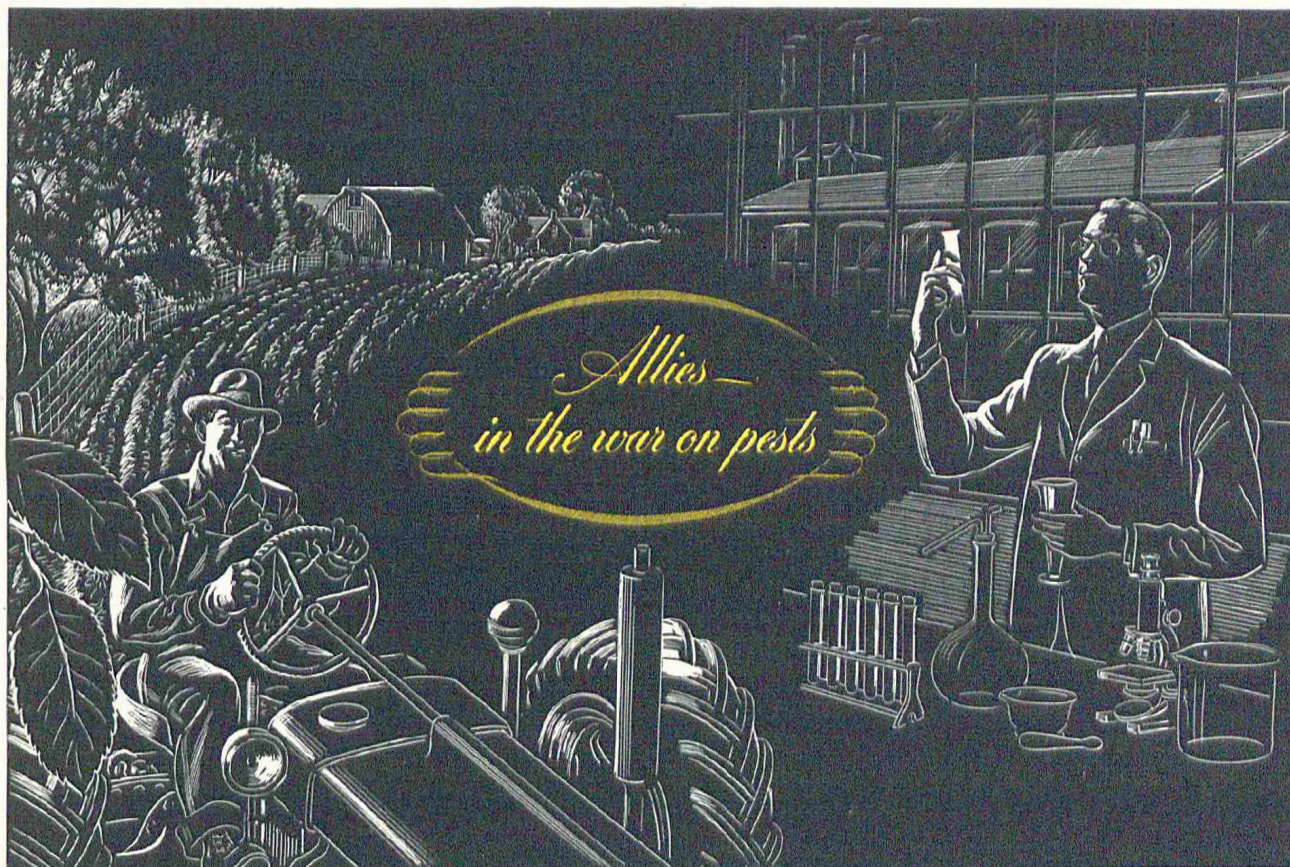


THE DETROIT MAGAZINE

BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY





DESTROYING THE DESTROYERS

THERE are thousands of different kinds of destructive insects—billions upon billions of them—on the farms of this country. Uncontrolled, this predatory population would destroy valuable food crops of first importance to the farmer and to you.

But the scientists and the farmers have banded together to fight these insect pests, and the result of their joint work is to make the American farmer the most productive farmer, and the American family the best fed, in the world.

At Du Pont, research scientists are continually seeking for new and better insecticidal compounds to aid the farmer in his age-old battle against insect enemies. More than 30 such compounds, listed at right, testify to the continual effort of Du Pont scientists in helping the farmer with his task of destroying the destroyers.

E. I. du Pont de Nemours & Company (Inc.), Grasselli Chemicals Department, Wilmington 98, Delaware.

DU PONT PEST CONTROL PRODUCTS



BETTER THINGS FOR BETTER LIVING
... THROUGH CHEMISTRY

DU PONT PEST CONTROL PRODUCTS

- "Grasselli" lead arsenate
- "NuRexform" lead arsenate
- "Deenate" DDT insecticides
- Calcium arsenate
- "Alorco" cryolite
- Paris green
- Lime sulfur solution
- Dry lime sulfur
- "Sulfuron" wettable sulfur
- Flotation sulfur paste
- Copper-A Compound
- Bordeaux mixture
- Du Pont Garden Dust
- Du Pont Potato Dust
- Copper sulfate (blue vitriol)
- Black Leaf "40" (nicotine sulfate 40%)
- Black Leaf "155" (fixed nicotine)
- Copper sulfate—monohydrated
- "Parapont" paradichlorobenzene
- Du Pont Spreader-Sticker
- "Loro" contact insecticide
- Dust mixtures
- Zinc sulfate—flake and crystal
- Spray oil—dormant
- Spray oil—summer
- "Fermate" fungicide
- "Krenite" dinitro dormant spray
- "Parmone" pre-harvest fruit-drop inhibitor Spray—Dust (also in Oil for Airplane and Ground spraying in the Pacific Northwest)

SO TO SPEAK

AT NO TIME during the war have American farmers and Victory gardeners faced a more challenging task than the one this year. Food supplies, we are told, are not being produced in large enough volume to keep pace with the demand for them overseas and at home. While the war in Europe is over, the one against Japan is still to be won. Our armed forces now in the Pacific theater of operations, and a host of their comrades who will join them, must have ample food supplies. It is America's responsibility to produce crops and to fight off the enemies that destroy crops during the growing season. Du Pont agricultural chemicals can help in this longest of all wars.

THE article about microfilm in this number has the authorship of a man who is eminently qualified to discuss the subject. Lieutenant (j.g.) Vernon D. Tate, before entering the Navy as a reserve officer, served for years as Chief, Division of Photographic Archives and Research in the National Archives—world's largest depository of official U. S. Government records. With his background of experience, it would seem unnecessary to say more. Du Pont's contribution to microfilming is its 16 and 35 mm. "Microcopy" Safety Film, which is designed especially for this work. It is manufactured by the Photo Products Department at Parlin, New Jersey.

AS WE go to press, word is received that a jury in Federal Court, Newark, New Jersey, has acquitted two chemical manufacturing companies—E. I. du Pont de Nemours & Co. and Rohm & Haas—and six individual defendants, of charges of violating the Sherman Anti-Trust Law in the plastics field.

Mr. Walter S. Carpenter, Jr., president of Du Pont, issued the following statement commenting on the verdict of not guilty:

"Du Pont is naturally gratified at the outcome of this case. The decision gives convincing answer to repeated charges, in many cases by responsible Government officials, alleging improper conduct in the plastics field. Long before any judicial proof was offered, books, magazine articles, testimony before Congressional Committees and speeches carried on an incessant barrage of insinuation which a jury has now determined to be unfounded.

"Two counts of the indictment, charging monopoly and conspiracy to monopolize, were dismissed at the instance of the prosecution before the case opened. A separate indictment concerning monopoly and restraint of trade in the denture field also was quashed.

"It has been charged that artificially high prices have been maintained by agreement, particularly those applying to denture material. It has been alleged that Du Pont was a part of a cartel to territorialize the world.

"Despite the serious implications and wide circulation of these charges, when the time came to produce supporting evidence in court the prosecution was unable to do so."

THE DU PONT MAGAZINE



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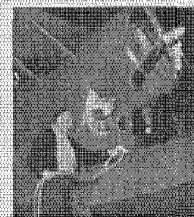
E. I. DU PONT DE NEMOURS & COMPANY (INC.)

Wilmington, Delaware

E. R. MANCHESTER, Editor

THE COVER

John Bielicki of St. Louis, Missouri, is putting the finishing touches on a U. S. Navy amphibious plane. There is a good reason for the high-visibility yellow finish; planes of this type are used on air-rescue missions and for towing targets. Reproduction is from a U. S. Navy Kodachrome.



OTHER CREDITS: U. S. Department of Agriculture photographs: Page 2, Kirkpatrick; Page 4, top, Ackerman; center, Rothstein; bottom, Knell; Page 5, top and bottom, Madeleine Osborne; center, Killian; Page 6, courtesy of Spencer Lens Company; Page 7, from G. Tissandier, Les Merveilles de la Photographie, 1874; Page 8, top, The Microfilm Corporation; bottom, U. S. Navy Department photo; Page 16, left, U. S. Army Signal Corps photo; Page 17, right, Boeing Aircraft Company photo.



THE LONGEST WAR

**FARMERS HAVE BATTLED CROP ENEMIES FOR CENTURIES.
HOW CHEMISTRY HELPS TO INCREASE OUR FOOD SUPPLY.**

By GEORGE ALBEE

WHEN we went to school, we were told the story of the friendly Indians who taught the Pilgrims to plant fish along with their hills of corn—"fish the corn," as it is still called in New England today. The story is given as an illustration of the friendliness of some Indian tribes. But it also illustrates the fact that, even at that early date, the soil of America needed fertilizers in certain localities.

The pioneers moved West. They cut or burnt down the forests, and planted crops. They plowed under the buffalo-grass of the Great Plains. And for a generation or two, where the soil was new, soil treatment was not needed in many areas. But the population grew. Millions came to the New World. Repeated plantings exhausted the soil. It had to be replenished with plant foods.

And, as American agriculture developed, the farmer found there were other things which might harm his crop—the crop on which he had to make a profit if he

hoped to stay in business. There were bacteria and fungi in the soil itself, which attacked his seed before and after sprouting. And there were insect enemies which destroyed his crops after the seeds were planted and after the plants appeared above ground.

Where could the farmer turn for an ally in his endless war against the many enemies which threatened him? To science!

Not to one kind of scientist, but to entomologists, chemists, plant pathologists, biologists and a dozen other groups working cooperatively. For the farmer's problem is a vastly-complicated one.

Fertilizer

In the first place, the supply of natural fertilizers, such as stable manure or guano, is limited. Nor do such fertilizers supply all of the soil's requirements. They are often lacking in the so-called "trace" minerals—minerals in very small amounts, which nevertheless must be replaced in the soil if plants are to flourish.



OF ALL

Dusting a cotton field to protect the crop from the enemy, boll weevils.

So it was necessary for the scientist to undertake research to learn just what compounds were best suited to the many kinds of soils, just what fertilizer constituents and proportions were to be used. "Uramon" fertilizer compound, manufactured by Du Pont, is formulated to give the soil nitrogen, for example. And Du Pont zinc sulphate "feeds" certain soils which are lacking in zinc.

Seeds That Fail

With his acres plowed, harrowed and fertilized, the farmer found that all too many of the seeds he planted still failed to grow.

For many years this seed failure was a mystery. But the plant pathologist stepped in; and what he discovered introduced a new chapter in agricultural efficiency. The scientist found that minute, invisible organisms in the soil—often carried on the seeds themselves—were killing many seedlings before they had a chance to struggle upward to the light, or "damping them off" shortly after they came above ground.

Certain rough-and-ready methods of seed treatment were known. Homer, the poet of ancient Greece, speaks of "the divine and purifying fumigation" of sulphur. The wheat farmers of the English coast had soaked their seed in sea-water to reduce smut. But these were trial-and-error methods. Science attacked the problem systematically.

Biologists, plant pathologists and chemists investigated many hundreds of compounds which might be of value, treated seeds experimentally, planted them and counted the seedlings that grew. Slowly, laboriously they discovered the chemicals that were effective. Formaldehyde was used in the 1890's. Copper carbonate proved successful about 1917. It was found that certain compounds of mercury protected fields of grain against the dreaded "smut;" and many vegetables against damping-off.

They tested, tested, tested—these friends of the farmer—and, returning to their laboratories, sought still other compounds that might be of value. The list grew.

Meanwhile farmers, entomologists and chemists working together tackled the problem of insect control.

Pests

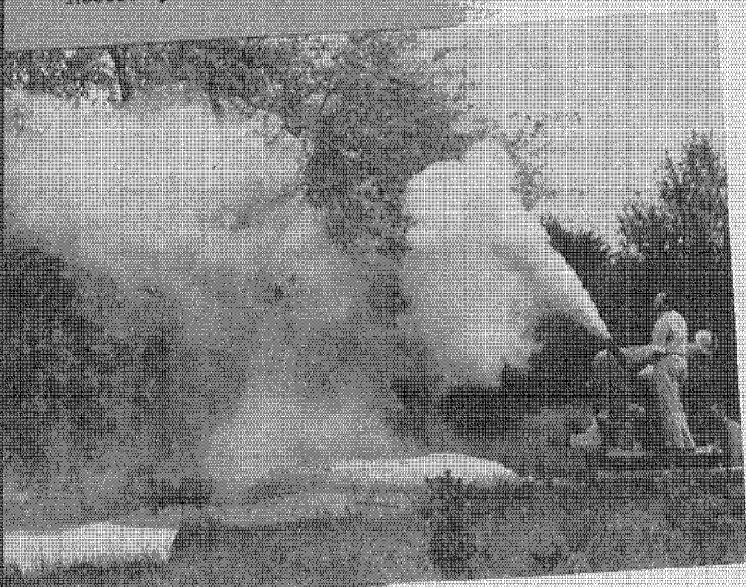
Some idea of the magnitude of the pest problem may be gained from the fact that there are 80,000 different kinds of insects in the United States. A single acre of a farmer's land may supply a home, on the average, for 15 million insect pests! Insect enemies are responsible for agricultural losses of more than \$2,000,000,000 a year.

Here it was necessary for the entomologist and his co-workers to become strategists. Not all insects get their food in the same way. Some chew the leaves of a plant; others suck its life-sustaining juices. It was necessary to learn the habits of the insects.

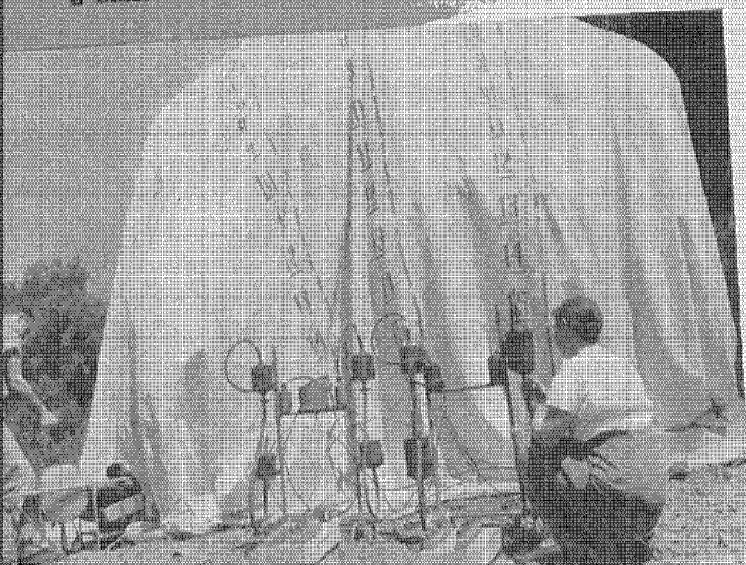
Again, slowly and laboriously, testing the compounds provided by chemists, checking their results over and over in field tests, scientists developed weapon after weapon to help the farmer in his unremitting battle against his insect enemies. First there were only a few compounds. Others were developed by chemists. Work



Treating seed wheat to destroy disease organisms is necessary—and that's the operation pictured here.



Codling moths in an Indiana orchard are receiving a blast of toxic dust in the grim chemical warfare.



Fumigation of citrus trees under tents like this is common practice in California to control "scale."

still goes on to improve them. Lead arsenate, for instance, a veteran of some fifty years, is better today than ever before.

But—to make matters more difficult—the bugs are "getting tougher!"

This is no exaggeration. Say a chemical compound known as Compound X killed a certain kind of insect in 1910. Nearly all of the bugs exposed to it died. But a few did not. They were individuals with an inborn resistance to the compound. And their descendants are resistant to it. As a result, the chemist today has had to change the formula of our imaginary Compound X, or provide another.

This is true in a number of cases. It is necessary to search continuously for new and more effective insecticidal compounds.

Plant-disease control presents a similar story.

Other Enemies

With what has been said already, it hardly seems possible that there can be any other hazards which the farmer must combat. But, as any farmer knows, his problem is only half solved when his land has been fertilized, his seed has been disinfected, and his crops have been safeguarded against the enemies which attack them just before or just after they come above ground.

The fruit farmer, for instance, with his oranges or lemons, his apples or pears, must remain constantly on the alert while his fruit is maturing on the trees. The fruit may be attacked by any number of rusts, scales and blights. Oranges marred by unsightly black specks, apples made ugly by woody scabs, used to be accepted as a matter of course. Neither the farmer who grew them nor the housewife who bought them realized that anything could be done about them. Here again it was the entomologist and the chemist who, after painstaking research, developed special dusts and sprays to destroy the organisms responsible for such blights.

Nor does the scientist's service to the farmer stop there. A long-time problem of the orchardist, for instance, has been "pre-harvest fruit drop." A man might nurse his crop of apples zealously to perfection on his trees, only to have the fruit fall by the thousands two or three days before his hired hands could pick them. He could control the fungous, bacterial, insect and other enemies which damage his crop; but he could not control the date on which his fruit fell. And this "cull," windfall fruit, inevitably bruised when it struck the ground, sold for only a fraction of the market price.

So it was necessary for scientists, working co-operatively, to tackle this problem as well. And now Du Pont "Parmone" pre-harvest fruit-drop inhibitor keeps apples and other fruit on the trees for a longer period, so that they may be picked at the right stage of maturity for best keeping and flavor. In addition to liquid and dust, Du Pont offers—for the Pacific Northwest—a "Parmone" solution in oil which may be sprayed from airplanes as well as from the ground.

Productivity

Throughout the rest of the world, two farm families are needed to produce food for themselves and one

other family. In the United States, according to the U. S. Department of Agriculture, a single farm unit provides enough food for itself and four other families.

Our farmers, in other words, are the most productive to be found anywhere. American agriculture is a multi-billion-dollar industry.

The fact that American farmers and scientists work as a team explains this productivity to no small degree.

Du Pont is proud of its record in the agricultural-chemical field. Du Pont has developed dozens of chemical products especially for the farmer. One of the newest is "Fermate" fungicide, an organic chemical which controls scab on apples and pears, cedar rusts of apples, leaf spot and brown rot on cherries, and a number of other plant diseases, such as blue mold in tobacco seed-beds.

"Copper," to quote W. H. Tisdale, manager of the Pest Control Research Section of Du Pont's Grasselli Chemicals Department, "is one of the most important fungicidal elements. Bordeaux mixture, in its various modifications, is still one of the leading fungicidal sprays. However, much has been learned about its effect on plants. It may cause russetting of apples and pears, leaf injury or stunting. This has resulted in extensive search for copper compounds that can be used safely as sprays on Bordeaux-sensitive plants." Du Pont Copper-A Compound meets the need for a copper fungicide safer than Bordeaux mixture. It gives a more uniform spray, and can also be used as a dust. It is used on celery, tomatoes, potatoes, sugar beets, cherries, citrus fruits and "cucurbits"—the oddly-named family which includes cucumbers, cantaloupes, muskmelons, watermelons and squash.

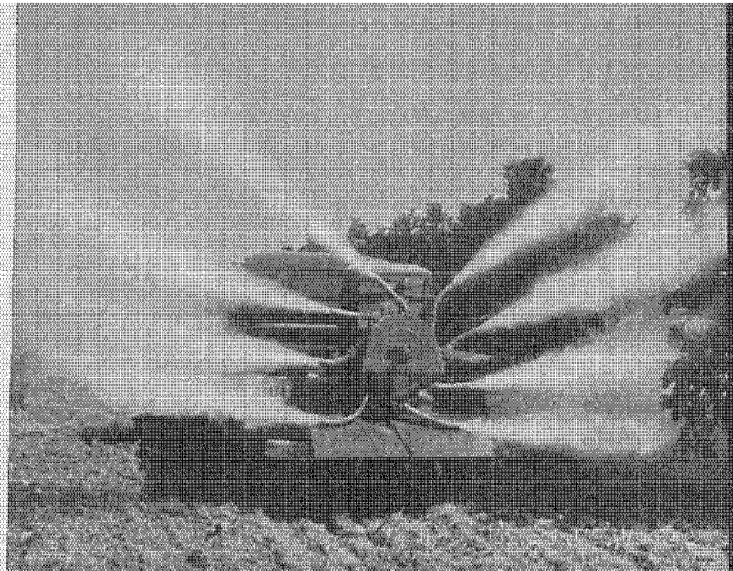
Another new Du Pont compound to emerge from field tests and be offered commercially is "Krenite" dinitro dormant spray, the active ingredient of which is sodium dinitro-orthocresylate. "Krenite" is useful against the overwintering form of rosy apple aphid, tent caterpillars and certain other insects and blights that affect peach trees, raspberries, pears and apples.

Other Helpers

Available to the farmer when the war ends will be DDT compositions. Du Pont's trade-mark for its agricultural insecticides containing DDT is "Dcenate." Almost unbelievable tales of DDT's ability to get rid of undesirable insect pests have come back from the fighting fronts. Much of the Army's DDT has been manufactured by Du Pont, and the "know-how" gained during the war years will go into products compounded for farmers.

Last but not least—Du Pont will offer the farmer new weed-killing compounds after the war. One of these, trade-marked "Ammate," was coming into widespread use before Pearl Harbor. It is poison to poison-ivy, among other troublesome weeds. Another, still newer compound has not as yet been given a trade-mark name, and still bears its laboratory nickname—2-4-D. Curiously enough, it was first investigated as a plant stimulant. And a plant stimulant it is, in small quantities. But, in larger quantities, it permeates the tissues of a plant and slowly kills it.

(Continued on Page Twenty-Four)



A multiple-nozzle power duster wages war against citrus rust-mites infesting a Florida orange grove.



Portrait of a pre-harvest "drop" of good apples going to waste. Such losses are now preventable.



A timely spray treatment with hormones enabled this grower to pick a full crop of red astrachan apples.

★ IT'S A SMALL WORLD ON MICROFILM ★ ★

By VERNON D. TATE
Lieut. (j.g.) USNR

IF ONLY a few years ago the ubiquitous "Inquiring Reporter" had stopped a dozen people on a busy street to ask, "What is a microfilm?", the chances are he would have been greeted with blank stares. For the art of microphotography, or "microfilming" as it is popularly called, was then almost unknown to the general public. Now, thanks to V-mail, "microfilm" is almost a household word.

Virtually everyone knows that a microphotograph is a reduced-size photographic copy of a document—perhaps a letter, a blueprint, or a book—made either because of the great saving in space it makes possible, or to preserve and make available copies of a rare book, a newspaper, or a file of business correspondence. The whole process is taken so much for granted that newspaper items, like the following extract from a current daily paper, are commonplace:

"SHAFF found that the only copy of a German book essential to the campaign against the Nazis was in the Library of Congress. Within a few hours, a microfilm copy of the volume was on its way to war by air."

The reporter thought it no more necessary to explain what a microfilm copy was than to spell out the abbreviation SHAFF.

Microfilm reading machines are of various types. Shown here is a simplified unit for use by individual scholars or scientists.

Anything that can be photographed can be recorded on microfilm in about one per cent of the space occupied by the original.

The general public has become acquainted with microphotography through V-mail, which is regarded as a marvelous new invention to handle soldiers' mail, brought about by the requirements of modern warfare. Actually V-mail is seventy-five years old, and was used in the Franco-Prussian War of 1870.

When Paris was besieged and encircled by the Prussian armies, telegraph and postal services were severed; only an occasional messenger could find his way through the lines. To meet this situation, the French photographer, M. René Dagron, conceived the idea of microscopic despatches, reproduced photographically,



that could be flown into Paris by carrier pigeon. As he was then in Paris, Dagron had to escape beyond the enemy lines to put his plan into action. There was only one way, by air, and since the airplane had not been invented, recourse was had to balloons.

Perforce, Dagron became an aeronaut, embarking with his equipment and assistants in two balloons. One was shot down. The other, borne by a favorable breeze, carried him far beyond the enemy lines, and after a series of hair-raising escapes, he finally reached Tours and set up a laboratory. Here despatches were photographically reproduced on collodion film, rolled into quills, and despatched by carrier pigeon to Paris. Prussian sharpshooters and even trained hunting falcons took heavy toll of the carrier pigeons, but many reached the city bearing news of the outside world. At first, the official despatches and personal letters were carefully unrolled and projected on a large screen, to be copied by a corps of secretaries; later, enlargements were made on sensitized paper and delivered to the addressees.

newspaper, after all, is the people's diary, and as such is a valuable record of local, regional and national affairs. But newspapers must be inexpensive, so only the cheapest grades of unpurified wood-pulp paper may be used. After a few years the papers turn brown and begin to disintegrate. Various preservatives were tried but were either ineffectual or too expensive. At least one large newspaper prints a rag-paper edition specifically for libraries. Finally, microphotography was applied. Almost 200 newspapers now maintain current and past files in this manner, for it has been found that rolls of microfilm in a good reading machine are far easier and quicker to consult than heavy bound volumes of crumbling originals.

Microfilming has become an important factor in the work of research libraries. Manuscripts and rare books by their nature can be available in only a few locations. Scholars, scientists and research workers formerly traveled hundreds and even thousands of miles to consult rare manuscripts or books that could not be borrowed on interlibrary loan. Now, at slight expense, microfilm reproductions can bring the texts to the user. Perhaps in the not-too-distant future the scholarly resources of the world can be made available to a student wherever he may be located.

A much-loved political figure often remarked, "Let's look at the record." In the future we shall have a constantly-increasing need to follow this advice, for records have become the key to our complex civilization, and they are accumulating by the millions, even by the billions, of pages, each year. A surprising number of people are engaged solely in examining, sorting, arranging and interpreting them. Some records must be kept, others not; but the aggregate bulk of those that should not be destroyed is unbelievably large.

Microfilming in business, in industry and in the Government has become an accepted means of "streamlining" or condensing voluminous files, and frequently the originals are thrown away. Conversely, by a curious quirk, it is a means of preserving original texts—the microfilm copies being put to use, while the valuable originals are stored in vaults for safekeeping.

Fire, flood and vermin take a huge annual toll of valuable and irreplaceable records, but such losses pale into insignificance beside those entailed by man's devilish destructiveness in times of war. Incendiary bombs in the great fire raid on London dropped alike on peaceful libraries and on war plants. Some of the priceless original documents had been sent away for safekeeping. Others could not be moved, but many of these were microfilmed, thanks to the Rockefeller Foundation which had generously provided funds for that purpose to the American Council of Learned Societies. More than three million pages have thus far been reproduced.

In the United States, where bombing, accident and sabotage were once grave possibilities, microphotography was employed to reproduce engineering drawings, specifications, plans, production reports and other essential papers. A microfilm reproduction, after all, is the cheapest insurance for documentary originals that can be purchased.



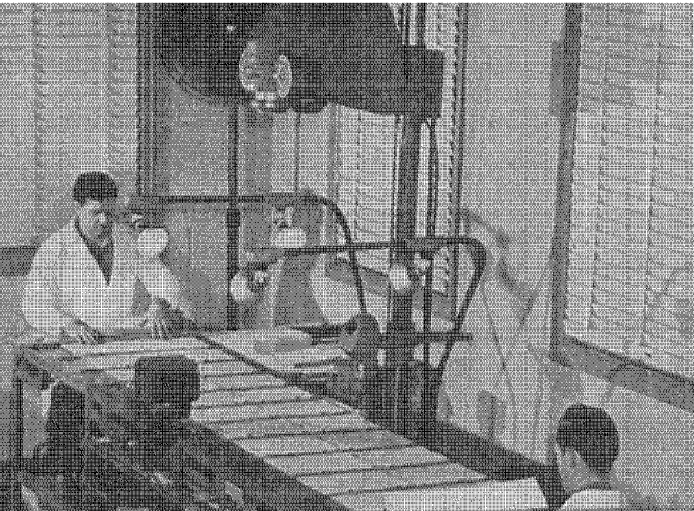
This goes back to 1870 when pigeon-borne microphotographic despatches were flown into besieged Paris. One of them is being projected for transcription.

So came the first V-mail.

In the present war, with armies scattered in the far corners of the earth, microphotography again has been called into play to transmit mail to and from the front. Collodion film is no longer used. It has been replaced with 16 mm. film in 100-foot reels, each reproducing 1,500 letters. The V-mail reel weighs $7\frac{1}{2}$ ounces; the corresponding 1,500 letters, $32\frac{1}{4}$ pounds. On receipt of the film, automatic equipment makes economical enlargement prints, somewhat smaller than the original letters, for delivery by the regular postal system.

The British organized the first "Airgraph Service" to maintain contact with troops in Egypt and India; as the American V-mail, the network of microfilm communication now encircles the earth.

V-mail itself is only one specialized wartime application of the science of reducing documents to small compass. For many years librarians have been concerned about the longevity of newspaper files. The



This 35 mm. camera is equipped with a conveyor to expedite reproduction of business records.

Public Records

Less publicized but equally important are the manifold uses of microfilming that touch upon the daily life of the individual. Each person who has filled out an application form for Social Security or for railroad retirement; every one who has purchased war bonds, or who has been a passenger on a ship or airplane arriving in the United States within the past fifty years; every individual whose name appears in the decennial census volumes can, through proper channels, locate a microfilm copy of the form or other pertinent papers in one public depository or another.

Business Records

Some department stores now use microfilming as an accounting medium. Bills are rendered from original sales checks and records on microfilm.

Most banks now microfilm every check passing through their hands, and the reproductions are legal evidence in court. In 1939, a famous criminal case, wherein a judge was convicted of accepting a bribe, was decided on the basis of microfilm copies of checks made in the regular course of business by a bank. When submitted in evidence over violent objection and even appeal by the defense, these copies were received as primary and conclusive evidence. This case made legal and microphotographic history.

Traveling auditors who frequently spent weeks and sometimes months auditing the books of large corporations on location may now be accompanied by a microphotographer who will copy pertinent documents in the files. The audit may be completed in the home office and any required supporting papers are attached in the form of enlarged paper facsimile prints, made from the tiny microfilm negatives.

Railroad companies, too, use microfilming to speed up the departure of loaded freight trains through the retention of microfilm copies of way bills and shipping information.

Insurance companies have used microfilming to coordinate, reproduce and preserve their vast files of data pertaining to policy holders, and in some cases to decrease storage space.

Medical Data

Microfilming is also an aid in the field of medicine. Hospitals microfilm their records for convenience and preservation; the case files of a world-famous brain surgeon have been reproduced for the study and use of his colleagues. The Surgeon General's Office has established a service whose primary purpose is to provide medical information to doctors, hospital workers, and research men all over the world. Current articles describing a new method of treatment, a new drug, appliance, or idea are speedily transmitted by air to the far corners of the earth. Files of medical x-rays have been satisfactorily reproduced on safety film, and in some cases a system of photography akin to microphotography has been developed for the making of x-rays in large numbers.

Helping Bedridden Veterans To Read

In the convalescent wards of a large military hospital, thousands of our soldiers are under medical care. Some of these men, encased in casts, must remain bedridden in a fixed position for weeks and months. Radio programs help to maintain morale, but even so, time drags. It would help these men if they could read—and now, thanks to microfilm reels, they can do so.

A small power-driven projector is used. Two simple control buttons position the microfilm to project an enlarged image on a ceiling or a special screen. A non-profit corporation, Projected Books, Inc., will supply microfilm copies of books for study or for recreational reading. Through the cooperation of publishers, even the latest books are available without payment of royalties or fees for this purpose. Even a patient in an "iron lung" can operate the machine for himself. A finger, a toe, an elbow, or a knee, or even a shoulder, with a slight movement can advance the film. The machine is quiet—can disturb no one. Once again the wounded man can read, and with his reading comes hope for the future, and with hope renewed, his recovery is often assured.

Microphotography is forging ahead rapidly. From small commercial beginnings, scarcely a decade ago, it has become a big business, and when the strictures on production of equipment and supplies are relaxed, it will grow even larger. Recently, representatives of the various groups in the industry met and organized the

(Continued on Page Twenty-Four)

Ships plans—28,000 blueprints—in background were all reproduced on 35 mm. film—69 rolls packaged in foreground. Weight saved, 8,680 pounds. Floor space released, 1,000 square feet.





CELLOPHANE.

• HOW DU PONT CELLULOSE FILM AND OTHER PRODUCTS HAVE AIDED THE WAR EFFORT.

THE preceding story of the Rayon Department dealt chiefly with Du Pont textile yarns and their wartime applications. Only brief mention was made of the film products manufactured by the Department's Cellophane Division. They also serve; in fact, their war uses are so important as to require a separate chapter.

Viscose rayon and cellophane are closely related. They are similar in substance. Both are processed the same way until the cellulose is ready to be extruded—in one case through filament-forming spinnerettes to produce rayon yarn; in the other, between the close-set blades of casting-machine "hoppers" to form the film. Both the film and the yarn, despite their dissimilar end uses, have grown up together.

Long before Pearl Harbor, cellophane was used extensively for packaging civilian merchandise. From an original use as a candy-box wrap it had been applied to thousands of products in the food, textile, tobacco, paper, drug and many other industries. Cellophane became world-famous, dating from the 30's. Then came

the war, and with it the necessity of packaging enormous quantities of military supplies for shipment overseas. And that's where this story begins.

Today, the greater part of all Du Pont Cellophane is allocated for essential war uses. Many Government packaging specifications call for various types and thicknesses of this film, some specially developed to meet specific requirements, sometimes laminated either to itself or to paper, foil or cloth. Literally thousands of products packaged for war are wrapped wholly or in part in cellulose film. Here are just a few items: emergency food rations, drugs, rifles, ammunition, airplane tank and truck parts, tools, electrical equipment. Scan the accompanying chart and you'll understand why many manufacturers of civilian merchandise have had to forego wrapping their products in cellophane or materially reduce their use.

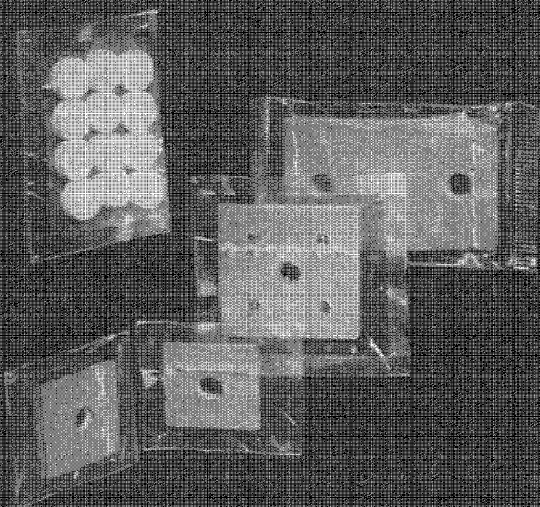
Moistureproof cellophane is an essential packaging material being used to protect military supplies against rust and corrosion, mold and mildew, dryness and damp-

Many a field hospital patient knows what's in the package the nurse holds—sulfa tablets.



USAAF bomber crews on long, strategic missions need a light lunch, which includes these items.

Heat-sealed cellophane keeps this mortar propellant powder in dry, usable condition at all times.



America met the last-named condition by shipping dehydrated, compressed foods—eggs, milk, meats, vegetables and soups—in smaller unit packages, many of which were wrapped in cellophane. That was, and still is, a big help. Dehydration and compression of eggs, soups and vegetables have saved from twenty-five to seventy-five per cent of cargo space, in addition to affording protection to these perishable products. Lend-lease now, and during the early post-war years, will undoubtedly continue to call for substantial amounts of cellophane for this purpose.

Metal Conservation

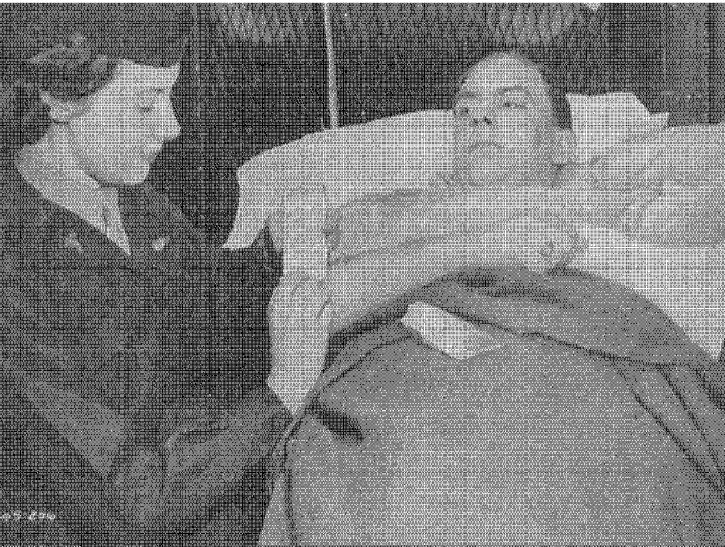
After Pearl Harbor, you will recall, the Japanese invaded the East Indies and cut off our main supply source of tin. America's food-container industry had to make serviceable cans without using so much tin. Du Pont chemists and technicians collaborated in the development of a continuous electroplating process that helped to conserve the diminishing stock pile. And the Cellophane Division had a hand in developing food containers in which the "body" sections, instead of being fabricated with metal, were replaced with moistureproof cellophane laminated to paper board. These containers were used chiefly in packaging shortenings, edible oils and paint. Another type of metal-replacement package consisted of a cellophane bag inside a pre-fabricated box; this type of package was used extensively in large quantities for frozen foods.

Rivet Bags

Still another packaging problem cropped up in the assembly rooms of airplane factories where millions of pre-frozen aluminum alloy rivets are used. It's important to keep these metal fasteners cold. How best to do that was the question. The right answer proved to be sealed cellophane bags. One type, called "bag-in-bag," provides dead-air space for insulation. Another type of single-wall construction, when filled, sealed and dispensed from portable refrigerator carts, keeps the rivets in usable condition long enough to effect time-and-labor-saving economies.

Weapons, Too

The packaging of military equipment has been greatly improved during this war. No longer are rifles issued with all parts coated with a sticky, heavy grease, making it necessary for soldiers to spend hours in cleaning them. Nowadays, rifles coated with only light oil are factory-packed in individual wraps of laminated

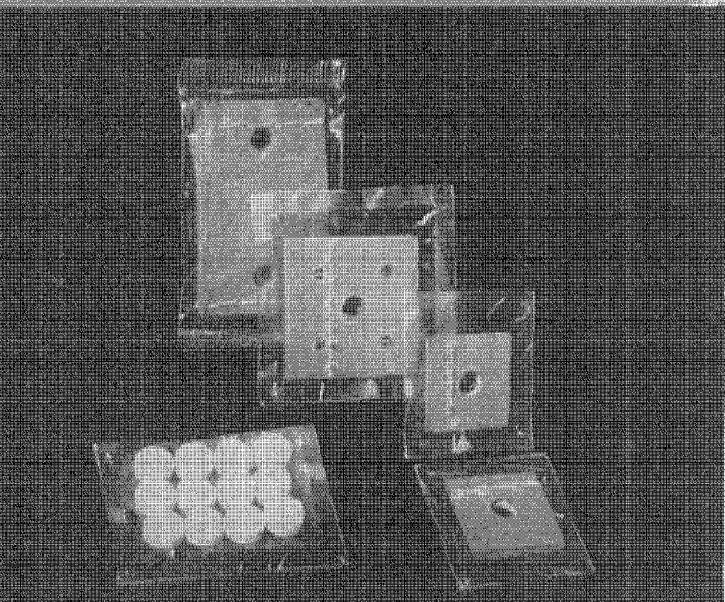


Many a field-hospital patient knows what's in the package the nurse holds—sulfa tablets.



USAAF bomber crews on long, strategic missions need a light lunch, which includes these items.

Heat-sealed cellophane keeps this mortar propellant powder in dry, usable condition at all times.



ness wherever our armed forces are fighting overseas. Enormous quantities of cellophane have been required. The plants at Buffalo, New York; Richmond, Virginia; Old Hickory, Tennessee; and Clinton, Iowa, have been and are now overtaxed to supply the demand. You'll understand why as this story unfolds.

When Ships Were Scarce

Earlier in this war, if you remember, enemy submarines were for a time sinking our ships almost as fast as we could build them. The shipping shortage was very critical. If we didn't build more ships, if we didn't protect them better, if we didn't make better use of existing cargo space, Germany might possibly have won the Battle of the Atlantic.

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fabrie and moistureproof cellophane. As soon as the wraps are removed, the guns are ready for use. The same thing applies to thousands of tank, truck, airplane and motor parts. Modern packaging, combining cellophane and other materials, protects them against dust, dirt, rust and corrosion, so that when received in the war zones they are ready for immediate use.

Gas Masks and Covers

Included in the equipment for our fighting men are gas masks, factory-wrapped in cellophane, and protective covers—large-size bags made of cellophane for emergency use. Should the enemy resort to mustard gas, each trooper pulls the cover over his head completely enveloping his body, rifle and other equipment, and then crouches down on the ground. The covers, protectively colored below the shoulder line, are transparent at the top so that soldiers can see on all sides and can use their rifles if the enemy comes within range. Large quantities of cellophane have been supplied to manufacturers of these gas-protective devices.

One of the latest applications of moistureproof cellophane is in packaging wafers of propellant powder for the 60 mm. and 81 mm. mortars—the guns that hurl high-explosive shells over the hillsides into enemy positions. It's important to keep the powder dry, so it is prepared in tightly-sealed cellophane packets which are attached to the "fins" of the shell before the gunners start loading. Increased use of mortars at the fighting fronts has resulted in a largely-increased demand for cellophane to prepare and protect this ammunition.

Food and Medical Supplies

By far the largest, most important wartime use of cellophane has been in packaging of military subsistence supplies, with rations high on the list. A fighting man's food must be protected against dampness and dryness, against dirt, germs and other contaminating agencies. That is why cellophane, either alone or laminated to itself or to kraft, glassine or foil, is used in packaging rations, such as the well-known "K" ration, for example. This includes, among other components, biscuits, a fruit bar and cigarette packages, each wrapped in cellophane, with all units further protected in a large bag of laminated cellophane.

Rations are of several types. In addition to "K," there is the "10-in-1" unit that contains enough food to feed ten men for one day. There is a life-raft ration, an aircraft bombing ration, a "C" ration and a "D" ration, which is a concentrated candy bar. Moisture-proof cellophane serves in the protective packaging of all of these rations. A very substantial quantity is needed to safeguard these food supplies for the millions of fighting men overseas.

The same precautions must be taken to protect medical supplies, too. Our soldiers carry in their pockets small packages of sulfa tablets sealed in cellophane. First-aid dressings, bandages, compresses and other medical and surgical supplies are packaged with this sanitary film. Even the hollow needles Army doctors use in giving blood transfusions are sealed in cellophane. In short, this protective film is applied in one way or



another to a great variety of products, large and small. See illustrations and chart, pages 12 and 13.

The foregoing testifies that enormous quantities of cellophane are required and allocated for essential war needs, and explains why there is little now available for packaging civilian merchandise.

It may surprise you to know there are forty-six different types of transparent Du Pont viscose cellophane now being made to supply our nation's military and civilian requirements.

Other Transparent Films

The Cellophane Division also manufactures cellulose acetate film using acetate flake similar to that which goes into Du Pont "Acele" rayon yarn. At the present time this is all under allocation for war purposes.

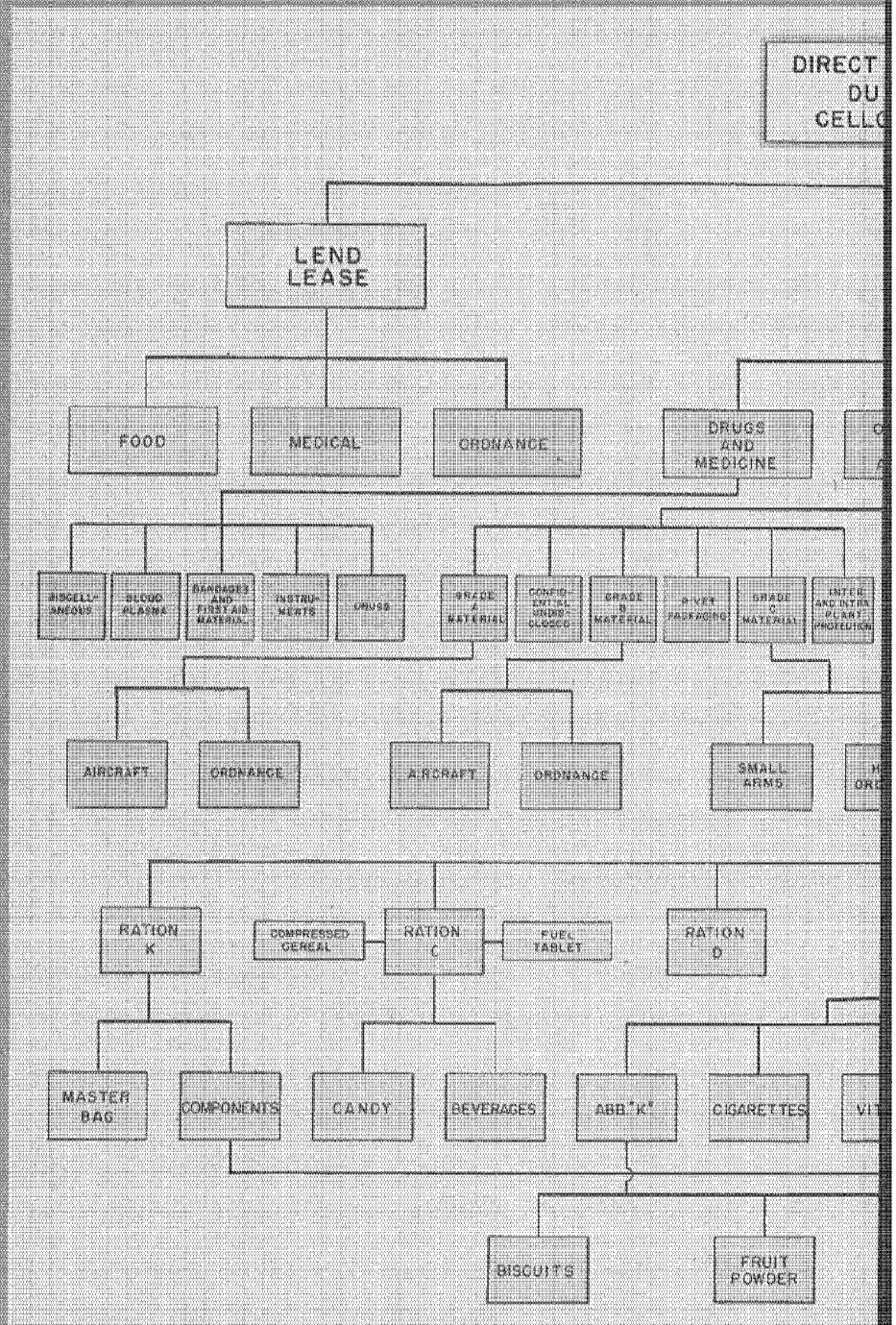
Laminated to foil, it is used to package highly-hygroscopic food products (Army rations) and medical supplies. Laminated to cloth and other materials, it has wide use for packaging of items, such as precision parts, sensitive instruments and the like. Combined with paper and fabricated into pressure-sensitive tape, it is used to seal vents and openings in tanks and other ordnance matériel.

Still another interesting application is for lamination on charts and maps to protect them from soiling and the ravages of the weather. Many of these uses will undoubtedly have post-war applications.

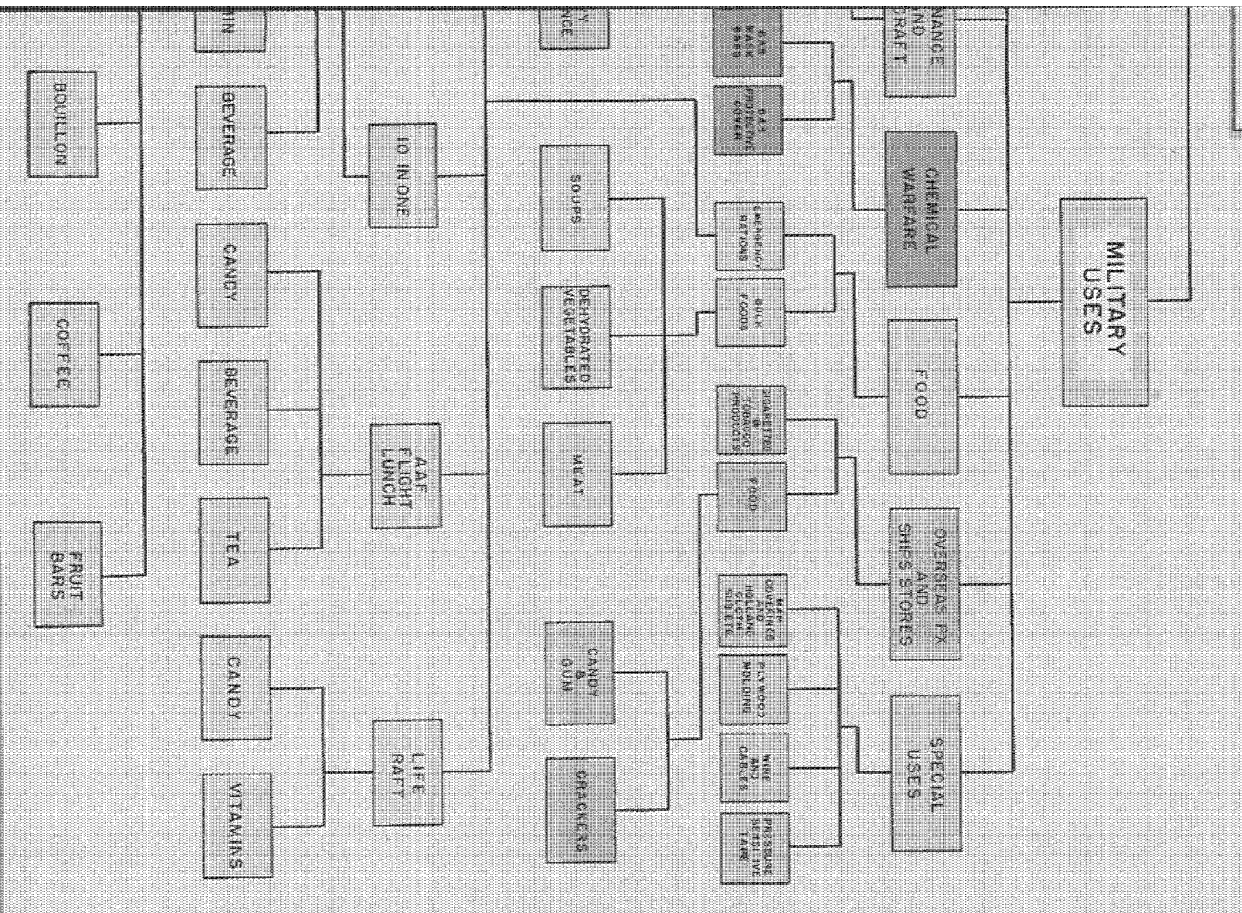
In addition to the continuous research work on

(Continued on Page Twenty-Four)

CELLO IN WARTIME



In the preceding article you have learned about some of the wartime uses of cellophane. The illustrations and the chart shown here will give you a more complete picture of the war uses to which this product is being put. They will also suggest the magnitude of the war demands on cellophane-production



facilities and explain why there is a definite limitation on the amount of food available for civilian uses. Military requirements have continually increased during the war period, with the result that today a very substantial percentage of cellophane production capacity is needed to fill war orders.





Impact-resistant headlamp lens of molded "Lucite" methyl methacrylate resin has proved its worth on amphibious craft in the Pacific. See illustration on page 16.

FOR POST-WAR CARS AND PLANES

*By DR. G. M. KUETTEL**

PLASTICS are established as essential war materials. Since Pearl Harbor they have found an increasing volume and variety of uses, especially in the planes and automotive equipment of the armed forces. The rate of this increase has been so rapid that popular imagination tends to exaggerate the possibilities of these comparatively-new products. To outline the course toward an orderly and sound post-war development of this expansion, an evaluation of plastics' war achievements seems essential at this time.

Virtually thousands of plastics are possible theoretically. Less than a score, however, have achieved substantial success. Some of the successful plastics are the polyesters of acrylic and methacrylic acid, phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, alkyds, cellulose nitrate, cellulose acetate, nylon, polyvinyl alcohol, polyvinyl butyral, polythene, polyvinyl chloride, and polyvinyl chloride-acetate copolymers.

In general, the overall properties by which plastics

have won wide acceptance have been light weight, ease of fabrication, durability, economy, and the unique characteristics of particular plastics. Of importance in the commercial and passenger-car field have been beauty and color which add two more distinctive advantages for the design engineer. These considerations assure a growing acceptance of plastic as components in the planes and cars of tomorrow. But of controlling importance in the aviation and automobile industries is the fact that on the basis of war performances, certain plastics are now recognized as among the sturdiest of outdoor materials. Notably so are the acrylics, such as "Lucite" methyl methacrylate resin, which provide the familiar crystal-clear enclosures on virtually every type of war plane. These acrylics have met Army and Navy specifications, fulfilling outdoor requirements far more stringent than those for commercial and civilian use.

The clear transparency of "Lucite," its light weight, good tensile strength, high impact-resistance, ready formability and ease of repair, all combine to make it

*Assistant Manager, Technical Service Du Pont Plastics Department.

the preferred material for gunners' turrets, pilots' and bombardiers' enclosures and navigators' astrodomes or canopies. These properties will recommend this plastic for uses in post-war commercial and civilian planes.

Airport Lighting

Light transmission, together with rugged resistance to outdoor exposure, also dictated the use of methacrylates for lenses of signal lights and landing-light sets which guide pilots on Navy plane carriers or at advanced Army flying fields. This development stemmed back to the automobile industry's use of "Lucite" for edge-lighting dash dials and gauges, lenses for tail lights, license-plate lamps and signal-light lenses before the war. In these lens installations colored "Lucite" retained its original hues exceptionally well; in fact, some of the first colored "Lucite" lenses of this kind are still in service, as bright and colorful as they were when first molded, although the metal housings and other parts may have rusted or corroded.

The manufacturer of landing-light lenses found that "Lucite" has a light transmission up to ninety-two per cent as compared to eighty-eight per cent for top-quality pressed glass, and that with simple, fast procedure of molding, light transmission is prismatically brought out in a manner comparable to that accom-

plished by fine, precision-ground optical glass. Use of "Lucite" makes possible a lens design which transmits almost three times as much light from a lamp of specified power as was transmitted through ordinary glass, nearly tripling the illumination obtainable from the same source. And the plastic lenses weigh only about half as much as the glass lenses. Here, then, is a development that promises to increase vastly the range of automotive lighting visibility.

These new-type lenses are made of a methacrylate formulation developed since Pearl Harbor, HM-122 "Lucite" molding powder, which has a heat-distortion temperature of 197° F. It will be of interest to the engineer because of its possibilities for improving the durability and service of many parts, such as lenses for parking lamps, side-bonnet, signal and directional lamps; radiator ornaments, and rear lights.

Headlight Lenses

Another wartime development of promise for post-war experimentation is the new molded "Lucite" lenses for sealed-beam headlamps. They were specified for American amphibious tanks as a replacement for conventional glass lenses, which could not withstand the

"Lucite" lies with the Airacomet, Bell Aircraft's jet-propelled P-59A. The parts shown below are the top and side sections of the cockpit enclosure. At the right, a worker is polishing the dome-shaped lens which protects the landing light in the tip of the nose.





Sealed beam headlight lenses of "Lucite" are needed when "ducks" fight the sand and surf.

battering of water and gravel encountered in surf landings. Aside from its superior properties as a lens material, "Lucite" was found to be more durable in service. That will carry a suggestion to boat-builders.

Current evaluation of "Lucite" for automotive and aviation manufacturers suggests its use as a material in electric storage batteries, both as an outside covering and as "spacers" between electrodes. Chemical inertness of "Lucite" to battery-acid action and its advantageous weight-to-strength ratio indicate that these applications, now in development stages, are practical.

Working Models

Plane manufacturers have used "Lucite" in the construction of working models, the better to visualize the internal operation of hydraulic and fuel systems, so that engineers can discover the sources of weakness or failure in such installations. Extension of this model-building work for research purposes by the automotive and aviation industries may be expected after the war.

For Greater Safety

Polyvinyl butyral resins, developed in pre-war days as the plastic interlayer for safety glass, are outstanding for their toughness and flexibility. A development of the utmost importance owes its value to these properties and to the unique impact-absorption feature of this vinyl sheeting. It has contributed to safety in wartime flying.

The plane-enclosure takes full advantage of the shatter-resistance of "Butacite" polyvinyl butyral resin, not in combination with glass, but with "Lucite." Laminated "Lucite"-Butacite is highly resistant to the shattering effect of gunfire. At ordinary temperatures, even in pressurized cabins, the hole left by the passage of a bullet is small, and its shattering effect confined to a small area. In most cases the bullet hole may be covered promptly with a repair patch of rubber or transparent "Butacite" sheeting, thus allowing the pressure in the plane cabin to be maintained.



Transparent "Lucite" enclosures are featured in this streamlined, Higgs-built helicopter.

This development is significant to engineers and designers of peacetime air-cargo and passenger-transport planes and also to designers of highway-transport and passenger cars.

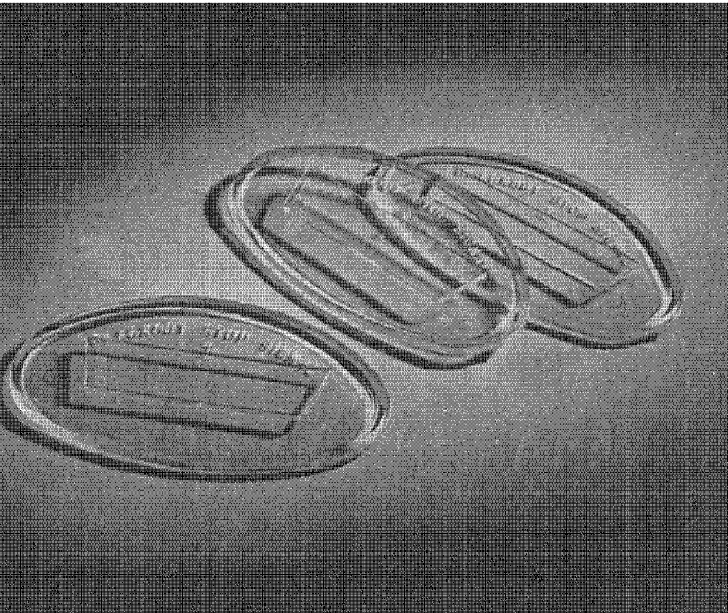
Polythene

Among the newer wartime synthetics, polythene is outstanding because of its unusual combination of electrical and mechanical properties. This plastic was developed by Imperial Chemical Industries, Ltd., of England, and the generic name, polythene, was adopted in this country to designate those polymers of ethylene the Du Pont Company manufactures for use in plastics.

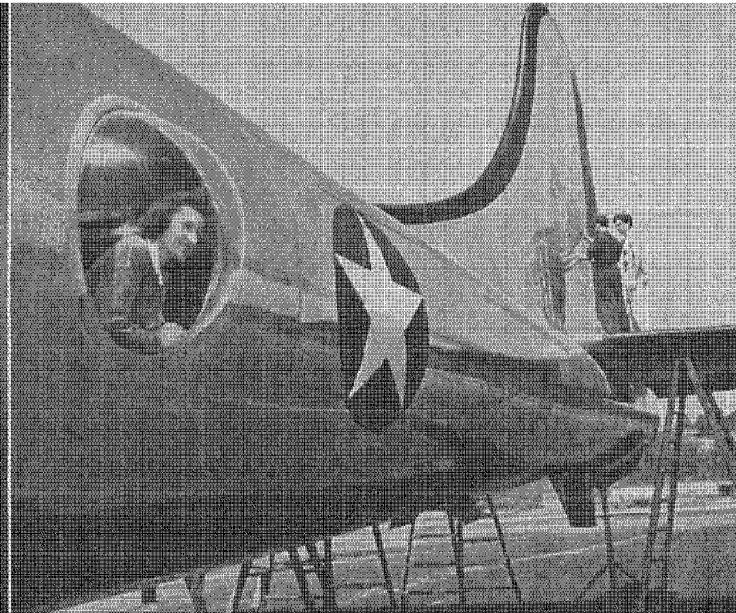
Polythenes are remarkably tough and flexible over a wide range of temperatures. They are unusually resistant to water, possess much-desired electrical properties, such as extremely low power factor and low dielectric constant, as well as high resistivity and dielectric strength. Polythene is particularly suitable for use in insulating high-frequency and high-voltage circuits. Resistance to water and chemical attack makes it outstanding as a waterproofing, corrosion-proofing or gasketing material.

Like "Lucite," already mentioned, polythene has interesting post-war possibilities as a material for fabricating storage-battery cases and separators. Its unusual insolubility and inertness to chemical reagents recommend it for these uses. At room temperature, polythene is substantially unaffected by concentrated hydrochloric, sulfuric, or even hydrofluoric acids. Nitric acid has no visible effect on this plastic, but does ultimately impair its tensile strength and elongation. Evaluation of the material for these applications is now in progress.

Meanwhile, in Army and Navy fighter planes polythene is an indispensable insulating material for varied types of electrical equipment. These uses, together with others for communications wire and cable on land and sea, now consume the entire production of this plastic. But it will be available in substantial quantities for post-war needs of automotive and aviation engineers.



Blackout lenses are molded of heat-resistant "Lucite" for use on Army transport vehicles.



Visitors' day on a B-29, with a pretty girl looking out through a "blister" of "Lucite."

Nylon

Nylon is another of the synthetics with a distinguished war-service record. Its textile and cordage uses have been numerous and important. Monofilament nylon has figured largely in the brush-making industry, and other plastic forms have been field-tested in war service; they will probably be utilized extensively by all industries when Federal restrictions are removed.

It should be understood that the term nylon refers not to any one product, but rather to a whole family of compounds, and no one yet knows how numerous that family will be. At least ten types have been produced commercially thus far, and the research program is only fairly started. But even now nylon has potentialities of interest to automotive and aeronautical engineers and designers. For example, hydraulic packings of nylon for the brakes and shock absorbers of cars and for the landing gears of planes are now being evaluated. Another type of nylon gives promise as a component of brake linings. Conceivably, steering-wheels may some day be molded of nylon.

Structural Parts

For floats and other parts of carburetors that come in contact with fuels, nylon, with its high resistance to the chemical action of gasoline, may well meet service requirements. The fact that nylon is also easily molded and that it possesses high softening temperature indicates the probability of its use for seats of valves and as a gasketing material.

The Navy has made successful use of nylon plastic in both of these applications. Special valve seats of molded nylon were used instead of valve-stem packing in an important part of a highly-secret device. This eliminated the packing operation and also provided a good gasket material. In this case, the plastic valve seats proved to be better than those made of metal for an additional reason. The metal had to be machined to exact dimensions, a delicate precision job, and then the part had to

be ground by hand and carefully fitted to function efficiently. The molded nylon parts did not require these attentions.

As FM-1 nylon molding powder, this plastic has also been molded into spools on which are wound electrical coils to activate aircraft instruments. In this case nylon was selected because of its high resistance to distortion under heat. The wall thickness of these spools is only 0.012 inch. Even so, they are amply tough to meet the requirements of assembly operations. They are flexible enough so that the sides of smaller spools can be forced together until they meet, and when released, they almost instantly resume their original molded shape. Coil forms for head-sets of military phones have also been molded of nylon.

The foregoing citations suggest good possibilities for the increased use of nylon molding powders. When the automotive and aviation industries are released from military restrictions on production, they will manufacture better cars and planes than could be made before the war; and it may be assumed that they will not overlook the opportunity to use nylon fabrics, filaments, sheetings in a variety of ways. Already nylon textiles have been suggested for the upholstering of seats and interiors of planes; this may obviate the need for slip covers. Embossed nylon sheeting—attractive and very durable—may find use as interior wall coverings. Nylon-bristled paint brushes, now used by the Army and Navy, are likely to be in demand for plant maintenance needs and for finishing automobile or airplane parts and equipment.

This report only touches upon some war developments that hold the promise of tomorrow in the plastics field. It is by no means exhaustive. The complete story of how plastics have served in scores of secret devices may not be revealed. But enough has been told to make one point clear—plastics in increasing variety and volume will be ready for the post-war needs of manufacturers of automobiles and planes.

Some Defender officials, past and present: Left to right, J. H. Kitchen, L. R. Moore, R. S. Potter, L. D. Field, K. T. Mohr, J. C. Powers and C. P. Schlegel. America's tallest are those now active in the newly organized Du Pont Division.

DEFENDER JOINS DU PONT

IT WAS 1895. Mules strained in their harnesses as canal boats, laden with grain from the West, were drawn toward the far-famed Aqueduct where the Erie Canal crossed over the Genesee River at Rochester. In a loft of the Pitkin Building on Rochester's West Main Street a young man, Frank Wilnot, founder of the Defender Photo Supply Company, stood at the window and gazed thoughtfully at the familiar scene.

Ordinarily he had little time for dreaming or window-gazing. This afternoon, though, he had finished his run of "Disco" photographic paper early. Up before dawn, he had mixed the light-sensitive emulsion by hand in a large kettle. When ready, he had applied it to the paper, using a coating machine he himself had built. Now the products of his work were all ready and packaged. In the shed behind the building his horse was contentedly munching oats, ready to take him out the next day on

Defender

DU PONT
SINCE 1802

his round of calls to the western New York photographers. Already they were beginning to depend upon the quality and the uniformity of the paper this young man offered.

Frank Wilmot probably dreamed then of the future growth of his business. What young man wouldn't who had invested his whole savings of \$1,500 in it, who gave it every waking moment, alternating his time between manufacture of the product and sales trips through the territory? But he probably never envisaged the day, still fifty years away, when the company his enterprise founded would join forces with a company that was even then, in 1895, a ninety-three-year-old American institution. Yet on May 28, 1945, fifty years from the date young Wilmot founded his business, the Defender Photo Supply Co., Inc., joined forces with E. I. du Pont de Nemours & Co. (Inc.). Thus, an association began that is certain to be of far-reaching significance to photographers everywhere.

An American Story

The story of the Defender Photo Supply Company, now the Defender Division of the DuPont Photo Products Department, is a story of perseverance and faith that is typically American.

Shortly after its founding, with a steadily-growing demand for this "fresh" photographic paper, Wilmot took a partner into the business and changed the title of the organization to the Wilmot-Fairman Company.

The first factory was on the West Main Street site, facing the old Erie Canal. The hand-built coating machine installed there turned out 500 feet of "Disco" paper, 26 inches wide, each day. However, by starting before dawn, production could be stepped up to 1,000 feet a day.

With a partner to assist him, Frank Wilmot could devote more time to sales work and he could venture farther afield. On his first such trip he made his initial out-of-town sale—in Canandaigua, thirty miles from Rochester—and then continued as far south as Corning, New York. He left there without an order, disappointed and empty-handed. However, on his return to Rochester he found a letter from the Corning Glass Works reporting "a call from your very gentlemanly representative," and inclosing an order for ten gross of $6\frac{1}{2} \times 8\frac{1}{2}$ "Disco." Whereupon that same gentlemanly representative rolled up his sleeves and proceeded to make the "Disco."

The firm grew rapidly and in less than a year moved to larger quarters. At the same time, Fairman, who had only been giving part of his time to the business, decided to leave. His place was taken by Martin B. Hoyt, who could and did take a more active part in the company's affairs, and who also had the adequate financial backing so essential in this period of rapid growth.

It was at this time that the name of the company was again changed. Both young members of the firm, when time permitted, were enthusiastic yachtsmen and, like nearly everyone at that time, keenly interested in the International Yacht Races in which the "Defender" had been successful. Conscious of the publicity value of that name, they adopted it for their company. For many years a picture of the sloop-rigged yacht was a familiar trade-mark on Defender products.

In 1899, "Monox," a bromide paper was added to the Defender line. If you posed for a while-you-wait photograph at a county fair or at the seaside in those days, it was highly probable that the postcard stock came from Rochester in a box labeled "Monox." "Argo," the second "D.O.P."—developing-out paper—or "Gaslight Paper," to be made in America, came next.

Dependent at that time upon European sources of paper stock and glass for photographic plates, the Defender Company weathered World War I with extreme difficulty. After many lean years, in 1923, a reorganization of the management was effected under L. Dudley Field, president of Defender since that date.

About this time "Velour Black" became an important part of the company's production. Combining the qualities of a chloride paper with the speed of a bromide, it soon became the outstanding rapid printing paper for photographic enlargements. Today, wherever there is a salon exhibit of fine photographs, and in professional studios and commercial establishments, you will find that a large proportion of the outstanding pictures have been printed upon "Velour Black." For contact prints, such as those furnished by photo-finishers, Defender also produces an equally outstanding paper known as "Apex."

In 1927 the Defender organization added sheet film to its line, taking over exclusively the finishing and retail distribution of the professional and commercial-type film sensitized at the DuPont Company's Parlin, New Jersey, plant. As new films were created and old ones improved through the joint efforts of the Defender and DuPont research staffs, they, too, were added to the line. Today sheet-film sales represent a sizable portion of the business.

Looking Ahead

Large as has been the contribution of the Defender Company to the war effort, reconversion to peacetime production imposes virtually no problem. Products supplied to the armed forces are manufactured in the same manner and to the same high standards of quality as those supplied to the public in time of peace. Improvements in manufacturing procedure developed to meet accelerated military demands will undoubtedly permit larger, more efficient production of civilian photographic supplies in the future.

For meeting urgent military schedules and maintaining its high-production record the plant received the Army-Navy "E" Award in April, 1944, with a star added in October, 1944, and a second one in May, 1945.

No change in Defender management or policies is contemplated. L. Dudley Field will serve as manager of the Defender Division with Karl Tec Molin acting as assistant manager. Present Defender branch offices will be maintained in Boston, Chicago, Los Angeles, New York and Seattle.

For the future, this association of Defender and DuPont promises not only a continuance of the fine photographic products for which each name has stood in the past, but also new and better films, papers and chemicals . . . photographic products that will truly belong among DuPont's "Better Things for Better Living . . . Through Chemistry."



ENGINEERED

A "close-up" of the big dragline, showing the cam mechanism that enables the machine to walk. Operator sits in the cabin above.

STRIPPING HELPS INCREASE OUR COAL SUPPLY

The world's largest dragline excavator is at work near Pottsville, Pennsylvania, on a job that involves the blasting and removal of 11,000,000 cubic yards of rock

By RICHARD R. BRANDA, Mining Engineer, Correale Construction Company

THE Beechwood Stripping Project of the Philadelphia & Reading Coal & Iron Company near Pottsville, Pennsylvania, is probably the most difficult rock excavating job now in progress in this country.

Its primary objective is the recovery of anthracite coal from the Mammoth Vein which was first mined many years ago. The real problem, of course, is the removal of 11,000,000 cubic yards of overburden, a large percentage of which is rock overlying the vein.

The rock must first be drilled and blasted in preparation for its excavation on benches of 100 to 120 feet in depth. The excavated rock must then be moved and shifted about to permit taking successive cuts. To further complicate operations there are only 5,000,000 cubic yards of dumping space available on the property—less than half the amount required to receive the bulk of the overburden.

What's What, Where?

Since information obtained from maps of the original working was meager and incomplete, a large number of test holes of large and small diameters were drilled to determine the extent and quality of the coal vein and character of the overburden.

From cross-sections based on this information the economic limits of the project were determined and the volumes of the several types of materials involved were calculated. As a result of competitive bidding by the various stripping contractors, the job was awarded on November 19, 1942, to the Correale Construction Company of Hazleton, Pennsylvania.

Huge Working Tools Required

This contractor purchased in Nevada, for use on this project, a 14-cubic-yard Bucyrus-Monaghan dragline. After a long journey eastward and months of reassembling, the dragline finally started excavating in August, 1943.

But this was not enough! More help was needed and the following year a new and larger dragline was installed, an 1150-B Bucyrus-Erie equipped with heavy-duty operating motors. The total weight of this machine is about 2,300,000 pounds—1,150 tons. Its 180-foot boom carries a bucket that alone weighs 61,000 pounds and when loaded tips the scales at 130,000 pounds. The bucket—13 feet high, 17 feet long and nearly 12 feet wide—has a capacity of 25 cubic yards. A special car hauled it from the factory along with forty-five other cars loaded with other parts of this gigantic machine.

Machines That Walk

An interesting feature about these huge draglines is that they walk. This is accomplished by means of two large shoes mounted to an eccentric cam mechanism on either side of the revolving frame. While digging, the walking shoes are carried off the ground, and the machine is supported and rotated on its base. To walk, both shoes are lowered simultaneously, the weight being transferred from the base to the shoes, and the whole body of the unit is then lifted off the surface, advanced in position and gently deposited back on the ground. The shoes are then lifted free of the surface and advanced, a process that can be repeated as many times as desired.

These machines were selected for their ability to dig rock. Also by virtue of their capacity and flexibility they are much better adapted to the size and operating difficulties of this job than a series of smaller machines would be. In order to eliminate as many moves as possible it was desired to keep the number of working benches to a minimum. Digging depths on bench heights were set at 100 to 120 feet for which these machines with their long reach are admirably suited. They also lend themselves readily to the necessary repeated rehandling of the excavated material to make room for subsequent rock cuts and to take advantage of all available storage space including portions of the completed pit area.

It is estimated that 28,000,000 cubic yards of spoil (including necessary rehandling) will have to be moved in mining 4,000,000 tons of raw coal. In other words, the ratio is seven to one. The maximum ultimate depth to be obtained by the draglines will be 340 feet below the original surface.

The actual stripping operation proceeds in accordance with careful and detailed plans. Each move of the draglines has been outlined and the equipment scheduled with exactitude so that the work is coordinated and can be advanced smoothly. Ramps must be carefully planned in order to maneuver these huge machines from operating levels 100 to 200 feet below the surface to the mountainous spoil piles rising 210 feet above it.

One of the supplementary problems of some significance is handling of the water from surface drainage and old flooded underground workings. This requires the installation of several high-head pumps providing a total capacity of some 2,000 gallons per minute.

Drilling and Blasting the Overburden

The importance of blasting rock effectively cannot be overemphasized, particularly on a project such as



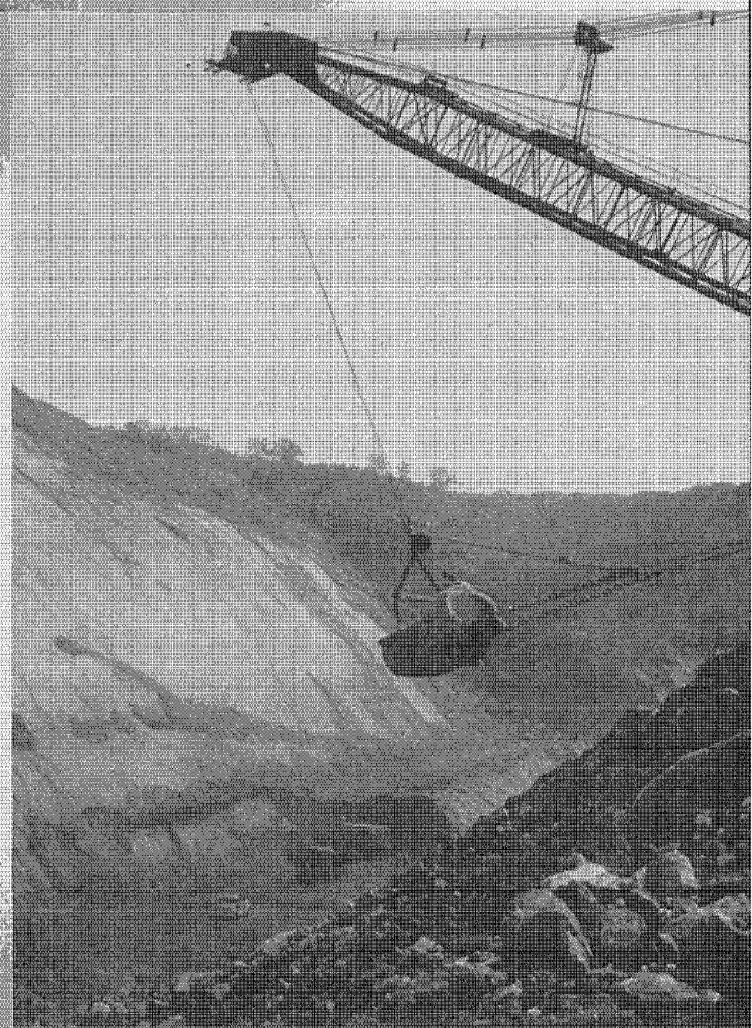
Loading a 7 x 24-inch primer with the Primacord detonating fuse attached. A portion of the "Nitramon" has been placed in the hole. Another primer will be loaded later. The shot will consist of a number of similarly-loaded holes.

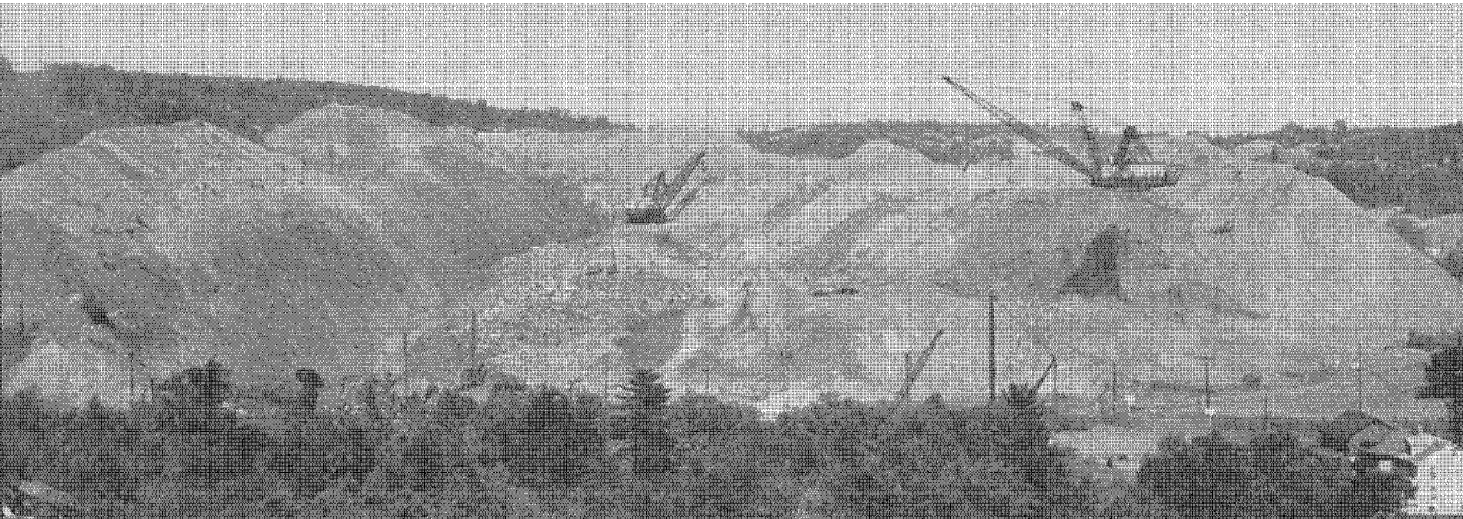
Looking down into the pit from which overburden has been removed. The four-cubic-yard shovel is digging in the Mammoth Vein. Notice the parked automobiles standing on the haulage road which runs along the top of the remaining coal vein.

this where the movement of great quantities of material must be continuous and on schedule. A uniform digging floor must be provided at the bottom of the cut as this will later serve as the working level of the next bench below. The rock at the bottom of the cut lying at the extreme working limit of the dragline must be thoroughly shattered to permit efficient operation. Good digging means greater yardage, less wear and tear on equipment and lower overall costs.

Blasting requirements on the scale practiced at Beechwood are unusually severe. In order to obtain the best results possible, the technical staff of the DuPont Company's Explosives Department has worked in close collaboration with the operating and engineering departments of the Correale Construction Company. Depth and spacing of the blast holes, type and quantity of blasting material, its distribution in the holes and method of detonation—these were some of the problems that had to be solved at an early stage of the work.

All operations are planned. Before any drilling is done, each hole is staked out by survey and its required depth determined. Uniformity of spacing is thus achieved and the amount of drilling required is kept to a minimum.





A long-range view of the Beechwood operation from the west end of the pit. Note the big dragline working on an intermediate bench, left center, and the smaller unit on top of the spoil pile, right.

To eliminate all guesswork as to underground conditions, a record of the rock strata, small overlying veins and any openings or broken areas caused by subsidence due to previous mining operations, is kept as each hole is drilled. This information is then plotted and cross-sections made to show the relative positions of the various strata. Based on such a clear picture of sub-surface conditions, which is thus made available to the blasting crew, the blasting material can be placed so as to produce most efficient results.

Churn drills of nine-inch diameter—five electric and one Diesel—are used at Beechwood. To date they have completed 1,416 holes, representing 135,476 feet of drilling, or the equivalent of a single hole more than 25½ miles deep. It is estimated that 362,000 feet more—the equivalent of 68½ miles—will have to be drilled, loaded and blasted in order to break the remaining overburden for dragline operations.

To date 2,105,156 pounds of explosives have been used in blasting 2,634,992 cubic yards of overburden in preparation for excavation. The largest single shot made thus far involved the use of 131,000 pounds, the largest proportion of which was Du Pont "Nitramon" blasting agent. Under suitable hole conditions, "Nitramon" is always the first choice, due to its safety, high-shattering action and overall economy. Circumstances occasionally require the use of dynamite. In areas containing cracked

or settled material, due to subsidence from mine workings, the well-drill holes often encounter pockets and caves and at best are apt to have rough walls. Here a gelatin-type explosive is necessary. Du Pont Hi-Velocity Gelatin best meets the requirements of high heads of water and long periods of exposure, with Special Gelatin the economical choice for more normal conditions.

As this is written, stripping operations at Beechwood are well under way, but an enormous yardage of rock still awaits the attentions of the blasting crews.

Coal Removal

The stripped coal is dug with a four-yard shovel operating on benches 25 feet deep and loading into trucks. It is first rough cleaned and sized to "minus 6 inches," then passing by conveyor belt over an automatic weighing device to the coal company's breaker for final cleaning and preparation for the market. Handling is simplified with this 36-inch conveyor belt which is 3,000 feet long, travels 350 feet per minute and handles 400 tons per hour.

Under the direction of such capable men as Messrs. Frank, Palmer and Fred Correale who have guided the organization of this project, the Correale Construction Company is paving the way for more extensive stripping operations in the future. This company has become widely known for its achievements in this field of endeavor.

The big dragline in operation, with the engineers surveying a stripping bank.



A typical cross-section showing the relative location of overburden and coal veins.



The Longest War of All

(Continued from Page Five)

These compounds are merely the latest products in the long list of agricultural aids developed by the DuPont Company. As conditions change, as more knowledge is acquired, others will be added in future.

No citizen is more important to our national welfare than the farmer. He is the foundation-stone upon which the structure of our society rests. It is the responsibility of modern industrial chemistry to provide him with every possible aid, from the fertilizer with which he must enrich his soil to the cellophane in which his product finally reaches the display counter of the store.

It's a Small World on Microfilm

(Continued from Page Eight)

National Microfilm Association. A trade paper for the information of members and their clients will probably soon be published. The academic counterpart of the trade paper, the *Journal of Documentary Reproduction*, directed primarily to library, scholarly and museum applications, began publication in 1938, but was suspended in 1943 for the duration of the war.

Microfilming Technique

Microfilming begins with the camera, often a highly-specialized precision tool, costing thousands of dollars. An operator produces a series of images, each often smaller than a postage stamp, on a long length of sensitive film, either 16, 35 or occasionally 70 mm. in width. A machine, capable of processing 16,000 pages or more an hour, develops the film. A semi-automatic printer may make positive duplicates on film or enlargements on paper. The paper prints are read just as the originals would be, while film prints require a machine, which essentially is a projector with self-contained screen and controls for positioning the images for easy reading. Such machines for individual use cost from thirty to fifty dollars. The larger ones for library readers may cost several hundred. Methods of storage are adapted for large or small reels and sometimes short strips or individual pictures.

Legality—Lasting Qualities

So widespread has become the use of microfilming that a legal basis was deemed essential to protect and extend its potentialities. Public Law 115, 78th Congress, 1st Session, assures the legality of Federal microfilm reproductions and provides that, when properly made and attested, they must be judicially noticed. Many states have adopted similar legislation. The best scientific skill in the country has been devoted to the production of microfilm that will last hundreds of years. The raw materials are tested and the finished product must conform to rigid specifications.

Incidentally, the Siege of Paris microfilms that have survived are as legible today as when they were first made. Results clearly demonstrate that microfilms currently produced, when stored and used in accordance with accepted standards, will last indefinitely.

This infant industry, forged and tested by the requirements of war, remains for the world of peace a valuable aid to better living.

Cellophane

(Continued from Page Eleven)

cellulose films, intensive work is under way on other film-forming materials to provide new products for new markets. Polyvinyl alcohol films, for example, are already in an early stage of commercial manufacture. Others, still in the development stage, are now being laboratory-tested; they may come into the open market after hostilities cease.

Other Products

"Cel-O-Seal" caps and bands are manufactured by the Cellophane Division at Buffalo. You have seen them tight-fitted over primary closures of bottled wines and liquors and you may have wondered how they were applied. It's a simple operation. The caps or bands, pre-cut to the size required, are shipped in a chemical solution and then applied wet over the tops of bottles and around their necks. Drying causes each cap or band to shrink, forming a smooth, tight, sure seal.

"Wind-O-Band" seals, to mention another type used by bottlers of distilled spirits, are designed to serve as counterfeitproof closures; they also keep the required U. S. Revenue strip stamps visible and protect them from being torn accidentally.

Now these caps and bands have several wartime uses, notably in the aviation industry. Mass production of military planes is the work of many subcontractors. Some make individual parts, others whole sections of planes. In wartime, when precautions must be taken to thwart saboteurs who might plug up pipes and otherwise tamper with a subcontractor's finished work en route to assembly plants, it has been the practice to apply "Cel-O-Seal" caps over the open ends of pipes and to seal with bands any other parts that need protection. Any tampering by unauthorized persons is thus quickly detected.

Du Pont Cellulose Sponges

If you haven't been able to find many cellulose sponges on sale since World War II began, there is a good reason for it: practically the entire output is going into the war effort.

Where are they going? Well, chiefly for general cleaning purposes in the armed services. For example, there is a small, compressed sponge in each "10-in-1" ration kit issued by the Army. Bailing sponges are provided for use on life-rafts. Sponges are used as space fillers around self-sealing gas tanks in the wings of military airplanes. In photographic and map work, sponges are needed to wipe negatives, prints and the like; and there are certain uses of cellulose sponges not to be mentioned for reasons of military security.

The Cellophane Division of the Rayon Department is contributing substantially to the war effort. The knowledge and experience gained during these fateful years will be put to good use when the time comes to resume peacetime activities.



SAFETY AWARD ... FOR THE THIRD TIME

WILMINGTON, June 20—At a meeting of the Company's executive committee in Wilmington, the Du Pont Company was awarded—for the third consecutive time—the National Safety Council's "distinguished service to safety" emblem.

In making the presentation, Mr. Ned H. Dearborn, president of the national council, said in part:

"In 1942 you received the first 'S' pennant; in 1943, the second year, one star was added, and this year a second star proudly proclaims to the world that du Pont has done and is continuing to do a splendid safety job in spite of wartime conditions and ever-increasing production schedules.

"During 1944, your Seaford plant established a World Safety Record of 18,871,795 hours. That record would have been impossible without the application of tried methods of accident prevention. It alone is worthy of the highest award.

"But you people at du Pont seem not to be content with one good record in one plant. You seem to want good records in all of them—in the smallest, as well as the largest. So, in addition to the record made by the huge Seaford Plant, we find that the Burnside Laboratory where you conduct smokeless powder research, has operated over 23 years without a reportable injury!

"Finally, I note that 58 du Pont plants operated the *entire year* without a *single lost-time injury* and that 27 of those plants also worked throughout 1943 without a *reportable injury*.

"Such a record is, in the highest sense, an inspiration. It is an inspiration to your workers, who cannot help but appreciate your interest in safeguarding their lives and limbs. . . . It is an inspiration to other firms, both large and small, which will say, 'If du Pont can do it, so can we.'

"I am very happy, therefore, Mr. Carpenter, to present this two-starred 'S' pennant to you. I hope it will be the means of increasing, if that is possible, your Company's interest in the safety not only of their employes but of other Americans everywhere."

Mr. Walter S. Carpenter, Jr., replied, in accepting the award for the Du Pont Company: "I am delighted to accept for the du Pont Company this Distinguished Service to Safety Award of the National Safety Council, which, I understand, is given us because of the feeling of the Council that a good job on safety has been done by the du Pont Company.

"It has always seemed to me that there is as much or more satisfaction in safety work than in almost any other branch of industrial endeavor. I think that perhaps this is due to the fact that lack of safety constitutes what we would refer to in the vernacular of the gridiron as a 'triple threat'—let us call it a 'Triple-P Threat'—a threat to personnel, a threat to property and a threat to production.

"The campaign for safety offers an abundance of incentive along humanitarian lines in the relief of pain and distress on the part of our employes, and along financial lines in the relief from great and continuing expenses accompanying accidents.

"Safety in Industry has always been important, but perhaps never so important as during this great war—during which the conservation of personnel, property and production is of such paramount importance.

"Mr. Dearborn, practically all of the men in this room today occupy key positions in our organization—they are all interested in safety. They all recognize too that to get results in safety requires a continuing effort throughout the range of management to instill into the mind of every employe an ever-present consciousness of danger, an interest in its avoidance and a knowledge of how to eliminate it.

"It is in connection with this constant program of education that this Award, which you have extended us today, will be of particular value. We will bring to the attention of all our employes—not once, but many times—the fact that their efforts have been recognized. I believe they will be thrilled by the receipt of this Award and encouraged to further and continuing effort because of it."



A BOY'S BIG MOMENT! The morning air bright and clear, a frisky young pup at his side, his 22 rifle loaded and ready, and his first jack rabbit scrambling for cover! What boy doesn't live for this moment . . . what man ever forgets it?

We hope the day is not far off when we can again furnish sportsmen with Remington rifles and shotguns,

Remington Hi-Speed 22's with Kleanbore priming, Remington Express and Shur Shot shells, and Remington big game cartridges with soft-point Core-Lokt bullets. Today, of course, we're engaged in the production of military matériel for the armed forces. If you'd like a color enlargement of this painting, write: Remington Arms Company, Inc., Dept. C7, Bridgeport 2, Conn.



Remington Model 511 Scoremaster
bolt action 22 repeating rifle.

PAPER PACKS A WAR PUNCH—SAVE IT!

Hi-Speed, Express, Shur Shot, Kleanbore and Scoremaster are Reg. U. S. Pat. Off.; Core-Lokt is a trade-mark of Remington Arms Co., Inc.

Remington



"If It's Remington—It's Right!"