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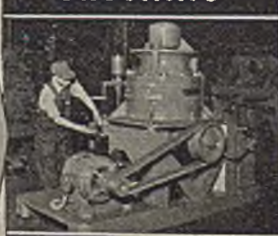			
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WATCHING WASHINGTON

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Problems of finding newsprint for February's extra day confronts officials . . . Metal, glass and paper packaging materials are relatively scarce, scarcer, scarcest . . . Soybean oil edges into cottonseed oil market . . . Selective Service restricts number of college men deferred for educational purposes . . . Choice must be made between men for chemical production and for the Army . . . Grain has been allotted and molasses purchased for alcohol . . . Will research results be patentable hereafter? . . . 330,000,000 lb. cutback made in aluminum . . . Chemical production and requirements are nearly in balance . . . British and Americans interchange patents.

LEAP DAY CONSTERNATION

No better illustration of the shortage of wood and wood pulp can be found than the consternation of the newspaper publishers and government officials over the necessity of finding additional newsprint tonnage for the extra day in February of this year. While the government reports of the amount of pulpwood produced in 1943 indicate the goal for last year was met, an unprecedented drive is being made to increase production a million cords this year.

Aim of the present campaign is to increase wood cutting by farmers in their early spring slack period. The drive to mobilize the farmers is a coordinated effort of War Production Board, War Manpower Commission and War Food Administration. Field representatives of these agencies will assist in putting the program across. The paper industry and paper users should know the best or the worst within 90 days.

MINERALS PROGRAM

Chemical manufacturers dependent upon the metal and mineral industry for raw materials now find control of the mineral program of the War Production Board in the hands of a new vice chairman, A. H. Bunker. At the close of the year a realignment of WPB topside commands established the new office with control over all mineral agencies.

At the time of going to press the appointment of members of Bunker's staff had not been announced. It was believed that at least two deputies would be named and that there would also be some rearrangements within the structure of the metal divisions under his control. Neither had a successor been named for H. O. King, director of the Copper Branch who announced that his resignation would take effect Feb. 1.

Bunker was formerly the director of the Aluminum-Magnesium Division, where he was succeeded by his former deputy Philip D. Wilson. Before joining WPB, Bunker was executive vice president of the Lehman Corp. He has held such important positions as president of the Carib Syndicate of U. S. Vanadium Corp. He was also active in the formation of the Potash Company of America.

SCARCE, SCARCER, SCARCEST

The relative scarcity of packaging materials was officially established by the recent orders M-81 and L-103-b giving the 1944 quotas for metal and glass containers. Since all are in short supply, it is a case of scarce, scarcer, scarcest, with metal, glass and paper packaging coming in that order.

A number of items of interest to the chemical industry have been added to the list that may be packed in tin this year. These include: alcohol, flammable cleaning fluid, hydraulic brake fluid, movie films, polishes and waxes, roof coatings, turpentine, lubricating oils, motor oils, putty and caulking compounds, lacquers, shellacs, liquid disinfectants and fungicides, varnish removers and some food items. Aside from the relaxation in the number of items that can be packed in tin, there is relatively little change from last year's quotas. The same is true of the glass and metal closure quotas now covered by the same order, L-103-b.

The limitation orders for glass and metal containers have been integrated. Certain products for which glass containers in gallon and half-gallon sizes have been allowed previously are now in most cases restricted to smaller sizes. Chemical manufacturers who are again using metal for the larger sizes of containers as provided in the order are referred to the special provisions of the can order where the quantity of glass used for packing products listed in M-81 is charged against the tin quotas.

The order which prohibited the use of new containers of less than 5-gal. capacity for packaging anti-freeze mixtures other than the ethylene glycol type has been revoked. Glass containers of more than 1½-gal. capacity may now be used for any type of anti-freeze. Larger sizes of metal containers may be used for ethylene glycol anti-freeze.

PRIORITY PLANS MODIFIED

Changes in the chemical industry's maintenance, repair and operating supply order P-89 made in January are technical in character and will not affect the chemical producers. The amendment which was put into effect Jan. 14 increases the range of action of the administrator of the order in that applications from producers can now be handled, which heretofore would only justify a rating lower than AA-1. The order previously specified the assignment of the AA-1 rating after Jan. 1, 1944. A further change deletes paragraph C of the old order which referred only to the fourth quarter of 1943.

The producers will continue to use the same ratings and symbols as they have in the past. This is in accordance with a letter of authorization which was mailed to all producers.

There has been no change in the restrictions of P-98 which prohibit the application of MRO ratings and symbols assigned under it "to any order for fabricated parts or equipment having a unit cost of $500 or more, or to purchase orders placed during any calendar quarter for an aggregate amount of aluminum in any of the forms or shapes constituting a controlled material in excess of 500 pounds."

SOY OIL ELBOWS IN

Soybean oil is edging in to take a larger and larger share of the cottonseed oil market in spite of the wishes of industry and government officials. This is a direct result of the supply situation.

Authorization for the use of edible oils for the first quarter of 1944, announced in early January, showed an increase in the number of tank cars of soybean oil and a decrease in the number of tank cars of

other oils—cottonseed, peanut and corn. This is contrary to the desires of the refiners who always demand cottonseed oil in preference to soybean oil which must be hydrogenated. The preference for cottonseed oil is particularly great at this time since hydrogenation facilities are taxed to the limit of their capacity. This is probably the underlying reason why quotas for margarine producers have not been raised from their present level of 167 percent of the base period.

The number of cars authorized for use in the first quarter of 1944 is approximately 1,100 less than was authorized for the last quarter of 1943. No inference can be drawn from this since the action was based on the formal application of the users received at FDA prior to Jan. 1.

Oil refiners, shortening and margarine manufacturers will not only have to get along with less cottonseed oil, but corn oil and peanut oil as well. For months, crop reports have shown a steady decline in the supply of peanuts available for crushing. This decline has been variously attributed to increased feeding of peanuts and to the increased manufacture of peanut butter to bolster the short supply of spreads. The short corn supply has been the subject of discussion for months.

STUDENT DEFERMENTS

A January ruling of Selective Service, which becomes effective Feb. 15, restricts the number of college students deferred for educational reasons. Only 10,000 men may be so deferred in the groups including students of chemistry, all engineering, physics, geology, and geophysics. The selection of individuals so deferred will be made by National Roster approval of applications from the colleges. Quotas will be set up by professions, and by other criteria to insure equitable distribution. A somewhat comparable plan applies to medical and medical science students. Further deferments for general educational reasons are practically terminated by this ruling. Only the boys who expect to graduate by July 1 of this year can now expect further delay in military call on educational grounds. What will happen to these 10,000 students as soon as they graduate isn't much of a puzzle at the present stage of affairs, for a recent ruling has eliminated, except in very special cases, all occupational deferments of men between the ages of 18 to 22. These are reasons to believe, according to some reports, that the "very special cases" will be non-existent in actual practice. There are also some reasons to believe that the no-deferment rating may be upped to include all men under 26 years of age. Such a change would, of course, strike hard at the engineering, research, and scientific personnel of industries now turning out war goods. One very large engineering concern, devoted entirely to war work and a leader in new developments in its field, can prove that 35 percent of all its technical personnel is less than 26 years old.

MANPOWER SHORTAGE

Manpower shortages in the chemical industry are expected to continue in spite of WMC's revised estimate that 600,000 fewer men need be added to the national labor force by July 1. Requirements of the armed services and industry for the first half of 1944 remain huge in view of the available manpower supply. The lowering of labor requirements actually is in no small part a paper saving brought about by the deflation of manufacturers' requirements. It is also the result of some actual cutbacks in the munitions program resulting from changes in high strategy.

The chemical manufacturer may be faced with a relatively more severe problem in the months immediately ahead than at anytime in the past because demands of Selective Service must now largely be met by pre-Pearl Harbor fathers. These men now represent the backbone of the production organization. They are the sergeants and corporals of the industry. The situation seems to be approaching when the choice must be made between chemical production and men for the Army.

There is no help in sight from the cancellation of war contracts on a major scale. Overall industrial activity is scheduled to go up in 1944. There is some possibility of better utilization of labor easing the situation locally. This will be brought about by closing plants in the worst shortage areas when cutbacks are made and by closing the least efficient operations when there is opportunity to make such choice.

TECHNICALLY TRAINED MEN

Process industries continue to find grave difficulty in getting technically trained men for control or development work, and experienced skilled operators are also practically unavailable through U. S. Employment Service. Nevertheless, Washington insists that the first move in searching for such men should be to apply to a local U.S.E.S. office to see whether there are eligibles registered there.

GRAIN ALLOTTED FOR ALCOHOL

It is expected by War Food Administration that 170 million bushels of grain will be required for industrial alcohol manufacture in the United States during 1944. This allotment was determined on the assumption that the bulk of the Cuban molasses could be purchased for alcohol manufacture, a result reported simultaneously with the announcement of the grain plan.

With the grain now assigned to alcohol production it is expected that about two-thirds of the 1944 output of industrial alcohol will come from that source. However, it is hoped that some further cutback in edible grain assigned can be made during the spring or summer. Such reduction in demand for grain can come from any one of three causes. The Caribbean area may supply more molasses; a little more alcohol may be made from petroleum refinery gases; or some significant development of alcohol from wood sugar may be possible. However, this last possibility can hardly be realized in time to affect 1944 business significantly.

MOLASSES PURCHASE MADE

For alcohol production near the Eastern Seaboard, a large quantity of invert molasses will be brought from Cuba beginning at once. The State Department has negotiated an agreement with a committee representing the Cuban industry by which 800,000 tons of fermentable sugar in invert molasses will be transported to the United States.

This molasses is purchased for government alcohol manufacture at 2.5c. per lb. of contained fermentable sugar. This price is approximately half-way between the original offer of Uncle Sam which was 6c. a gal. bid, and the original proposal of the Cubans which was 18c. a gal. asked. The pound rate works out to about 14c. a gal. of ordinary blackstrap.

IMPROVED ALCOHOL PROCESS

A process of cooking grain mash which will reduce labor, save fuel, and minimize maintenance has been patented by P. A. Singer of Century Distilling Co., Peoria, Ill. The inventor and his company have given to the government for the duration of the war permission to use this process royalty-free. In announcing this offer to the Army as an aid to economic alcohol manufacture, WPB states, "A 50 percent saving is estimated in maintenance work and fuel requirements in cooking operations through the new method of introducing steam to cook mash."

AID FOR MARCH 15

The Bureau of Internal Revenue is arranging to station its experts at industrial plants to assist employees in making out their income tax returns. An employer wishing to arrange for this aid may consult the public relations officer of the Bureau in Washington. The purpose is to reduce loss of time and eliminate employee confusion as the problems of March 15 are met by millions of individuals inexperienced in preparing tax returns.

RESEARCH NOT PATENTABLE

Washington is trying to figure out whether any research results will be patentable from now on, if a decision in mid-January of the U. S. Circuit Court of Appeals prevails. That Court stated, "Routineering, even by the most highly

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trained specialists, step by step improvements, the carrying forward of a new and more extended application of the art, are not invention." This opinion was written by former Anti-Trust Assistant-Attorney-General Thurman Arnold who now sits on the Circuit Court bench. It related to an improvement patent sought by Teletype Corp.; but the decision is so phrased as to have quite general implication and probably general application.

The decision makes it clear that Justice Arnold is seeking to prevent corporations from getting patents by "experimentation on a vast scale," which he reasons "is to use the patent law to reward capital investment and create monopolies for corporate organizers instead of men of inventive genius."

It remains to be seen whether the Patent Office itself will take notice of this finding, which presumably will be appealed to the Supreme Court shortly.

LOCATIONS RESTRICTED

New manufacturing of any commodities for civilian purposes must be kept out of labor-shortage areas to prevent interference with war production. WPB has officially announced this policy in January after struggles with the question of how renewed civilian manufacturing can be authorized.

ALUMINUM CUTBACK AND PLANS

Closing of four pot lines on the last day of 1943, closing of three more on Feb. 1 and the voluntary shutdown of eight small lines by Alcoa represents a cutback in aluminum production amounting to approximately 330,000,000 lb. annually. This is about 14 percent of the domestic capacity of 2,330,000,000 lb. Canadian capacity is about 1,100,000,000 lb., giving the North American continent a total capacity in round figures of 3,330,000,000 lb. per yr. of primary metal.

The present stockpile of pig aluminum being built up by the government is 250,000,000 lb. of primary metal and 75,000,000 lb. of secondary metal. This does not include the rough castings and semifinished parts which are "riding on the line." The entire stockpile including all stocks and work in process might amount to 750 million pounds. Most of this metal would be remelted if plane production were to be halted for any reason, and therefore must be considered as a part of the backlog of raw material. Total reserves of all kinds are more than a billion pounds.

In closing the four pot lines on Dec. 31 and the three additional lines a month later, the War Production Board "killed two birds with one stone." In addition to making a desired cut in the production of aluminum ingots, 2,250,000 tons of coal per yr. will be saved by all cutbacks which will ease both the fuel situation in the New York area and the strain on the transportation system. Alumina for the New York plants is shipped from the Mississippi Valley. Some of this railroad haul has been eliminated. The very tight fuel situation in the neighborhood of New York was disclosed when Solid Fuels Administrator Ickes announced that 35,000 tons of low-volatile bituminous coal was being sent to areas within "A-card" driving distance of the anthracite fields.

MAGNESIUM CONTINUES

No cutback has been made in the production of magnesium, although there is a possibility that some adjustment may be made by late spring or early summer. At the present time magnesium is being produced at a rate slightly in excess of consumption. When the stockpile becomes large enough, action to curtail production may be expected. The cutoff may be expected when the stockpile reaches two month's consumption at the then current rate. This is in keeping with WPB policy in the case of other metals.

WHERE SHORTAGES EXIST

Chemical production and requirements are nearly in balance the WPB Chemical Division has announced through the monthly allocation of chemicals. There are a few changes that might need a short word of explanation.

Copper chemical allocations were down. This does not indicate a shortage. They have been under allocation for some time and all requests were granted in the January distribution. Benzene is rapidly becoming critical because of the demands of the aviation gasoline program. Polystyrene and phenolics which are dependent upon benzene as a basic raw material, will be allocated to the hilt as a result. Cellulose plastics have been adversely effected by the depletion of the phthalic plasticizer stockpiles. Some of the marginal uses will suffer until non-critical substitutes can be made available. Paint and ink manufacturers have had to take a sharp cut in their permitted use of chrome pigments. There is a shortage of bichromate resulting from a number of causes of which one is a lack of labor.

The temporary tightness of butyl alcohol is the aftermath of a strike in the plant of a large producer. The matter has been settled and is not expected to cause further trouble. There is a shortage of ketones. They have been in a bad position for some months because of shortages of other chemicals. The present situation is becoming cronic. Sulphuric acid is on the list for the first time. It is being allocated only on the west coast. Among the many chemicals in an easier position is chlorine.

HIGH EXPLOSIVES CUT

Closing down of some of the Army's high-explosive plants during early January does not mean that the need for ammunition to carry on the war has declined. Quite the contrary is true. The ammunition program for 1944 is to be greater than that of 1943. The real fact of the matter is that the Army overbuilt and the closing of explosive plants is merely a realignment of production which will permit the plants remaining in operation to function at close to their most efficient rate rather than to "dog" along as they have at much less than capacity production.

Whether the chemical industry will be able to relieve some of its manpower shortages by absorbing labor released from the explosives plants is problematical. The general indications have been that the experienced workmen have scattered to other operations rather than chemical.

BRITISH PATENTS SHARED

For some time there has been an agreement between British and American officials for interchange of patents important for any war project of interest to either ally. The details of the agreement under which American firms may use British patents are now fully described in a recent publication of the Department of State. That document also makes clear the conditions under which British manufacturers may use American patents.

HEAT-RESISTANT STEELS

WPB has moved along a broad front to relax restrictions on manufacture of heat-resistant steels, and alloy tool steels, and use of electric furnace facilities. The greater availability of alloying materials and the expanded electric furnace capacity of the nation made possible several moves by WPB, which together make a sweeping change in the alloy steel picture.

By revoking Direction 1 to Supplementary Order M-21-h and Supplementary Order M-21-g, WPB removed all restrictions on the formulas by which vanadium, tungsten, molybdenum and nickel alloy steels and chromium-nickel alloy iron and alloy steel were produced. Hereafter, producers may use any alloy content they desire in making these melts.

WPB estimated that by permitting the free use of alloys in tool steel and considering the present tonnage of tool steels being melted monthly, increases in the use of alloying elements would not exceed five percent in any case.

RENEGOTIATION COMPLETED

In the middle of January Chemical Warfare Service announced that it had completed renegotiation of all its 1943 contract cases. Whether any of these cases will be reopened, especially if Congress radically modifies the present law, remains uncertain. None of the other divisions of the War Department is anywhere near through with its 1943 assignments.

INTERPRETATIONS

This installment covers orders, rules and regulations issued by the War Production Board and the Office of Price Administration during January, 1944. Copies of each item interpreted here may be obtained from the appropriate federal agency.

CARBON TETRACHLORIDE

Carbon tetrachloride, formerly under limited control, was placed under full allocation on Jan. 15 through issuance of Allocation Order M-363. Deliveries to customers ordering 7,000 lb. or more in any month must be individually authorized, while deliveries of less than 7,000 but more than 700 lb. per month will be authorized by certification of end use to distributors. A certain amount of the product will be allocated each month to fill orders of less than 700 lb. without reference to end use.

CHROME PIGMENTS

On January 21, WPB issued Allocation Order M-370 placing under complete allocation chromium oxide green and zinc chromate, while limiting the purchase of the other chrome pigments (chrome yellow, chrome green, chrome orange, molybdate chrome orange, hydrated chrome exide) to 25 percent of a user's aggregate purchase of these pigments in 1941. Fifty percent of 1941 purchases is allowed to users in the printing ink industry, but no additional supplies are allowed for filling government orders. These restrictions reflect the increased military uses for chrome pigment in camouflage and corrosion resistant coatings for metal.

CYANIDE

Allocation Order M-366, issued by WPB on January 6, establishes restrictions on deliveries and uses of cyanide, defined as any grade or mixture of sodium cyanide or solutions of sodium cyanide containing 20 percent or more of cyanide by weight. Specific WPB authorization is required for delivery except in the case of orders for 1,000 lb. or less (computed on 96 percent basis) in any month, provided the purchaser's inventory will not exceed 200 lb. (96 percent basis) or a 45 day supply, whichever is greater.

HARD-FACING MATERIALS

Restrictions on the distribution, sale and use of hard-facing materials were removed on Jan. 12 by WPB through revocation of General Limitation Order L-223, which controls the use of cobalt, chromium, tungsten, nickel, molybdenum, vanadium and secondary aluminum. A year's operation under this Order has shown that relatively small amounts of these alloys are used in the hard-facing industry.

COAL TAR CEILING EXEMPTIONS

Maximum prices established for coal tar products by MPR-447 or the General Maximum Price Regulation may be disregarded in the case of sales and deliveries under participating and barter-type contracts. A participating contract is defined as the general contract made by a seller with a manufacturer of coal tar product derivatives and specifying a base price pending upward or downward adjustment after the buyer has realized profits from the derivatives. Barter-type contracts are those in which the seller agrees to exchange coal tar for fuel oil supplied by the buyer. These latter contracts require the approval of OPA and will be permitted only when the appropriate Federal agency in charge of coal tar supplies certifies that they are necessary to promote the production and distribution of coal tar essential to total supply both as to volume and quality. The above changes are contained in amended MPR-447 issued Jan. 5.

ROTENONE PRICES

OPA revised MPR-298 on Jan. 8 to provide a price adjustment method for some manufacturers of rotenone who might otherwise be forced out of business by frozen low prices. At present, manufacturers are permitted to charge no more than their March, 1942 ceiling or their 1941 price plus increased costs of material, whichever was lower. To obtain a price adjustment, the seller must show that he cannot continue to sell at his present maximum price and that any adjustment granted will not raise his price above that of the competitor who might sell to his customers in the event he were forced out of business.

OITICICA OIL

Increased stocks of oil and good prospects for the current nut crop in Brazil have permitted OPA to suspend restrictions on oiticica oil by amending Food Distribution Order No. 31. The amendment, which became effective on Jan. 1, suspends until July 1, the provisions of the Order applying to use and delivery of oiticica oil. During this period, oiticica oil may be used for any civilian use within the limits prescribed in Food Distribution Order No. 42 which restricts the use of fats and oils in general. Manufacturers using more than 1,000 pounds of oiticica oil per month must certify to their suppliers that they have reported their previous consumption to the Bureau of the Census. Suspension of restrictions also applies to cacahuananche oil and laceta oil produced from Mexican tree nuts.

PRP LIQUIDATED

PRP was finally liquidated by WPB through revocation of Regulations No. 11 and 11A, superseded on July 1, 1943, by the Controlled Materials Plan. Revocation of the regulations does not terminate any possible continuing liability under PRP.

P-89 REVISION

Preference Rating Order P-89 was amended by WPB on January 14 providing for assignment of individual preference ratings and allotment symbols for application to purchase orders for maintenance, repair and operating supplies, in place of the blanket rating of AA-1 and the allotment symbol MRO-P-89, formerly used by manufacturers operating under this Order.

MISCELLANEOUS ORDERS

Several Allocation Orders were amended to permit increases in the amount of deliveries permitted in any one month without specific authorization by WPB, . . . M-226 covering dichlorethyl ether, now permits exemption of small orders of 550 lb. or less. . . . M-304 covering adipic acid and derivatives permits acceptance of orders of 10 lb. or less. . . . Other increases included methanol (M-31) from 54 gal. (1 drum) to 540 gal. . . . Phosphate plasticizers (M-183) from 100 to 1000 lb. . . . Calcium carbide (M-190) from 10 tons to 30 tons. . . . Phthalate plasticizers (M-203) from 55 gal. or less of any one kind or 110 gal. or less of different kinds, to 220 gal. or less of all kinds consisting of not more than 110 gal. of any one kind of group I plasticizer and not more than 55 gal. of any one kind of group II plasticizer. . . . Furfural (M-224) from 55 gal. to 110 gal. . . . Copper chemicals (M-227) from 1500 lb. of copper sulphate or not more than 300 lb. each of copper carbonate, copper oxide, copper nitrate, copper chloride or copper cyanide, to 4000 lb. of copper sulphate or not more than 1000 lb. each of copper carbonate, copper chloride, copper cyanide and cupric oxide (no exemptions for cuprous oxide). . . . Phosphorus (M-230) from 1000 to 10,000 lb. . . . Anhydrous aluminum chloride (M-287) from 50 lb. to 600 lb. . . . Potash (M-291) from 1 ton to 5 tons. . . . Miscellaneous chemicals (M-340) methyl abietate and hydrogenated methyl abietate from 450 lb. each to 5000 lb. each. . . . Formaldehyde, hexamethylenetetramine and pentaerythritol (M-25) from 1500 lb., 100 lb. and 350 lb., to 10,000 lb. (plus 3000 lb. or less of paraformaldehyde), 10,000 lb. and 100 lb., respectively.

By amendment of MPR 465 on January 5, OPA has provided for compensation to sellers of installed used vessels (such as underground gasoline and fuel oil storage tanks) for the original installation cost if it was in excess of $100, the amount of such cost to be depreciated at the rate of 5 percent per year for the time elapsed since installation was made. . . . By amendment of MPR-188, certain ready mixed interior and exterior paints with changed formulas necessitated by limitation of amounts of linseed oil used in their production, may continue to be priced by manufacturers at present maximum prices as long as the changes in formulas are necessitated by an Order of the WPB. . . . Multiwall paper sacks, now standardized for all government and many commercial purchases, have been standardized as to their design, strength and other factors in the new federal specification UU-S-48, effective January 1.

CHEMICAL
& Metallurgical
ENGINEERING

ESTABLISHED 1902

FEBRUARY, 1944

S. D. KIRKPATRICK, Editor

For Men in Uniform

JUST IMAGINE, you men on the home front, that you are reading this over the shoulder of a chemical engineer in uniform. Maybe he's one of your buddies from the plant or the development laboratory, that bright young cadet from the chief engineer's office, or that mighty promising boy who just had time to change a cap and gown for Army khaki or Navy blue. Maybe he's still at a camp over here, but the chances are he's already in the South Pacific, in Africa, in Italy, or waiting for the jump-off from bristling Britain. Wherever he is, we hope we can reach him with this "Overseas Supplement" to your twenty-first annual review issue of *Chem. & Met.*

In a sense this is our answer—and yours, too, we hope —to some of the questions these fellows are beginning to write home about. Here's a typical letter from a young naval lieutenant whose only address is care of Fleet Post Office, San Francisco. It comes to us in an advisory capacity from Editor John R. Kuebler of the *The Hexagon* of Alpha Chi Sigma, professional chemical fraternity:

> "There have been some questions in the minds of some of us chemical engineering graduates out here in the war zone which perhaps you can help us clarify. Most of us finished our full four-year courses, but because of the war we had no chance to put our education to the acid test of experience. We figure this thing will be over in a few more years and we're beginning to wonder about what prospects the postwar chemical industries are going to offer for us orphaned grads. We've had plenty of bull sessions on this subject, but because we have no contact with the industrial side of the war the conclusions we've reached may be and probably are all cock-eyed. Any dope you can relay on to us will surely be appreciated." . . . .

That struck a really sympathetic chord with me. Twenty-five years ago I was stationed for almost a year in Paris—much to the envy of some of my A.E.F. buddies who visualized a continuing round of pleasant diversions and distractions. The honest truth, however, is that I was not only homesick, but was actually hungry for industrial and technical information—of all things! Many an evening I sneaked away from the Montmarte to browse through the stacks of the old Bibliotheque at the Sorbonne just to read in the chemical journals of what had been happening in the industries and to the people I'd left behind. My experience, I later found, was not at all unique. One of the sergeants became the most popular man in our outfit when we discovered that his folks were sending him the then weekly copies of a certain publication that modesty prevents my mentioning here!

Now, unfortunately, we know we can't send these bulky magazines to the boys at the various fronts. The next best thing, it seemed to me, was to get out an air-mail supplement to old *Chem. & Met.* and pack it full of information on postwar prospects in the various fields of chemical engineering. To make certain that these were not just one man's opinions, I sent telegrams to fifty prominent chemical engineers and executives in industry, in consulting work and in the universities, asking each for a brief statement on the immediate and long-term possibilities. Forty-four responded, which shows how much interest these busy men have in the problems of providing training and jobs for the men who are now with the armed forces. Their views, together with a series of long-trend charts on the chemical process industries, appear in the following pages.

In presenting this to you chemical engineers in uniform, it is my privilege to salute you on behalf of these leaders of our industry and profession. We envy you your youth, energy and enthusiasm. You are doing a nasty but necessary job. We admire your courage and your convictions to fight as Americans have always fought for principles and institutions that are dearer than life itself. We are not going to let you down.

Sidney D. Kirkpatrick

CHEMICAL ENGINEERING

Yesterday, Today, Tomorrow

If it be true that chemical engineering had its birth in World War I, then it is equally true that its coming-of-age coincided with the outbreak of the current conflict. This greater strength and maturity has stood us in good stead as a nation because this war, in contrast with all its predecessors, has been fought without any cramping handicaps of shortages of chemical munitions. Nevertheless this young and vigorous profession of chemical engineering is not content to rest on its military laurels. It looks forward to greater job-creating achievements as swords are beaten into plowshares for new chemical engineering industries.

When World War I ended so abruptly Nov. 11, 1918, there was both doubt and speculation as to the future of many war-born industries and professions. Some saw the imminence of a post-war boom to be followed by complete collapse. Others saw some permanent gains in the war advances in technology that, after a period of readjustment, would inevitably lead us to ever higher levels of production and consumption of goods and services. One of these who looked thus hopefully on our prospects was the late and great mining engineer, John Hays Hammond, whose work had brought him into close contact with some of the early practitioners of the chemical engineering profession. Writing for *Scribner's* in 1919, he made this significant statement:

> Chemical engineering more than any other may be called the engineering of the future. It is the result of an evolution in which most of the other branches have played a part. . . . The chemical engineer stands today on the threshold of a vast virgin realm; in it lie the secrets of life and prosperity for mankind in the future of the world.

How well he visualized that future is evident from the charts that appear on the following pages. In all of them there is a pronounced and upward trend, particularly during those twenty "peace-time" years between 1919 and 1939. To project ahead that "normal" rate of growth is today our best assurance of what the future holds for chemical engineering tomorrow. But in doing this, let us not forget too soon the lessons of yesterday.

The American chemical industry came out of the first World War with expanded plants and swollen inventories, particularly of war goods, like smokeless powder and TNT, benzol and phenol, acetone and solvents. But we also came out of the war with a new technological resourcefulness. Chemical engineers who had received their "baptism of fire" in producing sorely needed munitions, turned their swords into plowshares as they quickly laid the foundations for great new chemical industries. Nitrocellulose lacquers, destined to revolutionize the paint and varnish industries, quickly absorbed our surpluses of powder and solvents. Plastics soon used up what was normally a six years' supply of phenol. Rayon, dyestuffs, photographic chemicals, new medicinals—all came into industrial fruition as the business curve of the chemical process industries began to rise from its temporary setback during the period between 1920–21.

In noting that trend as shown in the accompanying chart, one must not lose sight of the fact that value in dollars is the only practical measure we have of the over-all totals. Quite obviously that sharp decline from the 1919 peak was due very largely to a drop from the inflationary prices of the war. Likewise the dip that followed the 1929 boom would not be nearly so deep if it could be shown on a tonnage basis. Remember that the early thirties were the years during which chemical engineers were doing most to increase the efficiency of production and to lower prices in order that markets might be broadened and other industries encouraged to recover from the depression.

Chemical engineering has contributed another less obvious but very important influence on the remarkable growth of these industries. Because it was based on the concept of unit operations and processes applicable in a wide range of industries, chemical engineering gradually became the common bond of technology that drew ever closer together many apparently diverse and sometimes conflicting interests. Today there is no longer controversy over the respective fields and functions of the chemist, on the one hand, and the chemical engineer on the other. Both have their responsibilities and it is through their teamwork that industry has advanced.

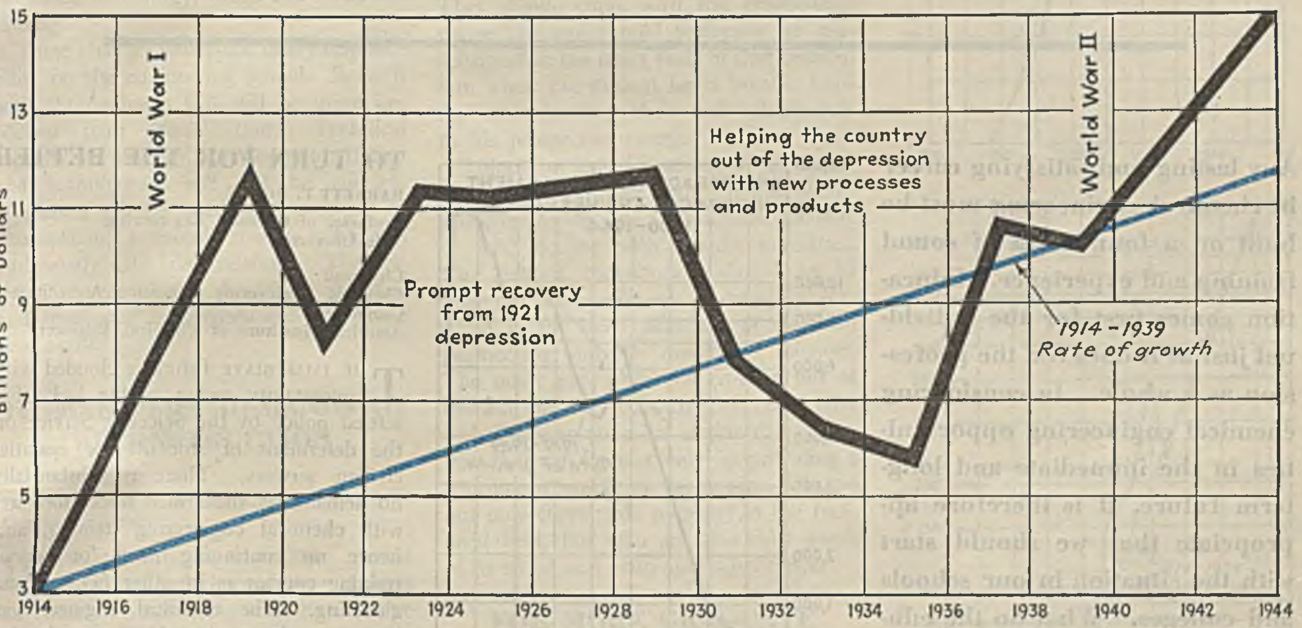
Prior to World War I the American Chemical Society was still comparatively small but it had shown steady and consistent growth since its founding in 1876. With the impetus of the War in 1917 came striking increases in membership that continued with but slight interruption until the depression of the early thirties. Then like other associations and institutions it barely held its own until the general business recovery. Since 1937 the growth has been most striking, with membership (including juniors) increasing during the present war at a much higher rate than would be indicated by the 1919–1939 growth curve. Already, by all odds the largest of the scientific societies, it is evident that the American Chemical Society may be expected to reach a membership of 50,000 in the early years after the end of World War II.

Founded in 1908 with but 40 charter members, the American Institute of Chemical Engineers did not really come into its own until some time after the first World War, when the universities began to modify their curricula to provide modern training in the unit operations and unit processes. Since about 1930 the rate of growth has been increasing notably, with the most rapid rise since the war began in Europe in 1939. Today the Institute has a total membership of more than 4,000 active, associate and juniors and in addition there are normally some 6,000 members in its 80 student chapters.

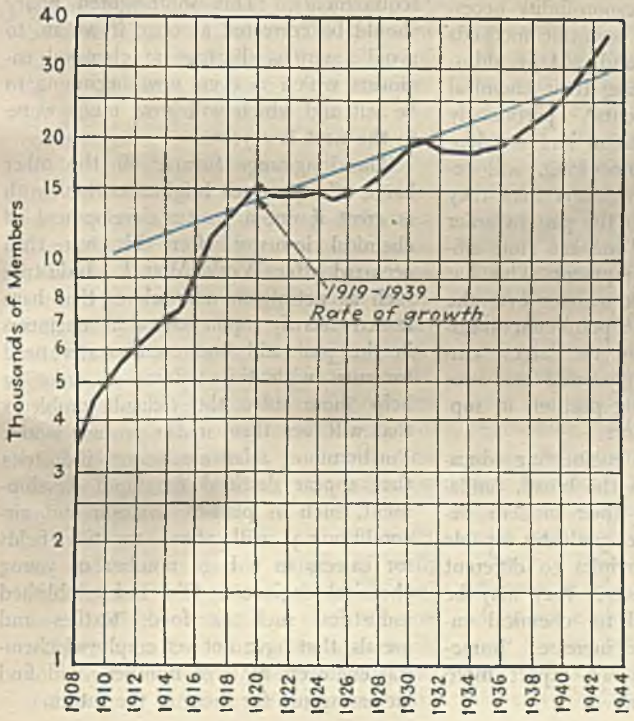
On the basis of surveys made by the National Roster of Scientific and Specialized Personnel, it has been estimated that there are approximately 20,000 chemical engineers in the United States. Fully half of these have graduated from accredited university courses during the past ten years.

What, then, does the future hold for chemical engineering? Already there is convincing evidence that the chemical process industries will be able to change quickly from war to peacetime operations and that they will continue to advance rapidly as the technological gains of this war are translated into new products and more efficient production. There is equally convincing evidence that chemical engineering will continue to broaden the sphere of its influence and that great industries like textile, coal and fuel processing, lumber and cellulose products, will offer increasingly large opportunities for engineering applications of the unit operations and processes. Well trained chemical engineers will be in great demand after this war just as they were after World War I.

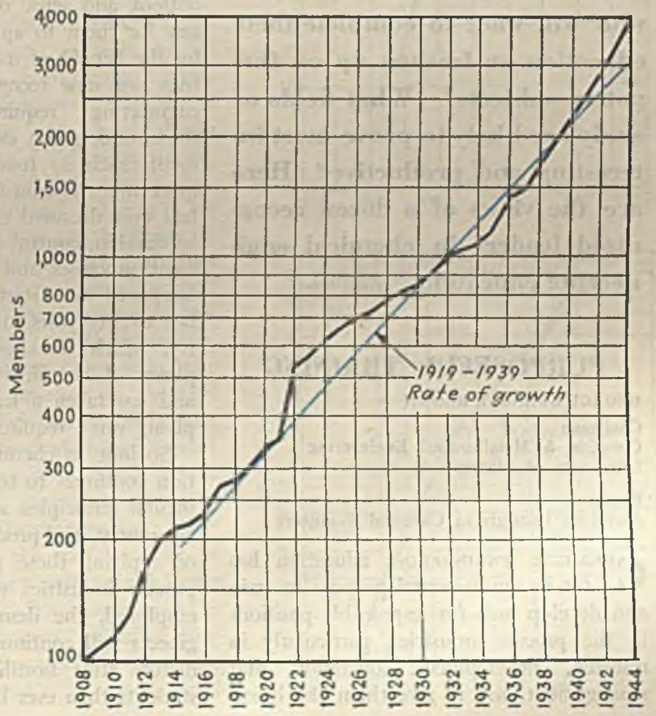
Thirty years expansion of the chemical process industries as measured in total value of production



Membership in the American Chemical Society, largest scientific and technical society in the world, has almost trebled since World War I.



Much smaller but increasing rapidly, membership in American Institute of Chemical Engineers is now 15 times what it was in 1918



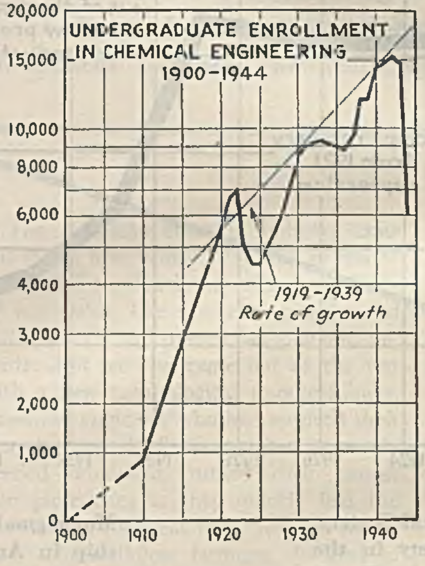
EDUCATION
Comes First in Our Postwar Planning

Any lasting and satisfying career in chemical engineering must be built on a foundation of sound training and experience. Education comes first for the individual just as it does for the profession as a whole. In considering chemical engineering opportunities in the immediate and long-term future, it is therefore appropriate that we should start with the situation in our schools and colleges. What do the educators see ahead? How are the universities equipped to take care of the returning veterans who will want to complete their education or freshen up on forgotten subjects? What fields of study are likely to prove most interesting and productive? Here are the views of a dozen recognized leaders in chemical engineering education. —*Editors.*

PURPOSEFUL TRAINING

GEORGE GRANGER BROWN
Chairman
Chemical & Metallurgical Engineering
University of Michigan
President
American Institute of Chemical Engineers

CHEMICAL ENGINEERING education has for its fundamental purpose to train and develop men for responsible positions in the process industries, particularly in research, development, operation and management, and to give them the broad



outlook and sense of responsibility necessary for them to apply scientific methods for the benefit of mankind. Many industries not now recognizing their chemical engineering requirements, particularly those undergoing expansion and development, such as food processing, will require more chemical engineers than they had ever dreamed of in the past in order to develop, control and manage more efficient processes and equipment. This has happened in a startling manner over the last twenty years in the petroleum industry, which has become the largest employer of chemical engineering graduates and has taken a leading position in supplying war's requirements.

So long as chemical engineering education continues to teach the broad, fundamental principles and their modern development, and produces graduates capable of applying these principles to different process industries wherever they may be employed, the demand for chemical engineers will continue to increase. Immediately after hostilities we expect more students than ever before.

TO TURN FOR THE BETTER

BARNETT F. DODGE
Professor of Chemical Engineering
Yale University
Chairman
Chemical Engineering Education Accrediting Committee
American Institute of Chemical Engineers

THE IMMEDIATE future is clouded with uncertainty owing to the lack of a settled policy by the Selective Service on the deferment of students for essential civilian services. There is substantially no demand by the armed forces for men with chemical engineering training, and hence no continuing need for special training courses as in other fields of engineering. The chemical engineer can best serve the country in the production army, but there is no provision for insuring a continuing flow of technically trained men for either civilian or army requirements. This short-sighted policy should be corrected at once if we are to avoid a serious shortage of chemical engineers which is even now beginning to be felt and which will grow much worse in the next few years.

The long-range future, on the other hand, offers a much brighter outlook with as great if not a greater development of chemical industry after this war than occurred after World War I. Industries such as petroleum and rubber that have leaned heavily upon chemical engineers in the past will find even greater need for men with this training in order to help them solve the difficult problems that will face them in the postwar world. Furthermore, relatively young industries that appear destined for rapid development, such as plastics, aviation and air-conditioning, will offer attractive fields for careers to a large number of young chemical engineers. Old and established industries, such as food, textiles and metals, that have not yet employed chemical engineers in large numbers, will find increasing use for them in the future.

SEES NEW NEEDS

WILLIAM H. McADAMS

Professor of Chemical Engineering
Massachusetts Institute of Technology

When war activities begin to slacken, the demand for adequately trained men will increase because of the necessary time lag in giving postwar training to the generation of chemical engineers now in the armed services. The war's developments will necessitate postwar transformation of many old industries and creation of new ones, thus enhancing the demand for chemical engineers in industries such as petroleum, plastics, synthetic fibres, metallurgy, drugs and air-conditioning.

These changes will place heavy responsibility on the engineering schools. Breadth with thoroughness will still be more important than specialization. Technical capacity in research, development, design and manufacture will not be enough. Graduates will be faced with problems of management, economic analysis, sales, and particularly with labor relations. The curricula of our schools should be modified and developed in accordance with these new needs.

TO MEET THE DEMANDS OF RECONSTRUCTION

F. H. RHODES

Director of School of Chemical Engineering
Cornell University

Demands of the reconstruction period will undoubtedly impose some changes on chemical engineering education in the United States. This country will be called upon to provide a very considerable part of the food and materials needed for sustaining and rebuilding those countries that are being devastated by the war. At the same time, we must make provision for returning the discharged members of the armed forces to their proper and useful places in the economic life of the country.

Much of the responsibility for making this transition from war to peace will rest on the chemical engineering industries. Even after the immediate change to peacetime life has been effected, we can look forward to a rather long period of industrial development, both in this country and abroad, in which chemical engineering will play an increasingly active role. The serious depletion of our American reserves of fundamental raw materials will make it necessary for us to develop new supplies of such materials or to discover substitutes for them.

If we are to carry this load effectively, we shall need a steady supply of really capable and well-trained chemical engineers. Those institutions that are now training men for this profession should consider seriously the type of training that will be most useful in these years to come. It is my opinion that we shall see a rather general adoption of the five-year undergraduate curriculum in chemical engineering. Our experience before the war has convinced us that it is possible in five years to train a man to do effective professional work in chemical engineering, and also to provide in a five-year curriculum a background for intelligent appreciation of the social and economic significance of his professional work. This is difficult to do in less than five years.

The so-called cultural subjects should not be covered by requiring one or two years of work in a liberal arts course before the beginning of technical training. They should come with the professional curriculum and should preferably be concentrated in the latter years of that curriculum when the student has a broader basis for understanding their real relationship to his prospective career.

I question the desirability of including in any undergraduate curriculum in chemical engineering any considerable amount of work dealing with specific industries. Our greatest contribution should be to turn out men who are thoroughly prepared in the basic principles of chemical engineering and the underlying sciences. The many new problems growing out of the war and the reconstruction effort offer a challenge to chemical engineering education that can be met only by providing a continuous supply of young men who are not only thoroughly prepared in the technical field, but who are also fully aware of its social and economic significance.

FOR MORE GRADUATE TRAINING

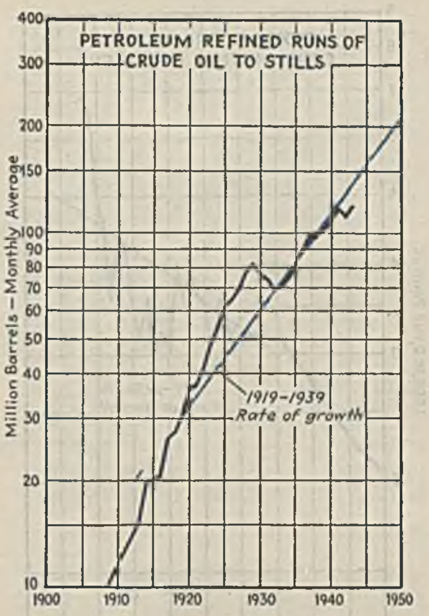
CHARLES A. MANN

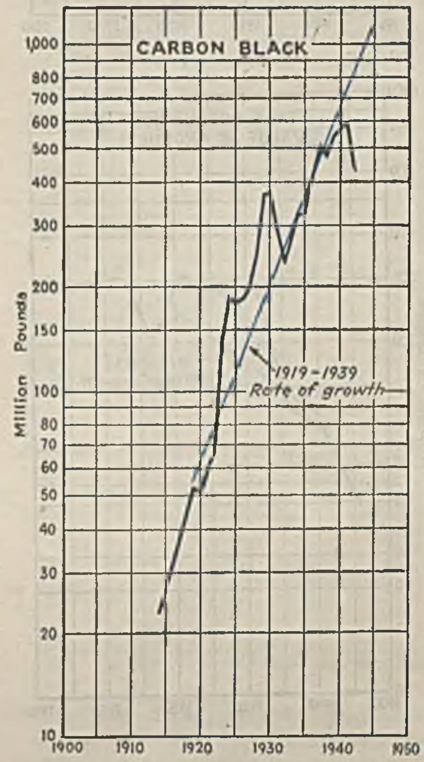
Chief, Division of Chemical Engineering
University of Minnesota

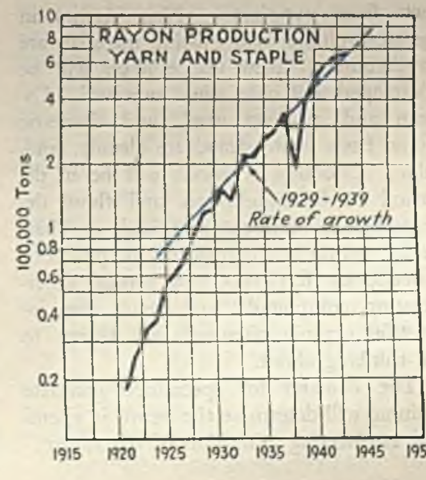
Today the accredited chemical engineering curriculum is built around the unit operations, with limited attention paid to unit processes. Courses in chemical engineering economics, design and thermodynamics have been added, with the elimination of shop courses, languages and some cultural subjects. No further material changes can be made in the four-year curriculum, at least not until the service men return to our schools with their demands for refresher courses and additional training in fundamentals.

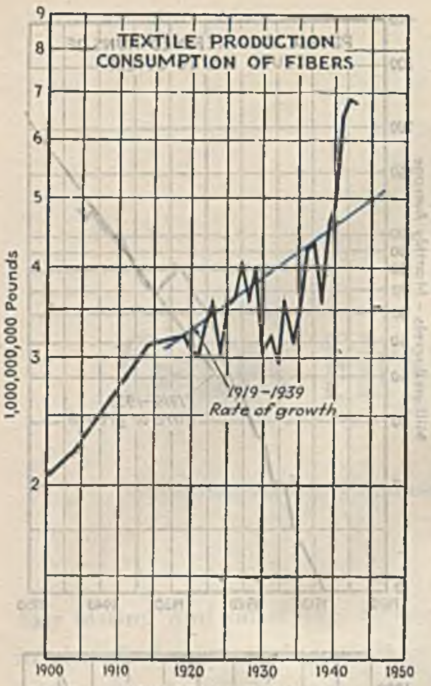
Industry is requesting more men who have had graduate training in chemical engineering, particularly on the unit processes. Educational institutions with qualified faculties and facilities must in the future offer special graduate courses to train such men for local industries.

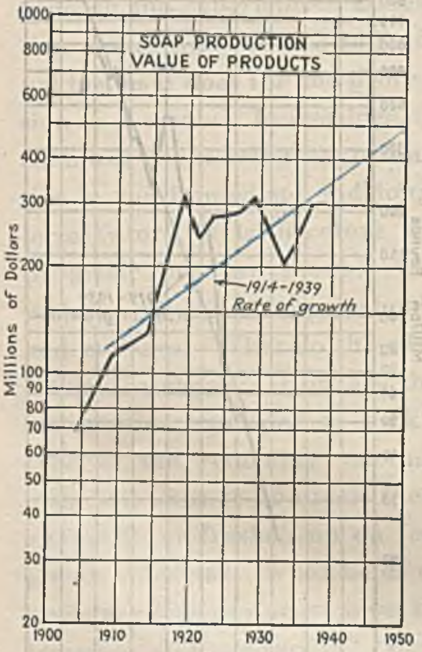
In my opinion, the metallurgical industries of the future will require fewer chemical engineers. The same may be true for synthetic rubber. Greater progress will be made, however, in producing liquid fuels from coal and organic prod-











ucts from petroleum. New plastics in greater volume than existing materials are forthcoming. New textile fibers will be developed and older ones improved. Casein and soy-bean wool, and domestic linen from waste straw, are already available. Chemical engineers will be in demand in food industries and those depending on fermentation and on bacterial action. Pharmaceutical products, insecticides, fertilizers, new glasses, water-treating compounds, and many new industrial organic chemicals are things to be thinking about.

The demand for specialized graduate training will determine the trends in chemical engineering education of the future.

MORE AND BETTER TRAINING

WARREN L. McCABE

Head, Department of Chemical Engineering
Carnegie Institute of Technology

During the remaining war years, the immediate future of chemical engineering education is uncertain. Under existing Selective Service directives, undergraduate students who can finish the requirements for the bachelor's degree in twenty-four months or less can request deferment. If such a policy remains effective, the present junior and senior classes will graduate during the next eighteen months and will become available for industry—supplying between a half and a third of normal needs. Chemical engineering departments can continue chemical engineering training on a professional basis as long as manpower policies will permit them to operate.

Larger enrollments, both graduate and undergraduate, are expected in the years immediately following the war. The problems of the school will be to screen out the able students from the others and to maintain staff and facilities adequate to train properly the better men. To accomplish such a task chemical engineering educators must prevent their curricula and teaching techniques from becoming frozen and static. They must maintain close liaison with industry. They must do their share in increasing the basic knowledge and technique required to solve the scientific problems of the process industries.

TOWARD EDUCATIONAL MATURITY

JAMES R. WITHROW

Professor of Chemical Engineering
Ohio State University

The immediate future of chemical engineering should be tied up with every effort to win the war through maintaining cooperation with our educational institutions in their efforts to prepare the men most needed for the armed services and for our war industries. Apparently this means continuance of accelerated courses, but at the same time our more fundamental concepts of education must not be forgotten.

The long view would require that the "hot-house" and A.S.T.P. types of acceleration be abandoned at as early a date as possible in order to give educational maturity, eliminate nervous strain and get back to proper sequences in order to provide practical experience for the student during summer vacations.

In spite of all the propaganda, there will be no industrial revolution after this war. Industry will still base itself on the needs and purchasing power of its customers. The chemical business will have a heavy tax load and excess plant capacity and equipment, but the forward-looking companies will, as always, seek out and adopt whatever will reduce costs or raise quality. Every new raw material or idea will be welcomed. Research and development will be desired as never before. Well thought out programs for undergraduate and graduate education will certainly be required.

LOOK TO LITTLE INDUSTRIES

ROBERT M. BOARTS

Professor of Chemical Engineering
University of Tennessee

Chemical engineering education has found but little in the army program that would indicate a need for a major revision of its curricula. All that is now lacking is students. For the long-time view, however, the future seems sound if chemical engineering can avoid surrounding itself with a set of dogma. Adherence to fundamentals will pay off in increasing utility of the unit operations and unit processes. Our best bets for emphasis in the future technical program are colloids, surface phenomena, and kinetics. Biochemical reactions should not be ignored.

More attention must be paid to labor and management problems to prevent young employees from making serious errors in industry. Probably the cooperative plan of education will expand after the war because of its inherent advantages in this respect.

Chemical engineers, in my opinion, will have their greatest opportunity in smaller industries, particularly those concerned with consumer goods, such as foods and oils. Graduates must relax their insistence in wanting to operate a still or an evaporator, and be prepared to work in other capacities than as chemical engineers in the restricted technical sense. Chemical engineering needs more men who have progressed through technology to management and who can exert influence in their communities all over the country.

POSTWAR TRAINING

R. NORRIS SHREVE

Professor of Chemical Engineering
Purdue University

Our first problem in chemical engineering education will be to bring up to date both the young men who left in the midst of their undergraduate training and those who upon graduation immediately went into the armed services. To effect this it will be necessary to have these young men take what we may call "refresher non-credit courses." These will be designed to bring men up to a position where they will be on a par with men of corresponding training at the time. Such courses will only be a partial review. They, however, should summarize and present newer advances that have taken place in the particular field.

Following the war there will certainly be a period in which more stress must be placed upon sales and market developments. As the chemical industries sell services as well as goods, men with chemical engineering background are needed for this work. Certain of the men returning from the armed services may wish to supplement their chemical engineering training with additional courses in economics, public speaking, psychology and business in order to enter the sales and sales promotion fields.

LOOKING AHEAD

M. C. MOLSTAD

Professor of Chemical Engineering
University of Pennsylvania

In the postwar period the accumulated war experiences of engineering teachers, as well as of their students, will pay dividends. Broader knowledge of the practical application of chemical engineering operations and processes should make for more effective understanding and teaching of scientific principles. The new developments in plastics, fuels, synthetic rubber and petroleum chemicals will give added emphasis and significance to the teaching of reaction kinetics and unit processes.

All signs now point to a large increase in the number of men seeking chemical engineering training after the war. Many of these will be best served by the shorter vocational courses or by part-time adult education. The universities will have the opportunity of raising admission and graduation standards higher than ever before. Accordingly, the universities should be expected to produce superlatively trained and socially-minded engineers and citizens for the postwar world.

OPPORTUNITIES HERE AND ABROAD

O. A. HOUGEN

Professor of Chemical Engineering
University of Wisconsin

Chairman
Chemical Engineering Education Projects Committee
American Institute of Chemical Engineers

One democratic principle upon which Americans agree is that educational opportunities shall be provided at public expense for ex-service men. For the first few years following the war, therefore, a doubling of enrollment in chemical engineering can well be expected because of the well-recognized importance of this profession in undoing the ravages of war. Every conflict makes us more dependent upon technical ingenuity in establishing higher standards of living. Creative chemistry will be called upon to supplement if not ultimately supplant the metals and minerals now no longer easily accessible. The chemurgical developments required to accomplish this will demand research projects of vast magnitude. The great danger to this program will be the shrinkage of capital for private enterprise and the sterility of efforts if undertaken by government alone.

A world-wide interest in the methods of teaching chemical engineering education as employed in the United States has recently developed. These methods have not been adopted by foreign countries largely because of the English system of units used in American textbooks and the prevalence, even at this late date, of the German influence in technical education outside of the United States. The American Institute of Chemical Engineers is, therefore, in a strategic position to render an international service by making available to foreign universities—particularly to the schools of Russia, China, and to the South American countries—a publication of the methods and standards of chemical engineering education as practiced in the United States.

MORE EMPHASIS ON RESEARCH

E. P. SCHOCH

Professor of Chemical Engineering
University of Texas

Postwar industry will need not only its usual share of production engineers for which undergraduate work should be adequate, but will require more and more research men of specialized training along chemical and chemical engineering lines. Graduate programs must expand to take care of these demands. The spirit of graduate work and research should be the most conspicuous feature of the chemical engineering departments in all of our universities, and a large fraction of the student bodies should be in graduate courses.

The chief concern of the chemical engineer in the postwar world should be to develop new and better uses for the natural resources of this country. The production of liquid hydrocarbons from gas and coal will be one of the major new developments of the postwar world.

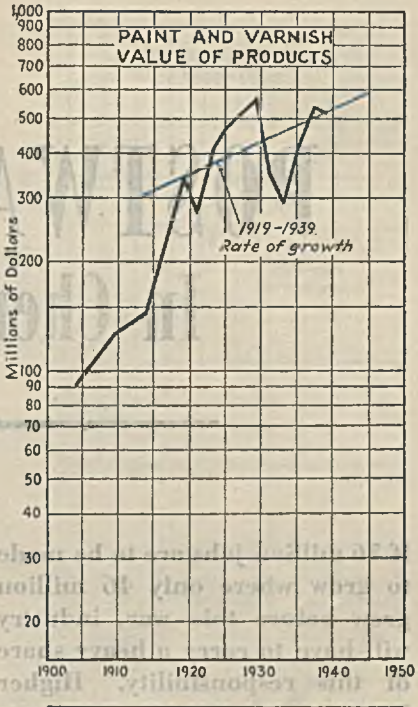
NEW PRIVILEGES AND OBLIGATIONS

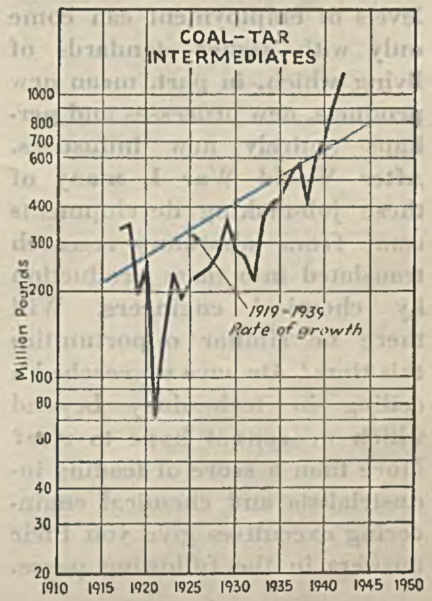
R. C. ERNST

Professor of Chemical Engineering
University of Louisville

Young chemical engineers of postwar America will enter a more mature field than those pioneers who followed World War I. They will enter a profession accepted in the family of engineers with new privileges and new obligations.

The training of engineers in the past decade has been concerned primarily in establishing firmly the philosophy of the unit operations. This has been the chemical engineer's outstanding contribution to the thinking of the engineering profession.





Along with the opportunities for rebuilding along modern lines, industries laid bare by the demands of an exhausting war, young chemical engineers will find that their future responsibilities lie in the new synthetic industry and in a new consciousness of the responsibility to a national and international conservation and development program.

The demands and opportunities for chemical engineers will be almost unlimited. The responsibilities are grave, and it would be well for those concerned with the education of future engineers to give some serious thought to a rededication to the comprehensive principles of training professional chemical engineers to meet the changing demands of industry and government.

(*Please turn to page 110.*)

POSTWAR OPPORTUNITIES

In Chemical Process Industries

If 56 million jobs are to be made to grow where only 46 million grew before this war, industry will have to carry a heavy share of this responsibility. Higher levels of employment can come only with higher standards of living which, in part, mean new products, new processes and perhaps entirely new industries. After World War I, many of these job-making developments came from laboratory research translated into mass production by chemical engineers. Will there be similar opportunities this time? Or have we reached a ceiling in technology beyond which we cannot hope to rise? More than a score of leading industrialists and chemical engineering executives give you their answers in the following pages.

NEW PLANTS BRING NEW PROBLEMS

CHARLES BELKNAP
President
Monsanto Chemical Co.

THE IMMEDIATE development of the chemical industry after the war will, in my opinion, be keyed to the great changes in capacities of many fundamental chemicals, such as formaldehyde, ammonia and ethyl alcohol. These great plants will be crying for utilization and will provide the chemical industry with a new set of low-cost bases on which to build for the future.

For the long-term trend I should expect the chemical industry, now in possession of so much more plant and experience than before the war, still further to penetrate into allied fields, such as petroleum, leather, paper, soap and textiles, with new materials to enhance the value of the products produced by these chemical consumers. In both of these activities chemical engineers will play a great part.

In conclusion, I would like to point out that whereas the problems of production have been to the fore in the past five years, those of distribution will dominate in the five years after the war until consumption has caught up with the ability to produce. Chemical engineers can find a new usefulness in introducing and establishing the applications and values of the new materials that chemical industry will have to sell to the postwar world.

CONSIDER THE INORGANICS

ALBERT E. MARSHALL
President
Rumford Chemical Works

LACKING the glamour of the more spectacular organic chemical industry, the study of the chemistry and of the processes utilized in inorganic chemical production has evidently had little appeal for young chemical engineers in recent years. There has been an unfortunate dearth of men interested in centering their professional careers in inorganic chemical technology.

The mineral acids, alkalies and salts, 80 percent of which are consumed by the chemical process industries, provide a substantial and permanent part of the foundation on which the entire structure of all of our chemical enterprises rest. These industries have an annual peacetime production value of over a half billion dollars, as well as interesting possibilities of process developments through research and better application of the unit operations of chemical engineering. This field provides useful work for chemical engineers today with an even greater promise for tomorrow.

Continuous wartime operation has prevented the undertaking of improvements in heavy chemical plants so that there will be postwar needs for additional chemical engineering personnel in production and deferred maintenance. Most importantly, will there be opportunities in the further development of a branch of chemical enterprise which, in a chemical engineering sense, has lagged behind its very young and attractive sister, the organic chemical industry, ever since the end of the first World War.

COAL PROCESSING, UNLIMITED

FRED DENIG
Vice-President and Director of Research
Koppers Co.

WITH a present record tonnage of over 100 million tons of coal carbonized annually (one-sixth of the bituminous coal now mined in the United States), it is quite possible that some of the older coke-oven batteries will be shut down when war-time peak demands for steel have passed. Near-future operation tonnage will be largely determined by demand for metallurgical coke, and it is expected that this will be above the pre-war annual tonnage for some years in the future.

The demand for byproducts of coal carbonization, such as are obtained from the light oil and tar, has exceeded the available supply. Several new commercial chemicals obtainable from the primary byproducts of coal carbonization have been developed during the war period, and it is expected that these will find markets in the postwar industries. These developments, plus some potential projects now in the laboratory stage, should provide excellent and continuing opportunities for chemical engineers in the near future.

The long-time future development of coal processing has the promise of being one of the largest and most useful chemical engineering programs of all time. With coal resources available for more than a thousand years in the future, American chemical engineers have a real challenge in the development of coal processing industries that will furnish motor fuels for automobiles, smokeless fuels for our homes and industries, and useful chemicals in tonnages scarcely considered possible today.

MANPOWER SHORTAGES

JULIAN M. AVERY
Vice-President
Diamond Alkali Co.

BASICALLY, the production part of the job of winning the war seems to be well in hand, although continuing pressure and resourcefulness in readjustments are still necessary to provide the finishing touches. With the alkali and related industries working at full tilt, the effect of the draft has been to develop a serious shortage of technically trained men, particularly chemists and metallurgists, and the engineers of both professions. Consequently, opportunities for qualified men in these fields are unusually good for the immediate future.

The postwar period is bound to involve extensive readjustment in the production and marketing of established products. Competition will be keen. The development of new products and processes on a large scale is certain to occur. Not the least of industry's problems will be the reemployment of millions of men as they are mustered out of service. Management in all branches of our industry will have to rely heavily upon technically trained men to help work out the fundamental solutions of such problems. Opportunities for chemical engineers should improve rather than lessen in the postwar period if the country can be kept on a sound economic basis.

ELECTROLYTIC CHLORINE AND CAUSTIC SODA

R. L. MURRAY
Vice-President
Hooker Electrochemical Co.

EVERYONE interested knows that the productive capacity of the United States for electrolytic chlorine and caustic soda has more than doubled since 1939. While this is a big expansion in tonnage, it is very modest indeed when compared percentagewise with that which has taken place in the case of aluminum, magnesium, synthetic ammonia and several other important chemicals.

Chlorine is one of the most active and versatile of all chemicals, and at the same time one of the very lowest priced. This has in part been responsible for the rapid growth of the industry in the past fifteen years. If the rate of growth for the ten years directly preceding World War II is projected ahead, it would appear that all of the new capacity built during the past three years, with the possible exception of the chlorine plants at the arsenals and perhaps one or two others, will be fully utilized within a few years after the end of the war.

The use of chlorine in the manufacture of solvents and other products derived in one way or another from petroleum, although now huge, may well be just beginning. Perhaps the same can be said for the chlorine which is entering into the fields of plastics, resins, protective coatings, lubricant additives, and textile impregnants. The rapid and further modification in the uses of chlorine which surely lie ahead is going to require the attention and services of many chemical engineers. In addition, many more will be needed to improve present processes and to reduce costs. The electrolytic chlorine and alkali industry is still a relatively young and vigorous industry. To those with imagination and courage, it still has a long way to go.

SULPHUR ITSELF

W. W. DUECKER
Chemical Engineer
Texas Gulf Sulphur Co., Inc.

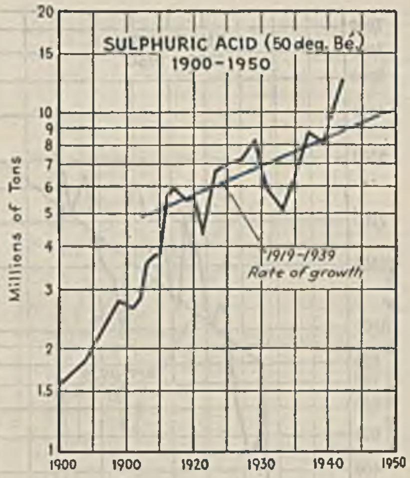
IN HIS search for new products and in his efforts to improve processes, the chemical engineer has used to great advantage the main derivative of sulphur, namely, sulphuric acid. Since its price is about 20 percent of the next cheapest mineral acid, he will undoubtedly continue to use it to advantage. But in contemplating the postwar era, he may find it fruitful to redetermine the utility of sulphur itself.

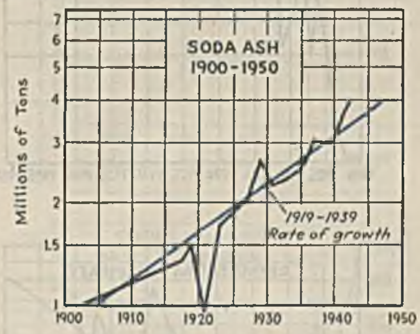
Sulphur is a peculiar element. Attempts have been made to use it in various ways with little success largely because of limited knowledge of sulphur itself. Recently new techniques in applying ray spectra, the electron microscope etc., were developed. Their application to the fundamental study of sulphur may lead to surprising results. It is not anticipated that basic research of this character can be other than of long duration. It will utilize the ingenuity of our best physicists and chemists and may well pave the way for important chemical engineering developments.

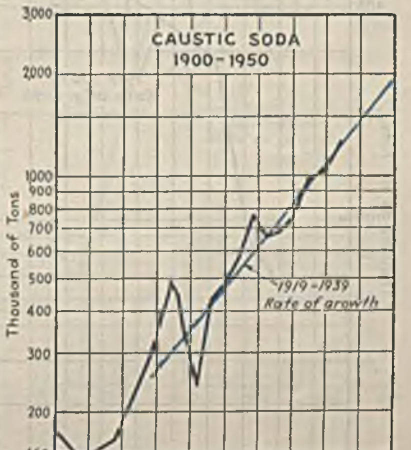
ORGANIC CHEMICALS FROM PETROLEUM

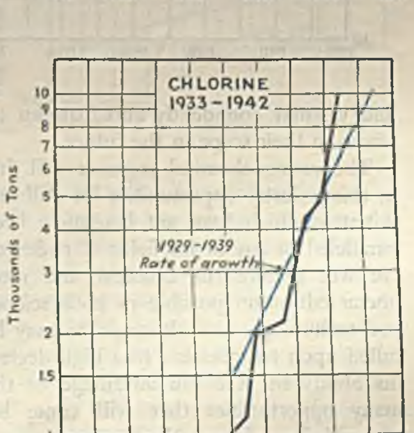
J. OOSTERMEYER
Shell Chemical Division
Shell Union Oil Corp.

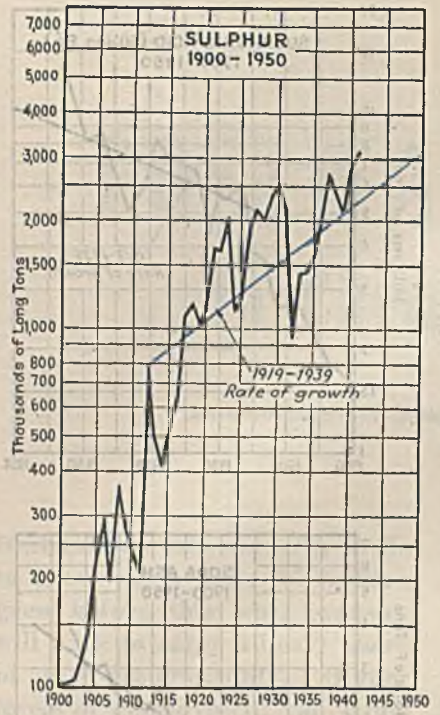
IT IS our considered opinion that the synthesis of chemical products from petroleum is a potential source of new and improved materials, manufacturing processes, and industrial applications, the surface of which has as yet hardly been scratched. Whereas in the immediate future the development of these products will continue to be directed fully toward the successful prosecution of our war aims, the tremendous weight of energy, experience and technical skill inherent in the petroleum chemical industry will subsequently be swung over to civilian needs,

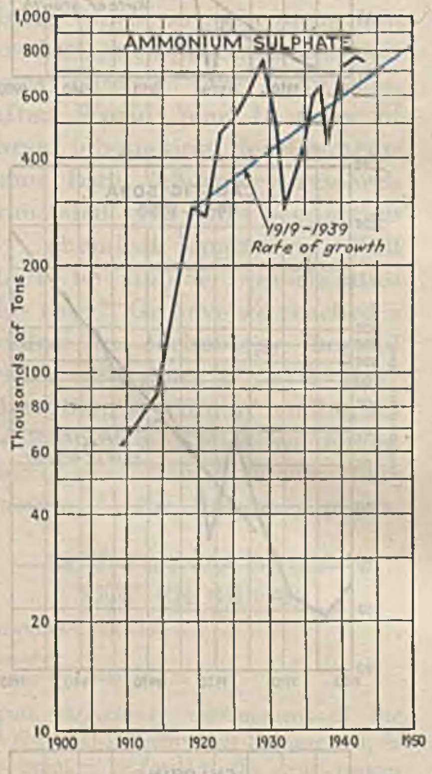












and we may confidently anticipate an increase in their scope in the future.

The young chemical engineer will find in this industry opportunities for skill and initiative which have not heretofore been paralleled in any of his fields of endeavor. He will require the broadest and most liberal education possible in both science and technology, and although he may be called upon to specialize to a high degree, his ability to take full advantage of the many opportunities that will come his way will depend upon the thoroughness of his basic training. Granted this background, plus plenty of initiative, he will find a challenge worthy of his ambitions.

PETROLEUM AND NATURAL GAS

ROBERT P. RUSSELL
Executive Vice-President
Standard Oil Development Co.

The processes developed for the production of certain key petroleum products, indispensable to the winning of the war, such as aviation gasoline, synthetic rubber and synthetic toluol, have been outstanding chemical engineering achievements of the past few years. These vital war materials have been made possible by the development and application, on a commercial scale, of catalytic reactions that were laboratory curiosities a few years ago. Extension of such developments may be expected in the future, and individual petroleum hydrocarbons, particularly the gaseous compounds derived from both petroleum and natural gas, will grow in importance as chemical raw materials. The separation and purification of these gaseous components, as well as their subsequent chemical conversions, will be an increasingly interesting challenge to chemical engineers.

The application of catalysis in petroleum refining processes has just begun. The traditional function of the petroleum industry has been to supply fuels and lubricants, yet there appear to be unlimited new fields in modifying these products to meet the many special requirements of modern machines. At the same time new products will continue to be developed. Some of them are already being made in tremendous quantities. Chemical engineers well grounded in the fundamental sciences must play an important part in all these developments and will be greatly in demand.

DEMAND FOR DYES AND DRUGS

F. M. FARGO, JR.
General Manager
Calco Chemical Division
American Cyanamid Co.

Improvements in the technology of dyes and related chemicals call for well-trained chemical engineers with high capacity for leadership. These products are indispensable to the maintenance of our present standard of living. They will increase in importance in relation to developments in industry. With the expansion of plastics, for example, and I include synthetic rubber and synthetic fibres, will come new demands for dyes, pigments and other conditioning agents, the production of which will create new problems for the chemical engineer.

This is also true of the related pharmaceuticals. New drugs will be produced for the treatment of diseases and the processes developed will involve a synchronization of effort and a higher degree of technological development beyond any we now have.

NEED NEW USES FOR NITROGEN

F. A. WARDENBURG
General Manager, Ammonia Department
E. I. duPont de Nemours & Co.

Pre-war capacities for the manufacture of fixed nitrogen fell far short of meeting the war demand for munitions. In consequence, the government financed plants to assure an adequate military supply. The combined capacities of the privately-owned and government-financed plants greatly exceed any postwar demand for fixed nitrogen that can now be visualized, even though its use in fertilizers may be materially expanded.

Thus, the government and industry must so arrange the disposition to be made of the over-capacity that all post-war needs will be adequately met without impairing the industries which were built to meet the pre-war requirements. On these plants was based the expansion which was so necessary to the military program. The abundance of synthetic ammonia now available presents not only a challenge, but an opportunity to industry and its chemical engineers to develop new uses for nitrogenous products so that at least part of the over-capacity may be utilized.

POTASH AND FERTILIZERS

PAUL D. V. MANNING
Vice-President in Charge of Research
International Minerals and Chemical Corp.

Fertilizer use has increased during the war. This has resulted in capacity production by all American facilities and is especially true in the case of potash. Although the requirements of world commerce and politics will doubtless aid in the reestablishment of the importation of European potash into the United States after the war, total consumption will increase and this indicates that the problem of meeting our domestic capacity with continued demand will not be too difficult.

Opportunities for chemical engineers in this field appear to be in working with the agronomists on the one hand to develop new potash-containing commodities best suited for agriculture and with the mining engineers and metallurgists on the other to lower the cost of ore dressing and of processing the mineral raw materials. Since potash is a relatively young industry in the United States, new uses for potassium compounds and byproducts from potash mining and refining operations also hold real potentialities.

PLASTIC PROBLEMS AS WELL AS PROMISES

HARRY M. DENT
President
Durez Plastics & Chemicals, Inc.

While there has been much over-statement about plastics and over-emphasis on many of the new developments which as yet are not fully proved, there is no doubt but that synthetic resin products and their applications will materially increase once wartime restrictions are lifted. There will be new competition among these synthetic plastics. They will be in competition with new material developments from other fields. But plastics, molding compounds and resins will hold their own or find new uses wherever their inherent physical properties prove them superior.

The numerous and excellent accomplishments of chemical engineers that have improved our products to meet the exacting specifications of the armed services, and have developed materials to solve new problems, will undoubtedly lead to new outlets. As far as one cares to prophesy, plastics are headed over the long run to many new adventures, leading to a promising although not necessarily an easy future.

The success and expansion of plastics and their use will create new needs for chemical engineers. Their services will be required not only by the plastics industry in great numbers, but they will find opportunities in research departments of many manufacturing companies that realize resin possibilities and are carrying on their own specialized product development in conjunction with the broader and more general work of the manufacturers of plastic molding compounds.

CELLULOSE AGE APPROACHES

RALPH A. HAYWARD
President
Kalamazoo Vegetable Parchment Co.
President
Technical Association of the Pulp and Paper Industry

The pulp and paper industry has a glorious future. The period immediately following the war may well merit the name "The Cellulose Age." There will be innumerable new products, many of them incorporating chemicals of one kind or another for giving special properties to paper for special services.

The volume of paper consumed throughout the world will increase at a tremendous rate after the war is over. The results of this war inevitably will be a great movement forward in the education and living standards of countries like Russia, China, India, and those of South America. Their per capita consumption of paper will rapidly increase.

With the development of hundreds of new products and new manufacturing processes, together with the rapidly expanding industry, the opportunities for engineers, chemists and other technically trained personnel are unlimited in the pulp and paper field. In my opinion the service of this industry to the national economy in the future will depend upon the number of scientific and technically trained men who are associated with it.

NAVAL STORES

S. J. SPITZ
Vice-President
Newport Industries, Inc.

From the amount of research that has been done to date and the results obtained, it would appear that naval stores offer attractive raw materials for future chemical engineering developments. The production of a whole line of interesting chemicals from pine oil has been accomplished. However, the government controlled prices of gum turpentine and gum rosin do not allow each of these products to seek their own economic price level, and we cannot look forward to much constructive development work on turpentine as a chemical raw material until such time as the government removes its artificial props. The future is bright for the expansion of rosin as a chemical raw material and also for the intermediate terpene products on which prices are not artificially controlled.

SOAP AND GLYCERINE INDUSTRIES

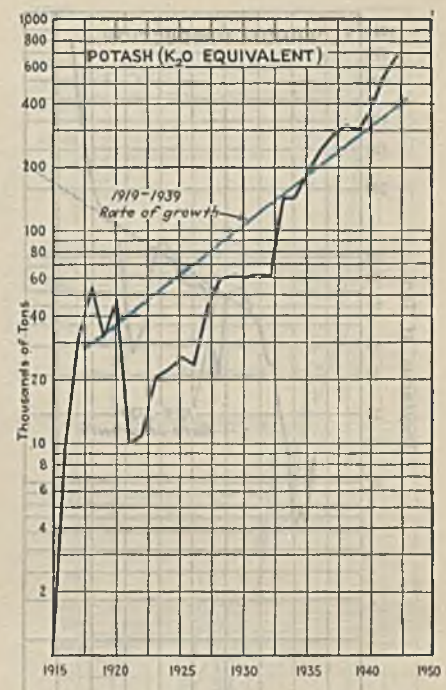
OSCAR H. WURSTER
President
Wurster and Sanger, Inc.

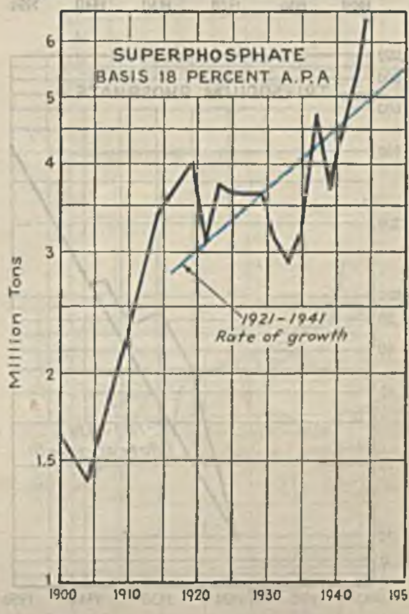
Improvement of methods and the development of new processes in the soap and glycerine industries are taking place at a constantly accelerated pace. The outstanding trend is toward continuous processes.

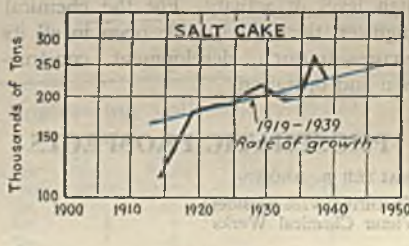
Batch fat-splitting methods are yielding to continuous fat splitting. Fatty acid pot stills are being displaced by continuous stills. Fats are modified to fulfill specific requirements instead of depending on what nature has provided. The hydrogenation of fats is expanding with resulting activity in the study of the processes involved. Continuous soap making processes are in use for some products, and continuous glycerine distillation plants have been in operation for some years.

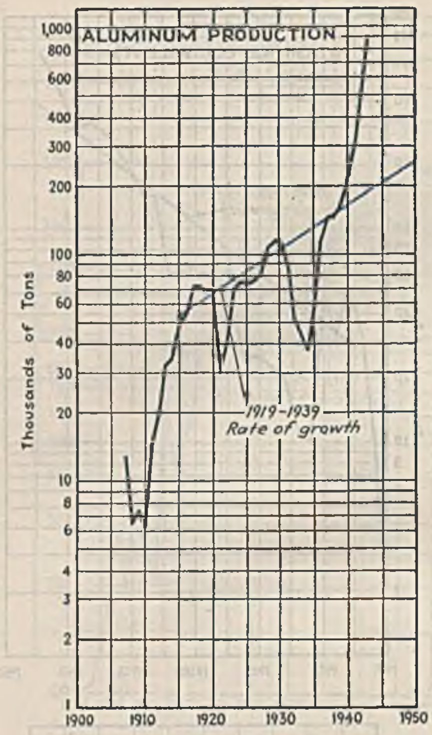
Incentives for these advances have been improvement in quality, increase of yields, and economy of production, backed by the human urge for achievement. These relatively recent developments are only the beginning of the greater interest and concentration on research and development work in the fat, oil, soap and glycerine industries. Never before has there been such a widespread desire for new and improved methods. The industries are not only asking for the solution of their individual problems, for which the answers are known, but for answers to problems which have not yet been solved. The sources from which these demands are coming are increasing and the cry is for action.

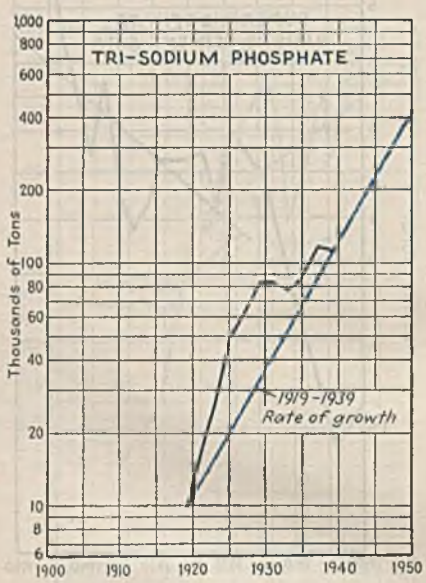
The study of fats and oils, of the products—old and new—made therefrom, and of the processes used, has reached a new











high level of activity. For the chemical engineer, the field is wide open in all its phases—research, development, construction and operation.

PHOSPHATIC PROSPECTS

WALTER B. BROWN
Executive Vice-President
Victor Chemical Works

WHILE the staple phosphatic compounds probably will return to their normal place in the industrial picture after the release from present governmental restrictions, at the end of the war, the future hope for phosphorus compounds in general will, in my opinion, depend mainly upon industrial and chemical research. New uses and new forms of chemicals containing phosphorus must be found to take care of the greatly expanded production brought about by the war demands.

In the development of new products, new processes and new uses, chemical engineers employed by the manufacturers and users of these materials will necessarily play a prominent part. The field is one of continuing opportunity for employment.

Standard phosphates are old and well known, but new reactions only recently have been recognized, particularly in the organic field. To manufacture and utilize these compounds when their values have once been proved is a big postwar job for men with chemical and chemical engineering training.

NATURAL AND SYNTHETIC RUBBER

HOWARD E. FRITZ
Director of Research
The B. F. Goodrich Co.

UNTIL now, Nature has been the chief chemical engineer in the production of rubber. Today chemical engineering is essential and indispensable in the manufacture of the raw materials and in the production of man-made rubber so vital to our victory. This giant new industry must depend as never before upon scientists and engineers to direct and control its future developments.

This field offers vast opportunities for chemical engineering in the after-war era. We can now see far enough ahead to say with certainty that there will be keen competition between natural and synthetic rubber for many uses. The lower the cost of synthetic rubber, the more competition there will be. If our scientists are able to double the performance life or usefulness of synthetic rubber, that is equivalent to a 50 percent decrease in price. The ability to bring about steady improvement in the quality or adaptability of synthetic rubber will be a factor of tremendous importance in writing the answer to America's future rubber problems.

NEW-OLD OPPORTUNITIES

JOHN C. HOSTETTER
President
Mississippi Glass Co.

IN THE field of ceramics—products made by the action of fire on earthly materials—opportunities for technical men are increasing rapidly. While the ceramic industry is one of the very oldest, technical progress in recent years indicates practically unlimited possibilities in new processes, products and applications.

Ceramic products are basic materials in a vast variety of industries. One need but enumerate the major types of such products and the wide range of properties inherent in them to see that industry both in war and in peace is definitely dependent upon these earthly products of the fiery furnace. Their function may be direct or indirect, but it is always essential. Without refractories there would be no metals, without abrasives the high speed and remarkably accurate finishing of metal parts for airplane motors would be impossible; electric power and electronics are dependent upon ceramic insulation; our cities are built of brick and tile and glass; and, finally, consider the thousand uses of glass in the home, in industry, and in the laboratories of science. The list could readily be extended, but is sufficient to indicate the far-reaching and ever-growing importance of ceramics.

Raw materials used in ceramics are abundant and cheap. The manufacturing processes are basically simple and direct. Like other older industries, there is some degree of empiricism and tradition in the established processes of production, but it is just this condition that makes the opportunity for the chemical engineer. He can apply his knowledge of chemistry, physics and engineering to the improvement of existing process or to the development of entirely new processes. His training fits him for the testing of products and the development of new ones. Especially is he qualified for that important job of engineering new applications to solve new and old problems in a new-old industry.

GLASS ENGINEERING

GAMES SLAYTER
Vice-President and Director of Research
Owens-Corning Fiberglas Corp.

AMONG man's basic materials, glass was late in getting the assistance of science. Only within the present generation have research and technology recognized it as a versatile material capable of being engineered into many new and useful forms.

Advances achieved in laboratory and pilot plants, and subsequently translated into volume production, now make it possible to exploit properties of glass not previously utilized. Developments resulting during the last decade from extensive scientific investigation of processes and technique for the manufacture of glass in filament or fiber form, for example, have created products with new combinations of properties now widely used and commercially available to forward-looking design engineers; glass fiber materials in wool and textile forms that are incombustible, non-hygroscopic, chemically stable. In the wool form they are easily fabricated into resilient, light-weight thermal and acoustical insulation; in textile forms they provide durable inorganic fabric with high tensile and dielectric strength unaffected by corrosive agents.

Growth of our own corporation since 1938 from zero to many thousand employees, coupled with postwar prospects for reconversion of glass fiber materials to peace-time applications of newly developed products for which the war has been the proving ground, presage a continuing need of and opportunities for chemical engineers who have not been taught that "it can't be done," and who want to help create practical materials marketable at economic price levels. This is their opportunity.

LOOKING AT THE LIGHT METALS

FRANCIS C. FRARY

Director, Aluminum Research Laboratories
Aluminum Company of America

THE OPPORTUNITIES for chemical engineers within the light-metals industry center around the reduction in production costs of both the metals themselves and their non-metallic raw materials and products, and the improvement of some of these products. Examples of such products are the various fluxes required in the magnesium foundry, and the varied new forms of alumina and aluminum hydrate which have been recently developed. While most of the problems of broadening markets and reducing fabricating costs of the light metals themselves will require metallurgical and mechanical engineers, there will also be opportunities for chemical engineers in that field.

To chemical engineers in other industries the increased production of these metals, their lower prices and the advances in their fabrication, offer opportunities for new uses and substitutions which will improve their companies' processes and products and reduce costs. The new alumina products above mentioned are attractive raw materials for a variety of industries. Their efficient utilization is largely a chemical engineering problem.

Chemical engineers, therefore, need to look at the light metals industry as furnishing not only opportunities within itself, but also great opportunities for development in other industries and products by virtue of its wartime development.

WHAT ABOUT MAGNESIUM?

PAUL D. V. MANNING

Vice-President in Charge of Research
International Minerals and Chemicals Corp.

MAGNESIUM metal in the period immediately after the war will present a most interesting picture. For at least several years this picture will be of the slow motion variety for much work must be done to fit the metal and its alloys into the user's requirements, and to find new alloys which will better serve his needs. At the same time, markets must be developed. Combinations of this metal with aluminum, its alloys, and with plastics in order to resist corrosion, would seem to form the best opportunities here.

Competition of the light metals with steel does not appear to be as great a factor as competition with non-ferrous metals, including copper, zinc, lead and tin.

New methods of fabrication, such as die casting by cold extrusion, forging, etc., should broaden the horizon for magnesium and its alloys. The fact that the present magnesium metal manufacturing industry is at least 85 percent government-owned, coupled with the present shortage of fabrication facilities, constitute the principal problems that will have to have immediate attention before one can chart the future of this "miracle metal."

PEACETIME EXPLOSIVES

J. L. BENNETT

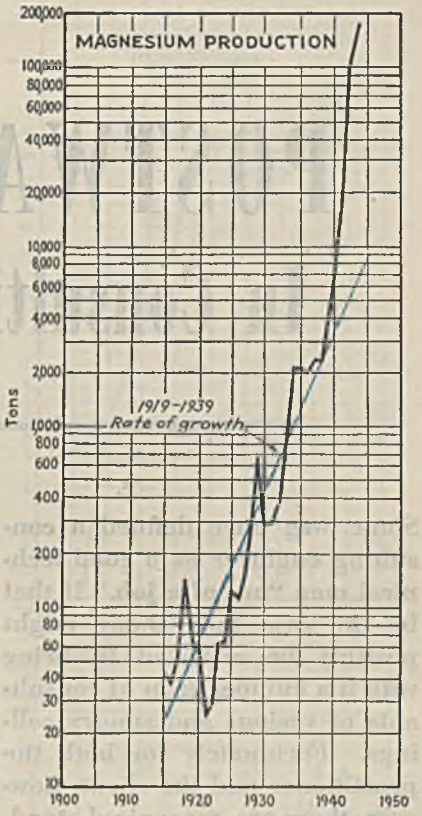
Explosives Department, Hercules Powder Co.
Immediate Past-President
American Institute of Chemical Engineers

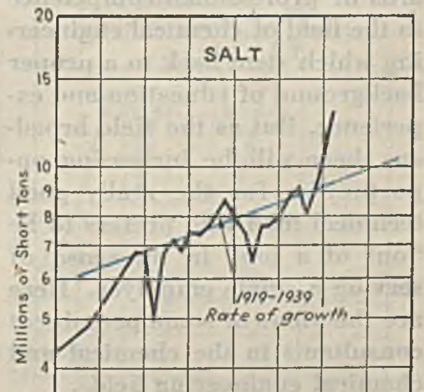
CHEMICAL engineers are rendering valuable service in the manufacture of military and commercial explosives and allied chemicals. Demand for commercial high explosives in the last six years has exceeded 360 million pounds annually and if the postwar economy operates at full employment rate, the demand should increase.

Production of industrial explosives employs the services of chemical engineers in the supervision of plant operations, in research and development and in design of equipment. Emphasis on efficiency of operations will be continued. The chemical engineer will be particularly valuable in coordinating operations and equipment design to provide for maximum efficiency and low cost.

The marked development of industrial explosives and the chemicals associated therewith since World War I should continue and take full advantage of developments during World War II, particularly in the allied chemical field.

Explosives are a source of quickly available energy that may be made useful in other types of services. There is every reason to expect that the training and experience of the chemical engineer will enable him to play an increasingly important role in the explosives industry and its allied chemical field.





Undergraduate Enrollments in Engineering Colleges, 1940-1941

Engineering Courses	Freshmen (1st year)	Sophomores (2nd year)	Juniors (3d year)	Seniors (4th year)	5th Year (of 5-yr. Curriculum)	Special Students	Evening Students	Others	Totals
Aeronautical	1,150	1,009	750	528	71	27	186	2	3,723
Agricultural	271	189	212	187	4	1	......	....	864
Architectural	310	313	239	234	15	6	......	2	1,119
Ceramic	199	172	151	171	.....	37	......	..	730
Chemical	4,002	4,309	3,528	2,784	222	59	1,245	28	16,177
Civil	2,499	2,794	2,575	2,226	124	55	837	42	11,152
Electrical	3,185	3,035	3,477	2,913	161	76	1,630	28	15.505
Industrial	320	692	632	590	62	9	132	5	2,442
Mechanical	7,185	7,370	6,007	4,532	286	121	2,704	404	28,609
Metallurgical	385	537	603	497	3	5	240	6	2,276
Mining	578	534	595	547	11	19	8	2	2,294
Unclassified	13,666	2,722	1,659	1,433	83	100	5,963	101	25,727
Totals, 1940–41*	33,250	24,676	20,428	16,642	1,042	515	12,945‡	620	110,618
Totals, 1939–40†	31,797	24,184	19,552	16,782	877	458	11,624	628	105,892

* 155 schools reporting to the Society for the Promotion of Engineering Education and published in *Engineering Education* for Dec., 1941. † 146 schools reporting. ‡ 994 are distributed among classes and should be added to this for Cooper Union.

POSTWAR OPPORTUNITIES
In Consulting and Professional Work

Some wag once defined a consulting engineer as a good technical man "out of a job." If that be the case then D-day might possibly be expected to bring with it a bumper crop of consultants of various and sundry callings. Fortunately for both the practitioner and the client, however, there are recognized standards of professional competence in the field of chemical engineering which stem back to a proper background of education and experience. But as the field broadens there will be increasing opportunities for the really good technical man who prefers to be "out of a job" in the sense of serving a single employer. Here are the views of some prominent consultants in the chemical and chemical engineering fields.

SWORDS TO PLOWSHARES

GUSTAVUS J. ESSELEN
President, Gustavus J. Esselen, Inc.

At the end of this war we will have the age-old problem of converting swords into plowshares. In the present industrial economy of this country this will mean the development of new products to utilize the available facilities of labor and equipment. It will also be fundamental for every manufacturer to have a chemical audit made of his existing processes to disclose those respects in which they need to be modernized in order to take advantage of the results of intensive wartime developments.

In these activities the consulting chemical engineers, and particularly the experienced consulting chemical engineering organizations, will serve as coordinators of the specialized knowledge of methods, materials and consumer needs. They will quickly and economically translate the new technical war-time developments into the peace-time economy. They will not only review and evaluate the work of the research and development divisions of the large manufacturing companies, with a view to determining their future prospects, but they will also provide for the smaller concerns facilities for research and development equivalent to those which larger companies provide for themselves.

In the years following the war there will be unparalleled opportunities for consulting and professional services to the industries that depend upon chemical engineering.

SCIENTISTS vs. SCIOLISTS

CHARLES RAYMOND DOWNS
Consulting Chemical Engineer

The status of the average consulting chemical engineer, if there be such, will undoubtedly fluctuate in the postwar period with the economic cycles of the average industry utilizing chemical engineering principles. Accordingly, if we can prophesy the postwar pattern of industry, we can plot the curve for chemical engineering opportunities. But if we can't, we can only consult the postwar planners, most of whom, unfortunately, are authors and not authorities. The difference is much greater than the comparative length of the two words would indicate.

The authors frequently introduce their remarks with "The statement has been made," thereby shedding responsibility for accuracy which might otherwise hamper their junkets into unfamiliar fields. Authorities, on the other hand, generally refrain from sticking their necks out in public prognostications, for fear that future events may prove them wrong and lead others astray. If everyone did this we would be better off. We would then "leave no stone unturned" to find the treasure of Mardonius in our own fields. At times, however, even the authorities realize that they are not infallible and call in a consulting chemical engineer as an assistant dowser. He may never have dowsed in their fields before, but he has dowsed in many others and there is an outside chance that he may find something they have missed.

If the consulting chemical engineer is a scientist, and lucky, he will be a successful consultant in any decade. If he is a sciolist, and unlucky, the breaks are against him even in boom times.

WHEN THE VEIL IS LIFTED

CARL S. MINER
Director, Miner Laboratories

There is a tremendous number of current developments which necessarily are secret. Most of these will be disclosed early in the postwar period. This will result in a concentrated effort to adopt these developments to strictly industrial purposes. Much of this effort will be on the part of organizations not adequately staffed with personnel properly trained and experienced for this purpose. Consequently the demand for consulting services in the chemical engineering field is likely to exceed by far the present limited supply.

POSTWAR BURDENS

FOSTER D. SNELL
President, Foster D. Snell, Inc.

Chemical engineering, which may be said to have had its birth in World War I, has come of age in World War II. The accomplishments of the chemical engineer are an indispensable factor in the victories toward which we are surely headed. Butadiene and synthetic elastomer production on a fantastic scale were chemical engineering speculations which proved successful. Few appreciate the risks taken, but all give credit to the chemical engineer, perhaps less than he merits. The credit for accomplishments in those fields must be multiplied by a substantial whole number to represent the many military projects about which few people know.

When this war is over, management is going to expect more magic from the chemical engineer, perhaps again paralleling the experiences in the delirious '20s. Not only will there be a postwar shortage of chemical engineers, because of the current interruption in the production of members of that profession, but it is going to be a long time before enough will be available to saturate the demand. That will necessarily extend the war-time burden on those already in the profession, because one of the things we're going to learn immediately after victory is that it takes years of training and experience to qualify chemical engineers for important consulting and professional work.

IMMEDIATE AND LONG-TERM PROSPECTS

ANDREW M. FAIRLIE
Consulting Chemical Engineer

Many plants needed for supplying war-time products, such as alcohol, high octane gasoline, magnesium, synthetic rubber, ammonia, explosives and oleum have now been built. The erection of steel furnaces and rolling mills and shipyards has about been completed. Meanwhile, for lack of construction materials, much needed repair work has been left undone, and the expansion and construction of non-war plants have been postponed and neglected.

The completion of these war plants should release some materials and man-power for execution of this neglected work. In addition, the demand for some commodities, such as superphosphate and sulphuric acid, is still increasing. Executives with vision, anticipating a future rush of demand for engineering facilites, are beginning to close contracts now for the preparation of drawings and bills of material, in order to be ready for immediate construction when the war is over. These features seem to insure that chemical engineers will, for the immediate future, continue in demand for professional and consulting work.

For the more distant future, we must realize the fact that the war will not be over at one time. With the conclusion of the European phase, a period of transition from total war to partial war will ensue, causing some confusion and hesitation. The war demands of the Japanese side of the conflict will increase, but this increase will be accompanied by a considerable letdown from the demands of total war, and executives should soon be able to formulate plans for the period of partial peace. With hungry millions in Europe to be fed, demolished cities to be rebuilt, wrecked factories to be restored, before European commodities and materials of construction can be made available, supplies must for a time flow from this country. This creation of order from chaos calls for continuing the activity of the chemical engineers of America.

The conclusion of the Japanese phase of the war will bring about another period of transition—from partial war to total peace. The consideration of the effects of this seem to belong to some future year beyond 1944.

GLOBAL ENGINEERING

C. L. MANTELL
Consulting Chemical Engineer

Apparently our patent system is going to come through the war-time period with relatively little change in its major aspects, and, after the war, we will see a surge of patent litigations which will demand attention of consultants in reference to development work, court preparations and expert testimony and presentations.

In reference to plant construction, design and initial operation, it appears that the demands of foreign countries for process industries will require a considerable amount of attention of professional chemical engineers in a wide variety of chemical and related industries. One has every reason to expect that chemical engineering processes and unit operations will be spread over the world, and that professional men will go with them in the same way that we passed through the period of disbursing our mining engineers to all corners of the world during the past four decades.

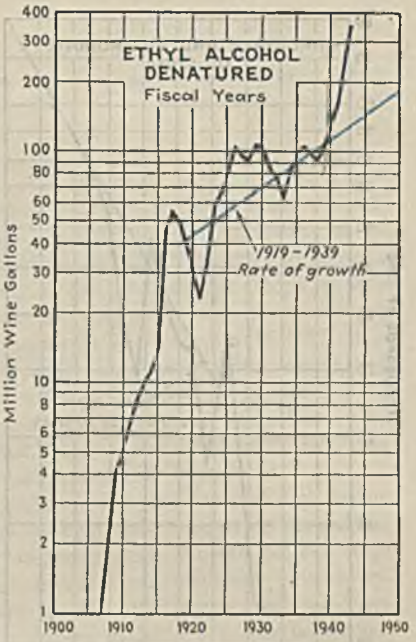
A REGIONAL REPORT

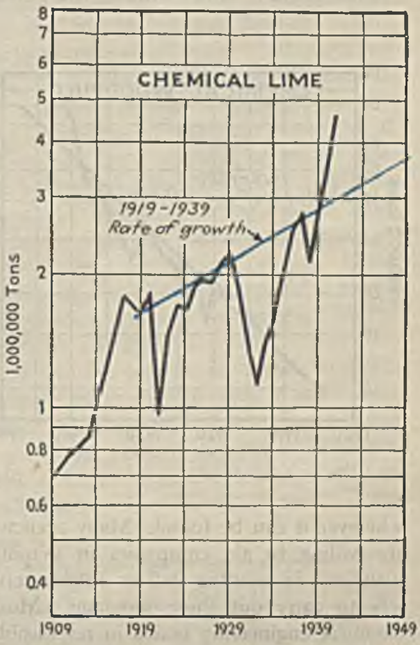
LAWRENCE W. BASS
Director
New England Industrial Research Foundation

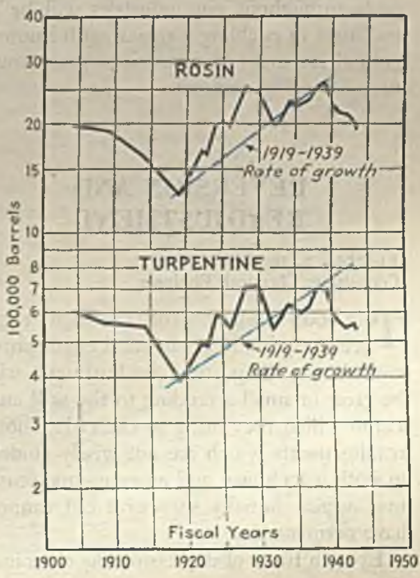
The wartime emergency has given chemical engineers an unusual chance to adapt their training and experience to the technologies of other industries. This situation is particularly true in New England. The excellent regional survey in the September 1943 issue of *Chem. & Met.*, shows clearly that the production of chemicals is a minor fraction of industry in these states, but that the use of chemicals is very large. A great opportunity lies in the application of chemical engineering principles to older industries which must move forward technically if they are to meet the competition of the postwar years.

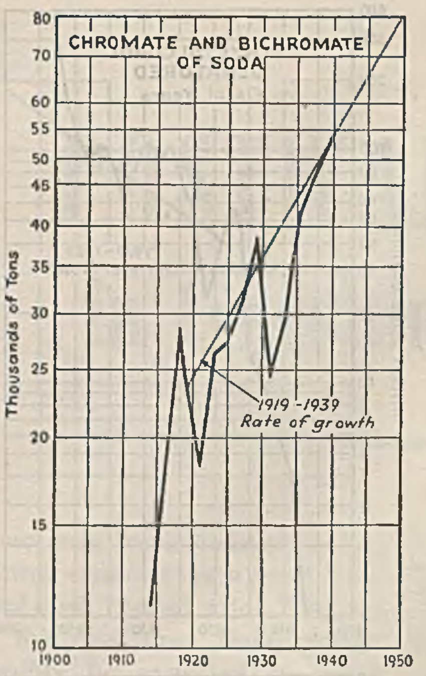
During the transition period, large sectors of New England's industries will be well poised for a rapid return to peace-time products. Many companies for the first time have come to rely on technical men for guidance and it is expected that they will continue to seek help from the same source. These circumstances should provide a favorable climate for chemical engineering developments, above all by men who can translate their knowledge into terms of other specialized fields.

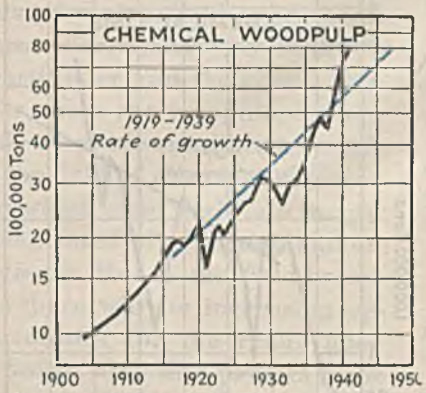
The long-range outlook also is encouraging, provided that our managements continue progressive and aggressive policies. New England manufacturers are conscious of threatening competition from other areas and are realistically looking for help











wherever it can be found. Many agencies are willing to aid companies in shaping plans and in securing staff or outside services to carry out these programs. More chemical engineering brains in responsible posts throughout our industries will be a real asset in enabling a region with limited natural resources to maintain a prosperous manufacturing economy.

REVERSION AND READJUSTMENT

RUSSELL S. McBRIDE
Consulting Chemical Engineer

THE CONTRIBUTION of chemical engineers, especially of chemical engineering consultants, to postwar readjustment will be great or small according to the skill and vision which they bring to the task. Those readjustments which are not wisely guided in both a technical and an economic sense may appear initially successful but cannot have permanence.

Even in times of depression the chemical process industries have never experienced such intensive competition as will confront the maker of industrial materials in the next few years. The immediate postwar demands, which will probably exceed the supply of many goods, may conceal this fact for a time. But before many years it will be necessary to be producing a superior product, a cheaper product, or a new product that can replace an old one, in order to stay in a profitable business. This means that good old-fashioned chemical engineering must be reapplied more intensively than ever before.

And most important of all, it means that it will be more important to find new uses for old products and ways to keep the other fellow from taking away present business with a different product. Inter-commodity competition is likely to be more serious as a postwar threat than inter-company competition ever was.

EDUCATION Comes First in Postwar Planning

(*Continued from page* 101)

POSTWAR OPPORTUNITIES

W. W. HODGE
Head, Department of Chemical & Metallurgical Engineering
West Virginia University

PRESENT trends in engineering education have tended to eliminate the liberalizing subjects and to focus all attention on super-concentrated courses in sciences, engineering and technology. This is a necessary part of our country's "win the war" program, but I anticipate that in most postwar chemical engineering curricula we will return to former standard or improved courses in mathematics, basic sciences, and, in addition, will include more economic and social science subjects than ever before. More credits in military science of specialized types may be required. Four-year curricula for the bachelor degree will undoubtedly predominate, but there will be some three-. five- and six-year curricula.

The demands for chemical and metallurgical engineers will continue in the light-metal, iron and steel alloys and the byproduct coke and fuel industries. Other promising fields for chemical engineers are as follows: Improving synthetic rubber and its products, petroleum refining, fuels and lubricants, plastics, rayon and other textiles, and, most importantly, discovering and developing technically and economically sound processes for making useful products from billions of tons of waste now polluting our streams and atmosphere. We must also give more attention to the utilization of farm and forest crops and their byproducts, to obtaining better yields of gasoline and oils from coal and shales, and in the manufacture of inorganic and organic chemicals.

CAPITALIZE WAR EXPERIENCE

GEO. W. GLEESON
Professor of Chemical Engineering
Oregon State College

OUR chemical engineering research during the war has been concerned largely with four major fields: (1) Conservation through substitution and more complete utilization of our natural raw material resources, such as timber and mineral supplies. (2) Production of possible substitutes for motor fuels. (3) The further exploitation of petroleum as a chemical raw material. (4) Greater use of annual land crops as raw materials for chemical industries.

In the postwar period we want to capitalize on the lessons we have learned both in research and in methods of instruction developed under the pressure of war demands. Those educational procedures that have proved successful could be utilized to help us prepare students for foreign service as teachers and as engineers. From the standpoint of technology we want to place educational emphasis on the need for graduate study, particularly in the field of reaction kinetics, process development, and in economic and technical preparation for such expanding fields as applied electrochemistry, synthetic fibers, instrumentation (especially electronic devices), applied biochemical processes, plastics, light-metal metallurgy (especially application and fabrication), organic synthesis from gas and petroleum, glass technology and food processing. The opportunities these fields offer bring corresponding responsibilities for our educational institutions.

Note: **Complimentary copies of this 16-page "Overseas Supplement" are being mailed to all *Chem. & Met.* subscribers and former subscribers in the armed services for whom we have recent and accurate addresses. We shall be glad to send an additional copy to any other chemical engineer in uniform any place in the world provided you will forward us the necessary information on previous employment and present connection with the Army, Navy or Maritime Services. Companies and colleges desiring reprints for other distribution may purchase them at 25 cents per copy or $10.00 per hundred — as long/as the supply lasts. Address all communications to POSTWAR EDITOR, *Chemical & Metallurgical Engineering*, 330 W. 42nd St., New York 18, N. Y.**

COMMODITY REVIEWS

Sulphuric Acid and Sulphur

Despite production approaching 14,000,000 tons (50 deg. basis), which was 11 percent greater than the previous peak year, sulphuric acid users in some areas were scraping the bottom of the barrel in 1943. There was excess capacity in some regions.

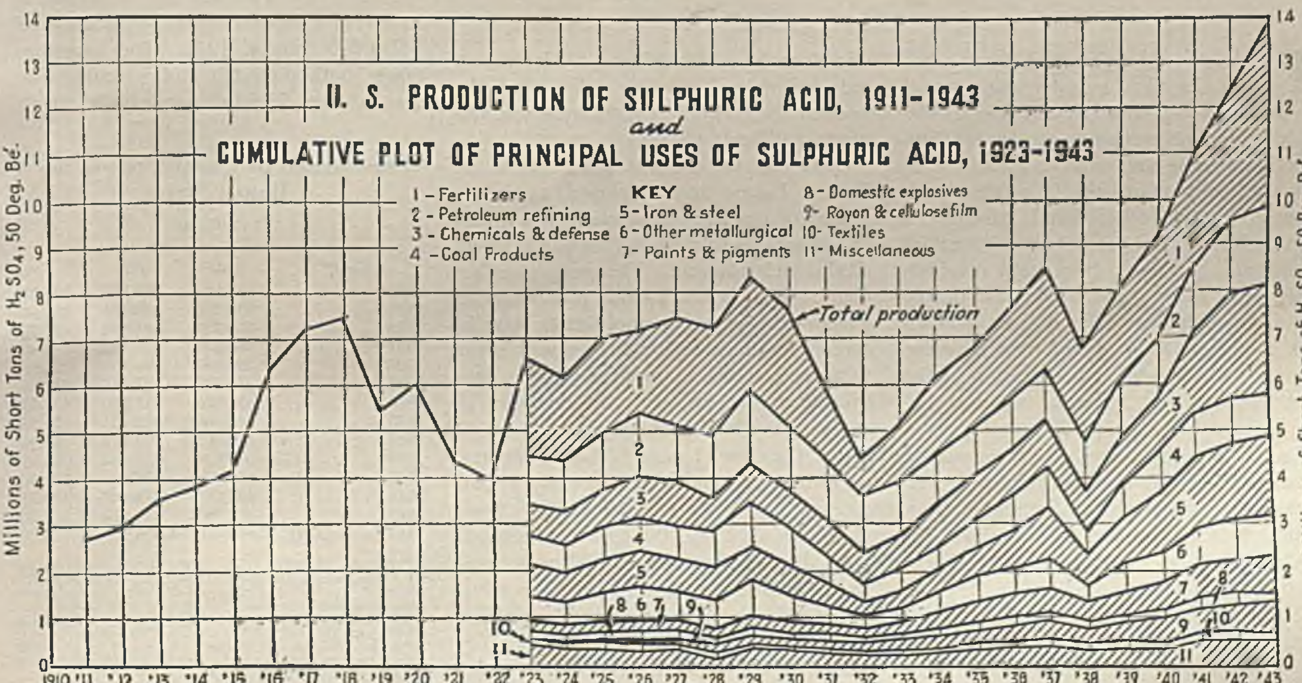
During 1943 previously threatened shortages in sulphuric acid began to appear, in spite of the fact that the total capacity was greater than needed, resulting in the shutting down of some government owned acid plants, and the failure to start others that were ready to go into operation during the year. A considerable problem, therefore, will be put in the laps of the military during 1944, namely, whether to attempt to make up the deficiencies that will almost certainly result, by running some of the ordnance acid plants for civilian production.

Except for the need for further expansion in superphosphate production, the problem would not arise, since the country's acid plant capacity has been increased since 1939 by something like 2¼ million tons, on a 50 deg. Bé. basis. Tremendously enhanced need for fertilizers, however, makes the difference. No less than six new superphosphate plants and one triple-super plant are scheduled for construction during 1944, widely scattered throughout the country, and there are probably others in the offing. The government plants, in the main, are not well situated from the standpoint of turning out superphosphate acid, and to use them for this purpose will require some exceptionally long and uneconomic freight hauls—to compete with the rail movement of petroleum products.

By a considerable margin the acid output of 1943 exceeded all earlier records. Output was nearly 70 percent above 1939, and is estimated to have totalled fully 13,930,000 short tons of acid on a 50 deg. Bé. basis, as compared with 12,520,000 tons in 1942 and 10,944,000 tons in 1941. Consumption closely approximately production, with the figure for 1943 estimated at 13,917,000 tons, compared with 12,515,000 tons in 1942 and 11,040,000 tons in 1941. The 11 percent increase in usage was due in large measure to the fertilizer situation, as is evident from the first of the tabulations on the following page, where acid for fertilizer is estimated to have increased nearly 40 percent as compared with the preceding year. For the rest of the applications, the trend was mixed, with only average increases in most cases and a few decreases. The largest percentage increases came in petroleum refining, owing to increased run to stills, chemicals and defense, owing to increases in both categories, and paints and pigments, due to continuing expansion in the titanium branch. Iron and steel, other metallurgical, rayon and film and miscellaneous applications showed smaller percentage gains, while there were actual losses registered in textiles, industrial explosives and coal byproducts.

Trends in the production of high octane gasoline hold some interesting possibilities for sulphuric acid. At the present stage the sulphuric acid alkylation process appears to hold chief favor, with evidence of a decline in interest in the competing HF process, owing possibly to unfamiliarity with and fear of hydrogen fluoride. There has been some effort to use spent alkylation acid for fertilizer production, although as yet there does not seem to have been uniform success in the attempt. A number of plants have been installed, or are now being built for the regeneration of alkylation spent, but the general feeling is that a more economic procedure would be direct use in fertilizer without recovery if this should prove possible, a contingency which would still further enhance the prestige of the sulphuric acid process.

As was the case in our report on 1942, wartime elimination of some of our former sources of information, notably imports and exports, has made it difficult to be as certain as formerly of the total quantity of acid made. The U. S. Bureau of the



Estimated Distribution of Sulphuric Acid Consumed in the United States

(Basis, 50 deg. Bé.)

Consuming Industries	1941 Short Tons (Revised)	1942 Short Tons	1943 Short Tons
Fertilizers	2,500,000	2,950,000	4,100,000
Petroleum refining	1,400,000	1,650,000	1,720,000
Chemicals and defense*	1,790,000	2,250,000	2,350,000
Coal products	940,000	970,000	927,000
Iron and steel	1,500,000	1,600,000	1,650,000
Other metallurgical	800,000	840,000	860,000
Paints and pigments	700,000	760,000	800,000
Industrial explosives	190,000	195,000	190,000
Rayon and cellulose film	555,000	625,000	635,000
Textiles	165,000	145,000	135,000
Miscellaneous	500,000	530,000	550,000
Totals	11,040,000	12,515,000	13,917,000

* To avoid disclosing estimates of direct war applications of acid, such as in military explosives, these uses are lumped with chemicals in 1941-1943.

Data and Estimates on U. S. Sulphur Activity and Sulphuric Acid Production, 1941–1943

(Sulphur and pyrites in long tons; acid in short tons, 50 deg. Bé.)

	1941 (Revised)	1942 (Revised)	1943
Sulphur mined	3,150,000	3,496,000[1]	2,570,000[4]
Sulphur exports	725,000	[2]	[2]
Domestic shipments	2,675,000[3]	3,164,000[4]	3,070,000[1]
Approx. mine stocks at end of year	3,975,000	4,300,000	3,800,000
Non-acid uses of sulphur	705,000	1,325,000[5]	1,520,000[5]
Sulphur available for acid	1,970,000	1,839,000	1,550,000
Change in consumer stocks	+500,000	+85,000	−515,000
Acid from sulphur	7,580,000	9,040,000	10,630,000
Pyrites imports	310,000	[6]	[6]
Domestic pyrites	670,000	1,020,000[7]	1,000,000[7]
Acid from pyrites	2,044,000	2,260,000	2,200,000
Acid from smelters	1,250,000	1,120,000	1,300,000
Acid from hydrogen sulphide	70,000	98,000	100,000
Total sulphuric acid made	10,944,000	12,518,000	13,930,000

[1] Includes in 1942 3,460,686, and in 1943 about 2,550,000 long tons of sulphur mined on the Gulf Coast, plus western sulphur, recovery from fuel gases and sulphur imports from Trail, B.C., which are lumped to avoid disclosing estimate of imports. [2] Lumped with non-acid uses to avoid disclosing estimate of exports. [3] Does not include import from Trail, B.C., nor sulphur from fuel gases, estimated to total about 31,000 tons. [4] Total shipments, including exports. [5] Includes sulphur exports. [6] Lumped with domestic pyrites consumption. [7] Includes estimated pyrites imports.

Census has recently released 11 months' figures which do not, however, include acid made in ordnance plants, whereas we attempt to estimate the total production. The second tabulation on this page presents data and estimates on sulphur and other acid raw materials, and acid production, for 1941–1943. These figures are based on certain Bureau of Mines data for 1942, together with *Chem. & Met.* and trade estimates.

According to trade estimates, sulphur mining was at a considerably lower level than the record rate of 1942. Sulphur mining approximated 2,550,000 long tons on the Gulf Coast, to which we have added an estimate of 20,000 tons for far western sulphur, imports from Trail, B. C. (which were much curtailed owing to need for fertilizers in Canada), plus recovery of sulphur by wet gas purification processes. This compares with the 1942 figure of about 3,496,000 long tons, of which 3,460,686 tons was mined in the Gulf area. Added to production was about 500,000 tons withdrawn from producers' stocks at mines, giving total shipments, including exports, of about 3,070,000 long tons, compared with 3,164,000 tons in 1942. Sulphur exports, to which we have added domestic non-acid uses to conceal exports for reasons of security, are estimated at 1,520,000 tons, compared with 1,325,000 tons in 1942. Thus there appears to have been not more than 1,550,000 long tons of sulphur left for acid during the year, an impossibility owing to the materially increased output. The answer lies in the stocks of sulphur in consumers' hands which, under urging of the government

(*Continued on page* 119)

Alkalis and Chlorine

Soda ash, caustic soda and chlorine all were stepped up substantially in 1943, producing new records in each case. The increase was nearly 16 percent for soda ash production, while for caustic soda it was 13 percent. Chlorine's advance was over 21 percent.

THE YEAR 1943 was one of heavy activity in the alkali industry, with record levels achieved at nearly every point. The only important exception was in the production of lime soda caustic, which was at a lower level than in 1941, its previous peak year. On the other hand, electrolytic caustic hit some 12 percent above its earlier peak year, and could have been considerably larger except for the fact that caustic finishing equipment has not been installed for a fair amount of the new chlorine capacity which went into operation in the last couple of years. Caustic was in a situation more or less unique in recent years—in good demand and no longer completely outclassed by its partner, chlorine. In fact, troublesome stocks of earlier years—which totalled in the neighborhood of 100,000 tons at the close of 1942, were partially cleared away in 1943.

Soda ash production pushed into new ground, considerably higher than had appeared to be its ultimate capacity. This was done by working both the ammonia soda and natural capacity to the limit. In spite of these efforts, the material was frequently difficult to get.

This year for the first time, the U. S. Census Bureau has developed a current system of reporting production of a group of heavy chemicals, among them, the heavy alkalis and chlorine. The new monthly Census data do not include production at government plants in most cases, but in several instances it has been possible for us to extend the 11 months' Census data for the entire year, with the inclusion of an estimate covering the entire production. Based, then, on 11 months' Census figures, we estimate that in 1943 there was a total production of soda ash of 4,562,000 tons, made up of 4,380,000 tons of ammonia soda, 164,000 tons of natural soda, and 18,000 tons of electrolytic soda. This total, which is an increase of nearly 16 percent above 1942, compares with the similar figures of 3,788,583 tons of ammonia soda, 136,172 tons of natural soda, and 18,000 tons of electrolytic soda in 1942, and 3,606,826 tons of ammonia soda, 100,734 tons of natural soda and 18,000 tons of electrolytic soda in 1941.

With the sole exception of soap, all principal users of soda ash increased their 1943 requirements compared with earlier years. The total, which we estimate as 4,543,000 tons in 1943, is more than 15 percent in excess of the corresponding estimate of 3,934,000 tons in 1942. The largest increase, both absolutely and percentagewise, was in the field of non-ferrous metals,

Production of Caustic Soda in the United States

(Short Tons)

Year*	Lime-Soda	Electro-lytic	Total
1921	163,044	75,547	238,591
1923	314,195	122,424	436,619
1925	355,783	141,478	497,261
1927	387,235	186,182	573,417
1929	524,985	236,807	761,792
1931	455,832	203,057	658,887
1933	439,363	247,620	686,983
1935	436,980	322,401	759,381
1937	488,807	479,919	968,726
1939	532,914	512,492	1,045,406
1940 (estimated)	505,000	595,000	1,100,000
1941	685,999	743,316	1,429,310
1942	634,291	939,878	1,514,169
1943 (estimated)	665,000	1,050,000	1,715,000

* Figures for 1921-1942, except 1940, are from the U. S. Bureau of the Census. Electrolytic caustic soda figures do not include that made and consumed at wood-pulp mills, estimated at about 30,000 tons in 1927 and 1929, at about 24,000 tons in 1931, 21,000 tons in 1933, 20,000 tons in 1934, 17,000 tons in 1935, 19,000 tons in 1936 and 1937, 18,000 tons in 1938, 25,000 tons in 1939, 30,000 tons in 1940, 30,000 tons in 1941, 30,000 tons in 1942 and 30,000 tons in 1943.

mostly for aluminum where the year's output was about three-quarters larger than the preceding year. Miscellaneous uses also increased materially. The figure now includes exports (for security reasons), but also includes a number of other importantly increased wartime uses. Quite possibly the use of cleansers was considerably greater than indicated, owing to army amp use. On this point however there is a continuing controversy, since dozens of small concerns which include the word "chemical" in their names put out alkaline cleansers and nobody has ever succeeded in arriving at an accurate estimate of this diverse business.

Although the percentage increase in use of caustic soda was greater than that for soda ash, the percent of production change was considerably less, owing to the cushion of stocks from the preceding year. Our estimate is that caustic production totalled 1,715,000 tons in 1943, compared with 1,514,169 tons in 1942, an increase of 13.2 percent. This production is believed to have included 665,000 tons of lime soda caustic and 1,050,000 tons of electrolytic caustic. For 1942 the comparable figures were 634,291 tons and 939,878 tons. It will be observed that the percentage of electrolytic caustic is climbing slowly, as shown in the accompanying tabulation of caustic by sources, now having reached some 61 percent of the total. Uses of caustic, which we estimate to have totalled 1,783,000 tons in 1943, increased by almost 22 percent compared with the 1,464,000 tons of consumption which we estimated for 1942. With the exception of soap, which declined, and vegetable oils, which changed little if at all, there were sizable increases all along the line. There is some question whether caustic for soap manufacture actually declined as much as indicated. Usage of oils and fats by soapers declined materially during the year, but the total volume of soap was off less than this decrease. In fact, orders in the last quarter called for maintaining volume con-

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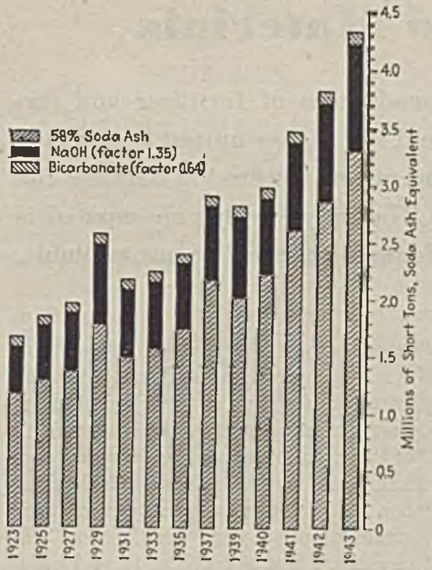


Production for sale of principal ammonia soda products (ash equivalents)

Estimated Distribution of Caustic Soda Consumed in the United States

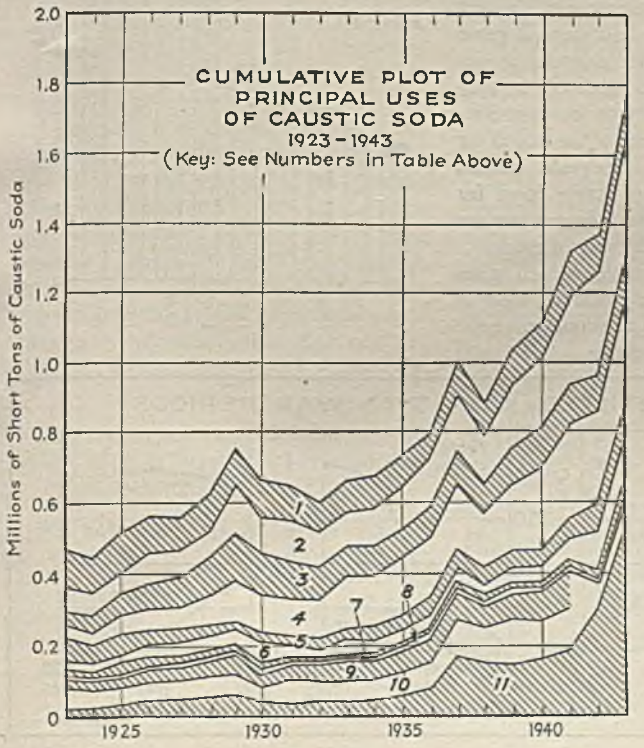
Consuming Industries	1941 Short Tons (Revised)	1942 Short Tons (Revised)	1943 Short Tons
1. Soap	125,000	120,000	105,000
2. Chemicals	260,000	300,000	360,000
3. Petroleum refining	116,000	100,000	130,000
4. Rayon, staple fiber and cellulose film	270,000	300,000	320,000
5. Lye and cleansers	52,000	70,000	100,000
6. Textiles	63,000	110,000	120,000
7. Rubber reclaiming	18,000	20,000	24,000
8. Vegetable oils	20,000	19,000	19,000
9. Pulp and paper	100,000	85,000	95,000
10. Exports	120,000	*	*
11. Miscellaneous	230,000	340,000	510,000
Totals	1,374,000	1,464,000	1,783,000

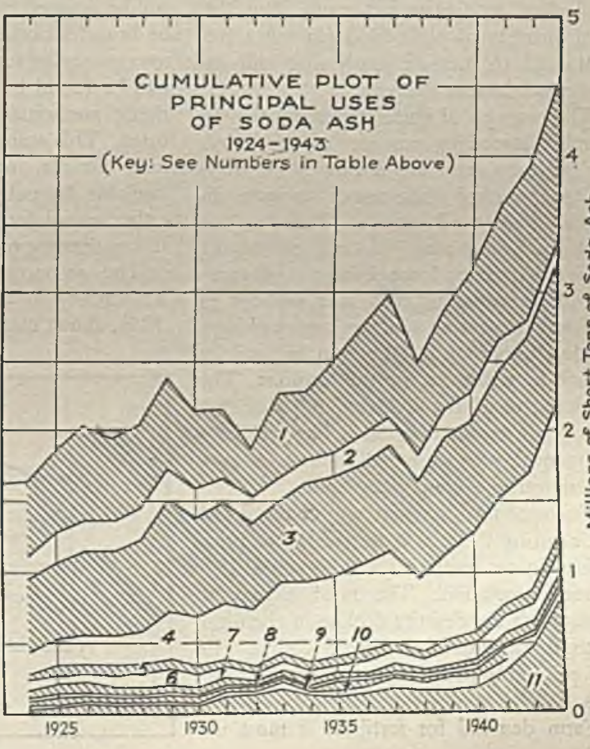
* Included in miscellaneous.

Estimated Distribution of Soda Ash Consumed in the United States

Consuming Industries	1941 Short Tons (Revised)	1942 Short Tons (Revised)	1943 Short Tons
1. Glass	990,000	1,100,000	1,200,000
2. Soap	170,000	165,000	150,000
3 Caustic and bicarbonate	1,033,000	960,000	1,010,000
4. Other chemicals	800,000	840,000	950,000
5. Cleansers and modified sodas	70,000	80,000	85,000
6. Pulp and paper	155,000	145,000	155,000
7. Water softeners	70,000	80,000	95,000
8. Petroleum refining	23,000	18,000	20,000
9. Textiles	60,000	56,000	58,000
10. Exports	85,000	*	*
11. Miscellaneous	140,000	230,000	370,000
11. Non-ferrous metals†	150,000	260,000	450,000
Totals	3,746,000	3,934,000	4,543,000

* Included in miscellaneous. † In miscl. on chart.





Fertilizer and Materials

Another all-time high record for production of fertilizer and fertilizer materials was made in 1943 and still higher output is expected in 1944. Unlimited demand for food means continuing demand for fertilizer to aid farm production. The only surplus anticipated is of anhydrous ammonia for which adequate "carrier" is not available.

FERTILIZERS and fertilizer materials were produced and sold during 1943 at a record high rate. During the coming year there will be still greater demand and still greater supply of all. The total sales of fertilizer during the calendar year 1943 were about 11 million tons. Thus there was continued for a fourth successive year an increase in output of just about a million tons per year.

Demand during the past year exceeded supply for certain of the component chemicals, especially for sodium nitrate and ammonium sulphate to be used alone on crops and for potash. Supply barely equalled demand for mixed fertilizer, but will fall definitely short of "official" estimates of need in the spring of 1944. Demand may exceed supply of superphosphate if sulphuric acid supply is limited by transport restrictions. But no shortage of ammonia is expected except locally in a few areas during the season of peak manufacture of superphosphate.

The plant food content of fertilizer in 1943 has been a trifle less in percentage because of the necessity for reducing the concentration of nitrogen due to short supply. Thus there is currently a slight interruption in the upward trend in the concentration of total plant food in mixed goods. But the total quantity of plant food (in tons) has continued to increase yearly and will increase still further this year.

The program of grade standardization to simplify marketing practices of the industry proved a great aid during 1943. It is being continued with minor revisions in certain states and regions. The result is that each company. instead of having scores of varieties, is supplying a small number of formulas in each area without in any way preventing a farmer from picking a grade appropriate for the crop and soil on which he wishes to use the fertilizer. The enthusiasm of the industry indicates that this grade standardization is likely to be a permanent practice for all companies even when wartime compulsion ends.

Prices of fertilizer materials changed but little during 1943, as indicated by the price index figures prepared by National Fertilizer Association. The most significant change was the definite decline in chemical nitrogen compounds, a trend contrary to the price movement of most other materials.

Farm demand for fertilizer is most influenced normally by the cash income from the sale of agricultural products. Thus the demand for fertilizer in 1944 would under ordinary circumstances be far above normal. But there is also the need for increased production per acre with less available farm labor. These factors give farmers even greater incentive than usual. Some enthusiasts say that as much as 12 or 13 million tons of fertilizer would be used in 1944 if available. Actual consumption will probably exceed 11.5 million tons; and the total may be even greater if A.A.A. and T.V.A. continue aggressively their free or subsidized distribution for "soil conservation" and experimental or demonstration purposes.

The general program of fertilizer manufacture for the spring and early summer of 1944 includes two major uncertainties. First, there is some doubt as to whether enough sulphuric acid can be supplied after March to meet superphosphate manufacturing demand in certain areas. Final decision of military authorities on use of acid capacity at plants built for explosives will determine this question. Second, great uncertainty exists as to two official actions on nitrogen supply. It remains problematical as to whether adequate ship space will be assigned for the nitrate which might be brought from Chile; and there is grave uncertainty as to whether practical means will be found to utilize much of the synthetic ammonia which can be manufactured. This ammonia cannot be stored for long periods, nor are adequate carriers available to put it into usable form for either mixed fertilizer or independent use in top dressing or side dressing of crops.

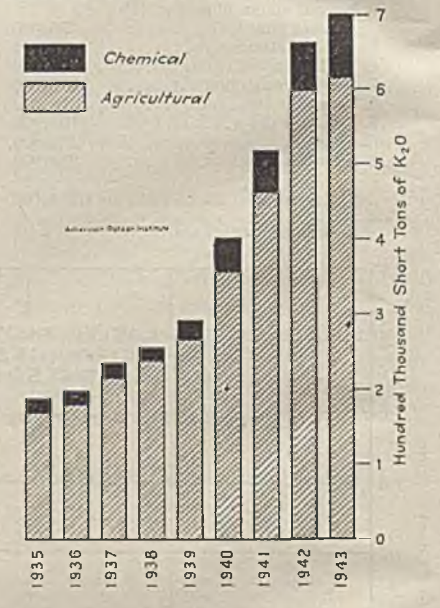
The accompanying table, which gives a summary of fertilizer materials used in 1941, shows clearly the relationship of the fertilizer industry to many divisions of chemical manufacture and the chemical process industries.

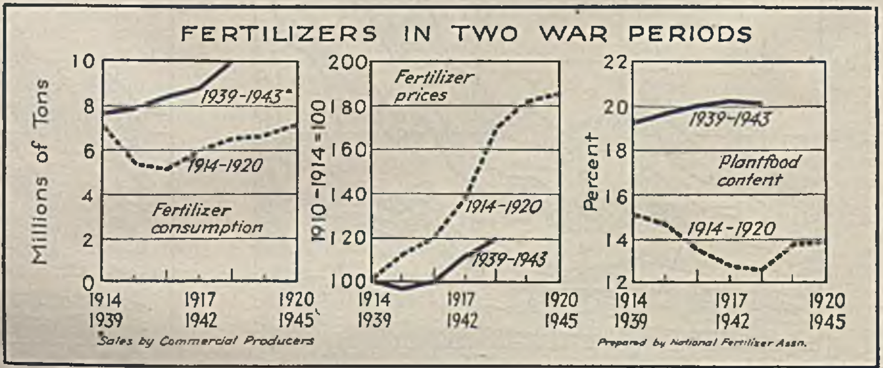
PHOSPHATES

Phosphate rock producers were pressed last year for rock supplies by the fertilizer industry as never before in their history. At certain stages it was necessary for superphosphate makers to shop around in order to find rock of the desired quality available on schedules suited to their acidulating plans.

During the calendar year 1943 there were produced approximately 6.5 million tons of superphosphate, calculated on the 18 percent P_2O_5 basis. (The actual average was about 19.5 percent.) More than 6.8 million tons would have been made if ordnance acid could have moved more promptly in certain areas. The output for the fertilizer year, ending June 30, is expected to be close to 7 million tons if present acceleration can be continued. Of the total, more than 6 million tons will be distributed by commercial fertilizer companies. The balance will be handled through Government programs of A.A.A. The production of high-concentration superphosphate, 45 percent P_2O_5, will be

Potash Deliveries by U. S. Companies





nearly 300,000 tons of which about one-third is expected to be exported through Lend-Lease.

Demands for 1944 include more fertilizer and superphosphate for Government distribution than can be made available. Some critics believe that this portion of the demand should not in any event be met because much of it will require labor and materials which can ill be spared during the war period for mere soil conservation purposes.

During 1944 it is expected that there will be built at least six new plants for making superphosphate, and one new plant for manufacture of triple-super in Texas. The former establishments will be widely scattered geographically authorizations by W.P.B. having been made already for Maine, Missouri, Louisiana, Texas, Idaho, and California.

POTASH

The four major domestic potash concerns, assisted by a few minor establishments, are currently producing potash products at the rate of 700,000 tons of K_2O per year. This is practically double the 1940 rate, but still well below the demand for fertilizer, chemical industry, and export. The early allocations of potash for 1943–44 (the fertilizer year which ends July 1, 1944) were as follows:

	Tons of K_2O
United States and territories	540,000
Export to United Kingdom.	36,000
Export to Canada.........	35,000
Export to Latin America, etc.	4,000
Chemical manufacture.....	85,000

The allocation for export has been severely criticized, and actual shipments may be much less than anticipated at the beginning of the fertilizer year. Some of the material has been re-allocated for chemical industry use. Even if there were no export, there would still be a greater demand for use in fertilizers than the total supply for purposes other than chemical. The actual use for chemicals manufacture in the United States is expected to be close to 100,000 tons during 1944.

It is anticipated that there will be some expansion during 1944, both of facilities for manufacture of potash chemicals for use in industry and in output of potash-bearing fertilizer materials of high K_2O content. Forecasts are that the primary refiners will be able to produce at the rate of 760,000 tons of K_2O per year by the fall of 1944.

Potash Materials Used for Agriculture in the United States and Territories, Thousands of Tons of K_2O

	1941–42	1942–43	1943–44
Muriate (60%)	410	461	388
Muriate (50%)	33	37	45
Manure salts (25%)	37	48	47
Sulphate (50%)	34	37	39
S. P. M. (22%)	7	7	11
	521	590	530

Data from American Potash Institute with estimates for 1943-44.

NITROGEN

Agriculture is still the most important consumer of nitrogen compounds, with military activities a poor second. The nitrogen materials used for fertilizer during 1943 contained about 460,000 tons of N, of which 256,000 was used in mixed fertilizer, and the balance for top dressing or side dressing of crops. Government agencies promise 625,000 tons of N for fertilizer use in 1944, of which 354,000 is wanted for mixed fertilizer according to present plans. There will also be used a limited amount of material containing organic nitrogen products, but the bulk of such nitrogen carriers is to go for either food or feed usage in preference to fertilizers.

Two major technical problems remain largely unsolved at the beginning of February. One has to do with supply of nitrate nitrogen for top dressing; the other relates to the use of anhydrous ammonia for ammoniation of superphosphate.

Conversion of ammonia to sodium nitrate affords the preferred form of fertilizer material for independent use on many crops. It and Chilean nitrate are expected to be supplied this year to the extent of about 825,000 tons. Fully a million tons is wanted. There could be more imported if ship space were available. Production of domestic sodium nitrate could be increased at existing plants if more alkali could be spared for this purpose and only small modifications in equipment were authorized. Later in the spring it is expected that the cut-back in other military activities may release the necessary alkali and permit some such plant expansion at existing synthetic ammonia plants. But those shifts will not come soon enough to give any aid in fertilizer before the crops of the spring of 1945.

Because sodium nitrate cannot be made in the amounts desired, it is planned that about 230,000 tons of ammonium nitrate will be supplied by one or two commercial producers, by T.V.A., and by some of the Ordnance Department arsenals equipped to

(*Continued on page 134*)

Fertilizer Materials Consumed in the United States, 1941, Tons*

Material	Continental United States: Mixed	As Such	Total	Territories	Grand Total
Normal superphosphate [1]	2,487,000	1,533,000	4,020,000	28,000	4,048,000
Nitrate of soda	69,000	789,000	858,000	22,000	880,000
Sulphate of ammonia	354,000	177,000	531,000	139,000	670,000
Muriate of potash [2]	522,000	80,000	602,000	38,000	040,000
Dolomite and limestone [3]	301,650	74,000	375,650	....	375,650
Concentrated superphosphate [4]	95,000	167,000	262,000	200	262,200
Phosphate rock [5]	35,147	160,380	195,527	....	195,527
Ammonia and solutions	186,000	7,000	193,000	....	193,000
Sewage sludge (all kinds)	144,000	16,000	160,000	....	160,000
Cottonseed meal [6]	13,000	137,000	150,000	....	150,000
Wet-mixed base goods	130,000	0	130,000	....	130,000
Cyanamid	33,000	83,000	116,000	4,000	120,000
Manure salts and kainit [7]	90,000	21,000	111,000	....	111,000
Tobacco stems	80,000	20,000	100,000	....	100,000
Process tankage	89,000	3,000	92,000	....	92,000
Castor pomace	77,000	12,000	89,000	....	89,000
Land plaster [8]	70,000	14,000	84,000	....	84,000
Sulphate of potash and of potash-magnesia	59,000	5,000	64,000	6,000	70,000
Basic slag [9]	5,000	60,000	65,000	....	65,000
Ammonium phosphates [10]	22,000	28,000	50,000	13,000	63,000
Peanut-hull meal	50,000	0	50,000	....	50,000
Uramon, urea, calurea, etc	31,000	6,000	37,000	4,000	41,000
Nitrate of soda-potash	9,000	16,000	25,000	14,000	39,000
Dried fish scrap	30,000	7,000	37,000	1,000	38,000
Bonemeal	10,000	26,000	36,000	1,000	37,000
Peat	30,000	5,000	35,000	....	35,000
Cocoa byproducts	30,000	2,000	32,000	....	32,000
Miscellaneous natural organics [11]	4,000	21,000	25,000	3,000	28,000
Miscellaneous potash materials [12]	7,000	17,000	24,000	....	24,000
Dried animal manures	10,000	12,000	22,000	....	22,000
Miscellaneous chemical nitrogenous [13]	9,000	9,000	18,000	2,000	20,000
Garbage tankage	14,500	500	15,000	....	15,000
Guanos	14,500	500	15,000	....	15,000
Miscellaneous seed meals [14]	10,000	3,000	13,000	....	13,000
Acidulated fish	11,000	0	11,000	....	11,000
Miscellaneous materials [15]	4,500	5,500	10,000	1,000	11,000
Calcium metaphosphate [16]	0	8,949	8,949	....	8,949
Manganese sulphate	8,000	500	8,500	....	8,500
Tung meal	3,000	3,000	6,000	....	6,000
Miscellaneous phosphatic materials	....	4,000	4,000	....	4,000
Sand and other filler	650,000	....	650,000	500	650,500
Total [17]	5 797,297	3,533,329	9,330,626	276,700	9,607,326

* From U. S. Department of Agriculture. [1] Grades containing 14 to 24 percent available P_2O_5. Includes 728,320 tons distributed as such by the A. A. A. [2] Of that consumed as such, 48 percent was 50 percent grade. [3] Used as fertilizer filler or sold as such by the fertilizer industry. In addition, more than 15,000,000 tons sold by the lime or other industries was consumed in agriculture in 1941. [4] Grades containing 30 to 48 percent available P_2O_5. Includes 95,280 tons distributed as such by the A. A. A. and 18,353 tons distributed by the T. V. A. [5] Includes 6,953 tons distributed as such in Illinois by the A. A. A. [6] Includes 110,640 tons of meal used as fertilizer on cotton farms and more than 10,000 tons of cottonseed meal denatured with castor pomace. [7] Includes 19,204 tons of 20 percent kainit consumed as such. [8] Material handled by the fertilizer industry only. In addition, 130,000 tons distributed by other industries was consumed as such in agriculture in 1941. [9] Mostly open-hearth basic slag, of which 42,682 tons was distributed by the A. A. A. [10] About ¾ of the total consumed as such was the 16-20 grade. [11] Dried blood; shrimp, blue crab, and king crab scrap; hoof and horn meal; etc. [12] Vegetable potash, cement-kiln dust, lime-potash, wood ashes, cotton-hull ashes, etc. [13] Calnitro, calcium nitrate, ammonium nitrate, etc. [14] Linseed, soybean, peanut, apricot seed, hemp-seed, sesame-seed meals, etc. [15] Copper sulphate, zinc sulphate, borax, sulphur, and unsegregated. [16] All distributed by the T. V. A. [17] Figures for all States and Territories are included.

Synthetic and Natural Rubber

Synthetic rubber made great strides during the past year and should continue its upward climb during the months ahead. Imports of natural rubber were slightly higher than had been predicted. Yet rubber will be very scarce in 1944.

There is no question regarding the outstanding development in rubber during the past year. The synthetic rubber industry made tremendous strides as had been expected, and well it did for the safety of this country depended upon the success. It is estimated by the Office of the Rubber Director that 233,400 long tons of the four types of synthetic rubber were produced. Our natural rubber imports from all sources, including those outside of the Western Hemisphere, for the year 1943 totaled approximately 60,000 tons. The tire collection plan of last year brought in 12,000,000 tires. The consumption of crude and synthetic rubber in the United States was about 424,000 long tons, while the consumption in 1944 will be about 757,000 tons.

The breakdown of the 233,374 long tons of synthetic rubber produced in the U. S. and Canada is about as follows: buna S, 183,635 tons; butyl, 2,292 tons; neoprene, 32,574 tons; and buna N, 14,875 tons.

As of November 1, the synthetic rubber program had progressed to the point where completed plants had a rated annual capacity of 646,000 long tons. Eighty-seven percent of the butadiene-from alcohol plants had been completed and 39 percent of those producing butadiene from petroleum.

Progress should continue throughout 1944 as many new plants will come into production, especially in the first half of the year. It is expected that the production will be about as follows: buna S, 710,000 long tons; butyl, 39,000 tons; neoprene, 49,200 tons; and buna N, 20,000 tons.

The Rubber Director reports that disappointments were encountered in the production of butyl rubber. Intensive research is being carried on in the hope of finding a satisfactory solution to this problem. Pending results of this research, production is negligible.

All neoprene plants have been completed and are producing at rated capacity. These have been among the most successful parts of the rubber program.

Imports of natural crude rubber from all sources, including those outside of the Western Hemisphere, for the first ten months of 1943 were 51,008 tons, according to Douglas H. Allan, president of the Rubber Development Corporation (before the Gillette Committee of the U. S. Senate Dec. 9, 1943). For the entire year Dewey estimated imports would reach 60,000 tons. It is expected that imports in the current year will be augmented by increased shipments, from British territory and be about a third greater than in 1943. As a result of the creation by the President of the Office of Foreign Economic Administration, all American development and procurement programs in foreign countries have become its responsibility.

The United States has a satisfactory supply of scrap rubber on hand. The first day of October this amounted to 754,000 tons, including 463,000 tons of pneumatic tires and tire parts. The monthly consumption of scrap rubber is 35,000 tons.

Besides the tires brought in during the tire collection plan of last year, a large amount of assorted scrap was collected by the government. Much of this has been and is being used in the manufacture of reclaim rubber. A part of this miscellaneous scrap, however, is of such low quality that it can not be used and will have to be destroyed.

Due to numerous complex factors the problem of setting a price on the different rubbers had not been simple. The most practical approach, according to the Progress Report, No. 4 of Office of Rubber Director, has been to average all of the cost of all of the synthetics under present conditions and all of the crudes now being obtained and then price the various rubbers in such a way that those who are required to use any particular synthetic are not at a serious disadvantage when in competition with those using any other.

Based on this reasoning, crude and synthetics used in making government products are priced per pound as follows:

	Cents
Crude rubber	40
Neoprene (GR-M)	45
Buna S (GR-S)	36
Butyl (GR-I)	33

It was expected by Rubber Director Dewey that the stockpile of crude and synthetic rubbers at the end of 1943 would amount to 205,000 long tons and by the end of 1944 will drop to 151,000 long tons. It should be noted, however, that by the end of 1944 perhaps 50 percent of the stockpile will be in synthetic rubbers and there will be less crude than the Baruch Comittee considered an irreducible minimum. He has stated that during 1944 restrictions on the use of crude rubber will be increased until the ultimate objective of a practically complete conversion (all but a few large and heavy duty tire sizes, etc.) has been obtained and we are able to live within our income of new crude receipts.

The president of one of the large rubber companies recently said that assuming the rubber lands will not be destroyed when the Japanese are driven out potential world rubber capacities will be roughly 1,800,000 tons of natural and 1,000,000 tons of synthetic. This is a total of 2,800,000 tons annually of natural and synthetic rubber or more than twice as much rubber as the world has ever used in any one year. These estimates assume that low-priced natural rubber or synthetic rubber, or both, will be available after the war, which is more than likely.

Position of United States and Canada at end of 1943 and 1944

	1943	1944
Inventory, January 1	443,000	205,000
New supplies:		
Crude	60,000	81,000
Synthetic	223,000	818,000
Total	736,000	1,104,000
Requirements	531,000	953,000
Balance, December 31	205,000	151,000

Data from Progress Report No. 4 of Office of Rubber Director

Status of Plants on Nov. 1, 1943

Product	Rated Capacity	Rated Capacity of Construction Completed—10/31/43	% Completed
	Long Tons	*Long Tons*	
Buna S	735,000	585,000	80
Butyl	75,000	21,000	28
Neoprene	40,000	40,000	100
	850,000	646,000	76
Butadiene:	*Short Tons*	*Short Tons*	
From alcohol	230,000	200,000	87
From petroleum	460,400	179,900	39
	690,400	379,900	55
Styrene	202,700	163,700	81

Data from Progress Report No. 4 of Office of Rubber Director

1943-1944 Estimated Quarterly Production of Synthetic Rubber for Buna S, Butyl, Neoprene, and Buna N

	1943 1st	1943 2nd	1943 3rd	1943 4th	Year Total	1944 1st	1944 2nd	1944 3rd	1944 4th	Year Total
Buna S	3,102	18,792	56,741	105,000	186,635	145,000	185,000	190,000	190,000	710,000
Butyl	35	393	364	1,500	2,292	4,000	6,000	12,000	17,000	39,000
Neoprene	4,372	5,853	10,049	12,300	32,574	12,300	12,300	12,300	12,300	49,200
Buna N	2,977	3,335	4,063	4,500	14,875	5,000	5,000	5,000	5,000	20,000
Total Synthetic	10,486	26,373	71,217	123,300	233,376	166,300	208,300	219,300	224,300	818,200

All quantities are estimated in long tons. *Includes neoprene and Buna N capacities of private plants. Data from Progress Report No. 4 of Office of Rubber Director

Plastic Materials

Wartime applications for plastics by the Army and Navy carried the industry to an all-time high. As was the case in other fields production would have been much greater had raw materials been available. Several new resins have important peacetime significance and should be watched for important developments.

THE PRODUCTION of cellulose acetate plastics in 1943 was far ahead of that in the previous year. In fact, it was as large as the War Production Board would permit. Several factors played a part in its limitation, the principal one being the supply of plasticizers. Notwithstanding this rapid growth in production, manufacturers were not able to meet military demands which made it necessary to place all cellulose derivatives on allocation in July. Part of the expansion in production facilities has been made at the expense of cellulose nitrate.

CELLULOSE PLASTICS

High acetyl cellulose acetate production went up rapidly throughout the year and the trend shows every evidence of continuing. This high acetyl plastic is being used wherever dimensional stability over a wide range of temperatures and humidity conditions are required. Another attraction is its moisture resistance which is better than that of the ordinary types of cellulose acetate.

In the case of the very high acetyl cellulose acetate, known as triacetate, not much progress has been made. This lack of progress is said to be due to inability of existing equipment to extrude and otherwise fabricate this new material. At present a limited amount is being spun, by using a solvent, into bristles. High acetyl molding powder prices remained steady throughout the year. The base price for all acetate molding powder has been 44c. per lb.

Production of cellulose acetate in the form of sheets, rods, tubes, and molding powder in 1943 is estimated to have been 39,000,000 lb., which may be compared to an estimated 36,200,000 lb. in the previous year.

Cellulose acetate butyrate showed an increase in consumption during the year and is expected to continue the growth in the months ahead. The splendid molding characteristics and dimensional stability accounted for increased demand for this plastic for wartime applications. During the year about 15,000,000 lb. were consumed. The figure for the previous year was in the neighborhood of 12,000,000 lb.

All cellulose nitrate production facilities were kept in continual operation, however, as previously mentioned, more and more of the equipment was converted to production of acetate. This condition was due to the fact that the demand for acetate was greater than for nitrate. As a result of this switch production slumped to 13,765,000 lb. In 1942 production had been 15,148,000 lb. and in 1941, 16,479,000. While a plasticizer shortage had no effect on the production in 1943 the lack of sufficient camphor is now cutting into the volume. This shortage is expected to result in a further reduction in the production of cellulose nitrate during the first six months of the current year.

Ethyl cellulose was in such urgent demand by the Army and Navy that WPB placed it on allocation early in the year. This demand continues to lead production although facilities have been increased. It is being used as a molding powder and in coatings. It shows great promise in low-pressure laminations with cloth for landing boats and parachute drop containers due to the high impact strength of the fabricated object. In 1942, production of molding powder probably reached 3,000,000 lb., double the output for the previous year. Price of ethyl cellulose molding powder in the first six months of the year was 58c. per lb., then a reduction of 2 cents on finished molding powder was made.

PHENOLIC RESIN

Phenolic resin production took a sharp upturn last year as a result of completion of several new phenol plants. At last the phenol capacity has reached and passed the demands making unnecessary completion of certain of the plants. Production of phenolics last year has been estimated at 250,000,000 lb. which may be compared to 122,439,000 lb. in 1942. About 115,000,000 lb. of molding powder were turned out last year, and 68,000,000 lb. of laminating resin (on a dry basis).

There have been no price changes in the phenolics in some time. Price of the dark colors remained at 13½c. per lb. An improved type of resin was developed to meet certain requirements which was priced at 16c. per lb.

Like all plastics the ureas and melamines continued to make progress. Probably as much as 60,000,000 lb. were produced last year. Of this poundage about one-half represents urea molding powder. The U. S. Tariff Commission reports 1942 production of 37,515,785 lb. of urea resins.

There have been no price changes in the urea-formaldehyde resins. The price remained at 22c. per lb. in carload lots. However, there was a slight downward trend in melamine resins. They are selling at 50c. per lb.

Due to the enormous demands for styrene by the synthetic rubber industry applications for polystyrene resins have been confined to military needs more urgent than rubber tires, inner tubes and so forth.

Late in 1942 polystyrene molding powder price dropped from 45 to 30c. per lb. When large lots of the styrene now going into rubber are available for plastics the price is expected to go even lower.

One of the largest gains in the plastics industry was made by the vinyl resins. Production of all the vinyl resins (including vinylidene chloride) has been estimated at over 100,000,000 lb.

VINYLIDENE CHLORIDE RESIN

Vinylidene chloride resins have made considerable progress in many new directions. While they are still best known in the process industry as a new piping material, they are also useful for moldings, coatings, films and filaments. A recent development has been transparent film or sheeting of vinylidene chloride. Its moisture resistance has made it popular for these purposes. It is nonflammable, and flexible. New methods of extrusion have made possible pipe with a wall thickness as large as ⅜ in. and a pipe size of 4 in. Tubing and piping have been used far more extensively in the chemical industry than heretofore.

Increased demand from the Army and Navy for acrylic resins for aircraft parts, and ships of various kinds have made it necessary to enlarge manufacturing facilities. At the year end the plants had a combined annual capacity of 32,000,000 lb.

Many and varied have been the developments. It will suffice to mention only a few. Polyethylene resins are adaptable to the manufacture of products as varied as collapsible tubes for toothpaste, waterproof coatings, piping, adhesives and electrical insulation. The resins are available in substantial quantities on allocation for war applications. They are made by E. I. duPont de Nemours & Co. and Carbide and Carbon Chemicals Corp. This new material is particularly valuable for its dialectric properties and water resistance. Benzyl cellulose is being studied by Hercules Powder Co. Among the characteristics of this material are extremely low moisture absorption, resistance to chemicals and useful electrical properties. Thermoplastics for laminating at no pressure, low pressure, or high pressure appear to have a bright future.

In 1944 large articles probably will be produced from thermoplastics, there will be larger injection molding machinery, extruders will produce larger tubes, sheets, and the like. Also there will be more developments in blowing cellulose esters.

Alcohol and Solvents

Although new production records were established last year in the solvents industry, military and other essential requirements increased so rapidly that they absorbed the greater part of the output. The outlook is not regarded as favorable for much improvement in the supply situation in the current year.

The alcohol and solvent business last year was decidedly interesting inasmuch as almost every problem which can be anticipated in a business of this kind presented itself and demanded a prompt solution. To begin with, there was an urgent call for deliveries both for domestic and foreign account. This placed producers in a position where they were called upon to enlarge operations in the face of manpower shortages, difficulty in securing ample supplies of raw materials together with unusual problems connected with packaging and shipping. In some cases activities were affected by difficulties in plant operations and even the elements, in the form of floods and hurricanes, played a part in upsetting production schedules. Nevertheless, when the final tabulations had been made it was found that the industry had done remarkably well and had come close to meeting the bogies which had been set.

ETHYL ALCOHOL

At the beginning of the year, it was estimated that a total of 502,000,000 gallons of ethyl alcohol would be produced from all sources. This estimate was reached on the assumption that 375,000,000 gallons would come from grain, 68,000,000 gallons from molasses, and 59,000,000 gallons from synthetic. Consuming requirements were estimated at 453,000,000 gallons which meant that stockpiles would be increased by 49,000,000 gallons. However, as the year advanced it was found necessary for various reasons to make revisions in the earlier estimate and the actual outturn was reported at 451,000,000 gallons which still left a surplus as consumption was 433,000,000 gallons. Production ran considerably above consumption in the first six months and by the middle of the year the surplus had reached approximately 130,000,000 gallons. Later on, requirements expanded rapidly and toward the close of the year were exceeding production by about 10,000,000 gallons a month. As a result there was a drain upon the reserve holdings which reduced them to about 80,000,000 gallons at the end of the year.

A supply of molasses was on hand at the beginning of the year and for a time a number of plants operated solely on this material. When the molasses supply had been exhausted, these plants turned to grain as a raw material but some plants used up their inventories before their grain-grinding facilities were ready to operate and as a consequence some alcohol production was lost at this point. After the grain facilities had been installed, the Commodity Credit Corp. changed its buying set-up which proved a handicap in securing supplies of this material. Fortunately, however, the tanker situation turned more favorable and the Maritime Commission made available fifteen tankers for transporting molasses which eased matters in the Gulf and Eastern Seaboard areas. Further assistance was found in the bringing into operation of a new synthetic plant which contributed substantially to the grand total for the year.

On the consuming front, relatively new outlets increased their demands at a time when producers were sorely pressed to meet already existing demands. Military requirements for glacial acetic acid were abnormally high and some alcohol plants used their outputs for conversion into acetic acid. Around the middle of the year, butadiene plants which use ethyl alcohol as a raw material, came into operation and it was not long before these plants began to exceed their rated capacities. In the latter part of the year butadine production was consuming alcohol at a rate of close to 27,000,000 gallons a month. Consumption for anti-freeze purposes was the largest in more than 10 years and amounted to 48,000,000 gallons. Lend-lease requirements also were heavy with the bulk of shipments going from the eastern seaboard and this kept stocks in that area at a low level throughout the year.

In line with the higher cost of production, ceiling prices for alcohol were considerably above the levels of the prewar years. A special, and very high, price was permitted in the case of a producer on the Pacific Coast where it was found necessary to relieve a trying situation even though it meant a rift in the uniform price ceiling.

METHANOL

Methanol followed the pattern which ran through the solvents industry, namely a speeding up of consuming requirements and the forcing of outputs to new records. All plants worked at capacity with reports that government plants attained results higher than had been anticipated. Total production is estimated at about 100,000,000 gallons of which commercial plants accounted for about 70,000,000 gallons. Commercial production was divided about 65,000,000 gallons to synthetic and a little under 5,000,000 gallons to natural. The extent to which methanol production has been increased may be inferred from the fact that the 1943 outturn was practically double that of the last normal year. This material was continued under directive control of shipments with a surplus maintained in anticipation of any special military demand which might arise. The ban on the use of methanol in the anti-freeze trade was continued and very little of that product went for such end purposes. The wood distillation branch found a larger market for denaturing grade but was not able to extend production as much as desired owing to the shortage in supplies of wood.

All indications point to a shortage of ethyl alcohol in 1944. If this proves to be correct, it may follow that permission will be given to release a substantial amount of methanol for anti-freeze so as to cut down demand for ethyl alcohol from that quarter.

ISOPROPYL ALCOHOL

Isopropyl alcohol made vast strides during 1943 and emerged as a major product with production reaching a total of approximately 65,000,000 gallons. The greater part of this material was converted into acetone and other chemicals but the rise in output made it possible to supply a number of other important consumers and the broadening of its markets is regarded as an indication that production will continue to gain in volume.

ACETONE

The course of acetone production was beset with difficulties to an extent greater than in the case of any of the other solvents. At times the situation was so confusing that both producers and important military agencies were disturbed by the possibility that vitally needed supplies would not be forthcoming. One producing company ran into a series of unfavorable circumstances which resulted in a substantial loss in output. Early in the year, this plant was put out of operation for some weeks due to the Mississippi floods. Later, production was again curtailed because of inability to obtain a sufficient supply of coal. Still later, the plant was slowed up by a strike of the workers. Another plant, and one of the largest, was crippled for a time as a result of a hurricane. A third producer, manufacturing both fermentation and synthetic, ran into serious problems with both operations which brought the output below what had been anticipated.

These conditions were all the more regretable because both lend-lease and military requirements had increased sharply. Other essential uses also were extended particularly where acetone might be used to relieve the shortage of ethyl acetate and methyl ethyl ketone. Total production for the year was about the same as in 1942 but as demand was larger, this material was in a tight position at all times. The supply situation was greatly helped by the fact that one isopropyl alcohol producer was able to increase his output sufficiently to supply two other producers with part of their requirements and at the same time convert part of the isopropyl alcohol in spare equipment. This action in large part made up for the forced loss in acetone production.

HIGHER ALCOHOLS AND ACETATE

Both production and demand for normal butyl alcohol were curtailed by the same disasters that affected the acetone market, but the producer of synthetic was able to turn out enough additional material to offset these losses so that production was equal to or slightly exceeded the amount produced in 1942. As in the previous year, virtually the entire production was disposed of in special military channels and lend-lease shipments. The chief difficulty experienced by butyl alcohol producers was in obtaining raw material supplies at prices which would enable them to operate within their ceiling price. The year was marked by frequent price adjustments attended by official regulations.

Synthetic amyl alcohol was available for civilian use only in a very small way as the bulk of production was reserved for military purposes. Secondary butyl acetate found a receptive market but here again trading was restricted by the paucity of offerings. The greatest part of secondary butyl alcohol production was diverted to the manufacture of methyl ethyl ketone.

THE OUTLOOK

On the assumption that the European phase of the war will continue into the late summer or early fall, it may be possible to form more or less definite views regarding the outlook for solvents in 1944. It is practically certain that demand for ethyl alcohol will be substantially greater than it was in 1943. Latest estimates place total requirements for the year at 632,000,000 gallons and the prospective output is estimated at 593,000,000 gallons. Surplus holdings at the close of 1943 were approximately 80,000,000 gallons and as 1944 consumption is figured to outstrip production by 39,000,000 gallons, the stockpile will have been reduced to 41,000,000 gallons at the end of December. Since about 30,000,000 gallons are regarded as the minimum working inventory at synthetic rubber plants, arsenals, powder plants, and tankport terminals, there is no cushion for any shortages in raw materials in case of plant breakdowns.

Requirements for industrial alcohol for 1944 are classified as follows:

	Gallons
Direct military use	48,000,000
Lend-lease	59,000,000
Synthetic rubber	328,000,000
Indirect military and civilian	165,000,000
Antifreeze	32,000,000
	632,000,000

If military and lend-lease requirements are not pared down to an absolute minimum, any reduction in total needs as now estimated, will have to come from the synthetic rubber program and from indirect military and civilian allotments. As the butadiene plants which depend on alcohol are running about 150 percent of their normal, the probability is that they will require more alcohol than scheduled rather than less.

It is expected that not more than 200,000,000 gallons of blackstrap will be produced in Cuba and 40,000,000 gallons in Puerto Rico. This points to the conclusion that a large percent of alcohol production must come from grain and the grain supply will not become clear until more information is at hand regarding acreages and growing conditions.

The major problems confronting producers and government agencies in charge of the alcohol program are to make every effort to increase production of butadiene from petroleum in order to reduce requirements for alcohol; to obtain increased production facilities in time to relieve the threatened shortage; to maintain strict control over distribution so that producers of essential end products will have their requirements met, and at the same time to minimize all non-essential uses.

As it is anticipated that demand for acetone in the current year will be less active than it was in 1943, larger quantities of isopropyl alcohol should be available for general distribution which may help somewhat to relieve the shortage of ethyl. However, in order to extend the supply of methyl, it is possible that larger amounts of isopropyl will be earmarked for that purpose, so that possibly the civilian supply will not show any improvement over the 1943 position.

SULPHURIC ACID

(*Continued from page 112*)

and the producers, had grown to unprecedented levels by the end of 1942. These stocks now appear to have fallen to normal levels, and the amount consumed thus during the year seems not less than 515,000 long tons. Thus total acid from sulphur was evidently about 10,630,000 short tons (50 deg. basis).

Only a negligible amount of Spanish pyrites is believed to have entered the country during 1943. What imported pyrites was used came chiefly from Canada. However, the largest Canadian mine ceased operation during the latter part of the year. Total domestic and imported pyrites consumption is believed, however, to have been nearly as large as in 1942, so that the total has been set at 1,000,000 tons (compared with 1942 domestic production of 720,360 long tons averaging 42.6 percent S), yielding approximately 2,200,000 short tons of acid (50 deg. basis).

In 1942 the Bureau of Mines credited smelters with production of 1,120,000 short tons of acid (50 deg. basis) from waste metallurgical fumes, while the same source is author of the estimate of 98,000 short tons recovered in plants using H_2S as the sulphur source. For 1943 we estimate the comparable figures as 1,300,000 tons and 100,000 tons, giving a total 1943 production of 13,930,000 short tons, 50 deg. Bé. basis, compared with 12,518,000 tons in 1942. Of the total, about 62 percent was made by the contact process.

One possible source of confusion with the new monthly Census figures on acid production is the presentation of two sets of data, total new acid, and total new acid plus re-cycled spent acid. The re-cycled spent acid is not included in our estimates.

ALKALIS

(*Continued from page 113*)

stant. Where the oil deficiency is made up by addition of rosin, as it frequently was, it appears that the consumption of caustic is little affected, since the rosin saponifies with the production of detergent material claimed to equal or even improve on the soap it replaces.

Largest caustic increase was in the miscellaneous classification, which now includes exports, for security reasons. Exports were relatively large, while several other uses lumped here, including metals production, synthetic rubber, and explosives, all contributed materially to the total.

Chlorine production was about 22 percent larger than in 1942, so far as that part of the production reported by the Census is concerned. We have not attempted in this case to add the output of the unreported ordnance plants. Without them, 1943 evidently saw production of about 1,200,000 tons (estimated from 11 months' figures), compared with 987,784 tons in 1942. Of this total, we estimate that some 937,000 tons was produced in plants which finished the caustic soda which was produced simultaneously, while 133,000 tons was produced by electrolysis of salt, but without finishing the caustic. Finally, in addition, about 130,000 tons was produced by other processes, such as in the manufacture of KOH, metallic sodium, synthetic sodium nitrate and electrolytic soda ash.

Synthetic Organic Chemicals

For the synthetic organic chemical industry, the past year has witnessed precedent-breaking production in almost every branch of the field. Most spectacular, of course, have been the advances made by those synthetics of non-coal-tar origin. Increasing attention has been given to the use of petroleum and natural gases as raw materials for the synthesis of many industrial organic chemicals.

Production of synthetic organic chemicals, particularly those of non-coal-tar origin, continued to spiral upward during 1943. The pace, however, was not as rapid as for 1942, in which year production of non-coal-tar synthetic organics increased 141 percent over 1939 and 46 percent over 1941 to reach an all-time record of some 3,660,000 tons. The accompanying chart shows the precipitous rise of this important branch of the organic chemical industry.

PETROLEUM SYNTHETICS

Output of high-octane gasoline, largely a blend of synthetic organic chemicals, skyrocketed during 1943. Aviation gasoline production at the beginning of 1942 was at the rate of 45,000 bbl. daily; it is now in excess of 225,000 bbl. daily and will probably reach 400,000 bbl. well before the end of the year. At present, 34 units are producing aviation gasoline, and 38 more will be in production within another six months. Some 22 or more projects will be completed during the second half of 1944.

Until 1939, production of toluol in this country depended entirely on the coal-tar industry and amounted to about 20 million gallons yearly. Now, however, the petroleum industry is supplying close to 75 percent of the entire toluol output, about 90 percent of which is used in the manufacture of TNT.

Chemicals for up-grading aviation gasolines have attracted much attention during the past year. Among the more important blending agents that have received serious consideration are cumene, certain xylidines and other aromatic amines. Some of these are already in large-scale production and in use on our air fronts.

In total, the petroleum refineries of the United States are contributing enormous quantities of at least seven special products necessary to the prosecution of the war. These include (1) butadiene for synthetic rubbers; (2) toluol for TNT; (3) benzene for blending in aviation fuels and for manufacture of cumene and styrene; (4) butylenes for aviation fuels and for butadiene; (5) xylene solvents; (6) isobutylene for synthetic rubber and hydrocarbon fuels; (7) ethylene for synthetic alcohol. In addition, the petroleum industry is contributing considerable quantities of other vital chemicals, ranging from sulphuric acid to methyl ethyl ketone.

Early in 1943 the Standard Alcohol Co., affiliated with Standard Oil Co. of Louisiana, began large-scale production of ethyl alcohol from ethylene gas in a new plant at Baton Rouge. Total production of alcohol by synthetic processes last year amounted to about 55,000,000 gal. of 190-proof product. Chemical manufacturing in 1942 took about 74,000,000 gal. of alcohol, of which acetaldehyde accounted for about 45 percent, ethyl chloride for 15 percent, ethyl acetate for 13 percent, ethylene dibromide for 4 percent and synthetic acetic acid for 2 percent.

This marked trend toward the increasing use of petroleum and natural gases as raw materials for chemical products is illustrated by the very recent announcement that Celanese Corp. of America has begun construction of a new $5,000,000 chemical plant near Corpus Christi, Texas. This unit will produce acetic acid, acetone, methanol and formaldehyde from Texas petroleum materials.

CHLORINATED HYDROCARBONS

Chlorinated hydrocarbons continued in heavy demand, but the situation was eased by the new Dow units in Freeport that began producing substantial amounts of carbon tetrachloride and hexachlorethane during the year. A new duPont unit in Michigan began operations during 1942. Trichlorethylene, with an annual production now probably in the neighborhood of 100,000 tons, has become the tonnage king of this group of industrial organic chemicals. Carbon tetrachloride is second in importance tonnage-wise.

A new plant addition, making possible a 55 percent increase in the productive capacity for Freon (dichlorodifluoromethane), was announced during the year by Kinetic Chemicals, Inc. This plant addition, authorized even before a previous increase in capacity had been completed, is scheduled to begin operations during the first quarter of 1944. This chemical is in big demand as a refrigerant and as the propelling and dispersing agent in the new aerosol insecticide developed to combat the malaria-carrying mosquito on tropical fighting fronts. Demands from the armed services are heavy, but needs are not yet always available. Incidentally, this new insecticide development is believed to have a promising postwar market in household units. Civilian requirements for Freon for use in refrigeration and air conditioning equipment during 1944 have been estimated at approximately 6,700 tons.

Table I—U. S. Production of Specified Synthetic Organic Chemicals [1]

	1939	1940	1941	1942
Acetaldehyde	....	201,484,831	179,516,000	224,445,142
Acetic acid (100%)	119,652,650	186,364,384	225,671,063	264,898,632
Acetone	....	201,506,334	....	336,000,000 [1]
Acetylsalicylic acid	5,371,682	6,409,824	8,084,003	8,170,113
Amines, total	1,487,643	1,969,441	3,190,659	4,436,492
Butyl acetate, normal (90%)	....	....	....	67,024,658
Butyl acetate, total	77,734,214	86,721,057	100,381,337	....
Ethyl acetate (85%)	67,897,408	75,368,803	94,689,878	85,993,621
Ethyl ether	....	....	22,645,521	55,017,609
Formaldehyde (40%)	134,478,827	180,884,573	277,000,000 [2]	485,000,000 [3]
Hexamethylenetetramine, tech	....	....	....	15,332,993
Hydroquinone, phot. grade	1,441,329	1,288,647	1,883,611	3,005,688
Isopropyl alcohol	179,062,266	219,925,900	....	380,000,000 [3]
Methyl chloride (100%)	3,021,078	3,041,661	4,911,360	4,557,597
Methyl cyclohexanol	....	....	997,645	1,656,778
Methyl salicylate	1,684,619	1,641,571	2,577,601	2,250,124
Oxalic acid	10,416,269	12,921,227	15,851,200	15,110,276
Plasticizers, non-coal-tar	6,031,548	8,474,052	12,118,032	25,032,829
Salicylic acid	4,259,675	5,068,010	5,326,080	4,131,483
Sulfa drugs, total	....	....	....	5,434,427

[1] From U.S. Tariff Commission. All figures are given in pounds.
[2] Approximated by *Chem. & Met.* for 1941. [3] Approximated by *Chem. & Met.* for 1943.

Table II—U. S. Production of Coal-Tar Synthetic Organic Chemicals [1]

	1937	1938	1939	1940	1941	1942
Intermediates	575,893	401,943	607,175	805,807	1,006,564	1,230,965
Dyes	122,245	81,759	120,191	127,834	168,595	151,878
Color lakes and toners	18,041	14,407	18,154	19,213	26,278	17,176
Medicinals	14,800	11,097	15,188	18,214	29,775	35,318
Flavors and perfumes	4,356	3,837	5,349	5,485	9,931	7,947
Rubber chemicals	29,202	18,771	29,966	37,139	40,575	34,235
Miscellaneous	42,395	39,593	69,681	92,023	155,069	227,809

[1] As thousands of pounds. Data from U.S. Tariff Commission.

Production of pentaerythritol and hexamine (hexamethylenetetramine) for high explosives increased greatly during the past year, but the magnitude of this increase is a military secret. Hexamine is the basis for one of the principal ingredients in the so-called "block buster" bombs. Both these chemicals will undoubtedly find a ready postwar market in the plastics field.

PHENOL

Phenol production has continued to rise because of the heavy demand for its use in plastics and in military explosives. Total production of natural and synthetic phenol for 1942 amounted to about 75,000 tons, of which all but about 14,000 tons was of synthetic origin. In that year some 50 percent of phenol production went into various phenolic plastics, 11 percent into chemicals and medicinals, 17 percent was destined for export, and over 20 percent was earmarked for military explosives and other uses. By the second quarter of 1943, production of synthetic phenol was at the rate of over 90,000 tons per year. One small plant ceased operations during 1943, while another one erected in the South by Reichhold Chemicals, Inc. is now being started up.

Construction of a second plant for the manufacture of acrylonitrile was announced in May by Rohm & Haas. This unit, now in production, brings to four the total number of acrylonitrile plants in operation in this country.

A number of new organic chemical plants were constructed during the year for the primary purpose of producing various accelerators, antioxidants and other chemical agents for the synthetic rubber program. Among these plants were three units to produce phenyl napthylamine, both alpha and beta, that will have a combined yearly capacity reported to be in the neighborhood of about 15,000 tons and five small plants to make dodecyl mercaptan that will have a total capacity estimated at over 2,300 tons. A large ethyl chloride plant has been erected by duPont at Baton Rouge, while the Ethyl Corp. has built a big ethylene dichloride plant at the same location.

Total production of industrial methyl alcohol has increased to its present rate of some 100,000,000 gallons yearly, substantially twice the production in the last normal year. It is likely that a substantial quantity of methanol will be used for antifreeze purposes during 1944 to release badly-needed ethanol for butadiene and other industrial uses.

Isopropyl alcohol has now become a heavy-tonnage chemical, with production for 1943 estimated at about 65,000,000 gallons. A substantial portion of this production was converted into acetone and other chemicals. Postwar prospects for isopropyl alcohol are reported to be quite promising.

Production of all synthetic vitamins increased tremendously during 1943. Niacin and ascorbic acid are now in mass production, and a number of other vitamin products are being turned out in substantial quantities. Production of sulfa drugs, which reached 2,700 tons in 1942, increased to probably 5,000 tons during 1943. Atabrine, the anti-malarial so vital to our troops in the tropics, probably reached a production of 600,000 lb. in the last year as compared to only 600 lb. in 1941.

D.D.T. (dichloro-diphenyl-trichlorethane) has proved to be extremely effective against body lice and is being used in quantity by the armed forces.

Production data for certain organic chemicals for the third quarter of 1943 are given in Table III.

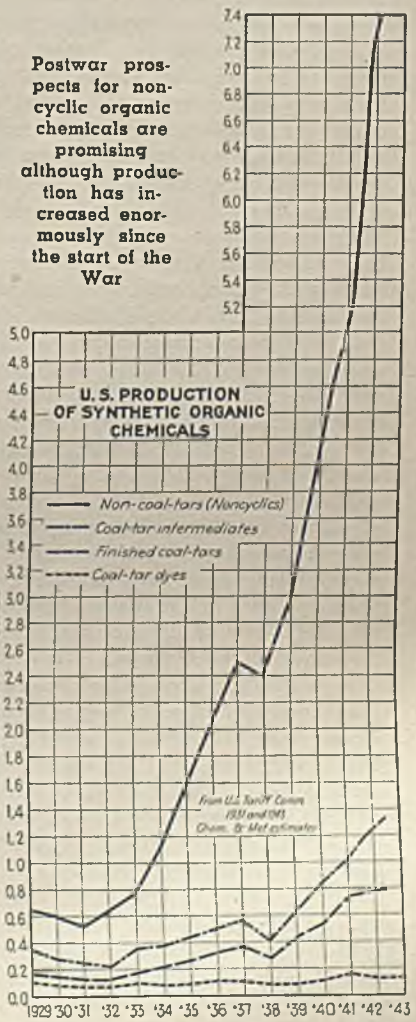


Table IV—Synthetic Organic Chemical Plants Constructed Primarily to Supply the Synthetic Rubber Program

Product	Firm	Location
Acrylonitrile	American Cyanamid Co	Linden, N. J.
Acrylonitrile	Rohm & Haas Co	Bristol, Pa.
Butene-2	Shell Oil Co	Wood River, Ill.
Dichlorethyl ether	Carbide & Carbon Chemicals Corp	S. Charleston, W. Va.
Dichlorethyl formal	Carbide & Carbon Chemicals Corp	S. Charleston, W. Va.
Diethylamine	Sharples Chemicals, Inc	Riverview, Mich.
Dipentene	Newport Industries	Pensacola, Fla.
Dodecyl mercaptan	E. I. du Pont de Nemours	Deepwater, N. J.
Dodecyl mercaptan	Hooker Electrochemical Co	Niagara Falls, N. Y.
Dodecyl mercaptan	Monsanto Chemical Co	Nitro, W. Va.
Dodecyl mercaptan	U. S. Rubber Co	Naugatuck, Conn.
Ethylene cyanhydrin	American Cyanamid Co	Linden, N. J.
Ethylene dichloride	Ethyl Corp	Baton Rouge, La.
Ethyl chloride	E. I. du Pont de Nemours	Baton Rouge, La.
Furfural	Quaker Oats Co	Memphis, Tenn.
Furfural	Quaker Oats Co	Cedar Rapids, Iowa
Hydroxylamine	U. S. Rubber Co	Naugatuck, Conn.
Isoprene	Newport Industries	Pensacola, Fla.
Phenyl naphthylamine	E. I. du Pont de Nemours	Deepwater, N. J.
Lauryl chloride	E. I. du Pont de Nemours	Grasselli, N. J.
Phenyl alpha naphthylamine	E. I. du Pont de Nemours	Deepwater, N. J.
Phenyl beta naphthylamine	E. I. du Pont de Nemours	Deepwater, N. J.
Phenyl beta naphthylamine	Monsanto Chemical Co	Nitro, W. Va.

Table III—Production of Certain Organic Chemicals, Third Quarter, 1943 [1]

	Thousands of Pounds		
	July	August	September
Butyl alcohol (normal)	10,806	11,244	10,571
Phenol			
Synthetic	16,217	15,196	15,223
Natural	2,176	2,604	2,218
Aniline	8,320	8,697	7,780
Phthalic anhydride	8,480	9,567	9,214
Acetic acid			
Natural	4,175	4,174	3,761
Synthetic	27,193	28,687	26,499
Acetic anhydride	38,500	39,253	38,337
Acetone	27,616	28,967	28,936
Formaldehyde (37% by wt.)	44,764	44,086	42,935
Isopropyl alcohol	32,932	35,030	35,399
Methanol[2]			
Natural	424	442	406
Synthetic	5,341	5,648	5,108

[1] Data from War Production Board. [2] As thousands of gallons.

Rayon and Synthetic Fibers

Considerably more rayon could have been used in 1943 than the 663,144,000 lb. of filament plus staple that was produced, despite the fact that this represented a 5 percent rise over 1942. Two facts are outstanding: rapid growth of tire yarn, and of viscose staple.

WITHOUT the impetus given by the war it is hard to guess what might have been the performance of the rayon industry in 1943. Based on the fact that there has been no recession in production since 1938, and that prior to that, there were few years which did not better the year before, it seems likely that a normal rate of growth would have been maintained. Be that as it may, 1943 was a war year when every pound of production that could be secured was needed. Rayon at present goes about 40 percent into direct war applications, about 60 percent to civilian uses. The civilian supply has become progressively tighter. Much new capacity could have been used if it had been available. Hence the increase of nearly 5 percent was remarkable not because of the growing demand it showed, but rather, because it was possible to squeeze that much more production from the industry.

To a small extent the increase came from the larger average denier which the industry produced, owing to the need for coarser yarns for many military requirements. A little may have come from new capacity for high tenacity tire cord yarns, although most of that product made in 1943 was made on equipment converted from regular production. Percentagewise the heaviest part of the increase came from viscose staple fiber, although the poundage increase of viscose filament yarn was three times as great. Raw materials shortages were felt seriously in the acetate industry, with the result that acetate experienced the first recession since 1934, and the second one in its history.

As has been the case for several years past, the production and consumption figures presented here, and summarized in the accompanying chart and tabulation, are those published by the *Rayon Organon*, as official collector of data for the industry. According to the *Organon*, total production of synthetic fibers of the types commonly described as rayon (excluding polyamide, glass, vinyl, vinylidene chloride, casein, soy protein and experimental synthetic fibers) amounted in 1943 to 663,144,000 lb., compared with 632,615,000 lb. in 1942 and 573,230,000 lb. in 1941. Compared with 1940, the last year that can be considered as little affected by the war, the increase is almost 35 percent. In 1943 this total was composed of about 75 percent filament yarn and 25 percent staple, in contrast with only ten years ago, when staple amounted to just 1 percent. Filament yarns totalling 501,125,000 lb. included 338,511,000 lb. of viscose plus cuprammonium (of which we estimate 14,000,000 lb. was cupra) and 162,614,000 lb. of acetate. Where acetate amounted to 35.2 percent of the filament yarns in 1942, in 1943 its percentage had fallen to 32.4 owing to the raw materials shortages mentioned. Staple fiber totalled 162,019,000 lb., a total which is not broken down by the *Organon*. Of this total, we estimate that about 23,000,000 lb. was acetate.

Consumption of filament and staple increased in nearly the same proportions as production. Total consumption was 656,066,000 lb. in 1943, compared with 620,624,000 lb. in 1942. In 1943 this was made up of 494,203,000 lb. of filament yarns and 161,863,000 lb. of staple, while in 1942 the components included 468,818,000 lb. of filament yarns and 151,806,000 lb. of staple.

By all odds the largest single war use for

Rayon Production and Imports, 1921–43

	Thousands of Pounds		
	U. S. Production	U. S.† Import Balance	World Production
1921	18,000*	3,276	65,000*
1922	26,000*	2,116	80,000*
1923	35,000*	3,029	97,000*
1924	38,750*	1,954	141,000*
1925	52,200*	5,293	185,000*
1926	62,575*	8,945	219,000*
1927	75,050*	14,633	267,000*
1928	97,700*	11,948	345,000*
1929	121,399†	14,832	404,000*
1930	127,333†	5,995	417,000*
1931	150,879†	1,490	470,000*
1932	134,670†	−456	509,000*
1933	213,498†	−176	660,000*
1934	208,321†	−2,432	799,589*
1935	257,557†	−2,193	932,780*
1936	277,626†	−1,558	1,022,000†
1937	321,681†	−525	1,199,000†
1938	257,916†	−1,195	990,000†
1939	331,200†	−1,703	1,145,400†
1940	390,072†	−1,440	1,143,960†
1941	451,204†	‡	‡
1942	479,330†	‡	1,447,200†
1943	501,125†	‡	‡

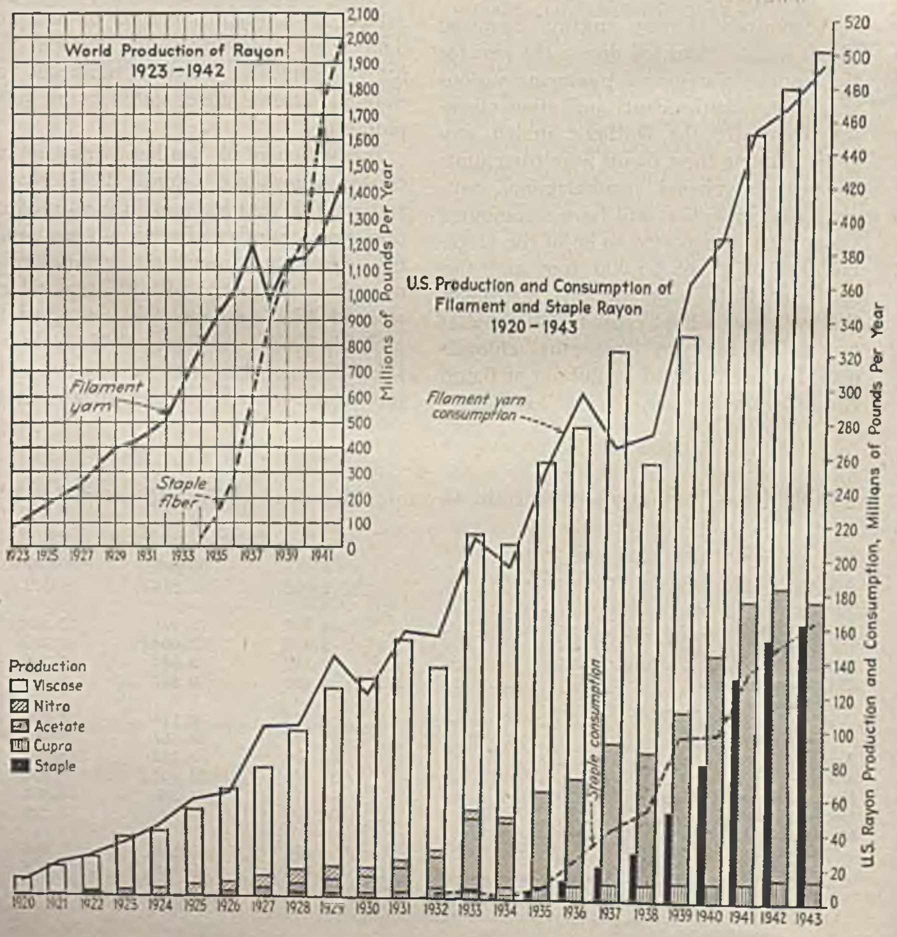
* From *Textile World* except as noted; does not include staple

† From *Rayon Organon*. Does not include staple which is estimated at 350,000 lb. in 1930; 880,000 lb. in 1931; 1,100,000 lb. in 1932; 2,100,000 lb. in 1933; 2,200,000 lb. in 1934; 4,000,000 lb. in 1935; 12,300,000 lb. in 1936; 20,244,000 in 1937; 20,861,000 lb. in 1938; 51,300,000 lb. in 1939; 81,098,000 lb. in 1940; 122,026,000 lb. in 1941; 153,285,000 lb. in 1942; and 162,019,000 lb. in 1943.

World staple estimated at 6,100,000 lb. in 1930; 52,700,000 in 1934; 139,900,000 lb. in 1935; 299,000,000 lb. in 1936; 619,000,000 lb. in 1937; 958,000,000 lb. in 1938; 1,082,000,000 lb. in 1939; 1,236,850,000 lb. in 1940; 1941 unknown; and 2,026,000,000 lb. in 1942.

Import balance does not include staple; minus sign indicates net exports; staple imports 12,721,000 lb. in 1936; 20,614,000 lb. in 1937; 23,197,000 lb. in 1938; 47,403,000 lb. in 1939; 17,736,000 lb. in 1940; and 11,600,000 lb. (est.) in 1941. Probably none in 1942 and 1943.

‡ No data available.



rayon is as yarn for tire cords, plus a smaller usage in self-sealing gasoline tanks. So important has this application become, with the approach toward completion of the synthetic rubber program, that the estimate of requirements was several times stepped up during the past year, until the program finally called for an annual capacity of 240,000,000 lb. of high tenacity tire yarns, almost equal to the total domestic consumption of filament yarns as recently as 1935. This production has been allocated among five producers. Much of it will be attained by the conversion of existing capacity, and so will represent a deduction from possible civilian use. Even so labor and equipment bottlenecks have been encountered and it will be some time before this capacity is completed. The *Organon* has estimated that 1943 production of these yarns was in the range of 50–60,000,000 lb. and that output in 1944 will be stepped up to around 144,000,000 lb. With the projected completion of the new capacity by mid-1944, the rate during the second half of the year should approach the projected capacity rate.

The year was not without its technical developments in the field of synthetic fibers, but most of what took place was under wraps, for postwar commercial development. Experimental work on the true (not cellulose-based) synthetics took place, for example among certain of the plastics which were produced as fibers, as well as coated on to fibers of other materials. It may be stated that the lines are now being drawn for the postwar battle between the regenerated cellulose and the completely synthetic fibers.

Turpentine and Rosin

Consumption of turpentine and rosin has been declining despite increased use within the chemical industry. Production has been adversely affected by shortage of labor at producing centers

Operations within the naval stores industry had been on the upgrade from 1932 to 1939 when the production curve turned downward and has continued in that direction up to the present with the exception of a moderate recovery staged by turpentine in the 1941–42 naval stores year which ends on March 31. For the 1942–43 fiscal year, production of turpentine was reported at 559,798 50-gal. bbl. which compares with 548,796 bbl. for the preceding year but was far short of the 709,218 bbl. produced in 1938–39.

Production of wood turpentine, which was only a little more than 11,500 bbl. in 1914, had been growing steadily up to the depression years and resumed its forward march from 1932 through the 1941–42 season when it reached its peak output of 263,746 bbl. as compared with 285,050 bbl. of gum turpentine produced in the same period. Of the 1942–43 total, 321,930 bbl. were credited to gum producers and 237,868 bbl. to the wood distillation branch.

The output of rosin in general has followed the trend reported for turpentine. Peak production was attained in the 1938–39 season when the total reached 2,612,391 500-lb. bbl. From that time, production dropped each year and the 1942–43 outturn was only 2,069,754 bbl. Gum rosin has maintained its position but its supremacy has been threatened by wood rosin which grew in output from 29,022 bbl. in 1914 to 1,145,955 bbl. in 1941–42 which topped the gum production for that season by 156,317 bbl. In the 1942–43 season production was divided, 1,085,873 bbl. for gum and 983,881 bbl. for wood.

In the current season the drop in turpentine and rosin production has been accelerated. This has largely resulted from a scarcity of labor and the new supply outlook became so unpromising that the Timber Production War Project which had been formed to settle lumber and pulpwood problems, was asked to extend its activities to include naval stores. This assistance has taken the form of sending field service men into the different producing sections to instruct operators in the most improved methods of expanding production. They also help in securing deferment from military service for labor now engaged and in obtaining additional crews of workers. Further help is given in the way of aiding in filling out application forms for priorities whereby needed equipment may be secured with the least possible delay. Even with this help, prospects for bringing the output up to last year's total are not regarded as bright.

Data for the first half of this season, April 1 to Sept. 31, recently were made available and show an output of 298,009 bbl. of turpentine as against 339,436 bbl. for the corresponding period of the previous season. For rosin the totals were 1,055,141 bbl. and 1,243,151 bbl. respectively. These figures show that operations in the second half of the year must be speeded up materially if the year's total is to make a fair showing.

While other factors have entered into the situation, the main reason underlying the slowing up of the naval stores industry is found in a declining market for these products. This refers not only to a lesser demand from domestic consumers but to an even larger extent to the loss in export trade. Due to the withholding of export figures in the last two years it is difficult to apportion total disappearance of turpentine and rosin between domestic and foreign buyers. Reference to earlier statistics, however, definitely establish the declining trend in over-all consumption. For instance, in 1927–28, total disappearance of turpentine was 719,256 bbl. while the figure for 1942–43 is but 427,954 bbl. Exports in 1937–38 amounted to 276,530 bbl. Disappearance of rosin in1937–38 was 2,226,206 bbl. of which 1,034,472 bbl. went abroad. In 1942–43 total consumption was 1,899,145 bbl. with no way of determining what part of this total was exported. The latest annual figures available place exports of turpentine in the 1940–41 season at 130,855 bbl. and exports of rosin at 535,128 bbl.

One of the interesting deductions which may be drawn from a study of recent naval stores statistics is found in the expanding volume of these products which is going into chemical products. This includes use in chemicals and pharmaceuticals, ester gum and synthetic resins, insecticides and disinfectants, and adhesives and plastics. Comparison for recent years is shown below.

The largest industrial use for rosin is reported for paper and paper size. In the 1941–42 crop year the amount of rosin credited to paper and paper size was 443,-

Consumption of Rosin in Chemical Products

500-lb. bbl.

	1937–38	1938–39	1939–40	1940–41	1941–42	1942–43
Chemicals and pharmaceuticals.....	119.246	123,339	163,583	116,007	251,251	258,765
Ester gum and synthetic resins......	111,812	108,611	127,036	127,230	270,477	185.329
Insecticides and disinfectants.......	4,060	3,963	5,125	3,678	5,669	5,704
Adhesives and plastics.............	17.596	11,816	17,968	16,793	23,009	17,195
	252.714	247,729	313,712	263,708	550,406	466.993

Consumption of Turpentine in Chemical Products

50-gal. bbl.

	1937–38	1938–39	1939–40	1940–41	1941–42	1942–43
Chemicals and pharmaceuticals.....	31,275	22,249	36,026	40,413	55,625	98,593
Ester gum and synthetic resins......	....	9	....	....	....	358
Insecticides and disinfectants.......	526	452	354	486	354	192
Adhesives and plastics.............	638	526	716	365	343	591
	32,439	23,236	37,096	41,264	56,322	99,734

944 bbl. which figure was reduced in the following year to 367,021 bbl. In the first half of the current season, 233,450 bbl. of rosin went to paper and paper size and if this rate is maintained over the second half, the 1941–42 peak will be exceeded. The larger use of rosin this year in the paper field in the face of a lowering in the output of paper is said to be due to the scarcity of other sizing materials, particularly starches, which have forced an expansion in the use of those materials which were available.

Soap makers have been taking an average of about 250,000 bbl. of rosin each year but so far this year there has been a trend toward increasing this amount and recent buying for soap account has been described as active. To a considerable extent this has resulted from a government directive which was issued late in the year and which calls for an increase of about 9 percent in soap output. In view of the shortage of some of the ordinary soap-making materials, the increase in production is to be brought about by changing soap formulas to increase the use of rosin and other fillers.

Prices for both turpentine and rosin have been moving upward for the last three years. Average prices for turpentine in the Savannah market are reported at 30.03c a gal. for 1940–41; 63.85c a gal. for 1941–42; 66.52c a gal. for 1942–43. For the first half of 1943–44 the average was 71.49c a gal. with indications that the average for the complete year will be still higher. Average prices for the various grades of rosin sold in the Savannah market were $4.55 per bbl. in 1940–41; $6.19 per bbl. in 1941–42; $7.59 per bbl. in 1942–43; and the average for the first half of 1943–44 is $8.71 and general direction of prices may be inferred from the fact that the average price for Sept. was $9.24 which makes it probable that the average for the entire 1943–44 season will be well over $9 per bbl.

The naval stores conservation program which had been suspended toward the latter part of the year has been made effective again. However, an attempt to obtain a money appropriation to continue experimental work along lines of increasing outputs by the use of chemicals, was denied. In making this request it was brought out that, according to tests, it was possible to increase the output per tree by at least 17 percent by applying a small quantity of caustic soda or sulphuric acid to freshly chipped streaks.

During hearings on this request for financial assistance, the Forest Service pointed out that new methods of chipping together with the use of chemicals offered about the only promise that total output could be brought up to the desired volume. It also was pointed out that war requirements called for production of 350,000 units, a unit being equivalent to 1 bbl. of turpentine and 3⅓ bbl. of rosin.

Data for foreign trade in naval stores have not been made public since the latter part of 1941 but quantities have been going out on lend-lease and in Great Britain imports are under government control which includes both the fixing of prices and allocation of supplies to consuming industries. Mexico has shipped some turpentine and rosin to this country but our imports never amounted to a large tonnage.

The position of the naval stores industry in outside countries also is difficult to appraise. France, which ranked second to the United States as a producer, undoubtedly has curtailed its output but no figures are available. Spain made arrangements to increase production in the latter part of the year but the latest statistics for that country cover 1942 when the output was reported at 14,000 tons of crude rosin, 3,000 tons of turpentine oil, and 10,000 tons of processed rosin oil.

Reported Consumption of Turpentine

50-gal. bbl.

	1943–44 Apr. — Sept. Total	1942–43 Apr. — Sept. Total
Abattoirs	0	0
Adhesives and plastics	250	313
Asphaltic products	0	0
Automobiles and wagons	141	103
Chemicals and pharmaceuticals	57,670	33,570
Ester gum and synthetic resins	6,737	0
Foundries and f'dry supplies	370	466
Furniture	130	170
Insecticides and disinfectants	95	49
Linoleum and floor covering	17	16
Matches	0	0
Oils and greases	44	14
Paint, varnish and lacquer	12,345	16,970
Paper and paper size	0	0
Printing ink	118	109
Railroads and shipyards	4,462	4,765
Rubber	83	56
Shoe polish and shoe materials	7,251	4,790
Soap	0	0
Other industries	79	141
Total industrial reported	89,792	61,532
Not accounted for [2]	Not available	Not available
Apparent U. S. consumption	Not available	Not available

[1] Included under "Chemicals and pharmaceuticals" in previous years.

[2] Principally unreported distribution of turpentine through retailers who sell in small quantities to ultimate consumers.

Supply, Distribution and Carryover of Turpentine

50-gal. bbl.

	1943–44 Apr. — Sept. Total	Gum	Wood	1942–43 Apr. — Sept. Total	Gum	Wood
Carryover April 1	288,213	213,285	74,928	156,369	86,448	69,921
Production	298,009	186,074	111,935	339,436	211,255	128,181
Imports	Not available			Not available		
Available Supply	586,222	399,359	186,863	495,805	297,703	198,102
Less Carryover Sept. 30	315,287	269,918	45,369	252,137	173,615	78,522
Appar. Total Consumption	270,935	129,441	141,494	243,668	124,088	119,580
Less Exports	Not available			Not available		
Appar. U. S. Consumption	Not available			Not available		
Carryover April 1	288,213	213,285	74,928	156,369	86,448	69,921
Carryover Sept. 30	315,287	269,918	45,369	252,137	173,615	78,552
Increase	27,074	56,633	....	95,768	87,167	8,601
Decrease	....	....	29,559	....	....	....

Supply Distribution and Carryover of Rosin

500-lb. bbl.

	1943–44 Apr. — Sept. Total	Gum	Wood	1942–43 Apr. — Sept. Total	Gum	Wood
Carryover April 1	1,605,286	1,324,796	280,490	1,434,677	1,230,817	203,860
Production	1,055,141	627,978	427,163	1,243,151	697,736	545,415
Imports	Not available			Not available		
Available Supply	2,660,427	1,952,774	707,653	2,677,828	1,928,553	749,275
Less Carryover Sept. 30	1,398,688	1,205,421	193,267	1,586,773	1,298,667	288,106
Appar. Total Consumption	1,261,739	747,353	514,386	1,091,055	629,886	461,169
Less Exports	Not available			Not available		
Appar. U. S. Consumption	Not available			Not available		
Carryover April 1	1,605,286	1,324,796	280,490	1,434,677	1,230,817	203,860
Carryover Sept. 30	1,398,688	1,205,421	193,267	1,586,773	1,298,667	288,106
Increase	....	....	....	152,096	67,850	84,246
Decrease	206,598	119,375	87,223	....	....	....

Reported Consumption of Rosin

500-lb. bbl.

	1943–44 Apr. — Sept. Total	1942–43 Apr. — Sept. Total
Abattoirs	614	188
Adhesives and plastics	11,820	11,687
Asphaltic products	1,760	2,646
Automobiles and wagons	122	139
Chemicals and pharmaceuticals	130,991	114,017
Ester gum and synthetic resins	81,860	73,536
Foundries and f'dry supplies	12,212	15,230
Furniture	9	109
Insecticides and disinfectants	3,266	2,596
Lincoleum and floor covering	8,534	24,319
Matches	892	790
Oils and greases	22,336	17,245
Paint, varnish and lacquer	77,337	73,631
Paper and paper size	233,450	176,198
Printing ink	8,554	7,994
Railroads and shipyards	6,834	1,990
Rubber	2,777	1,404
Shoe polish and shoe materials	6,769	3,569
Soap	138,783	125,250
Other industries	3,627	7,016
Total industrial reported	752,547	659,554
Not accounted for [1]	Not available	Not available
Apparent U. S. consumption	Not available	Not available

[1] Principally unreported distribution of rosin through retailers who sell in small quantities to ultimate consumers.

Fats and Oils

Domestic production showed an increase again in 1943. Demand is still above supply and will continue so during the war and for a few years thereafter. Doubling of soybean oil production was the most significant development of the year.

With the war against Japan in its third year, world supplies of fats outside of the Japanese-controlled area are still substantially under prewar levels. Although the most important phase of this shortage relates to edible fats and oils, industrial consumers of fats and oils have met considerable difficulty in fulfilling their requirements for military, naval and essential products.

However, looking back from this point, it is evident that our worst fears have not been realized, and that the picture is now somewhat brighter. Domestic production in this country was up 10 percent in 1942 over 1941 and showed another considerable increase during 1943. Improvement in ocean shipping conditions has permitted increased imports of oils and oil-bearing materials from South America, the South Pacific, and in some measure from West Africa.

While this increased production will help, it will not wholly relieve the shortage of raw materials for American industry since military and lend-lease exports are continuing to grow. Seasonably high output may have eased the situation for the present, but it is not unlikely that the domestic supply of fats and oils may become more stringent again later in 1944.

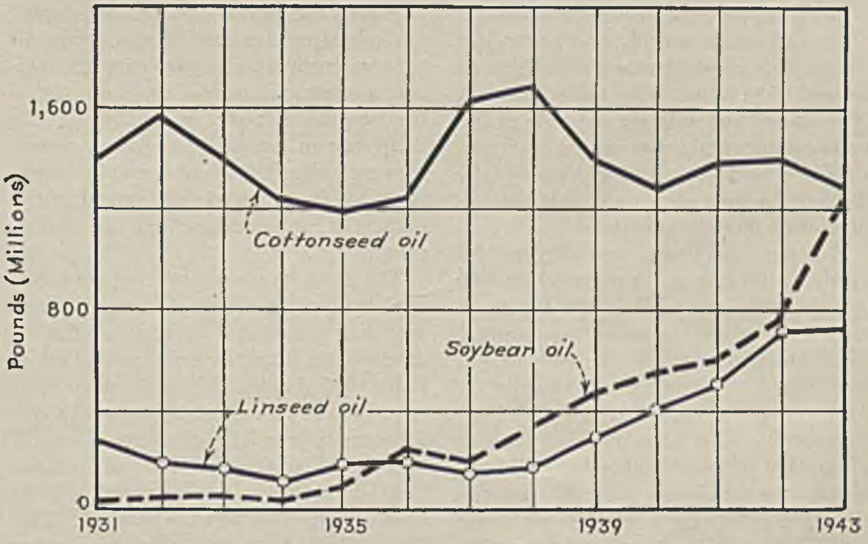
The Bureau of Agricultural Economics has estimated that production of fats and oils from domestic materials is likely to total about 11.2 billion pounds in 1943-44 compared with 10.6 billion pounds for the 1942-43 season. Factory and warehouse stocks on October 1 (the beginning of the season) were 80 million pounds larger this year than last.

Soy beans are threatening to dethrone "king cotton" as a source of oil. In the past few years production of soybean oil has risen so sharply that, coupled with a decrease in cottonseed oil production, it has come abreast of the latter and threatens to pass it. Without a doubt this is one of the most significant developments in this field.

Production of soap in 1943 amounted to approximately 2.8 billion pounds compared to 2.9 billion pounds in 1942 and 3.1 billion pounds in 1941, according to the Association of American Soap and Glycerine Producers, Inc. who base their figures on companies responsible for 90 percent of the total production. Rosin, silicates, edible lards and other materials were used increasingly as a filler when fats were not available. Use of the lards permitted the diversion of tallow into production of soaps for the synthetic rubber industry. Glycerine stocks were held at a fairly high level during the past year and permitted some easing of restrictions during the latter part of the year.

Linseed oil continues to be the main source of supply for the drying oils required in the paint industry despite other uses found for it, such as hydrogenation to an edible product for export to our Allies. Castor, oiticica, linseed, some animal oils, etc., have now been released temporarily from allocation control, indicating that somewhat better conditions may prevail this year.

Prices for fats and oils during 1943 held fairly constant at government set ceilings with only minor fluctuations and increases.



Above—Advancement of soybean oil production

Below—Factory production and consumption

	Millions of Pounds					
	1941		1942		1943	
	Prod.	Cons.	Prod.	Cons.	Prod.	Cons.
			Vegetable Oils			
Cottonseed, crude	1,392	1,399	1,386	1,385	1,312	1,323
Cottonseed, refined	1,313	1,358	1,290	1,233	1,233	1,326
Peanut, crude	150	144	77	83	146	137
Peanut, refined	137	107	76	59	128	86
Coconut, crude	318	718	111	199	143	193
Coconut, refined	303	283	98	82	66	72
Corn, crude	203	184	248	258	239	240
Corn, refined	165	65	234	115	221	118
Soybean, crude	586	507	762	722	1,226	1,139
Soybean, refined	446	403	649	570	1,026	879
Palm, crude	.....	278	.....	111	.....	60
Palm, refined	102	103	25	37	.....	3
Babassu, crude	46	42	31	22	.....	26
Babassu, refined	16	14	6	7	.....	6
Rapeseed	.....	14	.....	14	.....	20
Linseed	868	539	960	569	917	534
China wood (tung)	.....	54	.....	12	5*	12
Perilla	.....	7	.....	3	.....	2
Castor, No. 1 crude	.....	.....	.....	.....	93	43
Castor, No. 3 crude	155	90	147	91	28	27
Castor, dehydrated	.....	.....	.....	.....	16	16
Castor, sulphonated	.....	.....	.....	.....	.....	4
Sesame	.....	1	.....	1	.....	1
Oiticica	.....	.....	.....	.....	.....	3
			Animal Fats			
Lard, rendered	1,693	68	1,894	84	2,164	142
Tallow, edible	91	53	112	64	133	89
Tallow, inedible	821	1,191	920	1,342	846	1,070
Neat's-foot oil	4	7	5	8	3	9
			Secondary Products			
Stearin, vegetable oil	85	77	79	70	104	96
Stearin, animal, edible	46	31	55	40	41	37
Stearin, animal, inedible	40	18	45	13	48	19
Oleo oil	92	20	106	28	85	24
Vegetable oil foots (100% f.a. content)	127	109	126	107	179	183
Red oil	78	50	76	49	87	63
Stearic acid	56	22	52	23	59	37
Glycerine, crude	244	260	222	236	172	170
Glycerine, high gravity	88	58	110	56	96	60
Glycerine, c.p	114	42	77	32	64	28

*First 6 mo. only.

Consumption of Chemicals

Domestic production of chemicals rose sharply last year to the highest point ever reached. Consumption also touched a new high but was less than production because of large shipments abroad. The rise was principally due to expansion in military requirements.

When our defense program began to assume a definite form and later when it gave way to an all-out war effort, the chemical industry was concerned with finding an answer to the question of how high chemical requirements would go and in devising ways and means of bringing production as close as possible to the anticipated demand. With that program pretty well taken care of and with the outcome of the world conflict regarded as assured, there has been an almost general disposition to look ahead to the time when only peace-time requirements must be considered.

The most authentic yardstick for determining just how much chemical production has been expanded in the last three years is found in the index for chemical production compiled by the Federal Reserve Board. This index was recently revised in order to include all the additional capacity which has been provided whether government or private. Based on 1935–39 as 100, this calculation places the volume of output at 176 for 1941, 278 for 1942, and 378 for 1943. As the index number for some of the months was considerably above the average for 1943, it is evident that current capacities have been enlarged more than the yearly figure would indicate. As stockpiles have been built for some chemicals and large amounts were shipped out of the country without further conversion, it is equally evident that domestic consumption was materially below the production total.

Just as the earlier problem had been one of determining the extent to which production had to be increased, the current question is concerned with reversing the objective and with forming as accurate an opinion as possible about how much current capacities must be cut back so they may be in harmony with the needs of a peace-time economy. In this connection the *Chem. & Met.* index for consumption of chemicals may prove helpful since it relates only to the customary outlets to the exclusion of the temporary branches which have been war-created. To a certain degree, war influences have been felt throughout all industry partly because of buying for military account and partly because war activities have been largely responsible for the sharp rise in national purchasing power. However, these influences should be largely offset by the enforced curtailment in the output of an extensive line of civilian goods.

The index for consumption of chemicals records only a moderate advance over the preceding period and in some of the individual lines actual decreases are indicated. From 1935 through 1939 the index moved upward at an average acceleration of about 8 percent a year. Had this rate of growth been continued through 1943 the index for that year would stand at around 152 instead of the 176 actually reached. This figure affords a starting point for further projections but in such calculations the years immediately following the cessation of hostilities can hardly be called normal.

Incidentally, in looking ahead to a postwar era it may be well to look back to 1919 and the years immediately following. So far in this conflict, the chemical industry has been affected in a manner very similar to that experienced in the first world war and it may be that the parallels will hold true in some measure for the two postwar periods. In 1914 the domestic chemical industry was much smaller than in 1939 and was less self-sufficient particularly with respect to coal-tar chemicals and potash. In most other respects it was geared to satisfy consuming demands as they then existed. When we became directly involved there was added the impost of a war industry which had to be fed with a varied line of chemical products for which new plants and new capacities had to be rushed to completion.

In 1939 we had a large chemical industry, so large that many thought it could take care of any demands which might be made upon it. Yet it was large merely because it was geared to fill the huge demands which had evolved in the interim. When war requirements were added they were met by a combination of increasing plant capacities and cutting down on civilian outputs—an almost exact duplication of 1917–1918.

When the first world war terminated abruptly, large stocks of goods, including chemicals, offered a threat to the stability of the market. Yet the two succeeding years saw business reach almost boom proportions. This was followed by a sharp break in 1921 which was intensified by the fact that prices had been holding the abnormally high levels reached in the war years. The period of depression was short-lived due largely to the emergence of two new lines of manufacture which directly and indirectly stimulated production in a wide variety of fields. These industries were the mass production of automobiles and radios.

War experiences had given an impetus to research and it was not long before this became important in the steady development which chemical production enjoyed almost without a break up to the close of 1929.

In the coming postwar period, general conditions will be much in line with those of 1919. We will have large surplus holdings of materials, a surplus of capacity, the loss of wartime markets, and a drop in purchasing power. On the other side of the ledger we have a large backlog of all kinds of civilian goods and we have some new industries which are already in operation and there are many new developments of research which will quickly be converted into commercial realities. Hence, it does not seem out of order to look for a period of activity for at least a few years with the assurance that any recession will not be heightened by a collapse in values since the majority of chemicals have held at prewar levels.

Chem. & Met's Weighted Index for Consumption of Chemicals Based on

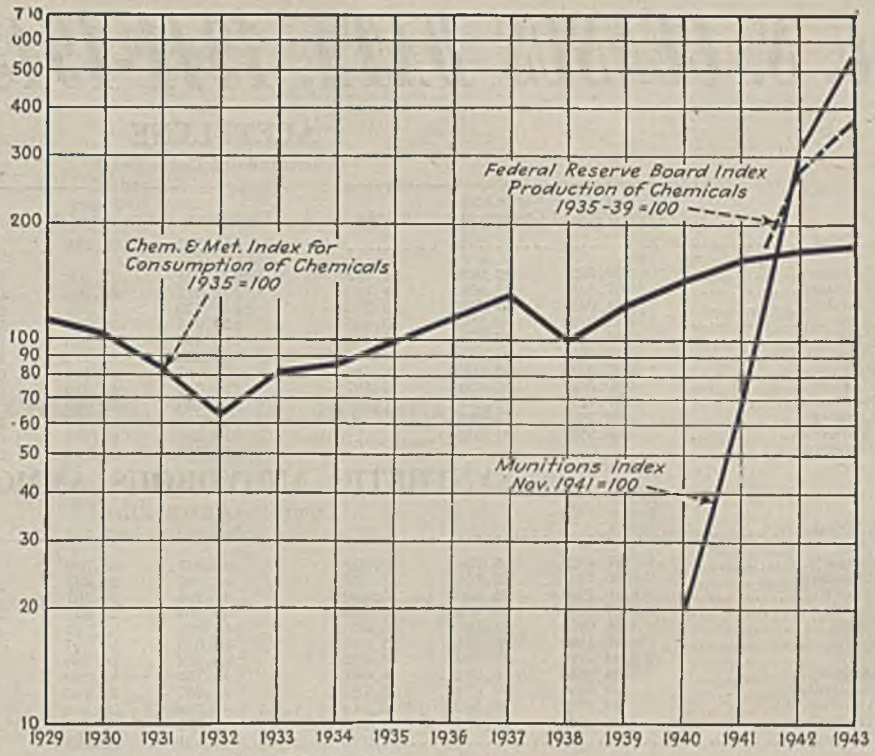
	1943											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fertilizers	40.56	41.53	40.18	38.90	40.06	39.95	37.16	40.85	38.73	40.20	40.80	42.75
Pulp and paper	20.80	18.75	19.89	19.40	19.98	18.80	18.33	18.86	18.40	18.77	18.70	17.95
Glass	18.12	16.58	18.42	18.50	19.30	18.95	18.74	20.06	18.80	20.60	18.94	18.50
Petroleum refining	14.82	13.43	14.79	14.56	15.07	15.12	15.84	16.32	16.41	16.79	16.39	16.88
Paint, varnish and lacquer	12.29	12.46	15.05	16.53	16.60	18.00	16.27	16.56	16.02	16.09	15.70	15.00
Iron and steel	13.63	12.40	13.86	13.42	13.84	13.14	13.51	13.71	13.56	13.81	13.38	13.67
Rayon	14.68	14.17	16.28	15.63	15.92	15.17	15.00	16.21	15.77	15.20	16.18	16.12
Textiles	11.48	11.07	12.58	11.82	11.47	11.57	10.74	10.86	11.10	12.32	11.13	11.10
Coal products	9.50	8.82	9.81	9.52	9.61	8.97	9.29	9.77	9.71	9.68	9.09	9.85
Leather	4.75	4.60	4.70	4.65	4.65	4.55	4.50	4.42	4.30	4.95	4.32	4.30
Industrial explosives	4.87	5.15	5.74	5.63	5.28	5.38	5.34	6.13	6.12	6.04	5.27	5.32
Rubber	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Plastics	4.70	4.45	4.60	4.60	4.80	4.75	4.70	4.90	5.10	4.60	5.10	5.30
	173.20	166.41	178.96	176.16	179.58	177.35	172.42	181.65	177.02	181.94	181.15	179.74

In reviewing the progress of chemicals last year, attention is drawn to the large increase in consumption of fertilizer products. The food program set up by government agencies called for increases in the acreage sown to grain and other foodstuffs. This in turn called for a more liberal use of fertilizer and production of superphosphate reached an all-time high which was reflected in the huge demands for fertilizer acid. An even higher goal for food outputs has been set for the current year which means that fertilizer chemicals will have to be made available in larger tonnage than in 1943. As production of fertilizer in recent months has at times been hampered by scarcity of acid supplies, this has been a factor in deciding to install new acid capacity during the current year.

The history of pulp and paper for the year is less satisfactory. In addition to a shortage of some important chemicals, the industry ran into serious difficulty in obtaining pulpwood. Shortage of labor in the woods brought a sharp drop in the cordage taken out and outputs of both pulp and paper were affected accordingly. The minimum goals for pulpwood were slightly bettered but even with a lowered minimum for this year there is some doubt about its being reached. Naturally this is unfavorable for an material improvement at pulp or paper mills.

One of the real developments for the year was the progress made in the synthetic rubber program. A high rate of output had been reached by the end of the year and this is being pushed up rapidly and this industry will be one of the large consumers of chemicals from now on. The long-term prospects for synthetic rubber are not clearly defined with divergent views held but the consensus seems to be that world consumption immediately after the termination of the war will require large outputs of both synthetic and natural. Later on markets will be divided with the percentage of each type used dependent on price and the progress made in improving synthetic so that it will be more serviceable for all-round use. In the consumption index rubber has been held at a nominal figure throughout the year but actual use was considerably higher than indicated.

The phenomenal growth of plastics has opened up an important outlet for chemicals and it has been very difficult of late to measure this growth with accuracy as official figures are lacking or are made available only at intervals. The war use of plastics has been large since some entire outputs have gone directly into war goods with none reserved for civilian products. Hence it is not clear how much of tôtal production could be classed as going into general industrial lines. The important question is whether the current rate of manufacture can be maintained when conditions return to normal. It is certain that their use in ordinary products would have been much larger had it been possible to obtain stocks.



Operations at glass works were much in line with those reported for the preceding year which means that container output continued to increase with a relatively low production of flat glass. Some improvement was made in the plate glass branch which showed up large in a percentage way but total volume was far below normal and while moderate gains may be made this year, full-scale operations will not be possible until automotive production comes into its own. The postwar prospects for flat glass are quite favorable if confidence can be placed on prognostications for building and automobiles. As the container branch is the most important from a chemical-consuming standpoint, its record production made last year a banner one which called for a record consumption of soda ash.

Soap makers have worked under the handicap of trying to keep supplies up to requirements in the fact of inadequate stocks of fats and oils. A large part of such oils as were suitable for edible purposes were channeled to refineries.

The data for rayon production and shipments are inclusive for the industry so the index number in this case does not represent industrial consumption alone. Military requirements are important and were accounting for an increasingly large percentage of total as the year advanced. The course of production continued upward. Military requirements for film and for other synthetic fibers was heavy with a consequent cutting down of offerings for the general lines of trade. It is probable that in postwar years synthetic fibers will find a market large enough to absorb production at the rate it has been going.

Productive Activities in Principal Consuming Industries, 1931-1943

1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	
18.53	11.64	17.78	18.91	19.47	22.57	28.93	23.72	25.13	28.80	31.49	37.33	........................Fertilizer
10.71	9.34	10.80	11.15	12.39	14.31	15.96	13.70	16.52	19.98	21.92	20.51	..................Pulp and paper
8.00	6.03	7.71	8.21	10.58	12.45	13.61	9.00	12.51	13.15	15.03	15.91	..........................Glass
9.77	8.93	9.37	9.74	10.51	11.61	12.87	12.68	13.45	14.08	15.20	14.43	...............Petroleum refining
8.62	5.96	6.80	8.54	10.35	10.77	11.33	9.47	10.66	11.12	15.03	14.35	.......Paint, varnish, and lacquer
5.56	3.10	4.46	5.43	7.20	8.00	9.21	5.87	8.21	10.54	12.88	13.32	...................Iron and steel
3.65	3.29	5.23	5.09	6.29	7.01	7.97	5.82	9.08	11.43	12.87	14.93	..........................Rayon
5.62	5.13	6.40	5.52	6.11	7.44	7.62	6.14	7.89	8.52	11.06	11.97	........................Textiles
5.23	3.58	4.22	4.88	5.74	7.46	9.66	5.37	7.17	8.91	9.28	9.54	...................Coal products
3.25	3.11	3.55	3.65	3.95	4.08	4.10	3.35	4.16	3.96	4.88	4.88	........................Leather
3.97	2.76	3.04	3.74	3.62	4.60	4.71	3.89	4.53	4.91	5.54	5.73	.............Industrial explosives
1.58	1.57	1.86	2.10	2.17	2.58	2.56	1.86	2.79	3.05	3.91	3.00	.........................Rubber
.82	.64	.78	1.09	1.62	1.97	2.28	1.30	2.05	2.77	3.71	4.36	.........................Plastics
85.31	65.08	82.00	88.05	100.00	114.85	130.81	102.00	124.15	141.22	162.80	170.27	

U. S. CENSUS DATA, 1941-1943

ACETYLENE

(Thousands of Cubic Feet)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	3,235,067	469,572	....	2,378,200	369,475	....
January	329,522	42,928	14,461	233,204	37,263	11,240	182,308	30,066	15,742
February	307,316	42,826	14,783	232,012	35,208	12,203	168,029	28,245	14,685
March	354,042	47,389	13,243	243,120	31,987	11,816	180,581	24,610	15,521
April	342,873	48,082	13,415	250,075	37,733	12,632	182,928	30,884	14,387
May	344,329	47,372	15,582	255,407	39,543	13,771	187,145	31,822	15,271
June	344,633	44,813	14,079	255,209	39,372	11,189	190,155	32,616	12,725
July	337,574	46,050	12,566	266,917	40,372	12,019	188,338	28,691	13,193
August	390,502	61,731	11,597	274,500	44,019	11,928	204,068	31,436	12,718
September	307,707	71,672	11,397	284,330	41,099	11,709	205,156	31,821	11,985
October	408,796	73,775	....	310,301	41,767	11,668	222,830	32,101	12,488
November	458,992	81,082	....	312,289	41,414	13,036	222,761	32,364	12,392
December	....	....	....	317,703	39,795	11,866	243,901	34,819	13,765

SYNTHETIC ANHYDROUS AMMONIA

(Short Tons 100% NH_3)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	543,352	262,442	....	501,271	274,587	....
January	47,482	25,234	6,869	45,997	25,708	3,235	43,834	25,652	5,892
February	40,724	27,754	3,892	42,085	24,332	5,003	40,865	24,137	4,794
March	46,718	28,300	3,029	44,294	24,407	4,714	43,558	24,147	5,243
April	47,161	28,433	3,028	45,502	24,832	3,448	36,214	24,719	4,463
May	45,695	24,521	2,427	45,999	19,245	4,255	42,769	24,058	5,061
June	43,198	28,825	3,001	40,068	16,817	2,425	38,972	21,004	3,450
July	44,376	33,184	4,023	40,824	16,684	3,694	40,878	20,215	3,603
August	44,398	35,262	4,081	44,755	17,320	6,017	41,512	21,709	3,656
September	42,382	33,918	2,782	45,707	21,185	6,122	41,176	20,694	4,683
October	45,770	36,560	5,344	49,766	23,868	5,746	43,387	22,622	4,647
November	46,318	38,301	4,911	48,871	23,104	5,459	43,057	21,947	4,498
December	....	....	....	49,484	24,940	3,828	45,049	23,683	5,031

BLEACHING POWDER

(Thousands of Pounds 35–37% Available Cl_2)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	67,588	15,547	....	36,569	....	....
January	5,523	496	1,154	4,661	1,079	1,169	2,457	....	2,266
February	5,865	418	1,291	4,158	1,165	915	2,451	....	1,842
March	5,856	598	600	5,481	1,267	1,305	2,868	....	1,565
April	6,188	559	569	5,330	1,178	1,158	2,934	....	1,513
May	6,042	626	939	5,355	1,408	1,164	2,702	....	932
June	5,107	574	1,565	5,432	1,427	664	2,498	....	814
July	3,928	483	1,978	5,539	1,182	863	3,015	....	792
August	4,304	493	1,371	5,672	1,314	906	3,493	....	732
September	4,630	523	1,001	5,832	1,271	1,019	3,051	....	543
October	4,724	1,528	570	6,927	1,419	1,076	3,257	....	616
November	4,987	1,605	679	6,715	1,301	1,246	3,711	....	784
December	....	....	....	6,515	1,536	1,723	4,132	....	676

CALCIUM ACETATE

[Thousands of Pounds 80% Ca $(C_2H_3O_2)_2$]

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	26,692	....	....	23,645	....	....
January	1,882	....	2,196	2,303	....	965	1,896	....	4,395
February	1,706	....	2,076	2,138	....	1,087	1,736	....	3,920
March	1,736	....	1,812	2,144	....	901	1,834	....	2,711
April	1,726	....	514	1,723	....	605	1,481	....	1,431
May	1,428	....	290	2,139	....	556	1,593	....	505
June	1,393	....	223	2,438	....	804	1,661	....	601
July	1,575	....	492	2,372	....	.,183	2,217	....	541
August	2,155	....	589	2,096	....	1,082	2,186	....	542
September	2,007	....	509	2,248	....	1,608	2,300	....	483
October	1,759	....	328	2,719	....	1,941	2,490	....	544
November	1,416	....	413	2,309	....	2,039	2,006	....	606
December	....	....	....	2,063	....	2,685	2,245	....	588

CALCIUM ARSENATE

[Thousands of Pounds 100% $Ca_3(AsO_4)_2$]

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	77,796	3,762	....	48,833	1,169	....
January	3,272	11	3,947	806	31	2,204	937	8	14,399
February	3,148	75	3,827	2,603	48	2,239	964	21	14,491
March	3,751	173	3,245	3,579	64	1,592	1,325	20	15,025
April	4,219	252	1,190	5,195	150	1,547	895	33	14,221
May	5,209	269	1,213	7,837	470	1,608	2,162	149	10,896
June	8,528	370	1,370	10,372	346	1,238	5,396	303	6,537
July	13,063	579	1,285	13,655	252	1,418	12,376	111	1,538
August	11,641	1,153	4,306	13,352	168	1,055	13,348	2	1,945
September	5,301	342	8,174	9,351	152	3,916	6,679	34	3,372
October	4,358	243	10,257	4,438	817	5,563	2,466	30	4,288
November	1,518	72	8,349	3,524	64	6,347	1,025	448	4,110
December	....	....	....	3,263	1,201	5,167	1,261	9	3,571

CALCIUM CARBIDE

(Short Tons 100% CaC_2)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	500,781	....	....	370,294	....	....
January	48,493	....	16,477	38,832	....	14,248	30,982	....	21,899
February	44,498	....	15,080	36,991	....	13,564	26,897	....	22,474
March	51,808	....	16,569	42,337	....	18,316	30,474	....	19,619
April	51,179	....	18,644	40,184	....	20,064	29,988	....	19,489
May	52,019	....	17,792	42,075	....	22,967	29,488	....	18,863
June	51,631	....	17,545	40,956	....	24,296	28,226	....	18,059
July	51,549	....	15,844	40,567	....	24,060	29,369	....	16,776
August	54,133	....	14,259	41,421	....	21,277	30,466	....	16,454
September	51,485	....	12,650	41,888	....	18,640	30,531	....	15,121
October	55,610	....	11,078	44,341	....	15,802	32,648	....	13,950
November	52,457	....	11,571	42,783	....	13,229	32,643	....	12,431
December	....	....	....	48,406	....	12,005	38,582	....	12,178

CALCIUM HYPOCHLORITE, TRUE

(Thousands of Pounds 70% Available Cl_2)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	11,321	....	....	9,953	....	....
January	1,007	....	354	856	....	418	600	....	1,153
February	870	....	572	885	....	557	663	....	1,060
March	886	....	312	1,019	....	573	830	....	1,080
April	932	....	331	1,055	....	478	767	....	956
May	953	....	454	1,078	....	488	802	....	577
June	907	....	355	1,091	....	571	739	....	368
July	1,020	....	360	879	....	594	721	....	183
August	912	....	303	863	....	152	715	....	271
September	958	....	410	792	....	411	847	....	334
October	1,176	....	622	922	....	464	1,040	....	502
November	985	....	950	998	....	366	1,059	....	371
December	....	....	....	883	....	266	1,170	....	378

CALCIUM PHOSPHATE, MONOBASIC

[Thousands of Pounds 100% $CaH_4(PO_4)_2$]

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	63,941	....	....	65,392	....	....
January	6,195	....	5,213	5,669	....	4,596	3,675	....	5,586
February	6,708	....	6,394	5,568	....	5,120	4,919	....	4,641
March	4,732	....	5,300	5,554	....	5,520	6,596	....	5,916
April	5,831	....	5,949	6,033	....	6,772	5,499	....	4,599
May	4,462	....	5,741	3,501	....	6,848	4,951	....	4,938
June	3,729	....	5,580	4,355	....	6,522	4,500	....	4,315
July	4,997	....	5,609	5,484	....	6,151	744	....	3,200
August	4,848	....	4,657	4,290	....	5,982	6,940	....	3,658
September	7,429	....	5,752	5,272	....	5,406	8,211	....	4,030
October	6,577	....	5,640	6,999	....	5,090	6,266	....	4,008
November	5,872	....	279	5,313	....	5,110	6,299	....	4,430
December	....	....	....	5,903	....	6,019	6,792	....	4,355

CARBON DIOXIDE, LIQUID AND GAS

(Thousands of Pounds 100% CO_2)

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	280,348	90,063	....	246,635	78,238	....
January	20,635	2,441	2,371	17,782	7,165	2,258	13,206	3,680	1,413
February	20,527	2,173	2,542	17,612	6,532	2,355	14,611	4,803	1,550
March	22,356	2,422	1,655	19,010	6,674	2,317	16,084	6,273	1,265
April	23,912	2,393	2,370	22,635	7,445	2,451	18,968	7,141	1,385
May	28,826	2,351	1,867	24,472	8,980	2,394	22,938	8,147	1,054
June	27,916	2,462	986	26,543	8,851	1,734	25,770	8,310	946
July	33,332	2,353	1,237	27,974	8,915	1,335	26,938	8,368	975
August	33,066	2,504	1,284	30,677	9,506	1,785	27,935	8,721	1,008
September	31,823	2,407	1,841	29,669	9,043	1,927	25,384	7,392	1,492
October	25,173	2,362	1,741	22,254	7,706	1,950	20,068	5,242	1,679
November	23,819	2,253	1,861	21,330	6,746	1,970	16,583	4,745	1,437
December	....	....	....	19,860	2,500	2,192	18,149	5,416	1,687

CARBON DIOXIDE, SOLID

(Thousands of Pounds 100% CO_2)

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	505,609	13,183	....	429,387	11,910	....
January	29,945	587	5,424	22,324	697	1,370	17,284	470	478
February	33,336	625	9,015	24,839	681	5,231	18,037	459	1,543
March	38,214	611	9,140	29,731	586	9,117	23,880	419	5,760
April	39,743	817	13,708	35,720	834	10,755	32,965	632	8,437
May	50,161	1,061	9,489	44,036	1,070	11,029	44,404	1,054	9,976
June	54,197	1,220	7,918	55,491	1,740	10,562	50,519	1,545	8,154
July	61,992	924	4,472	60,487	1,376	5,374	56,898	1,832	3,736
August	61,304	1,102	4,484	64,719	1,299	3,981	57,509	1,689	1,583
September	57,294	893	6,659	57,505	1,660	6,204	45,590	1,570	1,284
October	45,169	921	4,033	40,740	1,736	1,892	32,893	855	1,229
November	40,150	779	3,514	37,177	787	1,493	21,464	760	1,196
December	....	....	....	32,840	717	4,915	27,944	625	1,099

CHLORINE

(Short Tons)

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	987,784	557,796	....	797,976	396,079	....
January	93,742	54,080	10,717	75,279	41,399	5,692	58,425	27,680	6,089
February	88,939	52,476	10,255	70,194	38,724	5,765	56,518	26,395	5,182
March	101,631	60,435	7,961	77,785	42,619	5,047	62,494	27,456	5,078
April	99,443	62,183	7,336	77,704	44,911	5,411	60,171	28,032	3,806
May	102,005	62,641	8,053	81,605	46,482	7,377	63,092	29,188	2,366
June	97,520	57,323	7,203	82,675	43,759	7,835	67,468	31,806	3,613
July	98,409	57,979	9,353	79,506	43,317	7,704	66,259	31,551	3,709
August	100,562	59,453	6,344	81,446	44,982	6,510	69,262	35,042	4,976
September	102,631	58,447	4,126	86,111	49,710	5,881	73,164	39,423	4,878
October	109,034	61,356	5,136	90,114	52,942	5,389	69,183	39,690	4,904
November	106,420	51,830	741	90,526	52,374	6,979	72,302	39,074	5,591
December	....	....	....	94,839	56,577	8,260	79,638	40,486	5,658

CHROME GREEN

(Thousands of Pounds C. P.)

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	8,919	1,113	....	11,524	1,422	....
January	513	117	1,194	1,092	134	937	810	82	1,985
February	575	75	1,328	1,117	154	935	815	85	2,050
March	569	69	1,481	1,169	175	1,054	866	128	2,048
April	667	48	1,442	915	83	994	977	118	2,033
May	744	76	1,295	695	68	1,023	982	116	1,724
June	738	54	1,853	589	89	1,138	940	141	1,546
July	692	46	1,220	609	80	1,139	1,009	137	1,266
August	749	87	1,077	453	119	1,219	1,014	121	1,096
September	698	90	987	476	87	1,218	969	134	990
October	783	110	822	599	61	1,199	1,055	125	866
November	665	35	840	460	37	1,133	910	111	870
December	....	....	....	560	25	1,212	1,177	124	864

HYDROCHLORIC ACID

(Short Tons 100% HCl)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	297,099	189,604	....	228,270	100,805	....
January	28,297	19,024	3,324	25,063	16,339	2,815	14,986	6,977	3,136
February	25,933	17,022	3,163	23,426	14,672	3,210	13,663	6,404	3,325
March	27,844	17,753	2,647	24,566	15,761	3,023	14,255	6,486	3,365
April	28,915	18,069	2,336	22,805	15,082	3,198	15,367	7,570	2,713
May	28,504	17,506	3,027	24,692	15,556	3,268	16,393	7,648	2,787
June	26,531	16,779	2,599	24,020	14,934	3,639	19,619	9,553	2,418
July	27,707	17,183	2,060	22,495	14,491	4,137	19,506	9,651	2,777
August	28,804	17,464	2,322	23,506	14,946	3,850	20,422	10,599	2,816
September	27,955	17,557	2,825	23,960	14,933	3,381	23,436	10,983	4,183
October	30,827	17,083	3,138	27,039	17,241	2,978	22,818	12,192	2,751
November	29,698	17,329	2,398	27,754	17,888	2,817	23,217	12,742	3,425
December	....	....	....	27,773	17,761	3,432	24,588	14,776	3,073

HYDROGEN

(Millions of Cubic Feet)

	1943 Production	Made and Consumed	Stocks	1942 Production	Made and Consumed	Stocks	1941 Production	Made and Consumed	Stocks
Total	....	....	....	21,214	....	17,530	17,593	....	13,113
January	1,958	....	1,608	1,636	....	1,374	1,347	....	1,061
February	1,741	....	1,480	1,534	....	1,322	1,312	....	990
March	1,980	....	1,649	1,695	....	1,484	1,330	....	987
April	1,925	....	1,592	1,716	....	1,446	1,412	....	1,099
May	2,058	....	1,722	1,774	....	1,471	1,463	....	1,143
June	2,019	....	1,697	1,623	....	1,337	1,364	....	1,136
July	1,912	....	1,635	1,751	....	1,436	1,445	....	1,094
August	1,960	....	1,654	1,859	....	1,519	1,583	....	1,157
September	1,973	....	1,702	1,897	....	1,539	1,592	....	1,147
October	1,983	....	1,692	1,975	....	1,572	1,509	....	1,017
November	1,680	....	1,372	1,881	....	1,509	1,590	....	1,079
December	....	....	....	1,873	....	1,521	1,646	....	1,203

LEAD ARSENATE, ACID AND BASIC

(Thousands of Pounds)

	1943 Production	Made and Consumed	Stocks	1942 Production	Made and Consumed	Stocks	1941 Production	Made and Consumed	Stocks
Total	....	....	....	63,577	4,124	....	74,443	476	....
January	6,506	34	4,993	8,682	79	12,148	6,673	40	17,206
February	6,914	200	5,757	7,690	176	10,369	6,593	44	19,146
March	8,642	219	4,469	8,342	172	7,694	8,451	36	18,858
April	9,979	198	2,972	8,259	313	4,960	10,026	146	12,735
May	10,102	368	3,146	6,938	120	3,356	10,319	116	10,012
June	6,251	291	2,476	5,573	235	2,664	6,696	49	7,502
July	1,529	86	1,580	1,286	87	2,258	2,901	18	5,348
August	1,089	164	1,520	1,003	219	1,304	872	15	1,868
September	2,561	58	2,815	1,812	179	1,957	2,504	0	2,619
October	5,840	76	6,006	3,560	98	3,495	3,734	0	2,820
November	7,572	73	8,464	3,838	542	4,299	6,887	2	5,735
December	....	....	....	6,594	1,904	4,446	8,787	11	10,215

METHANOL, NATURAL

(Gallons 80% CH_3OH)

	1943 Production	Made and Consumed	Stocks	1942 Production	Made and Consumed	Stocks	1941 Production	Made and Consumed	Stocks
Total	....	....	....	5,852,706	....	....	6,024,868	....	....
January	463,665	....	655,816	495,938	....	687,201	526,637	....	750,857
February	406,884	....	667,658	514,613	....	669,092	472,754	....	709,571
March	410,091	....	653,924	541,463	....	649,395	488,474	....	630,007
April	345,106	....	605,835	491,782	....	731,062	478,466	....	640,422
May	356,206	....	563,515	449,527	....	869,505	526,368	....	685,879
June	396,641	....	580,589	525,603	....	878,010	471,859	....	652,940
July	424,022	....	581,082	428,139	....	900,261	482,189	....	663,437
August	443,172	....	542,921	439,426	....	859,909	477,702	....	591,221
September	400,492	....	384,762	456,837	....	807,746	513,504	....	648,182
October	452,658	....	303,270	523,875	....	757,390	501,624	....	658,422
November	366,620	....	261,344	534,810	....	698,438	527,143	....	711,611
December	....	....	....	450,693	....	720,869	558,148	....	700,615

METHANOL, SYNTHETIC

(Thousands of Gallons 100% CH_3OH)

	1943 Production	Made and Consumed	Stocks	1942 Production	Made and Consumed	Stocks	1941 Production	Made and Consumed	Stocks
Total	....	....	....	62,344	....	....	55,847	....	....
January	5,870	....	4,944	5,654	....	2,446	3,866	....	868
February	5,730	....	5,691	5,067	....	3,254	3,600	....	1,052
March	6,245	....	6,079	5,347	....	4,035	4,164	....	1,809
April	5,500	....	5,705	5,421	....	3,901	4,202	....	1,966
May	5,253	....	5,997	4,944	....	3,719	4,410	....	842
June	5,161	....	6,271	4,942	....	4,186	4,658	....	822
July	5,341	....	6,553	5,190	....	5,067	4,731	....	654
August	5,648	....	6,940	4,887	....	4,462	4,999	....	791
September	5,107	....	6,520	4,724	....	3,910	5,084	....	793
October	4,824	....	5,768	5,135	....	3,482	5,403	....	963
November	5,210	....	5,143	5,233	....	3,398	5,082	....	1,020
December	....	....	....	5,800	....	4,318	5,648	....	1,781

NITRIC ACID

(Short Tons, 100% HNO_3)

	1943 Production	Made and Consumed	Stocks	1942 Production	Made and Consumed	Stocks	1941 Production	Made and Consumed	Stocks
Total	....	....	....	428,624	343,451	....	347,360	289,847	....
January	34,705	26,155	9,655	31,330	26,336	11,825	27,091	23,140	11,003
February	38,581	31,254	10,028	32,089	27,204	11,185	27,069	21,736	12,116
March	39,779	33,179	8,931	32,774	27,366	10,830	25,827	21,835	12,348
April	41,392	33,576	8,572	35,367	30,519	9,857	27,103	23,101	11,160
May	38,067	29,311	8,228	37,032	31,511	9,894	28,444	23,057	11,668
June	42,465	35,145	7,712	35,655	31,180	9,406	28,502	25,227	10,906
July	43,004	34,847	8,425	35,958	26,983	10,454	29,361	25,264	10,761
August	40,895	33,530	8,284	38,083	29,440	9,709	29,570	26,156	11,114
September	42,200	33,763	7,729	37,592	26,929	10,012	29,315	24,133	10,287
October	42,211	35,936	7,621	39,264	30,267	10,387	31,496	24,574	10,720
November	42,404	37,917	8,556	38,072	27,922	11,167	32,005	24,782	11,878
December	....	....	....	35,408	27,794	13,276	31,577	26,842	12,124

PHOSPHORIC ACID

(Short Tons 50% H_3PO_4)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	617,269	567,568	....	661,504	597,985	....
January	52,123	48,334	15,911	52,497	49,802	15,374	63,377	58,388	15,515
February	49,531	46,094	15,324	55,534	49,260	16,935	58,837	54,705	15,341
March	51,382	46,957	14,494	56,388	53,813	22,267	70,015	64,736	16,248
April	53,501	47,630	15,628	60,059	51,542	16,757	56,560	55,549	14,819
May	58,446	51,231	17,463	56,307	51,371	17,372	58,073	55,200	14,971
June	53,406	47,067	17,892	53,819	45,359	22,977	51,860	44,175	15,744
July	50,201	43,259	17,774	42,283	42,058	22,020	45,359	42,219	13,076
August	56,710	49,142	20,272	42,360	38,532	19,426	47,841	38,195	12,923
September	51,926	47,900	19,462	52,216	47,311	17,779	50,255	44,400	14,738
October	52,955	49,408	16,818	51,449	49,671	18,790	53,550	46,553	15,857
November	52,790	51,107	12,551	47,019	41,641	19,694	51,095	45,148	16,371
December	....	....	....	47,338	47,208	15,374	54,681	48,717	17,093

POTASSIUM BICHROMATE AND POTASSIUM CHROMATE

(Thousands of Pounds 100% Bichromate and 100% Chromate)

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	10,125	....	....	10,518	....	....
January	989	....	1,003	887	....	1,566	835	....	946
February	883	....	826	852	....	1,690	773	....	832
March	974	....	705	838	....	1,720	973	....	507
April	933	....	669	720	....	1,751	997	....	460
May	913	....	611	848	....	1,930	924	....	501
June	662	....	661	726	....	1,947	890	....	292
July	674	....	544	521	....	1,269	799	....	295
August	730	....	610	881	....	945	943	....	635
September	726	....	575	900	....	904	745	....	739
October	729	....	815	993	....	1,010	911	....	912
November	697	....	725	976	....	1,003	839	....	1,115
December	....	....	....	1,007	....	926	889	....	1,210

POTASSIUM HYDROXIDE

(Short Tons 100% KOH)

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	35,028	7,839	....	34,641	7,938	....
January	2,987	702	2,951	3,576	822	2,113	2,459	251	1,752
February	3,018	483	3,081	3,293	762	2,543	2,126	250	1,500
March	3,479	680	3,063	3,443	862	2,622	2,390	283	1,333
April	3,481	740	3,497	3,455	858	3,519	2,678	536	1,176
May	3,408	731	2,629	3,335	906	3,314	2,730	883	910
June	3,600	775	2,425	3,464	797	4,165	2,897	847	1,028
July	3,268	788	2,130	2,953	761	4,282	3,201	813	1,009
August	3,464	753	2,433	2,452	500	4,721	3,106	813	1,200
September	3,470	746	2,401	2,078	340	4,505	3,014	744	1,178
October	3,476	726	2,152	2,113	287	4,028	3,479	870	1,187
November	3,619	809	2,242	1,980	410	3,381	3,145	796	1,174
December	....	....	....	2,886	534	3,770	3,416	852	1,441

SODA ASH, AMMONIA SODA PROCESS

(Short Tons 98-100% Na_2CO_3)

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	3,788,583	....	....	3,606,826	....	....
January	354,554	....	104,801	338,795	....	34,832	252,308	....	109,087
February	326,254	....	99,937	308,348	....	38,636	251,737	....	100,923
March	368,662	....	91,199	346,662	....	56,704	280,734	....	100,980
April	361,104	....	88,530	335,580	....	71,983	288,821	....	90,313
May	368,149	....	81,650	345,181	....	96,422	310,158	....	79,540
June	356,411	....	71,431	319,052	....	117,525	303,000	....	57,380
July	364,835	....	66,862	297,378	....	132,220	308,952	....	42,869
August	377,607	....	64,418	276,538	....	128,681	311,805	....	36,193
September	369,652	....	50,170	278,388	....	116,385	307,429	....	30,685
October	388,724	....	33,800	302,768	....	101,547	323,264	....	25,289
November	379,015	....	24,460	318,517	....	106,208	325,907	....	27,094
December	....	....	....	321,376	....	108,411	342,711	....	36,213

1943, Finished Light / 1943, Finished Dense

	1943, Finished Light						1943, Finished Dense		
January	186,393	35,412	68,453	....	....	....	110,937	5,448	36,348
February	164,038	31,976	56,281	....	....	....	109,873	5,447	43,656
March	185,773	37,219	51,040	....	....	....	120,027	6,137	40,159
April	175,334	35,335	50,657	....	....	....	123,068	6,805	37,873
May	189,389	39,992	46,897	....	....	....	119,419	4,816	34,753
June	181,356	37,891	40,136	....	....	....	118,648	4,555	31,295
July	198,197	40,283	38,283	....	....	....	108,659	4,033	28,579
August	202,136	39,148	45,430	....	....	....	114,356	5,732	18,988
September	188,607	43,542	28,366	....	....	....	121,354	4,543	21,804
October	215,363	44,341	21,633	....	....	....	112,194	2,889	12,167
November	207,553	39,490	16,288	....	....	....	110,902	2,682	8,172
December	....	....	....	....	....	....	....	....	....

SODA ASH, NATURAL

(Short Tons)

	1943 Production	1943 Made and Consumed	1943 Stocks	1942 Production	1942 Made and Consumed	1942 Stocks	1941 Production	1941 Made and Consumed	1941 Stocks
Total	....	....	....	136,172	....	....	100,734	....	....
January	10,738	....	1,966	12,843	....	3,366	10,814	....	....
February	11,542	....	2,446	11,173	....	2,810	10,877	....	....
March	14,114	....	1,932	11,918	....	1,513	10,645	....	....
April	15,101	....	2,123	11,901	....	1,297	7,159	....	13,887
May	13,242	....	1,754	11,305	....	1,393	6,503	....	13,415
June	13,745	....	1,435	11,357	....	1,465	6,698	....	154
July	13,475	....	1,074	11,128	....	939	2,677	....	11,350
August	12,974	....	916	10,901	....	1,107	11,054	....	9,307
September	14,112	....	1,515	10,752	....	992	11,458	....	7,581
October	15,380	....	2,036	10,624	....	1,106	350	....	150
November	15,337	....	2,205	10,757	....	1,132	11,374	....	4,802
December	....	....	....	11,513	....	1,054	11,125	....	3,240

SODIUM BICARBONATE, REFINED

(Short Tons 100% $NaHCO_3$)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	160,637	....	....	169,446	3,311	....
January	15,122	....	5,747	15,163	....	6,110	13,548	164	5,628
February	13,820	....	4,999	12,720	....	6,335	12,249	409	5,015
March	15,378	....	5,028	14,171	......	6,964	13,180	391	5,600
April	15,241	....	5,242	13,128	....	6,605	13,484	220	5,680
May	13,909	....	5,825	10,797	....	6,947	12,866	377	5,288
June	12,255	....	4,815	10,723	....	5,720	13,188	491	5,311
July	13,177	....	4,701	12,070	....	5,658	14,452	289	5,078
August	16,161	....	5,322	14,305	....	6,727	15,313	241	4,867
September	14,081	....	4,738	13,344	....	6,315	15,221	221	4,935
October	15,477	....	4,607	14,551	....	4,431	16,171	310	3,911
November	15,185	....	4,862	15,349	....	4,918	15,422	75	5,159
December	....	....	....	14,316	....	4,186	14,352	143	5,595

SODIUM BICHROMATE AND CHROMATE

(Short Tons 100% Bichromate and 100% Chromate)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	78,955	....	....	83,415	....	....
January	6,968	....	2,150	6,484	....	1,865	6,777	....	2,655
February	6,304	....	1,536	6,188	....	1,851	6,065	....	1,163
March	7,278	....	1,356	6,647	....	1,699	7,763	....	1,793
April	7,075	....	1,477	6,851	....	2,448	7,342	....	2,644
May	7,157	....	1,576	6,939	....	3,126	7,307	....	1,069
June	6,362	....	1,070	6,804	....	3,589	7,404	....	847
July	6,740	....	846	5,241	....	3,130	6,559	....	585
August	6,380	....	639	6,849	....	3,565	7,027	....	1,191
September	6,827	....	685	5,917	....	2,920	6,750	....	1,500
October	7,235	....	864	7,149	....	2,673	7,211	....	2,411
November	7,450	....	894	6,945	....	2,240	6,597	....	2,283
December	....	....	....	6,941	....	2,055	6,613	....	1,508

SODIUM HYDROXIDE, ELECTROLYTIC PROCESS

(Short Tons 100% NaOH)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	939,878	219,445	....	743,316	161,065	....
January	87,731	21,755	34,772	69,416	15,999	33,255	53,394	12,688	54,771
February	78,262	15,717	46,946	63,787	14,919	32,739	52,240	11,099	54,352
March	91,683	17,436	38,489	73,301	14,536	36,154	57,977	11,938	51,057
April	87,724	19,306	38,119	73,093	15,662	40,621	55,702	11,334	50,722
May	87,285	22,042	36,310	74,665	14,965	52,216	58,552	12,749	44,245
June	87,282	19,378	35,663	80,855	17,256	63,983	63,223	13,399	37,810
July	84,367	18,928	33,514	78,038	17,216	65,423	60,110	13,059	37,308
August	36,020	19,015	31,894	78,485	18,998	73,883	63,764	13,866	30,631
September	92,923	22,019	29,945	84,527	19,546	76,529	70,558	14,790	35,999
October	100,230	23,207	28,247	86,541	21,035	79,281	67,018	15,187	25,669
November	97,588	21,042	33,645	86,173	22,272	87,529	66,580	14,839	26,271
December	....	....	....	90,997	27,041	90,480	74,198	16,117	30,967

SODIUM HYDROXIDE, LIME-SODA PROCESS

(Short Tons 100% NaOH)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	634,291	....	....	685,994	....	....
January	51,933	....	29,994	60,773	....	34,688	44,638	....	51,093
February	46,184	....	28,376	61,220	....	37,906	46,604	....	49,284
March	57,033	....	28,130	64,719	....	39,122	50,547	....	48,470
April	56,083	....	28,545	59,197	....	41,759	49,978	....	44,765
May	56,695	....	26,122	52,657	....	43,551	57,318	....	35,551
June	54,946	....	24,101	47,487	....	43,657	59,736	....	31,440
July	55,578	....	20,244	46,751	....	44,305	63,833	....	33,019
August	55,609	....	15,953	45,310	....	43,274	61,412	....	29,735
September	56,723	....	15,852	45,656	....	41,370	60,285	....	26,995
October	59,803	....	16,020	48,679	....	37,461	62,352	....	26,103
November	56,871	....	17,131	49,035	....	32,643	63,310	....	30,464
December	....	....	....	52,807	....	29,426	65,981	....	33,084

SODIUM PHOSPHATE, MONOBASIC

(Thousands of Pounds 100% NaH_2PO_4)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	20,934	....	....	16,509	....	....
January	1,179	....	729	1,420	....	475	1,006	....	570
February	1,851	....	928	1,575	....	676	1,090	....	524
March	1,776	....	843	1,986	....	490	1,654	....	519
April	1,861	....	638	2,396	....	552	1,302	....	643
May	1,763	....	689	1,694	....	290	795	....	566
June	1,898	....	640	1,670	....	677	1,385	....	429
July	2,045	....	698	1,589	....	531	1,321	....	283
August	1,523	....	595	1,486	....	693	1,175	....	286
September	1,838	....	674	1,782	....	897	1,620	....	414
October	1,918	....	733	1,691	....	947	1,578	....	302
November	2,062	....	541	1,570	....	1,116	1,706	....	404
December	....	....	....	2,073	....	1,121	1,876	....	442

SODIUM PHOSPHATE, DIBASIC

(Short Tons 100% Na_2HPO_4)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	30,115	12,833	....	22,573	7,675	....
January	4,018	....	922	2,208	832	881	1,120	332	1,303
February	3,774	....	867	1,698	477	685	1,942	808	1,186
March	4,114	....	969	2,098	514	1,043	1,743	270	1,239
April	4,004	....	948	2,252	863	1,137	2,074	966	1,124
May	3,864	....	1,045	1,799	481	1,387	2,443	1,074	1,109
June	4,025	....	708	2,041	730	1,343	1,940	819	994
July	3,062	....	692	1,590	343	1,352	1,708	476	859
August	4,666	....	1,152	1,315	110	1,211	1,989	634	1,025
September	3,716	....	1,229	3,125	2,060	1,377	1,377	372	834
October	2,977	....	803	3,801	2,436	1,321	2,014	794	598
November	3,744	....	645	3,663	1,259	883	1,808	448	589
December	....	....	....	4,525	2,978	1,098	2,366	682	770

SODIUM PHOSPHATE, TRIBASIC

(Short Tons Na_3PO_4)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	78,902	2,413	....	86,315	4,044	....
January	5,140	159	2,015	7,863	246	2,698	7,029	411	6,079
February	5,197	143	1,963	7,460	199	2,457	5,184	208	3,880
March	5,757	158	1,576	6,242	201	1,914	7,847	446	3,351
April	5,992	151	1,335	6,064	152	3,178	7,487	227	4,079
May	6,242	162	1,560	6,157	165	3,776	7,650	435	4,226
June	6,282	164	1,131	4,608	112	4,568	7,189	426	4,129
July	6,709	260	1,769	6,240	157	5,965	6,904	228	2,947
August	6,038	192	1,672	4,437	233	3,105	6,726	267	2,975
September	6,076	210	1,253	4,643	166	3,919	7,517	408	3,079
October	6,337	207	1,298	5,456	119	3,063	7,599	262	3,384
November	6,399	156	1,325	5,792	379	2,785	7,296	419	3,064
December	....	....	....	5,640	223	2,347	7,889	266	4,277

SODIUM SILICATE, LIQUID

(Short Tons 40° Baumé)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	767,977	....	....	932,551	....	....
January	56,489	....	98,696	61,714	....	89,178	61,094	....	107,587
February	67,500	....	99,497	72,207	....	91,267	55,575	....	102,159
March	84,499	....	107,153	83,636	....	99,877	82,483	....	111,102
April	70,802	....	107,406	69,260	....	119,019	71,261	....	104,592
May	78,959	....	111,287	57,930	....	112,313	72,162	....	99,565
June	86,254	....	118,429	59,188	....	117,146	68,726	....	85,963
July	52,362	....	100,947	52,679	....	114,448	83,944	....	85,516
August	61,107	....	88,315	56,852	....	118,042	81,040	....	85,079
September	84,318	....	84,228	56,598	....	110,317	79,932	....	83,900
October	94,024	....	100,006	60,506	....	99,809	99,012	....	92,936
November	90,584	....	105,581	70,811	....	110,647	88,555	....	109,958
December	....	....	....	67,525	....	107,503	88,767	....	119,141

SODIUM SILICATE, SOLID

(Short Tons All Forms Combined)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	76,303	24,259	....	90,858	....	....
January	3,992	1,567	7,432	7,480	1,918	9,741	5,392	....	9,045
February	7,484	2,369	7,293	7,239	2,279	10,038	5,761	....	9,011
March	7,621	2,640	7,087	7,851	2,865	10,895	5,130	....	7,905
April	8,750	2,182	7,643	7,237	2,338	11,938	8,264	....	9,241
May	9,452	2,166	8,863	3,882	1,583	10,097	7,963	....	10,125
June	9,618	2,426	9,940	3,722	1,379	9,166	6,776	....	9,474
July	8,034	1,852	10,506	6,885	1,986	9,946	6,495	....	7,750
August	8,315	1,920	10,719	6,285	1,932	10,390	8,132	....	7,388
September	9,870	2,819	11,151	7,574	1,966	11,634	9,320	....	9,094
October	10,249	3,037	11,765	7,797	2,416	11,538	9,852	....	9,660
November	9,854	2,368	11,041	5,011	1,533	10,207	9,787	....	11,813
December	....	....	....	5,690	2,064	9,878	7,986	....	9,969

SODIUM SULPHATE, GLAUBER SALT AND CRUDE SALTCAKE

(Short Tons Na_2SO_4)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	793,409	84,461	....	721,796	79,762	....
January	65,465	6,450	47,817	72,670	7,832	15,538	56,185	5,740	48,098
February	63,786	6,733	51,425	67,798	7,152	15,613	49,223	5,501	43,589
March	68,226	6,478	51,677	72,614	6,762	17,717	55,263	6,063	39,262
April	67,972	6,818	54,097	68,663	7,553	19,601	53,984	6,212	36,792
May	67,874	6,224	59,043	73,487	6,486	23,831	54,864	6,343	36,470
June	64,449	6,848	57,209	60,755	9,477	20,891	54,307	6,380	34,034
July	63,616	5,084	55,515	59,423	8,401	20,947	55,658	6,433	27,844
August	70,593	5,765	63,315	60,841	3,699	21,976	63,683	6,655	26,638
September	67,019	5,403	65,306	60,782	5,818	21,873	65,670	7,305	19,634
October	68,899	6,088	66,004	64,454	6,767	23,538	70,180	7,884	18,732
November	69,196	6,684	67,820	63,978	7,430	25,891	69,545	7,275	17,347
December	....	....	....	67,944	7,084	27,615	73,231	7,971	17,903

SODIUM SULPHATE, ANHYDROUS, REFINED

(Short Tons 100% Na_2SO_4)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	57,735	....	....	54,248	....	....
January	3,997	....	1,363	5,894	....	1,352	4,962	....	2,464
February	5,514	....	1,404	5,036	....	1,365	3,219	....	1,226
March	6,239	....	1,491	6,004	....	1,937	4,682	....	1,496
April	5,386	....	1,770	5,566	....	1,492	2,535	....	1,228
May	5,489	....	1,613	4,130	....	1,846	2,495	....	1,295
June	5,683	....	3,453	3,425	....	1,542	3,875	....	1,234
July	5,248	....	2,812	3,839	....	1,689	2,326	....	902
August	4,550	....	4,183	4,485	....	977	6,655	....	1,221
September	5,519	....	5,210	3,911	....	812	5,590	....	1,286
October	5,400	....	5,740	4,465	....	1,184	6,274	....	1,716
November	5,402	....	5,435	5,164	....	1,158	5,774	....	2,002
December	....	....	....	5,816	....	2,062	5,861	....	1,194

SULPHUR DIOXIDE

(Thousands of Pounds 100% SO_2)

	1943			1942			1941		
	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks	Production	Made and Consumed	Stocks
Total	....	....	....	56,608	25,852	....	54,970	30,045	....
January	5,480	2,849	2,655	5,355	2,568	3,284	3,925	2,165	3,430
February	5,615	2,785	3,236	4,930	2,673	3,210	3,921	2,397	2,845
March	5,592	2,987	3,693	5,119	2,665	3,167	4,293	2,325	3,304
April	4,842	2,627	3,071	5,466	2,774	3,462	3,826	2,412	2,743
May	5,281	2,244	2,206	4,580	2,309	3,386	4,436	2,335	2,343
June	5,964	3,082	2,265	3,757	1,546	2,595	4,207	2,552	2,095
July	6,082	2,527	2,169	4,448	1,932	2,569	4,784	2,810	1,887
August	5,185	2,599	2,568	4,506	1,679	2,626	5,286	2,625	2,481
September	6,626	3,033	2,210	4,836	1,548	3,452	5,135	2,560	2,483
October	8,268	4,569	2,682	4,526	1,699	3,313	4,928	2,667	2,178
November	7,410	2,799	3,175	4,751	2,320	2,887	5,257	2,457	2,580
December	....	....	....	4,334	2,138	2,427	4,970	2,739	2,887

SULPHURIC ACID

(Short Tons 100% H_2SO_4)

Month	1943 Production: Chamber Process	1943 Production: Contact Process	1943 Stocks	1942 Production: Chamber Process	1942 Production: Contact Process	1942 Stocks	1941 Production: Chamber Process	1941 Production: Contact Process	1941 Stocks
Total	....	....	....	2,914,722	4,839,258	....	3,011,929	3,758,155	....
January	257,605	443,454	250,954	274,047	387,084	204,605	253,676	277,886	266,300
February	254,921	412,086	256,188	258,163	358,151	198,016	244,824	262,815	274,466
March	270,847	433,060	246,948	270,533	387,030	198,950	253,380	301,782	271,883
April	248,110	438,959	244,245	251,596	394,380	235,774	239,133	277,386	254,715
May	257,887	445,404	243,489	249,589	390,050	241,784	242,715	287,691	228,851
June	245,401	434,773	213,551	224,730	387,726	232,506	273,344	294,839	213,236
July	242,420	453,433	213,846	223,742	400,895	229,462	237,947	323,632	188,932
August	256,553	451,018	209,064	231,652	427,208	230,734	240,799	323,460	191,338
September	255,838	438,200	206,575	217,633	419,474	229,674	242,550	380,029	195,554
October	266,726	489,064	186,831	231,096	427,368	223,794	263,376	341,904	182,036
November	297,215	493,864	190,942	238,455	425,095	218,489	270,453	356,367	215,497
December	....	....	....	243,486	434,797	221,004	285,732	380,364	237,277

ZINC YELLOW

(1000 Pounds C.P.)

1943	Production	Made and Consumed	Stocks
January	1,210	217	1,681
February	1,698	247	1,376
March	2,491	282	1,497
April	2,175	273	1,790
May	2,286	235	1,425
June	2,391	326	1,146
July	2,324	268	1,124
August	2,101	179	829
September	2,247	153	859
October	2,348	216	670
November	2,428	198	811
December	.....	...	.....

MOLYBDATE ORANGE

(Pounds C. P.)

1943	Production	Made and Consumed	Stocks
January	72,428	652	197,172
February	125,311	1,790	207,385
March	169,942	767	232,274
April	151,094	1,094	215,979
May	186,064	3,396	238,524
June	173,031	7,279	271,997
July	145,399	8,566	240,723
August	186,224	3,504	208,262
September	146,129	2,946	185,234
October	137,198	5,028	93,785
November	131,474	3,070	119,549
December	....	.....	....

These statistics for production, consumption and stocks of chemicals were compiled by the Bureau of the Census from manufacturers reports collected for the War Production Board. These data will be continued on a monthly basis in supplemental reports to be issued as soon as data are available. The Census Bureau's present monthly survey on chemicals was started in September 1941. Initially data were requested on 56 chemicals but the number of items has been increased gradually to meet the administrative needs of the war agencies so that at present data on 228 chemicals are reported by more than 700 establishments.

Production statistics are believed to be complete except for quantities produced in government-owned arsenals, ordnance works, and certain plants operated for the government by private interests. Chemicals manufactured by the Tennessee Valley Authority, however, are included.

Footnotes

Stocks—Figures refer only to stocks held at producing plants.

Chlorine—Statistics are for all known commercial plants. Data for government-owned plants are not included.

Hydrochloric acid—Statistics are for commercial plants only and do not include government-owned plants.

Methanol—Data for natural methanol are complete for the industry but synthetic production refers only to commercial output and does not include government plants which currently produce a considerable quantity.

Nitric acid—Data are for all commercial plants and one government-owned and operated plant. Several other government plants having a large production are not included.

Phosphoric acid—Data are for all known manufacturers including one government-owned plant.

Soda ash—ammonia soda process—Total wet and dry production including quantities diverted for manufacture of caustic soda and bicarbonate and quantities processed to finished light and dense soda ash. Production of electrolytic soda ash is unimportant and is excluded.

Sodium hydroxide, electrolytic process—Production for all commercial plants. Government plants not included but they account for only small part of total production.

Sodium hydroxide, lime-soda process—Data for all commercial plants not including production at soap and paper plants.

Sodium silicate, solid—Data include production of solid meta, ortho, and sesqui.

Sodium sulphate—Seven of the plants reporting obtained approximately 20 percent of the total production of salt cake and glaubers salt from natural sources. No data are included for niter cake.

Sulphuric acid—Production statistics are for all commercial plants. Data for contact process acid include the oleum grades. Data for several large government plants are not included. While these plants currently produce large quantities of acid it is for the most part available only for military use. Most of government production is supposed to be by contact process. Data for chamber process acid include a small amount which is also included in the contact acid total due to fact that two plants drip chamber acid into their contact units in the process of producing new contact acid. Contact acid production figures include spent acid and oleum. Production for contact acid production in 1943 excluding spent acid were: Jan. 399,666; Feb. 374,670; March 393,145; April 399,208; May 405,104; June 392,915; July 412,392; Aug. 409,818; Sept. 393,846; Oct. 424,556; Nov. 423,314; Dec. not available. No similar data available for 1942 or 1941.

FERTILIZER

(*Continued from page 115*)

make this chemical for high-explosive use. The end product will be grained and coated, made by methods developed recently by Hercules Powder Co. and government chemists and engineers. The commercial production will be distributed through usual fertilizer company sales; T.V.A. output and the Ordnance production will be sold by Associated Cooperatives, Inc., under a contract with Commodity Credit Corp.

Capacity for production of synthetic ammonia in the United States far exceeds the combined requirements of military and civilian users. Several large synthetic ammonia plants have not been operating regularly and it is anticipated that some of them will not operate again until entirely new production and marketing plans are developed in the postwar period. Exact data are not yet subject to release, but it is well known that almost half of the installed capacity is commercially owned and the other half is in Government plants which are or have been operated by industrial firms under contract with the Army or its agent, Defense Plant Corp.

Some of the present surplus capacity for synthesis of ammonia could be utilized to increase the nitrogen content of mixed fertilizers if it were practical to schedule operations at all superphosphate plants in such a manner as to take regularly throughout twelve months each year the anhydrous ammonia shipped to them. However, the seasonal nature of the fertilizer business, with the shortage of tank cars to move the ammonia, give an anomalous combination of conditions. Under war conditions it seems impractical to prevent simultaneous occurrence of surplus ammonia and shortage of fertilizer nitrogen where and as we wish it. It is expected, however, that this unfortunate combination will be eliminated before the end of 1944 as better distribution facilities and expanded plant capacity can be provided.

E. W. HAYWOOD, C. L. EMERSON, JR. AND W. M. DAVIS
New England Alcohol Co., Everett, Mass.

RECONVERTING

Alcohol Production From Wartime Raw Materials

Recent improvement in coastwise shipping permitted this company to revert to Caribbean molasses as raw material after having spent considerable time and money during 1942 in changing over to the use of wheat flour. Fortunately, reconversion offered few problems and little expense. This "Off agin, On agin, Gone agin, Finnegan" experience is not necessarily typical of all chemical plant reconversion programs, but is offered here as an interesting example of what can be accomplished under the continuing pressures of wartime production.— ***Editors.***

In less than a year's time the New England Alcohol Company has gone through a complete conversion from molasses to grain and has then switched back from granular wheat flour to Caribbean blackstrap.

The reconversion was a singularly easy job. The revision to molasses as raw material, made possible by the reopening of sea lanes to the West Indies, called for no new equipment. Reconversion involved practically no capital cost with the exception of changing minor piping and cleaning up the equipment used for grain cooking. Dollar outlay was less than $2,000 as compared with an original capital expenditure for the conversion to grain of approximately $35,000. It is hoped that in this respect the case of New England Alcohol may be typical of other units in the chemical industry.

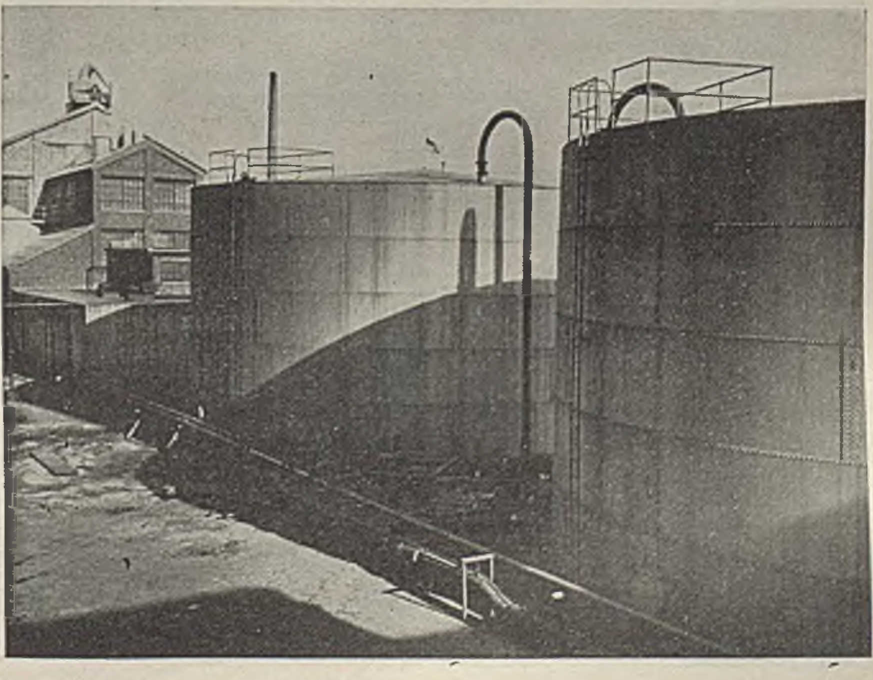
The story of initial conversion as forced by enemy torpedoing of the last cargo of molasses en route to Everett in April 1942 has already been told (See Chemical Industries, May 1943, pages 594-6). The plant was makeshift and hastily constructed of salvaged materials—elimination of critical items and speed having been the principal criteria.

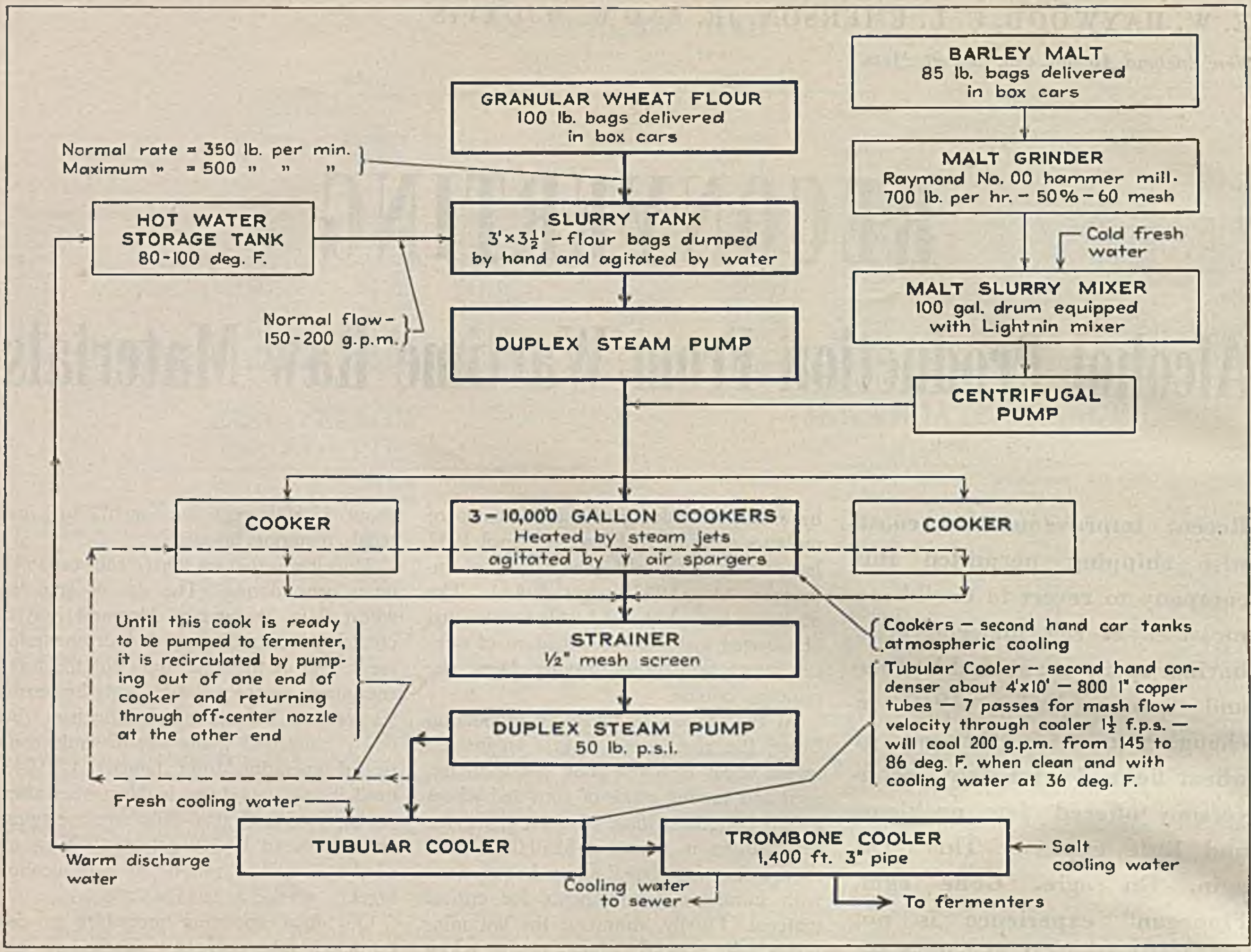
At the request of the War Production Board the company had first engineered several types of whole-grain plants to use corn and varying ratios of corn and wheat as raw material. Some of these called for expenditures in excess of $250,000—even though they were based on used equipment with minimum requirements for critical material. Finally, almost at the last minute, we hit upon the timely new development of a granular wheat-flour process and rushed through a conversion from molasses to grain-handling equipment in less than two months. The cost, as previously noted, was only about 14 percent of that for the original proposal and of this amount only about $2,500 went for construction materials requiring priorities.

Thus it was that we started the year 1943 on a new footing. The use of granular wheat flour (known as Alcomeal) saved critical grinding, storage and dryer equipment, and at the same time cut the total equipment and installation costs by nearly 90 percent. Despite initial difficulties, the newly converted grain alcohol unit continued operation from January 1, 1943 until it was shut down in November after having produced at a daily rate averaging from 8,000 to 17,500 gallons—a total of nearly 4 million gallons of war alcohol urgently needed in 1943.

Our final operating procedure as determined after several months of experience with wheat-flour mashes may be helpful and of interest to other producers who are still operating with Alcomeal or are just beginning to face the prospect of completing the cycle back to molasses alcohol.

Tanks used for storage of molasses



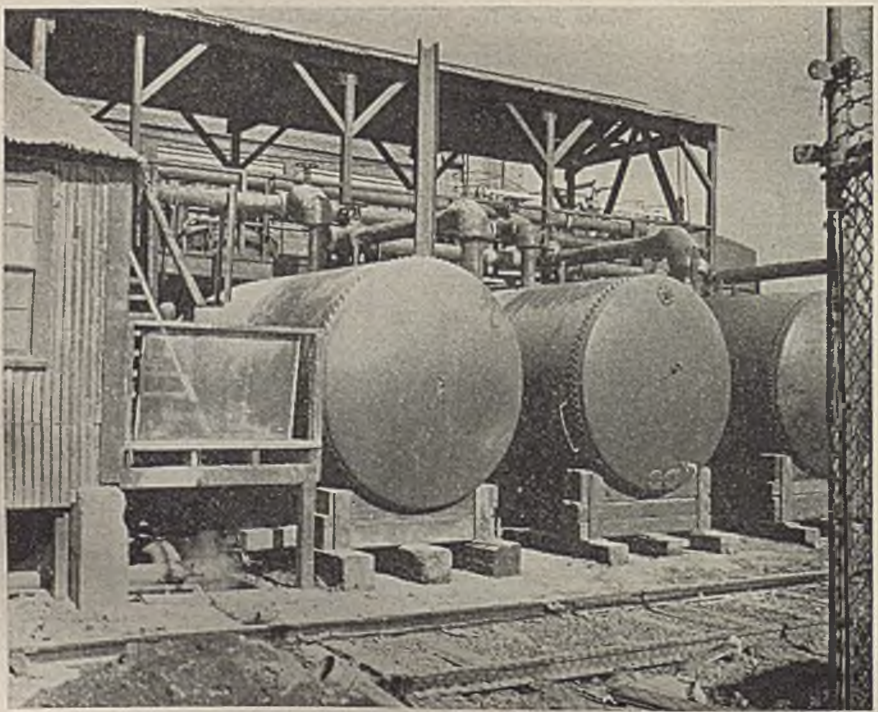


Schematic flowsheet of alcohol-from-flour process

At the outset it should be noted that carefully conducted laboratory experimentation proved of key importance to our grain operations. In previous years, the attitude had often been that trial laboratory fermentations were of limited usefulness because of the disparity between laboratory conditions and those actually found in plant operation. And it is true that during our first few months of operation with grain mashes we did run into difficulty in approximating laboratory results, due largely to infection hazards. However, this difficulty was eventually overcome by revisions in the laboratory set-up and more attention to the technical aspects of fermentation tests. Agitation during trial fermentation was obtained by motor driven stirrers approximating the Lightnin mixers used in the plant, and thermostatically controlled thermos bottles were used to insure close control of temperatures.

Our conclusion after several months of work was that the lab test results could be approximated in the plant. In those cases where discrepancies appeared, the reasons were generally discovered and corresponding modifications in plant operating procedure were made to correct the difficulty.

The following summary of our operating procedure as finally developed after many months of experience with flour fermentation is based on a recent engineering report prepared by our Engineering Department for possible help and guidance in the event that a similar cycle of conversion and



Three second hand 10,000 gal. tank-cars used as cookers

Dumping bags of granular flour into the slurry mixer

reconversion may some day again become necessary. The accompanying diagrammatic flow sheet will be helpful in following the procedures we developed:

COOKING

The granular wheat flour was received in 100 lb. bags which were dumped directly from the freight car into the wheat slurry tank, continuously mixed there with warm water and continuously pumped to the cookers. This pump (a duplex steam pump) served not only to move the material into the cookers but also to finish mixing the slurry. Such mechanical mixing proved decidedly advantageous in getting a uniform cook. The temperature of the water used in slurring should be between 80 deg. and 105 deg. F. The use of either too hot or too cold water will result in forming doughballs.

Premalt was added to the cooker before the wheat slurry was started. The premalt was mixed with cold water by mechanical stirring and pumped to the cooker in the ratio of 1.8 lb. premalt per 100 lb. wheat as received. Only enough water was used to move the malt to the cooker.

As the cooker filled, it was heated with open steam to 70 deg. C. and held for forty-five minutes at this temperature. The full cooker contained approximately 8,000 gal. of wheat slurry. A slurry concentration of 1.79 lb. granular flour per gallon slurry (14,300 lb. per 8,000 gal.) gave satisfactory cooking results. A concentration of 1.82 was found liable to thicken into a slurry very difficult to handle.

MALTING

The malt was received in bags, ground in a Raymond hammer mill and mixed with water in a 100-gal. drum equipped with a ½-hp. Lightnin mixer. The resulting slurry was pumped by a centrifugal pump to the cookers. Grinding rate was about 700 lb. per hour. Screen test of ground malt: approximately 60 percent through 60 mesh.

Before main malting a cook, two control steps proved necessary: (1) to adjust the pH to 5.65 and (2) to lower the temperature to 65 deg. C. To aid conversion during cooking, limestone, oil and vitriol and calcium acid phosphate were added to the cooker in the proportions 7.15, 5.70 and 2.85 parts per 100,000 respectively. These proportions proved right for the particular type of water available locally and would, of course, vary depending upon hardness elsewhere.

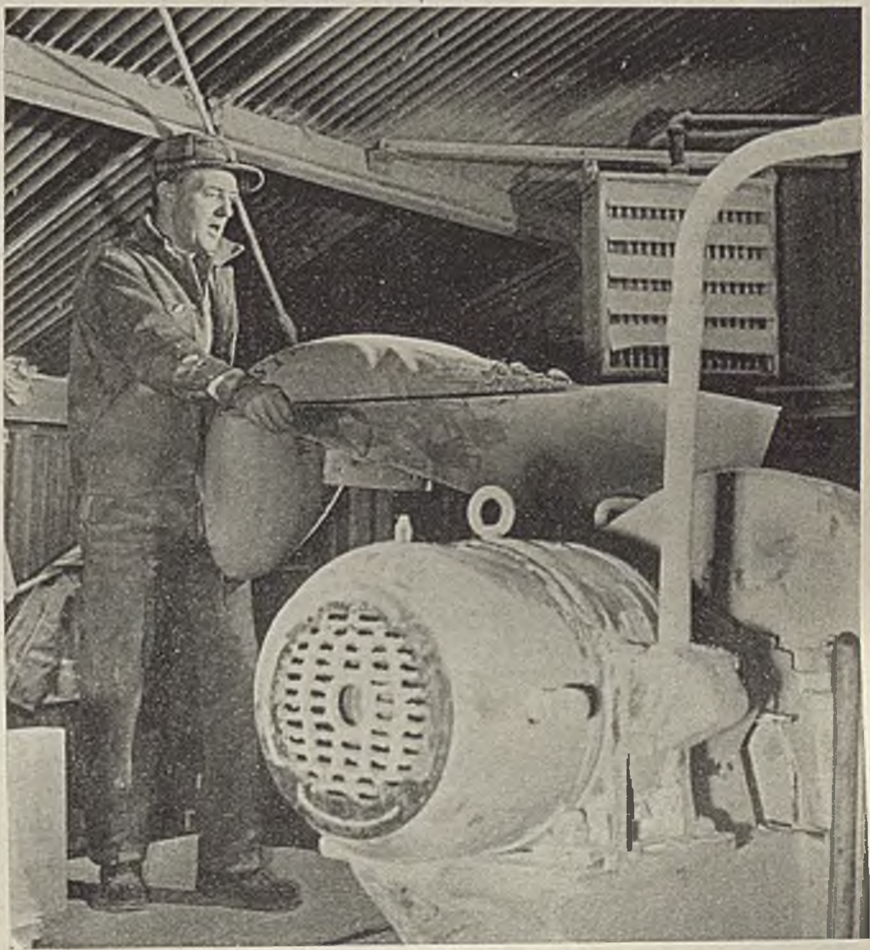
Any malt added to the cooker above 65 deg. C. seemed to have little effect in converting starch to maltose. Hence, the cooker was cooled to 65 deg. C. by addition of cold, fresh water. The main malt was then added with enough water to lower the temperature to 60-62 deg. C. This main malt was added in the ratio 6.0 lb. per 100 lb. of wheat as received. The contents of the cooker were then circulated by pump recycling for five to ten minutes, after which the cook was ready to be pumped to the fermenter.

Air agitation was found necessary during cooking and malting, both for maintaining uniform temperatures and for mixing the materials added. The ground malt was found to vary considerably in fineness as the screens of the hammer mills became worn. No noticeable effect on efficiency was found until whole grains began to appear in the ground malt. At this time the malt screens were replaced. Freshly ground malt proved preferable for main malting but was not found to be of paramount importance for premalting.

FERMENTING

The mash from the cookers was pumped through the trombone cooler followed by a tubular cooler and entered the fermenter at 85 deg. to 86 deg. F. Fouling of the inside surfaces of these coolers was serious, resulting in decreased cooling capacity and giving rise to acid forming infection in the mash. A daily washing with antisepticized boiling water was found necessary. An occasional wash with 1–2 percent caustic solution was found to help heat transfer, but the routine use of caustic for washing seemed to effect efficiency adversely.

It was found desirable to avoid splashing upon entry to the fermenter tanks in-



Unloading malted grain into the hopper of a malt grinder

Cookers and pump used to transfer cooked slurry

asmuch as this caused excessive foaming. This was corrected by removal of the splash plates near the top of the fermenters.

Seven cooks were used to fill a fermenter, a 4.5 to 5.0 percent yeast seeding being added with the first cook. No acid was added to the mash. A fermenter filled in seven to eight hours finished filling at a pH of 5.0 to 5.2. This high pH seemed necessary to get the secondary conversion of starch to maltose, which conversion probably proceeds for at least another twenty-four hours in the fermenter.

Yeast food in the form of ammonium sulphate and calcium acid phosphate was added to the fermenter during filling. Each salt was added in a concentration of 0.017 lb. per gal. of mash (120 lb. each per fermenter). This food was added by hand sprinkling at various intervals during the filling time and proved necessary in order to get a sufficiently vigorous fermentation started to inhibit bacterial growth.

Foaming in wheat mash cooked at low temperature reduced fermenter capacity. It was found that it could be partially controlled by use of a defoaming agent, added when the fermenter was about three-quarters full.

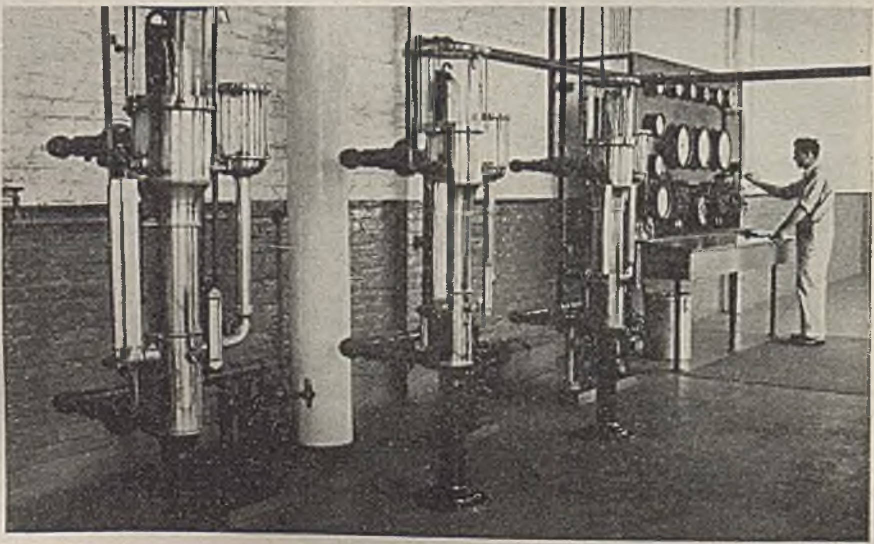
Best fermentation efficiency was obtained when the temperature of the fermenter was allowed to rise gradually during the first forty-eight hours to 91 deg. F. Cooling seemed necessary during this period but not after forty-eight hours.

Water usually was added to the fermenter during the first forty-eight hours. It was possible in this way to secure higher capacity because it permitted the use of a more concentrated mash inasmuch as sufficient space at the top level of the fermenters could be provided to allow for initial foaming. After this initial foaming had subsided it was then possible to add the remaining water requirement. This method also had a tendency to increase the fermentation rate, and at the same time assist in controlling the temperature of fermentation.

Thorough cleaning of fermenters was necessary before each filling. Each fermenter was washed, sprayed with a solution of sodium hypochlorite containing three parts of a 12 percent solution per thousand parts of water, and then steamed to 160 deg. F. within two hours of starting to fill. Mash lines and yeast lines were also steamed before and after each using. It was found that dead pockets must be eliminated from these lines, particularly from the mash line, since otherwise, harmful infection will develop rapidly.

All of the company's fermentation experience as described in the foregoing discussion was obtained under the following two conditions: (1) The yeast was grown in molasses mash, and (2) the molasses used was high test or commingled molasses. The company had no experience with grain yeasting. In the case of a blackstrap molasses yeasting, previous experience has shown that the optimum salt concentrations in the fermenter would be considerably lower than those given above and temperature control during fermentation would be somewhat less exacting.

Gage and control system for final alcohol



YEASTING

Proper control of the yeasting operation is important for three reasons: (1) Acid forming bacteria which develop in the yeast act to lower fermentation efficiency, (2) correct conditions in the final yeast can lower fermentation time and thereby increase plant capacity and (3) with weak yeasting, bacterial growth is greatly increased in the fermenter.

To eliminate bacterial growth, all yeasting mash was boiled before cooling and inoculating, and all transfer lines were steamed before and after each yeast transfer. Lines not in use were kept drained by means of bleeders. Between fillings, tubs were washed, treated with the same strength of sodium hypochlorite solution used in the fermenters, then heated with live steam to 212 deg. F.

In yeasting, a batch of 3,000 gal. of molasses mash at 15 Brix was dropped to the tub, boiled, cooled to 86 deg. F. and innoculated with yeast. Ammonium sulphate and calcium acid phosphate in the concentration 0.007 lb. of each per gal. of mash were added together with sufficient acid to lower the final pH of the tub to 3.8. Attenuation in the tub was controlled by time and temperature, an attenuation between 35 percent and 65 percent being considered satisfactory.

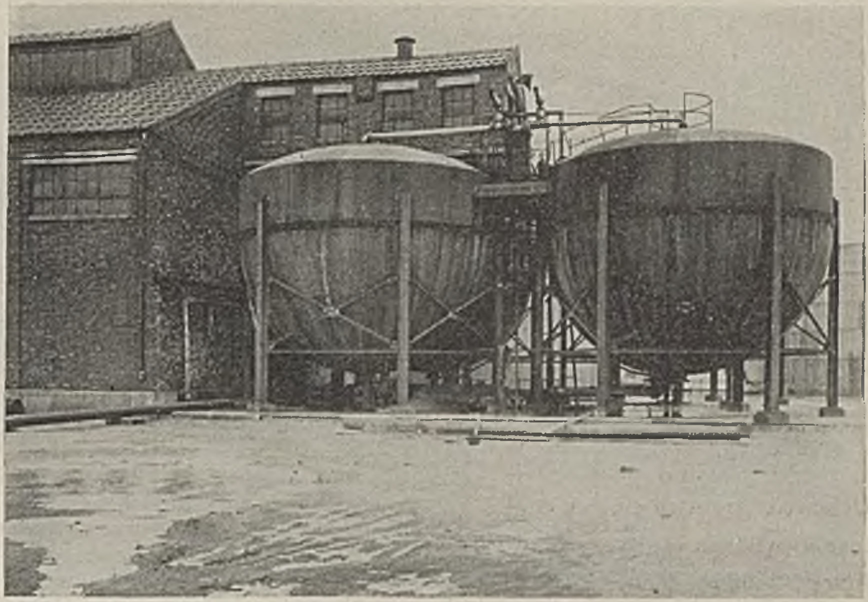
The yeast used on granular flour mashes was Seagram's No. 31 strain. Salt and acid concentrations in the machines were the same as in the tubs. Methods of handling the machines were standard.

DISTILLING

The major difficulties involved in distilling the beer produced in this process were (1) fouling of the beer column by included solids and (2) removal of the fusel oil produced in the fermentation because of greater relative quantity produced.

Malt husks and glutinous material left from the fermentation formed the substance which fouled the beer column. This fouling was rapid and the usual methods of cleaning seriously cut distillation capacity. A method of washing the beer columns with a 1 percent caustic solution was suggested and proved very satisfactory. Using this caustic wash, a scheduled time loss of about eighteen hours a month was necessary for cleaning the beer columns.

Fusel oil was produced from beer at the rate of about 0.5 percent of the total 190 proof production. Frequent bleeding of fusel oil section of the rectifying columns was found necessary to keep the fusel oil concentration down to a workable level and maintain the proof and quality of the extract. Infection in the beer was not found to affect extract quality, but this is a possibility in handling this material.



75,000 gallon outdoor fermenters at the New England Alcohol Company's plant in Everett, Mass.

YIELDS OBTAINED

Final yields obtained during the last full month's operation in October 1943 after the company had carried through its experimental development program were approximately as follows: 4.93 wine gallons of 190 proof warehoused ethyl alcohol (after all losses) per 100 lb. of mixed grains (approximate ratio 93 percent Alcomeal, 7 percent malt). Or, if expressed on a bushel basis, the yield was 5.25 proof gallons per 56 lb. bushel of mixed grains. In both cases, alcohol equivalent to 1 gallon of 190 proof per 14.8 lb. of sugar (in the molasses used for yeasting) was deducted from the total warehoused alcohol to give yields as expressed above.

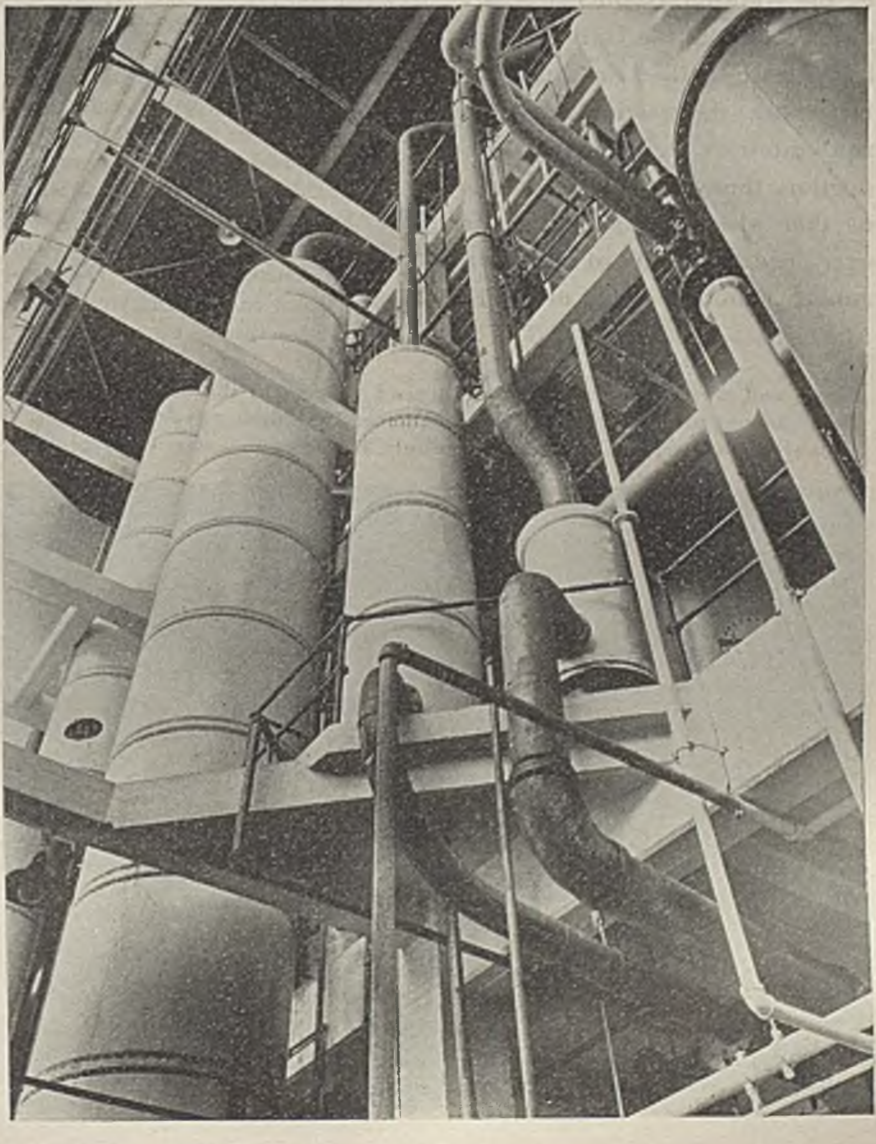
During the entire 10 months' operation most yields ranged between 4.6 and 5.1 wine gallons of 190 proof warehoused ethyl alcohol per 100 lb. mixed grains, although occasional fermentations went considerably lower, largely as a result of infection which was the major source of difficulty.

Yields of fusel oil ranged approximately twice those secured in conjunction with production of ethyl alcohol by fermentation of molasses.

The company hopes that the foregoing account may be helpful to others who may be experiencing similar problems.

The company wishes, as it has on past occasions, to make full acknowledgement to the Chemical Division of the War Production Board, and particularly to the Technical Staff and executives of the E. I. du Pont de Nemours Company for their helpful cooperation which was of great assistance in meeting and successfully overcoming many new problems encountered in the company's conversion of its alcohol plant from a molasses to grain as a raw material.

A view in the distillation building



JAMES A. LEE *Managing Editor, Chemical & Metallurgical Engineering*

AMAZON BASIN

As a Source of Rubber

Diseases, great distances making transportation costly, lack of sufficient food and fuel, poor soil, and the fact that rubber trees average only one to an acre of difficult jungle country all tend to make the collection of rubber in the Amazon Basin extremely difficult. While the United States has been justified in spending large sums in assisting the Amazon countries in increasing production, these obstacles convince us that when the emergency is over procurement of Amazon rubber should be left to South Americans.—*Editors.*

Imports of natural rubber from the Amazon Basin in 1943 were about 13,000 long tons, which compares with 6,000 tons for 1942 or an average prewar year. In the current year there probably will be a modest increase but it is not likely that there will be any further improvement in the near future. In addition to these imports of crude rubber, approximately 3,300 tons of rubber content of tires and tubes were made available by Brazil during the year to supply part of the essential requirements for tires and tubes of the South American Republics and the United States. Numerous difficulties will continue to prevent any great change in the rubber procurement program in this area. Therefore, the United States can expect to get but a small fraction of its natural rubber requirements from the South American nations. This conclusion is based on first-hand observations made by the author during a recent 15,000-mile trip under the auspices of the Rubber Development Corporation, through the rubber growing areas of Brazil and Bolivia.

Many and varied are the factors that tend to prevent the collection of a large amount of natural rubber in the Amazon for shipment to this country. This seringueiro can collect latex from only 150 trees in a day. CIAA photo

We left Miami, Fla., in a plane which took the party via Haiti and Puerto Rico to the Amazon Basin. This was the original home of the hevea tree from which we get most of our natural rubber. Here the rubber trade flourished and great fortunes were made until the early years of this century when the plantations of the East Indies came into bearing and almost ruined the Amazon wild rubber trade. However, the United States continued to get some rubber from South America. In the period from 1930 to 1941 there were imported on the average 6,000 tons a year from these countries.

Then came the Japanese control of the plantations of the Orient and our desperate quest for rubber. Naturally, we turned to the Amazon. Early in 1942 a basic rubber agreement was signed between the governments of Brazil and the United States. Ours obligated itself to buy all rubber produced in Brazil up to Dec. 31, 1946 at an agreed price. Brazil assumed responsibility for purchasing all rubber and turning over the exportable surplus to the United States.

In Bolivia the Rubber Development Corp., an agency of the United States Government, deals directly as a private corporation with the big rubber landowners, such as Carlos Seiler and the Suarez family, without having to go through such intermediary organizations as were established in Brazil.

The early planners of this great Amazonian project had grand ideas. They proposed to attack the problem by putting into the field an elaborate organization, disregarding the established commercial system, going directly to the seringueiro or rubber worker and in effect engaging in the management and production of rubber in all its phases and in connection there with adopting measures designed to bring about a radical change in the standard of living of the seringueiros and in the social conditions in the Amazon.

In typical American fashion supplies were ordered on a grand scale. 26,000,000 tin cups for collecting latex were ordered, 7,065 sewing machines for the wives of the seringueiros, 78,223 shotguns, and vast quantities of machetes, stoves and fishing tackle.

Tons of flour, salt pork and hard beans were sent up the Amazon. The flour and pork spoiled and the native seringueiros wouldn't eat the hard beans. We acquired several obsolete Chesapeake Bay steamers which were lavishly reconditioned—providing certain sanitary facilities thereon for rubber workers, who were ignorant of the use of such refinements of civilization, even in the somewhat cruder style immortalized by Chic Sales. One scheme called for the construction of a chain of 25 airfields on the theory that a network of air bases would open the rubber territory; a yacht was bought for the use of the officials.

From Apr., 1942, to Jan., 1943, the natural rubber program was under the joint jurisdiction of two agencies of the United States government. Upon the formation of the Rubber Development Corp. on Feb. 23, 1943, control over both policy and operations was centered in one agency of the government. Pres. Douglas H. Allen, long familiar with the Amazon country and its people as head of a firm of importers of mahogany and other products, adapted a policy of hard-boiled realism. He and his RDC organization have pursued a policy of spending whatever amount may be required to bring about the maximum production of natural rubber while liquidating projects not immediately and necessarily related to the production of rubber for war use, eliminating unnecessary expenditures and reducing American personnel in the field to the lowest possible minimum.

While informed Americans and Brazilians assert that there is still some waste and inefficiency in the rubber set-up, its officials have gone a long way towards putting it on a sane basis.

The actual gross disbursements of the Rubber Reserve Co. and its successor, the Rubber Development Corp., on the wild rubber program in the Western Hemisphere from its inception in 1941 to Oct. 31, 1943, including cost of rubber purchased, plus development expenditure, capital investments, loans, operating and administrative expenses of RDC and all other applicable disbursements aggregate $78,208,195, according to testimony of Allen before the Gillette Committee of the U. S. Senate. No deduction has been made for cash in banks in Latin American countries, or for inventories of tappers, supplies and equipment, and of foodstuffs held for sale, or for inventory of tires and tubes. The value of the tires and tubes alone amounted to nearly $5,000,000 as of Oct. 31.

CIAA photo

Ford has the only rubber plantation in South America. Near the Amazon he has 17,000 acres planted. A yield of 6,000 to 7,000 tons may be reached.

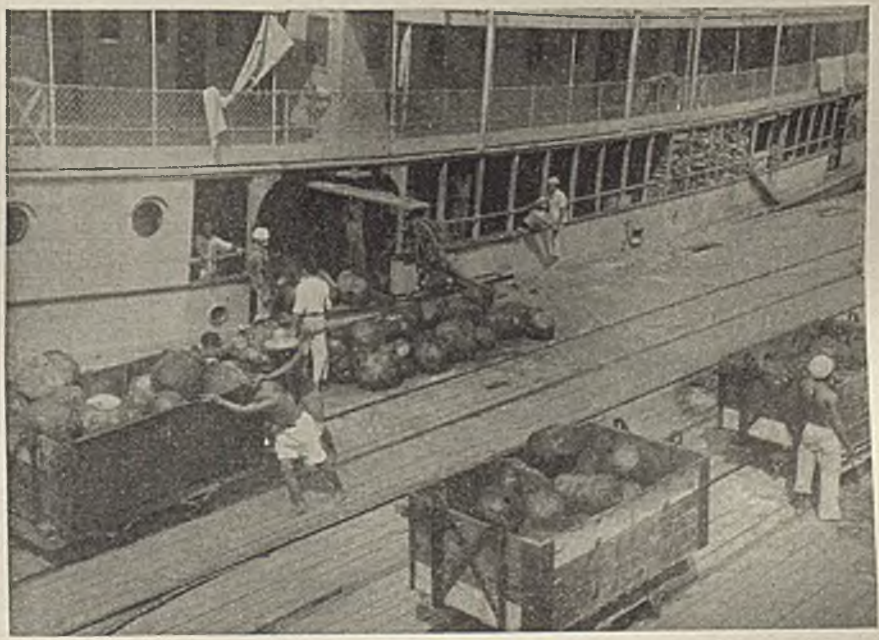
It is estimated that on Dec. 31, 1943, the total of all such disbursements, plus obligations due but not paid approximated $83,162,823. Out of this total, approximately $59,710,477 have been expended in the Amazon countries.

Imports from the Amazon from April, 1942, to Dec. 31, 1943, including rubber content of tires and tubes, approximated 23,700 tons. Charging against these totals the total expenditures from April, 1942, to Dec. 31, 1943, gives a cost of $1.12 per lb. for wild rubber. Allen estimates that the average cost of rubber that will have been received from the Amazon during the period of the contracts (1941-1947) will be less than 76c. per lb. after charging into the cost of the rubber all expenditures of every kind.

While he expressed the opinion that much larger imports could be expected in 1944 several Brazilians and Americans in South America told us that they were convinced the figure would be lower. My observations lead me to expect only a small increase at best. In fact, this year's production may be the largest for many years. When Uncle Sam withdraws his support, wild rubber production will not be able to compete with the natural rubber from the plantations of the East Indies and the synthetics of the United States.

Many and varied are the factors that

Transportation is a problem of great distances. It sometimes costs as much as 7c. per lb. to take the rubber to Belem from which it is shipped to the U. S.



tend to prevent the collection of a large amount of natural rubber in the Amazon for shipment to this country. Among the most important are lack of sufficient rubber collectors, lack of transportation facilities for supplies to the seringueiros and for conveying the rubber to the points of shipment to the states, great distances the rubber must be carried, lack of sufficient food and fuel, poor soil, tree and human diseases, and the difficulties encountered in collecting the rubber latex.

SERINGUEIRO'S TASK NOT EASY

Seringueiros live along the rivers in houses built entirely of jungle products without the aid of modern tools. Roofs and walls of woven or thatched palm leaves, floors of split palm logs form a house of one to four rooms. The house is generally elevated to a height of several feet on poles, leaving an open space beneath which is used as a shelter by the domestic animals. It is surrounded by a half-acre of cleared land planted in manioc, bananas, oranges and a few other fruits and vegetables, in some instances surrounded only by open grassy fields with grazing cattle to distinguish it from the jungle, for in such regions it is impossible to grow crops because the young plants are destroyed by ants.

After a light breakfast, long before daylight but by the light of the moon, the seringueiro starts up the river. The pirogue trip to the beginning of the estrada takes 30 minutes. Here the seringueiro leaves the boat and sets out on his trek along the narrow jungle path. About five hours are required for him to go from tree to tree, making a fresh cut in the bark of each and fastening a tin cup so as to collect the latex as it flows. He taps about 150 wild hevea rubber trees which average one to the acre.

Toward the end of the journey, it may be necessary to wade through stagnant water hip deep for an hour. The estrada ends near its beginning, being roughly in the form of a circle. When the river is reached, the young sons of the rubber worker are there with his lunch. After eating he repeats the same five-hour trek over again, this time with a container to gather the latex which has flowed from the trees since they were tapped on the morning trip. He returns to the river at about five o'clock.

On reaching home, he must smoke the latex before it spoils. Near the house is a smaller building which is used for smoking the latex into a compact ball convenient for transportation. Smoke pours out from every opening as the seringueiro sits near the smoky fire curing his day's collection.

When the seringueiro has prepared several of the 110 lb. balls of smoked rubber he puts them into his canoe and paddles it several miles to a landing place for a river boat which in turn will take the rubber to Belem, near the mouth of the Amazon.

If the rubber collector lives in the interior of Bolivia, for example on the Conquisto Central of Carlos Seiler on the Rio Madre de Dios, from which comes the finest rubber in the Amazon Basin, six to eight months are required to get the rubber to Belem and transportation costs are 3½c. per lb., which is more than the rubber industry has had to pay on certain occasions for rubber from the East Indies laid down in New York.

At Belem the rubber is inspected, graded, and if necessary washed to remove trash and dirt. It then starts the final lap of its journey to the United States.

Transportation is a problem of great distances. The Amazon and its tributaries are long. Travel on these great streams is not to be compared with that on the North American rivers. The currents are greater, and the channels are made hazardous by countless numbers of floating tree trunks and other obstacles.

Rate of travel is slow for the fuel is limited to wood. When the supply becomes low it is necessary for the boat to stop and take on a fresh supply or as in many cases to send its crew into the jungle to cut and bring on board the supply. When this is exhausted the process must be repeated.

TROPICAL DISEASES

Tropical diseases are the foes of rubber production. They are carried by clouds of insects, mostly mosquitoes, which infest the jungles. A doctor of the Office of the Co-ordination of Inter-American Affairs whom we met in Bolivia, told us that he had examined every child in the area and found evidence of malaria in half of them. It is the chief cause of lost efficiency and short life span of the rubber worker. Nelson Rockefeller's organization is making a brave effort to improve health, sanitation and food situation among the rubber workers but the task is enormous and may require years to make much headway.

Contrary to the opinion held by most persons the Amazon is not a very fertile country. Except for fruit not much food is grown. As a result quantities of foodstuffs must be brought in and distributed. In fact, 6,000 to 8,000 tons are shipped in from southern Brazil and elsewhere each month. We encountered many evidences of this lack of food wherever we went from Belem near the mouth of the great river to Riberalta, Cachuela Esparanza and other towns along the tributaries in Bolivia.

"If we could only get more workers" is repeatedly heard. Richard C. Lepper, who directs RDC operations in Bolivia and was for 15 years with Firestone Rubber Co. at Singapore, told us that if he only had the labor he could get 50,000 tons of rubber a year instead of the 4,000 as at present. Certainly, the shortage of manpower is the principal factor limiting the production of rubber in the Amazon.

In an effort to overcome this shortage the RDC finances recruiting. It agreed to pay the lump sum of $2,400,000 to the Brazilian government agency CAETA for which they undertook to procure and transport 16,000 men into the rubber producing area by May, 1944 (about $150 a man). On Oct. 1 about 10,000 workers had been recruited. Half of this number had been placed on rubber producing properties, 22 percent were at Belem waiting for transportation, 18 percent were engaged on projects or services essential to rubber production, such as ship repair, 9.3 percent were engaged in other contracts without permission.

FORD'S PLANTATION

The story of the natural rubber program in the Amazon would not be complete without at least some discussion of the Ford plantation experience. In 1928 Ford made a start at Fordlandia, 125 miles up the Tapajos River from the Amazon. Due to difficulties of a fungus disease of the new foliage and insect pests this area was abandoned except for experimental work. A new start was made in 1934 at Belterra, 90 miles nearer the Amazon. At the present time there are 17,000 acres planted with 3,500,000 trees at this new plantation, the only one in South America. Ford started with wild seedlings. Later these were grafted with high yielding stock from the Far East, but as they became diseased it was necessary to develop a resistant stock. At the time of our visit this new stock was being grafted onto the existing trees. We were told by engineers on the plantation that the yield for 1943 would be 300 tons and that a yield of 6,000 to 7,000 would be reached in 1951. However, in the opinion of at least some Brazilians in a position to know the condition of the soil and other local factors the plantation may never prove a profitable venture.

All that I saw and heard on this long trip through South America about the rubber project leads me to a very definite conclusion. When the Japs took the plantations of the Far East forcing the United States into a desperate quest for rubber, this country was justified in taking whatever measures were necessary to assist the South American countries in increasing their production. The measures that were taken, although unnecessarily elaborate, resulted in a few thousand tons additional rubber. The price paid was enormous. When the dire need for natural rubber has passed, the procurement of Amazon rubber should be left to the South Americans. We will certainly not be justified in continuing to invest tremendous amounts in an effort to get a few extra tons of rubber.

ALUMINA From Alunite

The following brief summary of the Kalunite process is taken from a paper by Arthur Fleischer, chief met., Kalunite, Inc., presented at the Annual Meeting of the A. I. M. E. held in N. Y. on Feb. 20-24.

THE KNOWN existence of alunite deposits, especially in the Marysvale, Utah district, furnished the motive for the original inquiry into the utilization of this raw material for aluminum production. These deposits were actively explored during World War I and utilized for the production of potassium sulphate, an essential fertilizer, but never had been used successfully in this country as a source of oxide for reduction to metal.

Now, after continuous study and development since 1929, on a laboratory and test plant scale with initial emphasis on the utilization of alunite as a raw material, the Kalunite process described here is approaching the major test in its history with the completion of a plant in Salt Lake City having a capacity of 100 tons of alumina per day for the conversion of Marysvale, Utah, alunite ores to alumina and potassium sulphate.

The principal general features of the Kalunite process in the solution of the fundamental problem of the resolution of normal potassium alum into its components can be summarized as follows:

(1) Conversion of potassium alum by heat treatment under pressure to a water-insoluble compound, a basic alum precipitate, with simultaneous regeneration of sulphuric acid–potassium sulphate solution.

(2) Calcination of the basic alum precipitate to evolve as gases the water and sulphur dioxide combined with alumina, to produce a calcine with a mixture of potassium sulphate and alumina.

(3) Separation of the calcine into its constituents, potassium sulphate and alumina.

The stoichiometry of this procedure was admirably adapted to alunite ore, since this ore contains one-third of its alumina contents in the form of aluminum sulphate. The sulphuric acid reagent required for a balanced operation could be recovered without the use of an acid plant for the conversion of sulphur dioxide, evolved in the calcination step, to sulphuric acid.

In the application of the Kalunite process, as outlined for alunite ores, to the treatment of clay ores, there is one obvious difference, which has to do with the sulphuric acid balance. Clays do not contain any available sulphuric acid, so that it is necessary to recover the sulphur oxides produced in the calcination of basic alum by providing an acid plant to convert sulphur dioxide to sulphuric acid.

DEHYDRATION OF ALUNITE

The object of the dehydration is to eliminate the bulk of the combined water without the loss of appreciable sulphur trioxide. The dehydration of alunite begins at about 450 deg. C. and proceeds with an appreciable velocity at 550 deg. C. Sulphur trioxide is evolved above 600 deg. C., and at an appreciable rate as sulphur dioxide at about 650 deg. C. with concomitant loss of alumina solubility so that definite temperature limitations exist, creating the need for furnace temperature control. Pilot plant experience with rotary kilns and with multiple hearth furnaces showed that the dehydration could be carried out with efficiencies of 90 percent or over, based on the soluble alumina content of the dehydrated alunite and with the loss of less than 5 percent of the sulphur trioxide content of the ore.

EXTRACTION OF "METALUNITE"

"Metalunite" * is treated with a solution containing sulphuric acid and potassium sulphate in sufficient amount to convert the valuable constituent of the ore into potassium alum. The leaching circuit is intended to operate to produce a 50 percent alum solution, that is, one in which the solution portion of the pulp product of the leaching circuit is 50 percent by weight of the hydrated alum, so that the total water content is about 75 percent and the salt content, on the anhydrous basis, is about 25 percent.

The rate of reaction of metalunite, especially when dehydrated completely without loss of sulphuric acid due to overheating, is extremely rapid. In a one stage leaching of the metalunite, it is necessary to use a large excess of acid to accomplish complete extraction of the alumina content, or to use a moderate excess of metalunite if a given volume of sulphuric acid solution of fixed concentration is to be neutralized. In either case the limit of the reaction is approached in about one-half hour at the boiling temperature.

CRYSTALLIZATION OF ALUM

The 50 percent potassium alum solution is permitted to settle in order to separate the bulk of the insoluble material which is advanced in the process to the acid circuit to extract the residual undissolved values. Then the muddy alum solution may be filtered prior to crystallization to get a clear potassium alum solution or may be cooled directly to crystallized potassium alum crystals in the presence of the insoluble material.

The solubility of potassium alum in water increases from about 10 percent by weight at 20 deg. C. to infinite solubility at 92 deg. C., the fusion point of potassium alum. On cooling a 50 percent alum solution to 20 deg. C., about 88 percent of the alum content of the solution can be recovered as crystals; by the use of vacuum cooling, an additional recovery is made corresponding to evaporation of some of the solvent water.

In the application of the "mud crystallization" process, eliminating filtration, the hot 50 percent potassium alum solution is first admixed with potassium alum mother liquor in order to lower temperature and start crystallization. The mixture is then pumped into vacuum crystallizers where heat removal and cooling is attained by boiling off water to a cooling water stream in a barometric condenser; suspension of crystals in solution is further cooled in heat exchangers to between 20 and 30 deg. C. depending on the cooling water temperature. The suspension of crystals and finely divided mud in potassium alum mother liquor is filtered directly on salt type vacuum drum filters.

Alum crystals are dissolved prior to treatment in the autoclave. When the crystals are produced by the application of the "mud crystallization" process, the solution is clarified by pressure filtration to remove and insure the absence of insoluble matter, which would contaminate the final alumina product.

BEHAVIOR OF POTASSIUM ALUM

When normal potassium alum is dehydrated slowly, it forms a compound which will no longer fuse in its water of crystallization. Upon raising the temperature of the partly dehydrated material about 225 deg. C. to 250 deg. C., the remaining water is evaporated to yield anhydrous potassium alum. When drying is carefully performed, anhydrous alum is obtained in grains which are pseudomorphs after alum crystals. On heating the anhydrous product to temperatures of 850 deg. C. to 1000 deg. C., depending on time, the sulphur trioxide combined with alumina is evolved, finally yielding a mixture of alumina and potassium sulphate.

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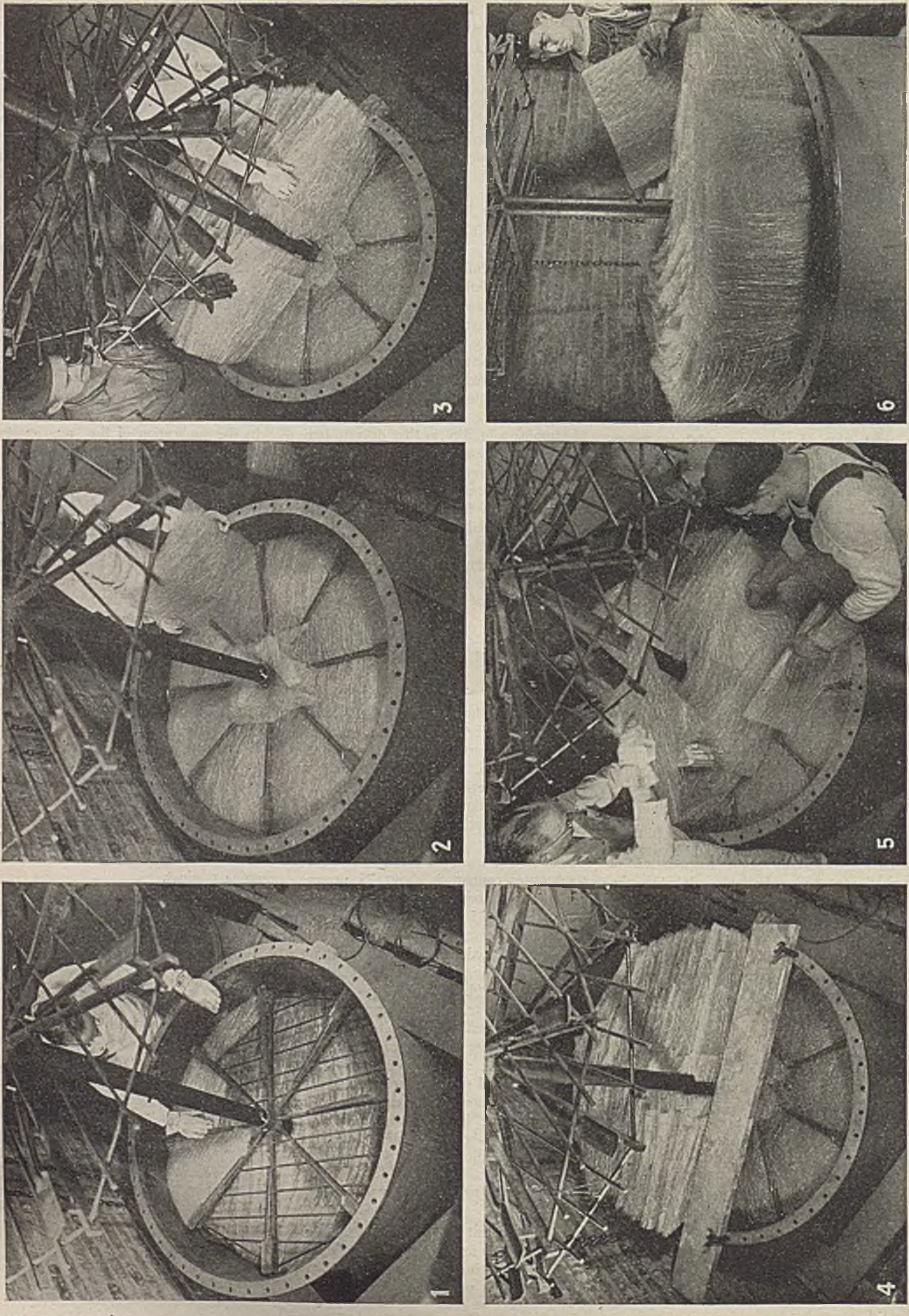
* For convenience, dehydrated alunite has been named meta-alunite or "metalunite", in keeping with the terminology of the dehydration of other solids, particularly kaolin and kaolinite.



FIBROUS GLASS

Used in Packing Alcohol Columns

This article, which is an abstract of a comprehensive paper containing much tabulated data and presented by Messrs. Minard, Koffolt, and Withrow at the recent meeting of the American Institute of Chemical Engineers, describes briefly the first of a series of investigations which is seeking to determine the properties of fibrous glass as a packing material for vapor-liquid contacting towers, such as distilling columns. Several full scale columns packed with fibrous glass are already being used successfully in the alcohol industry. *—Editors.*

To permit the rapid expansion of the industrial alcohol industry for wartime production, without the use of critical materials to a greater extent than absolutely necessary, a number of commercial scale fractionating columns have already been packed with fibrous glass and are now in successful operation. The investigations described in the paper of which this is an abstract were carried out at the Ohio State University with the object of securing full information regarding the performance of this material as a packing for the contacting of gases or vapors with liquids in equipment such as fractionating and scrubbing columns. The portion of the investigation described here consisted of some 600 test runs in which the work was carried out on a 1-ft. diameter column packed to a height of 6½ ft., and another column packed to a height of 1½ ft. Data were secured for both the enriching and stripping sections for mixtures of ethyl alcohol and water, and methyl alcohol and water. The tests also included the enriching of acetone and water. The tests examined the effect of reflux ratio, vapor velocity and composition on the performance characteristics. Detailed data on all tests were presented in the original paper, together with charts which correlated these results in various ways.

The authors found that fibrous glass packing was capable of good rectifying performance, giving a high rate of throughput with low pressure drop, low hold-up and consistent behavior. This packing is extremely light in weight per unit volume and is low in cost.

The fibrous glass tested in this investigation was in the form of common commercial air filters formed of fine fibers or filaments which are suitably cross-meshed and retained in standard size sheets about 20 in. square, by means of a temporary adhesive which is washed from the fibers after packing is completed.

The test equipment consisted of a 100-gal. still kettle equipped with a steam heating coil, supplying vapor to a column made up of 12-gage sheet metal pipe 11¾ in. inside diameter and packed to a height of 6½ ft. with No. 800 fibrous glass. The column discharged to a tubular condenser. Kettle, column and vapor lines were suitably lagged. For enriching the equipment was arranged to operate in a closed system, the condensate of the total condenser being divided by needle valves through calibrated rotameters so that one portion was measured as reflux, the other as product. The reflux was heated to within a few degrees of the column top temperature and returned to the top of the column through a reflux distributor while the product portion was returned to the bottom of the kettle to obtain steady-state conditions. The total vapor was the sum of these two flows. The run-back from the bottom of the column was also measured by means of a calibrated rotameter. A differential water manometer was used for determining the pressure drop through the column. The same equipment was used for stripping runs, except that the connections were so altered that the total condensate was metered and mixed with liquor from the bottom of the still kettle, the mixture heated to close to the column top temperature and the entire mixture then fed at the top of the column.

The column was packed in sections, each section supported on a 20-mesh copper screen to obtain an apparent pack density of about 4 lb. per cu.ft. The packing and connections of the 1.45 ft. column were similar except for the packed height. In the latter the apparent density of packing was

Abstracted from the paper, "Fibrous Glass as a Packing Material for Packed Column Distillation," presented at the Pittsburgh meeting of the American Institute of Chemical Engineers, Nov. 15-16, 1943, by the authors, E. W. Minard, Joseph H. Koffolt and James R. Withrow.

These views, which were supplied through the courtesy of Owens-Corning-Fiberglas Corp. and the Tom Moore Distillery at Bardstown, Ky., in which plant the installation was made, show how readily fibrous glass can be installed in a fractionating column. View 1 shows a completed section of tower packing within the column, above which is a metal grid for the support of the next section. This grid was bolted to the central support pipe before it was lowered below the working level of the column. The mechanic is placing a horizontal layer of packing on the grid to support the remaining vertical layers.

Note the redistribution channels on the grid, having large flanges at the outside to collect the liquor and discharge it near the center. In View 2 it will be noticed that a neat floor has been laid on the grid. The mechanic has used salvaged cuttings from the tower packing to close large voids around the grid support pipe in the center. He is placing the first pack of tower packing against the column wall with the grained surface in a horizontal position.

After one mechanic has started the packing, another comes on the project as in View 3. A helper feeds the tower packing to them. The section is now half completed. Note the succeeding grids above the mechanics' heads. If it should be necessary to leave the project before completing a section a plank can be used to hold the already installed packing in place. How this is done is indicated in View 4.

In View 5 the last half portion of a section of packing is being completed. The final packing, as in View 6, can be handled by one mechanic.

4.63 lb. per cu.ft., as compared with 4.06 lb. for the 6½ ft. column. This figured as 97.5 percent free space for the shorter and 98.0 percent free space for the taller column. By means of an empirical equation, it was calculated that the area of exposed packing was 153 sq.ft. in the short column, and 579 sq.ft. in the longer column.

Runs were made by charging the kettle with about 40 gal. of the desired mixture after which steam was admitted to the heating coil. When the charge was boiling and the condensate coming over, the steam was adjusted to give the desired vapor velocity. The column was run under total reflux conditions for over an hour, after which the desired product and reflux rates were set up by operation of suitable needle valves. With the reflux ratio adjusted, the composition was determined and adjusted to the desired concentration by butting-up with more alcohol or withdrawing some of the product. After steady-state conditions were attained, operation was continued for at least one hour.

Results of all runs were calculated to give the overall height of a transfer unit, according to the method of Chilton and Colburn. The average slope of the vapor-liquid equilibrium curve was computed by the method of Duncan, Koffolt and Withrow. The results were then correlated by Colburn's method, plotting the $(H.T.U.)_{ov}$ against the average slope of the vapor-liquid equilibrium curve, using the reflux ratio as a parameter. Excellent correlation was obtained, showing good performance characteristics. It was found that the observed values of $(H.T.U.)_{ov}$ were low in value for the range of industrial interest. A high *H.T.U.* value corresponding to a high value of the average slope of the vapor-liquid equilibrium curve does not necessarily mean a high tower to effect a given separation since a high average slope value usually requires a low number of transfer units which, multiplied by the corresponding *H.T.U.* value, gives a reasonable height of tower.

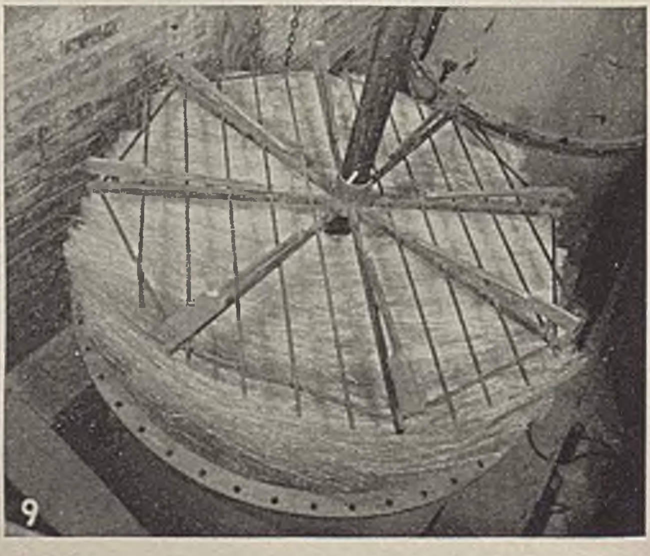
The use of the 1.45-ft. high column surprisingly enough gave lower $(H.T.U.)_{ov}$ values than for the taller column for the same average slope and reflux ratio values.

The authors state that much more work is necessary before definite film values can be determined. Work is being continued on this packing with systems other than those tested, as well as with other types of fibrous glass and other column arrangements. One observation was that rectification appeared to be better in the enriching than in the stripping section. This may be influenced by the greater amount of reflux in the stripping section which gives a thicker layer of liquid on the packing, thus making the rate of mass transfer lower.

Tests in which the rate of throughput was varied from a mass velocity of 200 to 1,200 lb. of vapor per hour per square foot of cross sectional area showed that within the ranges investigated, the rate of throughput had no appreciable effect on the performance characteristics of the packing. A column packed with fibrous glass in industrial production, it was noted, has operated successfully at a vapor velocity as high as 6 ft. per sec.

The accompanying illustrations show the packing of one of two 50-in. diameter columns 32 ft. high which were designed and put into operation at the request of the War Production Board by Hiram Walker & Sons Co. Design work was carried out by the company's engineers, Charles H. Rodgers and George Neureuther, and the installation was made at the plant of the Tom Moore Distillery at Bardstown, Ky.

View 7 was taken looking down as the mechanic completed a section of tower packing. The voids will be closed by compression as the packing is lowered into the column. A completed section of packing appears as in View 8 before it is lowered into the column. When a section has been completed, the next grid is lowered into place and bolted to the central supporting pipe as in View 9, after which the supporting pipe is lowered by means of a chain fall, thus lowering the completed section below the working level and compressing the fibers and eliminating all vertical voids through which vapors might otherwise channel during operation of the column. This view clearly shows the construction of the grid with its redistribution channels.



WILBUR G. HUDSON *Mechanical Engineer, Chicago, Ill.*

Design of Systems for Conveying PNEUMATICALLY

Pneumatic conveyors have a definite place in the materials handling field where, despite their large power requirements, they are superior to other methods in certain applications. Although they are widely used, there has been little or no explanation of their theory. In this article Mr. Hudson gives the applications and limitations of pneumatic conveyors and explains the simple mathematical procedure involved in determining the air velocity and power requirements in two typical applications.—*Editors.*

Fig. 1—Contamination of grain and similar materials in unloading can be largely avoided by pneumatic handling

Notwithstanding considerable early prejudice, the pneumatic conveyor has become recognized by engineers as offering the best solution to certain materials handling problems. The chief objection has been its high power requirement owing to low efficiency. This objection has become less serious as the cost of power has been reduced while labor costs have sky-rocketed, making it essential to use materials handling equipment which reduces labor costs, improves working conditions, and eliminates risk of injuries. Perhaps this minimizing of the power cost factor is well illustrated by the hydraulic ash conveyor, which the steam generating stations were slow to adopt because it involved a costly special type of centrifugal pump and a stand-by pump, each with a 100-hp. motor. This meant installation of about 10 times the motor power required for the average mechanical ash handling equipment for a large plant, but the advantages of dustless operation and absence of risk so far outweigh the power requirement that many of the larger stations are now so equipped.

The most extensive early use of pneumatic conveyors was for unloading grain at European ports of entry. The leader in this field is Henry Simon, Ltd., of England. As a rule these grain unloaders are mounted on self-propelling barges which are brought alongside the cargo ship off-shore and discharge to lighters through automatic scales. The capacities are quite impressive for pneumatic handling, ranging up to 300 tons per hour. European practice seemed to favor the use of inverted reciprocating air pumps, often driven by steam from the boiler of the barge. American manufacturers prefer the more compact and less costly high-speed positive exhauster.

The use of marine unloaders is rather rare in the United States as we are grain exporters; however one of the Henry Simon unloaders started operation in New York harbor some 20 years ago, essentially to expedite the discharge of vessels carrying part cargoes of flaxseed, etc. Its advantage lay in the possibility of unloading this part of the cargo to lighters while the ship was tied up at the point where the major part of the cargo was to be discharged, saving both time and towing costs.

Pneumatic unloading from open barges is quite common. The leading manufacturers use a high-speed rotary exhauster connected to a centrifugal type receiver and dust collector. The conveyor duct is of seamless steel tubing terminating in a reinforced rubber hose and adjustable feed nozzle so designed that pick-up air is automatically or, sometimes, semi-automatically controlled.

Dust separation usually is accomplished by a stocking-type collector. Incoming air passes up and outward through the cloth stockings, trapping the dust as the air passes to the exhauster. One group of filters after another is temporarily cut out and vibrated while a small amount of compressed air is passed through in reverse to clear the fabric.

An important field for the pneumatic conveyor is for unloading grain from box cars, especially where the sanitary requirements are strict. The door bulkheads remain intact and, except when cleaning up, there is a minimum of contamination of the grain (Fig. 1). When automatic shovels are used the bulkheads must be broken out and then the man tramps back and forth in the grain, working under some risk of injury. Of course the pneumatic unloader is not a competitor of the large-capacity tilting car dumper, but a capacity of 2,500 bu. per hour is not unusual.

Many bulk chemicals are shipped in box cars and frequently the dust must not be inhaled. Soda ash, which attacks the mucus membrane, is a notable example. The "vacuum cleaner" action of the pneumatic unloader is then of extreme importance as practically eliminating the risk of damage suits.

For all flowable materials the simple adjustable nozzle is used. Some materials, notably cement, will not flow into the nozzle and must be loosened up. The Fuller Co. provides an ingenious remote-controlled feeder employing a rotary disk which loosens up the mass and feeds it to a short, self-choking screw conveyor. The discharge from the screw is caught by a comparatively high pressure air stream and transported to the destination. The self-choking action of the screw prevents a blowout backward.

After the material has been deposited in the receiver, which may be under a higher or lower pressure than atmospheric, it must be passed out through an airlock gate. The Henry Simon airlock is a tilting device —swung backward and forward by a crank shaft—in which the adjacent segments are alternately filled and discharged. American practice prefers the simple rotary airlock.

Another important application of pneumatic conveying is the disposal of ashes, which has increased in importance with the growing insistence on dustless operation. The pneumatic ash conveyor employs either a constant-pressure, variable-volume centrifugal exhauster (fan), or a constant-volume, variable-pressure exhauster (positive type). There are handicaps in this application. Unless the dust collector is 100 percent effective—practically an impossibility—some dust passes through the exhauster. The centrifugal exhauster, operating at 3,600 r.p.m., cannot long withstand the erosive action of fine dust without the rotor becoming unbalanced, and very little unbalancing at this speed places a severe strain on the bearings. The positive blower suffers less from erosion but gradually loses efficiency as the clearance between impellers and casing increases. This may be corrected by pouring in a quick-hardening plastic while the impellers are slowly rotating. Sometimes the air flow is secured by a venturi water jet which serves as a dust collector when discharge is made to a sump. This is suited to the smaller capacities, as in flyash collecting systems.

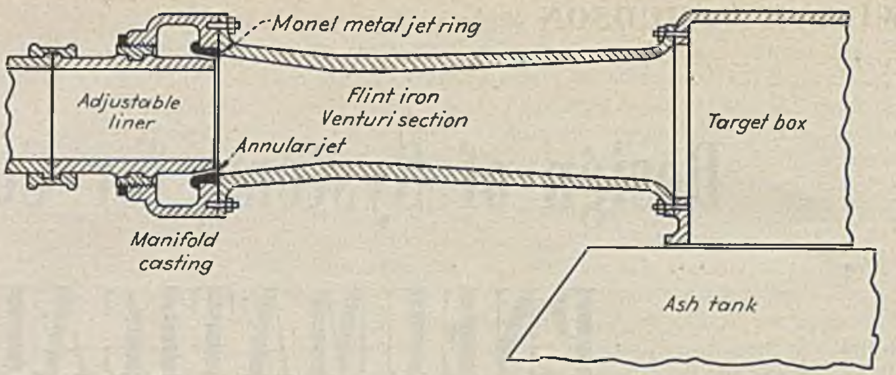


Fig. 2—Annular-jet type steam ejectors are used to a considerable extent instead of exhausters and blowers in smaller pneumatic installations

JET EXHAUSTERS

Another handicap of exhauster-operated equipment is the cost of the motor-driven exhauster as compared with a steam ejector device. The low cost of the steam jet system led to a very wide adoption in the smaller plants. It is too well known to require explanation here. It is cheap but so inefficient that the operating cost was as a rule objectionable. A substantial increase in efficiency was secured by substituting for the single jet nozzle at the foot of the riser an Argand-type jet in combination with a venturi section adjacent to the storage tank (Fig. 2).

Still another objection to the fan or blower type of pneumatic conveyor for ash handling was the fact that it involved a closed tank in which a partial vacuum was maintained while the conveyor was operating. The close-clearance discharge gate always permits some up-draught through the mass of ashes in the tank, and if the quenching spray should not function, and if the ashes should contain incandescent clinkers, conditions favoring an explosion would be present. With the increasing demand came the Nu-Veyor (United Conveyors Corp.) which eliminated this risk. It locates the venturi Argand-type exhausting fitting between a receiver and an air washer (Fig. 3). The receiver is mounted upon an open storage bin and has a trap door actuated by a time-limit relay which also controls the steam throttle. About once a minute the steam throttle is closed for 30 seconds and the trap door is opened to allow the 300 lb. or so of collected ashes to fall into the bin. Then the trap door is closed and the throttle opened, and the cycle repeats. The receiver and washer bear some resemblance to a centrifugal type dust collector but are of heavy cast sections. The washer has water sprays which agglomerate the dust and wash it down to a drain. Since the storage bin is not under reduced air pressure there is no up-draught through the ashes. The efficiency would be improved if the cycle were made continuous instead of intermittent, an improvement which will no doubt come with time.

Quite often all that is required of an ash handling system is that disposal be made to an adjacent area. The steam jet method then becomes a simple ejector. A water jet near the outlet end reduces the dust nuisance

Returning to the strictly pneumatic conveyor it will be apparent that the material may be drawn to a receiver connected with the inlet side of the exhauster and pass out of the receiver through an airlock gate, to be conveyed onward by the air stream from the pressure side of the blower, that is, the material bypasses the exhauster. In the early systems originated by Sturtevant, light materials such as cotton, wood shavings, waste paper, etc., were passed directly through the exhauster fan. In fact, some of the modern shop-dust collecting systems are so arranged when the dust is not erosive to the fan blades. It is usual to refer to a system which draws the material toward the exhauster as a "suction system," and one which blows the material from the blower as a "pressure system." Of course both are pressure systems, as in the former the exhauster merely reduces the terminal pressure and atmospheric pressure creates the air stream.

There are two pneumatic system types. One uses a large volume of air at low velocity, the other a small volume of air at high velocity. In "suction" systems the former is more efficient since the conveying medium is denser and so has greater carrying capacity than rarified air. Also frictional losses in the duct and in the exhauster are less. High pressure means higher slip and heat loss in the exhauster. However, heavy materials require a high-velocity air stream.

Some materials handle very nicely pneumatically, and some are difficult. Free-flowing granular materials such as flaxseed are in the first class, although flaxseed is abrasive on account of its glass-hard shell. All free-flowing pulverized materials handle nicely. Acid phosphate tends to pack and build up at the bends. Oats suffer degradation because of the fragility of the sheath. Copra tends to exude its oil and builds up in the receiver. Sometimes copra carries considerable grit or sand. Coal handles nicely if there is no objection to pulverizing it. Gentle handling is certainly not a characteristic of the pneumatic conveyor, so fragile materials are unsuitable except in certain special circumstances.

Because of many variables such as roughness of pipe, air leakages, temperature changes, variable air density, different physical characteristics of the material, etc., the performance and power requirements of a pneumatic conveyor cannot be predicted with the accuracy to which we are accustomed in the engineering of mechanical conveyors. The following analysis is derived largely from observed results in large-volume, low-pressure pneumatic conveyor installations.

AIR VELOCITY

The velocity of the air stream, which forms the conveying element, depends n the pressure head maintained by the blower or exhauster, and for all practical purposes is given by the equation:

$$V = \sqrt{2gh} \qquad (1)$$

where V = the air velocity in feet per second, h = the height of a column of air, in feet, equal to the head maintained by the blower, and g = 32.16. The weight of air at 60 deg. F. is 0.0764 lb. per cu-ft.; but as we will work with pressure in ounces per sq.in., then let p = the weight in ounces of a column of air h ft. high and 1 sq.in. in cross section. Hence $p = h\ (0.0764 \times 16)/144$ and $h = 118\ p$ (approx.). Substituting in Eq. (1), $V = 87.5/p$ and $p = V^2/7{,}600$. More conveniently

$$p = \frac{1.32V^2}{10{,}000} \text{ (approx.) oz. per sq. in.} \qquad (2)$$

An open-ended pipe has about 82 percent effective area for air inflow. Therefore, the velocity at the open end is higher than the velocity within the pipe or,

$$p' = \frac{1.32V^2}{10{,}000\ (0.82)^2} = \frac{V^2}{10{,}000} \times 2 \text{ (approx.)} \qquad (3)$$

Hose intake nozzles have about 60 percent of the duct area to speed up the "pick-up" velocity of the air entering the nozzle, or

$$p'' = \frac{V^2}{10{,}000} \times 5 \text{ (approx.)} \qquad (4)$$

This equation is used to determine the air velocity in the nozzle. The velocity drops as the air enters the pipe, but a lower velocity is sufficient to maintain the material in motion after it is started.

The head loss in the conveyor duct due to friction is found as follows: Let h = loss of head, in feet of air at 0.0764 lb. per cu. ft.; f = the coefficient of friction of air against internal wall of pipe; D = diameter of pipe, in feet; L = length of pipe, in feet; and R = hydraulic radius, which is $D/4$. Then:

$$h = \frac{fLV^2}{2gR} = \frac{4fLV^2}{2gD} = \frac{fLV^2}{16D} \text{ lb. per sq. ft.} \qquad (5)$$

Table I—Pressure Losses in Pipes

(Based on air velocity 100 ft. per sec. and pipe length of 100 ft.)

d, Pipe Diameter, Inches	p, Ounces per Sq. In.* Kent	Root	Unwin	Q, Air Volume, C. F. M.
4	8.00	10.00	8.50	520
5	6.40	8.00	6.25	820
6	5.35	6.67	4.80	1,170
7	4.57	5.72	3.95	1,600
8	4.00	5.00	3.25	2,090
9	3.50	4.44	2.77	2,650
10	3.20	4.00	2.43	3,270
11	2.91	3.64	2.14	3,960
12	2.67	3.33	1.93	4,710

* For pressure loss when velocity = V and length = L, $P_0 = p\ (V/100)^2 (L/100)$.

If 118 p is substituted for h in Eq. (5), if L is taken as 100 ft. and the diameter D is expressed in inches d, then 118 p = $f\frac{100V^2}{16(d/12)}$ and

$$p = f\frac{16V^2}{25d} \text{ oz. per sq. in.} \qquad (6)$$

which is the head loss due to friction, per 100 ft. of pipe. Table I shows the values for p arrived at by three authorities for $L = 100$ ft. and V = 100 ft. per second.* In what follows we will use Unwin's values for p, based on his trials. For values of V and L different than those used in the table, the value P_0 can be obtained by correcting p:

$$P_0 = p(V/100)^2 (L/100) \text{ oz. per sq. in.} \qquad (7)$$

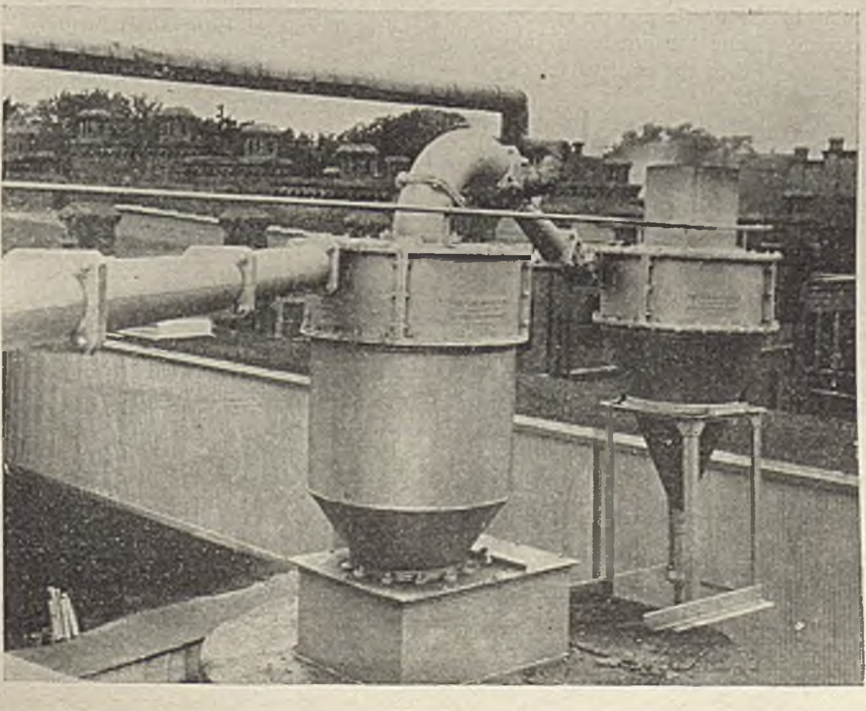
We must know the quantity of air and the velocity of the air stream. Each depends on the specific weight of the material (weight in the solid, not bulk weight) and on its physical characteristics, as well as on the required handling capacity.

In large-volume, low-pressure systems it has been found that the quantity of air is expressed by the simple formula, $Q = WT$ where Q = cubic feet of free air per minuate; W = specific weight (in solid) of material in pounds per cubic foot; and T = tons handled per hour. This may be written for cubic feet of air per pound of material as:

$$Q' = WT \div (2{,}000T/60) \text{ or } Q' = 3W/100 \qquad (8)$$

The velocity of the air stream depends on the size and weight of the average individual particle (small particles will boost along the larger). The force of the blast must be great enough to balance the particle in a vertical riser pipe, plus an additional force required to convey the material at a velocity usually of about 50 ft. per second. When material is moved horizontally the air velocity may be less than in a run with bends and risers. Let s^2 = the cross-sectional area of the average particle, sq. in.; l = the largest axis of the particle, inches; W' = the weight of the material in ounces per cubic inch; V = the air velocity in feet per second; and c = the efficiency of the blast. If W is the specific weight in pounds per cubic foot of the material, then W' = 16W/1,728 = W/108. The weight of a particle is then s^2lW/108 oz. and this weight must equal the required force of blast for balancing the

Fig. 3—Ash-handling NuVeyor pneumatic conveyor built by United Conveyors Corp. uses a jet exhauster between a receiver and an air washer



* Kent used f = 0.005, Root used f = 0.00625 and Unwin used f = 0.0028 (1 + 3.6/d).

particle in a riser, or $s^2lW/108 = V^2s^2c/7{,}600$. Thus the air velocity for balancing is:

$$V = 8.4\sqrt{Wl/c} \qquad (9)$$

This velocity must be increased to move the material at, say, 50 ft. per second. From a long series of tests on installations the values for velocity of the air in feet per second given in Table IV were determined and adopted with satisfactory results. It will be seen that when material is moved in a direct horizontal path the velocity required is less than for a line with bends and risers.

Knowing the volume of air and the pressure we can easily determine the required power and the size of blower and motor. The power required to handle Q cu. ft. of air per minute at P lb. per sq. in. pressure is expressed by the formula Hp. $= 144\,QP/33{,}000$ or $QP/229$. Assuming a mechanical efficiency of the machine of 87½ percent then:

$$\text{Initial Hp.} = QP/(0.875 \times 229) = QP/200 \qquad (10)$$

However, in figuring the required motor horsepower, Q should be increased to allow for slippage in the blower, which varies as the square of the pressure. We will therefore again allow 87½ percent as the pneumatic efficiency, giving:

$$\text{Motor Hp.} = QP/175 \text{ for a pressure system} \qquad (11a)$$

$$\text{Motor Hp.} = QP(14.7 + P)/(175 \times 14.7) \text{ for a suction system} \qquad (11b)$$

Equation (10) may be transposed to read $P = 200$ Hp./Q in pounds per sq. in. or:

$$P_0 = 3{,}200 \text{ Hp.}/Q \text{ oz. per sq. in.} \qquad (12)$$

This last is in the convenient form used in the following calculations.

CALCULATING A SYSTEM

Contrary to general belief, the determination of the velocity of the air blast and the power requirement for a large-volume, low-pressure pneumatic system is not difficult. We will give the procedure step by step and follow with the calculations for two simple layouts.

1. Determine the quantity of air to convey 1 lb. of material. Use Eq. (8), $Q' = 3W/100$ cu. ft. of air per pound of material, or use $Q = WT$ as the cubic feet of air per minute for conveying T tons per hour.

2. Determine the velocity of the air from Table IV for the material and layout under consideration.

3. Select a size of pipe which will suit Q cu. ft. of air per min. for the velocity in (2).

4. It is advisable in this step to adjust the volume and velocity to permit the use of a standard pipe size.

5. Now proceed with the calculation of air pressure losses:

5*a*. The orifice pressure loss, from Table II, at 63 percent efficiency (also Eq. (4)), is $(V_h^2/10{,}000) \times 5$ oz. per sq. in., where V_h is the air velocity in the hose.

5*b*. The hose pressure loss, for a hose assumed to be 35 ft. long, is found from Table I by Eq. (7) as $P_0 = p(V_h/100)^2 35/100$, where p comes from the column headed "Unwin," the diameter is as determined in step (3), and V_h is the hose velocity.

5*c*. The line pressure loss, for the actual length of line L, is determined from Table I by the same method as for hose, (5*b*), using V as the line velocity.

5*d*. For the tank pressure loss, 4 oz. per sq. in. per tank is a good average.

5*e*. For the air-line pressure loss, i.e., between the exhauster and the separator or between the separator and the dust collector, 3 oz. is a good average.

6. The total air pressure loss is then the sum of the losses calculated in steps 5*a*, *b*, *c*, *d* and *e*.

7. Calculate the material pressure losses, that is, the power required to move the material, over and above that required for the conveying air alone. We assume that velocity of the material is equal to 80 percent of the air velocity and that the material is accelerated from rest to this velocity by the nozzle pick-up velocity in 1 second. Taking the nozzle air velocity V_h as $1.6\,V$, then the material velocity is $V_h/2 = 0.8\,V$.

7*a*. Calculate the power required to accelerate the material initially. This is $MV_m^2/(2g \times 550)$ where M is pounds per minute of material moving at velocity V_m and $V_m = 0.8\,V$. This expression can be simplified to the approximate expression, Hp. $= T\,V^2/100{,}000$, where T is tons per hour and V is ft. per sec. air velocity.

7*b*. Calculate the hose pressure loss in terms of power requirement, assuming this equals one-half the power loss found in (7*a*).

7*c*. Determine the conveying pressure loss in terms of power requirement as Hp. $= T(H+L/5)/1{,}000$, where T is tons per hour, H is the feet lift, if any, and L is the length of line in feet.

7*d*. Calculate power losses in elbows of the line, taking for each 90-deg. elbow a loss equal to one-half the acceleration loss calculated in (7*a*).

8*a*. The total material pressure loss, as initial horsepower, is then the sum of the losses calculated in steps 7*a*, *b*, *c* and *d*.

8*b*. The total initial horsepower for the material is converted into pressure as (Step $8a \times 3{,}200)/Q$ oz. per sq. in.

9. Total pressure loss for moving air plus material is sum of Step 6 plus Step 8*b*. This sum divided by 16 is P in lb. per sq. in. Finally, from Eq. (11*a*), the total power for a pressure system is $QP/175$; or from Eq. (11*b*), the total power for a

Table II—Factors for Determining Orifice Losses

Type of Orifice	Efficiency, Percent of Perfect Orifice	Orifice Factor, k*
Perfect flared-end orifice	100	1.32
Full open end in straight pipe	82	2.0
Intakes	80	3.0
	75	3.5
	70	4.0
	67	4.5
	63	5.0
	60	5.5
	57	6.0
	50	8.0

* Orifice loss $= k\,V^2/10{,}000$ oz. per sq. in.

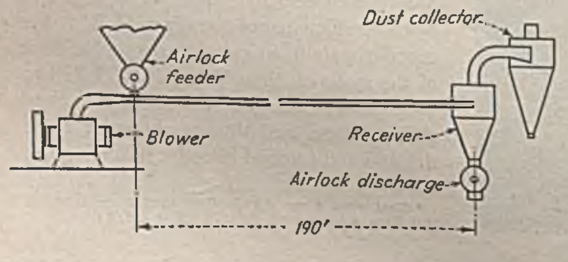
Table III—Resistance of 90-Deg. Elbows in Terms of Equivalent Straight Pipe

R/d*	Equivalent Straight Pipe, Ft.
1	10.0
1½	6.0
2	5.8
3	4.8
4	4.0

* Radius of elbow bend ÷ pipe diameter, inches.

Fig. 4. Below—Pressure system pneumatic conveyor installation with straight, horizontal run (Calculated in text)

Fig. 5. Right—Suction system pneumatic conveyor installation for box car unloading, with both horizontal and vertical runs (Calculated in text)



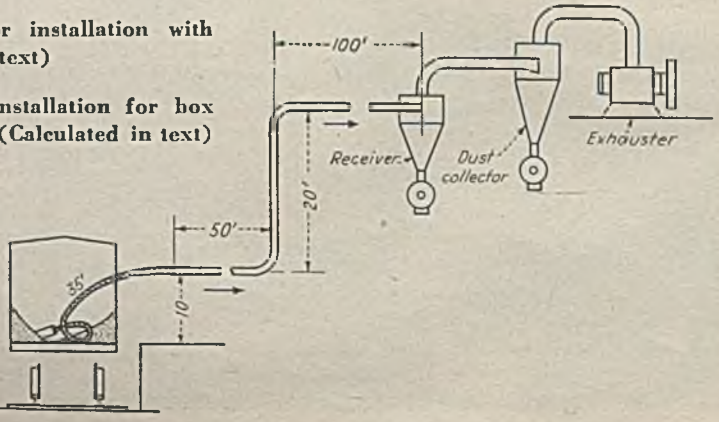


Table IV—Experimentally Determined Air Velocities Suitable For Moving Various Kinds of Material in Various Duct Arrangements

(Note: W is solid specific weight, without voids, not bulk density.)

		Air Velocity, Ft. per Sec., For		
		Balancing	Line*	Hose*
Direct horizontal ducts	Dustlike matl.	$5\sqrt{Wl/c}$	$10\sqrt{W}$	$16\sqrt{W}$
	Grains	$6\sqrt{Wl/c}$	$12\sqrt{W}$	$20\sqrt{W}$
	Gritty and uneven sizes	$7\frac{1}{2}\sqrt{Wl/c}$	$15\sqrt{W}$	$24\sqrt{W}$
Ducts with ells and risers	Dustlike matl.	$10\sqrt{Wl/c}$	$12\frac{1}{2}\sqrt{W}$	$20\sqrt{W}$
	Grains	$12\sqrt{Wl/c}$	$15\sqrt{W}$	$24\sqrt{W}$
	Gritty and uneven sizes	$15\sqrt{Wl/c}$	$18.75\sqrt{W}$	$30\sqrt{W}$

* Plus or minus 6 percent.

suction system is $QP(14.7 + P)/(175 \times 14.7)$. The last calculation gives the motor horsepower.

Problem 1—Let us apply the procedure outlined above to the layout shown in Fig. 4. This is a straight horizontal run of 190 ft. ($= L$), and we desire to handle 40 tons per hour of flaxseed ($= T$). We will use a pressure system, introducing the load through an airlock gate, and discharging to a receiver vented to a centrifugal dust collector. The solid specific weight of the flaxseed is 82 lb. per cu. ft. ($= W$).

1. Q in cu. ft. per min. equals $82 \times 40 = 3{,}280$.

2. V in feet per sec. equals $12\sqrt{82} + 6$ percent $= 117$.

3. Size of pipe (tentative): 110 ft. per sec. in 10-in. pipe $= 3{,}600$ cu. ft. per min.

4. Proceed with $Q = 3{,}600$ and $V = 110$.

5. Air pressure losses in oz. per sq. in.:

5a. Orifice loss $= 5 \times 110^2/10{,}000 = 6$.

5*b*. Hose loss $= 0$.

5c. Line loss $= (110/100)^2(190/100)\ 2.43 = 5.6$.

5*d*. Tank loss $= 4 \times 2 = 8$.

5e. Air-line loss $= 3$.

6. Total, $5a + b + c + d + e = 22.6$ oz. per sq. in.

7. Material pressure losses in terms of horsepower:

7a. Acceleration loss $= 40(110^2/100{,}000) = 5$.

7*b*. Hose loss $= 0$.

7c. Conveying loss $= 40(190/5)/1{,}000 = 1.6$.

7*d*. Elbow loss $= 0$.

8*a*. Total, $7a + b + c + d = 6.6$ hp.

8*b*. Material losses in pressure $= (6.6 \times 3{,}200)/3{,}600 = 6$ oz. per sq. in.

9. Total pressure loss $= (22.6 + 6.6)/16 = 1.8$ lb. per sq. in. For a pressure system Hp. $= (3{,}600 \times 1.8)/175 = 37$ hp. for the motor.

Even without considering first cost it is evident that a belt conveyor is better. To handle 40 tons per hour of flaxseed weighing 45 lb. per cu. ft. in bulk (82 lb. if all voids were eliminated), we might use a 16-in. belt conveyor at about 200 ft. per minute which would require a $1\frac{1}{2}$-hp. motor. Costing less but requiring somewhat more power than the belt, we might use a screw conveyor.

Problem 2—Let us go through the procedure with a layout for which the pneumatic conveyor is better adapted (Fig. 5). Here it is required to unload 40 tons per hour of flaxseed from box cars, and transport the seed 50 ft. horizontally, 20 ft. vertically, and 100 ft. horizontally to a storage bin. For this we will use the suction system, with a flexible hose and nozzle, a receiver and centrifugal dust collector (or a combination receiver and dust filter), and a positive type exhauster. If power is an important factor we can locate the receiver alongside the car and discharge to an inclined belt conveyor, as an alternate to the all-pneumatic system. Again, the solid specific weight of the material is 82 lb. per cu. ft.

1. Q in cu. ft. per min. equals 3,280.

2. V in ft. per sec. equals $15\sqrt{82} + 6$ per cent $= 146$.

3. Pipe size is selected as a 9-in. line, giving a velocity of 140 ft. per sec. This makes $Q = 3{,}700$ cu. ft. per min.; A 7-in. hose gives the same Q at 230 ft. per sec.

4. Proceed with $Q = 3{,}700$, $V = 140$ and $V_h = 230$.

5. Air pressure losses in oz. per sq. in.:

5a. Orifice loss $= 5 \times 230^2/10{,}000 = 26$.

5*b*. Hose loss $= (230/100)^2\ (35/100)\ 3.95 = 7$.

5c. Line loss $= (140/100)^2\ (190/100)\ 2.77 = 11$.

5*d*. Tank loss $= 4 \times 2 = 8$.

5e. Air-line loss $= 3$.

6. Total, $5a + b + c + d + e = 55$ oz. per sq. in.

7. Material pressure losses in terms of horsepower:

7a. Acceleration loss $= 40(140^2/100{,}000) = 8$.

7*b*. Hose loss $= 0.5(7a) = 4$.

7c. Conveying loss $= 40(30 + 170/5) \div 1{,}000 = 2.6$.

7*d*. Elbow loss $= 3(7a/2)$ approx. $= 12.0$.

8a. Total, $7a + b + c + d = 27$ hp. approx.

8*b*. Material losses in pressure $= (27 \times 3{,}200)/3{,}700 = 23.0$ oz. per sq. in.

9. Total pressure loss $= (55 + 23)/16 = 5$ lb. per sq. in. For a suction system Hp. $= 3{,}700 \times 5\ (14.7 + 5)/(175 \times 14.7) = 142$ hp. for the motor.

If the same analysis is worked through for a light material such as ground cork (solid specific weight $= 37.5$ lb. per cu. ft.) we find that an 8-in. line and 6-in. hose, with $Q = 1{,}600$, $V = 76$, and $V_h = 136$, give a conveyor with a 60-hp. motor. In either case it may be more convenient to use two smaller hose in parallel rather than a single large hose.

In a long conveyor of the pressure type the air is under considerable pressure at the feed end and is correspondingly dense. The velocity is lowest at that point and increases as the air expands ($p \times v =$ constant). However, the denser the air the more effective it is as a carrier. That is, dense air at a lower velocity has about the same carrying ability as the expanding air at higher velocities. Otherwise stated, if the material starts, it will continue.

It makes little difference, as regards power, on which side of the exhauster we locate the dust collector; but if we add a second collector to reduce the discharge of dust, additional power must be provided as measured by the added back pressure, which above was assumed as 4 oz. Thus, Hp. $= (Q \times 0.25)/175$ which approximates $5\frac{1}{4}$ hp. in the above example.

MATERIAL SATURATION

It is interesting to compare the volume of material with the volume of air required to transport it, that is, the saturation, as indicated by the formula, $Q = WT$. In terms of cubic feet of air per hour we may write $Q' = 60\ WT$, while the cubic feet of material per hour is $Q'' = 2{,}000\ T/W$. Hence the ratio of volume of air to solid material is $60\ WT/(2{,}000\ T/W) = 3\ W^2/100$. If the bulk density of the material (including voids) is W_b, then the ratio of volume of air to the bulk material is $(3\ W^2/100)\ (W_b/W) = 3WW_b/100$. For flaxseed, W_b, the weight in bulk, is 45 lb. per cu. ft., while W, the specific weight, is 82 lb. Hence the ratio of volume of air to volume of flaxseed in bulk is $3 \times 82 \times 45/100 = 110$, or a ratio of 110 to 1, which is an indication of the reason for the low efficiency of the pneumatic conveyor with the heavier materials.

With cork the saturation, as might be expected, is substantially better. Natural cork with 60 percent voids weighs 15 lb. per cu. ft., while "solid" cork weighs $15/0.40 = 37.5$ lb. per cu. ft. For granulated cork the volume ratio is $3 \times 37.5 \times 15/100$ or a ratio of 17 to 1.

The pneumatic conveyor is a more important member of the conveyor family than is generally recognized. Not a few problems in materials handling which are awkward or impossible for a mechanical conveyor can be solved by a simple pneumatic conveyor layout. Although the ratio of power to rate of handling is high from the very nature of the conveying element, power frequently is a negligible consideration. More important factors are cleanliness of operation and elimination of danger to those whose work brings them in contact with the installation. As regards these, the pneumatic conveyor is in a class by itself.

Country's Largest Spray Dryer Producing RESIN POWDERS

What is believed to be the largest spray dryer of its type in the United States, and certainly the largest equipment for the spray drying of resins, has recently been installed at the Bridesburg, Pa., plant of the Resinous Products & Chemical Co. Need for the enormous capacity of the new machine has been brought about by the present widespread use of synthetic resin adhesives for such applications as on-the-spot assembly of barges and landing boats at overseas points; wet strength improvement of paper; and waterproofing of laminated fiber and corrugated board. Spray drying for the company's phenolic and urea-formaldehyde resins has a number of advantages, both from a production and from a product standpoint. The powders produced save both weight and space, and are easily handled since they flow like water. Compared with liquid resins, they require lighter, non-critical containers and have a much longer storage life.

In spite of the company's ability to secure top priorities, it was found that a considerable saving in time could be made by the use of salvaged and second-hand equipment. Coolers, conveyors and the dryer furnace came from an Idaho potato dehydration plant. The 200-hp. fan motor was secured from a used equipment dealer in Pittsburgh, while the fan came from an abandoned Canadian mine. Iron gratings and stairways came from a dismantled rapid transit powerhouse.

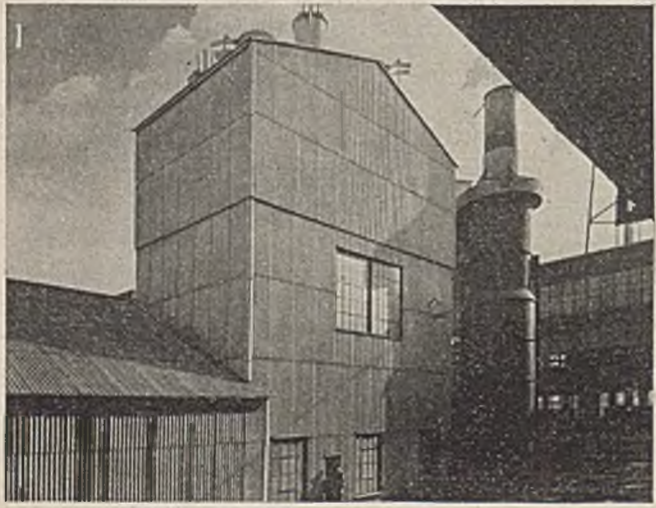
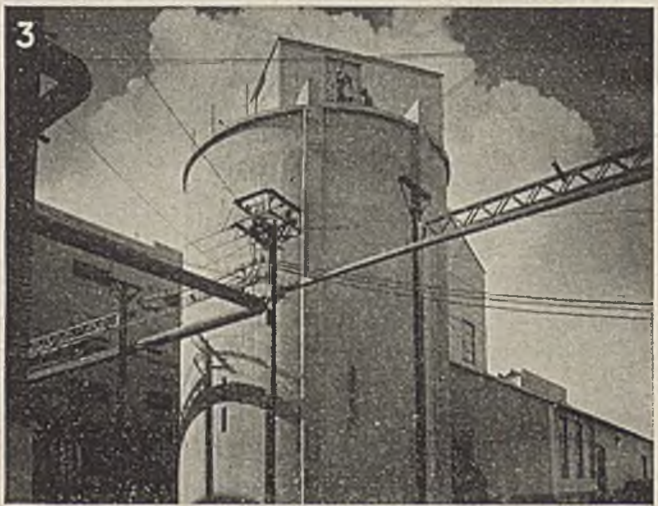
The Bowen dryer, shown from the exterior in Fig. 3, is about five stories high and uses a concrete shell. The liquid resin, in aqueous solution, is cooled to

Fig. 1—Exterior of resin drying building showing oil fired hot-air furnace for dryer air at right

Fig. 2—The aqueous solution of phenolic or urea-formaldehyde resin is pumped from this tank to the dryer

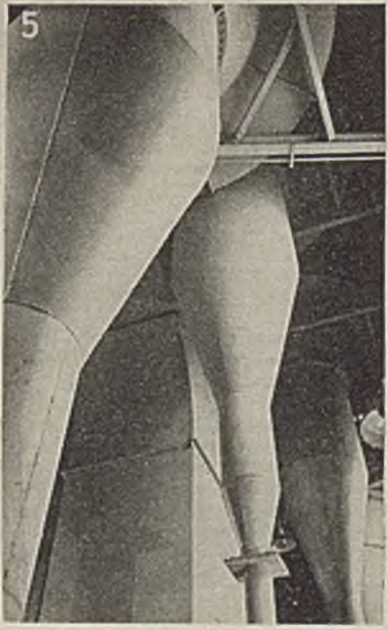
Fig. 3—An idea of the size of this five-story dryer can be gained from the men standing on the top

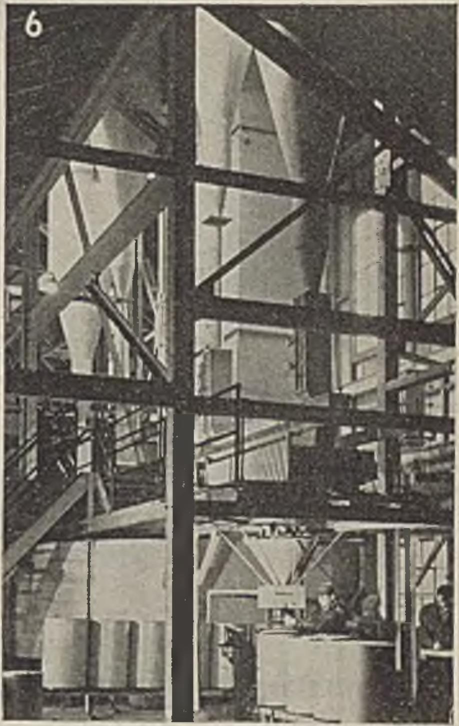
Fig. 4—Interior of the dryer showing concrete walls and the sweeper which cools and ejects the resin

room temperature to prevent further reaction and is pumped to the top of the dryer where it is converted to a fine spray by a high speed atomizer wheel. High temperature air, heated in the oil furnace shown in Fig. 1, enters around the atomizer. The resin forms a powder so impalpable that, even at a high production rate, the interior of the drying chamber has only a misty appearance. The powder falls to the base of the chamber where a sweeper blade rotated by jets of cold air cools the resin and brushes it into an open duct around the base. Thoroughly aerated, the powder passes through a duct into the fan and thence through a 4x6-ft. vertical riser to the centrifugal type dust collectors, which collect the product and separate the air.

From the collectors the powder is conveyed by a screw to Rotex screens from which it drops to filling equipment where it is weighed into fiber drums.





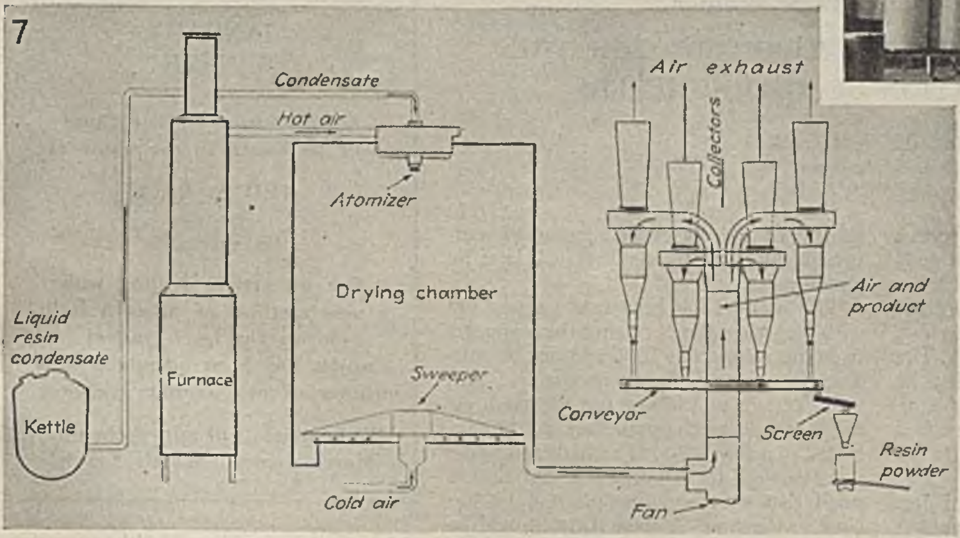


Fig. 5—Looking up at the centrifugal resin collectors

Fig. 6—This view shows the resin collectors above the fan, screw conveyors, screens and drum filler

Fig. 7—Flow sheet of the resin drying process shows how the aqueous resin solution is converted into an impalpable dry powder

Fig. 8—Powdered resins are filled here into fiber drums

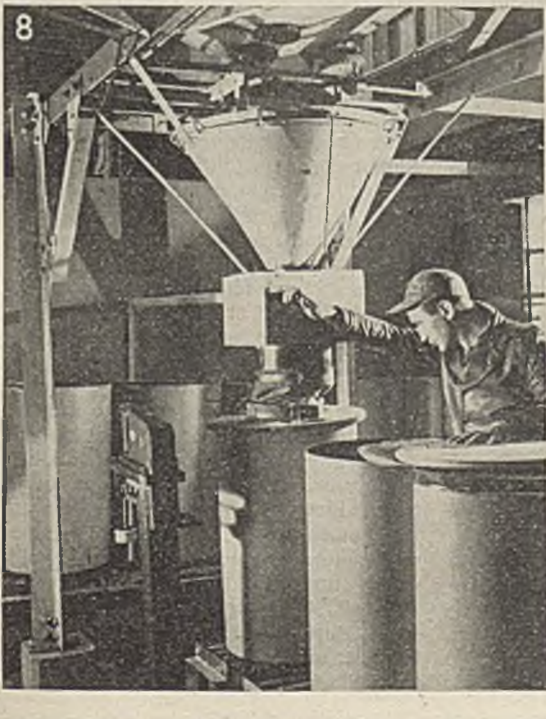
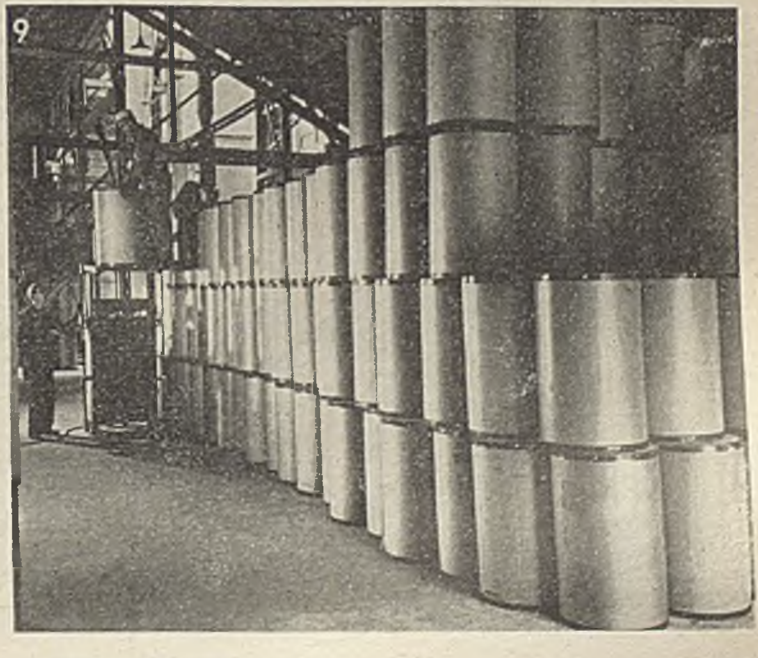


Fig. 9—Powdered resins are easily handled and stored in drums



CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

War Bond Awarded Each Month

Until further notice the contest which was first announced in our November 1943 issue will be continued. For the best short article received each month and accepted for publication in the "*Chem. & Met.* Plant Notebook," a $25 Series E War Bond will be awarded, in addition to payment at our usual space rate for this department. The award for each month will be announced in the issue of the following month. The judges will be the editors of *Chem. & Met.* Any item submitted may be published in this department, but all items so published will be paid for at our usual space rate for such material.

The contest is open to all readers of *Chem. & Met.*, other than employees of the McGraw-Hill Publishing Co., Inc.

Any number of entries, without limit, may be submitted by one person. Articles must be previously unpublished, and should be short, preferably less than 300 words, but should include one or more illustrations if possible. Finished drawings are not required and literary excellence will not be a factor in the judging. Winning articles will be selected on the basis of appropriateness, novelty and the usefulness of the ideas described.

Articles may deal with any sort of plant or production "kink" or shortcut which in the opinion of the judges will be interesting to chemical engineers in process industries, as well as with cost reducing ideas, and novel means of presenting useful data. Material to be entered in this contest should be addressed to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

December Contest Prize Winner

SIMPLIFIED NON-EQUILIBRIUM METHOD FOR THE RAPID CALIBRATION OF THERMOMETERS

JAMES H. WEIGAND
Chemical Engineer
Traverse City, Mich.

USUALLY when it is desired to calibrate a number of thermometers with a good degree of accuracy, the procedure is to place the unknown thermometers together with a standard reference thermometer in a well-stirred constant temperature bath. The thermometers and the bath must then be allowed to come to a temperature equilibrium at each test temperature, a method which is slow if much range is to be covered.

In cases where an accuracy of ± 0.1 deg. F. is all that is needed, as in thermometers with 1 deg. F. divisions, the equilibrium bath method is more accurate than is required, as well as needlessly time consuming. A dynamic method in which the bath temperature is raised continuously and uniformly can be used with excellent results, provided that the possibility of the several bulbs having different characteristics is recognized and means are adopted to compensate for such variations, as will later be discovered.

This method has been used successfully with glass thermometers, and there appears to be no reason why it should not be suitable for metal-bulb thermometers, provided certain precautions are observed. As many as a dozen thermometers can be calibrated in a few hours. The bath should be small enough for convenience, but not so small that the thermometers will be too close to the wall. A good stirrer should be provided, together with a hot plate or immersion heater which will provide a fairly uniform rate of temperature rise. A support should be used which will hold the thermometers securely at the desired depth of immersion. A simple support for glass thermometers can be made as shown in the sketch from two strips of wood and two strips of sponge rubber. The thermometers are thus supported flexibly.

Fig. 1—Arrangement of test bath for calibrating thermometers

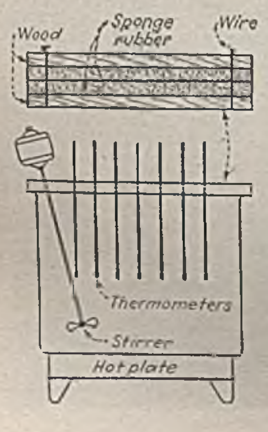
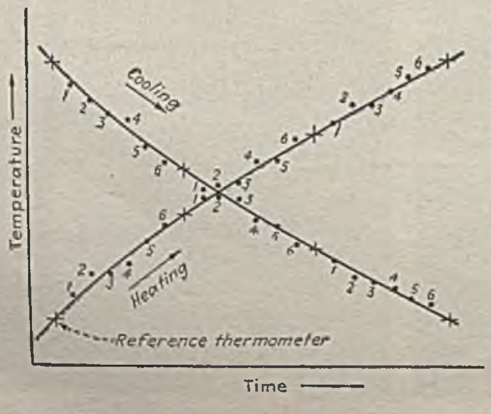


Fig. 2—Typical heating and cooling curves obtained in dynamic calibration



JANUARY WINNER!

A $25 Series E War Bond will be issued in the name of

TED A. BECK

Engineer
Milwaukee, Wis.

For an article dealing with a new method of using a light beam for level control which has been adjudged the winner of our January contest.

This article will appear in our March issue. Watch for it!

Starting at a point below the lowest desired calibration temperature, the bath is heated slowly with a constant rate of energy input to the heater. The speed of heating must be no greater than will permit uniform temperature distribution throughout the bath. Thermometers are then read in order, starting with the reference thermometer and reading the others from left to right at short uniform intervals of time, such as 15 sec. That is, the reference instrument is read at 0, No. 1 at 15 sec., No. 2 at 30 sec., etc., and when all the thermometers have been read, the sequence is repeated and the procedure continued until the temperature of the bath is above the highest desired calibration temperature.

This gives a continuous series of values which are best plotted directly on graph paper. Plotting is preferable to recording the numerical values, since any serious errors in reading will be evident immediately from the time-temperature plot. However, it is preferable to record the temperatures shown by the reference thermometer rather than to plot them, since it will later be necessary to correct these points from the standard thermometer's calibration curve before they can be plotted.

In Fig. 2 the curve ascending toward the right is such a plot, on which the corrected values of the reference thermometer temperatures have been entered as + marks. A smooth curve is drawn through the reference points and from it the deviation of the readings of each of the thermometers can be read at each of a succession of temperatures. These deviations can then be plotted against temperature as in Fig. 3, to give a correction chart for each thermometer.

As outlined so far, the method has assumed that the heat capacities and the rates of heat transfer through the bulbs of the test thermometers and the reference thermometer are all substantially the same and that, therefore, they would all read alike if they were read simultaneously instead of in sequence. This assumption is probably safe if the thermometers are geometrically similar, are made of the same materials, and are all of substantially the same weight and range. If they do not all have the same heat capacities and heat transfer rates, however, those of less capacity or higher transfer rates will lead, and those of greater capacity or lower rate will lag behind the rise of the reference thermometer. To take this into consideration it is necessary also to run a similar temperature curve for cooling of the bath, as shown in the curve descending toward the right in Fig. 2. In this way the lags and leads for the individual thermometers will be opposite in direction to those obtained during heating, and the average for each thermometer at each temperature will be the true value. Fig. 4 shows such a correction plot for one thermometer, giving the corrections obtained during heating, those during cooling, and their average.

If a cooling curve is necessary it is desirable to have the rate of cooling substantially equal to the heating rate at each temperature. If the cooling rate should be less at any temperature, then the lags and leads will be less pronounced, and the averages will no longer give true values. A small water cooling coil can be used, with the water rate adjusted by experiment to give about the right cooling rate. Or if natural cooling is to be used, then previous experiments will show what heating speed should be used to approximate the cooling rate. Even so, however, as in Fig. 2, the cooling curve tends to be steepest where the heating curve is least steep, owing to variable heat transfer and it may be necessary to adjust the heating or cooling rate to produce similar curves.

Thermometers should be calibrated under approximately the conditions of use, that is, with the emergent stem or capillary at the operating temperature. For example, for thermometers such as the ordinary industrial type, in which all of the thermometer except the bulb operates normally at approximately room temperature, the thermometer should not be calibrated over an open bath, with hot vapors around the emergent stem as in Fig. 1, but should be calibrated in a bath in which it can extend through the vessel wall.

Fig. 3—Correction curves of this form can be plotted for each thermometer

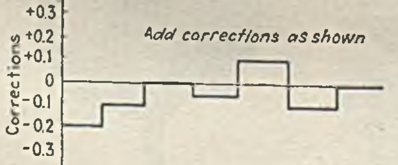
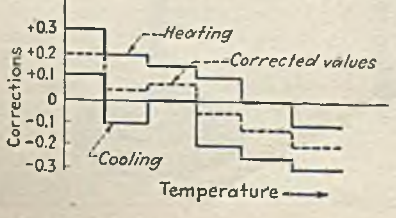


Fig. 4—The average of heating and cooling corrections is necessary where considerable lag is encountered

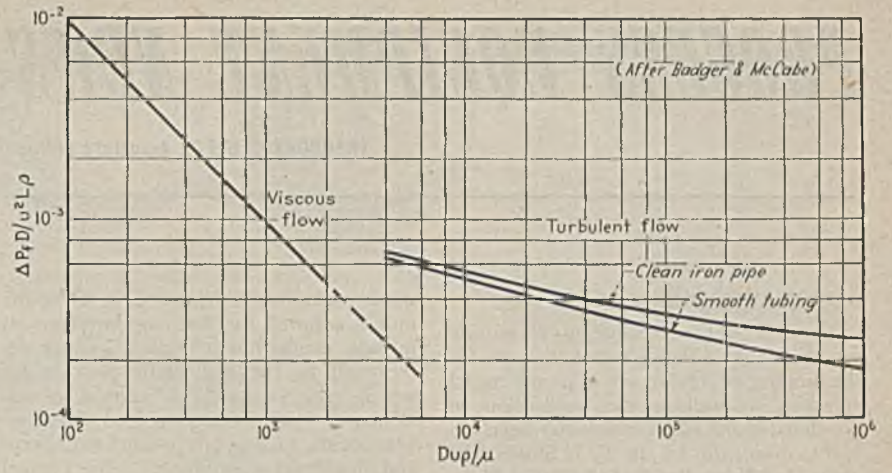


VISCOSITY ESTIMATED FROM PRESSURE DROP DATA

D. S. DAVIS

Wyandotte Chemicals Corp.
Wyandotte, Mich.

In the case of many aqueous solutions and organic liquids of industrial importance viscosity data are meager or entirely lacking. This is unfortunate in view of the importance of such data in the design of equipment for heat transfer and fluid flow. However, in pilot plant or full-scale operation where such solutions or liquids are already flowing in reasonably simple piping systems it is possible to obtain a fair idea of the viscosity, for further use, from the measured pressure drop, the diameter and equivalent length of the pipe, the velocity and density of the fluid flowing, and one of the readily accessible friction factor plots[1,3,4,5].



Viscosity can be calculated from the Reynolds number, once the pressure drop due to friction in a piping system is known

For instance, using Fig. 14 of reference 1 (reproduced in simplified form here), calculate the value of $\Delta P_f D/u^2 L \rho$ where

ΔP_f = pressure drop due to friction, lb. per sq. ft.

D = inside diameter of pipe, ft.

u = avg. velocity of fluid, ft. per sec.

L = equivalent length of pipe, ft.

ρ = density of fluid, lb. per cu .ft.

and read the Reynolds number, $D u \rho/\mu$, where μ is the viscosity in English units, lb. per ft. and sec., from the turbulent flow curve in the great majority of cases or from the viscous flow curve, less frequently. (There is usually little question as to the type of flow.) The viscosity can then be calculated from the Reynolds number.

The method can also be applied to gases, when the final pressure is greater than 90 per cent of the initial pressure, and to suspensions which exhibit apparent rather than real viscosities. It has been used successfully for sulphate stocks[2].

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GAS FREEZING REDUCED BY ALCOHOL INJECTORS

A recent issue of the American Gas Association *Monthly* describes measures which have been adopted for standby service by the United Gas Pipe Line Co. in several southern Louisiana natural gas fields, to combat the freezing of hydrates in the lines in case the dehydration plant is out of operation. The company has installed single and in some cases double alcohol injectors to introduce an alcohol spray into the lines to prevent freezing.

The injectors consist of 20-ft. lengths of 12.75-in. O.D., 49.56-lb. pipe with welded-on heads, welded feed and equalizing lines and gage glasses, designed for 1,000 lb. working pressure. In operation the cylinders are partially filled with alcohol. An equalizing line is tied into the gas line above the point of the feed line connection, so that gas flows through the cylinder. In addition, the cylinders are set high enough for gravity flow to the gas line. The flow rate is controlled by a valve setting. About 1 gal. of alcohol per million cubic feet of gas is required.

PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

AUTOMATIC PRESS

Type R is the designation of an improved, high-production automatic press for the molding of steatite and other dry-mixed ceramics, as well as the production of powdered metal parts, which has been announced recently by the F. J. Stokes Machine Co., Tabor Road, Olney P. O., Philadelphia, Pa. The manufacturer states this device is suitable where closest accuracy in dimensions and exacting control of density are primary requisites. The press is said also to be suitable for debulking chemicals, compressing food specialties and for similar purposes where automatic operation is necessary. Pieces up to 3 in. in diameter with a die fill of 2$\frac{5}{8}$ in. are compressed by this machine at rates of 15 to 45 per minute, employing pressures up to 20 tons from both top and bottom. Since the pressure adjustment can be made while the press is operating, the density in the piece may be controlled exactly. Construction features include separate ejection and compression levers, screw adjustment for compression, independent ejection cam, variable-speed drive and extra heavy construction throughout.

HYDRAULIC CLASSIFIER

Developed to utilize fully the principles of hindered settling classification, an improved hydraulic classifier known as the Dorrco Hydrosizer has been announced by the Dorr Co., 570 Lexington Ave., New York 22, N. Y. The unit is continuous in operation and completely automatic, producing a number of sharply classified products from a feed composed of 4-mesh and finer particles. Separation is effected by differences in specific gravity, or particle size, or both.

The machine consists of a tank subdivided into five or more trapezoidal pockets increasing in area from the feed to the overflow end. These pockets are separated from each other by baffle plates and are provided at the bottom with a perforated constriction plate having holes of a diameter and spacing corresponding approximately to the size of particles to be retained in each pocket. Hydraulic water is introduced under each constriction plate, flowing upward through the pocket. At the center of each constriction plate is a discharge valve operated by a modulating, reversible valve motor under the control of an extremely sensitive pressure registering device which measures the hydrostatic head in a standpipe located in each pocket. Changes in head are immediately transferred to the valve motor which thereby raises or lowers the plug to maintain the head constant.

Feed is introduced at the narrow end of the machine into a feed compartment where preliminary sorting occurs. Once the unit is adjusted the discharge mechanisms in each compartment reach a balance determined by the hydrostatic pressure for which each outlet valve control is set. When no major change in feed characteristic occurs, each spigot product is uniform and discharges continuously. No manual adjustments are necessary except when abnormal changes in feed occur.

So far, this machine has been applied successfully in preparing table feed and specification sand, and in the concentration of phosphate rock, iron ore and chromite.

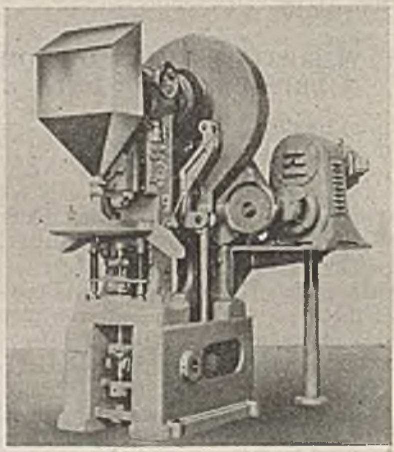
INFRA RED LAMP

An improvement in the construction of infra-red heat lamps for tunnel use has been announced by the Birdseye Division of Wabash Appliance Corp., 335 Carroll St., Brooklyn, N. Y. The new construction, known as Superlock, is intended to avoid the difficulties encountered in conventional lamps employing the usual method of cementing and strapping the bulb to the base. The old construction is said not to hold up under continuous high temperature service. The new construction uses no cement or strap, relying instead on a base lining with special protrusions which fit tightly into indentations in the neck of the bulb and are locked by special crimping of the metal base. Another improvement is a ceramic heat reflector disk which replaces the mica disk formerly used.

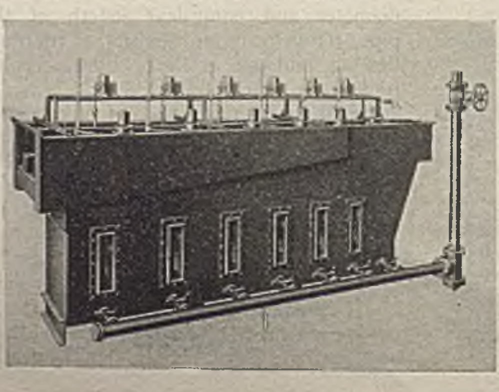
CENTRIFUGAL CLUTCH

Torkontrol is the name of a new automatically engaging and self-disengaging centrifugal clutch recently developed by the Amalgamated Engineering & Research Corp., 100 West Monroe St., Chicago 3, Ill. The new clutch, which can be produced in an unlimited range of sizes and capacities, may be used either as a coupling between shafts or as a driving pulley or gear in a transmission, as well as a starting cushion between power units and driven mechanisms. It consists of a partially filled oil chamber fitted with a freely rotating hub carrying a series of movable wedge-shaped flyweights. As the hub revolves,

High-production automatic press

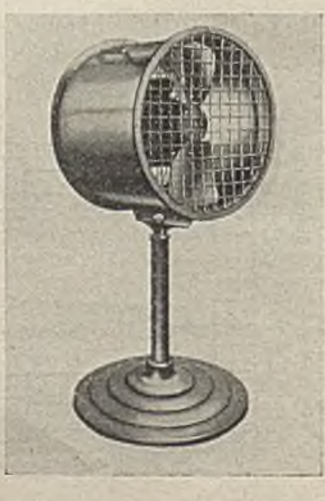


Improved Dorrco Hydrosizer



Improved infra-red heat lamp

Air-blast spot-cooling fan



Improved control valve positioner

Sawtooth anode for electroplating

New chemical porcelain

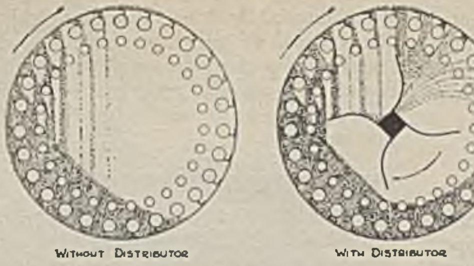
these weights fly outwardly and engage the internal rims of the outer case, binding the hub and shell into the equivalent of a solid pulley or coupling. The unit works equally well in either direction and is adjusted to engage or release at a given speed and to slip in case of overload. Since overload capacity is therefore not required for accelerating the load, smaller motors can be used.

SPOT COOLER

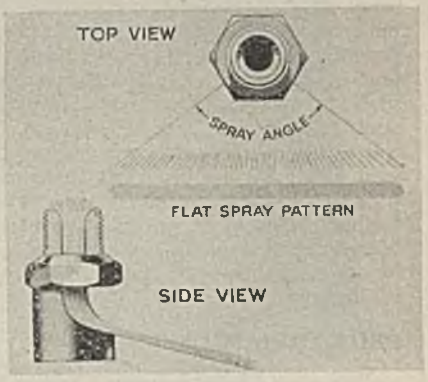
Known as the Air Blaster, a new pedestal type spot cooler manufactured by the Chelsea Fan & Blower Co., 1206 Grove St., Irvington, N. J., is built in sizes ranging from 18 to 30 in., for the delivery of 6,000 to 11,000 c.f.m. of air in a high velocity stream which is said to travel over a considerable distance with only a little expansion. Suitable for use as a man cooler in hot spots, the equipment is also suggested by the maker for the cooling of condensers, compressors and transformers. The unit consists of a welded steel housing mounted on an adjustable pedestal which may be tilted 60 deg. up or down. Within the housing is a direct-connected ball-bearing motor, driving a heavy steel die-cut fan.

LEAD ANODE

A new type of lead anode for electroplating has been developed by the Heil Engineering Co., 12901, Elmwood Ave., Cleveland, Ohio. Known as a "sawtooth" anode, it differs from standard flat anodes in several ways. For example, having a multiple-angled surface, it gives 50 percent more area than a flat anode and is said to result in greater electrical efficiency and



Operation of rotary steam tube dryers with and without rotating distributor



Wide-angle spray nozzle

throwing power. One side has ten edges, the other side a central spine ½ in. thick running down the center. This spine connects directly to the hook, insuring double the average anode life, according to the manufacturer, and providing greater current carrying capacity from top to bottom. The angular construction furthermore lends rigidity and offers resistance to buckling or warping.

VALVE POSITIONER

Improvements in its control valve positioner have recently been announced by The Foxboro Co., Foxboro, Mass. The new Foxboro Vernier Valvactor is actuated by air pressure changes as slight as ½ in. of water and can produce valve stem movements as small as 0.001 in. The operating principle is the same as that of the company's earlier positioners but the new construction involves a completely different arrangement of actuating elements, facilitating and increasing the range of adjustments, especially for duplexing and sequencing. The new positioner provides snap action for relay service or step sequencing of valves or damper motors.

IRON-FREE CERAMIC PRODUCT

Cerawite is the name of a new white iron-free ceramic product developed especially for use in the pharmaceutical field by General Ceramics Co., Chemical Stoneware Division, Keasbey, N. J. This new industrial chemical porcelain can be substituted for chemical stoneware in practically all of this company's standard equipment, except the larger shapes. The product has a brilliant white glaze over a dense white body, the latter having zero absorption, according to the manufacturer. In addition to industrial products, the new porcelain ware can be supplied in table tops and sinks.

New 4-lb. CO_2 extinguisher

ROTARY DISTRIBUTOR

To increase the capacity of rotary steam tube dryers, the Louisville Drying Machinery Co., 464 Baxter Ave., Louisville 4, Ky., has developed a new rotary distributor which, in effect, enables tubes which are normally out of operation, as the dryer rotates, to be in contact at all times with material being dried. Under normal conditions, only the tubes at the lower and ascending side of the cylinder contact the material. However, with the introduction of a rotating element which catches the showering material as it falls from the tubes and lifting flights on the ascending side, and throws the material against the upper part of the descending side of the dryer cylinder, heating surface which would otherwise be idle is utilized.

According to the manufacturer, tests have indicated that this distributor is capable of adding 20 to 30 percent to the capacity of steam tube dryers operating on suitable materials. The new distributor requires little power to operate and can be applied to existing steam tube dryers. It also can be built into new ones. It is not suitable for handling such types of materials as muddy filter cakes and similar products which dry into pellet and lump form, but in general it is suitable for comparatively light and bulky materials containing a relatively high moisture content which are granular when fed and remain so throughout the drying cycle. Such materials as distiller's slop, brewer's grain, soy beans, fish meal, wood flour, granular chemicals and fertilizers are indicated.

FLOODING NOZZLE

Designed to produce an exceptionally wide flat spray, a new flooding nozzle has been developed by Spraying Systems Co., Chicago, Ill. Intended primarily for spraying eliminator plates in air conditioning systems, the nozzle is also suitable for other similar applications. It is made in brass and other standard materials.

PORTABLE FIRE EXTINGUISHER

Speed and maneuverability are featured in the design of the new Model F-4 carbon dioxide fire extinguisher recently put on the market by Randolph Laboratories, Inc., 8 East Kinzie St., Chicago 11, Ill. This new 4-lb. extinguisher features a self-aimed, fixed discharge horn and a thumb-operated trigger valve. The extinguisher requires only one hand in operation, leaving the operator one hand free for precautionary measures.

ELECTRONIC LEVEL CONTROL

For controlling the level of liquids, as well as electrically conducting solids, within open or closed tanks, bins, hoppers or other containers, Trimount Instrument Co., 37 West Van Buren St., Chicago 5, Ill., has introduced a new level control operating on the electronic principle. This instrument indicates the level by signals or can be installed to operate solenoid or motor-driven valves, pumps, lights, bells or other electrical devices. The control has no moving parts and can be installed in containers involving extreme temperatures. Various combinations of single and double electrode installations are available.

TABLE-TYPE PRINTER

Models B1 and B2 are the designations of two new table-type continuous printers for the production of blueprints and direct-process black-and-white prints that have been developed by Peck & Harvey, 4327 Addison St., Chicago, Ill. The two models are similar except that one employs two Cooper-Hewitt mercury vapor tube lamps, the other one. Both produce prints up to 44 in. wide in any length at speeds up to 41 in. per minute, depending on the character of the material reproduced and the print paper used. The printers are compact and portable, as well as easy to operate and maintain, according to the manufacturer. No special wiring is required. They take cut sheets or continuous rolls, handling any drawing, tracing or other material up to 44 in. wide. Exposure is accomplished by moving the original and the print paper in sliding contact over a hand-polished glass contact cylinder, power from the variable-speed motor being transmitted through individual moving fabric bands which run in guides under automatically controlled tension.

PARTICLE-SIZE METER

Measurement of particle sizes too small to be measured by sieves is the function of the new Sub-Sieve Sizer recently announced by Fisher Scientific Co., Pittsburgh, Pa., and Eimer & Amend, New York, N. Y. The instrument operates on the principle of air permeability. This method follows the rule that a current of air flows more readily through a bed of coarse powder than through an otherwise equal bed of fine powder. The instrument includes an air pump, an air pressure regulating device, a precision-bore sample tube, a flow meter, calculator chart and accessory equipment, all mounted in a hardwood case. In operation, the motor-driven air pump builds up pressure in the pressure regulator to a constant head, assuring a uniform flow of dried air passing through a packed powder sample. The average particle size of the sample determines the rate of air flow which is then read directly from the calculator chart as indicated by the level of liquid in the flow meter manometer. Possible variables in the procedure are eliminated by using a sample weight in grams equal to the true density of the sample, and packing the sample to a known degree. The range of particle sizes measurable with this instrument is from 0.2 to 50 microns.

SYNTHETIC DIELECTRIC

After several years of research the General Electric Co., Schenectady, N. Y., has announced Lectrofilm, a new synthetic dielectric material for capacitors, which is made of materials available in the United States. The development was hastened by the growing shortage of high grade mica. According to the manufacturer, the new product has a greater combination of desirable properties than were previously available in any one dielectric material. It is available in rolls and sheets and can be used in present manufacturing lines with little, if any, change in equipment or methods of manufacture. This product is being made available by the maker for use by other manufacturers making capacitors for the armed forces.

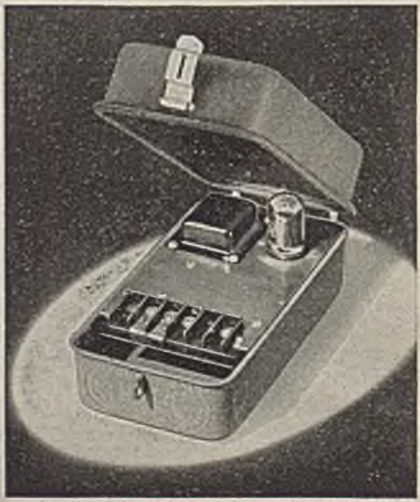
PROTECTED MOTOR

Sizes from 1½ to 15 hp. are available in the new Century Form J general purpose motor announced by Century Electric Co., 1806 Pine St., St. Louis 3, Mo. This motor is available in a new protected design. The upper half of the end bracket is closed to minimize possibility of dripping liquids or falling solids entering the vital parts of the motor. Two powerful fans located behind the bearing brackets draw cooling air through the bearing bracket openings, around the bearings, across the windings and to the air passages between the outer surfaces of the magnetic core and the frame, with the heated air expelled through openings at the side and bottom of the frame.

AIR RELAY VALVE

To assure better and faster process control by speeding up the operation of pilot-operated diaphragm values, and by eliminating the lag in long control lines, Fisher Governor Co., Fisher Building, Marshalltown, Iowa, has introduced a new air relay which is available in two types.

Electronic level controller



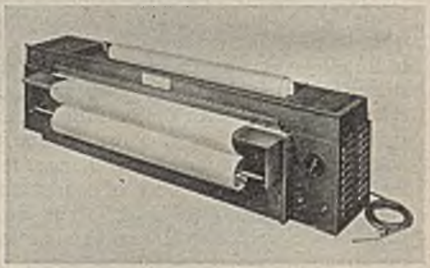
Type 2601 has a loading ratio of 3 to 1, providing 3 lb. output pressure for each pound of air pressure variation on the relay diaphragm. Type 2601A has a loading ratio of 1 to 1 so that a pound change at the diaphragm produces a pound of output pressure change. The unit consists of a cast bronze body with a single-seated, double-acting inner valve construction. Seats are cut in the body and in the upper diaphragm follower. The device operates rapidly. For example, with a supply pressure to the inlet side of 20 lb., a main valve diaphragm of 107 sq.in. area and a 2-in. valve stroke, the time required for stroking the valve in either direction is 10 seconds.

WELDED PRESSURE VESSELS

Designed particularly for research and pilot plant work is a new line of welded pressure vessels for the storage of compressed gases at pressures up to 6,000 lb. per sq.in., which has been announced by the American Instrument Co., Silver Spring, Md. Under certain conditions this equipment can be operated up to 8,000 lb. per sq.in. Standard units may be used as high-pressure soaking drums or reaction vessels in cases where it is known that corrosion will not take place and solids will not settle out within the cylinder. In some cases the vessels are suitable for separation of gases and liquids, as well as for liquid-pressure accumulator service. The vessels are of low-carbon steel, normally built with both ends closed, although special units can be provided with removable ends of several types. The vessels are made in sizes of 2 and 4 liters, as well as cubic-foot sizes ranging from ¼ to 1¼.

Another new development of the company is a preliminary test bomb for making preliminary tests of reactions at high pressure, with safety and convenience, at low cost. Each bomb, which is made of high-strength steel, is individually tested to 15,000 lb. per sq. in., for a working pressure up to 10,000 lb. The calculated bursting pressure is over 40,000 lb.

New table-type printer



Samples of new dielectric


THE GIRDLER CORPORATION

STYRENE BY DOW PROCESS

Commercial production of styrene was begun by the Dow Chemical Co. in 1935 after earlier United States attempts had failed to prove successful. Until the enormous demands of the Buna S program made themselves felt, Dow remained the only large-scale producer. Now the process here described, used in four Dow-operated plants and in part by two other producers, is scheduled to supply almost 90 percent of the styrene demands of the rubber program.

The basic chemistry is: 1. Alkylation of benzene with ethylene to form ethyl benzene. 2. Dehydrogenation of purified ethyl benzene to give styrene.

Ethylene gas and benzene enter a tower operating at essentially atmospheric pressure. Then with the assistance of a catalyst, alkylation takes place to form ethyl benzene, diethyl benzene, and polyethyl benzenes. The crude ethyl benzene so formed is then sweetened and distilled to give pure ethyl benzene. Also separated in this step are benzene, which is recycled, and polyethyls, which are returned for dealkylation to ethyl benzene.

Ethyl benzene is dehydrogenated over a fixed catalyst in the presence of steam to give styrene and small amounts of benzene, toluene, and tar. In the distillation step these components are separated at reduced pressure to give recycle benzene, recycle ethyl benzene, toluene byproduct. and styrene of 99.5 percent or higher purity. The fractionation step is a delicate one due to only 9 deg. C. difference in the normal boiling points of ethyl benzene and styrene, as well as the strong tendency of styrene to polymerize. The proper combination of high-vacuum distillation technique plus suitable inhibitors has made a routine operation out of an extremely difficult problem.

Before tank car loading, styrene is cooled to 60 deg. F. and a few parts per million of polymerization inhibitor are added. The finished product has many uses, the most important of which lies now in the production of enormous quantities of Buna S rubber. Other essential needs are filled by polystyrene plastics, noted for their excellent electrical properties, chemical resistance, and molding properties.

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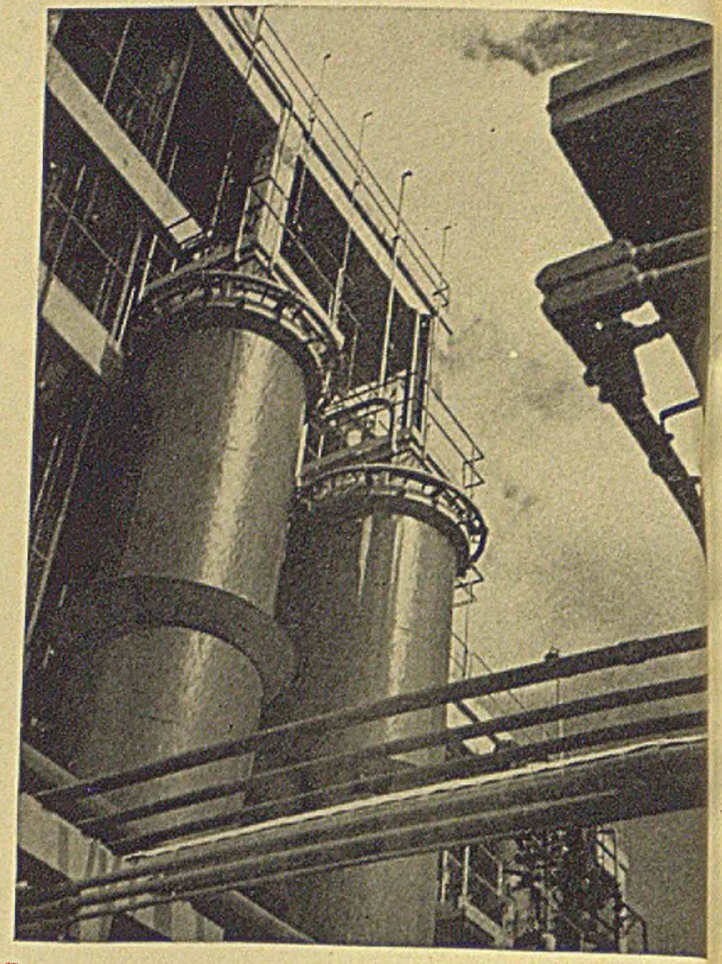
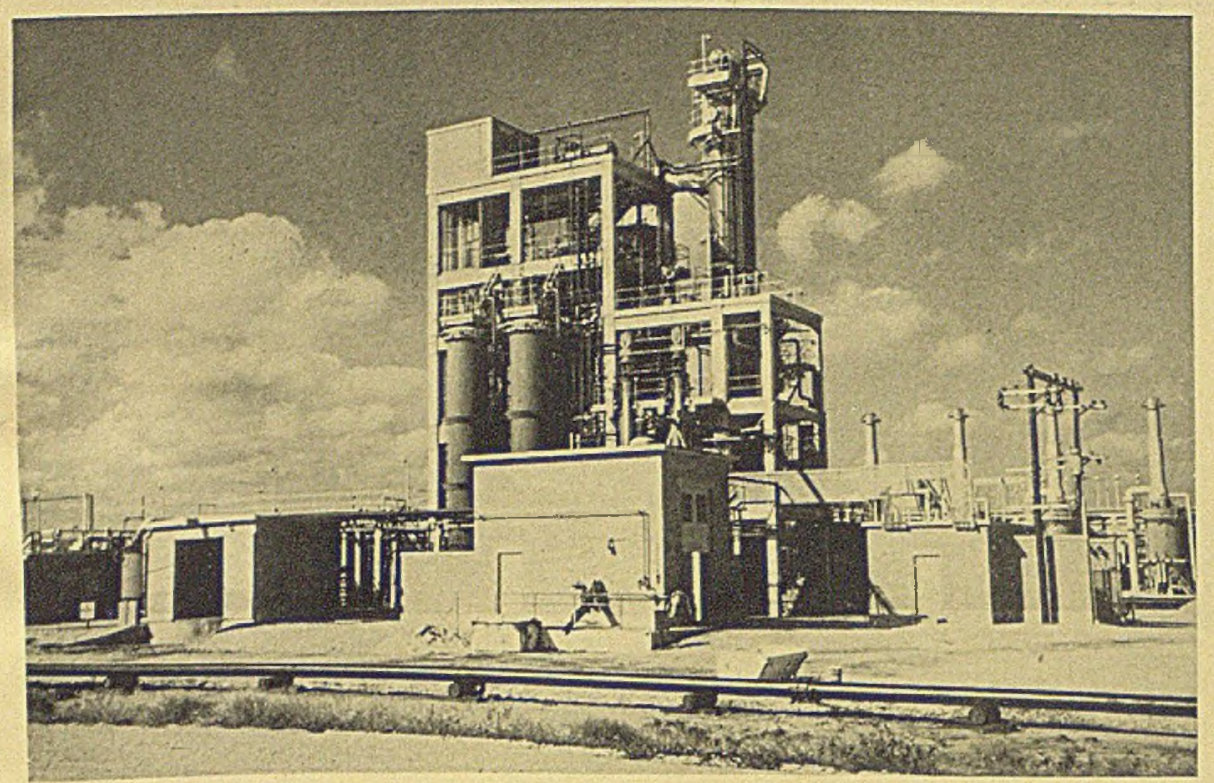
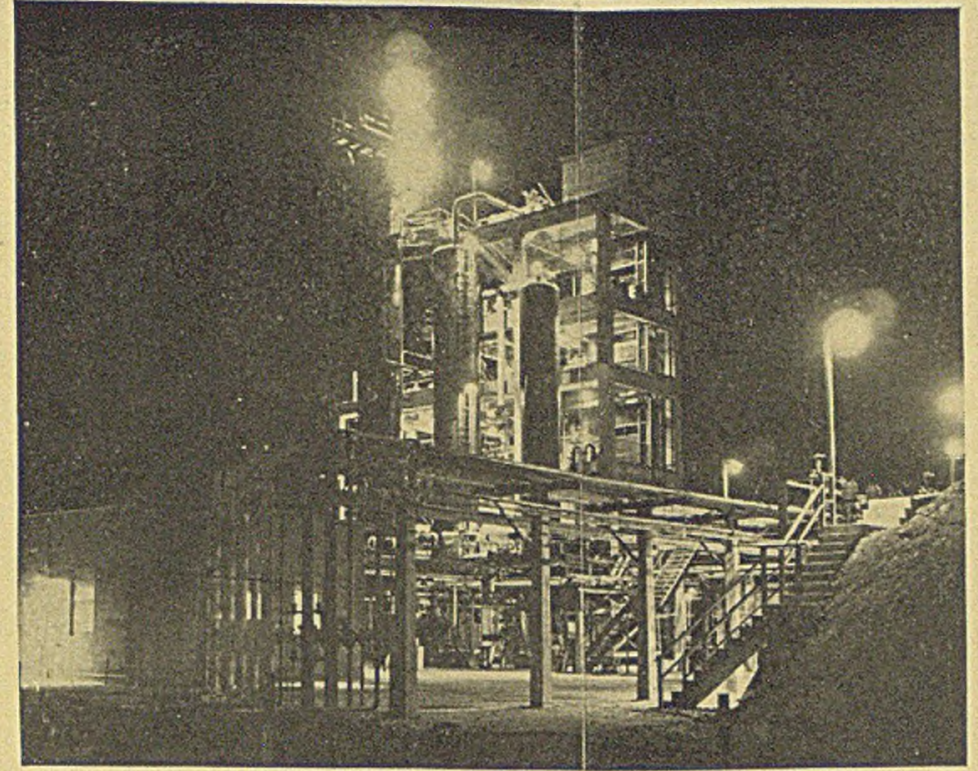


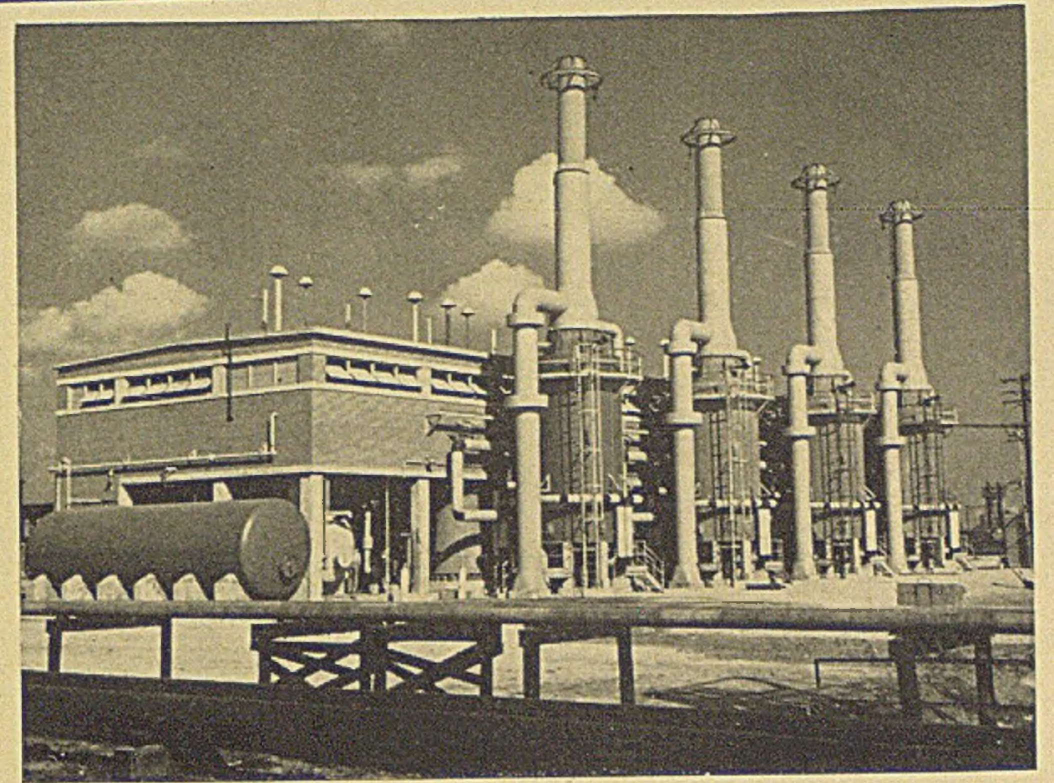
2 In these alkylators, ethylene and benzene r in presence of catalyst to form ethyl benzene



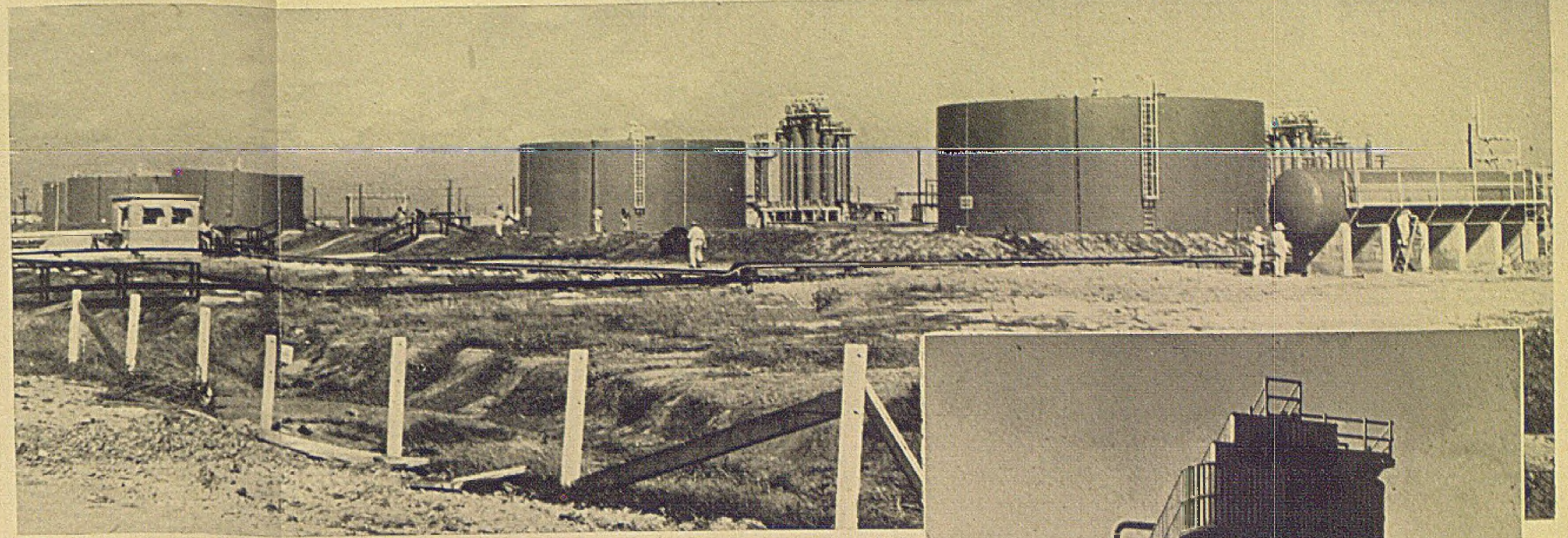
3 One of four ethyl benzene units at Texas plant. Alkylation takes place to form ethyl benzene and in addition diethyl benzene and polyethel benzenes



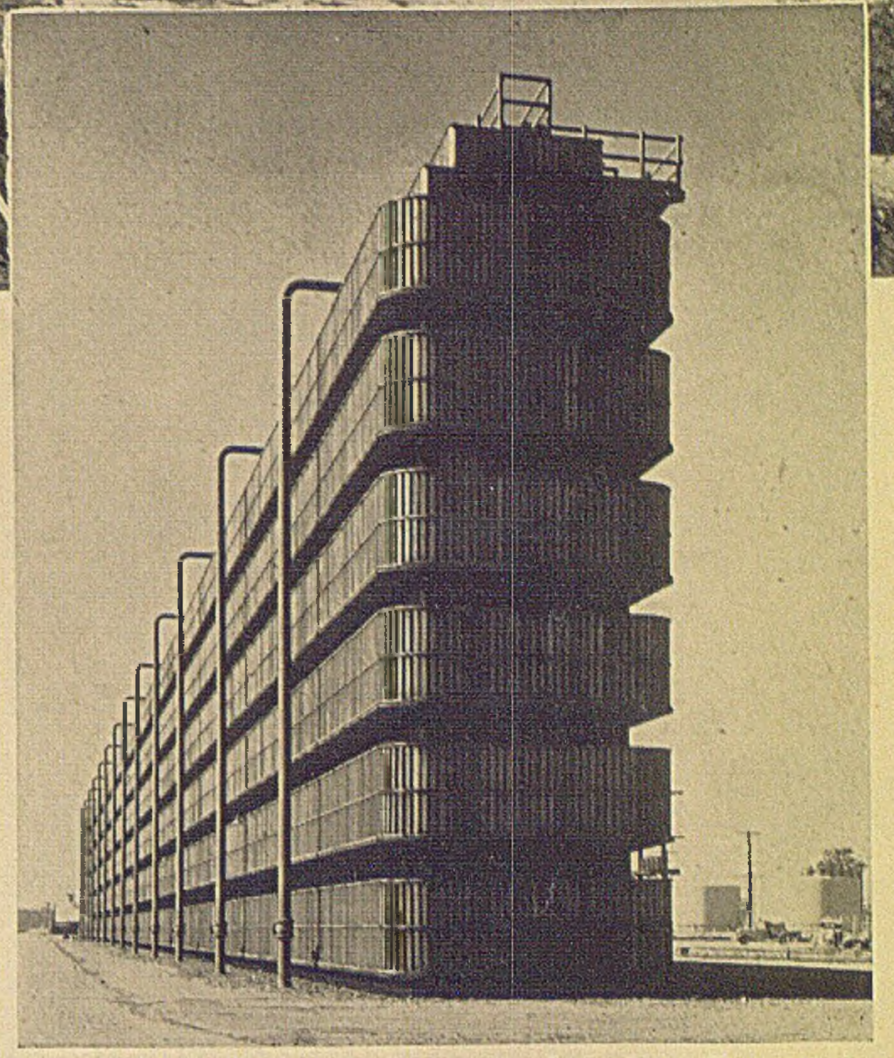
6 Ethyl benzene unit at California plant. This styrene process is used in four Dow-operated plants



7 The dehydrogenation of ethyl benzene is carried out using furnaces pictured. A catalyst case can be seen inside the building

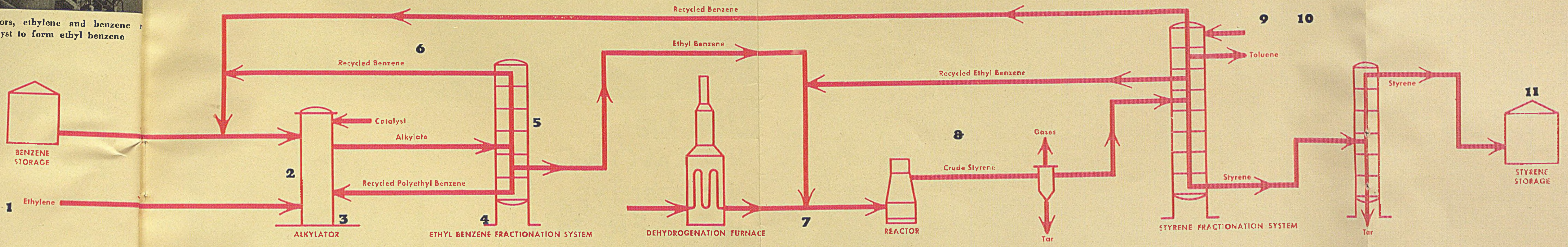


11 Benzene and finished styrene (99.5 per cent or higher purity), as well as intermediate products, are stored in this tank farm

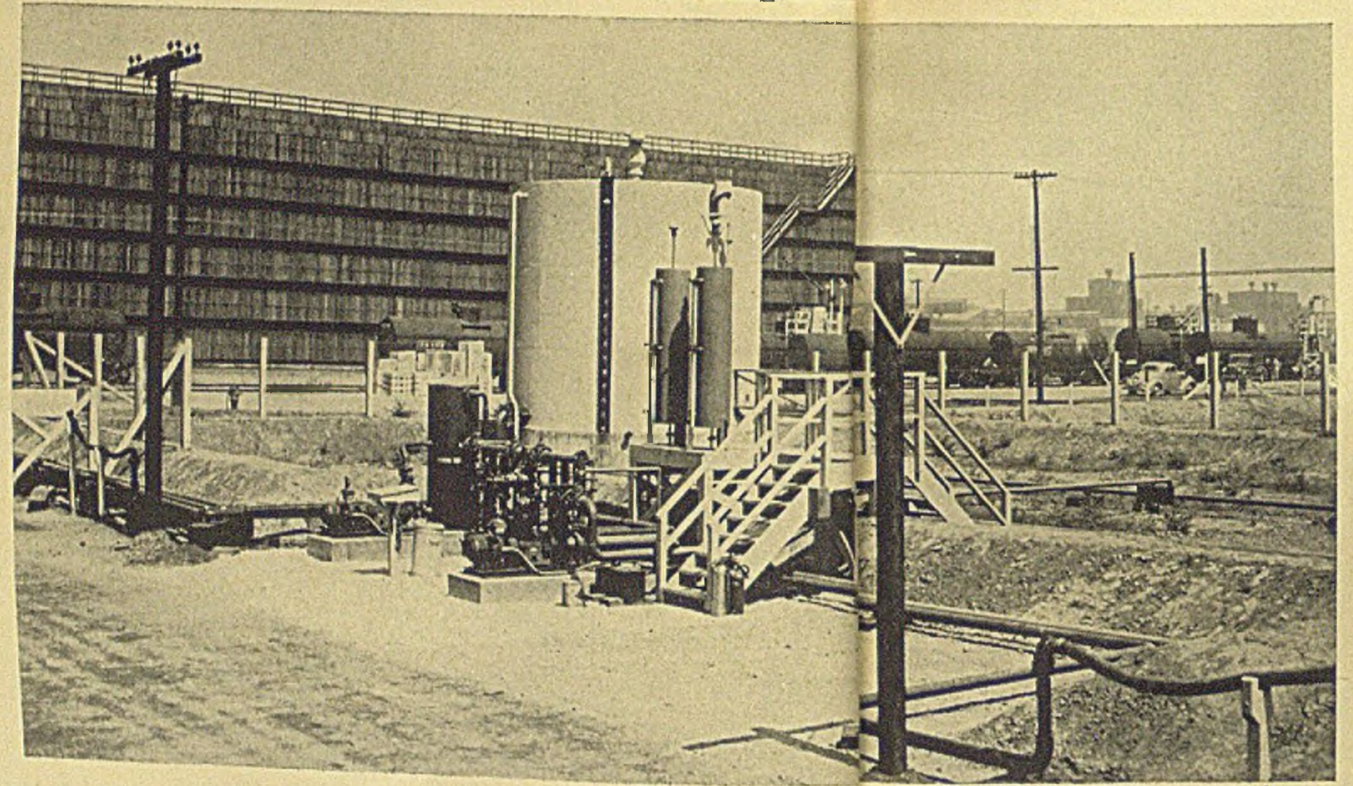


At the California plant, this natural draft cooling tower removes the heat picked up by recirculated water

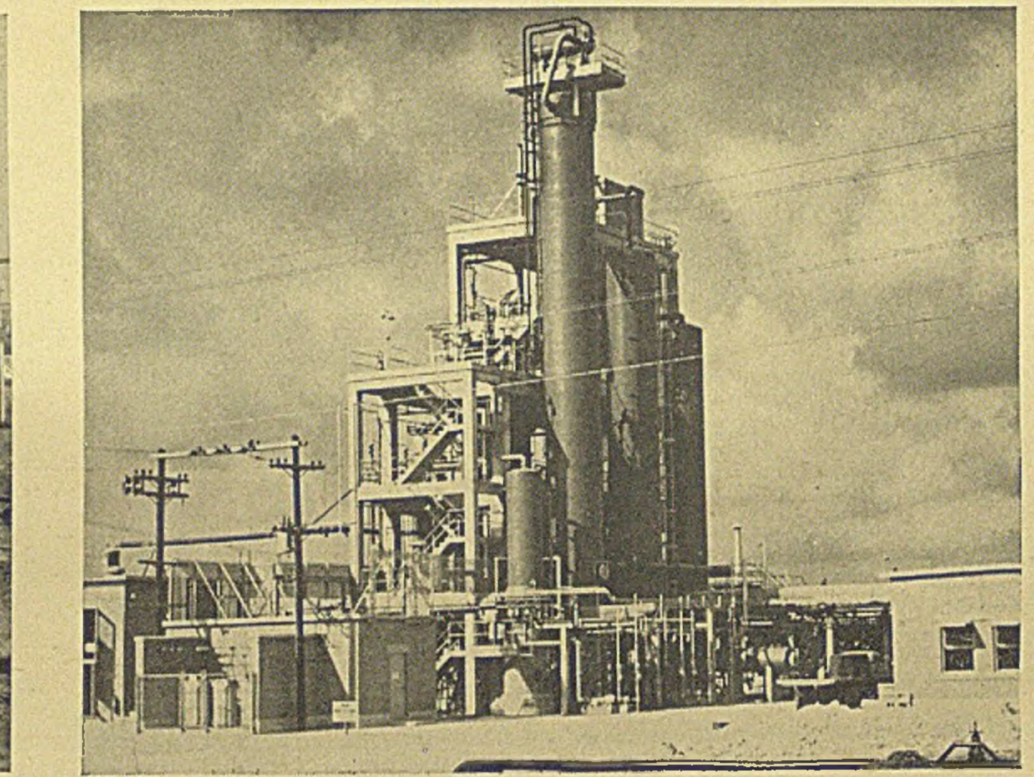
A Chem & Met FLOW SHEET



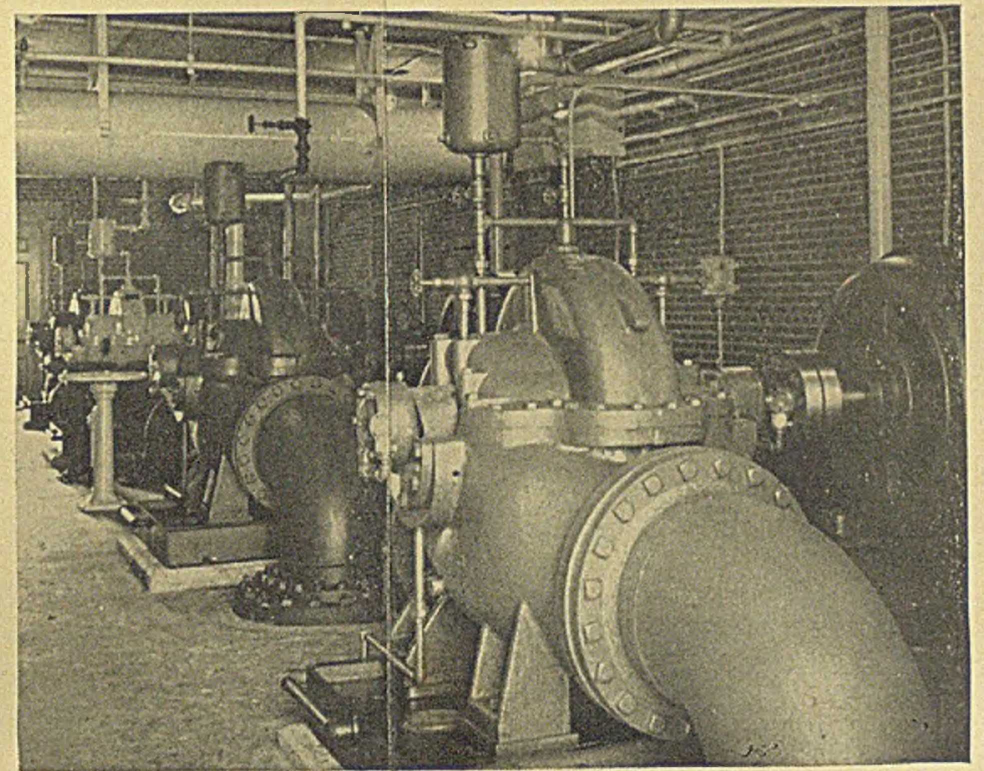
1 Source of ethylene at California plant is alcohol. At bonded measuring station, a check is made on entering alcol



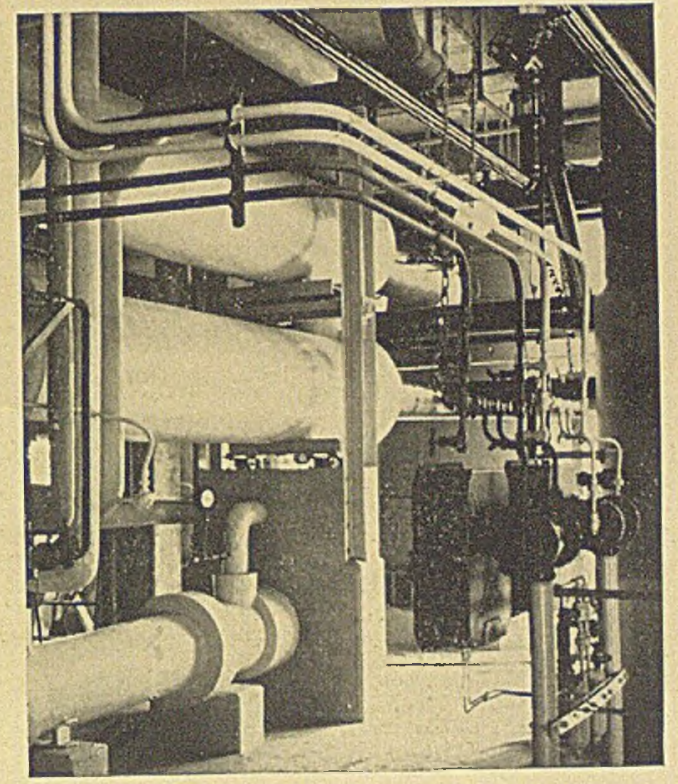
4 In these towers, the alkylate is separated into benzene, ethyl benzene, and higher boiling material



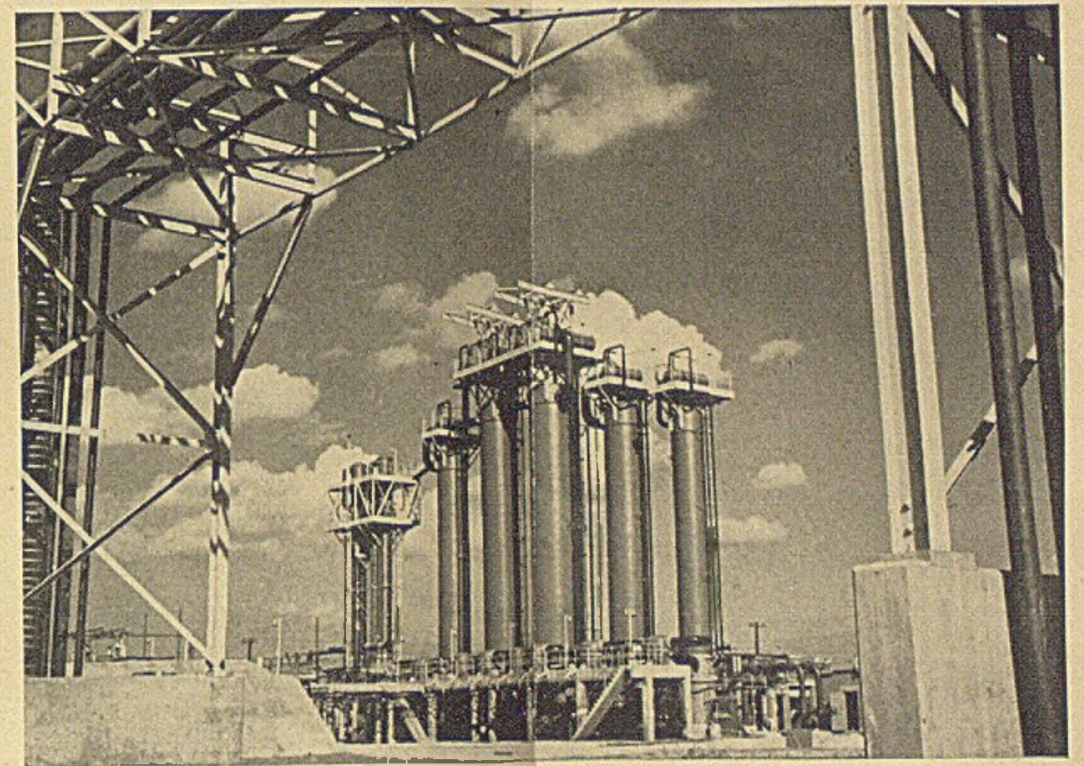
5 The pumps shown in this photograph are used to circulate water through the process and cooling tower



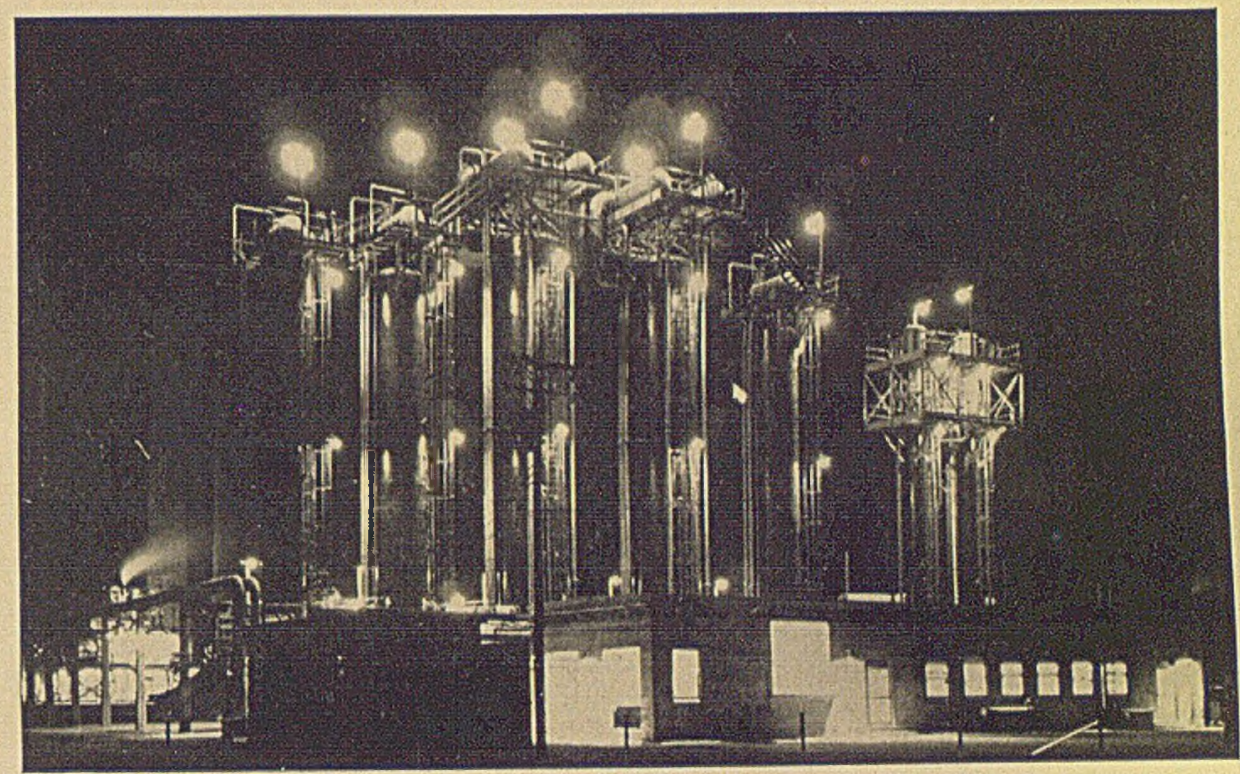
8 Heat exchange units for reactor products and incoming ethyl benzene and steam



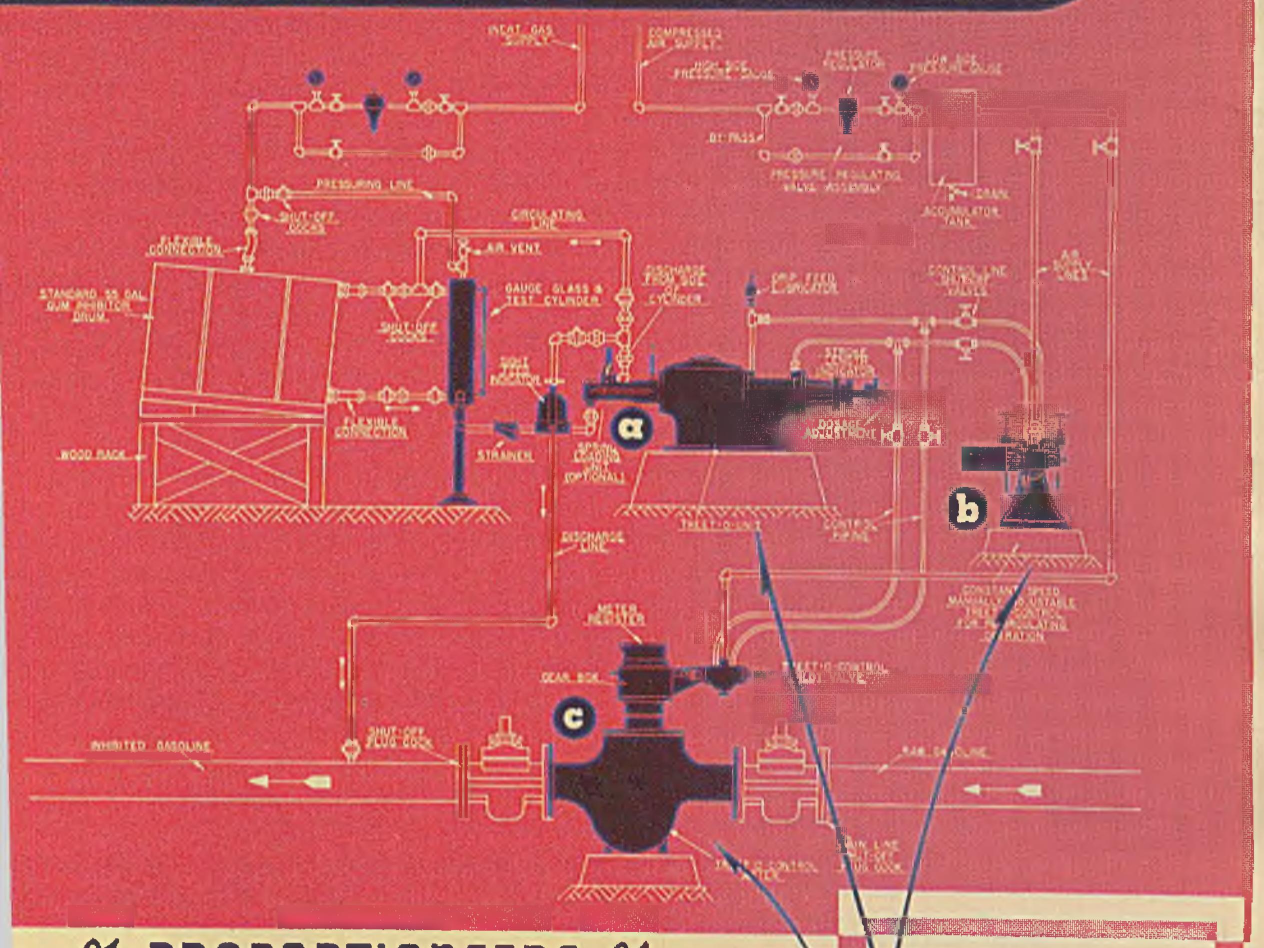
9 In these specially designed fractionating columns, the crude styrene is separated into its individual components



10 Styrene finishing unit. The proper combination of high-vacuum technique plus suitable inhibitors has made a routine operation out of a difficult problem



SIMPLIFY CONTINUOUS TREATING WITH
Treet-o-Control



% PROPORTIONEERS %
PORTIONATE CHEMICAL FEEDING EQUIPMENT

O-Control injects large or small quantities of treating chemicals at constant rate or flow proportionately. Flow diagram above ...tes method used for adding inhibitors to unstable hydrocarbons. ...ilar layout can be used for addition of water soluble oils in ...lic press work, feeding Calgon to water for corrosion preven- ...lphuric acid or caustic for control of pH, etc.

...umber of **TREET-O-UNIT** (a) proportioning pumps can be ...ed from a single **TREET-O-CONTROL METER** (c) or ...**MATIC PILOT** (b).

Write for Bulletin TOU-6

AUTOMATIC PILOT
Provides CONSTANT RATE control of one or more Treet-O-Units.

TREET-O-UNIT
Proportioning Pump in capacities from 0 to 10 gpm. injection accuracy of better than ½ of 1%.

TREET-O-CONTROL METER
Capacities 1 to 1000 gpm. accuracy 1/10% to 1½%. Operates the Treet-O-Unit Pump IN PROPORTION TO FLOW.

% PROPORTIONEERS, INC. %

WRITE TO %PROPORTIONEERS, INC.% 29 CODDING ST., PROVIDENCE 1, RHODE ISLAND

From end to end CRANE can equip it!

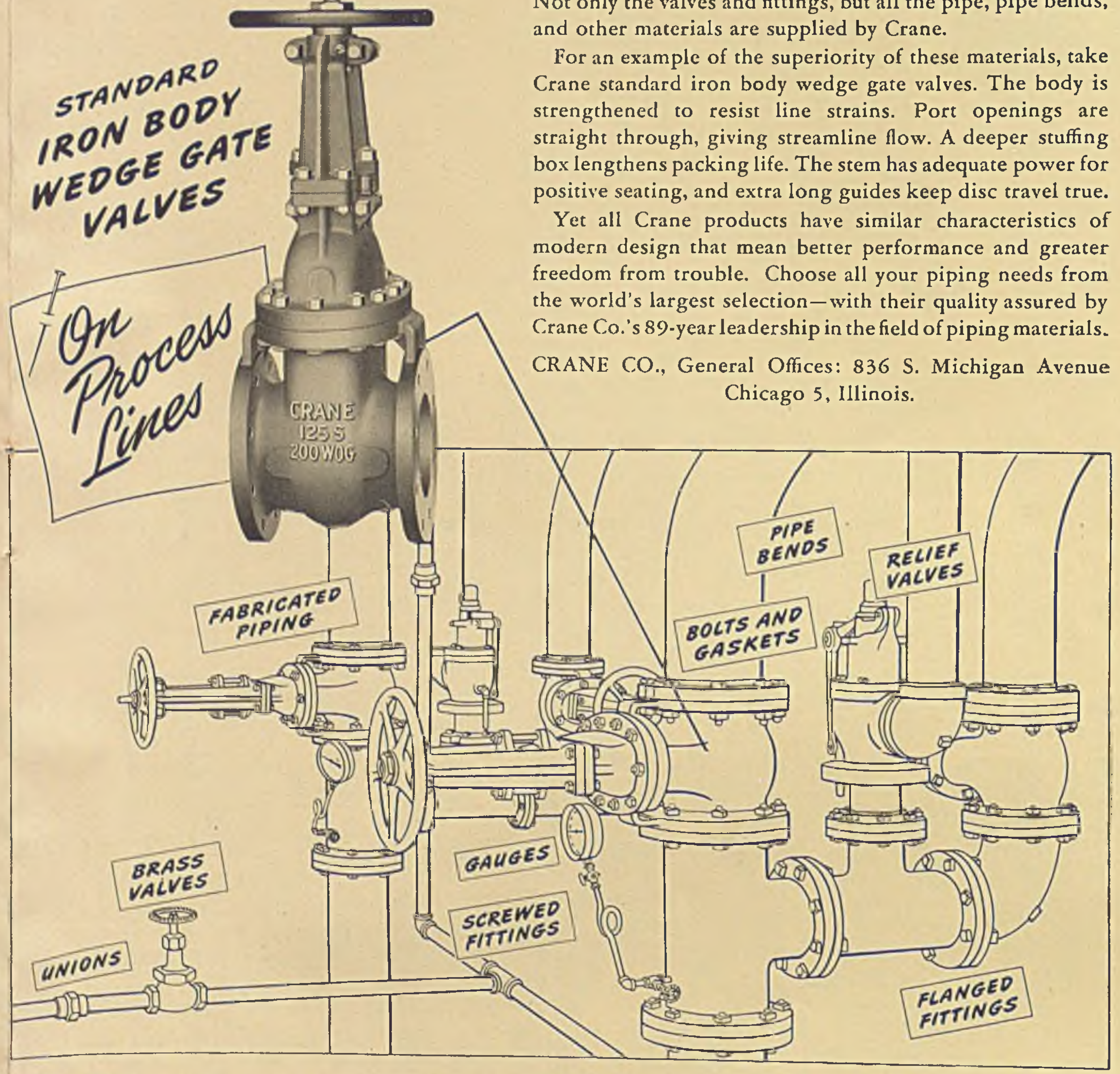
One high standard of quality throughout . . . One source of supply . . . One responsibility for all materials

WHEN you need a single fitting or an entire pipe line, you stand a better chance of getting exactly what you need from Crane. The unusual completeness of the Crane line sees to that—as indicated by the installation below. Not only the valves and fittings, but all the pipe, pipe bends, and other materials are supplied by Crane.

For an example of the superiority of these materials, take Crane standard iron body wedge gate valves. The body is strengthened to resist line strains. Port openings are straight through, giving streamline flow. A deeper stuffing box lengthens packing life. The stem has adequate power for positive seating, and extra long guides keep disc travel true.

Yet all Crane products have similar characteristics of modern design that mean better performance and greater freedom from trouble. Choose all your piping needs from the world's largest selection—with their quality assured by Crane Co.'s 89-year leadership in the field of piping materials.

CRANE CO., General Offices: 836 S. Michigan Avenue Chicago 5, Illinois.



CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

4 OPERATIONS in 1 MILL

Combination:
DRYING
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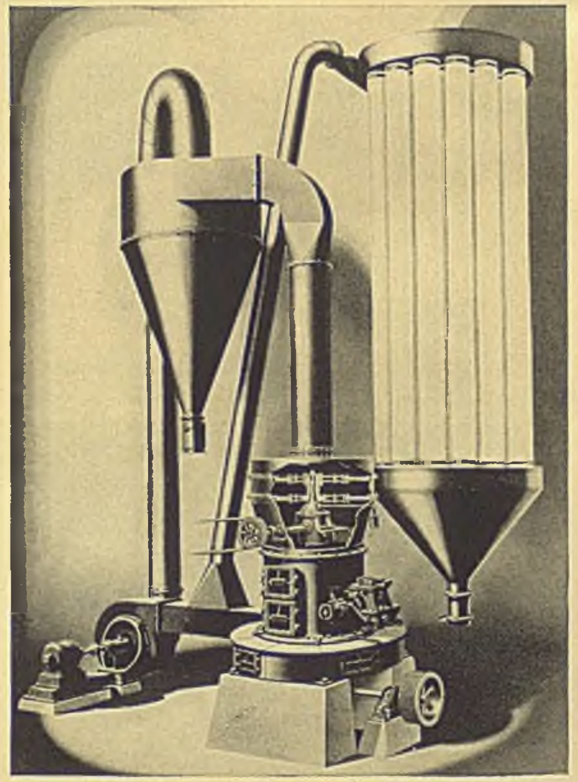
SEPARATING and
REMOVING Impurities

With the . . . RAYMOND Whizzer-Type ROLLER MILL

One answer to the manpower shortage is automatic equipment . . . like this modern High Side Roller Mill that handles the material from feeder to finish bin in a continuous, automatic, dustless operation.

Pneumatic feed control keeps a maximum "load" on the mill at all times, insuring the most economical rate of output. With the addition of an air drying system, surface moisture can be evaporated while pulverizing the material. Mill may be equipped with an automatic throwout attachment, as for eliminating mica and sand from kaolin, or removing impurities in pulverizing fine pigments.

Take advantage of Raymond Roller Mill economy for grinding chemicals, colors, clays and many other non-metallic minerals and manufactured products.



Showing double whizzer separator which gives easy fineness control from 60% minus 100-mesh to 99.9% through 325-mesh. Ask for Catalog #51.

RAYMOND PULVERIZER DIVISION
COMBUSTION ENGINEERING COMPANY, INC.
1311 North Branch Street Chicago 22, Illinois
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Canada: Combustion Engineering Corp., Ltd., Montreal

NEW PRODUCTS AND MATERIALS

JAMES A. LEE, Managing Editor

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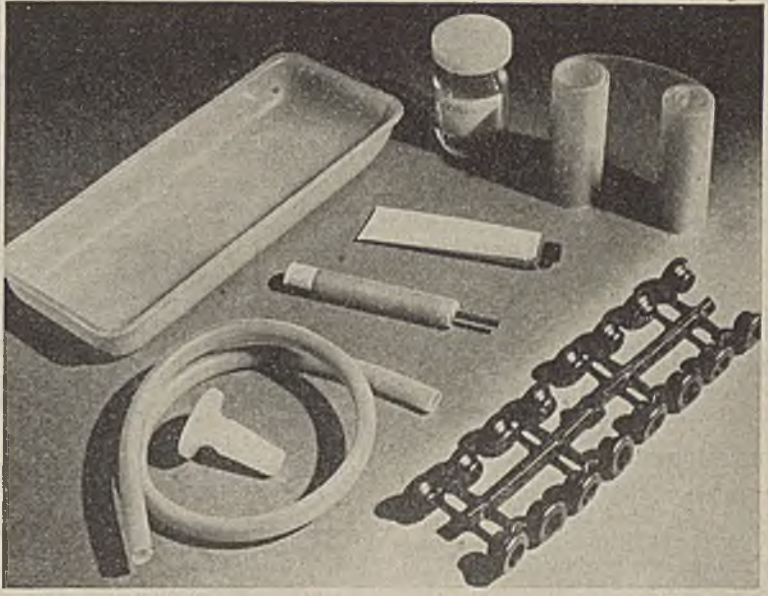

Products as varied as ice cube trays, jar tops, sheeting, collapsible tubes, wire insulation, and tubing may be made from polythene plastic

POLYTHENE PLASTIC

A plastic adaptable to the manufacture of products as varied as collapsible tubes for toothpaste, waterproof coatings, piping, adhesives and insulation for electric wiring and cable has been announced by the Plastics Department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

This new member of the plastics family represents the culmination of intensive experimentation and development undertaken five years ago and coming originally from Imperial Chemical Industries, Ltd. Polythene is the generic name for the tough plastic manufactured by the polymerization of ethylene. In announcing that it is now being manufactured in commercial quantities, the du Pont company emphasizes that the material is available in substantial quantities only by specific allocation for war purposes. Supplies of polythene heretofore available have gone into production of items urgently needed by the armed services, where this new plastic has adequately demonstrated its advantages as a covering for electric wiring and cable.

Outstanding properties upon which it is expected that many important uses will be based include flexibility and toughness over a wide range of temperatures; unusually good resistance to water and to penetration by moisture; chemical inertness; and excellent electrical properties. Possible future uses for this plastic, when available, will be various types of containers including collapsible tubes for food and cosmetics; gaskets and battery parts; flexible tubing or more rigid piping; water-proof and chemically resistant coatings; and adhesives.

Polythene occupies a peculiar place among plastics. In thin sections it may be classified as non-rigid, yet it does not have the limp rubbery quality that characterizes most non-rigid plastics. However, thick specimens exhibit sufficient stiffness to warrant classification of the material among the more rigid plastics.

The new plastic is readily molded and fabricated by present methods with existing molding and shaping equipment. It can be extruded, injection molded, compression molded and calendered. In sheet, rod or tube form it can be machined, cut, blown, blanked or swaged.

ALKYD RESINS

To meet the recently announced specifications (52-MC-21) of the U. S. Maritime Commission for a new alkyd resin to provide even greater durability, flexibility and adhesion in primers, and calling for a long, pure-linseed-oil modified alkyd resin, U.S.I.'s Stroock & Wittenberg Division, New York, N. Y. has announced the new specially-developed resin, Aroplax 1244, possessing the following physical constants:

Viscosity (G-H) at 70% solids	Y minus-Z1
Viscosity (G-H) when thinned further to 50% solids in mineral spirits	C–G
Color (G-H 1933)	7–12
Acid value of plastic	below 10
Wt./Gal. at 25 deg. C. at 70% solids	7.92–8.08 lb.

Another development from the same organization is interesting because of its availability; that is, Aroplaz 1306 solution (75 percent solids in mineral spirits). The physical constants of this new resin are:

Viscosity (G-H) at 75% solids	Y–Z.
Color (G-H 1933)	7–9
Acid value of plastics	10–20
Wt./Gal. at 25 deg. C. at 75% solids	7.9 lb.

The solution is so adjusted that when reduced to 50 percent solids the viscosity is suitable for use as a normal enamel vehicle. It is said that excellent white enamels can be produced with this material, approaching the whiteness obtained with the usual alkyd types now no longer available for civilian work because of government restrictions. Aroplaz 1306 has good color retention when compared to maleic resin varnishes, and is far superior to ester gum and phenolic resin varnishes. This resin is now available without allocation.

ETHYL SODIUM OXALACETATE

With the introduction of U. S. Industrial Chemical's, Inc., New York 17, N. Y., ethyl sodium oxalacetate, the instability of the ethyl ester of oxalacetic acid has been overcome. In a comparatively brief period this unusual new intermediate has found acceptance on a tonnage scale in the synthesis of both dyestuffs and pharmaceuticals, particularly the tartrazine and pyrazole groups. Its structure, moreover, suggests a variety of other possible reactions which will find increasing use in the preparation of many new products.

Ethyl sodium oxalacetate is prepared by reacting ethyl acetate and diethyl oxalate with metallic sodium. It is a fine granular powder, light yellow in color, and, as manufactured by U.S.I., has a purity of not less than 92 percent. Its stability is shown by the fact that a sample previously dried at 100 deg. for one hour loses not more than 3 percent of its weight in an additional 24 hours at 100 deg. Ethyl sodium oxalacetate may be used in most reactions in place of oxalacetic ester, but if desired the latter may readily be regenerated from the sodium derivative by dilute acids.

Typical reactions of oxalacetic ester in which the more stable sodium derivative

NEW PRODUCTS AND MATERIALS

JAMES A. LEE, Managing Editor

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Viscosity (G-H) when thinned further to 50% solids in mineral spirits	C–G
Color (G-H 1933)	7–12
Acid value of plastic	below 10
Wt./Gal. at 25 deg. C. at 70% solids	7.92–8.08 lb.

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Color (G-H 1933)	7–9
Acid value of plastics	10–20
Wt./Gal. at 25 deg. C. at 75% solids	7.9 lb.

The solution is so adjusted that when reduced to 50 percent solids the viscosity is suitable for use as a normal enamel vehicle. It is said that excellent white enamels can be produced with this material, approaching the whiteness obtained with the usual alkyd types now no longer available for civilian work because of government restrictions. Aroplaz 1306 has good color retention when compared to maleic resin varnishes, and is far superior to ester gum and phenolic resin varnishes. This resin is now available without allocation.

ETHYL SODIUM OXALACETATE

With the introduction of U. S. Industrial Chemical's, Inc., New York 17, N. Y., ethyl sodium oxalacetate, the instability of the ethyl ester of oxalacetic acid has been overcome. In a comparatively brief period this unusual new intermediate has found acceptance on a tonnage scale in the synthesis of both dyestuffs and pharmaceuticals, particularly the tartrazine and pyrazole groups. Its structure, moreover, suggests a variety of other possible reactions which will find increasing use in the preparation of many new products.

Ethyl sodium oxalacetate is prepared by reacting ethyl acetate and diethyl oxalate with metallic sodium. It is a fine granular powder, light yellow in color, and, as manufactured by U.S.I., has a purity of not less than 92 percent. Its stability is shown by the fact that a sample previously dried at 100 deg. for one hour loses not more than 3 percent of its weight in an additional 24 hours at 100 deg. Ethyl sodium oxalacetate may be used in most reactions in place of oxalacetic ester, but if desired the latter may readily be regenerated from the sodium derivative by dilute acids.

Typical reactions of oxalacetic ester in which the more stable sodium derivative might be used, include: (1) Ammonia and many of the primary and secondary amines add on to oxalacetic ester. The resulting products may be converted to the amines of oxalocitric acid lactone ester. (2) If aldehydes are present when certain amines are condensed with oxalacetic ester, dioxopyrrolidine carboxylic acids are formed. (3) Urea's condensation with ethyl-oxalacetate is of interest because both amino groups react, the product being ethyl uracil-4-carboxylate. The free acid melts at 347 deg. C. and is so stable that up to 185 deg. to 205 deg. C., 20 percent sulphuric acid has no effect on it. (4) In the presence of pyridine, ethyl oxalacetate and ethyl cyanoacetate form triethyl cyanoaconitate. (5) With hydrochloric acid, oxalacetic ester is converted into derivatives of alpha-pyrone. (6) According to a recent article, oxalacetic acid is reduced by yeast to malic acid. (7) In the presence of piperidine or diethyl amine, two molecules of oxalacetic ester condense with one molecule of an acyclic aldehyde. (8) Acetic anhydride and oxalacetic ester form ethyl acetoxyfumarate. (9) Heated to 250–350 deg. C., oxalacetic ester loses carbon monoxide and forms ethyl malonate.

CORK IMPREGNATED COATING

Several new aids to winter motoring have been developed. One of the newest is Motorcote, a lightweight cork impregnated coating developed by the J. W. Mortell Co., Kankakee, Ill. It is applied very much like a heavy paint to the engine oil pan and crankcase where it dries into a ¼-in. insulator to cut down warmup time and practically eliminate water condensation and crankcase dilution. It was originally developed for use by the Army in extremely cold climates. It is now available both to operators of trucks and bus fleets and to private drivers as well. It is said that the material holds up in temperatures from 60 deg. below zero to 250 deg. above and stands the gaff of vibration and travel over rough roads.

HIGHLY CHLORINATED PARAFFIN

While paraffin products containing 70 to possibly as high as 73 percent chlorine have been known for some time, paraffin with chlorine contents of 70 to 78 percent by weight have come on the market only in recent months. Limited quantities of paraffin containing as high as 78 percent chlorine are available from Hooker Electrochemical Co., Niagara Falls, N. Y. The Company's name for this series is Chloroparaffin Resin 70 (or 72, 74, 78, etc).

GUMMED PAPER REMOVER

A solution to the troublesome problem of removing gummed paper from plastic glass sheets and formed parts is offered by Turco Products, Inc., Los Angeles, Cal., manufacturers of a new chemical compound, Turco Gummed Paper Remover, which has been formulated for this special job.

Heretofore, aircraft factories have experienced considerable difficulty in removing the tightly glued masking paper which covers the sheets and formed parts when they are delivered from the manufacturer. If this glued paper is allowed to remain on the plastic for any length of time—or is exposed to heat or sunlight—the paper vulcanizes to the plastic glass and virtually becomes a part of it. Naphtha solvents when used for this purpose often cause "crazing."

Removal of the masking paper with this product, however, is a safe and thorough method, according to the manufacturer. Plastic sheets and formed parts are simply soaked in a tank full of the compound until the gummed paper is loosened—when it is easily peeled off. This product is recommended for Plexiglas, Lucite, Plastacele, acetate, Pyralin and all other transparent plastic glasses.

PROPOSED CORK SUBSTITUTE

A CORK SUBSTITUTE made from pithy agricultural wastes has been developed at the Northern Research Laboratory of the Department of Agriculture at Peoria, Ill. It has been christened Noreseal, as a SEALing material developed by the NOrthern REgional Laboratory. Firms interested in closure materials will be given any available information by the Laboratory, including samples of the products which have been made experimentally. The product will, it is anticipated, be covered by a patent which will permit all interested industries to use the development without royalty.

WET STRENGTH RAYON

It has been reported that the Du Pont Rayon Co., Wilmington, Del., is now shipping an entirely new type of strong rayon which is said to bridge the gap between ordinary rayon and nylon. Fiber G is said to be the result of an adaptation of a new spinning method to the rayon industry. The types now in common usage, all of which are in limited supply at present because of raw material shortages and diversion to war needs, is nitro-cellulose, cuprammonium, cellulose-acetate, and viscose. It is understood that at present the new fiber is available only in two deniers, the 240-denier containing 120 filaments and the 1,100 denier containing 480 filaments. Due to the superior wet strength compared with ordinary rayon, it is most likely to find its widest usage in the field of industrial textiles.

POLYVINYL ALCOHOL RESIN

Polyvinyl alcohol resins, a cross between plastic and synthetic rubber, have been developed by the Resistoflex Corp., Belleville, N. J. Known as Compars, they have quite different properties from the basic resins. They are said to be flexible, abrasion resistant and solvent proof. Some types are not at all affected by aliphatic, aromatic or chlorinated hydrocarbons or by ketones. Compar has high tensile strength and toughness, low permeability to gases, freedom from aging or oxidation, and flexibility under a wide range of temperature. It is said to be insoluble in water and promises a long life in use. Inertness to organic solvents is its most outstanding quality. It is the ideal material for hose used with the hydrocarbons that are hard to handle. Fuel line erosion is eliminated, ensuring diesel fuel free from small particles from the hose lining. Performance is equally good in extremes of heat or cold conditions. Hose made from the Compars is already used in handling airplane fuel, in naval diesel engine, and in chemical warfare equipment. It is used also for gloves, aprons and shoe coating to protect against petroleum solvents. By careful control of each operation a wide variety of finished products having different physical properties can be obtained. None of these need to be vulcanized.

Compar in the form of a solution has numerous uses. Baskets lined with it protect the finish of materials being handled. A coating on the inside makes a wooden box gas-proof. The solution makes a film that resists oil, grease and solvents.

POLYVINYL RESINS

The chemical division of the B. F. Goodrich Co., Akron, Ohio, has developed a group of polyvinyl resins to which it has given the name Geon. Two of these resins, Geon 202 and Geon 203, are entirely new vinyl chloride: vinylidene chloride copolymers, different from any others previously developed in this group. They can be processed easily on existing equipment. Purchases of any of the resins are subject to allocation by WPB under General Preference Order M-10, under which the polyvinyls are allocated, although reasonable quantities are available for experimental purposes. Two types are offered currently. The Geon 100 series are special vinyl chloride polymers characterized by their thermal and light stability, toughness and chemical inertness. Geon 101 was developed for electrical applications, such as wire and cable insulation, while Geon 102 is adaptable to general services. The new Geon 200 series was created to meet the need for polyvinyls which combine increased solubility and thermoplasticity with exceptional stability, chemical resistance and wide useful temperature range. Their resistance to hydrolysis by boiling water or even hot alkali is outstanding in the field of vinyl chloride copolymers, and like the Geon 100 series they have unusual stability to light and heat. Geon 202 is a general purpose copolymer, more soluble and thermoplastic than either of the Geon 100 resins. While these characteristics are still further stepped up by Geon 203.

Geon resins, when compounded with

Properties of Four GEON Resins

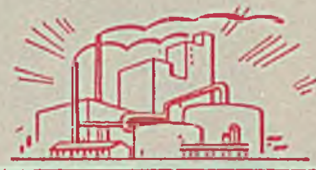
Geon Number	Specific Gravity	Average Acetone Extract	Average Specific Viscosity [1]	Recommended % Solids in M.E.K.[2] at 20 deg. C.	at 70 deg. C.	Plasticiser Index [3]
101	1.41	15%	.55	4.5	12	43
102	1.41	14%	.59	4.5	12	43
202	1.43	48%	.40	8	17	34
203	1.44	56%	.36	14	25	31

[1] At 20 deg. C. of 0.4% solution in nitrobenzene. [2] Methyl ethyl ketone. [3] Weight of dioctyl phthalate per 100 weights resin to give comparable hardness at room temperature.

Questions we are often asked

ABOUT GLASS-LINED STEEL

No. 5—Under what conditions are Glass-Lined vessels unsatisfactory?



"Many people think of Pfaudler only as fabricators of glass-lined steel equipment. As a matter of fact, Pfaudler is one of the earliest fabricators of stainless steel and alloy equipment, making important contributions to the technology of welding that type of equipment." G. F. Kroha, Vice-President, in charge of sales—The Pfaudler Company.

This is a rather difficult question to answer exactly since there are many qualifying circumstances but certain general rules apply and it is these we will discuss. Broadly, it may be stated that glass-lined steel equipment and, in fact, any glass is not satisfactory for handling caustics. Pfaudler silica base glasses are more affected by sodium and potassium hydroxide than by the alkaline earth alkalies.

However, small percentages of the hydroxides involved in a high velocity reaction might have little effect on the glass. On the other hand, to attempt to handle saturated solutions of any of these alkalies would mean that a progressive etching would occur. Again depending on conditions, it would eventually result in the removal of the glass from the steel by chemical action.

A PROPER COMPROMISE

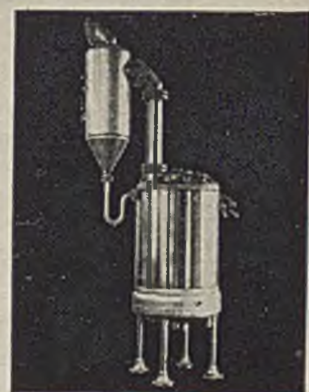
Alkaline solutions up to a pH of 10 at room temperature, and sometimes higher, have been handled in glass-lined steel with satisfactory results. A combination of required acid resistivity in the glass, along with the pH conditions of, for example, 9 necessitates the use of a unit which, practically speaking, was not available in any single material of construction. Hence, a glass-lined reactor turns out to be the most practical all around vessel.

To avoid such combinations, however, it is desirable to conduct the acid reaction in one vessel, if possible, and the alkaline reaction is another.

It is possible to handle neutralization in glass-lined equipment by introducing the product carefully into the center of mixer and by quick dumping of the product, followed by washing of the interior of the vessel. The handling of caustics is not recommended unless the procedure is carefully studied.

NICKEL, INCONEL, MONEL AND STAINLESS STEEL EQUIPMENT FOR ALKALIES

Pfaudler engineered vessels of corrosion resisting alloys are handling alkaline conditions satisfactorily. It is important that you realize the part proper design and fabrication plays in equipment performance. The outstanding service which Pfaudler builds into such equipment is a matter of record.



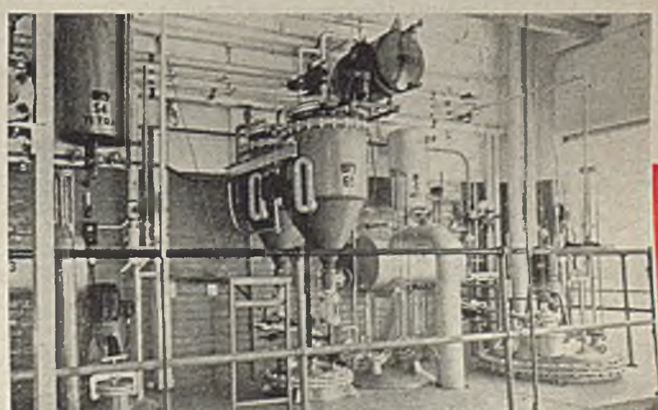
Stainless steel still used in manufacture of Pharmaceutical products.

If there is any doubt about the proper material to use for your operations, we welcome the opportunity to discuss it.

PRINCIPAL ALKALINE-RESISTANT APPLICATIONS OF NICKEL, INCONEL, MONEL

E—Excellent VG—Very Good G—Good P—Poor

Alloy	Alkalies	Neutral and Alkaline Salts	Acid Salts	Oxid Alk. Salts (except hypochlorites)	Organic Acids and Compounds
Nickel	V.G.	E	V.G.	V.G.	G
Inconel	V.G.	E	V.G.	V.G.	G
Monel	V.G.	E	V.G.	V.G.	G



The unequalled fabricating experience of the Pfaudler Company backs every piece of alloy metal equipment produced by us. It means dependable trouble-free performance.

THE PFAUDLER COMPANY, ROCHESTER 4, NEW YORK

ENGINEERED GLASS-LINED AND STAINLESS STEEL EQUIPMENT other materials, can be processed in many ways, including injection and compression molding, extruding, calendering, solution coating and film coating. Compositions varying from the rigid thermoplastic to a very soft jelly can be obtained by modifying the resins with other compounding materials. Each composition exhibits to a high degree the many desirable characteristics of the base resin used.

Among the outstanding qualities of plastics made with these resins are the remarkable combinations of rubber-like properties with non-flammability and resistance to oxidation. Compositions made from Geon 100 series are characterized by their resistance to deformation at elevated temperatures, in comparison to other vinyl thermoplastics.

In addition to furnishing the resins in powder form with the compounding done by the purchaser, the chemical division will supply them in ready-to-use form, either as granules or sheet. Standard Geon plastic compounds are available for many uses, such as fabric and paper coating, electrical insulation, automotive and aircraft tubing.

In addition, other tailor-made formulations can be supplied for special purposes. It is pointed out that because these materials can be varied so widely in useful properties, it is greatly to the advantage of the prospective user to consult the manufacturer in choosing a compound formulated to fit a specific need.

RUST PREVENTIVE

A combined rust preventive, cleaner and fingerprint neutralizer is announced by E. F. Houghton & Co., Philadelphia, for use in internal plant protection of steel parts between processing or machining operations.

This product—Cosmoline No. 805—is intended not to remove rust, but to neutralize the causes of corrosion, particularly acid perspiration from workers handling the parts. It also is effective in protection against corrosion caused by a chemical atmosphere, fumes, etc., or high humidity.

It is pointed out that final application of a rust preventive after completion of the part or assembly will not be effective if rust has already started while the part was being processed—ground, machined, heat treated and cleaned.

Cosmoline No. 805 is a fluid product which conforms to requirements of Ordnance Technical Manual TM 38-305. It will meet and exceed 24-hr. salt spray and 100-hr. humidity tests.

CORNSTARCH

A commercial crop of a new kind of grain is now available. It is processed in commercial quantities by American Maize Products Co., Rolier, Ind. Stein, Hall & Co., New York, N. Y., cooperated in the development. Known as Amioca, it is said to be useful in textile warp sizing, finishing and printing, paper tub, calender and coating work, veneer and laminating adhesives, box and envelope gums, and liquid glues. It differs from ordinary cornstarch in that the sticky glue-like gels formed when heated with water are long and gummy, remaining in a fluid condition and do not tend to set back to a paste. Substantially clear in appearance, Amioca resembles

How to protect stainless steel processing equipment from acid attack . . .

a suggestion based on experience in pickling steel cartridge cases

HERE is a suggestion that may help substantially to prolong the life of your hard-to-replace, stainless steel equipment . . . in processes where such equipment is exposed to acid attack . . . and where the additions of small amounts of ferric sulfate to the materials being processed could be tolerated.

Producers of steel cartridge cases have found that 1% to 3% Ferrisul (anhydrous ferric sulfate) in their 5% to 10% sulfuric acid pickling solutions acts as a passivating agent on their stainless steel pickling equipment, much of it originally designed for handling copper cases. As a result, the stainless steel is protected from sulfuric acid attack, yet the acid remains effective against annealing scale on the cases themselves.

☆ ☆ ☆

Ferrisul is widely used as a mild oxidizing agent in many metal finishing processes, as a highly efficient coagulant in the treatment of water and sewage and in various organic reactions. It contains a minimum of 90% soluble ferric sulfate with a maximum of approximately 5% insoluble. If the insoluble is undesirable, however, it can be removed with comparative ease.

A dry, granular powder, Ferrisul is easy to store, handle and use, is readily soluble in water and is now available in ample quantity.

If there is a possibility that Ferrisul may help *you* prolong the useful life of your stainless steel equipment, write today for samples and details. Monsanto's technical service men will be glad to help if you wish. MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston 49, Massachusetts.

Ferrisul (ANHYDROUS FERRIC SULFATE)
STANDARD FORM: Pellets 4-40 mesh
COLOR: Pale, reddish brown
TYPICAL ANALYSIS: 90% min. $Fe_2(SO_4)_3$
APPARENT DENSITY: 70 lbs. to cu. ft.
ANGLE OF SLIP: 34°
HEAT OF SOLUTION: 260 BTU to lb. of Ferrisul

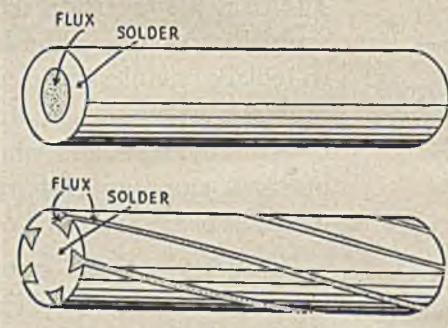
MONSANTO CHEMICALS

SERVING INDUSTRY...WHICH SERVES MANKIND

tapioca flour and has been found successful for many purposes which tapioca has served. Compared with oxidized starches, it is said to show up remarkably well, and dextrines and gum made from it give results as satisfactory as those made from tapioca flour.

FLUXED WIRE SOLDER

Wire solder which contains flux in longitudinal grooves on the surface rather than in the conventional core has just been placed on the market. According to the manufacturer, the product represents the first basic improvement in fluxed wire solder since the introduction of this type of material a number of years ago. The new material, called Fluxrite and put out by National Lead Co., New York, N. Y., is said to overcome completely an inherent disadvantage of regular cored solders which supply flux and solder to the surface simultaneously. Since the flux in the new product is outside rather than inside, it liquefies and flows onto the work before the solder melts. This insures thorough and complete fluxing and results in stronger and better solder joins.



Old type above, new type below

In addition to pre-fluxing, the new solder also is said to guarantee an unbroken flow of flux. Interruptions in the flow sometimes occur with cored solders due to gaps or voids in the flux core. Since the new product has more than one flux-filled groove, there is naturally a continuous flow at all times.

An additional advantage claimed comes from the fact that the flux supply, being outside the wire, is always visible to the user and can be checked quickly and readily. Gaps or voids in ordinary cored solders are not detectable until after soldering begins.

VERSATILE ADHESIVE

Recently there has appeared in the Swedish market Cellufix, an adhesive developed at the laboratory of the Svartik sulphite mill (Svenska Cellulosa A/B). This product, described as colorless, odorless and soluble in water at any temperature, is said to form a clear, homogeneous, viscose solution even when mixed with a large quantity of water. Tests show that 75 to 80 rolls of wallpaper can be pasted with one kilogram of the material. It can be used to produce blue paint, to replace gum tragacanth, substitute for oil in some cases, and make a thinner for washing compounds. Two types of this material are produced, Cellufix, a dry white material, and Cellugel, a gelatinous substance which is said to bind twice as much water.

The vicious land and sea fighter —*the amphibious*

WATER BUFFALO

Designed by the Engineers of PEERLESS PUMPS

America's newest fighting fortress has gone to War with a vengeance. It's the Water Buffalo. It swims through sea and surf, it crawls over beachheads, up over rocky terrain, trundles through mud and swamps—it goes everywhere, loaded with devastation. Peerless engineers designed this deadly attacker. Their "know how" of engineering hydraulics—their everyday knowledge of water problems and their detailed knowledge of pumps, were largely responsible for Peerless engineers becoming the world's authority on amphibian tractor designs. *Needless to say, Peerless engineering forces have been greatly strengthened and have knowledge of real value to the pump industry.*

PEERLESS PUMPS

TURBINE
HI-LIFT
HYDRO-FOIL

PEERLESS PUMP DIVISION
Food Machinery Corporation
Factories: 301 W. Ave. 26, Los Angeles 31, Calif.
Canton 6, Ohio; San Jose 5 and Fresno 16, Calif.

In the Production of Magnesium, Both Amsco Alloy and Amsco Manganese Steel Have Found a Place

Multiplying by many times America's output of magnesium to meet such needs as lightweight aircraft parts and incendiary bombs has been one of industry's major accomplishments.

In the Pidgeon process of magnesium production, both Amsco Alloy and Amsco Manganese Steel are used in applications where their respective properties help make continuous operation possible. This process consists of distilling metallic magnesium in the form of vapor from briquettes made of a mixture of ferro-silicon and dolomite under low pressure in a furnace, operating at a temperature of about 2150° F.

There are usually twenty retorts to each furnace, laid side by side. After gases (principally hydrogen) have passed off, the retort is sealed and a vacuum, as nearly perfect as possible, is produced. The retort castings must, therefore, be leakproof. The vapor is condensed by a water jacketed condenser sleeve inserted prior to sealing in the open end of the retort, crystals forming in a dense mass in the sleeve. These crystals, averaging about 15 lbs. per retort at the end of an 8-hour run, are melted and cast into pigs.

Picture R-864 shows some of the Amsco Alloy retorts employed, and in picture K-26 appears one of the many carloads of these retorts which have been shipped during the past two years to producers of magnesium by the Pidgeon process.

Amsco manganese steel also has a part in the same process, in the form of the pressure rolls shown in picture B-115, used for forming the briquettes of powdered ferro-silicon and dolomite. Here the high resistance of manganese steel to pressure loads and abrasive wear affords maximum service life.

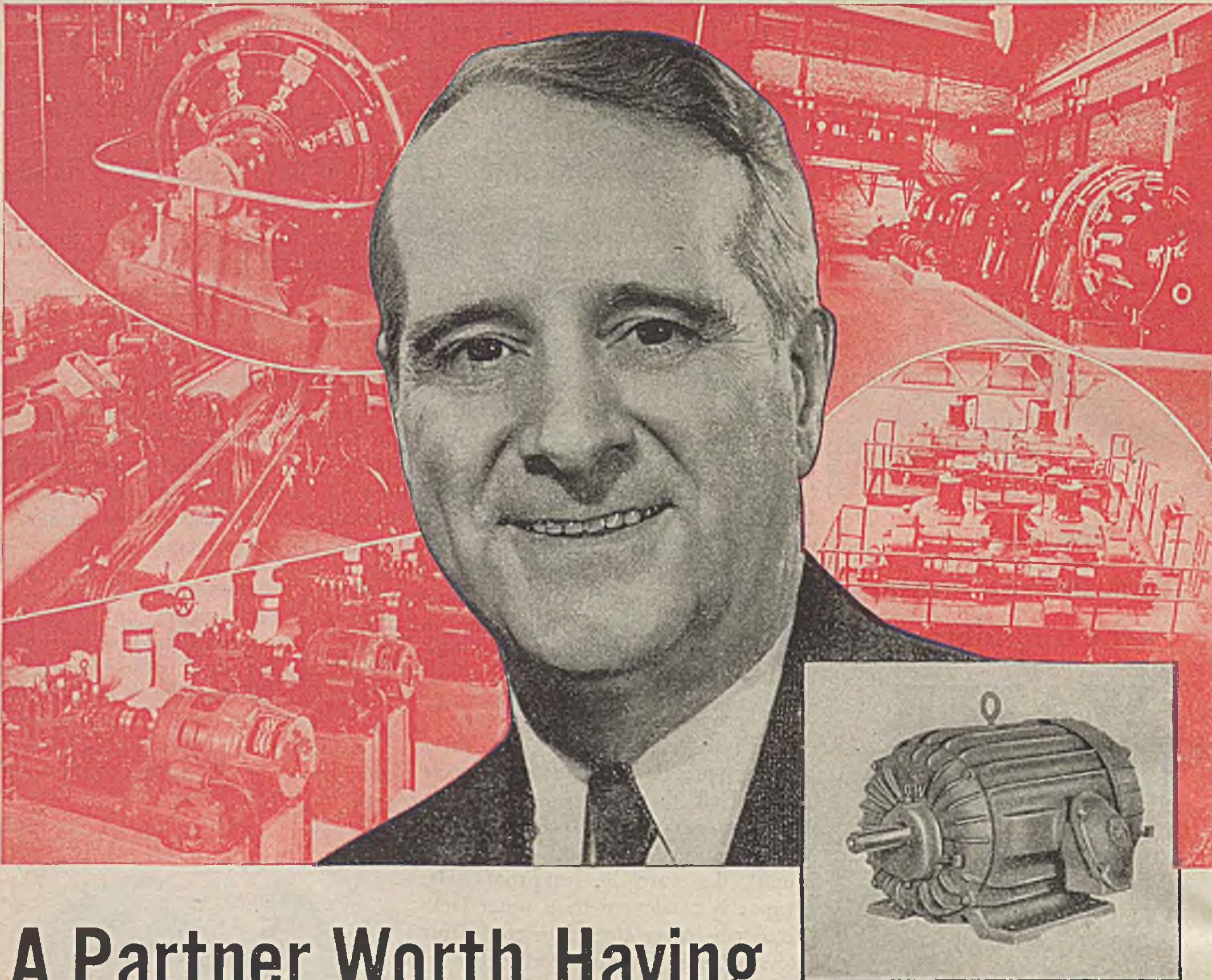
Bulletin 108 describes the uses of Amsco Alloy in all industry; and 1041A deals specifically with heat-treating containers.

Send for Bulletin 941W on Amsco Conservation Welding Rods.

Amsco

AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois
FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO.
OFFICES IN PRINCIPAL CITIES

AMERICAN Brake Shoe COMPANY



A Partner Worth Having

YES, THE CROCKER-WHEELER field engineer has an ear to the ground and an eye to the future. Not a miracle man, but thoroughly educated in engineering and with years of experience in the application of motors and generators.

Some men on our staff took part in the design and installation of the first steel mill motor . . . others installed the first motors geared to machine tools . . . still others worked on the first motor for printing presses, the first for pumps.

One of our men will be glad to discuss with you any motor or generator problem. While your plans are still in the blueprint stage is the time when his assistance can be most worthwhile. Write, wire or call on us at our nearest office.

CROCKER-WHEELER Trade Mark Reg. U. S. Pat. Off. Motors-Generators

JOSHUA HENDY IRON WORKS

CROCKER-WHEELER DIVISION

ESTABLISHED 1856

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Crocker-Wheeler Products

SQUIRREL CAGE MOTORS | WOUND ROTOR MOTORS | DIRECT CURRENT MOTORS | GENERATORS | FLEXIBLE COUPLINGS

CHEMICAL ENGINEERING NEWS

MANUFACTURING CHEMISTS OFFER EMPLOYMENT PLAN

The chemical industry of the nation, acting through its association, The Manufacturing Chemists' Association of the United States, has announced that it was seeking additional workers and offered to the War Manpower Commission a "blueprint for action" whereby thousands of returning soldiers would be given an immediate chance to work.

In a letter addressed to Paul V. McNutt, chairman of the War Manpower Commission, Harry L. Derby, president of the American Cyanamid and Chemical Corp., and president of the MCA, said that the chemical industry was not only welcoming back former employes but was seeking additional workers.

Mr. Derby said that there were approximately 100,000 men being mustered out or discharged from the armed forces each month. In laying down a working plan for their re-employment to be applied nationwide, Mr. Derby made these proposals to the War Manpower Commission:

"First—the situation would be very largely and speedily helped if the United States Employment Service headquarters obtained from the Army and Navy the names, addresses, and qualifications of these men prior to their being discharged from hospitals or mustered out.

"Second—that this information should be made available to the local office of the USES nearest to the home of the discharged veteran.

"Third—that this data should be available at least two weeks prior to the discharge from the service, which would give ample time for circularization of the employers in the area of the men's residence."

TWO ALCOHOL PROJECTS FOR PACIFIC COAST

Projects in the Pacific northwest for the production of alcohol from two waste products, sulphite liquor and sawdust, have received the approval of the production urgency committees of the War Production Board in Oregon and Washington, without which (under the West Coast Manpower Plan) no new undertakings can be launched.

For nearly two years the Puget Sound Pulp and Timber Co. has had application before the WPB to build an $800,000 plant at Bellingham, Wash., 100 miles north of Seattle, to make alcohol out of the sulphite liquor from its paper mills. The company claims it can produce alcohol for about 16c a gallon compared with the current Pacific Coast price of 90c and that a 6000-gallon-a-day plant could be in production about six months after construction was started.

The Willamette Valley Wood Distillation Co. at Eugene, Ore., commercial center for the largest stands of virgin timber left in the country, plans to convert sawdust to alcohol. A plant to cost between $1,000,000 and $2,000,000 will be built to turn out 10,000 gallons of alcohol daily at a cost of 20c a gallon.

WASHINGTON NEWS

News from Washington which, hitherto, has been found in this section, appears in this issue beginning on Page 84.

CHEMICAL ENGINEERS OPPOSE SELECTIVE SERVICE RULING

At a gathering held on Feb. 2 in the headquarters of the American Institute of Chemical Engineers, the group through Dr. Albert B. Newman, chairman of its manpower committee, went on record as opposing the new selective service regulation which went into effect on Feb. 1. This is the ruling which prohibits deferment for men between the ages of 18 and 22 except under very special conditions.

Dr. Newman said the waste of professional brains can be avoided by returning to the local boards the authority to determine industrial deferment. He declared this is a technical war and if we are to get ahead of our enemy in technical developments we must keep a steady stream of engineers flowing into our industries.

FERTILIZER AND ACID PLANT WILL BE BUILT IN IDAHO

Authority and priorities for the construction of a $1,000,000 plant at Pocatello, Idaho, for manufacturing fertilizer from the state's extensive phosphate deposits have been granted by WPB to J. R. Simplot, the onion and potato king of the state.

The complete plant will include an acidulation plant geared to produce 75,000 tons of superphosphate annually, a sulphuric acid plant with a capacity of 80 tons of 100 percent sulphuric acid daily, a laboratory and facilities for producing ammoniated phosphate, mixed fertilizers and complete fertilizers. It will be erected on an 80-acre site outside the city limits.

RESEARCH PROGRAM SEEKS TUNG OIL SUBSTITUTES

A research program to develop adequate substitutes for tung oil has been set up by the National Defense Council, in cooperation with the Research and Development Branch, Office of the Quartermaster General; Temple University, Philadelphia; and industry, the War Department has announced. Dr. William T. Pearch of the National Research Council is directing the study from Temple.

SUPERPHOSPHATE AND ACID PLANT FOR MAINE

Following approval by the Chemical Division of WPB, plans have been completed, contracts placed and erection started on a sulphuric acid and superphosphate plant at Searsport, Maine. J. E. Totman, president of Summers Fertilizer Co., Inc., Baltimore, Md., announces that Summers and its associates have organized the Northern Chemical Industries, Inc. which will operate the new plant.

The sulphuric acid unit will be a modern contact, Monsanto type, plant producing all grades of acid. Contract for this unit has been awarded the Leonard Construction Co., Chicago. The superphosphate and storage units will be built by T. W. Cunningham, Inc., Bangor, Me. The Sturtevant Mill Co., Boston, will supply the superphosphate and handling equipment. The rock grinding equipment will be a Raymond Mill unit.

Production at the plant is expected to commence about July 1 and it will have an annual capacity of 75,000 tons of superphosphate. The location is adjacent to Summers' mixed fertilizer plant at Kidders Point, Searsport.

Officers of the new company are J. E. Totman, president; R. E. Fraser, vice-president; W. H. Gabeler, vice-president; W. A. Fessler, secretary; N. K. Totman, treasurer; and F. P. Preti, clerk. Development of the project is under the direction of William H. Gabeler. R. E. Fraser will be resident manager, J. G. Moynihan, assistant manager, and W. B. Bird, general superintendent.

S. W. JACOBS CONTINUES TO HEAD CHLORINE INSTITUTE

At its annual meeting held on Jan. 26 at the Chemists' Club, New York, the Chlorine Institute, Inc., reelected S. W. Jacobs as president. Other officers elected were E. C. Speiden, vice-president and Robert T. Baldwin, secretary and treasurer. The following directors were elected for a two-year term: George M. Dunning, Wyandotte Chemicals Corp.; F. W. Fraley, Jr., Diamond Alkali Co.; R. W. Hooker, Hooker Electrochemical Co.; S. W. Jacobs, Niagara Alkali Co.; and E. C. Speiden, Innis, Speiden Co.

ANNUAL DCAT DINNER SET FOR MARCH 9

Edward T. T. Williams, chairman of the Drug, Chemical and Allied Trades Section of the New York Board of Trade, announced following a meeting of the Section's executive committee last month that the 19th Annual Drug, Chemical and Allied Trades Banquet to be held under the auspices of this organization will take place on Thursday, March 9, at the Waldorf-Astoria, New York.

WARTIME DEVELOPMENTS WILL BE REPORTED AT ACS MEETING

Wartime developments in chemical science and industry will be reported at the 107th meeting of the American Chemical Society, which, it is announced by Dr. Thomas Midgley, Jr., president, will be held in Cleveland April 3 to 7. Several thousand chemists and industrialists will participate. Hundreds of papers outlining advances in many fields of research will be presented.

Fourteen of the Society's eighteen professional divisions will convene. Postwar planning will feature sessions of the division of industrial and engineering chemistry under the chairmanship of Dr. Lawrence W. Bass of Boston. Progress in petroleum chemistry will be described before the petroleum division, of which Dr. Cecil L. Brown of the Standard Oil Company of Louisiana, Baton Rouge, is chairman.

"Antiparasitic Agents as Used in Tropical Diseases Other than Malaria" will be the general theme of the division of medicinal chemistry, headed by Dr. John H. Speer of G. D. Searle and Company, Niles Center, Illinois. "The Biological Value of Proteins" and "Carbohydrates for Industrial Use" will be discussed at a joint meeting of the division of agricultural and food chemistry and the division of sugar chemistry. Papers on vitamins will be read at a session of the agricultural and food and biological divisions.

"Industrial Demands for Non-Laboratory Chemists" will be the topic of the division of chemical education, of which Dr. Laurence L. Quill of Ohio State University is chairman. Papers on "Detergents and Their Actions on Biological Systems" and "Theory of Long-Range Elasticity" will be submitted to the division of physical and inorganic chemistry, of which Dr. Oscar K. Rice of the University of North Carolina is chairman.

General sessions will be held by the divisions of analytical and micro chemistry, cellulose chemistry, colloid chemistry, gas and fuel chemistry, organic chemistry, sugar chemistry and technology, and water sewage and sanitation chemistry.

A special program for women chemists is being arranged under the direction of a Cleveland commitee headed by Gilberta G. Torrey. Luncheons, group gatherings, meetings of committees, local section officers, and alumni of universities and technical schools are other scheduled events

Dr. Carl F. Prutton, professor of chemical engineering at Western Reserve University, has been appointed general chairman of the meeting. Dr. Eric A. Arnold, associate professor chemistry at Case School of Applied Science, has been named general vice-chairman. Dr. Harold S. Booth, head professor of physical science at Western Reserve, is honorary chairman. Registration will begin April 2 at Hotel Cleveland and Hotel Statler.

MAKERS OF RESIN ADHESIVES FORM ASSOCIATION

Representatives of ten large manufacturers of synthetic resin adhesives met in New York Jan. 13 and formed an association aimed primarily at "offering cooperation in utilizing synthetic adhesives for war products and unified industry action on industry-wide problems in dealing with the armed services and other government agencies."

The group will be known as the Resin Adhesive Manufacturers Association and includes a large share of the companies now producing synthetic resin adhesives for further sale or manufacture. The officers of the new association are: president, W. F. Leicester, vice-president Casein Co., of America; vice-president, C. F. Hosford, Jr., president Pennsylvania Coal Products Co.; secretary-treasurer, J. E. Waller.

The Board of Directors consists of the President and vice-president together with James L. Rodgers Jr. of the Plaskon Division of Libbey Owens Ford Glass Co. Two additional directors are to be elected in a subsequent meeting.

An important phase of the program instituted in the first meeting was the appointment of a Technical Advisory Committee including representatives of each member company.

Other objects of the association as outlined in the meeting included promotion of the general welfare of the resin adhesive industry, increasing the use of resin

CONVENTION CALENDAR

American Institute of Mining and Metallurgical Engineers, annual meeting, Waldorf-Astoria, New York, Feb. 20–24.

American Society for Testing Materials, spring meeting, Netherland Plaza, Cincinnati, Feb. 28–Mar. 3. Annual meeting, Waldorf-Astoria, New York, N. Y., June 26–30.

American Gas Association, war conference on industrial and commercial gas, Hotel Seneca, Rochester, N. Y., March 30–31.

American Society of Mechanical Engineers, spring meeting, Birmingham, Ala., April 1–3.

American Chemical Society, 107th meeting, Cleveland, Ohio, April 3–7.

The Electrochemical Society, spring meeting, Milwaukee, Wis., April 12–15.

American Institute of Chemical Engineers, semi-annual meeting, Hotel Cleveland, Cleveland, Ohio, May 14–16.

American Association of Cereal Chemists, annual meeting, Nicollet Hotel, Minneapolis, Minn., May 23–25.

adhesives in the arts and industries, study ways and means for eliminating waste in production and distribution, to promote safety, to encourage research, and to promote improvements in the quality of resin adhesives.

SOCIETY OF THE PLASTICS ENGINEERS ELECTS OFFICERS

The Board of Directors of the national Society of the Plastics Engineers, Inc. held its first 1944 meeting last month in Detroit for election of new officers and discussion of the year's program. Charles E. Henry, Chicago Die Mold Manufacturers, was elected national president. William B. Hoey, Plastics Process, Inc., Detroit, vice-president; George C. Gress, Monsanto Chemical Co., Detroit, secretary-treasurer. New directors chosen at the meeting are: N. J. Rakas, Chrysler Corp., John Mickey, Ford Motor Co., both of Detroit and Robert Morehouse, Cardinal Corp., Evansville, Ind. Continuing on the Board are: Charles Clark, Owens-Illinois Glass Co., Toledo; William Gogin, Dow Chemical Co., Midland, Michigan and H. McGowan, Bakelite Corp., Detroit.

The Chicago Section of the Society elected as 1944 president W. T. Cooper of the Bakelite Corp. The new vice-president is L. W. Amrine, Imperial Molded Products Co. and secretary-treasurer, J. W. Porte, Monsanto Chemical Co. At the first 1944 meeting L. W. Anderson, Chicago Molded Products Co. and J. O. Reinecke were chosen as directors with Witt Ellison, Richardson Co.; Lee Bordner, Eclipse Molded Products Corp.; C. C. Henry, Chicago Die Mold Mfg. Co., and A. W. Nelson, Rada Products Co., continuing as directors.

NEW STEEL MILL BEGINS OPERATION IN UTAH

Consuming requirements for chemicals in Utah were considerably broadened last month through the placing in operation of the government's new steel project near Provo. Construction of the plant was begun by Columbia Steel Co., west coast subsidiary of United States Steel Corp., in April, 1942. Geneva Steel Co., a newly formed U. S. Steel subsidiary, later contracted with the Defense Plant Corp. to operate the mill for the duration without profit or fee.

Iron ore is brought to the plant from the open pit iron mine near Cedar City. Coke is being produced in byproduct ovens at Geneva which began operations Dec. 14, using coal from the newly developed mine in southeastern Utah. Limestone and dolomite are obtained from Keigley quarry, a part of the Geneva project located 25 miles from the mill.

WESTERN PAPER MILLS AID RESEARCH PROGRAM

Twenty pulp and paper mills in the state of Washington have agreed to contribute jointly between $300,000 and $500,000 to the University of Washington, during the next five years, to finance a research program aimed at utilizing and neutralizing the mills' liquid waste.

COYLE SELECTED TO HEAD GAS MANUFACTURERS

Thomas Coyle, for many years manager of chlorine products in the former R&H chemicals department of the duPont company and more recently associated in an executive capacity with the electrochemical department, was elected president of the Compressed Gas Manufacturers' Association, Inc., at its 31st annual meeting in New York January 24-25. He succeeds H. Emerson Thomas, Fuelite Natural Gas Co., Westfield, N. J. The newly elected first vice-president is Robert J. Quinn, sales executive of Mathieson Alkali Works, and the second vice-president is now Clarence McL. Pitts of the Peoples Gas Supply Co., Ltd., of Ottawa, Ontario. Miss Florence Jacob, who has been acting secretary-treasurer since Frank R. Fetherston was commissioned major in the Army Service Forces, was elected acting secretary for 1944.

Research in high altitude flying, as described by Lt. Col. W. R. Lovelace, Jr., chief of the Aero Medical Laboratory, has developed an important but critical market for oxygen in military aircraft. Some of the problems and policies involved in this use were presented to Capt. E. V. Rupp, of Material Command at Wright Field. The broad services of the compressed air industry to the war effort were reviewed by Major Fetherston.

The important development and use of insecticidal aerosol was described by the co-inventor, Dr. Lyle D. Goodhue, senior chemist of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture. Many see in this development a postwar product that is destined for tremendous popularity.

CWS FIRST ARMY SERVICE TO CLOSE RENEGOTIATIONS

Chemical Warfare Service is the first Army Service to close renegotiation agreements covering all 1943 assignments, it has been announced by the War Department, which said that several billions of dollars in contracts was involved. The achievement, described as a source of great satisfaction to the Renegotiation Division of the Army Service Forces, is credited to a four-month effort of the Purchase Policies Branch of the CWS Materiel Command, beginning last August 31.

Under Major Robert M. Estes, CWS, of New York, four renegotiation squads were organized and put in the field under the supervision of CWS officers, all members of the Purchase Policies Branch. These units dealt directly with plant managements wherever they were located, rather than have manufacturers visit Baltimore, Maryland, where the sub-office is located, or Washington. Time and transportation were conserved and transactions were expedited as a result, the announcement said.

The field units were headed by Major Paul W. Brainard of Ithaca, N. Y., Major Thomas C. Conlin, of Dallas, Texas, Lieutenant Jasper S. Costa, of Westwood, Mass., and Lieutenant Edward Hale, Lancaster, N. Y.

NEW PROCESS FOR COOKING GRAIN MASH FOR ALCOHOL

PATENT rights to a new labor-fuel-saving process of cooking grain mash for war alcohol have been given to the Government for the duration of the war by a consultant to the Chemicals Bureau, WPB has announced.

P. A. Singer of Century Distilling Co., Peoria, Ill., a consultant to the Alcohols and Solvents Section, is inventor of the process which was developed at that company's Peoria plant as part of a program to reduce labor maintenance and fuel costs. A 50 percent saving is estimated in maintenance work and fuel requirements in cooking operations through the new method of introducing steam to cook mash.

Mr. Singer, through the War Production Board, invited all distillers of alcohol for war purposes to avail themselves of the new process, royalty free. As an inducement to distillers to adopt the process he has offered all rights to the Army to remove fears of possible infringement.

BUREAU OF MINES WILL RELEASE STATISTICS

ACTING under revised security regulations of the Bureau of the Budget, Dr. R. R. Sayers, director of the Bureau of Mines announced last month that certain heretofore confidential information on the production of aluminum, bauxite, copper, lead, magnesium, mercury, and zinc in the United States will be made public through resumption of regular reports by the Bureau of Mines on these commodities.

Dr. Sayers reported to Secretary of the Interior Harold L. Ickes that the 1942 Minerals Yearbook, like the 1941 addition, will remain confidential as an entire volume because censorship on foreign trade data has not been lifted and the volumes contain some commodity information that is withheld for security reasons.

The regular periodic commodity reports on aluminum, bauxite, copper, lead, magnesium, mercury, and zinc will be distributed by the Bureau of Mines to its established mailing lists, but other chapters can be obtained only from the Superintendent of Documents.

MORE METAL CONTAINERS FOR USE THIS YEAR

THE War Production Board has announced a list of 169 different products that may be packaged in metal containers this year, in making estimates of 1944 quotas. The list of quotas contains 22 items that could not be packaged in metal containers last year.

The 22 new items to be packed in metal containers are: Alcohol, infflammable cleaning fluid, hydraulic brake fluid, movie film, polishes and waxes, roof coatings, turpentine, lubricating oils, ~~motor~~ oils, putty and caulking compounds, lacquers, shellacs, liquid disinfectants and germicides, anti-freeze, varnishes, liquid insecticides and fungicides, varnish remover, lemon juice, sweet syrups, cranberries, pimientos, and boned chicken.

LARGER POST WAR MARKET FOR SOAP AND GLYCERINE

GREATER interest in cleanliness, due to military training, was predicted for the postwar period by E. H. Little, president of the Colgate-Palmolive-Peet Co., and president of the Association of American Soap & Glycerine Producers, who presided on Jan. 20 at that organization's 17th annual meeting, held in the Waldorf-Astoria, New York. He also said there will also be a large postwar market for glycerine, as many applications of this product developed during the war will continue in peacetime, and expanded research on new uses will go along with increased production.

Dr. C. W. Lenth, chief of the Soap and Glycerine Division of FDA, praised the industry for its efficient distribution of soap under war conditions. Leon Falk, head of the Oils and Fats Section of FDA, predicted an increase in the stockpile of fats and oils during the first quarter of this year, and said that agriculture has done a good job in making up stocks of these essential supplies.

The importance of price control now, in order to enable industry to enter postwar markets without inflated prices, was stressed by EdOma W. Ranson, head of the Soap and Glycerine Unit of OPA. He praised the glycerine industry's campaign to salvage left-over cooking fats, as did the two speakers who followed him—Walter S. Straub, OPA Director of Food Rationing, and H. M. Faust, head of the Salvage Division of the War Production Board.

William L. Sims, II, price executive of OPA's Chemicals and Drugs Branch, described the work of his department, and Wilder Breckenridge, manager of the National Fat Salvage Campaign, reported on the progress of the drive.

In the business meeting which followed, Mr. Little was reelected president. Three vice-presidents were chosen—R. R. Deupree of the Procter & Gamble Co., Cincinnati, for the Central section; G. R. Fulton of the Beach Soap Co., Lawrence, Mass., for the Eastern section, and A. Haas of the Newell Gutradt Co., San Francisco, for the Pacific Coast. N. S. Dahl of the John T. Stanley Co., New York, was reelected treasurer, and three new directors were chosen—Homer D. Banta of the Iowa Soap Co., Burlington, Iowa; Oscar M. Burke of the Manhattan Soap Co., New York, and Daniel M. Flick of Armour & Co., Chicago. Roscoe C. Edlund, manager of the Association, was elected secretary of the Board.

SITE FOR ALUMINUM PILOT PLANT SECURED

A TRACT of 100 acres immediately north of Salem, Ore., has been purchased by the Federal government as the site for the new $4,000,000 alumina-from-clay pilot plant of Defense Plant Corp. The plant, which is scheduled to be operated by Columbia Metals Corp. for DPC, will be built by Chemical Construction Co., an affiliate of American Cyanamid Co. Columbia metals is controlled by interests centered in the Northwest.

CONSTRUCTION OF NEW SYNTHETIC RUBBER PLANT IS UNDERWAY IN ENGLAND

Special Correspondence

WORK HAS begun on the erection of a synthetic rubber plant in Great Britain which has been licensed by the government after long deliberation and hesitation. The license has been granted to the British Celanese Ltd., a company which has for some time been known to consider active steps for an expansion of its activities into the field of plastics production. The synthetic rubber plant is to start production shortly after the middle of 1944 according to one report, while another source states that production will be well under way by the beginning of next summer. How big the output will be, has not been stated, but it is understood that it will cover only a fraction of British requirements. This is all the information officially available at present, but some further details can be pieced together from news which has appeared earlier.

In July, 1942, one of the directors of British Celanese Ltd. wrote a letter to the Press in which he mentioned the possibility of obtaining one ton of a synthetic rubber from 4½ tons of coal. He estimated the investment required for the plant at about £1,000,000 and assumed an annual output of 36,000 tons of synthetic rubber. Last summer the company formed its new subsidiary, Celanese Plastics Development Co. Ltd., which seems to have been concerned with these synthetic rubber plans.

The process to be used seems to be a special one developed by Celanese and considered to be so secret that the company even refused to divulge it during its negotiations with the government. It is claimed for this process that the product could compete with natural rubber even in peacetime. It is said to possess most of the useful properties of india rubber and to lend itself to variation in accordance with requirements.

While it is believed that the British Celanese Ltd. has been pressing for such a license as has now been granted to the company ever since 1942 or even earlier, the government has only recently acceded to the view that a case can be made out for the establishment of a synthetic rubber industry in the British Isles. Its attitude has been changing gradually, partly under the impression that the original U. S. synthetic rubber plans would not be realized and that therefore further plant was required. The government and the company also differed on the question of finance. Originally it was proposed that the government should finance the erection of a plant to be run by the company, but this was rejected by the authorities. Another objection was lack of raw materials, but this has been overcome by the erection of new capacity for extracting oil from coal. Possibly plantation rubber interests also opposed the synthetic rubber proposal. But all these objections have now been overcome. British chemical quarters wholeheartedly support the government's decision, not in the last place because of the opportunity the new plant will offer for research and development in a field which is bound to gain considerable importance in the future and in which British chemists have so far had little opportunity to train themselves. This advantage will accrue even from a comparatively small plant as the new synthetic rubber plant is likely to be in view of the shortage of equipment and the demands of other industries.

An attempt in another direction to mitigate the rubber shortage has failed. Experiments with the cultivation of kok-saghyz, krim-saghyz and tau-saghyz, three kinds of dandelion, from Russian seeds in various parts in the British Isles have shown that little hope can be entertained at present for a substantial relief from this side. Kok-saghyz, the most promising of the three plants, yielded 65–100 lb. of rubber per acre (as compared with 800–1000 lb. for Para rubber in tropical countries), but the plant needs good soil and requires hand-weeding. While the quality is said to be good, its general cultivation is not recommended by the British authorities, presumably because the necessary land and labor cannot be spared for this purpose. The labor problem has indeed caused some difficulty in the rubber reclaiming industry too, but recent measures are expected to enable the industry to meet all British requirements of reclaimed rubber.

NEW MEDICINALS

After the great success of penicillin, the mold-derived wound disinfectant, supplies of which are still reserved entirely for the needs of the armed forces, the announcement of the discovery at the London School of Hygiene and Tropical Medicine of another bacteriostatic agent—patulin in commercial and penicillium patulum in scientific language—has aroused keen interest, since it is claimed to provide a cure for the very frequent but still mysterious common cold. Pure patulin is a colorless crystalline substance melting at 111 deg. C. Its empirical formula is $C_7H_6O_4$ and it corresponds to anhydro-3-hydroxy-methylene-tetrahydro-γ-pyrone-2-carboxylic acid. Two strains of patulin have been grown from synthetic liquid culture media. Filtrates from these are evaporated to a smaller bulk, the active inhibitor of bacterial growth is then extracted by ether from which, upon evaporation, it crystallizes in large prisms or thick plates. The crystal is soluble in water and most organic solvents (though not in light petroleum). Experiments so far carried out are not quite conclusive, but it has been proved that the substance possesses bacteriostatic powers against both the gram-positive and gram-negative organisms studied, though it shows no selective differentiation between the two groups. It is more active than penicillin against gram-negative organisms. The trade name "Tercinin" has been given to the product by the Therapeutic Research Corp. which has supplied material for extended trials. The substance will not, however, be released for general use until further tests on a larger scale have proved its value and safety.

In this connection it may be mentioned that gramicidin, the bacteriostatic agent now being made in the U. S. A. and, according to a recent report, sent to Soviet Russia in considerable quantities is now being made in Great Britain. Very little is known publicly of research work in this field, but the striking success of penicillin has naturally attracted much interest to this field of research, and there is a distinct possibility that the work now being carried out will result in further beneficial developments.

A substitute for montan wax has been discovered in peat wax if experiments and investigations carried out by the Imperial Institute at the request of the New Zealand government on material obtained from the Chatham Islands peat deposits is any guidance. In its present condition the peat wax would be worth about 80-85 percent of the value of montan wax which it could replace for some purposes such as boot polish. The product may be capable of further improvement by removal of the undesirable "asphaltic" constituents.

Sisal is the latest vegetable source of valuable organic chemicals according to a report published by the African Sisal and Produce Co. on work which the enterprise has undertaken during the past few years. Wax, glucosides, pectates and plastic materials have been obtained from the sisal plant after the extraction of the fiber which accounts for no more than 3-4 percent by weight of the sisal leaf. Some of these chemical products are obtained in commercial quantities and disposed of without difficulty at the current prices. To make full use of the opportunities for the manufacture of chemical byproducts, the present decorcitators must be replaced by new ones which will permit the flesh and juice of the plant to be recovered. Apparently it is intended to change over to new machines as the old ones are withdrawn from operations.

Misgivings about the future of the British export trade in cosmetic products are entertained by British firms which complain that while severe restrictions have been placed on British imports of essential oils, shipments from British mandated territories continue to the United States. Earlier in the war substantial quantities of valuable raw materials for the cosmetic trade were sent to the Americas to pay for imports of goods for armament production, so that stocks in Great Britain have been exhausted and the basis for a resumption of exports after the war is no longer available. It is suggested that the British control authorities should issue licenses for the importation of limited quantities of high-class raw materials, from Switzerland among other countries, and such licenses as are being issued should be made available without delay to enable British importers to compete in foreign export markets. Some of the raw material difficulties experienced by British makers of toilet preparations concern such indigenous commodities as alcohol and oils. Hitherto the government has refused to make any concessions with respect to the release of controlled materials for luxury trades.

PAN-AMERICAN CONFERENCE ON ECONOMIC PROBLEMS

The Governing Board of the Pan-American Union, at a recent meeting, proposed that the governments of the 21 American Republics meet in conference to consider economic problems of the post-war period. The meeting would be held in Washington in September of this year, or earlier if circumstances make it advisable. If the suggestion meets with the approval of the governments, the Chairman of the Board, Cordell Hull, Secretary of State of the United States, was authorized to issue the formal invitations to the governments to be represented. The Inter-American Financial and Economic Advisory Committee was requested to prepare a project of program, and submit it to the Governing Board for definite approval.

The recommendation that the conference be convened was made by the Executive Committee on Post-War Problems, composed of the Ambassadors of Mexico, Ecuador, Brazil, Cuba, Uruguay, Guatemala, and the Charge d'Affairs of Colombia. It grew out of a resolution adopted at the Rio de Janeiro Meeting of Foreign Ministers. The proposal was appended to a comprehensive report prepared under the direction of the Committee, setting forth recent trends in inter-American economic cooperation. Copies of the report have been ordered printed for general circulation.

GERMAN MOTOR VEHICLES TO MAKE OWN GASOLINE

A REPORT reaching the Department of Commerce states that laboratories of the I. G. Farben-industrie in Germany have discovered a new, quick method of obtaining synthetic gasoline from coal. The chief chemist of the Farben works claims that gasoline will be produced not in a factory but in the motor vehicle itself. The driver, without technical or chemical knowledge, can learn in a few hours to be his own fuel manufacturer. The cost of the new product is further reported to be one-tenth that of the fuel formerly obtained from coal.

Between 1933 and 1938, Germany's production of oil by synthesis, hydrogenation, and low-temperature carbonization is said to have increased 10 times. The increase was due largely to the work of I. G. Farben in the field of production by synthesis and hydrogenation, and of Braunkohle-Benzin A. G. in the field of production by low-temperature carbonization.

Since 1938, output has risen still more. It is estimated that the present synthetic production in German-controlled Europe may total 42,000,000 barrels annually.

BELGIUM RESTRICTS USE OF SULPHURIC ACID

Prior to the war production of sulphuric acid in Belgium was largely dependent upon imports of raw materials including pyrites, blende, lead sulphide, and copper ore. When these imports were reduced in volume the output of acid fell accordingly with the two-fold effect of cutting down the number of operating plants and of restricting the use which might be made of the acid which was produced. The prewar production of the country was approximately 800,000 tons. No data are available for current production but the number of plants has been reduced to nine.

When the supply began to dwindle, it was found necessary to place controls over distribution and no acid was allocated for many industrial uses including manufacture of ammonium, sodium, and potassium sulphates. When some raw material supplies were obtained in 1941 the controls were eased to permit the use of acid in rayon manufacture, for superphosphate, and for metal dipping.

CHEMICALS FROM CELLULOSE BYPRODUCTS OF SWEDEN

In addition to lumber and pulp production, Mo and Domsjo of Hernosand, important pulp manufacturers in Sweden, have developed a considerable chemical industry, based on cellulose byproducts.

The company produces sulphite alcohol, turpentine, hydrochloric acid, chlorine, polyvinyl acetate, chloroform, ethyl acetate, triethanolamine, ethyl glycol, and ethylene glycol. Two new products—butanol and butyl acetate—recently have been announced. Chemical and cellulose plants are located at Domsjo, Hornefors, and Husum. The turpentine plant has been doubled in size and the equipment improved.

Production of sulphite alcohol in 1942 amounted to 7,579 metric tons; the output of caustic soda totaled 4,905 tons and that of chlorine 4,406. Other materials manufactured included 2,467 tons of liquid rosin and 1,037 tons of glycol products.

FLAT GLASS WILL BE MADE IN BRAZIL

A glass factory, the Cia. Vidreira Brasil "Covibra," nearing completion at Sao Goncalo, near Niteroi, State of Rio de Janeiro, Brazil, will manufacture flat glass, a product not previously made in Brazil. Although the plant expects to begin operations in a short time, production in any appreciable proportions will be delayed by the difficulty in obtaining machinery and the necessary supplies of soda ash.

Another plant, known as Cia. Paulista de Vidro Plano and affiliated with the Covibra plant, is under construction in Sao Paulo, but operations are not expected to begin before 1945.

The Covibra product is expected to be satisfactory, though the production process is not the most modern.

SWEDISH WOOD DISTILLERS FORM ASSOCIATION

Swedish producers of wood distillates, charcoal, turpentine, and tar and tar oils have formed the National Association of Wood Distillers.

Before the war, output of these materials in Sweden was small, but after imports were cut off and the need for various tar-based substitute products increased rapidly, steps were taken to stimulate large-scale domestic manufacture. Existing plants and the State Forest Industry AB. expanded their manufacturing facilities. Tar production now amounts to 50,000 to 60,000 metric tons annually.

Approximately 60 producers have joined the Association representing one-third of the total Swedish production, or about 18,000 tons.

INDIA PLANS DEVELOPMENT OF CHEMICAL INDUSTRY

Ammonium chloride and commercial hydrochloric acid can be manufactured from the bitterns salts, says a report of the Chief Chemist, Central Board of Revenues, Government of India. The local production of ammonium chloride from village refuse also has been investigated at the request of the Defense Department.

It has also been suggested that equipment be imported into India for the production of ammonium sulphate and other artificial fertilizers.

This was one of the recommendations made by the All-India Food Grains Policy Committee in its recent report.

SOUTH AFRICA HAS EXPORT SURPLUS OF LACTIC ACID

A chemical firm in Port Elizabeth, South Africa, now produces lactic acid on a scale sufficiently large to supply all the current needs of the domestic tanning industry and to leave a balance for export to other territories. Lactic acid, formerly imported chiefly from Germany, is now manufactured entirely from local raw materials.

MEXICAN PLANT PRODUCES CALCIUM CARBIDE

A new calcium carbide plant has been established in Mexico. A Mexican concern, known as Carburo, S. A., owns and operates the plant, which is located in Guadalajara, an industrial center and capital of the State of Jalisco. The factory has a daily capacity of 15 tons of carbide. Electric power and raw materials are obtained from local sources.

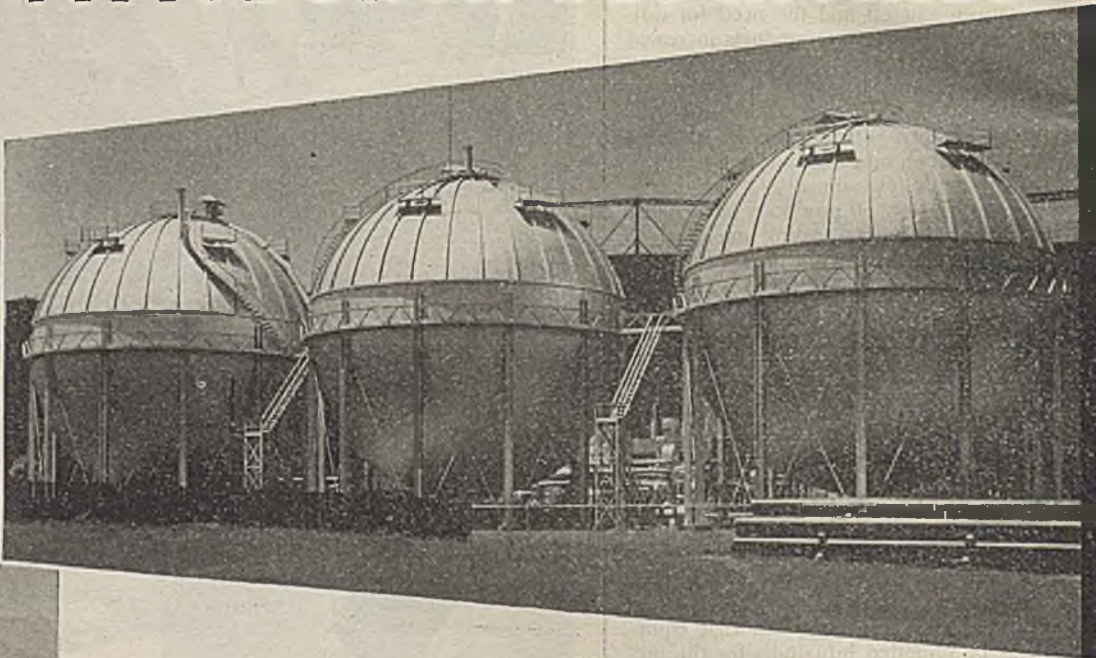
JAMAICA MAY MAKE ALCOHOL FROM BANANAS

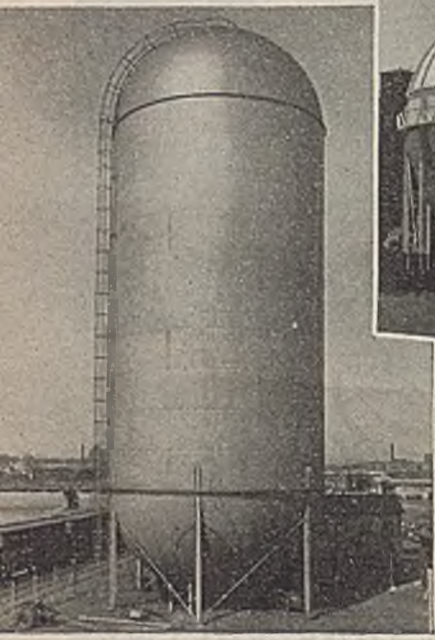
The establishment of a new industry in Jamaica to produce ethyl alcohol from bananas is contemplated. Proposed as a wartime measure, a plant would be set up to use rejected bananas as raw material. This project, it is expected, would prove of considerable assistance to the banana industry.

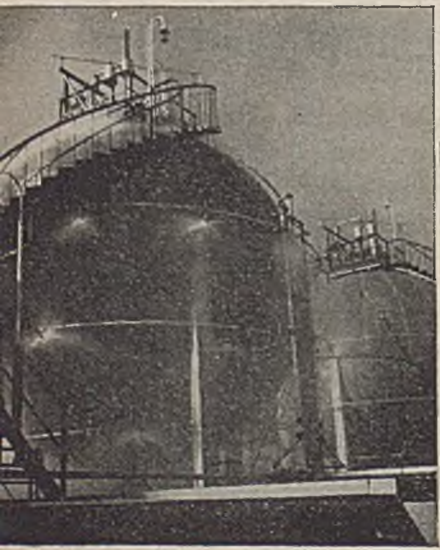
RESEARCH, FABRICATION and ERECTION . . .

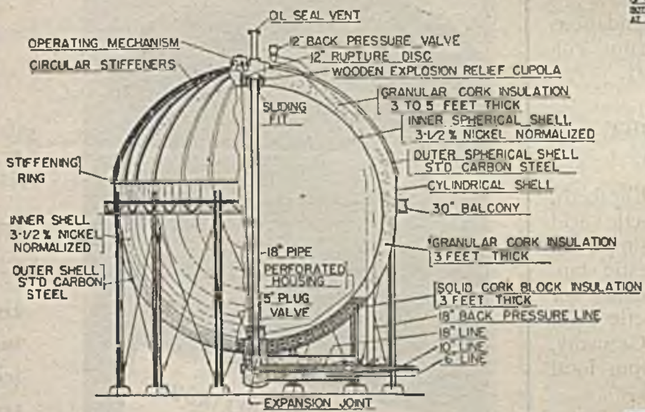
MODERN STORAGE FOR GASES and LIQUIDS . . .

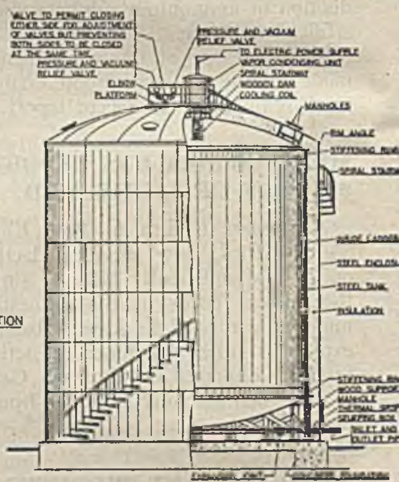
by PITTSBURGH-DES MOINES











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UNITY NOW

To the Editor of *Chem. & Met.*:

Sir:—I read with considerable interest the editorial entitled "Unity Now?" in the December issue. I agree with you that technical men, as a whole, should be in a position to better assert themselves than they have been in the past, but that a super-organization is not the answer.

You may be interested to know that here in Chicago the various technical groups, during the past several months, have formed an organization known as the Chicago Technical Societies Council, which seems to be the basis of a cooperative effort which may lead to something worthwhile. This organization resulted from a group effort to help in the solving of some of the war problems of this district. The first tangible result of this cooperation is the publication of the Sci-En-Tech News which monthly publishes a calendar of technical events for the coming month and which goes to members of all the local technical groups.

The Council's first effort is to help the local groups with respect to their programs. In addition to the publication of the calendar, a roster of speakers is to be maintained, a list of suitable meeting places is to be compiled, and such information collected as is necessary to assist the program committees.

No ambitious program has been set up for the local groups and as a result there has been no request for a paid secretary or other expenses which usually follow such a program and which often cause bitter criticism. The mere fact that there is some sort of an organization available to correlate all of the technical activities in this area is of significance and I am certain its value will grow with experience.

O. W. Storey
C. F. Burgess Laboratories, Inc.,
Chicago, Ill.

MORE ON UNITY

To the Editor of *Chem. & Met.*:

Sir:—Your editorial in the December issue of *Chemical & Metallurgical Engineering* entitled "Unity Now?" is very expressive of a serious problem. However, I cannot see why in connection with the desire to have one group represent the "political and legislative" side of engineering you did not take cognizance of the National Society of Professional Engineers, which is set up for just this purpose and which is, so far as its support will allow, doing a creditable job.

In this case we have the state societies and county chapters in the state, the necessary type of political set-up used to such good effect by the medical profession. Membership is confined to those who are licensed and hence legally entitled to the term "engineer."

It would appear that one of the basic

troubles lies in the opposition to licensing which was widespread in the engineering profession some years ago, but which I believe is dying out in all but a few quarters where they fail to realize that licensing is an accomplished fact and here to stay. I have consistently held that one of the troubles with chemical engineers is that they regret that legal enactments often fail to protect their interests, but take no active part in the one professional organization which could correct the errors.

A very small proportion of the membership of the American Institute of Chemical Engineers in New York State is licensed and a most minute percentage are members of the state society. They can hardly expect to have very much influence under these conditions.

We need no new society for the political and legislative side. We have one. If there is something wrong with it and its objectives, corrections can better be applied from the inside than the outside. Why add further to the "plethora" of organization?

John M. Weiss

John M. Weiss and Co.
New York, N. Y.

HIGH PRESSURE CORROSION

To the Editor of *Chem. & Met.:*

Sir:—The general subject of corrosion at high pressures, particularly from the standpoint of the chemical engineer, is one that has received less attention than it deserves. Little has been published on it. Many times specifications are prepared on equipment involving considerable amounts of material that may be critical without more than cursory information as the basis.

I am entering into the project of collecting and compiling all available information on corrosion at high pressures. Since much of it must be obtained from unpublished sources, I am sending letters of inquiry to many individuals known to be possibly interested in this phase of corrosion.

Naturally, I have given considerable thought to a suitable manner of publishing the results. It depends upon the amount and nature of information the effort yields. I anticipate that ultimately there will be both a comprehensive listing of available data on high pressures and also a scientific analysis of the principles involved in interpreting and drawing analogy of corrosion data at various pressures so that rates of corrosion under conditions for which no data are available could be predicted on a reasonable basis. Eventually I hope to have covered all of the aspects of high-pressure chemical technology, this being only one of the essential fields at present and unknown. At that time it is planned to put it in book form.

Successful collection of the information is going to require cooperation from a great many people, many of them strange to me. Anything that can be done to prevent the initial inquiries from ending up in the waste basket will be a hig help.

Douglas C. Meigs

P. O. Box 485
Silver Springs, Md.

FLOWSHEET INDEX

Prof. H. L. Olin, of the State University of Iowa, has sent us an index of *Chem. & Met.* pictured flowsheets which he has compiled for his students. *Chem. & Met.* has featured since 1939 the monthly presentation of four-page flowsheets of typical chemical engineering processes illustrated and with descriptive matter.

Index to *Chem. & Met.* Pictured Flowsheets, 1939–1943:

Acetic Acid (wood)	May 1940
Activated Sludge	Jan. 1941
Alcohol (molasses)	June 1939
Alumina	Oct. 1940
Aluminum Sheet	May 1943
Ammonia Soda Process	Feb. 1942
Ammonia Synthesis TVA	Nov. 1943
Amyl Alcohol and Acetate	July 1940
Bauxite	May 1943
Beer	July 1942
Beet Sugar	June 1942
Bromine (sea-water)	Dec. 1939
Buna S Rubber	June 1943
Butyl Rubber	July 1943
Cane Sugar	July 1941
Carbon Dioxide	Feb. 1939
Casein and Lactic Acid	June 1940
Caustic Soda	Dec. 1942
Cellophane	Jan. 1939
Cement (wet process)	Oct. 1939
Chemical Cotton	Apr. 1941
Chlorine	Dec. 1942
Coke (byproduct)	Dec. 1941
Cordite	Oct. 1943
Cyanamide	Apr. 1940
Diatomite	Aug. 1942
Formaldehyde	Sept. 1942
Furfural Refining (lubricants)	Dec. 1940
Gasoline (aviation)	Dec. 1943
Glass (plate)	Jan. 1942
Glycerine (and soap)	May 1942
Glycerine (and red oil)	Sept. 1943
Hydrogen Sulphide	Jan. 1940
Lactic Acid	June 1940
Leather (chrome)	Jan. 1943
Lubricants (dewaxing)	Oct. 1941
Lubricants (refining)	Dec. 1940
Magnesium (sea water)	Nov. 1941
Naval Stores	Mar. 1942
Paint	Mar. 1939
Phenol	Apr. 1939
Phenol	Nov. 1940
Phenol Plastics	Mar. 1940
Phenolic Resin	Sept. 1939
Phosphates	May 1939
Phosphates (super)	Apr. 1943
Porcelain	July 1939
Powder (smokeless)	Apr. 1942
Pulp (sulphate)	Nov. 1939
Pulp (sulphite)	Aug. 1941
Rayon (viscose)	Jan. 1939
Rayon (viscose)	Oct. 1942
Rubber (reclaim)	June 1941
Salicylic Acid	Aug. 1943
Salt	Aug. 1940
Silica Aerogel	Feb. 1943
Soap	May 1942
Soybean Extraction	Sept. 1941
Stearic Acid	Sept. 1943
Stoneware (chemical)	Sept. 1940
Sugar (beet)	June 1942
Sugar (cane)	July 1941
Sugar (refining)	Feb. 1940
Sulphur (mining)	Mar. 1941
Sulphuric Acid (sludge)	May 1941
Whiskey	Nov. 1942
White Lead	Mar. 1943
Zinc Oxide	Feb. 1941

NAMES IN THE NEWS

W. S. Richardson

Edward Ledoux

L. H. Brandt

W. S. RICHARDSON, general manager of the chemicals division of the B. F. Goodrich Co., has been elected vice president of the Hycar Chemical Co. He succeeds RAYMOND W. ALBRIGHT who recently resigned to become vice president and general manager of the Distillation Products, Inc., of Rochester, N. Y.

JOHN E. FICK, superintendent of the Steel and Tube Division of the Timken Roller Bearing Co., Canton, Ohio, became vice president in charge of the same division at a meeting of the company's board of directors last December.

A. N. SWANSON has been appointed chief process metallurgist in the Chicago Metallurgical Division of the Carnegie-Illinois Steel Corp., a U. S. Steel subsidiary.

FRANCIS J. PLOEDERL, who has been associated with Heresite & Chemical Co. since 1935 as a chemical engineer, has been appointed technical assistant to the president.

WALTER E. MURRAY was elected a vice president of the Warwick Chemical Co. at its annual meeting. Mr. Murray joined Warwick Chemical Co. two years ago as a sales manager of the Textile Chemical Department. In October, 1943, he was appointed manager of that department.

R. MAX GOEPP, JR. has been appointed director of organic research of the Atlas Powder Co. Dr. Goepp, who joined Atlas in 1932 as a research chemist, was graduated from Lehigh University and took his doctorate at Oxford University. His work has been mainly in the field of carbohydrate chemistry.

CHARLES A. GETZ, director of the Research Division of Cardox Corp., has been elected to fill the newly created position of vice president in charge of research of that company. Dr. Getz is recognized as an authority on carbon dioxide gas and its application to fire extinguishing.

EDWARD LEDOUX is now associated with the Dorr Company of New York as consulting engineer. Mr. Ledoux is the author of many technical articles and papers published here and abroad on the subjects of ventilation, air conditioning and adsorption of vapors. Several of these have appeared in *Chem. & Met.*

MARK LOVE, JR. is now research director at Wood River Refinery, Shell Oil Co. LAWRENCE LOVELL is the new research director at the company's Houston Refinery.

NORTH EMORY BARTLETT has resigned from his position as vice president of the Pennsylvania Salt Mfg. Co. Mr. Bartlett, who is a native of Easton, Md., had been with the company since 1894.

ROBERT W. KRESS, formerly with the research department of the Follansbee Steel Corp., Pittsburgh, who joined the Special Chemicals Division of the Pennsylvania Salt Mfg. Co. last November, has been assigned to the Chicago office of that company. He will assist in handling sales-service work on products of the company's Special Chemicals Division in the Chicago territory.

LEON E. OSMER and MELVIN H. MCKINNEY have recently joined the Gas Processes Division of the Girdler Corp., as engineers.

ARTHUR G. WAKEMAN, assistant director of the War Production Board's Forest Products Bureau, and formerly director of the Pulp and Paper Division, has left Washington on a special mission to England for the Forest Products Bureau. His assignment includes conferring with British and other government and industrial officials on problems involving pulp, paper and paperboard products. Special attention will be given to international problems, and the coordination of the activities of the allied countries.

L. H. BRANDT, formerly with the National Ammonia Division of duPont, has joined the technical service department of the Pennsylvania Salt Mfg. Co. Mr. Brandt is a chemical engineer who has been prominently identified with ammonia and other heavy chemical utilization in the fields of refrigeration, oil refining and heat treating. In his new position his services will be principally devoted to rendering assistance to heavy chemical users.

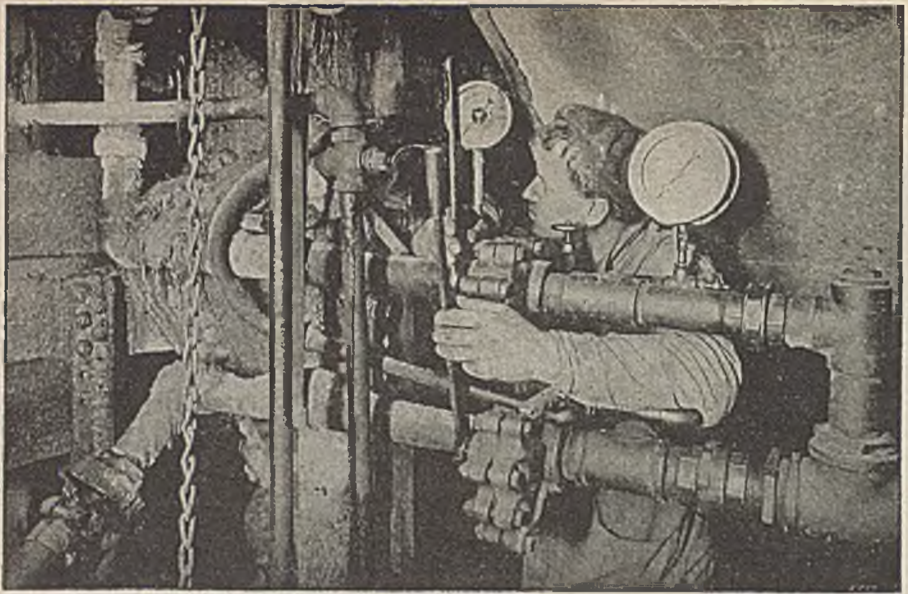
RALPH F. NICKERSON has joined the technical staff of the A. C. Lawrence Leather Co., Peabody, Mass., as senior research chemist. Formerly he was at Mellon Institute for several years where he engaged in cellulose, protein and fiber research and more recently was textile specialist with Firestone Tire & Rubber Co.

I. H. TAYLOR, vice president in charge of sales of Wyandotte Chemicals Corp., left that position Feb. 1 to devote his entire efforts to Merchants Chemical Co.

HARVEY N. DAVIS, president of Stevens Institute of Technology and director of the Office of Production Research and Development, War Production Board, has been elected an honorary member of the Institution of Mechanical Engineers in England. Dr. Davis is the fourth living American so honored.

JOHN M. LUPTON has resigned his position of director of public relations for Acheson Colloids Corp., Port Huron, Mich. Mr. Lupton left that company to become advertising manager for the Associated Business Papers, Inc.

ROLAND E. KREMERS has been appointed director of basic research, with supervision over organic chemistry and physical research sections, and the newly created biochemistry section of General Foods Corp. Other recently announced promotions and organization changes affecting the company's Central Laboratories include Dr. A.



G. Olsen who becomes manager of the Laboratories, Dr. H. M. Barnes who becomes director of the organic chemistry section, H. K. Murer appointed director of the biochemistry section, C. W. Kaufman to head the processing technology section, Dr. W. L. Roberts appointed director of the cereal technology section, H. W. Putnam to head the cereal chemistry division and Dr. Martha Johnson appointed head of the division of analytical chemistry.

William J. Gilbert has been added to the research department staff of Commercial Solvents Corp. Dr. Gilbert is a mycologist and botanist, having received his Ph.D. from the University of Michigan where until recently he was a teaching fellow. He will be associated with the biological division of Commercial Solvents research department.

William L. Sims II, of Orlando, Fla., has been appointed a price executive in the Chemicals and Drugs Branch of the Office of Price Administration. He succeeds Joseph D. Coppock. Mr. Sims went to OPA last November with some 20 years' experience in a business closely related with the drugs and chemicals industry, having been connected continuously with Colgate-Palmolive-Peet and predecessor companies since 1924.

Thomas Coyle

Thomas Coyle, chlorine products manager of the Electrochemicals Department of E. I. du Pont de Nemours & Co., was elected president of the Compressed Gas Manufacturers Association, Jan. 24.

T. C. Fong, instructor in chemical engineering at the University of Wisconsin, received his Ph. D. degree in May, 1943. He will join the staff of Shell Oil Co. in California in March. He expects to return to China after obtaining some industrial experience in the United States.

Harold S. Bell, widely known in the field of petroleum engineering, has become associated with Condenser Service and Engineering Co., Hoboken, N. J.

James D. Cunningham was recently elected to the board of directors of Allis-Chalmers Mfg. Co. He succeeds Charles W. Cox who resigned because of ill health.

IF IT'S A PROBLEM OF IRON REMOVAL—IT'S A JOB FOR DINGS

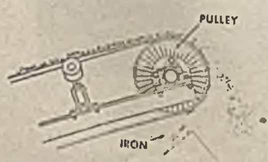
Separation—Purification—Concentration—Crusher and Grinder Protection

If you have any problem involving the removal of iron or iron oxides, submit it to Dings for consideration. Dings has made thousands of successful applications of electro-magnetic separation for removing iron from both wet and dry materials. A few of the standard models of Dings machines are briefly described on this page. Special applications of the principles of these separators can be made to meet almost any problem—you may be surprised what Dings *High Intensity* Magnetic Separation can accomplish for you. Jobs thought impossible a few years ago are now done daily by Dings Machines. Write today for complete information.

FOR REMOVING IRON FROM MATERIAL ON BELT CONVEYORS

Pulley—Dings builds the *most powerful magnetic pulley on the market for size!* Installed as head drive pulley on a belt conveyor system this unit automatically removes all contaminating iron. *Catalog 250* describes complete line of Dings air-cooled pulleys.

Principle of Operation



Iron is attracted by magnetic pulley and held fast to belt until it passes underneath and out of magnetic field where it discharges. Non-magnetic material passes over in normal trajectory. Simple — positive — automatic!

Suspended Magnets (Rectangular)—Ideal for applications not readily adaptable to pulley installation or where belt speed is excessive. Installed above belt, it pulls iron up and holds it fast. Daily cleaning of magnet face is usually sufficient. Unit shown is above belt travelling 800 ft. per min. Ask for *Catalog 301.*

FOR STATIONARY INSTALLATIONS

Magnetic Drum—Consists of revolving tubular shell around powerful coils. In effect, operation is like that of pulley. (Drawing shows operation.) Drums are available in a wide variety of housings when desired. Ask for *Catalog 660.*

Spout Magnet—For installation in bottom of chutes. A step is provided in magnet face, which iron collects. *Catalog 301.*

FOR PURIFYING POWDERED MATERIALS

Type C. F.—Equipped with vibrating feeder and inclined plates to remove small magnetic particles from finely divided materials which tend to cake or bridge. Material passes over four successive highly intensified magnetic gaps to insure complete separation. Completely automatic. High capacity.

FOR PURIFYING LIQUIDS

The De-Ironer—For removing iron particles as small as micron size from liquids, including ceramic slips and glazes, oils, etc. A recent development in wet type separators available in gravity or pressure feed models. Consists of a cast bronze bowl containing a set of highly intensified chromium plated stainless steel grids —over 9300 lineal ft. of iron-catching edges on large model! Operation is completely automatic. Solenoid valve on gravity model keeps bowl full of liquid. Device available for stopping flow of material through separator in case of current failure.

Other Types—Types T and U Separators are designed for use with troughs. Details on request.

FREE MAGNETIC TEST OF YOUR PRODUCT

To find out the iron content of your product and how to reduce it to the desired point, send a 25 to 50 lb. sample to Dings. It will be tested on Dings Separators and authentic results and complete recommendations will be furnished.

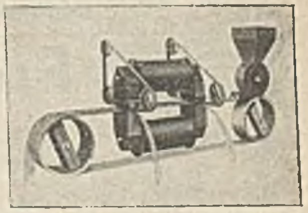
Send Sample Today!

Dings MAGNETIC SEPARATION HIGH INTENSITY

FOR PURIFYING WEAKLY MAGNETIC DRY MATERIALS

Type I. R.—A *Super High Intensity* induced roll separator being successfully used for purifying abrasives, salt, borax, nepheline syenite, feldspar, silica sand, barytes, bauxite, concentrating manganese, ilmenite, tungsten—many other difficult separations. Material passes by gravity over a series of generally three or more induced rolls where feebly magnetic particles are deflected. Can be built with as many successive rolls as necessary to effect desired separation. *Catalog 770.*

Cross Belt Type — Rowand Wetherill Separator)—A *Super High Intensity* machine which is more advantageous than a Type I. R. for separations involving finely divided materials which tend to adhere to the rolls on an I. R. The drawing shows how magnetic particles are "picked" off the main belt by magnets and discharged by smaller cross belts. These separators are built with as many as eight cross belts, producing eight different magnetic products and one non-magnetic. *Catalog 770.*



FOR LABORATORY WORK

Davis Magnetic Tube Tester — An ingenious device for determining the exact amount of magnetic iron present in ore. Operation is simple—analysis requires 10 to 15 minutes.

Laboratory I. R. and Cross Belt Separators. Small models of the large machines for laboratory test work.

ALNICO HORSESHOE MAGNET

Very powerful, 2½"x3" wide. Pole bases ¾"x¾".

DINGS MAGNETIC SEPARATOR CO., 505 E. Smith St., Milwaukee 7, Wis.

World's Largest Exclusive Builder of Magnetic Equipment. Est. 1899

The new Allis-Chalmers director is president of the Republic Flow Meters Co. and is also chairman of the board of the Illinois Institute of Technology.

Hampden W. Harding, secretary of H. C. Harding, Inc., of Philadelphia, was cited last September for participation in raids totaling more than 100 hours and received the Air Medal. First Lieut. Harding has been stationed in India for the past year.

G. O. Curme, Jr.

L. P. McAllister, who has been metallurgical engineer for Lukens Steel Co. since 1936, has been appointed assistant to the general superintendent with specific duties of quality control.

George O. Curme, Jr. has been announced the 1944 winner of the Willard Gibbs Medal. Dr. Curme is vice-president and director of research for the Carbide and Carbon Chemicals Corp. Formal presentation of the medal will be made in May.

Leon K. Grove has resigned his position as cost control and methods engineer at Southern Alkali Corp. to accept the position as assistant chief engineer of Great Southern Corp.

Donald Price has joined the research staff of Interchemical Corp. to coordinate their research projects in the pharmaceutical and fine chemicals fields. Dr. Price was formerly director of the Organic Research Laboratory of National Oil Products Co.

Frederick E. Herstein, formerly with Chemical Warfare Service at Edgewood Arsenal, has been engaged as development engineer and assistant to the chief engineer of the General Ceramics Co. He will work on the development of ceramic equipment for the chemical and allied industries with particular reference to postwar applications.

Charles E. MacQuigg, dean of engineering at Ohio State University, was given the James Turner Morehead Medal of the International Acetylene Association at a dinner in his honor Jan. 24. The medal is awarded annually by the Association in recognition of outstanding work in the acetylene industry or for advancements in the production or use of calcium carbide.

William I. Burt has been appointed general manager of the recently created chemical division of the B. F. Goodrich Co. and will be responsible for operation of all plants in the division. Other appointments include Dr. Frank A. Schoenfeld who directs technical matters, sales service and process development; and Dr. Victor E. Wellman, director of purchases.

Donald L. Collins has joined Pennsylvania Salt Manufacturing Co. where he will have charge of development of new and improved agricultural chemicals in furtherance of the company's recently announced agricultural chemicals division program.

William J. Colvin has been named plant manager of the Camden, N. J. operations of Monsanto Chemical Co. to succeed John J. Heck who has retired.

A. E. Steeves has been appointed chief chemist for Swift Canadian Co. with jurisdiction over the company's laboratories throughout the Dominion and headquarters in Toronto.

O. M. Urbain has been appointed to the staff of Battelle Memorial Institute and assigned to its division of analytical chemistry. Dr. Urbain graduated from Ohio State University in 1909 and received the degree of Doctor of Science from Ohio Northern University in 1928. From 1916 to 1943 he was the owner and director of the Urbain Laboratories, Columbus.

OBITUARIES

Guy C. Howard died last December 19. He had been associated with the Marathon Paper Mills Co. on special development work since 1927.

Robert C. Moran, supervising chemist of the research and development division of the Socony-Vacuum Oil Co., died January 10 at his home. Dr. Moran was a research chemist with the DuPont Co. before joining Socony-Vacuum in 1924.

E. J. Walsh, vice president and general manager of the Chattanooga Boiler & Tank Co., with which he had been connected since 1912, died January 10 in a Chattanooga hospital.

Lemuel M. Aycock died December 29 after being struck down by a hit and run driver.

Richard Jennings, a field engineer with Oliver United Filters, died Jan. 23 at Lawrence, Mass. Mr. Jennings, who joined the Oliver organization in 1927, had just completed some test work on filters in a paper mill when stricken with a cerebral hemorrhage.

Walter H. Hallsteen, vice-president and treasurer of the Ilg Electric Ventilating Co., Chicago, died Jan. 15. A graduate of Armour Institute, he joined the Ilg company in 1916.

Frank E. Manning, plant superintendent for the Linde Air Products Co., died last month at the age of 45.

INDUSTRIAL NOTES

The Corrosion Control Corp., Norwalk, Conn., changed its corporate name as of Jan. 1 to Cordo Chemical Corp.

W. S. Rockwell Co., New York, has purchased the business of the Gehnrich Corp. of Long Island City and will continue it as the Gehnrich oven division of the company.

Combustion Engineering Co., Inc., New York, has appointed Otto de Lorenzi director of education of the company. For some years Mr. de Lorenzi has served as assistant sales manager and in his new capacity will collaborate with engineering schools, technical associations and societies in the furtherance of technical education matters.

The Falk Cop., Milwaukee, has appointed Thomas F. Scannell general sales manager in charge of sales for all Falk products. John S. Wilkinson will act as assistant sales manager in charge of foundry sales.

Ross Heater & Mfg. Co., Buffalo, has opened a factory branch office in the New Center Bldg., Detroit. Frederick J. Lupke, Jr., who was assistant production manager at the Buffalo plant is in charge of the new branch.

Link-Belt Co., Chicago has elected E. L. Berry and Richard F. Bergmann vice-presidents of the company. Mr. Berry has been serving as vice-president and general manager of Link-Belt Ordnance Co Mr. Bergmann is the company's chief engineer. John E. Martin has been appointed manager of Link-Belt Ordnance Co. with headquarters at the plant.

B. F. Goodrich Co., Akron, has promoted Edward H. Fitch to the position of merchandise manager of the combined automotive, aviation and government sales divisions.

Kropp Forge Co., Chicago, has appointed Charles L. Foley engineering sales representative for New York and adjacent territory. Announcement is also made that W. R. Moore of West Hartford no longer represents the company as Connecticut has been taken out of the New England group and assigned to New York.

Kiely & Mueller, Inc., North Bergen, N. J., has given exclusive sales representation in Oklahoma to the F. L. Murdock Co. of Tulsa. The company will be represented in Texas and Louisiana by the Daniel Orifice Fitting Co. of Houston.

H. K. Porter Co., Inc., Pittsburgh, has opened a new office at 50 Church St., New York, which will serve as an eastern center for the company's sales and exports. Thomas Mac Lachlan has been named general manager. From the same office R. G. Newell will direct activities of the company's Quimby pump division in New England and New York.

Monsanto Chemical Co., Everett, Mass., has appointed Edward Hathaway purchasing agent for the Merrimac division and for the New England Alcohol division. He succeeds Everett E. Brainard who retired after 54 years service with the company.

The Edward Valve & Mfg. Co., Chicago, has promoted Ralph H. Heberling to the position of vice-president where he will continue to supervise manufacturing activities of the company.

Libbey-Owens-Ford Glass Co., Toledo, has expanded into the fields of plastic resins through the acquisition of Paramet Chemical Corp. The glass company formed a subsidiary, the Paramet Corp., which purchased the physical assets, patents and good will of the chemical corporation whose plant is in Long Island City.

Wyandotte Chemicals Corp., Wyandotte, Mich., announces that Fred A. Conkle is now manager of the distributor sales department. Mr. Conkle had been with the William Lynn Chemical Co., Inc., of Indianapolis since 1940, first as sales manager and later as general manager.

Diamond Alkali Co., Pittsburgh, announces that Raymond Diaz, formerly treasurer of Benner Chemical Co., Chicago, has joined the Diamond organization as supervisor of district offices for the Diamond Alkali Sales Corp.

Sharples Chemicals, Inc., Philadelphia, at the beginning of the year moved its executive offices to larger quarters at 123 South Broad St.

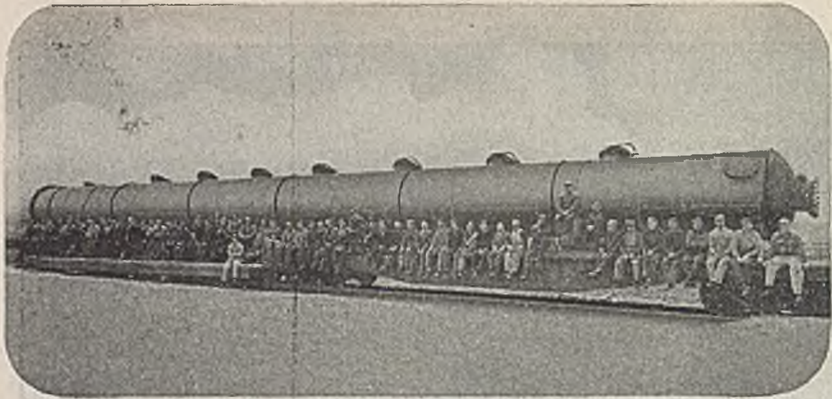
Pennsylvania Salt Co., Philadelphia, has established a new sales division to be known as the agricultural chemicals division. The company's research and development department is engaged in a study of important new agricultural chemicals.

Commercial Solvets Corp., Terre Haute, Ind., has organized an agricultural division of the sales department. The new division will be in charge of Hugh R. Stiles.

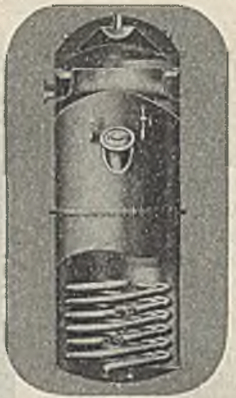
Devoe & Raynolds Co., New York, has appointed A. H. Mohrhusen general merchandising manager. This newly created post entails direction of a coalition of departments, including sales promotion, advertising, merchandising and sales research and training.

Freeport Sulphur Co., New York, has placed Phil A. Lawrence in charge of purchases for its subsidiaries, Nicaro Nickel Co. and Cuban-American Manganese Corp.

The Timken Roller Bearing Co., Canton, Ohio, has advanced A. M. Donze to the position of vice-president in charge of production. He is succeeded as factory manager by H. M. Richey.



ALL WELDED STEEL COLUMN
FOR SYNTHETIC RUBBER PRODUCTION



VACUUM PAN FOR
MILK & FOOD PRODUCTS

SELF-CONTAINED UNIT
FOR SOLVENT RECOVERY

ACME COPPERSMITHING & MACHINE CO.

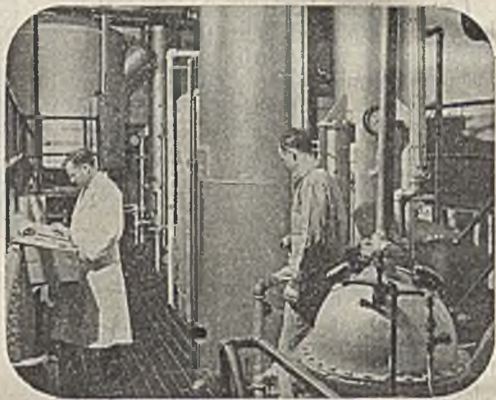
Versatility...

In the Process Industries, versatility demands the facilities, the experience, and above all the vision required to meet new problems successfully.

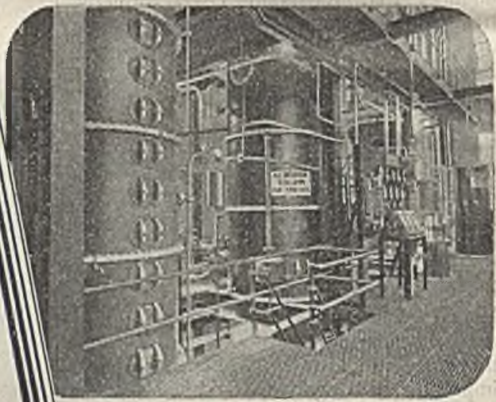
For many years, Acme has encouraged in its engineering department the ingenuity and the enthusiasm that lead to new engineering achievements.

It is because of this alert, creative attitude—coupled with expert craftsmanship—that Acme has been called upon so many times to assist in the development of a new process or in perfecting equipment for an old one.

From the simplest unit to a complete plant, from pilot plant to commercial operation, Acme's modern facilities insure the most efficient and economic operation.



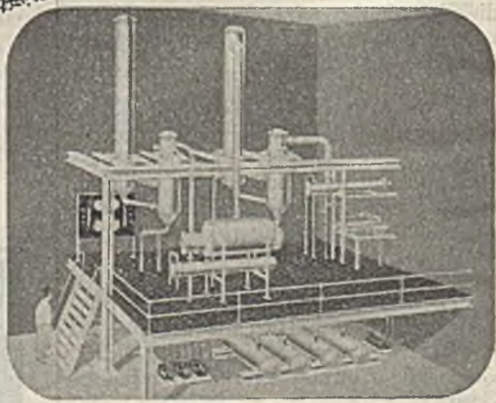
VITAMIN EXTRACTION PLANT



DISTILLATION PLANT FOR THE
PRODUCTION OF SUPERFINE ALCOHOL

ACME
Processing Equipment

ACME COPPERSMITHING & MACHINE CO., ORELAND, PA.



TYPICAL PILOT PLANT INSTALLATION

Heat Transfer • Evaporation • Drying • Distillation • Absorption • Extraction • Crystallization

FROM THE LOG OF EXPERIENCE

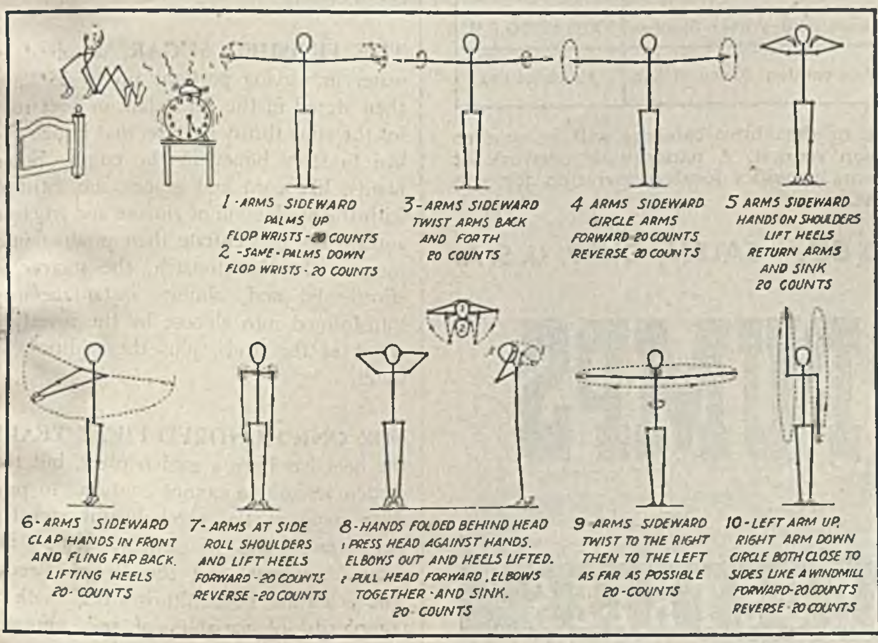
DAN GUTLEBEN, Engineer

THE FAMOUS AGRICULTURIST Theodore Hapke of the Pioneer Nebraska factory promoted a Beet Sugar House at Glendale, Arizona in 1905. Construction proceeded amid great enthusiasm, but not too much capital, or even investigation as to suitability of soil and climate. 5,000 acres of beets grew luxuriantly. Great was the prospect of profit. Then, like a thief in the night, came the pestiferous white fly out of the parching desert, attracted by the green beets. The flies multiplied in astronomical progression. The beet fields were dead; beaten by the white fly. However, amazingly, there stood in those ruined fields an occasional robust beet in defiance of the fly! With great care and kindliness these individuals were dug up and preserved over the winter.

Beets are biennial plants, producing sugar the first year and seed the next. The Glendale roots were now planted and yielded seed. The next year this seed produced beets which inherited in large part the disease-resistant qualities of the parents. Then the outstanding individuals from this crop were selected for future propagation. And so after many years of painstaking faithfulness and patience a beet was developed that laughs at white flies.

Thus evolved the famous Glendale seed farms jointly operated by Great Western, Holly, American Crystal and Amalgamated Sugar Companies and now supplying seed for a large part of the inter-mountain beet fields. Furthermore, by favor of the winterless climate, the former biennial beet which had to be carefully uprooted in the fall and replanted in the spring, now proceeds, after the sugar producing period, to grow into a seed producer without transplanting. The farms are a monument to a thoughtless mistake and would not have come into existence but for failure to investigate the beet producing ability of the locality. The factory failed and was dismantled but the value of the farms spread over the entire intermountain area.

SUGAR POSSESSES the peculiarity of growing best where least demanded. Tropical sunshine acts in the manner of a catalyzer to synthesize the sugar compound, but the phlegmatic tropical planter does not need the energy which the sun stores in the plant and so he ships it northward. A hundred million years ago heat energy accumulated in the tropical swamps in endless cycles of vegetation and subsequent consolidation into coal. A pound of coal has a calorific value of 14000 BTU., and a pound of sugar contains exactly half of this. In Pennsylvania the trucks deliver 6-ton loads of anthracite from the mines to tidewater and return with 6 tons of tropically grown sugar refined "in transit" at the tidewater refineries. Michigan or Colorado farmers can also raise sugar, but right where it is most craved the greatest effort is required to produce it.



Setting-up exercises applied by Lt. John G. Pershing in '95 to the freshmen at Nebraska, and since followed religiously by the chronicler every morning. Next month's issue will detail the remaining 8 exercises

NATURE HAS BUILT an amazingly ingenious sugar-making apparatus. The procedure of synthesizing from the three elements that compose sugar is known to some extent. The apparatus is a variety of plants widely distributed over the earth. It has roots for stabilization and for the extraction of plant food from the soil. Further, it is fitted with leaves where the manufacturing is accomplished, and a large structural stem which provides space for storage of the finished product and for the conveying mechanism between the various departments.

THE ROOTS EXTRACT nitrogen and mineral matter (potassium, phosphorus, calcium) from the soil for structural maintenance, and possibly for use as catalyzers.* These materials are transported through capillary tubes to the leaves by means of water drawn from the soil. The roots will go down after water even if they have to burrow seven feet to reach it. The water provides in part the raw material from which the sugar is made, and the surplus exudes from the leaves and evaporates so as to maintain continuous transportation upward from the soil. A cane plant requires 6 barrels of water for every pound of sugar it produces. An average beet root, operating in cooler and less humid surroundings, gets along on a third of a barrel of water for the season.

IN THE TROPICS the plant is designed to operate in the warmth above the ground. The only protection provided, besides sturdiness to resist wind, is a wax that oozes out to insulate the stem against evaporation of water in which the sugar is stored. The sugar is kept in dissolved state for convenience of transport and assimilation. In the Tropics, furthermore, this plant (tall rank sugar cane) grows with little assistance from the planters and thus conforms to the lethargic habits and predilections of tropical natives. After the harvest, a fresh crop sprouts out from the old roots, and this process repeats for as many as 10 crops. Notwithstanding Nature's lavishness, she responds prodigiously to the planter's co-operation. One hundred years ago, cane which the natives accepted as free manna from heaven delivered 5 tons per acre with 7% of sugar. Now the highly skilled Florida planters harvest 40 to 60 tons per acre at 17% of sugar while the Hawaiian planters harvest even more. The recent

* This word, according to Researcher Dietz, covers much ignorance of chemical process.

record on a Hawaiian plantation was 130 tons of cane per acre in 22 months of growth, equivalent to 17.97 tons of sugar.

BECAUSE OF THE RESTRICTIONS of wars, blockades and tariffs, nature's favored sugar bowl is not freely accessable to the north. For these regions, good old Nature, assisted by governmental decree, developed a prolific plant in the sugar beet. This plant is built mostly underground and is fitted with a crown from which leaves protrude like elephant ears to absorb the rays of sun. The big tap roots are thus protected against early frosts and excessive water evaporation. They send out fibrous roots in all directions to collect food and water from the soil. They likewise respond generously to the planters' cooperation.

THE MYSTERY OF THE PROCESS by which the plant combines carbon, hydrogen and oxygen into sugar ($C_{12}H_{22}O_{11}$) has been intriguing chemists for generations. The leaves contain green chlorophyll which is suspected of providing the screen for appropriating certain actinic rays of the sun. The water brings up minerals from the soil which are available as catalyzers while the sun furnishes heat to promote the reactions. With this equipment the leaves then proceed in four stages, to wit:

1. Carbon is extracted from the carbon dioxide of the air and is compounded with water to form water gas, a mixture of carbon monoxide and hydrogen. This is the same product that is produced at the city gas works when incandescent coke is sprayed with water.
2. The water gas converts into formaldehyde.
3. This is immediately transformed (polymerized) into glucose and fructose (also called dextrose and levulose).
4. One molecule of glucose plus one molecule of fructose are then condensed by the extraction of one molecule of water to form sucrose.

THE FINISHED SUGAR, dissolved in water in varying portions up to 25%, is then stored in the cane stalk or beet root for the same thrifty purpose that impels the bee to store honey in the comb. Some plants, like corn and grapes, are satisfied with the production of glucose and fructose and do not concentrate their product into sucrose. In the stomach, the sucrose is effortlessly and almost instantaneously transformed into glucose by the inverting effect of the acids, plus the addition of water.

FOR ONE HUNDRED FIFTY YEARS the beet has been a garden plant, but the garden technique cannot continue to produce sugar at the psychological nickel-a-pound rate while the gardener clamors for more abundancy and the 40-hour week. The scientific beet-culturists deal with a complexity of variables of soil, climate, moisture, seed qualities, parasites, soil infestation, weeds and farmer superstition. The beet seed is a shapeless miniature of a cabbage head. Each seed contains a number of germs. One hundred years of effort has failed to produce a machine that can plant these irregular seeds in squares as is done with corn to permit cross cultivation for weed control. The engineers have found it impossible to make a machine to fit the seed and so the farmers have hit upon the idea of fitting the seed to the machine. They have devised a mill to split the seeds to make them single germ and of uniform size. Under a 1943 developbent these rough seeds are enveloped in uniformly sized pellets composed of a mixture of water soluble inert and beneficial materials that protect the seed and make it round to resemble a pea. Heretofore the seeds were dropped in a continuous row and subsequently, with uncomfortable stoop labor, the surplus plants were uprooted. Now the labor cost of planting beets promises to be suddenly cut by 50%. Furthermore, harvesting machinery is now developing that will remove the bugbear of hand labor.

The tops of the beets under the restricted area where the leaves are attached, serving in the manner of a filter, collect certain impurities which hamper sugar extraction in the factory. These tops are cut off by means of a machete under benefit of the harvester's judgment. It has not been possible to endow a machine with discernment to cut at the correct line. If the machine cuts off too much, there is a loss of sugar. If too little is cut off, impurities enter the process to challenge the ingenuity of the chemists. At any rate, as costs of labor and materials have risen, the technologists have made process improvements to counteract these costs and thus maintain a constant sales price.

SUGAR HOUSE CHEMISTS collaborate with the farmers and cooperate with Nature in the improvement of sugar production. However, chemist Prudhomme, the Frenchman, proposed to usurp Nature's prerogative and offer competition. In order to establish priority he took out letters patent (U. S. No. 2 121 981). In 1934 our Doc, by invitation, visited his laboratory in France. Prudhomme made great mystery about his process. In order to create impressiveness he sent his assistants out of the laboratory and conducted his conversations with Doc in a whisper! He gave Doc some crystals which he claimed were produced in his pilot plant. Prudhomme and his fantastic activity were dramatized by novelist E. C. Large in "Sugar From The Air." For realistic effect, the novelist piped CO_2 from a neighborhood power plant chimney, but he did not have the daring to carry his process to the table variety of crystals. In the competition between planters and chemists, the planters have the advantage of superiority in numbers and of being first in the field.

PREPARATION OF STARCH ACETATE

POTATO starch has been acetylated by two methods. By Method A, the starch was esterified in a mixture of acetic acid, acetic anhydride, and a suitable catalyst. By Method B, starch was swelled by formic acid and then catalytically esterified with acetic anhydride. Perchloric and sulphuric acids were found to be superior among a number of catalysts evaluated. Acetylation of starch pre-swelled with formic acid requires approximately one hour at 95 deg. C., in comparison with 9 hours for unmodified starch.

Starch acetates having a wide range of viscosity and with different solubility characteristics were made by diversified conditions of preparation to obtain products of varying degrees of degradation. Owing to the short reaction time, acetyl starch prepared by Method B is only slightly degraded. As a result, this method gives esters having the higher viscosity solutions.

By method A, air-dry starch gives an acetate of higher viscosity than oven-dried starch of nearly zero moisture content. Oven-dried starch is preferable for Method B. In dilute solutions of organic solvents, starch acetates prepared by Method B have viscosities of the same order as high-viscosity commercial cellulose acetate.

Starch acetates produced by these two methods, although they give brittle films in the unsupported state, appear promising when applied as lacquers to wood, paper, and other fibrous materials and used as water-resistant adhesives, cements and binders.

Lee T. Smith and R. H. Treadway, Eastern Regional Research Laboratory, U. S. Department of Agriculture, Philadelphia, Pa., before the American Chemical Society, Pittsburgh, Pa., Sept. 6-10, 1943.

INCREASED CAPACITY

STEPPING up the capacity of existing plants, rather than expanding them, is the big job ahead for war industry both in the United States and Great Britain.

Both British and Americans agree that development of modified processes to increase the capacity of existing plants is more important now than construction of new plants based on new processes.

In major instances (in weapons of war and in production information concerning such things as ordnance, ship building and airplanes), exchange of information is being carried out quite satisfactorily; but in the field of production technique there is still room for considerable improvement. This is due in part to the fact that there is not yet a clear conception of the nature and limits of the field implied by the phrase "production techniques."

Another factor involved is the lack of a single agency in either country charged with that definite responsibility. Both British and American officials who conferred on the subject came to the conclusion that the most effective means of exchanging such information would be through conferences of industrial experts from each country.

Britons representing the chemical industries were agreed that the primary need for technical production in the chemical world is to have the know-how of every major development in that field. Such cooperation between the two countries may not only help to win wars, but much more important, may help to prevent them.

Donald B. Keyes, Chief, Chemical Industries Branch, Office of Production and Development, before an Alpha Chi Sigma fraternity dinner, New York, N. Y., Dec. 9, 1943.

BENEFICIATION OF ARKANSAS BAUXITE

ON A commercial scale, very little has been done in beneficiation other than washing. It is understood that considerable tonnages of South American bauxites have been treated in washing plants at the mines. In the United States some producers have tried washing and screening, but the products obtained from such operations have not been able to compete with high grade bauxite.

The silica in most Arkansas bauxite occurs as a constituent of kaolinite. In the majority of samples tested, the silica content can be materially reduced by flotation of the hydrous aluminum oxide, leaving the kaolinite in the tailing. The iron and titanium minerals, if not previously removed, are concentrated by flotation with the hydrous aluminum oxide. The general procedure that has been found to give the most satisfactory results in beneficiating bauxite consists of gravity or magnetic concentration for removal of the irons (ferric and ferrous) and titanium minerals, followed by flotation for the recovery of the hydrous aluminum oxide and rejection of the silica and other impurities. In some cases, it has been found desirable to use both gravity and magnetic concentration to remove the iron minerals because gravity concentration is not effective in removing very fine mineral particles.

The first prerequisite of satisfactory separation between the hydrous aluminum oxide and kaolinite in flotation is a dispersed pulp to avoid floccules of finely divided bauxite and clay. This may be accomplished on most bauxite by maintaining an alkaline pulp, but some may require additional dispersants. Sodium hydroxide is the preferred dispersant. Others, such as sodium carbonate and sodium sulphide, may be used, but are not as efficient in promoting flotation of the hydrous aluminum oxide. The list of dispersants that may be used is long, and the choice is optional.

The best results in the flotation of the hydrous aluminum oxide were obtainable in an alkaline pulp with a pH ranging from 8.7 to 10.0 during the first conditioning period and of approximately 8.6 in the final cleaning operation. Present tests indicate that a higher pH, or a more alkaline pulp, is required for separating the hydrous aluminum oxide from kaolinite as the proportion of kaolinite in the bauxite material increases.

A two-stage conditioning period has been found to be most advantageous. The first stage is with the alkali and dispersant, if one is needed, and the other is with the collectors and frothers. Ample time should be given for all reactions to be completed in both stages. The optimum time for each ore must be determined by trial.

A pulp consistency of 10 to 15 percent solids gives the most satisfactory results because there is a higher percentage of solids in a pulp of this viscosity owing to the large amount of clay in most low grade bauxite. A higher percentage of solids may be used, but it tends to lower the grade of the concentrate by the mechanical entrapment of a part of the dispersed clay in the pulp.

The most efficient collectors for the hydrous aluminum oxide are oleic acid and the fish-liver-oil fatty acid, Arisca Oil Products Co., type C. The fatty resinous byproducts of the paper mill waste liquor, such as Gulf States Paper Corp. Tallol and West Virginia Pulp & Paper Co. Ligro and Indusoil are fairly effective as collectors of the hydrous aluminum oxide, but they are more pronounced frothers. When used in conjunction with oleic acid or fish-liver-oil fatty acid, type C, or in combinations of all three, they add materially to the quality of the froth and assist in the flotation of the hydrous aluminum oxide mineral.

Sodium hypochlorite has been found to be an effective activator of the hydrous aluminum oxide in some bauxites, but in others it has a depressing effect.

Hard water is detrimental to the flotation of the hydrous aluminum oxide, probably because of the precipitation of the collectors as insoluble soap.

In general, the consumption of reagents increases and the proportion of kaolinite to hydrous aluminum oxide increases.

Samples selected for beneficiation were representative of fairly extensive deposits of high-silica bauxite.

Products containing less than 8 percent silica were produced from all samples by ore-dressing methods, and the tailing products would be suitable for treatment by the soda-lime sinter process of alumina extraction. Results have been confirmed by duplicate tests on numerous samples of similar high-silica bauxite.

The commercial flow sheet for beneficiation of high-silica bauxite would necessarily have to be very flexible to accommodate the rapid change of the grade and character of the material, especially in the removal of the iron and titanium minerals.

Separation of the hydrous aluminum oxide from kaolinite by flotation can be accomplished on most bauxite materials, except when a large quantity of hydrous aluminum oxide occurs in the amorphous state and is intimately associated with kaolinite.

The reagent combinations used were considerably different for the four samples; however, other tests not reported indicated that any combination of the two collectors, oleic acid and fish-liver-oil, gave equally good results. The use of the frothers, Indusoil and American Cyanamid reagent 708 was a matter of choice. Sodium hexametaphosphate and sodium hypochlorite as used in the additional tests were found to be optional, and their omission had little effect on the final result.

S. M. Runke, associate metallurgist, and R. G. O'Meara, senior metallurgist, Bureau of Mines, Central Region, Rolla, Mo., before American Institute of Mining and Metallurgical Engineers, New York, Feb. 24, 1944.

CAT CRACKING

During the past five years the fluid catalytic cracking process has received intensive study. An accelerated program of installation has been instituted because of the necessity of providing sufficient aviation-base stock. The catalyst used, of the so-called fluid type, is a powder intimately mixed with vapors in the reaction chambers. In general, the catalyst is of the synthetic silica-alumina type, which has definite superiority as to yield and octane rating of the base stock over that of the natural clay type. The silica and the alumina are prepared in a hydrated form by precipitation or gel formation. They may be precipitated together or separately and then blended.

The most obvious method of contacting oil with catalyst is to pass oil vapors through a fixed bed of catalyst. The variables in such an operation are: (1) temperature; (2) pressure; (3) the quantity of oil charged per unit of time per unit of catalyst (space velocity); and (4) the length of time the oil is passed through the bed before regeneration (process period).

In the fluid catalytic cracking process the conversion of oil into other products is dependent upon these same variables. The definition of weight-hourly-space velocity is, just as previously, the weight of oil charged per hour per weight of catalyst in the reaction zone. The weight of catalyst in the reaction zone remains constant, although there is a continuous flow of regenerated catalyst entering the reactor and spent catalyst leaving it.

In the fluid process it is convenient to use the concept of catalyst-oil ratio, which is defined as the ratio of the weight of catalyst entering the reactor per hour to the weight of oil charged per hour. From the units of the three quantities—weight-hourly-space velocity, residence time of the catalyst and catalyst-oil ratio—it is found that their product is equal to unity. From this fact it follows that, at constant weight-hourly-space velocity, an increased catalyst-oil ratio corresponds to a shorter residence time of the catalyst and, hence, results in an increased conversion. An increase in conversion, therefore, can be obtained by: (1) a higher temperature; (2) a higher pressure; (3) a lower space velocity; and (4) a higher catalyst-oil ratio.

In once-through fluid catalytic cracking, it has been found that the most important factors affecting product distribution are the type of the catalyst, the conversion level, the temperature, and the quality of the charging stock. The production of dry gas (C_3 and lighter) increases continuously at an accelerating rate with increased conversion. The yields of C_4 and C_5 fractions increase in a more nearly linear manner. The yield of gasoline also passes through a maximum and in the region of decreasing yield, overcracking is said to be taking place. If conversion is held constant, an increase in temperature results in an increase in the production of dry gas and a decrease in the yield of C_5, the yield of gasoline and the production of carbon.

Product quality in catalytic cracking can be considered an extension of product distribution, because it depends upon the relative yields of the different types of hydrocarbons in a given boiling range, i.e., the proportions of paraffinic, olefinic, naphthenic and aromatic hydrocarbons in each fraction. In general, the same factors affect product quality that influence product distribution.

It is well known that in thermal cracking a higher yield of gasoline can be obtained in a recycle operation than in a once-through operation. This same effect holds in catalytic cracking, and the yield of gasoline can be increased by a recycle operation. Furthermore, it is usually possible to realize the increased yield of gasoline with a more favorable gasoline-to-carbon ratio. In commercial practice, however, it is generally true that, although higher yields can be realized by a recycle operation, higher production from a given plant is possible in a once-through process. In most cases the improvement in yield obtained by recycle operation is accompanied by an improvement in the anti-knock quality of the aviation-base stock.

The single stage and the two stage units are characterized by considerable operating flexibility. At this time the many large commercial installations are the proving and developing grounds for the economic feasibility of the process.

C. L. Thomas, N. K. Anderson, H. A. Becker and J. McAfee, Universal Oil Products Co., Chicago, Ill. before twenty-fourth annual meeting of the American Petroleum Institute, Chicago, Ill., Nov. 10, 1943.

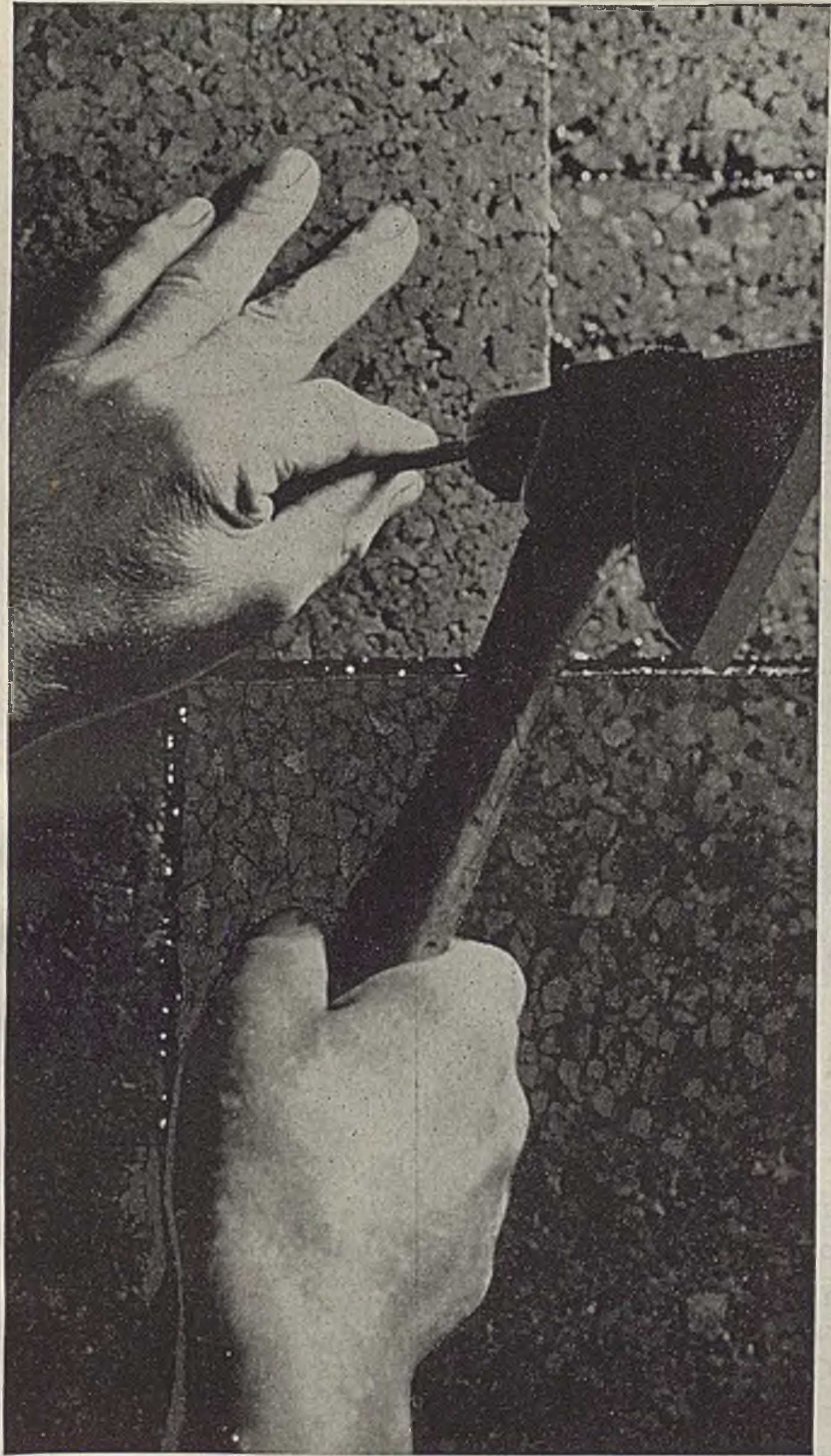
PLATING STEEL WIRE WITH NICKEL

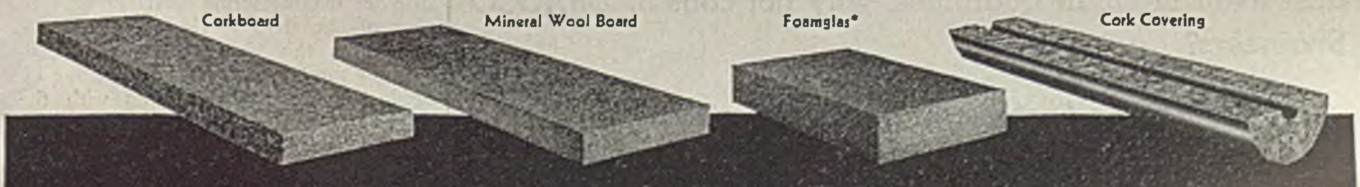
Due to the scarcity of nickel, a nickel-plated steel wire is used today in place of solid nickel wire for tungsten filament supports in incandescent lamps. Before the war, America consumed as much as 50,000 lb. of virgin nickel metal per month for these short leads and supports made of solid nickel.

The filament support and lead is composed of three sections: the support section inside the bulb, the sealing-in section (copper clad nickel-steel wire) passing through the glass wall, and the outer (usually copper) section which makes soldered contact with the brass base.

That part of the lead wire inside the bulb, formerly made of pure nickel, is now made of nickel-plated iron wire. The section next to the brass base is now frequently made of copper-plated iron wire. The upper end of the nickel-plated wire is flattened, and then bent almost flat on itself to make a hook to hold the tungsten filament. After the end of the filament is placed in this hook, the hook is flattened and closed to hold the tungsten filament tightly in place. The nickel coating of this support wire must possess excellent adhesion and good resistance to any volatilization of the steel core of the support. If the nickel coating does not have good adhesion and ductility, the basis metal will be exposed in the formation of the hook which holds the tungsten filament.

In present industrial installations, steel wire passes through a concentrated Watts' nickel plating bath at the rate of 12 ft. per min., a current density of 200-600 amp. per sq. ft., a bath pH of 2.0 and a bath temperature of 60 deg. C. A very adherent




Corkboard
Mineral Wool Board
Foamglas*
Cork Covering

nickel deposit (0.005 mm.) is obtained that may be safely subjected to sharp bends and which satisfactorily protects the steel basis during the life of the lamp.

After nickel plating, the wire is passed through a cold water rinse, and then a hot water rinse to dry the wire. It then passes around the tension drums and onto the spooling table where it is wrapped on 5.5-in. diameter spools. The speed of the spooling table and camshaft are synchronized with the tension unit to keep the whole coiling unit and tension unit in perfect balance. The line has an average daily output of over 1,000,000 ft. of precision-plated wire.

J. H. Conolly and Richard Rimbach, Hanover Wire Cloth Co., Hanover, Pa., before the Electrochemical Society, New York, N. Y., October 15, 1943.

PERFORMANCE OF AGITATED GAS-LIQUID CONTACTORS

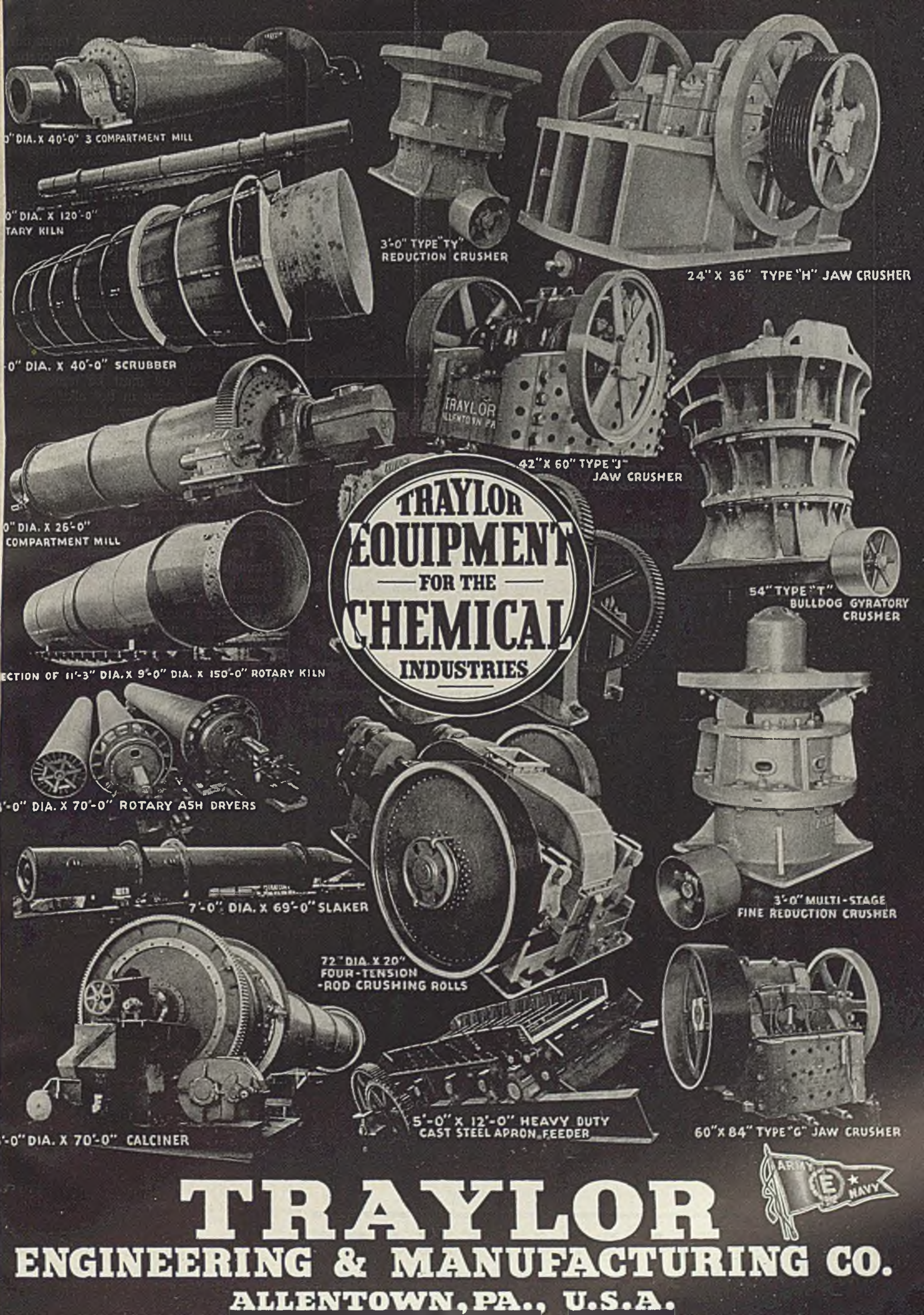
For absorption applications to which conventional columns are not well suited, such as gas-liquid reactions involving more than two phases, agitated gas-liquid reactors are useful. A method of studying the design variables pertinent to such apparatus has been developed, wherein the rate of oxidation of aqueous sodium sulphite by air and the power consumption of the agitator are measured. The sulphite-oxygen reaction is of zero order with respect to the sulphite ion.

Volumetric absorption coefficients vary with (agitation power)$^{0.95}$ at constant gas rate and with (gas superficial velocity)$^{0.67}$ at constant agitation power, giving rise to a new function, absorption number, defined as $K_v/V_s^{0.67}$, where K_v is the absorption coefficient and V_s is the average gas velocity based on the cross-section of the reactor. When plotted against agitation power input per unit volume of liquid, this function is shown to correlate data for a vaned-disk impeller design covering a threefold variation of scale size (6 in. to 18 in. vessels) and for a flat paddle design covering a tenfold variation (9.5 in. to 8 ft. vessels). Power magnitudes reported ranged from 10 to 3,000 ft.lb. per (min.)(cu.ft.) and gas rates lay between 30 and 360 ft. per hr.

C. M. Cooper, G. A. Fernstrom, and S. A. Miller, E. I. du Pont de Nemours & Co., Wilmington, Del., before the Tenth Annual Engineering Symposium, American Chemical Society, Philadelphia, Pa., Dec. 29, 1943.

ELECTROGALVANIZING OF STRIP STEEL

The first plant in the United States for the electrogalvanizing of strip steel in continuous lengths began successful operation some time before 1910, producing strip for manufacturing barrel hoops. In view of the state of the art of electrodeposition, the advantages of electrogalvanizing must have seemed compelling indeed, to overweigh difficulties with the crude, inefficient, uncertain generators, customarily operated without the aid of meters (which were still comparatively novel), and the general ignorance of the chemistry of electrolytes. Hot dip coatings, however, cracked and spalled when the steel was flared and applied to the barrels, and were costly because they carried more zinc than was needed. The consistently good workability, the greater



0" DIA. X 40'-0" 3 COMPARTMENT MILL
0" DIA. X 120'-0"
TARY KILN
3'-0" TYPE "TY"
REDUCTION CRUSHER
24" X 36" TYPE "H" JAW CRUSHER
-0" DIA. X 40'-0" SCRUBBER
TRAYLOR
ALLENTOWN PA
42" X 60" TYPE "J"
JAW CRUSHER
0" DIA. X 26'-0"
COMPARTMENT MILL
TRAYLOR
EQUIPMENT
FOR THE
CHEMICAL
INDUSTRIES
54" TYPE "T"
BULLDOG GYRATORY
CRUSHER
ECTION OF 11'-3" DIA. X 9'-0" DIA. X 150'-0" ROTARY KILN
'-0" DIA. X 70'-0" ROTARY ASH DRYERS
7'-0" DIA. X 69'-0" SLAKER
3'-0" MULTI-STAGE
FINE REDUCTION CRUSHER
72" DIA. X 20"
FOUR-TENSION
-ROD CRUSHING ROLLS
5'-0" X 12'-0" HEAVY DUTY
CAST STEEL APRON FEEDER
60" X 84" TYPE "G" JAW CRUSHER
'-0" DIA. X 70'-0" CALCINER
ARMY E NAVY
TRAYLOR
ENGINEERING & MANUFACTURING CO.
ALLENTOWN, PA., U.S.A.

range in coating thickness and uniformity, and the ease of control of electrocoatings tended then as today to displace the comparatively simple hot dip technique, now almost a century old.

Much cold rolled steel is annealed by passing it through a bath of molten lead at about 1,000 deg. F. which burns off the rolling oils fairly completely. Occasionally traces of fire-resistant deposits have been noticed. To avoid the adherence of lead to the strip, the bath is kept free from foreign metals and oxides and is covered with coke breeze, expanded mica, or silica powder. The hot steel accumulates a light scale which is removed by pickling it briefly in sulphuric acid or hydrochloric acid. Furnace annealing in reducing atmospheres does not remove rolling oils, and may produce residues difficult to clean. Annealing is usually carried out in the galvanizing line. If annealing is not practiced, oil must be removed by electrolytic cleaning in hot alkaline solution. An acid dip may then be required. The last step before plating is invariably a rinsing and scrubbing operation.

Acid baths (generally proprietary) are employed, because higher current densities may be used which, together with higher cathode efficiencies, afford much faster plating, while the cost of maintenance is very much lower than with cyanide baths.

The strip may be carried horizontally through the bath, with anodes below (and sometimes above) the strip; or it may pass through several vertical U-shaped loops, with vertical anodes. The horizontal plan has been usually preferred, although it requires greater space; for it affords easier threading and servicing, and simpler control of solution flow, temperature, and composition, while reducing the bending of the strip and the drag on it.

Usually only one side of the strip is plated at a time, and the strip, if narrow, is twisted 180 deg. in the center of the tank so as to coat the other side. Anodes used over the strip interfere with accessibility and ease of threading and, unless they are pure and the bath is filtered, may drop particles which produce pits in the coating; but upper anodes have been used successfully with certain baths. In some installations, the strip after being plated on one side is inverted to travel in the opposite direction through a second plating tank above the first, to coat the second side.

The pH is held, within 0.3 unit, at a point between 2.0 and 4.5. The operation and maintenance of the baths differ little from standard practice. Like round wire, sheet steel is also being galvanized with insoluble anodes and a strong acid electrolyte. The solution is circulated through suitable cooling and settling tanks; continuous filtering is customary.

When worn thin, anodes are piled on each other and completely consumed, or else are recast into full size anodes. Zinc is not wasted in dross, as in hot galvanizing. The bath drag-out may be kept to a very small figure by wipes and wringer rolls. The current density usually averages 110 to 150 amp. per sq.ft. of surface exposed to the anodes, and considerably higher current densities are used with suitable electrolytes and proper circulation.

Contact to the strip is made by copper

rollers or bars, carefully shielded from the anodes. The weight of the strip sliding over a contact bar is not sufficient to secure good contact; some form of hold-down roll or other positive contact device is necessary.

Because of wide variations in the sizes of tanks and strips and the weights of coating applied, it is not possible to give typical speeds or currents. Some machines applying "2 test" coatings run at 40 to 80 ft. per min. and produce about 35 tons of "BX" strip in 24 hr. Speeds as high as 150 ft. per min, have been reached on lighter coatings, and much higher speeds are quite feasible. It is customary to provide ½ to 1 gal. of electrolyte for each ampere of plating current to minimize composition changes and facilitate cooling.

After electrogalvanizing, the strip is carefully rinsed, dried, and coiled for shipment. In some instances, a very slow scratch-brushing lends more luster to the coating. Strip to be lacquered, enameled, or painted, as for Venetian blind slats is bonderized in the galvanizing line immediately after plating; without some such treatment, adhesion of organic coatings is often poor.

The electrogalvanizing-bonderizing-lacquering of steel offers a corrosion-resisting coating which has possibilities, which have often been overlooked. It may well substitute for much more expensive and more critical materials in severely corrosive exposures as in tropic, strong industrial, or chemical atmospheres. The three coatings appear to reinforce each other admirably.

Ernest H. Lyons, Jr., the Meaker Co., Chicago, Ill., before the 84th general meeting of the Electrochemical Society, New York, N. Y., Oct. 13-16, 1943.

CHLOROPHOSPHATE PROCESS FOR DICALCIUM PHOSPHATE

Aqueous or gaseous hydrochloric acid may be used on phosphate rock in conjunction with phosphoric acid and/or sulphuric acid for the production of calcium chloride-free monocalcium chlorophosphate. By ammoniation, the latter may be converted into a mixture of dicalcium orthophosphate and ammonium chloride. Or, by a simple thermal treatment in the presence of water vapor, the hydrochloric acid may be recovered and the residue converted to dicalcium phosphate.

Use of hydrochloric acid on phosphate rock without the addition of phosphoric acid yields an excess of calcium chloride which interferes with the conversion of the monocalcium chlorophosphate to dicalcium phosphate.

Thermal decomposition of the calcium chloride-free monocalcium chlorosphosphate without the addition of water vapor proceeds in two steps, yielding as the final solid product unavailable calcium pyrophosphate. The production of dicalcium phosphate by the chlorophosphate process would permit substantial economies in reagent material over methods currently employed in the production of available phosphates.

E. J. Fox and K. G. Clark, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, Beltsville, Md., before the American Chemical Society, Pittsburgh, Pa., Sept. 6-10, 1943.

Free Enterprise

. . . INCENTIVES AND TAXATION

There are three principal ways of making a living:

1. Getting on someone's payroll
2. Lending one's savings to business enterprises
3. Starting, or helping to start, a business enterprise

About three out of four of us fall in the first group—we are *job-holders.* Millions of us get some income, large or small, by lending our savings—directly or through such channels as insurance companies. We are suppliers of *loan-capital.* About one out of four of us has his own business enterprise, and several millions of us are part owners of business enterprises. Those of us who go into business for ourselves and those of us who are part owners of enterprises are *job-givers.*

The amount of employment in a community depends, in the main, on the number of persons who attempt to make their living, or part of their living, by giving jobs to others, rather than by getting on someone's payroll. A community seriously desiring a high level of employment and a high standard of living will strive to make job-giving attractive and to encourage a large part of its population to be job-givers rather than merely job-holders.

The number of men who attempt to make their living in whole or in part by starting new businesses or by expanding old ones depends upon the outlook for profits. When the outlook for profits improves, thousands of new jobs open up and thousands of men go to work; and, as men go to work, the farmer and everybody else benefits. When the prospect for profits becomes darker, the demand for labor, capital, and raw materials drops. It may be roughly estimated that an improvement in the prospect for profits of one billion dollars raises the demand for labor by anywhere from two billion dollars to five billion dollars.

One of the principal determinants of the outlook for profits is the amount and the nature of taxes. After the war, the Federal government will need to raise each year about twenty billion dollars in taxes—three times the amount required before the war, and six times the amount required in the Twenties. In the Twenties, the tax needs of the Federal government were roughly twice as large as corporate profits in a good year. After the war, Federal revenue needs will be roughly three times corporate profits in a good year. Obviously, it will be much more difficult, after the war, for the government to meet its needs *without discouraging enterprise,* and therefore without diminishing the number of jobs, than it was before the war. Far more than ever before, it will be necessary for the government in developing a tax program to take account of the effect of taxes upon employment and the standard of living. This means that it will be important for each and every citizen to give attention to these matters—because the policies of the government reflect, in the main, the thinking of the citizens.

Some taxes seriously discourage individuals and business firms from undertaking new and enlarged operations. Other taxes have little or no adverse effect on investments. Some taxes are a burden on consumption, affecting the sales of specific commodities, depending on the nature of the taxes. It is obvious that different kinds of taxes have different economic influences. *We must understand the forces that determine the level of employment and consider the tax program in relation to other measures designed to create more jobs.*

What are the tests of a good tax system?

1. Taxes should be designed to encourage production and enterprise and to make it attractive for a large number of people to earn all or part of their living by giving jobs to others.

2. Taxation must be fair in principle and administration, with no discrimination between persons in similar circumstances.

3. Taxes should be apparent and not concealed, and should be levied, in the main, directly upon individuals so that each of us will know how much our government is costing him. A moderate income tax at the lower income levels will bring a greater awareness of responsibility than will heavy taxes on consumption which the taxpayer does not see because they are hidden in the prices he pays.

4. In the aggregate, taxes should be somewhat progressive.

5. The tax system should be coordinated with the broader objectives of monetary and fiscal policy.

6. **Federal, state, and local tax policies should be integrated as to principles and objectives.**

Judged by these standards, our present tax system is extremely unsatisfactory; in fact, it is actually damaging. It is a conglomeration of hidden and direct taxes and of conflicting taxing jurisdictions and policies, with no comprehensive economic motive. It is distorted to appease pressure groups and includes uneconomic punitive measures. It is full of needless complexities. It is a paradise for tax lawyers and a source of confusion and despair for the honest, enterprising business man. In fact, it would seem almost as if our tax laws had been written by some fifth columnist for the purpose of making private enterprise unworkable. We in America pretend to believe in the pioneer spirit, but no one would ever suspect it by looking at our tax system.

When the war is over, there must be a thorough reform of our entire tax system. Federal taxes can and should be reduced substantially; and, in the process of reduction, changes can more readily be introduced. At that time, steps can be taken to achieve some degree of coordination and unity of purpose among federal, state, and local taxing agencies. Taxes play too important a role in our total economic life to ignore the adverse consequences of unrelated and inconsistent policies of different taxing jurisdictions.

The following reform measures are needed in federal taxation:

1. **Repeal of the excess profits tax at the earliest possible date after inflationary dangers subside. In the case of most enterprises, the excess profits tax destroys all incentive to do a larger volume of business than in 1939; it appropriates virtually all increase in profits above the level of 1939.**

2. **Coordinate corporation and individual income taxes so as to avoid double taxation and impediments to risk-taking. Preferably, corporation income taxes should be wholly eliminated. Otherwise, the corporation tax rates should be reduced to the lowest effective rate on personal incomes. Full credit should be given to stockholders for all corporate income taxes paid.**

3. **Encourage competition and particularly the formation of new enterprises by allowing new corporations generous tax exemptions for a period of five years. Extend the same principle to unincorporated concerns.**

4. **Encourage risk-taking (and hence job-**

giving) through extending the loss carry-over to six years or more.

5. Provide for averaging incomes over a period of years in order to remove discrimination against those with irregular incomes and those who take risks of loss in business ventures.

6. Rely upon the personal income tax as the main source of revenue, with broad coverage. The reduction in total taxes after the war should favor the elimination of excise taxes before reducing income taxes.

7. Reduce the upper range of personal income tax rates to a maximum of perhaps fifty to sixty per cent so that risk-taking investments will be really attractive. Higher rates are punitive in character, yield small receipts, and throttle risk-taking.

8. Encourage risk-taking by individuals in the higher brackets by making the surtax on incomes of $20,000 a year or more half as much on income in the form of dividends as on income in the form of salaries or interest.

9. Encourage risk-taking by individuals by permitting capital losses to be charged against general income provided the reduction of tax liability in any one year is not more than fifty per cent.

10. Repeal the tax-exempt privilege for all *new* securities issued by all governmental jurisdictions.

11. Eliminate excise taxes which place a disproportionate burden on persons with lower incomes so as to encourage greater consumption and provide an expanded market for our vast industrial capacity.

12. Reform tax administration to simplify forms and procedures, to broaden the scope of enforcement, and to encourage the spirit of fairness.

With such reforms and continuing reappraisal of the tax program as it affects the economic situation, we can look toward taxation as an instrument of constructive influence in giving the fullest encouragement to free enterprise and in attaining continued prosperity.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

MOTOR FUEL ALCOHOL

Since 1931 the Brazilian government has been encouraging the use of alcohol as a motor fuel in place of gasoline so imports of the latter have been steadily decreasing. The Institute of Sugar and Alcohol was established in order to study the manufacture of power alcohol from sugar. All anhydrous alcohols produced in the country and all alcoholic beverages intended for use in manufacture of anhydrous alcohol or fuels are exempt from taxation.

First objective of the Institute was the construction of large distilleries, the first one of which was built in the state of Rio and had a daily capacity of 60,000 liters of alcohol. At present there are approximately 175 distilleries in Brazil, 30 of which produce anhydrous alcohol and have a total capacity of 427,000 liters. The remaining 145 manufacture beverage alcohol and have a capacity of 513,575 liters. The state of Pernambuco is the largest central producer in Brazil, having 58 distilleries with a total capacity of 343,395 liters. Rio takes second place with 26 and a capacity of 231,400 liters, and Sao Paulo has 31 with a total capacity of 221,280 liters. Brazil's total production of fuel alcohol has been steadily increasing, as shown in the attached table.

Digest from "Fuels Available in Brazil." *Revista Brasileira de Quimica* XVI, No. 92, 140-150, 1943. (Published in Brazil.)

RAMAN SPECTRUM OF ISOPRENE

Work was done on the determination of the Raman spectrum of the isoprene monomer during polymerization, and of solutions of isoprene polymers in benzene and carbon tetrachloride. Aside from the frequency characteristic of the conjugated bond in the monomer, there also appears a higher frequency corresponding to the isolated double bond in the polymer. Dur-

Production of Motor Fuel Alcohol in Brazil in Liters

		Substances Used in the Fuel Mixture			
Year	Motor Fuel Alcohol	Alcohol	Gasoline	Kerosene	Other Substances
1932	19,265,909	12,147,957	7,096,405	16,491	5,056
1933	14,630,854	12,963,002	1,638,996	23,933	4,923
1934	27,285,269	14,115,963	13,154,824	14,278	204
1935	47,524,474	16,741,945	30,776,386	3,527	2,616
1936	138,611,595	24,340,393	114,268,502	2,700	.....
1937	112,342,593	18,446,646	93,858,920	35,826	1,201
1938	213,477,743	32,689,879	180,774,813	11,592	1,459
1939	312,683,596	49,065,372	263,613,752	2,920	1,552
1940	299,216,620	44,834,030	254,382,328	......	262

ing polymerization the frequency rate of the conjugated double bond decreases, whereas the frequency rate of the isolated double bond increases. Due to the increase in the number of individual bonds in the polymer, the frequency rate of the ordinary bond, 1005, is considerably greater in the polymer than in the monomer. In samples with a high content of polymers (over 50 percent) the frequency rate of the conjugated double bond is much higher than that of the isolated double bond.

Digest from "Change in the Raman Spectrum of Chloroprene and Isoprene in the Polymerization Process," by A. R. Gantmacher and S. S. Medvedev, *Zhurnal Fizicheskoi Khimii* XVII, No. 1, 12-19, 1943. (Published in Russia.)

ABSORPTION SPECTRA OF NITROGEN DIOXIDE

Investigations were made on the absorption spectra of nitrogen dioxide adsorbed on films of benzene, naphthalene, anthracene and phenol. A new absorption range was found which did not correspond to the ranges of NO_2 and N_2O_4 or that of nitro derivatives. The long-wave boundary of this range is displaced in the direction of long waves with increase in the chemical activity of the adsorbent in relation to the NO_2. It has been proposed that this absorption range belongs to the RNO_2 complex in which R is the molecule of adsorbent. Displacement of the long wave boundary is explained as the result of an increase in the stability of the bond in the complex on changing to more active adsorbents.

In working with benzene, for example, the experimental technique was as follows: thin films of benzene were applied to the cold surface of a quartz tube by evaporation in the vacuum. There was no noticeable absorption of NO_2 and N_2O_4 at such low temperatures as —80 to —100 deg. C. At —20 to —25 deg. C. there was slight absorption in the 3300 Å range. This increases with rise in temperature and at —2 to —5 deg. C. it includes the range from 3100 to 3700 Å. No further change with increase in temperature could be observed since the benzene melts.

As the accompanying table shows, the absorption range of the adsorbed molecules moves regularly in the direction of the long waves with increase in the chemical activity of the adsorbent.

Adsorbent	Limit Å
Benzene	3680
Naphthalene	3950
Anthracene	4600
Phenol	5800

Digest from "Absorption Spectrum of Nitrogen Dioxide on Films of Aromatic Compounds," by I. O. Gorislavetz, *Zhurnal Fizicheskoi Khimii* XVII, No. 2, 97-101, 1943. (Published in Russia.)

POSTWAR INDUSTRIAL BRAZIL

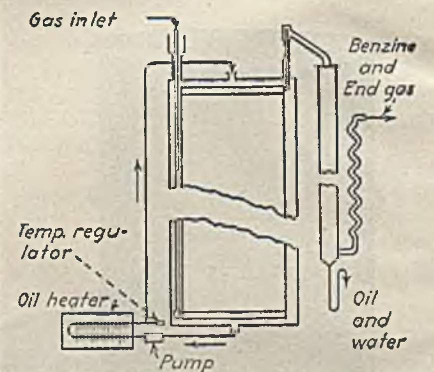
The technological revolution taking place in the world today should have the same effect on Brazil as the industrial revolution of the 18th century had on England. Brazil is a country with a rich but little-developed hinterland. Its productive iron mines are inconveniently located, and the coal is not too plentiful or easily accessible. A network of railroads is needed to connect vast distances if Brazil is to be prop-

erly developed industrially. But the future trend is toward electricity rather than steam, aluminum rather than steel, aerial transportation rather than railroads, and Brazil is well fitted for such a future. There are many suitable locations for large-capacity power stations. This electricity can be used to work the rich deposits of bauxite and magnesium ores and to manufacture light alloys and various light-alloy products, including airplanes. Aerial transportation could connect important points in the interior, overcoming the natural barriers with little effort. Preliminary treatment of raw materials in order to reduce their weight and volume will make it possible to transport much material by air. There will also be a close alliance between Brazil and the United States, resulting in mutual benefit to both countries.

Digest from "Increase in Brazil's Industrial Production," by Morris L. Cooke, Joao Alberto. *Revista de Quimica Industrial* XII, No. 132, 19-23, 1943. (Published in Brazil.)

FISCHER-TROPSCH GASOLINE

A technically sound and simple contact chamber has been developed for the synthesis of gasoline by the Fischer-Tropsch process. The chamber has given good service through months of continuous use. Contact chambers of a flat shape, connected in several batteries and immersed in a series of oil baths, were built by electrical welding from sheet iron 4 mm. thick, 5 meters long and 1.5 meters wide.



Contact chamber for synthesis of gasoline by Fischer-Tropsch Process

The contact mass of Ni-Mn-Al catalyst weighed 21.3 kg. and was used with a gas flow of approximately 6.8 cu.m. per hr. In order to reduce the catalyst, the contact chamber was heated with recirculated air to 450 deg. C., while simultaneously hydrogen (saturated with ammonia gas) streamed through. Conversion then followed, using "mixed gas" 24/48 at 190–210 deg. C. With this gas the yield was 100 cc. of fluid products per cu. m. of feed.

After 1,000 hr. of operation, regeneration was necessary. The decline in yield after 1,000 hr. was due to loss in catalytic activity and of large quantities of paraffins through the exit gases. The paraffine wax saturating the catalyst was washed out with benzine and recovered.

This apparatus was operated automatically during the first 200 hr. with only ordinary care. For the remaining 800 hr. it was continued without interruption, but some attention was given to gas analyses and temperature control. Operations were stopped as soon as the catalyst showed need for regeneration. The accompanying illustration gives the scheme of the test apparatus.

In building large commercial units it would be best to proceed so that the individual contact chambers could be hung next to one another in large oil baths, so as to form batteries. Such close formation in batteries has many advantages. Damage to a single chamber is easily remedied by disconnecting the chamber from the remainder of the battery. For the reduction stage, the chambers or cells can be collectively raised by a crane, withdrawn from the oil bath and brought to the desired reducing temperature in a special chamber or vat. The circulating oil removes the absorbed heat of reaction.

Digest from "The Synthesis of Gasoline by the Fischer-Tropsch Process," part I, by F. Fischer, Otto Roelen and W. Feist, *Brennstoff-Chemie* 13, No. 4, 1943. (Published in Germany.)

TOPAZ FOR REFRACTORIES

The Inhandjara wolframite deposit, discovered in 1941 by engineers of the Sao Paulo Geographical and Geological Institute, has been found to contain a high content of topaz. The Institute first considered utilization of this topaz for abrasive purposes but its interesting chemical composition indicated possible utilization for refractories.

The principal vein crops out for some 300 meters and is about 35 m. deep, and there are also three additional deposits nearby. The topaz in the veins is in the form of crystals of varying size. The total yield of topaz is expected to run into thousands of tons. The purer crystals have a melting point of 1,880 deg. C. and the contaminated crystals approximately 1,820 deg. C.

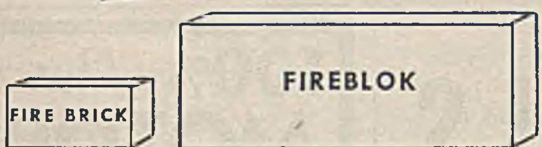
Sample refractory materials in the form of small cylinders were prepared from topaz calcined at 1,480 deg. C., varying in granularity, clay content and degree of pressing. A plastic clay with an alumina content of approximately 40 percent was used in proportions of 5 to 40 percent. Results are given in the attached table.

Since this topaz has a high alumina content and is fairly pure it should find wide application in the ceramic industry. The high fluorine content is also of interest industrially since this element must be removed before the mineral can be used in ceramic products.

Digest from "Topaz from the Inhandjara Mine. Possibilities of Its Utilization in Heat Refractories," by Frederico B. Angeleri, *Anais da Associacao Quimica do Brasil*, II, No. 1, 42-47, 1943. (Published in Brazil.)

Test Results on Sample Refractories Prepared From Inhandjara Topaz

	60% Topaz 40% Clay	80% Topaz 20% Clay	95% Topaz 5% Clay
Pressure (kg. per sq. cm.)...	300	300	300
Calcination Temperature, deg. C..................	1,480	1,480	1,480
Apparent sp. gr............	2.12	2.10	2.03
Porosity (percent by vol.)...	32.5	33.1	35.4
Refractoriness under load (2 kg. per sq. cm.):			
Beginning of deformation, deg. C................	1,500	1,490	1,560
Breakdown............	1,650	1,590	Above 1,650



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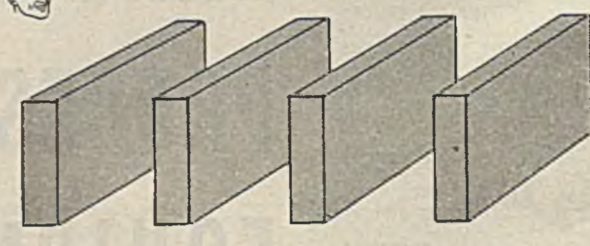

JM-1620 Fireblok—for exposed temp. to 1600° F. As back-up to 2000° F.

JM-20 Fireblok—for use up to 2000° F. Exposed or back-up

JM-23 Fireblok—for use up to 2300° F. Exposed or back-up

JM-26 Fireblok—for use up to 2600° F. Exposed or back-up

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CHEMICAL ENGINEER'S BOOKSHELF

REVISED AND AMPLIFIED

PRINCIPLES AND APPLICATIONS OF ELECTROCHEMISTRY. FOURTH EDITION. VOL. I, PRINCIPLES. *By H. Jermain Creighton. Published by John Wiley & Sons, Inc., New York, N. Y. 477 pages. Price $5.*

Reviewed by Hiram S. Lukens

THE AUTHOR of a text on electrochemistry is confronted with the problem of sifting an enormous wealth of material, discriminating between the significant and the less important, to compile finally a volume of appropriate dimensions to provide a useful text and convenient book of reference. The success with which Dr. Creighton has attained this objective is attested by the ready acceptance accorded the three previous editions appearing under the above title.

The current fourth edition is a careful revision and amplification of the third, retaining the previous arrangement and chapter headings. The notable departures from the third edition include the expansion of the chapter on coulometers to include consideration of the sodium coulometer, a revision of the discussion of conductance methods with the introduction of refinements in the computation of equivalent conductance, discussion of the moving boundary method of measuring electrophoresis and the inclusion of new applications of electro-osmosis and electrophoresis. Well chosen new references have been added to many chapters.

Developments in currently active fields of investigation have been recognized by expansion of the chapters on Electrokinetics, Potentiometric Measurements, Overvoltage, Electrolytic Reduction and Oxidation, Activity of Strong Electrolytes, and Theories of Strong Electrolytes. Among new topics included are Transference in Fused Salts, Electrode Potentials in Fused Salts, Polarographic Analysis, Wien Effect, Table of Solubility Products of Metallic Sulphides, and Glow Discharge Electrolysis.

The publishers have reduced the page size of this edition, eliminated many rules from tables without sacrifice and deleted certain illustrations of outmoded equipment. The printing of text and references is excellent. It is a reasonable expectation that this edition will find an even broader field of usefulness than the enviable one enjoyed by its predecessors.

INTEGRATED PICTURE

SCIENCE AT WAR. *By George W. Gray. Published by Harper & Brothers, New York, N. Y. 296 pages. Price $3.*

Reviewed by C. C. Furnas

GEORGE W. GRAY is one of the top men of the country in the business of presenting science to the public. In his most recent book, "Science at War," he has done a grand job in bringing together the latest available information on scientific developments as applied to the conduct of the war and has presented it in his usual clean-cut and readable style.

It is always a relief to find an author on scientific subjects who not only presents facts, but ties them together in an integrated picture, in contrast to the more usual product which closely resembles a series of library abstract cards distributed more or less at random. Not only does Mr. Gray do a fine piece of work in presenting an integrated and sensible picture of present activities; he also works in the historical roots of many developments that have been in the making for many years or even centuries.

Anyone who is engaged in some highly specialized activities of the application of science to the present war may find that some of the information in this book is not quite up-to-date, but the deficit is not more than a few months, at least in most cases. There are also some items which are of real significance which have been completely omitted or not touched on at all, but those are the ones that are still retained in the secret category for obvious military reasons. The book is surprisingly complete and up-to-date. The picture is well-rounded without revealing any military secrets.

Through a good part of the book, the author adopts the stand that this is a physicist's war, as contrasted to the first World War which was labeled as being primarily in the province of the chemist. He makes a very good point for the paramount position of the physicist, and I do not believe that any author can have very much argument with him on this point. However, he does not neglect the other sciences as they receive a great deal of attention at various points in the twelve chapters. Applied mathematics has a chapter unto itself and chemistry comes into its own under the title of "Out of the Crucibles." Metals and plastics are given a good presentation in the chapter on new materials. War medicine is treated quite thoroughly and there is a separate chapter on aero-medicine which has come in for some very specialized physiological work in recent years because aviation has the characteristic of suddenly jerking a man out of his natural habitat and putting him under conditions of extreme physiological and psychological stress. The developments here are largely along the lines of preventive, rather than curative, medicine. There is also a chapter on "The War of Ideas" which deals largely with mass psychology. The final epilogue is under the title of "Science in the New World" and is a brief glance in the future which is hopeful without being Pollyannish.

One important feature of this work is the presentation of the history and methods of working of the various organizations that are engaged in scientific research and development for the war. There is one chapter on the Office of Scientific Research and Development which is very valuable in presenting to the American public the story of the magnificent work of this organization.

A review which is worthwhile should not be all bouquets and any reviewer, I believe, is entitled to at least one negative criticism. In this case, one gathers the feeling as he goes from page to page that perhaps Mr. Gray is too apologetic in the defense of Science. The theme that scientists do not cause war and that they actually do not make it any worse than mass brutality is under the most primitive conditions recurs again and again. It does not seem to this reviewer that such apologies are called for and that it tends really to give the same reaction as a Southern Californian apologizing for rain on the day of the Rose Bowl game. All such apologies fail to help the situation and are actually not called for. Outside of this one minor criticism this reviewer whole-heartedly endorses Mr. Gray's book and I am sure that he will have a wide and appreciative audience.

PLASTICS FACTS

TECHNICAL DATA ON PLASTIC MATERIALS. *Published Plastics Materials Manufacturers' Association, Tower Building, Washington (5) D. C. 141 pages. Price $1.50.*

Reviewed by R. S. McBride

THIS data book is unquestionably the most reliable and comprehensive summary of facts regarding plastic materials that has ever been made available by anyone. Its sponsor, Plastics Materials Manufacturers' Association, has done a remarkably fine job in preparing it "as a service to the representatives of the Governmental Agencies concerned with the use of plastics materials in the war effort, and to its customers."

The volume is divided into 18 sections which deal in turn with the following 18 types of plastic materials: Casein plastic; cast phenolic resins; cellulose acetates; cellulose acetate butyrates; cellulose nitrate; ethyl celluloses; laminated phenolic plates, rods and tubes; melamine molding materials; methyl methacrylates; nylon; phenol-formaldehyde molding materials; phenol-furfural molding materials; polystyrenes; polyvinyl formals, acetals, and butyrals; polyvinyl chloride plastics; urea-formaldehyde molding materials; vinyli-

RECENT BOOKS RECEIVED

Applied Safety Engineering. By H. H. Berman & H. W. McCrone. McGraw-Hill. $2.

Aviation Gasoline Manufacture. By Matthew Van Winkle. McGraw-Hill. $3.

Emulsion Technology. A symposium. Chemical. $5.

A Laboratory Manual of Plastics and Synthetic Rubbers. By G. F. D'Alelio. Wiley. $2.

Magnetochemistry. By P. W. Selwood. Interscience. $5.

Materials Handbook. 5th ed. By G. S. Brady. McGraw-Hill. $5.

Rubber Red Book. 4th ed. Rubber Age. $5.

dene chloride (saran); vinyl chloride-acetate resin compounds.

For each type of material there is presented a brief description of the source, character, and usefulness, followed by standard tabular summary of the significant properties. In each case the properties are those reported by the manufacturers themselves as the result of tests made by the most dependable methods of measurement. The methods of test are usually those of A.S.T.M. and the data are as nearly as possible comparable for the different types of materials described.

Thus the would-be user of plastic materials has for the first time a comprehensive and reliable means for judging by the measurable properties which plastics he should consider for any particular job. And he has means for judging the relative performance with respect to each property which he may expect. There is only one danger in this. The non-technical purchaser may think that he can simply pick off these tables his selection of material and without skilled guidance be adequately informed as to performance expected. Anyone so misguided as to do that will soon find out his error. Then he will doubtless go back to the proper practice of seeking advice from the 18 reliable firms which make up Plastics Materials Manufacturers' Association.

SELF-STUDY TEXTBOOK

Chemistry Made Easy. *By Cornelia T. Snell and Foster D. Snell. Published by D. Van Nostrand Co., New York, N. Y. 1,214 pages. Price $7.95.*

Reviewed by Donald F. Othmer

This four-volume set is intended to teach chemistry to those who wish to learn it by themselves. The presentation is simple and direct, in an agreeably informal literary style, with points illustrated by the familiar and practical, rather than being in the heavier, pedantic style of the usual academic text. As the authors say in their introduction: "We have tried to avoid a stiff and rigorous textbook treatment of the subject; we have tried to humanize the subject with illustrations from everyday life so that it will pique the intellectual curiosity of the reader, and present the principles of the science in an understandable way, putting first things first, and progressing step by step through the more difficult portions of the subject. We hope that we have accomplished this objective." This reviewer believes they have; without, of course, contributing either a compendium for the trained chemist nor a textbook for professional training. It is "generalized chemistry" attractively presented for the home study of a person whose interest or work would be implemented by "a foundation for understanding the nature of the various chemicals of commerce."

Vol. I introduces the reader to theoretical chemistry and furnishes a fundamental basis on which facts can be built in a way that the reader can understand. Vol. II deals with non-metals such as chlorine, phosphorus and sulphur, and with many of the important metals. Methods of preparing or obtaining these are described, as well as typical reactions of their compounds. In Vol. III, the structure and relationship of the basic aliphatic and aromatic compounds are explained. Here, as in the other volumes, interesting everyday sidelights are examined; in this case vitamins, foods, cosmetics, soaps, etc. Vol. IV is not a textbook, but is intended rather for reference, since this lists a great number of compounds and naturally occurring chemical materials which are used commercially. The most essential facts are given as to properties, composition and uses. (Vol. IV was published in 1939 as "Chemicals of Commerce." See *Chem. & Met.*, Oct. 1939, p. 642.)

The first three volumes contain review questions at the end of each chapter and a final examination at the end of each book, with directions for self-grading. With serious application a person should be able to master much of the fundamentals of the relation of the science to life and industry with the aid of this set, which seems to be a real contribution to a rather untouched field in chemical literature.

FOR BEGINNER COURSES

PRINCIPLES OF PHYSICAL METALLURGY. *By Frederick L. Coonan. Published by Harper & Bros., New York, N. Y. 238 pages. Price $3.25.*

Reviewed by Robert F. Benenati

THIS elementary textbook is written in three parts: the first, general principles; the second, non-ferrous alloys including brass, aluminum, magnesium, nickel, copper and beryllium; and the third, alloys of iron and carbon. Physical principles, the foundation for the remainder of the book, are laid down in the first three chapters in an interesting and informative manner. The liberal use and clear explanation of phase diagrams add to the clarity of this section. The three chapters covering the non-ferrous alloys contain a wealth of material which perhaps has been gone over too hurriedly by the author. The section on ferrous metallurgy surpasses the rest of the book with the chapter on Heat Treatment of Steel (VIII) outstanding. The various types of heat treatment necessary to adjust the properties of steel have been fully explained and illustrated. The subject of Corrosion and Corrosion-Resistant Steels receives careful treatment in chapters XII and XIII. The large number of phase diagrams and photomicrographs used throughout the book were chosen with great care and are well explained, all of which make for clear understanding and appreciation of the subject with minimum verbiage. The book is a well prepared summary of the large subject covered and, as such, should find acceptance as a textbook for beginning courses.

RECENT BOOKS and PAMPHLETS

Petroleum Reservoir Efficiency and Well Spacing. Published by Standard Oil Co. (New Jersey), 30 Rockefeller Plaza, New York 20, N. Y. 77 pages. Results of an extensive survey of pools in the South and South America.

American Standards. Published by American Standards Association, 29 W. 39 St., New York 18, N. Y. 24 pages.

Price list of the more than 600 ASA standards.

Liquid Densities of Hydrocarbons. By C. S. Cragoe. Available from A. E. Miller, secretary, Technical Advisory Committee, Petroleum Industry War Council, 50 W. 50 St., New York, N. Y. Tables giving liquid densities of 11 hydrocarbons found in commercial C_4 mixtures.

Recommended Commercial Standard for Mineral Wool: Blankets, Blocks, Insulating Cement, and Pipe Insulation for Heated Industrial Equipment. Recommended Commercial Standard, TS-3633, issued by National Bureau of Standards, Washington, D. C. 28 pages. Thermal conductivity, density, standard sizes and tolerances for the different types of mineral wool insulation.

Allowable Concentration of Toluene. Standard Z37.12-1943 published by American Standards Association, 29 W. 39 St., New York 18, N. Y. Price 20 cents. Sets safe limits for the amount of toluene permissible in the air of industrial workshops to safeguard the health and efficiency of workers.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. In ordering any publications noted in this list always give the complete title and the issuing office. Remittances should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper covers unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the Bureau responsible for its issue.

Index to Publications of the United States Department of Agriculture 1936-1940. By Mary A. Bradley. Department of Agriculture. Clothbound. Price $1.50.

Information Sheet on the Determination of Ascorbic Acid in Fresh, Frozen, and Dehydrated Foods. By Western Regional Research Laboratory, Albany, California. No. AIC-35. Obtainable from Bureau of Agricultural and Industrial Chemistry. Washington, D. C. Mimeographed.

Studies on Nicotine Fumigation in Greenhouses. By Henry H. Richardson, J. W. Bulger, R. L. Busbey, R. H. Nelson, and C. A. Weigel. Department of Agriculture, Circular No. 684. Price 10 cents.

Harvest Sprays for the Control of Fruit Drop. By L. P. Batjer. Department of Agriculture, Circular No. 685. Price 5 cents.

Soybeans and Soybean Products as Food. By Marion Julia Drown. Department of Agriculture, Miscellaneous Publication No. 534. Price 10 cents.

Industrial Insulation with Mineral Products. By Oliver Bowles. Bureau of Mines, Information Circular I. C. 7263. Mimeographed.

Natural Mineral-Paint Extenders. By Charles L. Harness. Bureau of Mines, Information Circular I. C. 7264. Mimeographed.

Trends in Consumption and Prices of Building Materials. By Oliver Bowles and Nan C. Jensen. Bureau of Mines, Information Circular I. C. 7265. Mimeographed.

Graphite—Natural and Manufactured. By G. Richards Gwinn. Bureau of Mines. Information Circular I. C. 7266. Mimeographed.

Tentative Bituminous and Lignite Mine Inspection Standards. Revised September 1943. Bureau of Mines, Information Circular I. C. 7268. Mimeographed.

Marketing Magnesite and Allied Products. By Charles L. Harness and Nan C. Jensen. Bureau of Mines, Information Circular I. C. 7269. Mimeographed.

Tests of the Heliopore Coal-Carbonization Power-Plant Process. By A. C. Fieldner, J. D. Davis and others. Bureau of Mines, Report of Investigations R. I. 3733. Mimeographed.

Grounding Electrical Equipment In and About Coal Mines. By F. E. Griffith and E. J. Gleim. Bureau of Mines, Report of Investigations, R. I. 3734. Mimeographed.

National Motor-Gasoline Survey, Summer 1943. By A. J. Kraemer and O. C. Blade. Bureau of Mines, Report of Investigations R. I. 3735. Mimeographed.

Active List of Permissible Explosives and Blasting Devices Approved Previous to June 30, 1943. By J. E. Tiffany and Z. C. Gaugler. Bureau of Mines, Report of Investigations R. I. 3736 Mimeographed.

Thermal Analysis of Clay Minerals and Acid Extraction of Alumina from Clays. By Joseph A. Pask and Ben Davies. Bureau of Mines, Report of Investigations R. I. 3737. Mimeographed.

Modern Beehive Coke-Oven Practice, 1. Preliminary Report. By G. S. Scott, J. A. Kelley, E. L. Fish, and L. D. Schmidt. Bureau of Mines, Report of Investigations R. I. 3738. Mimeographed.

Precision of the Volatile-Matter Determination for Anthracite, Low-Temperature Coke, and Sub-bituminous Coal. By W. A. Selvig. Bureau of Mines, Report of Investigations R. I. 3739. Mimeographed.

Beneficiation of Del Monte (Calif.) Sand. By John Dasher, Robert R. Rough, and Frank L. Bacon. Bureau of Mines, Report of Investigations R. I. 3740. Mimeographed.

Limits of Inflammability and Ignition Temperatures of Acetic Anhydride. By G. W. Jones, F. E. Scott, and G. S. Scott. Bureau of Mines, Report of Investigations R. I. 3741. Mimeographed

Control of Sulfur and Ash in Mine-Run Metallurgical Coal, Report 1. By Henry F. DeKay, Jr., Louis A. Turnbull, James N. Scudder, and Albert L. Toenges. Bureau of Mines, Report of Investigations R. I. 3742. Mimeographed.

Control of Bulk Density of the Coal Charge in Byproduct Coke Ovens. By William Seymour and L. D. Schmidt. Bureau of Mines, Report of Investigations R. I. 3743. Mimeographed.

Geology and Ore Deposits of the Shafter Mining District, Presidio County, Texas. By Clyde P. Ross. Geological Survey, Bulletin 928-B. Price 65 cents.

Occurrence of Manganese in Eastern Aroostook County, Maine. By Walter S. White. Geological Survey, Bulletin 940-E. Price 25 cents.

State Mineral Figures. U. S. Bureau of Mines has issued a series of 14 reports by states of the mineral production in 1943 as estimated for preliminary mimeographed announcement. An individual report is available for each of the 12 major Western mining states, one for "Central States," and one for "Eastern States."

Preliminary Mineral Statistics, 1943. Bureau of Mines is issuing in a preliminary form estimates of production of various minerals and metals during the calendar year 1943 in short mimeographed statements of its series, Mineral Market Reports (These are the sheets numbered in the M. M. S. series). During January there were issued, among others, reports on iron ore, mercury, lead and zinc, and fluorspar. Those desiring data should indicate to the Bureau the specific commodities or metals of interest. The complete series will be made available in the course of a few months.

Annual Report of the Tennessee Valley Authority for the Fiscal Year Ended June 30, 1943. Price 35 cents.

Annual Reports of the Food and Drug Administration for the Period from July 1, 1941, to June 30, 1943. Price 15 cents.

Army Supply Procedure, Parts 1 and 2. War Department Technical Manual TM38-205. Price 10 cents.

Military Pipe-Line Systems. War Department Technical Manual TM5-350. Price 40 cents.

Effectiveness of Wood Preservatives in Preventing Attack by Termites. By Thomas E. Snyder and James Zetek. Department of Agriculture, Circular No. 683. Price 10 cents.

Fertilizer Consumption in 1941 and Trends in Usage. By A. L. Mehring and Grace P. Vincent. Department of Agriculture, Circular No. 689. Price 10 cents.

Preventing Damage to Commercial Dried Fruits by the Raisin Moth. By Heber C. Donohoe, Perez Simmons, and others. Department of Agriculture. Leaflet No. 236. Price 5 cents.

Insecticides and Equipment for Controlling Insects on Fruits and Vegetables. By N. F. Howard, C. A. Weigel, C. M. Smith, and L. F. Steiner. Department of Agriculture, Miscellaneous Publication No. 526. Price 10 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.

Temperature Control. C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn 5, N. Y.—A 38-page illustrated booklet (catalog No. 1101H) describing the company's electric thermometers, pyrometers, photoelectrically balanced recorders, indicators, controllers, recording controllers, etc.

Chain Drive Maintenance. The Chain Belt Co., 1600 W. Bruce St., Milwaukee 4, Wis.—Bulletin No. 435, a 20-page descriptive booklet issued as a guide in the wartime care of chain belt drives.

Air Conditioning. Carrier Corp., Syracuse, N. Y.—An 8-page brochure called "Problems and Solutions" reviewing the company's experience in industrial installations of temperature and humidity control equipment.

Hydraulic Presses. A. B. Farquhar Co., York, Pa.—Bulletin No. P5M43, a 50-page illustrated catalog showing the complete line of hydraulic presses manufactured by this company with specifications and photographs of actual installations illustrating their uses. Potential postwar uses are suggested.

Electronic Control. General Electric Co., Schenectady, N. Y.—A 12-page illustrated bulletin (GEA-4126) describing the fundamentals and various applications of electronic control. The publication lists the functions of eight of the more widely used industrial type tubes. Also, it includes applications in rectification, resistance welding, timing, processing operations, counting, sorting, weighing, measuring, registering, illumination and temperature control.

Air Circuit Breakers. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—A slide rule designed to simplify the determination of the correct size air circuit breakers for all industrial substation applications. The same information is also available in nomogram form in the company's bulletin B-6285.

Welding. C. E. Phillips & Co., 2750 Poplar St., Detroit 8, Mich.—A 12-page illustrated booklet describing the company's electrodes for electric arc welding of cast iron.

Valves. Jenkins Bros., 80 White St., New York 13, N. Y.—A 6-page brochure describing the company's new line of air furnace malleable-iron gate, globe, angle and check valves.

Solvents—alcohol—extenders. C. P. Chemical Solvents, Inc., 60 Park Place, Newark 2, N. J.—A 60-page booklet describing the properties of alcohol, ketones, esters, aromatics and aliphatic petroleum naphthas and coal tar naphthas. Additional miscellaneous information of general assistance to solvent users is included in the booklet.

Control. Pesco Products Co. (a division of Borg-Warner), 11610 Euclid Ave., Cleveland 6, Ohio.—A 30-page illustrated booklet containing information for design engineers and others concerned with improved methods of handling liquids and utilizing pump power in their products or processes. "Pressurized Power and Controlled Flow by Pesco" was developed to meet the demands of the aircraft industry and is now offered for possible adaptation to other fields.

Continuous Dialysers. Brosites Machine Co., Inc., 50 Church St., New York 7, N. Y.—A 4-page form describing laboratory and commercial size Webcell continuous dialysers.

Fire-Retardant. The New Jersey Zinc Co., 160 Front St., New York 7, N. Y.—A 16-page booklet describing the physical and chemical properties of zinc borate-3167, which has found wide use in fire retardant compositions for treating textile fabrics such as camouflage netting, osnaburg cloth, cotton duck and cotton drill. Considerable interesting information on the uses of this product is included in the booklet.

Electric Power Distribution. Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.—Bulletin B6285, a 15-page description of standardized load center unit substations of 100 to 2,000 kva. capacity for meeting the power supply needs of all types of industries. A nomogram is included which makes it possible to select the correct air circuit breaker for any application of a standardized load center unit substation.

Operation and Maintenance. Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wis.—A pocket-size magazine succeeding Allis-Chalmers' "Victory Production and Maintenance News", containing maintenance tips as well as timely articles on current trends for the shopman and the executive. The "Review" will be issued bi-monthly.

Steel. United States Steel Corp., Research Laboratories, Carney, N. J.—A 105-page "Atlas of Isothermal Transformation Diagrams". The booklet contains 56 diagrams representing a total of 47 different compositions, giving the time required for the transformation of austenite at any temperature level. Each "S-Curve" represents the time of response of a particular steel to specified conditions of temperature and therefore serves as a map to guide the practical man to the proper heat treatment of each of the steels.

Air Recovery. W. B. Connor Engineering Corp., 114 E. 32nd St., New York, N. Y.—A folder describing what can be accomplished by the use of air recovery in connection with heating, ventilating and air conditioning systems. It should be of interest in connection with fuel conservation.

Centrifugal Pumps. Bell & Gossett Co., Morton Grove, Ill.—A 40-page booklet describing the manufacture of various pumps, flexible couplings, etc. Also included are data required for pump selection and other valuable engineering data.

Wire Rope. Macwhyte Co., Kenosha, Wis.—Pamphlet No. 43-85 containing a series of illustrated articles on wire rope conservation of interest to all wire rope users.

Ball Bearings. New Departure Division, General Motors Corp., Bristol, Conn.—Booklet ND-A57, entitled "Service Procedure for Ball Bearings" and including in simple terms all the steps from dismounting, cleaning, judging condition to remounting. 15 pages illustrated with drawings and photographs.

Induction Heat Treatment. The Ohio Crankshaft Co., 3800 Harvard Ave., Cleveland 1, Ohio.—A revised 32-page booklet entitled "The Tocco Process," covering induction heat treatment technique in the field of metallurgy. It contains illustrations and various examples of applications of high frequency induction heating.

Tractor Shovels. The Frank G. Hough Co., Libertyville, Ill.—A 4-page folder describing the company's payloader (1 cu.yd.) tractor shovel used for material handling or construction work.

Motor Controls. General Electric Co., Schenectady, N. Y.—A 4-page bulletin (GEA-4139) illustrated and describing the company's low-speed synchronous motors and controls for compressor drives.

Equipment. Air Devices, Inc., 17 East 42nd St., New York 17, N. Y.—An illustrated bulletin (R201) describing the company's various products including air diffusers, heavy duty ranges, bake ovens and stoves, air exhausters, air filters, hot water generators, heat baffles for oil burners and hot gas generating furnaces.

Feed Water Control. Northern Equipment Co., 1945 Grove Drive, Erie, Pa.—A 4-page illustrated folder (Form 435) describing the company's steam-flow water-level feed water regulator, also its applications in various industries and on various types and sizes of boilers.

Butterfly Valves. R-S Products Corp., Wayne Junction, Philadelphia 44, Pa.—36-page catalog No. 14-B describing complete line of butterfly valves and illustrated with both manual and power operated valves for pressures from 15 to 900 lb. per sq.in. It also contains detailed specifications, applications and descriptions of new types of valves.

Carbon and Graphite Products. Carbon Products Division, National Carbon Co., Inc., Cleveland 1, Ohio.—A 16-page bulletin (catalog section M8000) covering the industrial applications of "National" and "Karbate" carbon and graphite products. Included are applications in the chemical, metallurgical, mechanical and electrical fields.

Plug Valves. American Car & Foundry Co., Valve Department, 30 Church St., New York, N. Y.—An 8-page bulletin describing the company's line of lubricated plug valves.

Fire Brick. M. D. Valentine & Bro. Co., Woodbridge, N. J.—A 16-page catalog section describing the company's fire brick and specialty products. Applications and installation data are included in the description.

Industrial Ovens. J. O. Ross Engineering Corp., 350 Madison Ave., New York 17, N. Y. —No. 5 of A Series, a 4-page bulletin emphasizing the considerations which are important to the buyer of industrial ovens.

Vacuum Cooling. Elliott Co., Jeannette, Pa. —Bulletin G-8, an 8-page description of steam jet vacuum cooling equipment. Application possibilities are detailed and illustrated by photographs and flow diagrams.

Pumps. Chain Belt Co., 1600 W. Bruce St., Milwaukee, Wis.—A 20-page illustrated bulletin (No. 433) describing the mechanical parts, construction and operation of the company's Rex speed prime pumps. They are made in capacities ranging from 3,000 to 125,000 gph. Also included are specifications and capacity charts to aid in pump selection.

Mercury-Arc Rectifiers. General Electric Co., Schenectady, N. Y.—A 36-page bulletin (GEA-3706) describing the company's Ignitron mercury arc rectifier for 501 kw. and higher ratings, 250 to 900 volts. Illustrated with charts, diagrams and photographs, the bulletin lists many applications for this equipment and describes in detail its installation and operation.

Vacuum Switches. Tube Division, General Electric Co., Electronics Department, Schenectady, N. Y.—A 4-page bulletin describing four new vacuum switches for a wide variety of industrial switching applications.

Gas Regulators. Victor Equipment Co., 844 Folsom St., San Francisco 7, Calif.—An 8-page booklet entitled "Gas-O-Dome Regulators," and describing the company's gas-loaded regulator made for inlet and delivery pressures higher than those handled adequately with spring-loaded diaphragm regulators.

Metal Treatment. Youngstown Welding & Engineering Co., Youngstown, Ohio.—A 16-page bulletin describing the company's welded monel and inconel baskets, crates, chains, hooks and accessories for pickling, annealing and heat treating.

Speed Reducers. Stephens-Adamson Mfg. Co., Aurora, Ill.—Catalog No. 643, a 12-page description of the company's Saco speed reducer complete with design and installation data.

Adjustable Speed Motor Drive. General Electric Co., Schenectady, N. Y.—A 40-page bulletin (GEA-4025) describing the company's Thymo-trol electronic drive for providing and controlling adjustable voltage power from a-c lines to permit the use of d-c motors with their inherent advantages. The first section describes the uses and operation of the device and the second section provides a technical explanation of its operation.

Steam Plant Equipment. Yarnall-Waring Co., Chestnut Hill, Philadelphia 18, Pa.—Revised editions of the company's bulletins on plant equipment (G-1306), steam traps (G-1738), and expansion joints (EJ-1909). Bulletins EJ-1909 and G-1306 have considerable new illustrative and descriptive material.

Turbines. Elliott Co., Jeannette, Pa.—Bulletin H-14 describing the company's single stage mechanical drive turbines with built-in reduction gears.

Screens. Wedge-Bar Screen Corp., 145 Hudson St., New York, N. Y.—An 8-page bulletin describing screens for shaking, vibrating and rotary equipment.

Heat Inclosure. George P. Reintjes Co., P. O. Box 856, Kansas City, Mo.—A 4-page bulletin (No. 431) describing Reintjes sectionally-supported upper side wall for bent-tube boilers.

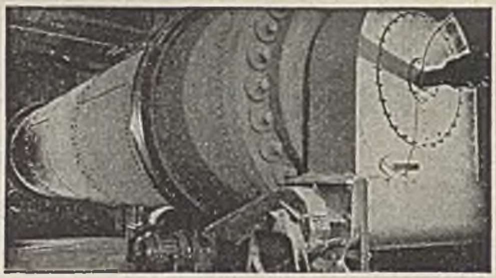
Temperature Control. Wheelco Instrument Co., Harrison and Peoria Sts., Chicago 7, Ill.—Bulletin A2-3, an 8-page description of the potentiometer method of heat measurement and control, and giving various data concerning the company's instrument, the Potentiotrol.

Vacuum Cleaning System. Allen Billmyre Co., 431 Fayette Ave., Mamaroneck, N. Y.—Bulletin D4, an 8-page description of the company's "Exidust" central vacuum cleaning system for industrial plants and buildings of all types.

Fire Pumps. Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.—Bulletin 5813FS, a folder describing the company's new line of gasoline-engine driven fire pump units in capacities of 500, 750 and 1,000 g.p.m.

Humidifiers. Armstrong Machine Works, Three Rivers, Mich.—Bulletin 158, an 8-page illustrated bulletin presenting engineering data and complete details on unit type humidifiers now available from this company. Operating features, installation data and other information are included.

Hydrogenated Rosin. Hercules Powder Co., Wilmington, Del.—A 14-page booklet describing the company's Staybelite esters, including data on their physical properties and listing typical materials compatible with Staybelite esters.



LOUISVILLE CRYSTALS DRYER CUTS DRYING COSTS $1.41 PER TON!

It's hard to imagine that any two dryers, individually built to dry a very familiar crystalline material, could yield such varying results as those shown in the "blueprint" at the right. But they *did*—and this case is by no means unique.

Louisville Dryers are not "built to a price." They are precision-engineered to do *more economical drying*. It's true that by better engineering we often (as in the case at the right) save our customers money on the original installation. But our primary interest is to save you thousands of dollars over the years, rather than dimes or dollars on purchase price. Hence this company maintains complete laboratories and pilot plants in which our engineering recommendations are checked against actual operations, and economies are *proved* in advance. Let us tell you the whole interesting story. *Address:* Louisville Drying Machinery Co., *Incorporated*, 451 Baxter Avenue, Louisville 4, Kentucky. (Subsidiary of General American Transportation Corporation.)

FORMER DRYER

Installed Cost	$35,000
Annual Production (Tons)	11,000
Drying Cost Per Ton	$2.71

(Space Required, 3000 sq. ft.)

LOUISVILLE DRYER

Installed Cost	$18,000
Annual Production (Tons)	11,000
Drying Cost Per Ton	$1.30

(Space Required, 1400 sq. ft.)

Yearly Savings of Louisville Dryer, in Operating Costs Alone . . . $15,510

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INDUSTRIAL CONSUMPTION OF CHEMICALS APPEARS TO BE PROGRESSING ON A FAIRLY EVEN KEEL

But little difference was registered in the volume of chemicals consumed in general industrial lines in December as compared with the preceding month and only a slight gain over December is indicated by the partial reports which are at hand regarding operations in January. From the programs which have been planned one may look ahead with the confidential belief that some finished products will be turned out in volume larger than the 1943 totals. The most definite of these is fertilizers where the industry is working with government agencies in an attempt to smooth out all difficulties so that the full food program may be successfully met.

This program envisions an increase in all food crops with an attendant growth in the amount of fertilizer made and consumed. This, interpreted in terms of chemicals means a larger outlet for all nitrogen-bearing materials, phosphates, and potash. Every effort is being made to assure the necessary supplies. New superphosphate and sulphuric acid capacities are being provided and all indications point to a new record for superphosphate production and for a similar result for acid consumption. The shortage of acid for acidulators of rock has been partially relieved by shipments of ordnance acid with reports that 24,000 tons of 60 deg. acid had been delivered in January with a slight increase promised for February. To attain the quota set for superphosphate, plants must work at near-capacity rates each month. This may lead to a bottleneck when the active mixing season has passed as storage capacities are limited and mixers will be called upon to accept fairly even monthly deliveries in order to obviate any such problem.

It is reported that new buying orders from army air forces have been received by manufacturers of rayon which offers proof that military requirements will take a relatively higher part of total output than it did last year. The rising trend for rayon output should receive no setback this year.

As measured by the *Chem. & Met.* index, consumption of chemicals in ordinary channels is running a little higher than it was a year ago and as the index for the first quarter of last year was 172.86 it is probable that this will be exceeded this year by about 5 percent. The index number for December was 179.74 compared with revised number of 181.15 for November. In 1942 these numbers were 169.38 and 169.69 respectively. The Federal Reserve Board index reported a considerable drop in chemical production for December which no doubt was accounted for by a reduced rate of operations at government plants which in some cases represented a complete stoppage of production where further outputs were not needed.

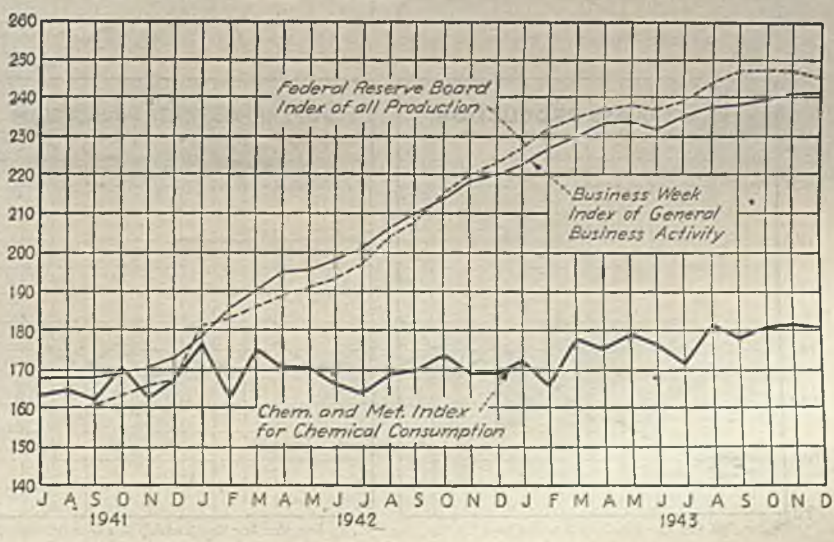
As chemicals enter in some form into most of the finished products classed as direct war goods, it is not difficult to understand why their consumption gained rapidly last year in these directions when reference is made to the index for munitions production which climbed from 453 for January to a preliminary figure of 662 for December. Furthermore WPB has forecast the probabilities for this year with planned production schedules, from an all-over standpoint, aimed at a 25 percent increase over 1943. Referring to small arms ammunition the report credits a drop in the closing part of the year with further downward revisions in prospect. Artillery ammunition, on the other hand was turned out in larger volume in December and the 1943 gain over 1942 was placed at 36 percent with the 1944 gain over 1943 estimated at 80 percent.

The position of oils and fats has not changed materially. Larger crushing operations are reported for linseed oil and the supply of oil has been larger but other oils are moving largely under directives. A recent development affecting imports of oils was the return to private interests of the bringing in of a new group including cashew nut oil from India, neat's foot oil from Argentina, curicury kernels from Brazil, and cohune kernels from Honduras. The first group was released in November and included castor and oiticica oils; cashew nut oil from Brazil; sesame seed, tucum and muru muru kernels and oils; glycerine from Argentina and Canada; oleic acid, stearic acid, and corn oil from Argentina. Other oils and fats for import are bought by the Commodity Credit Corp.

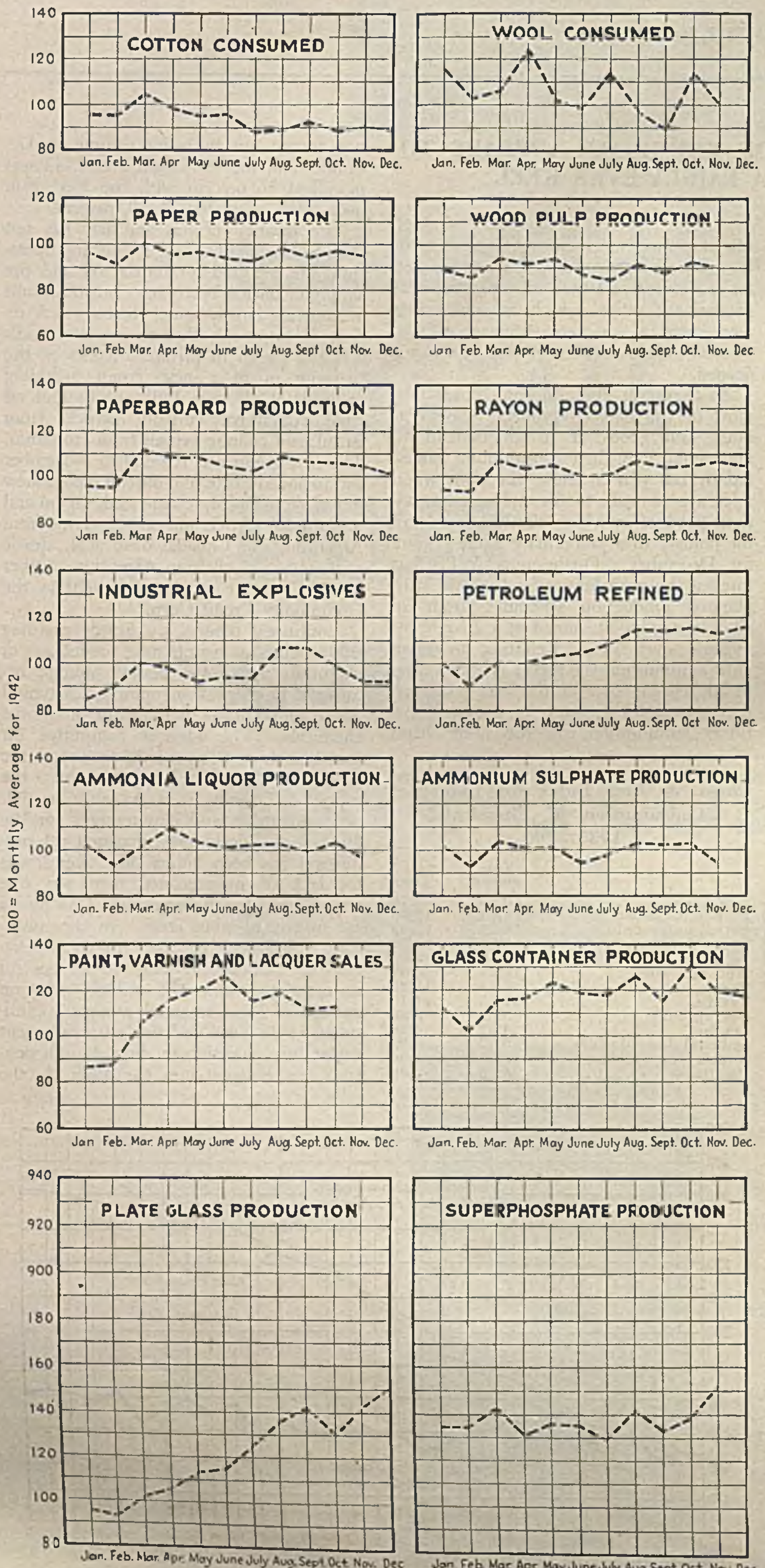
Continued reports are heard regarding the problem of maintaining production of chemicals up to the desired volume because of shortage of manpower. A typical case is found in the manufacture of chrome chemicals. The advisory committee for that branch met last month to discuss the possibility of devising ways to increase the supply. Chrome ore is available in sufficient quantities and requirements for the finished chemicals have increased yet production has been falling off. Shutdowns for lack of maintenance men was one reason given for this condition. All plants are in critical labor areas. In the meantime it has been necessary to place deliveries of chrome chemicals under control in order to assure the military program enough of these essential products. Chromium oxide green and zinc chromate went under full allocation on Feb. 1 with controls less stringent over the other chrome salts.

Chem. & Met. Index for Industrial Consumption of Chemicals
1935=100

	Nov. revised	Dec.
Fertilizers	43.80	42.75
Pulp and paper	18.70	17.95
Petroleum refining	16.39	16.88
Glass	18.94	18.50
Paint and varnish	15.70	15.00
Iron and steel	13.38	13.67
Rayon	16.18	16.12
Textiles	11.13	11.10
Coal products	9.09	9.85
Leather	4.32	4.30
Industrial explosives	5.27	5.32
Rubber	3.00	3.00
Plastics	5.25	5.30
	181.15	179.74



PRODUCTION AND CONSUMPTION TRENDS



THE GENERAL tenor of reports regarding industrial activities in January indicate relatively low rates of operation in the first week with a gradual speeding up which resulted in an improvement over the December totals. At paper mills progress was reported for each succeeding week although it also was made known that mills have no surplus holdings of pulp and are working on a hand-to-mouth basis. The industry is in a position where it is dependent on the outcome of the campaign to produce pulpwood to the planned tonnage. The 1944 goal is 1,000,000 cords greater than what had been estimated as the minimum requirement for last year. The additional quantity is necessary for packaging purposes and applies especially to weather-proof paper and kraft board.

In the glass trade, plate has been improving its position but permissible car output for the early part of this year hardly gives encouragement for any real expansion right away. Containers which made their best showing last year appear to have hit close to maximum as closure allotments for the present year would indicate that there will be very little change in the container totals for 1943 and 1944. Last year container production was around 92,000,000 gross and the chief of the container section of WPB in referring to the order limiting their use stated that the 1944 quotas are designed to bring the permitted use into balance with productive capacity.

While there have been some cutbacks in the military program which have affected distribution of raw materials, the over-all program has not been reduced and in January government spending for war account was reported at \$7.1 billion which was lower than the total for November but considerably above the December figure.

Enlargement of aluminum and magnesium production has opened up a fertile field for chemicals. In the case of aluminum, which is a large consumer of alkalis, a stockpile has been built up which has made it advisable to place a check on new output. It is now disclosed that current rate of production is more than 1,-500,000 tons a year which if continued would mean quite an increase over the 1943 total of over 900,000 tons.

The percentage of synthetic rubber which is being used in the industry is climbing. Last month one manufacturer stated that rubber manufacturers this year would be called upon to process more than 50 percent more rubber than they did in 1940. This is a composite figure including both natural and synthetic. The statement is significant as an indication of activities in that industry and in estimating the larger demand for chemicals which the enlarged program would imply. Incidentally there has been an increase in arrivals of crude rubber from foreign producing centers.

Production of high octane gasoline is forging ahead and is responsible for a large disappearance of chemicals.

CHEM. & MET.
Weighed Index of Prices for CHEMICALS

Base = 100 for 1937

This month	109.59
Last month	109.54
February, 1943	108.89
February, 1942	109.20

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell fob works, quotations are so designated. Prices are corrected to February 12.

INDUSTRIAL CHEMICALS

Acetone, tanks, lb	$0.07 –	....
Acid, acetic, 28%, bbl., 100 lb	3.38 –	$3.63
Boric, bbl., ton	109.00 –	113.00
Citric, kegs, lb	.20 –	.23
Formic, cbys, lb	.10½–	.11
Hydrofluoric 30% drums, lb	.08 –	.08½
Lactic, 44%, tecn., light, bbl., lb.	.073–	.075
Muriatic, 18°, tanks 100 lb	1.05 –	....
Nitric, 36°, carboys, lb	.05 –	.05½
Oleum, tanks, wks., ton	18.50 –	20.00
Oxalic, crystals, bbl., lb	.11½–	.13
Phosphoric, tech., tanks, lb	.04 –	....
Sulphuric, 60°, tanks, ton	13.00 –	....
Tartaric, powd., bbl., lb	.70 –	....
Alcohol, amyl	–	....
From Pentane, tanks, lb	.131–	....
Alcohol, butyl, tanks, lb	.10½–	.18½
Alcohol, ethyl, denatured, 190 proof	–	....
No. 1 special, tanks, gal. wks.	.50 –	....
Alum, ammonia, lump, bbl., lb	.04½–	....
Aluminum sulphate, com. bags, cwt	1.15 –	1.40
Aqua ammonia, 26°, drums, lb	.02½–	.03
tanks, lb	.02 –	.02½
Ammonia, anhydrous, cyl., lb	.16 –	....
tanks, lb	.04½–	....
Ammonium carbonate, powd. tech., casks, lb	09½–	.12
Sulphate, wks., ton	29.20–	....
Amylacetate tech., from pentane, tanks, lb	.145–	....
Arsenic, white, powd., bbl., lb	.04 –	.04½
Barium carbonate, bbl., ton	.60.00 –	65.00
Chloride, bbl., ton	79.00 –	81.00
Nitrate, casks, lb	.11 –	.12
Blanc fix, dry, bags, ton	60.00 –	70.00
Bleaching power, f.o.b., wks., drums, 100 lb	2.50 –	3.00
Borax, gran., bags, ton	44.00 –	....
Calcium acetate, bags	3.00 –	....
Arsenate, dr., lb	07 –	.08
Carbide drums, ton	50.00	
Chloride, flake bags, del., ton	18.50 –	25.00
Carbon bisulphide, drums, lb	.05 –	.05½
Tetrachloride drums, gal	.73 –	.80
Chlorine, liquid, tanks, wks., 100 lb.	2.00 –	....
Copperas, bgs., f.o.b., wks., ton	18.00 –	19.00
Copper carbonate, bbl., lb	.19½–	.20
Sulphate, bbl., 100 lb	5.00 –	5.50
Cream of tartar, bbl., lb	.57 –	....
Diethylene glycol, dr., lb	.14 –	.15½
Epsom salt, dom., tech., bbl., 100 lb	1.90 –	2.00
Ethyl acetate, tanks, lb	.11½–	....
Formaldehyde, 40%, bbl. lb	.05½–	.06
Furfural, tanks, lb	.09 –	....
Glaubers salt, bags, 100 lb	1.05 –	1.10
Glycerine, c.p., drums, extra, lb	.18¾–	....
Lead:		
White, basic carbonate, dry casks, lb	.08½–	....
Red, dry, sck., lb	.09½–	....
Lead acetate, white crys., bbl., lb.	.12½–	.13
Lead arsenate, powd., bag, lb	.11½–	.12
Lithopone, bags, lb	.04½–	.04¾
Magnesium carb., tech., bags, lb	.06½–	.06¾
Methanol, 95%, tanks, gal	.58 –	....
Synthetic, tanks, gal	.28 –	....
Phosphorus, yellow, cases, lb	.18 –	.25
Potassium bichromate, casks, lb	.09½–	.10
Chlorate, powd., lb	.10 –	.12
Hydroxide (c'stic potash) dr., lb.	.07 –	.07½
Muriate, 60% bags, unit	.53½–	....
Nitrate, bbl., lb	.05½–	.06
Permanganate, drums, lb	.19½–	.20
Prussiate, yellow, casks, lb	.17 –	.18
Sal ammoniac, white, casks, lb	.0515–	.06
Salsoda, bbl., 100 lb	1.00 –	1.05
Salt cake, bulk, ton	17.00 –	....
Soda ash, light, 58%, bags, contract, cwt	1.05 –	....
Dense, bags, cwt	1.15 –	....
Soda, caustic, 76%, solid, drums, cwt	2.30 –	3.00
Acetate, del., bbl., lb	.05 –	.06
Bicarbonate, bbl., cwt	1.70 –	2.00
Bichromate, casks, lb	.07½–	.08
Bisulphate, bulk, ton	16.00 –	17.00
Bisulphite, bl., lb	.03 –	.04

CHEM. & MET.
Weighed Index of Prices for
OILS & FATS
Base = 100 for 1937

This month	145.24
Last month	145.24
February, 1943	143.13
February, 1942	139.36

Chlorate, kegs, lb	.06¼–	.06¾
Cyanide, cases, dom., lb	.14 –	.15
Fluoride, bbl., lb	.08 –	.09
Hyposulphite. bbl., cwt	2.40 –	2.50
Metasilicate, bbl., cwt	2.50 –	2.65
Nitrate, bulk, cwt	1.35 –	....
Nitrite, casks, lb	.06¼–	.07
Phosphate, tribasic, bags, lb	2.70 –	....
Prussiate, yel. drums, lb	.10½–	.11
Silicate (40° dr.), wks., cwt	.80 –	.85
Sulphide, fused. 60–62%, dr. lb.	.03 –	.03¾
Sulphite, crys, bbl., lb	.02¼–	.02¾
Sulphur, crude at mine, long ton	16.00 –	....
Dioxide, cyl., lb	.07 –	.08
Crystals, bbl., lb	.39¼–	....
Zinc, chloride, gran. bbl., lb	.05¾–	.06
Oxide, lead free, bag, lb	.07¼–	....
5% leaded, bags, lb	.07¾–	....
Sulphate, bbl., cwt	3.85 –	4.00

OILS AND FATS

Castor oil, No. 3 bbl., lb	$0.13¾–	$0.14¾
Chinawood oil, bbl., lb	.38 –	....
Coconut oil, Ceylon, tank, N. Y., lb	nom	....
Corn oil crude, tanks (f.o.b. mill), lb	.12¾	....
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12¾–	....
Linseed oil, raw car lots, bbl., lb	.151–	....
Palm casks, lb	.09 –	....
Peanut oil, crude, tanks (mill), lb.	.13 –	....
Rapeseed oil, refined, bbl., lb	nom	....
Soya bean, tank, lb	.11¾–	....
Menhaden, light pressed, dr., lb	.1305–	....
Crude, tanks (f.o.b. factory) lb.	.089–	....
Grease, yellow, loose, lb	.08¼–	....
Oleo stearine, lb	.09¾–	....
Oleo oil, No. 1	.11¾–	....
Red oil, distilled, dp.p. bbl., lb	.11½–	....
Tallow extra, loose, lb	.08¾–	....

COAL-TAR PRODUCTS

Alpha-napthol, crude bbl., lb	$0.52 –	$0.55
Alpha-naphthylamine, bbl., lb	.32 –	.34
Aniline oil, drums, extra, lb	.15 –	.16
Aniline, salts, bbl., lb	.22 –	.24
Benzaldehyde, U.S.P., dr., lb	.85 –	.95
Benzidine base, bbl., lb	.70 –	.75
Benzoic acid, U.S.P., kgs., lb	.54 –	.56
Benzyl chloride, tech, dr., lb	.23 –	.25
Benzol, 90%, tanks, works, gal	.15 –	....
Beta-naphthol, tech., drums, lb	.23 –	.24
Cresol, U.S.P., dr., lb	.11 –	....
Cresylic acid, dr., wks., gal	.81 –	.83
Diethylaniline, dr., lb	.40 –	.45
Dinitrophenol	.23 –	.25
Dinitrotoluol bbl., lb	.18 –	.19
Dip oil, 15%, dr., gal	.23 –	.25
Diphenylamine, dr. f.o.b. wks., lb.	.60 –	....
H-acid, bbl., lb	.45 –	.50
Naphthalene, flake, bbl., lb	.07 –	.07½
Nitrobenzene, dr., lb	.08 –	.09
Para-nitraniline, bbl., lb	.47 –	.49
Phenol, U.S.P., drums, lb	.10½–	.11
Picric acid, bbl., lb	.35 –	.40
Pyridine, dr., gal	.170 –	1.80
Resorcinol, tech., kegs, lb	.75 –	.80
Salicylic acid, tech., bbl., lb	.33 –	.40
Solvent naphtha, w.w., tanks, gal.	.27 –	....
Tolidine, bbl., lb	.86 –	.88
Toluol, drums, works, gal	.33 –	....
Xylol, com., tanks, gal	.26 –	....

MISCELLANEOUS

Casein, tech., bbl., lb	$0.21 –	$0.24
Dry colors		
Carbon gas, black (wks.), lb	.0335–	.30
Prussian blue, bbl., lb	.36 –	.37½
Ultramarine blue, bbl., lb	.11 –	.26
Chrome green, bbl., lb	.21½–	.30
Carmine, red, tins, lb	4.60 –	4.75
Para toner, lb	.75 –	.80
Vermilion, English, bbl., lb	3.05 –	3.10
Chrome yellow, C.P., bbl., lb	.14¼–	.15¼
Gum copal Congo, bags, lb	.09 –	.30
Manila, bags, lb	.09 –	.15
Demar, Batavia, cases, lb	.10 –	.22
Kauri, cases, lb	.18 –	.60
Magnesite, calc, ton	64.00 –	....
Pumice stone, lump, bbl., lb	.05 –	.07
Rosin, H., 100 lb	4.95 –	....
Turpentine, gal	.88 –	....
Shellac, orange, fine, bags, lb	.39 –	....
Bleached, bonedry, bags, lb	.39 –	....
T. N. bags, lb	.31 –	....

NEW CONSTRUCTION

	Current Projects		Cumulative 1944	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	....	$44,000	$40,000	$509,000
Middle Atlantic	$495,000	....	495,000	120,000
South	480,000	360,000	480,000	400,000
Middle West	....	2,722,000	80,000	1,587,000
West of Mississippi	3,830,000	6,325,000	5,370,000	745,000
Far West	....	4,500,000	500,000	4,500,000
Canada	2,580,000	....	2,580,000	....
Total	$7,385,000	$13,951,000	$9,545,000	$7,861,000

PROPOSED WORK

Ark., Lewisville—Barnsdall Oil Co., 2620 North Lottie St., Oklahoma City, Okla., plans to construct a high test gasoline manufacturing plant. Estimated cost will exceed $250,000.

Ky., Clermont—James B. Beam Distilling Co., Clermont, plans to construct additional plant facilities. Project will be financed by Defense Plant Corp., Washington, D. C. Estimated cost $140,000.

La., New Orleans—Stauffer Chemical Co., Freeport, Tex., plans the construction of a plant to produce a complete line of refined, ground and processed sulphurs.

Md., Baltimore—Baltimore Pure Rye Distilling Co., 111 East Redwood St., plans to construct additional plant facilities. Project will be financed by Defense Plant Corp., Washington, D. C. Estimated cost $315,000.

N. J., Raritan—General Ceramics Co., Jackson Ave., plans the construction of a 1 story warehouse. Estimated cost $40,000.

Pennsylvania—Petroleum Solvents Co., Butler Savings & Trust Co. Bldg., Butler, Pa., is having plans prepared by Michael Baker, Jr., Engr., Baker Bldg., Rochester, Pa., for the construction of steel storage tanks and loading docks. Estimated cost $100,000.

Pa., New Kensington—Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh, Pa., plans the construction of a 1 and 2 story research laboratory. J. W. Schreiber, c/o Company, Ch. Engr.

Tenn., Elizabethtown—North American Rayon Co., Elizabethtown, will soon receive bids for the construction of the superstructure for an addition to its rayon mill. Moran, Proctor, Freeman & Mueser, 420 Lexington Ave., New York, N. Y., Archts. Contract for substructure has been let to Hughes-Foulkrod Co., Schaff Bldg., Philadelphia, at approximately $300,000.

Tex., Kilgore—Petrolite Wax Co., Kilgore, plans to reconstruct its warehouse. Estimated cost $40,000.

Tex., Port Neches—Lummus Co. plans to construct a pilot building at its refinery here. Estimated cost $40,000.

Tex., Rusk—Defense Plant Corp., 811 Vermont Ave., N. W., Washington, D. C., plans the construction of a blast furnace and chemical plant. McCrossin Engineering Co. et al, 120 Wall St., New York, N. Y., will operate. Estimated cost $3,500,000.

Alta., Calgary—Ecuchwa Oils, Ltd., c/o A. Hannah, Calgary, plans the construction of a refinery.

B. C., Vancouver—General Paint Co., Ltd., 950 Raymuir Ave., plans to construct a 2-story addition to its plant.

Ontario—Marathon Paper Mills of Canada, Ltd., 326 Bay St., Toronto, is having plans prepared by Kimberly Clark Corp. of Canada, Ltd., 330 University Ave., Toronto, for two major pulp mills at two northern Ontario points. Estimated cost $1,250,000 each; complete program $10,000,000.

CONTRACTS AWARDED

Ala., Birmingham—Ferro Enamel Co., 4150 East 56th St., Cleveland, O., has awarded the contract for the construction of a plant to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $200,000.

Ga., Valdosta—Turpentine & Rosin Factors, Inc., Jacksonville, Fla., will construct a turpentine packaging plant. Work will be done by own forces. Estimated cost $40,000.

Ind., Indianapolis—U. S. Rubber Co., 549 East Washington St., has awarded the contract for remodeling and constructing addition to its plant to Service Construction Co., 417 Castle Hall, at $92,000.

Ia., Clinton—Clinton Products Co., Clinton, has awarded the contract for additions and expansions to its alcohol factory to Weitz Construction Co., Inc., 406 Fleming Bldg., Des Moines. Estimated cost $275,000.

Mass., Everett—Monsanto Chemical Co., Chemical Lane, has awarded the contract for the construction of a warehouse to William M. Bailey Co., 88 Broad St., Boston, at $44,000.

Mich., St. Clair—Morton Salt Co., F. C. Philbrist, Gen. Mgr., has awarded the contract for rebuilding plant destroyed by fire to Bryant & Detwiler Co., 2304 Penobscot Bldg., Detroit. Estimated cost $2,000,000.

N. M., Carlsbad—United States Potash Co., T. M. Cramer, Mgr., has awarded the contract for expanding its plant to C. C. Moore & Co., Vermont St., San Francisco, Calif. Estimated cost $1,000,000.

North Carolina—American Enka Corp., Enka, has awarded the contract for an addition to its lacquer building to Merchant Construction Co., Asheville. Estimated cost will exceed $40,000.

O., Akron—Mohawk Rubber Co., 1235 Second Ave., has awarded the contract for a 2-story addition to its factory to B. F. Perry Co., 106 North Main St. Estimated cost $125,000.

O., Cleveland—Aluminum Co. of America, 2210 Harvard Ave., has awarded the contract for the construction of a laboratory to Albert M. Higley Co., 2036 East 22nd St. Estimated cost $400,000.

O., Cleveland—Cleveland Graphite Bronze Co., 16800 St. Clair Ave., has awarded the contract for a 1-story, 35x600 ft. plating building to A. M. Higley Co., 2036 East 22nd St., Cleveland. Estimated cost $105,000.

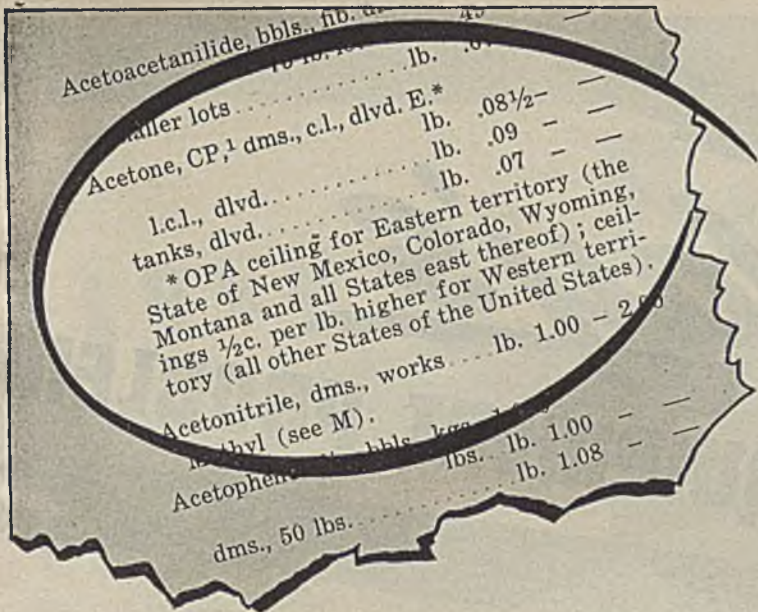
Okla., Miami—B. F. Goodrich Co., 500 South Main St., Akron, O., has awarded the contract for the design and construction of a rubber tire manufacturing plant, including 2-story, 300x350 ft. and 300x650 ft. factory buildings, boiler room and storage building to Austin Co., 16112 Euclid St., Cleveland, O. Estimated cost $5,000,000.

Ore., Salem—Defense Plant Corp., 811 Vermont Ave., N. W., Wash., D. C., has awarded the contract for design and construction of alumina-from-clay plant to Chemical Construction Corp., 30 Rockefeller Plaza, New York, N. Y. Columbia Metals Corp., Securities Bldg., Seattle, Wash., will operate. Estimated cost $4,500,000.

S. C., Greenville—Deering Milliken & Co., Inc., Church and Leonard Sts., New York, N. Y., has awarded the contract for the construction of a rayon mill to Daniel Construction Co., Greenville.

Tex., Arp—Inreco Refining Co., Arp., will reconstruct the cracking unit at its refinery. Work will be done by force account and subcontracts. Estimated cost $50,000.

Va., Front Royal—American Viscose Corp., Wilmington, Del., has awarded the contract for the construction of a rayon cord manufacturing plant to Rust Engineering Co., Clark Bldg., Pittsburgh, Pa.



...but it costs only ½ cent a pound to recover Acetone with Columbia Activated Carbon

BECAUSE of their low-operating expense and their high over-all efficiency—usually greater than 95 per cent—solvent recovery plants using Columbia Activated Carbon recover acetone and other volatile solvents for a half cent a pound ... or less ... a fraction of the cost of new solvent.

The table shows typical operating costs for a large plant recovering acetone with Columbia Activated Carbon. This plant, like all of the solvent recovery plants that we design and supply, is equipped to separate and purify the recovered solvents so that they can be re-used immediately.

Solvent recovery plants using Columbia Activated Carbon can recover all kinds of volatile solvents . . . esters, ketones, alcohols, hydrocarbons, chlorinated compounds, ether, and carbon bisulfide . . . with high efficiency and low cost comparable to the record of this acetone recovery unit.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

In almost every type of manufacturing operation where solvents are vaporized under conditions which permit collection of the vapor-laden air, these solvent recovery plants can help insure the supply of solvents and lower manufacturing costs. More than $65,000,000 worth of solvents will be recovered annually by plants now in operation or under construction.

We design and supply complete solvent recovery plants to fit specific requirements—plants with guaranteed operating characteristics that quickly pay for themselves.

If you vaporize solvents in your operations, and would like more information about solvent recovery with Columbia Activated Carbon, write for our 28-page booklet.

Typical Operating Expense of a Large Plant
(Per Pound of Solvent Recovered Ready for Re-Use)

Steam at 40¢/1000 lb.	$0.0020
Electric power at 1¢/KWH	0.0008
Water at 10¢/1000 gal.	0.0010
Supervision	0.0005
Maintenance	0.0004
Total, Per Pound	$0.0047

This plant has the capacity to handle 3,000 pounds per hour of acetone and 30,000 cubic feet per minute of vapor-laden air measured at 100°F.

Representative Industries For Which We Have Designed and Supplied Complete Solvent Recovery Plants Include: *Rayon, Artificial Leather, Lacquer Coatings, Rubber, Rotogravure Printing, Smokeless Powder, Plastics, and Transparent Wrappings.*

For information concerning the uses of "Columbia" Activated Carbon, address:

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

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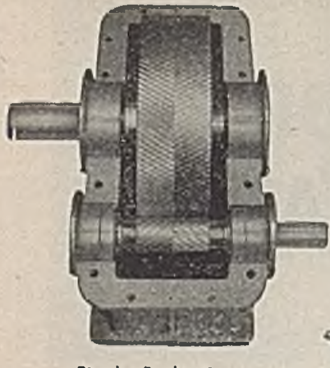
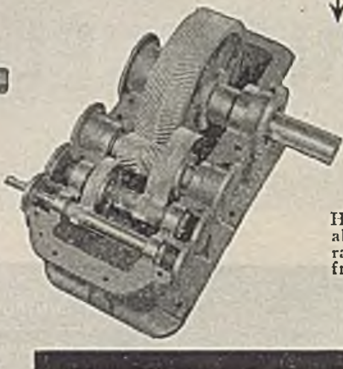
30 East 42nd Street, New York, N. Y.

PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

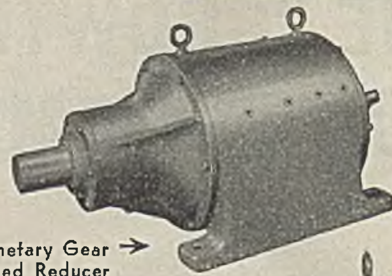


Double and Triple Reduction Continuous-Tooth Herringbone Gear Reducer
(Triple reduction illustrated below)
With offset shaft. Available in 24 sizes in a ratio range of 10 to 350:1 and from .63 to 380 h.p.



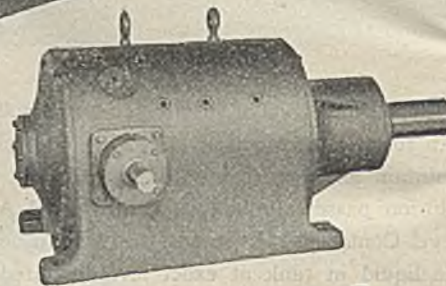
Single Reduction Continuous-Tooth Herringbone Gear Reducer
Available in 14 sizes, in a ratio range of 2 to 10:1, and from 1 to 1230 horsepower.

PLANETARY REDUCERS

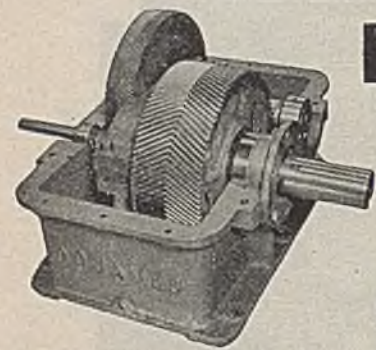


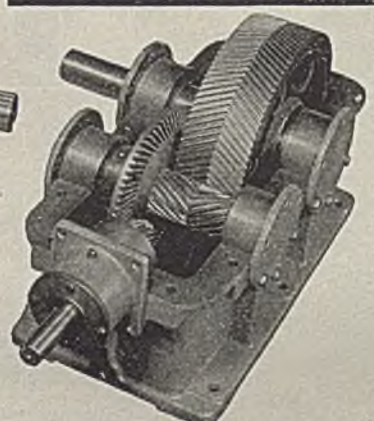
Planetary Gear Speed Reducer
Horizontal drive. Available in 35 sizes in a ratio range of 10 to 1200:1 and from ¾ to 75 horsepower.

Right Angle Spiral Bevel Planetary Gear Speed Reducer
Horizontal drive. Available in 33 sizes in a ratio range of 8 to 1100:1 and from ½ to 75 horsepower.



HERRINGBONE REDUCERS

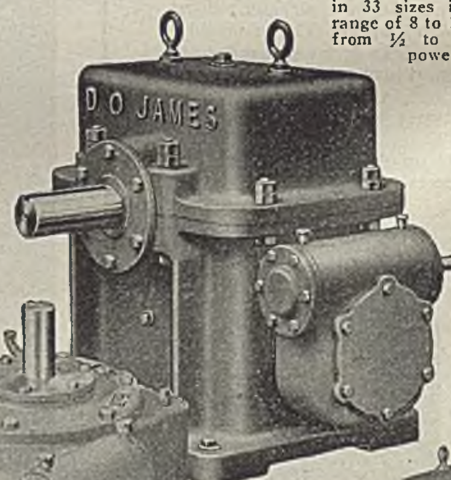




Right Angle Spiral Bevel Herringbone Gear Reducer
Available in 11 sizes in a ratio range of 6 to 45:1 and from 1 to 250 horsepower. Horizontal and vertical drive. (Horizontal drive illustrated.)

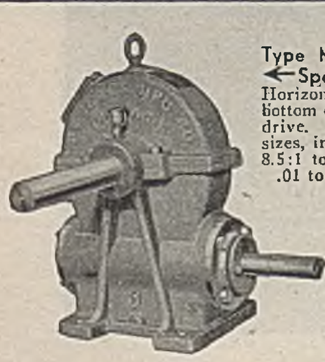
Double Reduction Continuous-Tooth Herringbone Gear Reducer
With straight-line drive. Available in 12 sizes in a ratio range of 10 to 75:1 and from 1 to 500 horsepower.

Right Angle Spiral Bevel Planetary Gear Speed Reducer
Vertical drive. Available in 33 sizes in a ratio range of 8 to 1100:1 and from ½ to 75 horsepower.

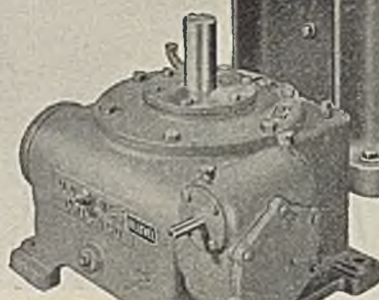


Double Worm Gear Speed Reducer
Horizontal drive. Available in 10 sizes in a ratio range of 150 to 8100:1 and from ⅛ to 50 horsepower.

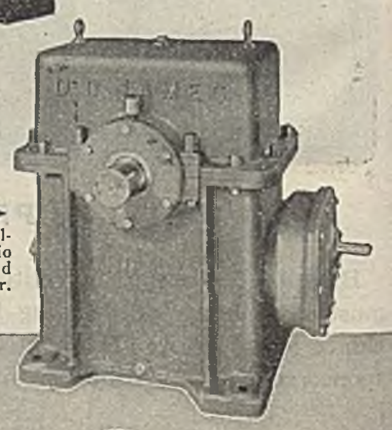
WORM GEAR REDUCERS



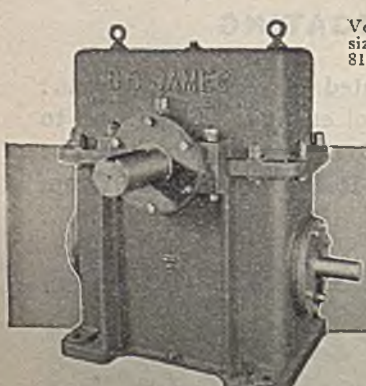
Type M Worm Gear Speed Reducer
Horizontal drive, worm bottom or top, or vertical drive. Available in 48 sizes, in a ratio range of 8.5:1 to 240:1 and from .01 to 42 horsepower.



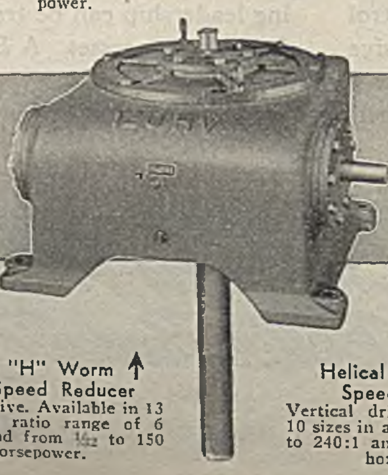
Double Worm Gear Speed Reducer
Vertical drive. Available in 10 sizes in a ratio range of 150 to 8100:1 and from ⅛ to 50 horsepower.



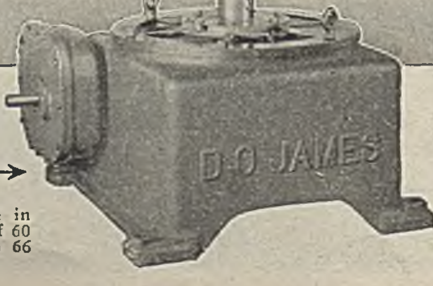
Helical Worm Gear Speed Reducer
Horizontal drive. Available in 10 sizes in a ratio range of 60 to 240:1 and from ¼ to 66 horsepower.



Type "H" Worm Gear Speed Reducer
Horizontal drive. Worm bottom or top. Available in 26 sizes in a ratio range of 6 to 65:1 and from 1/12 to 150 horsepower.



Type "H" Worm Gear Speed Reducer
Vertical drive. Available in 13 sizes in a ratio range of 6 to 65:1 and from 1/12 to 150 horsepower.



Helical Worm Gear Speed Reducer
Vertical drive. Available in 10 sizes in a ratio range of 60 to 240:1 and from ¼ to 66 horsepower.

BANISH CORROSION FOR

IN TANKS, PUMPS, PIPE AND FITTINGS

corrosion is one of your arch enemies. It eats up profits—slows production. Now is the time to plan your post-war anti-corrosion campaign. Call on Ace Rubber engineering to help protect your equipment from its costly ravages.

ADD synthetic rubber to the forces which Ace has ranged against corrosion and contamination. Together with natural rubber, both soft and hard, and other new synthetic compounds, it helps spell economical operation in chemical processing plant operations.

Ace Rubber is fully resistant to almost all active metal-destroying solutions. Long-lived, it is good for years of heavy-duty service within a wide temperature range. Ace Rubber is non-porous, tough, smooth, easy-to-clean. Our engineering and research staffs are at your service, naturally without any obligation to you.

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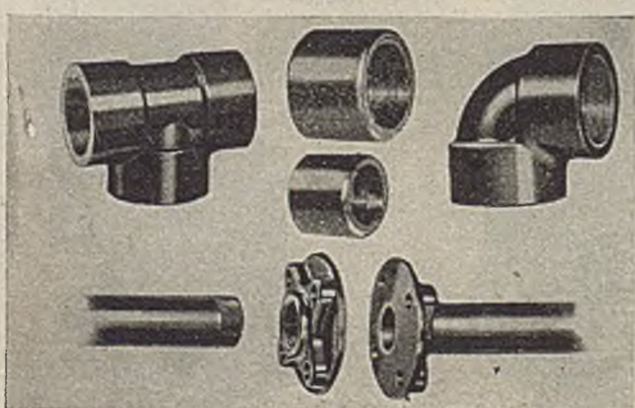
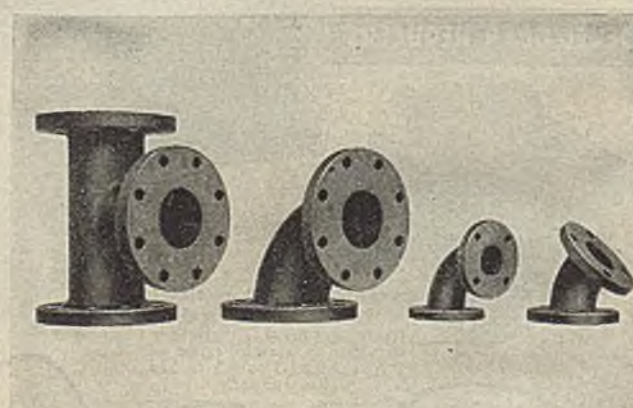
ACE PLASTIC (SARAN)



ACE PLASTIC (SARAN). Pipe available in all iron pipe sizes from ½" to 4" I.D. Fittings presently available up to 2" I.D.

ACE RUBBER



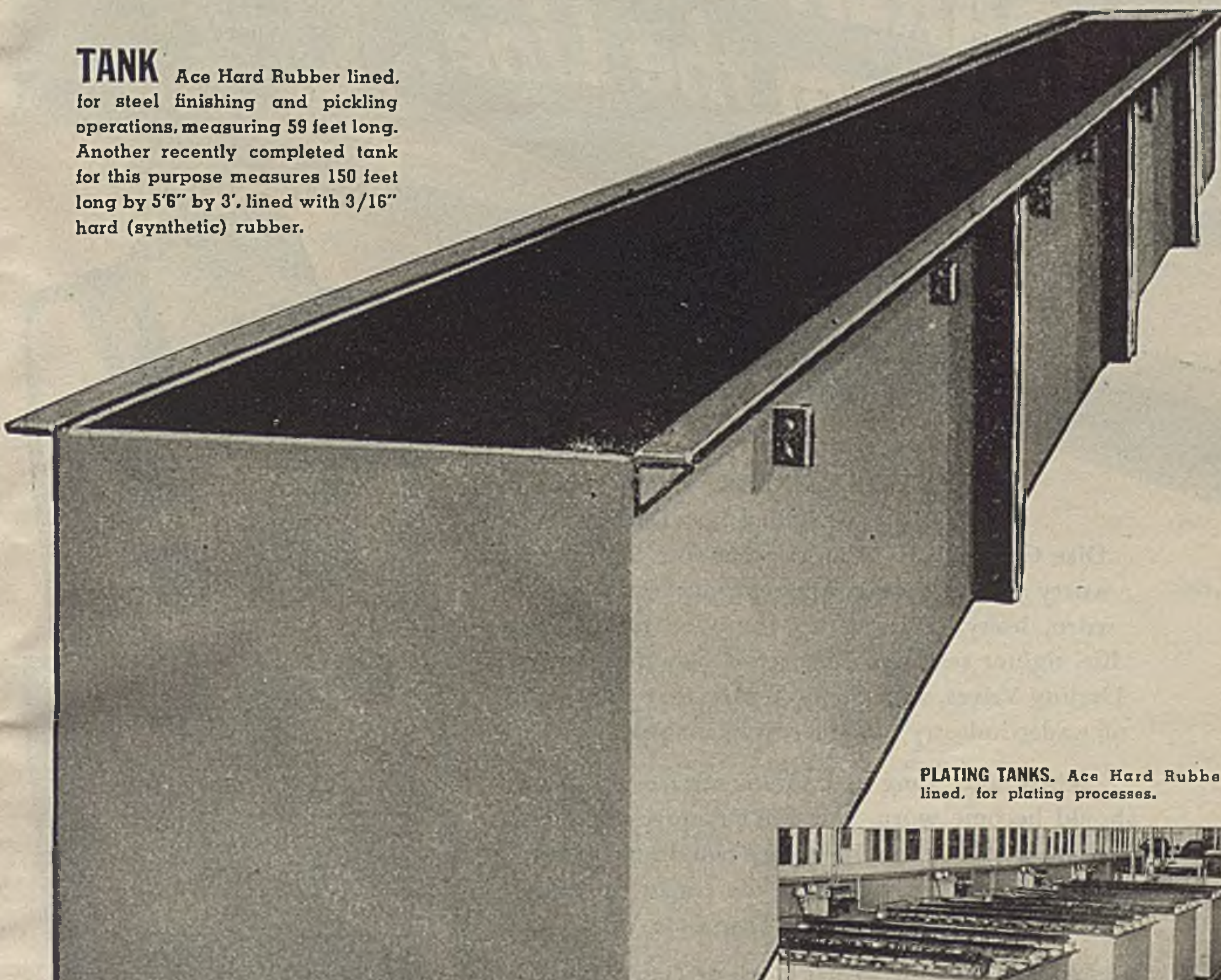
PIPE & FITTINGS. Ace Hard or Soft Rubber lined, I.P.S. standard, sizes 2" to 12". Also solid hard rubber pipe and fittings.

WRITE FOR YOUR FREE COPY

of 65-page catalog of Ace Rubber Protection —an invaluable reference book for plant engineers.

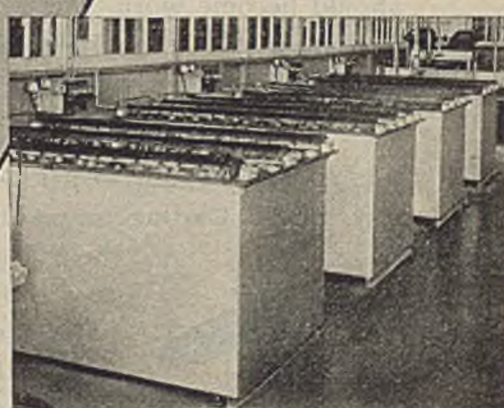
ACE

POST-WAR ECONOMY



TANK Ace Hard Rubber lined, for steel finishing and pickling operations, measuring 59 feet long. Another recently completed tank for this purpose measures 150 feet long by 5'6" by 3', lined with 3/16" hard (synthetic) rubber.

PLATING TANKS. Ace Hard Rubber lined, for plating processes.



SARAN Distinguished addition to the Ace group of non-corrosive rubber and plastic materials. SARAN is notable for its inertness in contact with almost all active chemicals. SARAN supplements in utility the Ace line of hard rubber and rubber lined pipe and fittings. Available for special injection-molded articles for chemical resistant services. Illustrated Saran description circular on request.

NATURAL and SYNTHETIC

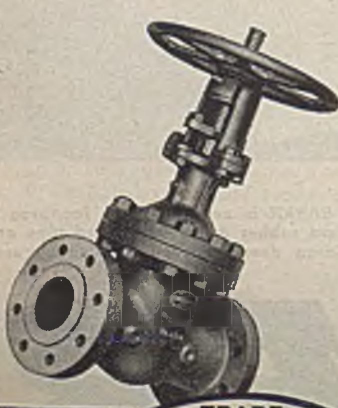
RUBBER

PROTECTION for POST-WAR PRODUCTION

LUCKY BREAK, wasn't it, the day you installed those Darling Double Disc Gate Valves. It means that you don't have to worry about slowing down production to remove worn, leaky, faulty valves from the line. Longer life, tighter seating, better service *are designed into* Darling Valves, with 4 simple parts that have stood up under industry's toughest jobs for years.

When, after long and severe service, the parts should become worn, you don't remove the valve from the line. You simply replace two discs and two wedges—4 inexpensive parts—the entire working assembly of a Darling Double Disc Gate Valve.

It may be diffcult to get Darling Gate Valves today. Most of Darling's output has been enlisted to help float Uncle Sam's ships to victory. Replacement parts are available. New valves will also be available for shipment immediately following government release from present commitments, on or before the time the war is over.



Only 4 PARTS

Two discs and two wedges—the entire working part assembly of a Darling Double Disc Gate Valve. There is no other valve with this design. The seats are parallel. The discs are *fully revolving*, seating in a different position each time the valve is operated. This means tighter seating, less wear, longer operation and lower maintenance costs with Darling Gate Valves.

You don't have to take a Darling Double Disc Gate Valve out of the line to replace the parts. Simply insert new and inexpensive assembly parts and replace Stem and Bonnet. Valve is again ready for long, hard service.

TRADE DARLING MARK VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.