ably would have found it difficult to drive a nail straight or hang a picture. This is entirely untrue—Gibbs had useful hands, but we all have heard of the fable of the three black crows! Truth grows by the application of controlled imagination, and untruth by imagination uncontrolled.

It was my privilege as a young man to become acquainted with a considerable number of distinguished scholars of the generation of Willard Gibbs who seemed to me to be much alike in their simplicity, dignity and friendliness—gentleman of the old school we youngsters called them. They did not wish to be hero-worshipped, they were not patronizing, they did not proselytize, they were living examples of what the best in university life has been, is now, and will be so long as there are youth who are inspired by such examples to try to become in all simplicity worthy successors to them.

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REPORTS

WARTIME INVESTIGATIONS AT MELLON INSTITUTE

IN the industrial research proceedings of Mellon Institute during its fiscal year from March 1, 1943, to March 1, 1944, as set forth in the thirty-first annual report of the director, E. R. Weidlein, there are many facts of professional interest. As the following summary reveals, the emergency has raised the levels of investigational capacity and thereby has increased research usefulness.

OUTSTANDING CERAMIC RESEARCH RESULTS

The physical and chemical treatment of gypsum, for its improvement and for obtaining new products, has been given thoroughgoing study during the past five years, with especially valuable results in 1942–3. The use of gypsum in the manufacture of light-weight refractories has been extended. An investigation of mottled or colored silica brick has been described and definition has been made of the effect of furnace gas pressure on the life of refractories. A number of urgent wartime high-temperature problems have been solved by the use of "Carbofrax" and "Monofrax." A new apparatus has been contrived for aging dry cold-set mortars. "Garsand," a novel glass-making material, was introduced. The multiple industrial fellowship on ceramic chemicals has been devoting the full time of its enlarged staff to research on problems in wire-wound resistors. Eight fellowships in all are in the field of ceramics.

ACHIEVEMENTS IN METALLURGY

Many effectual war implements have been formed by metallurgical studies on thirteen fellowships of the institute. Fundamental relations within the foundry cupola have been examined critically. Iron compacts of improved physical properties are a contribution to powder metallurgy; in addition, a new grade of sponge-iron powder possessing excellent compressibility and uniformity has been developed, several original uses of importance have been devised for iron powder, and the commercial production of silicon powder has been worked out. Desirable physical properties have been imparted to arc-deposited low-alloy steel through the employment of novel slag compositions. The failure of restrained welds and the destructive testing of structural joints, involving special gaskets, have had much attention, and protective coatings for steel storage containers are being investigated. A new flux for silver soldering came into extensive use in war industries and a copper-brazing flux was introduced. Advances were made in chromium plating of tools and gages. Many improvements have been achieved in shell manufacture, mainly in the production and finishing of casings and components. Lock-nut technology has been benefited by fundamental mathematical and physical studies. These results have brought the institute close to the zones of military action. Announcement was made of a differential solubility process for treating waste pickle liquor, and basicity factors were interpreted as aids in evaluating limestones and limes as neutralizing agents.

MUCH IS BEING DONE ON COAL PRODUCTS

Methods have been investigated for improving heating efficiency and for conserving anthracite; better procedures of control and operation have been prescribed for house-heating equipment. Smoke-producing tendencies in coals of various ranks have been under inspection. A large program of research on the hydrogenation, dehydrogenation, oxidation and alkylation of coal products has been widened considerably, and several new catalytic processes are under development. The recovery of low-boiling compounds from coke-oven by-products is an allied project. Physical procedures are being applied experimentally to separating coke-oven gas constituents. A new process of making ethylbenzene has been put in large-scale operation. Another investigation has been concerned with the effect of paraffins on the nitration of toluene. Basic research on the production of phenols is well under way. Another group is working on the separation of cresols and xylenols from their mixtures. New

derivatives of naphthalene are getting much attention. A detailed investigation, both theoretical and experimental, has been carried out on the conversion of ammonium thiocyanate into thiourea. Studies of the rheological properties of bituminous materials have been continued, and the commercial production and utilization of pitch compounds which exhibit improved flow properties have been supervised. Many of these new products have found industrial application as weather-resistant protective coatings for various metals.

Helpful Research on Natural Gas and Petroleum

Thermodynamic properties of air, liquefaction and storage of natural gas, and thermal insulation are other programs that are going ahead. Research has also been conducted on various ramifications of natural gasoline utilization. Detailed consideration has been given to the economics of production of relatively low-pressure natural gasolines suitable for use as blending agents with various base stocks in the preparation of high quality motor fuels. Because of increasing markets for many of the hydrocarbon components of natural gasoline, investigations have been carried on to determine the identity and quantity of the individual hydrocarbons contained in natural gasolines. Of special wartime interest has been developmental work along the line of producing with air and natural gasoline an industrial fuel having the characteristics of natural gas; the results have proved so successful that several concerns have installed the simple equipment necessary for utilizing this fuel. In crude petroleum correlation research, characteristic portions have been separated, all below 100° C., and a hydrocarbon correlation index of broad scope is in active preparation. Substantial progress has been made in improving fractional distillation techniques under extremely high vacua. An oscilloscope has been devised for determining the dimensions of oil films. The development of special lubricants for fine instruments has been carried along gainfully; entirely new products with superior properties have been created for the Navy. Close cooperation is continually kept up with governmental agencies having to do with liquid fuels, lubricating oils and hydraulic fluids of all kinds.

Scientific Development of Foods

Seven fellowships pertain to major problems of the food industry. Improvements have been brought about in dehydrating prepared foods. The time needed in drying yeast satisfactorily has been shortened. New knowledge has been gleaned in research on decolorizing adsorbents and a new synthetic granular adsorbent has been evolved for the sugar industry. Another fellowship has prepared a dried molasses. A fundamental investigation of the wheat flour lipolytic system is a project in which significant results have been recorded. Carbohydrate preparations for infant feeding have been studied with medical collaboration. The staling of bread is under research of large scope. Certain protein hydrolyzates have been found promising as food-flavoring agents. Aqueous dispersions of bentonite, added to distillery waste, have been shown to be precipitants of the proteins in easily recoverable form.

Solving War Problems in Textile Technology

Several illustrations may be cited from eleven different programs to bring out how textile chemistry is woven into our military fabric. Members of the institute are serving as consultants to the Office of the Quartermaster General in the appraisal of U. S. Army clothing and supplies. Experimental and newly developed items must be subjected to scientifically controlled laboratory and field-use tests; commodity standards and textile specialists from the institute have aided in the planning of these projects and in the analysis of the findings. The weathering of treated fabrics employed as covers over the guns of coastal defenses has been investigated to secure textiles more resistant to sun, salt air, wind and rain. New yarns have been made of soybean protein, alone and with viscose. A synthetic textile lubricant has been composed for the woolen industry. Advances have been gained in the processing of animal fibers used in felt and some physical properties have been correlated with felt quality. Machinery for the production of fresh-water pearl buttons has been improved.

Wood Products and Especially Paper

The piles of wood waste which have been accumulating at wood-working mills producing small protective disks for shells will become a valuable material for making these disks in consequence of studies carried out on the utilization of such waste. Research on lignin degradation products has been advanced. Progress has been realized toward the development of an integrally greaseproof and waterproof carton stock at economic price by elimination of some of the objectionable features associated with such stock in the past. The war's exacting demands for technical paper of many types have necessitated concentrated work on improving strength and durability as well as finding satisfactory substitute raw materials for manufacture. The possibilities for these improvements have been increased by the development of high polymers and other chemicals. GR-S latex has been applied commercially to the saturation of sulfite papers, with

results indicating satisfactory comparability with rubber-latex treated papers but with somewhat less tensile strength.

PATHFINDERS OF PROGRESS IN PLASTICS

The institute's plasticians have maintained their master researchmanship on twenty-four diverse fellowships. Growing attention to cyclopentadiene in the synthetic plastic and organic chemical fields has greatly stimulated research on methods for its utilization. In action is a study of the electrolytic preparation of certain organic compounds of relevance in the manufacture of synthetic resins, rubbers and fibers. A completed two-year investigation has yielded a new curable liner for container closures. Continued research on resin-pulp products has led to further applications for pre-formed materials. The use of new vulcanizable elastomers and low-temperature curing resins has likewise brought advances in the field of cellulosic molding. Organic salts of hydrous aluminum silicates have been studied with reference to their employment as plastics. The development of military and industrial applications of leather-like plastics, announced a year ago, has been extended. Artificial filaments of various types are receiving long-range research. The synthesis of morpholinomethyl derivatives of ureas has been published. New techniques have been introduced for the preparation of vinyl-resin coating compositions; ketones have been described as solvents for those resins.

W. A. HAMOR

(To be concluded)

SPECIAL ARTICLES

THE RELATOINSHIP OF LYSOZYME TO AVIDIN[1,2]

FROM hen's eggwhite two seemingly unrelated biological principles have been obtained, lysozyme and avidin. Lysozyme is a basic protein[3,4] which lyses susceptible microorganisms like *Micrococcus lysodeikticus* or *Sarcina lutea* by depolymerizing and hydrolyzing a mucoid contained in the bacterial membrane[5,6]; while avidin is said to be a basic protein[7] which combines stoichiometrically with biotin, thus depriving the test microorganisms[8] or the animal[9] of this essential vitamin. Some of the reported chemical properties of avidin were so similar to those of lysozyme that we undertook the study of their relationship, although Woolley and Longsworth[7] reported their avidin preparation free of lysozyme activity.

Seven avidin preparations[10] were tested for lysozyme activity against *M. lysodeikticus* and two strains of *S. lutea*. Avidin activity, varying from 60 to 5,200 units per gm, was proportional to lysozyme activity, varying from 4 to 160 units per mg.

The action of biotin[11] on the lytic action of lysozyme was then tested. In these tests acetone dried *M. lysodeikticus* were used, suspended in M/15 KH_2PO_4, corresponding to a density of a No. 10 $BaSO_4$ standard. With live organisms in 0.9 per cent. NaCl the activity is about double. It is known (see review[12]) that the organisms do not dissolve in acid solution, although lysozyme activity is optimal at an acid pH. To demonstrate visible lysis a drop of N NaOH is added at the end of the experiment (usually 1 hour at 37° C.) to stop enzyme activity and to observe clearing of the suspension. The controls without lysozyme are not affected by this treatment.

It can be seen from Table 1 that addition of 10 γ of biotin increases the activity of lysozyme, both against live and acetone-ether killed and extracted organisms, from 8 to 250 times. The effect of 10 γ of biotin is even more marked if incomplete lysis

TABLE 1

Lysozyme preparations	Lysozyme units per mg		*M. lysodeikticus*
	Without biotin	With 10 γ biotin	
Avidin (5200 units/gm)	640	2,600	Living
85 B	2,600	164,000	Living
85 C	1,300	164,000	Living
85 C	640	164,000	Acetone dried
85 C	16	2,000	Acid acetone extracted
85 C	640	164,000	Acetone dried
97 C	1,300	20,500	Acetone dried
97 D	640	5,000	Acetone dried

[1] From the Department of Ophthalmology, College of Physicians and Surgeons, Columbia University, and the Institute of Ophthalmology, Presbyterian Hospital, New York.

[2] The author is greatly indebted to William L. Laurence for suggesting experiments on the relationship of avidin to lysozyme, and to Miss Anita Steinberg for assistance in this work.

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[10] We are indebted to Dr. Vincent du Vigneaud, of Cornell University Medical College, and to Dr. H. M. Wuest, of Hoffmann-La Roche for the samples of avidin.

[11] The generous gift of synthetic crystalline biotin by Dr. D. F. Robertson, of Merck and Co., is gratefully acknowledged.

[12] R. Thompson, *Arch. Path.*, 30: 1096, 1940.