CHEMICAL
& Metallurgical
ENGINEERING

JUNE • 1944

Volume 51 Number 6

In this Issue

Cover Picture

These CWS boys are doing their share. Are you doing yours? Buy that extra bond during the Fifth War Loan Drive.

AN INDEX TO ADVERTISERS WILL BE FOUND ON PAGE 392

Published monthly. Price 35 cents per copy. Publication office, 99-129 North Broadway, Albany 1, N. Y. Address communications about subscriptions to Director of Circulation, Chem. & Met., 330 West 42nd St., New York 18, N. Y. Subscription rates: United States, Mexico, Central and South American Countries, $3 per year, $4 for two years, $5 for three years. Canada $3.50 per year, $5 for two years, $6 for three years (payable in Canadian funds). Great Britain and British Possessions, 30 shillings per year, 60 shillings for three years. All other countries, $5 per year, $10 for three years. Entered as second class matter September 3, 1936, at Post Office at Albany, N. Y., U. S. A., under act of March 3, 1879. Contents copyrighted, 1944 by McGraw-Hill Publishing Company, Inc. Branch offices: 520 North Michigan Avenue, Chicago 11; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W. C. 2; Washington 4; Philadelphia 2; Cleveland 15; Detroit 2; St. Louis 8; Boston 16; Los Angeles 14; Atlanta 3; Pittsburgh 22.

Return Postage Guaranteed

McGRAW-HILL PUBLISHING CO., INC.
JAMES H. McGRAW
Founder and Honorary Chairman

Publication Office
99-129 North Broadway, Albany 1, N. Y.
Editorial and Executive Offices
330 West 42nd Street, New York 18, N. Y.
JAMES H. McGRAW, Jr. .... *President*
HOWARD EHRLICH
Executive Vice-Pres. for Business Operations
JOHN ABBINK
Executive Vice-Pres. for Editorial Operations
CURTIS W. McGRAW
Vice-President and Treasurer
J. A. GERARDI .... *Secretary*
J. E. BLACKBURN, Jr.
Director of Circulation
Member A.B.P. Member A.B.C.
Cable Address McGRAWHILL, New York

CHANGE OF ADDRESS

McGRAW-HILL PUBLISHING COMPANY
330 West 42nd Street, New York 18, N. Y.
Director of Circulation:

Please change my address on Chemical & Metallurgical Engineering

From ....

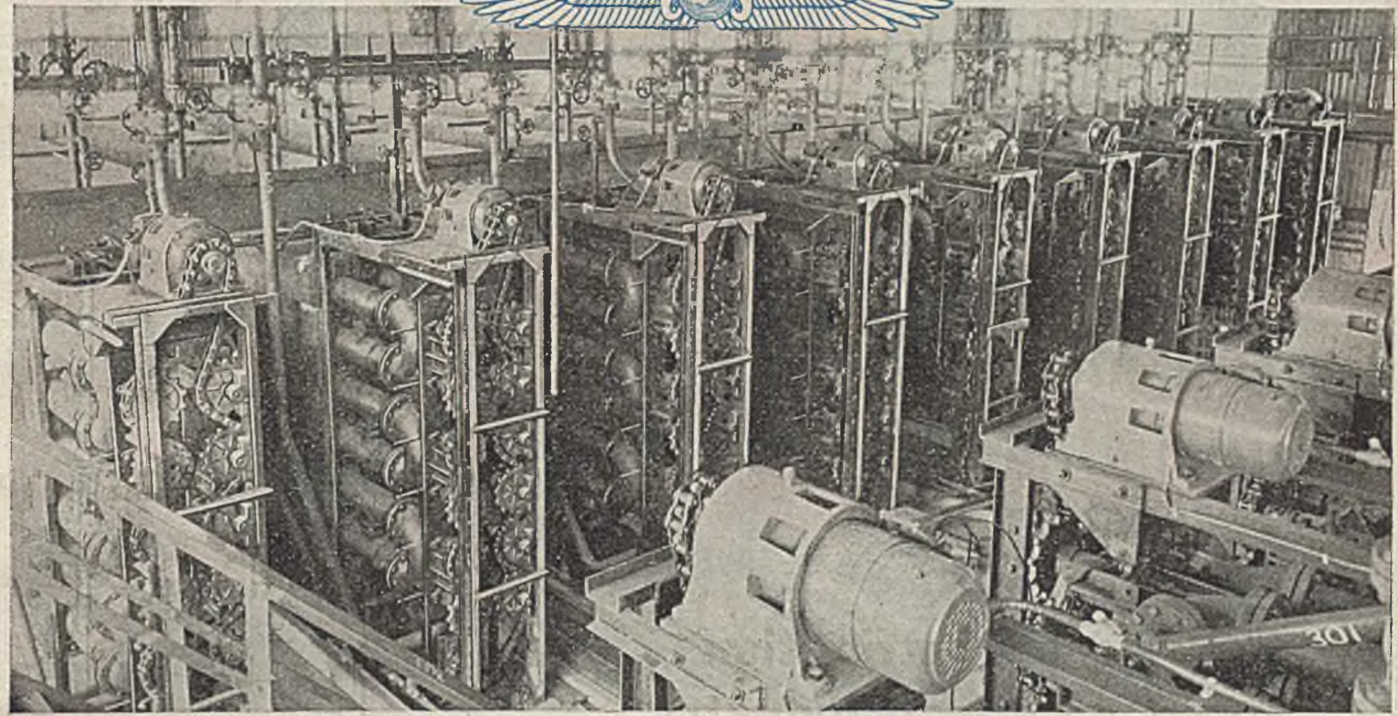
....

To ....

....

Signed ....

LET'S FOLLOW THE REFRIGERANT THROUGH A WORTHINGTON DOUBLE-PIPE CHILLING MACHINE



. . . and see how heat-transfer rate is increased 3 important ways

1. No "flash" gas enters the chilling sections—Volatile refrigerant is fed directly into an accumulator where "flash" gas, formed as the refrigerant passes from liquid to evaporating stage, is released. It returns to the refrigerating machine. Only liquid refrigerant at saturated temperature reaches the chilling sections. *Thus, you get the heat-transfer benefit of full evaporation where you need it*

2. Inclined position improves circulation—The refrigerant-vapor outlet is higher than the liquid refrigerant inlet—an exclusive Worthington feature. Gravity-flow fed from the accumulator, the liquid refrigerant enters the bottom of each chilling section. Surplus is swept back to the accumulator. *This circulation greatly increases the heat transfer rate.*

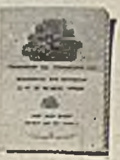
3. Spring-loaded scrapers keep pipes clean—As fluid to be chilled—wax-bearing oil or other solutions—passes through the inside pipes, it transfers its heat to the refrigerant. The crystals form but do not adhere to the cold surface as inside surfaces are continuously cleaned by rotating spring-loaded scrapers. This insures the most efficient heat transfer

Worthington double-pipe exchangers have same design, and construction as direct-expansion chilling machines except for level position and non-volatile refrigerant.

Full details in new Bulletin C-1100-B-15

This new bulletin describes other unique features: special safety scraper drive with shearing protection for each section; easily removed drive shaft with pressure lubricated bearings; external ball-type thrust bearings; improved chain-and-sprocket-type main drive with adjustable outboard bearings.

Write for Bulletin C-1100-B-15 today and learn how Worthington's experience for more than fifty years with this type of equipment has resulted in improved design, construction and operation.



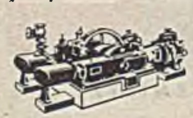
WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J.

WORTH BEHIND THE NAME WORTHINGTON

FIVE MORE REASONS WHY WORTHINGTON LEADS IN INDUSTRIAL REFRIGERATION

AR4-13

1. Horizontal compressors for ammonia, propane, butane



2. Angle engine compressors

3. Centrifugal compressors

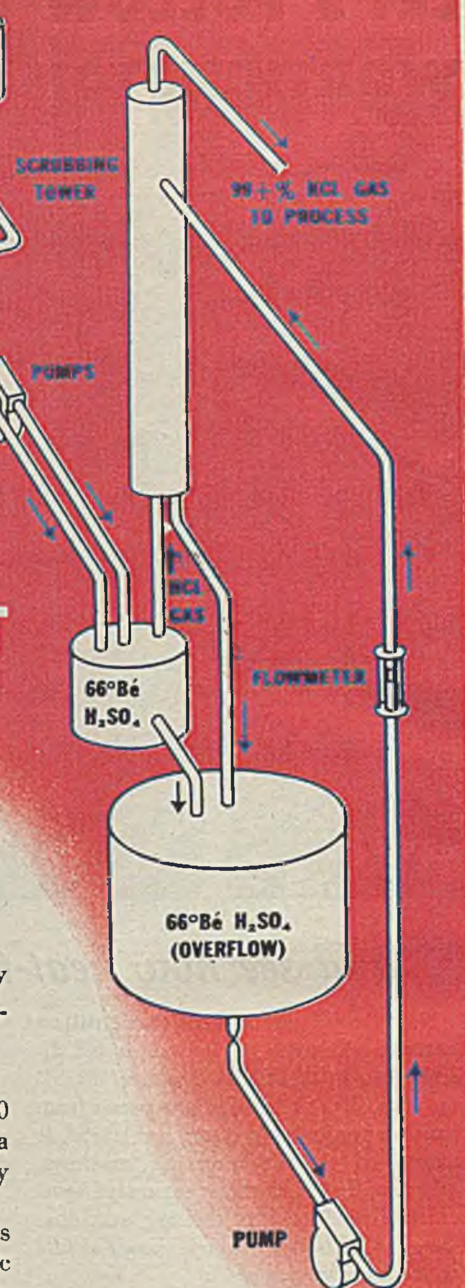
4. Absorption refrigerating machines

5. Shell and tube refrigerating equipment

Are you using **ANHYDROUS HCL** in the production of

- AVIATION GASOLINE
- SYNTHETIC RESINS
- VINYL CHLORIDES
- PHARMACEUTICALS
- AMINE HYDROCHLORIDES

HERE'S A NEW WAY TO PRODUCE 99+% HCL RIGHT IN YOUR OWN PLANT



As a contribution to American Industry...

...an unrestricted and royalty-free license will be granted to any company wishing to manufacture anhydrous HCL with chlorosulfonic and muriatic acids.

SIMPLICITY describes this new Du Pont process.* No other process for producing anhydrous HCL in moderate quantities costs so little to install—or is so safe, easy and economical to operate. By direct reaction—without supplementary purification—you get 99+% HCL. The by-product is 66°Bé sulfuric acid—a strength readily usable or salable.

If you're now using as little as 50 pounds of anhydrous HCL daily, a unit can be designed which will pay for itself in less than a year.

For further details of this process and for information on chlorosulfonic and muriatic acids write: E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Department, Wilmington 98, Delaware.

*U. S. PAT. NO. 2,303,537

QUICK FACTS ABOUT THIS NEW PROCESS

Low investment: Much of the necessary equipment may already be available in your plant. Only standard materials of construction are required.

Simplicity of operation: Occasional adjustment of but *one* valve is all the control required. Process can be started and stopped at will.

Low operating cost: Power consumption is negligible. Operation requires part-time attention of only one man.

By-product: Approximately two lbs. of usable or salable 66°Bé H_2SO_4 per pound of HCL are obtained.

High purity yield: 99+% Hydrogen Chloride.

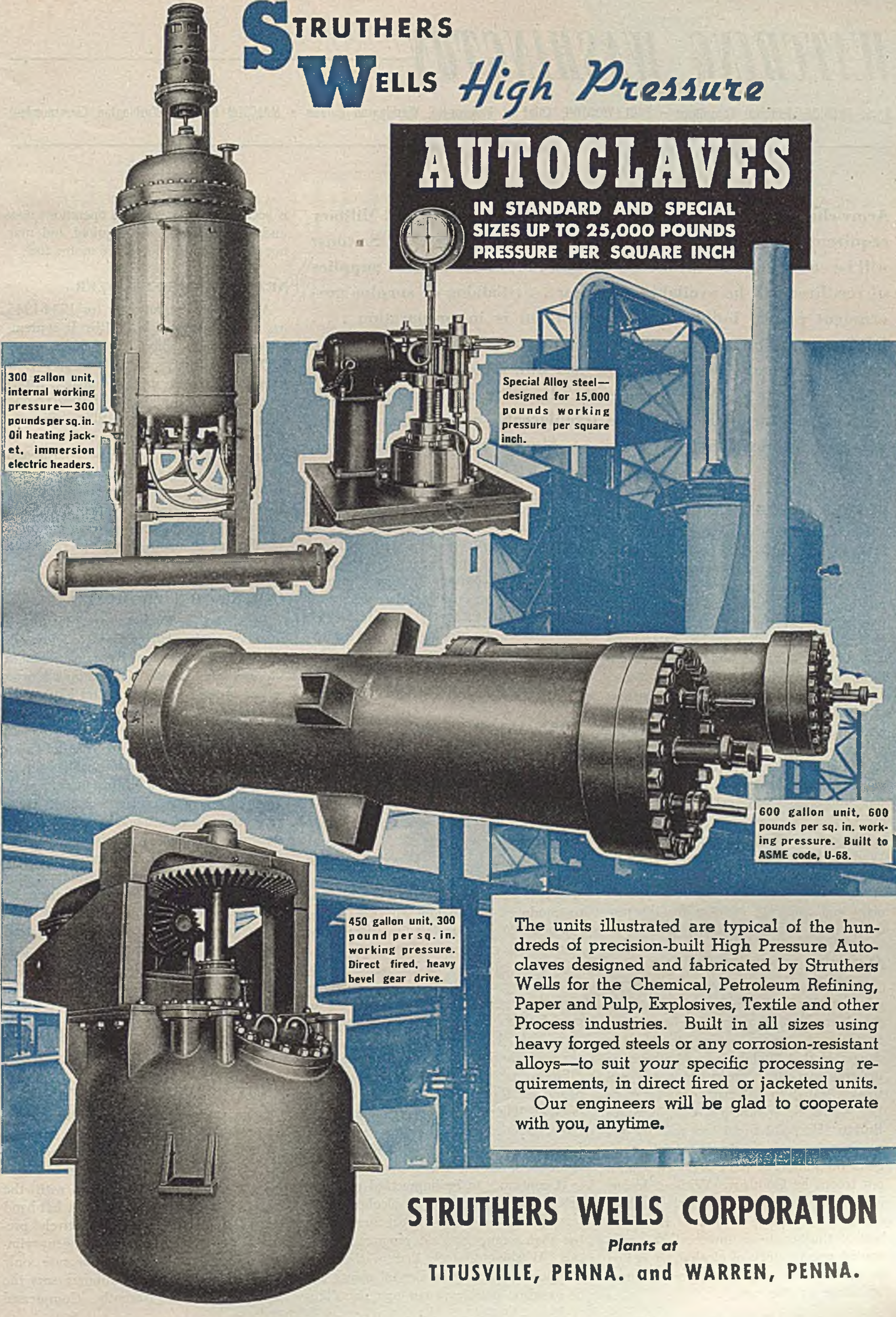
TYPICAL ANALYSIS OF DU PONT CHLOROSULFONIC ACID

Specific gravity @ 60°F.	1.752
Total chlorosulfonic acid ($HCLSO_3$)	98.8%
Free sulphuric acid (H_2SO_4)	0.7%
Iron (Fe)	0.001%
Boiling point	316°F. (Approx.)
Freezing point	−112°F. (Approx.)

DU PONT CHLOROSULFONIC ACID

DU PONT

BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY


STRUTHERS WELLS High Pressure
AUTOCLAVES
IN STANDARD AND SPECIAL SIZES UP TO 25,000 POUNDS PRESSURE PER SQUARE INCH
300 gallon unit, internal working pressure—300 poundspersq.in. Oil heating jacket, immersion electric headers.
Special Alloy steel—designed for 15,000 pounds working pressure per square inch.
600 gallon unit, 600 pounds per sq. in. working pressure. Built to ASME code, U-68.
450 gallon unit, 300 pound per sq. in. working pressure. Direct fired, heavy bevel gear drive.
The units illustrated are typical of the hundreds of precision-built High Pressure Autoclaves designed and fabricated by Struthers Wells for the Chemical, Petroleum Refining, Paper and Pulp, Explosives, Textile and other Process industries. Built in all sizes using heavy forged steels or any corrosion-resistant alloys—to suit your specific processing requirements, in direct fired or jacketed units.
Our engineers will be glad to cooperate with you, anytime.
STRUTHERS WELLS CORPORATION
Plants at
TITUSVILLE, PENNA. and WARREN, PENNA.

WATCHING WASHINGTON

R. S. McBRIDE, Editorial Consultant • PAUL WOOTON, Chief of McGraw-Hill Washington Bureau • MALCOLM BURTON, Washington Correspondent

Army changes its mind on the Gopher Ordnance project . . . Military requirements demand all available alcohol capacity . . . Sawdust will be converted into alcohol in Oregon . . . All-time record supplies of fertilizer will be available next year . . . Catalog of surplus government plants, buildings and equipment is in preparation . . . DDT may be excessively effective in its insect killing . . . The medical profession wants to know just how effective quinine really is . . . Bureau of Mines makes its plans for an investigation of synthetic motor fuels . . . More irreplaceable young men may be deferred by new Hershey ruling . . . Aluminum production is cut.

GOPHER ORDNANCE WORKS

Negotiations that were expected to lead to the operation of the Gopher Ordnance Works in Minnesota for the manufacture of sulphuric acid and superphosphate have been held up. Army Ordnance has withdrawn the plant and is holding it until it can be determined whether operation of some of the oleum facilities should be started. The freeze is for a 90-day period pending determination of whether the production is needed in the war effort. If Ordnance decides to resume the manufacture of smokeless powder at the Gopher works, it is probable that the plant will be used also to make some superphosphate and acid as originally planned.

Three firm offers were received by the War Production Board in response to its announcement that it was seeking firms to operate the plant and to convert the oleum plant and construct facilities for the production of superphosphates.

ALCOHOL NEEDS FORECAST

Congress continues to press WPB for relief of the alcohol beverage industry so that it can go back to making hard liquor to replenish rapidly waning stocks. The danger of that "holiday" for the beverage makers from their present war job was frankly stated to a Senate committee by Dr. Walter G. Whitman of the Chemicals Bureau. He pointed out that military precautions demand a readiness to make toxic gases for warfare if these are used against our troops by Germany. Without in any way presuming to forecast such methods of fighting he made it clear to the members of the Senate committee that a substantial reserve stock of alcohol for poison gas making was an essential precaution at this stage of the war.

No decline in the demand for alcohol is suggested by any of the responsible government officials as yet. The synthetic rubber industry and the making of military explosives continue to impose huge requirements, not only for the balance of 1944, but prospectively also for 1945. Until the Pacific war has gone far enough to permit a resumption of natural rubber movement to the United States, alcohol makers are, it appears, going to be busy.

MORE ALCOHOL SOUGHT

New sources of alcohol are still being investigated by WPB by plant-scale and large pilot-plant investigations. After many setbacks the plan to produce industrial alcohol from wood sugar made from sawdust was approved. That project of Willamette Valley Wood Chemical Co. provides for a plant at Eugene, Ore., at a cost of $2,247,000 that is estimated to produce 4.1 million gal. per yr. at capacity. Waste sawdust is available for many times this output.

Pressure continues for the authorization of a new synthetic alcohol plant to use a high-temperature cracking process for manufacture of acetylene and ethylene from natural gas as a first step toward alcohol. Despite the recommendations of OPRD, that project had not yet had approval for the proposed plant at the end of May. There had been premature previous announcements that this plant for Louisiana was approved; but such was not the case.

It continues to be impractical to divert petroleum refinery gases to alcohol manufacture because of the great urgency of the high-octane gasoline program. However, Washington feels that in the postwar period several new alcohol plants will be based on petroleum raw materials. This is because aviation gasoline operations now under way will not be required and may not be economical for other motor fuel.

NEXT YEAR'S FERTILIZER

A program for fertilizer for 1944-1945 has been formulated by WPB. It contemplates the availability of 700,000 tons of K_2O from primary potash salts; 1,500,000 tons of P_2O_5 as superphosphate, triple-super, and special phosphate fertilizers; and at least 710,000 tons of fertilizer nitrogen. These amounts represent an increase of about one-sixth in supply of potash and phosphate, but an increase of only 6 percent in nitrogen as compared with the fertilizer year ending this June. High farm income will undoubtedly develop promptly a sufficient demand to absorb these all-time record supplies.

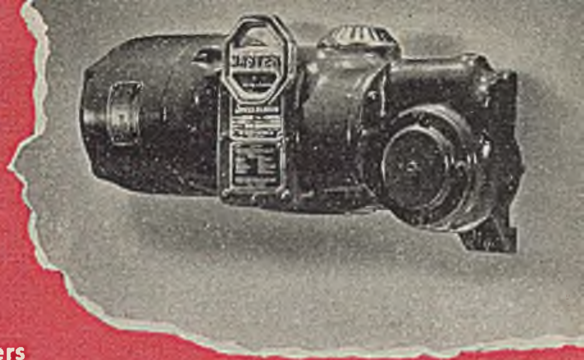
CAREER MEN PROMOTED

Dr. Paul B. Dunbar, over 35 years a member of the staff of Food & Drug Administration, was named commissioner to succeed Dr. Walter G. Campbell who retired at the end of April after 37 years of government service. Charles W. Crawford was also advanced from the position of assistant commissioner to that of associate commissioner in order to fill the post vacated by Dunbar's advancement.

It is generally understood that these promotions are intended not only to recognize long and distinguished service to the public, but also to indicate an intention of Federal Security Administrator McNutt to have the prevailing policies of F&DA continued in long established lines. Since many of the administrative and public relations policies of F&DA have for years been under the direction of these two executives, it is very unlikely that any important modifications of policy will follow at this time merely because they have each stepped up one rung on the official ladder.

ARMY COOPERATES ON VALVES

Safety requires uniform adherence to the standards for hydrogen valves on high-pressure cylinders carrying that industrial gas. Until recently not all cylinders used by the Army have complied with the standard screw requirement of a left-hand thread connection which effectively prevents the attachment of hydrogen cylinders where not intended, because only these valves of standard cylinders carry the left-hand thread. Recently, Compressed



VARIABLE SPEED operation offers tremendous advantages on many applications and you'll find it's easy to secure even greater advantages from your variable speed drives if you use Master Speedrangers.

Greater advantages because the Speedranger is a compact integral unit . . . only one unit to mount . . . saves space, saves money.

Greater advantages because Speedrangers are available for every current specification, every type enclosure, with gearheads, unibrakes . . . and in the whole wide range of types in the Master line. This wide flexibility makes it easier to secure just the right drive for each installation.

And it's easy to keep right on enjoying these advantages because the all-metal construction of the Speedranger insures much longer trouble free service than units in which less durable materials are used. In addition, the complete Speedranger is designed and manufactured as a unit in one plant by one manufacturer, so there is no division of responsibility for its satisfactory operation.

investigate how easily YOU can secure the many advantages of variable speed operation if you use Master Speedrangers.

THE MASTER ELECTRIC COMPANY
DAYTON 1, OHIO

MASTER

SPEEDRANGERS

Gas Manufacturers Association has persuaded the Army to cooperate. As a result, the Army has asked the Association to instruct its members to notify the chief of engineers if any Army cylinders with nonstandard valve outlets are sent to their plants for filling with hydrogen. He will supply a new valve with proper connections which can be installed on the cylinder before filling.

SURPLUS PLANTS FOR SALE

Before the end of June it was unofficially announced by interested executives of Defense Plant Corp. that several industrial works could be offered to interested bidders by Uncle Sam. First such establishments opened for discussion under the new surplus property program included three detinning plants, two explosives nitration works of small size, one activated charcoal establishment, and one natural graphite mining and concentration unit in the South.

Activities in the early weeks of this work are proceeding slowly. Officials are anxious that no blunders be made which would cause embarrassment in the program. Only by cautious negotiations do they expect to establish precedents which can be followed regularly as other manufacturing facilities become available for sale.

Discussions on a much larger scale are expected. Included in the talk of Washington is the problem of disposal of caustic-chlorine facilities, especially those which Chemical Warfare Service is holding in reserve for the duration. The government would welcome a discussion of means for settling these projects promptly when it is certain that their need for offensive programs has passed. Final settlement in such cases can probably not occur at least until the end of active fighting in Europe is approaching. Meantime, they must be held in reserve to back up the stocks of chemical weapons which are at present adequate as reserves but would not suffice if new types of warfare should be forced on the Allies.

SURPLUS PROPERTY CATALOG

A catalog is planned to describe the plants, buildings, and general production facilities which Defense Plant Corp. must sell ultimately as a part of its surplus war property disposal program. Early in June the staff of DPC was still working to develop some sort of a loose-leaf catalog which most usefully would serve both the government and those who might be interested in investigating the possibilities of purchase from Uncle Sam. The form of the catalog had not then been fully determined, but it was hoped that by July some items would be ready for this listing.

Defense Plant Corp. has an investment interest in about 500 to 600 such establishments. Some of these doubtless will be taken over by the companies operating them, through exercise of options in contracts under which they were built or operated. But a substantial percentage of the total will have to be converted from original war uses to something entirely different. It is this latter group which must be brought to the attention of would-be purchasers so that they most intelligently may study the individual establishments in which they might be interested.

Firms interested in new plant possibilities will want to keep in touch from time to time with the surplus property division of Defense Plant Corp. in Washington. From that source they will be able to receive information as to where plants are located and how this catalog may ultimately be made available.

WPB TO COOPERATE

Another step in the Surplus War PropertyAdministration's careful approach to its problem was taken late in May when W. L. Clayton, SWPA administrator, announced that the War Production Board would cooperate in the disposal of the property left over from terminated contracts. The work will be carried on by WPB's 13 regional offices which will offer the available material in accordance with the price policy recently established by SWPA. The regional offices will handle chemicals, aluminum, copper, steel and other raw materials, as well as semi-finished goods and scrap. These will be disposed of to buyers who are permitted to purchase such surplus materials under the WPB regulations.

DISPOSAL AGENCIES

Regulation No. 1 was announced by the Surplus War Property Administration in mid-May. It governs the declaration of surplus war property by the Army, Navy and Maritime Commission and includes a list of disposal agencies, the location of their regional offices, who is in charge, the classification of property showing types to be disposed of by each agency. The entire regulation was published in the Federal Register of May 13, 1944, which can be secured from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The list of disposal agencies has been increased to eight from the five suggested in the Baruch-Hancock report.

SUGAR AS RAW MATERIAL

Periodical revision of the allocations of various sugars for industrial use is required even more importantly this year than last. Assignment of necessary quantities of fermentable carbohydrates has been needed for various chemical and pharmaceutical production purposes. Manufacture of ethyl alcohol is of course the major user, but many specialties such as penicillin take their toll from the total supply.

Recent government estimates are that 14 million lb. of lactose would be available this year, of which approximately half has been allocated to penicillin manufacturers. Increased allotments of other fermentables are provided by special new authorizations which permit makers of pharmaceuticals, allergy foods, vitamin oils, cough drops, and like products to apply for 25 percent increases in sugar supply, as compared with their base period allotments.

OCCUPATIONAL DEFERMENTS

Hopes for a more logical administration of occupational deferment for key registrants in the 18 through 25 year old group were raised on May 17 by the addition of the Office of Scientific Research and Development and the Review Committee on deferment of government employees to membership in the important Inter-Agency Committee, which has jurisdiction over recommendations to Selective Service in this field. Dr. Vannevar Bush, director of OSRD, was commissioned to report on the critical need for occupational deferment of certain scientists and engineers engaged primarily in research, development and experimental production. The Review Committee, of which Edgar F. Puryear is chairman, may recommend occupational deferment of employees of foreign governments as well as the federal government who come within the criteria previously adopted by the Inter-Agency Committee.

Additional activities that have been added to the previously approved list of occupations recommended by other claimant agencies include: (1) Production of certain crude rubber in Liberia, as recommended by the Office of Rubber Director, (2) trained chemists for the production of explosives, as recommended by the Army Service Forces, (3) technical services relating to the manufacture of special lubricants as recommended by the Petroleum Administration for War.

OVER-EFFECTIVE INSECTICIDE

An insecticide can become too effective for satisfactory use. Washington is seriously concerned as to whether the new synthetic DDT may not be excessively effective in its insect killing. This is one of the reasons why civilian use of this new product will not be permitted this year. The other reason, obviously more important, is that the Army is going to take the entire production for this season.

Two problems are being investigated regarding the desirable limitations to be placed on the distribution of DDT when Army demands no longer require the entire commercial output. It seems probable that there will be no health hazard to human beings or to pets from general household or institutional use of this chemical. That point is being carefully investigated by government and industry

THE use of Tygon "T", the rubber-like plastic, for gasketing is indicated where pressure-tight seals are required in connection with the handling of acids, alkalies, fresh or salt water, alcohols, oils, greases, or gasolines.

In such service, the inherent chemical inertness of Tygon "T", its non-aging and non-oxidizing properties, and the ease with which pressure-tight seals are formed, represent advantages not fully possessed by any other natural or synthetic material.

Tygon "T" may be readily formulated to meet a wide range of specific requirements. It may be made in formulations which will not support combustion; in non-toxic formulations for food and beverage handling; in formulations of varying flexibilities, some of which retain their flexibility at temperatures as low as 80 degrees below zero. Tygon "T" gasketing is suitable for use at temperatures up to as high as 150° F.

Tygon gasketing is available in these forms:

- We can furnish sheets, tape, ribbons, strip or extruded rings from which you can cut your own gaskets;
- We can furnish the complete gasket, died out from sheets, or cut from extruded tube or rod stock, to meet your specifications.
- Or we can furnish molded gaskets to solve highly complex sealing problems.

Why not send detail and assembly prints to us for analysis, suggestions, and samples of Tygon formulations best suited for your needs? Write today to: The U. S. Stoneware Company, Akron, O. In Canada, to: Chamberlain Engineering (Canada), Ltd., Montreal.

The development of effective means of corrosion control has been the work of The U. S. Stoneware Company for more than 78 years. Today, some fourteen production divisions in the United States and Canada, all operating under unified research and management policies, are manufacturing a wide range of specialized materials, each having individualized abilities for combating various corrosives. If you have a corrosive problem, we offer our help.

U. S. STONEWARE

Since 1865

New York — Akron, O.

TYGON TANK LININGS AND GASKETING MATERIALS • TYGON SHEETINGS FOR SURGICAL AND HOSPITAL USE • TYGON FLEXIBLE TUBING
TYGON MOLDED ITEMS • TYGON LIQUID FORMULATIONS • TYGON DIPPING FORMULATIONS • TYGON TAPE • TYGON MASKING MATERIALS

research groups. It is hoped that the toxicologists will give this chemical a proper clearance later this year so that 1945 sales for fly sprays and similar applications in the hands of the general public may be permitted.

Agricultural uses of two types are being studied. Use on the farm in barns, dairy, and buildings other than houses may prove the most important future use. Some entomologists claim that a cow barn effectively sprayed every three or four months will kill all flies which go into the barn and alight on the walls or other fixed equipment. This suggests the possibility that the farm fly problem may be on its way to solution. But government experts are not going to OK that hopeful possibility until they are sure that there are not secondary disadvantages in having this very persistent insecticide where cows, chickens, and other domestic animals or pets may get it in excessive quantities.

If used in orchards, there certainly will need to be careful restrictions imposed, and perhaps for garden and other crop uses. This chemical is so potent against almost all types of insects that it kills the beneficial as well as the pest types. Thus, effective spraying of an orchard might kill the bees and destroy their effectiveness in pollinating fruit. Obviously we might thereby rid the orchard of both pests and product.

A very extended symposium on studies by economic entomologists has recently been published in *Journal of Economic Entomology*. Those desiring to review our present knowledge of the use of this new chemical should secure the February, 1944, issue from Prof. Ernest N. Cory, secretary, American Association of Economic Entomologists, University of Maryland, College Park, Md. (75c. per copy)

QUININE QUESTIONS ASKED

Synthesis of quinine by research fellows of Polaroid Corp. first stirred in Washington enthusiastic praise. The secondary, and quite unexpected result, has been a controversy that is going on quietly in the medical profession regarding the effectiveness of quinine. No one wants this controversy to lessen the compliment to the scientists who have made an important contribution to synthetic chemistry. The practical meaning of it all demands much more than a study of the new method.

SYNTHETIC LIQUID FUELS

The Senate has passed the appropriation bill for the Department of Interior funds, including a large appropriation for the Bureau of Mines to start its investigations of synthetic liquid fuels. It is anticipated that the members of the House will approve this new item and that the Bureau will therefore have its funds for use beginning the first of July.

As adopted by the Senate, a total of $30,000,000 is provided. Of this, $8,000,000 is definitely appropriated for use on contracts that will be completed or well under way during the fiscal year 1944-1945. The balance of $22,000,000 is authorized in a manner to permit contracts within the fiscal year for which payments will not be required until after July 1, 1945.

The Bureau plans are going ahead immediately along the following lines: They will expand their small-scale research at Pittsburgh as fast as they can get men and equipment. They will complete plans and build immediately the larger experimental facilities for development work at the substation of Bruceton, Pa., near Pittsburgh. The limiting factor in the latter item will be the ability to get both priorities for special machinery and skilled research men to do the work.

MORE DEFERMENTS

Selective service director Hershey authorized state directors to expand the list of activities for which irreplaceable men 18 through 25 years of age may be deferred. On request of appropriate federal agencies, deferments may be made for men in crude rubber production in Liberia; chemists in explosives production; riggers and toppers in logging operations in California, Oregon, Washington, Idaho and Montana; technicians on special lubricants for the armed forces.

ALUMINUM PLANTS CLOSED

Orders to close operation of four aluminum potlines in the Defense Plant Corp.'s Alcoa operated plant at Maspeth, L. I., were given by WPB's Aluminum Division, to take effect in June. This is another move to bring aluminum production more nearly into line with requirements and to cut this production where the possibilities of saving fuel are the greatest.

SEASONAL CAN FACTORS

Because paint manufacturing is seasonal in nature, members of that industry are now permitted to take in one quarter of the year up to 40 percent of the total quota of cans. Other seasonal industries can probably get comparable variations from uniform delivery if they will ask for it. But considerable advance planning is needed.

BRIEF GLIMPSES

Industrial mineral reports have been prepared by the U. S. Geological Survey for numerous mica, fluorspar, pyrrhotite, kyanite, and other non-metallic mineral deposits of possible strategic interest. Because these reports cannot be promptly published, they are made available by the Survey to those interested at Washington headquarters and occasionally at branch offices in the field where the greatest interest is likely to be found. Those wishing to consult such reports should address the Washington office for such information as to what is available and where.

Real estate to the extent of about one-fifth of the land area of the United States is owned by Uncle Sam. State and local officials are complaining that private land owners pay an excessive share in taxes. Nobody has yet figured out how Uncle Sam can be made to pay his share.

Tax collection will be a job of every factory management under the new law which undertakes to simplify tax reporting for individuals. Each company will have to figure out both how to explain the larger deductions to its staff and how to simplify its own bookkeeping and reporting procedure.

Re-use of more containers is necessary. There is nothing else so scarce now in this country as packaging materials.

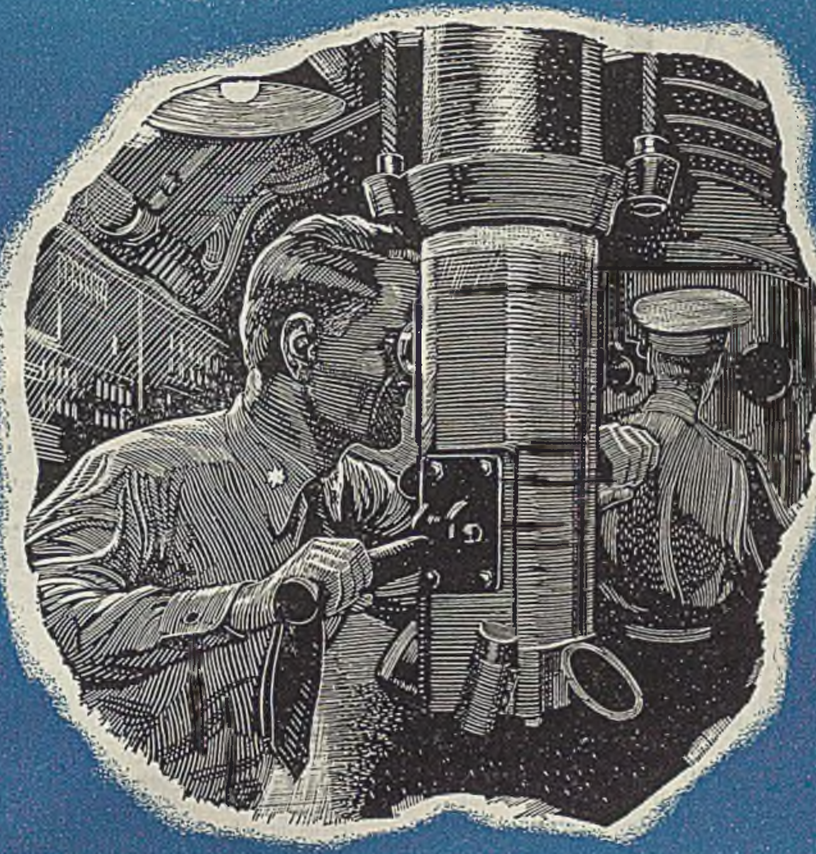
Stock more coal now! This is an imperative bit of advice from Washington. Everyone who can build a stockpile should do so to avoid shortages when transportation is more difficult next winter. If any mines shut down now for lack of market, somebody is sure to be cold or without necessary steam coal later.

Trade names are worth something, even OPA is now convinced of that. Part of the education came from the bootlegging of such things as cheap rayon hose which had been doped up to look like nylon. Purchasers in the black market at high prices were provided automatically with a penalty as the inaccuracy of the nylon label was revealed at the first laundering. Bootlegging of trade names can be punished by OPA and will be if industry goes at it right, and if they can catch the offender.

Settlement of war contracts was rather fully provided for in early June legislation, but Congress postponed full consideration of surplus property disposal problems. Since the flare-up over the veto of the tax bill which lead to the Barkeley insurrection, Congress seems to be accepting Presidential leadership rather fully. Everybody is content for the time being to follow the Clayton program for surplus war property disposal. But the honeymoon will probably be over when election campaigning starts.

Ammonium nitrate as grained and dust-coated by new chemical engineering methods is proving amazingly satisfactory during early summer distribution. But the packaging of this material is far from solved, according to all reports to Washington.

Small plants will get the first breaks on resumption of civilian manufacture. But it is the full purpose of WPB and other Washington agencies to minimize any kind of discrimination between one company and another as authorization is granted to get back at peace business. Expectable, however, are plenty of charges of favoritism.



The *perfect combination*

THEY'VE stalked the enemy in his own waters . . . waited days for the prize, every minute tense with danger. At last the target has been sighted, its range, speed and course determined . . . the torpedo is on its way.

And now, more than 1,300 precision parts must function perfectly to steer the deadly charge to the target. The terrific blast against the enemy hull celebrates the courage of the heroes of the submarine service . . . and the perfect combination of American creative genius and craftsmanship.

In less spectacular but also important roles, this combination is at work for thousands of products essential in war and peace. As its share in peak production and high standards of many of them, Columbia supplies its customers with chemicals which always conform to exacting specifications.

COLUMBIA CHEMICALS

PITTSBURGH PLATE GLASS COMPANY
COLUMBIA CHEMICAL DIVISION
GRANT BUILDING • PITTSBURGH 19, PA.

CHICAGO • • • BOSTON • • • ST. LOUIS • • • PITTSBURGH • • • NEW YORK • • • CINCINNATI
CLEVELAND • • • MINNEAPOLIS • • • PHILADELPHIA • • • CHARLOTTE

WATER, WATER—a veritable lake of it is required for the daily operation of Columbia plants. Visualize a body of water one mile long, over 500 feet wide and 10 feet deep. Within 24 hours it would be drained completely dry in order to keep Columbia plants in average production.

A THIRSTY CHEMICAL is Columbia Calcium Chloride. Its nature causes it to dissolve itself when exposed to relative humidities above 30-35%. Because of this, a fast-growing use is its employment as an economical dehumidifying agent in basements and other storage areas where dampness must be overcome. Its effectiveness can be gauged by the absorption capacities of one pound of 77-80% Calcium Chloride. At a relative humidity of 70, it absorbs two pounds of water . . . at a relative humidity of 90, it absorbs five pounds of water—or five times its own weight!

TOUGH GOING! In drilling the shafts for Columbia's limestone mine at Barberton, Ohio, 22.6 pounds of dynamite were required for each foot. As the total depth of the two shafts is 4,581 feet, approximately 52 tons of dynamite were used in preparing the way for what is now the world's deepest limestone mine—2,323 feet.

ONLY A V-MAIL letter is always certain to reach its destination overseas. For if the plane carrying your letter is lost, a record of its mail cargo quickly leads to the dispatch of a duplicate copy. Use V-Mail for fast, sure service . . . and to conserve valuable cargo space. One cargo plane can carry 400,000 V-Mail letters. 112 planes are required to transport the same number of standard size letters—an important factor in the handling of 34,000,000 pieces of overseas mail *each week!* And remember—V-Mail is the *only* mail that *always* flies.

COLUMBIA CHEMICALS include Soda Ash, Caustic Soda, Sodium Bicarbonate, Liquid Chlorine, Silene EF (Hydrated Calcium Silicate), Calcium Chloride, Soda Briquettes, Modified Sodas, Caustic Ash, Phosflake, Calcene T (Precipitated Calcium Carbonate), and Calcium Hypochlorite.

INTERPRETATIONS

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

SIMPLIFYING PAPER WORK

In conformity with the Chemical Bureau's policy of transferring as many materials as possible to General Allocation Order M-300 to simplify paper work, metallic sodium, styrene, polystyrene, glycol, acrylic monomer and acrylic resin have been placed under that order and previous orders controlling these chemicals have been revoked. The transfer of metallic sodium does not introduce any substantial changes except to require that it be used for the purposes for which it was allocated.

At the same time WPB announced that for the first time dichlorostyrene and polychlorostyrene, new materials developed for high frequency electrical insulation, have been placed under full allocation control.

GLYCERINE REPORTS

Because supplies of glycerine are adequate to meet current needs, WFA has revoked War Food Order No. 34, which regulated use of the end product prior to the suspension of use limitations on April 1. Since then monthly reports have been required from producers, refiners, distributors and users. The new ruling, effective May 16, makes the filing of these reports unnecessary.

LARD AND PORK FAT

Restrictions have been removed on the use of lard and rendered pork fat purchased and delivered during the period May 15 to June 30, for the manufacture of soap and edible finished products. A manufacturer may use the lard and rendered pork fat that he buys and receives during the specified period, for the manufacture of soap without regard to quotas. These materials likewise may be used in the manufacture of edible products prior to Oct. 1 providing a report on the quantity accepted and to be so used is made to the Fats and Oils Branch on or before July 15.

GRAPHITE CONSERVATION

An amendment of WPB conservation order restricting delivery, acceptance, and processing of graphite to quantities authorized, has removed Madagascar fines and has added Ceylon amorphous, over 95 percent carbon, to the controls of the order and has lifted all restrictions on delivery of foundry crucibles. It also provides a small order exemption of 200 lb. a month on Madagascar flake graphite.

PROTECTIVE COATINGS

A proposed order establishing uniform procedure for allocating raw materials required in the production of protective coatings has met with the approval of the industry advisory committee. Simplified allocation procedure also has been approved by the committee. This procedure deals particularly with allocation of organic lacquer solvents and as presented by the Chemicals Bureau involves a system of broader end uses than those required in the past. Despite the general improvement in the drying oil situation, the committee favored retention of order M-332 which limits the use and delivery of oil for protective coatings, for so long a period as War Food Order 42 governing drying oils remains in effect.

POTASH ALLOCATIONS

As a result of increased production, all allocations for high grade muriate salts for agricultural use from June 1944 through March 1945 will be 30 percent larger than those from June 1943 through March 1944. Improved production technique, incentive wage plants, and expanded facilities are responsible for the increased outputs. Domestic production also is expected to supply the needs of Canada, Latin American Republics, the West Indies and New Zealand but to help the over-all supply, WPB announces that a 10,000 ton shipment of high grade muriate from Russia has been arranged.

PINE OIL ALLOCATIONS

Production of steam-distilled pine oil in the southern pine district has been drastically reduced and stocks have been completely depleted at various distribution points throughout the country. Attempts are being made to step up production and to replenish inventories but in the meantime WPB has announced that allocations for uses other than those of a military character cannot be made. Pine oil is distributed to consumers from some 200 stock points which are supplied by tank car shipments direct from the producer and officials said it would not be economical to attempt to replenish stocks by less than tank car shipments even if drums and labor which would be needed for such shipments were available.

FATTY ACID INVENTORIES

Amendment to War Food Order 87 permits the basing of fatty acid inventory limitations on current consumption. The required 60-day limitation previously had been based on one-third of the aggregate use from June 1 to Dec. 31, 1943. Now the limitation may be figured on the previous 60 days usage or on scheduled operations for the ensuing 60 days. The amendment also raises the quantity of fatty acids not subject to inventory control from 3,000 lb. to 12,000 lb. to remove the possibility of placing purchase penalties on small users by making it possible for them to purchase in ton-lot quantities.

ALKYD RESINS

As a conservation measure, effective June 1, alkyd resins may not be used for low visibility exterior gray paints except as primers for maintenance of ocean-going vessels. The order does not apply to new vessels or to naval vessels. A previous order directed that all phthalic alkyd resins to be used in Specifications ES-680A and all classes except 147 and 248 are limited to a phthalic anhydride content based on solid resin of 31.5 percent. For Army Specification 3-175, 3-177, 3-178, 3-183, and AXS-946, the limit is set at 31.5 percent. For Specifications AXS-750 -752, the limit is 16 percent. For Navy Specification 52R13, the limit is 24 percent and for Maritime Commission Specification 52-MC-21 the limit also is 24 percent.

MISCELLANEOUS ORDERS

Direction 5 of Priorities Regulation 3 to place bleached shellac under end use control as a maintenance, repair and operating supply, has been amended. The amendment prohibits the extension of AA-1 and AA-2 blanket MRO ratings.

Because a manufacturer often must obtain materials for his product before he receives the order from his customer, WPB amended Order M-340 which governs the sale of miscellaneous chemicals. Now a manufacturer is permitted to obtain materials on the basis of expected orders.

Limitation Order L-40 has been changed to remove the restriction on the use of fish liver oils and other oils in feeds.

Applications for priorities assistance for refrigeration equipment other than industrial processing and air conditioning equipment are to be filed with local WPB field offices.

The Chemicals Bureau has recommended the removal of beeswax and carnauba wax from List C of General Imports Order M-63.

Oiticica, castor, cashew nut shell, and raw linseed oils are still subject to WFO 32 which restricts consumption to specified percentages of average use in 1940 and 1941 but other distribution controls have been revoked.

The small-order exemption for triethylene glycol has been raised from 250 lb. to 600 lb. and for mixed glycols from 250 lb. to 1,000 lb. The new order also provides for submission of a customer's use certificate in place of Form PD-600, formerly required for certain intermediate quantities of glycols above specified exemptions.

PRICE REGULATIONS

Importers who contracted for natural menthol at a higher price before the ceiling of $15 a lb. went into effect, may qualify for a higher ceiling price on resales.

The new producer of superphosphate at Searsport, Maine, was granted a ceiling level of 82c a unit of APA. This is in line with the price of 75c a unit at Lowell, Mass., considering the difference in freight charges on phosphate rock.

OPA has price schedule for vegetable waxes same as those listed by WPB in import licenses required by American buyers except a single price of 45c a lb. is established for ouricury wax. Price for Western Hemisphere pure beeswax will be re-established at 38c a lb.

Maximum price for hydrogenated lard set at 1½c a lb. over the ceiling for base or standard commercial lard which is 14.55c a lb. in tierces at East St. Louis and Chicago.

Comfortable • easy-to-wear

RESPIRATORY PROTECTION *by* M·S·A

AGAINST HARMFUL DUSTS, FUMES, MISTS, PAINT-SPRAY VAPORS, LIGHT CONCENTRATIONS OF ORGANIC AND ACID GASES

TRANSPARENT:

THE *Clear-Vue* MODEL

DUSTFOE RESPIRATOR

Officially approved by the U. S. Bureau of Mines for All-Dust protection, the Clear-Vue Dustfoe Respirator has facepiece and filter container of strong *transparent* plastic—permitting quick visual check of filter type, seal, adjustment and state of cleanliness without disassembly. Durable, odorless, non-corrosive, non-conductive of electricity or heat—tops in comfort, too! Write for descriptive Bulletin No. CM-6.

TWIN CARTRIDGE:

THE M·S·A *Comfo*

CHEMICAL CARTRIDGE RESPIRATOR

For protection against vapors encountered in paint-spraying operations, and also against light concentrations of toxic or irritating organic and acid gases—occurring singly or in combinations. The factory-packed twin chemical cartridges are quickly replaceable, afford maximum breathing ease, and long service life. Comfo-type facepiece fits any face; easy to clean and sterilize when desired. Write for Bulletin No. EM-3.

METAL FUME SAFETY:

THE M·S·A *Comfo*

METAL FUME RESPIRATOR

Wherever metal fumes are a hazard, this U. S. Bureau of Mines-approved respirator is preferred—for protection, lightweight wearing ease, and durability. Of basic Comfo design, the respirator protects against inhaling the toxic fumes of lead, cadmium, zinc and a wide variety of metals when burning, cutting or molding, etc. Filters have high efficiency—are quickly replaceable. Bulletin CR-6.

PLASTIC FILTER CONTAINERS:

THE M·S·A *Comfo*

DUST RESPIRATOR

The original, favorite twin-filter Comfo Dust Respirator—now built with filter containers of high-strength plastic. Thinner, rounded edges improve downward and sidewise vision; even lower resistance to airflow has been achieved—with better appearance! U. S. Bureau of Mines-approved for All-Dust protection—wearer-approved for comfort and sturdy durability. Bulletin No. CR-9.

MINE SAFETY APPLIANCES COMPANY
BRADDOCK, THOMAS AND MEADE STREETS
PITTSBURGH, PA.

Diamond

Research Chemists and Development Engineers cooperate in the perfection of Diamond Products to meet industry's ever-changing requirements.

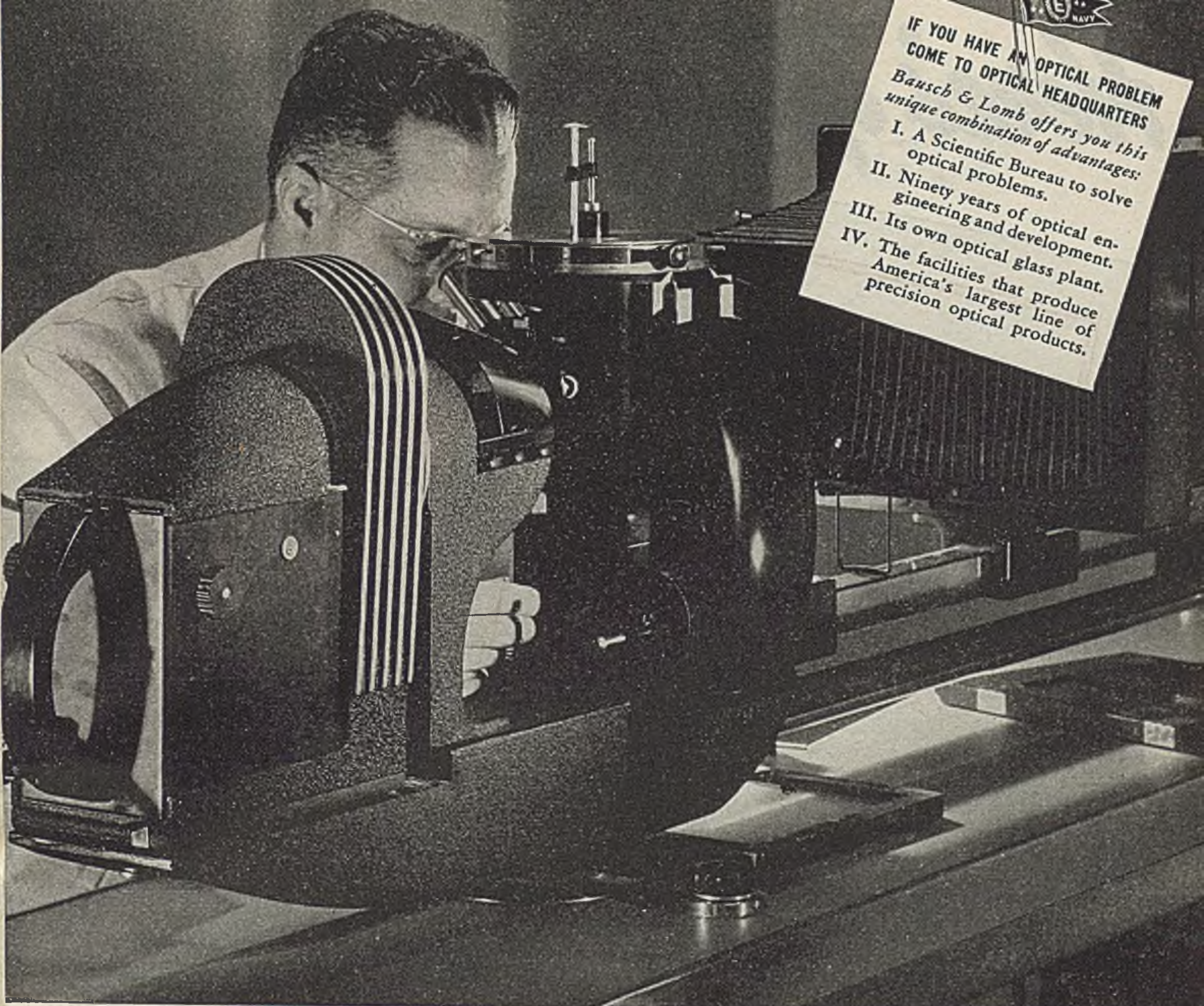
Through close teamwork of our field and development engineers, research chemists and manufacturing personnel, DIAMOND coordinates a variety of specialized technical skills in perfecting the service rendered to users of Diamond Products.

Thus any change in your requirements can be quickly and accurately provided through the close cooperation of the Diamond personnel and facilities.

ALKALI

DIAMOND ALKALI COMPANY

Pittsburgh, Pa., and Everywhere . . .


IF YOU HAVE AN OPTICAL PROBLEM
COME TO OPTICAL HEADQUARTERS
Bausch & Lomb offers you this unique combination of advantages:
I. A Scientific Bureau to solve optical problems.
II. Ninety years of optical engineering and development.
III. Its own optical glass plant.
IV. The facilities that produce America's largest line of precision optical products.

THE COST OF
Tomorrow's Peace

Today peace-loving Americans are united with thirty-three other nations in a common objective of destruction.

Millions of our fine, young men and women find themselves invading foreign lands in order that their own shores may be spared, and their free way of life preserved.

Their sacrifices will be great. Their job will be well done.

But what of the job they will expect of us when they have finished theirs . . . the job of turning their hard-won victory into a lasting pattern of peace?

Can we come up to their great expectation? We must realize that this is the last opportunity of our generation. We must do a better job of it than we did in the Twenties and the Thirties.

We have our backs to the wall, and the scars of World War I and a thirteen-year depression still are upon us. The final test of our way of life is at hand!

As we look over our shoulder into the immediate past, we see little to encourage us. But we also see much to make us pause. We see a tremendous fighting machine, created in a matter of months by the miraculous organization of our resources.

We, the largest of the peace-loving nations, have overnight become masters at the business of waging war. Today, as a result of the coordination of industry, labor, and government, we are producing *for war alone* as much as our total normal production for peace.

* * *

We have amply demonstrated our ability to harness the vast productive capacity we possess. Why cannot these resources, which we have organized so efficiently for the destruction of life and property, be directed toward the destruction of the causes of war?

May not the patriotic and emotional strength and the unity of action which have been stimulated for the purpose of winning the war be directed, at least equally well, toward the attainment of world peace and international harmony?

If they are not so directed, what lies ahead but another war? And how can America, in a world that is so rapidly shrinking in size, avoid involvement in *any* of tomorrow's conflicts?

International peace is an ambitious dream and its price is high, but the price of war is even higher. Our world cannot long survive the periodic waste of its human and material resources.

Our country can be the most potent single force in bringing about the international understanding that leads to peace, in developing the unity that will make the most of the ample resources nature has provided everywhere.

* * *

There is no unity in selfishness. There can be no unity if any one of the great powers fails to do its part in determining and eliminating from the world the basic causes of aggression.

These basic causes stem from greed and the suppression of opportunity for individual progress; for self-preservation is the first law of nature.

Mussolini's dramatic march on Rome in 1922 was made possible by disillusioned veterans of World War I who could find no jobs and whose future held no promise. Some of Hitler's most determined followers came from the same ranks.

Men denied the opportunity to make a living, for themselves and for their children, are easy prey to false doctrines and dangerous "isms."

In any realistic appraisal of our domestic problems—economic, labor, racial—it is clear that we can solve them, not by waiting until we reach some utopian accord, but by making a series of compromises. We do this because we know how discord can impair the very roots of private enterprise, self-government, and self-discipline—the essentials of a dynamic democracy.

Similarly, peaceful reconstruction of our world economy depends on the ability of nations to reconcile their differences in a series of working agreements.

If we in the United States want lasting peace and if we want to preserve our democratic way of life, we must take over our full share of the task of initiating these compromise measures. Acknowledging our inescapable responsibility as the greatest economic and military power in the world, we must attempt to insure the free flow of world trade, and develop—with profit for both parties—backward areas abroad as well as at home. And we must do this by making all nations share the responsibility, not by allowing ourselves to be manoeuvered into being an international Santa Claus.

With our allies, we will have to see to it that the devastated portions of the world rehabilitate themselves as quickly as possible; that practicable and realistic trade and economic relations between nations are developed; and that the energies and productive capacities of these nations are set free to function in a climate that is favorable to the growth of free enterprise and individual initiative. As the most powerful economic force on earth, we have the most to gain and the most to lose at the peace table; and we must never forget that with our power comes responsibility.

We cannot hope to solve all of the problems of all nations—nor even all of our own—but our way can become the way for more of the world's humanity. Our strength can become the guiding spirit of the smaller nations.

* * *

In the development of a sound American foreign policy, let us take care not to attempt to control the destinies of other nations. Let us remember that we must set the example of self-determination of independent, free peoples.

Freedom is essential to international peace; and free competition—whether it be between individuals, between businesses, or between nations—is the mainspring, the synchronizer, and the preserver of freedom. For competition always is synonymous with private enterprise.

We are not a covetous nation. We have no territorial ambitions. Our international commercial aspirations are dominated by the conviction that we have a great stake in world unity and world prosperity. We know that we can no longer live apart from other nations and that we cannot ignore the fundamental elements which affect the well-being of other countries.

Our foreign policy must encompass a world of trade, and help develop it.

We dare not blunder in the execution of that foreign policy if the American way of life is to survive. A democracy resolved upon isolation is doomed in the world of tomorrow.

Let us resolve that out of this devastating catastrophe we shall emerge with fuller understanding and greater determination to build the kind of world which can materialize only if this country has the vision and the will to see it through.

We still are free to decide our own fate—still free to shape our own future. We still are free to preserve the liberty and happiness that has made our country the hope of the world.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

CHEMICAL
& Metallurgical
ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, Editor

JUNE, 1944

Big Questions About Little Business

SHALL "small business" (herein defined as "any enterprise for profit" employing "500 persons or less" or whose net sales "shall aggregate not more than $1,000,000 for any calendar year") be entitled to technical and economic research at government expense? Shall such concerns be allowed the preferential use of "any invention, discovery, trademark, process, patent or patent right" whether held by "any government department or agency or any person, firm or private corporation"?

Shall "small business concerns and groups of such concerns" be authorized by a new billion dollar government-sponsored "Small Business Corporation" to use "the physical, chemical, engineering, and other technological, research, laboratory, and technical services and facilities of the Federal, State, and local governments, educational and research institutions and foundations and of qualified individuals and private enterprises"?

Shall small businesses be entitled to government-guaranteed bank loans for reconversion and for working capital irrespective of "the collateral offered or the lack of any collateral, or the status of the balance sheet or financial statement"? Shall small business be given prior right to "purchase, lease or otherwise acquire government-owned or controlled surpluses of materials, equipment and plants"?

The quoted words and phrases above are from Senate bill S. 1913 introduced May 12 by Senator James E. Murray of Montana as chairman of the Special Committee to Study the Problems of American Small Business Enterprises. It was read twice and referred to the Committee on Banking and Currency. To those of us who saw some slight threat of regimentation in Senator Kilgore's several proposals for political control of research and technology, this latest outgiving is evidence that in spite of all our opposition his ideas for national socialization of business have continued to receive support from his close colleagues in the Senate's Military Affairs Committee. That these ideas can become part of the present popular interest in helping little business at the expense of big business shows excellent timing and shrewd strategy. Thus if we continue to oppose the principles underlying these "reforms," we automatically line ourselves up with the agencies of monopoly, cartelization and economic crime.

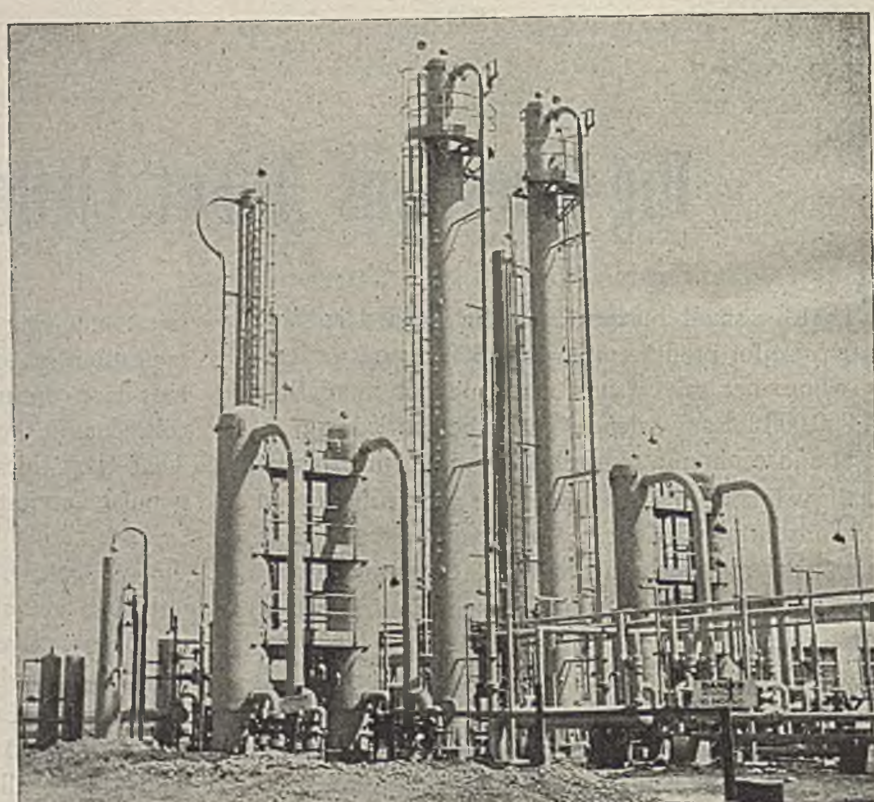
Few if any of us would disagree with the statement of Mr. Maury Maverick, chairman and general manager of the Smaller War Plants Corporation, that little business is the backbone of free enterprise in America. When we close up the 3,000,000 stores, shops and plants that employ less than 500 people each, we are through as a nation and as a people. Even in manufacturing we cannot possibly afford to shut down the smaller factories that supply more than 60 percent of our normal civilian production. But the simple and apparently forgotten truth is that we are not going to shut them down. They have so proved their economic value to the American way of life that they will continue, probably even in the face of such un-American practices as paternalism, preferential treatment and governmental subsidies.

This coddling of the little fellow may seem like good politics to the senators, especially in a year of presidential election. But in many ways it insults the intelligence and integrity of all thinking people who, whether in big companies or little companies or as individual soldiers and sailors, are fighting for the fundamental principles that have made America great. Equality of opportunity is just as important for business enterprises as it is for each of us as individuals.

HELIUM

Recovery Process Improved

Immediate availability of helium for private and commercial users renews interest in possible industrial applications of this unique gas. The spectacular wartime expansion program increasing production 25 times the prewar output is due to the addition of four plants and to improvements in extraction methods and increased efficiency of operation. Since the early years of the Amarillo plant much progress has been made in the methods of removing carbon dioxide and other constituents in gases which is reflected in the new plants.—*Editors*



Where carbon dioxide, water vapor, and hydrogen sulphide are removed from incoming helium-bearing natural gas by a scrubbing process at Exell, Tex., plant of the Bureau of Mines. Several tons are removed in a day

Helium production activities came into world-wide prominence in 1938 when the Nazi government asked to buy 18,000,000 cu.ft. of helium to inflate dirigibles. The United States denied the request, thus depriving the Nazis of a strategic instrument which was to have been a part of the arsenal of fascism.

Most of the helium is allotted to the Navy for giving buoyancy to blimps on patrol against U-boats. The requirements of the Army are also met. Some helium is used in anesthetics, in deep-sea diving, in treatment of respiratory illnesses, and in a new welding process for magnesium airplane parts.

In 1942-43, the Amarillo, Tex., plant facilities were expanded further as a part of the Bureau of Mines' $16,000,000 helium program. A new plant was rushed to completion at Exell, Tex., and went into production in March, 1943. Another plant in the Southwest began producing in October, 1943, a fourth unit started production in January, 1944, and the fifth plant—the Navajo unit—was opened in March.

From its plants in the Southwest the Bureau has shattered all previous records. Production is now 25 times the prewar output. At the same time, improvements in extraction methods and increased efficiency of operation have reduced the production cost of helium to about 1c. per cu. ft.

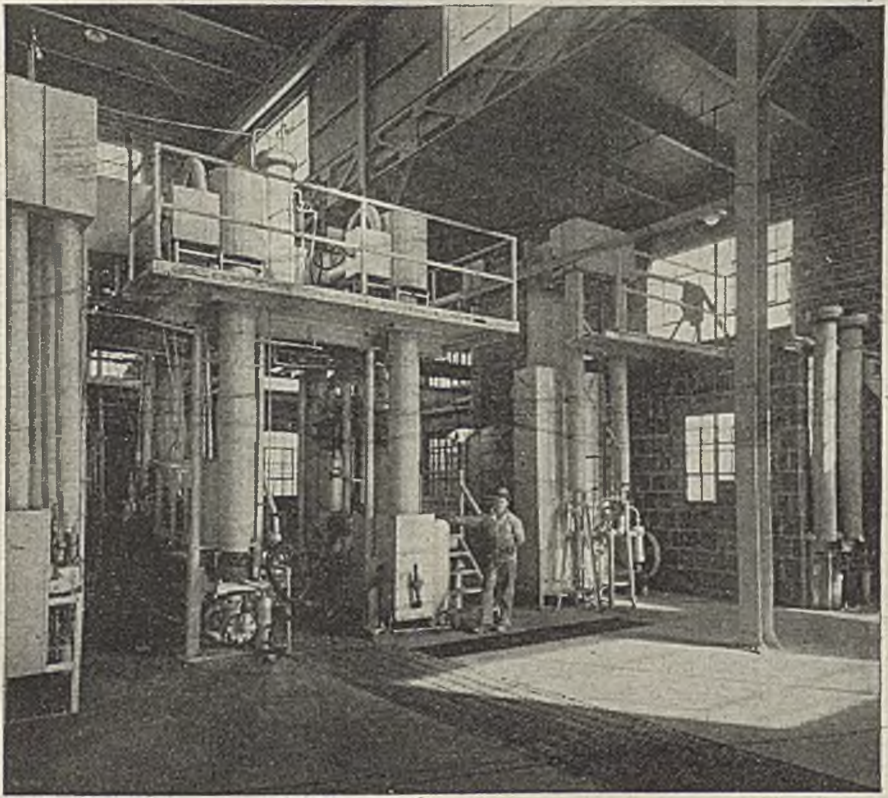
The helium content of the incoming natural gas at various plants operated by the Bureau ranges from 1 to 7 percent.

The first step in the process of helium extraction is the removal of small quantities of carbon dioxide and water vapor contained in the helium-bearing natural gas, and the removal of hydrogen sulphide, if any. Usually the carbon dioxide comprises only about ½ percent of the volume of the untreated gas, but some gases contain larger percentages. Depending on the capacity of the plant and the carbon dioxide content of the gas, the weight of carbon dioxide removed may total several tons a day. It would not require a large quantity of carbon dioxide or water in the solid state to plug the small tubes used in part of the extraction equipment.

The carbon dioxide and water vapor are removed from the incoming natural gas by a scrubbing operation which employs a mixture of solutions of monoethanolamine and diethylene glycol. These chemicals are reclaimed later by the addition of heat which releases carbon dioxide, hydrogen sulphide, and water. Therefore, the chemicals are regenerated and only additions due to mechanical loss are necessary for the successful working of the cycle. The removal of carbon dioxide, water vapor, and hydrogen sulphide (if present) is effected at about 650 lb. per sq, in.

By use of countercurrent heat exchangers the natural gas, freed of carbon dioxide and water vapor, is cooled progressively to —185 deg. C. At that temperature, and under a pressure of about 300 lb. per sq. in., all the constituents of the natural gas, except helium and a small amount of nitrogen, are liquified. The liquids then are withdrawn from the apparatus, sent back through the heat exchangers, and are warmed to room temperature by the incoming gas. The crude helium, which has remained in a gaseous state throughout the operation, is withdrawn at the top of the equipment for further purification.

The initial refrigeration of the natural gas and the gas needed to continue the process is produced primarily by means of an expansion-engine cycle. Nitrogen that has been separated from the natural gas is compressed to about 600 lb. per sq. in. and expanded through the engine. The engine runs a hydraulic brake or hydrotarder which provides a means for the removal of heat energy from the nitrogen. The temperature of the exhaust from the engine is about 85 deg. C. lower than the temperature of the inlet high-pressure gas and this exhaust is employed to cool the nitrogen flowing to the engine. The nitrogen is thus cooled progressively until a sufficiently low exhaust temperature has been reached. The nitrogen refrigeration cycle is entirely separate from the natural gas cycle.

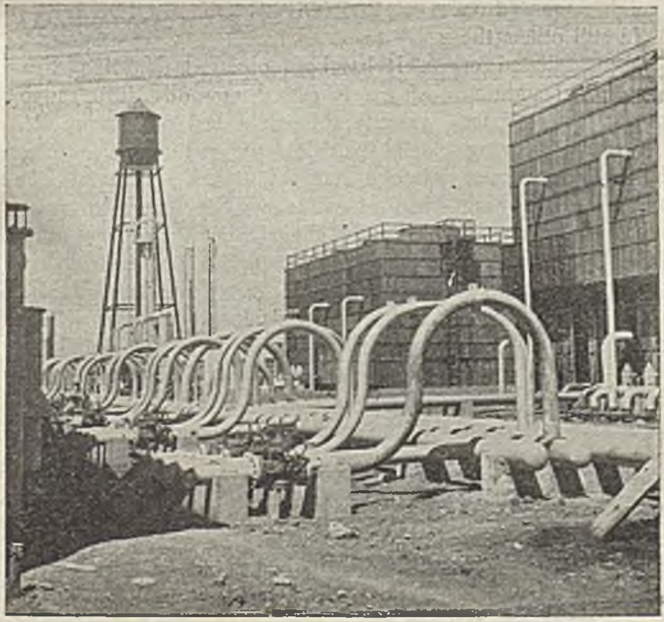


Gas from removal towers is cooled and all constituents except helium and some nitrogen are liquefied. Nitrogen is then separated leaving helium

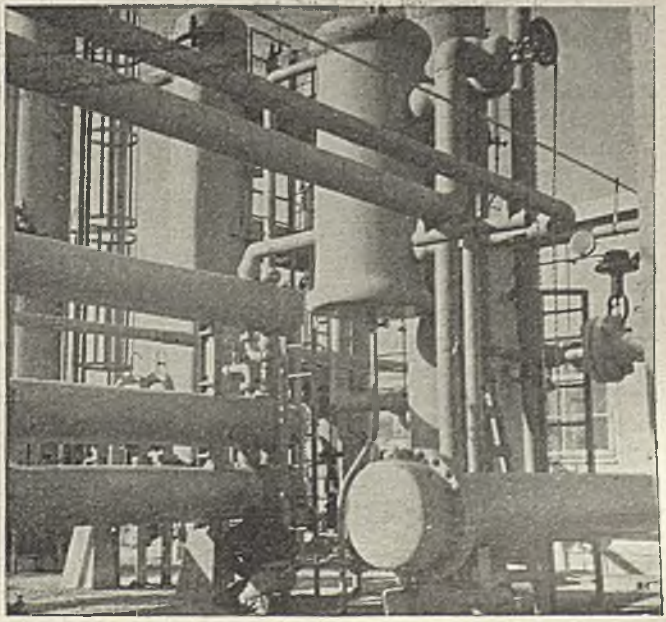
Helium of about 50 percent purity is produced in the operation, the impurity being nitrogen. High-purity helium could be produced in one operation, but as helium is soluble in the liquefied natural gas and as high pressures are required for the production of high-purity material, appreciable quantities of helium would be lost through solubility. To avoid such losses, the final product, which has a purity of more than 98 percent, is produced in two steps. These steps, although distinct, are similar as to method and are carried on simultaneously. The second cycle, which operates at a pressure of 2,500 lb. per sq. in., discharges the purified helium directly into tank cars or other shipping containers without any further compression. Modern shipping containers for helium consist of a number of seamless steel cylinders mounted on special railroad trucks. Less than one minute is required to claim the helium from a given cubic foot of natural gas after it enters one of the helium plants.

"Aside from the future of helium for use in lighter-than-air craft," Director R. R. Sayers, of the Bureau has stated, "I believe that the years to come will bring forth new and better uses for helium. We have only scratched the surface in its application in the field of medicine. We have barely touched the field of industrial utilization. This wonder gas, by its inherent traits, challenges science to harness it, to put it to use in new ways in the factory, in the hospital, in the home for a better way of life for all of mankind."

Water pumps and coolers in the Exell helium plant. This is one of five such plants of the Bureau



Exchanger, reboilers, and columns of the new carbon dioxide removal equipment at Amarillo helium plant



JOHN C. KALBACH *Chief, Chemical Processes Section, Institute of Gas Technology, Chicago, Ill.*

Improving Solids-Gas Contacting by FLUIDIZATION

Development of the fluid catalyst process for aviation gasoline manufacture has aroused much interest in the possibilities of achieving better solids-gas contacting for a variety of purposes by the use of "fluidized" solids. Tracing fluidization processes back to their first appearance in the patent literature, Mr. Kalbach points out that despite the considerable time it has found occasional use, it is only recently that the full implications of the fluidizing tool have been recognized. He suggests a number of uses and proposes a process for fuel gas purification.—*Editors*

What is essentially a chemical engineering tool for obtaining intimate contact between gases and soldis is the subject of this discussion. This tool, "fluidization" of solids in a finely divided state by means of a gas, is an idea that has been abroad in the world for a long time, but has only been brought into large scale and spectacularly fruitful use within the last few years. In the United States the most noteworthy example is the fluid catalyst system for cracking petroleum, which has been reduced to practice on an immense scale by Standard Oil Development Co. and its associates. The statement that the general idea underlying this application of fluidization is not new is in no sense derogatory to those who have brought it to successful employment, since that is the way with most scientific ideas. A thought generally occurs to a number of people before it reaches the mind of the person or group with the genius to appreciate the full implications and to apply it under optimum conditions.

The present article will describe something of the history and logic of fluidization without attempting to discuss the design features of actual systems, which must await the relaxation of present restrictions on war-important technical information. In addition to a preliminary review of the methods of obtaining solids-gas contact which have come down to us from the past, we will glance here briefly at the fluid catalyst process, and also at an as yet hypothetical adaptation of fluidization to manufactured gas purification.

Many methods have been used for bringing about solids-gas contact, probably the first being the technique of air and solar drying developed by our pastoral ancestors for the drying of fodder and fruits, and later, of sodium chloride and other soluble salts. With the coming of industrialization and the need for reliable performance independent of the vagaries of wind and weather, dryers of many types began to make their appearance. Today, some present the solids on trays or belts to the action of air or gas under controlled conditions of temperature and humidity; others provide for circulation of the air or gas through solids supported on grates or porous belts. In still others the solids are continually raked, agitated or tumbled through the gases. In addition to drying, solids-gas contact is needed for other purposes such as metal winning. Primitive man's method of using open fires for recovering the lower melting metals gave way to processes leading to the modern blast furnace, but even this differs in no essential principle from the early blast furnaces which are still used by primitive races today.

The idea incorporated in the blast furnace, namely, the passage of an appropriate gas through a bed of solid restrained by its own weight or by the walls of a confining chamber, occurs again and again in modern technology. Examples are found in gas dryers and solvent recovery equipment using adsorptive solids; in gas masks; in gas producers and water gas generators; and in most gas-phase reactions employing solid catalysts, such as the contact process for sulphuric acid. A variant, where the solid is dropped through a stationary or rising bed of gas, also is found frequently. An early form was the shot tower, still to be seen in some of the Eastern states. Soap powders are sometimes so produced, and when centrifugal motion and eddy currents are added to the basic idea, the modern spray dryer results.

None of these ideas is completely satisfactory and universally applicable for solids-gas contact, owing to one or more of several reasons: poor control of temperature, atmosphere and uniformity of contact; low capacity; frequent high maintenance; and time lag in securing penetration of heat and reacting gases into the interior of the solid particles, due either to film resistance or to the diffusional resistance of the particles themselves.

No single solution of the problem can, in fact, be expected owing to the diverse aims of solids-gas contacting operations, but the fluidization idea does offer solutions in certain cases which for elegance and simplicity are as satisfying to the intellect as their pragmatic success is gratifying to their industrial proponents.

PRINCIPLE OF FLUIDIZING

It has been observed that if a stream of gas is passed upwardly at a suitable velocity through a bed of suitably sized solid particles, the particles are thrown into a state of extreme agitation. The bed of solids will be found to expand under the influence of the rising gas so that each of the particles is individually suspended in the gas stream and all of its surface is available for contact. There exists what is called a pseudo-liquid level above which a comparatively small amount of the finer material which is carried out of the solid bed, or pseudo-liquid, remains in suspension. This interface presents much the same appearance as the surface of a boiling liquid. The extremely turbulent action within the pseudo-liquid may be demonstrated by adding to it particles of a dissimilar color. It is then observed

Condensed from a paper presented by the author in Chicago on Apr. 17, 1944, before the mechanical engineering section of the Western Society of Engineers.

that the fluidized solids approach homogeneity with great rapidity. Similarly, if heat is added through the walls of the chamber or by the continuous addition of hot solid particles, an unusually uniform temperature condition is observed throughout the fluidized mass. The pseudo-liquid possesses many of the properties of a true liquid in that it may be withdrawn from or added to the main body of fluidized material through pipelines and valves. Thus, a continuously operating system can be designed by providing a hopper or standpipe from which the solid material is picked up by a moving gas stream and carried into the fluidizing chamber, while the pseudo-liquid is continuously withdrawn from another connection. Usually a cyclone separator is connected to the gas outlet to recover fine solids which are carried above the pseudo-liquid level.

While it is apparent that systems of this type possess desirable characteristics for carrying out certain types of reaction, they are, of course, not without their drawbacks. They do not readily adapt themselves to counter-current operation with the well known advantages of such an arrangement. In fact, due to the turbulent action in the pseudo-liquid, calculation of the contact time between the gas and solid must be treated statistically with respect to the contact time of the individual particles. The hold-up of solids in the fluidization chamber must then be sufficient so that, on the average, the desired contact time is obtained and only a permissible proportion of the solids is allowed to escape from the chamber before a certain critical contact time.

On the other hand, the complete and efficient contact obtained between the gas and the solid, the small size of the particles handled, the mechanical simplicity of the contact equipment and the uniform conditions existing throughout the contact chamber by virtue of the excellent mixing which prevails are compelling advantages for certain applications. Furthermore, the fluid-like characteristics of these systems can be used to accomplish various other aims besides simple solids-gas contact. Systems have been devised taking advantage of these properties in the transport of finely divided solids and in the separation of solids of differing specific gravity or particle size using a fluidized solid as the logical equivalent of the dense liquid in a sink-and-float process.[1] Again, finely divided solids circulating in a fluidized system can be used as temperature control and heat transfer agents in carrying out gaseous reactions, inert solid particles being heated or cooled in a separate chamber and then introduced into the reaction vessel for heat control purposes. The possibility of combining one or more of these auxiliary steps with the achievement of solids-gas contact is a cogent argument for the application of the fluidizing technique in many processes. Having reviewed the basic phenomena of fluidization it is appropriate now to examine some of the proposed and practical applications of this process as discussed in the literature.

In 1879 a patent was issued to Charles E. Robinson[2] which appears to be the first instance in which the properties of a fluidized system were appreciated. The patent, Fig. 1, describes the roasting of ores, especially auriferous ores, in a vertical shaft furnace provided with a standpipe and slide valve for the introduction of ore, and a bottom inlet through which enters a stream of air or steam to keep the solids in suspension. Another stream of air is preheated by combustion of a suitable fuel in an auxiliary chamber and is passed upward through the pseudo-liquid. In the words of the inventor the bed of ore is caused "to boil or play like the waters of a fountain." The chloridization as well as the oxidation of ore in a system such as this were envisaged by the inventor. The fine particles blown out of the roasting chamber were collected separately or returned for further treatment. Operation was batch-wise. There was no known industrial application of the Robinson proc-

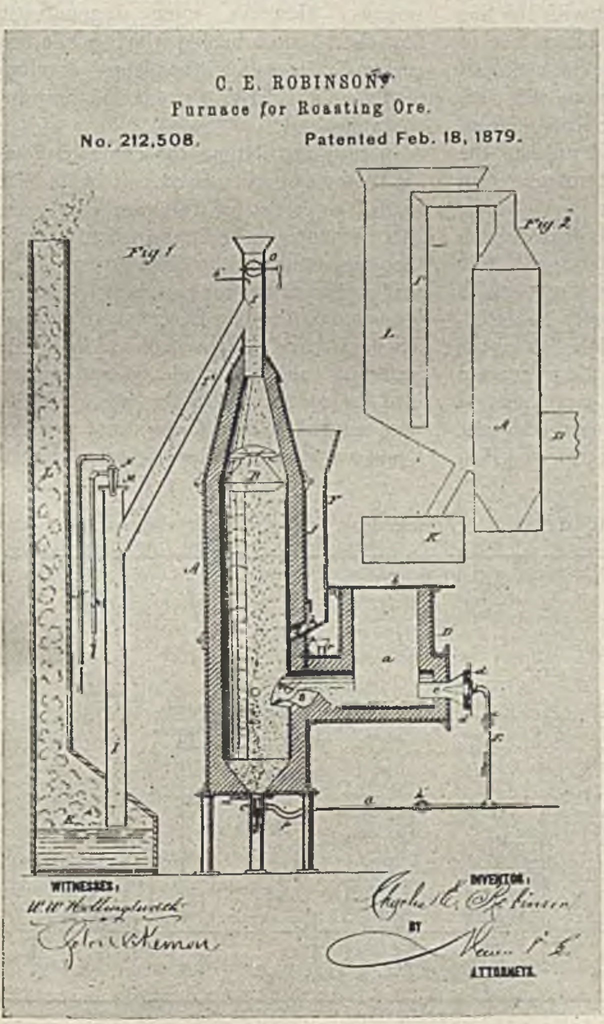
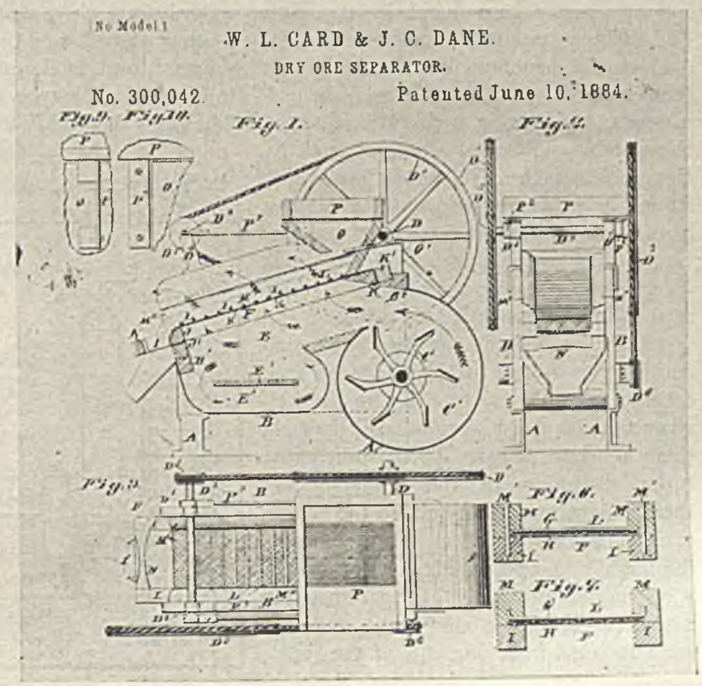


Fig. 1, Left—C. E. Robinson's U. S. Patent of 1879, describing an improved furnace for roasting ores. Air or steam admitted at the bottom of cupola *A* made the pulverized solids admitted from *F* "boil or play like the waters of a fountain," according to the inventor

Fig. 2, Below—Dry ore separator patented in 1884 by Card and Dane. The ore, fluidized by an air blast blown upward through a screen deck covered with cloth, moved downward as a pseudo-liquid over the deck, leaving auriferous material behind the riffles



ess, perhaps because, in his time, fine grinding was not as widely practiced as now.

Five years later another patent, Fig. 2, was issued to William L. Card, and Joseph C. Dane[3] in which the fluid-like properties of a suitable mixture of gas and solid particles were recognized. Their device was a sloping table of screen construction, provided with a fan for blowing air up through the screen. The screen was equipped with riffles on its upper surface. Ore was fed to the upper end of this table by means of a hopper so as, in the language of the patent, "to cause the material operated upon to flow like a liquid." The heavy metallic particles, in this case gold, were retained by the riffles after sinking through the pseudo-liquid. This invention is distinctly reminiscent of the air tables currently in operation in the mineral industries. The "Air-Flot" table of Sutton, Steele & Steele is an example.

MODERN USES

The fluidizing idea received impetus from the invention of the Fuller-Kinyon pump. This device is described in a series of patents issued to Alonzo C. Kinyon, James W. Fuller and their colleagues,[4] beginning in 1918. The pump consists of a screw conveyor of gradually decreasing pitch which compresses particulate solid material at the same time as it advances in the direction of the entrance to a pipe system. Thus, the backward leakage of gas is prevented. At the end of the screw gas is admitted so as to fluidize the solids which are then carried through a pipe or other desired equipment by the action of the screw in adding solids to the system. This type of arrangement is quite different from those in which the solid particles are picked up and carried bodily in dilute suspension by a fast moving gas. In the latter the solids lag behind the flowing gas and are merely kept fluent by it. The Fuller-Kinyon pump has long been widely used in the handling of pulverized coal, cement and a variety of finely divided minerals, transporting such materials over considerable horizontal distances and to elevations as high as 300 ft. It is a useful adjunct to other fluidized systems. It has been suggested, for instance, that the reduction of ores can be accomplished by fluidizing with a reducing gas and passing the pseudo-liquid through heated pipes[5].

There is a voluminous literature[6] concerning the mixing of finely divided materials, particularly cement, in vertical chambers by passing upwardly through them a stream of gas. To the inherently turbulent action in the pseudo-liquid, there may or may not be added the action of a mechanical impeller. In either case, the fluid-like properties obtainable in such a system are utilized. The gas may be introduced at one or more levels and the solids recycled from one part of the apparatus to the other, according to any of several patterns.

Germany, in its effort to achieve independence from foreign sources of essential raw materials, was early faced with demands for immense quantities of hydrogen for the synthesis of ammonia and for various hydrogenation processes, also of mixed carbon monoxide and hydrogen for the production of motor fuel by the Fischer-Tropsch process. Such gases would formerly have been made in conventional blue-gas generators, using coke as the starting material, but adequate supplies of coke and coking coals were not available. There exists in Germany, however, a large supply of brown coal which by virtue of its friable nature is unsuitable for use in the conventional water-gas set where it tends to form too dense a fuel bed, which in turn leads to channeling and the formation of blow-holes in the bed and inefficient operation.

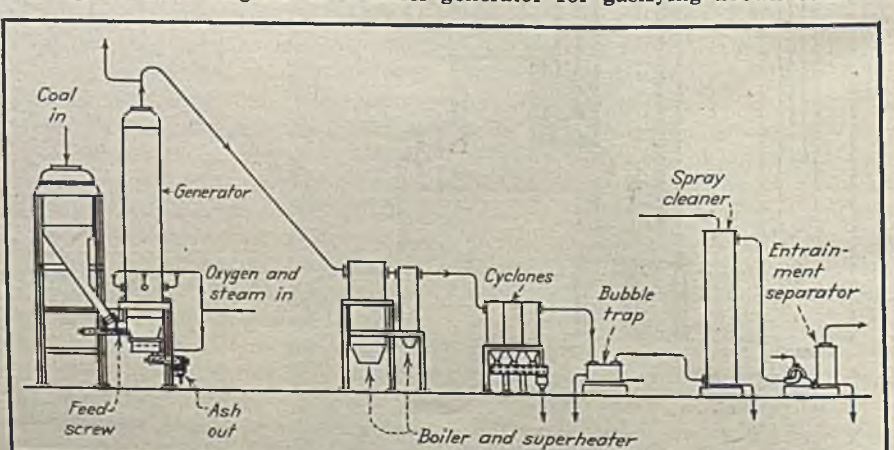
The Winkler Process[7] has tapped this large supply of material on the grand scale. The generator, as diagrammed in Fig. 3, consists of a vertical cylinder having at its base a grate through which an upwardly moving stream of steam, oxygen and air or steam and oxygen are distributed. Brown coal pulverized to roughly 0.05 to 0.1 in. size is fed by means of a screw conveyor to a point slightly above the grate and is fluidized by the upward flow of gas. Above the pseudo-liquid another stream of steam and air is introduced to react with the fine particles of coal which are blown out of the pseudo-liquid and with the hydrocarbons which are vaporized from the coal. About 10 to 20 percent of the ash from the coal is agglomerated and sinks to the level of the grate where a rotating arm carries it to an out-going screw conveyor. The remaining 80 to 90 percent of the ash is carried out of the generator with the product gases and, after passing through a waste-heat boiler, superheater and feed-water heater, where the sensible heat of the product gases is used to provide power and process steam, is cleaned in a cyclone and following bubble-type and spray cleaners. The gas is then ready to be further purified and used for synthesis purposes. The capacity of a Winkler generator 18 ft. in diameter and 70 ft. high has been stated as 2,600,000 cu. ft. of gas per hour. This is about six times the capacity of a conventional blue gas machine of similar diameter.

FLUID CATALYST

In the United States the outstanding application of the fluidizing technique has been in the fluid catalyst process for cracking petroleum. The solid material here is the catalyst while the reactions are conducted in and upon the fluidizing medium, namely vaporized crude oil. The original patents for systems of this type were issued to W. W. O'Dell[8] in 1934 and reissued in 1940. Intensive research by Standard Oil Development Co., The M. W. Kellogg Co. and associated concerns brought the process to its present high state of development. In these systems full advantage is taken of the liquid-like properties of fluidized solids for the transport of catalyst from one section of the unit to another and for temperature control as well as for carrying out the actual catalytic cracking and the regeneration of the catalyst. Because of the importance of the aviation gasoline program to the war effort, details of the process have not been published nor have the fundamental engineering data concerning the design of fluidized systems. However, some diagrammatic flow sheets[9] are available which, while not necessarily revealing the latest developments, do at least give an idea of the principles involved.

In early installations the crude oil flowing to the system received part of its heat from fuel vaporizing furnaces, part from heat exchangers which are used to control the temperature in the catalyst regenerator and part from the sensible heat of the regenerated catalyst. Regenerated catalyst flowing from a hopper was picked up by the incoming vaporized crude oil and carried into the reactor where the vapor velocity was reduced and a fairly dense pseudo-liquid was formed. The cracked petroleum

Fig. 3—Flow diagram of Winkler generator for gasifying brown coal



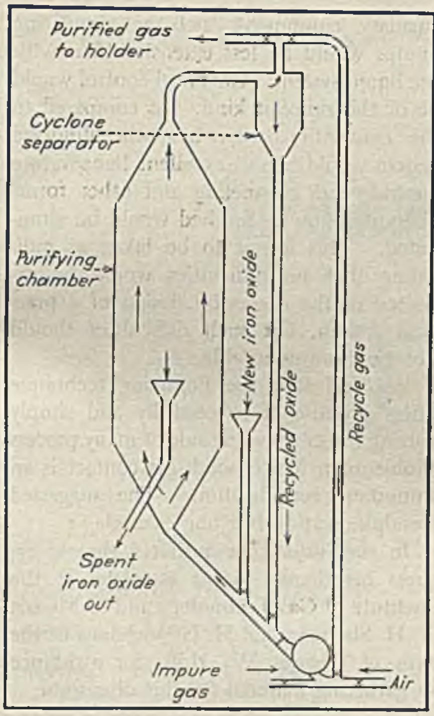


Fig. 4—Flow diagram of process proposed by the author for gas purification, using iron oxide in fluidized state

and the catalyst issued from the top of the reactor and entered a cyclone separator where most of the catalyst, now fouled with the carbonaceous products of the cracking process, was recovered. The vapors went on to a conventional fractionating system. The fouled catalyst from the reactor cyclone was picked up by an air stream and carried into the regenerator where the flow of gas was again slowed down and the solids were held up long enough to allow time for burning off the carbon from the catalyst. The catalyst and stack gases issuing from the regenerator passed through a cyclone which sent the catalyst to the storage hopper while the waste gases passed onward through a Cottrell precipitator which recovered any extremely fine catalyst that had been passed by the cyclone and eventually reached the stack. Heat control in the regenerator was obtained by recycling a controlled proportion of the catalyst around the circuit of regenerator, cyclone, hopper, heat exchanger, regenerator, etc.

The process has been improved by certain simplifications and in some installations by carrying out the catalytic cracking in two stages, the second of which operates on the gasoline fraction from the first cracking operation. Also in the newer installations most of the catalyst is removed from the reactor and the regenerator as a pseudoliquid instead of being blown out of the top of the unit and collected in cyclone separators. By this means a considerable load is removed from the vapor cleaning system. Also, in recent installations, waste-heat boilers have been inserted in the lines which carry the stack gases away from the generator. It has been found that little heat is needed to vaporize the incoming crude oil except that obtainable from the generator itself by the oxidation of the byproduct carbon. The temperature in the reactor is reported to be in the range of 800 to 975 deg. F., while the temperature in the regenerator is regulated to about 1,000 to 1,150 deg. F.

The dimensions and capacity of a fluid catalyst system and the weight flow of material through it reach surprising proportions. One of the first installations, that at Bayway, ran 20 stories into the air to a height of 235 ft. The capacity of a single unit of this size is of the order of thousands of barrels per day while the weight of catalyst recycled is measured in hundreds of tons per hour. The catalyst loss is held down to a small fraction of 1 percent of the daily throughput. Here again a previously discontinuous process involving, in this case, alternative cycles of use and regeneration of the catalyst has been rendered continuous, not to mention improvements in cracking and control of temperature.

We can see from the above that the fluidizing technique is right now working overtime and making a substantial contribution to our own war effort as well as to that of the enemy. It seems to be assured of a permanent place in the engineering picture. It has stimulated more groups than one to seek new fields for its application. For instance, Prof. Warren K. Lewis[10] of M. I. T. has recently been issued a patent for a sponge iron process in which the reducing gas is the fluidizing medium for finely divided particles of iron ore.

DESULPHURIZING GAS

As one example of a conceivable future development, a suggestion of the Institute of Gas Technology for the desulphurization of manufactured gas by a fluidizing process (Fig. 4) will be described.

There are at present two rival methods of removing hydrogen sulphide from manufactured gas which represent between them practically all of the industrial installations. These are the so-called dry box purification with solid iron oxide, and the family of liquid methods of purification which involve scrubbing of the gas with a solution capable of removing the greater part of the H_2S, after which it can be regenerated for re-use. Both types have compelling advantages, as well as counterbalancing shortcomings, and their relative merits are argued in the gas industry with an intensity usually reserved for politics and religion. Without intending to add fuel to this fire, this paper presents a suggestion which attempts to combine the merits of the two.

The dry box method involves passage of the gas to be purified through a stationary bed of iron oxide which is usually mixed with a material such as shavings or tanbark to give porosity to the bed. After the oxide has combined with a certain amount of H_2S it can be revivified by oxidation of the sulphide with air, reforming the original oxide and depositing elemental sulphur. This can be accomplished in place, either by adding a small amount of air to the gas stream, or by cutting out a purifier box and passing air through it. Or, the spent oxide may be removed from the box and subjected to atmospheric oxidation in open piles. Whichever scheme is followed the oxide eventually becomes so charged with sulphur that it must be replaced. This system is effective, tried, and capable of removing all but the last traces of H_2S from the gas. The material is low in cost, highly skilled labor is not needed, and no nuisance arises from disposal. On the other hand the equipment is bulky (232 cu. ft. of gas throughput per day per cubic foot of box in a recent installation), and relatively high in first cost. There is a possibility of considerable loss of activity through heating due to improper revivification[11], and the labor incident to revivification is unpleasant and may be hazardous. Also channeling may occur.

In liquid purification systems, of which there are several, the gas is scrubbed in a column or spray tower with a liquid which reacts chemically with the H_2S. The liquid is then regenerated in a second column by a suitable reaction, releasing the sulphur either as H_2S or as elemental sulphur. The space requirements are much less than for the dry box method,[12] while the need for routine labor is reduced and working conditions are notably improved. First cost is comparatively low and the back pressure on the gas producing system is small. However, sulphur removal is not usually as complete as with the dry box and, in fact, a small box is sometimes used to remove final traces of H_2S. A certain amount of skilled chemical control is needed, while the chemicals used are comparatively costly and may be consumed by side reactions. Sometimes there is a problem of H_2S disposal.

Several attempts have been made to improve purification methods. One is the one-tower purifier, used to some extent in England and on the continent. This employs a number of removable trays of iron oxide in a vertical column, with means for cutting out individual trays for purification. Several attempts have been made at handling the iron oxide in finely divided form and in motion while in contact with the gas stream.[13] Some of these have approached rather closely the ultimate simplification possible with truly fluidized systems. One type, the invention of E. J. Brady,[13] does not appear to have been carried beyond a small experimental stage. In it the gas passes through an annular space the walls of which carry a multiplicity of baffles. Oxide rains downward through the space, the inner wall being rotated to maintain free motion of the falling oxide. A second type, the invention of Walter Raffloer in Germany,[13] is said to have commercial application abroad. This process involves a series of shallow beds of iron oxide in each of which, according to the terms of the patent, the oxide is in a fluidized state as the gas rises through the bed of solids. Solids are fed from one level to another by star feeders, part of the discharged material going to regeneration in a similar unit while the remainder recycles.

It would appear that such suggestions as these are capable of improvement by mechanical simplification and by allowing a more suitable time for contacting. Fig. 4 suggests a proposed relatively simple system in which impure gas mixed with a small amount of air sufficient for oxidation of the H_2S would be passed through a fluidizing chamber in which the solids are iron oxide. A cyclone separator would serve to catch the small amount of oxide which would be blown out of the system, returning it to a point where it could be picked up by the incoming gas stream. Provision would be made for withdrawal of a small amount of spent oxide in pseudo-liquid form, and for the equivalent addition of fresh oxide. Provision would also be made for recycling of purified gas to maintain a constant flow rate despite unavoidable fluctuations in the gas flow from the manufacturing unit. Revivification would, of course, be continuous owing to the admission of air with the gas stream. Construction would be simple, and all material would be transported by means of the gas stream. Extreme turbulence of the pseudo-liquid would result in uniform and controllable temperature.

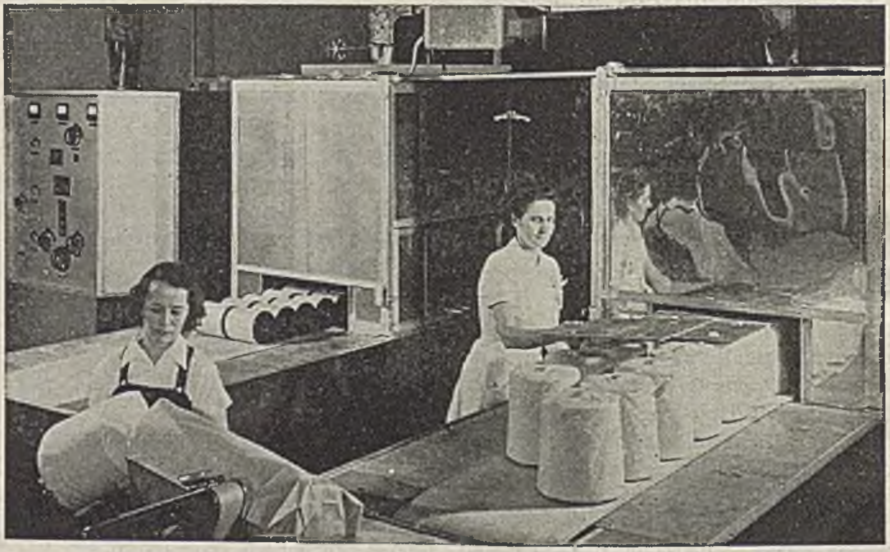
By such a system the economy of space, labor and capital characteristic of the liquid system would be secured, while substantially complete removal of hydrogen sulphide with a low cost reagent would result, as in the dry box process. Furthermore, auxiliary equipment such as circulating pumps would be less extensive than with the liquid system. Chemical control would be of the simplest kind. As compared to the conventional dry box, the fluidized system would permit excellent temperature control, and channeling and other forms of local action in the bed would be eliminated. This is not to be taken as indicating that no difficulties would be expected in the successful design of a practical system, but such difficulties should not be insurmountable.

We feel that the fluidizing technique offers promise of successfully and simply solving the engineering side of many process problems in which solids-gas contact is an important consideration. The suggested desulphurization but one example.

In conclusion, the author wishes to express his thanks to his associates at the Institute of Gas Technology and to Messrs. B. H. Sherman and H. N. Vagenius of the firm of Charles W. Hills, for assistance in gathering material for this discussion.

PATENTS AND REFERENCES

1. W. L. Card and J. C. Dane, U.S.P. 300,042, June 10, 1884; T. Fraser and H. F. Yancey, U.S.P. 1,534,846, April 21, 1925; H. N. Durham, Re. 20,082, Aug. 25, 1936; J. D. Morgan, U.S.P. 2,069,325, Feb. 2, 1937; M. A. Kendall, U.S.P. 2,303,367, Dec. 1, 1942; C. Stump, U.S.P. 2,332,183, Oct. 19, 1943.
2. Robinson, U.S.P. 212,508, Feb. 18, '79.
3. See (1) above.
4. A. G. Kinyon, U.S.P. 1,258,911, Mar. 12, 1918; A. G. Kinyon and A. I. Jacobs, U.S.P. 1,258,912, Mar. 12, 1918; J. W. Fuller, U.S.P. 1,608,499, Nov. 30, 1926; A. G. Kinyon, U.S.P. 1,652,281, Dec. 13, 1927; A. G. Kinyon, U.S.P. 1,677,119, July 10, 1928; J. H. Morrow, U.S.P. 1,778,429, Oct. 14, 1930; L. Manico, U.S.P. 1,796,381, Mar. 17, 1931; J. H. Morrow, U.S.P. 1,941,572, Jan. 2, 1934; J. H. Morrow, U.S.P. 1,941,573, Jan. 2, 1934; J. H. Morrow, U.S.P. 1,971,425, Aug. 28, 1934; V. K. Newcomer, U.S.P. 2,102,330, Dec. 14, 1937; H. S. Lenhart, U.S.P. 2,141,920, Dec. 27, 1938; C. O. Davis, U.S.P. 2,299,470, Oct. 20, '42.
5. W. M. Grant, U.S.P. 1,969,264, Aug. 7, 1934.
6. C. Pontoppidan, U.S.P. 1,616,547, Feb. 8, 1927; M. Lepersonne and E. Hastert, U.S.P. 1,806,068, May 19, 1931; E. Anderson, U.S.P. 1,839,456, Jan. 5, 1932; N. Nielson, U.S.P. 2,027,697, Jan. 14, 1936; P. Gochels, U.S.P. 2,125,913, Aug. 9, 1938; A. Hasselbach, U.S.P. 2,244,195, June 3, 1941; N. Nielsen, U.S.P. 2,292,897, Aug. 11, 1942.
7. F. Winkler, U.S.P. 1,687,118, Oct. 9, 1943; see anon., *Z. Ver. Deut. Ing.*, 79, 1094 (1935); also E. A. Thau, "Large Scale Water-Gas Manufacture for Chemical Synthesis," *Oel & Kohle*, 38, 589-601, 617-624, 685-90, 721-727 (1942).
8. W. W. Odell, U.S.P. 1,984,380, Dec. 18, 1934; W. W. Odell, Re. 21,526, Aug. 6, 1940; C. E. Hemminger, U.S.P. 2,303,047, Nov. 24, 1942; F. G. Brueckmann, U.S.P. 2,303,680, Dec. 1, 1942; E. J. Gohr, W. I. Thompson and H. Z. Martin, U.S.P. 2,320,273, May 25, 1943; C. E. Hemminger, U.S.P. 2,322,019, June 15, 1943; C. W. Tyson, U.S.P. 2,322,075, June 15, 1943.
9. Anon, "20 Story Cracking Plant Makes Aviation Gasoline by Fluid Catalytic Method," *Nat. Petrol. News*, 35, R-56 (1943); C. L. Thomas *et al.*, "Cracking with Catalysts," *Oil & Gas J.*, 42, 131 (Nov. 11, 1943); E. V. Murphree *et al.*, "Fluid Catalyst Cracking for Premium Fuels," *Oil & Gas J.*, 42, 37 (Nov. 18, '43).
10. W. K. Lewis, U.S.P. 2,343,780, Mar. 7, 1944.
11. G. E. Seil, "Dry Box Purification of Gas," American Gas Assn., New York, 1943; B. McYeigh, "Oxide Purification," *Gas J.*, 243, 50-61, 85-86 (1944).
12. Anon, "Sulphur Extracted From Coke Oven Gas by the Ammonia Thylox Method," *Blast Furn. & Steel Plant*, 32, 119 (1944).
13. E. J. Brady, U.S.P. 1,626,664, May 3, 1927; E. Raffloer, U.S.P. 1,624,625, April 12, 1927; E. Raffloer, U.S.P. 1,672,773, June 5, 1928; E. J. Brady, U.S.P. 1,731,223, Oct. 8, 1929; D. K. Dean, U.S.P. 1,957,251, May 1, 1934; W. Raffloer, Germ. P. 470,844, Feb. 1, 1929; C. Otto & Co., Germ. P. 578,810, June 16, 1933.



Setting twist in rayon tire cord by electronic heating at Industrial Rayon's Cleveland plant; pre-wrapped 18-lb. cones emerge from the heater at the right, being packaged for shipment at the left

Electronic Heating Used for Tire Cord

FOR MORE than eight months electronic heating has been used by Industrial Rayon Corp. for setting the twist in rayon tire cords. The new process, developed for the twist-setting of textile products generally by the company's technical staff, and subject of patent applications assigned to Industrial, is also in use under license by the B. F. Goodrich Co. The original installation at the Cleveland plant of Industrial includes high frequency power generating units each having an output of approximately 22,500 B.t.u. per hour, which were furnished by the Thermex Div. of the Girdler Corp. Each is capable of handling several thousand pounds of packaged tire cord per 24-hour day. Units employed by Goodrich were supplied by RCA. Industrial plans to install additional high frequency units at Cleveland, as well as in its new tire cord department at Painesville. Both new units will go into production during the Fall.

As shown in the accompanying view, setting of the twist of the tire cord is accomplished by placing the already wrapped 18-lb. cones of cord in a high frequency electrical field where heat is generated uniformly in the cord, the processing requiring only a matter of minutes. Moisture content control is facilitated by the pre-wrapping in moisture-proof paper.

R. C. BINDER *Associate Professor of Mechanical Engineering, Purdue University, Lafayette, Ind.*

Incompressible vs. Compressible

FLOW IN PIPES

When a compressible fluid flows adiabatically in a pipe the relations are simple and well understood. Flow of a compressible fluid, however, is much more complex. On this account it is often the practice, when dealing with a small pressure drop of compressible fluid, to assume that the result will be close enough for engineering purposes, and apply the incompressionable fluid laws. Professor Binder shows mathematically, and then by plotted results, just how different the two relations are, and what errors may be introduced if the simpler law is used for gases at high velocity or large pressure drop. He also presents a type of chart enabling use to be made of the simpler relation, with the introduction of a correction which can be obtained from the chart.—*Editors*

RELATIONS encountered in the flow of a compressible fluid in a pipe are much more complicated than the simple relations for the flow of an incompressible fluid or a liquid. The simple relations for incompressible flow are well established, but these relations should be applied with caution when dealing with the flow of gases at high velocities or large pressure differences. The question is frequently raised as to the limits of application of the incompressible flow relations, and the possibility of using the incompressible flow relations for studies of compressible flow. Some direct comparisons will be drawn between the incompressible flow relation and the relation for the flow of a gas through an insulated pipe. These comparisons will be helpful in answering questions regarding application.

The following discussion will be confined to steady flow in horizontal, constant-diameter pipes. It will be necessary to establish some basic relations before drawing comparisons.

BASIC RELATIONS

For the flow of an incompressible fluid in a horizontal pipe the pressure drop can be written as

$$p_1 - p_2 = \frac{f l V_1^2}{2 g D v_1} \qquad (1)$$

where p_1 is the initial pressure and p_2 is the final pressure at the end of length l. The friction factor f is a function of the Reynolds number. The meaning of all terms is given in the table of nomenclature.

The next step will be to develop a direct, general relation between pressure and length for a gas flowing in an insulated pipe. This problem is complicated by the varying specific volume, and hence the varying fluid velocity. There are various possible ways of deriving the final relation; the following method seems to be the simplest for obtaining a convenient and sound form of relation.

Let dl represent the length along a pipe

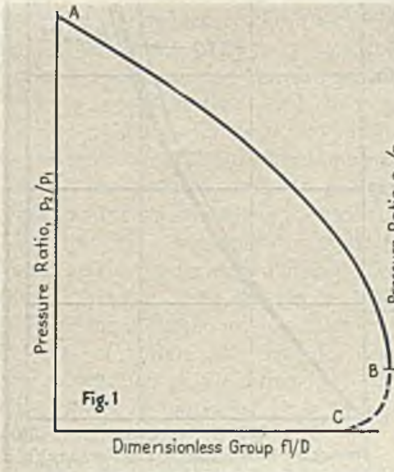
NOMENCLATURE

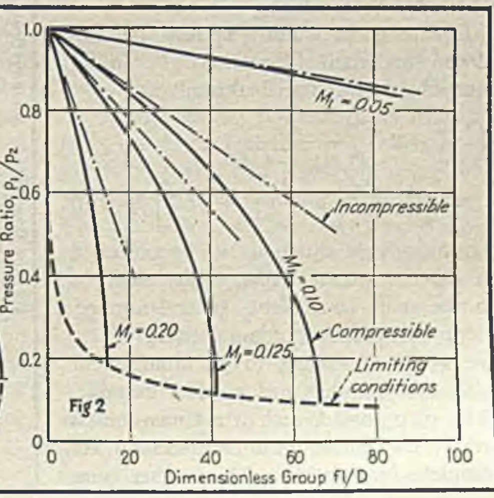
(Units, any consistent system)

A = Cross-sectional area of pipe
B = $(k - 1) M_1^2 [2 + (k - 1) M_1^2]$
c = Velocity of pressure propagation
D = Internal diameter of pipe
f = Pipe friction coefficient
g = Gravitational acceleration
k = Ratio of specific heat at constant pressure to specific heat at constant volume
l = Pipe length
M = Mach's number, V/c
p = Absolute pressure at any point in pipe
v = Specific volume of fluid
V = Velocity of fluid
W = Weight rate of flow.

Fig. 1—Type of plot of pressure ratio vs. *fl/D* for compressible flow in a horizontal insulated pipe (adiabatic flow)

Fig. 2—Variation of pressure ratio with *fl/D* and Mach's number, for adiabatic flow, and for gases with *k* equal to 1.4





of an infinitesimal element of fluid. The specific volume of the fluid in this element is v. The pressure drop across the element is dp, and the velocity change is dV. The general energy equation, in differential form, can be written as

$$vdp + \frac{d}{2g}(V^2) + dh = 0$$

where dh is the lost head. The usual practice will be followed, in expressing the lost head in the form

$$dh = \frac{fV^2}{2gD}\,dl$$

The general energy equation can then be written as

$$\frac{2gv}{V^2}\,dp + 2\frac{dV}{V} + \frac{fdl}{D} = 0 \qquad (2)$$

Note that each term of Equation (2) is a dimensionless ratio. The next step is to express the variables v, V and dV in terms of pressure p and pertinent constants, so that an integration will give the functional relation between pressure and length.

It will be assumed that the gas follows the relation $pv = RT$, where R is a gas factor and T is the absolute temperature. From the equation of continuity for steady flow,

$$W = \frac{AV}{v} = \text{constant}$$

$$\frac{dv}{v} = \frac{dV}{V}. \qquad (3)$$

The energy equation, equation of state, and the equation of continuity can be combined to give a relation between pressure and specific volume, as

$$pv + \frac{(k-1)\,W^2v^2}{k2gA^2} = p_1v_1 + \frac{(k-1)\,W^2v^2_1}{k2gA^2} = G \qquad (4)$$

where G is a constant. The pressure–volume relation for the irreversible process in an insulated pipe is not so simple, for example, as that for isothermal flow in which pv is a constant. For convenience in intermediate steps, let Equation (4) be written in the form

$$pv + bv^2 = G \qquad (5)$$

where b is a constant.

Equations (3) and (5) can be employed to arrange Equation (2) in an integrable form. The final result is

$$\int_0^l \frac{fdl}{D} = 2\int_{p_1}^{p_2} \frac{dp}{\sqrt{p^2 + 4bG}} - \frac{gA^2}{GW^2}\int_{p_1}^{p_2}\left[p + \sqrt{p^2 + 4bG}\right]dp \qquad (6)$$

The integrated equation can be expressed in different forms. A question arises as to the most convenient, general arrangement for practical computations. There are many advantages to an arrangement with dimensionless ratios. For example, fl/D, p_2/p_1, and k each is a dimensionless ratio. One more ratio is necessary for complete formulation. Many other compressible flow studies have shown the convenience of a velocity ratio called Mach's number, which is defined as

$$\text{Mach's number} = M = \frac{\text{fluid velocity}}{\text{acoustic velocity}}$$

Mach's number is a dimensionless ratio. The acoustic velocity or velocity of pressure propagation c for an adiabatic process is $c = \sqrt{kgpv}$. The initial Mach's number, then, is

$$M_1 = \frac{V_1}{\sqrt{kgp_1v_1}}$$

Physically, Mach's number is proportional to the square root of the inertia force to the elastic or compressibility force. Mach's number is a useful parameter just as the Reynolds number is a useful parameter. Physically, the Reynolds number is proportional to the ratio of inertia force to viscous force.

After integration Equation (6) can be expressed in the final form

$$\frac{fl}{D} = \frac{k-1}{kB}\left[1 - \frac{p_2^2}{p_1^2} - \frac{p_2}{p_1}\sqrt{\frac{p_2^2}{p_1^2} + B} + \sqrt{1+B}\right] + \frac{3k-1}{k}\log_e\left[\frac{\frac{p_2}{p_1} + \sqrt{\frac{p_2^2}{p_1^2} + B}}{1 + \sqrt{1+B}}\right] \qquad (7)$$

where

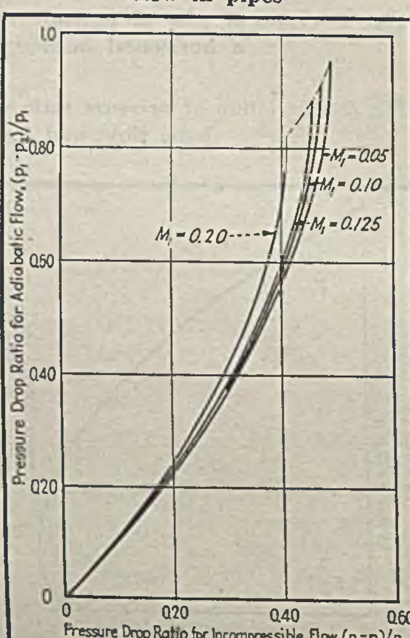
$$B = (k-1)\,M_1^2\,[2 + (k-1)\,M_1^2].$$

Equation (7) gives the functional relation between length and pressure for the flow of a gas in an insulated pipe. The relation for incompressible flow can be put in the form

$$\frac{p_2}{p_1} = 1 - \frac{kM_1^2fl}{2D} \qquad (8)$$

Equations (7) and (8) can now be used to make some comparisons.

Fig. 3—Pressure drop ratio for adiabatic flow, as a function of pressure drop for incompressible flow in pipes



COMPARISONS

Fig. 1 shows the type of plot obtained by applying Equation (7) for certain inlet conditions (certain M_1). The pressure in the pipe drops as the length increases, as shown by the solid curve *AB*. If Equation (7) is used blindly beyond point *B*, the curve *BC* results. Note that curve *BC* has a reverse slope from that of curve *AB*. Curve *BC* is shown dotted because the process is physically impossible. For example, in going from *C* to *B* the curve indicates a pressure *rise* with an increase in length. Curve *BC* is clearly an improper extension of the use of Equation (7) for flow *in* the pipe. The tangent at point *B* is vertical; investigation of this feature shows that at point *B* the local Mach's number is unity. At point *B* the fluid velocity equals the local acoustic velocity. Point *B* is a limiting condition for flow *in* the pipe; for example, the pressure in the pipe cannot drop below the pressure corresponding to point *B*. The simple relation for incompressible flow does not show any such limiting condition.

In Fig. 2 is shown a plot of the pressure ratio against fl/D for different initial Mach's numbers. The dotted curve represents limiting conditions. Equation (8) was employed to plot the straight dot-dash lines. A comparison of a dot-dash line and a solid line, for the same M_1, brings out the differences between compressible flow and incompressible flow.

A more direct comparison between the two types of flow can be given by the type of plot shown in Fig. 3. Equations (7) and (8) were employed to plot the curves for the initial Mach's numbers.

Sometimes the rule is indicated that the incompressible flow relation can be applied to compressible flow problems if the pressure drop $p_2 - p_1$ is less than 10 percent of the initial pressure p_1. Of course, the application of such a rule depends upon the accuracy desired; Fig. 3 illustrates the accuracy. There is not much difference between the incompressible and the compressible relations for values of $(p_1 - p_2)/p_1$ less than 0.05. At higher pressure ratios, however, the difference may be large. For example, with an initial Mach's number and a certain fl/D ratio (about 257), the incompressible flow relation gives a pressure drop $p_1 - p_2$ equal to $0.45p_1$, whereas the more accurate compressible flow relation gives a pressure drop $p_1 - p_2$ equal to $0.70p_1$.

The pressure drop for adiabatic compressible flow can be determined by first using the simple relation for incompressible flow, and then using a chart of the type shown in Fig. 3.

G. C. FINGER *Chemist, Illinois State Geological Survey, Urbana, Ill.*

FLUORINE

Compounds in Organic Syntheses

Not much has been heard of the impact of the new tool, fluorine and its compounds, upon the synthetic chemical industry, nevertheless the effect has been widespread and of vital importance in such wartime applications as 100-octane aviation gasoline and insecticides. In this article the author discusses the two-fold use of fluorine, first, the introduction into other chemicals, and second, its use as a catalyst. The discussion may suggest other means of using this material to make new products.—*Editors*

Commercial development of the Freon refrigerants in 1930 and the more recent development of the "alkylate" for 100-octane aviation gasoline strikingly illustrate the impact of a new tool, fluorine chemistry, upon the synthetic organic industry. These developments represent two entirely different roles played by fluorine compounds, and are harbingers of what can be expected in the future. In the first instance, the Freons are organic fluorine compounds, and in the latter, the aviation alkylate does not contain fluorine in its molecules but depends upon hydrogen fluoride as a catalyst in its synthesis. The object of this discussion is, first, to describe briefly these processes and other commercial developments, second, show by these illustrations that further developments are now within the scope of good commercial practice, and third, point out the almost unlimited field of research that may lead to many important developments.

In this new research the "key chemical" is hydrofluoric acid (aqueous and anhydrous). It enters directly or indirectly into almost every process of fluorine chemistry, therefore a thorough understanding of its physical and chemical properties is a prime prerequisite. The production, handling, and properties of this chemical have been covered thoroughly in the literature, therefore will not be discussed in this article.

REFRIGERANTS

The initial industrial achievement in organic fluorine chemistry came when Midgley and Henne in 1930 announced the commercial production of new refrigerants, Freons. They put into industrial practice a chemical reaction discovered in 1892 by Swarts, a Belgian chemist. The Swarts reaction, in its simplest terms, involves the replacement of chlorine by fluorine in a suitable organic compound by means of anhydrous antimony trifluoride. In some cases, antimony pentachloride is necessary. The reaction has been extended considerably as to catalysts, types of compounds that can be prepared, and the fluorinating agents involved.

Freons are chlorofluoro derivatives of methane and ethane, and are prepared from carbon tetrachloride, chloroform, and hexachloroethane depending upon the compound desired. For illustrative purposes, the commercial synthesis of dichlorodifluoromethane (F-12) is described. Carbon tetrachloride and anhydrous hydrofluoric acid (correctly called hydrogen fluoride) are fed continuously into a heated reactor containing the anhydrous antimony halide. The reaction products pass into a fractionating column where the free acids (HCl and HF) are separated from the Freon and the insufficiently fluorinated raw material is returned to the system. This fractionation is simple as, for example, in the case of carbon tetrachloride, where each substitution of a fluorine for a chlorine atom is accompanied by a lowering of the boiling point of about 52 deg. C. By means of scrubbing and drying towers the final product is condensed. It is sold in cylinders or in carload lots. The active fluorinating agent or catalyst, antimony trifluoride, is continuously regenerated.

Freon is a trade name of Kinetic Chemicals Co., for the new refrigerants. Since there are a number of these compounds, they are differentiated by symbols. The most common is F-12, CCl_2F_2 (loosely spoken of as Freon), in addition, there is F-11, CCl_3F; F-21, $CHCl_2F$; F-22, $CHClF_2$; F-113, CCl_2FCClF_2; and F-114, $CClF_2CClF_2$. Due to their outstanding properties of stability, non-toxicity, non-flammability, and non-corrosiveness they are used extensively in refrigeration and air-conditioning equipment.

Fumigation of tents, barracks, airplanes, tanks and military installations, especially in the tropics, has become a simple operation as the result of a new aerosol fumigator called "bug bomb." Such insects as mosquitoes, flies and other disease carriers are readily exterminated in a matter of several minutes. This bomb, which can be carried in one hand, contains a mixture of pyrethrum, sesame oil, and liquid Freon. All of the components are harmless to humans. By opening the ejection valve, the Freon begins to boil (its boiling point is about —19 deg. F.) expelling the insecticidal mixture and virtually exploding it as a fine mist which remains suspended in air for a long time. One bomb contains sufficient material to fumigate a space of 150,000 cu.ft. Over 7,000,000 of these bombs have been delivered to the Armed Services. Already postwar plans call for their use in civilian life, and it has been suggested that a new paint gun using this principle be developed for spray painting. The production of Freon upon completion of two new plants will be approximately 2,400 tons per month.

AVIATION GASOLINE ALKYLATE

The most recent and distinguished work in organic synthesis involving fluorine chemistry is the preparation of "alkylate" for 100-octane aviation gasoline by hydrogen fluoride alkylation. The discovery of this process by Ipatieff and his coworkers in the Universal Oil Products laboratories, and the initial plant installation by the Phillips Petroleum Co. in 1942 is of inestimable value to the war effort in respect to air supremacy. Due to war restrictions, details on this process are not available, but the essential principles are known.

The process is essentially the conversion of olefines in the presence of isoparaffins to saturated products with anhydrous hydrofluoric acid as a catalyst. Usual engineering materials are employed for corrosion is not a serious factor so long as moisture is excluded.

A thoroughly mixed feed stock of olefines and isoparaffins is fed into an alkylation chamber containing anhydrous hydrofluoric acid. Since HF is quite insoluble in the hydrocarbon mixture and since considerable heat of reaction is evolved in the alkylation, the chamber is equipped with suitable stirring equipment and cooling coils. The reaction products are passed into a separating tank to allow the HF to separate as a lower layer and be returned to the alkylation chamber. From the separating tank, the hydrocarbon mixture is passed successively into a HF stripping column, a dehydrofluorinator, a de-isobutanizer, a debutanizer, and finally through a fractionating column to give the desired alkylate fraction. Since the alkylation is a liquid phase reaction, it is necessary to maintain sufficient pressure so that the reacting components remain in a liquid state.

The alkylate is a mixture of branched methyl side chain isomers of heptane, octane, etc. The 100-octane aviation gasoline may contain from 25 to 40 percent of this alkylate. Triptane, 2, 2, 3-trimethylpentane, recently announced as the most powerful aviation fuel component known, can also be made by this process, but in very low yields.

In addition to the desired reaction in the alkylation chamber, a variety of other reactions take place such as de-alkylation, polymerization and depolymerization, hydrofluorination and dehydrofluorination, hydrogen transfer, and isomerization. All of these reactions must be taken into consideration in order to obtain the most favorable yield. Without a doubt, this process with its numerous reactions is an excellent example of the versatility of hydrogen fluoride in organic chemistry, and a thorough knowledge of these reactions should lead to many other interesting developments.

DYES

Shortly after the appearance of the Freon refrigerants, the I. G. in Germany introduced a new series of fast Naphthol AS type dyes which contained fluorine in their molecules. Some of these dyes appeared on the American market. The print dyes exhibit unusual clearness in color (mostly yellow, orange and red) and possess excellent light fastness. It has been stated that one of the red colors meets German Government specifications for use in the official banner. In general, they are coupled products of a Naphthol AS type with fluorine containing diazotized bases as used in the recently developed Rapidogen colors for printing cotton goods. Fast Orange Salt RD is probably a representative of one of the diazotized bases. The diazotized bases are supposedly derivatives of benzotrifluoride (a fluorine analog of benzotrichloride).

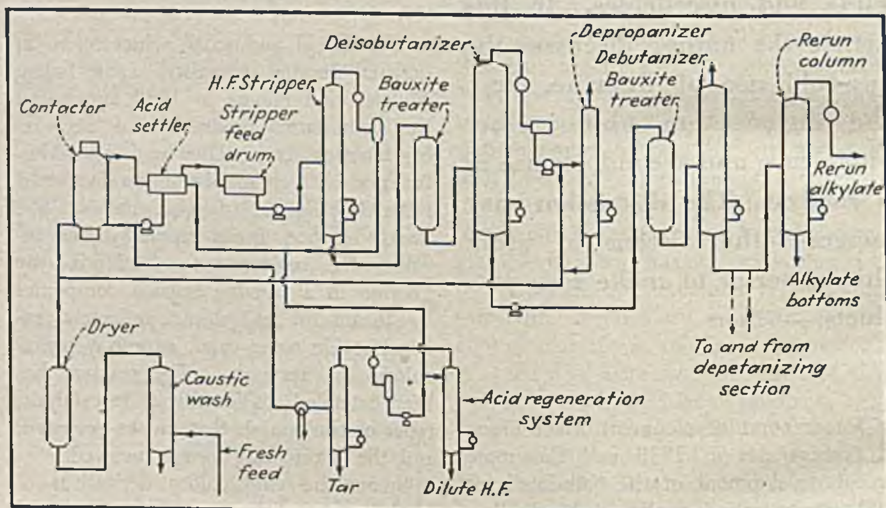
BENZOTRIFLUORIDE

Since benzotrifluoride ($C_6H_5CF_3$) can be considered as the parent of these dyes, a brief discussion of its synthesis and properties is apropos. The fluorine is present in the form of a $-CF_3$ group. This group in contrast to its chlorine analog, $-CCl_3$, is very stable, does not hydrolyze under ordinary conditions, and many of the usual reactions used in the synthesis of dye intermediates have no deleterious effect upon it. Benzotrifluoride can be prepared from benzotrichloride by the Swarts reaction in the absence of a catalyst. Commercially, anhydrous hydrofluoric acid is used in place of antimony trifluoride. The reaction takes place in an autoclave under heat and pressure resulting in an almost quantitative yield. The process is similar to the production of Freons.

In general, fluorine in the aromatic nucleus is quite stable and an effort has been made to develop dye intermediates possessing such a structure. None have found a place in the competitive market. However, a brief discussion of the introduction of fluorine into the aromatic nucleus is pertinent as some of these syntheses may find industrial application. An aromatic amine may be converted to the corresponding fluorine compound by two methods. The first method involves the diazotization of the amine in highly concentrated or anhydrous hydrofluoric acid with sodium nitrite followed by decomposition to the fluorine compound. This synthesis can be carried out in iron equipment. An 87 percent yield has been reported for fluorobenzene from aniline.

SCHIEMANN REACTION

The second method involves the formation of an insoluble diazonium fluoborate (also called borofluoride) followed by a thermal decomposition to the corresponding fluorine compound. This method is known as the Schiemann reaction, unfortunately not named after its discoverers, but after the scientist who made an extensive study of its possibilities. When a soluble diazonium salt, most generally a chloride, is treated with fluoboric acid (HBF_4), a precipitate of the diazonium fluoborate is formed. The diazonium fluoborates are quite insoluble and surprisingly stable, thus it is possible to isolate and dry them. Since these salts can be readily isolated, many diazonium compounds can be purified as the fluoborate salts. Since these compounds have definite decomposition temperatures (usually not over 200 deg. C.), the dried salts can be thermally decomposed to the desired fluorine compound, with nitrogen and boron trifluoride being evolved as gases. Sodium fluoborate can be used in place of fluoboric acid thereby eliminating to a large extent the intrinsic corrosiveness of the acid and simplifying the method so that many aromatic fluoric compounds can be prepared



The most recent work in organic synthesis involving fluorine chemistry is the preparation of "alkylate" for 100-octane aviation gasoline by the hydrogen fluoride alkylation process

in ordinary laboratory glassware. In general, the yields are good; and, by recovering the boron trifluoride the cost can be materially reduced.

Stabilized diazo compounds in the form of complex double salts, etc., have been available for a long time. In a broad sense, the diazonium fluoborates are stabilized diazo compounds. For instance, Fast Red RL Salt, chemically known as 2-methyl-4-nitrobenzene diazonium chloride can be stabilized by conversion to the fluoborate salt. It is conceivable that some diazonium fluoborates may appear on the market as such. The most attractive feature of these compounds lies in the fact, that certain diazonium compounds too difficult to obtain in sufficient purity for dyeing can be readily purified through the fluoborate salts. It has been reported that borofluoro sulphonic acid, fluorosulphonic acid, and certain metallic fluorides also will form stabilized salts.

POLYMERS

Swarts in his studies on fluoroethylenes reported that a number of these compounds gave polymers of varying degrees of hardness. A striking example cited by him in 1909 was that α-bromovinylfluoride ($CH_2 = CBrF$) gave a "translucent block as hard as glass." Nothing further was done on this subject until a patent was issued to the I. G. in 1939 on some vinyl polymers that are described as nonflammable, insoluble in organic solvents, and very stable to chemical agents. In this group, trifluorovinyl-chloride exhibited these properties to the greatest extent. Theoretically, tetrafluoroethylene should give the most stable polymer and in 1941 a patent was issued to the du Pont company on this polymer. In the latter patent, it was indicated that this polymer was fairly clear and transparent, and could be molded. There is no question that such a product will find some interesting applications.

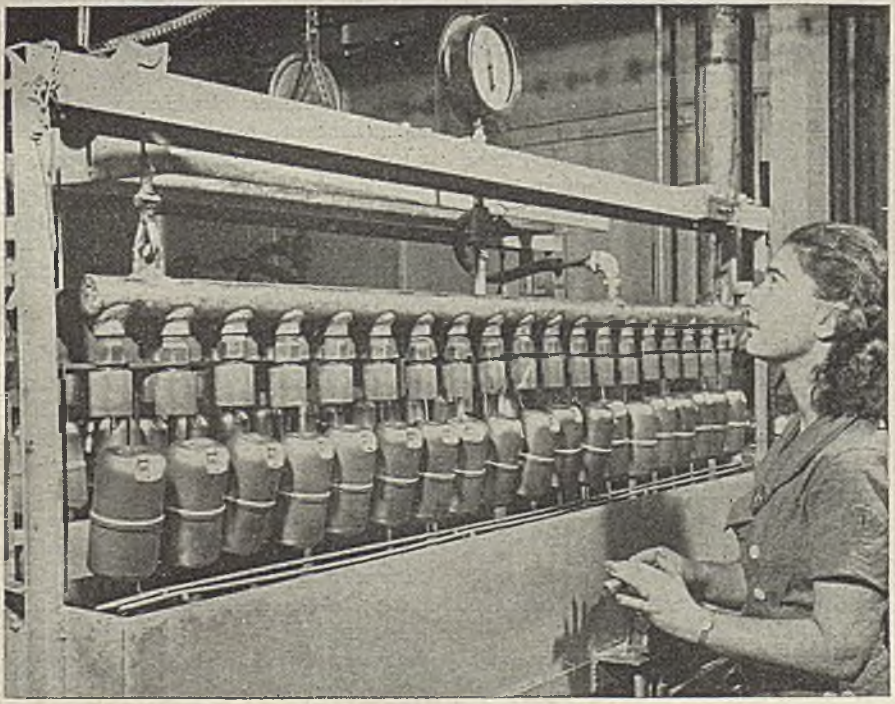
The fundamental compounds for the synthesis of these polymers are directly related to the ethane type of Freons discussed earlier in this article. In general, the fluorinated olefines may be synthesized from an appropriate chlorofluoroethane by the removal of HCl or two adjacent chlorine atoms with well-known reactions. Halogen acid may be removed by various alkaline reagents.

The preferred reaction is the removal of two chlorine atoms on adjacent carbon atoms by zinc in a suitable solvent such as alcohol.

It is interesting to note that chlorine is preferentially removed over that of fluorine. Heat and pressure are sometimes necessary to obtain satisfactory yields. Since the higher fluorinated ethylenes are gases, they are synthesized and polymerized in closed systems.

In the case of non-fluorine polymers, boron trifluoride has been used as a catalyst in the synthesis of a rubber-like polymer from isobutylene. It is doubtful that BF_3 is being used in the present synthetic rubber program. The ability of HF as a catalyst in polymerizing olefines in rather common knowledge; also, certain vegetable oils are readily polymerized to a rubber-like material.

The fumigation of airplanes, tanks, and military installations has become a simple operation as the result of a new fumigator called an aerosol or "bug bomb." This bomb contains a mixture of pyrethrum, sesame oil and liquid Freon. Here containers are tested before being filled



ACETIC AND PROPIONIC ACIDS

One of the most important applications of boron trifluoride as a catalyst is in the new synthetic acetic and propionic acid process of the du Pont company. The catalyst is actually used in the form of a hydrate. The process is essentially a condensation of carbon monoxide with methanol or ethanol under pressures as high as 900 atmospheres at 260 deg. C. Yields of 79 percent for acetic and 50 percent for propionic acid are reported.

It is possible to effect many other condensations with this catalyst, particularly where an acid type of catalyst is required for the operation.

The question of the use of fluorine compounds as insulating and cooling oils for transformers and the like has been superficially investigated. Chlorinated paraffins and biphenyls are being used for this purpose and it is only natural to suspect that the fluorine compounds may be more stable. A number of patents have been issued covering the use of some of the chlorofluoroethanes (Freon derivatives) and chlorinated benzotrifluorides for this purpose. The possibilities have not been exhausted and practically no correlation data are available between constitution and such factors as dielectric constants, power factors, and the like.

PHARMACEUTICALS

Some interest has been indicated in medical and pharmaceutical fields. Unfortunately, little information is available on the physiological effect of organic fluorine compounds. In some cases they may be toxic and in others not. Fluoroform (CHF_3) is practically inert as far as anesthetic and physiological properties are concerned; as a matter of fact, it can be substituted for nitrogen in air with no apparent effect. In Germany, 3-fluorotyrosine was sold under the name of Pardinon for treatment of hyperthreosis; and an ointment Epidermin containing *p. p'*-difluorobiphenyl for the treatment of wounds and burns was also available. It has been indicated that *p*-fluorosodium benzoate can be used as an internal antiseptic as it is not as toxic as sodium fluoride.

Fluoroacetic, fluorobenzoic and fluorobenzene sulphonic acids have been suggested for use as fungicides, insecticides and disinfectants, but in most cases there is a question of their efficacy. Fluorostearic acid is reported to be as effective as certain copper preparations for mildew control. This compound is readily propared by the addition of HF to oleic acid; the addition of HF to the double bond is rapid in contrast to HCl which combines very slowly. Outside of a few instances, the field of fungicides, insecticides, etc., is practically unexplored and should hold considerable promise for future investigations and developments.

S. D. KIRKPATRICK *Editor, Chemical & Metallurgical Engineering*

Kaiser's Stake in the MAGNESIUM INDUSTRY

Returning this Spring to the West Coast after almost three years, Mr. Kirkpatrick found evidence of many changes in the magnesium projects on which the Kaiser interests had embarked so auspiciously in the early days of the defense program. Many costly lessons have been learned as his engineers have struggled to work the "bugs" out of the carbothermic process. Meanwhile vast new raw material sources have been uncovered and several valuable products and byproducts developed for war uses. Now, at long last, the whole enterprise seems to be moving in the right direction, i.e., toward producing a purer metal at lower cost.—*Editors*

Having for so long been on the receiving end of so many rumors regarding the ups and downs of Mr. Kaiser's magnesium enterprises, this writer welcomed an opportunity afforded earlier this Spring to make a first-hand inspection of the California operations. He was particularly interested in the installation at Permanente of the country's first and only plant to use the often-debated carbothermic process which was introduced here in 1940 by Dr. Fritz Hansgirg, the Austrian ex-patriate chemist who is now teaching in Black Mountain College, N. C. That plant has had a stormy career since it was first described in *Chem. & Met.*'s September, 1941 issue. It is not yet on "easy street," even after three years of intensive and costly experimentation, but sufficient progress has been made to prove that it is at last moving in the right direction. Valuable products have been developed for war uses and new sources of raw material are being exploited not only for the carbothermic process at Permanente but also for the silicothermic process at Manteca.

An interesting cartoon-map of Kaiser's many projects for magnesium production appears on the opposite page and should be consulted in connection with the following discussion.

Dolomite is quarried at Natividad, which is not far from Salinas, the nation's salad bowl and the California home of guayule rubber. A virtual mountain of rich (13 percent Mg) ore is being shot down and picked up by several 3-cu-yd. drag shovels to be loaded into Tournapull buggies that carry it to the primary crusher and screens. Here all material of less than ½ in.—largely sand and granite—is rejected while the oversize finds itself on a typical Kaiser belt conveyor that delivers it to the kilns several hundred yards below in the valley. There are two 308 ft. kilns of Smidth design, fired with natural gas. One normally produces a soft burned, fine, fluffy MgOCaO for use in the seawater process at Moss Landing and, ultimately, for metal production at Permanente.* The other kiln is generally used for producing a hard burned material to which some fluorspar has been added. This goes to the silicothermic magnesium plant at Manteca.

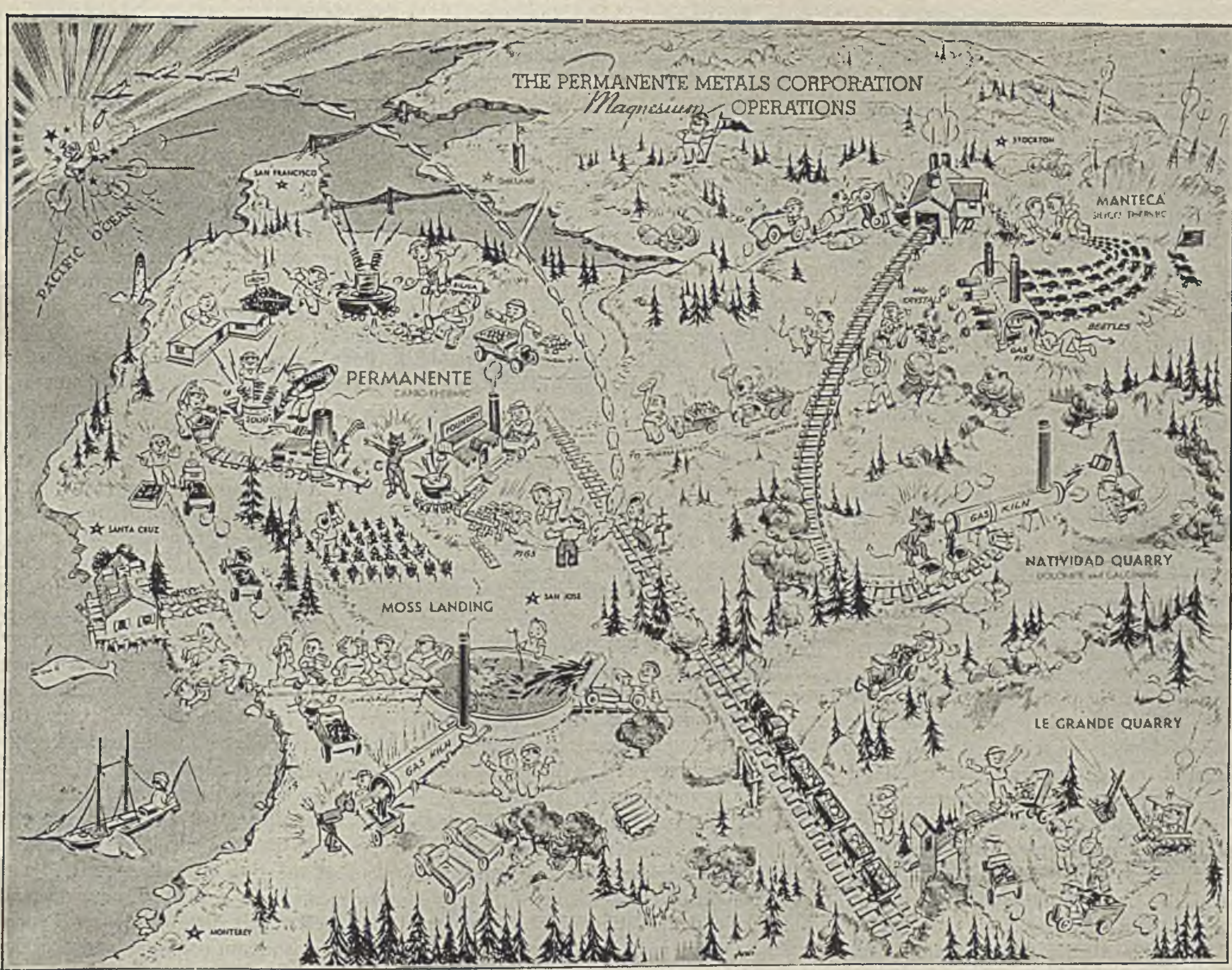
Trucks carry the soft-burned "dolime" from Natividad down to the ocean at Moss Landing, which is on Monterey Bay. Here is a beautifully constructed, modern chemical plant that utilizes seawater not only for its own magnesium content but also for processing the calcined dolomite to free it from calcium.

The calcined dolomite from Natividad is first slaked and enough of the slurry is added to the incoming seawater to remove the carbonates and bicarbonates. This pretreatment is effected in two 75-ft. and one 125-ft. hydrotreaters and the resulting precipitate of calcium carbonate is pumped to waste. The overflow goes to a 50-ft. reactor tank where the bulk of the calcined dolomite is introduced. Here the major reaction takes place with the precipitation of magnesium hydrate and the release of calcium chloride to the solution. From the reactor tank the $Mg(OH)_2$ slurry goes to a series of four 250-ft. Dorr thickeners where the hydrate underflow is pumped counter-currently to each succeeding tank while the fresh water is flown currently through each of the tanks. The precipitated washed magnesium hydroxide is pumped from the last thickener into a slurry tank, from which it is fed to five large 14x18-ft. panel type Oliver vacuum filters. (The operators call them "G-string" filters because the cake is removed by a string that stretches across the bellied panels on the discharge side).

The magnesium hydrate is finally burned to the oxide in a Smidth rotary kiln which, under different operating conditions, is also used for burning the refractory grade of magnesia known as artificial periclase. It is of passing interest to note that Kaiser uses this material to produce refractory brick for his steel plant at Fontanna and cement plant at Permanente and has sufficient magnesia capacity as well to supply the needs of other manufacturers and processors. Approximately one-half of the magnesia shipped to Permanente from Moss Landing comes from the seawater and the other half from the dolomite.

Since the writer's prior visit to Permanente in July, 1941, some tremendous changes have taken place. The great cement plant continues to be one of the country's largest—if not most unique—producers. Whole mountains of rock have passed through its kilns en route to war

*A *Chem. & Met.* pictured flowsheet of the operations at Natividad, Moss Landing and Permanente will be found in pp. 128-131 of this issue.



To Mr. Togo with Mr. Kaiser's compliments and best wishes for a hot time in the old town of Tokyo

construction jobs all over the world. Several projects requiring new equipment and expanded facilities have been completed in record time to fill pressing needs of Britain and other United Nations. A huge ferrosilicon plant produces the 75 percent alloy required for the silicothermic magnesium plant at Manteca, as well as for use in iron and steel operations throughout the Nation. But most interest attaches to the famous carbothermic plant that stretches for a half mile up the mountainside adjoining the cement mill. Here the most impressive additions, as viewed from the valley, include the alloy plant and foundry facilities, the new and modern research laboratories and the engineering and administrative office buildings. Permanente is an impressive sight—even from the outside.

Equally or more startling are the changes within the plant, although not all of them are immediately evident. Rather the visitor gets the impression of smooth running, orderly production with the minimum of the tearing down and rebuilding that characterized this plant's earlier history. No useful purpose would be served by reviewing in detail here all of the troubles that have been encountered. Perhaps it is sufficient to report that one by one they have been overcome and that, as soon as war demands will permit, Permanente Metals Corporation will be back in the large scale production of magnesium by an improved carbothermic process. Nor should we lose sight of the fact that despite its troubles, considerable magnesium was produced at a critical time when it was sorely needed in the war effort. For the present most of its facilities are being used to meet the war needs for a special military product that is in ever-increasing demand.

One of the most reassuring of Permanente's many projects is a pilot plant for the study of the Hansgirg process—something some chemical engineers felt should have been the company's first move three years ago. Here it has been possible to work out on a small scale a number of important improvements in the process—some of which have greatly simplified operations and reduced costs. For example, in the original process the magnesium dust and gas from the furnace were cooled in a huge horizontal condenser of mild steel with an outer shell to provide circulation of cooling oil. Within the condenser is an oil-cooled stainless steel reamer that was a continuing source of trouble since it would often crack and leak oil. First a new reamer was developed of special casting with inserted cutting edges of hard alloy designed so it did not require cooling. In order to shorten the reamer shaft and eliminate some of the internal bearings in the condenser, as well as to eliminate the cantilever span, it was suggested that a vertical condenser should be substituted for the horizontal type. This was tried out first in the pilot plant and later substituted in the most modern plant unit. The dust that collects in the bottom of the vertical condenser goes directly by gravity to a screw conveyor that carries it to the dust bin so it is no longer necessary to provide a troublesome scraping mechanism. This suggested other simplifying improvements.

By installing a spool and a gate valve between the condenser and the furnace it is now possible, by closing this valve and the one on the top of the condenser to isolate it from the balance of the system just as effectively as through the cumbersome withdrawal of the old horizontal chamber. Once isolated, the vertical condenser can also be cleaned much more readily.

Another early source of trouble was at the glands where the electrodes enter the furnaces. These were originally made of copper or cast bronze and cost several thousand dollars each. Now the company makes its own from secondary aluminum at a tenth of the cost, but more important, they have never had a gland failure since installing the new design. The gland itself consists of an internal sleeve through which the electrode passes and it is, therefore, at the same potential as the electrode. The inner gland rests on a ring of Micarta that insulates it from the outer gland which is of the same potential as the furnace roof In order to eliminate any building-up of carbon between the inner and outer glands, which would cause arcing, the new design introduces a stream of hydrogen gas tangentially through the outer gland in order to clean the areas between the two glands. In the original copper glands there was always a certain amount of sweating from the cooling oil reservoir and after this reached the surfaces between the inner and outer glands, the oil would crack and form a hard carbon deposit, which in turn resulted in arcing and burning out of the gland.

Such have been the character of many of the difficulties met at Permanente. They were mechanical and electrical rather than chemical or metallurgical. Yet not until they were conquered was it possible to improve the process itself.

The chief raw materials at Permanente are magnesia from Moss Landing and petroleum coke from California oil refineries. These are mixed, ground together in ball mills, then pelleted into tiny briquettes called "beetles," each about the size of a large lima bean. These are tumbled to remove dust and then taken by overhead conveyors to be charged into one of the electric furnaces. There are five of these 3-phase 8,000 kva. reduction furnaces —four for continuous operation and one for standby. For a time the plant operated with single phase furnaces, three of which were built and are now being used for experimental purposes. This return to the remodelled 3-phase furnaces came, however, only after many experimental operations had eliminated the earlier difficulties.

OPERATING PROCEDURE

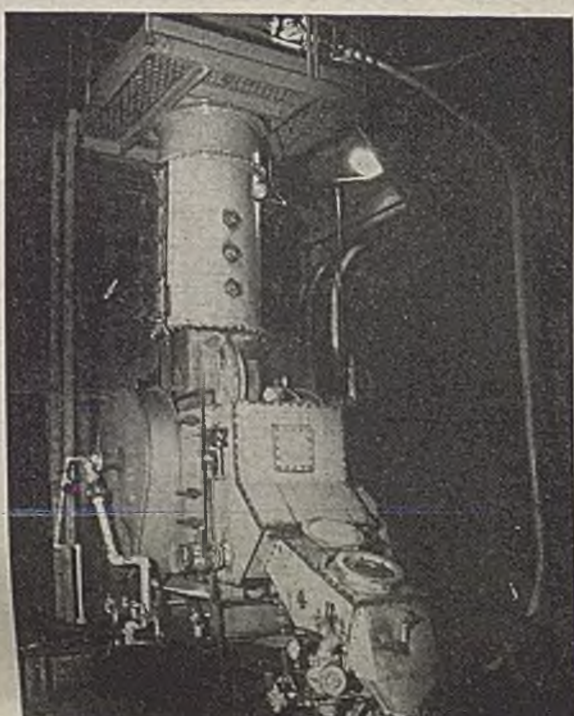
The furnaces operate at approximately 3,600 deg. F. and, after the MgO is completely reduced, the furnace products must be quickly chilled to about 400 deg. F. Natural gas in large volume is used for the shock chilling and is then pumped to the cement plant for use as fuel. Hydrogen is manufactured in electrolytic cells for use as a sweeper gas, as previously stated, and the oxygen byproduct of this operation is bottled and sold to the shipyards for oxyacetylene welding. The nitrogen used for purging operations throughout the plant is manufactured by burning the oxygen from air and scrubbing out the CO_2 gas.

The sub-microscopic magnesium dust produced in the furnace is removed from the gas in a battery of bag filters and then conveyed to dust bins for storage.

It was interesting to note that Kaiser's engineers have developed a method of dry pelleting this powder (that is without the incorporation of oil which was first introduced as a modification of the Hansgirg process). This pelleting is done in an atmosphere of inert gas to yield pellets that can be directly reduced in the retorts, thereby eliminating the cost and waste of time in cracking off the oil prior to subliming the metal itself. This sublimation process is effected at a temperature of 1,400 deg. F. at an absolute pressure of 0.2 mm. of mercury. In the upper condensing portion of the retorts there is a liner which collects the crystals of magnesium. When the sublimation is complete, the retorts are cooled, the liners removed and the crystals of magnesium stripped from the liners. These crystals of over 99.99 percent purity are melted and alloyed to produce the various war products in which magnesium is now playing an increasingly important role.

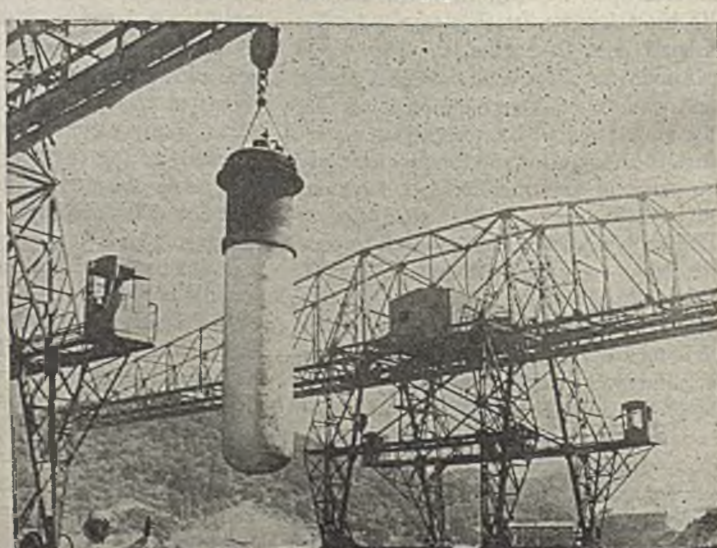
Permanente is marketing an interesting byproduct material called "Carbothermic Magnesia" which is made by converting magnesium oxide to metallic magnesium in the presence of carbon in the electric furnace followed by the back reaction to yield this special grade of magnesium oxide. Since it contains its own carbon black and filler, it is advantageous for use in compounding certain types of synthetic rubber in order to improve physical properties. As previously noted, the company also markets various grades of magnesium oxide from Moss Landing as well as an extremely fine silica obtained from the ferrosilicon operation at Permanente.

Thus it is that Mr. Kaiser and his associates have invested at least $20,000,000 of their own money and at least three years of valuable time and energy in the development of the carbothermic process. If, as now seems fairly evident, the war demand for specialty products based on Permanente's magnesium continues and provides the necessary additional time and funds, Kaiser will be back in metal production and the country will have, for the first time, an important source for the purer magnesium made by the carbothermic process.



Left — Dry pelleting of magnesium-carbon powder is done in air-tight presses under inert atmosphere

Below — After magnesium metal has been sublimated in electrically heated retorts, they are picked up by a giant crane and carried to cooling pits



J. L. MARSH, G. H. FREMON, R. D. GLENN, V. D. LUEDEKE and D. J. PORTER
Technical Committee, Charleston Section, American Institute of Chemical Engineers

The Coming Search for Synthetic MOTOR FUELS

The Senate has authorized expenditure of $30,000,000 to develop processes for obtaining motor fuels from coal, shale and forest products. This is necessary for another world war might bring on a crisis suddenly, and make synthetic gasoline as vitally important as synthetic rubber is today. It may be desirable to begin the use of these other fuels long before the supply of petroleum becomes critically short. Therefore, it is interesting to consider the methods which are available for producing motor fuels from sources other than petroleum. The experience of other countries which are already making synthetic fuels may point the direction in which developments in America will occur.—*Editors*

Fear of a petroleum shortage has existed in the United States ever since the motor car first came into common use. Twice before, the situation has been labeled critical, and substitutes for gasoline have been sought. Both times, enormous new oil fields were discovered, and the enthusiasm for synthetic gasoline died down. Today, the question is again being discussed seriously. Congress recently completed a lengthy investigation of methods for producing synthetic gasolines and has now authorized an expenditure of $30,000,000 to develop processes for obtaining motor fuels from coal, shale and forest products.

It is well known that synthetic gasoline forms a large part of Germany's supply, and that synthetic or substitute motor fuels have been used to an appreciable extent in other countries which do not have large petroleum deposits. Published reports and statements before Congress provide considerable information about the processes used in these countries. These processes are of interest to chemical engineers, because the motor fuel industry, in using them, will be applying chemical engineering techniques more than ever.

The reason which is given by the Congress for sponsoring a development which would ordinarily be left to private industry is that this country must be fully prepared to produce synthetic gasolines whenever petroleum resources of the country become inadequate. Another world-wide war might bring on a crisis suddenly, and make synthetic gasolines as vitally important as synthetic rubber is today. Increasing civilian demand may eventually result in a shortage of gasoline which can only be met by producing motor fuels from materials other than petroleum. Whatever the future development, the principal factor in determining when this country will begin to produce synthetic gasoline in quantity, is the estimate which is made of the country's petroleum resources.

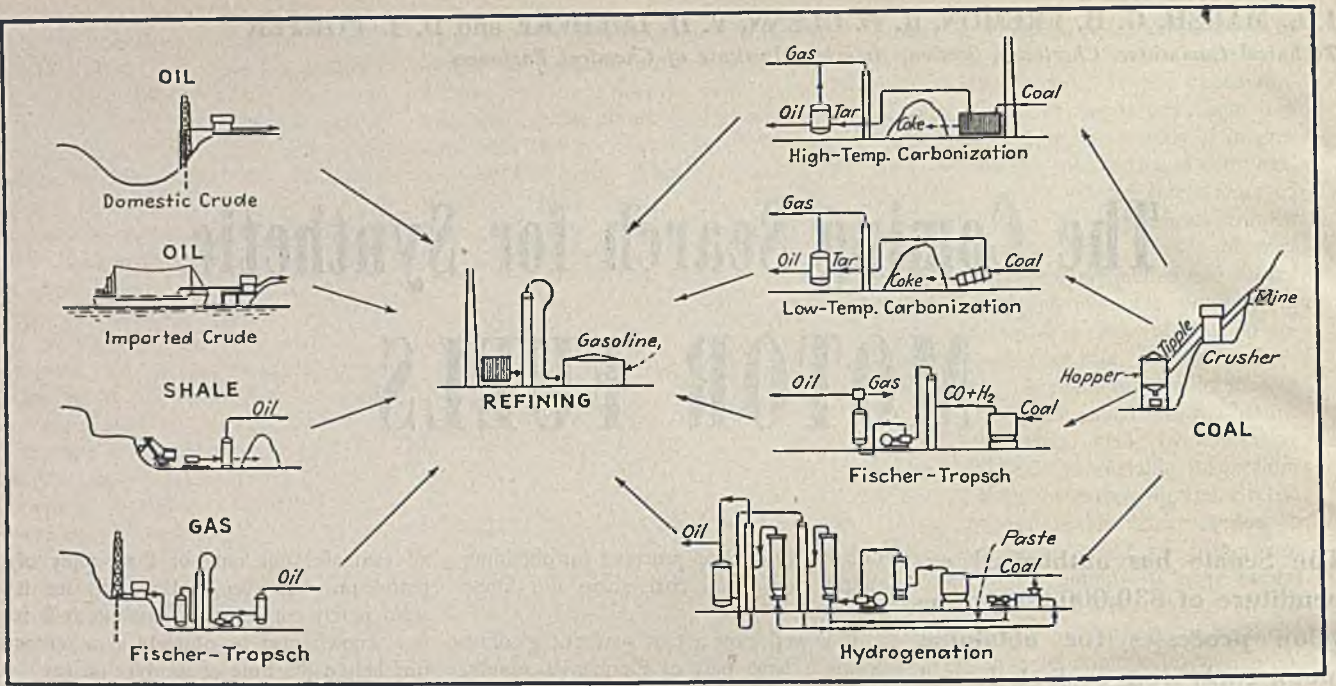
The evidence points to the conclusion that there is no cause for serious concern about a petroleum shortage within the next 25 to 50 yr. The present supply, supplemented by discoveries even at a low rate, will suffice to maintain current consumption for over 20 yr. The normal forces of supply and demand will automatically bring into use methods of recovery and refining which will probably double the life of the domestic petroleum supply. Imports of petroleum will extend still further the period during which petroleum will be available from present sources. Thus, the probable date of the crisis in petroleum supply is postponed so far into the future as to make all estimates not only of the supply of petroleum, but also of the need for it seem purely conjectural. Gasoline as it is now known may be obsolete as a motor fuel before the time of shortage arrives.

Even though a petroleum famine does not appear imminent, engineers are studying processes for petroleum substitutes. In the past, the petroleum industry has established an admirable record of supplying products of continually improving quality at continually decreasing cost. With the petroleum supply becoming more difficult to exploit, however, a period of rising costs and prices may soon be unavoidable. The cost of drilling a modern 10,000-15,000 ft. well can be as much as $350,000, but since some of the best prospects for new oil are at the deeper levels, wells of this type will become more common. Similarly, refineries employing the modern high-yield techniques are considerably more expensive to construct, yet these improvements may be needed to help conserve the declining supply of petroleum. As the price of motor fuel from petroleum rises, the competitive position for substitutes and synthetic fuels will improve. It may be desirable to begin the use of these other fuels long before the supply of petroleum becomes critically short. Thus, it is interesting to study the methods which are available for producing motor fuels from sources other than petroleum. The experience of other countries which are already producing synthetic fuels may point the direction in which future developments in this country will occur, although it seems likely that the present rather crude processes will be vastly improved before they become either necessary or profitable in the United States.

SOURCES OF FUELS

Countries such as England, Germany, and Japan which are not liberally supplied with petroleum have investigated and developed methods of producing motor fuels from sources other than petroleum. The two principal substitutes which have been used are the oil shales and coal. Natural

Based on a paper entitled "Production of Synthetic Hydrocarbon Motor Fuels From Sources Other Than Petroleum" presented May 4, 1944.



The evidence points to the conclusion that there is no cause for serious concern about a petroleum shortage within the next 25 to 50 years; however, it is time to investigate other sources and methods for gasoline

gas has been used to some extent as a compressed gaseous fuel, and can be converted to a liquid fuel. Artificial gases, derived from coal, and powdered coal burned directly, have been tried. Wood-fired producer gas generators have been installed in trucks and buses in Europe. Although these substitute motor fuels, as distinguished from "synthetic" gasoline derived from non-petroleum sources, were used in Europe quite extensively before the war, the substitute and synthetic fuels obtained from shales and coal are the most significant.

OIL SHALE AND TAR SAND

Oil shales are rock from which petroleum-like oils can be derived by heating. The oil can be treated by standard refinery methods to yield satisfactory motor fuel. Shale oil is thus the simplest, most obvious, and most easily usable substitute for natural petroleum. It has not come into wide use in this country because the added cost of distilling the oil from the shale has resulted in too high a price for the resulting motor fuel. Again it is apparent that the natural economic results attendant on a diminishing supply of petroleum, or savings made possible by further experimental work on oil shales, will ultimately bring shale oil into common use.

The United States is liberally supplied with oil shale. The most probable estimates place the total oil reserve in shales of all types at nearly 150 billion bbl., of which it is believed 100 billion can be reclaimed. This constitutes a reserve five times the size of the present estimated petroleum reserve, and the fact that this shale reserve exists means that the time when this country will be completely without a petroleum supply is probably well over 100 yr. away.

Tar sands, from which petroleum-like oils can also be derived by heating, are even more abundant, although the principal deposits are located in Canada. It is believed that up to 250 billion bbl. of oil are contained in the Canadian tar sands. Little is known of the recovery problems involved. It is apparent, however, that the tar sands of North America constitute a huge reserve which can be tapped some day when other resources begin to fail.

Oil shales have been processed in Scotland for over 90 yr. The process can thus be considered as well-proved technically, although modifications would doubtless be introduced if it were to be used in this country.

In Sweden and in Australia attempts have been made, with some success, to distill shale oil from un-mined deposits by drilling or tunneling into the bed and introducing heat.

Gasoline is derived from shale oil by conventional refining methods, with slightly lower yields than from petroleum. The normal yield, when shale oil is cracked to residuum, is 35-55 percent. If the oil is cracked to coke, a yield of 70 percent can be obtained. The product has an octane number of 55-70. The maximum yield of 80 percent to gasoline is obtained by hydrogenating shale oil. The gasoline produced by hydrogenation has an octane number of 65, which can be raised to 83 by the addition of tetraethyl lead.

Estimates of investment and operating cost for mining and retorting shale vary widely. It is probable that an investment of about $1,200 would be required per barrel of oil produced per day. This may be compared with an average investment of $900 per bbl. of oil per day to bring petroleum out of the ground. The investment in refineries would be about the same in both cases: roughly $300 per bbl. of oil per day. The best estimates of the cost of producing shale oil are about $2 per bbl., in comparison with a current petroleum price of $1.25. This should result in a gasoline cost from shale oil of 9 to 10c. per gal. compared with 6 to 7c. per gal. for gasoline from petroleum.

FROM COAL BY CARBONIZATION

Motor fuel similar in properties to gasoline can be obtained from coal in several ways. Carbonization of coal to produce coke is a well-established practice. In the operation, the complex structure of coal is broken down and liquid hydrocarbons are obtained which can either be used as such or refined to yield a satisfactory motor fuel. It should be emphasized that the liquid hydrocarbons are obtained simply as byproduct and the yield by high-temperature carbonization, which is the common operation, is small. The liquid products are light oil (benzol and toluol) and tar, which can be hydrogenated and cracked to obtain a gasoline fraction. The maximum gasoline yield is probably about 10 gal. per ton of coal, which means that only 18 million bbl. of gasoline a year, or about three percent of the national requirements, could be obtained from all existing high-temperature carbonization plants in the country.

Coal may be carbonized at lower temperatures with a higher production of oils. Low-temperature carbonization of coal is carried out at 425 to 700 deg. C. to yield gas, light oils, tar and coke. For the production of liquid fuels, the light oils, tar and gas are of particular interest. The yields are about 2.5 gal. of light oil, 20 gal. of tar and 5,000 cu.ft. of gas per ton of coal.

The possibility of obtaining liquid fuels from low-temperature tars has been considered thoroughly by the British. The tar can be hydrogenated at 480 deg. C. and 200 atmospheres pressure, with a molybdenum catalyst, to yield gasoline of 70 octane number, at the rate of 1 gal. per gal. of tar charged. With a total of 22.5 gal. of tar and oil per ton of coal, 22.5 gal. of gasoline may be obtained. The gas from the low-temperature carbonization will provide adequate hydrogen for the reaction. With the above yield of gasoline per ton of coal it soon becomes evident that large quantities of coal must be handled.

SYNTHETIC FUELS FROM COAL

Coals vary in type and composition from the brown coals of Germany which are half water and only one-third combustible, to the best anthracite with only 1 percent water and 96 percent combustible. The ratio of carbon to hydrogen in the combustible fraction is about 10 to 1 for the brown coals, 15 to 1 for lignites, 17 to 1 for bituminous, and 30 to 1 for anthracite.

Liquid hydrocarbon fuels are composed of smaller molecules, with a carbon-hydrogen ratio of 6 or 8 to 1. Thus, the problems in converting coal to a liquid fuel are to reduce the carbon-hydrogen ratio by adding hydrogen, and to break down the complex structure to yield the volatile liquids desired. In carbonization processes, the coal structure is split up, the hydrogen rearranging with part of the carbon to form liquid products. The yield is small, however, because only the hydrogen originally in the coal is available for forming the liquid products, and a considerable part of this hydrogen is driven off in the gases. Low-temperature carbonization, where the treatment of the coal is milder, yields over twice the quantity of liquid products. Even in this case, much of the carbon in the coal ends up in solid coke rather than in liquid products.

There are two methods of obtaining much higher yields of liquid products from coal. In the first of these, hydrogen is added directly to the coal, to reduce the carbon-hydrogen ratio and to break down the complex molecules. This is the Bergius or coal-hydrogenation process which has been used extensively in Germany, and more recently in England. In 1910, Bergius discovered that by treatment of coal with hydrogen at 100 atmospheres pressure and at temperatures of 350–400 deg. C. it was possible to effect an 85 percent conversion of its organic content to oils and gas. The Billingham plant of Imperial Chemicals Industries in England was producing, in 1935, about one million bbl. per yr. of gasoline by hydrogenation of coal and coal tar.

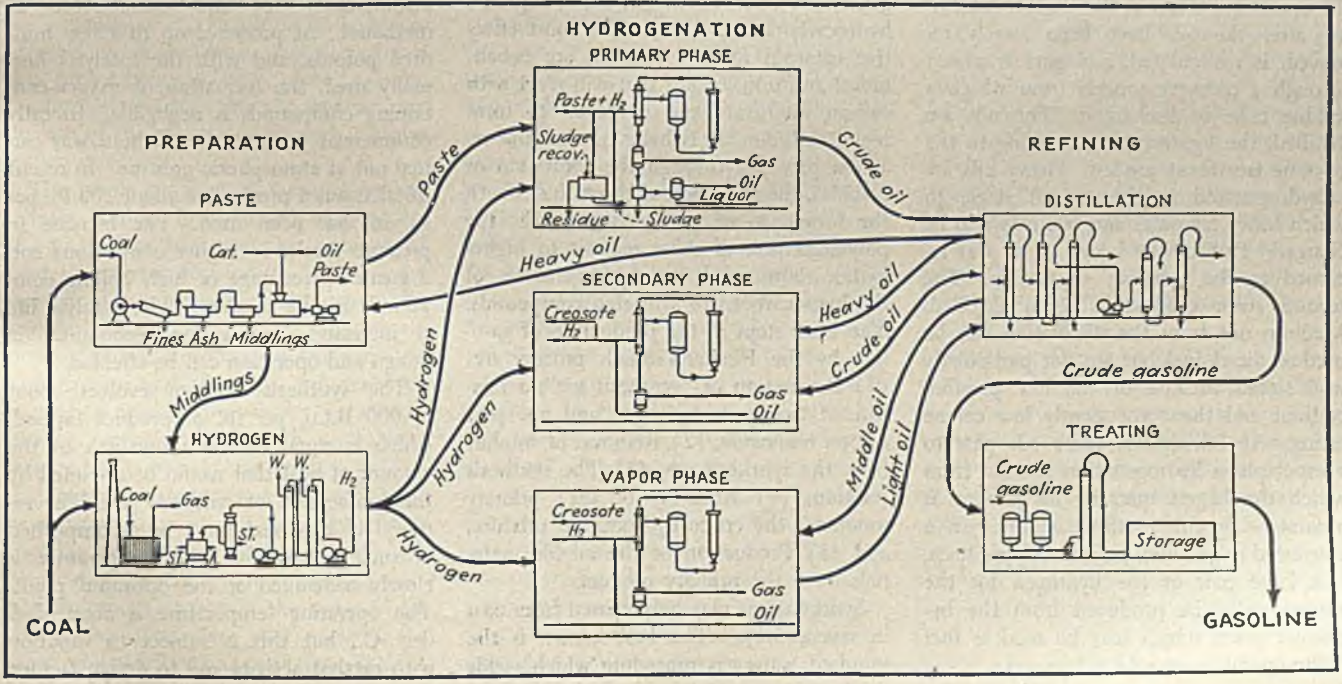
The second method of obtaining a high yield of liquid fuel from coal is to convert the coal first to a mixture of carbon monoxide and hydrogen. These gases react, in the presence of the proper catalysts, to produce straight chain hydrocarbons suitable for use as gasoline. This is the Fischer-Tropsch synthesis which has been used extensively in Germany and Japan.

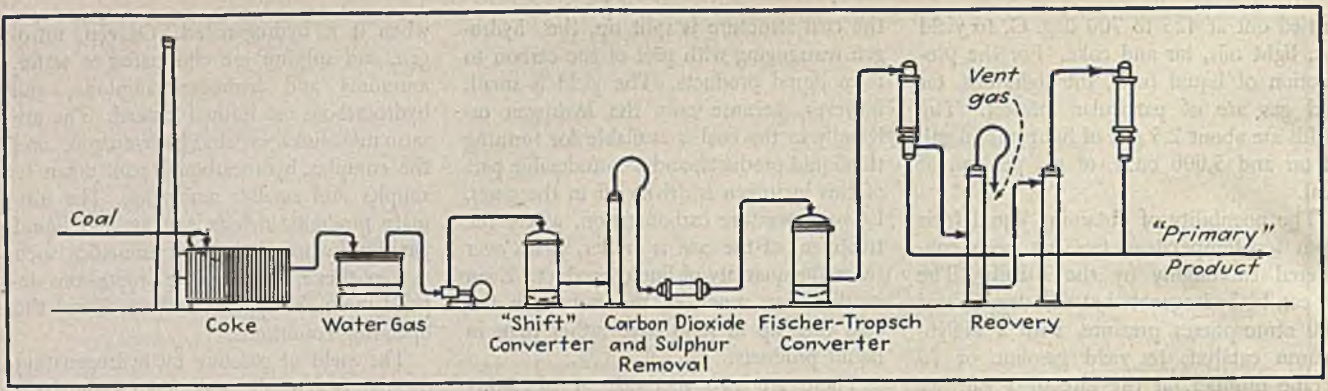
Coal undergoes a number of reactions when it is hydrogenated. Oxygen, nitrogen, and sulphur are eliminated as water, ammonia and hydrogen sulphide, and hydrocarbons are formed instead. The unsaturated linkages absorb hydrogen, and the complex hydrocarbons break down to simpler and smaller molecules. The ultimate products include gaseous and liquid paraffin hydrocarbons and aromatics such as naphthene. The relative proportions depend upon the type of coal used, and the operating conditions.

The yield of gasoline by hydrogenation of coal is generally reported on the basis of total coal consumption, including coal for fuel, power, and hydrogen production. In the Billingham plant, where coal is used for all these purposes, the yield is about 60 gal. per ton of coal brought into the plant. It would be possible to obtain a large part of the hydrogen by treating the byproduct methane with steam, and if this were done the coal consumption would be decreased and the yield would be about 80 gal. of gasoline per ton of coal. The power and fuel requirements of the process are large, and account for about half the coal used. In the Billingham plant the yield of gasoline from the coal actually hydrogenated is reported to be about 60 percent, which would correspond to a production of over 200 gal. of gasoline per ton of coal (ash and moisture free.) Thus, it is theoretically possible to obtain over ten times as much motor fuel by hydrogenating coal as by carbonizing it, even at low temperatures. The actual yield, where coal must be used for fuel, power, and possibly for hydrogen production, is three to four times that obtainable by carbonization.

The quality of the gasoline produced by hydrogenation of coal is good, and refining

Even partial replacement of the petroleum refining industry with coal hydrogenation plants such as the one shown here will be costly. Cost of gasoline produced by coal hydrogenation is 16c. per gal. without amortization





Production of synthetic oil from coal may be accomplished by the Fischer-Tropsch process

operations are simple and similar to those used in refining petroleum. The product has an octane number of 70–75 which can readily be raised to 85–90 by the addition of tetraethyl lead.

At Billingham, hydrogen is obtained by coking coal, and producing water gas from the coke. The water gas is purified, to remove sulphur, and is treated with steam in the presence of a catalyst, to convert the carbon monoxide to carbon dioxide and produce additional hydrogen. The product is compressed to 50 atmospheres, and scrubbed with water, to remove carbon dioxide. It is then further compressed to 250 atmospheres and scrubbed with a copper-containing solution which removes the small amount of carbon monoxide. The purified hydrogen enters the suction of the hydrogen-circulating compressors.

Hydrogenation is carried out in three stages, the first two of which are at 250 atmospheres pressure and 300–450 deg. C. The first stage operates on coal-paste and produces a mixture of gases, light and heavy oils, unconverted coal and residue, and byproducts such as water, ammonia and hydrogen sulphide. Gases and byproducts are separated and discarded from the operation. Part of the sludge, remaining after the oils have been largely removed, is recirculated, and part is passed through a recovery process from which a residue coke is discharged. The oils are distilled, the lightest fraction going to the gasoline treatment process. Heavy oils are re-hydrogenated in the second stage, to which heavy creosotes and tars may also be charged. Part of the heavy oil is also returned to the "pasting" operation. The second stage product is again distilled. Medium oils from the distillation can be used as diesel fuel but are not particularly well suited because of the low paraffin-content and the consequently low cetane rating. At Billingham, these oils pass to a vapor phase hydrogenation process, from which the largest quantity of gasoline is obtained. By this method, all the coal is converted to gasoline, gases, and byproducts.

A large part of the hydrogen for the process could be produced from the byproduct gases, which may be used as fuel in the operation or sold as fuel gas.

The Fischer-Tropsch synthesis is a radically different method of adding hydrogen to coal and breaking down the size of the molecule. The coal is used to generate carbon monoxide and hydrogen and these are then recombined in the desired ratio to produce hydrocarbons suitable for refining.

Since the raw material is first converted to carbon monoxide, it is possible to use almost any substance containing carbon, including natural gas. In this respect the Fischer process is much more flexible than the hydrogenation process. Gas has advantages, including the requirement of one-third less investment for the preparation of the carbon monoxide-hydrogen mixture. The chief disadvantage of natural gas is the limited supply. Obviously, it is impractical to divert a large fraction of the natural gas supply from its present uses, and the amount of gasoline which might be produced from natural gas by the Fischer process is accordingly limited.

FISCHER-TROPSCH SYNTHESIS

In the Fischer-Tropsch synthesis a gas mixture consisting of $\frac{2}{3}$ hydrogen and $\frac{1}{3}$ carbon monoxide, referred to as synthesis gas, is converted to straight-chain, aliphatic hydrocarbons and water. The most effective catalysts for the reaction are cobalt, nickel and iron, metals that will react with carbon monoxide and hydrogen to form metal carbides. It is believed that the reaction proceeds through the formation of carbides, the reduction of the carbides with the formation of methylene radicals, the polymerization of these radicals to higher hydrocarbons, and the hydrogenation of the hydrocarbons to saturated compounds. The basic steps in the production of gasoline by the Fischer-Tropsch process are: (1) Production of "synthesis gas", a mixture of two parts hydrogen and one part carbon monoxide, (2) Removal of sulphur from the synthesis gas, (3) The synthesis reaction, (4) Recovery of the "primary product", the crude hydrocarbon mixture, and (5) Production of the salable materials from the primary product.

Synthesis gas may be prepared from coal in several ways. The best known is the standard water-gas procedure which yields a one-to-one mixture of carbon monoxide and hydrogen. This is enriched by treating part of the gas with steam to produce more hydrogen and carbon dioxide, removing the carbon dioxide, and recombining the gases to obtain the synthesis mixture. Alternately, the water gas can be enriched by direct addition of hydrogen, as from coke oven gas.

Another method in use in Germany, and in other European countries using "non-coking" types of coals, is the Bubiag-Didier process. This involves the operation of a vertical, externally heated chamber-oven in which the charge is treated continuously with superheated steam. The product is a gas containing about 33–35 percent carbon monoxide and 50–52 percent hydrogen, with less than 1 percent saturated and unsaturated hydrocarbons. The operation is flexible and the composition of the gas may be varied so as to produce the synthesis gas mixture directly.

In the synthesis reaction, pressure is one of the important variables. At very high pressures there is a tendency toward the formation of oxygen-containing compounds, and if the catalyst is changed, the process becomes identical with that used commercially for the manufacture of methanol. At pressures up to a few hundred pounds, and with the catalysts normally used, the formation of oxygen-containing compounds is negligible. In early commercial practice the reaction was carried out at atmospheric pressure. In recent installations a pressure of about 100 lb. per sq. in. has been used. The increase in pressure results in higher conversions and a greater percentage of high boiling compounds in the product. The catalyst life is increased, and certain economies in design and operation can be effected.

The synthesis reaction evolves about 17,000 B.t.u. per lb. of product formed, which is equal to about one-fifth of the amount of heat that would be obtained by the combustion of synthesis gas. The removal of this heat must be accomplished in such a way that the temperature is closely controlled at the optimum point. The operating temperature is about 200 deg. C., but this is subject to variation with catalyst activity and to design factors, particularly contact time. The removal of heat and the maintenance of accurate temperature control are the two major considerations in designing a converter for the synthesis reaction. In the atmospheric pressure synthesis the converters contain horizontal tubes provided with fins. The catalyst is outside the tubes and water is circulated through the tubes. Heat absorbed by the water is used to generate byproduct steam, and the temperature is controlled by regulating the pressure of the steam. In the synthesis at 100 lb. per sq. in. the converters have vertical tubes and water circulates outside of the tubes.

CATALYSTS

The development of improved catalysts has been the subject of intensive research, but the published results are, in most cases, rather vague. In German commercial practice a two-stage conversion system is used. The conversion is carried to about 75 percent in the first stage and to an overall figure of 90 percent in the second.

The gas leaving the converters is cooled, in order to condense as much as possible of the liquid product, and is then passed through an activated carbon absorption system or an oil absorption system. In the latter case, the oil used is a medium boiling fraction of the synthesis product. The residue gas contains carbon monoxide, hydrogen, methane and inerts. It may be burned as fuel, or, if the inerts are removed, it can be used for the manufacture of synthesis gas.

The product of the Fischer-Tropsch synthesis is a mixture of straight-chain hydrocarbons having a wide boiling range. It is more similar to petroleum than to gasoline, since it must undergo a series of refinery operations in order to produce marketable products. The production of a high quality diesel fuel is relatively easy. Gasoline for ordinary use can be produced by means of cracking or reforming operations, but the production of high-octane aviation gasoline is relatively difficult and requires the use of the more modern and complex refinery processes.

The whole problem of working up the primary product into a series of products of the quality and quantity required to meet the market demand is similar to the problem of refining crude petroleum. The modern refinery processes of catalytic reforming, catalytic cracking, polymerization, isomerization and alkylation can probably be used to convert the primary product to gasoline. A yield of about 85 percent has been estimated and the quality of the product will be determined by the requirements of the market and the price that it is willing to pay. Expressed in other terms, the yield of primary product from an average bituminous coal is in the order of 70 gal. per ton, including coal required for power generation. The ultimate yield of gasoline is about 60 gal. per ton of coal, a figure which compares favorably with the yield by hydrogenation.

The 1941 consumption of motor fuel in the United States was 700 million bbl. To produce this quantity of gasoline by coal hydrogenation alone would require more than 5,000 billion cu. ft. of hydrogen per year.

There are a number of methods which may be used for the production of hydrogen, but there are only a few which would be of importance for the production of motor fuels from coal. Three methods are now used for almost the entire world's production of hydrogen. Total gasification of coal, coke, and lignite by the water-gas and producer-gas processes appears to account at the present time for about 55 percent of the total. Separation of hydrogen from coke-oven gas by the use of the Linde, Claude, and similar low-temperature compression liquefaction processes provides about 26 percent of the total. Electrolytic processes yield about 16 percent of the total, leaving about 3 percent for all other methods. Since 1925 there has been a decline in the production of hydrogen from water gas, a rapid rise in the production from coke-oven gas, and a slow increase in the use of electrolysis. In 1925 nearly 90 percent of the hydrogen for all purposes came from water gas.

A coal hydrogenation plant could obtain hydrogen by any of these methods, or could use the byproduct gases from the hydrogenation process. Methane, which is the chief constituent of these gases, can be treated with steam over catalysts to produce a carbon dioxide and hydrogen mixture from which the carbon dioxide is readily removed. Natural gas, if it were available, could be used as a source of hydrogen.

The cost, in England, of the Billingham coal hydrogenation plant was between $25 and $30 million. A similar plant built in this country today would probably cost nearly $40 million. The Billingham plant has an annual capacity of one million bbl. of gasoline, or approximately enough to supply the Charleston section of the Kanawha Valley. A modern petroleum refinery with the same capacity could be built for about $2 million, or about 1/20 the cost. It is immediately apparent that even the partial replacement of the present petroleum refining industry with coal hydrogenation plants will be costly.

The best estimate of the cost of gasoline produced by coal hydrogenation is about 16 c. per gal. without amortization, or 23 c. per gal. with amortization. These costs are exclusive of distribution expense and taxes on the gasoline and should be compared with a normal cost of about 6 c. for gasoline produced from crude oil at $1.25 a bbl. In terms of the Charleston area, the extra cost of synthetic gasoline would be about $2.5 million a year.

Synthetic fuels by the Fischer-Tropsch process are likely to be cheaper, and the plants would probably cost considerably less. It is estimated that a Fischer-process plant to supply the Charleston area by producing gasoline from coal would cost $23 million. Fischer-process gasoline would probably cost about 15 c. a gal., without amortization, or 19 c. a gal. with amortization included. In the estimates, both for the Fischer process and for hydrogenation, coal is charged at about $2.50 per ton. The cost of coal is, however, less than one-fourth the cost of the gasoline produced, so that the estimated manufacturing costs will not be altered greatly if the price of coal is changed.

Gasoline could be produced by the Fischer-Tropsch process from natural gas, and both the investment and the manufacturing cost would be lower. It is probable that the investment would be only $15 million for a plant to supply the Charleston area, and that gasoline would be produced for slightly less than 10 c. per gal., including amortization. As already pointed out, however, known natural gas resources have an estimated life of only 30 yr. at the present rate of consumption, and would be rapidly exhausted if an attempt were made to produce much gasoline from them.

The modern refinery using petroleum is the least expensive to build. The costs of plants for synthetic fuels and the costs of synthetic products are high in comparison even with gasoline from shale oil.

CONCLUSION

The petroleum supply for the United States, if the possibilities for importing crude oil and for improving present gasoline yields are exploited, seems to be assured for the next twenty-five to fifty years. Carbonization processes will yield small amounts of gasoline to supplement the supply but cannot be expected to produce significant quantities. Shale oil is the most promising substitute, which will probably be developed as soon as the cost of petroleum rises to $2 per bbl. If the shale oil resources are completely developed, enough oil should be produced to supply the country for at least another fifty years. Tar sands, too, are a source of vast amounts of petroleum which can possibly be recovered very cheaply.

Synthetic fuels from coal are at present expensive and the cost of building large plants to use these processes is very high. Until the processes are improved and the costs are reduced, there will be no economic incentive to use these processes. In view of the adequate supplies of other raw materials from which motor fuels can be obtained, it seems unlikely that there will be large scale production of synthetic fuel from coal in this country within the near future.

FROM THE VIEWPOINT OF THE EDITORS—

WEBB ACT vs. SHERMAN LAW

EXPORT associations selling chemicals and other goods abroad have been deeply troubled by the recent indictment of the U. S. Alkali Export Association and its member companies. They have felt that the proper protection of firms cooperating for the export of American goods had been withdrawn by this effort of the Department of Justice. It is interesting and informative, therefore, to have a statement of official policy on this subject.

This interpretation comes in an address presented early last month by Assistant Attorney-General Wendell Berge, who directs the Anti-Trust Division. Mr. Berge clearly traces the course of reasoning by which the Department of Justice distinguishes between proper cooperation, as he defines it, and illegal efforts of export associations organized under the Webb Act. Many executives and lawyers are not going to agree with Mr. Berge, but they can profitably study his views as they were presented before the Commerce and Industry Association of New York City.

It is not easy for engineers and other laymen to understand some of the fine legal distinctions which are made by Mr. Berge. But it is important for us to see that the Federal Government does not intend to have export efforts become so aggressive as to involve international agreements of the kind which are charged against the alkali group. Here are some of the things proscribed in Mr. Berge's language: "Associations organized under the Webb Act cannot legally enter into international agreements which restrict production and distribution, divide territories and fields of operation, fix prices or otherwise regiment industry throughout the world. Neither can they legally enter into agreements which restrain trade within the United States, restrain the export trade of any domestic competitor or association, or which enhance or depress prices or substantially lessen competition within the United States."

LET'S HAVE THE FACTS!

ALIEN PROPERTY Custodian Markham and the executives of Standard Oil Company (N. J.) have been discussing questions of the German influence in the ownership of certain companies and certain patents in which the I.G. formerly had some proprietary interest. As a result, the Custodian is seizing these stocks and these patents in order to vest them in his office to be licensed generally to all American firms.

Standard Oil executives deny that there has been any German proprietary interest since 1939. This is a fact that should be determined by proper court action. It is not reasonable that American firms which have acquired rights in foreign property in accordance with both law and good taste of prewar years should now be deprived of that property without recourse to the due processes of law. It is not a function of the Alien Property Custodian to upset proper developments of that kind by unwarranted seizures and subsequent licensing for competitive development. Even if the latter may give some temporary benefit to purchasers of the end products, the destruction of property rights legitimately obtained is too great a price to pay for that temporary expedient.

We have no idea as to all the facts which may develop in this case. But we hope that they will have full consideration in the courts and that the American principle of property ownership may be properly protected. We believe that the Alien Property Custodian's office will seek justice in these matters. We certainly hope so.

INDIRECT COSTS ARE GREATER

SAFETY of employees is an ever present concern of chemical engineers both in design and in operation of industrial equipment. Anyone who needs the figures to prove that safety pays dividends or anyone who wants to be better informed on industrial safety can well utilize the recent guide book entitled "Safety Subjects" which has been issued as Bulletin No. 67 of the Division of Labor Standards in the U. S. Labor Department. It will serve equally well as a text for plant safety meetings or as a basis for a college curriculum on safety.

Even in wartime we cannot afford to let down the standards either on equipment or operating methods. Careful study of this booklet will reveal new practices of value and convince even the most hard-boiled production executive that safety saves money rather than adds expense.

WHERE CREDIT IS DUE

FOUR recent industrial advances have been based on fundamental work done by the Government in some of the regional laboratories of the Bureau of Agricultural and Industrial Chemistry. This fact is interesting for three reasons.

First, we note with satisfaction that this Government work is making substantial contributions. Second, we note that the Bureau continues its policy of encouraging industrial development based on its primary studies. Thus the Bureau makes its results a step toward public service without injecting the Government into business. Third, these recent incidents exhibit rather a striking contrast on the part of the industries which have used the Government work as a springboard for further investigations and development.

In one of the four cases the industrial organization involved gave generous, perhaps even a bit over-generous, credit to the Bureau for its primary findings. In the other three cases little or no credit has been given to the

Government investigators. In one case there has been very conspicuous an apparent desire to take too much credit for certain individuals in the company developing the project.

Many undertakings of a fundamental sort cannot be developed by most of the companies in the chemical process industries. Few of these companies can take the long chance that there may be something worthwhile at the end of a research road that is vague and uncertain at its beginning. Such projects are well started under Government auspices when the spirit is such as that shown by the Bureau of Chemistry staff.

These fundamental workers should have more credit than they sometimes get. The credit given them by industry, both with the public and with other professional workers, is important for two reasons. In the first place, it builds morale and maintains a spirit of cooperation between Government research and industrial development groups. But also it is important because the future of this Government work rests on appropriations; and Congress is likely to support the long-range researches which it finds have real industrial value later.

Credit should be given to these Government laboratories, and to others, when it is due. Industry will not suffer if it gives even a little too much credit sometimes.

IN BETWEEN

A JURISDICTIONAL dispute was one of the major reasons why American Federation of Labor did not wish to readmit United Mine Workers lead by John L. Lewis. This refusal to welcome the return of the prodigal is likely to have serious repercussions for chemical industry.

We can now expect more effort on the part of both A.F. of L. and U.M.W. to organize chemical workers. District 50, the catch-all of U.M.W., will undoubtedly stir many jurisdictional battles in months and years to come. It is going to be important that chemical executives watch this situation and do whatever is legally possible to prevent their companies being ground between these millstones of "fraternal" controversy.

FACTS ON THE FUTURE OF RUBBER

MANY wonder about the future of the rubber industry. Because of the Japanese seizure of most of the rubber growing territory two years ago, the industry is just coming through the worst crisis of its history. Fortunately our huge synthetic rubber program is now coming into full production. The question, "What part will this new material play in the postwar future of the industry?" is answered for us by one of the best qualified rubber executives in the country, Dr. R. P. Dinsmore, vice president in charge of research and development of the Goodyear Tire & Rubber Co. At a recent meeting of the National Association of Purchasing Agents in New York this able chemical engineer spoke on "Looking Ahead in the Rubber Industry." His address is worthy of careful consideration by all concerned with the future of this great industry.

Dr. Dinsmore estimates that the world requirements for rubber in the (assumed) postwar year 1947 will be 1,526,500 tons and in 1950, 1,900,000. While most of the rubber will be for automobile tires and other established applications, some of it will be demanded for accelerating present and potentially new uses. Thus the cushioning and energy-absorption capacities of rubber have developed certain outstanding applications that have proved their merit and are certain to advance in the postwar era, perhaps to require as much as 40,000 tons of rubber per year. Rubber-spring suspensions for automobiles are on the way to replacing steel springs. They could use from 10,000 to 25,000 tons annually. Rubber tires are developing for the use of farm vehicles, tractors and other implements. Such machinery might require an additional 10,000 to 20,000 tons of rubber. Of special interest to the chemical industry is the use of rubber as a starting material for chemical reactions. Rubber derivatives suitable for lacquers, adhesives and plastics can be made from natural rubber and suitable synthetics. Certain uses of these products such as for the packaging of fruits, vegetables, other foods and perishable materials are of the utmost importance in our economic development. These chemical uses may require from 25,000 to 100,000 tons of rubber annually.

Of course, no one can say with certainty when the plantation areas will be recovered and in a position to help meet the enormous world demands for rubber. Undoubtedly, steps will be taken immediately for their rapid rehabilitation. Reorganization of labor and replacement of equipment on large estates will be a difficult and tedious job. The attitude of the natives may be uncooperative. International disputes are not unlikely. It is expected, therefore, that after complete re-possession, the first year will not produce over 400,000 tons and the second year not more than 700,000. It may require two more years to reach 1,500,000 tons output, according to Dr. Dinsmore.

Granted the validity of the reasoning, the world may be facing a tight rubber situation for nearly four years after the war even though all the United States synthetic rubber plants (with their expected capacity of all types of rubber of about 1,075,000 tons per year) are kept in operation. This is quite a different view from the one frequently expressed that, in the postwar era, the market will be flooded with cheap crude which will drive synthetic out of existence. It is important, because it means that synthetic must not only meet our war needs, but must be able to supply a large portion of our expanded postwar requirements. It is likewise evident that synthetic has five or six more years in which to become truly competitive, in cost and quality, with the natural product. As Dr. Dinsmore states, "Can any informed individual doubt that this is sufficient time?"

CONTAINER INCENTIVES

MAXIMUM re-use of scarce shipping containers is necessary. WPB officials are urging that employers offer their employees a suitable nominal incentive for the return of containers from customer premises. Little bonus payments of this kind will often stimulate more complete and prompt re-use to offset shortages.

Perhaps even a customer incentive of like nature might be offered in some cases, provided, of course, that such bonuses conform with legal limitations on pricing and do not create too much inducement for the bootlegging of second-hand containers.

Dominant in all our planning should be the thought that we must now have more re-use of containers of all kinds.

CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

$50 WAR BOND FOR A GOOD IDEA!

Starting with July 1944, and until further notice, *Chem. & Met.* will award a $50 Series E War Bond each month to the author of the best short article received during the *preceeding* month and accepted for publication in the "*Chem & Met.* Plant Notebook." Articles will be judged during the month following receipt, and the award announced in the issue of that month. The judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest may be published if acceptable, and if published will be paid for at space rates applying to this department.

Any reader of *Chem. & Met.*, other than a McGraw-Hill employee, may submit as many entries for this contest as he desires. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

MAY WINNER!

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

THOMAS B. DORRIS
Chief Chemical Engineer
Sprout, Waldron & Co.
Muncy, Pa.

For an article dealing with a new method for size reduction of low-melting waxy solids which has been adjudged the winner of our May contest.

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

April Contest Prize Winner

IMPROVED BYPASS GIVES BETTER FILTRATION WHEN USING A CENTRIFUGAL PUMP

W. A. WELCH
Industrial Chemical Sales Division
West Virginia Pulp & Paper Co.
Philadelphia 6, Pa.

In the operation of a filter press there are three types of pumps currently in use, namely, reciprocating pumps, gear pumps and centrifugal pumps. The reciprocating type pump has the advantage of variable speed and can be slowed down to a point where the volume of liquid can be regulated to what the press will handle without running up excessive pressure. In this way a reciprocating pump, when used for pumping liquids through a filter press, can be run slowly at the beginning of the filtering operation and thus deliver the required volume of material to the press without building up pressure on the filter cake until such additional pressure is required toward the end of the filtering operation.

PRESSURE CONTROL

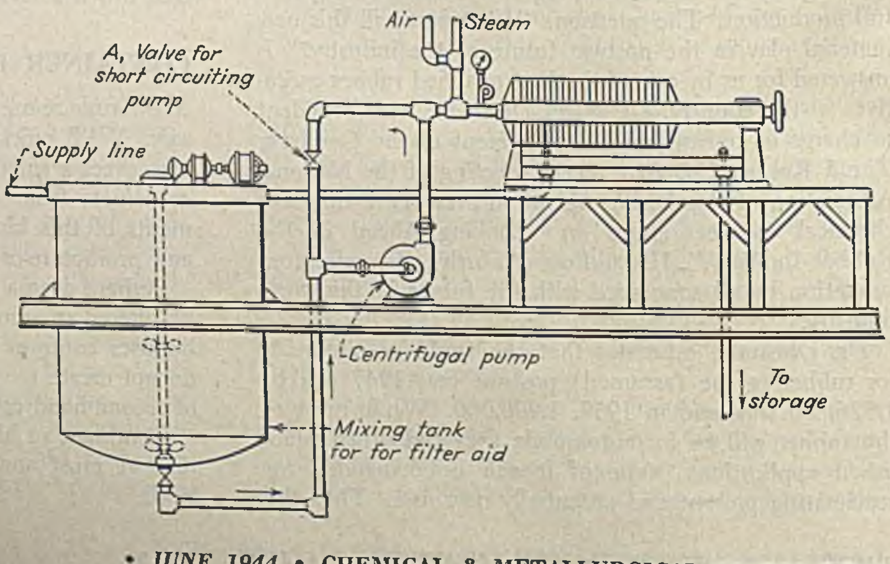
Building up pressure gradually in this manner considerably facilitates filtration because it prevents "squeezing" the filter cake into a compact mass and thus losing much of the advantage to be gained by the use of filter aids. Of course, as filtration progresses, the filter cake becomes thicker and therefore offers more resistance to flow, making it necessary gradually to increase the pressure sufficiently (and only sufficiently) to maintain the filtration rate. The use of a greater pressure at the earlier stages of filtration might momentarily give a larger rate of discharge, but in the end it would result in slowing down the overall filtering rate because it would quickly compress the cake and make it necessary to use extreme pressure toward the end of filtration.

The disadvantage of a reciprocating type pump is the tendency for the liquid to be delivered to the filter press in surges. This is especially true if the check valves on the pump are not in perfect condition. These surges, which accompany each cycle of the pump, create a "breathing" action of the press cake against the cloths and this action is likely to give rise to the formation of cracks in the press cake which allow solid material to pass through the cloths until a new mat is formed on the surface of the exposed cracks.

Centrifugal pumps are usually preferred to the gear type pump because of the abrasive nature of many solids which must be filtered. Of course, a centrifugal pump runs at constant speed and for this reason tends to discharge its full capacity into the

(Continued on page 123)

Filtering set-up showing use of bypassed centrifugal pump



PACIFIC NORTHWEST

Offers Power and Resources for Industry

Economically immature in spite of its great power and natural resources, the Pacific Northwest in many respects is still in a semi-colonial status. Because of this, potential industries for the region must be chosen with care and developed with vigor or they will face insurmountable competition from established industries in other parts of the nation. Above all there is the need for a comprehensive and thorough investigation of resources and markets and for studies in power utilization that will provide a firmer basis for industrial enterprise. The Bonneville Power Administration, making an excellent step in this direction, has just released its broad study on "Pacific Northwest Opportunities," from which most of the data in this report have been adapted. The Bonneville study, which should be consulted for details, is of particular interest to chemical executives, engineers and enterprising industrialists who are seeking opportunities for inidvidual initiative and private enterprise.

An appraisal of the present economy of the Pacific Northwest reveals that there is still great need for diversification in industrial processes and production, for the integration of basic plants in industries, and for secondary manufacturing activities. There is also need for wider utilization of regional raw materials—agricultural, forest and mineral.

Conservation of lands calls for a tremendously expanded use of commercial fertilizers, a use relatively very low in the region in spite of the co-existence of basic raw materials and intensive cropping.

Use of forest products is still in its infancy. Almost two-thirds of the tree is now wasted. New and more complete uses of tree crops will demand increased amounts of electrical energy for the production of wood, plastic and chemical products.

Before the above developments can be effectively carried out there is an urgent need for clear and correlated programs of investigation. Whether electricity is used for motive power, for heat or for industry, a sound technical and economic basis must be established for the utilization of material and energy resources. The availability of power and raw materials is no assurance of prompt and proper use.

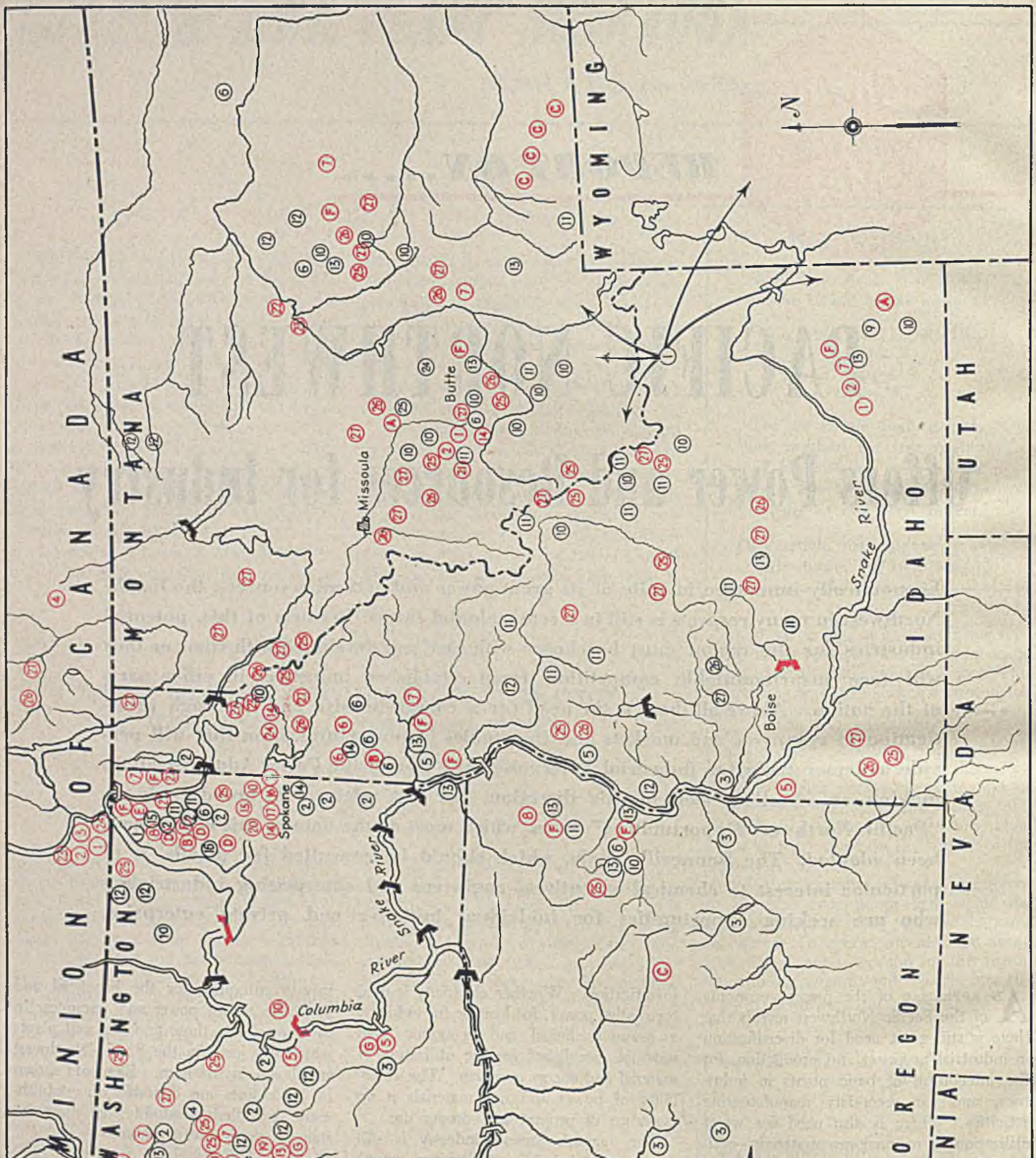
The region's present industry is still very largely tied down to primary extraction and production of raw and semi-processed materials. Its raw material potentialities are not yet well known, nor have processes been developed to make the widest and best use of them. Wastefulness of unused rich resources must be changed to wealth productively used. The wantonly expensive system of shipping raw materials 3,000 miles east and the resulting finished product 3,000 miles back west must be eliminated.

Charts and maps used in this report, adapted from those in the Bonneville Power Administration study, show in what field opportunities can be developed for private enterprise for the beneficial and profitable use of power and resources. In the flow charts, those resources and plants which now exist in the Pacific Northwest are shown in red lines. Elements shown in black lines are desirable of establishment but their feasibility, in most instances, needs investigation.

POWER THE MAGNET

Hydroelectric power is an outstanding resource in the Pacific Northwest. Power draws minerals from the earth; becomes an essential ingredient in electro-manufacturing; cuts down the cost of other manufacturing. Power fosters the growth of many diverse industries and distributes them throughout the region. Power is the magic that flows from river development and leads to regional development.

At the end of 1943 the government's Columbia River power system was transmitting to large industries and the power


DOMINION OF CANADA
WASHINGTON
MONTANA
IDAHO
OREGON
WYOMING
UTAH
NEVADA
CALIFORNIA
PACIFIC OCEAN
Spokane
Seattle
Tacoma
Portland
Missoula
Butte
Boise
Columbia River
Snake River
Willamette River
N

distribution agencies of the region 1.25 million kw., about as much as the combined capacities of all other power systems in the region.

Bonneville Dam (constructed and operated by the U. S. Corps of Engineers) 35 miles east of Portland and Grand Coulee Dam (constructed and operated by the U. S. Bureau of Reclamation) some 90 miles west of Spokane, are the first two of a number of multiple-purpose projects to be constructed on the Columbia River system which will ultimately develop between 15-20 million kw. of hydroelectric energy. This is approximately one-third of the potential hydroelectric power available in the United States. Navigation locks in the Bonneville Dam and in other dams to be built on the lower Columbia will bring water-borne rates and navigation facilities to the very center of this vast inland empire.

Key to the industrial future of this region is low-priced electric power made available initially by the construction of Bonneville and Grand Coulee Dams. In 1939 the total capacity of the eleven major utility systems of this region totaled about 1,000,000 kw. By 1944 the power capacity in the area had reached over 2,500,000 kw. In December, 1943, Bonneville Dam was completed with the installation of a tenth and final generator, bringing Bonneville's installed capacity to over 518,000 kw. Ultimate installed capacity at Grand Coulee will be 1,944,000 kw., of which 798,000 will be reached during 1944. These figures are exclusive of overload capacity.

Industrial rates for this power are the lowest in the United States, approximately 2 mills per kwh. at 100 percent load factor. Bonneville Power Administration has constructed and maintained a high-voltage, high-capacity regional transmission system of over 2,500 circuit miles, making power available to almost every part of the Pacific Northwest.

Plants and Resources of the Pacific Northwest

Plants and Mines

1. Superphosphate
2. Sulphuric acid
3. Synthetic ammonia
4. Coke plant
5. Mixed fertilizers
6. Fire brick
7. Cement plant
8. Lime plant
9. Steel plant
10. Ferrosilicon
11. Ferrochromium
12. Other ferro-alloys
13. Shipyards
14. Iron foundry
15. Aluminum reduction
16. Aluminum rolling
17. Magnesium reduction
18. Alumina from clay
19. Aircraft plant
20. Copper smelter
21. Aircraft parts
22. Electrolytic copper
23. Electrolytic zinc
24. Lead smelter
25. Copper mine
26. Zinc mine
27. Lead mine

A. Phosphate rock
B. Sand pits
C. Chromite mine
D. Magnesite mine
E. Dolomite quarry
F. Limestone pit
G. Pumicite mine
H. Diatomite mine

Unexploited Deposits

1. Phosphate rock
2. Silica deposits
3. Diatomite area
4. Pumicite area
5. Garnet deposits
6. Refractory clays
7. Olivine deposits
9. Vanadium area
10. Magnesium area
11. Tungsten area
12. Iron ores
13. Limestone
14. High-alumina clay
15. Dolomite
16. Magnesite

Existing dams-red
Programmed dams-black

MARCH OF LIGHT METALS

Alumina is now shipped into Pacific Northwest aluminum reduction plants from various plants located in the eastern part of the United States. There are no plants for production of alumina in the Pacific Northwest. There is, however, a semi-commercial plant at Salt Lake City for the production of alumina from Utah alunites. This plant is operated by Kalunite, Inc., a subsidiary of the Olin Corp. which operates an aluminum reduction plant at Tacoma, Wash. Byproducts of this plant are potash and sulphuric acid. A small experimental plant for the production of alumina from Northwest clays has been authorized for construction by the Columbia Metals Corp. and Chemical Construction Corp. near Salem, Oregon. The plant will utilize an ammonium sulphate recovery process.

High-grade carbon for electrodes for use in aluminum reduction plants is principally calcined petroleum coke from the calcination plant of the Great Lakes Carbon Co. at Wilmington, Calif.

The Pacific Northwest has one source of carbon suitable for aluminum electrodes. This is byproduct carbon from the oil gas plant of the Portland Gas & Coke Co. Possibilities of developing low-ash coke by chemical treatment of certain western and northwestern coals have been under preliminary investigation by the U. S. Bureau of Mines.

Aluminum capacity of the Pacific Northwest totals 315,000 tons of metal annually, double the United States capacity prior to 1940. The region has one large modern continuous sheet mill which probably has adequate capacity to turn out sheet requirements for the region for several years to come. There are no extrusion presses nor forging hammers, nor any large casting plants. A few small foundries are making sand and die castings. The Boeing Aircraft Co. is the only large regional user of light metal sheets, extrusions, forgings and castings, although some subcontracting firms are making sub-assemblies for Boeing and other aircraft companies. Commercial light metal workshops are absent.

Regional production centers should be developed which would include an alumina purification plant, reduction plant, secondary plants for rolling, extruding, forging and casting, and manufacturing plants. Such integrated manufacturing centers may be expected to grow up around the Spokane, Puget Sound and the lower Columbia River area.

The Pacific Northwest has one magnesium plant, located in Spokane. This uses dolomite and ferrosilicon as its raw material. Dolomite is obtained in Stevens County, north of Spokane, while ferrosilicon is produced at the plant from silica obtained at Denison, a short distance north of the plant. Carbon coke for ferrosilicon is obtained from Utah and Fernie, B. C. This plant has a capacity of about 18,000 tons per year of magnesium and about the same amount of ferrosilicon.

More extensive field exploration is needed for developing magnesite tonnage. Research should be conducted on the recovery of magnesium from olivine, which occurs in the northwest in inexhaustible quantities. Further work needs to be done on dolomite to develop lower cost methods than the present ferrosilicon reduction process.

Market studies are needed to determine outlets for manufactured products. In such studies, emphasis must be placed upon new marketing possibilities rather than upon displacement of present suppliers. Market saturation in the local territory determined by product costs and income levels, is important and must be determined. The effect of transportation costs must be studied to determine the competitive position of local manufacturers in their own territory, and to determine the boundaries of their markets in competing territories.

FERROUS METALS MATERIALS

Iron ores, in the form of magnetite, occur in Washington, Idaho, British Columbia, and southeastern Alaska. Limonite beds of some importance are located near Portland. Black sands are found along the Oregon coast in the vicinity of Marshfield. A few pyrite deposits are known in the Cascade Range of western Washington and Oregon. Near Cle Elum and Blewett Pass are chrome-nickle-iron ore deposits which are believed to be important for alloy steel production. None of these ores are being exploited for iron smelting, although several have been explored.

Coking coals are located in Pierce County, Wash., and in British Columbia. Byproduct coke ovens are operating at Tacoma and in Fernia, B. C., supplying coke for metallurgical, domestic and commercial purposes. Some coke is also obtained from Utah, where coke ovens of both the beehive and byproduct type are operating.

Chromite for ferrochromium and for direct smelting to stainless steel occurs in Oregon, Washington, Montana and Alaska. Most of the Northwest ores are low grade, requiring concentration to bring the chromium content up to 45–48 percent. They are characteristically high in iron and in most cases cannot be concentrated to the standard 3:1 chrome-

Light Metals Plants Now Located in the Pacific Northwest

Aluminum	Location	Capacity, tons per yr.	Approx. Plant Investment	Power Requirements, kw.	Remarks
Aluminum Co. of America............	Vancouver, Wash.	91,000	$17,000,000	182,000	pre-baked electrodes
Aluminum Co. of America (DPC).....	Troutdale, Ore.	65,000	20,000,000	130,000	pre-baked electrodes
Aluminum Co. of America (DPC).....	Spokane, Wash.	97,500	25,000,000	195,000	pre-baked electrodes
Olin Corp. (DPC)...................	Tacoma. Wash.	21,000	6,500,000	42,000	self-baking electrodes
Reynolds Metals Co.................	Longview, Wash.	33,000	5,000,000	66,000	self-baking electrodes
Aluminum Co. of America (DPC).....	Spokane, Wash.	120,000	56,000,000	50,000	sheet and plate fabrication
Magnesium					
Electro Metallurgical Co. (DPC)......	Spokane, Wash.	18,000*	20,000,000	56,000	ferrosilicon process

* About the same amount of ferrosilicon is produced at this plant.

iron ratio needed for standard ferrochromium. However, they can be used for making certain ferroalloys or for direct smelting to stainless steel. By special chemical treatment such ores can be brought to the 3:1 ratio with iron elimination. Chromite-bearing beach sands along the Oregon coast have been treated for recovery of chromite by mechanical concentration.

Montana is the principal source of ferro-grade manganese ore and concentrate. Some ferro-grade ores are mined on the Olympic Peninsula in Washington, but in general these are silicious, high in iron, and unsuitable for the production of standard ferromanganese.

Defense Plant Corp. has a ferrosilicon plant at Wenatchee, Wash., operated by Wenatchee Alloys, Inc., subsidiary of Ohio Ferro-Alloys Co. The plant capacity is about 15,000 tons of 75–85 percent silicon ferrosilicon. The plant is equipped with three 7,000-kw. open-pit electric ferroalloy furnaces with a fourth furnace under construction in 1943. Power requirements are 22,000 kw. for the three furnaces, with a potential additional requirement of 7,000 kw.

The Electro Metallurgical Co. plant (operated for DPC) at Spokane has a capacity of about 20,000 tons of 75–85 percent silicon ferrosilicon. The plant is equipped with four 7,500-kw. open-pit electric furnaces, and is operated only to supply ferrosilicon for magnesium reduction operations.

The Electro Metallurgical Co. plant at Portland has a capacity of 5,000–10,000 tons of ferroalloy annually. The plant is equipped with two 7,500-kw. open-pit electric furnaces, one of which is used for calcium carbide production.

Ohio Ferro-Alloys Co., with a plant at Tacoma, has a plant capacity of about 18,000 tons annually. The plant is equipped with two 6,000-kw. electric furnaces and is producing ferrochromium exclusively. Olympic Mines, Inc., with a plant at Hoodsport, Wash., has a capacity of four tons of electrolytic manganese per day.

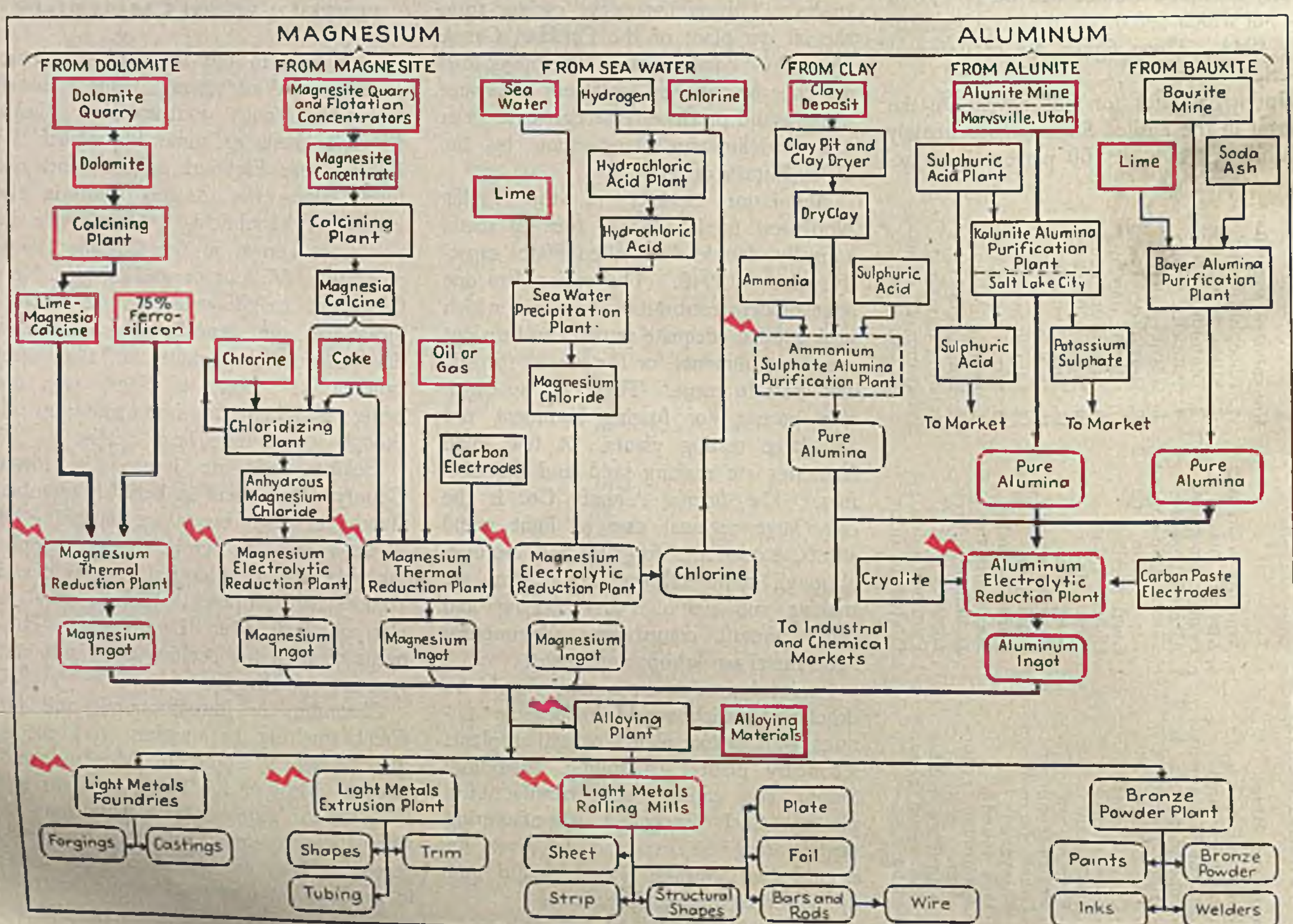
The Pacific Northwest has several well established fabricators of rolled steel products, as well as a number of commercial iron foundries and steel casting plants. Rolled steel consumed exceeds the local production several times.

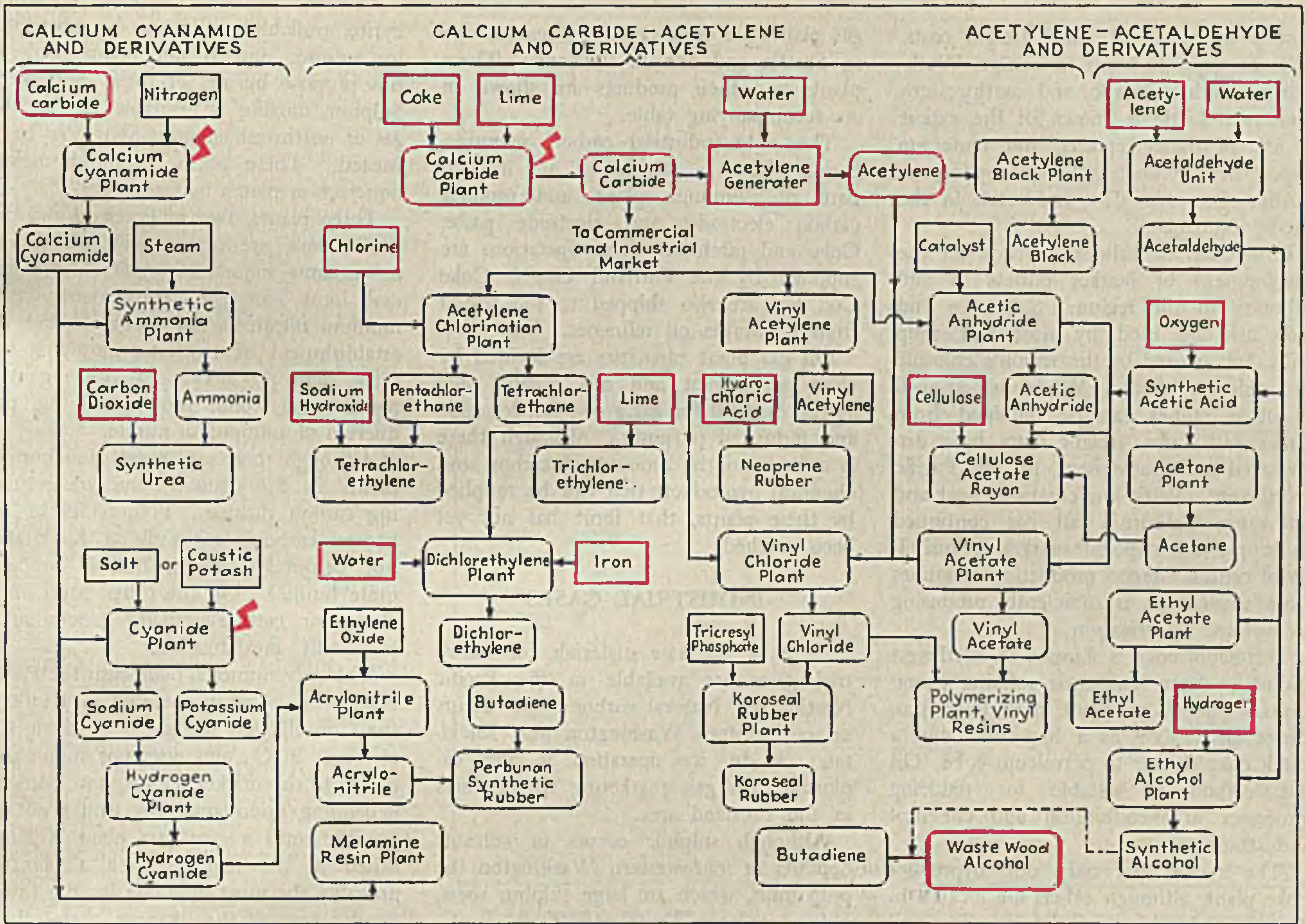
NON-METALLIC MINERALS

Tremendous deposits of limestone for builders' lime and cement, metallurgical flux, or for chemical purposes where purity is not a governing factor are available in the region. Some of the largest deposits are in northeast Oregon and along the Snake River in Nez Perce County, Idaho, and Asotin County in Wash. Large deposits are located along the Columbia River, Northport district.

Where high purity is required, as in glass and calcium carbide, care is needed

Light metals chart for the Pacific Northwest, showing existing raw materials and plant facilities in red





The Pacific Northwest now has few plants for producing the cyanamide-carbide-acetylene chemical derivatives

in selecting the limestone. Tremendous quantities of limestone are available which assay 96–99 percent with 0.5–1.0 magnesia and relatively low iron and phosphorus. Exceptionally pure limestone is found in southwestern Oregon.

Deposits are being worked in the Puget Sound area, and stone is also being imported to a Puget Sound cement plant from southeastern Alaska. Deposits are also known in southeastern Idaho and southwestern Montana. Both areas are being mined for cement operations.

Lime production is limited, not because of lack of stone, but because of the limited markets. Existing plants are supplying all needs for the present lime market, but a return of building activity with continuance of calcium carbide production and other lime uses would make the present capacity inadequate. Two small idle plants can be started to increase the output; for any appreciable increase in demand new plants would have to be built.

A number of clay beds are scattered over the Northwest; many are being worked for making common face brick and tile. These deposits are chiefly of a low-grade variety best suited for heavy clay products.

Deposits of fire clay exist that offer some promise of additional firebrick manufacture whenever the market expands. These deposits are found in northern Idaho and in the Spokane area.

Quartzite for silica brick is available in eastern Washington is inexhaustible amounts. No deposits of clay high enough in alumina to make high-alumina refractories are known to exist in the region. However, pure alumina from plants in the Mississippi Valley and Salt Lake City is shipped to the region and under normal conditions might be diverted to the manufacture of such brick. A new alumina-from-clay plant authorized for construction at Salem, Oregon, may supply alumina for refractory manufacture in the postwar period.

WHAT ABOUT GLASS?

Deposits of silica sand are located in Washington and western Oregon which might be made suitable for glass-making by a dilute acid wash to reduce the iron content. A large deposit of silica sand is located in Wyoming near Laramie. Ground quartz is being used by the existing container glass plant at Seattle for making amber glass, and the sodium silicate plant at Tacoma uses sand from a deposit in eastern Washington.

Soda ash is obtained from California, but potentially commercial deposits are located near Green River, Wyo., and Lake County, southern Oregon, accessible to the Southern Pacific Railroad.

The only glass plant is that of the Northwestern Glass Co. in Seattle, which makes container glass and uses an oil-fired furnace. Owens-Illinois Glass Co. has indicated intentions to build a container glass plant at Longview, Wash.

Glass containers find their chief outlets in areas where food processing industries are established and where bottled goods are put up for distribution; development of these industries is a measure of the degree to which container glass manufacture can develop. The plants now located in the Pacific Northwest will just about take care of present container glass needs of the region.

Possibilities for developing a plant producing abrasives are good, particularly in the field involving electric furnace operations. Fused alumina will be one of the most promising possibilities when a source of purified alumina becomes available. Silicon carbide raw materials are available in the region; this abrasive will be an excellent addition.

Limitations attending development of abrasive manufacturing are principally those of distribution. Since eastern industries are the biggest consumers of abrasive wheels, a Pacific Northwest plant would be restricted to the small but growing Western and Oriental markets, or would be under the disadvantage of trans-continental freight costs.

Barite deposits occur in eastern Washington, southern Idaho, and southwestern Montana. Little is known of the extent of any of these deposits, and none are under development. No lithopone or barium chemicals plant is located in the Pacific Northwest.

Production of salines depends on the development of market outlets in and tributary to the region. Salt cake and soda ash are used by northwest pulp mills. Salt is used by the region's chlorine and chlorate plants. While salt as well as other salines can be obtained from Great Salt Lake, freight costs have discouraged any movement to the Pacific Northwest. With low coastwise boat and rail rates, California salt has continued to supply the regional market. Possibility of central Oregon production of salines from alkali lakes is sufficiently promising to warrant investigation.

Petroleum coke is shipped to northwest industries from California refining operations. The oil gas plant in Portland produces gas carbon as a byproduct and a pitch coke similar to petroleum coke. Oil gas carbon is suitable for reducing processes in metallurgical and chemical industries.

The region has only one byproduct coke plant, although others are located in British Columbia and Utah. Two oil gas plants are located in the region, one in Seattle and one in Portland. These plants and their products are shown in an accompanying table.

The only industrial carbon manufacturing plants in the region are integral parts of aluminum plants and produce carbon electrodes and electrode paste. Coke and pitch for these operations are supplied by the Portland Gas & Coke Co., and are also shipped to the region from California oil refineries.

Oil gas plant capacities are limited by their gas market and can expand only as the demand for gas grows for domestic and industrial purposes. Although there is a limit to the amount of carbon and chemical byproducts that can be supplied by these plants, that limit has not yet been reached.

INDUSTRIAL GASES

Most of the raw materials for industrial gases are available in the Pacific Northwest. Natural carbonic gas occurs in southwestern Washington near Klickitat. A dry ice operation is now exploiting this gas, marketing its products in the Portland area.

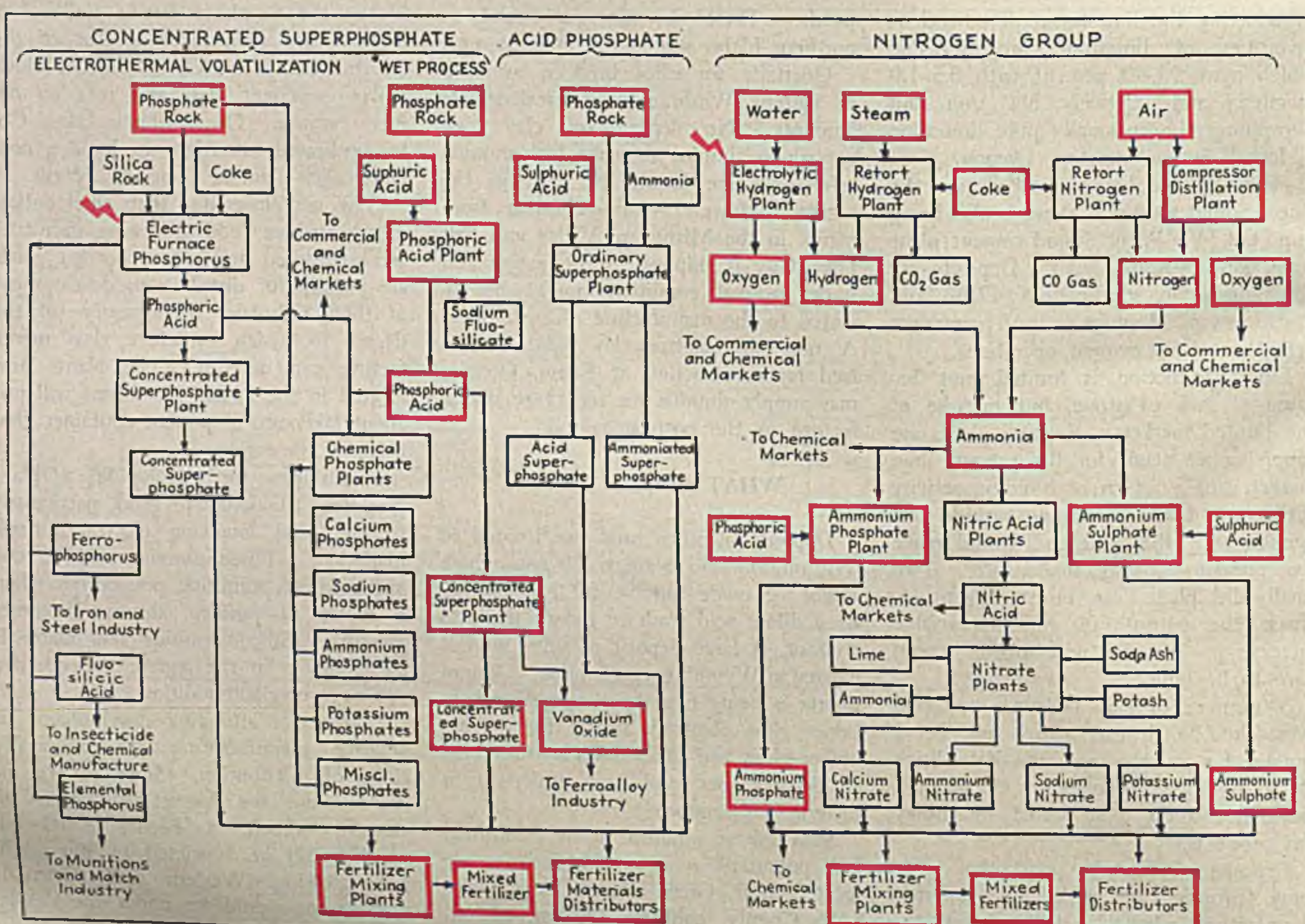
Although sulphur occurs in volcanic deposits in southwestern Washington the pulp mills, which are large sulphur users, obtain it from Texas and Trail, B. C. Pyrite, available locally, can be substituted for sulphur, but is not being used for this purpose by any of these local mills. Sulphur dioxide is available in the flue gas of northwest smelters; it is now being wasted. There are no sulphur dioxide liquefaction plants in the region.

Three plants, two in Portland and one in Tacoma, are making calcium carbide in amounts more than sufficient for normal local acetylene requirements. Ammonium nitrate is not produced, but the establishment of synthetic ammonia and nitric acid production in the region is needed and would provide for the production of ammonium nitrate.

Although there are several lime-burning plants in the region, none are recovering carbon dioxide. Potentiality of the natural carbonic gas wells at Klickitat is not definitely known, but is probably quite limited. On the other hand, limestone for carbon dioxide generation is practically inexhaustible.

The only ammonia plant near the Pacific Northwest is being operated as a unit of the Consolidated Mining & Smelting Co. at Trail, B. C., and does not supply ammonia to the market. Thus, developments depending upon ammonia would not be possible until a synthetic plant is established in the region. Such a plant is probably the most desirable for the future development of the nitrogen chemical in-

Raw materials and existing facilities now in the region for producing fertilizers are outlined in red



dustries, as well as for use in refrigeration.

The chlorine and caustic soda industry of the Pacific Northwest was established in the late 1920's when the sulphite pulp industry began a period of rapid growth. A substantial part of the chlorine and caustic capacity now serves the bleached sulphite pulp mills located on Puget Sound, Grays Harbor, the lower Columbia River, and in the Willamette Valley.

CHLORINE AND CAUSTIC

Raw material for chlorine and caustic is salt, and the process best suited to the Pacific Northwest involves the utilization of electrolytic cells with a power consumption of 3,000 kwh. per ton of chlorine. Chemical products which naturally group around a chlorine industry include hydrochloric acid, hypochlorites, sodium chlorite, chlorate and perchlorates, metallic sodium and peroxides.

Salt used in the existing two chlorine plants is shipped from California, where sea water salt is recovered by solar evaporation. Oregon has several lakes containing salt, soda ash, and other alkalies, but none are now exploited. If Utah-Pacific Coast freight rates were made competitive with California-Tacoma rates, Salt Lake salt could be shipped to the northwest. The supply is unlimited.

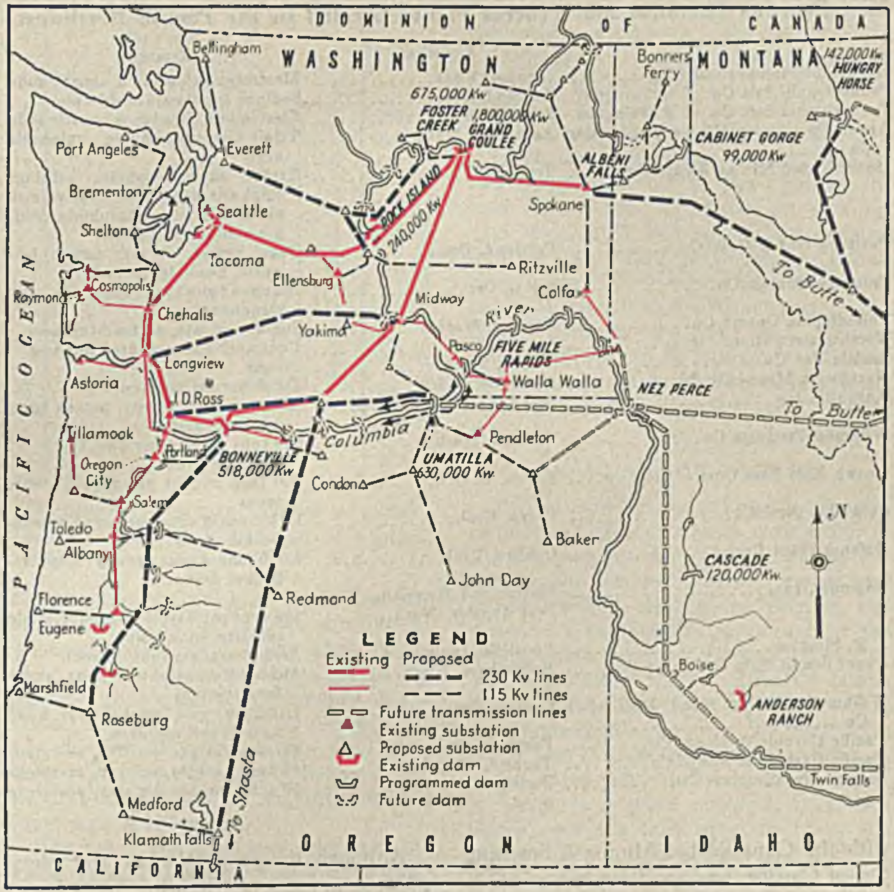
Soda ash is supplied to northwest pulp mills from California although Alkali Lake in Lake County, Oregon, has almost pure soda ash. Shipments from California can be increased for any reasonable requirement, but if a large consumption were anticipated Alkali Lake deposits should be developed.

Plant capacity of chlorine and caustic is limited to present needs of the region and cannot be expanded without providing local industries to consume the output. Chlorates, however, can be distributed in the national market, and possible future production is limited only by this national requirement.

In this group of chlorine and caustic soda chemicals and related products, the most promising and desirable include viscose rayon and cellophane, synthetic phenol and phenolic compounds, ethylene glycol, synthetic glycerine, carbon tetrachloride and the inorganic chlorides.

CARBIDE DERIVATIVES

Three calcium carbide plants are located in the Pacific Northwest. These are shown in an accompanying table. Raw materials for converting acetylene and cyanamide into synthetic chemical products include carbon dioxide, oxygen, hydrogen, nitrogen, chlorine, caustic soda, lime for chlorinated acetylene solvents, hydrogen chloride for vinyl chloride and chloroprene, tricresyl phosphate plasticizer for Koroseal and high-alpha cellulose for cellulose acetate.



Power is the key to the Pacific Northwest; facilities are here shown

High-alpha cellulose available to the region is the dissolving grade of sulphite wood pulp produced in three northwest pulp mills. All of these are owned and operated in Washington by Rayonier, Inc., and include a plant at Shelton with a capacity of 325 tons daily, a plant at Hoquiam with a capacity of 285 tons daily, and a plant at Port Angeles with a capacity of 275 tons daily.

While three carbide plants are located in the region, production of calcium carbide derivatives has hardly begun. There is no limiting factor to prevent an important synthetic chemical industry from developing, although certain units may have practical limitations that make their immediate development doubtful.

There is nothing to prevent establishment of one or more production units for chlorinated acetylene solvents. A start in this direction has, in fact, already been made in Tacoma.

No cyanamide derivatives units can develop until a cyanamide plant is established. A northwest cyanamide plant would have no problem of raw material supply, but market outlets would have to be developed in the region to justify the operation.

Vinyl chloride and vinyl acetate resins would be desirable additions for development of plastics manufacture. Vinyl chloride can be produced with existing acetylene and hydrogen chloride capacity; vinyl acetate would require synthetic acetic acid.

Synthetic acetic acid, acetone and acetic anhydride derivatives are exceptionally good possibilities for development. They are desirable for the establishment of a cellulose acetate, rayon, and plastics industry.

FERTILIZER MATERIALS

Two large phosphate rock areas exist in the Pacific Northwest, one covering the southeast corner of Idaho and southwest corner of Wyoming and extending into northeastern Utah, and the other in western Montana. Reserves are very large.

The Anaconda Copper Mining Co. operates a phosphate rock mine at Conda, Idaho, and ships the rock to its Anaconda superphosphate plant. The Montana Phosphate Products Co., closely associated

Pulp and Paper Production Capacity in Tons per 24-Hr. Day*

	Washington	Oregon	British Columbia
Pulp			
Mechanical	765	665	896
Unbleached sulphite	1,388	455	245
Bleached sulphite	1,820	110	410
Unbleached sulphate	1,165	180	255
Bleached sulphate	250	...	...
Soda	60	...	...
Paper			
News	423	370	960
Sulphite	495	305	82
Sulphate	570	150	105
Book	70	...	...
Board	570	...	25
Others	12	320	18

* Tacoma Chamber of Commerce.

Miscellaneous Chemical and Process Plants Located in the Pacific Northwest

	Location	Remarks
Hooker Electrochemical Co.	Tacoma, Wash.	Electrolytic chlorine & caustic soda
Pennsylvania Salt Co. of Washington.	Portland, Ore.	Sodium & potassium chlorates
Pennsylvania Salt Co. of Washington.	Tacoma, Wash.	Electrolytic chlorine & caustic soda
Anaconda Copper Mining & Smelting Co.	Anaconda, Mont.	Triple superphosphate, sulphuric acid
Conselidated Mining & Smelting Co.	Trail, B. C.	Treble superphosphate, sulphur, sulphuric acid, ammonia, ammonium sulphate, phosphoric acid, ammonium phosphate
Portland Gas & Coke Co.	Portland, Ore.	Coke, benzol, oil gas, carbon briquets, pitch, lampblack
Columbia Metals Co.	Salem, Ore.	Alumina from clay (under construction)
Philadelphia Quartz Co.	Tacoma, Wash.	Sodium silicate; oil-fired furnaces
Northwestern Glass Co.	Seattle, Wash.	Container glass; oil-fired furnaces
Seattle Gas Co.	Seattle, Wash.	Oil gas
Northwest Magnesite Co.	Chewelah, Wash.	Dead-burned magnesite
Kalunite, Inc.	Salt Lake City, Utah.	Alumina from alunite, potash salts, sulphuric acid
Wilkeson Products Co.	Tacoma, Wash.	250 tons of coke per day, tar; Knowles ovens
Crown Nest Pass Coal & Coke Co.	Fernie, B. C.	350 tons of coke per day; Knowles ovens
Columbia Steel Co.	Provo, Utah.	1,030 tons of coke per day; Koppers-Becker ovens
Defense Plant Corp.	Geneva, Utah.	3,000 tons of coke per day; Koppers-Becker ovens
Rayonier, Inc.	Shelton and Hoquiam, Wash. Port Angeles, Wash.	885 tons per day of dissolving grade sulphite wood pulp
J. R. Simplot	Pocatello, Idaho.	Acid phosphate (authorized)
Puget Sound Pulp & Timber Co.	Bellingham, Wash.	Alcohol from sulphite liquors (under construction)
Willamette Valley Wood Distillation Co.	Eugene, Ore.	4,100,000 gal. alcohol by wood hydrolysis (approved)
Pacific Carbide & Alloys Co.	Portland, Ore.	15 tons carbide per day, acetylene
Pacific Carbide & Alloys Co.	Tacoma, Wash.	40 tons carbide per day, acetylene
Electro Metallurgical Co.	Portland, Ore.	60 tons carbide per day, acetylene

with the Consolidated Mining & Smelting Co. of Canada, was operating two mines in Montana and shipping rock to Trail, B. C. Another Montana producer, the Mineral Hill Mining Co., shipped crude rock to Anaconda. In Utah, Garfield Chemical & Manufacturing Co. operates one mine and ships rock to Garfield.

Three sources of sulphur for sulphuric acid are available to a new Pacific Northwest fertilizer phosphate plant. These include elemental sulphur from Texas, pyrite from the Cascade Range of Washington and Oregon, and byproduct sulphur dioxide from roasting of sulphide ores in northwest smelters.

Pyrite desposits are known in Whatcom and Snohomish Counties in Washington. A large supply is available for purchase at Britannia Beach in British Columbia.

Byproduct sulphuric acid is produced from smelter gases at Anaconda, Mont., and Trail, B. C. The dilute sulphuric acid produced at Anaconda cannot be shipped in tank cars. The Trail plant of Consolidated Mining & Smelting Co. makes concentrated acid which can be shipped in tank cars, although there have been no movements south of the Canadian border. Most of the sulphuric acid now consumed in the northwest is shipped in from San Francisco Bay. This source can be considered as too expensive for northwest fertilizer production.

Ammonia is produced synthetically at Trail, B. C., where it is used with sulphuric acid in making ammonium sulphate and with phosphoric acid for making ammonium phosphate. There is no other present northwest source of ammonia.

Although the production of acid phosphate is an important industry in the states east of the Mississippi River, no plants of this type have yet been established in the Pacific Northwest. Present northwest fertilizer requirements are supplied by shipment from California and the Atlantic Coast. A recently authorized acid phosphate plant at Pocatello, Idaho, is more favorably located to supply interior markets than those of the Pacific Coast. New fertilizer capacity would have to look to markets outside of the region as well as to expansion of local requirements.

Expansion of fertilizer production is not only desirable but necessary to meet increasing needs. Location in the Pacific Northwest of the world's largest deposits of phosphate rock and the nation's largest power resource are important factors favoring large-scale production of elemental phosphorus, phosphoric acid and phosphate fertilizer. Availability of coal and electric power makes possible the production of fixed atmospheric nitrogen as synthetic ammonia, nitric acid and nitrate fertilizers.

PLASTICS POSSIBILITIES

Basic materials from which to manufacture the raw materials for a well-balanced regional plastics industry are readily available in the Pacific Northwest. However, the region needs the establishment of chemical plants to convert these basic materials to the chemicals required by plastics manufacturers.

Chemicals important from the plastics point of view manufactured in the region include: (1) High-alpha cellulose chemical pulp, nitrating or acetylating grade, from sulphite pulp mills located along Puget Sound and Grays Harbor in Washington and nitrating grade pulp manufactured on the Columbia River; (2) calcium carbide, for the production of acetylene, from Portland and Tacoma plants; (3) ethylene and benzol, in limited quantities, as products of the oil gas plants in Portland and Seattle; (4) hydrochloric acid manufactured in Tacoma; (5) sodium hydroxide, hydrogen and chlorine produced in Tacoma from electrolysis of salt; (6) wood flour, manufactured in Tacoma and available as a byproduct of plywood mills; (7) casein manufactured in the Willamette Valley.

No plastics intermediates are manufactured in this area except soybean, casein, urea, and phenolic adhesives for the plywood industry. Four molding and manufacturing plants are located in Seattle and two in Portland. Three adhesive manufacturing plants are located in Seattle, one in Tacoma, one in Hoquiam, and one in Portland. Four of these plants manufacture their own resins. There are approximately 30 paint and varnish plants, located at Seattle, Tacoma, Longview and Spokane, Wash., and Portland, Oregon. The establishment of molding and manufacturing plants is limited by present apparent markets in the Pacific Northwest and by lack of several basic chemical plants.

A phenol plant, using benzol from the Portland and Seattle oil and coal gas plants, as well as from the petroleum industry of California, would be one of the first raw material plants needed. Formaldehyde would be another logical development. The large coal deposits in the Pacific Northwest, through carbon dioxide and ammonia synthesis, could supply urea which, added to formaldehyde, would serve as the basic raw material for urea-aldehyde plastics. Acetic acid is needed as a raw material for cellulose acetate and vinyl acetate.

In general, establishment of numerous basic chemical industries in the northwest is urgently needed to supply the wide variety of raw materials required by plastics industries. Since the Pacific Northwest contains a large percenetage of the timber resources of the United States, it would appear that a plastics industry based upon these resources could be justified. The production of pulp preforms, cellulose derivatives, impregnated paper and impregnated compressed wood would be the logical utilization of forest resources.

Reprints of this report are available at 25 cents per copy. Address the Editorial Department, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

PLANT NOTEBOOK

(Continued from page 114)

filter press as soon as the operation is started. If allowed to do so, this would mean that the filter cake would build up a resistance to flow very rapidly and such resistance would become progressively higher during the filtering operation because of the undesirable compression of the filter cake.

This objection has been overcome by putting a bypass line on the discharge side of the pump so that a portion of the discharge is returned to the supply tank or mixing tank for adding the filter aid.

A much more convenient arrangement is to "short circuit" the pump with a short line connected from the discharge to the intake of the pump as indicated in the accompanying sketch. Valve "A" is inserted in this line so that with the valve wide open the liquid merely circulates through the pump and none of it goes through the filter press. The amount of material which is permitted to go through the filter press can easily be regulated by gradually closing valve "A." Thus, the liquid can be delivered to the press at a steady, even pressure which can be increased as necessary during the filtering operation without producing pressures that would tend to block the filter. The full pressure of the pump can be utilized by completely closing the valve toward the end of the filtering operation.

An arrangement of this sort has an advantage over using a bypass line back to the supply tank, in that it not only prevents exposure to the air of certain liquids, such as oils and fats, which results in unnecessary oxidation, but it also makes it possible to expose a minimum amount of liquid to atmospheric cooling. This cooling effect is especially undesirable in the filtration of some liquids where a relatively high temperature must be maintained in order to facilitate the filtration of the liquid.

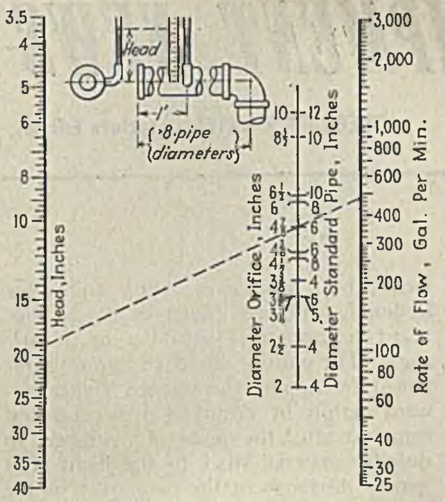
The writer has seen a few installations similar to the one outlined here and claims no originality for this suggestion. However, there are a great number of installations now in operation where the advantages of this method of operation are still not recognized, perhaps because the simple things are sometimes the least obvious.

CHART FOR WATER FLOW RATE FROM END OF PIPE

D. S. DAVIS

Wyandotte Chemicals Corp.
Wyandotte, Mich.

Based on data from a Peerless Pump Co. bulletin plotted as a family of curves on logarithmic paper (Water Wks. and Sewerage, 88, 262, 1941) the accompanying alignment chart permits rapid and convenient calculation of the rate of flow of water through a circular orifice at the end of a length of horizontal standard pipe. As shown in the insert on the chart the pipe is tapped for a $\frac{1}{8}$-in. nipple at a distance of 1 ft. from the orifice and the head



Nomograph for rate of flow of water from an orifice in the end of a pipe

of water in a vertical glass tube is read on a yardstick mounted nearby. Further requirements are: (1) There shall be no tees, elbows, or other fittings except the nipple within eight pipe diameters of the orifice; (2) the pipe shall be running full; (3) the level in the glass tube shall be at least 1 in. above the top of the pipe; and (4) the nipple shall be set flush with the inner wall of the pipe.

The use of the chart is illustrated as follows: What is the rate of flow from a circular orifice $4\frac{7}{8}$ in. in diameter at the end of a horizontal length of 6-in. standard pipe when the measured head is 19 in. of water? Connect 19 on the head scale at the left with the point for a $4\frac{7}{8}$-in. orifice in 6-in. pipe on the diameter scale, and read the desired value at 480 g.p.m. on the scale for rate of flow at the right.

The chart, which was constructed by line coordinate methods described in the author's book ("Empirical Equations and Nomography," p. 140, McGraw-Hill, 1943), offers the advantages of a head scale graduated to eights, fourths, and halves of an inch and of freedom from excessive coordinate ruling. Additional gage points for other orifice and pipe sizes can be located on the diameter scale by connecting corresponding values of observed heads and rates of flow.

ARC WELDING A PATCH ON AN ACID TANK*

A small leak in the bottom of a tank-like piece of equipment handling a corrosive liquid presented a difficult and costly repair problem.

Offhand, one might assume that a small leak in a tank or vessel could easily be repaired by welding a patch over the hole. However, welding on equipment in acid service is not that simple. Owing to chemical action which takes place in equipment in certain types of acid service after the vessel has been drained, a sludge forms on interior surfaces, crevices and corners. When heated, as in welding, a combustible gas may be liberated from the sludge and the collection of such a gas where it can be ignited by a spark or by hot metal is obviously undesirable. It is the practice, therefore, to wash and vent all such vessels thoroughly before welding on them.

In the case under discussion the difficulty and expense was not in the repair of the tank but in its preparation for welding. The tank could not be washed without shutting down the department and a shutdown at the time was most undesirable and costly. Even if the department were shut down, considerable time and expense would be required to dismantle elaborate equipment above and within the tank before it could be washed and vented properly.

MAKING THE REPAIR

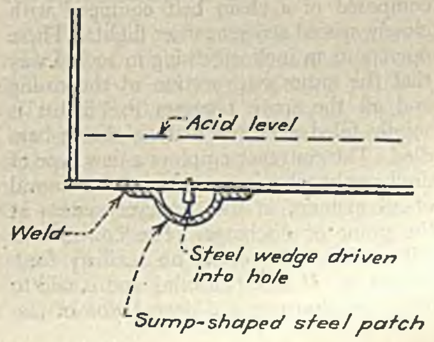
With the use of arc welding equipment, simple and efficient repairs were made in the following manner: The equipment was temporarily thrown out of service and drained, while a steel wedge, or plug, was driven into the hole in the bottom of the tank as shown in the accompanying sketch. This operation was completed before sludge could form inside the tank. Acid was immediately run into the tank to a depth less than normal for operation. A prefabricated patch in the form of a sump, or bulge in a piece of plate, was then placed over the hole so as to cover the plug in the bottom of the tank and the patch welded to the tank with two beads, a fast light bead to seal the patch in event the plug leaked, and a second heavy permanent bead to insure a lasting, tight job.

The low head of acid in the tank during welding prevented the formation of sludge and its accompanying hazard. Any sludge that formed on the metal above the acid level was not considered dangerous because the welding was confined to the tank bottom and this was insulated with a head of acid.

There is no way of knowing whether or not the steel plug is still tight but whether tight or not, we know that the patch over the plug will hold for some time to come.

The repairs were made at a great saving of time and money. Actual cost was $40 as compared with an estimated $600 or more had the tank been dismantled for washing. This is a saving of 1,400 percent. This estimated cost does not include set costs of shutting down and starting up, or loss of production while down. Adding these costs would more than triple the above savings.

Method of patching a hole in bottom of an acid tank



* From a paper submitted by C. D. Blanke, Engineer, E. I. duPont de Nemours & Co., Inc., Grasselli, N. J., in the Industrial Progress Award Program sponsored by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

CHLORINE DIOXIDE PROCESS

CHLORINE dioxide, a powerful oxidizing and bleaching compound which must be generated at the point of use, but which has an oxidizing power in terms of available chlorine of 2½ times that of chlorine, may now be used for industrial purposes by means of equipment developed by the Mathieson Alkali Works, 60 East 42nd St., New York. This was described at the recent meeting of the American Institute of Chemical Engineers. Chlorine dioxide is said already to have been proved of specific value in improving taste in public water supplies, in reducing spoilage of fruits and canned foods, and in certain other applications. It has been shown experimentally to increase the yield of penicillin when used to sterilize the atmosphere and it is expected to show superiority in the bleaching of other products such as flour, starch, soap, paper and textiles.

Chlorine dioxide is generated by feeding chlorine and air into towers which are filled with flaked commercial sodium chlorite. The generator consists of two vertical steel towers, 4 in. in diameter and 3½ ft. high, lined with stoneware or glass and filled almost to the top with the sodium chlorite. Chlorine and a large excess of air are fed at the bottom through the first tower, and the chlorine dioxide formed is carried through by the air current into the base of the second tower, passing out at the top into a mixed gas manifold. When the chlorite in the first tower is exhausted, the flow is reversed, the first tower being disconnected, recharged and introduced as the second tower, without interruption to continuous gas generation. A cabinet housing the necessary control equipment appears beside the two towers in the accompanying illustration. Necessary control equipment includes safeguards to insure harmless discharge of the gases in case of an accident, and a regulator for total pressure control.

MASS HANDLING CONVEYOR

UNI-FLO is the name of a new type of conveyor for the mass handling of free-flowing bulk materials, recently announced by Chain Belt Co., Milwaukee, Wis. This conveyor is of the continuous-stream type, composed of a chain belt equipped with closely spaced scraper-carrier flights. These operate in an inclosed casing in such a way that the entire cross-section of the casing and all the space between the flights is solidly filled with the material being handled. The conveyor employs a new type of discharge mechanism said to insure removal of all material in the conveyor system at the point of discharge. The conveyor is self-feeding and requires no auxiliary feeding device. It is self-cleaning and is said to minimize churning and degradation of materials, both during operation and after feeding has stopped. Materials may be conveyed horizontally, vertically, or at any angle. The positive discharge feature is obtained by tipping the pivoted flights forward sharply by means of a power-driven cam just after the point of discharge, to dislodge material stuck to the flight after gravity discharge of the main part of the flow.

RADIATOR-TYPE COOLING UNIT

AFTER more than a year of successful operations in a southern Illinois refinery, where they are used in the production of iso-butane and butane, restrictions have been lifted to permit the Young Radiator Co., Racine, Wis., to release the first installation pictures of the company's Quad coolers and condensers, said to be the largest radiator-type cooling units ever manufactured. Although similar in appearance to an induced draft cooling tower these units consist of radiator-type heat-transfer surfaces through which air is drawn by a large induced-draft fan.

Three of these units condense 40,000 lb. of steam per hour at 10 lb. gage pressure, while six, of which four are provided with lubricating oil cooling cores mounted in front of the water-cooling cores, handle the heat rejection from eight 600-hp. compressors and their driving engines. Each of the units in this installation has heat transfer surfaces on only two of the four sides, but when contemplated plant expansion is undertaken, cores will be installed in a third side. For still larger capacity, the fourth side can be used if desired.

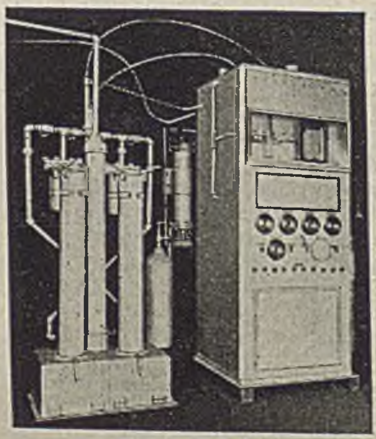
COLD CATHODE LIGHT

STANDARD UNITS in a new line of cold cathode fluorescent industrial lighting equipment are now being manufactured under the name of Kold-Volt by the Mitchell Mfg. Co., 2525 North Clybourn Ave., Chicago 14, Ill. Heretofore, according to the manufacturer, cold cathode lighting has for the most part been used for a limited number of "custom-built" lighting jobs. It is claimed that the Kold-Volt is the first standard-package unit of this type for general industrial use. The new lamps are similar in appearance to conventional fluorescent lamps, except that they are 7 ft. 9 in. long, 1 in. in diameter, and employ a different type of cathode, or filament, at the tube end. The new lamps require no starters and start instantaneously. They do not flicker and are claimed to have a useful life four times that of a conventional Type F fluorescent lamp. The average life expectancy is said to be 10,000 hours, or about three years of normal service. The new lamps are claimed to operate satisfactorily at lower room temperatures and to be insensitive to line voltage variations. One of the new fixtures is said to do the work of two conventional fluorescent fixtures of the 2-40-watt F Type. The fixture employs four cold cathode tubes and delivers 8,800 lumens of light.

NEW BOILER METER

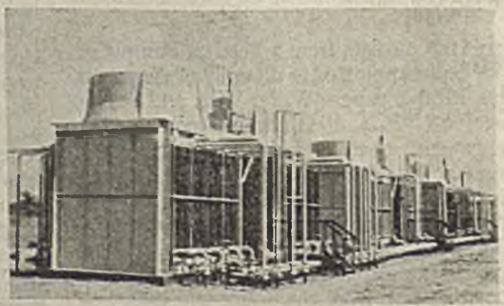
SEVERAL important advantages are claimed for a new boiler ratio meter recently introduced by the Cochrane Corp., Philadelphia 32, Pa. By using the new meter, the operator can establish the relation of air supply to fuel supply (measured by the steam generated) which is most favorable to his particular operation by

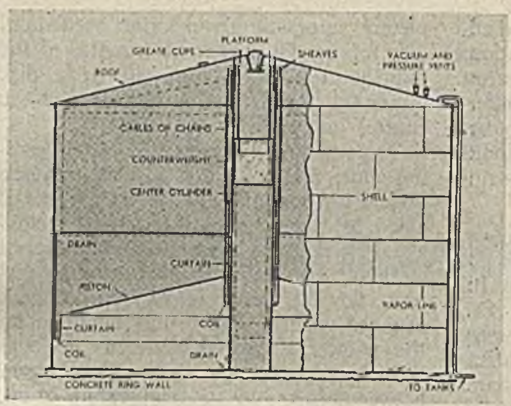
Equipment for producing chlorine dioxide, developed by The Mathieson Alkali Works



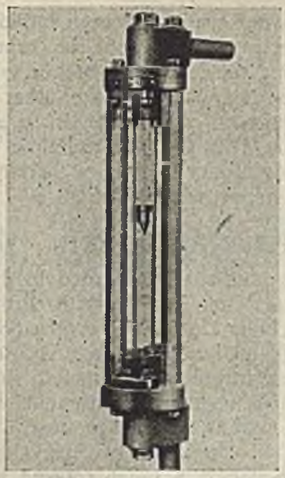
New mass handling conveyor

Radiator type coolers in a refinery

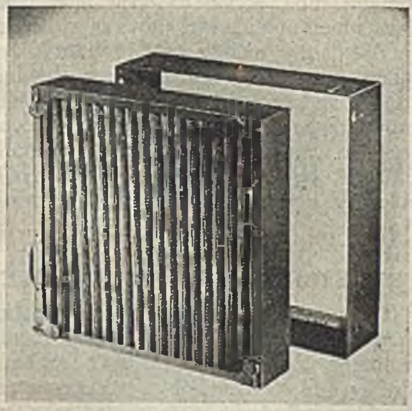




Improved dry-gas storage tank



Improved Universal rotameter



Viscous filter panel

means of an easily adjustable cam in the air-flow mechanism. To facilitate reading, the instrument is provided with a red indicator pointer operating across a white 10-in. scale. The steam flow mechanism is that of this company's standard electric flowmeter which operates on the null balance principle, while the air-flow mechanism is based on the Hays slack diaphragm, equipped with an electric motor follow-up for ample power.

GAS STORAGE TANK

Complete re-design of the Wiggins Piston Balloon type of storage tank for low pressure gases and vapors has been announced by the manufacturer, Chicago Bridge and Iron Co., 2124 McCormick Building, Chicago 4, Ill. Medium and large-sized installations are built as shown in the accompanying illustration, while smaller installations do not have the central cylinder. The piston balloon provides a means of storing gases or vapors at pressures usually less than ½ in. of water, in a dry space. It consists of a steel tank or shell with a cone roof, inside of which is a counterweighted piston that moves up and down as the gas flows in or out. The gas storage space is above the piston in the new design, rather than below it. The piston itself is a cone-shaped diaphragm made of light-weight steel plates, about 1 ft. less in diameter than the tank shell and supported on a central cylindrical column by cables or chains passing over sheaves at the top of the cylinder and attached to a counterweight on the inside.

The latter is a steel box partially filled with concrete and adjusted with sand ballast. The space between the outer edge of the piston and the shell is closed by a flexible curtain or seal connected to the shell at mid-height and long enough to permit the piston to travel to the top or the bottom.

To prevent buckling or sharp folding of the curtain seal, a metal coil with a circular guide rod through the center rides in the loop of the curtain, rolling as the curtain moves so as to eliminate wear. The space between the inner edge of the piston and the central cylinder is similarly closed by means of a curtain. The central cylinder contains gas and is gas-tight. It extends to the top of the balloon and supports the center of the roof. This construction requires no liquid seal and eliminates need for a floor on the ground.

VISCOUS PANEL FILTER

Designated as Model DPV, a new viscous panel filter offered by Dollinger Corp., Rochester, N. Y., is primarily for use in air conditioning and ventilation systems where filter resistance up to approximately 0.60 in. of water is permissible.

In the new filter the filtering medium consists of crimped layers of galvanized screen cloth and woven copper mesh. When coated with Pingene PD-10 Filter Oil, this medium is said to form an unusually efficient filter. A minimum of servicing is required since the medium is arranged so as to provide an extremely large dirt-holding capacity. The cells are made of 16-ga. steel and are fitted with handles and cam-type locking latches which hold them tightly in place, sealing the unit against air leakage. The supporting frames can be riveted together to form a flat bank or, by the addition of angles, a series of "V's." Thus, a maximum of filter capacity can be installed in a given space.

IMPROVED FLOWMETER

Greater flexibility of installation and easier maintenance are claimed for the new Universal rotameter recently announced by Schutte & Koerting Co., 12th and Thompson Sts., Philadelphia 22, Pa. As indicated in the accompanying illustration, the new instrument employs a one-piece frame construction, similar to that of previous rotameters supplied by this company, but provided with new type end-castings which permit 25 different piping hook-ups. The inside of the tube can be cleaned without removal and the tube assembly can be withdrawn, if necessary, without disturbing the pipe connections.

COMMUNICATION SYSTEM

An improvement in intercommunication systems, enabling the general manager or other executive employing the master station to communicate with from one to ten outlying departments without going through the central switchboard, has been announced by the Talk-A-Phone Mfg. Co., 1219 West Van Buren St., Chicago 7, Ill. The improved system, known as C-410, can be built up from one master station and a single sub-station, with the addition of extra sub-stations as needed, to a total of ten. A special feature shuts out at the master station all sounds originating at the sub-station locations, yet permits sub-stations to originate calls to the master station at will. A new feature provides special booster action under control of a pushbutton so that calls may be powerfully amplified to penetrate high noise levels if necessary. This volume level feature is controlled by the master station which operates on 110-115 volts, a.c. or d.c.

EQUIPMENT BRIEFS

Intended for shielded arc welding, as well as for use as a filler rod in carbon arc welding, is a new coated aluminum bronze electrode designated as Airco No. 100 which has been announced by the Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y. This high-tensile bronze rod is said to produce deposits of great strength and hot ductility, combined with desirable resistance to corrosion. In this last respect the rod is claimed to be superior to standard manganese bronze, and to equal the latter in strength, hardness and ductility. The new rod can be used for welding dissimilar metals, such as cast iron to brass, and steel to malleable iron, as well as for similar metals of these types.

It has been announced by Century Electric Co., St. Louis 3, Mo., that Century Form J Splash Proof motors in sizes from 1½ to 15 hp. are now available with two-way ventilation. Fans on each end of the rotor draw in the cooling air through baffled openings in the bottom of the end brackets. The air is then blown through and around into all parts of the motor, and out through louvered openings in the side of the frame below the center line and at the bottom. During plant wash-down and in outdoor operations this construction is claimed to protect the vital parts of the motor.

Anyone who can qualify under Rubber Order R-1 can now obtain industrial gloves made in two styles from synthetic rubber by The B. F. Goodrich Co., Akron, Ohio. They are said to be equal in most respects to those made from natural rubber, and to be as good as natural rubber gloves in acid resistance as well as oil and grease resistance. One of the gloves is a light-weight type of 0.15 in. ga., 10½ in. length, and sizes from 7 to 11. The other glove is of 0.30 in. ga., 14 in. in length, and in sizes 10, 10½ and 11. The latter type is available in straight finger style only.

Designed for use in their dust respirators, colored filters have been developed by Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8, Pa. The color can be seen through the transparent filter container thus assuring at a glance the correct filter use for each type of job. Red indicates U. S. Bureau of Mines approved protection against toxic dusts, lead, cadmium, magnesium, etc.; while green indicates a filter for protection against fibrosis and pneumoconiosis producing dusts and mists. Grey is the color used for protection against toxic fumes from molten metals. Knowledge and use of these colors enables better respiratory safety.

Improved materials, heat-treating and lubrication are some of the features claimed for the new 1300 Series tube cleaner developed by the Elliott Co., Jeannette, Pa. The motors have been proportioned so that they now clean curved as well as straight tubes. This is made possible through the use of the FH coupling, an all-metal device which is flexible enough to negotiate sharp tube bends and also provides full cross-sectional area for flow of air from supply hose to motor. This last is said to be a definite advance over the section of rubber hose formerly used, and permits greater speed and power.

Availability of a line of alternating-current generators for gas-engine drive, in sizes from ½ to 150 kva., has been announced by Century Electric Co., 1806 Pine St., St. Louis, Mo. Types for either direct connection or belt drive are being supplied. The generator is of the revolving field type. In the direct connected type the generator bolts directly to the engine housing. The engine end of the shaft requires no bearing, since it is supported by the engine bearing. The exciter is mounted on the end of the generator opposite the engine, its shaft inserted in and driven by the generator shaft. Compactness of generator and exciter are emphasized.

Conductive-type solid rubber industrial tires for operation in hazardous locations are now being made by the United States Rubber Co., Rockefeller Center, New York, from synthetic rubber. It has been found that the synthetic product is equal to or better than the formerly used natural rubber in retention of conductivity in service, an important consideration in view of the fact that any high-conductive rubber tends to decrease in conductivity owing to flexing in service.

RUBBER COATING

Successful coating for steel propeller shafts carrying bronze propellers has been accomplished by the flame-spraying of Thiokol synthetic rubber, according to Schori Process Corp., Long Island City, N. Y. Heretofore such propellers on steel shafts of wooden vessels have produced electrolytic action with serious deterioration of the shaft.

The same coating has been employed advantageously, according to the corporation, for lining the interior of bronze valves on seawater pipe lines and for other underwater portions of steel vessels. It appears, therefore, that the new technique should offer possibilities for rubber coating in numerous industrial applications.

SENSITIVE RELAY SET

Now being manufactured by H-B Instrument Co., 2504 North Broad St., Philadelphia 32, Pa. is a sensitive SS-5 relay set to be used in conjunction with contact-equipped meters, galvanometers, gages and other relay-operating instruments that require low-gram contact pressure.

The set consists of two relays mounted side by side in a hinge covered housing, 5¾ in. wide, 5¼ in. high and 3½ in. deep. One relay is of the iron-core-magnet type and can be operated on 110 volts and 2 milliamperes, while the other is a selenoid type mercury plunger relay, the tube of which will handle a load up to 30 amperes at 110 volts A.C., or 20 amperes at 220 volts. Terminals for line connection are marked on a convenient terminal block below the two relays, and a 4 ft. armored cable, attached to the side of the housing, is equipped with a plug for connection to the instrument.

CONTROL INSTRUMENTS

Instruments claimed to enforce any desired heating or cooling program have been announced by Wheelco Instruments Co., Harrison & Peoria Sts., Chicago 7, Ill. The instruments, named Chronotrols, employ an electronic principle of temperature control. It is said that, regardless of changes in temperature desired for a given process or application, they provide completely automatic temperature regulation. The rotation by synchronous motor of the temperature control cam cut on a disk moves the temperature setting lever of the control instrument.

Temperature change, noted by the sensing unit, results in the instant response of the instrument's control unit. This is aided by the absence of mechanical linkage between the measuring and control sections. The frequency of oscillating current flowing between pick-up coils is changed when a control flag mounted on the pointer is moved between the coils by a temperature rise or is moved from between them by a temperature drop. This frequency change in the control circuit governs the output current of a vacuum tube, acting to open relay contacts which operate fuel valves or switches.

Twenty-five models of Chronotrols are offered, including ten for proportioning control and others for two-position on-off and three-position on-intermediate-off control for high and low temperature applications. Thermometer models are available in both recording and indicating types.

PREDETERMINED WEIGHT SCALE

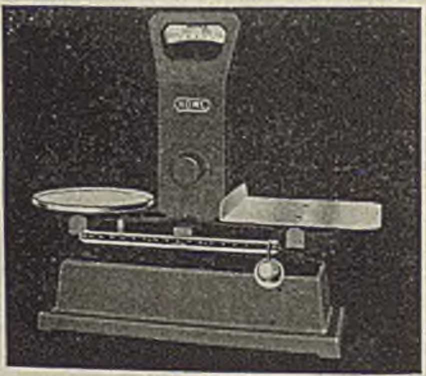
To permit accurate packaging, check-weighing, balancing, counting and compounding, the Howe Scale Co., Rutland, Vt., has added a new line of predetermined weighing scales which are offered in a variety of shapes, capacities and platter sizes to meet a wide range of requirements. These scales are said to be sturdy, fast-performing and accurate. The particular scale shown in the accompanying illustration, designated as Model 1520, has a capacity of 11 lb., and a 9x9 in. commodity platter.

Spraying steel propeller shaft with molten Thiokol synthetic rubber

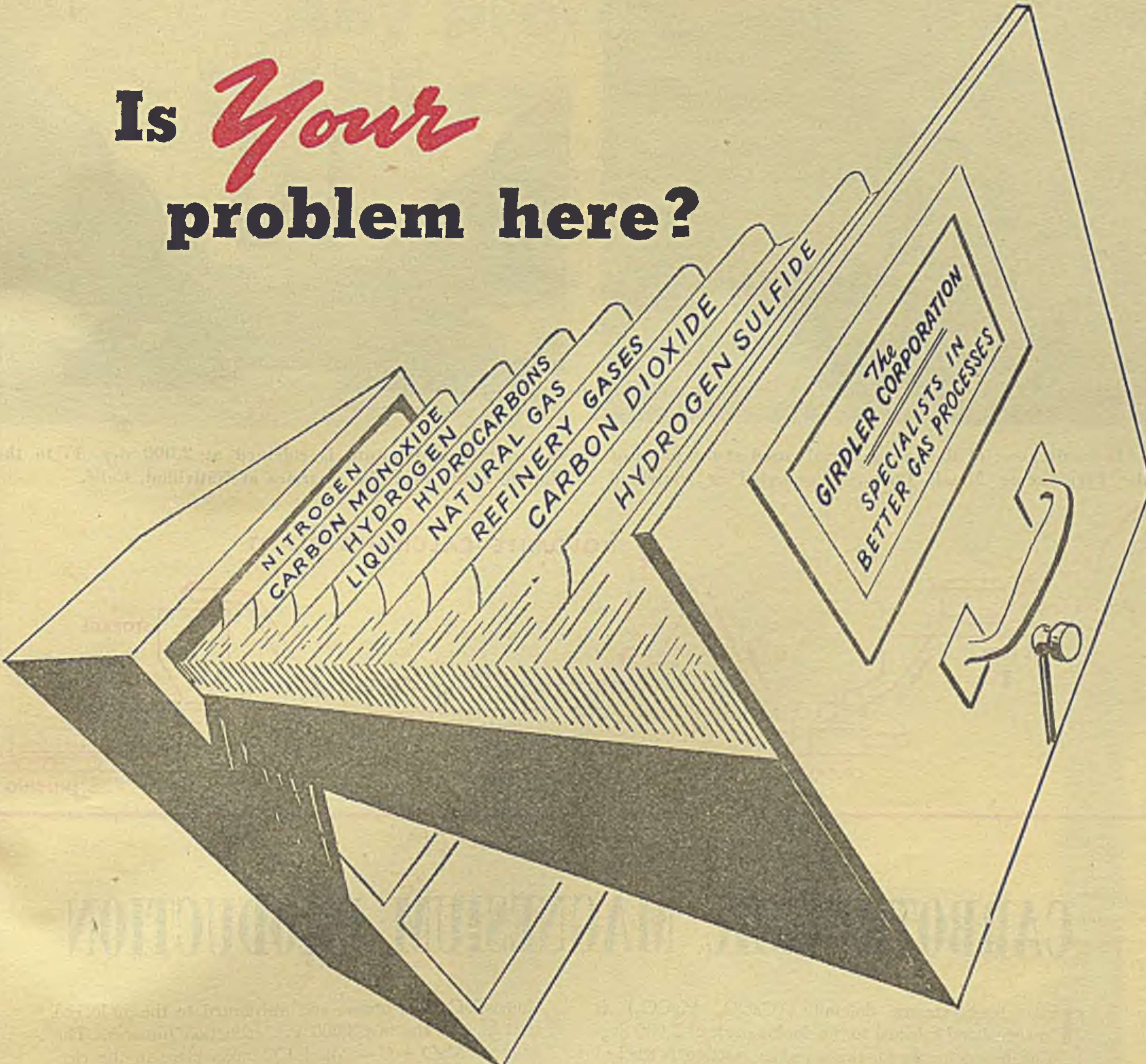
Sensitive relay set

Improved cycle controller

New predetermined weighing scale



Is *Your* problem here?

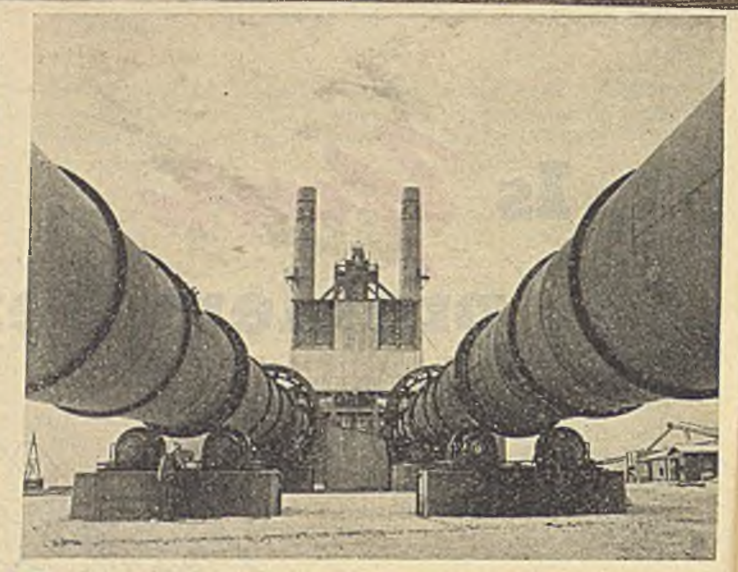


CONSULT GIRDLER on *any* question involving production or purification of gaseous mixtures or liquid hydrocarbons. GIRDLER offers engineering service backed by a long and successful record of prompt, practical, and economical solutions to gas processing problems. Our engineers are armed with facts, experience and — most important — ability to contribute constructive ideas, whether the job at hand is simple or complex. Call Girdler *first!*

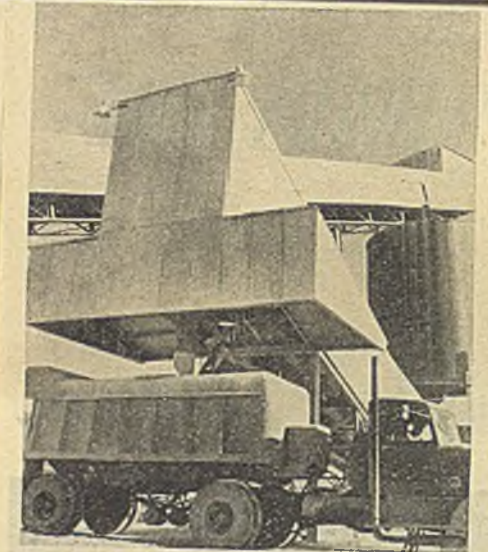
The GIRDLER CORPORATION
Gas Processes Division · Louisville 1, Ky.

CHEMICAL ENGINEERS AND CONSTRUCTORS

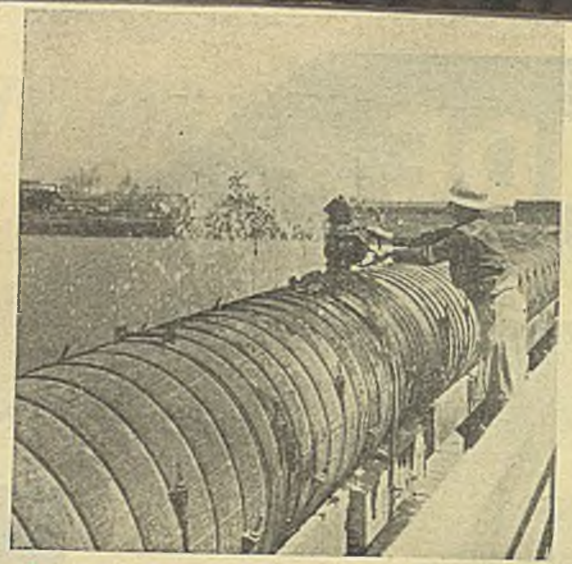
1 Dolomite, one of the raw materials used at the plant of the Permanente Metals Corp., is quarried at Natividad



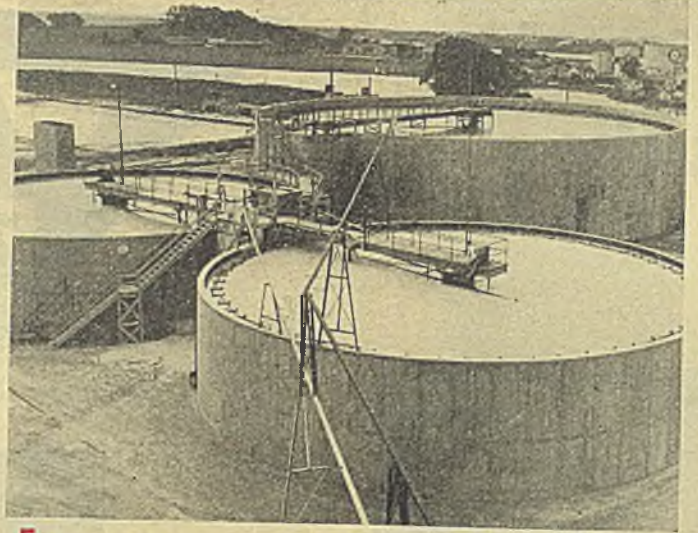
2 Crystalline dolomite is calcined at 2,000 deg. F. to the double oxide near the quarries at Natividad, Calif.



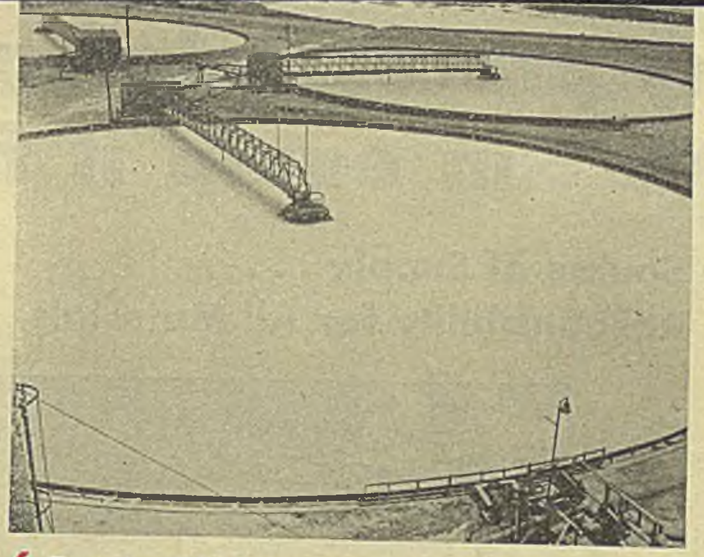
3 Calcined material is sent to Moss Landing, located on Monterey Bay



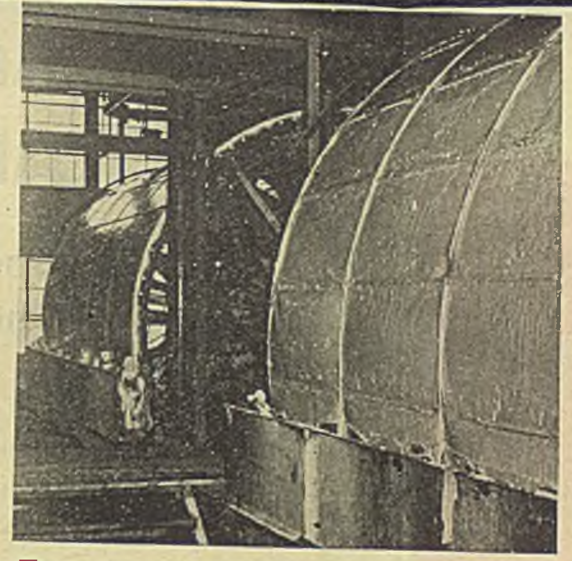
4 6,500 g.p.m. of sea water are pumped through a wood stave line to hydrotreator



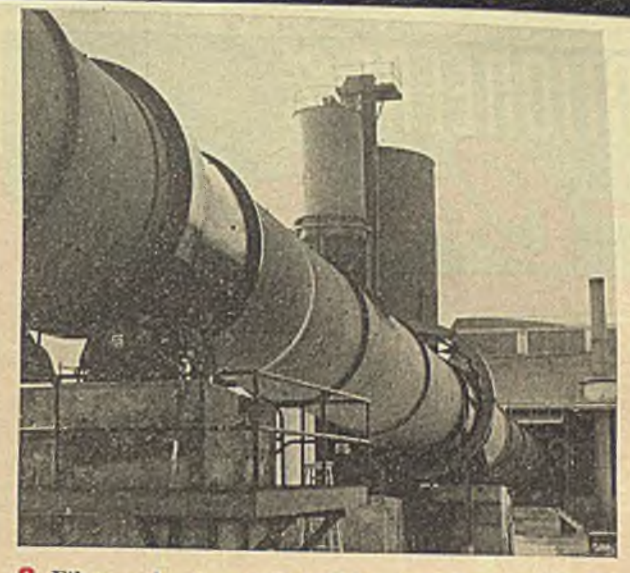
5 In the hydrotreator tanks suspended solids and carbonates are precipitated before sea water flows to reactor



6 From four 250-ft. thickeners the underflow is pumped in series and counterflow to a fresh water wash

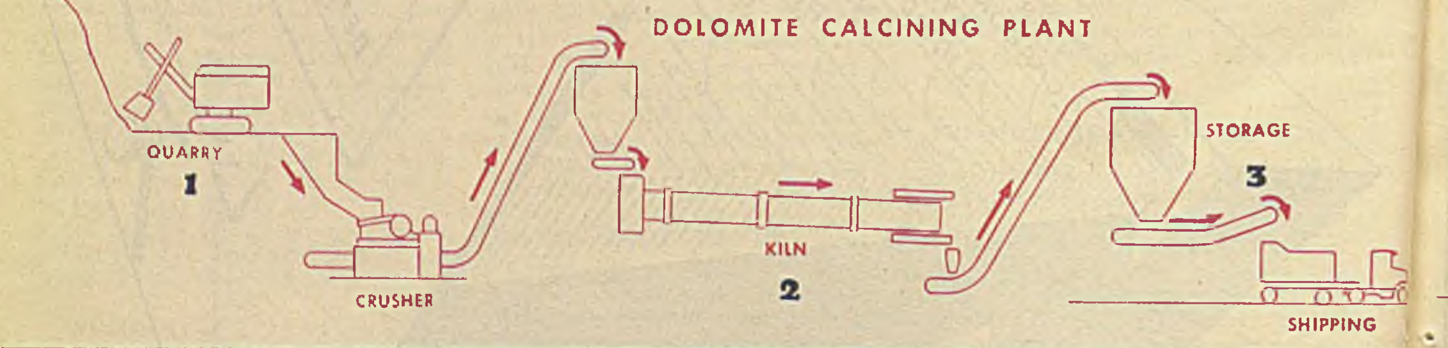


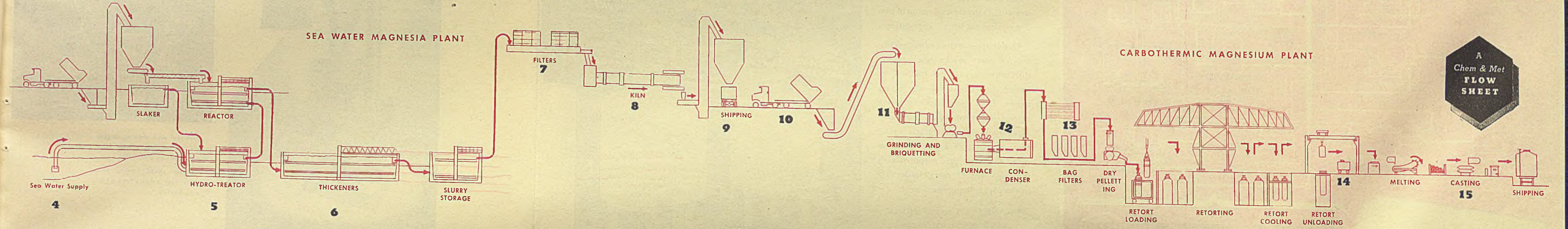
7 Washed magnesium hydroxide slurry is pumped to filters where water is removed



8 Filter cake is conducted by screw conveyor to rotary kiln where it is dehydrated at 2,300 deg. F.

9 After dehydration the material, over 96 percent MgO, is trucked to the carbothermic plant





CARBOTHERMIC MAGNESIUM PRODUCTION

True crystalline dolomite ($CaCO_3$ $MgCO_3$) is quarried and calcined to the double oxide at 2,000 deg. F. Calcined dolomite for the sea-water reaction is trucked to Moss Landing, Calif., located on Monterey Bay. 6,500 g.p.m. of sea water are pumped through a wood stave line with a lift of 40 ft. from mean tide to hydrotreater. Here suspended solids and carbonates are precipitated. The treated sea water then flows to the reactor where dolomite is introduced, thence to the first of four 250 ft. thickeners. The thickened underflow is pumped in series and counterflow to a fresh-water wash of 1,000 g.p.m. The washed magnesium hydroxide slurry is pumped to a battery of Oliver filters where the bulk of the water is removed and the filter cake is conducted by screw conveyor to the rotary kiln where it is dehydrated at a temperature of 2,300 deg. F.

This material, over 96 percent MgO, is trucked to the carbothermic plant at Permanente where it is mixed in the desired proportions with petroleum coke and interground in 26-ft. ball mill. This material is briquetted in Komarek-Greaves presses and distributed to the air-locked feed bins of the five 8,000 kva. reduction furnaces. The reaction $MgO + C = Mg + CO$ takes place in the electric furnaces operating at 3,600 deg. F. and the gaseous products as they emerge from the furnace are shock chilled by a stream of natural gas. The submicroscopic magnesium dust produced by this reaction and shock chilling is removed from the gas by a battery of bag filters and conveyed to dust bins and from dust bins to gas-tight, enclosed, pelleting presses of special design. Pellets are loaded into vertical retorts which are lowered into vertical air-tight electric resistance furnaces.

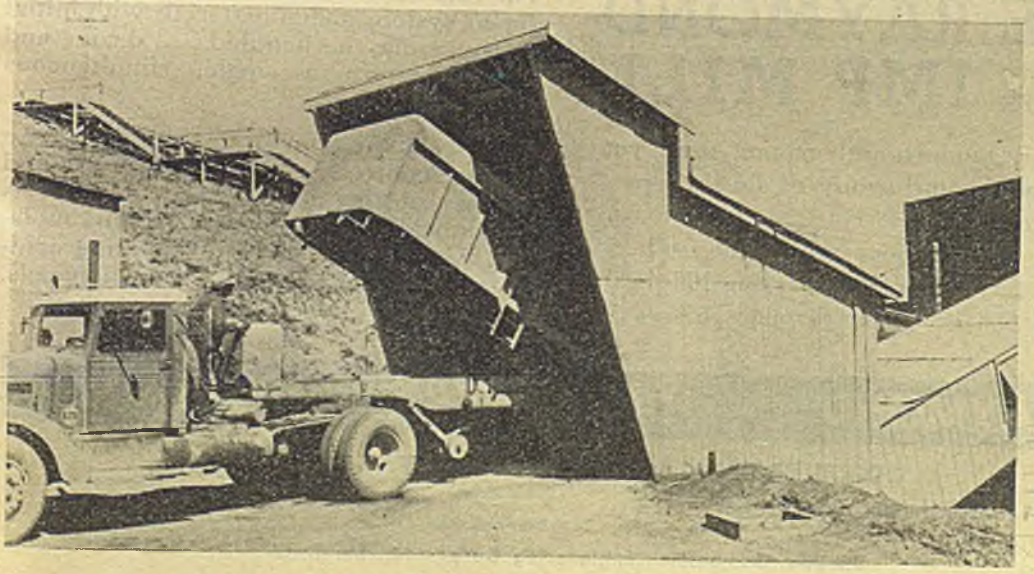
The magnesium metal is sublimated from the pellets at 1,400 deg. F. at an absolute pressure of 0.2 mm Hg. In the upper condensing portion of the retort is a liner which collects the crystalline magnesium sublimate. When sublimation is complete, retorts are cooled, liners removed, and crystals stripped from liners. These crystals of over 99.99 percent purity are melted and alloyed to produce the various alloys in demand for the war effort.

CHEMICAL & METALLURGICAL ENGINEERING

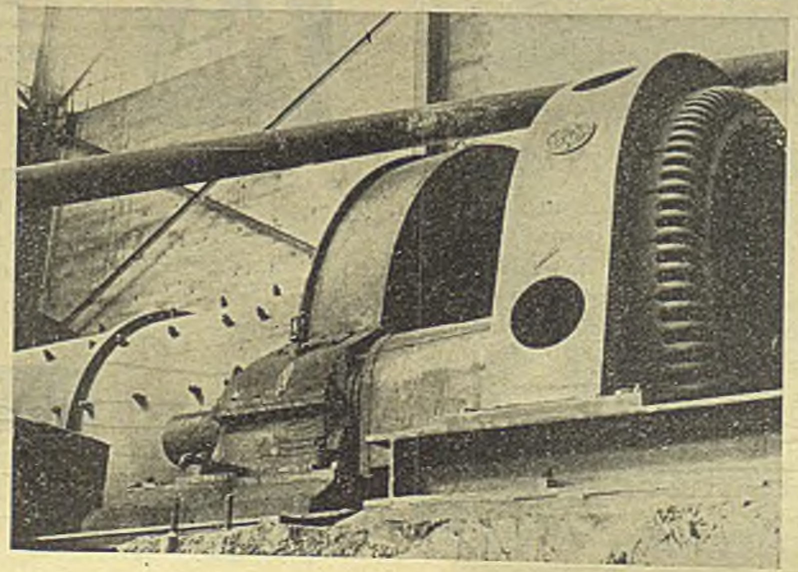
June, 1944

PAGES 128 to 131

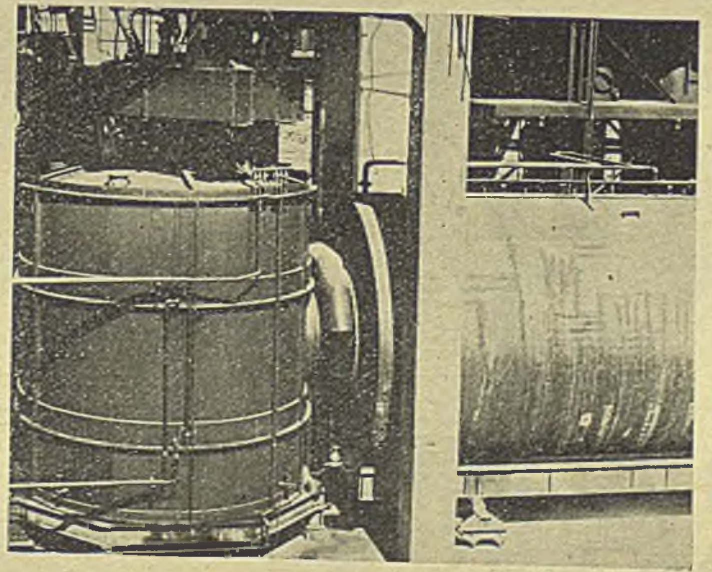
10 Raw material from Moss Landing plant is unloaded at carbothermic plant where it is mixed in the desired proportions with petroleum coke



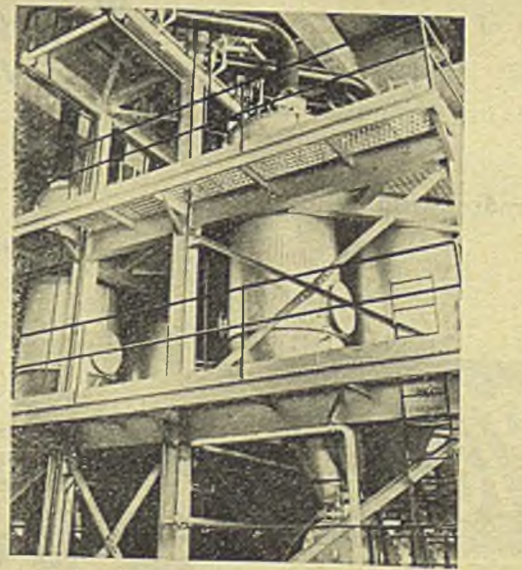
11 After grinding in this ball mill the mixture of magnesium and petroleum coke is briquetted and distributed to reduction furnaces



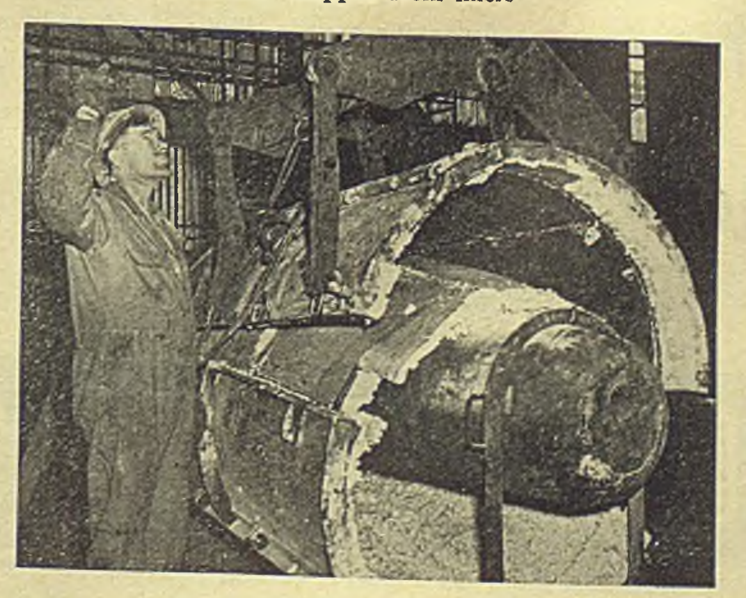
12 Oxide is reduced in 8,000 kva. furnaces. Gaseous products are shock chilled by natural gas



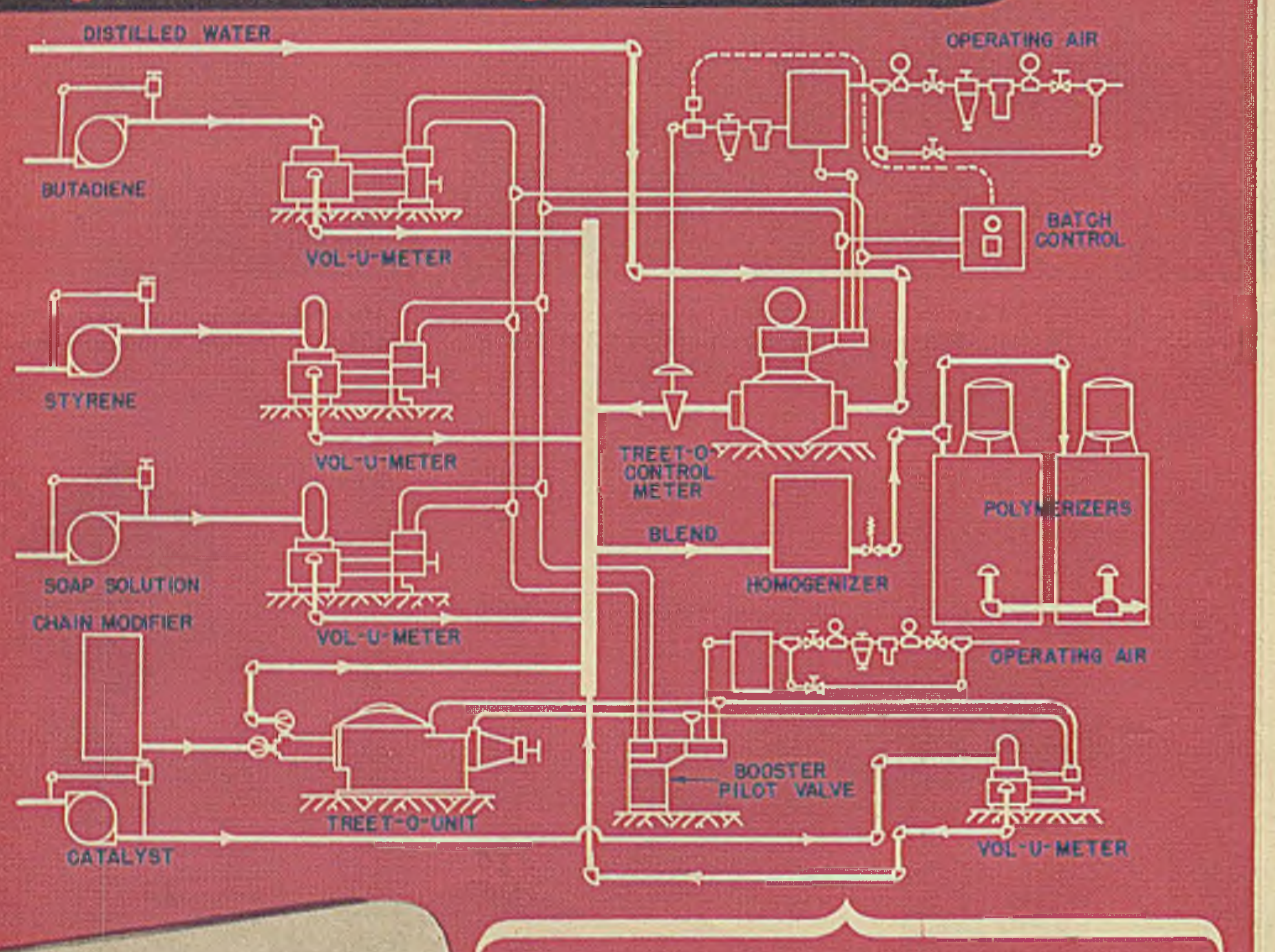
13 Sub-microscopic magnesium dust is removed from gas by bag filters

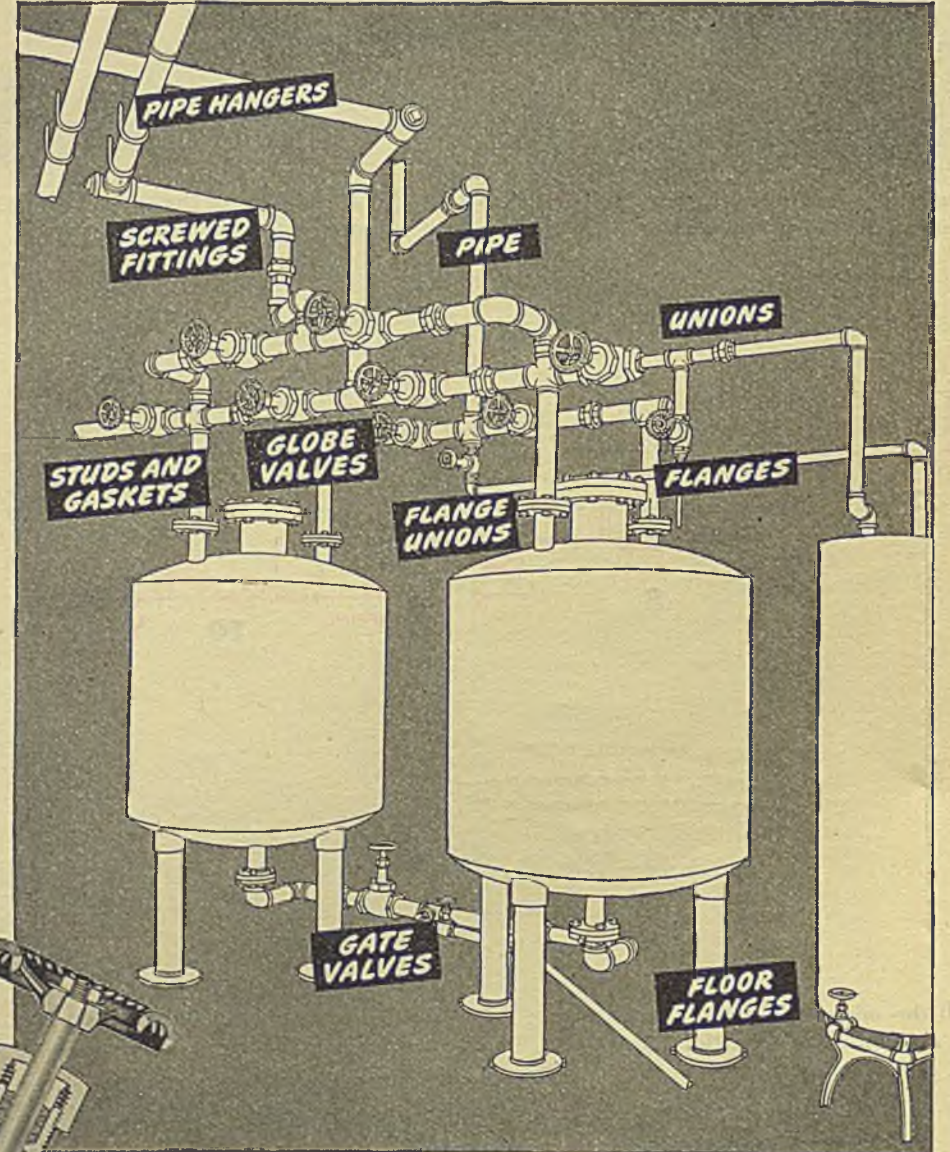


14 When sublimation is complete, retorts are cooled, liners removed, and crystals stripped from liners

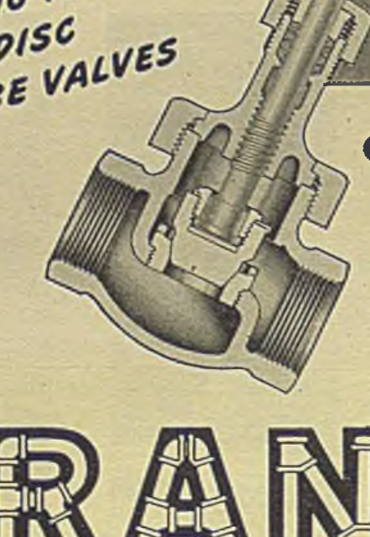


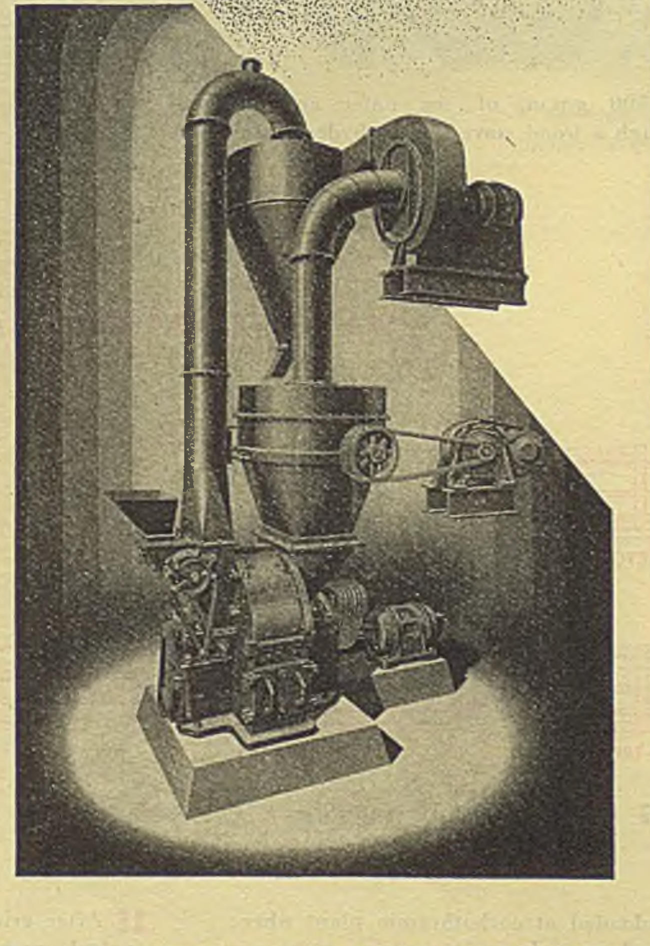
15 Metal is alloyed to make objects such as bomber control being cast

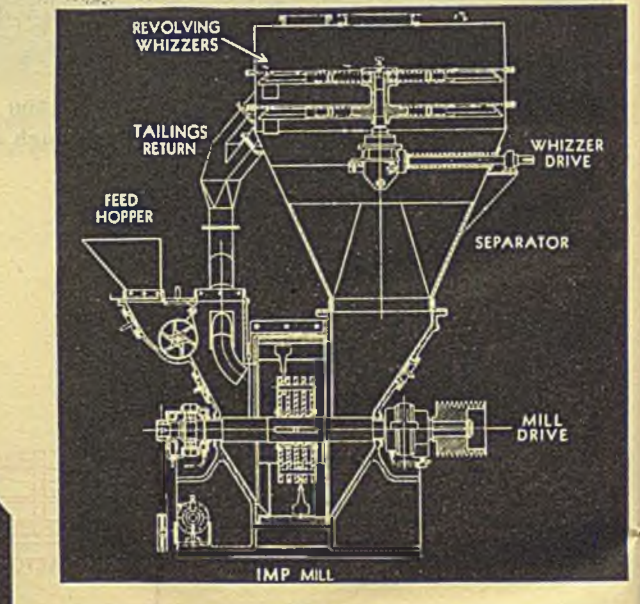




Processing unit in chemical plant—piping by Crane







Sectional view showing double whizzer separator, built integral with the IMP MILL.

Variable speed control provides easy adjustment of classification.

NEW PRODUCTS AND MATERIALS

JAMES A. LEE, Managing Editor

CONTENTS

VINYL CHLORIDE RESIN LATEX

PRODUCTION of a true latex of vinyl chloride resin without using costly and dangerous solvents, a project on which B. F. Goodrich Co., Akron, Ohio, has been working for some years, has been achieved. The company's Geon resin is dispersed with water instead of with the flammable and toxic solvents formerly used, some of which are extremely critical as regards supply. It can be adapted to a wide variety of uses in coating textiles, wires and other materials, and in film manufacture. Resembling the latex of rubber in appearance, the new colloidal substance holds in suspension vinyl resin particles so tiny that 25 trillion are contained in a single cubic inch. The new latex can be used in thin form to fiber structure, thus allowing the materials treated to "breathe" or it can be applied as a flexible, impervious coating. In clear or colored form, it can be brushed, sprayed or dipped. It is more pliable and more thoroughly impregnates fabrics or fibers to which it is applied than older vinyl resins. Resistance to flame, increased wear and easy cleaning are among the advantages it will bring to materials on which it is used.

LUBRICATING OIL

BY COMBINING an Einstein equation with a Staudinger equation, chemists in the Richmond, Calif., laboratories of California Research Corp., a Standard Oil of California subsidiary, recently developed a lubricating oil which thickens when heated and thins when chilled. This oil which to date is known only by its laboratory slang name, the "Oily Outlaw," was first developed as a theory on paper. By combining the two equations, it was proved that properly selected high-viscosity material added to the oil would dissolve when heated and thicken the oil, and that the dissolved material would separate out again when the temperature dropped. The added substances are mostly resins many times as viscous as the oil itself, however, they are finely divided particles each of which is composed of only a few thousand molecules. Subsequent tests showed that at ordinary temperatures the particles remained suspended in the oil and do not affect its viscosity, but when the oil becomes heated the particles gradually break up. The higher the temperature the greater the breakage, until finally they are reduced approximately to molecule size. In that state they form a solution with the oil and contribute greatly to its viscosity. When the oil cools, the molecules slump together again and become particles suspended in the lubricant and the oil returns to its former low viscosity state. While Standard of California officials have pointed out the new oil is still a laboratory curiosity, the hope has been expressed that some day it may be instrumental in solving the problem of lubricating equipment that necessarily operates through wide temperature ranges.

SYNTHETIC RUBBER

SYNTHETIC rubber moved a step further into fields once held exclusively by natural rubber with the announcement by the Goodyear Tire & Rubber Co. of Pliolite S-1. The product is a synthetic substitute for the prewar natural rubber Pliolite which was produced by Goodyear by a process which preserved the original rubber's inherent characteristics while adding low solution viscosity and rigidity. Pliolite S-1 has generally the same range of usefulness and applications as its natural rubber forerunner. The new product was even superior in some respects to the prewar natural rubber product. Potential postwar uses include golf ball covers, safety and football helmets, moisture-proof coating for paper, and an alkali- and water-resistant vehicle for paints.

CLEANING COMPOUND

A SIMPLE dip or spraying of the work with Cyclodiene hydrocarbon solvent, recently announced by Technical Process Div., Colonial Alloys Co., Philadelphia, Pa., should economically remove the oil and dye, and leave clean metal surfaces. Cyclodiene can be handled in ordinary open tanks or spray machines at room temperature. Toxicity may be said to be negligible. Since Cyclodiene is tested neutral, and shows no signs of hydrochloric, oxalic, nitric or sulphuric acids, or cyanides, it is safe to use with all metals including the aluminum and magnesium. The solvent recovery rate is high, and so the solutions may be used over and over again. This results in a low per gallon cost for cleaning. Magnafluxed parts thus cleaned are soon thereafter ready for such operaions in surface finishing as rust-proofing, painting or other organic or chemical finishing, electroplating or anodizing.

DEGREASING SOLVENT

THE SELF-EMULSIFYING degreasing solvent, Gunk Concentrate P-96, is a versatile concentrate base which, when properly diluted forms the basis of several different cleaning solvents. It is made by the Curran Corp., Malden, Mass. This alkylphenolic compound does not give off toxic vapors and is non-explosive.

INSECTICIDE-FUNGICIDE

A NEW chemical compound which is sprayed on the ground and absorbed by food-producing plants to render them immune both to insect and fungi destruction, has been shown to increase potato crops as much as 25 to 100 bu. per acre, it was announced by Rohm and Haas, Philadelphia, Pa. The plant inocculation possibilities of the new synthetic, known professionlly as diethylene-sodium-misdithiocarbamate and familiarly as Dithane, were discovered by accident, and later tests proved it to be fatal to both chewing and sucking insects but harmless to plants and non-toxic to man.

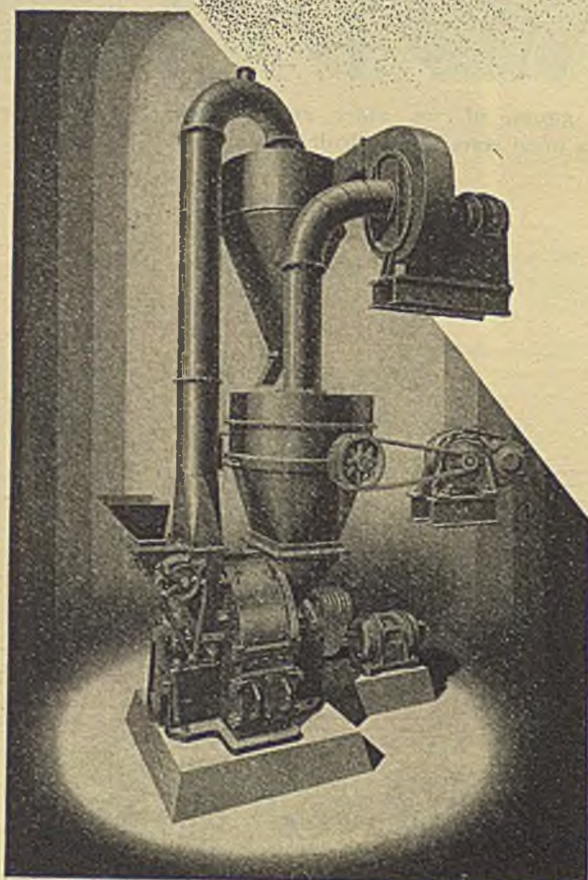
In recent field tests in Florida and Texas, Dithane has not only proved deadly to such fungi menaces as late blight which swept many food-producing areas of the South this spring, but also made possible potato yields running from 25 to 100 bu. more per acre than plots sprayed with conventional fungicides. Further proof of this chemical's remarkable powers is revealed by the fact that it not only acts as a repellent to certain insects—unlike such standard fungicides as bordeaux mixture which actually builds up aphid infestations—but actually kills them. The serum-like effect of the chemical was discovered after unsuccessful attempts to grow beetles on a plot which had been sprayed with the experimental "fungicide." It will not be available for several months.

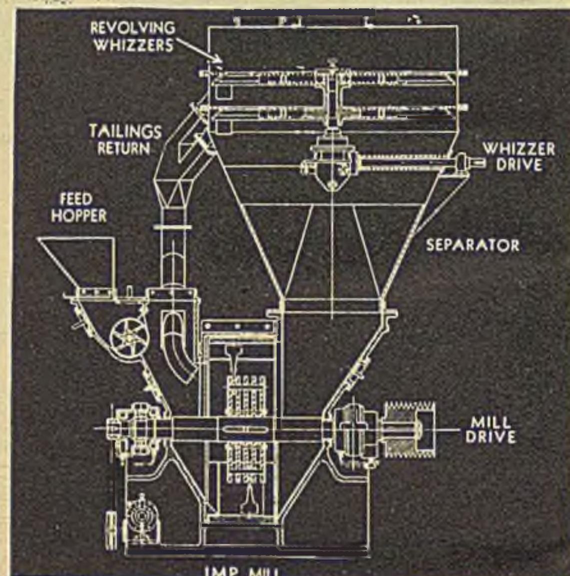
INSECTICIDES

SYNTHETIC organic compounds, carrying such forbidding chemical names as beta-beta-dithiocyano diethyl ether and beta butoxy beta thiocyano ethyl ether have been designed to replace the dangerous and highly toxic stomach poisons, lead and calcium arsenate. One compound still in early stages of development by

WIDE . . . FLEXIBILITY

in — FINENESS CONTROL





Sectional view showing double whizzer separator, built integral with the IMP MILL.

Variable speed control provides easy adjustment of classification.

SINCE 1887

THE RAYMOND WHIZZER-EQUIPPED IMP MILL

With this modern pulverizing unit, you can maintain uniformity of finished product throughout the run . . . or you can regulate the fineness while the mill is operating . . . from 80% passing 100-mesh up to 99.5% or better through 325-mesh.

The Imp Mill can also be furnished with a drying system so that materials with initial moisture may be handled . . . drying and pulverizing in a single, simultaneous process.

This combination unit gives you close product control . . . both in fineness and dryness of the finished material. It is economically adapted for removing moisture while grinding, as in handling acid-treated clay and washed kaolin, chemicals, pigments and manufactured products.

RAYMOND PULVERIZER DIVISION

COMBUSTION ENGINEERING COMPANY, INC.

1311 North Branch Street **Chicago 22, Illinois**

Sales Offices in Principal Cities

Canada: Combustion Engineering Corp., Ltd., Montreal

For other combinations of the IMP MILL with a Mechanical Air Separator or with Flash Drying System . . . see Catalog # 41.

NEW PRODUCTS AND MATERIALS

JAMES A. LEE, Managing Editor

VINYL CHLORIDE RESIN LATEX

Production of a true latex of vinyl chloride resin without using costly and dangerous solvents, a project on which B. F. Goodrich Co., Akron, Ohio, has been working for some years, has been achieved. The company's Geon resin is dispersed with water instead of with the flammable and toxic solvents formerly used, some of which are extremely critical as regards supply. It can be adapted to a wide variety of uses in coating textiles, wires and other materials, and in film manufacture. Resembling the latex of rubber in appearance, the new colloidal substance holds in suspension vinyl resin particles so tiny that 25 trillion are contained in a single cubic inch. The new latex can be made to conform to fiber structure, thus allowing the materials treated to "breathe" or it can be applied as a flexible, impervious coating. In clear or colored form, it can be brushed, sprayed or dipped. It is more pliable and more thoroughly impregnates fabrics or fibers to which it is applied than older vinyl resins. Resistance to flame, increased wear and easy cleaning are among the advantages it will bring to materials on which it is used.

LUBRICATING OIL

By combining an Einstein equation with a Staudinger equation, chemists in the Richmond, Calif., laboratories of California Research Corp., a Standard Oil of California subsidiary, recently developed a lubricating oil which thickens when heated and thins when cooled. This oil which to date is known only by its laboratory slang name, the "Oily Outlaw," was first developed as a theory on paper. By combining the two equations, it was proved that properly selected high-viscosity material added to the oil would dissolve when heated and thicken the oil, and that the dissolved material would separate out again when the temperature dropped. The added substances are mostly resins many times as viscous as the oil itself, however, they are finely divided particles each of which is composed of only a few thousand molecules. Subsequent tests showed that at ordinary temperatures the particles remained suspended in the oil and do not affect its viscosity, but when the oil becomes heated the particles gradually break up. The higher the temperature the greater the breakage, until finally they are reduced approximately to molecule size. In that state they form a solution with the oil and contribute greatly to its viscosity. When the oil cools, the molecules slump together again and become particles suspended in the lubricant and the oil returns to its former low viscosity state. While Standard of California officials have pointed out the new oil is still a laboratory curiosity, the hope has been expressed that some day it may be instrumental in solving the problem of lubricating equipment that necessarily operates through wide temperature ranges.

CONTENTS

SYNTHETIC RUBBER

Synthetic rubber moved a step further into fields once held exclusively by natural rubber with the announcement by the Goodyear Tire & Rubber Co. of Pliolite S-I. The product is a synthetic substitute for the prewar natural rubber Pliolite which was produced by Goodyear by a process which preserved the original rubber's inherent characteristics while adding low solution viscosity and rigidity. Pliolite S-1 has generally the same range of usefulness and applications as its natural rubber forerunner. The new product was even superior in some respects to the prewar natural rubber product. Potential postwar uses include golf ball covers, safety and football helmets, moisture-proof coating for paper, and an alkali- and water-resistant vehicle for paints.

CLEANING COMPOUND

A simple dip or spraying of the work with Cyclodiene hydrocarbon solvent, recently announced by Technical Process Div., Colonial Alloys Co., Philadelphia, Pa., should economically remove the oil and dye, and leave clean metal surfaces. Cyclodiene can be handled in ordinary open tanks or spray machines at room temperature. Toxicity may be said to be negligible. Since Cyclodiene is tested neutral, and shows no signs of hydrochloric, oxalic, nitric or sulphuric acids, or cyanides, it is safe to use with all metals including the aluminum and magnesium. The solvent recovery rate is high, and so the solutions may be used over and over again. This results in a low per gallon cost for cleaning. Magnafluxed parts thus cleaned are soon thereafter ready for such operaions in surface finishing as rust-proofing, painting or other organic or chemical finishing, electroplating or anodizing.

DEGREASING SOLVENT

The self-emulsifying degreasing solvent, Gunk Concentrate P-96, is a versatile concentrate base which, when properly diluted forms the basis of several different cleaning solvents. It is made by the Curran Corp., Malden, Mass. This alkylphenolic compound does not give off toxic vapors and is non-explosive.

INSECTICIDE-FUNGICIDE

A new chemical compound which is sprayed on the ground and absorbed by food-producing plants to render them immune both to insect and fungi destruction, has been shown to increase potato crops as much as 25 to 100 bu. per acre, it was announced by Rohm and Haas, Philadelphia, Pa. The plant inocculation possibilities of the new synthetic, known professionlly as diethylene-sodium-misdithiocarbamate and familiarly as Dithane, were discovered by accident, and later tests proved it to be fatal to both chewing and sucking insects but harmless to plants and non-toxic to man.

In recent field tests in Florida and Texas, Dithane has not only proved deadly to such fungi menaces as late blight which swept many food-producing areas of the South this spring, but also made possible potato yields running from 25 to 100 bu. more per acre than plots sprayed with conventional fungicides. Further proof of this chemical's remarkable powers is revealed by the fact that it not only acts as a repellent to certain insects—unlike such standard fungicides as bordeaux mixture which actually builds up aphid infestations—but actually kills them. The serum-like effect of the chemical was discovered after unsuccessful attempts to grow beetles on a plot which had been sprayed with the experimental "fungicide." It will not be available for several months.

INSECTICIDES

Synthetic organic compounds, carrying such forbidding chemical names as beta-beta-dithiocyano diethyl ether and beta butoxy beta thiocyano ethyl ether have been designed to replace the dangerous and highly toxic stomach poisons, lead and calcium arsenate. One compound still in early stages of development by

Rohm and Haas, Philadelphia, Pa., holds great promise of eventually replacing dangerous arsenic. Other synthetics, among them one known as H-264, are proving deadly to the destructive Mexican bean beetle and may eventually replace a large tonnage of rotenone roots, imported from East Indian territories now under Japanese control.

ANTI-AGING MATERIALS

Investigation of a number of materials having age-resisting properties in natural rubber indicates that diphenyl ethylene diamine, Stabilite, is outstanding in protecting vulcanized GR-S against the changes brought about by heat, according to George M. Massie, Harrison & Morton Laboratories, Cuyahoga Falls, Ohio, and A. E. Warner, the C. P. Hall Co., Akron, before a recent meeting of the Rubber Division, A.C.S.

CAMOUFLAGE ENAMEL

Packed cans which must be coated with camouflage enamel will meet the finishing requirements of Army specification No. CQD 200A when finished with A&W No. 471-15 camouflage enamel, according to Ault & Wiborg Division of Interchemical Corp., New York, N. Y. This new finish, which protects cans from corrosion and prevents visibility from the air, may be applied either by spraying or by dipping. It air-dries in 8 to 10 min., and if air heated to approximately 175 deg. F. is caused to flow over the cans as they come out of the dip tank or spray booth, drying time is cut to 3–5 min. It is said to have excellent adhesion and will not chip off and fall into the contents of the can when opened.

NON-SKID WALKWAY COATING

Non-Skid walkway coating known as Flight Floor has been developed in the laboratory of the Glenn L. Martin Co., Baltimore, Md. The new coating weighs only 47.5 grams per sq.ft. against 232.1 grams for the rubber matting previously used. It is applied at room temperature with an open-nozzle paint spray gun and is easily repaired in the field. Its principal ingredients are ground cork and Thiokol synthetic rubber. Flight Floor is tailor made to meet a specific need of the aircraft industry, namely, a non-skid surfacing material for floors and walkways that stand up under hard wartime usage. Other properties desired in the new material include adhesion to metal, plywood and painted surfaces; flexibility and resiliency at temperatures from −20 deg. F. to +160 deg. F.; fire resistance; resistance to gasoline, aromatic fuel, oil, de-icer and hydraulic fluids, salt water and oxidation; and easy repair in the field. The material dries rapidly and panels coated with it may be stacked on end after two hours drying and a light dusting of talc.

INSULATING WINDOW

Freedom from condensation and frosting during the winter, conservation of heating fuel, insulation against heat, cold and street noises all the year round are promised to home owners in all kinds of buildings by Thermopane, the insulating window glass developed by Libbey-Owens-Ford Glass Co., Toledo, Ohio. Since each glazing units consists of two panes of polished plate glass which form an insulating sandwich with a "dehydrated air space hermetically sealed in by a special metal-to-glass bond around the edges of the glass," it will come precut to any given window dimension up to 8x5 ft. Over-all thickness of residential glazing is $\frac{9}{16}$ in., which includes an air space of $\frac{3}{16}$ in. Strength of the adhesion of the metal bond to glass is over 1,000 psi.

RUBBER PIGMENT

The new reinforcing grade of precipitated calcium carbonate especially adapted to use in GR-S stocks is known as Witcarb R, and has been developed by Witco Chemical Co., New York 17, N. Y. This pigment of ultra fine particle size has exceptional reinforcing properties when used in natural rubber, reclaim and all types of synthetic rubbers. It is said to produce exceptional tensile strength, tear resistance and flex cracking resistance in GR-S. In addition it gives stocks of relatively low hardness and modulus even at high loading.

FUEL TABLET

A new type of fuel tablet for heating the meat components of combat rations or heating water in a canteen cup in the field for coffee or cocoa has been developed by the Quartermaster Corps in collaboration with the Office of Scientific Research and Development, the War Department has announced. The tablet is a synthetic compound known as trioxane with a binder to hold it in solid form when burning and coloring matter to distinguish it as non-edible. It has several advantages over the previously developed square candle, made principally of paraffin, such as a fast rate of heating, light weight, compactness and a blue flame of low luminosity. The tablets are flat, weigh slightly more than one ounce, and each will heat an individual meal from the "C" or "K" combat rations in 6 or 7 min. The new fuel is substantially free from smoke-producing ingredients and will not smudge the bottom of the vessel being heated. It is packed in a moisture-proof foil envelope and may be burned in a small trench or behind a small shield to protect the flame from wind.

LACQUER FROM SOYBEANS

A new synthetic lacquer derived from soybeans promises to be cheaper and better than most materials now used in coatings for papers, films and foils, as heat-sealing and laminating agents and as protective dipcoatings. Norelac is an ethylene diamide polyamide. It was developed by the Northern Regional Research Laboratory of the U. S. Department of Agriculture, Peoria, Ill. The new material is thermoplastic, gives an excellent heat-seal, and has excellent resistance to moisture penetration. It is grease proof, resistant to alkalis and acids, highly adhesive and cohesive, transparent, rapid drying and retains flexibility at low temperature.

FIRE RESISTANT NITROCELLULOSE

The first step towards successful production of a practical flame-resistant nitrocellulose composition has been made in Hercules Powder Co.'s (Wilmington, Del.) laboratories, according to a report made available to industry by the company's Cellulose Products Department.

The report describes the results obtained from varying the proportions of tricresyl phosphate and magnesium ammonium phosphate in a nitrocellulose formulation, and furnishes other technical information. A good moldable flame-proof plastic was obtained when the nitrocellulose : tricresyl phosphate ratio was held constant at 30 : 40 and the magnesium ammonium phosphate was varied from 30 to 60 parts.

A flame-resistant nitrocellulose composition has long been desired by industry and it is hoped that the results recently obtained in Hercules laboratories may aid in the solution of some practical problems, which when coupled with nitrocellulose's low cost may have particular significance in postwar developments.

The company emphasizes that the data outlined are of a very preliminary nature and that they have been made available in order that the suggestions in them might be used as a basis for further experimental work in industries such as lacquer, plastics, coated textiles and any other similar industries.

POST-FORMING LAMINATE

The newly developed post-forming material, Panelyte Grade 906, is supplied as a fully cured laminated thermosetting sheet that can be stamped, bent, and drawn in a process similar to that used in metal stamping. However, the processing is greatly simplified over metal working in that molds of Kirksite, cast phenolic, or wood may be used.

The working of the sheet is accomplished by heating the material to temperatures higher than those used in manufacture. It is not necessary to use hot molds, but merely to heat the material, mold it, and leave it for a very short period in the mold for partial cooling.

Durable laminated phenolic parts having compound curvatures and fairly sharp bends can be made from Grade 906. Bends having inside radius of the thickness of the material are very practical. High pressures are not required. Small air cylinders are very suitable, and in some cases, even hand presses will suffice. The process is fast and economical. Panelyte Grade 906 opens up entirely new fields in plastic fabrication, according to the Panelyte Division of St. Regis Paper Co., New York, N. Y.

CATTLE FEED COMPOUND

A raw material containing urea, designed especially to supply some of the crude protein equivalent in mixed feeds for cattle and sheep, is now being allocated to feed manufacturers, the E. I. duPont de Nemours Co., Wilmington, Del., has announced. This new product, which has been given the name Two-Sixty-Two Feed Compound, can effectively replace part of the hard-to-get protein supplements, such as linseed meal, in the ration of ruminants. In fact, the War Production Board has for some months been allocating crystal urea to manufacturers for inclusion in their feeds for ruminants, this aiding considerably in

Questions we are often asked

ABOUT GLASS-LINED STEEL

How does the resistivity of Pfaudler glass-lined steel compare with other materials of construction?

The table of resistivities reproduced below is a tabulation from a comprehensive paper "Materials of Construction." If you are working with corrosive products or reagents, you will find it helpful. George F. Kroha, Vice-President in Charge of Sales.

In order that you may have a clear picture of the resistivity of materials of construction normally used for process equipment, we prepared the table below which gives the comparison with glass-lined steel at a glance.

You will note that we list four glasses. Nos. 42 and 24 are resistant to all acids (except hydrofluoric and commercial phosphoric, containing fluorides as impurities) at all concentrations and temperatures. They are spark tested with high voltages . . . a method Pfaudler has developed to make sure that there are no imperfections in the glass surfaces of equipment for highly corrosive work. Nos 48 and 27 glasses are acid resistant but are not designed for the heavy duty services that Nos. 42 and 24 are.

This range of glasses is sufficiently broad to give you exactly the type of glass that is best suited to your operating conditions.

In describing our glasses as "resistant", "fairly resistant" or "non-resistant," we have set ourselves very rigid standards. We do not qualify our claims in any way. If the glasses are "fairly resistant" they are immediately placed in the non-resistant class. When we class our glasses as "resistant," you can depend on it—they are!

Copies of this Resistivity Table in letterhead size are available upon request.

TABLE No. 1—RESISTIVITIES

				PFAUDLER GLASS LININGS				OTHER MATERIALS													
TYPICAL SERVICE CONDITIONS		% by Wt.	PH Value	42	24	48	27	Nickel	Monel	Inconel	Aluminum	Copper	Durichlor	Hastelloy A, B, C, & D	Karbate No. 2	Haveg	Lead	Rubber	304 Stainless	316 Stainless	347 Stainless
HCl	Hydrochloric Acid	Conc. 33.0% 22° Be.	—	R*	R*	NR	NR	NR	NR	NR	NR	NR	R†	A group of nickel- molybdenum -iron alloys in varying composition which provide remarkable resistance to hydrochloric acid, wet chlorine, sulfuric, phosphoric and other acids; ideal for accessories in difficult service; see page 9.	R*	R	NR	—	NR	NR	NR
HCl	Hydrochloric Acid	N 3.58%	0.1	R*	R*	NR	NR	R	R	NR	NR	NR	R†		R*	R	NR	R	NR	NR	NR
HCl	Hydrochloric Acid	N/10 0.36%	1.0	R*	R*	NR	NR	R	R	R	NR	NR	R†		R*	R	NR	R	NR	NR	NR
HCl	Hydrochloric Acid	N/100 0.036%	2.0	R*	R*	NR	NR	R	R	R	NR	NR	R†		R*	R	NR	R	NR	NR	NR
H_2SO_4	Sulphuric Acid	Conc. 77.0% 60° Be.	0.2	R*	R*	NR	NR	NR	NR	NR	NR	NR	R**		R*	NR	R	—	NR	R*	NR
H_2SO_4	Sulphuric Acid	N 4.75%	0.3	R*	R*	NR	NR	R	R	R	NR	R	R**		R*	R	R	R	NR	R	NR
H_2SO_4	Sulphuric Acid	N/10 0.49%	1.2	R*	R*	NR	NR	R	R	R	NR	R	R**		R	R	R	R	R	R*	R
H_2SO_4	Sulphuric Acid	N/100 0.049%	2.1	R*	R*	NR	NR	R	R	R	NR	R	R**		R	R	R	R	R	R*	R
HNO_3	Nitric Acid	Conc. 60.0% 40° Be.	0.03	R*	R*	NR	NR	NR	NR	NR	R	NR	R**		NR	NR	NR	—	R*	R*	R*
HNO_3	Nitric Acid	N 6.30%	1.0	R*	R*	NR	NR	NR	NR	R	R	NR	R**		NR	NR	NR	—	R*	R*	R*
HNO_3	Nitric Acid	N/10 .63%	2.0	R*	R*	NR	NR	NR	NR	R	R	NR	R**		NR	NR	NR	—	R*	R*	R*
H_3PO_4	Phosphoric Acid	N 3.30%	2.0	R*	R*	R	NR	R	R*	R	NR	R	R**		R	R	R	R	—	—	—
H_3PO_4	Phosphoric Acid	N/10 0.33%	1.5	R*	R*	R	NR	R	R*	R	NR	R	R**		R	R	R	R	—	—	—
CH_3COOH	Acetic Acid	N 5.96%	2.4	R*	R*	R	NR	R	R	R	R	R	R**		R*	R	NR	R	R*	R*	R*
CH_3COOH	Acetic Acid	N/10 0.60%	2.9	R*	R*	R	R	R*	R*	R*	R	R	R**		R*	R	NR	R	R*	R*	R*
CH_3COOH	Acetic Acid	N/100 0.060%	3.4	R*	R*	R*‡	R	R*	R*	R*	R	R	R**		R*	R	NR	R	R*	R*	R*
$C_2H_2(OH)_2(COOH)_2$	Tartaric Acid	N/10 0.75%	2.2	R*	R*	R*‡	R	R*	R*	R*	NR	R	NR		R*	R	—	—	R*	R*	R*
$COOHCH_2CH(OH)COOH$	Malic Acid	N/10 0.67%	2.2	R*	R*	R*‡	R	R*	R*	R*	NR	R	NR		—	R	—	—	R*	R*	R*
$C_3H_4(OH)(COOH)_3H_2O$	Citric Acid	N/10 0.64%	2.2	R*	R*	R*‡	R	R*	R*	R*	NR	R	NR		R*	R	—	—	R*	R*	R*
$CH_3CHOHCOOH$	Lactic Acid	N/10 0.90%	2.4	R*	R*	R*‡	R	R*	R*	R*	NR	R	NR		R*	R	—	—	R*	R*	R*
$NaHCO_3$	Sod. Bicarbonate	N/10 0.84%	8.4	R	R	R	R	R*	R*	R*	NR	NR	NR		—	R	R	—	R*	R*	R
Na_2CO_3	Sod. Carbonate	N/10 0.53%	11.6	R	R	R	R	R*	R*	R*	NR	NR	NR		—	R	R	—	R*	R*	R
NH_4OH	Am, Hydroxide	N/10 0.35%	11.1	R	R	R	R	R	R*	R*	NR	NR	NR		R	R	R	—	R*	R*	R
NaOH	Sod. Hydroxide	N/10 0.40%	13.0	NR	NR	NR	NR	R*	R*	R*	NR	NR	NR		—	R	NR	—	R*	R*	R
KOH	Pot. Hydroxide	N/10 0.56%	13.0	NR	NR	NR	NR	R*	R*	R*	NR	NR	NR		—	R	NR	—	R*	R*	R
$Na_3PO_4 \cdot 12H_2O$	Trisod. Phosphate	N/10 1.27%	12.0	NR	NR	NR	NR	—	—	—	NR	NR	—		—	—	NR	—	—	—	—
			COMPOSITION ▸	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]

— NOTE —
R —Resistant at Room Temperature.
R* —Resistant at Boiling Point.
R† —Resistant up to boiling point, providing ferric chloride content is low.
R**—Durimet is recommended in preference to Durichlor.
NR —Not Resistant.
R*‡—48T Glass, suitable for certain service at elevated temperatures.
These resistivity ratings do not make allowance (except in the case of Pfaudler glass where it is no problem) for the possible effects of turbulence and aeration which may break down protective, corrosion-product layers or otherwise accelerate corrosion; nor for the effect of impurities or corrosive additives. However, the rating on lead for phosphoric acid assumes commercial quality phosphoric; C.P. phosphoric attacks lead.

THE PFAUDLER CO., ROCHE
Revised 2-10-44

the solution of the critical wartime feed problems created by acute shortages of the usual protein supplements.

Numerous experiments as well as practical feeding experience have demonstrated the efficiency of urea for this purpose. Because crystal urea tends to take up moisture and subsequently dry out into a hard mass, difficult to handle, the du Pont Ammonia Department has conducted considerable research in its own laboratories to develop a special free-flowing urea-base feed compound for exclusive use in feeds for ruminants.

Two-Sixty-Two feed compound gets its name from the fact that it supplies 26 percent crude protein equivalent. Every pound therefore has nitrogen equivalent to a 2.62 lb. of crude protein. The new feed compound has a light gray color and free-flowing characteristics. It is therefore easy to handle and mix with other feed ingredients.

ALLYL RESIN MONOMERS

The complete line of allyl resin monomers formerly known as Columbia resins and designated as C.R. 39, etc., has been given the trade name Allymer. The numbers such as 39 and 149 will be continued to designate types.

ADHESIVE FOR CONTAINERS

Last fall E. I. du Pont de Nemours & Co. introduced adhesive 77 for the production of weather-proof paperboard shipping containers that stood up under the Army practice of floating materials into beachheads. Now the same company has developed a companion adhesive that reduces the box-maker's operative costs. It is listed as Du Pont adhesive 78 and is said to contain all the qualities of the water-soluble vinyl resin glue introduced last year. Board made with the new adhesive meets the rigid government specifications for water-proof shipping containers. The new material is stable, dry white powder that can be simply prepared in standard mixing equipment.

PLASTIC SHEETING

A three-ply laminated plastics sheeting designed to give added protection to American airmen flying in pressurized high-altitude planes has been announced by E. I. du Pont de Nemours & Co., Wilmington, Del. The sheeting reduces the possibilities of disintegration of clear plastic canopies when pierced by bullets or flak while flying at high speeds under pressurized conditions. Called laminated Lucite-Butacite, it consists of a single layer of Butacite polyvinyl butyral resin sandwiched between two layers of Lucite methyl methacrylate resin. An important part of the problem was the development of a special adhesive to accomplish the lamination.

Tests conducted by both the Army and the Navy show that, under certain conditions, the new laminate has a self-sealing tendency in that holes created by bullet penetration close up almost completely because of the rubber-like nature of the Butacite interlayer sheeting. The weight per square foot of the laminate is less than that of equivalent thicknesses of solid acrylics now being used.

after 300 million years

of darkness...

Phosphorus and Related Products

By the World's Largest Producer of Elemental Phosphorus

PHOSPHORUS (YELLOW)
PHOSPHORIC ANHYDRIDE
PHOSPHORIC ACID—TETRA
PHOSPHORIC ACID—85%
PHOSPHORIC ACID—75%
MONO SODIUM PHOSPHATE
DI SODIUM PHOSPHATE (ANHYDROUS AND DUOHYDRATE)
TRI SODIUM PHOSPHATE
SODIUM ACID PYRO PHOSPHATE
TETRA SODIUM PYRO PHOSPHATE
AMMONIUM PHOSPHATES
CALCIUM PHOSPHATES (MONO-DI-TRI)
CALCIUM PYRO PHOSPHATE
POTASSIUM PHOSPHATES
MAGNESIUM PHOSPHATES
SODIUM IRON PYROPHATE
FERRO PHOSPHORUS
SPECIAL PHOSPHATES FOR SPECIAL APPLICATIONS

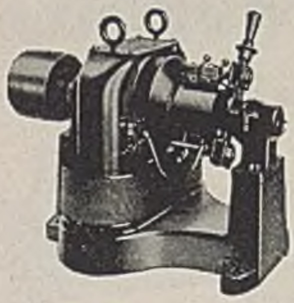
Within reddish-brown material, mined from Tennessee's Bixby limestone, is a light that began 300 million years ago. The material is phosphate matrix, formed of shells and of phosphorescent marine life in tropical seas of a younger world.

Today, that long-imprisoned light glows in the elemental phosphorus that Monsanto's giant electric furnaces extract from matrix.

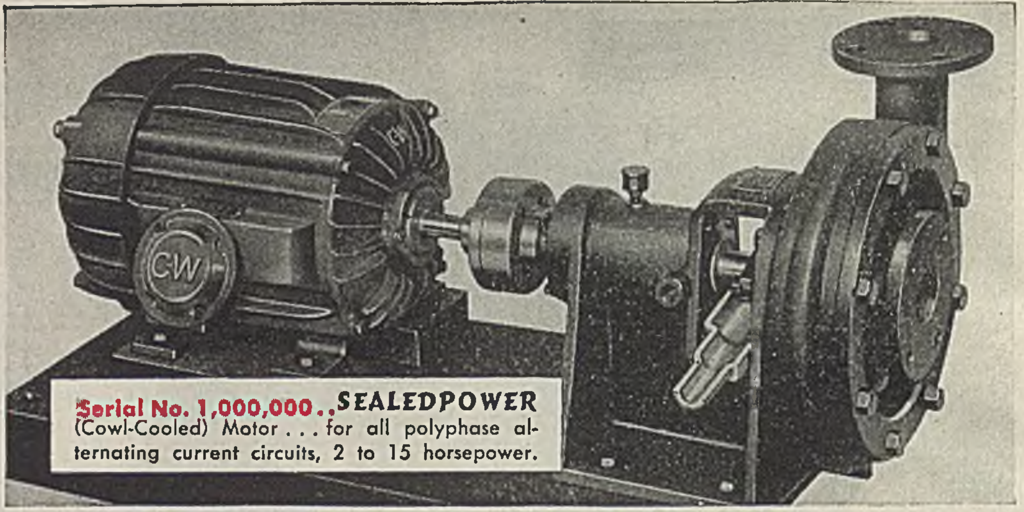
Monsanto elemental phosphorus is rendering a brilliant service with Allied Armed forces. Along with products derived from it, the element phosphorus shines as a servant of both the home front and war industries.

Monsanto Phosphoric acids and phosphates are uniformly high in quality because they are derived from elemental phosphorus of nearly absolute purity. Quality is the reason so many industries consider Monsanto to be headquarters for phosphorus, phosphoric acids and phosphates. Your inquiries will receive prompt attention. MONSANTO CHEMICAL COMPANY, Phosphate Division, 1700 South Second Street, St. Louis 4, Mo. District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Montreal, Toronto.

MONSANTO CHEMICALS
SERVING INDUSTRY...WHICH SERVES MANKIND



Serial No. 1 Crocker-Wheeler Motor, built in 1888.



Serial No. 1,000,000..SEALEDPOWER (Cowl-Cooled) Motor . . . for all polyphase alternating current circuits, 2 to 15 horsepower.

SEALEDPOWER

Industry's Most Trouble-Free Motor

PRODUCED BY CROCKER-WHEELER'S 56 YEARS OF EXPERIENCE

CROCKER-WHEELER FEATURES:

1. Patented "Groovseal"—no greasing needed for at least a year. Grooves minimize grease loss. This seal makes bearing maintenance expense negligible. It permits use of softer grease, for better lubrication and longer bearing life. Airtight seal prevents dust or other foreign matter from entering bearings.

2. Crocker-Wheeler's exclusive De-Sludging Impeller. Automatically desludges . . . churns and distributes grease to bearings when motor is started.

3. Vacuum Impregnation—standard on *all* Crocker-Wheeler motors. Seals out foreign matter and moisture from each individual coil . . . fills all interstices, making windings a homogeneous mass . . . reduces hot-spot temperature and lengthens insulation life. Adherence of varnish prevents vibration of wires either inside or outside of slot. (Photograph shows cross sections of baseballs, (left) after vacuum impregnation and (right) before vacuum impregnation. Note penetration of varnish to center of tightly-wound ball, making it a moisture-proof, homogeneous mass.)

SEALEDPOWER FEATURES:

4. Totally Enclosed Cowl-Cooled Construction resists corrosion. Protects against acid or alkali fumes, splashing or dripping liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, etc.

5. Fin Type Construction for non-clog ventilation and easy cleaning.

WRITE FOR LITERATURE ON THE **SEALEDPOWER** MOTOR, WHICH IS WINNING THE PREFERENCE OF MACHINERY MANUFACTURERS AS WELL AS OF MOTOR USERS. OR CALL OUR NEAREST OFFICE.

JOSHUA HENDY IRON WORKS

CROCKER-WHEELER DIVISION

ESTABLISHED 1856

AMPERE, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON • LOS ANGELES

RUTGERS FORMS COUNCIL TO PROMOTE RESEARCH

Rutgers University has announced the creation of a Research Council to promote research in all departments of the university. A survey is now being made of personnel and facilities to determine where new funds for research can best be invested. The Council consists of nine members from various colleges and departments, including Dr. P. A. van der Meulen, professor of chemistry and James L. Potter, professor of electrical engineering. Dr. William H. Cole, professor of physiology and biochemistry at Rutgers since 1928, has been appointed Director of the Council. He will serve in a staff relationship to deans, department heads and faculty members concerning research programs, and will represent the university in developing reciprocal arrangements with governmental, industrial, business and professional institutions outside of the university.

Four projects in chemistry and three in engineering of immediate value to the war effort are now under way and it is expected that others will be started within the next few months. A special research fund has been placed at the disposal of the Council and applications for grants for next year are now being considered.

FOREMEN COMPLETE SAFETY TRAINING COURSES

Certificates signalizing satisfactory completion of an industrial safety training course were conferred on May 23, upon more than 150 of the approximately 250 foremen who have been attending a safety training course for supervisors conducted by the Greater New York Safety Council. The course, comprising five lecture and discussion periods, was part of the Council's industrial service "Victory Program" designed to aid in conserving manpower for war production.

Throughout the course, foremen, supervisors, and members of employee safety committees from 80 New York industrial plants studied methods of preventing accidents and injuries, of reducing lost time, and of preventing economic loss. Since the forum discussion period following each lecture premitted general discussion of specific safety problems, foremen were able to obtain expert advice in combating situations within their own plants. Present plans contemplate development of subsequent training courses for supervisory employees of other local industrial plants.

CARBON BLACK PROSPECTS FOR RUSSIA AND IRAN

American manufacturers of carbon black, now in extremely short supply, have been asked to consider the construction of carbon black plants in Russia and Iran. The proposal was advanced by H. LeRoy Whitney, technical adviser to Donald M. Nelson, WPB Chairman, at a meeting of the industry advisory committee.

Mr. Whitney pointed out that there are large untapped supplies of natural gas, from which carbon black is made, both in Russia and at the head of the Persian Gulf. Transportation facilities are available, as well, he said. After officials of WPB's Chemicals Bureau at the meeting had emphasized the importance of additional production and new manufacturing facilities, members of the committee agreed to explore the possibilities of meeting the expanding program.

Chemicals Bureau officials said they expect to attain the anticipated 1944 goal of 1,300,000 lb. of carbon black, of which 700,000,000 lb. would be channel black and 600,000,000 lb. furnace black. This, they asserted, should be sufficient to meet the requirements of the military and civilian tire programs this year.

CANADA TESTS PROCESS FOR CARBONIZING COAL

New process for manufacture of gasoline from coal is to be tested by the Research Council of Alberta, Canada. Dr. E. H. Boomer, member of the technical advisory committee to the council and professor of chemical engineering in the department of chemistry at the University of Alberta, will inspect work in progress at the U. S. Bureau of Mines laboratories in Pittsburgh. This is to enable him to plan details of the work to be done at the university.

The appropriation of $60,810 for the Research Council, passed at the last session of the Legislature, includes a sum for work on the new process, to be carried out in cooperation with the U. S. Bureau of Mines. The new process does not involve high capital outlay. Almost any Alberta coal could be used for this purpose, it was said. As to carbonization, it is stated that large and small tests have been made in Ottawa with high and low temperature carbonization, and small-scale tests have been made here.

ALLIED CHEMICAL & DYE TO CONTINUE FELLOWSHIPS

Announcement has been made by Allied Chemical & Dye Corp. that it will continue its graduate fellowships plan in universities and colleges during the academic year 1944–45. Although registration in graduate schools is at present below peacetime level, the company believes that availability of these fellowships will make possible additional research studies of war importance originating at the schools and at the same time will aid outstanding graduate students to complete their work for the Ph.D. degree. Nominations of fellows and selection of research subjects are made by the schools; any subject may be chosen which is expected to prove suitable for a Ph.D. thesis. Stipend of each fellowship is $750.

ACTIVE CALL FOR SPACE AT CHICAGO CHEMICAL SHOW

The Third National Chemical Exposition to be held Nov. 15 to 19 at the Coliseum in Chicago will not only stress the importance of the chemical industry in the war effort but will reveal much that is planned for the postwar-era, according to its sponsor, the Chicago Section of the American Chemical Society. M. H. Arveson, chairman of the show committee, announces that space is already about gone. Despite the fact that more than twice the area of the two preceding expositions has been made available for exhibitors, there is early indication, he says, that some late applicants may not be accommodated.

The management has succeeded in leasing the South Annex of the Coliseum and hopes also to acquire the North Hall but even with this additional space the show seems destined to have a waiting list of applicants.

An important feature of the show again this year will be the National Industrial Chemical Conference. Noted authorities on virtually all phases of pure and applied chemistry will appear on the program at the various sessions to be held during the five-day period.

DR. GUSTAV EGLOFF HEADS INSTITUTE OF CHEMISTS

At the annual meeting of the American Institute of Chemists, held in New York last month, Dr. Gustav Egloff was reelected president. Other officers elected were Dr. Donald Price, vice president; Dr. Frederick A. Hessel, treasurer; and Howard S. Neiman, secretary. A symposium preceded the election at which Dr. Egloff reported on activities in the past year and announced plans for the coming year. The following were selected as councilors at large of the Institute: Donald H. Andrews, F. G. Breyer, Stuart R. Brinkley, Harry L. Fisher, Donalf B. Keyes, Raymond E. Kirk, Frank O. Lundstrom, Robert J. Moore, Foster D. Snell, and W. D. Turner.

PAPER INTERESTS SPONSOR WASTE DISPOSAL STUDY

The National Council for Stream Improvement has established an industrial fellowship in Mellon Institute. The research program will be concerned with developing methods for the disposal and utilization of wastes from the manufacture of pulp, paper and paperboard. The Council, which was formed recently, has offices at 271 Madison Ave., New York, and is supported by contributions from pulp, paper and paperboard manufacturers. Officers are George E. Dyke, president of Robert Gair Co., chairman of board of governors; J. D. Zink, president, Strathmore Paper Co., treasurer; Russel L. Winget, executive secretary; and Dr. Harry W. Gehm, technical supervisor.

ALIEN PROPERTY CUSTODIAN TAKES GERMAN STOCKS

The Alien Property Custodian last month issued an order demanding the surrenders by the Standard Oil Co. of New Jersey of 20 percent of the outstanding stock of the Standard Catalytic Co., 50 percent of the outstanding stock of Jasco, Inc., and 25 percent of the outstanding stock of the Hydrocarbon Synthesis. These securities were formerly the property of I. G. Farbenindustrie A.G. The three American corporations were organized to operate in the United States certain patent pooling arrangements sponsored jointly by the Standard Oil Co. and I. G. Farben. The order applied also to approximately 675 patents and about 100 applications for patents.

The interest of I. G. Farben in both the patents and the shares was vested in the Alien Property Custodian March 25, 1942. The pooling arrangements were declared illegal in the consent decree entered March 25, 1942.

The ownership of the stock and these patents has been the subject of a series of conferences, now concluded, between the Custodian and officials of the Standard Oil Company. After giving full consideration to the claims of the Standard Oil Company that it was the owner of the patents and shares of stock, the Custodian has concluded that his vesting of the interest of I. G. Farben in the patents and shares took full and complete title because I. G. Farben owned them at the time of the vesting.

TIMKEN FORMS COMPANY TO OPERATE IN SOUTH AMERICA

In connection with its forward planning, the Timken Roller Bearing Co., Canton, Ohio, has organized a subsidiary, The Timken Roller Bearing Co. of South America which, after the war, will service and handle engineering development of the company's products in the Latin-American countries. Headquarters will be in Sao Paulo, Brazil, and Jules A. Morland, former New York representative, will act as manager. Mr. Morland is now in Sao Paulo and recently wrote that industrial machinery manufacturing got a good start in Brazil about five years ago and due to import restrictions the new companies have forged ahead at a rapid rate.

As part of its organization program, the Timken company has two young Brazilian engineers in its Canton plant where they are learning about engineering production and application of the company's products. Later they will spend some time in the Mt. Vernon plant and upon their return to South America will serve as field engineers and general representatives for the company.

RESEARCH EXECUTIVES MEET IN PITTSBURGH

The Industrial Research Institute held its sixth annual meeting May 19-20 at the Roosevelt Hotel, Pittsburgh. A large group of research executives was in attendance. Harold K. Work, manager of research and development, Jones & Loughlin Steel Corp., was elected chairman for the ensuing year. John M. McIlvain, administrative supervisor, research and development department, the Atlantic Refining Co., was elected vice chairman and Charles S. Venable, director of chemical research, American Viscose Corp., and Harry M. Williams, vice president, The National Cash Register Co., were elected to the executive committee. It was announced that the fall meeting of the Institute will be held in late September.

TEXTILE RESEARCH GROUPS COORDINATE INTERESTS

An understanding has been reached, by representatives of the American Association of Textile Chemists and Colorists and of the Textile Research Institute, to avoid duplication of effort by discussing with one another new research projects to determine any possible interference.

The Textile Research Institute proposes to undertake research work, both fundamental and applied, on all phases of textile manufacture. The American Association of Textile Chemists and Colorists is primarily concerned with the wet processing of textiles and is preeminent in the development of standard test methods for the use of the textile chemist, dyer, colorist, finisher, converter and consumer of textiles. The two organizations have a common interest in the promotion of knowledge of textiles through research but their programs do not overlap and through voluntary coordination will avoid any possibility of duplication.

CONVENTION CALENDAR

National Fertilizer Association, annual meeting, Biltmore Hotel, Atlanta, Ga., June 20–21.

American Society for Testing Materials, annual meeting, Waldorf-Astoria Hotel, New York, N. Y., June 26–30.

American Chemical Society, 108th meeting, New York, N. Y., Sept. 11–15.

American Association for the Advancement of Science, Cleveland, Ohio, Sept. 11–16.

Electrochemical Society, Inc., fall meeting, Hotel Statler, Buffalo, N. Y., Oct. 13–14.

Third National Chemical Exposition, Chicago Coliseum, Chicago, Ill., Nov. 5–19.

SUPERPHOSPHATE OUTPUT SET AT RECORD LEVEL

The Chemicals Bureau of WPB has recognized a tentative production goal of 9,464,000 tons of normal superphosphate for the agricultural year beginning July, 1944, to keep pace with the increased demand for fertilizer required for expanded food and fiber programs. The production goal for 1943-44, which was set at 7,000,000 tons of normal superphosphate, is expected to be met.

New plants, most of which have already been approved, are expected to produce 650,000 tons of the 1944-45 total of normal superphosphate, and existing plants will be asked to step up output during the coming year by an average increase of 28 percent, to be attained by the elimination of bottlenecks and increased efficiency of plant operation. Thus, with the new production and increased output in existing plants, it is hoped that the peak goal of 9,464,000 tons will be realized.

Limiting factors in attaining the goal are provision of raw materials—phosphate rock and sulphuric acid—and manpower necessary to convert the raw materials into finished superphosphate. Supplies of spent acid for superphosphate production will be greater this year, as a result of increased output from government facilities. WPB said. Approximately 207,000 tons, basis 100 percent, were made available to the superphosphate industry last year, from government facilities, as contrasted with the 309,000 tons anticipated for next year.

NEW YORK INDUSTRY AIDS IN WAR LOAN DRIVE

The director of the commerce and industry division of the War Finance Committee for New York, William E. Cotter, has announced that more than 275 of New York's key industries are participating in the drive on the 30,000 business houses and corporations in the city from which the U. S. Treasury must receive more than $3,000,000,000 during the Fifth War Loan which started on June 12. Walter S. Gifford, president American Telephone & Telegraph Co. is chairman of the advisory committee of which Benjamin O'Shea, president of Union Carbide and Carbon Corp., is a member. Committees from various branches of the chemical industry also have been formed.

MANUFACTURING CHEMISTS REELECT OFFICERS

At the 72nd annual meeting of the Manufacturing Chemists' Association, held at the Waldorf-Astoria Hotel, New York, on June 2, all officers were reelected for another year. Harry L. Derby, president of American Cyanamid & Chemical Corp., will serve in a similar capacity for the Association and Lammot du Pont, chairman of E. I. du Pont de Nemours & Co., Inc., will continue as chairman of the executive committee.

Other officers reelected for the coming year were George W. Merck, Merck & Co., and Charles Belknap, Monsanto Chemical Co., vice presidents; J. W. McLaughlin, Carbide & Carbon Chemicals Corp., treasurer; and Warren N. Watson, secretary.

SCARCITY OF CHEMICALS IN PRINTING INK FIELD

The special problems confronting printing ink manufacturers as a result of chemicals shortages, which have become more serious in recent weeks, are being given careful consideration by officials of the Chemicals Bureau. Officials informed the industry committee that although the situation regarding chrome pigments was very difficult, the government hopes to maintain present quotas through the summer—which represents the danger point from the standpoint of relative supply.

In order to provide officials with information on which to base their controls, some members of the committee who have special problems owing to the shortage of synthetic resins—both alkyds and maleics—agreed to inform the Chemicals Bureau immediately regarding the precise nature of their difficulties.

Officials informed the committee that there was little change in the supply picture as to organic and titanium pigments. With nearly all the phthalic anhydride going to the military, the officials informed the committee that the supply of certain colors will inevitably be affected, especially phloxine toners, rhodamines, madder lake and phloxine pigments. Seventy-five percent of the titanium pigments are now going to the military, the committee was informed.

Members of the committee reported that as a result of the synthetic resins shortages they have greatly increased their consumption of rosin since the start of the war and that they are now encountering supply difficulties as a result of the labor shortage in the naval stores industry in the south.

RULES FOR FLUORINE RESIDUE ON FRUIT

A public hearing was scheduled to begin on June 27 to consider proposed regulations of Food and Drug Administration regarding the quantity of fluorine which may remain as an insecticide residue on apples and pears. Those desiring to appear had to be prepared to participate in the formal proceedings in the same manner as though this were an action leading to a food standard. Appearance can be by personal testimony or by affidavit.

Primarily, the plan was to secure factual evidence and competent, expert opinion regarding the number of milligrams of fluorine which can properly remain per kilogram of such fruit as marketed in interstate commerce.

U. S. RUBBER BUILDING NEW LABORATORY

Coinciding with a general expansion program designed to double production capacity of U. S. Rubber Co.'s Los Angeles, Calif., plant, a new control and development laboratory costing $20,000 is under construction and will be completed by August. Analytical and testing units once scattered throughout the plant will be integrated in the new building and the present staff, which includes 128 chemists, specialists and development engineers, will be enlarged.

APPROPRIATION FOR WORK ON SYNTHETIC LIQUID FUELS

The Senate has passed the appropriation bill for Department of Interior funds, including a large sum for the Bureau of Mines to start its investigations of synthetic liquid fuels. As adopted by the Senate, a total of $30,000,000 is provided for this purpose. Of this, $8,000,000 is definitely appropriated for use on contracts that will be completed or well under way during the 1944-45 fiscal year. The remaining $22,000,000 is authorized in a manner to permit contracts within the fiscal year for which payments will not be required until after July 1, 1945. The Bureau plans are going ahead immediately. It will expand its small-scale research at Pittsburgh, and it will complete plans and build larger experimental facilities at Bruceton, near Pittsburgh.

Three plants for demonstration purposes may be designed in the first fiscal year if the Bureau can work that fast. One of these probably will be a coal processing plant in the east. One will almost certainly be an oil shale processing plant for Utah or some nearby state. The third plant in the east. One will almost cer- of natural gas or lignite.

LARGER OUTPUT OF SOME PIGMENT MATERIALS

Officials of WPB informed the industry committee that some of the materials used in making pigments are increasing in supply. Production of acetoacetanilide which has been turned out at the rate of 60,000 lb. a month is expected to reach an output of 80,000 lb. in July. This material is used in the manufacture of organic yellow pigments and the larger production has come from improvements in method and not from increased plant facilities.

Paratoluidine which is used in the manufacture of red and yellow pigments is now being turned out at the rate of 230,000 lb. a month. As a byproduct orthonitrotoluene is produced. This chemical is used in dyestuffs outside the pigment field and the supply is reported to be excessive to a point where WPB recommends that new uses be developed.

SALES OF CARBON BLACK EXCEED PRODUCTION

Production of carbon black increased 3 percent last year over the 1942 output and sales were 40 percent above the 1942 level. The Bureau of Mines reports production last year at 593,421,000 lb. as compared with 574,006,000 lb. in 1942. The sales figure for 1943 is placed at 629,300,000 lb. as against 449,931,000 lb. for 1942. The 1943 breakdown for sales credits 473,473,000 lb. for rubber, 23,530,000 lb. for ink, 3,945,000 lb. for paint and 128,352,000 lb. for miscellaneous uses.

Expansion in synthetic rubber manufacture, which calls for large amounts of the softer blacks, was reflected in the production of furnace blacks which increased 47 percent over 1942. They comprise 36 per cent of total production compared with 27 percent in 1942 and 17 percent in 1941. 1941.

PLASTICS PRODUCTION AND MATERIALS CONSUMED

At the annual meeting of the Society of the Plastics Industry, one of the most interesting papers was delivered by E. M. Houts, allocation officer of the Chemicals Bureau, WPB. His paper included a statistical summary of the plastics industry for 1943 giving data for production, value of products, and quantities and values of raw materials consumed. The data follow:

Production of Plastics, 1943

	Production (1,000 lb.)	Value ($1,000)
Vinyl resins	86,600	$53,260
Polystyrene	3,500	1,120
Nitrocellulose	85,200	22,150
Ethyl cellulose	3,900	1,600
Acrylic monomer	36,400	46,400
Phthalic alkyd	147,100	44,130
Cellulose acetate	60,200	34,920
Melamine and urea	123,600	44,990
Cellulose viscose	79,400	35,730
Phenol formaldehyde	283,400	68,010
Casein	41,700	10,430
Totals	951,000	$362,740

Raw Materials Consumed in Plastics, 1943

	Consumed (1,000 lb.)	Value ($1,000)
Phenol formaldehyde		
Methanol	83,200	4,160
Formaldehyde	144,400	5,780
Hexamethylenetetramine	6,100	1,710
Benzene	109,500	3,290
Phenol	109,500	12,050
Substituted phenols	4,400	660
Orthocresol	700	80
Meta and para cresols and cresylic acid	17,500	3,150
Cresol and cresylic acid imported	1,800	.....
Casein		
Methanol	760	40
Formaldehyde	1,500	60
Acrylic monomer		
Methanol	22,100	1,110
Phthalic alkyd		
Phthalic anhydride	49,000	6,370
Glycerine	26,400	4,490
Vinyl		
Calcium carbide	109,000	4,910
Methanol	1,600	150
Polystyrene		
Styrene	4,200	1,180
Nitrocellulose		
Chemical cotton pulp	24,600	2,210
Nitric acid	40,900	2,320
Sulphuric acid	19,600	320
Ethylcellulose		
Chemical cotton pulp	41,200	3,710
Ethylene dichloride	11,000	1,870
Caustic soda	3,900	80
Cellulose acetate		
Cellulose acetate	279,400	100,580
Chemical cotton pulp	84,000	7,560
Acetic anhydride	423,600	46,600
Melamine urea		
Methanol	57,500	2,880
Formaldehyde	115,000	4,600
Urea	45,400	1,700
Cellulose viscose		
Chemical cotton pulp	95,200	8,570
Caustic soda	102,100	2,220
Carbon bisulphide	27,800	1,390
Sulphuric acid	143,000	2,350
Glucose	39,700	1,490

CONTINENTAL CAN FORMS PLASTICS DIVISION

The Continental Can Co., Inc., has announced the formation of a plastics division under the supervision of O. G. Jakob. The company has been engaged in the production of Marco-Board, a synthetic resin laminate, since early this year and last month acquired the business and manufacturing facilities of the Reynolds molded plastics division of Reynolds Spring Co., Cambridge, Ohio. The new division of Continental will be located in New York and will comprise a laminated plastics department handling its own product and a molded plastics department handling the products of the newly acquired Cambridge factory.

BRITISH CHEMICAL INDUSTRY INTERESTED IN PLANS FOR EXPANDING POSTWAR EXPORT TRADE

Special Correspondence

There has been some easing of British export control for chemical products recently, but with home market requirements at a high level and the scarcity of shipping continuing, overseas shipments of chemicals are still limited to supplies for essential war purposes, and there is no hope that this position will change materially before the end of the war. Nevertheless the export problem receives considerable attention in the British chemical trades, since the home market cannot be expected to provide adequate outlets for the whole postwar production and Britain's dependence on foreign raw materials makes a satisfactory export business one of the essentials of satisfactory chemical production in general.

Broadly speaking, postwar export prospects are considered good, even though it is not thought that the continental countries of Europe will disappear as competitors from the export markets. Disregarding the possibility of special controls, responsible quarters in the British chemical industry do not think it possible to base any export plans on the expectation that chemical exports from Germany and Japan will be smaller than they were before the war. On the other hand, it is thought that countries which relied on large imports of chemical manufactures will still import considerable quantities of them. Though the Dominions and the South American Republics have greatly extended their production of basic chemicals the tendency towards increased industrialization in these countries should open up a large market for more specialized articles, quite apart from the fact that a large backlog of chemical orders has accumulated in the course of the war years which will provide extra employment immediately after the end of hostilities.

To convert this potential demand into actual business, however, special measures may have to be taken. A more comprehensive and flexible scheme for export credits is believed to be capable of greatly enhancing British export chances in Brazil, Argentina, Australia, India, China and other countries, even if these countries decided to manufacture more basic chemical products. Another means of stimulating exports would be to apply existing scientific and technical manufacturing knowledge to the specific requirements of overseas importing countries and by specialization on refinements and luxuries to balance any fall in the export of more easily manufactured products. British-based research organizations, such as the Imperial Institute and some of the research institutions specializing in certain commodities, should be able to render considerable help. Swift change-over of plant from wartime to peacetime needs should help to provide these import markets with large quantities of products they require.

Comparatively less attention has been paid in public discussion to the possibility of intensifying the exchange of chemical manufactures with other highly-developed industrial countries, but in fact great hopes are based on the potentialities of the U. S. import market, especially in connection with some of the products automatically produced in certain British chemical trades as byproducts of other articles in greater demand. The United States absorbed considerable quantities of certain coal-tar products before the war, and it is thought likely that the two countries will after the war still be able to supplement each other in many respects. Great Britain, having a smaller home market and therefore being more dependent on foreign markets to absorb surpluses of certain products, is probably more interested in such a partnership, but it is argued that as the two countries partly rely on different raw materials and work under different conditions, there should be ample scope for such cooperation. Just as Great Britain is able, for instance, to relieve American manufacturers of some of the surplus production of petroleum byproducts, since there is no large petroleum industry in the British Isles, the United States may be able to absorb British coal-tar surpluses.

Such a division of work would, of course, normally occur in the course of international trade if no artificial barriers are set up, but price differences may cause certain difficulties. Generally speaking, British organic chemicals are more expensive than products of similar type and quality in the United States. The higher cost of the British article is not necessarily and not always due to inferior efficiency. British industrial leaders tend to attribute it at least in part to higher tax burdens, the smaller size of the home market, and less favorable conditions of raw material supply. They contend that some such special taxes as the duties on hydrocarbon oils (intended to hit the "luxury" motor traffic) impose an unjustified and uneconomic burden on the chemical industry because they raise the price of light coal-tar oils. They argue that the particularities of the hydrocarbon duties indirectly affect even the prospects of the plastics industry, and they hold other taxes on industrial activity responsible for the hesitation of industrialists to risk large capital expenditures in certain directions.

It is more than likely that these questions will be reopened as a result of the proposed reorganization in important British staple industries. The impending reorganization of the British coal mines and gas industries, for instance, will create entirely new conditions for the production of organic chemicals. It is certain that the output of these will greatly increase, and their producing costs also are likely to change. Even now the output of these products in the British Isles is comparatively larger than that in the United States if the difference in population and industrial aggregate production between the two countries is taken into consideration. A further increase would no doubt demand a further expansion of exports, either of coal products or of manufactured articles into which they enter.

There is another likely postwar development in British chemical production which cannot but have a profound effect on the country's export capacity: the expected tendency towards "regionalization." The prewar trend characterized by the industrial migration to London and other big population centers is now held largely responsible for the emergence of "depressed areas" and the neglect of indigenous raw materials which caused so much suffering and poverty in certain parts of the country. Some of the leading industrial enterprises have announced their intention to erect large factories in previously neglected areas, and the Government will certainly encourage such projects. Thus Imperial Chemical Industries Ltd. announced that it was contemplating a vast program of reconstruction, extending over years and necessitating the eventual erection of new plants in South Wales. A war plant erected there is working with the company's factories in the Midlands, quite a distance away, without, it would seem, undue difficulties, and this plant will be retained after the war, contrary to previous intentions. It so happens that these neglected areas to which now more attention is being given are in a relatively favorable geographical position with regard to export markets. It is even argued that the transport advantage of these rediscovered industrial areas should be sufficient to offset the benefit accruing to big plants from the vicinity of large consumption centers. There are other arguments—social and economic—for a decentralization of industry and limitation of production capacities in single units, but the hope to improve export prospects is certainly not without influence on this latest industrial trend.

From all the developments, even though they are at present still in the planning stage, the impression is gained that British chemical exporters, while believing that a potentially large export market will be open to them after the war, are also convinced that extra efficiency and competitive power will be needed to make use of the opportunities in foreign countries. Public opinion is firmly set against market protection agreements which threaten to hamper progress, but informed critics agree that some sort of cooperation with foreign competitors will be necessary, especially if trade barriers in the form of tariffs are to be abolished. Such cooperation, however, should be effected by, or under control of, the State. Just as general opinion in the British chemical industry hopes for open export markets, it favors the removal of import restrictions. While there is not sufficient published information available to state the facts with certainty, it seems that the higher cost of producing chemical products in Great Britain is due primarily to higher raw material costs and that it could be reduced by insuring that the cheapest raw material sources are drawn upon.

To sum up, it may be said that British chemical manufacturers are in favor of free trade conditions, with the rider that the Government should help to develop export markets by market research, export credits, development grants, etc. They hope for increased use of indigenous raw materials where these can compete with imported materials and expect that the cooperation within the British basic industries will help them to make the best use of the good opportunities which the postwar world is likely to offer to the export trade.

BRITISH CHINA CLAY OUTPUT IS REDUCED

China clay production in the United Kingdom is under control in accordance with a plan of the Board of Trade and the industry is concentrated with some pits closed. Compensation is received from taxes on goods made by pits that remain in operation. Practically all sales are to essential war industries but even with this restriction, it has been found necessary to draw upon stocks as the mines cannot hold enough labor to keep production up to requirements.

PORTUGAL'S SULPHUR OUTPUT USED IN VINEYARDS

Annual consumption of sulphur in Portugal is about 12,000 tons all of which is refined in the Barreiro plant of Companhia Uniao Fabril. The entire output is used in vineyards. This company makes 360 tons of sulphuric acid a day and 1,500 tons of copper sulphate a month. It also produces copper oxide. A superphosphate works operated by the concern has an annual capacity of 240,000 tons.

LARGE WOOD DISTILLATION PLANT FOR AUSTRALIA

Prior to the war, plans had been made to establish a large-scale charcoal iron industry in the Bunbury district of Australia. The plans are expected to be carried out after the war. One part of the program calls for the erection of a large wood distillation plant to provide charcoal for the two proposed blast furnaces. In addition to charcoal, substantial quantities of glacial acetic acid and methanol will be produced. It is thought possible that the availability of these chemicals will lead to the establishment of plants for transparent paper and rayon.

BRAZIL DEVELOPS VITAMIN OILS INDUSTRY

In the prewar period Brazil was a regular importer of fish oil, especially pure cod liver oil. When shipments from primary markets were interrupted, attempts were made to develop a home source of supply. While no data for production of vitamin oils are available, it is stated that livers from sharks which abound in Brazilian waters are being used in a large way and that the supply of oil is sufficient to take care of the country's requirements.

PHARMACEUTICAL INDUSTRY OF SWEDEN

A very comprehensive report on the way the pharmaceutical industry has been expanded in Sweden has been furnished by Herschell V. Johnson, American Minister at Stockholm. Sulfonamide preparations were among the first drugs that Sweden produced. The principal substance for this is made by Bofors from domestic materials. Chloroamine which was developed for defense purposes against mustard gas, is used as a disinfectant. This is being made by Nobel Powder Co. "Lokastin," a substitute for procaine has been developed by the Pharmacea Co. from domestic materials. Ether is produced from ethyl alcohol and collodion from nitrocellulose by Bofors. The Mo & Domajo Co. produces chloroform from alcohol. Aspirin will be produced by Nobel in a plant now under construction. Hoganan-Billesholm Co. is making magnesium compounds as well as activated carbon and paraffin. The Swedish Fish Oil Central Office is manufacturing medicinals from cod-liver oil. Carotene is being extracted from carrots by Karlshamns Oil Co. Thiamine is derived not only from beer yeast but also from fodder yeast from cellulose lyes.

COPRA AND COCONUT OIL IN CEYLON

Production of copra in Ceylon in 1944 is expected to be between 125,000 and 130,000 tons. However if weather conditions should be unfavorable and if the current rate of home consumption of coconuts continues, these figures may prove too high. In 1943 about 84,000 tons of coconut oil were produced of which about 40 percent was consumed locally. A production of 90,000 long tons is the present aim.

EIRE DEVELOPS PROCESS FOR MAKING ACETONE

The European technical press is credited as the authority for the statement that the Emergency Research Bureau in Eire has developed a process for making acetone from alcohol. The Bureau also is said to be conducting plant-scale experiments on the production of ether from alcohol. Acetone has been produced in Eire for some time by a wood-distillation process but the productive capacity has been small.

SULPHUR OIL IMPORTANT IN GREEK SOAP PRODUCTION

Under normal conditions Greece has an annual output of about 130,000 tons of olive oil. In conjunction with this, about 20,000 tons of sulphur oil or olive oil foots are produced. One-half of this sulphur oil was exported and the remainder used at home in making soap. According to recent reports to the Department of Commerce, there are between 40 and 50 soap plants operating in Greece at present with 1943 output estimated at 12,000 tons. Although domestic requirements run close to 20,000 tons, more than half the 1943 production was exported.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN, Engineer

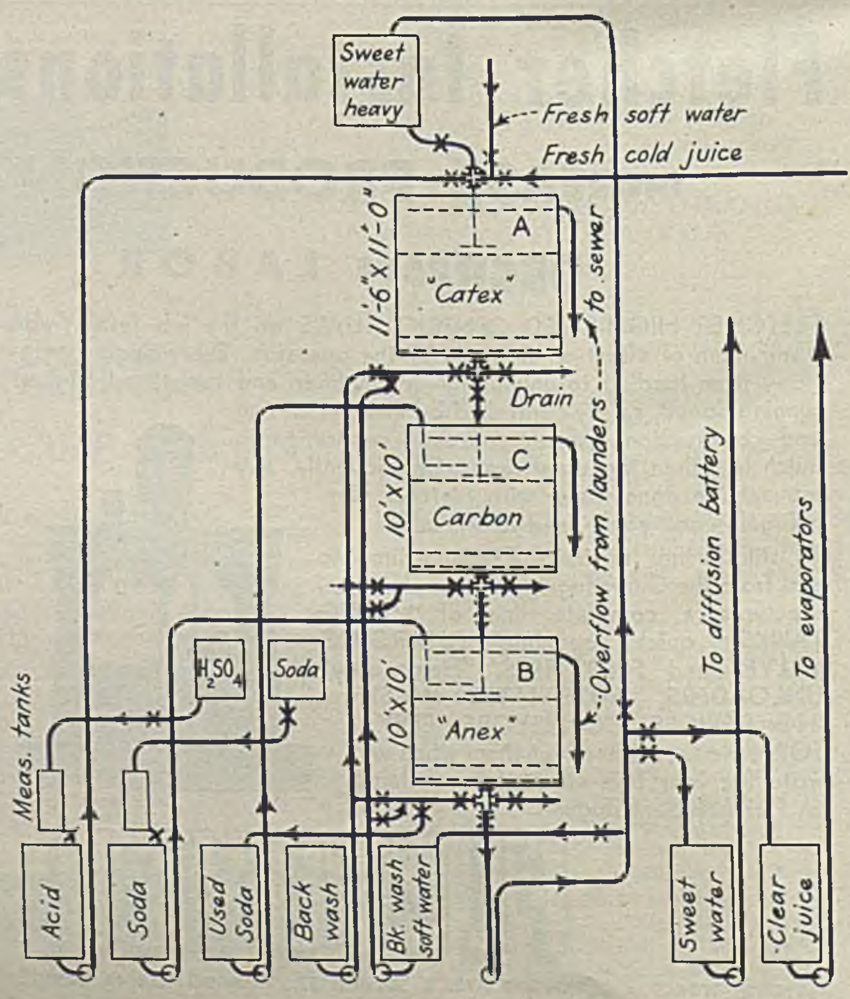
THE OLD MAN DEVELOPED a sudden urge a couple of years ago to acquire the details about Henry Vallez' ion interchange process whereby the amber colored beet sugar liquor is made water white and soft as rain water. He instructed the Chronicler and Superintendent Harvey to proceed to Mount Pleasant, Michigan to interview Henry and bring back the facts. "And when you're through," added the Old Man, "look around. Don't be in a hurry. The house doesn't need either one of you." The journey was accomplished via the old Ann Arbor Combination which has on occasions administered travel accommodations for the Chronicler over forty years ago. The same old conductor still delivers the kids to school as he did their parents, and gathers their forgotten belongings for return on the next trip.

IN 1890 HENRY HAD FINISHED school in France and was serving as chemist in a French beet sugar house. About this time accord and cooperation replaced strife between the two San Francisco refineries and they observed that Dyer's crude little beet sugar house across the Bay at Alvarado was still in operation in spite of their fight which had depressed the price of sugar below their own cost of manufacture. They could not squelch the infant by competition and so they negotiated and bought the little plant. Operating a beet sugar house was a new experience. After a week of beet slicing in the Summer of 1890, not a pound of crystals had been produced. Sugar boiler Clarence Granger, young son of the proprietor of the widely known Granger House in Alvarado, lamented that his syrup bubbled like boiling oil but refused to crystallize. Adventitiously, Henry Oxnard was in San Francisco. He had imported sugar expert Brysselbout from France to direct his Grand Island operation, and, by way of Americanization, he had stationed him temporarily in the "Western" refinery laboratory under the supervision of Nephew Dick Sprague (son of Oxnard's sister). A distress signal was sent to Oxnard requesting the loan of his expert for Alvarado. It did not take Brysselbout long to grasp the cause of the trouble. There was lack of chemical control, especially at the carbonator station. With this adjusted, the oil-like viscosity of the juice disappeared and before night, Clarence Granger sent down a strike of crystals! Great was the rejoicing. Manager Burr reserved the dining room at the Granger House and the entire staff ate, drank and made merry in celebration.

BURR ASKED BRYSSELBOUT if there were any more like him in France. This led to the recommendation of Henry Vallez, brother of Brysselbout's wife. Thus it came about that Henry immigrated to California. After installing a chemical control system in the Alvarado factory, he indulged his wanderlust and moved to Grand Island and subsequently to the new Lehi factory in Utah of which Granger had become superintendent. Everything was available at Lehi except trained operators. In the process of providing training, patient, understanding Henry was a past master. George Bushby, the firey bantam, was operating the plate-and-frame presses. His losses in the cake were very high. Granger hesitated to expose his inexperience as well as his personal safety and accordingly sent Vallez to George's station while he stood apart. George was washing the presses with all of the plate cocks open, thus by-passing some of the cake. Vallez applied tactfulness in his approach and thereby avoided bodily violence. He won Bushby's willingness to accept suggestions and, presto, the heavy sugar losses ceased. Thereafter George revered Vallez as the Master!

TWO YEARS LATER, Henry was superintendent at Lehi. In '99 he moved East and operated plants respectively at Binghamton, New York and Bay City, Michigan. When the difficulties in personnel and improper installations overwhelmed the Salsburg house (now "Monitor") a few miles from Bay City in 1902, Vallez was invited to report on ways and means of pulling it out of the hole. Joseph Kohn had operated the house during its second campaign and his principal output was molasses. He needed molasses anyway for his alcohol plant in Bay City. Joseph proposed to the bondholders an expenditure of $350,000 to place the factory into efficient operating condition. Having been attached to Constructor Kilby's staff, Kohn possessed a prejudiced viewpoint. He planned to discard a large amount of equipment. By example, the diffusion battery ($18,000) being side

Purification of beet sugar liquor by ion interchange process



discharge, was to be junked although its only disadvantage lies in its demand for excessive flushing water. Vallez' proposed a conservative course. The Receiver accepted his plan and ordered him to put the house in earning position for an equipment expenditure of $50,000. At the time of the Chronicler's last visit, 40 years later, the diffusion battery was still performing effectively. During Vallez' 25-year incumbency as General Superintendent, the earned surplus provided the funds for the construction of plants at Paulding, Ohio and Mount Pleasant, Michigan.

VALLEZ SOLD HIS INTERESTS in 1928 just at the moment when prices were teetering at the peak before precipitation into the slough of 1930. He acquired a luxurious Cadillac and betook himself and his family to France with the idea of retiring from the sinking beet sugar industry. In a short time leisure became a burden and so he applied himself towards the exploitation of the Vallez rotating leaf filter which had attained popularity in Europe. The device of rotating the filtering element suggested itself when coating the surface with filter aids came into use. The rotating leaf builds a coating of uniform thickness over the entire surface while the stationary leaf has a tendency to make its coat thicker at the bottom.

A YEAR OF SOJOURN IN EUROPE satisfied Henry and he came back to Bay City. By 1930 the price of beets had inflated to nearly ten dollars per ton which the industry could not support. Vallez' monument in Mount Pleasant was down in the dumps with the rest. The Village Chamber of Commerce urged Henry to "come back." With Henry in the saddle again, the farmers promised 12,000 acres of beets at $6 per ton. Henry kicked in $15,000 and induced nine others to follow his example so as to finance the re-opening of the works. He persuaded the doubting farmers to fertilize their fields, himself advancing the price of the materials. The large signs on the respective fields "This field fertilized," "This field not fertilized," convinced the farmers, ex post facto, that there was profit in Henry's hokus pokus! At the end of the year the farmers had done right well, and each of Henry's financial backers got back his $15,000 plus a bonus of $20,000. Then Henry and associates bought back the defunct plant.

VALLEZ' MOST AMBITIOUS project was the purification of best juice by filtering thru zeolite. The Chronicler's 1934 log refers to a visit and describes his laboratory work and a complexity of glass tube "mechanos." By '39 he had progressed as far as a 6 in. glass pilot plant. From the facts which these evolved, Vallez extrapolated figures to proportion a full-size installation which he made in 1941. He applied himself with such relentless zeal against unanticipated difficulties that he had to be forcibly removed from the plant for nervous recuperation. By 1942 the normal ten-year period between test-tube experimentation and commercial production had elapsed. The shirtlosing stage was weathered and he was achieving water-white, ash-free beet sugar liquor of low viscosity, the equal of char-filtered cane. Evaporation of this juice proceeds with remarkable facility and the heating surfaces remain free from scale.

UNDER THE MELLASIGENIC property, 1 lb. of lime restrains about 2½ lb. of sugar from crystallizing and 1 lb. of potash restrains 4 lb. of sugar. Zeolite removes these impurities to such an extent as to raise the quality of the beet juice from the usual of about 91 deg. to 98 deg. or higher. With final molasses at 60 deg., the theoretical yield of sugar from 91 deg. and 98 deg. juices respectively compares as 82 percent and 95. This emphasizes the importance of the removal of bicarbonates, potash, etc. from sugar solutions.

THE PROCESS OF PURIFICATION by an ion exchanging, as developed to date, is effective only on thin juice and is therefore economically adaptable only for clarifying before concentration. The flow of the juice through the granular purifying mediums is to some extent retarded by the increased viscosity due to the necessity of chilling the juice before processing. Purification of the juice takes place in three processing tanks. A (acid), C (carbon), and B (basic), arranged vertically in this order for gravity flow as shown. Active beds of material charged in these tanks are about five feet deep, respectively the acidic exchanger "Catex" in A (International Filter Co.); carbon (Darco) in C; and the basic exchanger "Anex" in B. Under these beds there is a 12 in. base of graded anthracite coal, silica sand, originally used, being unsuitable under acid conditions. The Catex absorbs the ash, the carbon absorbs the color and colloidal organic matter, and the Anex removes the acid ions. Filtered carbonated thin juice enters at the top of A, flows successively through A, C, and B and is withdrawn out of the bottom of B by the juice pump which delivers the purified liquor to the blending tanks. The same pump in regular sequence, then draws out the "heavy" and "light" sweet waters from the lixiviation of the processing tanks and delivers these to the blending tanks or to the storage tanks for initiating the succeeding lixiviation. From the blending tanks the juice is pumped to the House for concentration and crystallization. Heavy sweet water may also be delivered to the evaporators. The light sweet water is sent to the diffusion battery and enters at the 5th cell where the sugar content is comparable. This thin sweet water, having zero hardness, ameliorates the operation of the battery.

EFFLUENT from A, having its basic ions removed, drops to an average acidity of about 2.5 pH. Under this condition the sucrose would rapidly be inverted if the influent were entered at the initial juice temperature of 90 deg. C. To avoid the inversion, the juice is cooled to 20 deg. C. or less before entering the purification process. The performance of the carbon is enhanced by the acid condition of the carbon as well as the juice. Cooling is economically accomplished by the use of spiral heat exchangers (American Heat Reclaiming Corp.). The heat of the incoming untreated juice is absorbed by 3 units (at 472 sq.ft.) arranged in series, using the cold juice in counter flow and followed by one unit using cold water. The treated juice, in passing through the heat exchangers, reaches a temperature of 60 deg. C. before entering the preheater in front of the evaporators while the untreated juice drops to 40 deg. C. before the cold water exchanger. Sweet water for the battery is heated before it reaches the battery.

THE GROUP OF TANKS A, C, and B, together with the juice pump is a processing unit to be multiplied according to the capacity required. Accessory pumps, cross headers, and tanks serve a multiple of these units. The three processing tanks are rubber lined (Goodyear) and all of the piping connecting these are of hard rubber. Hills-McCanna rubber diaphragm valves are used at the tanks and Merco cocks elsewhere. The juice, acid, and soda supply lines are provided with indicating and integrating meters and with flow-rate indicators. Rate of flow is controlled by throttling valves ahead of the meters.

THE CLARIFICATION CYCLE of each processing unit requires 2½ hr. and through-put during this period is 26,000 gal. of juice. This performance was determined by trial and error with filtered carbonated juice of 11 to 12 Brix, 90 to 93 purity, 8.0 to 9.0 pH, and an ash content of 0.4 or more, the criterion being the economical exhaustion of the ion exchangers.

REGENERATION STARTS with lixiviation of the beds to recover the sugar in process. Then follows a vigorous backwashing with river water. After this, regeneration is accomplished by trickling through Catex tank (A) a ½ Normal Solution of H_2SO_4; through Anex tank (B) 1 percent caustic soda solution; through carbon tank (C) used caustic from above followed by a rinse of a part of the acid from A.

A FRESHLY REGENERATED BED of catex acidic ion exchanger (14-60 mesh) emits the juice at 2 pH, indicating thorough removal of the ash—(calcium, sodium, potassium, magnesium). The pH rises, and when it reaches 3, regeneration is required. The test for carbon (12-20 mesh) is the absorptive capacity for color organic matter. A freshly regenerated bed of Anex (10-60 mesh) emits the juice at about 11pH and requires regeneration when this drops below 7pH. All three purification media under test in Vallez' laboratory have undergone 700 regenerations without loss of efficiency. The cycle is completed by a rinsing with river water and when this is drained down to the level of the surface of the bed, it serves to avoid chaneling when the flow of juice is turned on. The time that elapses for lixiviation and regeneration is two hours. The total cycle from juice on to juice on is a minimum of 4½ hr.

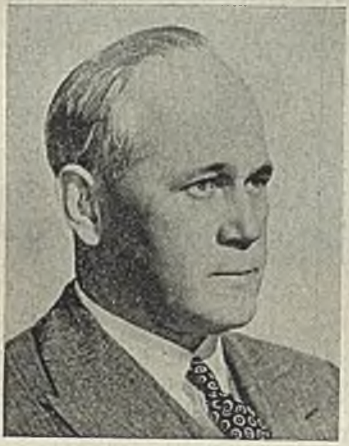
Return ticket for Dad

TO JIMMY...

buying a war stamp
is serious business
... serious because
his Dad is in the
service.
He's not worrying about
a safe investment...
nor of curbing inflation
... nor of building
a reserve.
Jimmy is just thinking
about how he can help
bring his Dad home sooner
... every stamp he buys
is one more payment on a
Return Ticket for Dad.

COMMERCIAL SOLVENTS
Corporation
17 EAST 42nd STREET, NEW YORK 17, N. Y.

NAMES IN THE NEWS



Joseph G. Davidson

George H. Young

Wanamaker-Underwood & Underwood

J. E. Underwood

Joseph G. Davidson has been elected president of Carbide and Carbon Chemicals Corp., and Carbide and Carbon Chemicals, Ltd. Dr. Davidson holds degrees in Chemistry from the University of Southern California and Columbia University. He participated in the early work in synthetic organic chemistry which led to the foundation of Carbide and Carbon Chemicals Corp., and has served this company in technical and executive capacities since its formation.

Frank B. Jewett, Jr., and **John M. Fox** have been elected vice presidents of National Research Corp. Mr. Jewett heads the newly-formed vacuum engineering division, which is the design, construction and installation unit of the corporation, while Mr. Fox is in charge of administration and sales.

E. A. O'Neal, Jr., has been promoted to the position of production manager of the phosphate division of Monsanto Chemical Co. **James A. Wilson** has been named plant manager of the Trenton plant to succeed Mr. O'Neal.

Thomas J. Craig resigned May 31 from his position of Chief of the Protective Coatings Branch of the Chemicals Bureau of WPB. He is succeeded as chief of the branch by **Wells Martin.**

M. E. Putnam, vice-president and member of the board of directors of the Dow Chemical Co., received an honorary degree of doctor of science from Albion College on May 22.

H. J. Rose, of Mellon Institute, Pittsburgh, has been elected vice-president and director of research of the Bituminous Coal Research, Inc. Dr. Rose will be in charge of the expanded investigational and developmental program of the bituminous coal industry. He is resigning as vice-president in charge of research of Anthracite Industries, Inc., to accept the new position.

George H. Young has been appointed executive assistant at Mellon Institute of Industrial Research. Dr. Young has been associated with the Institute since 1935, first as Industrial Fellow, then as Senior Fellow, on the Stoner-Mudge, Inc., Multiple Industrial Fellowship on Protective Coatings. His new duties, dating from June 1, are concerned with the management of research programs of the Institute.

R. W. McClellan has been appointed special assistant to **F. A. Wardenburg,** general manager of the Du Pont Co. Ammonia Department.

Roland Wilbur, formerly of the Ecusta Paper Corp., is now production manager for the Crossett Paper Mills, Crossett, Ark.

Victor Burstein, formerly of the Institute of Paper Chemistry, is now chemist for the North Carolina Pulp Co., Plymouth, N. C.

John F. Hicks has joined the Panelyte Division of the St. Regis Paper Co., Trenton, N. J. He was formerly with the Lehon Co.

T. S. Carswell is now Western manager for Monsanto Chemical Co. Mr. Carswell on June 1 left his position as assistant director of development of the Plastics Division of the company at Springfield, Mass., for the new position on the West Coast.

Edward N. Poor has resigned his position as technical director of W. C. Hamilton and Sons, Miquon, Pa., to become associated with the American Cyanamid and Chemical Co., New York, N. Y.

Lawrence W. Bass has been appointed associate director of chemical research to serve in this capacity jointly for Air Reduction Co., Inc., and U. S. Industrial Chemicals, Inc. He will be responsible for coordination and expansion of research of the two companies.

J. E. Underwood has been appointed director of research of Diamond Alkali Co. and will be located at Painesville, Ohio. Prior to his present position, Mr. Underwood was associated with WPB's Office of Production Research and Development.

Charles A. Bigelow has retired from Hercules Powder Co. where he was vice president, director, and member of the finance committee. Mr. Bigelow had been with Hercules since 1921 when Aetna Explosives Co. was acquired by Hercules, and shortly thereafter he was placed in charge of explosives manufacture.

R. H. Thielemann has been appointed development engineer for Allegheny Ludlum Steel Corp. He was formerly associated with the research laboratory of the General Electric Co. at Schenectady, and since 1941 has worked on the development of precision testing practices for casting parts to sizes of high melting point alloys and stainless steels.

James Edward Mills, chief chemist of Sonoco Products Co., Hartsville, S. C., was honored with the presentation of the Herty Medal at ceremonies held in Milledgeville, Ga., on May 6.

Donald R. Knowlton, who had been a director of the Petroleum Administration for War since February, 1942, has resigned to become manager of the foreign division of the Phillips Petroleum Co., with headquarters in Bartlesville, Okla.

Brig. Gen. Charles E. Loucks, formerly commander of the Rocky Mountain Arsenal at Denver, Colo., has been named chief of the industrial division of the office of the chief of the Chemical Warfare Service, succeeding **Brig. Gen. Paul X. English,** assigned to headquarters of the Seventh Service Command, Omaha, Nebr. **Brig. Gen. Alexander Wilson,** commandant of the CWS School at Edgewood Arsenal, will succeed Loucks at the Rocky Mountain Arsenal.

James W. McLaughlin

Stanley B. Kirk

James W. McLaughlin has been named the new president of the Bakelite Corp. He will direct all of the plastic operations of units of the corporation, including the plastics division of Carbide and Carbon Chemicals Corp. Other new officers of units of the Union Carbide and Carbon Corp., include Stanley B. Kirk, who becomes president of The Linde Air Products Co., The Prest-O-Lite Co., Inc., Dominion Oxygen Co., Ltd., and Prest-O-Lite Co. of Canada, Ltd.; Arthur V. Wilker, who has been elected president of National Carbon Co., Inc., and Canadian National Corbon Co., Ltd.; Francis P. Gormely, who has been elected president of Electro Metallurgical Co., Electro Metallurgical Co. of Canada, Ltd., Haynes Stellite Co., Michigan Northern Power Co., and Union Carbide Co. of Canada, Ltd.; John D. Swain, who becomes president of Electro Metallurgical Sales Corp.; and John R. Van Fleet, who has been elected president of United States Vanadium Corp.

Frederick W. Russe, director and vice president of Mallinckrodt Chemical Works, was the recipient last month of the J. Shipman Gold Medal for distinguished service to the advancement of purchasing.

C. R. Downs, consulting chemical engineer of New York and Stamford, Conn., has been elected president of The Chemists' Club. He succeeds C. R. DeLong,

Arthur V. Wilker

Francis P. Gormely

chemical consultant of New York City. A. G. Syska, of the firm Kelly, Syska and Hennessy, is the newly elected secretary, and C. L. Knowles of the General American Transportation Corp., has been chosen resident vice-president.

Charles G. Ferrari, authority on cereal chemistry, has joined the research and development division of Standard Brands, Inc.

H. Wade Rinehart, chemist with the Du Pont Co. for the past eighteen years, has been appointed to the newly established position of personnel manager of the company's rayon technical division. Dr. Rinehart comes to the rayon technical division from the company's service department where for five years he has been in charge of recruiting technically-trained college men for various positions in the company. His new duties entail responsibility not only for the existing personnel of the division, but for additions to the staff as well.

LeGrand Jarrett has been appointed superintendent of the Fairmont Glass Plant of the Westinghouse Electric & Mfg. Co. He joined Westinghouse in 1913.

Frank Moody Biffen, a member of the staff of Foster D. Snell, Inc., was recently elected to Fellowship in the Institute of Chemistry of Great Britain and Ireland.

O. A. Houghen

Olaf A. Hougen, professor of chemical engineering at the University of Wisconsin, was the recipient of the 1944 William H. Walker Award of the American Institute of Chemical Engineers. The medal, granted for outstanding contributions to chemical engineering literature, was presented at the banquet during the semi-annual meeting of the Institute at Cleveland, May 16.

Russell Hopkinson has been appointed director of the newly formed Commercial Development Department of the United States Rubber Co. The department will act as the focal point for consideration of new businesses, new ideas and products submitted to the company.

John F. Corwin has been appointed chemical director of the Casein Co. of America, where he will be in charge of research and chemical operations.

R. R. Burtner was elected president of the Chicago Chemists Club at the May 12 meeting. At the same time L. O. Hill was elected first vice-president and R. N. DuPuis second vice-president. Herman Kerst, Jr., and E. C. Leamon were reelected secretary and treasurer, respectively.

L. L. Malm has joined the technical staff of Industrial Rayon Corp. at Cleveland.

V. P. Victor, who for more than fourteen years was associated with the J. O. Ross Engineering Corp., has started a consulting engineering practice in New York.

Felix N. Williams, formerly production manager of the phosphate division of Monsanto Chemical Co., has become general manager of the company's plastics division at Springfield, Mass., to succeed the late John C. Brooks.

Carl L. Wallfred, of the Batelle Memorial Institute, has been appointed manager of the pilot plant department of Ansul Chemical Co., Marinette, Wis.

Edmund D. Wingfield has been elected assistant secretary of Freeport Sulphur Co. Mr. Wingfield, who joined the Freeport organization in 1933 in the operating department at Freeport, Tex., will continue to serve also as administrative superintendent with headquarters in the company's operating offices at New Orleans.

C. Langdon Campell

C. Langdon Campbell has joined the Diamond Alkali Co. in the capacity of assistant chief engineer.

John R. Eck, a member of the Central Research staff of Monsanto Chemical Co. at St. Louis, has been appointed assistant plant manager of the Monsanto plant at Trenton, Mich.

OBITUARIES

Louis Mansfield Rossi, 66, vice president of Bakelite Corp., died May 25 in New York following a sudden illness.

Kenneth J. King, 46, chief engineer of the Commercial Solvents Corp., died suddenly at Terre Haute on April 24.

Vernon Edler, 47, vice president and general manager of the Peerless Pump Division of the Food Machinery Corp., died May 1.

Michael M. Klosson, 51, chief engineer of Buffalo Pumps, Inc., died suddenly on April 11 while on a trip to the West Coast.

George Steiger, 74, retired chief chemist of the U. S. Geological Survey, died April 18 in Washington, D. C.

Newton I. Steers, 67, who retired two years ago as president of the Du Pont Film Manufacturing Corp., died May 15.

Hiram J. Halle, 77, president of Universal Oil Products Co., died May 29 at his home in Pound Ridge, N. Y.

William Mason Grosvenor, 70, consulting chemical engineer and president of Grosvenor Laboratories, died May 30 in New York.

William M. Corse, 66, widely known consulting chemical engineer and metallurgist, died June 3 at his New Hampshire home.

Burrows Morey, 61, well-known chemical engineer and former superintendent of the soap products department of the Larkin Co., Buffalo, died suddenly May 14, in Monterey, Mexico, while en route from Buffalo to his home in Mexico City. Two years ago Mr. Morey went to Washington to accept a position with the Federal Economics Administration.

INDUSTRIAL NOTES

The Bristol Co., Waterbury, Conn., has appointed H. C. Clarke district manager of the Pittsburgh territory. A new branch office has been opened in the Engineers Bldg., Cleveland. G. H. Gaites is regional sales supervisor of the Cleveland and Pittsburgh territories.

Independent Pneumatic Tool Co., Chicago, has advanced W. H. Brewer to the position of general factory manager. He is succeeded as works manager of the Aurora plant by Edward N. Haas.

Allen-Bradley Co., Milwaukee, has moved its Cleveland office to 4506 Prospect Road. R. J. Roy is district manager.

Selas Corp. of America, Philadelphia, is the new corporate name for the Selas Co. There has been no change in organization, service, or personnel.

The National Radiator Co., Johnstown, Pa., has transferred David M. Ramsay from New England to Johnstown where he is serving as assistant to the manager of the industrial division. Edward A. Bertram is connected with the New York office in the sales end and also in charge of design of heat equipment.

The Pennsylvania Salt Mfg. Co., Philadelphia, has made Gilbert H. Corbin district sales manager at Minneapolis. He had been field sales manager of the company's laundry and dry cleaning division.

California Research Corp., San Francisco, is a recently formed subsidiary of Standard of California. The new company will carry out research, development and technical service in the fields of petroleum and chemical products and processes.

C. M. Kemp Mfg. Co., Baltimore, has appointed D. B. Gooch sales manager. Mr. Gooch formerly was connected with the Blaw-Knox Co.

Victor Chemical Co., Chicago, announces that Irwin E. Smith has been acting as sales manager since May 1. Elwood M. Myers is now in charge of company advertising.

American Cyanamid Co., New York, has named Sam Klein western sales manager of the Calco Chemical division. His headquarters are in Chicago.

Dow Chemical Co., Midland, Mich., has appointed K. T. Vanganes manager of magnesium distribution and engineering service in the Pacific coast area.

Allis-Chalmers, Milwaukee, has formed a new research and gas turbine development division of which Dr. J. T. Rettaliata is manager.

General Controls Co., Glendale, Calif., recently opened an office at 687 Boylston St., Boston with William Marsh in charge. Also a new office at 1505 Broadway, Cleveland with L. E. Wetzel as manager.

E. I. duPont de Nemours & Co., Inc., Wilmington, has appointed E. L. Gartner manager of the metal and ore division of Grasselli Chemicals department. V. R. Daub and L. C. Pejeau will act as assistant managers.

Detrex Corp., Detroit, has made R. W. Pflug manager of the central region territory. He had been manager of the north central region.

Kieley & Mueller, Inc., North Bergen, N. J., is now represented in Ohio by the Willis Engineering Co., Columbus.

Ross Heater & Mfg. Co., Buffalo, is now represented in the southern California territory by Arleigh W. Anderson with offices at 164 South Central Ave., Los Angeles.

Revere Copper and Brass Inc., New York, has opened a sales office at 1225 Circle Tower, Indianapolis, under the supervision of P. H. Anderson who has been with the Dallas division in Chicago since 1922.

Standard Oil Co. of New Jersey, New York, has appointed William P. Headden assistant manager of the sales engineering division. He has been devoting most of his time to the solution of lubrication and fuel problems of war industries.

Farrel-Birmingham Co., Inc., Ansonia, Conn., has appointed Albert P. Leonard manager of its New York office to succeed Edward S. Coe, Jr., who has been transferred to Ansonia to serve as assistant to the plant manager. The New York office has been moved to the Chrysler Bldg.

Morse Boulger Destructor Co., New York, has purchased all assets, patents, rights, and other property of Robinson air-activated conveyor systems.

Boston Woven Hose & Rubber Co., Boston, has made H. F. Maxon general sales manager with W. I. Lewis as assistant. W. F. Carroll succeeds Mr. Maxon as district sales manager of the New York and Pennsylvania districts.

Wilbur B. Driver Co., Newark, N. J., reports that Wilbur B. Driver has retired as president and become chairman of the board. His son Robert O. Driver has succeeded to the presidency. William J. Wind is vice president in charge of production.

Worthington Pump and Machinery Corp., Harrison, N. J., has purchased the Electric Machinery Mfg. Co. of Minneapolis. The latter company will continue to operate independently and its present executive personnel will continue.

HARD RUBBER PRODUCTS FROM SYNTHETICS

Since the start of the war the technologists of the hard rubber industry have been successful in making a conversion of 90 percent of their products to synthetic rubber. Hard rubber is a highly vulcanized rubber containing a large proportion of sulphur. When a mixture of crude rubber and sulphur is heated a point of saturation is reached and there results pure ebonite (47 parts of sulphur are combined per 100 parts of rubber).

There are two types of the synthetic rubbers which can be satisfactorily vulcanized to hard rubber, namely, GR-S (buna S) and buna N.

As used in the industry, the term "hard rubber" generally means any hard or semihard vulcanized mixture with sulphur ratios ranging between 20 and 47 parts, in the case of natural rubber, and in synthetics ratios between 15 and 44.

Hard rubber dust has generally been recognized as one of the best fillers to use in hard rubber compounding and the industry has been able to develop a satisfactory quality of hard rubber dust made from GR-S.

Ebonites made from GR-S have physical and electrical properties which compare favorably with values for ebonites made with natural rubber. For example, GR-S ebonite values—tensile strength, psi., 8,800 to 9,900; elongation, percent, 4.2 to 8.5; transverse strength, psi., 13,400 to 14,700; impact resistance, Izod, ft-lb. (notched), 0.50 to 0.56; Rockwell hardness, 100 to 110; softening point, deg. F. 144.

Excellent ebonites have been made from buna-N compounds with better tensile strengths and softening temperatures than natural rubber ebonites, and these are used for a number of special applications.

Walter H. Juve, Consulting Rubber Technologist, before American Society for Testing Materials, Cincinnati, March 2, 1944.

ACCIDENT ANALYSIS IN WARTIME CHEMICAL PLANTS

In this war as in the first World War, the chemical industry has been called upon to supply hazardous materials for which new plants had to be designed, for which there was little if any peacetime need and about which information was extremely limited. It has been difficult, and is rapidly becoming more difficult, to secure necessary equipment, raw materials, supplies and technical manpower. New and improved munitions and fighting equipment are continually coming off the drafting boards.

New commercial chemical processes are usually several years from the laboratory to production. But wars and Commanding Generals will not wait for trials, pilot plants or elaborate experiments. During such a blitz, plant safety is an easy item for plant management to forget. The relaxed effort is not immediately apparent; hence, it

It takes more than these to make a good insulation job . . .

THE right insulation is important, of course. And so are the proper erection materials and tools. But these alone won't assure you of an efficient low-temperature job. Performance depends on the way the material is installed. And that means the men who erect it must have "know-how" and experience.

You can be certain of getting competent, experienced mechanics when you come to "Insulation Headquarters." All Armstrong district offices and distributors maintain crews of men who have been acquiring their skill in the erection of low-temperature insulation over many years—some more than 35. They are at your service.

When you come to "Insulation Headquarters" you can be certain, too, of having a complete line of efficient insulations to choose from, for Armstrong offers Corkboard, Foamglas*, Mineral Wool Board, and Cork Covering. Armstrong's engineers will gladly help you choose the correct material or combination of materials for your particular insulating problem.

For complete information—including physical data and erection specifications—write today to Armstrong Cork Company, Building Materials Division, 3306 Concord Street, Lancaster, Penna.

*Reg. U. S. Pat. Off. Product Manufactured by Pittsburgh Corning Corp.

ARMSTRONG CORK COMPANY

Insulation Ⓐ Headquarters

would be little wonder if safety was asked to wait until the pressure was off before it was resumed. Frequency and severity rates for private chemical plants assigned Chemical Warfare Service for continuing protection indicate that there has been little or no compromise with safety during this emergency, but this is largely because the products most inimical to safety are manufactured in the arsenals.

In January of this year, private plants assigned to Chemical Warfare Service for continuing protection developed a frequency rate of 23.6 and a severity rate of 3.48. The safety section of Chemical Warfare Service was started under a War Department directive in November of 1942. January was the first month that the program really got under way. Men who were well informed in plant protection had to be trained in safety. In February of 1943, the frequency rate came down three points to 20.7 and severity was reduced from 3.25 to 0.32. By June the frequency rate was down to 18.9 and severity, after fluttering around a bit, landed at 2.7. For six months' period from January through June, the rates were: frequency 20.9 and severity 1.62. These suffer by comparison with the chemical industry rate of 9.90 and 1.29 respectively. But in comparing these rates, it must be remembered that those assigned to CWS are all of the heavy chemical group, that they are processing extremely hazardous materials many of which are not used commercially.

Private plants contracting for war products under the Technical Services, such as ordnance and Chemical Warfare, are manufacturing under the Walsh-Healey Act and are, therefore, subject to cancellation of contract or work stoppage if they do not maintain a safe work place. There have been only two occasions of contract cancellation and three of work stoppage by CWS and none of these cases were in strictly chemical plants. The chemical industry generally has been extremely cooperative and frequency and severity rates quoted are considered to be very good.

No plant is perfect and recommendations are in order everywhere, but these recommendations must be tempered by the inspector's knowledge of the availability of equipment and manpower to make the recommended changes. However, it has been clearly demonstrated that neither safety consciousness nor plain common sense can be taken for granted.

In addition to the private contracts, Chemical Warfare Service has four manufacturing arsenals. These arsenals manufacture all the war gases, including loading them into many types and calibers of shells and bombs. They do all the research and developing of new chemical products. These arsenals produce an amazing quantity and variety of products, that are unknown commercially, with very few serious injuries.

However, the frequency of injuries has been quite high. Collectively for the first six month of 1943 four arsenals have had a frequency rate of 54.34 and a severity rate of 2.0. It actually took six months to determine the causes of injuries on which to base an accident prevention program. That program is now in execution and it is expected rates will be cut 50 percent before

1943 is over. The arsenals producing the greatest number of man hours have turned in frequency rates of 8.5 and 11.6 for the past two months and severity rates for the same period of .04 and 0.1. This shows excellent progress and indicates what can be done.

The spirit of competition, plant safety, recognition of hazards and lots of respect for the hazardous products will, it is felt, overcome the insidious conditions imposed because of the war. The chemical industry will profit greatly by the experiences the arsenals and the chemical plants themselves are having. New products are being developed, many of which are hazardous and which create a hazardous atmosphere in which to work. The plant that eliminates these hazards will also eliminate most of the objectionable working conditions and, as a result, will attract the better-class worker. This worker will turn out the best product, and management will doubtless find that the time and money which have been used for safety developments will pay unexpected dividends when the war is over.

Capt. G. C. Whalen, Chemical Warfare Service, before 32nd National Safety Congress, National Safety Council, Chicago.

VULCANIZED ACRYLIC RESINS

Rubberlike materials have been made by copolymerizing emulsified ethyl acrylate with small proportions of allyl maleate and vulcanizing the resulting unsaturated acrylic resins. As little as 1 percent of allyl maleate gave copolymers that could be vulcanized readily with sulphur and accelerators and with certain other agents in the absence of sulphur. Acrylonitrile (preferably about 6 percent) had a beneficial effect, possibly because of its tendency to decrease cross-linkage.

Ammonium persulphate was preferable to three other oxidizing agents as a polymerization catalyst; a small amount sufficed. With this catalyst, polymerization proceeded smoothly. Benzoyl peroxide was also effective as catalyst, but it produced properties, such as insolubility and toughness, that are sometimes attributed to cross-linkage. Although not so active as benzoyl peroxide, hydrogen peroxide was moderately satisfactory. Sodium perborate had no particular advantage.

Properties of sulphur-cured vulcanizates depended on the content of carbon black (Furnex beads). As carbon black was increased from 15 to 100 parts per 100 parts of the copolymer, ultimate elongation decreased, hardness increased, and the brittle point was raised. A mixture of Micronex and Furnex beads increased the tensile strength and decreased the elongation without hardening the vulcanizate or raising its brittle point.

Non-sulphur vulcanization methods gave promising results. Combinations of quinone, dioxime, quinone dioxime dibenzoate, red lead, and lead peroxide produced vulcanizates with considerably higher tensile strength and somewhat greater hardness than did sulphur. When the copolymers were compounded with benzoyl peroxide, vulcanization or curing occurred in 10 to 20 min. at about 100 deg. C. The peroxide-cured products were soft and elastic.

The vulcanized acrylic resins described

were resistant to oils, solvents, oxygen, and heat, presumably because of their saturated character. Most of them had a moderately high brittle point (—10 to —20 deg. C.), but it could be lowered by blending with certain other synthetic rubbers. The soft and rubbery vulcanizates had a tensile strength and an ultimate elongation of approximately 1,250 lb. per sq.in. and 900 percent, respectively, whereas some of the harder products had a tensile strength of over 2,000 lb. per sq.in. and much less elongation.

W. C. Mast, L. T. Smith and C. H. Fisher, Eastern Regional Research Laboratory, before Division of Rubber Chemistry, American Chemical Society, New York, April 26, 1944.

ELECTROLYTIC HYDROGEN CELLS

When, in 1930, the Consolidated Mining and Smelting Company decided upon the type of cells to be used in their new electrolytic hydrogen plant, the decision was based not only on a study of various commercial installations in use elsewhere, but also on local trials of full sized units. The original hydrogen plant was itself in the nature of an experiment in that two tank type batteries and, to compare with these, one filter-press type battery were installed. In the subsequent years of service these and other types were carefully watched and the results of observations and experience were used in developing improved designs for possible future expansion.

It was found, for example, that nickel plating on the anodes should be not less than 0.002 in. if the corrosive effects of service in potassium hydroxide were to be resisted for a reasonable period; that cells must be robust; that welds at corners should be avoided; that insulators for anodes in contact with nascent oxygen need to be decidedly resistant if a satisfactory life is to be obtained. The use of metal gas collecting bells and chambers was found to lead to a variety of unexpected effects with partial short circuits not uncommonly giving very rapid corrosion and impure gas. The installed cells of the filter-press type were found to require considerable maintenance work which was inconvenient and expensive because of the size of the units. These and many other such findings which were made the hard way resulted in the development of a new cell. While it is not claimed that this is by any means the ideal cell, it is believed to be in many respects a great advance on other and older types.

The concrete top, the characteristic feature of the new cells, is a casting comprising the gas collecting bells and gas chambers, the electrode supports and insulators and the cell cover, which in earlier hydrogen cells of the tank type were all separate items. To this concrete top are attached the electrodes, the asbestos diaphragms, the outer asbestos collecting skirt, the feed water system and the bus bar and gas main connections. When the assembly is fitted onto the steel cell tank, it forms a complete cell for the production of hydrogen and oxygen.

The cell top is made entirely of reinforced concrete and is in the shape of a rectangular box divided by a 5-in. vertical partition into two equal compartments serving respectively as hydrogen and oxygen collecting chambers. The open ends are subsequently closed by cementing in concrete plates. The electrodes are held in position by metal rods attached to the centers of their upper edges.

Directly above each electrode and parallel to it there is in the concrete, which forms the floors of the two gas chambers, a "slot" or long narrow inverted trough which serves as a gas collecting bell. One half of the length of each "slot" or trough is closed in above with a sloping ceiling which constitutes a section of the floor of the gas chamber immediately above. Over the other half of its length the slot is open into the other gas chamber. As the slots after assembling are alternately over anodes, and cathodes, thus collecting respectively oxygen and hydrogen, they are open alternately on one side and the other feeding the gas into the appropriate gas chamber. The oxygen and hydrogen, kept from mixing by means of asbestos diaphragms, are thus caught in the collecting bells and pass through the openings or ports into their respective chambers.

The diaphragms are woven asbestos cloth 0.1 in. thick and weighing about 0.36 lb. per sq.ft. Low cotton content, about 1 percent, is specified. The standard diaphragm arrangement is to enclose completely each anode with an asbestos cloth bag, open only at the bottom below the lower edge of the anode. These bags force the rising oxygen into the proper gas chamber. The cathodes are not individually enclosed but a single skirt of asbestos cloth surrounds the entire electrode assembly. The hydrogen is thus all trapped and, being excluded from the oxygen collectors, is directed through the cathode slots or bells into the hydrogen chamber.

In actually assembling the cell, the anode diaphragms are first attached while the concrete top is inverted. The latter is then supported upright on a rack and the anodes put into place. The cathodes are next inserted and the asbestos skirt then put in place around the whole top. This is hung on the stove bolts and has a 4-in. overlap which is closed in place by hand sewing. Holding strips of iron are put over the bolts and tightened down with nuts whereby the skirt is permanently held in place. A cement grout is placed between the top edge of the strips and the concrete of the cell top.

In the top of each concrete gas collecting chamber there is set a standard 2-in. iron coupling. This serves as the gas off-take and screws into a 4-in. or 5-in. tee.

A bracket bolted to the concrete cover supports the feed water line which is made of lengths of glass tubing joined with rubber sleeves. At each cell there is a steel tee with a nipple and valve directly above the feed water cup attached to the side of the cell tank.

Cell tanks are of welded 0.16 in. mild steel plate construction, avoiding welds at the corners as far as possible. The tank for the standard 15 electrode, 10,000-amp. unit is just over 2 ft. x 3½ ft. x 4 ft. high. When arranged in double rows with the minimum convenient working space, each cell requires 18 sq.ft. of floor area, including aisles and space for auxiliary equipment.

The electrodes are formed of two 0.06-in. mild steel plates welded together to give an effective 0.3-in. thickness. Bus bar connectors and supporting rods are riveted in place between the plates. Anodes have a 0.003-in. nickel electroplate directly on the steel while the cathodes are plain. In this 15-electrode cell there are seven anodes and eight cathodes, each about 39 in. square. This gives an anode current densitl of 67 amp. per sq.ft. The face-to-face spacing of the electrodes is 1.3 in. and the voltage is about 2.25 v. with 28 percent potassium hydroxide solution at the normal operating temperature of 75 deg. C. An alternative 17 electrode type cell using the same steel tank but with 1.1-in. face-to-face spacing, is also in use to a considerable extent and gives a somewhat lower voltage, about 2.15 v., but is higher in initial cost.

As this is a fairly recent development, the total life of these cells is not known but the earliest units are now in their sixth year, with every hope of at least three or four years still ahead of them. From experience with other cells it is expected that diaphragms are good for not less than ten years and that anodes will not need to be replated with nickel within that period. The iron electrodes themselves and the iron cell tanks should last considerably longer. The life of the concrete remains to be seen but it is certainly sufficiently long to make this material economic. The cost of the new cells is a little over half that of the older cells, originally installed.

B. P. Sutherland, Consolidated Mining and Smelting Co. of Canada, before The Electrochemical Society, Milwaukee, April 13-15, 1944.

PROFESSIONAL MEN

Judgment and discretion plus broad knowledge, training and experience make the professional man. He serves society in its most complex fields, and loses his professional status when he assumes that society serves him.

The professional group service new problems, sometimes even novel problems. Judgment and discretion are the two things that the college cannot teach in its undergraduate courses; they can receive only very limited attention in the postgraduate field, and therefore must be acquired after graduation. Experience alone does not suffice, for that leads too much to repetition.

Judgment and discretion require a background of most profound knowledge. The professional man can never acquire too much knowledge. Since education is the one best method of acquiring knowledge it is, therefore, essential that those qualifying for the professions must continue education after leaving college. They must set up a special curriculum fitted to their chosen professional field that ever broadens their knowledge. The text cannot be discarded with the commencement gown.

A new and broader phase of knowledge enters here. Each new fact must be analyzed as to its applicability, its limitations, its potential utilization. In the field of chemistry, for example, it is not alone sufficient to be familiar with the chemical phenomena, for one must also understand the impact of application upon society in general. This is the training which develops judgment and discretion. Society expects this service of the professional man.

It seems almost self-evident that a man possessing these qualifications automatically possesses high standards of ethics. He respects his fellow man and recognizes the necessity of the service rendered by other groups. He must understand that he is an essential part of society and that society delegates to him the solution of certain complex problems. The solution lies not alone in the technologic aspect of the specific field, for society is not interested in the means and the method but only in the service of the result, and on the impact on society as a whole.

Society wants goods which will lighten the burdens of living throughout its whole complex organization. It demands ever increasingly better standards. So that the service is of the greatest possible benefit to the largest possible fraction, it is essential that all phases of impact on the social system be understood and be taken into the ledger account. It does not want benefits to a few at the expense of the many. True professional status is never determined by rate of pay, though society generally compensates it by commensurate reward.

—W. S. Landis, American Cyanamid Co., before American Chemical Society, Cleveland, April 4, 1944.

CHLORINE DIOXIDE GENERATOR

Because of its instability, chlorine dioxide must be generated at its points of use. The development of a new method which makes this practical is expected to be followed by various industrial applications, since the oxidizing power of chlorine dioxide in terms of "available chlorine" is 2½ times that of chlorine.

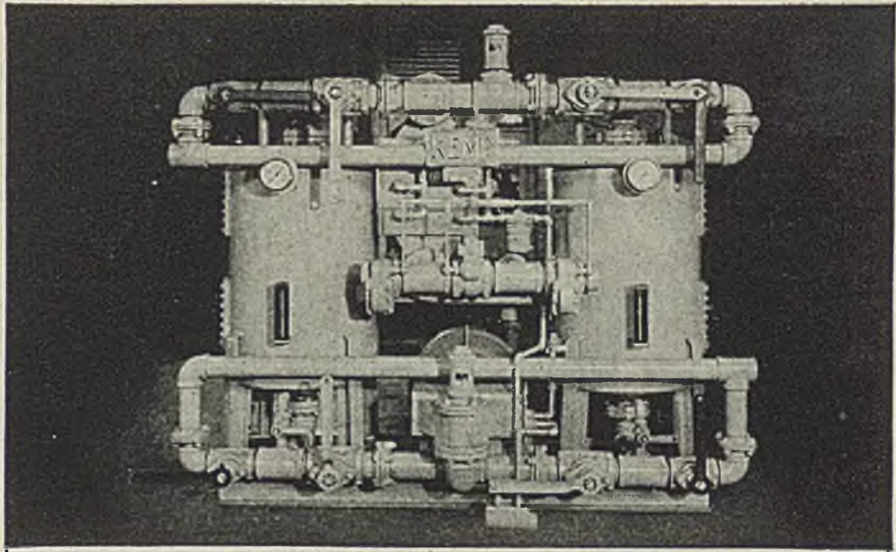
Chlorine dioxide has already proved to have specific values in improving taste in public water supplies, checking blue mold in citrus fruits, and reducing spoilage in canned foods. On an experimental scale, sterilizing the atmosphere with chlorine dioxide increases the yield of penicillin.

In the maturing and bleaching of flour, chlorine dioxide has demonstrated it superiority over other chemicals, and it is expected to prove useful also for bleaching such products as starch, soap, paper and textiles.

The generator used in the new process consists of two vertical steel towers, 4 in. in diameter and 3½ ft. high, lined with stoneware or glass, and filled almost to the top with flaked commercial sodium chlorite. Chlorine and a large excess of air are fed at the bottom of the first tower, and the chlorine dioxide formed is carried through by the air current into the base of the second tower and passes out the top into a mixed gas manifold.

When the chlorite in the first tower is exhausted, the flow is reversed, the first tower being disconnected, recharged, and introduced as the second tower, without interruption to continuous gas generation.

Although the possibility of an explosion



is remote because an air pressure operated control valve in the chlorine line guarantees proper dilution of the chlorine with air, safeguards are provided which will allow harmless discharge of the salts and gases in case of accident.

Chlorine dioxide distribution lines may be as numerous as necessary. Each is controlled through a hand-operated valve, a rotameter, and a valve for admitting by-pass air into the line.

The control of the total pressure is effected by means of an Arca regulator, which is actuated by the pressure of the gases. The control of the partial pressures can be maintained by varying either the input of chlorine or the air flow.

To determine the chlorine dioxide content in the gas mixture, an opaque Hempel tube is used for sampling, the gas is absorbed in 10% potassium iodide, and titrated with 0.1 N or 0.01 N thiosulfate.

E. R. Woodward, Mathieson Alkali Works, before American Institute of Chemical Engineers, Cleveland, May 16, 1944.

SAFETY IN STYRENE PRODUCTION

WHEN war came to the U. S., industry was called upon to design and build for mass production plants to produce a material which previously had been made in comparatively small quantities. The war time demand for styrene rose to approximately thirty-three times that of any peacetime need. This demand called for more than just design and construction. It called for men who could take the plant, put it into operation and produce the desired product. The job of teaching these men safe practices, while preventing accidents, turned into a major project.

The styrene plant has the usual safety problems that are found in the chemical industry, plus a number of those common to the refining of petroleum. Among the most common chemicals used are: propane, ethylene, natural gasoline, muriatic acid, anhydrous hydrogen chloride, sulphuric acid, aluminum chloride, caustic soda, ethyl benzene and styrene. In addition to these, there are a number of intermediates which include mixtures of the above chemicals in varying proportions. Safe handling of most of these chemicals is well known throughout the chemical and petroleum industry. It was just a question of teaching the men who had never worked in either of these industries how to work safely with these chemicals.

The one material upon which there was little information available, is styrene. Styrene is a colorless liquid with a boiling point of 145 deg. C. It has a peculiar gassy odor which provides ample warning of toxic concentration. It does not seem to produce the blood damage so characteristic of benzol and other ring compounds which styrene closely resembles in structure. In a series of several hundred periodic examinations of workers, no damage was found.

The principal toxic action of styrene seems to be that of irritation of the lungs upon inhalation and of the skin upon contact. Also to be considered is the fact that light narcosis may be produced by inhaling small amounts of styrene, as with other aromatic hydrocarbons. Following exposure to high concentrations of styrene, with the accompanying respiratory tract irritation, there may also be liver and kidney damage. The eye and nose irritation produced by styrene serves as a warning against hazardous concentrations. At 200 ppm. a disagreeable odor is present but eye and nose irritations should not be produced. It is believed that no serious health hazard should result in the case of repeated exposures to this concentration.

The styrene plant at Texas City is so built that such concentrations are almost impossible to obtain. The entire plant is outdoors, with only the closed control houses inside the area where styrene is present. These control houses are built and ventilated so that a positive pressure is maintained inside them which does not allow the entrance of any vapors from the outside. This same arrangement also prevents toxic action from benzol, which is present in quantities as large, or larger, than styrene.

All of the chemicals used have a distinctly corrosive action upon the skin, if men come in contact with it in even small quantities. A number of safety devices have been installed throughout the plant to handle accidents of this kind. All areas are equipped with safety showers, eye baths and fire blankets.

Safety equipment, such as goggles, respirators, hard hats, rubber gloves and rubber suits, are furnished to the men wherever necessary. Mechanical guards have been placed on all machinery and equipment.

The plant is equipped with a medical department consisting of an up-to date dispensary with a registered nurse in charge and trained first aid attendants on duty twenty-four hours a day, seven days a week. First aid training is given to as many people in the plant as possible. Employee safety meetings are held once a week. A large bulletin board, close to the entrance to the plant, shows the safety record, as well as the records of various departments throughout the plant.

It is hoped that each employee will not only work safely for himself, but will also be on the lookout for the safeguarding of everyone who works with him. Safety in a styrene plant, outside of a few extra precautions which must be taken, is no different than safety in any other industry.

H. K. Eckert, Monsanto Chemical Co., before 32nd National Safety Congress, National Safety Council, Chicago.

PORCELAIN PIPE AND FITTINGS

PORCELAIN used in pipe and valves has a thick wall and is glazed inside and outside. Systems of 2,000 feet or more have been installed with many branches and change of pipe size. It is being used indoors, outdoors, and underground.

The manufacture of this porcelain may be considered as similar to the manufacture of cast iron. It is run into absorbent molds in a liquid state, and the molds absorb a large part of the moisture. It goes through further careful drying, is then machined, glazed, and fired at high temperature, after which the final finish is made and the metal parts, such as iron flanges and valve operating mechanisms, are put on. Porcelain may be cast into any desired shape or size which it is possible to mold and fire with success.

The only metal used is on the outside

and this metal in no way comes in contact with the materials which the porcelain handles. Valve stems, valve check balls, housings, etc., are all of porcelain, so there is no possibility of chemical or electrolytic action.

This porcelain is being used successfully at temperatures as high as 800 degrees F.

Porcelain pipe is made in sizes up to 8 in. i.d. and with all fittings such as ells, tees, angles, crosses, reducers are equipped with standard iron pipe size flanges and bolt circles, so that it is possible to replace parts of metallic pipe systems with porcelain. In order to obtain pipe with uniform wall thickness and density, pipe lengths are limited to 5 ft. Special parts and devices for chemical processes are being made of much large diameters. Valves such as check valves, angle and "Y" valves, plug valves, globe valves, dump valves, also slip joints and porcelain strainers, are made in sizes up to 6 in.

E. H. Jacobs, Illinois Electric Porcelain Co., Macomb, Ill., before National Association of Corrosion Engineers, Houston, Tex., Apr. 12, 1944.

POSTWAR ENGINEERING EDUCATION

After the war industry expects better educated engineers. As a matter of fact, industry was expecting them before the war. It is a continual request and need.

Considering possibly that industry does not know exactly what it expects from the engineering schools because many in industry are not sufficiently well acquainted with the work which these institutions are carrying on, industry has got what it deserves from our engineering schools and maybe more. Possibly the engineering schools have done more than their share in the cooperation that is so necessary between them and industry. They have made an honest effort to anticipate industry's needs and have attempted to meet them so far as good engineering education policies and limitations would permit.

There has been considerable talk of late regarding the short-comings of engineering education; that engineers should know more about history, English, social sciences, and the like. Much of this lack is due to the type of education which our young people are getting in our public schools. If the colleges had better trained young men and women to work with they would doubtless turn out a better product and could devote their time to better use than at present, for they would be relieved of a certain amount of educational responsibility.

The war has upset practically every line of activity in this country, including education. The demand for engineers and technically trained men has increased beyond belief. From an education standpoint it may seem that the demands of the armed forces have brought about a type of inferior education; but perhaps this present crisis has not merely served to accelerate a trend which had been developing over a long period of years. We are advancing technologically at an accelerating rate, but educationally we may be moving in the opposite direction. In other words, we have been putting an increasing emphasis on engineering and a decreasing emphasis on education, and yet we all know that in order to fulfill his proper destiny the engineer must be an educated man.

Expediency has too often been the controlling factor in the past just as we find it at the present time in an aggravated form. A practical engineering education has been recommended with a heavy accent on "practical," less on "engineering," and least on "education." Those who advocate this type of education probably have in mind trade-schools and have not distinguished between that type of education and an engineering education, which should be something entirely different.

Possibly another fault with the educational system, and in this can be included under-graduate education leading to a bachelor's degree, is that the educators have taken a leaf from industry's book. Our mass production in industry has been one of the wonders of the world and has contributed so much to our way of life and its enjoyment. Mass education, however, is an entirely different matter, for you are not dealing with inanimate things but with human beings, each one of whom is an individual with individual characteristics—no two are exactly alike, nor will they respond similarly to similar treatment as we expect industrial materials to behave and to conform. Furthermore, each one considers himself an individual and inwardly revolts at being considered a part of a mass, an unimportant unit in a group. In this country particularly, the individual has been a dominating factor and it is important that we recognize this in our educational work.

Industry expects and needs well educated men and women. We expect the engineering schools to choose carefully the best of the talent presented to them. The graduates from our schools should have a fundamental, technical education with a thorough understanding of engineering habits, engineering methods, and engineering ethics. The engineers turned out after the war must be better than the ones being turned out before the war, and each succeeding year must show an improvement in the quality of your product.

Young people should know their place and the place of their profession in our social structure. They should be given to understand that their qualifications fit them to be the peers of any in the other professions and that they can meet them at least on even ground. They should understand that since their profession is dedicated to the service of mankind and to the improvement of man's lot on earth, they should know something about man.

Investigations have shown that engineers have a greater opportunity to become leaders in industry than men with any other type of education. This is a great tribute to our engineering schools, but it is not surprising when we consider that we are living in a technological age. The engineer must continue to play an increasingly important part as the influence of technology grows. However, the importance of human engineering has become so great that it is an absolute necessity for the continued progress of industry. If the engineer fails in this assignment he may find that those in other professions who are less qualified, will assume duties right-fully belonging to him, thus belittling his importance and that of his profession.

So anything that can be done to fit these young people to be good citizens and to give them a proper understanding of their place in our social structure will benefit not only industry but our profession and our nation as well.

A. D. Bailey, Commonwealth Edison Co., before Division of Administrative Officers, S.P.E.E., Chicago, Oct. 25, 1943.

PRESSES AND PROCESSES FOR METAL POWDER PRODUCTS

POWDER metallurgy is the art of producing metal powders and of making shaped objects from individual, mixed, or alloyed metal powders, with or without the inclusion of non-metallic constituents, by pressing or forming these objects and simultaneously or subsequently heating them to produce a coalesced, sintered, alloyed, brazed or welded mass, characterized by either the absence of fusion, or by the fusion of a minor component only. The art is definitely not limited to pure metals. The methods include those of producing ceramic parts, which are largely metal oxides, as well as cutting dies and drawing dies of metal carbides. Abrasives made of carbides and/or oxides are inseparable in their similarity.

The essential features of powder metallurgy are the production of a metal powder, and the consolidation of this powder at a temperature below the melting point of the major constituent into a reasonably strong solid form. The coalescence of the particles requires the application of mechanical pressure and (except with metals having a low thermoplastic range) heat.

Metal powders of almost every known metal are now available. Most are produced by either electrolysis, atomization or gaseous reduction of metal oxides or other salts. Tungsten metal powder, for instance, is manufactured by the reduction of tungsten trioxide by either carbon or hydrogen. Iron, nickel and copper metal powders are usually produced by the reduction of their oxides by gas (hydrogen or carbon monoxide) or by electrolysis. Low melting point metals such as aluminum, zinc, and lead are frequently produced in powder form by atomization of the molten metal. There are other methods but the above methods provide more satisfactory materials for the fabricators of metal powder compacts.

In the preparation of powders purity, size, and proportion of sizes are very important factors for compounding alloys or mixtures with non-metallic components. A wide variety of powders and powder mixtures is available. Correct particle size of powders, as usually gaged by the standard screen mesh through which they will pass, is highly essential to proper flowing and filling of mold or die and the relation of voids in initial compacting. The method of powder preparation also governs whether particles are more or less equiaxed or relatively flat. The metal powders are successfully handled in much smaller average grain size than synthetic resin mixtures.

Shape of metal powder particles is determined, for the most part, by the method of preparation. Aluminum powder made by granulation is quite different from that made by stamping. Copper powder made by reduction of copper oxide is decidedly different from that made by electrolysis. The shape of particle of metal powders is spherical when produced by condensation, as in the case of zinc, or by the decomposition of carbonyls, as in the case of iron or nickel.

Powders may be pressed either hot or cold, but in the majority of cases the operation is carried out at room temperatures. The powder is pressed in dies or molds made of hardened or special steels, selected to have as low a coefficient of friction as possible. In some cases, where small pieces are pressed from highly abrasive powders, the dies are made of hard carbide compositions produced in turn by powder-metal methods. Shrunk ring die construction is often used with pre-stressed wall members to minimize deflections under load.

Depth of the die will depend to a certain extent upon the compression ratio of the powder which is usually in the neighborhood of 3:1. In some cases, however, where fine powders are used, the compression may be as high as 6:1, or even 8:1.

Pressures required vary between 5 and 100 tons per sq.in. and are related to the yield point of the metals and density and flow shape of the part. Slow compression is not as satisfactory as a quick stroke. A fast powerful stroke tends to greater uniformity of working. A brief dwell may be required to relieve the bursting compression of trapped air unless the powder hopper is evacuated. The timing of presses has proven highly satisfactory.

Compression molding of metal powders follows much the same rules as govern the synthetic resins. Pressure-welding of powders of thermoplastic materials, both metallic and organic, takes advantage of intermolecular attraction for bonding purposes. Distinction should be noted between such pressure-welding of similar fragments and the bonding of powder mixtures in which some filler powders are bound together by other constituents introduced as adhesives or binders and in which the reaction may be considered to be thermosetting.

The four essentials of thermoplastic pressure-welding are: (1) intimate contact, (2) clean particles, (3) suitable temperatures within their thermoplastic range, (4) sufficient time to permit adjacent particles to improve their relative alignment and bring into play cohesive forces for bonding. Such pressure-welding can occur almost instantly between particles of a steel shaft in a steel bearing or of a steel sheet in a steel draw die when the insulating film of lubricant breaks down.

Pressure above the yield point of the material assures intimate contact. Further improvement may be accomplished by mechanical working of the compact, forging granules into even more uniform compactness and filling cavities which molecular or atomic forces could not close. Oxidation of particle surfaces forms an effective barrier against forming molecular bonds and accordingly a protective atmosphere such as hydrogen is usually required during the welding or sintering period.

Where porosity is desired the particles

need only join at random points of contact. However, voids among the cohesive particles may be reduced by pressure or subtantially eliminated by plastic working during or between applications of heat sufficient for recrystallization. The thermoplastic range begins at initial recrystallization temperatures and continues to the melting point. As lead and tin recrystallize below atmospheric temperatures, it is reported that their powders may be pressure-welded without added heat at pressures as low as 500 lb. per sq.in. Tungsten is an outstanding commercial example of converting metal powder into practically flawless, ductile wire without ever attaining the melting point though temperatures are necessarily high during processing.

Where continuous porosity is needed for lubrication or for filtering, the voids between particles must be kept connected or opened up. To do this about 1 percent of zinc stearate or other finely powdered metallic soap is mixed throughout the metal powder before briquetting and then boiled out in a low temperature baking oven before sintering.

Porous and oil impregnated bushings for self lubrication, made by powder metallurgy, are commonly mass produced in competition with solid bushings. Many iron powder bushings use a small percentage of copper as a binder and are sintered in a hydrogen atmosphere well up in the recrystallization range of copper. At such temperatures, a copper-iron solution can form at the contact points between particles to join the iron particles together as in copper brazing. In the bronze bearings, the tin is activated to form a copper-tin bonding alloy between the copper grains.

Metal powder products which are dense, as opposed to the porous types may be divided into two classes: those products which probably could not be made otherwise as satisfactorily, such as refractory-metal wire and sheet, cemented-carbide tools, electrical contact materials, etc.; and those parts which can also be made by such methods as die-casting, or by precise machining of wrought or cast metal, such as gears and other complex shapes. It is often possible in powder metallurgy to briquette and sinter a piece to the finished size to tolerances of ±0.001 in. so that expensive machining and scrap are entirely eliminated.

Density, especially in the case of metal powder products, is decidedly important. Upon it depends tensile strength, impact strength, hardness, and ductility, all of which increase with increasing density. A charge of exactly the right amount of powder is especially important in the production of dense compacts to precise dimension.

Press construction for powder compacting requires all the precision and ruggedness of the best metal working presses. Die clearances are even closer than in most metal working so that precision gibbing and carefully keyed frames with prestressed tie rods are of particular value on both hydraulic and mechanical types. Fast crank actions contribute to uniformity.

E. V. Crane and A. G. Bureau. The E. W. Bliss Co., before The Electrochemical Society, Milwaukee, April 13-15, 1944.

FILMS OF SYNTHETIC MATERIALS

TRANSPARENT oiled silk has attained great popularity for making light raincoats, capes and umbrellas. During the last three years the use of unsupported synthetic films has become firmly established and articles made from them have shown great serviceability. Preparation of these synthetic films involves a process essentially different from that used for oiled silk. In the latter method, Japanese silk is impregnated with blown linseed oil which is oxidized and polymerized at a temperature of 80-90 deg. C.

Development of synthetics has produced many materials suitable for preparation of rainproof clothing and other commodities. These materials are of great importance since they make it possible to produce films which can be readily fabricated and which need no woven fabric to give them the necessary tensile strength. Polyvinyl chloride is the most important of these. In the free state this is a colorless, tasteless and odorless powder, characteried by a high resistance to aging and to chemicals. Since polyvinyl chloride is thermoplastic there is an upper temperature limit to the conditions under which it may be used. This temperature is about 70-80 deg. C.

Introduction of plasticizers gives products resembling rubber or leather. Soft, flexible and elastic films may be made from a mixture of 60-65 parts of polyvinyl chloride and 40-35 parts of plasticizer, to which coloring material and fillers may be added. The mixture is allowed to stand for some fifteen hours at a temperature of 80 deg. C. During this preliminary treatment the polyvinyl chloride absorbs plasticizers. The period of subsequent treatment at a higher temperature is thus reduced. Final gelatinizing is carried out on pairs of rollers heated to about 150 deg. C., the relative speeds of rotation of the rollers being 4:5. Under these conditions the mixture forms a homogenous plastic mass which is rubbery at normal temperatures. The hot mix is transferred to a calendering machine the rolls of which are heated to about 150 deg. C.

Quality of the finished article depends upon the method of incorporation and upon the various additions, particularly plasticizers. The following have been found to be compatible: tricresyl phosphate, dilauryl phosphate, various dialkyl and glycol phthalates, and toluene sulphonic esters or sulphonamide derivatives. These are all liquids which have practically no vapor pressure at normal temperatures. Plasticizers vary in their softening ability and in their effect upon the fluidity of the polyvinyl chloride on the heated mixing and calendering rolls. The tensile strength and resistance to cold of films are also influenced by the plasticizer. The best compromise between high tensile strength, resistance to cold and to chemicals is achieved by the use of mixed plasticizers. It has been shown that a considerable improvement in the resistance to cold may be brought about by the incorporation of other plastic materials which, although not compatible with polyvinyl chloride alone, form homogeneous mixtures in the presence of suitable liquid plasticizers.

An order in 1940 by the Reichstelle für Chemie stipulates that materials of this type to be used for clothing must have a tensile strength of 1.5 kg. per cm. and 120 kg. per sq.cm. and must be able to sustain an extension of 200 percent, as well as show satisfactory resistance to an impact test at —15 deg. C.

Digest from "Unsupported Films of Synthetic Materials," by T. Trimborn, *Melliand Textilberichte*, 125, March 1942. (Published in Germany.)

COPPER SULPHATE FOR WATER PURIFICATION

THE USE of copper sulphate for cleaning filters was so successful in removing clots of mud in gravel beds that it was decided to use this same compound for treating waters of the Water Supply and Sewage Department of S. Salvador, Baia.

The water is difficult to treat because it contains large quantities of iron salts, organic materials and muds which form a complex floc. The resulting suspension of iron hydroxide and organic material tends to ferment and decay. Such water was treated with copper sulphate on a laboratory scale with satisfactory results. It was then applied on an industrial scale, using half a gram per cubic meter in a mixture with aluminum sulphate. The hydroxide was precipitated so as to remain on the surface of the water. The organic material was destroyed by carbonization. The final pH of the treated water should be 6.2-6.3 during treatment. By varying the copper sulphate doses from 0.5 to approximately 0.8 g., the water distributed to the public contained 1.32-2.46 g. of iron salts per cu. m.

Digest from "Interesting Aspects of Treatment of Water," by Armando Navarro Ramos, *Revista Brasileira de Quimica*, XVI, No. 95, 416-420, 1943. (Published in Brazil.)

OXIDATION OF FUELS

RECENT tests have shown that when the intake temperature is raised from 65 to 150 deg. C., at 1,200 r.p.m., the octane number of cracked gasoline drops from 72 to 60. With straight-run gasoline the drop was only from 69 to 68. When the motor method of testing was used, the octane number of the cracked gasoline dropped from 77 to 69, while for straight-run gasoline it remained at 69.

At elevated temperatures of preheating in the intake system, cracked gasoline of 74 octane number is not as stable against knocking as straight-run gasoline of 66 octane number. A rise in cylinder temperature results in a sharp drop in the octane number of olefins. An increase from 100 to 190 deg. reduces the octane number from 87 to 66, while for a gasoline consisting of naphthenes and paraffins, the drop under the same conditions was from 84 to 78 octane.

In order to determine the cause of the specific temperature sensitivity of olefin fuels, experiments with a model engine intake system were conducted. Changes in the fuel occurring in the suction stroke which could affect the stability to knocking were determined by analyzing the condensate for peroxides.

Oxidation in the intake system occurs only in the liquid film on the wall of the tube with incomplete vaporization of the fuel and when the latter contains unsaturated hydrocarbons. Preheating the tube and air to 170 deg. completely prevents formation of peroxides.

Amount of peroxide formed in the liquid film is sufficient for substantial lowering of the antiknock properties of the fuel. A modification of the preheating system to permit rapid and complete evaporation of the fuel would be useful. Properties of the surface of the intake tube should be studied to improve vaporization of the film.

Digest from "Oxidation of Fuels in the Intake System of Engines," by B. A. Kravets and A. S. Sokolik. *Izvestiya Akademii Nauk, Otdelenie Tekhnicheskikh Nauk*, No. 3-4, 27-32, 1942. (Published in Russia.)

ANDA-ASSU DRYING OIL

Production of drying oils has become an important industry in Brazil in recent years. Approximately 4,000 tons of linseed oil was produced in 1935, for example, and 21,000 tons in 1939.

A very promising oil which is little known to the paint and varnish industry is anda-assu oil obtained from the seeds of *Joannesia princeps*, a plant which flourishes in Brazil, especially in the state of Espirito Santo.

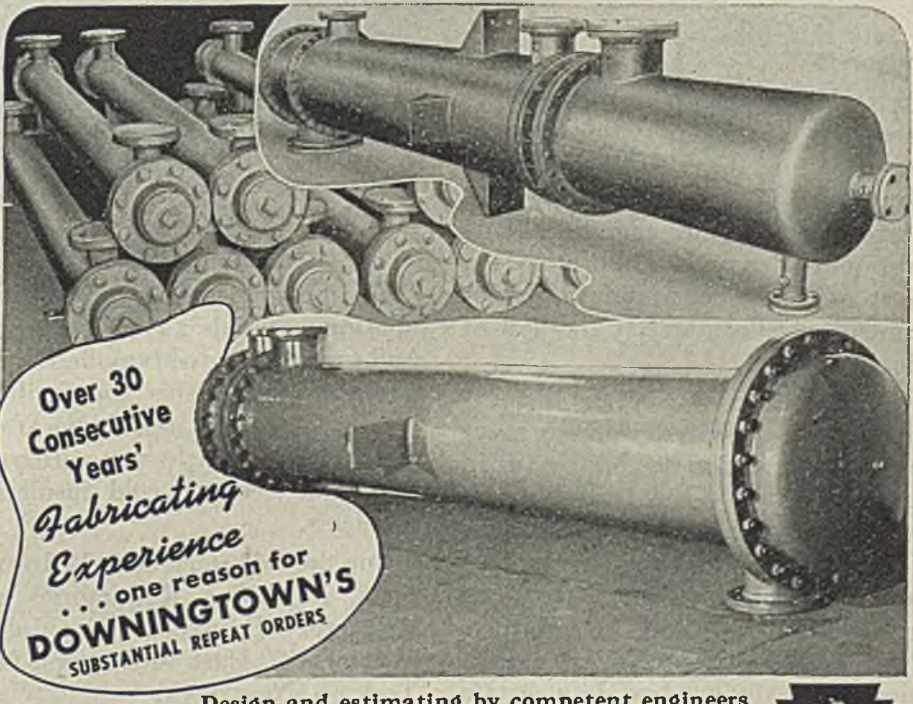
The oil is extracted in the cold. A pressure of 300 kg. per sq.cm. applied for 30 min. gives a yield of 22 percent oil of a clear, yellow color. It has an iodine index of 142 (by Wijs method) and an acid index of 0.30. When spread on glass plates under ordinary laboratory conditions a dry film forms after 60 hr. When the oil is treated for 5 hr. at 180 deg. in the presence of CO_2 with 0.15 percent lead and 0.03 percent manganese, in the form of precipitated resinates, a dry film forms after 24 hr. at 20 deg. C. and 65 percent humidity.

Two paints were prepared, one with the crude oil and the other with boiled oil, having the following composition:

Oil	53 percent
Zinc oxide	52 percent
Turpentine	5 percent

Drying agent was added to the paint made with crude oil. Two coats of each paint were applied to iron plates and the plates set out in the open at an angle of 45 deg. and facing north. After 12 months of exposure the paint made with boiled oil was practically unchanged whereas the other had fine cracks. The painted surfaces were also exposed to artificial conditions, which consisted of the following cycle: 17 consecutive hours of carbon arc light and a half minute humidification every half hour; 3 consecutive hours of energetic washing followed by one hour of airing. The surface of the paint made with crude oil disintegrated after 11 such cycles whereas the paint with boiled oil lasted through 16 such cycles.

Digest from "Application of Anda-Assu Oil," by Antonio Sacco Neto, *Revista de Quimica Industrial*, XII, No. 139, 18-19, 1943. (Published in Brazil.)



CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor

RECOMMENDED AS ESSENTIAL

Chemical Engineering Thermodynamics. *By Barnett F. Dodge. Published by McGraw-Hill Book Co., New York, N. Y. 663 pages. Price $6.*

Reviewed by George Granger Brown

Here is a thorough scientific treatment including a complete explanation in English as well as in the language of mathematics. In reading this volume one feels that Professor Dodge has so put himself into this volume that when you open the pages he speaks directly to you as though he were sitting across the table. He begins properly with the fundamental concepts, which are clearly set forth in the excellent discussion of the first two chapters, setting forth the definitions and concepts of the two fundamental hypotheses, or "laws," and reviewing some mathematical relationships to be used in the following chapters.

The third and fourth chapters cover the mathematical development of the first and second laws in an orthodox manner, with the ideal gas properly relegated to little more than a single page. Chapter 4 includes the treatment of solutions and special cases of equilibrium, with a few lines on generalized forces in which the function F is redefined in a different way than used elsewhere throughout the text. Fortunately this double meaning is used only on p. 151. At no other place is any attempt made to cover surface, electrical or effects other than heat, compression and chemical.

The pressure-volume-temperature relationships and equations of state are presented in chap. 5 and used in chap. 6 to develop the thermodynamic properties of fluids.

The last seven chapters bear titles that a chemical engineer would expect to find in a text on unit operations or principles of chemical engineering. Thus for the first time we have a clear demonstration of the total dependence of modern chemical engineering on thermodynamics.

Chapter 7, "Compression and Expansion of Fluids," covers the application of thermodynamics to piston compressors, jets, and free expansion. Most of the treatment is based on the ideal gas relationship rather than the use of specific properties of various materials. Chapter 8 on fluid flow covers the flow equation and its application to flow meters, nozzles, pipes, etc. In chap. 9, "Heat Transfer," we find also the properties of materials and solutions and their application to heat transfer problems. Chapter 10, "Refrigeration," also covers liquid air and air separation, solid CO_2, as well as the compression and absorption processes of refrigeration.

Chapter 11, "Chemical Equilibrium," includes the application of the "third law." Chapter 12, "Vaporization and Condensation," includes the phase rule, vapor pressure and vapor liquid equilibria. Chapter 13, "Distillation Processes," covers differential vaporization, multicomponents, steam distillation, equilibrium plates and plate efficiency, the various methods for computing equilibrium plates, heat loss from column, and vapor recompression.

In treating these various operations the author has shown the thermodynamic phases without attempting a thorough treatment from all standpoints as in the specialized texts and handbooks dealing with such operations. But the treatment and information presented are invaluable to anyone dealing with these operations or teaching chemical engineering.

The book appears to have been written primarily from the standpoint of a reference volume or text for graduate or advanced students. With skillful handling and the addition of problems it might prove satisfactory for undergraduate work, but it appears poorly arranged and burdened with many equations of special application for that purpose. The complete explanations and large number of examples demonstrating the application of the principles and the derived equations make the volume ideal for self-study.

There are surprisingly few places where the reviewer might like to ask Professor Dodge for further explanation. The stable and neutral equilibria of Gibbs appear to have been merged into a single concept which may have lead the author to state that $dF = 0$ is a criterion for equilibrium but $\Delta F = 0$ is not.

"Chemical Engineering Thermodynamics" is recommended as essential to all practicing chemical engineers, teachers, and advanced students.

RECENT BOOKS RECEIVED

The Analytical Chemistry of Industrial Poisons, Hazards and Solvents. 2nd ed. By M. B. Jacobs. Interscience. $7.

Basic Mathematics for Engineers. By P. G. Andres, H. J. Miser & H. Reingold. Wiley. $4.

Colorimetric Determination of Traces of Metals. E. B. Sandell. Interscience. $7.

Hackh's Chemical Dictionary. 3rd ed. Edited by J. Grant. Blakiston. $12.

Modern Wood Adhesives. By T. D. Perry. Pitman. $3.

Plastic Horizons. By B. H. Weil & V. J. Anhorn. Cattell. $2.50.

Quantitative Chemical Methods for Engineering Students. By O. M. Smith & L. F. Sheerar. McGraw-Hill. $2.50.

Systematic Inorganic Chemistry. By D. M. Yost & H. Russell, Jr. Prentice-Hall. $6.

Tool Steels. By J. P. Gill and others. American Society for Metals. $6.

TARDY TRANSLATION

The Chemistry of Synthetic Substances. *By Emil Dreher. Published by The Philosophical Library, New York, N. Y. 103 pages. Price $3.*

Reviewed by C. L. Mantell

Although not obvious, this volume is a translation from the German. It attempts to give an introduction to the chemistry of organic high polymers, discussing the high molecular organic compounds with a survey of relations of synthetic high molecular compounds to drying oils, the principles of polymerization, the development of the chemistry of high molecular organic compounds, the various types of polymerization products, the influence of the constitution on the capacity for polymerization of low molecular compounds, the effect of substitutes, the processes of polycondensation, and the recognition of solubility of high molecular film-forming substances.

The book is written distinctly from the German viewpoint, with practically no references to the important American literature. The terminology is German and the translation leaves something to be desired, as does the printing and bookbinding job inasmuch as there are numerous misspellings and examples poor typography.

The presentation suffers from lack of good organization and falls far short of achieving its purpose. References after 1938 are conspicuous by their absence.

ANOTHER DICTIONARY

Illustrated Technical Dictionary. *By Maxim Newmark. Published by The Philosophical Library, New York, N. Y. 352 pages. Price $5.*

Reviewed by M. G. Callaham

Purpose of the dictionary, according to the author's preface, is to supply a wide and representative selection of officially approved and modern terms and to "contribute to the progress of standardization in the field of technical definitions." A very long list of subjects is covered and the idea is unquestionably good. Technical terminology is developing so rapidly that it is difficult to keep up with it without the aid of new dictionaries. Moreover, there is room for a dictionary of less scholarly nature than Chambers' excellent volume. But even a dictionary for the operator and more practical engineer may be expected to be reasonably accurate. The symbol for aluminum, is still Al and not "A" according to the latest reports. The use of aluminum in the airplane industry is carefully omitted, although that is not a military secret. The author also overlooks the use of magnesium in alloys as a structural material. And since war technology is one of the fields, the author might have mentioned the use of magnesium in incendiary bombs. Lime, by the way, is not the "common name for limestone."

The material was collected from various organizations in order to get really modern definitions, and that was a good idea too. Unfortunately, however, many of the definitions sound like unedited notes. Under "Butadiene," the author says "It is the raw material from which the Buna rubbers are prepared. These rubbers are obtained by the polymerization of butadiene." Nippers, the author seriously advises, exert more force than pliers and should never be used as holding tools. A step-down transformer is "a transformer in which the energy transfer is from a high-voltage winding to a low-voltage winding or windings." Chambers, the scholar, is more direct, "a transformer for changing a high-voltage supply into a low-voltage supply."

In modern terminology, this dictionary has every appearance of having been "batted out," which is a pity. As one reviewer has already pointed out, there is a paper shortage.

CHEMISTRY OF CELLULOSE

CELLULOSE AND CELLULOSE DERIVATIVES. *Edited by Emil Ott. Published by Interscience Publishers, Inc., New York, N. Y. 1,176 pages. Price $15.*

VOLUME V of Interscience's High Polymers series is an ambitious cooperative effort to which 36 authorities have contributed. Their various chapters and chapter sections follow cellulose from sources to uses. Among major divisions of the text are sections on occurrence, chemical nature of cellulose and derivatives, structure and properties, preparation from natural sources, bleaching and purification, derivatives, physical properties, and technical applications.

As is usual for a symposium type of book, many specialist authors make for authoritativeness while complicating the work of the editor whose job it is to eliminate duplication and at the same time preserve a logical sequence of presentation. Dr. Ott, Director of Research for Hercules Powder Co., has succeeded very well in his position in the driver's seat. His authors have all pulled together to bring forth a volume which will serve as a specialized reference for many years to come.

RECENT BOOKS & PAMPHLETS

The Outlook for Synthetic Rubber. By M. A. Brenner. Planning Pamphlet No. 32, published by National Planning Association, 800 21st St., N. W., Washington 6, D. C. 32 pages. Price 25 cents. Synthetic rubber before and after Pearl Harbor, and postwar supply, demand and competition with natural rubber.

A.S.T.M. Standards on Rubber Products. Published by American Society for Testing Materials, 260 So. Broad St., Philadelphia 2, Pa. 413 pages. Price $2. Enlarged 1944 edition, giving in latest form specifications and test methods covering rubber and synthetic rubber products.

Surplus War Property Administration Regulation No. 1. Issued by SWPA, Washington, D. C. Mineographed release listing disposal agencies, locations of their regional offices, the

personnel in charge, and the classification of property, broken down in detail to show the types to be disposed of by each agency.

Safety Subjects. Bulletin No. 67 of the United States Department of Labor, Division of Labor Standards, Washington, D. C. 152 pages. Text book for safety courses. Basic information on industrial accident prevention.

Mellon Institute in the Second Year of War. Published by Mellon Institute of Industrial Research, Pittsburgh 13, Pa. 12 pages. Gratis. Reprint describing the Institute's activities.

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 publication 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.

Statistics of Income for 1940, Part 2. Bureau of Internal Revenue. Price 45 cents.

Directory of Important Labor Market Areas (revised February, 1944). War Manpower Commission. Price 5 cents.

Report of the Federal Trade Commission on Distribution Methods and Costs—Part I. Important Food Products. Federal Trade Commission. Price 30 cents.

Annual Report for the Period March 11, 1942 to June 30, 1943. Office of Alien Property Custodian.

The Metallography of Meteoric Iron. By Stuart H. Perry. U. S. National Museum Bulletin 184. Price 60 cents.

Manganese Deposits of the Sweet Springs District, West Virginia and Virginia. By Harry S. Ladd. Geological Survey Bulletin 940-G. Price 35 cents.

Relations of Structure to Mineral Deposition at the Independence Mine, Alaska. By Walter Clericus Stoll. Geological Survey Bulletin 933-C. Price 15 cents.

List of Commercial Standards. National Bureau of Standards Letter Circular LC745. Mimeographed.

Fundamentals of Coal Sampling. By Bertrand A. Landry. Bureau of Mines Bulletin 454. Price 20 cents.

Langbeinite. By Bertrand L. Johnson. Bureau of Mines Information Circular I. C. 7277. Mimeographed.

Standardized Construction of Mine Ventilating Doors. By J. C. Hartley and A. C. Moschetti. Bureau of Mines Information Circular I. C. 7280. Mimeographed.

War Manpower Commission Handbook on Appeals. War Manpower Commission. Mimeographed.

Electric Power Requirements of Industrial Establishments; 1939-1942 (Actual); 1943 and 1944 (Estimated). Federal Power Commission. Price 50 cents.

Paints, Varnishes, and Related Products (Colors and Containers). National Bureau of Standards. Simplified Practice Recommendation R144-43. Price 5 cents.

Effect of Humidity on Physical Properties of Paper. By Frederick T. Carson. Bureau of Standards. Circular No. C445. Price 5 cents.

Air Compressors for Automotive Service Stations and Garages (Motor-driven, ½ to 10 horsepower). National Bureau of Standards. Simplified Practice Recommendation R202-43. Price 5 cents.

Bituminized-Fibre Drain and Sewer Pipe. National Bureau of Standards. Commercial Standard CS116-44. Price 5 cents.

Painting Steel Potable Water Tanks. National Bureau of Standards. Letter Circular LC744. Mimeographed.

Treat Seed Grain. By A. G. Johnson, R. W. Laukel, and R. J. Haskell. U. S. Department of Agriculture Miscellaneous Publication No. 219.

Sewage and Garbage Disposal on the Farm. By J. W. Rockey and J. W. Simons. U. S. Department of Agriculture Farmers' Bulletin No. 1950. Price 10 cents.

Dispenser for Aerosols and Highly Volatile Fumigants. By Floyd F. Smith, L. D. Goodhue, and W. R. Ballinger. Agricultural Research Administration. ET-216. Mimeographed.

A Sound Plan for Post-War Roads and Jobs. Special Senate Committee on Post-War Economic Policy and Planning. 78th Congress, 2nd Session. Price 10 cents.

Synthetic Liquid Fuels. Hearings on S. 1243. 78th Congress, 1st Session. Senate Committee on Public Lands and Surveys. Price 75 cents.

Safety Subjects. U. S. Department of Labor. Bulletin No. 67. Price 20 cents.

Wartime Prices. Part 1—August 1939 to Pearl Harbor. By John M. Blair and Melville J. Ulmer. Bureau of Labor Statistics. Bulletin No. 749. Price 35 cents.

Industrial Injuries in the United States During 1942. Bureau of Labor Statistics. Bulletin No. 758. Price 10 cents.

Sugar, Molasses, and Confectionery. An industry report prepared by Foodstuffs Unit. Bureau of Foreign and Domestic Commerce, May 1944. A statistical resume of supply and consumption data. Mimeographed.

Pulp and Paper. An industry report prepared by Pulp and Paper Unit, Bureau of Foreign and Domestic Commerce, May 1944. A statistical resume of supply and consumption data. Mimeographed.

Facts for Industry. This designation is used for a considerable number of periodic reports on metals, minerals, chemicals, and industrial commodities for which monthly or quarterly production, sales, and stocks data are now available from the Bureau of the Census. Those requiring specific data should make specific requests so that the Bureau may send them such facts as have been thus far released.

Productivity and Unit Labor Cost in Selected Manufacturing Industries: 1939-1943. Bureau of Labor Statistics. Mimeographed.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog on the following items: Varnish, Asphalt, TT-V-51a. Shortening, EE-S-321. Calcium-Chloride, Hydrated; Technical Grade, O-C-106a. Lithopone, Dry (Paint-Pigment); TT-L-426. Sodium-Bicarbonate, Technical Grade; O-S-576. Enamel, Drum-Coating. Exterior, Rust-inhibiting. Solvent-Resistant; TT-E-485. Price 5 cents each.

Packings and Gaskets. A new series of Government Specifications has been prepared for various types of gaskets and packing materials, principally those having an asbestos base. Now available are: Gaskets, asbestos, metallic-cloth; HH-G-76a. Packing, asbestos, metallic-cloth, sheet, and tape; HH-P-31a. Packing, hydraulic; HH-P-112a. Packing, spiral, gland, low-pressure; HH-P-171a. Packing, asbestos, rod, high-pressure; HH-P-36a. Price 5 cents each.

The Grade Terminology Problem. By I. J. Fairchild. National Bureau of Standards. Miscellaneous Publication M-173. This paper sets forth in digest form the grade terms, designations, and bases for grading or rating for 64 commodities and characteristics selected as broadly representative of the various grading and rating system used in the United States. Price 10 cents.

Geological and Geophysical Survey of Fluorspar Areas in Hardin County, Illinois. Part 1. Geology of the Cave in Rock District. By L. W. Currier. Part 2. An Exploratory Study of Faults in the Cave in Rock and Rosiclare Districts by the Earth-Resistivity Method. By M. King Hubbert. Geological Survey Bulletin No. 942. Price $1.25.

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.

Abrasive Millers. Andrew C. Campbell Div., American Chain & Cable Co., Inc., Bridgeport, Conn.—Illustrated reference book for production men, purchasing men, and engineers concerned with abrasive cutting developments. Contains data and specifications for the No. 302 Campbell Horizontal Wet Abrasive Cutting Machine. Also includes a chart outlining features of the standard models in the Campbell abrasive cutting line.

Agitators. Process Div., Struthers Wells Corp., Warren, Pa.—12-page illustrated bulletin describing construction and operating details of the Struther Wells Radial Propeller Agitator which features a new principle of agitation. Movement of the liquids is caused by propulsion rather than centrifugal action. Bulletin No. 52-W.

Autoclave. Industrial Machinery Co., Bloomfield Bank and Trust Bldg., Bloomfield, N. J.—2-page bulletin describing and illustrating the One Gallon Autoclave. Includes design data. Bulletin 48.

Belt Fastenings. Jewell Belt Hook Co., Naugatuck, Conn.—Small folder illustrating and describing the malleable iron belt hooks this company offers. A price list and application instructions are included.

Belts. Dept. 112, The American Pulley Co., 4200 Wissahicken Ave., Philadelphia 29, Pa.—70-page handbook explaining the automatic belt tension control feature of American Econ-o-matic Drives. Also includes V-belt and flat-belt drive selection tables, specifications and installation instructions.

Boilers. Heilman Boiler Works, Allentown, Pa.—Three Power and Process circulars describing the different types of boilers which this company has to offer. They range in sizes from 3,000 to 450,000 lb. of steam per hour with pressures from 100 to 1,500 lb.

Calcium Chloride. Michigan Alkali Div., Wyandotte Chemicals Corp., Wyandotte, Mich.—13 small folders on calcium chloride issued by this concern during the past year. Circulars Nos. C-51 to C-63.

Combustion Control. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.—16-page illustrated catalog describing this concern's system of combustion control designed for the small industrial or municipal power plant. Includes many schematic photo-diagrams and drawings explaining operation and application. Catalog No. N-O1P-163.

Compressors. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.—32-page catalog of compressors and vacuum pumps in sizes from ½ to 10 hp. Includes installation views showing various applications, accessories and special purpose units as well as details of construction. Form 1502.

Controllers. The Bristol Co., Waterbury 91, Conn.—A bulletin describing this concern's line of Free-Vane Electronic Controllers for automatically controlling temperature, pressure, liquid level, and humidity. Contains wiring diagrams, principle of operation and general description and features of the instruments. Bulletin No. B220.

Dust Suppressors. Whiting Corp., Harvey, Ill.—2-page illustrated bulletin dealing with the Whiting individually engineered type R Hydro-Clone Dust Suppressor. Includes application and design data. Bulletin FY-127.

Fire Extinguishers. Walter Kidde & Co., 140 Cedar St., New York 6, N. Y.—12-page illustrated booklet outlining a basic mainte-

nance system for first aid fire extinguishers. It is graphically illustrated with drawings, photographs and simple charts and includes questions of supervision, record-keeping, and recharging of all types of extinguishers.

Flow Measurement. Fischer & Porter Co., 918 County Line Rd., Hatboro, Pa.—32-page illustrated catalog on the F&P Rotameter, the area-type flow meter. Contains design and application data. Catalog No. 10-B.

Industrial Clothing. The B. F. Goodrich Co., Akron, Ohio—4-page catalog section illustrating and describing the design and construction of this company's line of clothing covered with rubber-like materials and designed for laboratory and industrial use. Catalog Section 12000.

Instruments. Photovolt Corp., 95 Madison Ave., New York 16, N. Y.—4-page folder on Lumetron Photoelectric Colorimeters Model 400-A and 400-G. Includes a price list and design and application information.

Laboratory Equipment. Dings Magnetic Separator Co., 509 East Smith St., Milwaukee, Wis.—8-page bulletin describing the work carried on in the company's magnetic analysis laboratory and the equipment available for mining, metallurgical, and research laboratories. Includes data on magnetic tube testers and separators. Catalog No. 11.

Laboratory Equipment. Scientific Glass Apparatus Co., Bloomfield, N. J.—4-page bulletin presenting Stedman Packed Columns for close fractionation. Includes design data and operating instructions.

Laboratory Equipment. Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4, Mich.—8-page leaflet illustrating and describing this concern's Two-Minute Carbon Determinator, Three-Minute Sulphur Determinator, Glotemp Combustion Furnace, and Varitemp Combustion Furnace.

Materials Handling. The C. O. Bartlett & Snow Co., Cleveland 5, Ohio—4-page bulletin dealing with the company's Plug Feed Type Skip Hoist Loading Gate. Contains detailed engineering diagrams and a table giving the dimensions of eleven standard sizes. Bulletin No. 92.

Materials Handling. Robins Conveyors Inc., Passaic, N. J.—12-page illustrated bulletin dealing with this concern's Floatex Full-Floating Foundry Shakeouts. Includes design and application data. Bulletin No. 124-A.

Materials Handling. Acme Steel Co., 2840 Archer Ave., Chicago 8, Ill.—12-page issue of Acme Process News illustrating and discussing the shipping of food, naval shells, army trailers, logs and many other war and essential civilian products. No. 15.

Molding Machines. Watson-Stillman Co., Roselle, N. J.—4-page bulletin describing the line of horizontal injection machines offered by this concern. Specifications covering five models, with hopper feed capacities ranging from 6 to 24 ounces, detailed drawings, including platen and die layouts, and data on operating features are included. Bulletin 621-A.

Motors. Century Electric Co., 1806 Pine St., St. Louis 3, Mo.—12-page bulletin illustrating and briefly describing this concern's Direct Current Motors and their parts. Includes design data.

Motors. Century Electric Co., 1806 Pine St., St. Louis 3, Mo.—2-page bulletin illustrating motors of steel construction in fractional and integral horsepower sizes up to 600.

Pipes. Johns-Manville, 22 East 40th St., New York 16, N. Y.—108-page booklet entitled, "Transite Pressure Pipe for the Pulp and Paper Industry," illustrating and describing pipe and couplings, their selection, construction, application and assembly. Includes photographs of typical installations as well as a partial list of installations.

Pipes. J. N. Fauver Co., Inc., 49 W. Hancock, Detroit 1, Mich.—16-page illustrated catalog covering installation accessories for lubrication, hydraulic, steam, liquid and air applicatoins. Includes design and price data. Catalog No. 17-A.

Presses. The Watson-Stillman Co., Roselle, N. J.—4-page bulletin dealing with a general purpose hydraulic press suitable for diversified utility work in the metal-forming, ceramic or plastic industries. Detailed description of construction and equipment and specifications for five sizes and capacities are covered. Bulletin No. 370-A.

Presses. The Cleveland Crane & Engineering Co., Wickliffe, Ohio—Catalog on Cleveland Steelweld Bending Presses illustrating and covering many of the details of construction. A table of sizes and dimensions is included. Catalog No. 2010-A.

Protective Coatings. The New Jersey Zinc Co., 160 Front St., New York 7, N. Y.—24-page booklet entitled, "How Zinc Saves Steel from Rusting," describing and illustrating the functions of metallic protective coatings. Includes some primer and finish paint specifications requiring zinc pigments in their formulation.

Protective Coatings. Wailes Dove-Hermiston Corp., Westfield, N. J.—4-page illustrated folder presenting Bitumastic Blacks, protective coatings for industrial plant maintenance where exposure conditions are unusually severe. Tables of general information. Form 144-10M.

Pumps. Eastern Engineering Co., 45 Fox St., New Haven, Conn.—8-page bulletin illustrating and describing this concern's midget industrial pumps. Contains design, performance and construction data. Catalog P-106.

Pumps. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.—8-page illustrated catalog form covering this concern's line of centrifugal pumps for beet sugar mills. Includes a 2-page flow chart of a typical beet sugar factory showing the number and variety of pumps needed in a representative installation. Form 7019.

Pumps. Worthington Pump and Machinery Corp., Harrison, N. J.—4-page illustrated bulletin dealing with Worthington's centrifugal pumps for refinery process service. Includes diagrams and design data.

Pyrometers. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.—48-page revised edition of this concern's catalog describing and illustrating the new Rayotube equipment for temperature-measuring jobs. Catalog N-33B.

Reconversion. J. O. Ross Engineering Corp., 350 Madison Ave., New York 17, N. Y.—12-page booklet on reconversion discussing why, how and when.

Refining Processes. The Lummus Co., 420 Lexington Ave., New York, N. Y.—54-page book describing complete processes which this company is prepared to supply to the petroleum industry, including Thermofor and Houdry catalytic cracking, 100 octane gas manufacture, and processes for budadiene, styrene, toluol, ammonium picrate and phenol. Also deals with specific types of equipment and includes a large number of flowsheets.

Regulators. Grove Regulator Co., 1190-67th St., Oakland, Calif.—6-page illustrated folder covering this concern's small volume high pressure regulators. Includes diagrams and tables of design and application data. Bulletin No. 125-A.

Resins. Hercules Powder Co., Wilmington, Del.—12-page illustrated booklet on Stabinol, a Hercules resin for soil stabilization. Includes tables of useful information.

Screens. Link-Belt Co., 307 North Michigan Ave., Chicago, Ill.—8-page illustrated book on Liquid Vibrating Screens for recovering waste products and reducing pollution. Contains photographs of actual installations, and gives construction details, dimensions and weights of the various sizes of screens available. Book No. 1977.

Steel Castings. Warman Steel Casting Co., 6100 South Boyle Ave., Los Angeles 11, Calif.—16-page illustrated booklet presenting the history as well as an up to date picture of this company's activities in steel casting.

Storage. The Nicholson Co., Inc., 10 Rockefeller Plaza, New York 20, N. Y.—32-page illustrated booklet dealing with this concern's technique of Streamlined Storage for practically every type of bulk material. Presents 20 typical industries and diversified installations. Contains diagrams and design and construction data.

Surface Grinders. Savage Tool Co., Minneapolis, Minn.—16-page illustrated booklet describing the line of surface grinding equipment and accessories offered by this concern to the metal working industries. Also shown are the production methods used in the manufacture of these surface grinders and a brief description of the DoAll Precision Gage Blocks and Instruments.

Temperature Control. Niagara Blower Co., 6 East 45th St., New York 17, N. Y.—4-page illustrated bulletin presenting this concern's Balanced Wet Bulb control of temperature for cooling liquids or gases through use of Aero Heat Exchanger. Includes design and operation diagram. Bulletin 96.

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

MOVEMENT OF CHEMICALS TO REGULAR CONSUMING LINES OF RECORD PROPORTIONS

Munitions production fell behind schedule in April and was reported at a drop of 2 percent from the March level. A corresponding drop from March is shown in the index for all production as measured by the Federal Reserve Board. The Board's index for chemical production also holds below the heights reached in the latter part of last year although the same authority gives a more favorable report for production of industrial chemicals. The *Chem. & Met.* index for consumption in the regular industrial fields is currently running at record levels. For the first four months of the year the index averaged 183.45 as compared with 173.50 for the like period of 1943. The index for April stood at 180.44 as compared with 189.49 for March. This index is intended to chart actual consumption, hence does not attempt to make adjustments for seasonal influences. Apparently the rate of consumption in April did not vary much from that of March, the difference in the index numbers resulting from the shorter working period in April. Last year the indexes were 176,16 for April and 178.96 for March.

From the production data which are being made available, it seems that outputs have fallen in the case of some government-owned plants, some of which were closed because inventories of finished products had piled up. In a few cases, production at private plants had dropped from peak levels. For instance, in the first quarter of this year production of nitric acid was 110,436 tons. This compares with 113,065 tons in the first quarter and with 124,186 tons in the final quarter of last year. Some of the other chemicals in the first quarter of this year topped the totals reported for the comparable period of 1943 but have just about maintained the rate of output set in the final quarter.

With regard to the outlook, some uncertainty exists concerning the overall prospects for chemical production because the manufacture of military explosives is such a large outlet. Cutbacks in that direction already have been made but this has been somewhat offset by greater efficiency at plants which are kept in operation and some of those which have been closed may start production if the need develops. So far as industrial chemicals are concerned, the prospects are more definite in the case of industries for which set goals have been established and from which it is possible to figure their chemical requirements. A good example is found in the case of superphosphate where a production bogie of 9,464,000 tons has been agreed upon for the agricultural year beginning July 1. This total is far above anything the industry has turned out in the past but there is good reason to believe the objective will be reached, hence a record demand for such materials as sulphuric acid and phosphate rock is indicated for that manufacture.

Last year the rubber industry increased its use of carbon black by more than 50 percent and will greatly expand its requirements in the present year. While the demand for rubber chemicals will not grow in the same proportion, some idea of the greater demand can be obtained from the carbon black comparison. Petroleum refining, rayon, plastics, insecticides are other lines of manufacture where enlarged outputs are in prospect. Soap makers in the past have found considerable difficulty in securing sufficient stocks of raw materials. At present the supply situation is better than it has been since we entered the war even though some of the oils customarily used are not too plentiful.

Chem. & Met. Index for Industrial Consumption of Chemicals

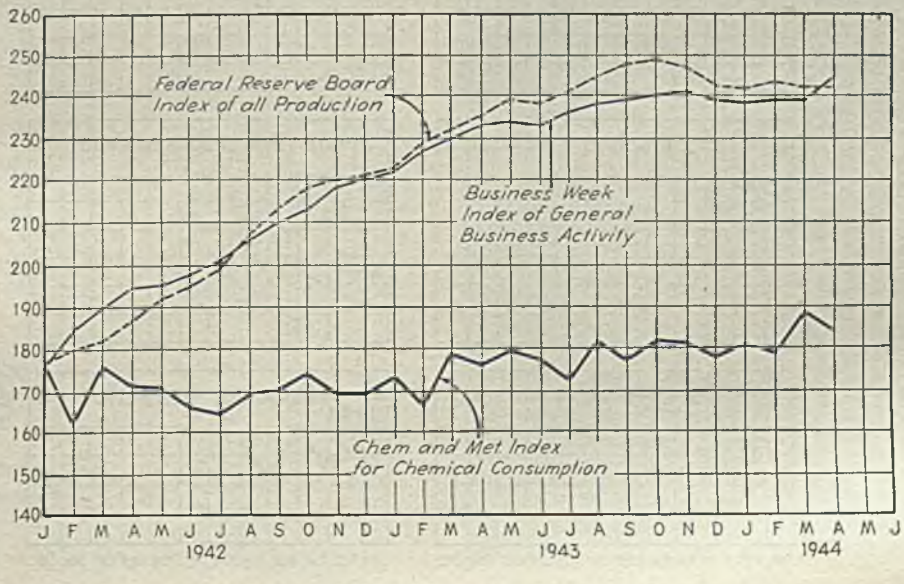
1935 = 100

	March revised	April
Fertilizers	43.52	41.05
Pulp and paper	19.80	19.40
Petroleum refining	17.74	17.18
Glass	20.30	19.30
Paint and varnish	17.42	17.00
Iron and steel	13.80	13.45
Rayon	17.11	15.77
Textiles	11.80	10.19
Coal products	10.20	9.95
Leather	4.20	4.10
Industrial explosives	5.20	4.85
Rubber	3.00	3.00
Plastics	5.40	5.20
	189.49	180.44

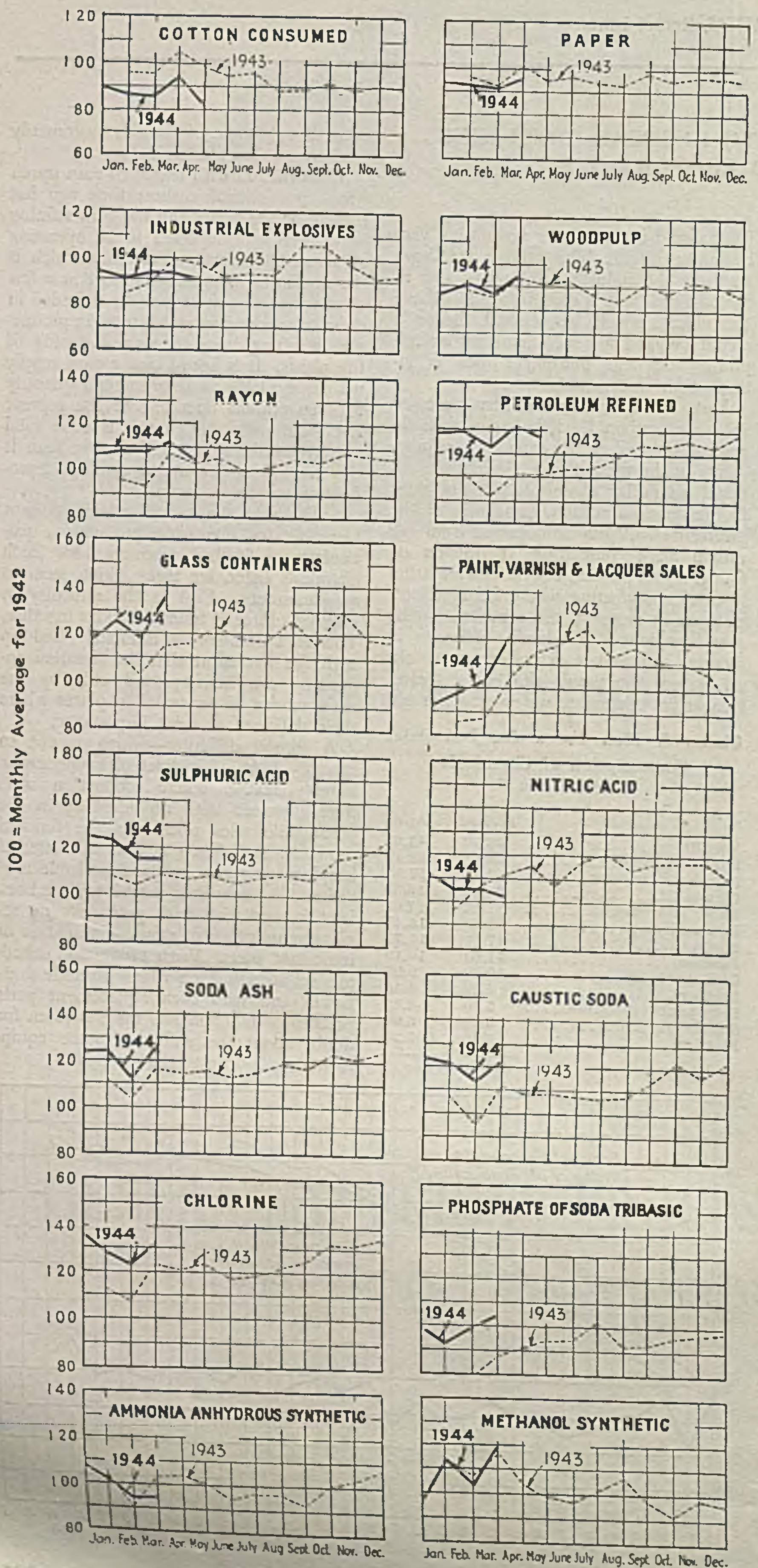
The situation with regard to corn starch which was critical a short time ago has turned for the better and the corn refining industry is now reported to be operating at about 80 percent of capacity which is the maximum permissible except in a few cases where this limit may be exceeded in order to make up in part for loss in production resulting from the forced closing of the plants. It is hoped that a corn supply will be available in large enough quantity to keep refiners operating at the present levels but even though this is done total output for the year will be lower than it was in 1943 as only a part of the lost production can be made up.

Looking at the factors which are not favorable for increasing production, particularly of finished products into which chemicals enter, are three which seem to be paramount. First is the difficulty in keeping a force of trained workers together. This is a problem so intimately tied up with the war effort that the situation apparently can be improved only by the maintenance of personnel in places where their skills are of most importance.

A second difficulty—which is not so general—is found in lines of manufacture, notably textile, where production costs have advanced with no flexibility in the permissible sales prices for the finished products. And finally comes the matter of keeping equipment in good workable condition. In many lines machines have been kept in operation with practically no replacements either of new equipment or of important parts. With production schedules set at high levels which preclude shutdowns and with even replacement parts practically unobtainable, there is room for doubt about the ability of some equipment to stand up to the demands.



PRODUCTION AND CONSUMPTION TRENDS



Developments with the last month have indicated but little change in trends for production and consumption of chemicals. Most significant was the announcement of progress in butadiene and synthetic rubber production with new capacity coming into production. This of course had been anticipated but the completion of building programs is in itself a guarantee of the projected trends.

According to a WPB report, production, though meeting with some cutbacks, is still on the increase and the schedule for war production calls for a continuing output with the peak now set for November and established at a desired level 10 percent above that reported for April. As the regular manufacturing lines, with few exceptions, are holding up well, the trend for total output, and consequently for consumption of raw materials, is definitely upward.

The situation with regard to supplies of chemicals and allied products has been subject to change in recent months with some materials formerly scarce now in ample supply. However, there is a fairly long list of chemicals which still are scarce. Chrome chemicals, for instance, are being turned out in a large way but such a large part of production is directed into specified fields of consumption that many other consumers are not able to fill their requirements and there appears to be no relief for the immediate future.

Some manufacturers who formerly used synthetic resins in their products have turned to gum rosin as a substitute. Now concern is felt about the supply of the natural product. Scarcity of workers at primary points and long periods of unfavorable weather have combined to slow up the movement of the new crop. Recent receipts have shown but little improvement and government officials are working with the industry to improve matters.

The Department of Agriculture has issued its report on naval stores for the fiscal year ended March 31. The report shows that consumption of rosin for the year was 2,440,342, bbl. of 500 lb. gross as compared with 1,899,145 bbl. in the preceding fiscal year. As production in 1943–44 was 1,828,539 bbl. aganist 2,069,754 bbl. in the 1942–43 period, it is evident that the carryover has been greatly reduced and current receipts become of more than ordinary importance. It is worthy of note that consumption of rosin in soap in 1942–43 was 238,658 bbl. while in 1943–44 it jumped to 408,823 bbl. Paper and paper size accounted for 367,021 bbl. of rosin in 1942–43 and in 1943–44 consumed 477,959 bbl. The increase in industry consumption of rosin last year was almost universal.

There was a rather sharp drop in delivery of cotton to mills in April but it is explained that the rate of consumption actually was higher than in March although total consumption for the month was down because of a smaller number of working days. Rayon production likewise was down for the same reason.

CHEM & MET.
Weighted Index of Prices for
CHEMICALS
Base = 100 for 1937

This month	109.59
Last month	109.49
June, 1943	109.01
June, 1942	109.39

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 June 8

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 –	.085
Lactic, 44%, tech., 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 –	.12½
Phosphoric, tech., tanks, lb	.04 –	....
Sulphuric, 60°, tanks, ton	13.00 –	....
Tartaric, powd., bbl., lb	.70½ –	....
Alcohol, amyl	.... –	....
From Pentane, tanks, lb	.131 –	....
Alcohol, butyl, tanks, lb	.10¼ –	.18½
Alcohol, ethyl, denatured, 190 proof	.... –	....
No. 1 special, tanks, gal. wks.	.50 –	....
Alum, ammonia, lump, bbl., lb	.04¼ –	....
Aluminum sulphate, com. bags, 100 lb	1.15 –	1.40
Aqua ammonia, 26°, drums, lb	.02¼ –	.03
tanks, ton	65.00 –	....
Ammonia, anhydrous, cyl., lb	.16 –	....
tanks, lb	.04½ –	....
Ammonium carbonate, powd. tech., casks, lb	.09½ –	12
Sulphate, wks, ton	28.20 –	....
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	45.00 –	....
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, liuid, tanks, wks., 100 lb.	1.75 –	2.00
Copperas, bgs., f.o.b., wks., ton	17.00 –	18.00
Copper carbonate, bbl., lb	.19½ –	.20
Sulphate, bbl., 100 lb	5.00 –	5.50
Cream of tartar, bbl., lb	.57 –	....
Diethlylene glycol., dr., lb	.014 –	.015½
Epsom salt, dom., tech., bbl., 100 lb	1.90 –	2.00
Ethyl acetate, tanks, lb	.11½ –	....
Formaldehyde, 40%, tanks, lb	.033 –	....
Furfural, tanks, lb	.09 –	....
Glaubers, salt, bags, 100 lb	1.05 –	1.10
Glycerine, c.p., drums, extra, lb.	.18¼ –	....
Lead:		
White, basic carbonate, dry casks, lb	.08¼ –	....
Red, dry, sck, lb	.09½ –	....
Lead acetate, white crys, bbl., lb.	.12¼ –	.13
Lead arsenate, powd., bag, lb	.11½ –	.12
Lithopone, bags, lb	.04¼ –	.04
Magnesium carb., tech., bags, lb.	.06¼ –	.06½
Methanol, 95%, tanks, gal	.58 –	......
Synthetic, tanks, gal	.28 –	....
Phosphorus, yellow, cases, lb	.23 –	.25
Potassium bichromate, casks, lb.	.09¼ –	.10
Chlorate, powd., lb	.09¼ –	.12
Hydroxide (c'stic potash) dr., lb.	.07 –	.0½
Muriate, 60% bags, unit	.53½ –	....
Nitrate, bbl., lb	.05½ –	.06
Permanganate, drums, lb	.19¼ –	.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	15.00 –	....
Soda ash, light, 58%, bags, contract, 100 lb	1.05 –	....
Dense, bags, 100 lb	1.15 –	......
Soda, caustic, 76%, solid, drums, 100 lb	2.30 –	3.00
Acetate, del., bbl., lb	.05 –	.06
Bicarbonate, bbl., 100 lb	1.70 –	2.00
Bichromate, casks, lb	.07¼ –	.08
Bisulphate, bulk, ton	16.00 –	17.00
Bisulphite, bl., lb	.03 –	.04

CHEM & MET.

Weighted Index of Prices for

OILS & FATS

Base = 100 for 1937

This month	145.24
Last month	145.24
June, 1943	145.55
June, 1942	143.60

Chlorate, kegs, lb	.06¼–	.06½
Cyanide cases, dom., lb	.14½–	.15
Fluoride, bbl., lb	.07 –	.08
Hyposulphite, bbl., 100 lb	2.40 –	2.50
Metasilicate, bbl., 100 lb	2.50 –	2.65
Nitrate, bulk, 100 lb	1.35 –	....
Nitrate, casks, lb	.06¼–	.07
Phosphate, tribasic, bags, lb	2.70 –	....
Prussiate, yel. bags, lb	09½–	.10
Silicate (40° dr.), wks., 100 lb	.80 –	.85
Sulphide, bbl., lb	.02½–	....
Sulphite, crys, bbl., lb	.02¼–	.02¾
Sulphur, crude at mine, long ton	16.00 –	....
Dioxide, cyl., lb	.07 –	.08
Tin crystals, bbl., lb	.39½–	....
Zinc, chloride, gran, bbl., lb	.05¾–	.06
Oxide, lead free, bag, lb	.07¼–	....
5% leaded, bags, lb	.07⅝–	....
Sulphate, bbl., cwt	3.85 –	4.00

OILS AND FATS

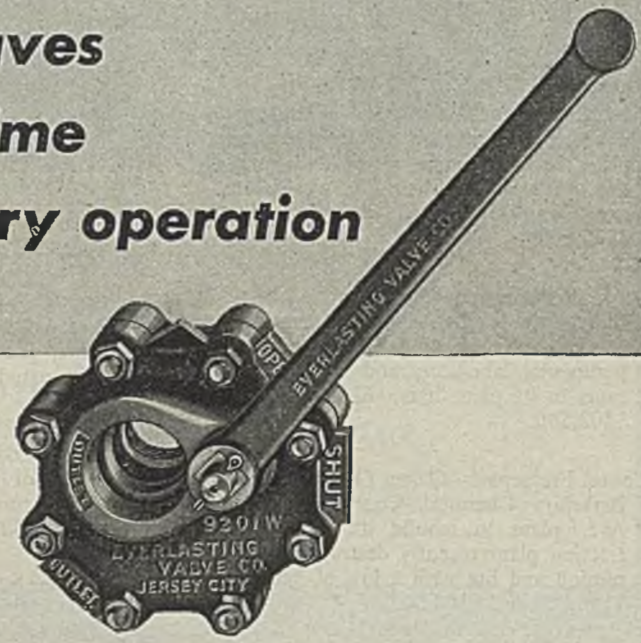
Castor oil, No. 3 bbl., lb	$0.13¾–	$0.14½
Chinawood oil, bbl., lb	.38 –	....
Coconut oil, ceylon, tank, N. Y., lb	nom	
Corn oil crude, tanks (f.o.b. mill), lb	.12¾–	....
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12¾–	....
Linseed oil, raw, car lots, bbl., lb	.151–	....
Palm casks, lb	.09 –	....
Peanut oil, crude, tanks (mill), lb	.13 –	....
Rapeseed oil, refined, bbl., lb	nom	
Soy 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	.09½–	....
Oleo oil, No. 1	.11½–	....
Red oil, distilled, dp.p. bbl., lb	.11¾–	....
Tallow extra, loose, lb	.08⅝–	....

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
Diphenyl, bbl., lb	.15 –	....
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
Hydroquinone, bbl., lb	.90 –	....
Naphthalene, flake, bbl., lb	.07 –	.07¼
Nitrobenzene, dr., lb	.08 –	.09
Paracresol, bbl., lb	.41 –	....
Para-nitraniline, bbl., lb	.47 –	.49
Phenol, U. S. P., drums, lb	.10½–	.11
Picric acid, bbl., lb	.35 –	.40
Pyridine, dr., gal	1.70 –	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 –	.37
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	2.75 –	2.80
Chrome, yellow, C. P., bbl., lb	.14½–	.15½
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	6.27 –	....
Turpentine, gal	.89 –	....
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	$190,000	$40,000	$730,000	$1,477,000
Middle Atlantic	142,000	80,000	5,907,000	7,787,000
South	....	....	9,985,000	15,084,000
Middle West	80,000	60,000	485,000	25,742,000
West of Mississippi	1,190,000	1,000,000	17,535,000	13,730,000
Far West	653,000	75,000	4,773,000	7,426,000
Canada	100,000	250,000	7,339,000	5,587,000
Total	$2,355,000	$1,505,000	$46,754,000	$76,833,000

PROPOSED WORK

Calif., Torrence—General Petroleum Corp., 108 West 2nd St., Los Angeles, plans the construction of new tank facilities at its refinery here. V. F. Grace, c/o Company, Engr. Estimated cost $135,000.

Calif., Wilmington—Shell Oil Co., Shell Bldg., Los Angeles, plans the construction of gasoline hydrogenation plant, experimental laboratory and other alterations to its plant here. Estimated cost $302,500.

Conn., Bridgeport—Castor Oil Division of Berkshire Chemical Co., 92 Howard Ave., plans to rebuild its solvent extraction plant recently destroyed by explosion and fire with a loss of between $100,000 and $200,000.

Conn., Naugatuck—Naugatuck Chemical Division of United States Rubber Co., Elm St., will soon award the contract for a factory addition. Francisco & Jacobus, 511 Fifth Ave., New York, N. Y., Archts. Estimated cost $40,000.

Ill., Peoria—Hiram Walker & Sons, Inc., Peoria, plans alterations to its plant to be used as a mash cooler. Estimated cost $40,000.

Kansas—Kansas Consolidated Gas Corp., Wichita, plans to construct and equip a dehydration plant on natural gas main line to have a daily capacity of 85,000,000 cu.ft., at some point in Stevens Co. Estimated cost $800,000.

N. J., Bayonne—Specific Pharmaceuticals, Inc., 331 Fourth Ave., New York, N. Y., is having plans prepared by Barnet D. Singer, Archt., 921 Bergenline Ave., Jersey City, for the construction of a 1 story, 50x125 ft. drug manufacturing plant. Estimated cost $50,000.

N. J., Newark—Celanese Corp. of America, 290 Ferry St., will soon award the contract for a 1 and 2 story, 54x200 ft. addition to its plant.

N. J., West Windsor—Heyden Chemical Corp., 50 Union Sq., New York, N. Y., is having plans prepared by The Austin Co., Engrs., 19 Rector St., New York, N. Y., for the construction of a 1 story animal house for chemical factory. Estimated cost $52,000.

O., Akron—Goodyear Tire & Rubber Co., 1144 East Market St., plans to construct 40x60 ft. and 80x100 ft. factory additions.

Ore., Oregon City—Hawley Pulp & Paper Co., Oregon City, plans to construct a log barking plant on the Willamette River. Estimated cost $175,000.

Tex., Amarillo—Phillips Petroleum Co., Bartlesville, Okla., contemplates the construction of a gasoline manufacturing plant in this area. Estimated cost will exceed $250,000.

Tex., Houston—Southern Acid & Sulphur Co., 7621 Wallisville Rd., will soon receive bids for the construction of a 100x437 ft. concrete storage silo for phosphate plant. Dorr & Co., 570 Lexington Ave., New York, N. Y., Engr.

Tex., Robstown—Stanolind Oil & Gas Co., Gulf Bldg., Houston, and Seaboard Oil Co. of Delaware, Continental Bldg., Dallas, plan to construct and equip a pressure maintenance plant. Estimated cost $100,000.

Utah, Salt Lake City—The Lang Co., 267 West First South St., is having plans prepared by Ashten & Evans, Archts., 312 Beneficial Life Bldg., for the construction of a hot dip galvanizing plant.

B. C., Shilliwack—International Plastics Corp., Ltd., 410 Seymour St., Vancouver, is having plans prepared by H. H. Simmonds and Ross A. Lort, Archts., 340 Burrard St., Vancouver, for a 40x100 ft. plant. Estimated cost $50,000.

Ont., Midland—Beatty & Ludlam, c/o G. W. Ludlam, Chemical Engr., Midland, plan the construction of a plant for manufacturing and processing oils, chemicals, solvents, etc. Estimated cost $50,000.

CONTRACTS AWARDED

N. J., Elizabeth—Apex Chemical Co., 200 First St., has awarded the contract for the construction of a laboratory building to Hansen-Jensen, 427 North Broad St., Elizabeth. Estimated cost $40,000.

Mass., Malden—National Co., Inc., 61 Sherman St., has awarded the contract for the construction of a laboratory addition to Dwan Construction Co., 29 Bay St., Dorchester. Estimated cost $40,000.

N. J., Hillside—Linde Air Products Co., 205 East 42nd St., New York, N. Y., has awarded the contract for the construction of a manufacturing plant to F. H. McGraw & Co., 51 East 42nd St., New York, N. Y. Estimated cost $40,000.

O., Ashland—Althouse & Jones, Archts., 28 Park Ave., Mansfield, O., have awarded the contract for a 1 story, 80x145 ft. factory addition for the Eagle Rubber Co., Inc., to F. Beymer, 211 Marlow Rd., Mansfield. Estimated cost $60,000.

Ore., Eugene—Silica Products Co., 808 Couch Bldg., Portland, will construct a sand treating plant here. Work will be done by force account. Estimated $75,000.

Tex., Andrews—Phillips Petroleum Co., Bartlesville, Okla., and O. C. Field Gasoline Corp., 944 Wilshire Blvd., Los Angeles, Calif., will construct a gasoline refining plant. Work will be done by force account. Estimated cost $450,000.

Tex., Bishop—Celanese Corporation of America, Bishop, and Jones Bldg., Corpus Christi, has awarded the contract for the construction of 78 mi. additional gathering system of 3 to 20 in. pipe lines to Gasoline Plant Construction Corp., Second National Bank Bldg., Houston. Estimated cost $110,000.

Tex., Elmendorff—Everett Wagley, Elmendorff (San Antonio P. O.), c/o T. B. Baker, Gunter Hotel, will construct and equip a brick manufacturing plant. Work will be done by force account and subcontracts. Estimated cost $40,000.

Tex., Houston—Humble Oil & Refining Co., Humble Bldg., has awarded the contract for expanding its gasoline refining plant to the Gasoline Plant Construction Corp., Second Natl. Bank Bldg., Houston. Estimated cost $400,000.

Que., LaTuque—Brown Corp., Ltd., LaTuque, has awarded the contract for a 1 story 180x200 ft. addition to its plant to Foundation Co. of Canada, Ltd., 1538 Sherbrooke St., W., Montreal. Estimated cost $250,000.

REMOTE CONTROL

of TEMPERATURE, PRESSURE and FLOW

The news comes by air when Bristol's Metavane System is employed for telemetering measurement of vital variables in the manufacture of high octane gasoline, butylenes for synthetic rubber and other products.

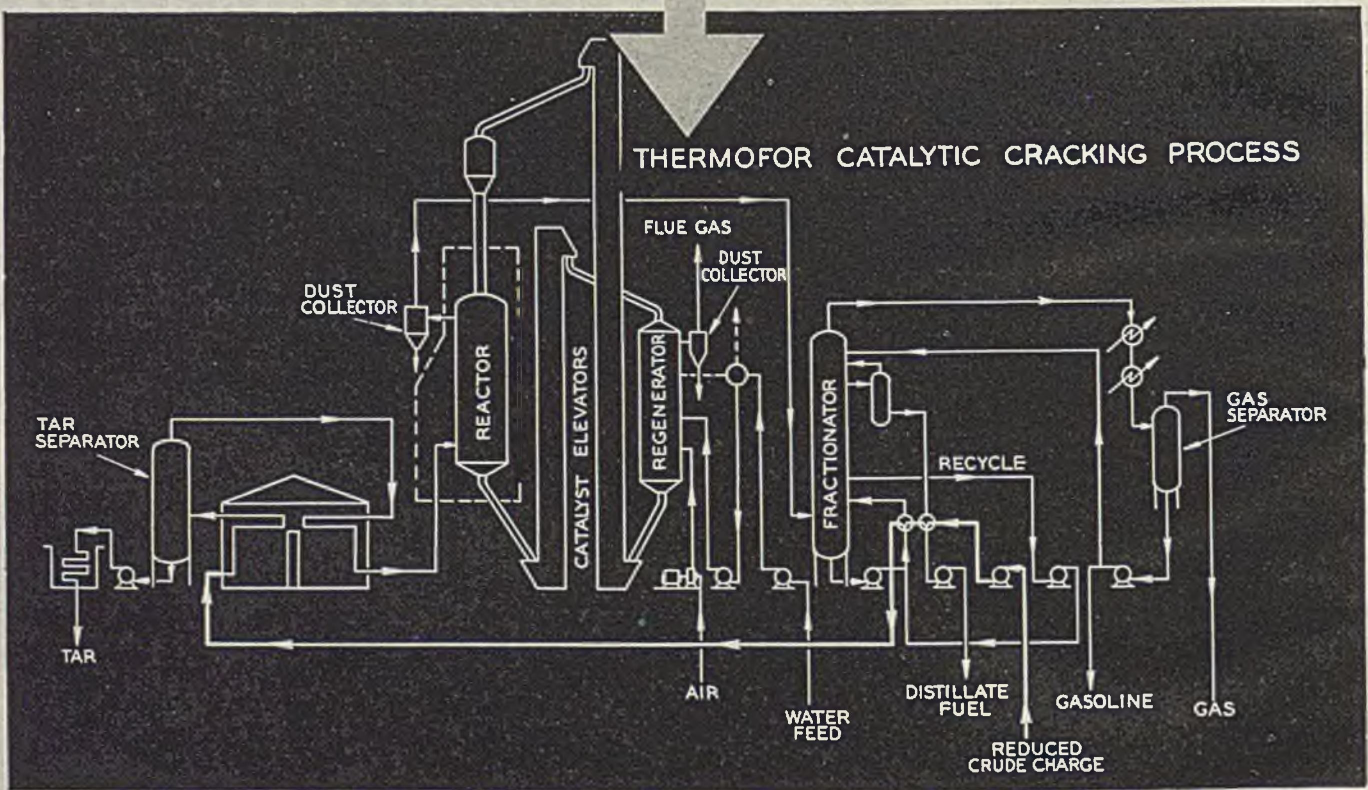
Illustrated is one of the newest refinery processes in the production of aviation fuel and butylenes for synthetic rubber. The Reactor Unit forms a critical part of this process. Bristol instruments of standard design help to provide high operating efficiency and product yield by maintaining precise values of temperature, pressure and flow. Recording and control instruments are centrally located at distances of up to several hundred feet from the points of measurement.

BRISTOL'S METAVANE SYSTEM

Information gathered by the Metavane Transmitter is passed on rapidly over a length of tubing to a Metavane Receiver at the control point. A 15 lb. air supply introduced at the Transmitter powers the system.

The Receiver may be a standard Recorder or an automatic Free-Vane Controller of either the Monoset, Ampliset, Preset, Reset or Magniset type, which actuates the proper mechanism, by air, to bring values into line.

Bulletin M1701 will give you complete information on the instruments used in this application.

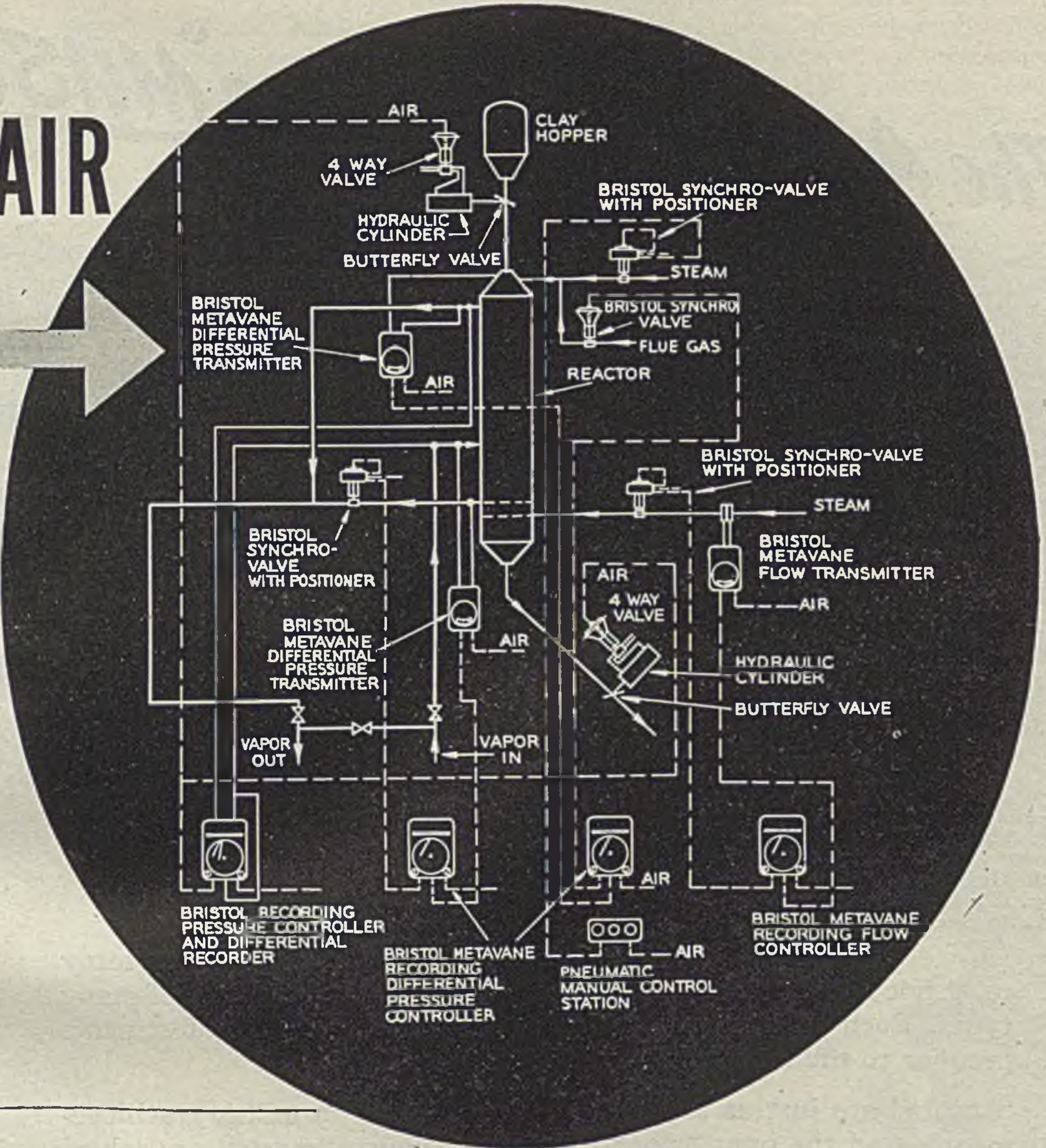


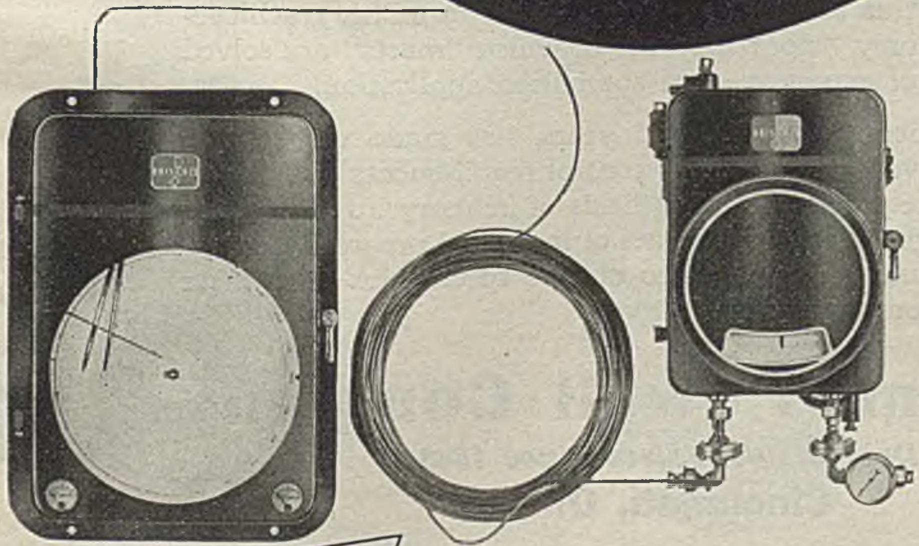
THE BRISTOL COMPANY
109 Bristol Road, WATERBURY 91, CONNECTICUT

The Bristol Company of Canada, Ltd.
Toronto, Ontario

Bristol's Instrument Co., Ltd.
London N.W. 10, England

VIA AIR

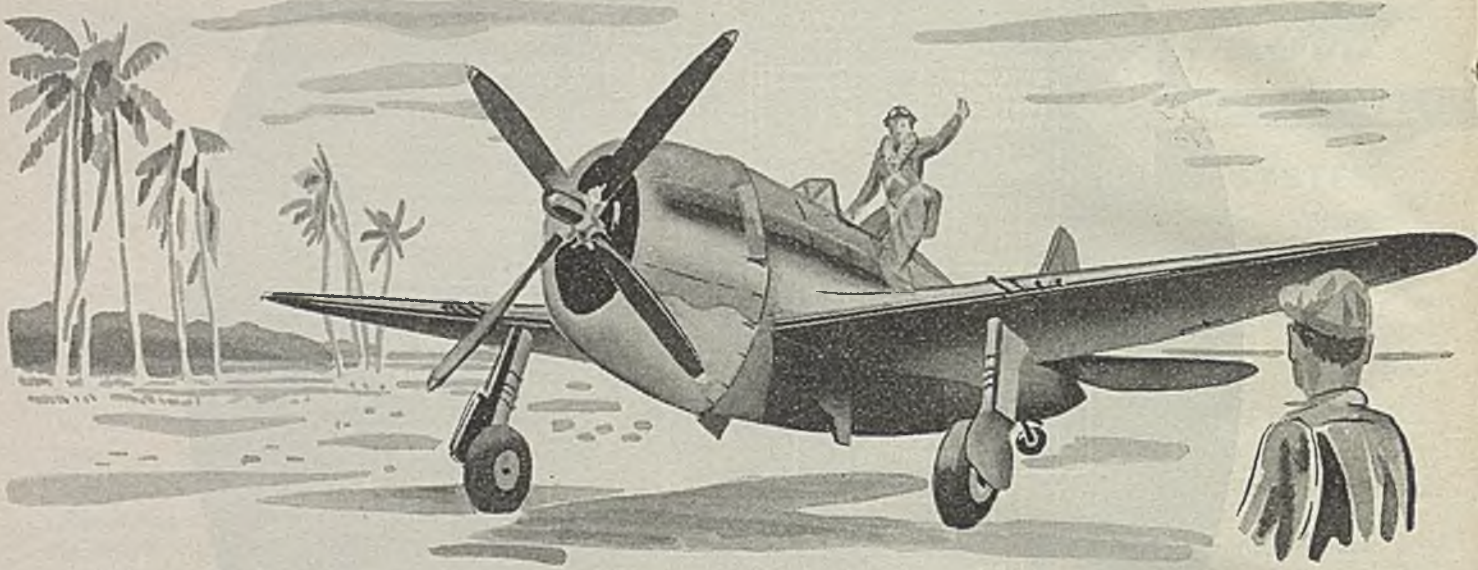




METAVANE FLOW CONTROLLER

Equipment illustrated is used for controlling flow

The Army's Answer to a "MUST!"



"Thunderbolt"—said to be the most powerful single seat fighter in the world, with four .50 caliber fixed machine guns mounted in each wing panel, a flying speed of 400 m. p. h. plus—and a diving speed greater than the speed of sound.

To be victorious in modern warfare, an army must not only have enough planes but they must be planes of many types. Each of these must satisfy all the functional requirements peculiar to the service in which it will be used.

"Musts" are just as constant in industrial, as in military achievements. And the only "stock-bin" out of which "musts" are solved is the stock-bin of experience and specialized application.

POWELL, for nearly one hundred years, has made valves, and valves only . . . valves for all flow control requirements . . . valves for the "must" requirements in all fields of industry . . . in war or peace . . . through nearly ten decades of industrial progress. Our experience in producing *the* valve to do *the* specific job—"to meet the must"—is yours on request.

The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati, Ohio

POWELL

POWELL Engineers have perfected valves especially adapted for catalytic cracking, where very high temperatures are frequently encountered—for example, in the handling of flue gases and hydrocarbons on transfer lines. These valves, in all sizes and pressure classes from 150 pounds to 2500 pounds, are available in special alloys, which tests have proven are not subject to embrittlement—so often the cause of fracture and failure. They are designed to provide the best possible flow characteristics with least amount of wear and tear on internal parts.

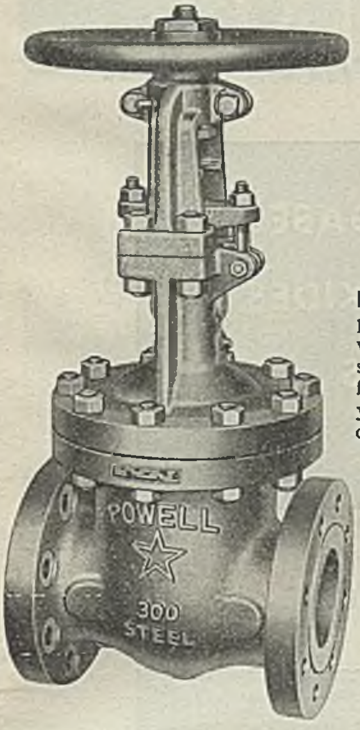
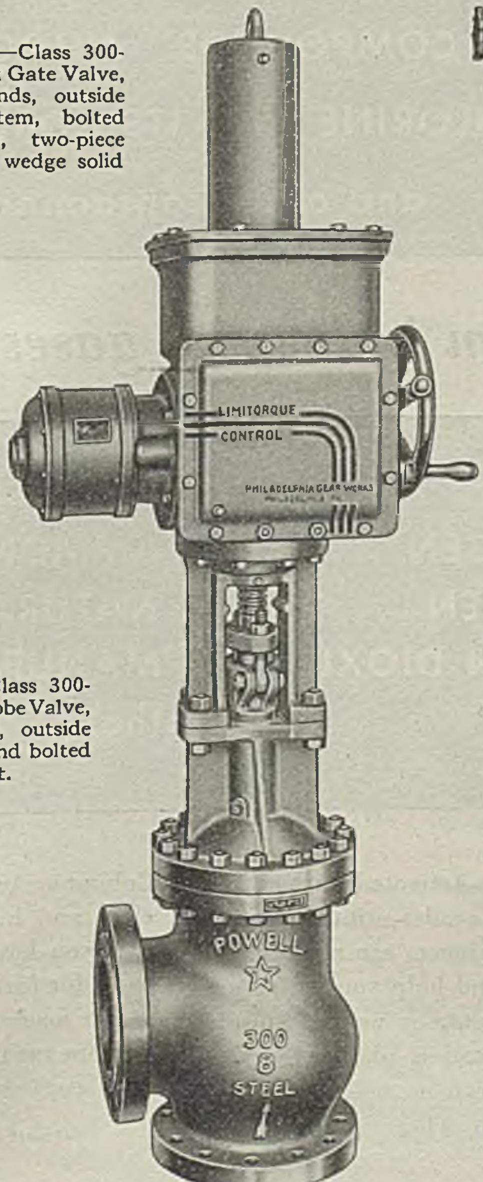


Fig. 3003 (left)—Class 300-pound Cast Steel Gate Valve, with flanged ends, outside screw rising stem, bolted flanged bonnet, two-piece yoke and taper wedge solid disc.

Fig. 3053 (below)—Class 300-pound Cast Alloy Steel Angle Valve with flanged ends. Streamlined flow areas through the body assure minimum restriction and pressure drop. This valve is adapted for high temperatures up to 1400 F. Equipped with top mounted, explosion proof electric motor for quick, positive operation.



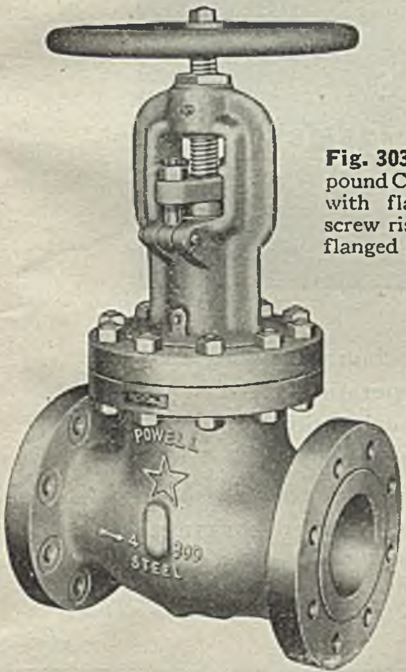


Fig. 3031 (left)—Class 300-pound Cast Steel Globe Valve, with flanged ends, outside screw rising stem and bolted flanged yoke bonnet.

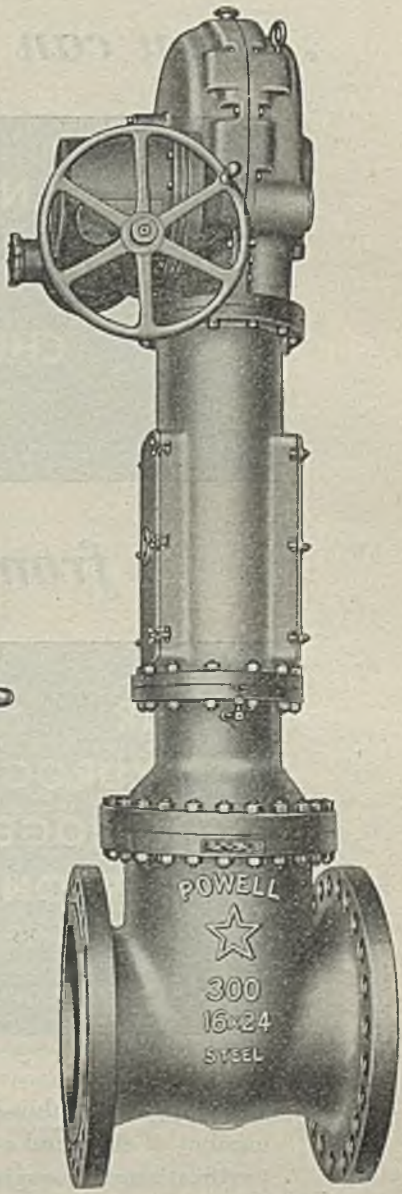


Fig. 3023 Mod.—Class 300-pound Cast Alloy Steel Gate Valve with flanged ends. Has 16″ port size venturied to 24″ size end flanges to accommodate insulated pipe. Equipped with top mounted, totally enclosed, explosion proof electric motor operator for quick, positive opening and closing.

VALVES