limited market such as ours, if sufficient demand exists for a product, the first concern making it usually takes over the market. Two manufacturers could hardly operate in the small market, and the product may be one too small for large concerns to bother with.

The longest stride we have made since 1929 was the building of our sodium pyrophosphate unit, started last year, and just recently put into full production.

Five years ago the country's demand for "pyro" was small. But soap manufacturers discovered its virtues and, more important for us, the California oil driller found that it imparted desirable qualities to drilling mud. We estimate that one pound is now used for each foot of drilling. More than 1,000 wells are drilled yearly in California alone, some of them 10,000 ft. deep. With a rough average of 7,500 ft. the consumption may run to 7,500,000 lb. per year. This is at present our largest market.

For pyro, we had to have phosphoric acid free of the impurities found in that made with sulphuric acid. The burning of electric-furnace phosphorus was decided upon.

But capital was now forthcoming—in fact was in competition for our patronage. Two things had happened since 1929; the banks were full of idle money, and we had proved our ability to stay in business and to make money.

In my pharmacy class thirty-five years ago, the professor gave each of us a fragment of yellow phosphorus from a bottle and cautioned us to be careful with this stuff with odd behavior.

We now melt this once-dangerous material by warm water at a controlled temperature, pipe it to thermostatically controlled storage tanks and pump it when needed to a special furnace where it is burned like fuel oil. Its dense white fumes of phosphorus pentoxide are absorbed in water to yield phosphoric acid of any desired strength. The whole process runs so smoothly that it looks deceptively easy.

Our plant, office and sales force today has grown to 75 people with an office and consulting laboratory in downtown Los Angeles and a factory on a seven-acre plot of ground in South Gate, an industrial suburb, eight miles away. Direct telephone connection facilitates communication, but we have more than once considered moving the office to the plant—that would have advantages, and disadvantages.

To the aspiring young chemical engineer who dreams of his own business, we can say that the ability to work with others is the principal asset needed. Provided the four distinct kinds of ability needed are present in a group that can team up, such questions as finance, hard as they will be, can be settled.

It must not be thought that such a group is a purring happy family. The very fact that its members are responsible for diversified duties breeds strong convictions and differences of viewpoint.

The sales viewpoint and the engineering and production viewpoint are as far apart as the poles. One with its enthusiasm is inclined to tell the customers that nothing is impossible; the other will see numerous difficulties.

But both are necessary and compromises must be arrived at without allowing a feeling of defeat for either side. Experience and the elimination of all personal feeling about purely technical and business questions develop the knack of getting along. Also, the hotter the battle may be, the greater the likelihood that something important in the way of new opportunities has been uncovered. We have always had free discussion and in the end have always ratified our decisions by unanimous vote on policy.

CHEMICAL MUNITIONS PLANTS

(*Continued from page 769*)

fixed fee basis. The operating contract has not been let at the time of this writing.

Space requirements for a loading plant are two to three times as much as those needed for explosives. The War Department prescribes 12,000 to 18,000 acres and most of the site must be on level terrain. It must be reasonably close to powder and explosive plants and to other factories from which component parts are obtained; and to field facilities where loaded ammunition is stored. Labor requirements call for a readily available supply of skilled, semi-skilled and unskilled, of whom approximately one-third should be women, and for the presence in the vicinity of the site of a reasonable number of metal workers, lead burners and others. Sites selected so far are:

1. Ravenna, Ohio, near Akron. The Atlas Powder Company got the job on a cost plus fixed fee basis, at an approximate cost of $14,215,000.

2. Wilmington, Illinois. Sanderson and Porter received the award on a cost plus fixed fee basis which will run to about $14,000,000.

The special requirements of anhydrous ammonia plants are space; the availability of coke, coal and water at not too great a distance; and large amounts of electric power. Negotiations for such sites are under way, but none had been completed at the time of this writing.

The principal materials demanded at not too great a distance for ammonium nitrate plants are anhydrous ammonia, nitric acid, plenty of water for operating the plant and fuel in sufficient quantities for large amount of heat evaporation. No sites for plants in this category had been officially announced at the time of this writing.*

PLANTS FOR FORGING AND MACHINING SHELLS

For such plants, sufficient level space must be available to accommodate all the separate units. Sources of steel and copper should be readily accessible. An ample supply of skilled labor in addition to the usual requirements for the unskilled is needed.

The only site selected at the time of this writing was Gadsden, Alabama. The construction contract on a cost plus fixed fee basis for $1,135,000 went to the Rust Engineering Company of Pittsburgh, Pa. The Lansdowne Steel and Iron Company of Morton, Pa., will operate the plant. The price had not been announced.

We have dealt principally with plants connected with the chemical industry. Sites for plane, tank, engine, small arms and other munitions factories call for further specialized needs.

The magnitude of the problem of building up munitions production to meet our armament needs is reflected but partially in the consideration of the factors governing site selections by the War Department. The choice of the Army must meet the approval of the Advisory Commission to the Council of National Defense. After the site is definitely agreed upon the real estate must be bought. Thousands of parcels of land may be involved. Owners, many of them stubborn for financial or sentimental reasons, must be encouraged to sell their properties. Buyer and seller must agree upon terms. Titles must be clear. All these steps take time. Condemnation proceedings would take even longer and every effort is made to avoid them. After the real estate is bought, the ground must be broken and construction started. Production can not start until the plant is completed, and in most cases that means about a year.

Is it any wonder that the War Department insists that it will take a year or two before a continual flow of munitions in sufficient quantities to meet the needs of an army of two million men will be available?

* Since Col. Ginsburgh's manuscript was received, the Government has located a synthetic ammonia and ammonium nitrate plant at Muscle Shoals, Ala. See accompanying map on p. 769 and *Chem. & Met.'s* most recent tabulation of chemical munitions plants on p. 795.—*Editor.*

DESIGN AND CONSTRUCTION

(*Continued from page 767*)

(a) How to design for reasonable adaptability to normal production, after the emergency is over.

(b) How to get quick completion of engineering and construction, coupled with pre-ordering of essential equipment. Many of the larger corporations have usually done their own engineering, and sometimes their own construction and equipment work. Now, they are calling in help from outside, with good results. Quick buying of essential construction materials and process equipment is important, even with government priorities to facilitate delivery.

High-Pressure Vessels

T. McLEAN JASPER
A. O. Smith Corp.
Milwaukee, Wis.

THE PRESENT INTENSIVE EXPANSION WORK in the chemical industry has more than ever focused attention on the urgent need for safe and satisfactory equipment. There is a definite trend toward higher operating pressures as well as temperatures. There is also an increasingly exacting need for resistance to corrosive attack.

In the field of high-pressure vessels, existing sources have long put serious limitations not only on size and design, but also on the number of vessels that could be made available in a given time. Multi-layer construction overcomes these limitations. The principle of this construction is to build up the vessel wall of relatively thin layers of steel plate, tightly wrapped around one another. Obviously, this construction removes size restrictions, so that single units of greater capacity can be safely built and used. This construction is generally accepted, so that it has become widely adopted as the safest solution for the most severe operating problems.

The A.S.M.E. Boiler Code Committee has recently succeeded in establishing the safe operating stresses for cast and wrought steels of widely varying composition and under various conditions of service temperature. We have available, therefore, a wide variety of materials with accepted stress values conforming to operating temperature conditions varying from minus 20 deg. F. to plus 1,200 deg. F. The successful fabrication of practically all of the above steels through welding, using electrodes of similar composition to the materials used, makes possible production of unusual designs altogether impossible a few years ago.

Machinery, Materials and Products

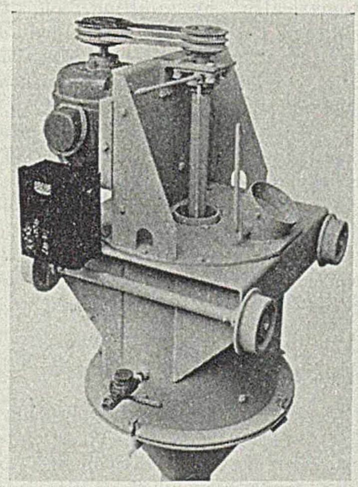
Chem & Met Process Equipment NEWS

Wet Disposal Unit

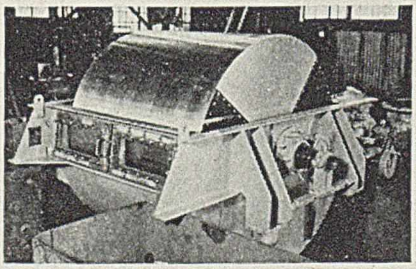
DESIGNED for wetting down and disposing of dry materials collected in dust collectors, the new American wet disposal unit recently developed by the American Foundry Equipment Co., 581 South Byrkit St., Mishawaka, Ind., is stated to simplify greatly the problem of dust discharge. Heretofore, the disposal of dust accumulated in dry type collectors necessitated more than ordinary care in handling because of the tendency for certain dusts to be dispersed into the air upon emptying the hoppers. Wet type collectors do not have this problem. The manufacturers state that the combined use of cloth-type dust collectors with the new wet disposal unit results in maximum overall dust collecting efficiency.

The new unit is a self-contained mixer which receives dry dust from the collector hopper and deposits it near the center of a high speed mixing disk. Water or other liquid is discharged at the center of the disk with the result that instantaneous mixing of dust and liquid is said to take place. The mixture flows from the sludge discharge at the bottom of the unit, which is claimed to handle dust approximately as rapidly as the hopper can be unloaded dry. In multiple hopper installations, the unit can be mounted on a track and moved from hopper to hopper as required, with quick-coupling devices at the various stations for connecting the dust hopper, water line and discharge.

Wet disposal unit for collected dust



Improved flaking drum



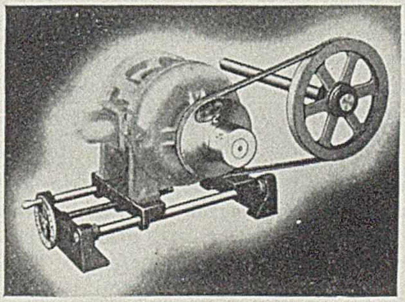
Flaking Drum

TO PROVIDE an economical method of converting a variety of liquid materials into flake form, the Blaw-Knox Co., Pittsburgh, Pa., has designed and introduced a new flaking drum employing a highly polished stainless steel chilling surface. The drum is driven by a motor through a large gear and motorized reducer, rotating in a pan containing the liquid material to be flaked. Solidified material is removed from the drum surface by means of a knife adjusted by a handwheel. Water or brine circulated within the drum provides the cooling effect. Normally inclosed (the top shell is removed in the illustration), observation of the knife action may be observed through the glass panels shown at the left.

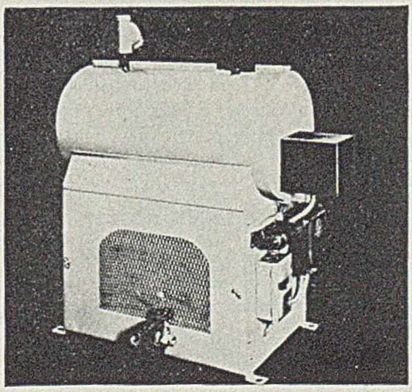
Variable Speed Drive

FOR VARIABLE SPEED driving of small and light machinery, the Reeves Pulley Co., Columbus, Ind., has announced the addition of the Vari-Speed Jr. to its complete line of variable speed control equipment. Any standard, constant-speed motor from fractional to $1\frac{1}{2}$ hp. may be employed with this unit. The Vari-Speed Jr. comprises a disk assembly and adjustable motor base. The disk assembly consists of two cone-shaped disks, one stationary and one laterally adjustable, a self-adjusting tension spring, a spring adjusting nut and cover. This assembly is applied to the standard shaft extension of the motor and the motor is mounted on the adjustable base. A standard V-belt is used. By means of an adjusting handwheel the motor may be moved forward or back so as to select the proper diameter of the drive pulley to secure the desired speed ratio. Six different sizes are available, providing speed control over a range from $1\frac{3}{4}$ to 1, to $2\frac{3}{4}$ to 1.

Reeves Vari-Speed Jr. drive



Circulating heater for heat transfer liquids



Heating System

A NEW heating and circulating system for heat-transfer media, for use with oils and other heat transfer materials where the desired temperature can be kept below the boiling point of the material, has been announced by John Royle & Sons, Paterson, N. J. Designed primarily for use in connection with this company's extruding machines, the heating system is also applicable to hydraulic presses, molds and other machines requiring the positive circulation of a thermostatically regulated heat transfer material.

The unit comprises a tank-type reservoir fully insulated with glass wool and covered with a steel jacket, mounted on a welded steel frame. A thermostatically controlled 6,000-watt electric immersion heater is provided, although heater elements of up to 11,000 watts capacity may be obtained at slight extra cost. A special motor-driven hot-oil pump, strainer and automatic pressure relief valve are provided. Motor and pump are concealed by removable panels inclosing the base.

New Products

PORCE-TITE is the name of a new "chemical ceramic" fireproof and waterproof paint recently introduced by Bedard & Morency Mill Co., 101 N. Lombard Ave., Oak Park, Ill. The new paint is recommended by the maker for both exterior and interior coating of masonry, concrete and building boards. Mixed to mortar consistency it can be used for filling cracks and holes in masonry. The material contains no oil, casein or cement, is applied by brush or spray and dries in 12 hours. Its constituents are entirely inorganic.

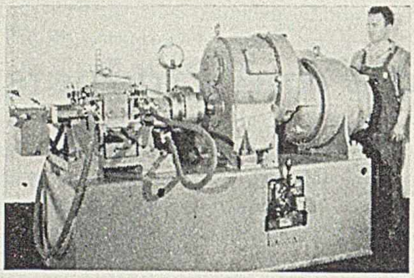
A GROUP of phosphorated oils said to be superior to sulphonated oils has been developed by The Beacon Co., 89 Bickford St., Boston, Mass. The group includes both sodium salts and unneutralized phosphorated oils such as castor oil, recinoleic acid and teaseed oil. These materials are suggested by the manufacturer for such uses as emulsion products, cosmetics, printing inks, wetting agents, paper and leather. They are claimed to be more stable than sulphonated oils, to have greater dispersing power and to be better wetting and penetrating agents.

SYNTHAL, a new synthetic rubber compound, superior to natural rubber in resistance to oils, greases, acids, alkalies and various chemicals, according to the manufacturer, is now being employed by the United States Rubber Co., 1230 Sixth Ave., New York, N. Y., in the production of a line of synthetic rubber clothing. The manufacturer points out that natural rubber clothing is superior and cheaper for less severe applications. An important feature of the new clothing is the elimination of stitch holes in seams through the development of a curing cement permitting all seams to be vulcanized. Clothing at present available includes coats, jackets, overalls, aprons, leggings, hats, boots and overshoes.

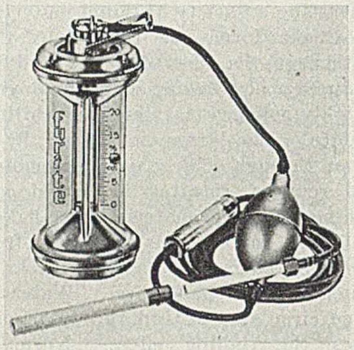
MANGANAL, a tough austenitic nonmagnetic steel containing 11 to 13½ per cent manganese and 3½ per cent nickel is now being stocked by Joseph T. Ryerson & Son, Inc., Chicago, Ill. This steel can be welded without subsequent quenching, and without loss of toughness. The material is claimed to be highly resistant to abrasion and impact. It is available in 48x120-in. plates, in thicknesses from 3/16 to 1 in.

KNOWN as Nypene resin, a new turpene polymer resin has been developed by the Neville Co., Neville Island, Pittsburgh, Pa. This resin has a melting point of 140-150 deg. C., is pale in color, neutral and non-saponifiable. With good resistance to water, acids and alkalis, according to the manufacturer, the resin is compatible with paraffine, natural and mineral waxes and is said to have exceptional softening action on rubber. The material is a synthetic product, originating from turpentine. Blended with 60 per cent rubber, it behaves as a pressure sensitive adhesive.

WHAT IS SAID to be the first coated aluminum bronze welding rod is now being offered by Ampco Metal, Inc.,



Size B Banbury mixer with four-speed motor



Plastic carbon dioxide indicator

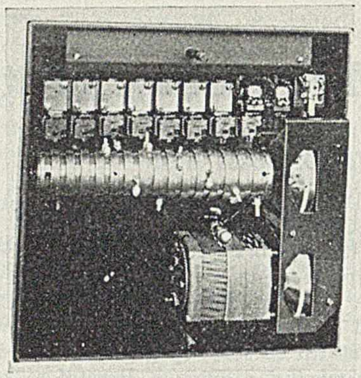
1745 South 38th St., Milwaukee, Wis. The new rod, which is recommended by the maker for rebuilding worn wearing and bearing surfaces, as well as in original work where the bearing properties and corrosion resistance of the metal are advantageous, features much higher ultimate tensile strength than the older bronze welding materials, as well as greater hardness.

Experimental Mixer

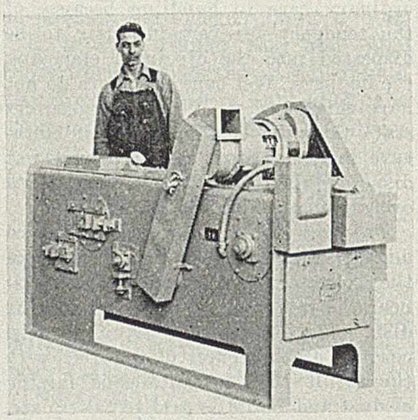
TO MEET the need for an experimental Banbury mixer, the Farrel-Birmingham Co., Ansonia, Conn., has introduced several sizes of smaller Banburies, designed on the same principles as the larger production models, but simplified to adapt them for laboratory use. Like the larger machine they can be used for the mixing of batches, not only of rubber, but also of asphaltic materials, phenolic condensation products, resinous compounds, paints, enamels, lacquers and other plastic materials. The machine illustrated, the intermediate of three sizes, is equipped with a four-speed motor and has a capacity of 2 lb. of crude rubber. The mixing chamber and the rotors are jacketed for heating or cooling. Two steel sheeting rolls on the extended rotor shaft outside the mixing chamber are provided to allow sheeting of the material after mixing.

Carbon Dioxide Analyzer

SIMPLICITY is the keynote of a new instrument for measuring the percentage of carbon dioxide in boiler flue gases, recently announced by the Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa. The



New Taylor Flex-O-Timer



New a.c. magnetic separator

new analyzer, known as the Fyrite, is constructed of molded, water-white, transparent plastic. A flue gas sample of known volume is pumped to the instrument by a hand-operated rubber bulb and trapped in the instrument automatically by pulling off the sampling hose. The instrument is then turned upside down, and back again, to mix the gas sample with the absorbing reagent, which is said to be good for several hundred samplings before replacement is required. The suction created by absorption of the carbon dioxide pulls the absorbing fluid up in the gage to a height indicative of the amount of carbon dioxide absorbed. Therefore, the level shows the CO_2 percentage in the gas.

Flexible Timer

EXTREME FLEXIBILITY of operation is a feature of the Flex-O-Timer introduced by Taylor Instrument Cos., Rochester, N. Y. This flexibility is obtained by the use of adjustable pins installed in circumferential undercut grooves on a revolving drum, and locked in place with a screw. For pneumatic operation, the pins actuate air valves while for electric operation, they make contact with switches. Both electric and pneumatic control can be incorporated in the same timer. The timer motor, which is of the fan-cooled synchronous type, is started by a solenoid device which may also be used to start simultaneously any other functions desired. To provide for a wide range of drum speeds, a unique dog-and-latch mechanism is employed, giving 78 different drum speeds for each gear train ratio. A new type of air valve, said to use effectively 99½ per cent of the air passing through it, is employed with this instrument.

Rubber-Lined Filter

A FILTER PRESS especially designed for the handling of corrosive liquids, in which all parts in contact with the liquid are rubber covered, has been announced by T. Shriver & Co., Harrison, N. J. As illustrated, the filter is a portable type, comprising an 18-chamber filter with 18-in. square plates and frames. Mounted on a base provided with casters, the unit includes a motor-driven pump and all interconnecting piping. The plates and frames, of cast iron, are rubber-covered by the anodic process. All piping as well as the drip-pan is rubber-lined steel. The diaphragm pump has the manifolding, valve chambers, heads and expansion chamber likewise rubber-lined, with a rubber diaphragm separating the fluid chambers from the working mechanism of the pump.

Fire-Fighting Trailer

FOR USE where a large capacity carbon dioxide type fire extinguishing unit is required, the C-O-Two Fire Equipment Co., Newark, N. J., has developed a line of two- and four-wheeled hose reel trailer units which can be attached to any truck or tractor and quickly towed to the scene of a fire. These units are designed to carry as many as ten 50-lb. cylinders of carbon dioxide gas, being equipped with one or two hose reels, with 100, 150, or 200 ft. of high pressure hose, and discharge horns fitted with quick-opening valves for controlling the discharge of the gas. These units employ pressure-operated valves whereby the pressure of the discharging gas from the initially released control cylinders is used to discharge a portion or all of the cylinders simultaneously. This feature simplifies control, facilitates the removal of cylinders for weighing or recharging and minimizes possibility of accidental discharge, according to the maker.

A.C. Magnetic Separator

UNUSUAL CONSTRUCTION for a magnetic separator is evident in the new Type AM machine recently announced by Stearns Magnetic Mfg. Co., Milwaukee, Wis. This separator, which is said to be particularly effective for treating finely ground powdered metals which may be contaminated with impurities such as oxide, scale, charcoal, silica and other foreign particles, employs alternating current to energize the magnetic field. On 60-cycle current, the material affected by the magnet thus receives 120 pulsations per second. Material is spread uniformly by an adjustable vibrating feeder which provides even distribution of the material on the separator belt. Here it is picked up by the magnet and carried along the underside of the separating belt, the high pulsating effect of the magnet freeing the non-magnetic impurities and allowing them to drop out. Under ordinary conditions three products can be produced: tailings, middlings and concentrates. An exhaust fan for dust removal, and dust-tight construction, are employed.

Vacuum Dryer

A ROTARY VACUUM DRYER of unique design, for use on chemicals and other process materials, has recently been built by L. O. Koven & Brother, Inc., Jersey City, N. J., for a prominent pharmaceutical and fine chemical manufacturer. The dryer comprises a stainless steel drum welded to dished heads and supported on trunnion bearings. A vacuum pipe outlet through one trunnion permits removal of vapors during drying. The drum rotates over a trough-like galvanized steel stand in the bottom of which are steam pipes, or alternately, gas or electric heating elements. Heat radiated to the rotating drum is absorbed by material within the drum which is thus subjected to a uniform exposure, assuring a uniform drying rate, according to the manufacturer. Swing bolts holding the reinforced stainless steel cover in place may be loosened to allow the cover to be removed. The drum is then tilted for removal of the material and recharging of the dryer.

Bag Closer

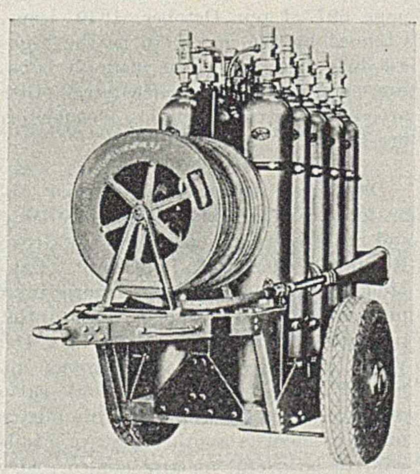
KNOWN as the Super-Looper, a new portable bag closer which operates without electric power by friction drive only, has been announced by Bemis Bro. Bag Co., St. Louis, Mo. Weighing only 8¾ lb., this bag-sewing machine may readily be operated by one man in packaging operations where the production schedule is limited. An incidental advantage is that the machine permits sewing tags into the closures.

As the machine is drawn across the bag, friction rollers transmit power to the needle through a train of gears operating on oilless bearings. The needle is so supported as to make bending impossible and breakage rare, according to the manufacturer. The driving mechanism is completely sealed against dust and dirt. The thread is automatically cut without stoppage or interruption by a continuous "follow through" motion of the machine as it leaves the bag. Speeds of closure of from four to seven bags per minute are claimed.

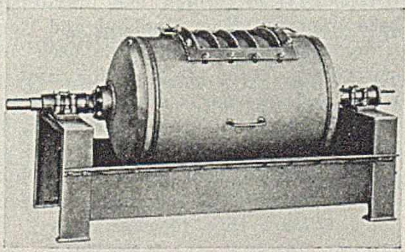
Flashlight Storage Battery

A NEW device introduced by the Ideal Commutator Dresser Co., Sycamore, Ill., is a miniature flashlight storage battery which, with proper charging,

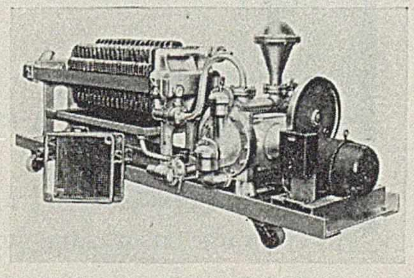
Carbon dioxide trailer



Rotary vacuum dryer



Rubber-lined portable filter



Friction-drive bag closer

is claimed to give up to 1,000 hr. or more service. Operating and maintenance departments employing flashlights extensively can, it is claimed, save up to 75 per cent of battery costs using rechargeable storage batteries of this type. The battery is of a size designed to fit all two-cell size D flashlight cases and, with the simple charger provided, is readily recharged at negligible cost from an ordinary light socket. Special low-voltage, low-priced bulbs are used with the battery.

Improved Still Heater

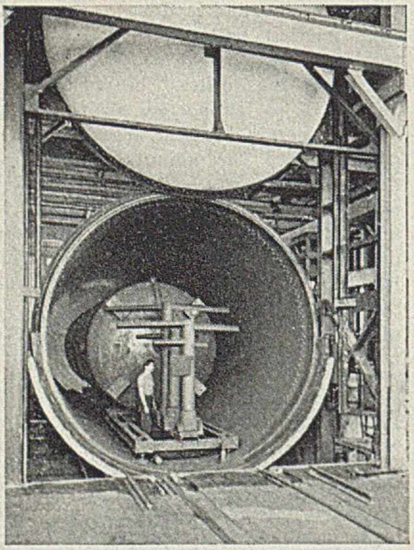
For use on hard water stills in the smaller sizes, from 1 to 5 gal. per hr. capacity, the Barnstead Still & Sterilizer Co., Boston, Mass., has introduced a bayonet type steam heating element which can be quickly unscrewed from the exaporator when cleaning is needed. It is unnecessary to remove the top or any other part of the still. This type of element is not available on larger sized stills although its advantages are obtainable in the recently developed method used by this company for larger heavy duty equipment. On such stills, a removable door is provided, with the heating coil mounted on it for accessibility for cleaning.

Boiler Return System

Intended especially for boilers up to 750 hp. at 200 lb. pressure, a new automatic boiler return system, announced by Micro-Westco, Inc., Bettendorf, Ia., includes a number of new features. The system comprises a copper-bearing steel condensate receiver, equipped with a float-controlled make-up-water valve; one of this company's standard turbine-type motor-operated pumps; a float-operated boiler level control unit; and the necessary starter, pressure gage, thermometer, etc. The condensate receiver is vented so that no back pressure is imposed on the return lines, which makes it possible to return condensate from high- as well as low-pressure equipment. Make-up water is automatically added in the receiver to compensate for loss of live steam. The boiler level unit is of an improved type in which packing is eliminated between float and mercury switches through the use of a specially built bellows above the water level. This unit starts and stops the pump, cuts off the burner or stoker if the water level should drop dangerously and sounds an alarm if this should occur. A feature of the pump employed is that replacement liners and impeller may be kept on hand for quick repairs, at about one-third the cost of a new pump.

Large Vulcanizer Installed

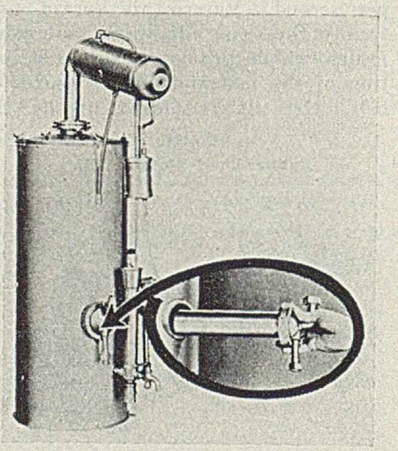
This vulcanizer, recently put into operation by the Manhattan Rubber Manufacturing Div. of Raybestos-Manhattan, Inc., Passaic, N. J., in anticipation of defense requirements, is believed by the manufacturer to be the largest in the country. Fifteen feet in diameter, it can accommodate practically any piece of equipment capable of shipment by rail. It has been designed for vulcanizing huge rubber-lined tanks and other processing equipment, as well as marine propellers, sea-water handling pumps, and the like.



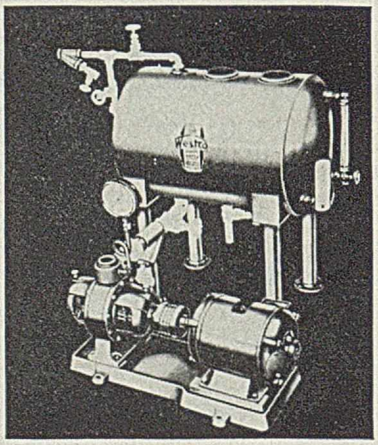
Boiler-Burner Unit

Covering the range from $1\frac{1}{2}$ to 25 hp. rated capacity, a new line of high pressure boiler units for automatic steam production for industrial use, has been announced by the York Oil Burner Co., York, Pa. Boilers are of the vertical type, designed and constructed to withstand high pressure and heavy steam loads, and conforming with A.S.M.E. codes and state and city requirements. They are fabricated from heavy boiler plate with copper alloy steel tubes (or charcoal iron tubes at additional cost). Standard equipment includes the proper size oil burner, controls, gages, hand injector for water and all other required parts. Helical baffles inserted in the tubes are used to increase overall efficiency and these baffles can also be used for periodic cleaning of the tubes. Fourteen sizes in all are available. The larger boilers of the line are equipped with this company's new Model T Series burners, featuring this company's Iris shutter for micrometer adjustment of the air-oil mixture. These burners are built in three sizes ranging from 3 to 27 g.p.h. oil rate, for from 19 to 64 boiler hp.

New still heater



Improved boiler return system



Equipment Briefs

Development of a lubricated plug valve capable of handling working pressures to 7,500 lb. per sq.in., and tested to 15,000 lb., has been announced by Merco-Nordstrom Valve Co., 400 Lexington Ave., Pittsburgh, Pa. This valve employs a special alloy steel with both plug and interior contact surfaces faced with Merchrome, this company's new development which was described on page 697 of our October, 1940, issue. Claimed by the maker to be the highest duty plug valve ever made, it is being employed in refineries and other process industries requiring tremendous pressures.

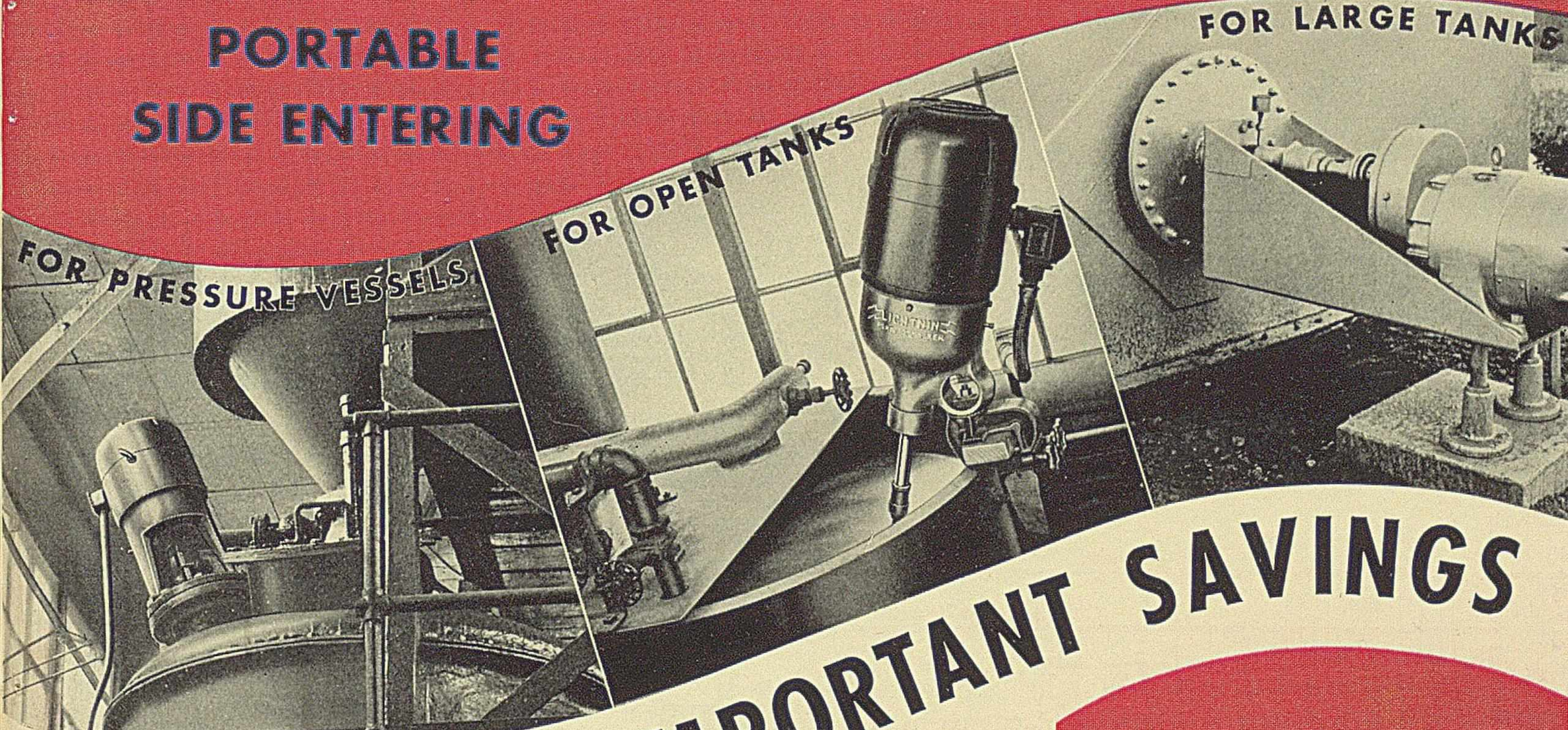
Developed for experimental and laboratory use, a new pressure reducing and relief valve announced by the Grove Regulator Co., 1737 Poplar St., Oakland, Calif., is stated to govern inlet pressures up to 3,000 lb. and outlet pressures from ½ to 1,000 lb. The valve is said to attain extreme accuracy owing to its enormous ratio of valve to diaphragm area. Simplicity of adjustment is another feature. It is said to be useful on any non-corrosive gas.

Wedge Wire, which has previously been imported from England and Germany, and has in the past been described in *Chem. & Met.* for use in sieves and screens, is now being manufactured in the United States and is available from the Wedge Wire Corp., 5200 Harvard Ave., Cleveland, Ohio. The wire, which is formed as an elon-

(Please turn to page 815)

LIGHTNIN MIXERS

TOP ENTERING
PORTABLE
SIDE ENTERING



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YOUR STEAM LINES KEPT HOT AND DRY WITH CRANE TRAPS

You are not getting the maximum heat and power from steam if your lines are not properly drained. You are straining the piping, shortening the life of valves, exposing steam-operated equipment to serious damage when condensate is not removed.

In steam lines up to 600 pounds pressure, the wasteful and damaging effects of condensate are completely eliminated with Crane Inverted Open Float Steam Traps. These sturdy, simple, and low-cost traps will pay for themselves many times over. Once installed they require minimum attention—yet, automatically, stop steam waste, step up efficiency.

For pressures up to 200 pounds, the Crane line of No. 981 traps will give maximum protection against condensate troubles.

TOMORROW—hundreds of plants may face a case like this: A midwestern manufacturer was suddenly swamped with orders. The plant had a good reserve capacity—yet, push as the management did, it failed to get the output needed.

The boilers and machinery were in excellent shape—but the steam lines were sluggish. The ailment was a common one—a condition that's quickly corrected with proper equipment.

That's how Preventive Maintenance entered the case. For, it's the only sure way of solving piping problems and keeping them solved. This simple technique guides you in installing and caring for pipe lines correctly; it helps you choose the right valves and fittings for every service.

This case shows how Preventive Maintenance works. While the management raved, the Superintendent put his hands on the trouble. The machines were not only slow in heating up, but they wouldn't stay hot. The drainage system was inefficient—it failed to remove condensate rapidly enough to keep the machines at maximum temperature.

The backlog of orders haunted the Superintendent. He saw that more than ordinary maintenance was necessary. "The Crane man," he said as he reached for a phone, "will help us solve this quickly and surely."

The two men reviewed the situation. To run the machines at top speed meant keeping them at maximum temperature. Condensate would have to be drained as rapidly as it formed. The correct solution, as Preventive Maintenance counseled, involved redesigning of the drainage system, and installing a Crane Inverted Float Trap on each machine.

Results: The condensate trouble was banished. Production was immediately doubled. Another user of piping knows the value of Preventive Maintenance. Also, knows that the best way to get most from piping maintenance dollars is to call in the Crane Man. Because, backed by Crane experience and the great Crane line of valves and fittings, he offers the means of a successful Preventive Maintenance program.

This case comes from the personal experience of W.F.C. —a Crane Representative in the Kansas City Branch

1940 our 85th YEAR

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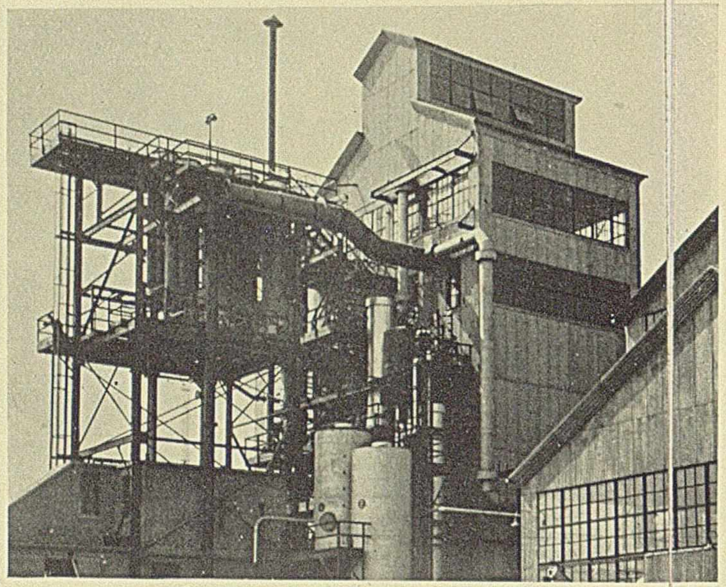
PHENOL

Vapor Phase Regenerative Process

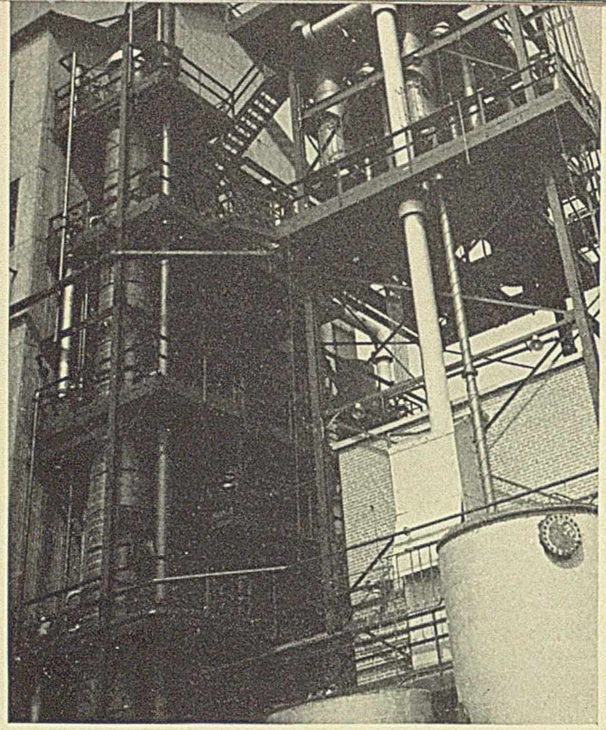
Pictured here, and illustrated also with a simplified pictorial flow sheet is the new vapor phase regenerative chlorination process for phenol synthesis which is being employed by Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. By this process phenol is being made at the rate of more than 15,000,000 lb. per year. The process, which is described in considerable detail on pages 770 to 775 of this issue, yields what is said to be the purest phenol commercially available, with the production of less than 0.1 lb. of byproducts per pound of phenol made, in comparison with the 2 to 5 lb. of byproducts made by the older synthetic processes. Developed by Dr. F. Raschig G.m.b.H., of Ludwigshafen, Germany, the process was licensed in 1938 by Durez and the new $2,000,000 plant, which is by far the largest of its kind, is now in operation after a two-year period of design and construction.

The process consists of two vapor phase catalytic stages which are fundamentally simple, but become complex in practice owing to the need for separating and recovering unreacted materials and the regenerated hydrochloric acid which circulates in the process. In the first stage, benzene is reacted with air and hydrochloric acid to form monochlorbenzene and water. In the second, the monochlorbenzene is reacted with steam to regenerate the HCl and produce phenol.

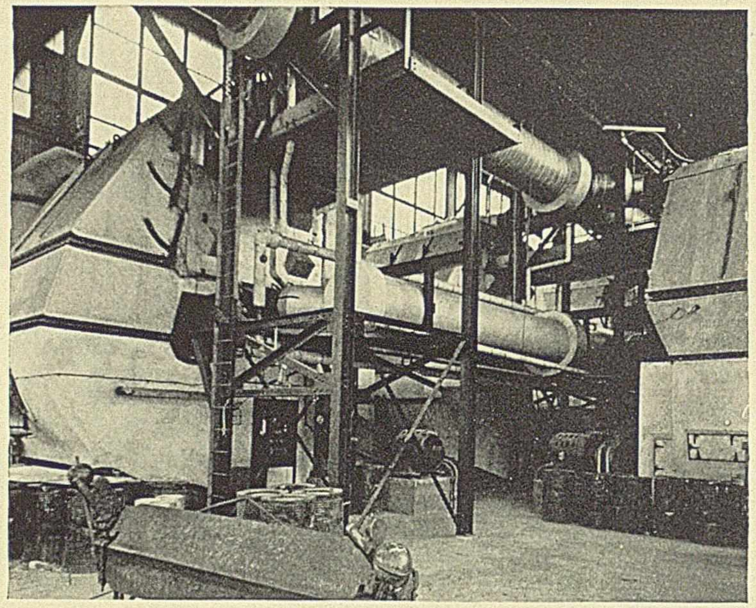
It may be considered that the process starts with the vapor superheater (*a*) near the center of the flow sheet. Benzene vapor, HCl and air mixed in (*c*) are drawn into a converter (*d*) by suction of fan (*h*) at the proper temperature for reaction. The chlorobenzene formed (with a small amount of polychlorbenzenes) condenses in a partial condenser (*e*), while the unreacted benzene condenses and returns to the process in a final condenser (*g*). The monochlorbenzene after purification is vaporized into the second stage of the process, where it circulates with steam through a series of towers, heat exchangers (*s*), a superheater (*t*), and a converter (*u*), in the last being in part hydrolyzed to phenol and HCl. The HCl is condensed in a partial condenser(*v*), then extracted with benzene at (*k*) to remove what phenol it carries and returned to the first stage process to be revaporized at (*b*). The phenol in circulation is first dissolved in water in a scrubber (*q*), then extracted by benzene from the water in (*l*), the water returning to the scrubber (*q*) for further duty. The combined benzene extracts of phenol are pumped to a fractionating column (*m*) in the first stage where the benzene is vaporized for the first stage process, while the crude phenol is discharged for final two-stage distillation to produce the finished product.



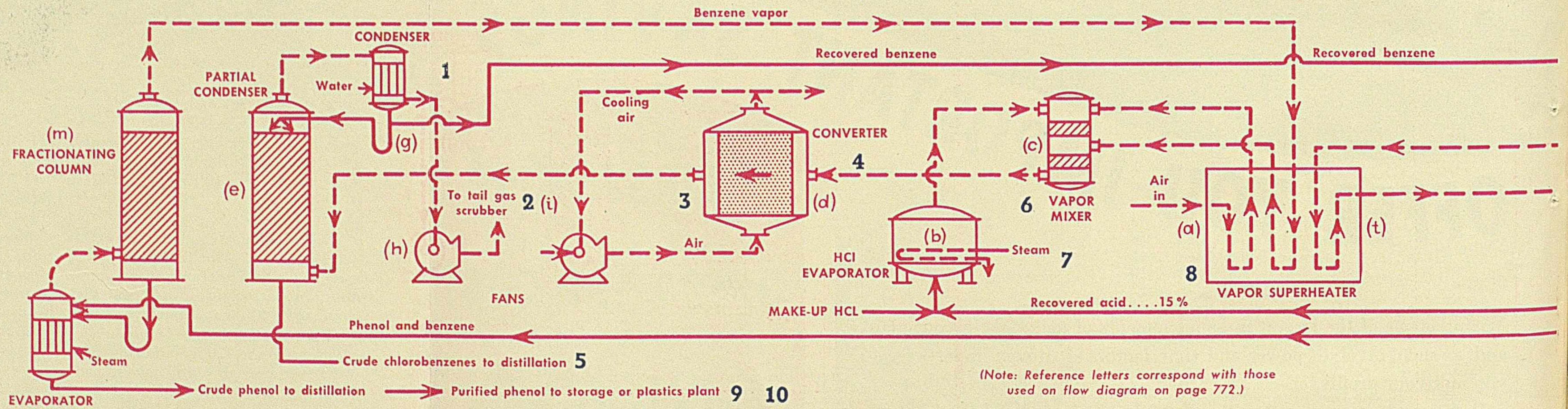
1 This view shows the six copper shell-and-tube final condensers for recovering benzene which passes through the first stage partial condenser. All cooling water for the plant is first used here

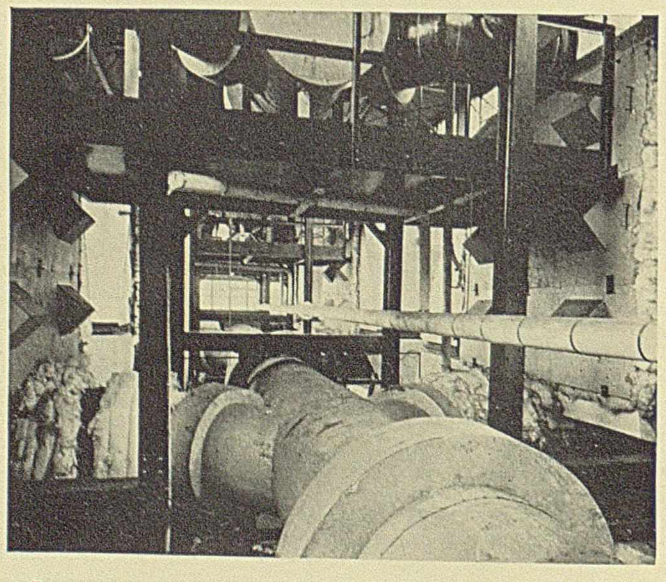


2 At the left is the tail gas scrubber in which benzene not condensed in the final condensers at the right is absorbed for recovery in a hydrocarbon wash oil

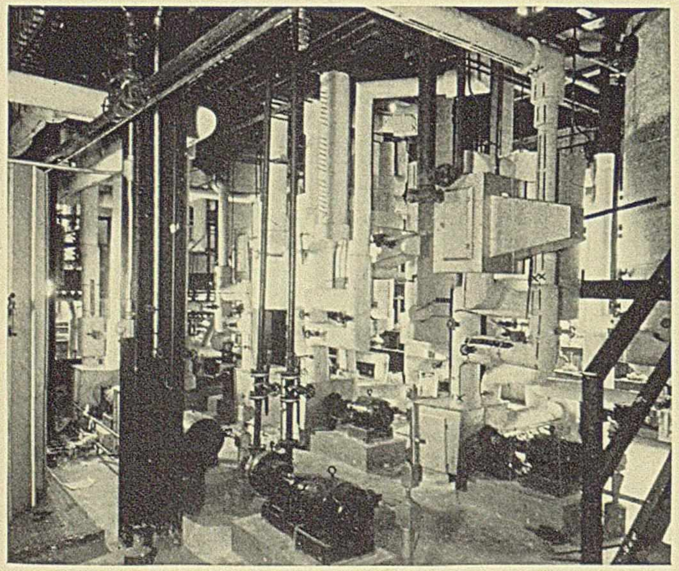


3 This converter for reacting benzene with HCl and air to form monochlorbenzene is cooled by circulating air with the fan in the lower part through air passages in the catalyst chamber proper

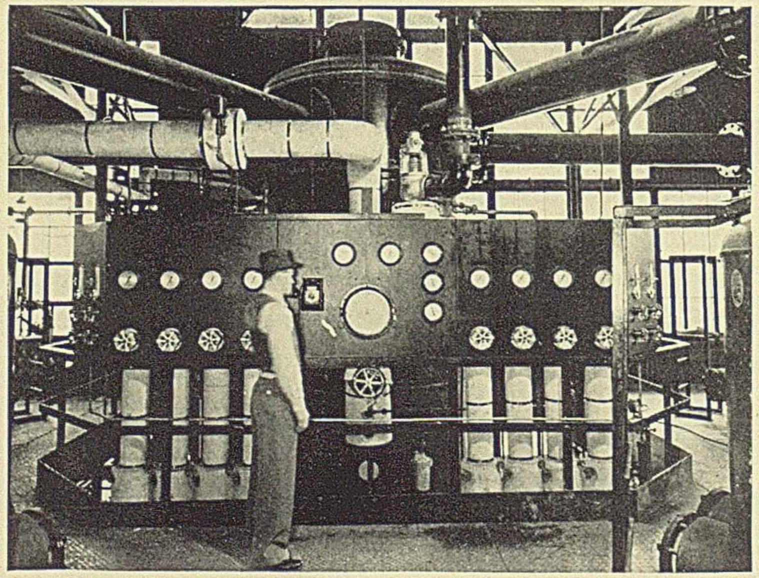




4 The lower ducts bring the reaction mixture to the first stage converters, while the upper remove the reaction products

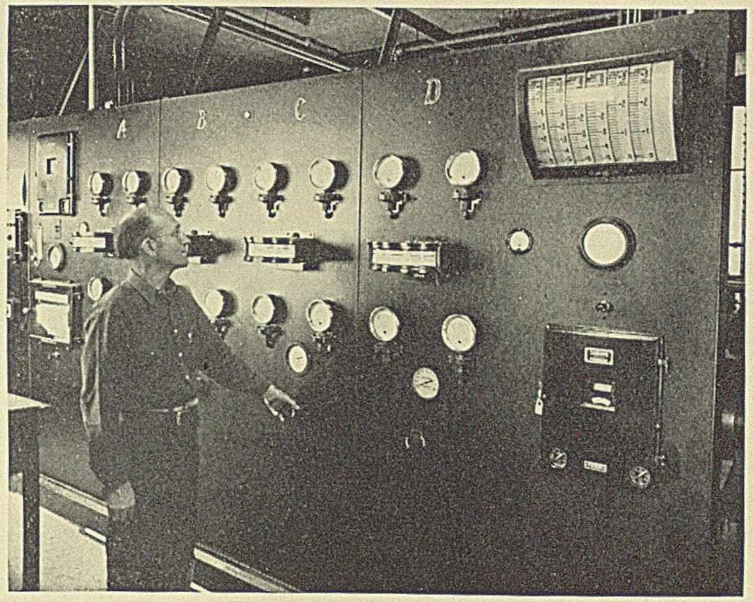


5 These stills in the distillation building purify chlorobenzene for conversion to phenol in the second stage process

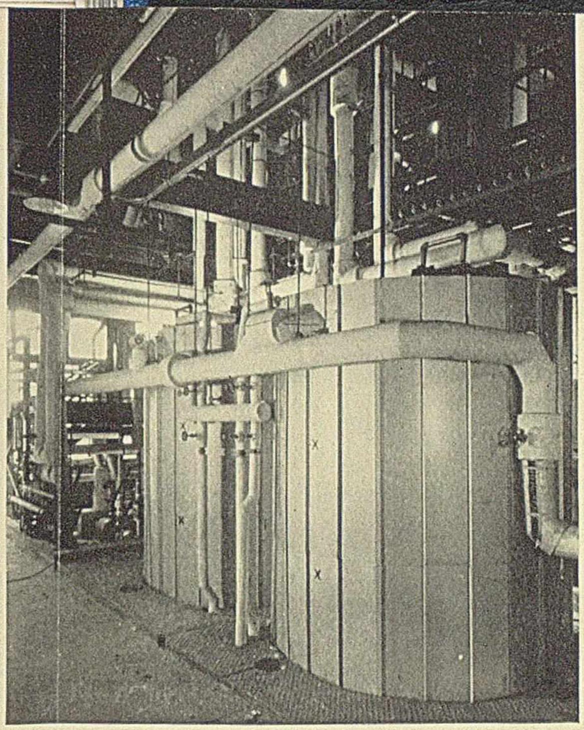


6 Control board for the HCl vaporizers, with two of the vaporizers at left and right barely visible, and the vapor mixer behind the board

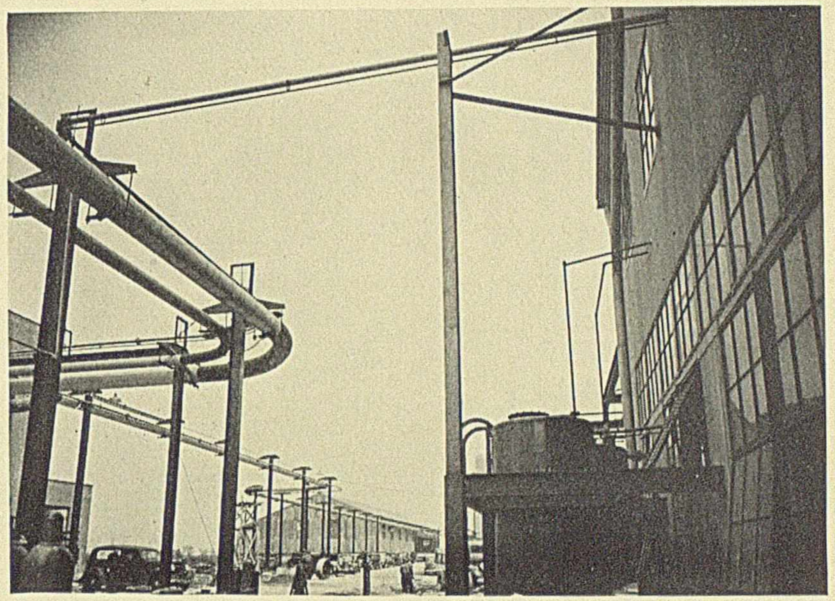
7 In this modern power plant with centralized control process steam is generated not only for the HCl vaporizers, but also for many other plant operations



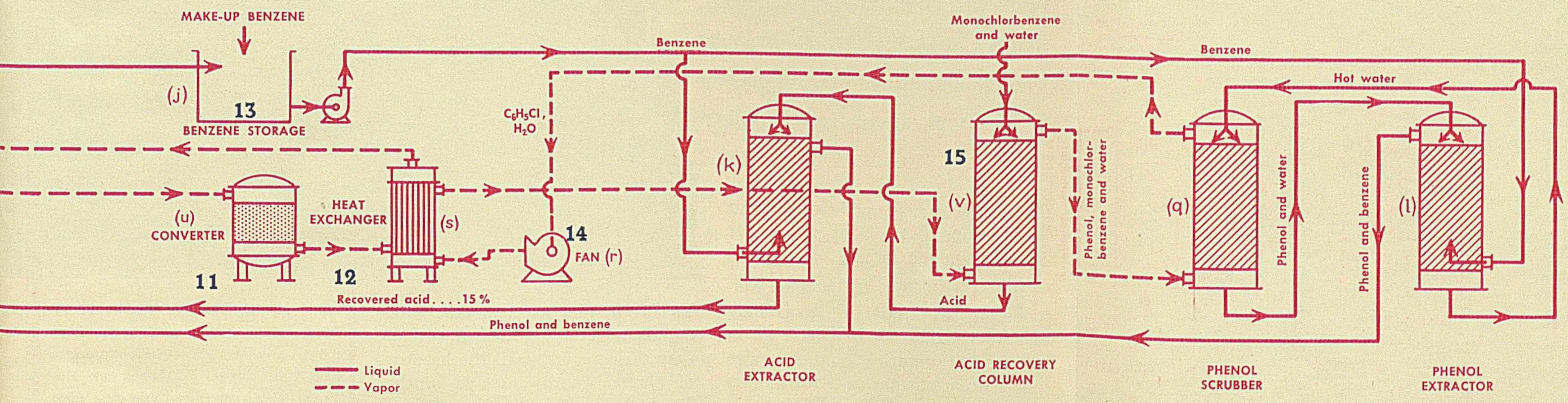
8 Control equipment for the vapor superheater which serves both stages of the phenol process is centralized on this panel board. The superheater provides three different temperature sections

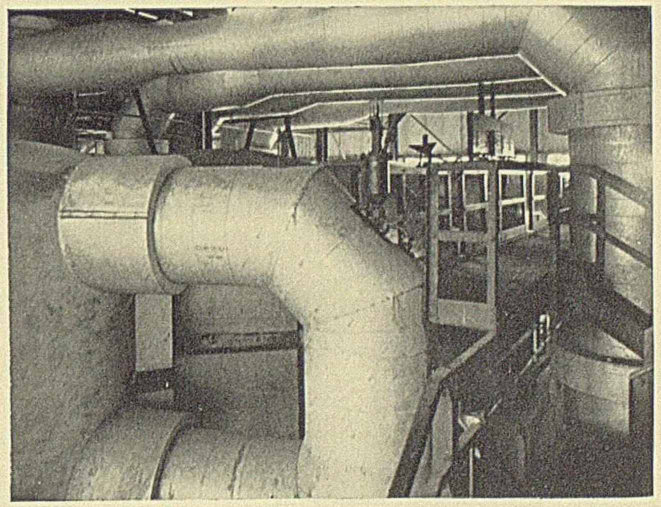


9 Pure phenol produced by two-stage vacuum distillation is accumulated in these insulated glass-lined tanks before running to storage or the plastics plant

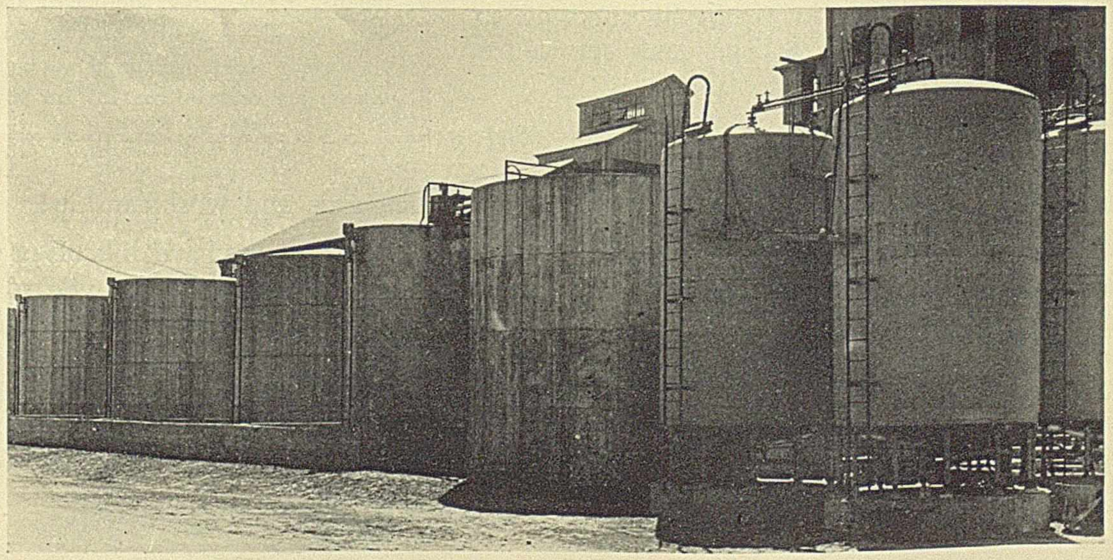


10 This small steam-traced nickel line (pictured before the insulation was applied) is used to carry pure phenol to the Durez plastics plant. Fully 700 ft. long, it is said to be one of the longest nickel lines in existence

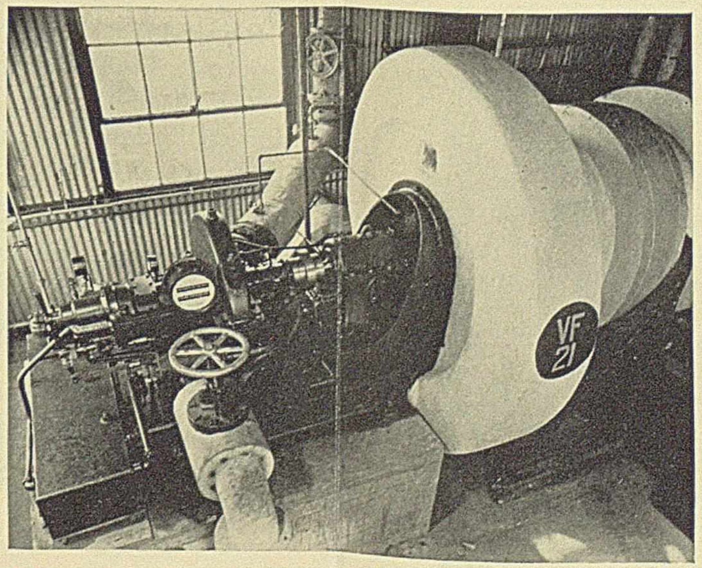




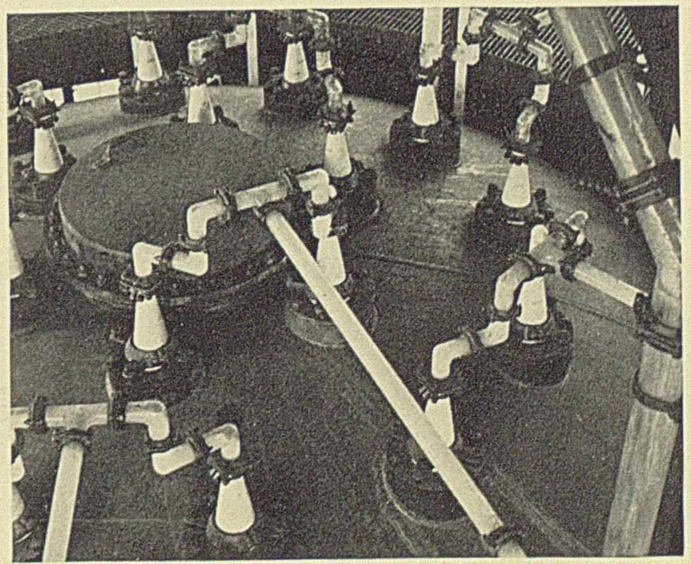
11 Pictured here is one of the four second stage converters where monochlorbenzene is hydrolyzed with steam



13 This is a part of the tank farm where phenol and intermediate products are stored during production from benzene and air. The glass-lined phenol storage vessels at the right are provided with steam coils

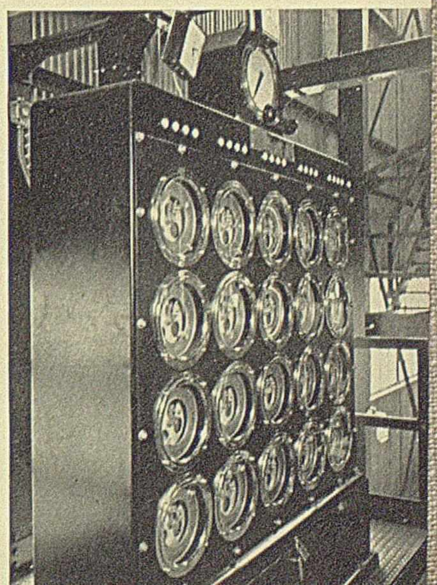


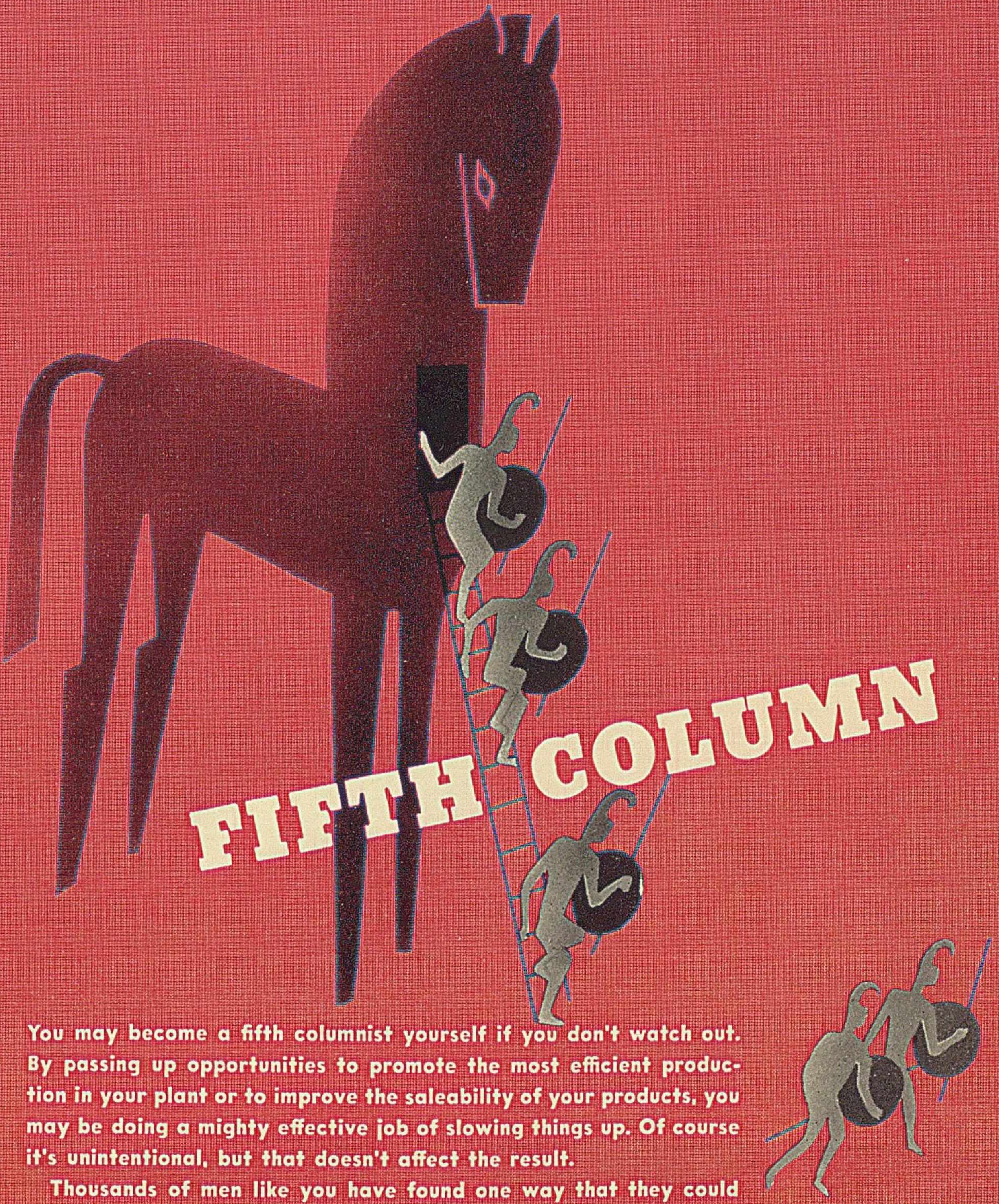
14 This 200-hp. steam-turbine-driven blower circulates the vapors used in the second stage reaction system



15 Porcelain and glass distribution piping at the top of the tower where HCl is recovered from the second stage reaction

12 This group of time switches controls the valves and dampers which switch the four phenol converters from reaction to activation





You may become a fifth columnist yourself if you don't watch out. By passing up opportunities to promote the most efficient production in your plant or to improve the saleability of your products, you may be doing a mighty effective job of slowing things up. Of course it's unintentional, but that doesn't affect the result.

Thousands of men like you have found one way that they could make truly remarkable improvements in their plant equipment and greatly increase the saleability of their motor driven products. It's an easy way, too, they simply use Master Motors built to meet exactly the individual requirements of each job. You, too, can lower costs, improve the appearance, efficiency and safety of your product or your plant equipment. Investigate MASTER'S unusual ability to serve you promptly and economically with motors that really fit your individual needs.

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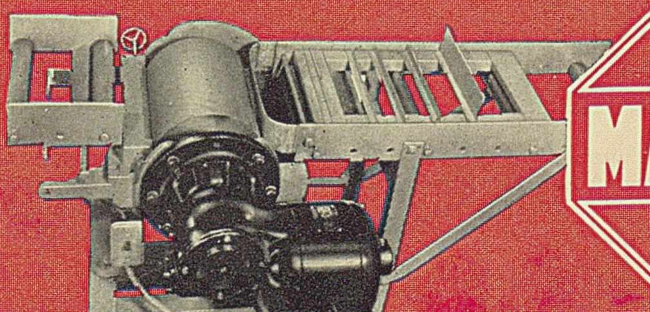


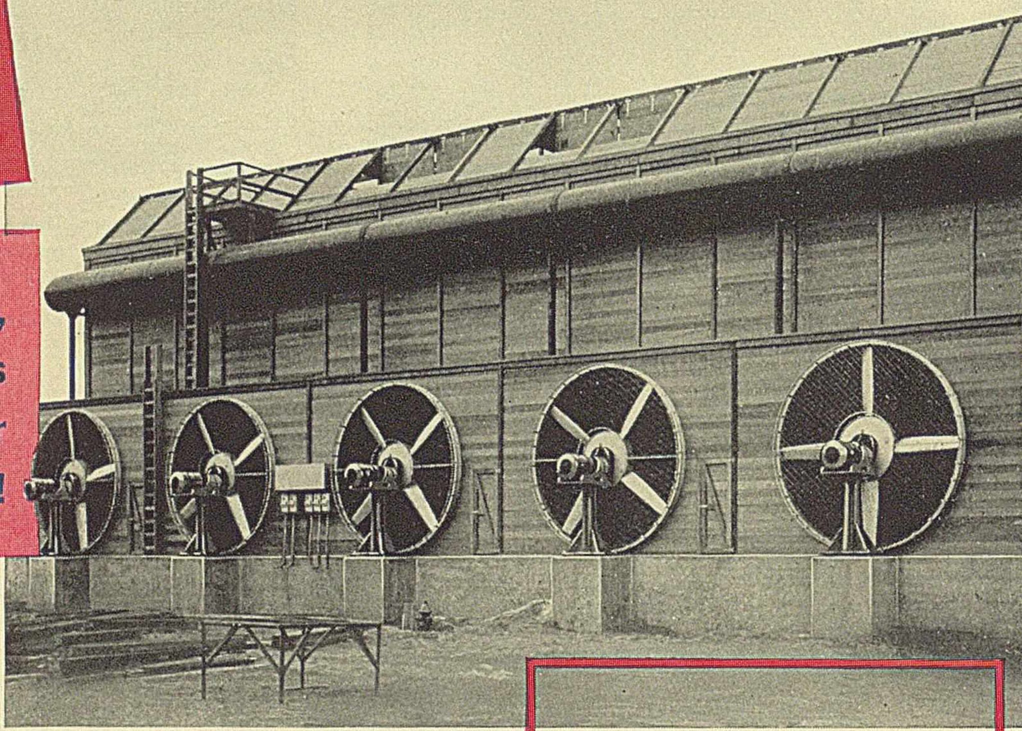
MASTER

MAKES A CYCLONE

WITH ALLIS-CHALMERS MOTORS!

Another true case history from the Allis-Chalmers files that proves **"IT PAYS TO BUY THE EQUIPMENT THAT PAYS FOR ITSELF!"**

Panhandle Power & Light Company, Borger, Texas, Finds Allis-Chalmers Lo-Maintenance Motors the Answer to a Tough Operating Problem!



THE PANHANDLE POWER & LIGHT Company heard amazing stories from their customers about the performance of Allis-Chalmers Lo-Maintenance Motors. That's why they chose these same motors to power the four-bladed axial flow fans in their new cooling tower . . . where 15,000 gallons of water per minute are cooled from 105° to 90°F.

MAKING a man-made cyclone to cool 15,000 gallons of water per minute is a job in itself . . .

But when it has to be done outdoors in all kinds of Texas Panhandle weather — in heat . . . in rain and dust storms . . . then you've got a situation that calls for motors that are *better* than ordinary.

Recently when the Panhandle Power & Light Company put in a Foster Wheeler cooling tower at Borger, Texas, they knew they were up against a tough operating problem. Here's how they solved it —

They went to their own customers in the carbon black industry where motor conditions were notoriously severe . . . found *one* motor in general use. And that motor, they discovered, to be the Allis-Chalmers dust-proof, weather-proof Lo-Maintenance Motor!

That's why they selected these same motors . . . why today they can snap their fingers at all the hazards of outdoor motor service in the Texas Panhandle. And best of all — they know they'll continue to get low-cost, dependable service for many years to come.

Cut Your Power Costs With Lo-Maintenance Motors!

For Allis-Chalmers Lo-Maintenance Motors are built with extra-value construction to give performance that's more than just their nameplate ratings. These motors are outstanding in having high carbon steel frame . . . indestructible rotor . . . distortionless stator . . . plus Allis-Chalmers famous no-stint policy in materials and workmanship!

Whether you have difficult or easy motor jobs, it will pay you to use Lo-Maintenance Motors. The trained engineer in the district office near you will be glad to tell you how you can cut power costs. Call him today. Or write Allis-Chalmers, Milwaukee.

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Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

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Technical, Industrial, Personal

Chem & Met NEWS

A. I. CH. E. WILL HOLD ANNUAL MEETING IN NEW ORLEANS

The thirty-third annual meeting of the American Institute of Chemical Engineers will be held at the St. Charles Hotel, New Orleans, Dec. 2-6. Registration will actually begin on the evening of Dec. 1 and will continue on the morning of Dec. 2. The meeting will get underway on the morning of Dec. 2 with a technical session at which Webster N. Jones will preside. This will be followed by a business session at which officers and directors for 1941 will be chosen. In the afternoon plant visits will be made to the Godchaux Sugar Refinery and to Shell Oil Refinery. Members will return to New Orleans in the evening for a theatre party.

Group breakfasts are scheduled for the morning on Dec. 3 followed by a technical and business meeting. In the afternoon plant visits have been arranged taking in a cottonseed oil plant, a cement plant, and a shrimp packing plant. The annual banquet will be held in the evening at which Dr. H. G. Knight, Chief of U. S. Dept. of Agricultural and Engineering Chemistry will be the principal speaker. Technical sessions on Dec. 4 are on the morning and afternoon schedules. Webster N. Jones will preside at the former and James G. Vail at the latter. After luncheon there will be a golf tournament and a sight seeing trip. On Dec. 5, a strip will be made to Grand Ecaille and on the following day plants will be inspected at Hattiesburg and Laurel, Miss.

Approximately twenty technical papers have been scheduled for the sessions on Monday and Tuesday mornings and Wednesday morning and afternoon. Professor E. P. Schoch and W. A. Cunningham of the University of Texas will discuss wet methods of producing gypsum plaster. Kermit Fischer, S. Blechman and E. P. Lipstein of Fischer & Porter Co., deal with the elimination of viscosity as a factor in determining rotameter calibrations. James A. Lee of *Chem. & Met.* has a paper on "Chemical Industries in the Deep South." R. C. Hills of Freeport Sulphur will give an illustrated account of the Grande Ecaille mine which is later to be visited by Institute members.

Tuesday's sessions feature a number of papers on petroleum. One of outstanding interest at this time comes from Dr. E. C. Williams of Shell Development Co., entitled "Synthetic Glycerine and Allied Products." E. O. Bennett of Continental Oil Co. discusses the economics of design and operation for pressure maintenance and condensate recovery. T. P. Simpson, E. S. Nicholls and J. W. Payne of Socony-Vacuum, review recent advances in the Thermofor kiln. L. B. Bragg of Foster Wheeler Corporation, discusses "Packed Columns for Close Fractionation." J. W. Peckie of Standard Oil Development Co., reviews distillation equipment in petroleum refining.

Professor W. H. Baskervill of the University of Tennessee, describes the packed-tower collection of phosphoric acid. D. H. Caldwell and H. E. Babbitt, of the University of Illinois, discuss "The Flow of Muds, Sludges and Suspensions in Circular Pipes." Another paper from the same institution under the authorship of H. F. Johnstone, R. L. Pigford, and J. H. Chapin (now with the duPont company) is entitled "Heat Transfer to Clouds of Falling Particles." James W. Irwin of Monsanto Chemical Co., is scheduled to discuss "The Chemical Engineer's Stake in Free Private Enterprise."

Two papers on different phases of solvent extraction are to be contributed by J. O. Maloney and A. E. Schubert of Pennsylvania State College and by V. G. Skogan, Standard Oil Co. (Ind.) and Marvin C. Rogers, of R. R. Donnelley & Sons, Chicago.

"Heat Transfer in a Long-Tube Vertical Evaporator" by O. C. Cessna and W. L. Badger of Dow Chemical Co. and J. R. Lientz of Swenson Evaporator Co.; "The Unsteady Flow of Heat through Porous Media," by W. D. Harbert, Humble Oil & Refining Co., D. C. Cain, Duncan-Macklenburg Co. and R. L. Huntington, University of Oklahoma; "Heat Transmission of Condensing Organic Vapors," by A. H. Cooper, R. H. Morrison and H. E. Henderson of Virginia Polytechnic Institute; and "Air Flow Distribution Following Contracting Tubes," by E. L. Piret and E. J. Kuth of University of Minnesota are also scheduled for delivery Wednesday afternoon. In addition there are two papers from Polytechnic Institute of Brooklyn, namely "Condensation of Vapors for Lower Alcohols" by D. F. Othmer and R. E. White, and "Acetone Absorption by Water in a Semi-Commercial Packed Tower," by D. F. Othmer and E. J. Scheibel.

SYNTHETIC RUBBER CONTRACTS NOW IN PROGRESS

Arrangements for synthetic rubber contracts are now being negotiated by the Rubber Reserve Co., subsidiary of the Reconstruction Finance Corp. At least a half dozen potential contractors are involved in the negotiations. While no details have been made public it is thought that the smaller contracts will provide merely for purchase by the government of products made in development or other small-scale plants. In a similar way contracts would be made with large plants which are privately owned and controlled. But in order to speed up production, the government may insist on one or more enterprises that will be government-owned and financed through Rubber Reserve Co. Such contracts for synthetic rubber would be analogous to those for explosives except that the RFC subsidiary would be the contracting agent instead of the Army.

With regard to the chemicals required for the manufacture of synthetic rubber, it is probable that the manufacturer of the rubber will be responsible for the procurement of the necessary raw materials. Should any doubt arise regarding raw material supplies, the government might take a hand as it did when there was a question of toluol supplies for the manufacture of explosives.

Du PONT TO BUILD SECOND PLANT FOR NYLON MANUFACTURE

A second plant for the manufacture of nylon yarn, Du Pont's new contribution to the textile industry, will be built at Martinsville, Va., the company recently announced. Work is to begin at once. The completed plant, it was said, will employ about 750 persons. An expenditure of approximately $11,000,000 is planned in the present development.

The plant is expected to come into production late in 1941, and be in full operation in the spring of 1942. With facilities already in operation or under construction at Seaford, Del., site of the company's present nylon plant, it is hoped that the Martinsville project will create an aggregate capacity of approximately 16,000,000 lb.

MICHIGAN ALKALI CELEBRATES GOLDEN JUBILEE

The golden jubilee anniversary of the Michigan Alkali Co., founded in 1890 by the late Capt. John Baptiste Ford, was celebrated on Oct. 17 at a banquet honoring 567 employes who have been with the company a quarter century or longer. Officials of the company, most of them direct descendents of the old Captain, presented gold watches to the entire list of honor guests as token awards for their long service.

Chem & Met Pictured Flow Sheet

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

DEFENSE contracts are being closed in rapid order. Erection of new plants, building of new process equipment at old works, and a general "make ready" job is being done rapidly. Actual production on any large scale for many specialities is not expected until late spring or summer.

Explosives plants are the major items of chemical engineering preparation. Despite some bitter policy controversies real progress is being made regularly along lines previously described in these columns. Two of the decisions reached during October were of highly political significance. One of the T.N.T. plants which the Army wanted to keep east of the Mississippi was placed in Missouri, by orders from the top. And the much disputed plan for giving TVA an ammonia plant culminated in a decision in favor of the Valley Authority, following instructions direct from the White House.

Commodity Procurement

The chemical process industry is almost as much interested as the mining and metallurgic industries in getting supplies of tin, quicksilver, zinc, manganese, and other strategic metals. The results of the strenuous effort last summer are beginning to show in the growth of stock piles of these materials.

The RFC subsidiary, Metals Reserve Co., has contracted to buy tin concentrates from Bolivia, enough certainly to make 12,000 tons per year of refined tin. There is a contract for an additional 6,000 tons of tin equivalent per year, contingent upon the availability of this material above the requirements of British smelters. Arrangements are being negotiated for the building of a smelter in the United States to process this ore. And there is a possibility of a second smelter, or greater capacity at the first, to handle Dutch ore or concentrates if they are brought from the Far East.

The major emphasis on manganese is means for conserving limited supplies. The special advisory committee of technologists has recommended a number of methods of saving that metal which may reduce the requirements in an emergency period substantially.

Tungsten from China is expected under an RFC purchase contract. If and when that metal comes it will be credited against the loan of $30,000,000 to the Chinese government made by Export Import Bank.

To stimulate domestic production of these strategic metals Congress has exempted from the excess profits tax any of the earnings from production in the United States of tin, tungsten, mercury, antimony, manganese, chromite, and platinum.

The need for more zinc than domestic producers can supply is being forecast by some of the mining industry spokesmen. Efforts to stimulate production without government subsidy are being made.

Washington hoped that recent decisions of the Mexican government indicated more enthusiasm for Hemisphere solidarity. It was reported that President Cardenas had taken a hand, ordering that Mexican quicksilver not be sold to the Japanese. Control on iron and steel scrap, petroleum, and other urgently wanted military materials was also indicated. But most of the embargo was short-lived and the ultimate policy of Mexico remained in doubt as October ended.

Aluminum has become the "baby" of this defense program. It's not as tough a nut as many of the strategics, nor as ticklish has some of the bottlenecks—machine tools, for instance. But the demands for aluminum have jumped to astounding figures, so that today's estimate of needs tomorrow is woefully inadequate.

Production of aluminum in 1939 in this country totaled 325,000,000 pounds. By mid-1942, on present schedules, production capacity in the country will exceed 700,000,000 pounds—350,000 tons.

Arranging for increased aluminum production was one of the first big problems dumped into the lap of the defense commission when it arrived in Washington. And it is one of the most recent problems back for new solutions.

Twice since June Alumnium Co. of America has scheduled huge increases in its reduction plants in the Tennessee Valley. The first 30,000,000-lb. unit of the company's new plant at Bonneville hardly had begun operations before plans were being made to increase its output from 60,000,000 to 150,000,000 lb. a year. The Reynolds Metals Co., with RFC funds, is entering the aluminum production field, in the TVA area, with TVA power.

Aluminum is the biggest power user of the Government's two biggest hydroelectric projects—TVA and the Bonneville-Grand Coulee pool. TVA got money from Congress to expand its system to supply aluminum needs and Aluminum Co. plans to start another power dam on the Little Tennessee River to supply what TVA cannot. The Reynolds company has contracted for 100,000 tons of bauxite a year from the Companhai Geral de Minas of Brazil, to feed its chemical plant.

More plant expansion is still expected. Yet so voracious are the demands for aluminum by the airplane industry in meeting defense contracts that even this huge increase in production may not be enough. Automobile manufacturers already are experimenting with increased use of magnesium in light metal alloys; have tested cars with magnesium alloy parts, looking to the time when they may have to reduce use of aluminum.

Priorities

The President's executive order late in October setting up formal machinery for Government priorities did not—and was not intended—to replace now the system of voluntary priorities already regulating defense order deliveries. This voluntary system will be continued just as long as it remains effective.

The executive order invoked the permissive authority given the President in legislation passed last June, but the agency which Roosevelt charged with the job of administering the authority quickly announced it did not intend to use its mandatory powers in the foreseeable future. Donald M. Nelson, named priorities administrator, said he hadn't a specific case in mind to recommend to the special board consisting of William S. Knudson, Edward R. Stettinius, Jr., and Leon Henderson.

One immediate objective of the order was an effort to provide legal protection against non-fulfillment of contract suits for manufacturers who agree under the voluntary system of preference rating on defense order deliveries to give Army and Navy orders the green light in their production schedules.

A growing need for such legal safeguards preceded promulgation of the formal machinery. More and more frequently, acceptance of defense orders with definite preference ratings is conflicting with schedules for deliveries to private accounts. In most cases, of course, the private accounts were personally willing to agree to delivery delays to make way for defense production, but legally they found it difficult to do so.

Existence of machinery to compel giving right-of-way to defense orders, often without it actually being used, is felt to be probably all that is needed to clear up these problems for the time being at least.

It is important to note that the executive order gives the priorities board full authority to require priority in deliveries of Army and Navy orders over all deliveries (not new orders) for private account or for export. The board planned to begin at once naming committees for industries in which voluntary priorities are in effect and to promulgate rules and regulations to implement the work of carrying on the voluntary system.

TVA Ammonia Fight

The old wounds suffered during earlier battles between public ownership and private ownership advocates in Washington were reopened during October. After much maneuvering behind the scenes, the Army Ordnance Corps was authorized to contract with TVA to design, build, and operate a synthetic ammonia plant as a part of an ammunition nitrate contract.

This puts TVA in the position of

manufacturing complete mixed fertilizers in competition with private enterprise, when the emergency is over. As a consequence the fertilizer and chemical interests are very much disturbed by the situation. They feel that this action, taken at the direct request of the President, was a needless diversion of defense activity in order to support a favorite philosophy of many New Dealers. It is hoped, probably rather vainly, that after the election hubbub has died down there may be some chance for reconsideration of the action.

There was some effort to make this decision appear a unanimous finding of the Defense Commission. Later it was definitely demonstrated that Stettinius and Knudsen opposed to the very end the putting of the government into business in this fashion. The other 5 voted for it, including 4 New Dealers and railway representative Ralph Budd.

The arguments used by TVA in advocating this plan were numerous, including two of technical significance. It was claimed that they could do the job cheaper because they already had land, utilities, and service facilities, and an antique ammonium nitrate plant. The saving is variously estimated, by opponents as zero, by friends as high as "several million dollars." The second technical argument was that TVA should have the ammonia plant so that it could expand its educational and demonstration work in support of concentrated fertilizer programs. Opponents have, of course, pointed out that education to the tune of 150 tons of ammonia per day is rather beyond usual pedagogic limits. If this amount of ammonia were used in a typical fertilizer concentration it would be equivalent to 3000 tons of mixed fertilizer per day, or ¾ of a million tons per year. That is more than 10 per cent of the country's average consumption.

Latest Revised Status of the Army's Munitions Plants

Type	Operator	Location	Cost
Smokeless Powder	DuPont	Charlestown, Ind.	$51,000,000
Bag Loading	DuPont	Charlestown, Ind.	*
Smokeless Powder	Hercules Powder	Radford, Va.	$35,000,000
Bag Loading	Hercules Powder	Radford, Va.	*
TNT-DNT	DuPont	Wilmington, Ill.	$11,000,000**
Ammunition Loading	Sanderson & Porter	Wilmington, Ill.	$14,000,000
TNT-DNT	Atlas Powder	St. Charles, Mo.	*
Ammunition Loading	Not announced	Union Center, Ind.	$14,000,000
Ammunition Loading	Atlas Powder	Ravenna, O.	$14,000,000
Ammunition Loading	Not announced	Davenport, Ia.	$14,000,000
Ammonia	DuPont	Morgantown, W. Va.	$7,500,000***
Ammonia	Allied Chem & Dye	Kentucky	$7,500,000***
Ammonium Nitrate	TVA	Muscle Shoals	$10,000,000***
Toluol (petroleum process)	Humble Oil Co.	Baytown, Tex.	$11,857,000****
Tetryl	DuPont	Not announced	*

Note: Additional TNT and Tetryl plants are expected.

* Cost not yet negotiated.

** Plant size to be increased, probably doubled.

*** Cost estimated, contract not yet signed.

**** Includes $1,097,000 for equipment at existing Humble plant.

Defense Plants

More major revisions marked the progress during October of the Army's projected chain of defense ammunition and powder factories. In several respects the construction list has been curtailed and, while the five munitions districts map for locating these plants west of the Alleghanies and East of the Great Plains has not been scrapped, the original schedule of making each of these districts largely self-sufficient, has been drastically altered.

Plants have been (or will be) located in each of the five areas, but different types of operations are tending to be concentrated—production factories in the North, raw materials producers in the South. Progress in getting these government-owned privately-operated plants underway stepped along at a faster pace in October, but a number of important units still are not under signed contract.

In some cases, however, contractors are going ahead with these plants while final negotiations on terms and even locations are being worked out. Political interference is responsible for a great part of this delay, but the tug-of-war over plant locations was more pronounced because the Army in the first instance wasn't all set to go.

Most important to the chemical industry among the program revisions is the fact that the proposed new arsenal for Chemical Warfare Service probably is out of the picture, at least insofar as the current year's appropriations. Transfer of Explosive D production to the DuPont-operated TNT plant at Wilmington, Ill., indicated also that the proposed combination picric acid and DNT factory planned for central Ohio has been dropped from the present program. Army planners, too, were tending, late in October, toward the belief that the scheduled cotton purification plant is not now needed.

It is probable, mostly because of the disputes over locations, that the two smokeless powder factories for which contracts have been announced, will be the only ones built in the present program, instead of four as planned. Both these factories—at Charlestown, Ind., and Radford, Va.—have been ordered greatly expanded from the size provided in original contracts. This same kind of telescoping of plant numbers has been carried into the TNT program also. The first TNT factory awarded—Stone & Webster built, DuPont operated—will be more than doubled by contract almost before ground is broken.

Biggest and sharpest dispute developed in getting the muntions program going has been over location and operation of ammonia and ammonium nitrate plants, and the decision, when it came late in October after weeks of heated dispute, was a distinct victory for the New Dealers over the defense commission's staff of chemical experts.

The commission approved the Army plan for a TVA-operated 150-ton daily capacity ammonia plant at Muscle Shoals and for modernizing the nitrate plant to produce ammonium nitrate. Originally, it was planned to have Allied Chemical & Dye operate the Muscle Shoals ammonia works, TVA the nitrate plant—but the Authority wanted to run the whole show, doubtless looking ahead to the day when it can make out a case before Congress to have the ammonia works turned over to it for commercial fertilizer manufacture. Allied still is to build an ammonia plant, somewhere in Kentucky, and there will be a third synthetic ammonia works operated by DuPont near Morgantown, W. Va.

Delay in starting the ammonia plants also is holding up decisions on TNT plants and locations. The DuPont factory at Wilmington can operate with existing commercial ammonia but further demands for explosives probably would crowd existing production capacity. The Army has announced that Atlas will operate one of the additional TNT factories but no site has been selected and operators have not even been picked for several other similar units.

News "Fines"

Overtime Wages—By no means all persons receiving $200 or more per month are exempt from the limited working hours under the new definitions of executive, administrative, and professional employees. Such workers to be exempted from overtime pay must be doing work requiring regular exercise of discretionary power or some special scientific or technical skill. Mere supervision of routine operations does not provide exemption.

Chemical Manganese—Stock pile purchases of manganese ore are being made by the RFC subsidiary, Metals Reserve Corp. If any of the ore offered appears to be of chemical grade this may be segregated in the stock pile so that it can be allocated to chemical industry users in the event of real emergency. However, this government buying does not include any special effort for these particular types of ore.

Manganese Beneficiation—The Bureau of Mines is to spend approximately $2,000,000 on a special study of the means for beneficiating domestic manganese ores. The various proposed methods for pilot plant trial have been reviewed critically by the special advisory committee to the Defense Commission. The Bureau is establishing several new field units to investigate the most promising recommendations and reserves.

COLONIAL INTERESTS OF GERMANY HAVE BEEN MADE SUBJECT OF RECENT INTENSIVE STUDIES

From Our German Correspondent

COLONIAL interests of Germany were emphasized at the congress on tropical medicine held in Hamburg Oct. 3-5 in celebration of the 40th anniversary of the founding of the Institute for Ship and Tropical Diseases. Significantly, "Colonial Hygiene in Africa" was the theme of the meeting. At the same time a new advanced Academy for Tropical Medicine in connection with the Institute was opened under the direction of Professor Holzmann, German authority on tropical diseases.

The University of Hamburg recently established a chair for the study of forestry in foreign countries and colonies. Prof. Franz Heske of Dresen is in charge of the new department which was established under the sponsorship of Marshal Hermann Goering. Goettingen University has set up an Institute for Colonial Agriculture, giving courses in geography, ethnology, climate and soil research, tropical hygiene, and native languages. The older Witzenhausen Colonial School has just revised its study plans to provide courses graduating colonial farmers.

Another indication of colonial interest was the annual convention held recently in Nurnberg of experts from all German universities engaged in the field of tropical medicine and science.

The Reich chemical industry has always played an active part in this colonial picture even in post World War I days when Germany was without colonies. For example, approximately 50 per cent of German chemical products shipped to South America last year were medicinal preparations. The total value of German medicinals exported to all parts of the world in the 7 months of 1939 before the outbreak of the war was 81,800,000 RM compared with 73,400,000 RM in the first seven months of 1938. Domestic requirements due to the war conditions have largely offset the losses in foreign sales, and the field of medicinals is still reported to be one of the most successful branches of the chemical industry.

The new materials exhibited at the Breslau Dechema fair included a large acid-proof container made from spun quartz, an ultra-light block of "solidified foam," latest insulating material, and a new fire extinguisher which generates a foam claimed to smother all fires, including those from gasoline and oil, more completely than extinguishing materials used heretofore. At the Leipzig Trade Fair a new waterproof material made entirely from artificial resin without any woven threads of textile structure was exhibited. The material resembles oiled silk, is elastic like rubber but has no smell, is resistant to heat, water and acids, and is claimed to be easy to clean. Men's and women's raincoats made of this material were exhibited, and a heavier quality of the same goods is being used for protective aprons for workers in chemical or metal factories.

New plastic products have also been displayed at recent fairs. The value of plastic production, especially synthetic resins, has expanded to about 300 million RM per year in the Reich. The shortage of imported raw materials has given added impetus to the development of new plastic products, many of which have come into their own, not as "substitutes," but as products with improved or entirely different qualities. Because of recent technical advances in plastics, an apprentice workshop, the first of its kind, has been established in Halle to train men from all parts of the Reich to work and weld the new plastic materials.

Production in the chemical industry has been hampered by the loss of skilled personnel called to army service in a recent "combing out" procedure. As a matter of fact, this shortage is common to all industries. During the past two months another 50,000 foreign workers have been brought into the Reich, bringing the total to 950,000. 550,000 of these foreign workers are in agriculture, and the remainder are engaged in various industries. In addition, an increasing number of skilled and unskilled war prisoners are being put to work in factories not directly connected with defense. An elaborate system has been devised whereby the factory must take no less than 10 and not more than 20 prisoners, must provide specific living accommodations for the prisoner-workers and for two army guards. The prisoners are paid about 60 per cent of the normal wage scale for German workers, and in exceptional cases up to 80 per cent, the money not being paid directly to the prisoner, but being held in trust, partly to cover cost of board, and the balance is to be given the prisoner upon release.

Although figures are no longer published, it has been indicated that the severance of Germany from overseas markets as well as the raw material shortages have caused declines in production of some chemical branches of dyes, paints and pigments, and soaps. The shortage of imported fats and oils has caused a definite deterioration in quality of soaps which now contain more domestic substitute fillers, and are carefully rationed. Textile rations have been increased 50 per cent since Sept. 1, indicating an easing of shortages in this field.

A considerable shift has occurred in the paint industry. For several years there has been a lessened consumption of imported drying oils, especially of linseed oil and gums. There has, however, been a great increase in production of nitrocellulose and synthetic resin lacquers, chlorinated rubber paints and other coatings. Glyptal and alkyd resins are being used as substitutes for linseed oil. It is claimed that a satisfactory substitute for turpentine has been found and that shellac is being obtained in small amounts from old phonograph records.

To encourage operators to convert diesel and other motored trucks to using wood generator gas in place of diesel oil and gasoline, the Reich government is granting a subsidy of 1000 RM for every diesel truck converted and 600 RM for every gasoline motor vehicle. A new company, the Gesellschaft fuer Tankholzgewinnung and Holzabfallverwertung A.G. has been founded to manufacture wood generator gas from lumber scraps and waste wood. The motor fuel is to be marketed through a newly formed organization which is setting up distributing stations all over the Reich.

COMMITTEES FOR CHEMICAL SECTION OF N.S.C.

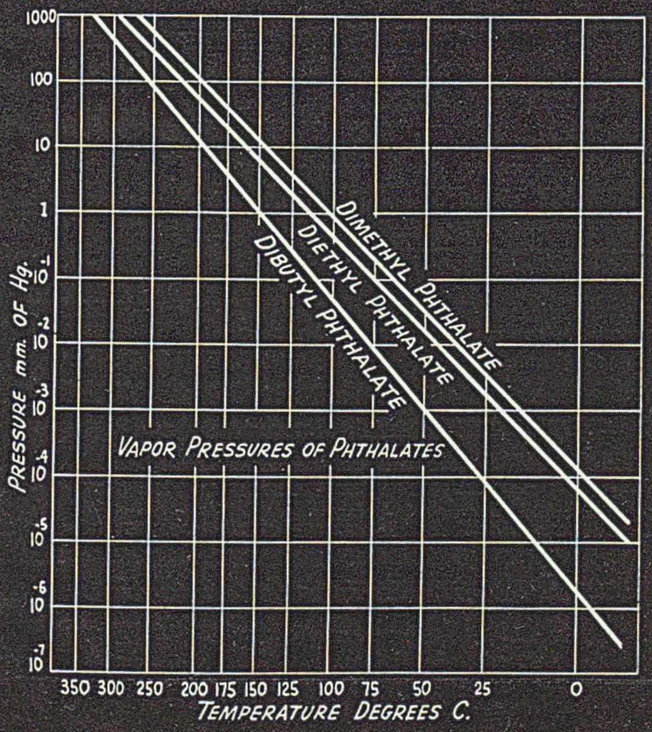
The Chemical Section of the National Safety Council has selected an executive committee consisting of Stanley Warzala, American Cyanamid Co., general chairman, F. W. Dennis, Hooker Electrochemical Co., vice-chairman in charge of program, S. W. Gurney, Liberty Mutual Insurance Co., secretary. The news letter committee is composed of James J. Duggan, Carbide & Carbon Chemicals Corp., chairman, R. S. Mackie, Incandescent Lamp Dept., General Electric Co., and J. H. Taylor, Procter & Gamble Co. D. S. McEachern is chairman of the engineering committee with Harold W. Baker, Eastman Kodak Co., F. W. Jurick, Westvaco Chlorine Products Corp., and S. E. Whiting, Liberty Mutual Insurance Co., as the other members.

S. M. McCutcheon, the Dow Chemical Co., heads the data sheet committee with Ralph O Keefer, Aluminum Co. of America. Dr. Leonard Greenburg heads the health committee assisted by John S. Shaw, Hercules Powder Co. C. E. Sevrens is chairman of the membership committee with W. L. Hammersley, Electric Storage Battery Co. as the other member. H. R. Bixler, chairman, Union Carbide & Carbon Corp., John Clements, Michigan Alkali Co., and Ralph L. Rogers, Tennessee Eastman Corp., make up the poster committee.

The publicity committee is headed by S. D. Kirkpatrick, *Chem. & Met.* with A. L. Watson, Koppers Co., and Clarence Wigle, Niagara Alkali Co. as the other members. John Roach, Deputy Commissioner of Labor, Trenton, and K. E. Roof, Willard Storage Battery Co. make up the safety instruction card committee with E. F. King, Lever Brothers Co., chairman. The statistics and contest committee is made up of R. C. Stratton, chairman, The Travelers Insurance Co., and H. L. Miner, E. I. duPont de Nemours & Co.

DIBUTYL PHTHALATE

A COMPARISON OF VAPOR PRESSURES OF THE MOST WIDELY USED PHTHALATE PLASTICIZERS



Dibutyl Phthalate is one of the most widely used plasticizers for nitrocellulose. It is also an efficient plasticizer for cellulose acetobutyrate and Kauri and Manila natural resins. It has good compatibility with polyvinyl chloride, and can be used in ethyl cellulose, alkyd and phenolic resins, and polyvinyl acetate, the degree of suitability depending upon the use intended for the finished goods. It is one of the plasticizers recommended for imparting maximum flexibility to the polyvinyl acetals. It is compatible with most lacquer resins.

Outstanding for its color stability, Dibutyl Phthalate is especially suited for use in colorless, white or delicately tinted products. Because of its chemical stability and high solvent power for most plastic materials, it is one of the most acceptable plasticizers for general use.

Dibutyl Phthalate finds additional uses, outside of the plastics and lacquer fields, as a lubricating agent, as a solvent for perfume oils and as a perfume fixative. For further information, inquire: MONSANTO CHEMICAL COMPANY, St. Louis, U. S. A.

SPECIFICATIONS

Appearance	Clear, oily liquid
Color	Practically colorless (APHA 10 max.)
Odor	Slight
Acidity (as phthalic acid)	0.01% max.
Specific Gravity 20°/20° C.	1.048 ± 0.001
Refractive Index at 25° C.	1.4905 ± 0.001
Purity	99% minimum
Sulfur (copper strip test)	Negative
Boiling Point	340° C. (760 min.) 206° C. (20 min.)
Crystallizing Point	−35° C. approx.

Miscible with all common organic solvents and with oils, but soluble in water only to extent of 0.001% at 30° C.

MONSANTO CHEMICALS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

OIL CHEMISTS REPORT ON OXIDATION PROBLEMS

A symposium on Oxidation, Rancidity, and Flavor Reversion of Fats and Oils was the high point of the recent Chicago meeting of the American Oil Chemists' Society. Intensity of interest in chemical changes common to fats and oils was shown by the record attendance, more than 300 registrants representing the oil and fat industries of this country and Canada.

H. A. Mattill, State University of Iowa, evaluated all observed evidence of the mechanism of the oxidation of fats as merely straws in the wind. His conclusion was that, "No all-inclusive theory of auto-oxidation can yet be formulated. Once the beginning or induction period is past, events follow thick and fast in greatest confusion but nevertheless according to a plan. The plan is flexible and in part dictated by the events or steps themselves. Perhaps the primary reaction in the oxidation of fat yet remains to be discovered."

Wayne R. Coe, Food Research Division, U. S. Department of Agriculture, identified metals and light as primary factors known to increase the rate of oxidation of fats and oils. Air, moisture, temperature and photo-sensitizers were tagged as contributing factors. Conclusions drawn by Mr. Coe were that: 1. oils and fats keep free from rancidity longest by excluding, as far as possible, objectionable metals (copper particularly); 2. when oil-bearing foods are exposed to light the ultraviolet, violet and blue regions of the spectrum (wave lengths below 4900 Å) promote rancidity most actively; and 3. light from those regions of the spectrum reactive in catalyzing rancidity appear to correspond with the light absorption regions of the oils.

H. S. Olcott, Mellon Institute of Research, described the mechanism of fat oxidation as a chain reaction because such small amounts of certain anti-oxidants were found to retard oxidation for long periods of time. Good sources of Vitamin E and of ascorbic acid (Vitamin C) as well as polyphenols, pyrogallol, hydroquinone, catechol, apional, and hydroxy-hydroquinone were suggested as antioxidants for lard. Less effective are the meta-substituted polyphenols such as resorcinol and phloroglucinol.

Action of the anti-oxidants was explained as preventing the combination of reactive fat molecules with oxygen of the air to form highly reactive peroxide derivatives, which would in turn transfer part of their molecular energy to inactive fat molecules to make them reactive. In the absence of an anti-oxidant, from 1,000 to 10,000 fat molecules might thus be made reactive and become oxidized with the development of rancidity.

F. C. Vibrans, Institute of American Meat Packers, identified the active oxygen test as the one most used in present day laboratories to estimate the relative keeping qualities of edible fats and oils. The Schaal test was given as the one quite generally used specifically in bakery laboratories.

Lucius W. Elder, Jr., General Foods Corp. Laboratories, Hoboken, N. J., classified the development of rancidity in flaked breakfast cereals as being quite different from that in shortenings and related oils. Solution of the rancidity problem in cereal flakes is viewed as resting heavily upon a study of colloidal or physical characteristics of the flake surface.

R. R. King, Interstate Cotton Oil Refining Co., Sherman, Texas, reported that refined cottonseed oil is preferred to crude oil for industrial storage. Refined oils made from stored crudes are not as stable for storage as those made from fresh crudes. However, good quality crudes can be stored satisfactorily under carefully selected and controlled storage conditions.

POTASH SUPPLY ADEQUATE FOR NATIONAL DEFENSE

That adequate supplies of potash are assured America's agricultural defense program, was stated at Knoxville, Tenn., on Oct. 22 by Dr. J. W. Turrentine, president of the American Potash Institute, Washington, D. C., in an address before the Rotary Club. In his opening remarks the speaker contrasted the years 1914 and 1939 in both of which war was declared in Europe.

When war was declared in 1914, the price of potash soared from $35 to $350 and even to $500 per ton. In 1939 when war was declared the price was $25 per ton and there it still remains—$10 lower for the same grades of potash salts than in 1914. The reason, as pointed out by Dr. Turrentine, is that during the intervening years America has developed a potash industry now capable of meeting American requirements for this essential fertilizer ingredient, whereas in 1914 the German potash mines represented the sole source of that commodity for world agriculture.

"WHO'S WHO IN ENGINEERING" UNDER REVISION

Engineers throughout the country will soon receive material, questionnaires and previously printed records, bearing on the new (5th) edition of "Who's Who in Engineering." This work is being revised under the editorship of Dr. W. S. Downs, with qualifications established by a committee of the engineering profession, composed as follows: Audrey A. Potter, chairman, Dean, Schools of Engineering, Purdue University; Col. L. B. Lent, vice-chairman, executive secretary, American Engineering Council; Frederic L. Bishop, secretary, Society for Promotion of Engineering Education; C. E. Davies, secretary, American Society of Mechanical Engineers; H. H. Henline, national secretary, American Institute of Electrical Engineers; T. Keith Legare, secretary, National Council State Boards of Engineering Examiners; A. B. Parsons, secretary, American Institute of Mining and Metallurgical Engineers; George T. Seabury, secretary, American Society of Civil Engineers; Stephen L. Tyler, secretary, American Institute of Chemical Engineers; John A. C. Warner, secretary and general manager, Society of Automotive Engineers.

BAUXITE AND ALUMINUM OUTPUT WILL BE INCREASED

Plans for further increases in the production of aluminum in sufficient volume to meet the military requirements of the national defense program as well as present civilian needs were announced last month by E. R. Stettinius, Jr., member of the National Defense Advisory Commission.

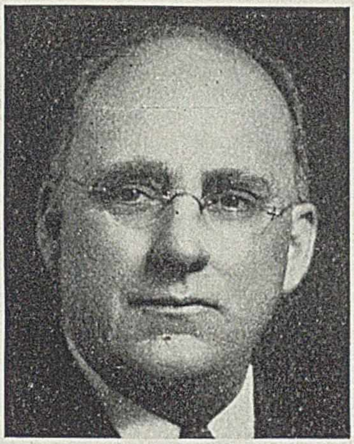
The Aluminum Co. of America, at present the sole producer of ingot aluminum in this country, will add three new units to its Bonneville, Wash., plant, which will increase production by 90,000,000 lb. per year, and will obtain approximately 100,000 kilowatts of additional power from the Bonneville Authority to supply these plants. The first unit of the Bonneville plant, which was started after the outbreak of the war, came into production in September and the second unit will be ready in December. A new unit at the company's plant at Alcoa, Tennessee, will begin operations early in 1941 and other units in the TVA districts will come into production during the early part of 1942.

Aluminum production of this country in 1939 was 325,000,000 lb. Present capacity is 450,000,000 lb. and it is now estimated that annual capacity by July 1942, including the projects already under way at TVA and the proposed increases at Bonneville, will reach a total of approximately 700,000,000 lb., or well over double the capacity of 1939.

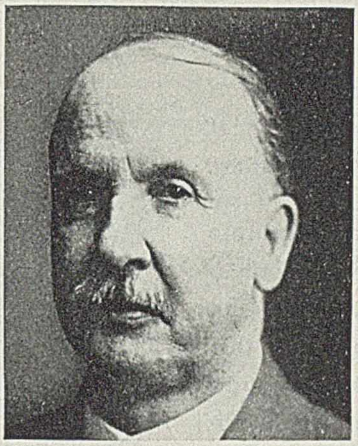
The Reynolds Metals Co. also is planning the production of ingot aluminum with the aid of a $15,800,000 loan from the Reconstruction Finance Corporation. Construction is expected to start immediately on a plant at Sheffield, Alabama, which the company anticipates will be in production by July 1941. The estimated output when in full production will be 60,000,000 lb. annually.

In connection with bauxite, Mr. Stettinius pointed out that about 55 per cent of this material is imported, chiefly from Dutch Guinea, and the balance comes largely from Arkansas. Imports from Dutch Guinea will be increased and greater production also is anticipated in Arkansas. While the Defense Commission does not anticipate any interruption in the supply from South America, it is estimated that the supply of bauxite available in this country, even were imports suspended, is sufficient to take care of requirements for at least eight years.

PERSONALITIES



Arthur W. Hixson



Edward Bartow

✦ Arthur W. Hixson has been appointed to be executive officer of the department of chemical engineering by the trustees of Columbia University. Dr. Hixson has been professor of chemical engineering at Columbia in charge of courses in process development and plant design.

✦ William W. Calihan, former district manager at Rochester, N. Y. for H. K. Porter Co., has been transferred to Pittsburgh to handle sales of process equipment division.

✦ Herman C. Bellinger, vice president in charge of operations for the Chile Exploration Co., has been named for the William Lawrence Saunders gold medal for 1941, by the American Institute of Mining and Metallurgical Engineers.

✦ L. H. Miller has been appointed to head the Ferro Enamel Corp.'s liquid plastics division. Mr. Miller was formerly with the Pittsburgh Plate Glass Co. at Milwaukee.

✦ Michael H. Baker is now with the Calvert Distilling Co. at Relay, Md. He is serving as dry house operator at this plant near Baltimore.

✦ Kenneth S. Wyatt has been appointed engineer to the staff of the Habirshaw Cable & Wire Div. of the Phelps Dodge Copper Products Co., New York.

✦ Gustav Egloff has been named as winner this year of the Octave Chanute Medal awarded annually for the best paper on mechanical engineering read before the Western Society of Engineers. Dr. Egloff's paper dealt with motor fuels of the present and the future. Presentation of the medal has been made.

✦ Edward Bartow is now associated with the Johns-Manville Corp. in its research laboratory at Manville, N. J.

✦ Claude L. Clark, formerly of the department of engineering research of the University of Michigan, has joined the metallurgical staff of the steel and tube division, Timken Roller Bearing Co. at Canton, Ohio, as development engineer.

✦ R. C. Ernst has been appointed director of the division of industrial research at the Speed Scientific School, University of Louisville, Louisville, Ky.

✦ H. J. French and T. N. Armstrong, metallurgists of the development and research division of the International Nickel Co., have been awarded the Lincoln gold medal for 1940 for their technical paper entitled "Weld Hardening of Carbon and Alloy Steels."

✦ Edward A. O'Neal, Jr., manager of the Anniston (Ala.) plant of the phosphate division of Monsanto Chemical Co., has been transferred to the company's new Trenton (Mich.) plant. He will go to Trenton to supervise the operation of the new plant as manager, shortly after January 1.

✦ O. W. Smith, for many years sales manager of the Prater Pulverizer Co., is now general manager of the company.

✦ Thomas B. Drew is now associate professor in the chemical engineering department of Columbia University. He was formerly in the chemical engineering experimental station of the E. I. duPont de Nemours & Co. at Wilmington, Del.

✦ James M. Church is now assistant professor of chemical engineering at Columbia University. He was formerly connected with the Monsanto Chemical Co. at St. Louis.

✦ Philip W. Schultz of the State College of Washington at Pullman is now a member of the faculty of the chemical engineering department at Columbia University.

✦ Joseph C. Alther, vice president and general manager of the Universal Oil Products Co., Chicago, has been elected a trustee of Illinois Institute of Technology, a new university created by the merger of Armour Institute of Technology and Lewis Institute.

✦ John J. Mitchell, a vice president and treasurer of the Universal Oil Products Co., has been elected a member of the board of the Illinois Institute of Technology.

✦ Linus Pauling, head of the division of chemistry and chemical engineering at California Institute of Technology, has been awarded the 1941 William H. Nichols Medal of the New York Section of the American Chemical Society. Dr. Pauling is cited "for his distinguished

CALENDAR

DEC. 2, 3, 4, **American Institute of Chemical Engineers, New Orleans, La.**

DEC. 11-15, **National Chemical Exposition, Chicago, Ill.**

FEB. 17-20, 1941, **Technical Association of the Pulp and Paper Industry, annual meeting, Hotel Roosevelt, New York.**

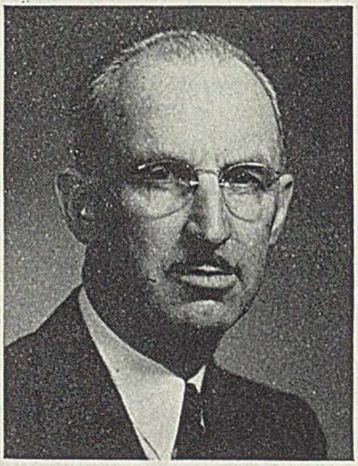
APRIL 7-11, 1941, **American Chemical Society, St. Louis, Mo.**

APRIL 16-19, 1941, **Electrochemical Society, annual meeting, Cleveland, Ohio.**

and pioneer work on the application of quantum mechanics to chemistry and on the size and shape of chemical molecules." He will receive the medal at a dinner of the section on March 7, 1941 at which time he will deliver the annual Nichols Medal scientific address.

✦ EUGENE R. PERRY has been promoted to manager of engineering and superintendent of the Micarta works of the Westinghouse Electric & Mfg. Co. at Trafford, Pa. Following several years of specialized studies of resins in the Westinghouse laboratories, he was transferred to the Micarta works in 1936 becoming engineering manager two years later.

✦ S. J. HORRELL has been appointed vice president of the power piping division of Blaw-Knox Co. He became associated with the company in May, 1939 and has been serving this division in the capacity of sales manager. It is also announced that Harry Gay has been engaged by the company and appointed chief engineer of the power piping division.


Harvey M. Harker

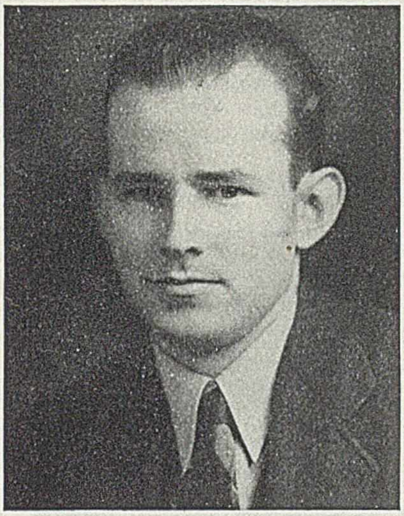
✦ HARVEY M. HARKER, assistant general manager of sales of the organic chemicals division, Monsanto Chemical Co., will leave St. Louis in November for Australia where he will conduct a chemical market survey of Australia, Tasmania and New Zealand.

✦ F. L. CURTIS, treasurer of Raybestos-Manhattan, Inc. and general manager of the Manhattan Rubber Mfg. Div., has been elected a director of the Rubber Manufacturers Association.

✦ B. M. TODD was tendered a testimonial dinner at the Newark Athletic Club on the evening of October 10 by the Consolidated Products Co. Mr. Todd retired after 21 years service and is the first employee of the Consolidated to receive a pension.

✦ JEAN BILLITER and his wife arrived in Pittsburgh a short time ago, ending a grim game of hide-and-seek with the

Nazis. The war in Europe deprived Dr. Billiter, a noted French electrochemist, and his wife of their worldly possessions, but a streak of luck brought them safely through a series of adventures that sound like a thriller melodrama.



Lester B. Pope

✦ Lester B. Pope, who joined the editorial staff of *Chem. & Met.* last year, has been promoted to the position of assistant editor. Mr. Pope attended Columbia University where he specialized in chemical engineering, graduating in 1935. Before coming to *Chem. & Met.* he served as associate editor of *Scientific American.*

✦ George W. Preckshot, is now attending the University of Michigan, as a Standard Oil Co. of California fellow. Formerly he attended the University of Illinois.

✦ Walter C. Sturgis, formerly in the chemical control division of General Chemical Co. is now chemical engineer in the production division of Distillation Products, Inc., Rochester, N. Y.

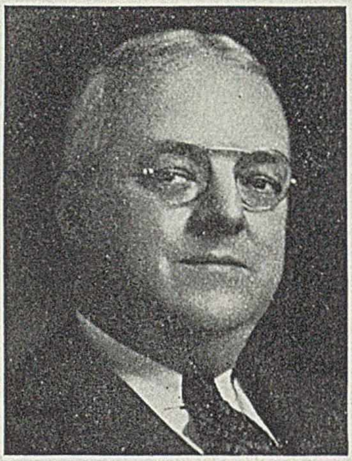
✦ George N. Danforth is making special studies on "growth" companies, especially aviation and chemical, for the Oil Statistics Co. and Roger E. Spear and Staff, Babson Park, Mass.

✦ H. R. Hanson has left Abrasive Co. in Philadelphia to establish and direct a research laboratory at the Frank Bancroft Co., Royal Oak, Mich. The laboratory is to be devoted to all phases of manufacture and use of abrasive products.

✦ M. H. Chetrick has accepted a graduate assistantship in the chemical engineering department at Ohio State University. He graduated last spring from the University of Alabama.

✦ E. C. Williams, vice president and director of Shell Development Co., resigned October 31. His resignation will take effect January 1. Meanwhile he is on leave of absence. He has been director of research for the Shell organization since 1928. Prior to joining this company he had been Ramsay professor of chemical engineering at the University of London.

✦ THOMAS D. TERVOE, chemical engineering graduate from Tufts, has joined the staff of the Johns-Manville Filtration and Filler Department as junior salesman. He enters training with the company in New York. Mr. Tervoe is 26 years old and is a native of Quincy, Mass.



L. A. Smith

✦ L. A. SMITH, who joined the Pennsylvania Salt Mfg. Co. in 1896 and advanced through several positions to the office of secretary and treasurer, has been elected vice president and treasurer of the company.

✦ STANLEY A. MCCASKEY, JR., has been appointed to an executive position in the Allegheny-Ludlum Steel Corp., Pittsburgh.

✦ A. A. HORVATH left the Horvath Laboratories, Chambersburg, Pa. on November 1, and has established a consulting business in Pittsburgh, Pa.

✦ GEORGE W. PHILLIPS is now connected with the U. S. Industrial Chemical Co., Inc. He is located at High Point, N. C.

✦ I. M. BERNSTEIN, formerly chief chemist, International Printing Ink Corp., Southern Div., Cincinnati, is now director of research for the H. D. Roosen Co., Brooklyn, N. Y.

OBITUARY

✦ Russell Kent died of a heart attack on October 30 as a taxicab was taking him to a hospital. He was 55 years of age. Mr. Kent at one time was *Chem. & Met's* Washington correspondent, and recently had been in a similar capacity for *Chemical Industries.*

A native of Chattanooga, he began his career shortly after getting out of high school as a reporter for the Chattanooga Times. For the next 17 years he worked on numerous papers in every capacity, including three times as managing editor. Among the papers with which he was associated were Memphis News-Scimitar, Times-Democrat and Times-Picayune of New Orleans, New York Sun, Knoxville Journal and Tribune, Montgomery Advertisers and United States Daily News.

✦ H. H. Timken, Sr., chairman of the board of The Timken Roller Bearing Co., died October 14 in his home at Canton, Ohio. The immediate cause of his death was pneumonia which developed from chronic asthma. His illness was of short duration.

✦ Robert G. Walker, manager of the special industrial centrifugal department of the DeLaval Separator Co., died Tuesday, October 22.

✦ Morrison Mills, eastern district manager of the construction equipment division of Chain Belt Co., died suddenly September 25, in Philadelphia, where he made his home. He was born in Calumet, Mich., 37 years ago and was a graduate of Harvard University in the class of 1925.

CANADIAN ENGINEERS JOIN ECPD IN ELECTING DOHERTY

President Robert E. Doherty of Carnegie Institute of Technology was elected chairman of the Engineers Council for Professional Development at its Eighth Annual Meeting in Pittsburgh, October 24, which also welcomed into full membership the Engineering Institute of Canada. Thus this conference of the engineering societies, which was organized to enhance the professional status of the engineer through cooperative work within the profession itself, now extends its influence through an eighth participating body. Those previously represented in ECPD were the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Institute of Chemical Engineers, the Society for the Promotion of Engineering Education, and the National Council of State Boards of Engineering Examiners.

Following the report of the nominating committee, a number of important appointments and re-appointments were made to the personnel of the various committees through which the Council has operated since its organization in 1933. Student Selection and Guidance, continuing under the chairmanship of Dean R. L. Sackett, adds to its membership H. F. Bennett of the Engineering Institute of Canada, and A. G. Hayden of New York City, to replace R. H. Jacobs of Alpine, N. J.; Robert L. Davis was re-appointed at the expiration of his term. Dean O. W. Eshbach of Northwestern Technological Institute, retired as chairman, but was re-appointed a member, of the Committee on Professional Training. He was succeeded in the chairmanship by S. D. Kirkpatrick of *Chem. & Met.* who had previously served as vice-chairman. Dr. E. B. Roberts of Pittsburgh succeeds A. R. Stevenson, Jr. of Schenectady, who, however, continues as a member of the Executive Committee. The Engineering Institute of Canada will be represented on this committee by Professor C. R. Young of the University of Toronto.

Dean A. A. Potter of Purdue University continues as chairman of the Committee on Engineering Schools and Dean G. M. Butler of Arizona, becomes vice-chairman of the Western Region. The latter is succeeded on the committee by Dean E. A. Holbrook of the University of Pittsburgh. Professor B. M. Woods of the University of California succeeds R. E. Doherty while Dean I. C. Crawford of the University of Kansas, was reappointed, by special vote of the Council, to serve his third term on this committee.

Professor Charles F. Scott continues as chairman of the Committee on Professional Recognition, to which has been added James Vance, representing the Engineering Institute of Canada. President H. S. Rogers of Polytechnic Institute of Brooklyn, was re-appointed, and W. B. Heroy of Houston, Tex., is to retire shortly in favor of a representative of the American Institute of Mining and Metallurgical Engineers, yet to be appointed.

Sydney A. Wilmot, editor of *Civil Engineering* becomes chairman of the Committee on Information and will work closely with the newly elected secretary, G. T. Seabury of the American Society of Civil Engineers. President C. C. Williams of Lehigh University is added to the Executive Committee to represent the Society for the Promotion of Engineering Education.

ECPD operates on a financial budget of approximately $10,000 per annum, about half of which is supplied by the Engineering Foundation. Three of the founder societies, ASME, ASCE and AIEE each contribute $850 per year. SPEE and NCSBEE each allocated $500 earmarked for the Committee on Engineering Schools. Engineering Institute of Canada is to contribute $250 and the AIChE $120 toward the 1940–41 budget. It is evident, however, that more funds will be required to carry on the work of ECPD—a problem that rests at this time with the Committee on Ways and Means under the chairmanship of E. R. Needles, consulting engineer of New York City.

Committee chairmen Sackett, Scott, Eshbach, and Potter reported for their respective committees. These reports are to be published in full in the

Eighth Annual Report, copies of which will be available later on inquiry to the office of the secretary in the Engineering Societies Building, 29 West 39th St., New York City.

At the conclusion of the ECPD meeting and in advance of the two-day conference of the Allegheny Section of SPEE, both societies joined in a banquet at the University Club, in Pittsburgh, on October 24. President Robert E. Doherty introduced Dean Potter who spoke on "Government and the Engineer." As chairman of the new advisory committee on engineering schools of the U. S. Bureau of Education, Dean Potter emphasized the pressing need for intensive training of engineers, inspectors and skilled operators for the defense program. Nine million dollars has been appropriated for these "refresher" and extension courses. Dr. E. B. Roberts, assistant to the vice president, Westinghouse Electric & Mfg. Co., spoke on "Industry and the Engineer." He showed the high proportion of technically trained men who climb to executive positions, especially in the heavy industries. S. D. Kirkpatrick's subject was "Preparedness and the Engineer." (See editorial foreword of this issue). Chancellor J. G. Bowman, of the University of Pittsburgh, followed with an inspiring address on "Society and the Engineer." He analyzes the engineer as 75 per cent scientist and 25 per cent humanist. The chief characteristics of the former, he said, is that he makes his contribution to science and presents it, if he has time, to the public, on a "take it or leave it" basis. His interests are in another direction; he must push on to new scientific achievements. But the engineer, on the other hand, thinks first in terms of what use can be made of the results of science—how mankind can be served or our civilization advanced by the practical application of knowledge new and old.

The dinner was concluded with a stirring speech from Professor C. R. Young of the University of Toronto. He described the long-time program of the Engineering Institute of Canada and its work in enhancing the status of the profession in the Dominion. In that connection he quoted an excerpt from a letter written in 1878 by Linsey Russell, one-time Surveyor-General of Canada, which still has important application to the problems of the engineering profession and of such an organization as ECPD.

"The only legitimate means of raising the status of the profession consists in the effort of each individual thereof, by the evidences of conduct, acquirements, and ability, to win for himself the good opinion of those of his fellow-citizens with whom he comes in contact. The more as individuals the members of any profession succeed in this, the higher as a class they will stand. If as a class they are held in slight esteem by the public, it is because they do not merit more. Public opinion is, on the whole, tolerably just, and no doubt rates the services of any class at their true value. I am afraid we will have to rest content with being of no more importance in the eyes of our fellow-creatures than the circumstances of our own merits, and the value of our services to them, have combined to prescribe."

READERS' VIEWS AND COMMENTS

Readers are invited to express their views on articles appearing in Chem. & Met. *or on other subjects of interest to chemical engineers. As far as our space permits such views and comments will be published in these columns. Address your letter to the Editor of* Chem. & Met., *330 West 42 St., New York, N. Y.*

SAFETY EDUCATION

To the Editor of Chem & Met.:

Sir:—The center illustration of the group of three on the cover of your September issue is not good safety propaganda. These men are working in a place where they can fall if a bar slipped. The accepted practice in well-run chemical plants as I understand it, is to provide either a long loading dock or an individual platform at a tank car loading station.

I know it is your policy to promote safety. With the chemical industry expanding and with so many new employees coming into the industry, it seems doubly necessary to stress process safety now.

Looking at safety from the viewpoint of a chemical engineer, it seems to me that a good educational job is now done on hazards which can be readily understood by a non-technical employee, i.e., falls, moving bodies, falling bodies, machinery, housekeeping, etc. It seems to me that a better job needs to be done on chemical hazards which are not obvious to a new man. The measures needed for protection against corrosives, toxic and flammable materials, compressed gases, vapors and fumes, are measures which are often meaningless to a new man. He must accept instructions on faith alone until he sees actual trouble in the shop.

Obviously the chemical industry has a long way to go on protection vs. chemical hazards and there is too much variation in what is rated as satisfactory practice in various plants.

Chem. & Met. can help a lot in promoting chemical process safety and I trust you will understand that I am writing this letter with the intention of offering a constructive suggestion.

G. C. McCarten

Calco Chemical Division
American Cyanamid Co.
Bound Brook, N. J.

UNIONIZATION OF CHEMISTS

To the Editor of Chem & Met.:

Sir:—I was very much interested in your recent editorial on labor unions; particularly since it has come to concern me vitally. For a long time I have felt that technical men should in some manner be banded together to put up a formidable front against any kind of encroachment. This could probably be handled through the A.C.S. and other technical groups, provided enough men desire it.

I have been going along as the others, not thinking about such things, until it is now too late to do anything except to join the CIO or quit my job. It seems in our case that the union has become so strong as to be able to dictate to the management of our company. They have simply said that everyone but confidential employees are to join the local. Their lawyers have put forth some foolish reasoning that technical men, except the chief of the department, are not confidential employees.

I personally feel that the time has come to put a very definite stop to the union organizations. I am prepared in my own case to leave my job rather than submit to a CIO dictatorship. However, that doesn't solve the case. Our technical employees can't seem to get themselves organized and agreed to fight the thing and so they will probably join.

I am writing to you because your editorial staff seems to be of my opinion and I am hoping I may get some concrete help from you. It will take organization to beat organization. But I would rather pay out of my money to support some lawyers and level-headed officers of an organization designed to go to bat for chemists and engineers, than to support the parasitic heads and organizers of the present labor unions.

I believe that throughout the country the great majority of technical workers feel the same way about this and would welcome something definite to be done.

If you should publish any of this, will you be so kind as to withhold my name and anything that might damage my position for the present.

W. J. C.

Chemist

EXTINGUISHING SODIUM FIRES

To the Editor of Chem & Met.:

Sir:—We have read with considerable interest the abstract of the paper "Extinguishing Fires in the Chemical Industry," by R. M. L. Russell, which appeared on pp. 548–50 of the August issue of *Chem. & Met.* Because of our interest in sodium and potassium, Mr. Russell's remarks on p. 548 regarding fires involving these elements and their compounds were particularly noted.

Mr. Russell lists absolutely dry sand, talc, asbestos powder, salt, and graphite as smothering reagents for sodium and potassium fires. Although in an earlier part of the article he mentioned soda ash as a fire extinguishing material for certain uses, Mr. Russell omitted fine, dry anhydrous soda ash from the list of recommended materials for sodium and potassium fires. In our experience, soda ash is the most effective, the safest, and the most generally applicable reagent for this purpose. Soda ash used for this purpose must be kept out of contact with moist air. Absorption of moisture may be readily recognized by the resulting aggregation of the soda ash.

Hot sodium reacts vigorously with sand if small amounts of the latter are in contact with comparatively larger amounts of sodium. Furthermore, sand may contain considerable water without appearing to be wet.

Sodium reacts with water of composition, present in most talcs. The addition of asbestos powder to sodium fires can result in extremely vigorous reactions, due to the fact that asbestos contains water of composition. Large crystals of salt decrepitate when thrown on burning sodium and the mild explosions scatter burning sodium. Sodium peroxide is often formed when sodium burns in air. In our opinion, this fact makes hazardous the use of graphite for extinguishing sodium fires.

It is true that some of the above mentioned reagents may be safely used under certain conditions to extinguish burning sodium or potassium. However, in view of our interest in the safe handling of sodium and potassium, we think it well to have all possible safeguards on this subject brought to the attention of *Chem. & Met.* readers.

C. B. HESS

Manager, Sodium Sales Development
The R. & H. Chemicals Department
E. I. du Pont de Nemours & Co.
Niagara Falls, N. Y.

MATERIALS OF CONSTRUCTION CORRECTIONS

Our attention has been called to an error in reporting data for PDCP copper made by Phelps Dodge Copper Products Corp., New York, on the large wall chart in the September issue. The value for mean coefficient of thermal expansion should have been reported as 0.933×10^{-5}.

In reporting forms in which OFHC, made by Scomet Engineering Co., New York, is available it should have been stated that it may also be obtained in refinery shapes, such as wirebars, cakes, billets and ingots.

Concerning Worthite, manufactured by Worthington Pump & Machinery Corp., Harrison, N. J., the upper line of data reported for tensile properties is for rolled material and the lower line of figures for sand castings.

The rate of penetration for Alcoa 2S in 65 per cent nitric acid should be 0.05 in. per yr. The Aluminum Company of America naturally does not recommend use of this alloy in contact with this strength acid. An error occurred in data for Alcoa 53S. In this case, penetration for 10 per cent acetic acid was placed under the column for 0.5 per cent acid. The penetration by 10 per cent acetic acid is 0.001 in. per yr.

FACTS ON FILTERING

Representative case histories on widely varied clarification problems condensed from field reports of Johns-Manville Filtration Engineers

Pure Salt Filtered From Waste

(Reported by J-M Engineer Scott Robbins)

NEW ORLEANS DISTRICT—In this salt plant, considerable dust results from the crushing process. This dust is collected by passing through water—an operation that also picks up undesirable impurities. Until recently, the resulting brine was considered practically worthless. Its only use was in producing a low-grade salt with practically no commercial value.

Tests indicated that this brine could be filtered to yield highest quality salt. Trials were made with a small filter press, and the correct method and filter aid determined. The method is simple, involving only a precoat filtration with Johns-Manville Hyflo filter aid. Pure salt is now being produced from what had been considered waste, with virtually no extra cost.

Lanolin Filtration Made Practical

(Reported by J-M Engineer T. A. Feuss)

NEW YORK DISTRICT—This company had been attempting to clarify refined lanolin by filtration. Flow rates through filters were low, and the filtrate had a dull, dingy appearance. Operation was so poor that the management felt filtration was of no practical value.

A number of trial runs were made here, using several different types of Johns-Manville filter aids. It was observed that Filter-Cel gave brilliant, sparkling clarity to the filtrate and produced remarkable increases in the rate of flow.

It is interesting to note that the cost of Filter-Cel is made up many times over through superior quality of the product and the fact that time and labor cost are markedly reduced.

Fast Filter Aid Cuts Costs in Glue Plant

(Reported by J-M Engineer Karl Dern)

SAN FRANCISCO DISTRICT—This manufacturer was faced with a serious production bottleneck. Although a filter aid was being used in clarification, only two 1800-gallon cooks of 6% glue could be filtered before cleaning was necessary. Time lost during this operation delayed evaporation and drying, made costs unnecessarily high.

After a check-up of equipment and operations, it appeared that the filter aid used was not the right one for the job. A change to Celite No. 545 was made with striking results. Production was raised to the point where *eleven* cooks of 9% glue are filtered before cleaning . . . an increase of 450% in capacity, despite a 50% higher glue content.

Here's why leading manufacturers use CELITE MINERAL FILLERS

From paint to paper . . . cosmetics to match heads . . . Celite Fillers are improving many different types of products. Check these advantages they offer for use in *yours:*

CHEMICAL INERTNESS . . . Celite Fillers are entirely mineral . . . composed of diatomaceous silica.

POROUS . . . Celite Fillers show under the microscope as irregularly shaped hollow shells . . . absorb up to twice their own weight of liquid.

LIGHT IN WEIGHT . . . Celite Fillers frequently can replace two to six times their weight of heavier fillers.

COMPLETE LINE . . . There is a type and grade of Celite Filler for virtually every requirement.

J-M Engineers are always available to help you select the Celite Filler that will produce best results for you. For details, write Johns-Manville, 22 East 40th Street, New York, N. Y.

Why Not Have J-M Check Your Filtering?

Cases like these are all in the day's work for J-M Filtration Engineers. Whether yours is a particularly difficult problem . . . or one that involves a simple change of filter aid . . . they're always ready to help you work out an efficient, economical solution. And time after time, they've checked plants where filtering seemed satisfactory . . . turned up surprising ways of stepping up production, cutting costs. For details and for facts on the complete line of modern high-flow-rate Celite Filter Aids, write Johns-Manville, 22 East 40th St., New York, N. Y.

JOHNS-MANVILLE CELITE FILTER AIDS

FILTER-CEL • STANDARD SUPER-CEL • CELITE NO. 512 • HYFLO SUPER-CEL • CELITE NO. 501 • CELITE NO. 503 • CELITE NO. 535 • CELITE NO. 545

New Titles, Editions and Authors

Chem & Met BOOKSHELF

UNIT OPERATIONS

APPLICATIONS OF CHEMICAL ENGINEERING. Edited by *H. McCormack.* Published by D. Van Nostrand and Co., New York, N. Y. 431 pages. Price $3.75.

IMMEDIATE ACCEPTANCE and widespread use by the teaching profession are probably in store for this text of unit operations. It will go far in dispelling what Prof. McCormack has called the "Chaos [which] reigns throughout the colleges and universities of the country in so far as they are concerned with the practical applications of the unit operations of chemical engineering." (*Chem. & Met.*, p. 73, Feb. 1935.)

Representing the cooperative efforts of twelve well-known professors of chemical engineering, the book's chapters cover measurement of temperature, flow of fluids, flow of heat, evaporation and evaporators, distillation, drying of solids, humidification and dehumidification, gas absorption, filtration, classification and concentration of solids, and size reduction. The experiments given in each chapter are preceded by discussions of theoretical and practical aspects. Sample data and calculations, directions for report writing, and bibliographies are also included. Each of the 72 experiments may be concluded in a single four-hour laboratory period.

NATURAL FATS

THE CHEMICAL CONSTITUTION OF NATURAL FATS. By *T. P. Hilditch.* Published by John Wiley and Sons, Inc., New York, N. Y. 438 pages. Price $6.50.

Reviewed by *Gordon W. McBride*

IN THIS book we find a veritable encyclopedia of information. It will take its place beside the dictionary on the desk of every chemist and chemical engineer who works with fats and oils, whether edible or inedible. Although it is not an engineering book, it is a reference volume of scientific data that will be invaluable to many engineers.

The arrangement of the book is designed for the maximum ease in reference. Chapter one is a general summary of the data which are discussed in fuller detail in the following chapters. A biographical classification is the basis for the order in which the various natural fats are considered. First, the component acids of aquatic flora and fauna are studied. This is followed by the land animals and the vegetable fats. The component glycerides are then considered, first qualitative investigations of natural fats, then the vegetable and animal fats themselves.

Biochemistry of fats is viewed both from the standpoint of synthesis and assimilation. The constitution of individual natural fatty acids is the subject of a chapter. Synthetic glycerides are reviewed, and the experimental technique employed in the quantitative investigation of fats is outlined.

Bibliographies at the end of each chapter are amazingly extensive. The author's aim has been to include as much as possible of data published through 1938. Some 1939 publications have also been included.

Even the index deserves special mention. It is very complete and is helpfully broken down into three sections: first, a general index of subjects, then an index of individual fats and waxes, including plant families, and finally, an index of individual fatty acids and glycerides.

X-RAYS IN INDUSTRY

APPLIED X-RAYS. Third edition. By *George L. Clark.* Published by McGraw-Hill Publishing Co., New York, N. Y. 674 pages. Price $6.

Reviewed by *W. L. Abramowitz*

ONE PURPOSE of the author is to show the value of X-rays as a great practical research tool in industry. His success is unquestionable. In the rolling or drawing of metals, the X-ray method finds extensive use in visualizing the completeness of removal of internal strain. The vital significance of absence of strain in the structural parts of aeroplanes, bridges, etc., is obvious. Radiography is now being used for such diverse purposes as examination of welds, castings, coal for classification of foreign mineral content, rubber tires for imperfect bondings, golf balls for centering of cores, complicated glass and plastics for improper fabrication, shells and cartridges for improper filling, wood for holes, location of pipes and wires in building walls, purity of food products, counting cigarettes, and last but not least, as a result of our advanced civilization, the examination of suspicious packages for bombs. In the study of alloys, ceramics, cements, glass, X-ray analysis has been of considerable utility in designing new and improved compositions.

Dr. W. H. Carothers, the inventor of nylon, once stated that "the most important peculiarity of high polymers is that they alone among organic materials manifest to a significant degree such mechanical properties as strength, elasticity, toughness, pliability, and hardness. Rubber exhibits a combined strength and elastic extensibility that is not even remotely approached by anything in the inorganic world." X-ray diffraction studies are making brilliant contributions to the knowledge of the structure of these giant molecules which are the building blocks of life in proteins, sugars, starches or cellulose. In medicine and dentistry the use of X-rays is, of course, well known. In the field of organic chemistry, examination of crystals represents the newest phase of X-ray science. Tremendous strides have been made in the knowledge of orientation of atoms and molecules, some practical applications of which are insulating oils for high tension cables and extreme pressure lubricants where it has been shown that a lubricant addend as methyl chlorostearate forms oriented films on the metal surface.

Because of the complex nature of X-ray equipment and interpretation more than half the book is devoted to the scientific and instrumental basis of X-ray technique and is by far the best presentation available.

TEXTS AND REFERENCES

PHYSICAL CHEMISTRY. By *Lewis J. Bircher.* Published by Prentice-Hall, New York, N. Y. 421 pages. Price $3.

SUBTITLED "A Brief Course with Laboratory Experiments," Dr. Bircher's book is directed at students preparing for medicine, biology, geology, agriculture and subjects other than chemical engineering. His work is presented in such a manner that it can be mastered by students who have not studied calculus. This sort of development may seem highly desirable to the students, but those who are majoring in chemistry and chemical engineering realize that such simplification is out of the question. The book could, however, serve to refresh their memories of subjects studied from more complete and comprehensive texts.

CHAMBERS'S TECHNICAL DICTIONARY. Edited by *C. F. Tweney* and *L. E. C. Hughes.* Published by The Macmillan Co., New York, N. Y. 1,698 pages. Price $12.

FROM acoustics to zoology, more than 120 industries and professions are represented by the 50,000 definitions in this latest technical dictionary. Its principal value to chemical engineers will lie in its ability to translate many of the esoteric terms of unfamiliar sciences into understandable English. For example, these words—wow, diaper, couch, pimple, hang-over, sand trap—all have familiar meanings in our everyday speech. But special significance is attached to them by various industries and sciences. Misleading or erroneous impressions could be formed when meeting them in non-chemical engineering technical literature unless a dictionary such as this were handy for consultation.

Physical constants and chemical data are given for many organic compounds, but the inorganic have been slighted somewhat. More of the industrially important chemicals and more definitions of chemical and chemical engineering terms should have been included to make the dictionary of still greater value to all who may need to consult it.

SOLUBILITY OF INORGANIC AND METAL ORGANIC COMPOUNDS. 3rd Edition. Vol. 1. By *Atherton Seidell*. Published by D. Van Nostrand Co., New York, N. Y. 1,698 pages. Price $12.

The second edition of this book appeared in 1919 and a supplement was published in 1928. When a new edition became necessary because of the mass of data which have appeared since the latter date, it was decided that a new supplement was inadvisable because of the difficulty in searching through three volumes for desired information. This book is therefore a complete revision. And in order to keep costs below prohibitive figures it was produced by offset printing. As a result, there are typographical variations and occasional indistinct figures. These defects, however, can all be overlooked by workers and researchers who have occasion to consult the pages of the volume.

THE MINERAL INDUSTRY DURING 1939. Vol. 48. Edited by *G. A. Roush*. Published by McGraw-Hill Publishing Co., New York, N. Y. 761 pages. Price $12.

The 1939 World Index of Mineral Production was above that for 1938. This, however, is attributed to reactions from the recession rather than to war demands. Only pig iron, tin and aluminum showed rates of increase materially above the average. Decreases were noted for chromium and manganese. Numerous gaps in the information contained in this familiar annnual publication are the unavoidable result of the interruption of normal conditions by World War II.

GAS BURNER DESIGN

RESEARCH IN FUNDAMENTALS OF ATMOSPHERIC GAS BURNER DESIGN. Bulletin No. 10, American Gas Association Testing Laboratories. Published by American Gas Association, New York, N. Y. 181 pages. Price $2.

Reviewed by *R. S. McBride*

Many chemical engineers confronted with heating problems require special fuel gas burners. The fundamental scientific and engineering principles underlying the design of such equipment are presented clearly and comprehensively in this special report of American Gas Association Testing Laboratories. A group of widely experienced and able members of the industry have participated in the research and in the formulation of this report. It is, therefore, a most reliable guide to burner design.

Whether the chemical engineer is planning to use city gas, some by-product gas from his own plant, producer gas, or other type of fuel, he can profitably study the technical sections of this document.

REVISED AND ENLARGED

HANDBOOK OF CHEMISTRY AND PHYSICS. 24th edition. Edited by *C. D. Hodgman* and *H. N. Holmes*. 2,564 pages. Price $3.50.

WITH EVERY REVISION, this well-known and long familiar handbook becomes more nearly indispensable to chemical engineers, chemists and students. And the revisions and new material of this year's new edition make it bigger and better than ever.

Some of the tables which were revised to include new material are those giving the properties of commercial plastics, vitamins, foods, and plate and film speeds. But most important, the table of physical constants of organic compounds has been changed from the paragraph form which has been used in the past few editions to the tabular arrangement which was previously employed. This is a definite improvement as it makes for easier reading and quicker location of desired data. More than 300 new compounds have been added to the list.

A new 65-page table of industrial organic compounds will be of value to many chemical engineers. Compiled from information supplied by 14 manufacturers, trade names, chemical names and formulas, and physical constants are given for more than 400 products.

EXPERIMENTAL CHEMISTRY FOR COLLEGES. Second edition. By *J. A. Harris* and *W. Ure*. Published by McGraw-Hill Publishing Co., New York, N. Y. 123 pages. Price $1.25.

PERFORATED and punched for a three-ring binder, the pages of this manual may be torn out and conveniently carried to the laboratory. This edition contains new material on qualitative analysis of groups I and III.

RECENT BOOKS and PAMPHLETS

The Layman Scientist in Philadelphia. Edited by W. Stephen Thomas. Published by The American Philosophical Society, Philadelphia, Pa. Price 15 cents. A 44-page booklet giving the results of a survey of the leisure-time scientific pursuits of thousands of non-professionals in a sample metropolitan district. A directory of resources in science and amateur scientists' organizations in the Philadelphia area.

Airplane Metal Work. Vol. I—Airplane Blueprint Reading. By A. M. Robson. Published by D. Van Nostrand Co., New York, N. Y. 59 pages. Price $1.15. A textbook for aircraft mechanics engaged in the industry and allied workers who desire to enter the aircraft industry.

The Domestic Production of Essential Oils from Aromatic Plants. Published by the National Farm Chemurgic Council, Columbus, Ohio. 77 pages. Price

50 cents. A Bulletin of the N.F.C.C., compilation of research papers relating to problems in the agricultural production of essential oils from the cultivation of aromatic plants. The six plants discussed are: coriander, caraway, anise, fennel, angelica and licorice.

The Preservation of Business Records. By Ralph M. Hower. Prepared by The Business Historical Society, Inc., Boston, Mass. 56 pages. Gratis. Entirely aside from legal and practical considerations, it is to the advantage of any business organization to have factual records of the firm's history. This pamphlet gives the reasons why. It also tells what material should be selected for preservation, how records should be preserved, and when preservation should be undertaken. Approximately half of the booklet is devoted to discussions of current practices of several different types of organizations.

Proceedings of the Twenty-Seventh Annual Meeting. Published by Compressed Gas Manufacturers' Association, New York, N. Y. 105 pages. Annual resume of the technical and other papers presented at the convention. It includes also the annual reports of all of the special committees. Those having to do with compressed gas activities either as producers or consumers will find the material of reference value.

A.S.T.M. Standards on Petroleum Products and Lubricants. Published by American Society for Testing Materials, Philadelphia, Pa. 354 pages. Price $2. Sixty-five standardized methods of testing, ten specifications and two lists of definitions of terms comprise this latest edition of the compilation of A.S.T.M. Standards on Petroleum Products and Lubricants. New standards included for the first time provide tests for carbonizable substances in white mineral oil, dropping point for lubricating grease, and the method for calculating viscosity index.

The Preparation of Undergraduate Engineering Theses. By W. H. Baskervill. Published by University of Tennessee, Knoxville, Tenn. 29 pages. Price 25 cents. A mimeographed booklet which discusses desirable characteristics of technical writing, organization of material, manuscript preparation, form of presentation and other details necessary for the satisfactory preparation of theses and term papers. Chemical engineers could study this inexpensive booklet with profit; its numerous suggestions would be reflected in clearer and more coherent reports.

A Laboratory Course in General Chemistry. By R. H. Crist. Published by McGraw-Hill Book Co., Inc., New York, N. Y. 219 pages. Price $1.50. A spiral-bound laboratory notebook for elementary chemistry courses. It contains 27 experiments designed to be completed in two semesters. Each experiment is accompanied by one or more sheets which can be torn from the book and submitted to the inspector as a laboratory report.

Confiscation or Expropriation? Published by Standard Oil Co. (N. J.), 30 Rockefeller Plaza, New York, N. Y. A series of seven pamphlets was published during the winter of 1939–40 by the Standard Oil Co. (N. J.), dealing with different aspects of the seizure of the oil industry in Mexico. This booklet is comprised of the material contained in these pamphlets. The booklet appears to be an unemotional presentation of the facts of Mexico's expropriation, her willingness and ability to pay for the property and other aspects of the situation.

What the Business Man Should Know of the Labor Law and Its Administration. By J. Raymond Tiffany and Benjamin Werne. Published by Book Manufacturers' Institute, 25 W. 43 St., New York, N. Y. 64 pages. Price 50 cents. Subtitled "Management — Its Rights and Responsibilities," this booklet advocates the repeal of the Wagner Act and substitution of new legislation which considers the four groups: public, labor, management, and the administering body and its personnel.

Plastics in the School and Home Workshop. Second edition. By A. J. Lockrey. Published by D. Van Nostrand Co., New York, N. Y. 233 pages. Price $2.50. As a rule, hobby books are not described on these pages. The subject of plastics, however, is so closely allied with chemical engineering that many chemical engineers will be interested in what can be done with "spare-time" labor. Materials, methods and machines are described and illustrated and numerous "projects" are included.

Quicksilver Resources of California. Published by the State Department of Natural Resources, Division of Mines, San Francisco, Calif. This consists of 133 pages, well illustrated with maps, photographs and tables. Coincidental with this, there has also been published an Economic Mineral Map of California, No. 1, entitled **Quicksilver.** Prices are 60 cents for the report and 50 cents for the map.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Synthetic Organic Chemicals, United States Production and Sales 1939. U. S. Tariff Commission, Second Series Report No. 140; 10 cents.

Transportation Lines on the Atlantic, Gulf, and Pacific Coasts, 1940. War Department Corps of Engineers, Transportation Series No. 5; 50 cents.

Fire-Retardant Treatments of Liquid-Oxygen Explosives, by A. R. T. Denues. U. S. Bureau of Mines, Bulletin 429; 20 cents.

Quarry Accidents in the United States During the Calendar Year 1938, by William W. Adams and Virginia E. Wrenn. U. S. Bureau of Mines, Bulletin 432; 15 cents.

Friability, Grindability, Chemical Analyses and High- and Low-Temperature Carbonization Assays of Alabama Coals, by E. S. Hertzog, J. B. Cudworth, W. A. Selvig, and W. H. Ode. U. S. Bureau of Mines, Technical Paper 611; 15 cents.

Federal Specifications. HH-P-256, Phenolic-condensation-products; laminated (for electrical purposes). O-S-604, Sodium-metasilicate, pentahydrate, O-T-671a. Trisodium phosphate, technical (phosphate cleaner). TT-C-96, Calcimine (cold- and hot-water types). TT-P-23a, Paint, cold-water, interior, light-tints and white. UU-B-536, Board, binders'. UU-P-79a, Paper, blueprint (sensitized and unsensitized). 5 cents each. SS-R-406, Amendment-1, Road and paving materials; general specifications (methods for sampling and testing); 10 cents.

Report on the Investigation of the National Labor Relations Board. House Report No. 1902, 76th Congress, 3d Session; 15 cents.

Price Statistics. Recent publications of the Bureau of Labor Statistics and Department of Agriculture give resumes of price figures for 1939 and first six months of 1940, cost of living index, changes in cost of living, unit labor costs, and the 1941 outlook for agriculture and agricultural commodities, as follows: Wholesale Prices—June 1940, Serial No. R. 1149; The Bureau of Labor Statistics' New Index of Cost of Living, March 15, 1940, Serial No. R. 1156; Changes in Cost of Living—June 15, 1940, Serial No. R. 1153; Unit Labor Cost in 20 Manufacturing Industries, 1919 to 1939, Serial No. R. 1142. (All of the above available from Bureau of Labor Statistics, Washington, D. C.) The Demand and Price Situation, October 1940 issue. (Available from Bureau of Agricultural Economics, U. S. Department of Agriculture, Washington, D. C.)

Industrial Injuries in the United States During 1939, by Max D. Kossoris and Swen Kjaer. Bureau of Labor Statistics, Serial No. R. 1144.

Family Expenditures in Selected Cities, 1935-36. Volume II—Food. Labor Department, Bureau of Labor Statistics Bulletin No. 648; 45 cents.

Safeguarding Manpower for Greater Production. The importance of safe working conditions in maintaining and increasing industrial output for national defense. Department of Labor, Division of Labor Standards Special Bulletin No. 1; 10 cents.

Standard Samples Issued or In Preparation by the National Bureau of Standards. National Bureau of Standards, Supplement to Circular C398. Available from National Bureau of Standards, Washington, D. C.

Outside House Painting. National Bureau of Standards, Letter Circular 603; mimeographed.

Inks, by C. E. Waters. National Bureau of Standards, Circular C426; 15 cents.

Production, Employment and Productivity in the Mineral Extractive Industries, 1880-1938, by Vivian Eberle Spencer. Work Projects Administration, National Research Project Report No. S-2. Available from Work Projects Administration, 1734 New York Avenue, Washington, D. C.

Financial Statistics. The Federal Trade Commission is issuing a series of reports giving financial statistics for various manufacturing corporations. The first of these to be issued thus far are: Aircraft Manufacturing Corporations; Cigarette and Tobacco Products Manufacturing Corporations; Lead and Zinc Producing and Manufacturing Corporations; Bread and Bakery Products Manufacturing Corporations. These and others to appear later are available from Federal Trade Commission, Washington, D. C.

United States Government Manual, July 1940. This edition of the Government Manual incorporates the changes made by Reorganization Plans III, IV, and V, and includes a section on the operations of the Federal departments and agencies as they relate to the National Defense Program. Office of Government Reports; $1.25 (cloth), 75 cents (paper).

Quicksilver Deposit at Buckskin Peak National Mining District, Humboldt County, Nevada, by R. J. Roberts. U. S. Geological Survey, Bulletin 922-E; 15 cents.

Manganese Deposits at Philipsburg, Granite County, Montana, by E. N. Goddard. U. S. Geological Survey, Bulletin 922-9; 40 cents.

Subsurface Geology and Oil and Gas Resources of Osage County, Oklahoma. Part 4. Townships 24 and 25 North, Ranges 10 and 11 East. By L. E. Kennedy, J. D. McClure, H. D. Jenkins, and N. W. Bass. U. S. Geological Survey, Bulletin 900-D; 35 cents.

Natural Water Loss in Selected Drainage Basins, by G. H. Williams and others. U. S. Geological Survey, Water-Supply Paper 846; 15 cents.

Report on the Agricultural Experiment Stations, 1939, by J. T. Jardine, F. D. Fromme, and others. U. S. Department of Agriculture; 25 cents.

Flax-Fiber Production, by B. B. Robinson. U. S. Department of Agriculture, Farmers' Bulletin No. 1728; 5 cents.

The Vitamin B_1 Content of Foods in Terms of Crystalline Thiamin, by Lela E. Booher and Eva R. Hartzler. U. S. Department of Agriculture, Technical Bulletin No. 707; 5 cents.

Selenium Occurrence in Certain Soils in the United States, with a Discussion of Related Topics; Fourth Report, by K. T. Williams, H. W. Lakin, and Horace G. Byers. U. S. Department of Agriculture, Technical Bulletin No. 702; 10 cents.

Arsenic Distribution in Soils and Its Presence in Certain Plants, by Kenneth T. Williams and Richard R. Whetstone. U. S. Department of Agriculture, Technical Bulletin No. 732; 5 cents.

Survey of American Listed Corporations. Supplements for 1939 have been issued on the industry reports for all refiners and distributors, distilled beverages, and clay products. Available from Securities and Exchange Commission, Washington, D. C.

Technology on the Farm. Summarizes the important economic and technical trends as they bear on agriculture. U. S. Department of Agriculture; 40 cents.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Air Conditioning. Carrier Corp., Syracuse, N. Y.—20-page booklet entitled "Production for the Emergency, and After," outlining 26 industrial case histories where absolute control of air is essential to production. Bulletins CR-159, -60, -61, leaflets describing this company's packaged evaporative condensers in five sizes ranging from 1½ to 32 tons capacity. Also leaflet AC-133, folder briefly classifying and describing the broad range of products made by this company for complete and partial air conditioning, and for refrigeration.

Air Washers. Buffalo Forge Co., Buffalo, N. Y.—Bulletin 3142-A—28-page bulletin on this company's air washers, detailing information on various types and their construction.

Alloys. Ampco Metal, Inc., 3830 West Burnham St., Milwaukee, Wis.—16-page booklet giving brief facts about this company's six grades and modifications of Ampco metal, with information on properties, uses and corrosion resistance.

Alloys. Electro Metallurgical Co., 30 East 42d St., New York, N. Y.—24-page pocket-sized handbook on this company's products and service, containing data on ferro alloys and metals. Covers newer types as well as alloys in common use such as those containing chromium, manganese, silicon, calcium, vanadium, tungsten, zirconium, columbium, and boron.

Alloys. International Nickel Co., 67 Wall St., New York, N. Y.—Technical Bulletin T-17—12 pages on the fabrication of Monel, nickel and Inconel seamless pipe and tubing, giving detailed information.

Bearings. Keystone Carbon Co., Bearing Division, St. Mary's, Pa.—24-page catalog on this company's Selflube porous bearings, showing types, sizes, code numbers, etc.

Bearings. Link-Belt Co., Indianapolis, Ind.—Folder 1846—12-page booklet describing this company's five different series of roller bearing units, likening the various types to various pugilistic classifications.

Bearings. SKF Industries, Inc., Philadelphia, Pa.—36-page catalog on this company's spherical roller bearings, with information on applications and bearing selection.

Boilers. Union Boiler & Mfg. Co., Lebanon, Pa.—4-page leaflet on this company's new Frederick steam generating unit in standard sizes from 6,500 to 25,000 lb. steam evaporation per hour.

Carbon Black. Godfrey L. Cabot, Inc., 77 Franklin St., Boston, Mass.—18-page book on testing procedures for carbon black used in rubber. Also 12-page book on this company's method of evaluating and grading its various rubber black products.

Centrifugals. Bird Machine Co., South Walpole, Mass.—Bird Extracts No. 8—4-page bulletin describing actual applications of this company's continuous centrifugal filters and suspended centrifugals, listing numerous products on which this equipment is operating successfully.

Ceramic Products. Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.—Publications as follows: 6-page folder on Duro acid-proof brick and tile showing types, dimensions and properties with list of recommended uses; 16-page bulletin on high temperature bonding mortars, listing applications; leaflet describing this company's Coleman brand fire clay brick.

Chemicals. The Barrett Company, 40 Rector St., New York, N. Y.—28-page book describing this company's hydrogenated coal-tar chemicals such as cyclohexane, cyclohexanol and derivatives.

Electrical Contacts. Gibson Electric Co., 8350 Frankstown Ave., Pittsburgh, Pa.—Catalog C-10—16 pages on this company's contacts made from ductile powdered metals in various combinations of silver with such materials as nickel, molybdenum, tungsten, cadmium and graphite. Discusses properties of various types and forms available.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-1755C, photoelectric relay accessories; GEA-2165A, oil circuit breakers; GEA-2963B, time switches for a.c. circuits; GEA-3191, a.c. magnetic control for heavy equipment; GEA-3434, high-speed synchronous motors; GEA-3436, eight applications of Reactrol control system with heating equipment.

Electrical Equipment. Micro Switch Corp., Freeport, Ill.—New data sheets covering various stock types of Micro Switch, including limit switches, all stock types, roller plunger switches and explosion-proof switches.

Electrical Equipment. Roller-Smith Co., 1766 West Market St., Bethlehem, Pa.—Catalog 3630—8 pages on this company's 7,500-volt oil circuit breakers for 50,000 kv.a. interrupting capacity.

Enameling. Ferro Enamel Corp., Cleveland, Ohio—15-page booklet published by this company's research staff, tracing the development of the raw materials used in the manufacture of cover-coat porcelain enamels over a period of about 500 years.

Equipment. Bradley Washfountain Co., Milwaukee, Wis.—36-page 1941 catalog on this company's group washing equipment, with information on washfountains, multi-stall showers, drinking fountains and washroom planning suggestions.

Fire Protection. American-LaFrance-Foamite Corp., Elmira, N. Y.—6-page folder briefly describing the wide variety of fire protection equipment made by this company, with classification of various types of fires, and listing of proper types of extinguisher for each kind.

Fire Protection. B. F. Goodrich Co., Akron, Ohio—Catalog Section 3750—4-page leaflet on this company's industrial fire hose with information on types, sizes and accessories.

Flooring. The Philip Carey Co., Lockland, Cincinnati, Ohio—12-page booklet describing this company's new Elastite asphalt tile for flooring, as well as for protection of flat roof areas used for recreational or other purposes.

Gratings. William F. Klemp Co., 6601 South Melvina Ave., Chicago, Ill.—AIA file No. 14-R—8-page bulletin on this company's floor armor, steel gratings and stair treads. Gives information on types, applications, safe loads, methods of use and assembling.

Instruments. The Esterline-Angus Co., Indianapolis, Ind.—Bulletin No. 640—16 pages on this company's electric tachometers, giving detailed information on construction of generator and recorder, with a long list of typical uses.

Instruments. Industrial Instruments, Inc., 156 Culver Ave., Jersey City, N. J.—4-page leaflet on this company's Solu-Bridge solution tester for measurement of conductivity, particularly of alkaline bottle cleaning solutions.

Instruments. Leeds & Northrup Co., 4907 Stenton Ave., Philadelphia, Pa.—Catalog N-01A-600—12-page bulletin on this company's furnace pressure controllers designed to maintain constant furnace pressure by automatic stack damper adjustments.

Instruments. Moto Meter Gauge &

Equipment Div., The Electric Auto-Lite Co., Chrysler Bldg., New York, N. Y.—Form 4178—8-page bulletin on this company's indicating and recording industrial thermometers in various ranges from —40 to +750 deg. F.

Lighting. Westinghouse Electric & Mfg. Co., Department 7-N-20, East Pittsburgh, Pa.—Catalog Section 61-150—2-page leaflet on this company's new Tufflite Concentrator floodlighting unit, with description and information on industrial applications.

Materials Handling. The C. O. Bartlett & Snow Co., Cleveland, Ohio—Catalog 90—372-page general catalog, replacing former No. 50 and No. 74 catalogs, giving complete details on this company's elevators and conveyors, chains and sprockets, crushers, gates and miscellaneous equipment.

Microscopes. Bausch & Lomb Optical Co., Rochester, N. Y.—Catalog D-184—30-page book on this company's microscope accessories in numerous types, such as objectives and eye-pieces, slides, counting apparatus and polarizing accessories.

Plastics. Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y.—20-page book describing in detail applications of this company's molding materials in a wide variety of uses.

Plastics. R. & H. Chemicals Dept., E. I. duPont de Nemours & Co., Wilmington, Del.—Technical bulletin giving information on different grades and specific applications of polyvinyl acetates, which are thermoplastic resins of value in various industries.

Plastics. Rohm & Haas Co., 222 West Washington Square, Philadelphia, Pa.—44-page book on Plexiglas and Crystalite acrylic plastics, describing development, properties and applications of these materials.

Ply Metal. Ingersoll Steel & Disc Div., Borg-Warner Corp., 310 South Michigan Ave., Chicago, Ill.—16-page welding manual giving information on welding and fabricating procedures for this company's stainless-clad ply metal.

Ply Metals. Jessup Steel Co., Washington, Pa.—New 24-page booklet on this company's Silver-Ply stainless clad steels; also a variety of folders and charts covering this company's tool and die steels.

Pulverizers. Raymond Pulverizer Div., Combustion Engineering Co., 1324 North Branch St., Chicago, Ill.—Bulletin 48—8-page bulletin on this company's laboratory hammermills and air separators, designed both for experimental and small production use.

Pumps. American Manganese Steel Div., American Brake Shoe & Foundry Co., Chicago Heights, Ill.—Bulletin 940—23 pages on this company's Amsco Nagle industrial centrifugal pumps, made in five types and 18 sizes, for severe pumping problems.

Pumps. Denver Equipment Co., 1400-17th St., Denver, Colo.—Bulletin P10-D-4—4-page leaflet describing vertical centrifugal sand pumps of the packless type offered by this company.

Pumps. Warren Steam Pump Co., Warren, Mass.—20-page catalog covering this company's complete line of centrifugal, single and duplex piston and plunger pumps, and steam-heat vacuum pumps.

Refractories. General Refractories Co., Philadelphia, Pa.—48-page export booklet entitled "World Wide Refractory Service," printed in English and Spanish and giving descriptive information on all major types of refractories made by this company, their uses, method of shipment, weights and other useful information.

Regulators. Askania Regulator Co., 1603 South Michigan Ave., Chicago, Ill.—Bulletin 100—12-page book entitled "Evidence," containing numerous installation views showing how this company's jet type regulator is being used in the control of furnaces in various industries.

Regulators. Foster Engineering Co., 109 Monroe St., Newark, N. J.—Bulletins 33, 35, 39—Leaflets giving complete engineering data on this company's pressure regulators, including capacities on steam and on gases, and a tabulation of the effect of pressure reduction on steam conditions.

Safety. C-O-Two Fire Equipment Co., 10 Empire St., Newark, N. J.—Bulletin C-24—8-page bulletin describing this company's complete line of carbon dioxide fire fighting and recharging equipment. Lists sales and service points.

Safety. Mine Safety Appliances Co., Pittsburgh, Pa.—Leaflet describing this company's new approved respirator for protection against metal fumes.

Samplers. Fuller Co., Catasauqua, Pa.—Catalog Sheet F-K-9—Leaflet describing this company's Fuller-Anderson sampler for dry pulverized materials, as applied to pneumatic conveyors and other handling equipment.

Separation. S. G. Frantz Co., 161 Grand St., New York, N. Y.—Bulletin 15—4-page leaflet describing this company's magnetic FerroFilter for the removal of magnetic particles from suspension in liquids.

Tubes. The Babcock & Wilcox Tube Co., 19 Rector St., New York, N. Y.—Technical Bulletin 11-C—Gives specifications on seamless tubular products including carbon and alloy steel, covering manufacture, finish, chemical and physical properties, etc.

Valves. Automatic Switch Co., 41 East 11th St., New York, N. Y.—Circular 100—8-page folder outlining the numerous types of solenoid-operated valves made by this company, designed to direct those interested to the proper catalog sections for detailed information.

Valves. Kennedy Valve Mfg. Co., 1108 East Water St., Elmira, N. Y.—Catalog 63—240-page catalog on bronze and iron body valves for low to high pressures, standard bronze and malleable iron screwed fittings, standard cast iron flanged fittings, fire hydrants, and valve specialties.

Water Treatment. The Permutit Co., 330 West 42d St., New York, N. Y.—Bulletin 2377—8 pages describing this company's new Mag-de-Sil silica and manganese removal process for the treatment of high pressure boiler feed.

Water Treatment. Proportioneers, Inc., 9 Codding St., Providence, R. I.—Bulletin AMM—4 pages on this company's aqua ammonia feeding equipment for water treatment, used in conjunction with chlorine treatment for taste and odor control.

Water Treatment. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin W-210-B26—8 pages on this company's new line of pressure filters for water purification, with description and engineering data; Bulletin W-210-B27, 8 pages on the company's new hot-process water softener for boiler feed-water treatment.

Welding. Air Reduction Co., 60 East 42d St., New York, N. Y.—Wall chart to facilitate electrode selection by arc welding operators, enumerating, according to metals to be welded, such things as suggested type of electrodes, weld procedure and recommended voltage and current values.

Welding. Lincoln Electric Co., Cleveland, Ohio—58-page Lincoln Weldirectory, giving procedures for producing all types of weld in mild steel and other metals used to a considerable extent industrially; also for applying surfacing metals for wear protection. Covers all principal welding positions and detailed information on numerous electrode types.

Zinc. American Zinc Institute, 60 East 42d St., New York, N. Y.—32-page book on the zinc industry, covering history and applications of zinc with information on production and marketing.

Wire Rope. Macwhyte Co., 2940 14th Ave., Kenosha, Wis.—Bulletin 483—Leaflet discussing the lengthening of the service life of wire rope through proper lubrication.

EQUIPMENT BRIEFS
(Continued from page 788)

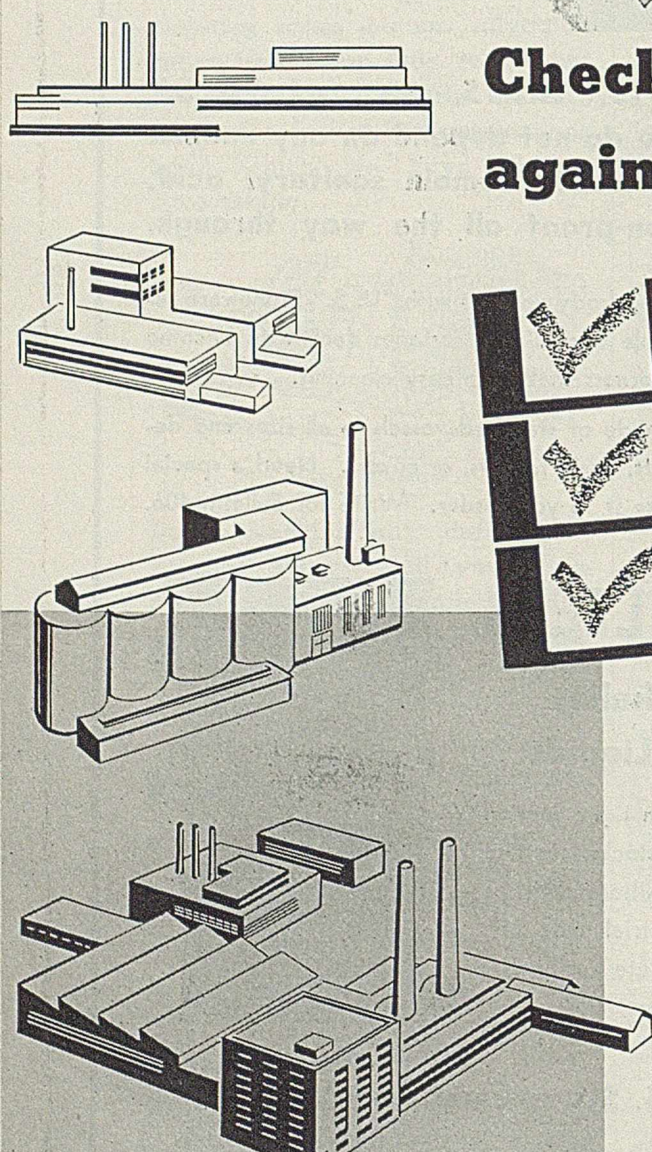
gated wedge in cross-section, is made up by the manufacturer into screening surfaces, consisting of parallel wires supported at proper intervals by wrapping around cross members, the narrow base of the wedge being the screening surface. Thus, the opening flares from the screening surface downward for ready discharge of material passing through. The construction is claimed to provide extreme rigidity and long life without mesh distortion and with continued aperture accuracy.

SOLUTION of the growing sabotage problem is facilitated, according to the Dudley Lock Corp., 325 North Wells St., Chicago, Ill., through a new watchman's tour system recently announced by the company. This system provides complete mechanical control over the watchman's activities and protects him in case of mishap. Approved by Underwriters' Laboratories, the system comprises a group of key stations recording at a central point on a long roll of paper the date and exact time each transmitting station is visited. A delayed alarm gives a warning when any transmitter box is not visited within a given time. The system enforces visits at the various stations only on a predetermined route and in proper sequence.

A NOVEL DEVELOPMENT to assist filtration is Filtomesh, a rubber mesh material with 3/16 to 1/4 in. openings developed by Paramount Rubber Service, Inc., 1430 Rosedale Court, Detroit, Mich. This material is a rubber-covered open-mesh net, used as a cushion between the filter plate and the filter medium. It is said to be applicable to all types of filters in which filter medium is backed by a channeled or perforated plate or disk. The manufacturer claims that use of this material improves clarity of solution, maintains a normal rate of flow over greatly extended periods, increases filter output materially, and drains the cake much drier. When covered with cheesecloth or other coarse fabric, this material is said to work well with paper filters.

CLAIMED to be the most economical and compact engine-driven compressor yet developed, the new Schramm Model 60 stationary Fordair compressor has been announced by Schramm, Inc., West Chester, Pa., to replace the former Model 55. This machine consists of a Mercury V-8 engine, converted to compressor service. Four cylinders are used to drive the other four, the latter serving as the compressor. The unit has a capacity of 60 cu.ft. per min. at 100 lb. actual air delivered. It is available with or without air tank, fuel tank and cooling unit. Box base, fan, air cleaners, water pumps, panelboard, starter and generator are standard.

AMERICAN DEFENSE
demands
MAXIMUM INDUSTRIAL PRODUCTION



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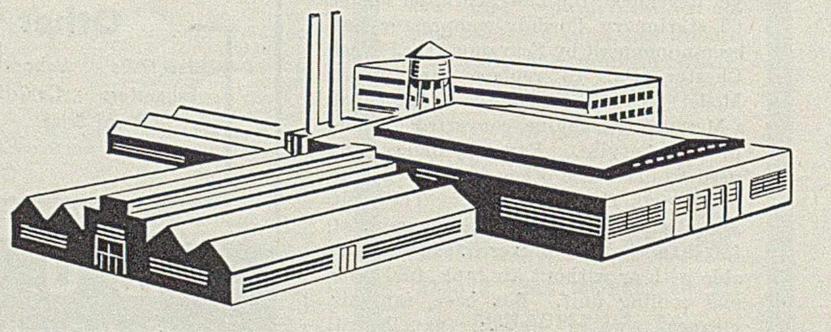

PITTSBURGH • DES MOINES STEEL CO.

PITTSBURGH, PA., 3417 NEVILLE ISLAND • DES MOINES, IA. 916 TUTTLE STREET

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CONSUMING INDUSTRIES CONTINUE TO EXPAND THEIR REQUIREMENTS FOR CHEMICALS

Most of the important chemical-consuming industries speeded up manufacturing operations in October and while complete data are not yet available it is probable that a new high for consumption of chemicals was established last month as the preliminary index stands at 149 as against a revised index of 141.44 for September and of 148.51 for October last year. Increases were reported in the explosives, pulp and paper, paint and varnish, steel, rayon, textile, and plastics groups. Throughout the present year the output of pulp has figured prominently in raising demand for chemicals in the pulp and paper industry with other branches showing considerable fluctuation from month to month.

Chem. & Met. Index for Consumption of Chemicals

	August revised	September
Fertilizer	27.88	26.10
Pulp and paper	20.45	20.35
Petroleum refining	14.16	14.05
Glass	14.08	13.68
Paint and varnish	11.83	11.50
Iron and steel	11.87	11.50
Rayon	12.09	11.30
Textiles	8.41	8.15
Coal products	9.29	9.32
Leather	4.27	4.23
Explosives	5.21	5.43
Rubber	2.92	2.90
Plastics	2.70	2.93
	145.16	141.44

Steel plants have been very active in recent weeks and with buying orders coming to hand in large volume, a high rate of operation is in prospect for some time to come. In the glass industry, there has been a seasonal drop at container plants but flat glass is being turned out in a larger way and a marked increase is reported for the glassware division. In the case of explosives, the official figures refer only to those which are destined for industrial use and this is an understatement in view of the amounts which have been shipped to domestic and foreign consumers for military purposes. Textile manufacturers were more active last month with silk mills sharing in the added activity. Sales of paint and varnish were below expectations in September but improved in October and should feel a less-than seasonal let-down over the remainder of the year.

So far, chemicals have been but indirectly affected by the provisions of the defense program. Woolen mills, for instance are working on government orders and this has increased call for chemicals in that direction. The building program has expanded demand for paints and glass which extends back to the raw materials. Later on, a direct call for chemicals is inevitable and large amounts of such chemicals sulphuric and, nitric acids, ammonia, toluol, and other products will be called for.

Industrial production continued to expand in October, bringing the Federal Reserve Board's seasonally adjusted index to an estimated 127 against 125 in September and 121 in the three summer months, the board announced on Nov. 7.

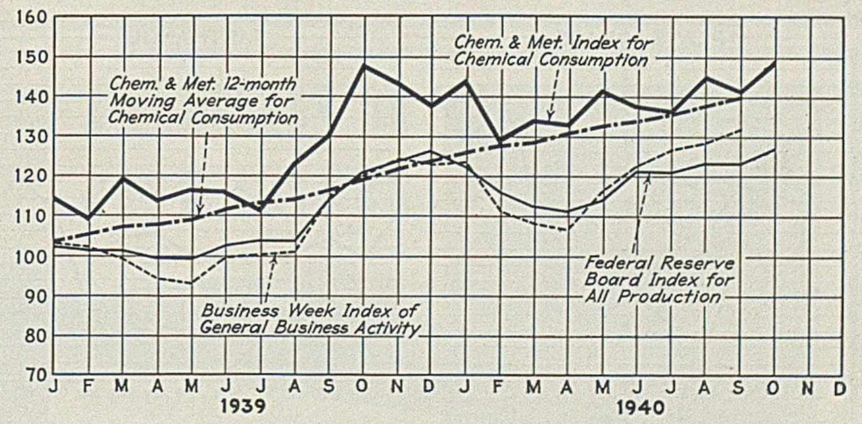
Activity in the steel industry was maintained at a high rate, the board reported, with ingot production close to 95 per cent of capacity. New orders for steel continued in large volume, according to trade reports, as some decline in foreign buying was offset in the total by increased orders from domestic consumers.

There also was further expansion of activity in the machine industries, and automobile production rose considerably to an unusually high level. Textile production also continued to increase, chiefly reflecting greater activity at cotton mills, as well as at woolen mills, where production was already at a high level in September.

Petroleum production, which had increased in September, following considerable curtailment in the summer, rose further in October. Bituminous coal production declined abruptly, following a high rate of output in earlier months, when stocks were accumulating in anticipation of the establishment of minimum prices.

Defense activity played a large part in the increased activity, the board reported. War and Navy Department contracts, aggregating $2,000,000,000 in June, July and August, rose sharply from the middle of September, bringing total awards since last Spring to nearly $8,000,000,000. In addition, it was added, about $2,000,000,000 had been committed for the estimated cost of additional equipment needed for naval vessels already under contract.

Receipt of defense orders by manufacturers and other contractors resulted in a broad movement to cover requirements for materials.

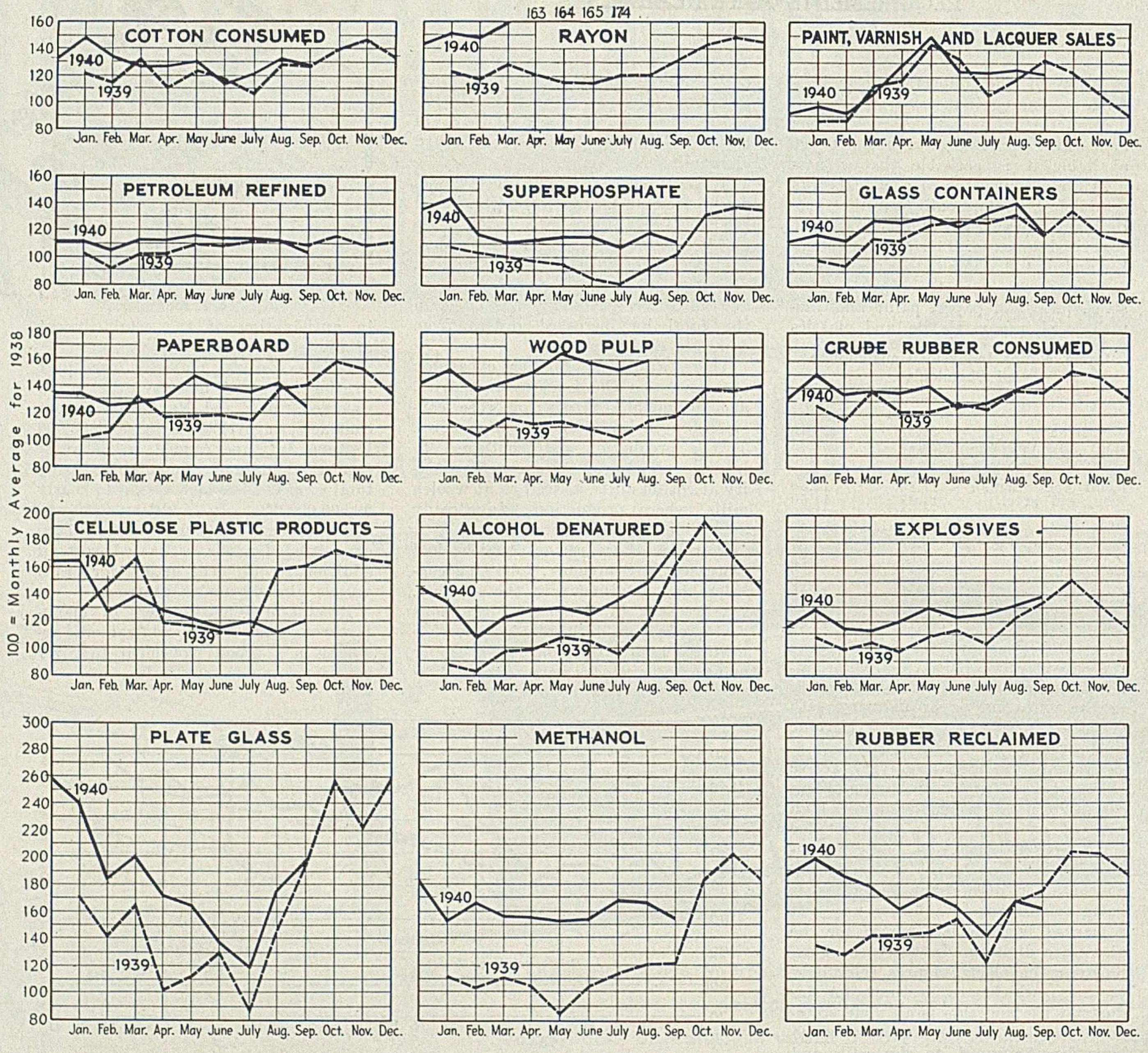


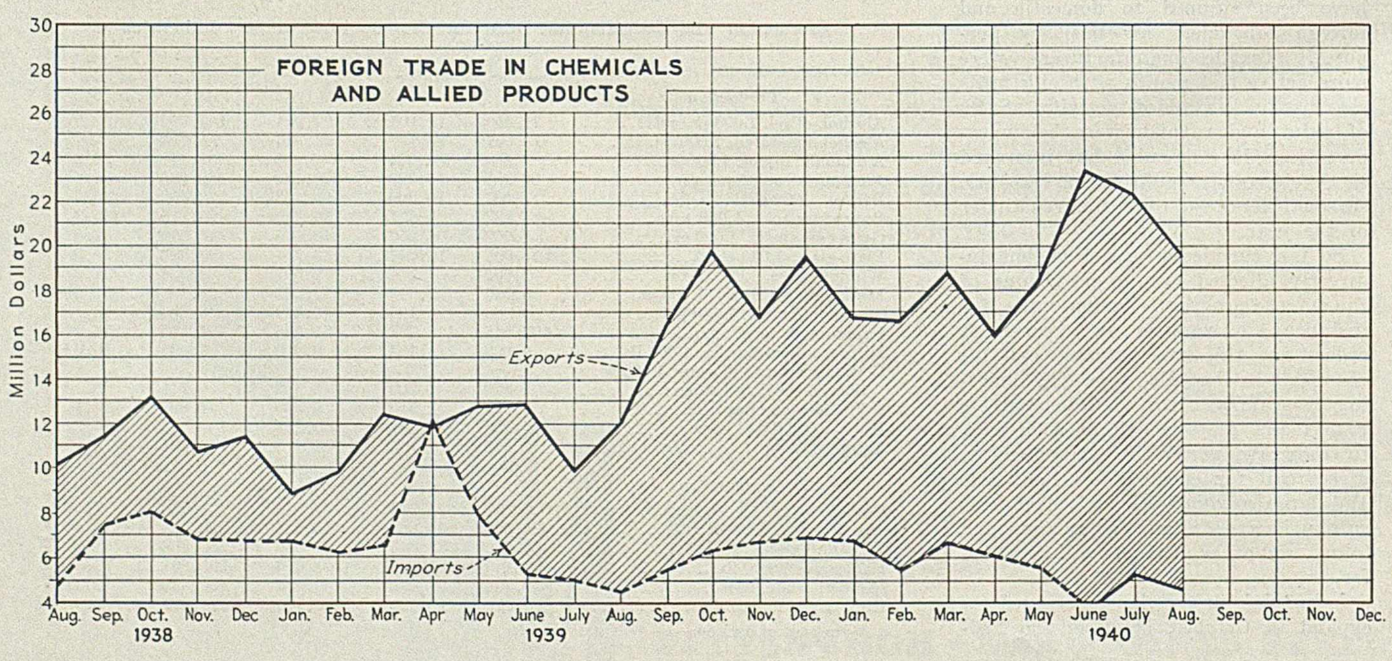
Production and Consumption Data for Chemical-Consuming Industries

Production	September 1940	September 1939	January-September 1940	January-September 1939	Per cent of gain for 1940
Alcohol, ethyl, 1,000 pr. gal	21,559	18,105	192,724	156,792	22.9
Alcohol denatured, 1,000 wi. gal	13,694	12,625	93,766	74,517	25.8
Ammonia, liquor, 1,000 lb	4,824	3,951	41,203	33,710	22.2
Ammonium sulphate, tons	62,483	52,992	526,162	400,280	31.4
Benzol, 1,000 gal	11,054	9,660	96,163	70,453	36.5
Byproduct coke, 1,000 tons	4,627	3,891	39,380	29,115	35.3
Glass containers, 1,000 gr	4,289	4,250	40,845	37,990	7.5
Plate glass, 1,000 sq. ft	14,091	13,663	113,751	89,082	27.7
Window glass, 1,000 boxes	1,002	914	9,607	7,324	31.2
Methanol, synthetic, 1,000 gal	3,549	2,640	32,207	21,301	51.2
Methanol, crude, 1,000 gal	366	405	3,879	3,283	18.1
Paperboard, tons	402,548	445,387	3,851,035	3,464,256	11.2
Nitrocellulose plastics, 1,000 lb	1,093	1,164	8,650	9,609	10.0*
Cellulose acetate plastics, 1,000 lb.					
Sheets, rods, and tubes	826	706	6,103	6,716	9.1*
Molding composition	1,709	1,312	9,996	7,863	27.1
Rubber reclaimed, tons	16,428	16,830	153,257	133,183	15.7
Toluol, 1,000 gal	2,230	1,793	[1]	13,421	
Consumption					
Cotton, bales	629,252	624,902	5,717,627	5,313,068	7.6
Silk, bales	28,828	36,869	216,358	288,204	24.9*
Wool, 1,000 lb	36,550	33,853	271,088	285,338	5.0*
Explosives, 1,000 lb	37,180	35,933	301,026	265,801	13.2
Rubber, crude, tons	50,206	51,402	450,934	420,329	7.3
Rubber reclaimed, tons	14,589	15,583	138,298	128,697	7.5

* Per cent of decline. [1] Not available.

Production and Consumption Trends





CONTRACT PRICES FOR MANY CHEMICALS HAVE BEEN EXTENDED TO COVER 1941 DELIVERIES

In recent weeks there has been considerable interest shown in the prices which will be effective for deliveries of chemicals after the turn of the year. There has been some hesitancy this year on the part of many producers to name figures for next years contracts but for several chemical products prices have been extended to cover forward shipments. There has been no general extension however and some of the chemicals involved are quoted with provisions for possible revisions at the end of the first quarter. In the case of some commodities outside the chemical industry, contracts are offered with prices for deliveries to be those prevailing at the time of shipment. Such contracts are made merely to protect the buyer in case of a scarcity of stocks and, so far at least, there is no indication that any of the chemicals will not be available in quantities sufficient to take care of all consuming needs. It is true that the defense program when it gets under full headway will greatly increase demand for many chemicals but there also is evidence that steps are being taken to increase production accordingly.

Export inquiry for chemicals has fallen from the high level maintained a few months back but it is still considerably above normal and this combined with generally higher industrial operations has resulted in a large tonnage of chemicals passing from producing plants. This condition is not expected to change materially over the remainder of the year as most recent reports have indicated that the active call for raw materials was being maintained.

Price developments during the last month have been in favor of firmness with basic carbonate and sulphate of lead quoted at higher levels and most of the important chemicals holding a steady position. Spirits of turpentine has also moved up in price and the solvents group as a whole has been stronger recently than has been the case in a long time. Vegetable oils and fats continue to sell at relatively low prices. Domestic consumption of lard for the last fiscal year ended Sept. 30 was the largest on record and the large supply of fats and greases accounts for the fact that vegetable oils find it difficult to stage any material price recovery. The situation is further complicated because oils in the markets of the world are maintaining a low price level.

Some of the newer chemicals command high prices while production remains on a limited scale but as consuming demand expands, producing costs are lowered and the saving is passed on to consumers. A case in point is found in methocel, a water soluble ether product, for which producers have just announced a lowering in price to 47c per lb. for carlots. Ethocel plastic granules also have been reduced in price and are now offered at 50c per lb. in lots of 5,000 lb. or more.

The accompanying tabulation gives a comparison of the dollar value of chemical exports for the first nine months of the year with that for the like period of 1939. Total net increase for the nine-month period is almost 55.6 per cent. The gain in export trade is more marked when it is taken into consideration that two of the groups—soap and toilet preparations—actually lost export markets during the period.

The largest gain was reported for the coal-tar group with an increase of almost 139 per cent. Such items as crude coal-tar, benzol, and creosote lost ground in the export field but toluol, which was not mentioned in the 1939 returns, was exported to the amount of 42,928,783 lb. valued at $2,481,038 this year. Shipments of phenol were more than tripled in volume and value. Colors and dyes went abroad in a much larger way with the nine-month total this year running above 19 million lb. as compared with 3.6 million lb. last year. An even larger increase was reported for intermediates.

The increase in shipments of medicinal and pharmaceutical products was rather evenly distributed among a large number of commodities and the same was true for chemical specialties. In the industrial chemical group, a net gain of close to 83 per cent was recorded but some of the important chemicals made a poorer showing than in the preceding year. Larger shipments were made in the case of acids and anhydrides and alcohols, but it is noted that declines ruled in the case of butyl alcohol and butyl acetate. Acetone shipments were above normal last year and while this trend continued this year the rate of gain was moderate. Potassium compounds made a good showing with exports about four times those of the 1939 period.

CHEM & MET.
Weighted Index of
CHEMICAL PRICES
Base=100 for 1937

This month	99.53
Last month	99.24
November, 1939	97.73
November, 1938	98.90

Contract prices for several important chemicals have been extended to cover delivery over the first part of next year and in some cases over the whole year. White lead contracts call for an increase of one-quarter cent per lb. Generally the market is in a firm position.

Outward shipments of sodium compounds amounted to 460,973,760 lb. compared with 447,180,986 lb. last year. Bichromate and cyanide figured prominently in the increase but such large tonnage items as soda ash, borate, and bicarbonate failed to hold last year's totals and only a slight gain was noted in shipments of caustic.

Imports of salt cake in September amounted to 828 tons valued at $14,529 which makes the nine months total 61,603 tons. Imports of chlorate and perchlorate were 1,008 lb. with no imports of chlorate of soda. Imports of nitrate of soda were 37,610 tons making the nine-month figure 573,403 tons.

Chemical Exports By Groups

	Jan.–Sept. 1940	Jan.–Sept. 1939
Coal-tar products	$21,976,038	$9,199,796
Medicinals	21,540,598	14,833,429
Chemical specialties	29,775,433	24,008,713
Industrial chemicals	39,917,026	21,831,696
Pigments and paints	17,390,265	15,900,330
Fertilizers	14,605,723	12,666,648
Explosives	17,343,854	3,038,999
Soap	2,119,697	2,235,447
Toilet preparations	4,319,264	4,897,732
Total	$168,987,938	$108,612,790

Chilean salt-cake imports into the United States were resumed in August with the arrival of a cargo of 4,500 tons from Antofagasta at Mobile, Ala. In addition to this lot, 1,965 tons of Chilean material entered the Georgia customs district during the month. Imports from Chile in the preceding 7 months totaled only 1,075 long tons. It is understood that all of the recent imports consisted of natural salt cake. Substantial quantities of salt cake have been produced in Chile as a coproduct of sodium nitrate, but with the close of the Scandinavian market, recovery of salt cake at nitrate plants ceased.

Of the total imports of salt cake reaching 61,603 tons in the first nine months of this year, the United Kingdom supplied 19,514 tons, Belgium 12,680 tons, Canada 11,082 tons, France 8,295 tons, Chile 7,540 tons, Germany 2,000 tons, and Italy 492 tons. All but 8,261 tons entered at southern customs districts.

CHEM & MET.

Weighted Index of Prices for

OILS & FATS

Base =100 for 1937

This month	68.79
Last month	66.95
November, 1939	80.76
November, 1938	71.89

Higher prices were paid for tallow and olive oil foots were strengthened by the shipping situation. Vegetable oils also started to move up in price in the latter part of the period. Soybean oil was especially strong.

Chem & Met Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.07½-$0.08	$0.07½-$0.08	$0.07 -$0.07½
Acid, acetic, 28%, bbl., cwt	2.23 - 2.48	2.23 - 2.48	2.23 - 2.48
Glacial 99%, drums	8.43 - 8.68	8.43 - 8.68	8.43 - 8.68
U. S. P. reagent	10.25 -10.50	10.25 -10.50	10.25 -10.50
Boric, bbl., ton	106.00-111.00	106.00-111.00	106.00-111.00
Citric, kegs, lb	.20 - .23	.20 - .23	.20 - .23
Formic, cbys., lb	.10½- .11	.10½- .11	.10½- .11
Gallic, tech., bbl., lb	.90 - 1.00	.90 - 1.00	.70 - .75
Hydrofluoric 30% drums, lb	.08 - .08½	.08 - .08½	.07 - .07½
Lactic, 44%, tech., light, bbl., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriatic, 18°, tanks, cwt	1.05 -......	1.05 -......	1.05 -......
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb	.10¾- .12	.10¾- .12	.10¾- .12
Phosphoric, tech., c'bys., lb	.07½- .08½	.07½- .08½	.07½- .08½
Sulphuric, 60°, tanks, ton	13.00 -......	13.00 -......	13.00 -......
Sulphuric, 66°, tanks, ton	16.50 -......	16.50 -......	16.50 -......
Tannic, tech., bbl., lb	.54 - .56	.54 - .56	.40 - .45
Tartaric, powd., bbl., lb	.43¼-......	.41¼-......	.31¼-......
Tungstic, bbl., lb	nom.	nom.	2.35 -......
Alcohol, amyl	......-......	......-......	......-......
From Pentane, tanks, lb	.101-......	.101-......	.101-......
Alcohol, Butyl, tanks, lb	.09 -......	.09 -......	.08 -......
Alcohol, Ethyl, 190 p'f., bbl., gal.	6.03 -......	6.03-......	4.54 -......
Denatured, 190 proof	......-......	......-......	......-......
No. 1 special, bbl., gal. wks.	.30½-......	.30½-......	.28½-......
Alum, ammonia, lump, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Potash, lump, bbl., lb	.03¾- .04	.03¾- .04	.03¾- .04
Aluminum sulphate, com. bags, cwt	1.15 - 1.40	1.15 - 1.40	1.15 - 1.40
Iron free, bg., cwt	1.60 - 1.70	1.60 - 1.70	1.30 - 1.55
Aqua ammonia, 26°, drums, lb	.02¼- .03	.02¼- .03	.02 - .03
tanks, lb	.02 - .02¾	.02 - .02¾	.02 - .02¾
Ammonia, anhydrous, cyl., lb	.16 -......	.16 -......	.16 - .16
tanks, lb	.04½-......	.04½-......	.04½-......
Ammonium carbonate, powd. tech., casks, lb	.09 - .12	.09 - .12	.09 - .12
Sulphate, wks., cwt	1.40 -......	1.40 -......	1.40 -......
Amylacetate tech., from pentane, tanks, lb	.11½-......	.11½-......	.10½- .10½
Antimony Oxide, bbl., lb	.13 -......	.13 -......	.17 -......
Arsenic, white, powd., bbl., lb	.03¾- .04	.03½- .03½	.03 - .03½
Red, powd., kegs, lb	.17 - .18	.17 - .18	.15¾- .16
Barium carbonate, bbl., ton	52.50 -57.50	52.50 -57.50	52.50 -57.50
Chloride, bbl., ton	79.00 -81.00	79.00 -81.00	79.00 -81.00
Nitrate, casks, lb	.08½- .10	.08½- .10	.07 - .08
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f. o. b., wks., drums, cwt	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	43.00 -......	43.00 -......	48.00 -51.00
Bromine, cs., lb	.30 - .32	.30 - .32	.30 - .32
Calcium acetate, bags	1.90 -......	1.90 -......	1.75 -......
Arsenate, dr., lb	.06½- .06¾	.06½- .06¾	.06¼- .07
Carbide drums, lb	.04¾- .05	.04¾- .05	.05 - .06
Chloride, fused, dr., del., ton	19.00 -24.50	19.00 -24.50	21.50 -24.50
flake, dr., del., ton	20.50 -25.00	20.50 -25.00	23.00 -25.00
Phosphate, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb	.04¾- .05½	.04¾- .05½	.04¾- .05½
Chlorine, liquid, tanks, wks., lb	1.75 -......	1.75 -......	1.75 -......
Cylinders	.05¼- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb	1.84 - 1.87	1.84 - 1.87	1.84 - 1.87
Copperas, bgs., f. o. b., wks., ton	18.00 -19.00	18.00 -19.00	17.00 -18.00
Copper carbonate, bbl., lb	.10 - .16½	.10 - .16½	.10 - .16
Sulphate, bbl., cwt	4.75 - 5.00	4.75 - 5.00	4.75 - 5.00
Cream of tartar, bbl., lb	.36¼-......	.34¼-......	.25¼-......
Diethylene glycol, dr., lb	.22 - .23	.22 - .23	.22 - .23
Epsom salt, dom., tech., bbl., cwt.	1.80 - 2.00	1.80 - 2.00	1.80 - 2.00
Ethyl acetate, drums, lb	.07 -......	.07 -......	.061-......
Formaldehyde, 40%, bbl., lb	.05½- .06	.05½- .06¼	.05¾- .06¼
Furfural, tanks, lb	.09 -......	.09 -......	.09 -......
Fusel oil, ref. drums, lb	.16 - .17	.16 - .17	.16 - .17
Glaubers salt, bags, cwt	.95 - 1.00	.95 - 1.00	.95 - 1.00
Glycerine, c.p., drums, extra, lb	.12½-......	.12½-......	.12½-......
Lead:			
White, basic carbonate, dry casks, lb	.07¼-......	.07 -......	.07 -......
White, basic sulphate, sck., lb	.07 -......	.06½-......	.06½-......
Red, dry, sck., lb	.08¼-......	.07½-......	.08 - ......
Lead acetate, white crys., bbl., lb.	.11 - .12	.11 - .12	.11 - .12
Lead arsenate, powd., bag, lb	.09 - .11	.08½- .11	.10 - .10½
Lime, chem., bulk, ton	8.50 -......	8.50-......	8.50 -......
Litharge, pwd., csk., lb	.07¾-......	.06½	.07 -......
Lithophone, bags, lb	.036- .04	.036- .04	.04 - .04½
Magnesium carb., tech., bags, lb	.06¼- .06½	.06¼- .06½	.06 - .06½

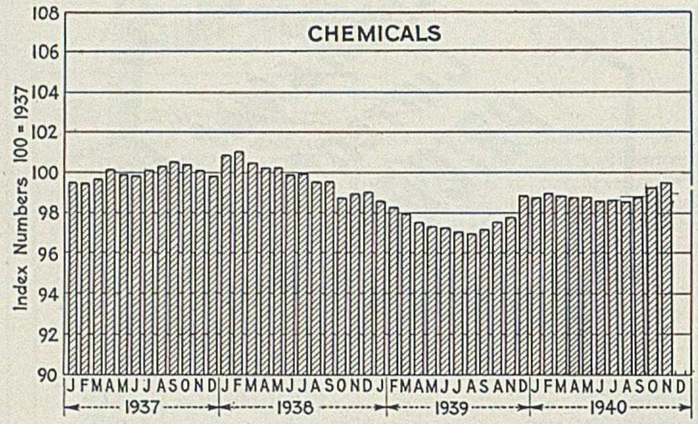
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Nov. 13

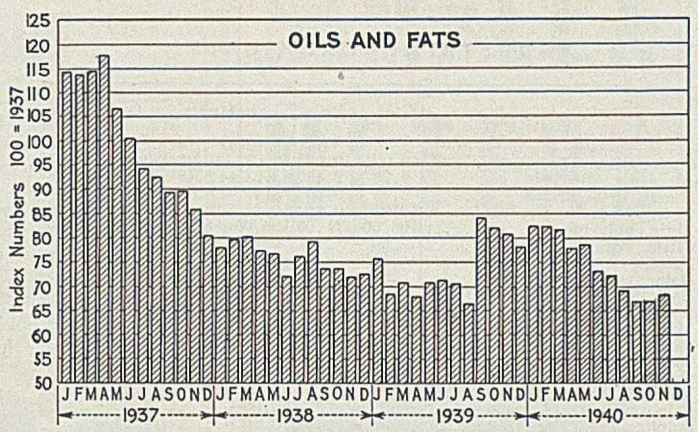
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.29 -......	.29 -......	.31 -......
97%, tanks, gal	.30 -......	.30 -......	.32 -......
Synthetic, tanks, gal	.30 -......	.30 -......	.33 -......
Nickel salt, double, bbl., lb	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb	.11¼-......	.10½-......	.10¼-......
Phosphorus, red, cases, lb	.40 - .42	.40 - .42	.40 - .42
Yellow, cases, lb	.18 - .25	.18 - .25	.18 - .25
Potassium bichromate, casks, lb	.08¾- .09	.08¾- .09	.08¾- .09
Carbonate, 80-85%, calc. csk., lb	.06½- .07	.06½- .07	.06½- .07
Chlorate, powd., lb	.10 - .12	.10 - .12	nom. ......
Hydroxide(c'stic potash) dr., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Muriate, 80% bgs., unit	.53½-......	.53½-......	.53½-......
Nitrate, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb	.18½- .19	.18½- .19	.18½- .19
Prussiate, yellow, casks, lb	.15 - .16	.15 - .16	.15 - .16
Sal ammoniac, white, casks, lb	.0515 .06	.05 - .06	.05 - .05½
Salsoda, bbl., cwt	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	23.00 -......	23.00 -......	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt	1.05 -......	1.05 -......	1.05 -......
Dense, bags, cwt	1.10 -......	1.10 -......	1.10 -......
Soda, caustic, 76%, solid, drums, cwt	2.30 - 3.00	2.30 - 3.00	2.30 - 3.00
Acetate, works, bbl., lb	.04 - .05	.04 - .05	.04 - .05
Bicarbonate, bbl., cwt	1.70 - 2.00	1.70 - 2.00	1.70 - 2.00
Bichromate, casks, lb	.06¾- .07	.06¾- .07	.06¾- .07
Bisulphate, bulk, ton	16.00 -17.00	16.00 -17.00	15.00 -16.00
Bisulphite, bbl., lb	.03 - .04	.03 - .04	.03½- .04
Chlorate, kegs, lb	.06¼- .06½	.06¼- .06½	.06¼- .06½
Cyanide, cases, dom., lb	.14 - .15	.14 - .15	.14 - .15
Fluoride, bbl., lb	.07 - .08	.07 - .08	.07½- .08
Hyposulphite, bbl., cwt	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt	2.35 - 2.40	2.35 - 2.40	2.20 - 3.20
Nitrate, bulk, cwt	1.45 -......	1.45 -......	1.45 -......
Nitrite, casks, lb	.06¾- .07	.06¾- .07	.06¾- .07
Phosphate, tribasic, bags, lb	2.25 -......	2.25 -......	2.10 -......
Prussiate, yel. drums, lb	.10½- .11	.10½- .11	.09½- .10
Silicate (40° dr.) wks., cwt	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, crys., bbl., lb	.02¼- .02½	.02¼- .02½	.02¼- .02½
Sulphur, crude at mine, bulk, ton	16.00 -......	16.00 -......	16.00 -......
Chloride, dr., lb	.03 - .04	.03 - .04	.03 - .04
Dioxide, cyl., lb	.07 - .08	.07 - .08	.07 - .07½
Flour, bag, cwt	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb	.54 -......	.54 -......	.54 -......
Crystals, bbl., lb	.38½-......	.38½-......	.38½-......
Zinc chloride, gran., bbl., lb	.05 - .06	.05 - .06	.05 - .06
Carbonate, bbl., lb	.14 - .15	.14 - .15	.14 - .15
Cyanide, dr., lb	.33 - .35	.33 - .35	.33 - .35
Dust, bbl., lb	.09½-......	.09½-......	.08½-......
Zinc oxide, lead free, bag., lb	.06½-......	.06½-......	.06¼-......
5% lead sulphate, bags, lb	.06⅝-......	.06⅝-......	.06½-......
Sulphate, bbl., cwt	3.05 - 3.25	3.05 - 3.25	2.75 - 3.00

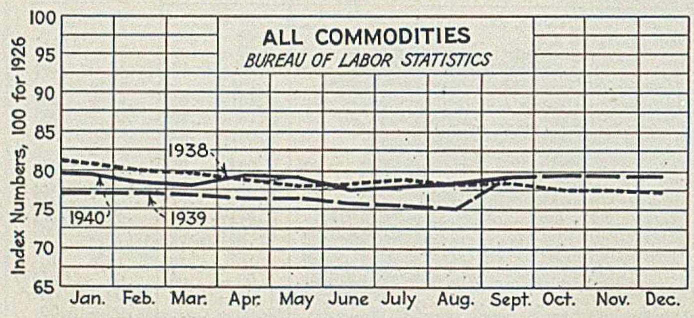
OILS AND FATS

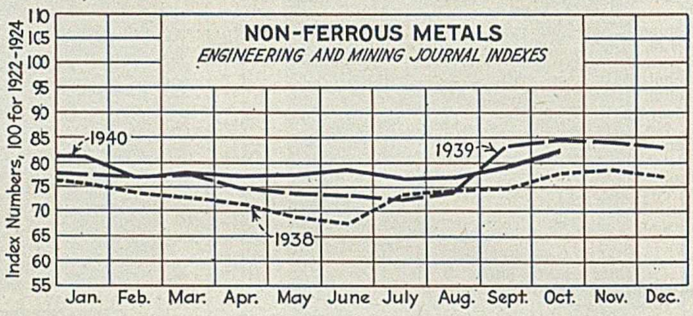
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.10¼-$0.11	$0.10¼-$0.11	$0.09½-$0.10
Chinawood oil, bbl., lb	.26 -......	.26 -......	.27 -......
Coconut oil, Ceylon, tank, N. Y., lb	.02⅞-......	.02¾-......	.03¾-......
Corn oil crude, tanks (f. o. b. mill), lb	.05¼-......	.05¼-......	.05⅛-......
Cottonseed oil, crude (f. o. b. mill), tanks, lb	.04¾-......	.04⅜-......	.05⅝-......
Linseed oil, raw car lots, bbl., lb	.087-......	.083-......	.099-......
Palm, casks, lb	.03½-......	.03½-......	.05½-......
Peanut oil, crude, tanks (mill), lb.	.05¼-......	.05¼-......	.07 -......
Rapeseed oil, refined, bbl., gal	1.10 -......	1.10 -......	.100-......
Soya bean, tank, lb	.04⅜-......	.03⅞-......	.05 -......
Sulphur (olive foots), bbl., lb	.10 -......	.09¾-......	.10 -......
Cod, Newfoundland, bbl., gal	nom.	nom.	nom. ......
Menhaden, light pressed, bbl., lb.	.067-......	.061-......	.074-......
Crude, tanks (f. o. b. factory), gal	.21 -......	.21 -......	.35 -......
Grease, yellow, loose, lb	.04⅛-......	.03½-......	.05½-......
Oleo stearine, lb	.06½-......	.05⅛-......	.08½-......
Oleo oil, No. 1	.05¾-......	.05¾-......	.08 -......
Red oil, distilled, d.p. bbl., lb	.06¾-......	.06½-......	.09 -......
Tallow extra, loose, lb	.04½-......	.03¾-......	.06 -......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.....	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb....	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb......	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb...........	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb....	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb..........	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb.....	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb....	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal...	.14 –......	.15 – .18	.16 – .18
Beta-napthol, tech., drums, lb....	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb............	.09½– .10	.09½– .10	.09½– .10
Cresylic acid, dr., wks., gal......	.58 – .60	.58 – .60	.58 – .60
Diethylaniline, dr., lb............	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb...........	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb............	.15½– .16	.15½– .16	.15 – .16
Dip oil, 15%, dr., gal............	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb..........	.25 – .27	.25 – .27	.32 – .36
H-acid, bbl., lb..................	.45 – .50	.45 – .55	.50 – .55
Naphthalene, flake, bbl., lb......	.07 – .07½	.07 – .07½	.05¾– .06
Nitrobenzene, dr., lb............	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb.........	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums lb.........	.13 –......	.13 –......	.13 –......
Picric acid, bbl., lb.............	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal................	1.70 – 1.80	1.70 – 1.80	1.55 – 1.60
Resorcinol, tech., kegs, lb.......	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb......	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal..	.27 –......	.27 –......	.26 –......
Tolidine, bbl., lb................	.86 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal.......	.30 –......	.30 –......	.27 –......
Xylol, com, tanks, gal...........	.26 –......	.27 –......	.26 –......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton....	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb...........	.11½– .13	.11½– .13	.20 – .22
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...	.028– .30	.028– .30	.02¼– .30
Prussian blue, bbl., lb.........	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb......	.11 – .26	.11 – .26	.10 – .26
Chrome green, bbl., lb........	.21½– .30	.21½– .30	.21 – .27
Carmine red, tins, lb..........	4.85 – 5.00	4.85 – 5.00	4.85 – 5.00
Para toner, lb................	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb....	3.12 – 3.20	nom......	2.70 – 2.90
Chrome yellow, C.P., bbl., lb..	.14½– .15½	.14½– .15½	.14¼– .15½
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..	.06 – .06½	.06 – .06½	.06 – .06½
Gum copal Congo, bags, lb......	.08 – .30	.08 – .30	.06 – .30
Manila, bags, lb..............	.09 – .15	.09 – .14	.09 – .14
Damar, Batavia, cases, lb.....	.10 – .22	.10 – .20	.08 – .24
Kauri, cases, lb	.18 – .60	.18 – .60	.18½– .60
Kieselguhr (f.o.b. N.Y.), ton.....	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton............	50.00 –......	50.00 –......	50.00 –......
Pumice stone, lump. bbl., lb.....	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb..........	.03 – .04	.03 – .04	.03 – .04
Rosin, H., 100 lb...............	2.51 –......	2.22 –......	.... –......
Turpentine, gal.................	.45 –......	.40 –......	.31½–......
Shellac, orange, fine, bags, lb.....	.26 –......	.25 –......	.25 –......
Bleached, bonedry, bags, lb....	.24 –......	.23 –......	.24 –......
T. N. Bags, lb................	.15 –......	.13 –......	.16 –......
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 –......

Industrial Notes

Monsanto Chemical Co., St Louis, has transferred Thornton C. Jesdale assistant manager of the Chicago branch, to Everett, Mass., where he will be in charge of sales of the organic chemicals and phosphate division.

Yeomans Brothers Co., Chicago, is now represented in New England by the Gustavo Preston Co., 113 Broad St., Boston.

Columbia Alkali Corp., New York, has established a sales office at Durham, N. C., in charge of J. R. Simson. After next Feb. 1 the office will be located at Charlotte, N. C.

Copperweld Steel Co., Warren, Ohio, has appointed R. S. Clingan as Chicago district manager.

Porcelain Steels Inc., Cleveland, has appointed Donald D. Smith to head sales and engineering of the enameled roofing and siding division.

Glyco Products Co., Brooklyn, has approved plans for a new building at 228 King St. It will house the administrative, research laboratory, and manufacturing divisions of the company.

John A. Roebling's Sons Co., Trenton, N. J., has transferred Roger H. Clapp from Philadelphia to the position of assistant general manager of sales at Trenton. The Babcock & Wilcox Tube Co., New York, has moved Harvey Wilson from the Philadelphia office to New York where he will act as district sales manager.

Sullivan Machinery Co., Michigan City, Ind., is represented in Syracuse, N. Y., by the H. A. Smith Machinery Co.

Bardco Mfg. & Sales Co., Los Angeles, has established a plant at Dayton, Ohio. Headquarters will be maintained at Los Angeles but the production and engineering branches will be concentrated at Dayton.

Keasby & Mattison Co., Ambler, Pa., has centralized all its research facilities. The work will be under the direction of Clyde R. Hutcheroft with William R. Morris as general consultant.

The Timken Roller Bearing Co., Canton, Ohio, has appointed George W. Curtis as division manager at Milwaukee.

Coopers Creek Chemical Corp., West Conshohocken, Pa., has announced that A. R. Craven has joined the company in the capacity of vice-president in charge of sales.

Chem & Met New CONSTRUCTION

	Current Projects		Cumulative 1940	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$500,000	$40,000	$780,000	$1,543,000
Middle Atlantic	$ 40,000	2,490,000	12,170,000	17,485,000
South	4,040,000	22,000,000	16,495,000	51,500,000
Middle West	10,315,000	26,820,000	18,295,000	6,240,000
West of Mississippi	80,000	16,822,000	27,670,000	33,118,000
Far West	....	1,075,000	4,990,000	4,353,000
Canada	2,650,000	86,000	30,535,000	22,521,000
Total	$17,625,000	$69,333,000	$110,935,000	$136,760,000

PROPOSED WORK

Fla., Bagdad—Bagdad Lumber Co., Bagdad, plans to construct a pulp and paper mill. B. M. Henderson is in charge. Estimated cost will exceed $40,000.

Ga., Howell—Allied Industries, Inc., 30 Rockefeller Plaza, New York, N. Y., is having plans prepared by J. E. Sirrine & Co., Engrs., Greenville, S. C., for the construction of a pulp and paper mill. Estimated cost $4,000,000.

Ind., Burns City—Navy Dept., Washington, D. C., plans to construct a naval powder storage plant near Burns City. Estimated cost $5,000,000.

Ind., Terre Haute—Commercial Solvents Corp., 17 East 42nd St., New York, N. Y., is to rebuild portion of its plant recently destroyed by an explosion here. T. P. Walker, Pres. Estimated cost including equipment $100,000.

Ind., Union Center—War Dept., 20th and Constitution Ave., Washington, D. C., plans to construct an ammunition plant on a 13,000 acre site here. Giffels & Vallet, Inc., 1000 Marquette Bldg., Detroit, Archts. Charles W. Cole, 220 West La Salle St., South Bend, Engr. Estimated cost $5,000,000.

Ia., Charles City—Salsbury Laboratories, Charles City, plan to construct a 2-story, 40x120 ft. and 1-story, 80x120 ft. chemical plant. Estimated cost will exceed $40,000.

Mass., Hanover—National Fireworks Co., Melvin Clark, Hanover, plans to construct a shell loading plant in the Beech Hill swamp section as part of National Defense Program. Estimated cost $500,000.

Mich., Ferndale—Ethyl Gasoline Corp., 7600 Eight Mile Rd., Detroit, is having plans prepared by Albert Kahn, Inc., Archt., New Center Bldg., Detroit, for a 2 story, 45x310 ft. addition to its gasoline laboratory. Estimated cost $75,000.

Neb., Salem—Nebraska Producing & Refining Co., Salem, contemplates the construction of an oil refinery and will be in the market for equipment. Estimated cost $40,000.

N. J., Jersey City—Colgate-Palmolive-Peet Co., 105 Hudson St., Jersey City, N. J., is receiving bids for a 3 story, 42x49 ft. lye treatment plant on Grand St. A. E. Windle, 105 Hudson St., Jersey City, Engr.

O., Cleveland—American Magnesium Co. of America, W. Brown, Gen. Mgr., 2210 Harvard Ave., plants to construct a 1 story, 50x100 ft. factory addition. Estimated cost $40,000.

O., Middletown—Sorg Paper Mills plan to rebuild their mill here recently destroyed by fire. Estimated cost including equipment $100,000.

Ontario—Canadian Industries, Ltd., Beaver Hall Hill, Montreal, Que., Can., manufacturer of paints, varnishes, etc., contemplates the construction of a factory in eastern Ontario. Estimated cost $2,500,000.

Ont., Toronto—Lever Bros., Ltd., 299 Eastern Ave., is having plans prepared by Ewart & Bryan, Archts., Excelsior Bldg., Toronto, for an addition to its pan building. Estimated cost $50,000.

Que., Chandler—Gaspesia Sulphite Co., Ltd., Chandler, is having plans prepared for an addition to its plant. Estimated cost $100,000.

CONTRACTS AWARDED

Calif., Bakersfield—Richfield Oil Corp., 333 Montgomery St., San Francisco, will construct a crude oil stabilizing plant in Coles Levee Field near Bakersfield. Work will be done with own forces. Estimated cost $300,000.

Calif., Los Angeles—Douglas Oil & Refinery Co., D. Douglas, c/o Douglas Aircraft Co., 3000 Ocean Park Blvd., Santa Monica, has awarded the contract for a refinery and cracking plant on East Rd. and Main St., to Fluor Corp., 2500 South Atlantic Ave. Estimated cost $650,000.

Conn., Shelton—Chromium Process Co., Shelton, has awarded the contract for a 2 story, 42x65 ft. addition to its factory to M. Durrschmidt, Main St., Derby.

Ill., Chicago—Dearborn Chemical Co., 310 South Michigan Ave., has awarded the contract for a 2 story plant addition to Dahl-Stedman Co., 11 South La Salle St. Estimated cost $50,000.

Ill., Chicago—Elliott Paint & Varnish Co., 4523 Fifth Ave., Chicago, has awarded the contract for a 1 story addition to its paint factory to Campbell, Lowrie & Lautermilch, 400 West Madison St., Chicago. Estimated cost $40,000.

Ill., Chicago—Sherwin-Williams Co., 101 Prospect Ave., Cleveland, O., has awarded the contract for a 330x700 ft. warehouse at 119th St. and Kensington Ave., Chicago, to W. E. O'Neil Construction Co., 2751 Claybourn Ave., Chicago. Estimated cost $600,000.

Ind., Charlestown—War Dept., Wash., D. C., has awarded the contract for construction and operation of a smokeless powder plant here to E. I du Pont de Nemours & Co., Wilmington, Del. Estimated cost $26,000,000. This is in addition to another contract for $25,000,000 plant of same type originally reported at Jeffersonville, Ind., but later changed to Charlestown.

Ind., South Bend—O'Brien Varnish Co., 101 Johnson St., will construct 1 and 2 story varnish plant by separate contracts. Contract for masonry and carpenter work has been awarded to Sollitt Construction Co., Inc., 518 East Sample St. Estimated cost $130,000.

Miss., Meridian—Flintkote Corp., E. P. Rowe, Vice-Pres., has aawarded the contract for an addition to its plant here to Rust Engineering Co., Martin Bldg., Birmingham, Ala. Estimated cost $1,000,000.

Mo., Weldon Springs—War Dept., 20th and Constitution Aves., Washington, D. C., has awarded contract for construction and operation of TNT and DNT plant for Ordnance Dept., to Atlas Powder Co., Delaware Trust Bldg., Wilmington, Del. Estimated cost $15,000,000.

N. J., Blevedere—Hercules Powder Co., 900 Market St., Wilmington, Del., has awarded the contract for the construction of a powder plant here to Bechtel-McCone-Parsons Corp., 601 West 5th St., Los Angeles, Calif. Estimated cost $2,000,000.

N. J., Rahway—Merck & Co., 126 East Lincoln Ave., has awarded the contract for a 3 story laboratory to White Construction Co., 95 Madison Ave., New York, N. Y. Estimated cost $200,000.

N. Y., Niagara Falls—R & H Chemical Co., division of E. I. duPont de Nemours & Co., Inc., Buffalo Ave., has awarded the contract for an addition to its plant here to Wright & Kremers, Inc., Main St. and Pine Ave., Niagara Falls. Estimated cost including equipment $40,000.

Pa., Allentown—Trojan Powder Co., has awarded the contract for ten 100x200 ft. warehouses here to H. E. Stoudt & Son, Colonial Bldg., Allentown. Estimated cost will exceed $50,000.

Pa., Philadelphia—Univesity of Pennsylvania has awarded the contract for a chemical laboratory to United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia. Estimated cost $200,000.

Tex., Aransas Pass—Union Carbide Co., Aransas Pass and Corpus Christi, will construct the second unit of its carbon black plant here. Work will be done by day labor and subcontracts. Estimated cost $175,000.

Tex., Baytown—Humble Oil & Refining Co., Baytown, will improve and enlarge existing Toluol plant here with own forces. Estimated cost $1,097,000.

Tex., Baytown—Humble Oil & Refining Co., Baytown, will improve existing Toluol plant unit here including steel tanks, pipe lines connecting with various tanks and plant units, etc., with own forces. Estimated cost $450,000.

Tex., Gladewater—Texas Oil Products Co. will improve its oil and gasoline refineries in the vicinity of Gladewater. Work will be done by day labor and subcontracts. Estimated cost $100,000.

Va., Martinsville—E. I. du Pont de Nemours & Co., Wilmington, Del., will construct a nylon plant on a 487 acre tract farm at Horse Shoe Bend near Martinsville. Work will be done with own forces. Estimated cost $11,000,000.

Va., Radford—War Dept, 20th and Constitution Ave., Washington, D. C., has awarded the contract for second unit of smokeless powder plant to be constructed under supervision of Hercules Powder Co., Delaware Trust Bldg., Wilmington, Del. Mason-Hanger Co., Inc., 500 Fifth Ave., New York, N. Y., will construct both projects. Estimated cost $10,000,000.

Wash., Bellingham—Puget Sound Pulp & Timber Co., has awarded the contract for additions to its mill here to Howard S. Wright & Co., 400 Yale Ave., N., Seattle. Estimated cost $125,000.

B. C., Victoria—Sidney Roofing & Paper Co., Ltd., Industrial Reserve, has awarded the contract for a 50x25 ft. plant to Parfitt Bros., Ltd., 503 Toronto Bank Bldg., Victoria. Estimated cost $46,000.

Ont., Hamilton—Procter & Gamble of Canada, Ltd., 39 Burlington St., E., has awarded the contract for an addition to Building No. 39 to W. H. Cooper Construction Co., Ltd., Medical Arts Bldg., Hamilton.