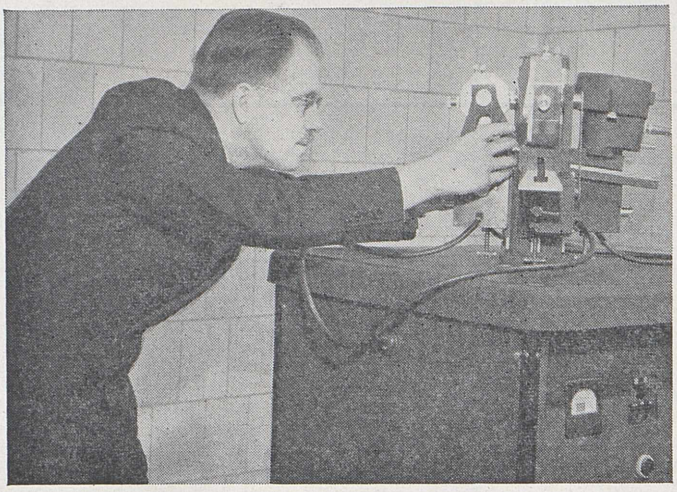
Researches of Mellon Institute 1945–1946

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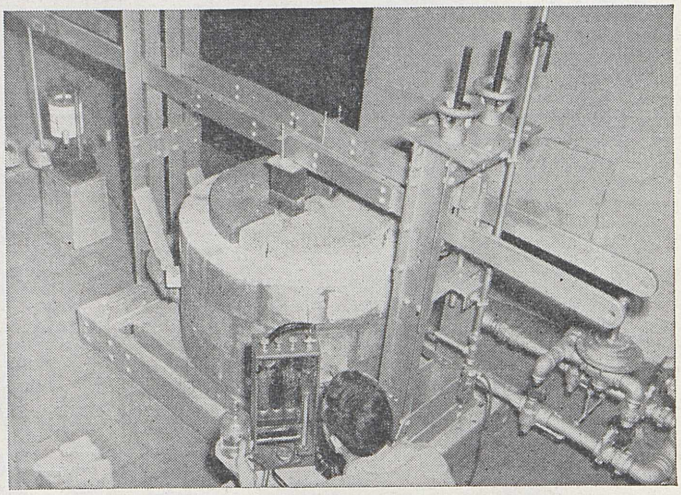
CHEMICAL AND ENGINEERING NEWS

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In the x-ray diffraction laboratory



Complete hot load test on a refractory



Study of the stress-strain relationship of cotton fibers

Researches of Mellon Institute 1945–1946[1]

Never before has scientific research done so much in so little time as during the past five years. Science has really moved forward mightily through this widespread and concentrated national investigational effort

In 1945–46, as in previous years of the war period, there have been many essential governmental demands on Mellon Institute, leading to noteworthy advances but restricting the inception of new basic programs and the resumption of intermitted long-term projects.

This experience forcibly indicates the need and occasion for researches on problems that are crucial and must be solved in bringing about postwar adjustments. There are ahead the stupendous tasks of removing the ruins of the war, retrieving what is recoverable in major ways, and relearning how to thrive in peacetime. The significance of this great responsibility as to specific objectives embraces healthy and vigorous communities and industries, well-being manifesting itself in the high level of living that has become a trait of the American societal structure. The open approach is plainly through the utilization of science and its research, thereby creating and fostering employment. Science may hold the balance of power between peace and war; certainly, with proper support, it will try most seriously to improve the lot of mankind.

The executive staff of the institute has therefore been inspecting specific problems of physical science that may best constitute from every standpoint effective research programs during the years following the return of peaceable conditions. As has been brought out in the three preceding reports[2], much investigational work of the institute since 1942 has not pertained to undertakings of long-range nature or normal scope, but has been concerned with urgent problems of war science and technology. The national emergency has had weighty impulses upon many long-established industrial fellowships which have been able to get answers to innumerable martial questions. Moreover, to expedite certain wartime investigations, a number of the long-time research programs have been interrupted or actually suspended.

Administrative study forecasts that the principal research motive for the future in terms of human welfare must undoubtedly be related to results gained by well-planned and well-conducted comprehensive fundamental investigations. Hence the institute is making ready for opportunities for more and more basic and vital service through pioneering researches of promise that comply with its standards. It then will explore for new things of importance along the recently improved routes of science for the direct or ultimate benefit of the public whose advancement is the eventual proof of the value of research. In accordance with its aim of continually strengthening its investigational facilities, the institute has established a department of research in chemical physics to apply the new techniques of this field in assistance to fellowships and in fundamental studies of its own choice. Programs in industrial hygiene, metallurgy, coal chemicals, elastomers, and petroleum have been among the first to utilize newer chemicophysical methods and instruments. The acquirement of other special research equipment for fellowship projects is mentioned below in the description of their progress.

General Information on the Institute's Activities

During the fiscal year March 1, 1945, to March 1, 1946, requirements of wartime ori-

[1] A review based on the contents of the Thirty-Third Annual Report of the Director, E. R. Weidlein, to the trustees of the institution, for the fiscal year ended Feb. 28, 1946.

[2] Chem. Eng. News, **21**, 467–78 (1943); **22**, 506–17 (1944); **23**, 520–30, 542–3 (1945).

gin as to more personnel and more space for many research programs have restricted to 82 the number of fellowships in action—29 individual fellowships and 53 multiple fellowships (see appended list). Of these 82 fellowships 4 have been proceeding 30 years or longer, others at least as follows: 4, 25 years; 9, 15 years; and 15, 10 years. An additional 28 fellowships have completed 5 years of investigation. As various fellowships have grown in size in 1945–46, with marked increases in the volume of their work, the institute is filled to its present operating capacity. Also evident throughout the institution is the cordial and dynamic cooperation of the Robert Kennedy Duncan Club, the organization of the members that is constantly helping to advance their well-being and proficiency, and of the institute's capable servicing staff numbering 175.

These conditions have conduced to exceptional productivity by the industrial research staff of 261 fellows and their 264 aids. There have been 19 more fellows and 32 more aids than in 1944–45. Of the total fellowship personnel 11 women have the grade of fellow and 139 are aids. There are also 4 women in the department of research in pure chemistry, 3 of whom rank as fellows, along with 4 men, and two female assistants in the analytical department. During the past fiscal year the institute's expenditures for pure and applied research were $2,410,384.

In 1945–46 there have been commenced fellowships on adhesives, optical cements, and silica gel. The imperative program on adhesives has been finished during the year. There are twelve fellowships on war-emergent intermission: air pollution control, carbon black, cork, cotton processing, enamels, foundry practice, iodine, leather reclamation, meter technology, new plastics, pine chemicals, and raolin. In the meantime research on iodine as an antiseptic is being sustained at the Philadelphia College of Pharmacy and Science under a grant through the iodine fellowship. Intermitted fellowships will be reinstated and new programs waiting for inception will be started just as soon as personnel and space become available.

Adhesion of Laminates for Martial Aircraft. A study of transparent methyl methacrylate–polyvinyl butyral laminates used in aircraft has been made for the Air Technical Service Command (Wright Field) by the multiple fellowship on adhesives. It has been shown that variable adhesion in flat laminate is associated with variable moisture content of the butyra interlayer during lamination as well as with the nature of the adhesive and the technique of application. Hazing and bubbling during forming into shapes are also ascribable, in part at least, to moisture. Diffusion of moisture from edges and through the methyl methacrylate itself contributes to deterioration of the formed shapes in service. It has been concluded that lamination should be accomplished in the absence of moisture and that the laminate should be kept free of moisture until formed into the finished shape. Surface treatment with moisture repellents should improve the service performance of finished shapes. The rate of stripping under constant load has been further developed as a measure of degree of adhesion and methods for the determination of plasticizer content of polyvinyl butyral and of the rate of diffusion of plasticizer through methyl methacrylate have resulted from the research.

Cementing Optical Assemblies. Because of the variety of conditions encountered in the several theaters of war, it was necessary to find substitutes for Canada balsam in cementing compound lenses and prism assemblies. Although the synthetic resins developed for this purpose were satisfactory in many respects, there were certain shortcomings which led to the establishment of the fellowship on optical cements by the Ordnance Department, U. S. Army. The fellowship is engaged in an investigation of the causes of failure of the resins which have been used as optical cements and is also formulating synthetic polymers which do not exhibit these deficiencies.

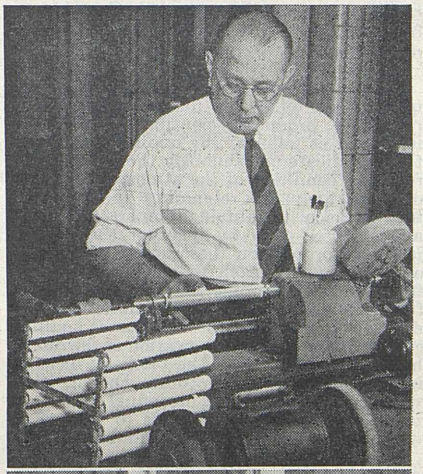
Silica Gel and Allied Products. The Davison Chemical Corp. has founded a multiple fellowship, whose work started on Feb. 1, that will carry on a broad program of research on the fundamental properties, methods of preparation, and uses of silica gel structures. In addition to work on the characteristics and applications of silica gel, with the aim of extending its knowledge, studies will be made of possibilities of producing the gel in novel forms. Preparation of other forms of fine silica andgel structures other than those of silica will be investigated.

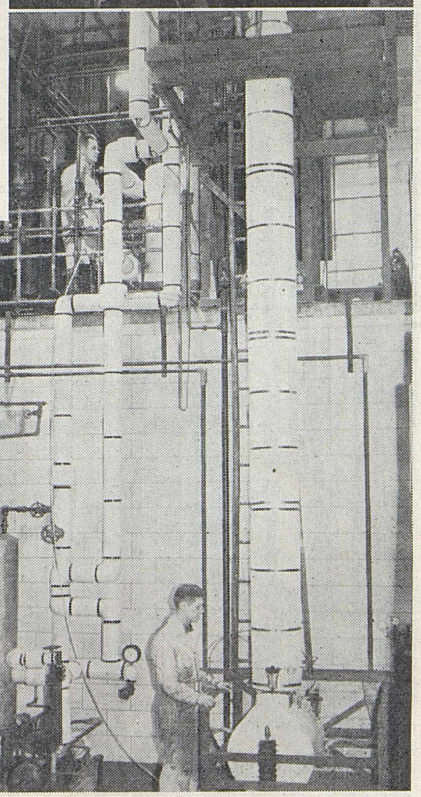
Concluded in 1945–46 were the programs of the fellowships on cellulosic molding, cigaret technology, constructional resins, disinfectant, lignin, phenol chemistry, tape technology, and tar derivatives, as well as the adhesives project. The disinfectant incumbent has rejoined the fellowship on tar distillation; the fellowships on phenol chemistry and tar derivatives have been merged with the multiple fellowship on tar synthetics. Other terminated programs have released research specialists and facilities fo further work of urgency.

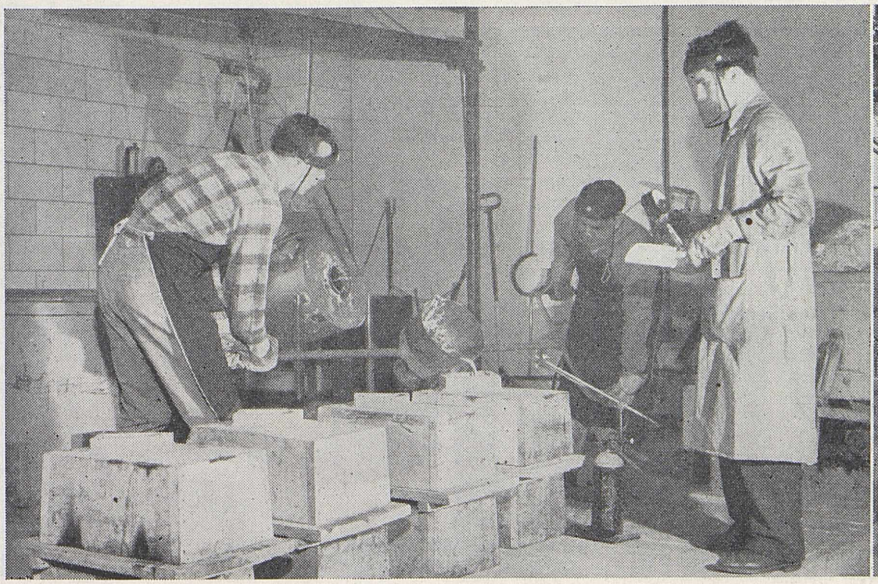
Publicational Data. Altogether, during 1945, 1 book, 11 bulletins, 43 research papers, and 38 other articles have come from the institute. The total publications for the 35 years ended Dec. 31, 1945, have been 22 books, 196 bulletins, and 2,157 journal contributions. In 1945, 32 U. S. patents and 25 foreign patents were granted to fellows of the organization, making the totals, since 1911, 979 U. S. patents and 920 foreign patents. New literature regarding the institute's research procedure and facilities is obtainable on request.

Progress in Continued Industrial Fellowship Investigations

The releasable news respecting fellowship researches that is summarized demonstrates that science and its investigation are tied firmly to the goals of useful technology, strong economics, and vigilant public health. Research, the right hand of science, is indeed the prime mover in adding to the welfare of mankind and no longer is the field of human relations an adjacent island rather than an integral part of the mainland of science. More concise accounts of a greater number







Below. Casting in the magnesium fellowship foundry. Right. Novel fractionating column widely applicable in hydrocarbon research (by Koppers Co.). Upper right. Application of silicone coating to resistors by rubbing

of projects would fail to show satisfactorily, in the space allotted to this review, the objectives, scope, and accomplishments of the fellowships concerned and the systematic ways in which researches are conducted in the institute. The programs selected for brief description here have come to stages where interesting information about their progression and results can be permissibly presented, in typical illustration of the institute's investigational principles and practice.

High-Temperature-Resistant Products. Research on the American Refractories Institute's multiple fellowship belongs to much of technology because the materials so studied are essential in nearly all industries.

Owing to concern in the use of brick laid as headers and as stretchers in the panel spalling test, close to 50 representative brands of high-heat and superduty fireclay brick have been investigated. The header method of laying shows, in general, more spalling loss, as might be expected from the fact that more corners are exposed, this effect being aside from any other contributing factors, such as structural properties of the product. The class of refractory mortars known as heat-setting has been evaluated to learn of its properties, particularly in comparison with clay-grog mixtures, so that clearly defined specifications can be prepared. Castable refractories have received similar study for much the same purpose.

The extensive highly specialized equipment of the fellowship for use in appraising refractory products scientifically has been improved as follows: by adding an apparatus to indicate continuously the oxidizing or reducing condition of the atmosphere in any of the kilns; by rebuilding the hot-load test furnace to obtain temperatures well above 1650° C.; by incorporating an injector to proportion the amount of gas and oxygen used to reach the highest temperatures in the pyrometric cone equivalent furnace; and by installing a radiation pyrometer on the furnace of the panel spalling equipment to enable observation of the rate of heating and cooling of the brick by measuring the surface temperature. During 1946, with the availability of personnel as well as facilities, the fellowship plans to resume its development of a procedure and apparatus for the slag testing of refractories and to install the ASTM thermal conductivity tester for studying insulating and other types of refractories.

New Porcelain Enamels; a New Wire-Wound Resistor. The ceramic chemicals fellowship was founded by the O. Hommel Co. in 1933, and for ten years its incumbents worked on a variety of problems concerned with the improvement of vitreous enamels of the types employed for the finishing of refrigerators, stoves, and washing machines. For example, the fellowship was active in the development of a novel two-coat single-fired cover-coat enamel. Keeping abreast of all technical advancements of the sheet-steel porcelain enameling industry is another objective of the fellowship, which reviewed that field in the literature during the year.

A systematic study of superopaque, antimony-free cover-coat enamels was interrupted in 1943, when the fellowship staff and facilities were given over to the War Metallurgy Committee of the National Research Council, acting in the interest of the Office of Production Research and Development of WPB, for the investigation of the very urgent problem of developing a vitreous enamel coating for fixed wire-wound resistors (power-type) having a sufficiently high resistance to thermal shock and moisture penetration to meet the rigid specifications of the Army and Navy for grade 1, class I resistors. These units are important components of electronic equipment, such as that used in radio and radar communication. The coating must withstand an operating temperature of 275° C. and must not break down under rapid changes of temperature, else moisture will enter and cause failure by corrosion of the resistance wire.

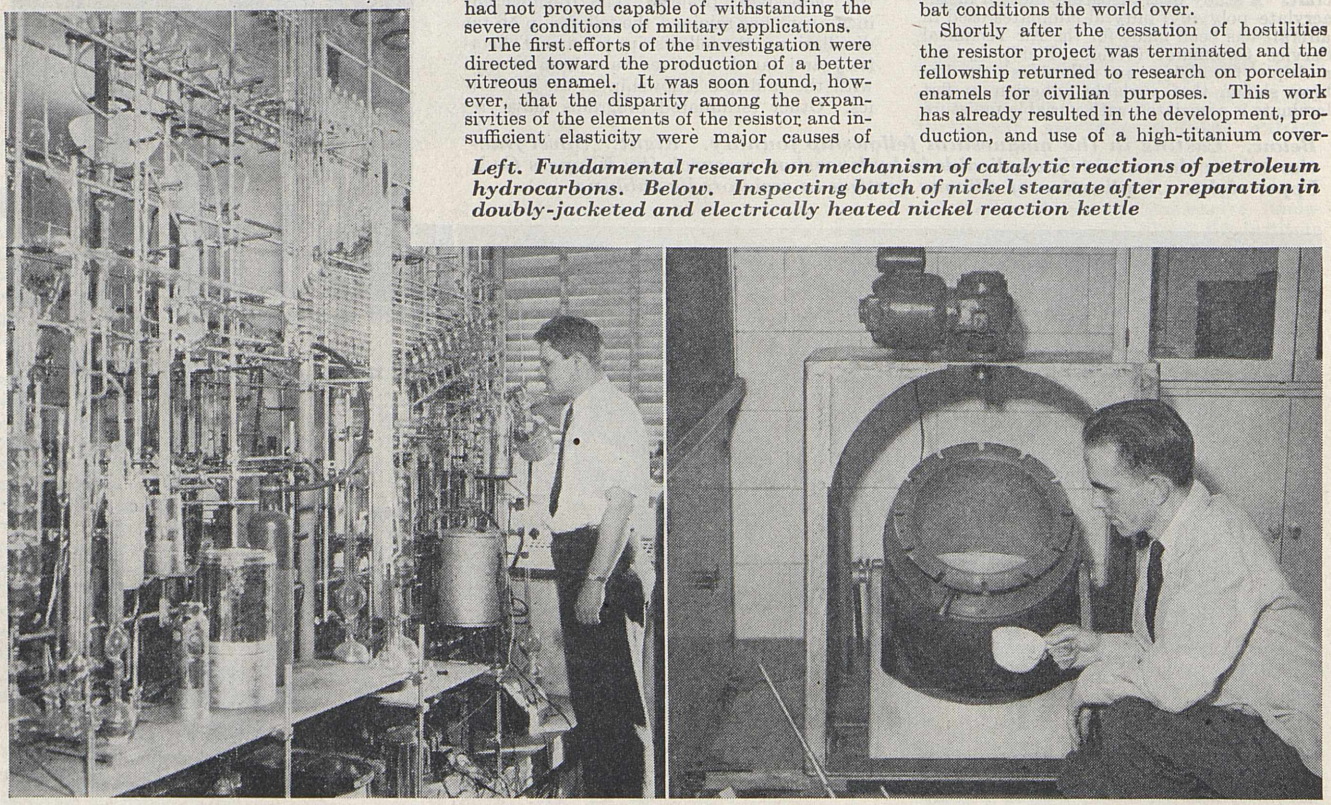
The conventional resistor consists of a tube of steatite or other ceramic material having a very dense structure, on which the resistance wire, usually Nichrome, is wound. The ends of the wire are attached to metallic terminals in the form of bands or ferrules. The wound tubes must be covered with an impervious coating to protect the wire from mechanical hazards and from the attack of moisture and chemicals. Commercial vitreous enamels, although very extensively used, had not proved capable of withstanding the severe conditions of military applications.

The first efforts of the investigation were directed toward the production of a better vitreous enamel. It was soon found, however, that the disparity among the expansivities of the elements of the resistor and insufficient elasticity were major causes of enamel failure and very difficult to overcome. Moreover, the insulating tubes themselves were shown to have too little resistance to thermal shock; and research revealed that, even though the coating were sufficiently stable under operating conditions, the resistor might still fail by the penetration of moisture through cracks in the tube. It was learned that an enamel that fits a tube having a high degree of resistance to thermal shock by virtue of low expansivity would not be suitable for the resistance wire, which has a relatively high expansivity.

Two compromises were sought in order to bring the disparity in expansivity within a small range. In the first case, a pre-enameled tube of steel was used as the insulating core on which to wind the wire. A satisfactory enamel coating was secured for this unit, but non-short-circuiting terminals were found to be necessary, and in the time available a completely effective design was not accomplished except for testing purposes. In the second case, elements of low expansivity were used, consisting of a zircon-porcelain tube, wound with Kovar wire attached to Kovar terminals of special design, and coated with an enamel made from Pyrex. Resistors of this type gave satisfaction in operating temperature and resistance to thermal shock, but the thermal coefficient of resistance of the wire was too high to meet the electrical requirements of the specification.

The problem was finally solved by using as a coating a silicone paste which opportunely had been originated by the fellowship of the Corning Glass Works and had been developed by the Dow Corning Corp. Upon curing, this material has a rubbery consistency and such high elasticity that it is independent of the expansivity of tube, wire, and terminals. Silicone coatings have the additional advantage of not being wetted by water nor affected in any way by atmospheric moisture. Nearly 300 resistors were made, using pre-enameled steel and several kinds of ceramic tubes covering a wide range of expansivity. These units were tested in army and navy laboratories and determined to meet fully the requirements of the specifications for resistance to thermal shock, salt water penetration, and humidity, and therefore were considered to be satisfactory for the most severe service imposed upon communications equipment in ground, sea, and air combat conditions the world over.

Shortly after the cessation of hostilities the resistor project was terminated and the fellowship returned to research on porcelain enamels for civilian purposes. This work has already resulted in the development, production, and use of a high-titanium cover-



Left. Fundamental research on mechanism of catalytic reactions of petroleum hydrocarbons. Below. Inspecting batch of nickel stearate after preparation in doubly-jacketed and electrically heated nickel reaction kettle

coat enamel having very high opacity, so that with very light applications the appearance of the enameled ware is excellent and the danger of chipping is greatly minimized. The new enamel also has high acid resistance.

In the Interest of Metallurgy. The institute's metallurgical specialists have kept on increasing their practical accomplishments. A wide range of difficult problems has been investigated and the results of many solved projects have been put to use.

On the fellowship of the Plastic Metals Division of The National Radiator Co. studies have been started on the reactions occurring during the sintering of iron powder compacts. Special apparatus has been designed and constructed to enable sintering under any desired atmosphere for any specific time at temperatures ranging from 540° to 1120° C. Preliminary work has shown that the sintering conditions prevailing in industry for producing iron powder parts can be reproduced accurately, that the results obtained with this apparatus can be duplicated readily, and that the atmosphere employed in sintering and the rate of gas flow from the sintering chamber exert considerable influence on the properties of sintered iron powder parts. Research has been uninterrupted on determining of the relationship between physical properties of iron powders and shape and size of the particles.

"Ferrocarbo", available in several different forms to the iron and steel industry, depending upon the use, has been getting observant care by the abrasives fellowship in cooperation with the donor, the Carborundum Co. Results from employing this vigorous deoxidizer in both open-hearth and electric-furnace steel practice have been assuring. Ferrocarbo is now utilized in the manufacture of about 90% of the chilled iron and alloyed iron rolls made in this country, and its application in the production of steel rolls is being rapidly extended, two of the largest manufacturers having adopted its use as standard practice. Research has divulged that Ferrocarbo is effective in improving the quality of malleable iron; it is, in fact, coming into general employment for this purpose. Ferrocarbo in the briquet form is proving particularly effectual in the deoxidation and cupola inoculation of gray iron, giving a metal of superior properties.

The American Iron and Steel Institute's multiple fellowship on acid recovery has completed eight years of its program of research on waste pickle liquor and of active cooperation with public health officials and industry. In 1945 samples of portland cement, in which iron sulfate replaced gypsum as a setting-time regulator, were studied after 5 years' storage and the strength was found to have been maintained satisfactorily. This potential use for iron sulfate offers a large market for a compound easily recoverable from waste pickle liquor. Considerable time has been given to a process for making black iron oxide and ammonium sulfate from pickle liquor, and it appears that its practicability is likely. The increasingly greater tonnage of stainless steel being pickled has prompted an investigation of procedures for treating the liquor from this operation. The production of pure calcium nitrate and a sinter for recharging to the furnaces indicates a relatively simple process; other methods, whose object is the recovery of chromium and nickel concentrates, are being studied. Improved techniques for treating waste liquor with limes and limestones also occupy the fellowship. Results of research on reducing the cost of this type of treatment have been released, and a paper tracing out the societal and legal problems in waste disposal has also been published.

Activities of the chemical storage multiple fellowship of the Pittsburgh–Des Moines Co. have comprised the following projects: field investigations involving stress analyses of large steel storage tanks; laboratory studies of spherical and cylindrical steel containers subjected to both internal and external hydraulic pressures; wind-tunnel problems; safe and economical storage of gasoline and of many chemicals of importance; paints to withstand high temperatures; and novel types of welded joints for steel structures. New work will center around the development of techniques of arc welding of aluminum and other light metals for storage containers.

Under close supervision of the Scaife Co.'s multiple fellowship on metal working, the production of hot-spun high-pressure flame thrower units was made possible in large quantities for the armed forces. Along therewith much experimental work was done in the control and fabrication of the hot-spun 500-lb. general-purpose demolition bomb. Heat treating and physical testing of numerous components used in the chemical mortar shell were completed for trial at subatmospheric temperatures. An investigation of pressure vessels, primarily allied to the study of stresses in the thin wall or the membrane type, will be conducted during 1946. Active participation with the research committee of the American Welding Society is planned on problems in fabrication and physical testing of containers and pressure vessels.

The wartime program of the tube fellowship of the Wheeling Stamping Co. included the most suitable types of collapsible tubes and tube coatings for packaging of ointments for the army. This fellowship also rendered helpful service in the selection of a satisfactory phenolic resin adhesive for cementing cork liners into canteen caps. As soon as the supply of lead became critical, a method was worked out for using the major portion of the donor's scrap metal in the manufacture of collapsible tubes. A completed survey of lead absorption by the contents of collapsible tubes will soon appear.

The multiple fellowship on magnesium, whose donor is the National Lead Co., is busying itself with fundamental studies on magnesium and the alloying properties thereof, with the prime object of producing alloys with superior characteristics. Special consideration has been accorded to new alloying possibilities by research on the influence of such basic factors as crystal structure, atomic size, alloying valence effect, electrochemical affinity, and thermodynamic behavior upon the alloying deportment of magnesium in combination with other metals. Therefore it is now possible to predict certain physical properties for a given alloy or to prepare magnesium alloys that meet specific physical requirements. The fundamental alloying nature of magnesium has been discussed in a paper. Much work is being conducted on the castability of magnesium alloys and related problems. A well-equipped foundry with a sand-control laboratory, mechanical mixer, and molding machines is operated by the fellowship in this research. New and efficient melting techniques have been developed, and to supplement them a basic study has been carried out to ascertain the effects of different alloying constituents, temperature, and other factors upon casting performance. In addition, a comprehensive program has acquired fundamental knowledge on the plastic deformational characteristics of polycrystalline magnesium alloys.

New Nickel Compounds and Improved Nickel Catalysts for Industrial Uses. Research on nickel derivatives has been expanded by more personnel and facilities. New nickel compounds and catalysts of special promise are being prepared and are under study in cooperative programs with industrial and governmental laboratories.

Nickel arsenate and nickel ethylene bisdithiocarbamate are possible pesticides for agricultural employment; and nickel arsenate, naphthenate, and sulfate are giving interesting results in long-term wood-preservation tests. Exhibiting suggestive properties are nickel dibutyldithiocarbamate, oleate, and stearate as lubricant additives; substituted nickel carbonyls and beta-diketone derivatives as motor fuel additives; and nickel diethyldithiocarbamate as an antioxidant and vulcanization accelerator in rubber chemistry. The familiar red dimethylglyoxime nickel derivative, as well as the maroon alpha-furildioxime compound, and several other less familiar organic complexes are being investigated as pigments; and nickel chromate as a corrosion-inhibiting pigment. Nickel catalysts are being made from organic compounds such as the formate and oxalate, from new alloys of the Raney type, and by the precipitation of a great variety of compounds ranging from pure hydrated nickel oxide to complex mixtures such as nickel tungstate-sulfide. Efforts are being exerted to develop catalysts with more highly reproducible properties, active over wider temperature ranges, and more resistant to poisoning. Collaborative projects in catalytic hydrogenation, dehydrogenation, and desulfurization, especially in petroleum chemistry and the synthesis of liquid fuels, are leading to valuable information on nickel catalysts, being made available to industrial users. The inclusive multiple fellowship is sponsored by the International Nickel Co.

Work in Coal Chemistry. Progress in chemical synthesis has spurred research on the chemicals obtainable in by-product coking operations. Novel methods for the recovery of ammonia and other well-known compounds are also in course of inquiry. New analytical and refining procedures are being applied to the identification and elimination of the impurities in the commercial grades of such chemicals as benzene and naphthalene. For instance, the fellowship of the Pittsburgh Steel Co. has found that the gradual deterioration in the quality of recycle benzene is attributable to the preferential accumulation of paraffins. Facts have been marshaled that shed light on many salient questions in coal chemical technology and the war has underscored the import of research in the entire field. The following paragraphs of this section brief investigational accomplishments of relevant multiple fellowships of Koppers Co., Inc.

In gas by-products many advances are apparent. The program on improvements in the technology of cyanogen derivatives has been accelerated and a process for the manufacture of high-purity sodium cyanide has been perfected. Projects involving the thiocyanation of organic materials are under lively prosecution and some compounds of interest to entomologists have been prepared. The polymerization of vinylnaphthalene has been delved into thoroughly. In contrast with published statements that the compound polymerizes slowly, this research has shown it does so speedily. Various phases of styrene polymerization have been studied and an industrial process is a prominent outcome. Work on the chemical improvement of wood has been encouraged, especially in dimensional stability, water-resistance, fire-retardation, and pest-repulsion.

The gas purification group has investigated the production of ammonium thiosulfate and calcium hydrosulfide, and has invented a process for the separation and recovery of ammonium thiosulfate and ammonium thiocyanate from plant waste solutions. In research on coke-oven gas the fellows have achieved the removal of organic sulfur by organic bases. Improvements have been made in the rapid measurement of minute amounts of sulfur in gas by a combustion procedure; a color method of great delicacy and approximate accuracy has been contrived for quickly estimating traces of or-



A research-improved life jacket in use

ganic sulfur by organic thallium salts; and a procedure can be prescribed for determining minute amounts of carbon dioxide in hydrogen sulfide gas that is also advantageously applicable to the titration of carbon dioxide in caustic solution.

The specialists on tar constituents have elaborated methods of separating and purifying mixtures characterized by high viscosity and low crystallization velocity. Novel procedures for the purification of benzene have been found that reduce considerably the impurity content of the purest samples available on the market. Other resources for future endeavor are new methods and improved apparatus for cryometry. A treatise on ebulliometric measurements has been published.

A universal-type 3-inch fractionating column, considered the most effective device of this kind and size ever built, is in use by the tar-distillation team. This fellowship has designed a novel type of 1-inch laboratory column that will soon be ready and has also originated a number of special appliances for a broad program on the physical constants of tar bases.

Opportune circumstances in like manner led to a fruitful year for the large staff of the fellowship on tar synthetics. The catalytic dehydrogenation of hydrocarbons and also their isomerization have been making good headway. Another productive project relates to the catalytic oxidation of aromatic hydrocarbons. In a broad program on alkylation and dealkylation of aromatics, benzene, naphthalene, and phenol derivatives have been given much investigation. Incidentally, the process of ethylating benzene at Kobuta came from this work. A publication pertained to the vapor-phase methylation of aromatic hydrocarbons over solid catalysts. A new method has been composed for the analysis of mixtures of naphthalene, tetralin, and decalin. A novel process for producing vinylnaphthalene and the preparation of alpha-tetralol and alpha-tetralone have attained the unit-plant stage. New uses for phthalic anhydride are being sought and a process has been developed for the manufacture of diphenylamine. A project is concerned with the separation and identification of nitrogen bases from "slop-cuts" in the production of pyridine, picoline, and quinoline, and the chemistry of the carbazoles is being fully cultivated. Certain principal features of the Fischer-Tropsch process have been studied for several years.

Researches for Petroleum Technology. The scientists on the multiple fellowship on petroleum refining (Gulf Research and Development Co.) are in the vanguard of their industry.

Fundamental theoretical studies of distillation, particularly of rectification processes, have been carried onward and five papers are ready for release. The dependence of efficiency on pressure has been determined; the curve shows a maximum near or slightly below atmospheric pressure and decreases almost linearly with the pressure at lower values. Above the maximum, increase in pressure reduces the efficiency very slightly. The dependence of efficiency on heat balance has also been examined. Nonadiabatic operation is frequently desirable, especially at low pressures.

A useful distinction has been made between contact and thermal rectification: in the former, enrichment is accomplished by spontaneous interphase transfer of material between vapor and reflux streams flowing in countercurrent contact; and, in the latter, similar effects are obtained by repeated partial vaporization and condensation. Several types of thermal columns have been investigated, of which the most efficient comprises two concentric tubes, the outer heated and the inner one cooled and rotated. The action of such columns is nearly insensitive to pressure and good efficiency can be had down to the molecular distillation range. Studies are under way on the effect of column holdup on batch distillation, for both packed and bubble-plate columns.

Research is collecting the physical properties of certain petroleum waxes and a new laboratory has been constructed for this purpose. Further regard has been given to a batch recrystallizer that performs repeatedly on a charge of wax material.

A program of fundamental research on the mechanism of catalytic reactions and on the nature and structure of catalyst surfaces has been begun. All reactions being studied at present relate to petroleum refining and its technology. In carrying on this work, use is being made of all the newer tools that have become available during the past few years—namely, radioactive isotopes of carbon and hydrogen; surface area measuring facilities; infrared, ultraviolet, and mass-spectrographic analysis; and, finally, the electron microscope, electron diffraction, and x-ray diffraction equipment. A published critical review pertained to methods for measuring surface areas of finely divided or porous solids; another contribution dealt with the adsorption of water vapor by carbon black.

The work of the engine laboratory has been connected chiefly with the development and application of a prototype test engine designed to meet requirements written by the laboratory. This engine is available in L-head and valve-in-head forms, both liquid-cooled and air-cooled. As a result of many years' experience, it has been concluded that oil consumption is one of the most important variables in engine testing of lubricating oils. Positive and direct control of oil consumption is thus desirable. A system is now being studied in which normal splash is baffled off from the cylinder or cylinders and a controllable positive oil feed to the lower cyclinder wall is employed. Effect of this system on normal oil deposit tendencies is not yet settled.

The multiple fellowship of the Texas Gulf Sulphur Co. has concluded a study of asphaltic products from petroleum extracts and also work on the reaction of ethylene and sulfur and of sulfur with petroleum polymers.

Synthetic Lubricants for Aircraft Instruments. The program on special lubricants, carried on by a multiple fellowship with the cooperative support of the Instruments Branch, Bureau of Aeronautics, Navy Department, has extended the development of new and improved lubricants for aviational instruments. One of the novel synthetic materials previously derived from this research has been manufactured commercially during the past year; and the needs of the armed services for a second type having more highly specialized properties have been met by comparatively large-scale production in the laboratory. Investigational effort has been guided toward the betterment of these lubricants and the possible discovery of novel types that will be superior.

The concurrent hunt for rapid and indicative laboratory tests to evaluate these lubricating materials has secured several new and useful procedures. Some of these tests have been devised especially to cope with the particular problems encountered, while others have been adapted from previously existing methods which in their original form were not well suited to this investigation.

A simple test which determines the stability to oxidation depends upon a small cell in which oxygen containing a trace of moisture is bubbled continuously through a sample of the lubricant held at 100°C. for a period of 100 hours in the presence of a small, weighed block of polished brass. This procedure functions simultaneously as a corrosion test by revealing the extent to which the lubricant or any of its possible oxidation products may attack the polished brass surface. Another method, designed to measure the evaporative property of instrument lubricants, utilizes a specially designed test cell in which a measured stream of dry nitrogen is saturated with the lubricant vapor at 70°C. The rate of evaporation is calculated from the loss in weight of the sample under test, and the results obtained for substances of known properties are in very close agreement with the published vapor-pressure data. Special methods have been applied to finding the nonspreading characteristic of oils, a property that is of extreme importance in lubricants for use in jewel-type bearings. Initial indications of this property may be had from measurement of the contact angle between drops of the lubricant and plane surfaces of ruby, steel, or brass. More accurate data are gained by actual determination of the increase in diameter of small drops maintained on such surfaces under controlled humidity conditions over a long period of time. Another important property of these jewel-bearing lubricants, their ability to decrease the coefficient of friction, is ascertained by a pendulum-type machine that measures the damping effect from friction between lubricated steel and ruby surfaces.

Research on the problem of instrument lubrication is at present centered on the improvement of specific properties of the synthetic oils through the use of small amounts of additive materials, each of which may modify or influence one property without unduly affecting others. Additives intended to give better rust protection, improved viscosity properties, greater stability, and more efficient reduction of the coefficient of friction are being investigated with the objective of combining into these synthetic lubricants a nearly ideal set of properties.

Organic Synthesis Creates Other Lubricants and a Number of Chemical Processes. The organic synthesis multiple fellowship of the Carbide and Carbon Chemicals Corp.—a research group that has completed its thirty-second year of continuous operation in the institute—has had a productive part in an investigational program on new synthetic lubricants, in collaboration with the donor's laboratories. The announcement of these lubricants followed the lifting of government secrecy orders covering them. Two types can be mentioned: an LB series, insoluble in water and useful for machinery and internal-combustion engines; and a 50-HB series, soluble in water and of utility in hydraulic fluids, cutting oils, and textile lubricants. The low pour point, high viscosity index, and nonsludging characteristics of these lubricants render them particularly adaptable to many special purposes, such as in the lubrication of powdered metal bearings, electric motors, and textile machinery; they are also of value in wire drawing and metal stamping. Greases exhibiting un-

usually high and low temperature properties can be produced from them. Laboratory and road tests have shown that cleaner engine operation, easier starting at low temperatures, and less than normal sludge and varnish deposits occur with the use of the proper LB lubricant in internal-combustion engines. In another project the fellowship conducted pilot-plant work on the synthesis of a special instrument lubricant for the Navy that led to the manufacturing stage.

Progress in applications of Vinylite resins from dispersions rather than solutions in organic liquids was speeded up by the termination of the allocation order relating to these resins. Resin particles of approximately 0.1 micron in diameter are suspended in inexpensive volatile liquids or in plasticizers. As the resin is dispersed, preparations containing 35 to 55% resin may be made without the handicap of the high viscosity associated with resin solutions. Extensive studies of the effect of the composition of the liquid vehicle on the viscosity of the dispersion have laid down a sound technical basis for the formulation of these coatings. Industrial uses, such as in metal, paper and cloth coating, film casting, and molding of flexible articles, have been highly successful. Research on heat stabilizers for chlorine-containing resins has developed a class of high-boiling materials with excellent properties.

The investigation of the chemistry of allyl compounds has brought industrially feasible processes for 2,3-dichloropropanol-1, 3-chlor-1,2-propanediol, and epichlorohydrin. Phenyl morpholine has been produced in development quantities to establish an industrial use for this amine. Studies on emulsions, surface-active substances, and water-soluble waxes were resumed as soon as permitted by the wartime obligations of the fellowship. Military requirements for nonionic surface-active materials initiated research in this field, and a number of polyglycol esters were developed, evaluated, and used with success—products that are now finding diversified applications in civilian life. The synthesis of a series of compounds for appraisal as miticides was undertaken some of them have been found to be highly effective. Solvents for DDT for special purposes have been investigated, also dispersants for fungicides and insecticides.

Notes about Food Researches. *Nutritional Observatory*, a periodical edited by the Heinz nutritional division in the institute (multiple fellowship on food varieties), has entered its seventh year of publication. This journal, issued three times annually, is distributed gratis to over 44,000 specialists. A revised 12th edition of the "Heinz Nutritional Charts" is scheduled for appearance in the spring and according to expectation 50,000 copies will be sent out; a Spanish translation will be available to 5,000 in Mexico and Puerto Rico. A pamphlet was published on the nutritive value of vegetables. In the laboratory a carbohydrate preparation of the maltose-dextrin type has been raised to a high degree of purity and the chemistry of sprouting grains is under investigation. The vitamin section of this fellowship has thrown light upon the effects of storage on the vitamin contents of regular and fortified strained foods. By a new program on vitamin methodology this section will function in close cooperation with the nutrition laboratory formed recently in the Heinz research department. In the same fellowship's program on vitamin-fortified foods for infants the groundwork was completed on a vitaminous dried precooked oatmeal. In another project, the preparation and use of certain vegetable protein hydrolyzates as food-flavoring materials, it has been shown that purifying procedures will be necessary to decrease the characteristic taste.

On the Standard Brands multiple fellowship on yeast, researches continue on the value of yeast as a therapeutic agent and as a source for vitamins, and a new broad study for the improvement of malt processing is emphasizing fundamental problems related to the steeping, germinating, and kilning operations. The wheat fellowship has examined successfully the control of mold growth and infections in bread and is now studying the factors influencing bread staling and methods for decreasing its rate. A granular adsorbent for sugar refining resulting from a far-reaching program of research and development by the multiple fellowship on bone products is under thoroughgoing industrial-scale tests at an eastern refinery; the fellowship has also investigated the techniques of superphosphate manufacture.

Stream Improvement Program Enlarged. The multiple fellowship of the National Council for Stream Improvement (of the Pulp, Paper, and Paperboard Industries) Inc. entered its second year with an increased staff and a much expanded research program. The investigations are directed toward the development of methods for disposal of waste materials from the pulp, paper, and paperboard mills so as to abate water pollution, and the discovery of processes for making usable by-products from some of the wastes. Among the materials being studied are deinking wastes, bleach liquors, and wastes from the pulping of flax. Work on the treatment and disposal of deinking wastes has reached a point where plans are being considered for pilot-plant investigations. The foreign wood-pulp situation together with the resumption of normal operations in the paper industry suggests that deinking operations and problems will continue to be of importance for many years.

The majority of the established concepts of stream pollution by industrial wastes are based on methods developed for the measurement of human contamination. Wastes of the domestic sewage type are highly putrescible as well as esthetically objectionable and have probably harmful physiological reactions if reingested in the animal body. There is no certainty that these concepts and methods of testing constitute the right yardstick for all industrial wastes. Cooperative researches on this problem are pointed to as valuable in the present widespread interest in abatement of water pollution.

The fellowship has participated in regional meetings of the National Council's groups of pulp and paper manufacturers (and state water control commissions) in all sections of the country. These activities have been part of a special effort to acquire familiarity with the problems peculiar to each area. In this nation-wide survey the necessity for considering the water courses into which the wastes are eventually discharged has become increasingly apparent. Hence the fellowship has already carried out an important sectional stream pollution examination in connection with plans being considered for the proposed treatment and disposal of the wastes from several pulp and paper mills. Certain general principles for treatment are evolving from the researches at the institute. But indications, based on data from stream surveys and on knowledge of the nature and conditions of the receiving water courses, are that each industrial plant's waste disposal problems will require considerable individual investigation to determine the most technically and economically satisfactory treatment and method of disposal to meet standards of water purity of the receiving stream.

Progress in Life Preserver Research. The invasion of Java by Japan cut off the chief source of the highest grade kapok and left available for all applications only an inadequate stockpile and minor amounts of lower grade kapok from other sources. Early in 1944 the armed services anticipated the complete exhaustion of this supply as well as existing substitutes by the close of 1945, even though reserved essentially for use in life jackets. This situation was aggravated by a sudden demand for the jumbo-sized jackets used by fully equipped troops landing on foreign shores. It was determined then that a quest should be made for an efficient domestic substitute in ample quantity.

This program was assigned to Mellon Institute by the Air Sea Rescue Agency of the Armed Services through the Committee on Quartermaster Problems of the National Research Council. The emergency transfer to this project of a group of specialists—the staff of the multiple fellowship on cork (intermitted for the purpose)—having previous and extensive experience with cellular synthetic substances materially shortened the introductory period. In a few months evidence was available that the greatest opportunity for producing an acceptable substitute for kapok in the quantity needed lay in the field of fibers, and the specific possibilities had been fairly well fathomed. Life preservers must be able to withstand rigorous conditions of service and temperature change. This requirement eliminated the use of resilient sealed cellular products as the buoyant filling material because additional bulk to compensate for possible buoyancy losses was not acceptable. To ensure their being worn, life jackets should be comfortable and not handicap men performing normal shipboard duties. Fibrous materials were investigated because many of them are resilient, soft, and devoid of plastic flow, while their buoyancy is unaffected by temperature change. Several waterproofed cellulose products, which could be prepared immediately in unlimited quantities, were developed and shown to be adequate stopgap substitutes for kapok. What appears to be a permanent replacement, however, is not of organic origin.

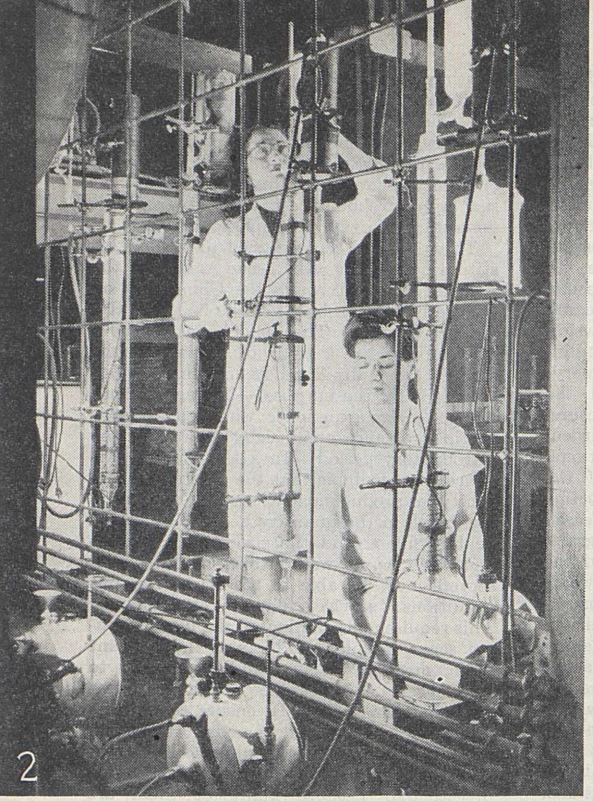
Cooperative research and development work with the laboratory of the Owens-Corning Fiberglas Corp. led to a treated, superfine Fiberglas which promises to replace kapok for use in life jackets on all naval vessels and may find employment for several other purposes on ships where its fireproof qualities are of first importance. Careful studies first to develop methods of evaluating the buoyancy, then to determine the role of packing density and column heights, have led to a broader understanding of the mode of function of fibrous buoyant materials. The essential differences between the buoyant Fiberglas and kapok have been defined, the advantages of Fiberglas evaluated, and application made to jacket design.

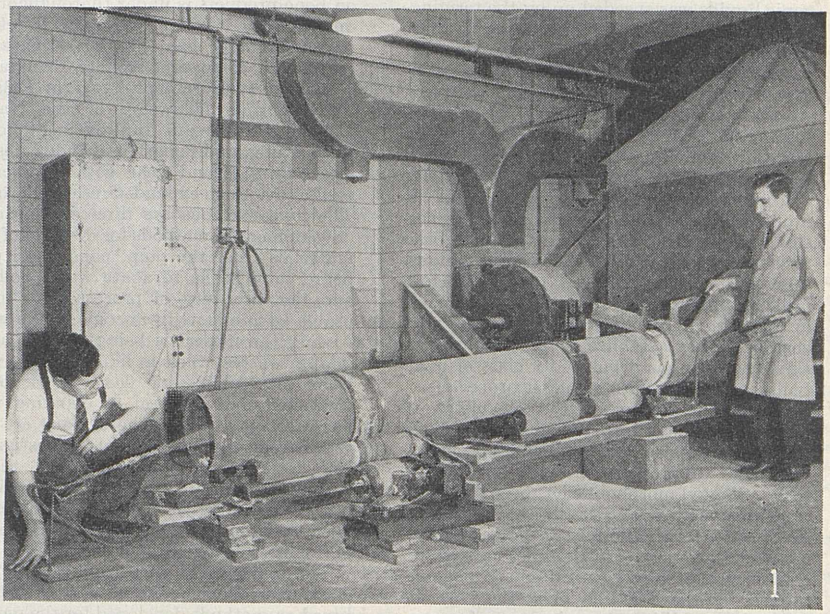
All phases of the problem have been searchingly scrutinized. For comparison with the results of the usual static buoyancy tests, the effects of rough water on the buoyancies of whole life jackets were investigated in waters adjacent to Florida. The first test of its kind, it showed a need for correlating laboratory observations with the effects of service use and gave invaluable information for later work on jacket design. Machines were constructed for determining the effects of dry and wet wear, and actual service tests were arranged for correlation. Service personnel and survivors were interviewed on damaged ships to obtain at first hand an understanding of the complicating factors involved in providing effective, satisfactory lifesaving gear. Not the least of these factors is wearability or comfort under all conditions of service.

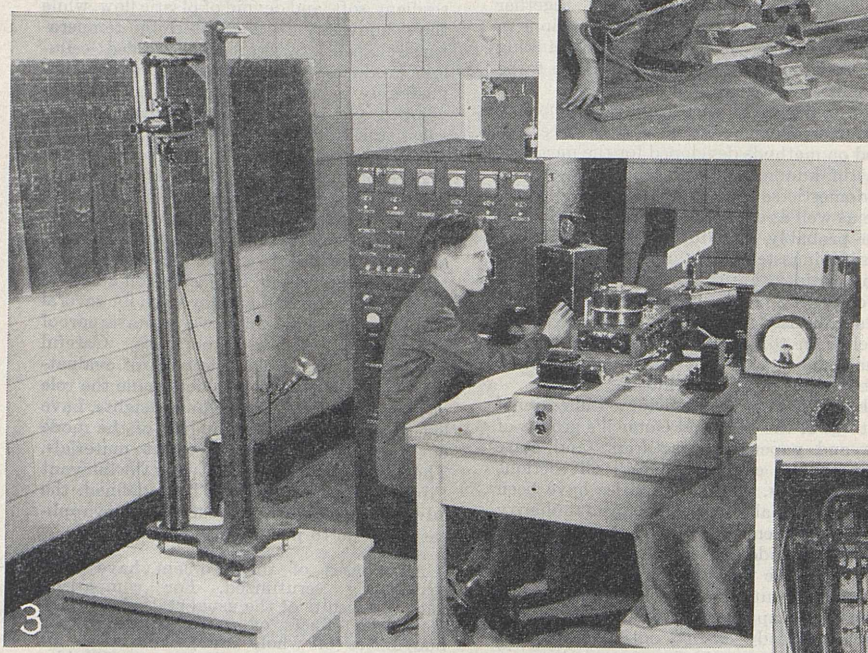
The research was extended to include the design of life jackets for the use of all services. Initial studies with a variety of human subjects demonstrated the distribution of buoyant material necessary to position individuals as officially prescribed, on their backs at an angle of 45° to 70° from the horizontal. Many experiments to determine the requirements for righting (turning the subject from a face-down to a face-up position) have shown that anatomical differences, the relative positions of the arms and legs, and in-

The Chemical

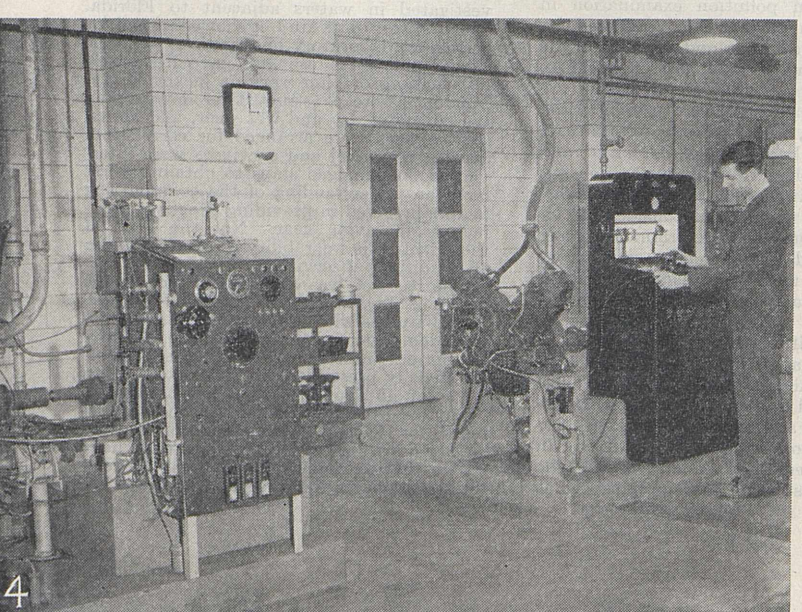
Research at Mellon Institute







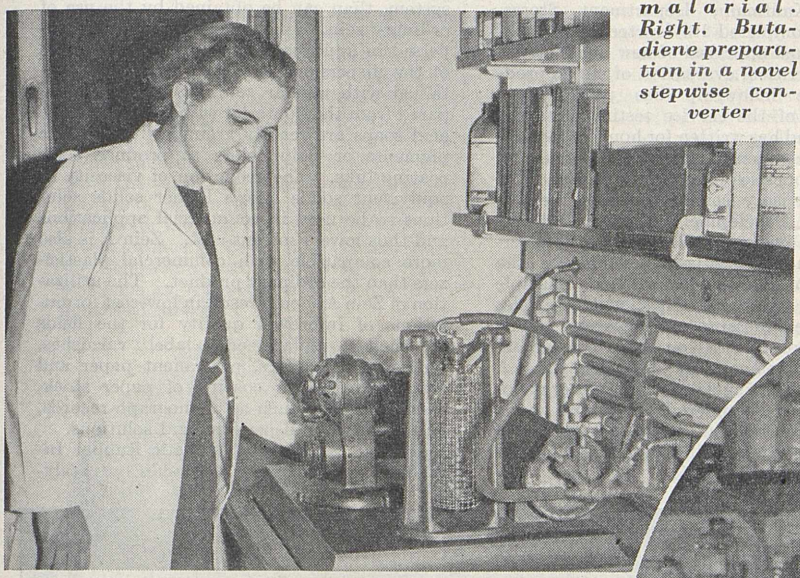
(1) A study of the drying characteristics of "Garsand", a new glass batch formulation, by the multiple fellowship on mineral products (Garco Products Inc.) (2) Defining improvements of butadiene yields from alcohol (3) A mass spectrometric study of fuel gases (4) Lubricating oil test engine under development by multiple fellowship on petroleum (5) Basic work on butadiene production efficiency

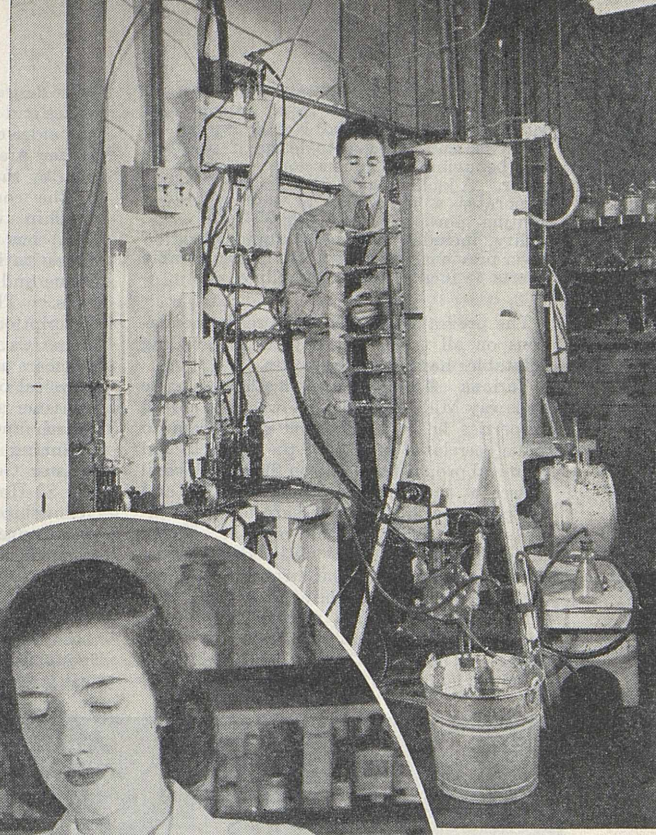


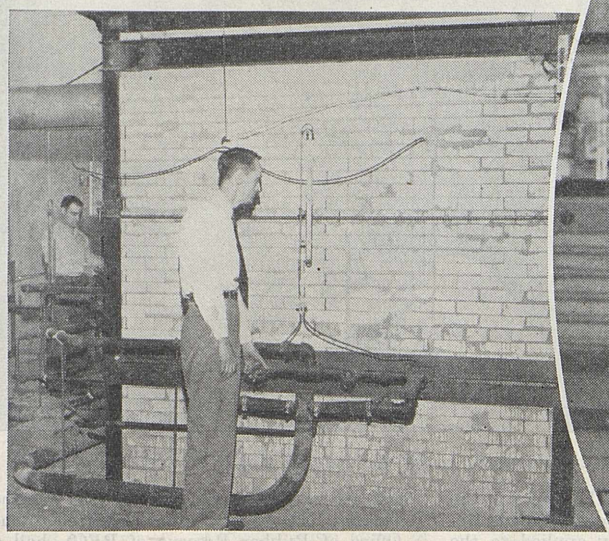


News Parade

Left. A step in making 4-(p-diethylaminobenzylaminoquinoline, a prospective antimalarial. Right. Butadiene preparation in a novel stepwise converter



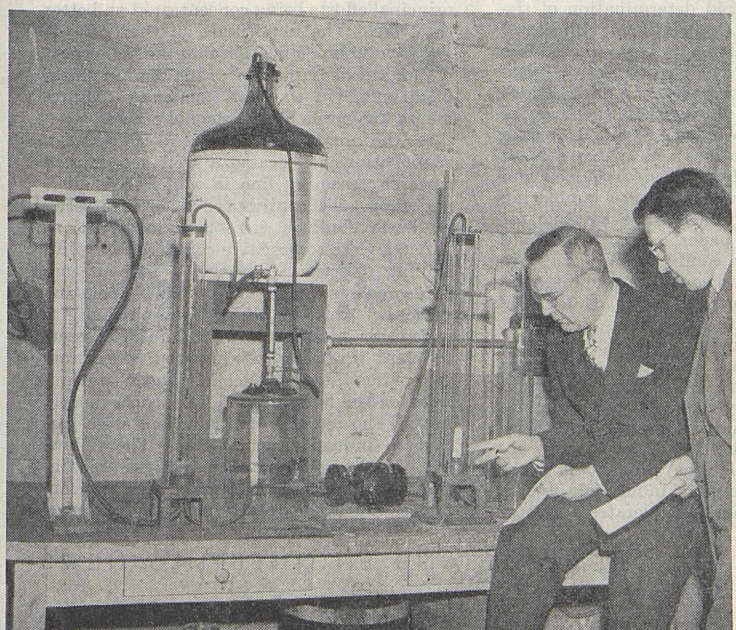


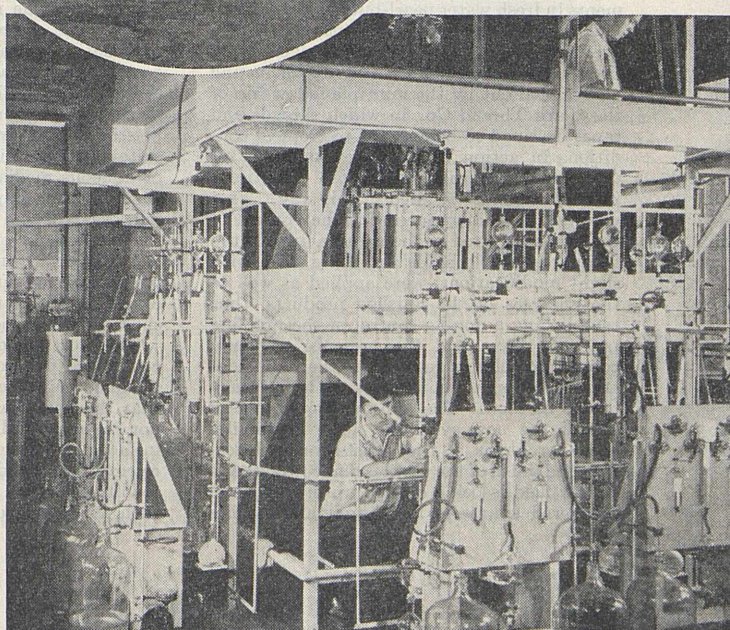




Oval. Observing the wear characteristics of a new felt Far left. Controlled furnace for studying fire-resistance of floor construction

Below, left. Continuous preparation of magnetic oxide from waste pickle liquor. Below, right. Multiple unit for rapidly determining catalytic activity





flated diaphragms are all-important factors. These observations led to a project now being conducted at the Naval Bureau of Medicine and Surgery to learn, if possible, the behavior of unconscious subjects in water. A jacket has been designed which incorporates a maximum of buoyancy and righting power commensurate with wearability, includes features of standardization never previously attained, and has removable inserts to facilitate launderability.

The program is to last until recommendations on all types of life jackets including inflatables have been drawn up.

Various Textile Investigations. The Callaway Mills' multiple fellowship on cotton properties has embarked on a program to make correlated studies of the physical and chemical properties of cotton fibers. Several phases of the work are under research and the personnel of the fellowship has been increased to facilitate the projects. Other textile fellowships have outlined in papers the determination of the structural components of cotton linters, the estimation of total sulfur and the gamma number of viscose, and the softening and lubrication of rayon fabrics. The Onyx Oil and Chemical Co.'s multiple fellowship on textile finishing has been engaged in the preparation of a series of nonionic detergents and emulsifying agents, and in investigations on the surface activity of a number of capillary-active materials, including several members of the group of cationic germicides. The nacre fellowship of the American Pearl Button Co. has aided in making several new and useful improvements in fresh water pearl-button technology.

During the war, in cooperation with the department of biology of the University of Pittsburgh, a continuous program of testing was carried out by the multiple fellowship of the Clark Thread Co., in which threads and tapes destined to be exposed to tropical conditions in action fronts were examined for their ability to withstand those conditions. Zippers were also studied in this way. Fast methods were introduced for the control of the baths required in the manufacture of the tropic-resistant threads and tapes, and, with slight modifications, were applied as well to the analyses of the finished products, thus establishing a double control of the proofing process. Dyes and the presence of many compounds closely resembling the fungicides employed were without effect on the accuracy of the method. The approaching increased use of the new synthetic fibers in textiles raises problems of the satisfactory lubrication and finish of the textiles made from them. A new field is being opened up in the use of recovered synthetic fibers to make textiles with desirable properties of their own. The cones and spools on which these textiles and the older ones, too, are to be offered to consumers are coming in for their share of attention by the thread fellowship.

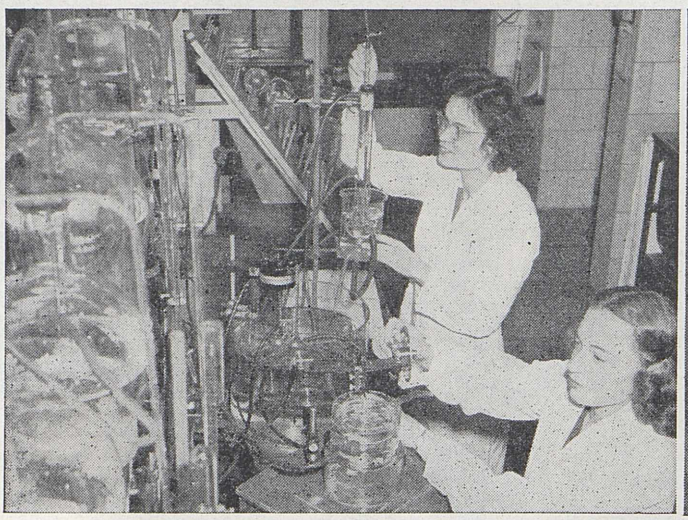
The commodity standards multiple fellowship (Kaufmann Department Stores, Inc.) has completed its fourteenth year of investigational appraisal of new merchandise items and critical evaluation of staple products. The fellowship has published a description of the service testing of textile materials and has written for home economics teachers a compendium of the chemical and physical properties of synthetic fibers. The wartime advisory connection with the Research and Development Branch, Military Planning Division, Office of the Quartermaster General, has been concluded. The U. S. Hoffman Machinery Corp. multiple fellowship, whose investigational activities have covered pressing machines and industrial filtration, started on Sept. 1 to accentuate improvements in dry cleaning. A novel type of drying device using water vapor instead of air is under development and a study of basic factors in the detergency of nonaqueous liquids will dominate the chemical program during 1946.

Uses for Corn Proteins. The work of the multiple fellowship of the Corn Products Refining Co. has been largely applied to the utilization of industrial proteins. Research has been carried out on the improvement of the gelation stability of zein and on the utilization of stabilized zein resins in the shellac replacement field. A study is concerned with methods for the rapid determination of the gelation life of protein solutions. Improved formulations based on mixed plasticizers have come from an investigation of the plasticization of ordinary zein. Combinations of zein and other materials in the form of plasticized and unplasticized resinous masses suitable for application from either solvent or aqueous media have been developed and evaluated for impregnating and laminating purposes. These products are suitable for the lamination of paper, cloth, wood, and glass fabric in any combination; they are particularly advantageous in attaching glass cloth to itself or to other materials, for they show very high bond strengths.

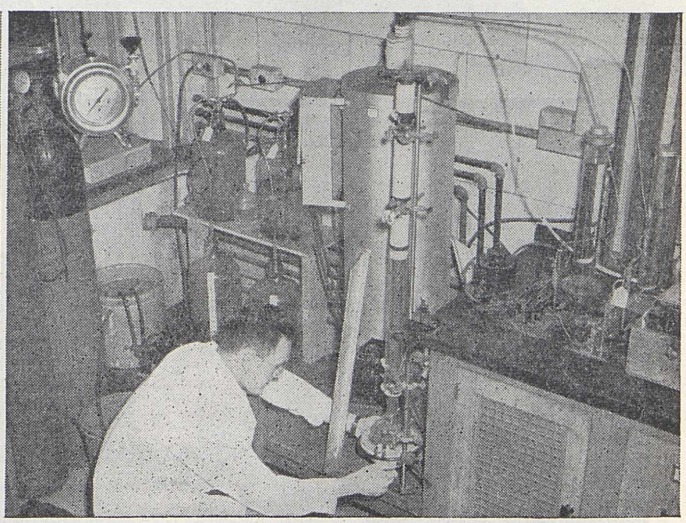
The most meaningful undertaking has encompassed the industrial uses of chemically modified zein (Zein A). It has been found that this material yields solutions which do not gel under ordinary industrial conditions; in fact, it is difficult to cause gelation by accelerated methods. The product is more readily soluble in common industrial solvents such as ethyl alcohol and tolerates a greater quantity of diluent than can be introduced into ordinary zein solutions. Its compatibility with resins is higher and it is more stable in the presence of metallic pigments. Invariably this material yields less viscous solutions at equivalent solids, regardless of the solvent system, than can be obtained by the use of ordinary zein. It is much more readily dispersed in aqueous media and the viscosities of the dispersions are lower than those obtained with regular zein. Dispersions prepared from this material with rosin and oleic acid soaps are readily ground with metallic pigments or pulp colors to produce color coating inks. The reduction of viscosity at equivalent solids allows higher solids solutions to be used in commercial applications and thus lowers solvent cost. Zein A is also more compatible with commercial plasticizers than the ordinary product. The utilization of Zein A should result in low-cost formulations of improved quality for the fields of shellac replacement, label varnishes, greaseproof coatings, permanent paper and textile sizes, color coating of paper stock, resinous masses such as phonograph records, and pigmented dispersions and solutions.

Discoveries for the Synthetic Rubber Industry. The multiple fellowship on catalysis, set agoing in midyear of 1944 by the Rubber Reserve Co. (later converted to the Office of Rubber Reserve of RFC), had a comprehensive program and an expanded staff of more than sixty investigators during 1945. The purpose of the investigations was to accomplish improvements in the manufacture of butadiene from ethyl alcohol, the principal efforts being concentrated on better catalysts. The importance of this work is apparent upon realization that the major part of the initial burden of production of butadiene sufficient to meet emergency requirements was borne by the alcohol process.

As the program progressed in its complex ramifications it became a well coordinated research assembly line in which specialists and their aids contributed a definite series of basic findings here and observations through close cooperative contact there, with skillful direction toward a planned end. Close collaboration with plant operating personnel was maintained throughout to expedite transmutation of laboratory results to plant practices. Owing to the termination of hostilities the alcohol plant operations were ended late in 1945 and consequently not all the research contributions were carried to industrial utilization. The fellowship developed methods of catalyst preparation and evaluation amenable to a program for testing 500 catalysts per year to deter-



Measuring surface-activity of new cationic detergent



Microplant for catalytic cracking of cyclic hydrocarbons

mine efficiencies in the synthesis of butadiene from alcohol. Analytical procedures for the product and by-product constituents evolved for these laboratory catalyst evaluations employed chemical and physical methods, readily adaptable for facilitating and maintaining efficient commercial plant operations. New catalysts were made and tested in the pilot-plant stage but did not reach industrial application. Other advances outside the field of catalysis include discoveries that butadiene yields from alcohol are appreciably increased by recycling of certain previously discarded by-products and by modifying the operating procedures. Because of the loss of government interest in the alcohol process for the manufacture of butadiene, the investigations in catalysis have ceased and the fellowship has been assigned critical problems in the commercial production of synthetic rubber.



Applying electrophotometry in industrial toxicology

Developments in Protective Coatings. The multiple fellowship on protective coatings sustained by Stoner-Mudge, Inc., carried ahead its investigation and development of organic linings for airplane integral wing tanks, a program effectively harnessed to the national need. Formulations were worked out that could be applied by flush-coating and cured with a gas—a practice that made possible the coating of areas inaccessible to brush-application. The demand for these lining materials by the aviation industry was so urgent that use proceeded simultaneously with development, and the fellows assisted in field supervision. A fundamental study of fouling of ships' bottoms and its prevention by the employment of antifouling paints was likewise contributed to the war effort. Papers pertained to the mechanism of accelerated corrosion under antifouling compositions applied to steel, to the anomalous inactivation of heavy metal antifouling paints, and to the comparative antifouling efficacy of DDT. New methods of protective coating manufacture have also been investigated, to provide more economical formulations for the postwar era.

Organic coatings have been evolved for steel, to permit the use of this metal for industrial structures and equipment where severe corrosive conditions exist or where metal products of corrosion are to be kept from contaminating a chemical manufacturing process. Paints and enamels have been formulated and evaluated for prefabricated structures; these products provide corrosion protection during storing and shipping and eliminate coating after assembly or erection.

New Uses for Organosilicon Products. The fundamental reasons for the unique properties of organosilicon compounds have been investigated by the multiple fellowship (technical glassware) of the Corning Glass Works, in cooperation with the Dow Corning Corp. The reactions of these compounds differ in many respects from those of wholly organic compounds and the findings of the past year add justification to the statement that these derivatives constitute a new and large subject of research that is definitely advancing on its own road.

It has been possible to widen the usefulness and the types of the polysiloxane fluids. One of the most spectacular applications is as an antifoaming agent in petroleum products. Minute amounts of the fluids prevent foaming in lubricating oils and therefore these additives found wide application by the armed forces. The fluids have also been employed in reducing foaming in acetone–carbon dioxide baths, saving time and effecting safety for the laboratory technician. Certain variants of the fluids minimize foaming in aqueous media and have introduced economies into mixing and distillation procedures. Other types of these fluids are being used as diffusion pump oils because of their low vapor pressure and stability to heat and moisture. Among other uses for these fluids are their applications as mold-release agents in the molding of rubber and in the injection and compression molding of organic plastics. The temperature range of the organosilicon lubricants having greaselike consistency has been extended so that they are now applicable at temperatures between −75° and 200° C. These lubricants are of value in the recently developed silicone-insulated motors that may operate efficiently at temperatures too high for conventional lubricants. The low-temperature lubricants introduce a safety factor in the operation of high-altitude planes. Other types of silicone fluids are being used as lubricants for high-temperature equipment such as conveyor chains subjected to both heat and humidity. The field of organosilicon resins has been increased to include electrical insulating varnishes that cure at conventional temperatures, as well as heat-resistant paints and coatings for protection of exhaust stacks and similar installations. Marked improvements have been made in the strength and compression set of the silicone elastomers, whose applications now embrace flexible coatings, gaskets, tubing, and wire insulation.

Investigations in Chemical Hygiene. Research facilities for ascertaining the hazards of handling new chemicals are far less abundant than are installations for discovering means to produce them. The recognition of this limitation by the Carbide and Carbon Chemicals Corp. in 1937 led to the establishment of the fellowship on chemical hygiene.

The beginning of this program was modest, with a staff of two persons, but growth has been steady and today there are twenty-three with facilities to house over 3,000 small animals. Shortly after the institute's old building was vacated, the fellowship commenced its studies there near space assigned to the department of industrial hygiene of the University of Pittsburgh school of medicine. The departments of pharmacology, physiology, and physiological chemistry of that school later took up their quarters in the building and offered fine opportunities for cooperation to the chemical hygiene group. Separation from the rest of the institute does not render difficult contacts with other fellowships, and proximity to the medical school and its library is highly advantageous.

About half the work of the chemical hygiene staff consists of preliminary studies of newly available chemicals with a view to outlining the nature and degree of their hazards to health, so that safety in manufacture can be defined and assured. The rest of the abilities of the group is devoted to selecting safe applications of compounds from among those uses which other workers suggest as suitable, helping to protect the public health from injurious molecules in foods, drugs, cosmetics, paints, and the like. Most of the findings resulting from the latter studies are published in the medical literature so that the conclusions may be generally known among specialists. During the past year papers have described the hazard from skin penetration of ethylene chlorohydrin, have contributed to understanding one phase of the biochemical response to carbon tetrachloride poisoning, and have given new information on the use of di-2-ethylhexyl phthalate as a plasticizer in food containers and relating to the use of polyethylene glycols in cosmetics and pharmaceuticals.

Industrial Hygiene Foundation in Readiness for the Postwar Era

Pervading all research on health and transcending it in purport are the sentiments of human regard and humane endeavor. During the past decade in particular the indusries have gained respect for the tenets of hygiene and for the scientific handling of their health problems. Since its organization ten years ago Industrial Hygiene Foundation, a nonprofit corporate body, with headquarters in Mellon Institute, has been building not upon general impressions but entirely upon determined needs of technology after systematic research. There are consequently, among the 300 member companies and associations, a definite consciousness of the high value of interindustrial health relations and a cordial appreciation of scientific investigation and education in support of plant hygiene, of improving physical working conditions, and thereby safeguarding the health and contentment of production forces.

The tenth annual meeting of the foundation, held at the institute on Nov. 14 and 15, 1945, was most successful[1]. Preceding that convention was the first engineering conference on industrial ventilation, the technical value of which was convincing. Other advancements of the year were the reinforcement of the foundation's staff of specialists, additional services to chemical manufacturing, completion of a sweeping dust-control study of the pottery industry, and refinement of the technique of appraising the degree of silica concentration to which workmen in dusty trades may be exposed. The foundation is concerned not only with the detection and control of specific health hazards in the industries but also with the general well-being of persons at work. The foundation's health engineers are being called upon by members to examine plans for new or remodeled plants from the viewpoint of infusing into such construction the maximum of correct physical working conditions in the light of present knowledge. Mechanical operations of various industries are getting reconnoissance by these engineers, with the intention of eventually easing performance in certain tasks.

The Institute's Department of Research in Pure Chemistry

Investigations in this department (L. H. Cretcher, head) have continued in the realm of synthetic organic chemistry applied to chemotherapeutic and biological problems. Much of the work has pertained to the preparation of new antimalarial drugs, in association with the Survey of Antimalarial Drugs of the National Research Council. Of the large number of compounds submitted for appraisal in malaria therapy, the ones that have proved to be of greatest value are related to pamaquine.

Synthesis of New Antimalarial Drugs. As mentioned in the 1944–45 report, it was deemed advisable to examine some hydroxyethyl analogs of the pamaquine series. This research involved the synthesis of 6-hydroxy-

[1] W. R. Bradley has described this meeting in CHEM. ENG. NEWS, 24, 34–8 (1946), and the transactions issued by the foundation contain the addresses, papers, and discussions.

ethoxy-8-aminoquinoline, first accomplished by alkylation of 6-hydroxy-8-nitroquinoline with benzyloxyethyl tosylate and hydrolysis to 6-hydroxyethoxy-8-nitroquinoline, followed by catalytic reduction. A new hydroxyethylating agent, discovered by W. W. Carlson of this department, was later substituted for benzyloxyethyl tosylate, resulting in a considerable increase in the yield and facility of isolating the product. Two 6-β-hydroxyethoxy-8-diethylaminoalkylaminoquinolines were then synthesized and found to possess significant antimalarial activity upon testing against several avian malarial infections (M. S. Morgan). In view of these findings, nine more compounds of this class (including both mono- and dialkylaminoalkylamino derivatives) have been made, in order to ascertain the effect of changes in chemical structure on toxicity and antimalarial activity (Morgan and R. S. Tipson). This work has entailed the synthesis of relatively large quantities of 6-hydroxyethoxy-8-aminoquinoline, an object successfully accomplished with appropriate modifications for large-scale preparation (Tipson and Farley Walton).

Before entering on a study of some of the lepidyl carbinols it was decided to attempt a clarification of the confusing data in the literature concerning certain quinaldyl carbinols. A publication from the department records the successful preparation and characterization of the three mononitrophenylquinaldyl carbinols (and their corresponding styryl derivatives) and catalytic hydrogenation to give the three monoamino compounds. A similar examination of the lepidyl carbinols is now in hand (Tipson and Walton). In research paralleling that previously described for the 2-styrylquinoline series, a number of new 4-styryl and 4-(*p*-dialkylaminostyryl)-quinolines have been made and the effect of hydroxyethylation at position 6 determined. Work on some 8-(*p*-dialkylaminobenzylidene)-aminoquinolines is under way (Tipson and Mary Clapp). An investigation dealing with the 4-(*p*-dialkylaminobenzylidene)-aminoquinolines and 4-(*p*-dialkylaminobenzyl)-aminoquinolines was concluded with the preparation of five derivatives of each type; their structures were verified by hydrolysis studies. Some azomethine derivatives of quinoline-4-aldehyde have also been made. Several new 7-methylquinoline derivatives were had as intermediates in the preparation of 4-amino-7-methylquinoline. 6-Hydroxyethoxy-4-chloroquinoline was synthesized for use in condensations with dialkylamino-alkylamines and -arylamines (Virginia Ramsey). A series of compounds structurally related to 2-styryl-4-amino-6-methoxyquinoline has been studied and submitted for testing to the Chemotherapy Center for Tropical Medicine in Washington, D. C. Unsymmetrical quinolyl sulfides as well as quinolyl isothiouronium salts, mercaptans, and symmetrical sulfides have been synthesized (Alice Renfrew).

Alloxan Diabetes and Other Topics. In collaboration with J. A. Ruben of the Montefiore Hospital, Pittsburgh, research has been conducted on the function of alloxan in causing experimental diabetes in animals. Two color tests of use in the qualitative detection of alloxan (or its reduction products) have been evolved. One of them, the pyrrole test, is given by both alloxan and dehydroascorbic acid; the presence of 1 part of alloxan hydrate in 50,000 parts of solution may thus be readily detected. The second test, which consists in the formation of a purple color on reduction with cysteine hydrochloride and alkalinization with barium hydroxide, is given by alloxan (0.01% solution). These two tests were then applied to extracts of a variety of animal tissues and fluids. The results obtained suggest that alloxan or its reduction products may be normal constituents of certain tissues, particularly the liver. Three papers describing this work have been published (Tipson).

Some polysaccharides of high molecular weight are being prepared, at the request of Maud L. Menten of the Children's Hospital, Pittsburgh, in relation to animal studies of kidney function and nephrosis (Renfrew).

Previous reports have discussed the development of new hydroxyethylating agents. These compounds, cyclic esters of glycol, have been found especially useful in the alkylation of phenols containing basic nitrogenous groupings, although they also react readily with amines and mercaptans. The study of these compounds has been extended to include the cyclic esters of a variety of substituted vicinal glycols as well as the esters of higher glycols. The hydroxyalkylation of phenols has been observed to proceed under alkaline, neutral, or acidic conditions, although, in general, alkaline condensing agents give the highest yields. Aside from their usefulness as hydroxyalkylating agents, interest in these compounds centers in the fact that they represent new additions to the list of esters in which alkyl-oxygen fission occurs with considerable ease. Acyl-oxygen fission is the usual mode of reaction of carboxylic esters; in general, alkyl-oxygen fission of esters takes place by a unimolecular solvolytic mechanism. Indications are that a bimolecular mechanism is involved in the case of cyclic glycol esters (Carlson).

Drug Standardization Research. A series of papers dealing with the rapid determination of iodine in pharmaceuticals, the identification of iodide adulteration of desiccated thyroid, and the stability over a 10-year period of desiccated thyroid and thyroid tablets has been published under the auspices of the U. S. Pharmacopoeia Convention (K. L. Waters and G. D. Beal). The investigators have also reported on the hydration of caffein and are similarly determining the constitution of the stable hydrates of a number of other pharmacopoeial chemicals.

Industrial Fellowships in Operation, March 1, 1945, to March 1, 1946[a]

Abrasives (1930). A. P. Thompson, sen.; E. A. Loria, from Jan. 1.

Acid Recovery (1938). W. W. Hodge, adv.; R. D. Hoak, sen.; C. J. Sindlinger, from Nov. 19; C. J. Lewis, to Oct. 1. Bernice Klein.

Adhesives (1945). E. P. Barrett, adv., from May 1 to Nov. 1; E. H. Balz, sen., from June 1; Aimison Jonnard, from May 1 to Nov. 1. C. D. Droman, from May 1 to Nov. 1; Joseph Cohen, from Sept. 11 to Nov. 1.

Amine (1937). R. V. Rice, sen.; G. M. Jaffe.

Anthracite (1937). R. C. Johnson, sen., to Feb. 1. R. R. Fernow.

Bone Products (1935). E. P. Barrett, sen.; Aimison Jonnard. Violet La Russo.

Box (1943). H. E. Bowers. Margaret Schreiner.

Bread (1930). H. A. Kohman, sen.

Calcite Technology (1941). W. J. Remington; Conrad Trost, adv., to Aug. 1.

Catalysis (1944). B. B. Corson, adv.; E. E. Stahly, sen.; J. A. Hinckley, Jr.; H. E. Jones; M. H. Whitlock; A. L. Marston; J. F. Miller; P. M. Kampmeyer; H. D. Bishop; M. C. Jaskowski; Gilbert Kivenson; Genevieve Diffendal; C. E. Welling, to Feb. 1; J. W. Lennon, from March 5 to Feb. 1; L. J. Lohr, to Sept. 8; C. D. Helm, to Feb. 1; H. R. Sheppard, Jr., to Feb. 1; W. C. Woodland, to Feb. 1; G. J. Haddad, to Jan. 15.

J. E. Gleeson; G. F. Haines, Jr.; T. K. Brown; R. J. Bonistalli; Betty Zehner; P. L. Shanta, from Oct. 1; J. H. Lieblich, from Oct. 17; Helen Lossman; Gertrude Linsky; Betty Johnescu; Florence Orlando; Reva Frankle; Hertha Bergmann; Alba Anania, from June 13; D. D. Shaffer, from Aug. 27; E. C. Kovacic; Albert Roth; John Smarsh, from Sept. 17; Juliet McKibben, to Feb. 1; C. W. Baulknight, to Feb. 1; W. J. Nolan, to Feb. 1; Ruth Cusick, to Feb. 1; Verna Sabella, to Feb. 1; Ferdinand Meyer, Jr., to Feb. 1; W. R. J. Merz, to Feb. 1; Martha Bissell, from March 19 to Feb. 1; L. M. Horwitz, from Aug. 1 to Feb. 1; Dorothy Hattman, from Sept. 1 to Feb. 1; Louis Joseph, from Sept. 19 to Feb. 1; Lois Lurie, from Oct. 10 to Feb. 1; Charlotte Miller, from Oct. 22 to Feb. 1; Joseph Cohen, from Nov. 1 to Feb. 1; E. G. Burtell, Jr., from June 13 to Jan. 28; Miriam Harper, to Jan. 14; Ruth Blumberg, to Dec. 1; W. S. Griffiths, from Sept. 24 to Dec. 1; Nancy Noyes, from Aug. 13 to Nov. 5; W. O. Powell, to Oct. 15; G. W. O'Brien, from April 24 to Oct. 1; Odette Parker, from June 4 to Oct. 1; A. G. Sisca, from July 11 to Sept. 29; J. E. Johns, from July 2 to Sept. 25; K. R. Newman, to Aug. 1; Madeline Corl, to July 1; R. H. Cahoon, to June 29; Dorothy Colwell, to June 1; J. A. Crowley, from April 23 to June 1; Sophie Smrkolj, to May 26; W. C. Church, to May 6; A. E. Hewitt, to May 1; Carol Sittler, to April 1.

Cellulosic Molding (1942). J. C. Williams.

Ceramic Chemicals (1933). E. E. Marbaker, sen. W. D. Caldwell, to Dec. 1.

Chain and Welding (1936). D. F. Helm, sen.; F. A. Kaufman. E. G. Burtell, Jr., from Jan. 28.

Chemical Hygiene (1937). H. F. Smyth, Jr., sen.; C. P. Carpenter; C. B. Shaffer; C. S. Weil, from Oct. 15; W. L. Thompson, to Sept. 15.

Louise Fischer; Frances Critchfield; C. A. Walker, from Dec. 3; Jane Brislin; Alene Garwood; Olga Bauer; Vivienne Bartholy; Martha Milie; Jo-Ann Hensley; Helen Colby, from May 11; Elizabeth McCulloch, from Aug. 27; Elise Miller, from Aug. 27; Annetta Emminger, from Oct. 9; Eleanor Lynch, from Sept. 25; Jane Davidson, from June 11 to Sept. 10; Jane Seaton, to Sept. 1; J. M. Beck, to Sept. 1; Jacqueline Front, to June 1.

Chemical Storage (1942). J. B. Garner, sen.; Ludwig Adams; R. M. Stuchell. Claire Ostrofsky.

Chicle (1944). M. G. Mayberry, sen.; A. V. Meigs. Peggy Khoury; P. L. Shanta, to Oct. 1.

Cigaret Technology (1932). A. W. Petre, sen. Virginia Campbell, to Feb. 1; Beatrice LaPeccerella, to Feb. 1; Esther Kennedy, from July 18 to Sept. 1.

Coal Products Analysis (1942). J. J. McGovern, from May 24; L. J. Brady, to Aug. 1. Sarah Schmidt, from Jan. 1; Anna Welborn, from Jan. 1; J. D. Rodgers, from Sept. 1; Alice Hanna, from April 2 to Jan. 1; Ruth Cardell, to Dec. 15; Diana Russell, from June 11 to Sept. 1.

Coke-Plant Constructional Materials (1941). C. F. Pogacar.

Coke-Plant Physical Technology (1943). F. A. Schwertz. Jeanne Brow.

Commodity Standards (1931). Jules Labarthe, Jr., sen.; Joseph Cohen, from Feb. 1; A. F. Tesi, to March 12. Jean Travis, from March 12; Argot Stockton, from June 1; Hazel Parisi, from May 21 to Sept. 15.

Constructional Resins (1939). W. B. Johnston, to Aug. 21. E. H. Neuwirth, to Aug. 1.

Corn Products (1944). R. G. Ruark, sen.; C. J. McDowell; K. M. Gordon; H. W. Durand; J. P. Gibbons, from May 1; J. M. Perrone, from Nov. 19; T. K. Maher, from Jan. 14; J. J. Wolken; G. W. Greenwood, to Oct. 1.

Frank Politzer, from Jan. 26; Margaret Levin, from May 1; J. C. Whetzel, Jr., from Aug. 1; J. D. Staling, from July 2; A. G. Sisca, from Sept. 29; Elizabeth Brown, to Jan. 15; F. E. Weindorf, to Oct. 1; G. F. Leger, to Sept. 20; G. W. Clark, to July 6; Katherine Clark, to July 1.

Cotton Properties (1944). T. H. Swan, sen.; T. F. Banigan, from July 1. Rebecca Watson, from June 19.

Disinfectant (1945). R. E. Muder, to Jan. 1.

Felt (1939). C. R. Barnes. Gretchen Smitmans.

Food Varieties (1921). Helen Wigman; L. L. Lachat; G. E. Helz, to Jan. 1. W. C. Bell; Audrey Best; Mary Duff, to Dec. 31; J. M. Beck, from March 24 to Aug. 30.

Frictional Materials (1944). J. L. Young, sen.

Fur (1941). A. W. Harvey, sen.; D. L. Deardorff. Bettie Stengel; Evelyn Mowry, from Sept. 17.

Gas By-Products (1940). W. H. Hill, sen.; R. H. Hartigan; J. M. Grim; T. E. Robbins; W. B. Johnston, from Aug. 25; W. C. Teach, from Oct. 1; D. F. Taylerson; Anna Coleman; H. R. Sheppard, Jr., from Feb. 1; J. H. F. Veltman, to May 1.

Irene Zewe; Elizabeth Howe, from Nov. 1; Dorothy Newhouse; Jean Talbot; Marian Allee; A. E. Hewitt, from May 1; H. C. Lavely, from July 1; Laura Stockton, from July 16; Bertha Most, from Sept. 1; Esther McCarriher, from Nov. 1; R. E. Lenhart, from Nov. 26; Madalene Deer, from May 1; W. F. Heintzelman, from Nov. 1; John Ivan, Jr., from Nov. 1 to Dec. 1; Harriet Pfann, to Nov. 15; Ruth Goucher, to Nov. 1; Pearl McNall, to Sept. 15; Helen Colby, to May 11.

Gas Purification (1939). J. A. Shaw, sen.; Elton Fisher.

Industrial Hygiene (1935). J. F. McMahon, adm.; F. R. Holden, sen.; W. C. L. Hemeon, sen.; T. F. Hatch, sen., from Nov. 1; E. C. Hyatt.

Insecticide (1917). O. F. Hedenburg, sen.

Insulation and Roofing (1916). R. H. Heilman, sen.; R. W. Ortmiller.

Lead (1936). F. J. Williams, adv.; J. W. Jordan, sen. Sylvia David; H. S. Stuchell; T. A. Guerin, from June 1 to Jan. 1.

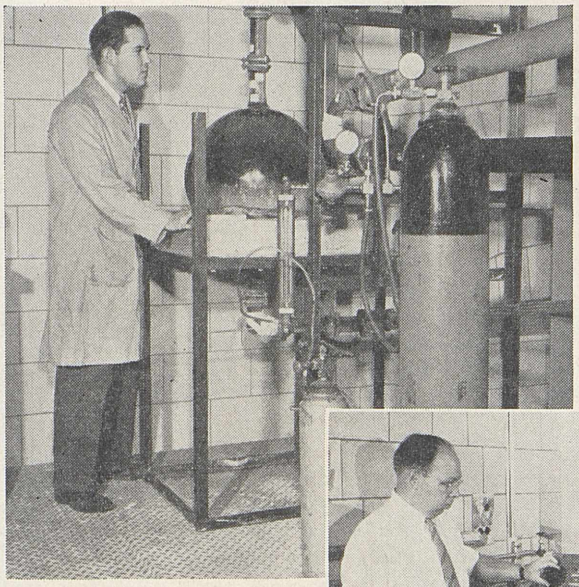
Life Preserver (1944). E. G. King, sen.; H. E. Weaver; E. R. Frederick. Lena Swirbul.

Lignin (1941). L. T. Sandborn. Mary Crandon, to Oct. 1.

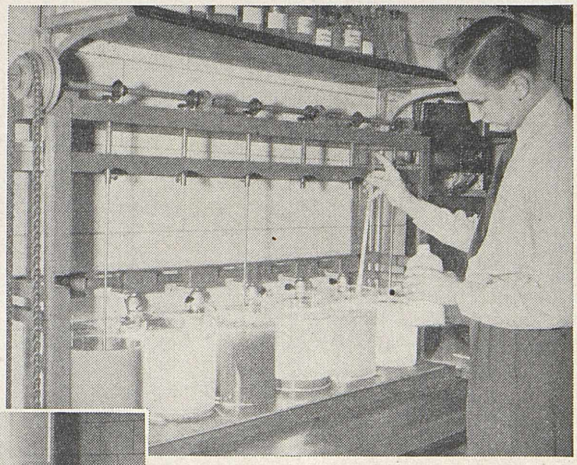
Magnesium (1943). L. A. Carapella, sen.; W. E. Shaw. L. J. Elyash, from Jan. 4.

Metalworking (1939). H. L. Anthony, sen.; J. C. Turnbull; S. B. Floyd; Ernest Vandale, Jr., from July 16. Madeline Miller, from April 2; Meryl Bennett, from Aug. 1 to Feb. 1; Jean Coles, to Aug. 1.

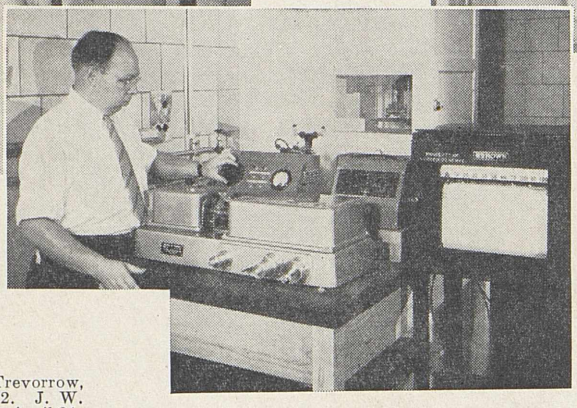
Meter Technology (1938). R. L. Wakeman, sen., to June 1; A. C. Frechtling, to Aug. 26.



Preparing novel chlorinated hydrocarbon plastic



Chemical treatment of de-inking wastes



Infrared absorption spectrographic examination of hydrocarbons

MINERAL PRODUCTS (1936). T. R. Trevorrow, adv.; A. F. Tesi, sen., from March 12. J. W. Bush, from July 10; G. S. Santmyers, to April 21.
NACRE (1940). R. N. Palmer. Pauline Yalch; Marjorie Roland, to April 23.
NATURAL GAS (1915). R. W. Miller, adv.; C. A. Erickson, Jr.
NICKEL (1942). J. G. Dean, sen.; R. G. Bossert; W. J. Kirkpatrick, from Jan. 1. Helen Gales; Charlotte Wray, from June 18; Ann Rea, to Jan. 1.
NITROGEN COMPOUNDS (1933). P. J. Wilson, Jr., sen.; J. H. Wells; Pauline Sommerfeld; G. J. Haddad, from Jan. 15. C. R. Liebel; R. E. Dalton, from Oct. 15.
OPTICAL CEMENTS (1945). E. P. Barrett, adv.; I. I. Bezman; F. J. Honn, from Sept. 1. Mary Duff, from Jan. 1.
ORGANIC SYNTHESIS (1914). D. C. Lewis, adm.; B. G. Wilkes, sen.; H. R. Fife; H. D. Cogan; H. G. Goodman, Jr.; Helen Wassell; R. W. Quarles; S. M. Livengood; A. B. Boese, Jr.; W. K. Vollmer; A. B. Steele; R. F. Holden; J. B. Mumma; A. C. Frechtling, from Aug. 27; R. W. Shiffler, from Oct. 1; W. H. McKnight, from Oct. 1; C. I. Spessard, to Nov. 1; J. M. Russ, to Oct. 1.
E. C. Martin; R. M. Jimeson; H. C. Colby, Jr.; William Samson; M. A. Bigelow, Jr.; D. F. Swartz, Jr.; D. F. Frey, from Oct. 16; R. C. Miller, from Oct. 16; J. R. Howell, from Jan. 17; D. S. Gorman, from Jan. 21; Jane Drury, from April 23; Loretta Meredith, from Sept. 17; Dorothy Kapsar, from Nov. 5; R. E. Graebert, from July 16; T. J. Regan, from Jan. 22; H. H. Noren, to Sept. 1; J. W. Yount, from May 11 to July 15; Marjorie Roland, from April 23 to July 1; T. H. Smeltzer, to May 7; C. D. Droman, to May 1.
PACKAGING (1941). W. L. Nelson, sen.
PAPER (1928). P. B. Davidson, sen.; R. T. Nazzaro, to Oct. 1; E. H. Neuwirth, from Aug. 1 to Oct. 1. J. C. Gallatin, Jr., from Nov. 1; G. G. Nahay, to July 15.
PETROLATUM (1940). W. S. McClenahan, sen.; Charles Steenbergen; H. A. Nelson, to Oct. 1. Autumn Colby; Mary Engle, from July 2.
PETROLEUM REFINING (1911). W. A. Gruse, adm.; D. R. Stevens, sen., exec. assoc.; W. E. Hanson, sen.; J. R. Bowman, sen.; P. H. Emmett, sen.; W. P. Ridenour; John Metschl; C. J. Livingstone; R. T. Davis, Jr.; P. T. O'Leary; T. W. DeWitt; L. G. Joyner; R. G. Hay; J. T. Kummer; R. S. Bowman; R. S. Spindt, from Sept. 18; Robert Kunin, from Oct. 1; J. G. Erdman, from Nov. 1; H. H. Podgurski, from Jan. 1; Alexander Lewis, Jr., from Jan. 10; M. T. Cichelli, from Jan. 29; W. B. Spencer, from Feb. 1; S. C. Camp.
C. L. Wolfe; E. I. Crowley; Augusta Little; C. J. Schaef; Alberta Jones; J. A. Stewart, from Oct. 17; W. J. Elway; J. D. Selvaggio, from April 1; T. W. Sherrick, from May 19; R. S. Rearick, from Nov. 19; S. L. Gorski, from Jan. 29; L. C. Armstrong, Jr., from Feb. 1; R. E. Hager, from Oct. 1; Elsie Corlett, to Feb. 1; June Whittaker, to Oct. 1; E. W. Gleditsch, Jr., from April 27 to Aug. 1; J. S. Jaczynski, to June 15; W. P. Stewart, to May 2.
PHENOL CHEMISTRY (1941). C. E. Welling, to Jan. 1. R. P. Buechele, to Jan. 1.
PISTON RING (1943). E. L. Cline. H. R. Peters.
PLASTIC METALS (1929). E. S. Byron, sen.; E. W. Kempton, Jr., from Sept. 10. P. J. Walkauskas; Genevieve Port, from Aug. 1.
PRESSING MACHINERY (1928). E. R. Clark, sen.; L. D. Fallon, from Oct. 21.
PROTECTED METALS (1918). J. H. Young, adv.; P. W. Jenkins; D. S. Hubbell; F. G. Singleton; W. D. Stallcup, from Feb. 18; H. J. Read, to July 1. C. J. Marion, from Dec. 1; G. D. Londos, to June 1.
PROTECTIVE COATINGS (1935). G. W. Seagren, sen.; W. K. Schneider; G. W. Gerhardt; Norman Ellis; Jean Zehner; J. M. Perrone, to Nov. 19; R. A. Patton, to Nov. 1; H. E. Westlake, Jr., to Sept. 1. H. J. Bach, from Jan. 14; Mary Daily; Helen Smith; Helen Darrah, from Oct. 1, to Dec. 7; A. E. Mutchler, from July 10 to Sept. 1.
RAYON CHEMISTRY (1933). R. J. Reitz; H. L. Barthelemy, sen., to Sept. 1. Suzanne Maury.
REFRACTORIES (1917). S. M. Phelps, sen.; R. W. Limes, from Jan. 15; F. K. Clarke, to Feb. 1. W. R. Deitz; J. P. Maloney; G. W. Calderwood; Eric Graebert.
RUBBER (1938). R. C. Briant, sen.; C. D. LeClaire; F. C. Weissert. J. F. Osterritter; Elizabeth Behrend; R. C. Hartman, from May 1; Sayre Rodman, from Sept. 17; G. W. Clark, from July 6; Argot Stockton, to June 1.
SHAVING (1932). E. J. Casselman, sen. G. H. Freyvogel, Jr., from Feb. 1; Virginia Floyd, to Feb. 1.
SILICA GEL (1946). C. E. Welling, sen., from Feb. 1; C. D. Helm, from Feb. 1.
SILK (1939). R. F. Stuewer.
SOYBEAN (1935). N. J. Beaber, sen.; J. H. Obey. J. R. Crouthers; H. J. Osterman; E. T. Massung, from July 1; R. C. Garlock, from May 14 to June 25; W. F. Bigge, Jr., to April 30.
SPECIAL LUBRICANTS (1942). G. E. Alter, sen.; J. R. McKlveen; G. E. Barker, sen., to Oct. 1; C. E. McKnight, to Sept. 8. D. M. Hood.
STEEL (1927). S. A. Braley, sen.; Daniel Neuman; A. J. Sterba, from Dec. 1; J. R. Anderson, to Aug. 7.
STREAM IMPROVEMENT (1944). W. W. Hodge, sen., from Jan. 1; Gladys Swope; P. F. Morgan, from Aug. 1; G. A. Harrington, sen., to April 16. G. G. Nahay, from July 15; Dorothy Taylor, from July 15; M. S. James.
STRUCTURAL GLASS (1944). H. E. Simpson.
SULFUR (1931). H. E. Westlake, Jr., sen., from Sept. 1; J. R. West; R. A. Patton, from Nov. 1; J. W. Estep, from Feb. 18. Jane Snyder.
TAPE TECHNOLOGY (1941). L. D. Fallon, to Oct. 21. Dorothy Kapsar, to Nov. 5.
TAR CONSTITUENTS (1941). (1) Wojciech Swietoslawski, sen.; J. R. Anderson, from Aug. 8; H. R. McGraw, to Oct. 1. (2) G. C. Akerlof, sen., from Jan. 1.
TAR DERIVATIVES (1944). Robert Johnson, to Jan. 1; R. H. Herter, from Nov. 1 to Jan. 1. Elizabeth Kodis, to Jan. 1; Meryl Bennett, to Aug. 1.
TAR DISTILLATION (1939). W. L. Glowacki, sen.; G. S. Black, from Aug. 1; Henry Freiser, from Sept. 10; R. E. Muder, from Jan. 1; G. J. Rozman, to Nov. 1. Margaret Price, to Nov. 1.
TAR PROPERTIES (1937). W. F. Fair, Jr., sen.; H. R. Beck; B. K. McKee; H. J. Cibula. Beatrice LaPeccerella, from Feb. 1; Mary Norton, to Feb. 6.
TAR SYNTHETICS (1939). B. B. Corson, adm.; W. M. Kutz; C. U. Rogers; Helen Thayer; T. H. Insinger; J. E. Nickels; R. S. Detrick; W. J. Cerveny; R. H. Nimmo; B. F. Tatterson, from Oct. 1; H. R. McGraw, from Oct. 1; H. F. Pfann, from Nov. 16; R. H. Herter, from Jan. 1; Robert Johnson, from Jan. 1; Mary Schwertz; E. G. Hamme, from Jan. 1; G. C. Akerlof, sen., from Oct. 1 to Jan. 1; E. L. d'Ouville, to Oct. 1; Simon Bonta, to Oct. 1; G. S. Black, to Aug. 1.
N. P. Greco; Harriet McKnight; Mary David; E. E. Fleck; Dorthy Hutchison; S. F. Orochena, from March 19; G. D. Londos, from June 1; Elizabeth Depp; Dorothea Wagner; Leaugeay Curry; Betty Kortlandt; Elizabeth Knapp; Alice Walker, from Sept. 17; E. C. Ney, from Sept. 17; Donna Morey, from Sept. 28; R. P. Buechele, from Jan. 1; R. E. Bucher, from Feb. 26; J. F. Contrael; H. N. Berger, from July 31; C. M. Fialon; J. T. Pershing; P. W. Lambert; D. R. Jones, from May 22; Odette Parker, from Oct. 1; Mary Hartlein, from Oct. 1; Merle Amic, from Oct. 13; W. H. Humes, from Nov. 29; W. M. Sonnett, from June 4 to Feb. 26; Miriam Harper, from Jan. 14 to Feb. 25; A. R. Cerveris, to Dec. 17; R. E. Lenhart, from March 29 to Nov. 25; Elizabeth Howe, to Nov. 1; W. F. Heintzelman, to Nov. 1; John Ivan, Jr., from Sept. 4 to Nov. 1; Margaret Barrett, to Oct. 1; B. V. Insenstein, from July 31 to Sept. 22; G. W. Martin, from June 4 to Sept. 15; Charles Bingham, from April 6 to Sept. 7; Bertha Most, to Sept. 1; Rosabelle McManus, from July 1 to Sept. 1; Nancy Konstanzer, to Aug. 25; Margaret Sullivan, from July 1 to Aug. 12; Rosemary Peterson, to July 1; Martha Gosztonyi, from April 18 to July 1; Grace Holmes, to June 1; M. M. Cleland, to May 21; T. W. Sherrick, to May 19; Elizabeth See, to May 15.
TECHNICAL GLASSWARE (1931). R. R. McGregor, sen.; E. L. Warrick; J. L. Speier, Jr.; J. T. Goodwin, Jr., from Feb. 11; C. F. Kohl, Jr. Helena Corsello; Ruth Zimmerman; George Cmorik, from Jan. 28.
TEXTILE FINISHING (1934). R. R. Ackley, adv.; R. L. Wakeman, adv., from June 1; L. M. Hobbs, sen.; E. B. Ayres; Barbara Howard, to July 15. Mary Turney; Jean Shera, from July 10; Margaret Hallock, from March 25.
THREAD (1935). T. A. Wilson, sen.; E. R. McLean; D. M. Jenkins. Virginia Campbell, from Feb. 11; Eleanor Brace, from June 18 to Aug. 25.
TUBE (1938). D. F. Menard.
WATCH TECHNOLOGY (1938). R. H. Lester, sen.; H. R. Hoge; Milton Fytelson, to July 7. H. F. Sutter; E. W. Gleditsch, Jr., from Aug. 20.
WHEAT (1937). G. E. Helz, from Jan. 1; R. J. Sumner, to Aug. 15. Elaine Gleeson; Mary Walsh, to Sept. 1.
YEAST (1935). J. J. Enright, sen.; H. W. Wilker; Dorothy Rathmann; K. M. Madison, from March 16; H. J. Paulus. Rose Lizzio, from July 23; Ruth Mingonet, from Sept. 1; Jean Zukas, to Aug. 11; Nina Shotton, to March 15.

[a] The following abbreviations are used in this roll: adv., advisory fellow; adm., administrative fellow; and sen., senior fellow. Names of aids (research associates and assistants, laboratorians, and technicians) follow listings of fellows of these and other grades (industrial and junior).

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