

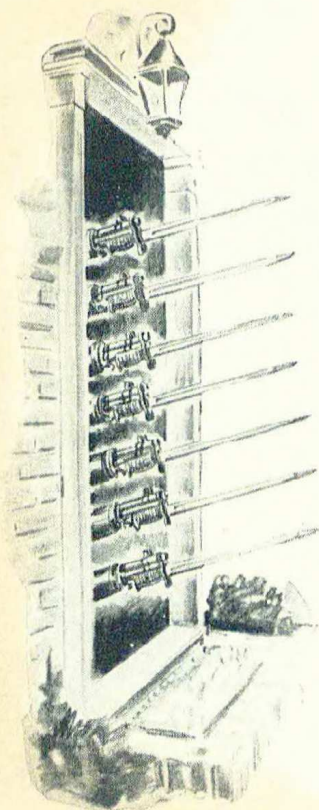
# THE DU PONT MAGAZINE

BETTER THINGS FOR BETTER LIVING...THROUGH CHEMISTRY





# The fight on the doorstep



**T**HIS WAR can't be won on battlefields alone. One of the most critical campaigns of all must be waged right on the doorstep of every family in America.

This is the fight against higher prices and higher wages. It's a fight that *must* be won... or victories on battlefields will be meaningless.

It's like this. In America this year, our total income after taxes will be about 133 billion dollars. But there'll be only about 93 billion dollars' worth of goods to spend it on. If we all start trying to buy as much as we can, prices will shoot up.

As prices rise, people will ask for—and, in many cases, get—higher wages. That will put up the cost of manufacturing, so up will go prices again. Then we'll need another pay raise. If we get it, prices rise again. It's a vicious circle.

The Government has done a lot to help keep prices down. It has put ceilings on food and rent... has rationed scarce articles. But the Government can't do it all alone.

It needs *your help!*

Your part in this fight won't be easy. It will mean foregoing luxuries, perhaps doing without a few necessities. Tough? Maybe... but don't say that where the veterans of Italy and New Britain can hear you!

You *want* to do your part, of course. So do we all... farmers, laborers, white-collar workers, business executives. And the way to do your part *right* now is to observe the following seven rules for Victory and a prosperous peace...

**1. Buy only what you NEED.** And before you buy anything, remember that patriotic little jingle: "Use it up. Wear it out. Make it do or do without."

**2. Keep your OWN prices DOWN!** If you sell goods, or your own time and labor, *don't ask for more money* than you absolutely must! No matter who tries to talk you into asking more... *don't listen!*

**3. No matter how badly you need something... never pay more than the posted ceiling price!** Don't buy rationed goods without giving up the required coupons. If you do, you're helping the Black Market gang—hurting yourself!

**4. Pay your taxes cheerfully!** Taxes are the cheapest way to pay for a war! The **MORE** taxes you pay now—when you have some extra money—the **LESS** taxes you'll pay later on!

**5. Pay off old debts.** Don't make any new ones! Get, *and stay*, square with the world!

**6. Start a savings account.** Make regular deposits, often! Buy life insurance. Keep your premiums paid up.

**7. Buy War Bonds... regularly and often!** *And hold on to them!* Don't just buy them with spare cash you can easily do without. Invest every dime and dollar you don't actually **NEED**... even if it *hurts* to give those dimes and dollars up!

**Use it up... Wear it out.  
Make it do... Or do without.**

**HELP  
US  
KEEP**

**PRICES DOWN**



# SO TO SPEAK

LOVE MAY MAKE the world go 'round—but rivets hold it together! At least they go a long way toward holding the machine world together. That's not just our personal theory either—proof is on pages 2 and 4.

DEVELOPMENT of Du Pont chemists, "Cordura" rayon yarn, is now in such great demand for tire cords that the War Production Board has authorized successive plant expansions to bring the nation's total annual output of this type of rayon up to 240,000,000 pounds—approximately seven times the volume produced in 1941. Du Pont's contribution, after completion of a second expansion which will add 7,000,000 pounds, will be about 55,000,000 pounds per year. "Spinning Into War," on page 7, shows something of what rayon is contributing to the military program.

WHEN THE WAR is over you'll have your nylon stockings back—all you can use—according to "Nylon—After the War," on page 10, a digest of a talk by R. A. Ramsdell, Sales Director of the Nylon Division.

THERE WERE 40,000 persons on the payroll of the Engineering Department and 10,000 on sub-contractors' rolls at the peak of their war construction. A comparison of that figure with the prewar employment total of 4,150 persons gives a picture of the magnitude of the tasks they have accomplished. The story is graphically told in the article, "Engineering and Construction," on page 11.

CINCINNATI, OHIO, was unaware that a momentous event had occurred, when one day in the early spring of 1839 a young traveler paused on the outskirts of the town and speculatively looked at the land.

But in that moment a now vital chemical industry was already being built in the fertile mind of Eugene R. Grasselli, and the site of his first plant was selected even as he stood there. In the Du Pont Company today the Grasselli Chemicals Department, with its sixteen plants, is still influenced by the traditional courage and foresight of the founding fathers of both organizations. "Heavy Chemicals for War," page 14, tells you something about the developments of the business that got off to a good start more than a century ago.

A SAFETY COLOR CODE FOR INDUSTRY," page 18, is another graphic indication of the efforts that are constantly being made to promote safer working conditions throughout the industrial plants of America.

AT LEAST one military academy records more hospitalizations from poison ivy than from any other cause. This points up the importance of the part planned for Du Pont "Animate" Weed Killer in the article on page 22.

## THE DU PONT MAGAZINE

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★ BUY MORE U. S. WAR BONDS AND STAMPS TODAY ★

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E. R. MANCHESTER, Editor

#### THE COVER

On the cover you see Mrs. Lavon Moser, Glenn Martin Aircraft employe, working with a Du Pont Riveting Iron on a bomb bay door. For a description of the new Du Pont Improved Explosive Rivet, see page 2. Photography by Charles S. Gunby.



OTHER CREDITS: Page 4, courtesy Business News Publishing Co. Page 6, bottom, courtesy Business Week. Page 8, top, Official U. S. Army Signal Corps photo; bottom, Official U. S. Navy photo. Page 9, bottom, Official U. S. Air Forces photo; top, Official U. S. Navy photo. Page 10, Underwood & Underwood. Page 15, center, Official U. S. Marine Corps photo; bottom, Official U. S. Navy photo. Page 16, top, Official U. S. Air Forces photo; bottom, Signal Corps photo. Page 17, left, photography by William M. Rittase, right, Harold M. Lambert.



# An improved



## EXPLOSIVE RIVET ★

*In the picture above, at right, note that the new rivet fills the hole and pulls the sheets of metal together*

**I**MPROVED Du Pont Explosive Rivets are now speeding the production of warplanes. Beyond the war, looking to the future, they show great promise for the peacetime manufacture of refrigerators, kitchen cabinets, radios, washing machines, prefabricated houses and many other things.

But let's go back to the beginning of the story:

A little more than two years ago Du Pont Explosive Rivets made their initial bow on our nation's aircraft production lines. Originally, they were a foreign invention. Du Pont perfected them and introduced them to a few American airplane builders in 1940. Since Pearl Harbor they have figured importantly in the building of many outstanding American combat planes.

An explosive rivet is just what its name implies. Unlike an ordinary aluminum rivet, which is fastened in place by two operators—one with a pneumatic hammer, the other with a bucking bar—an explosive rivet is set by a small expansion charge inside its shank. In other words, it is self-bucking. Only one operator is required, the riveter. He or she—usually “she” these days—stands outside, inserts the rivet and touches its head squarely with the point of a Du Pont Riveting Iron. Heat detonates the charge, causing the walls of the shank to expand and forming a barrel-shaped closing head—all in less than two seconds!

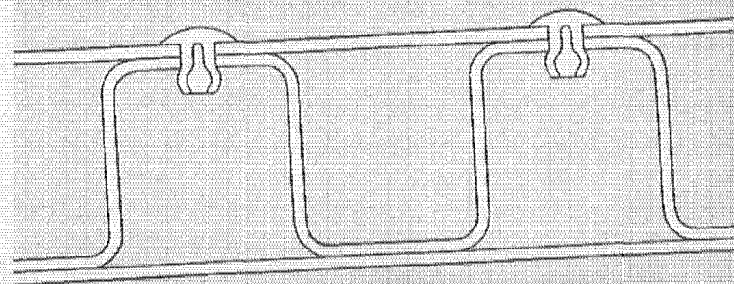
So finely has the explosive charge been gauged and controlled that the expansion it effects may be held within limits of twenty thousandths of an inch! Mark

that down as an example of extraordinary precision with modern explosives, and let it stand as an explanation of why aircraft manufacturers quickly became interested in these rivets.

Wartime brought to America's aviation industry a truly gigantic job. It called for mass-production schedules on a huge scale. It meant building more planes, better planes, larger planes than had ever been assembled before—and the job had to be done at top speed, despite material and manpower shortages. Unless assembly-line operations—particularly riveting—could be speeded up, there would be a serious “bottleneck.”

Now, fastening together most parts of a big bombing plane can be effected with aluminum alloy rivets driven and bucked in the usual manner. But some enclosures are entirely too small for a buck of normal size to work in them. Consequently, some companies employ dwarfs to buck rivets in such places.

But not even dwarfs can crawl into all the narrow compartments. So it was necessary to find some practical





means of fastening such parts together. That's where explosive rivets came into the picture.

The advantages gained by the use of these rivets are as impressive as their performance. Consider the labor-saving factor. One operator, not two, does the work—which means that less manpower or womanpower is needed. And explosive rivets are faster.

Under the best mechanical methods now employed, two to four ordinary blind rivets can be set per minute, once they are in place. Under the same conditions, single-handed, one woman can install explosive rivets at the rate of fifteen to twenty per minute.

Operating costs, considering the economies mentioned, also favor the use of explosive rivets wherever there is not ready access to both sides of an assembly.

### **Now These Rivets Are Improved**

In supplying America's aircraft industry with the first explosive rivets, DuPont helped to speed the production of military planes. That's the past tense of the story.

The big news today is that Du Pont Explosive Rivets of a markedly improved type are replacing the old ones. Here is the difference—

The expansion charge in the old rivet occupies a cup-like cavity in the end of the shank. The *new* rivet has an auxiliary cavity extending from the main chamber nearly to the top of the shank, so that the charge is more widely distributed.

This change of internal design and loading much improves the efficiency of the new rivet in action.

Heretofore, the utmost precision was required in drilling holes for explosive rivets. It was important to have each rivet fit its hole most exactly, so that when the charge exploded the rivet would be securely locked in place by its barrel-shaped closing head.

The new rivet, with its charge extended far up into the body, expands the shank throughout its length, not just at the end where the blind head is formed.

Now riveters need not be so particular in drilling holes to needlepoint accuracy; for if a hole is slightly oversize the exploding charge will spread the entire shank to fill it and insure an all-over, metal-to-metal, tight joint!

Tests show that these new rivets, even in holes 0.003 of an inch oversize, give substantially *tighter joints than can be obtained with standard Du Pont Explosive Rivets previously used in tight holes.*

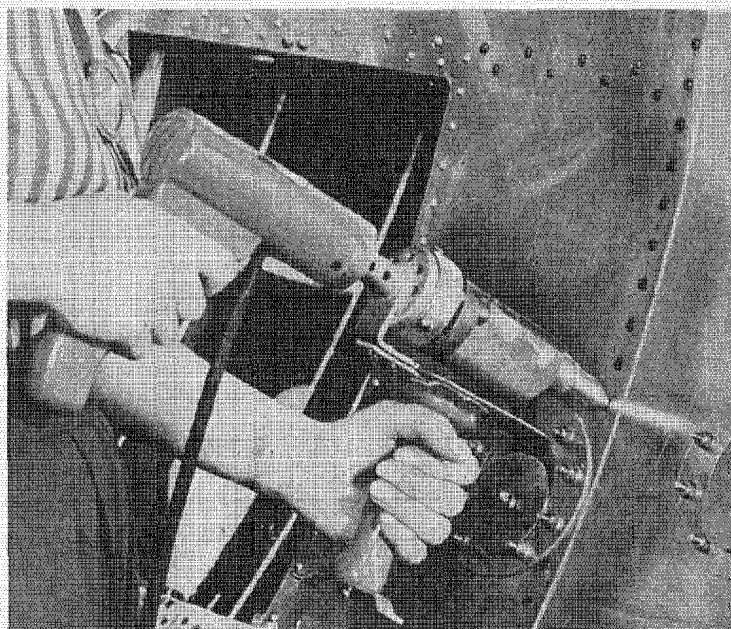
Riveters can insert and detonate the new rivets more rapidly, and obtain uniform good results.

The old and new type rivets are interchangeable. They are made of the same materials and installed with the same tools. They both possess the same high resis-

tance to corrosion. And the modified explosive charge in the new rivets has the same non-corrosive, non-toxic and high-stability qualities of the older rivets they will replace.

Du Pont Explosive Rivets do not require refrigeration to condition them for use. They are safe and may be installed without any fear of serious injury. They must of course be handled with reasonable care. Numerous safety tests have indicated that they will not detonate in mass; in fact, they are quite insensitive to shock and friction, although, as might be expected, fire or high heat will cause them to expand.

At present the improved rivets are being manufactured in two sizes—5/32-inch and 3/16-inch modified brazier head types. They have been evaluated and accorded primary structural approval by the Army and Navy, and they are rapidly coming into use in aircraft assembly work.



Explosive rivets will be needed by the million this year, and they will be produced and made available to aircraft builders. Each size and type of rivet will be readily identified by a distinctive color, as has been the usual practice.

Prior to the war, THE DUPONT MAGAZINE ventured to predict that explosive rivets "would be helpful in solving many aircraft production problems." We held out the possibility of their manufacture in still larger sizes, adding that time would no doubt develop the full picture.

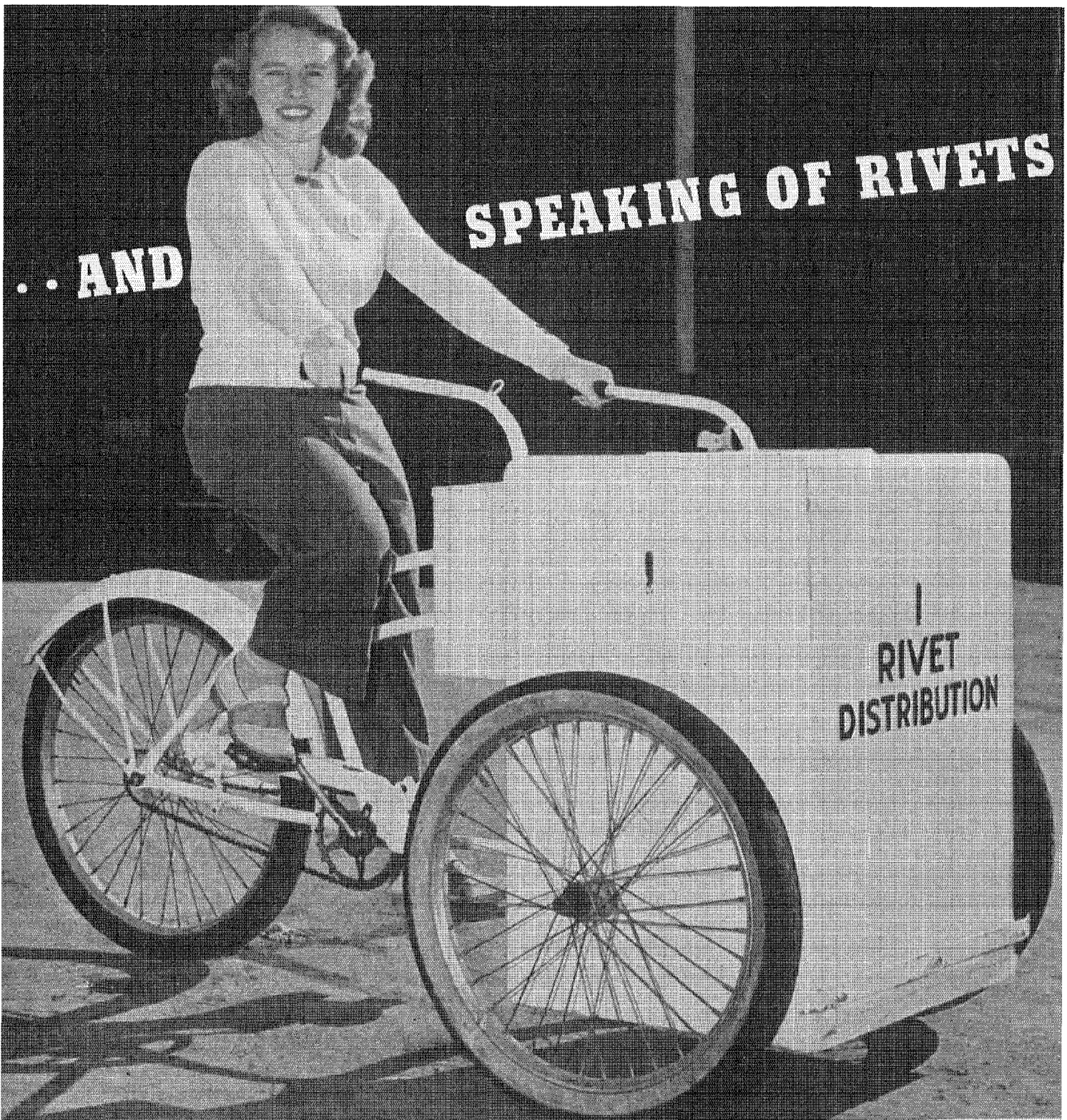
In midsummer 1941, no one knew that within four months our nation would need explosive rivets by the million.

Wartime, in truth, developed a "full picture!" Airplane rivet production alone has already exceeded one's wildest imagination.

Now comes the improved rivet.

When the fighting is at last over and industry gets back on a peacetime basis, another prediction may be in order. Even now engineers believe that the new explosive rivets will be extensively used by peacetime industry.





**G**RAVITY holds the earth together, but the builders of America's war machine need billions of rivets to hold a world of man-made things together. These metal fasteners are used extensively in the construction of bridges, buildings, ships, tanks, trucks and, importantly, aircraft.

Mass production of military planes in recent years has attained a truly grand scale. Our aviation industry is reported to be turning out planes at the rate of 8,500 per month—not just more planes but better and larger ones than their prototypes. Their construction, with wider wings and longer fuselages, involves the use of



more rivets than anyone ever dreamed of before this war.

Structurally, rivets are of many compositions, shapes and sizes; they serve widely-varying needs, but in building aircraft with light metals, aluminum alloy rivets must fit perfectly-formed holes, and the riveting must be done quickly and permanently.

Unlike steel rivets, which are hammered while hot, the harder aluminum alloy rivets are driven while cold. They are first heat-treated at 900° F., then quenched in oil or water, then "frozen" at -45° F. and stored in freezing chambers until they are used. Refrigeration keeps them malleable enough to be driven easily without cracking; it also arrests the age-hardening process until the rivets are set. Then, as they warm to room temperature, the metal becomes even stronger than before. Aluminum rivets of another type, after a heat treatment and age-hardening for four days at room temperature, can be driven without cracking.

### *Why Heat Helps*

The phenomenon of increased strength through "aging" was not plausibly explained until 1919, when the U. S. Bureau of Standards reported the work of P. D. Merica and his associates. Their theory, now generally accepted, is that when the alloy is heated, minute particles of the alloying metals, such as copper and magnesium, are driven into a supersaturated "solid solution." The metal can be held in this state by quenching and then freezing, which in effect locks the molecules in place.

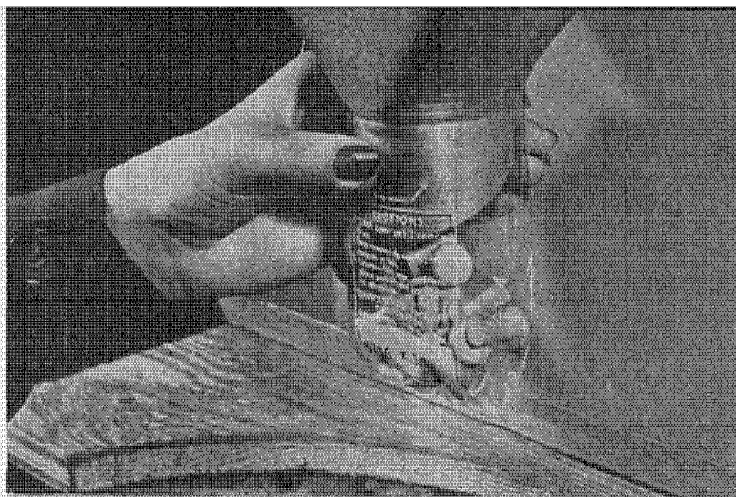
When the metal is allowed to warm up, mobility of the atoms and molecules increases and the alloying metals come out of solution and precipitate as copper aluminide or magnesium silicide. It is the presence of these extremely-fine precipitated particles that gives the metal its increased strength. For example, we are told that an aluminum alloy having 4.5 per cent copper reaches its maximum hardness when the copper aluminide particles are one ten-millionth of an inch in diameter!

If the temperature becomes too high or the metal gets too old, the particle size increases beyond the optimum desired for greatest strength, and the metal becomes softer. However, this does not occur during the service life of most aluminum articles.

### *Timing Is Important*

Prior to the war, it was the practice in aircraft factories to use aluminum rivets within thirty minutes after they were removed from the freezer compartment. Those not used within that time—rivets of all sizes—were tossed into a box for resorting, reheating, re-freezing and redistribution. And this reconditioning entailed a considerable loss of time. The industry was then building aircraft for commercial transport needs. Mass production of warplanes was still to come with its huge plants, long assembly lines, and the grim necessity of turning out bigger and better planes by the thousands.

Even before Pearl Harbor, aviation executives knew that some way must be found to keep rivets cold longer than thirty minutes. They foresaw the necessity of



*From this spout the rivets are discharged into the trim cellophane bags which will keep them cold until needed*



*The machine at the left automatically weighs the cold rivets. Bags are heat sealed by the machine at right*



*From the large refrigerator the rivets go into the cart which will carry them to the assembly line and final use*





*Here a girl riveter who "missed the wagon" goes directly to a central refrigerator for her cellophane envelope*



*In cellophane the rivets stay cold for an hour or even longer, calling for fewer steps for this busy young lady*



*The use of cellophane bags also saves the time which was lost when rivets, kept in open pans, used to spill out*

establishing a quick-delivery service of cold rivets for efficient operation.

They didn't have to look far for the answer to the first problem. Cellophane was being used to protect frozen foods. Why not frozen rivets? And for an efficient delivery service, these "Good Humor" carts might be used to deliver the rivets in cellophane bags to various production lines in the plant. Both ideas were sound, and both were put into practice, with excellent results.

Formed rivets—there are four hundred different sizes—are inserted in cellophane bags after the quenching operation. They are placed in low-temperature holding cases until needed. Then, they are loaded into the refrigerated carts for quick delivery to the riveters.

Cellophane packaging, and fast and frequent delivery service, thanks to the use of a "Freon" fluorine refrigerant manufactured by a DuPont subsidiary, have helped American aviation companies to set a pace in warplane production that must make the cold chills run up Hitler's neurotic spine.

Now rivets, colder than ice, in sealed cellophane packages remain in a serviceable condition for driving, not thirty minutes, but sixty to ninety minutes—an increase of one hundred to two hundred per cent!

The rivets are kept in the bags until the actual moment of use. Any unused after the expiration of the time limit are put back in their original bags and sent back for reconditioning. These "returns" are less likely to be mixed, and much less time is required for resorting.

How has this system worked out? One aircraft manufacturer reports that prior to his use of cellophane bags, 15,600 pounds of rivets had to be resorted each month. Now the comparable figure is only six hundred pounds, with an accompanying reduction in waste loss from fifty per cent to one and one-half per cent. He reports saving \$7,500 per month in addition to eliminating much of the expense of reheating and recooling rivets.

The Consolidated Vultee plants in San Diego, California, where *Liberator B-24* bombers and *Catalina* and *Coronado* flying boats are produced, now use several hundred thousand cellophane envelopes every month, with a very substantial savings in dollars annually.

Cellophane is no novice in the packaging of products at sub-freezing temperatures. Years ago it was and is still being used to safeguard quick-frozen foods. In packaging frozen rivets, it is rendering an equally acceptable service. Due to cellophane's lightness, strength, ease of handling and transparency, it lends itself better than any other material for the job.

This package development, pioneered by Consolidated Vultee in its West Coast plant, has now spread to many other aircraft factories, including some operated by Boeing, Henry Kaiser and Glenn Martin.

Solid metal rivets constitute the largest number of individual parts used in airplane assembly work. For example, more than 300,000 rivets hold each *Liberator* bomber together. Consider the thousands of military planes assembled each month, and you can understand why aircraft builders need literally billions of rivets each month, and why refrigerants and cellophane are really important as a means of saving time, money and labor.





# WAR

OUR fighter and bomber planes, our trucks, howitzers and big guns ride to battle on—rayon. Special high-strength rayon cords in military tires are able to stand the gaff of military service. Tests have shown this rayon to be the only type of rayon available that will withstand the high temperature developed by tires made of Buna S synthetic rubber.

*By Ellen H. Crosman*

Late in 1943 the WPB directed that a substantial part of Du Pont's capacity for manufacturing yarns for the textile trade be converted to the production of "Cordura" high-tenacity rayon yarns for tire cords in 1944. This will bring Du Pont's contribution for this use to approximately 55,000,000 pounds out of an industry total of 240,000,000 pounds.

### *Easy Let-Down*

Parachutes for airmen are required to be made of silk or nylon, but rayon chutes have been found to be





*Rayon-covered sleeping bags, wind resistant and water repellent, keep soldiers warm in Alaska*

eminently satisfactory for aerial delivery of arms, ammunition, food, medical supplies and other items. Even jeeps have been dropped successfully.

For two years we have kept the guerrilla armies in China, India and other oppressed countries supplied with food, ammunition and guns by the means of parachutes.

Increasing need of cargo chutes has resulted in the development of a variety of special fabrics, tapes and cords for making them.

It has been reported that the development of our mine-laying parachute was unknowingly aided by the Germans. The first ones, made of cotton, were unsatisfactory. One day a German rayon chute attached to a magnetic mine was fished out of the English Channel, and it furnished the clue to the development of our present mine chutes.

Aerial mine-laying is done at night from a low altitude, usually during a fog. The mine, weighing about 1,200 pounds, is dropped quickly and stealthily, and the chute should automatically detach itself from the mine and float away. The chute fabric is camouflaged by a sea-green dye.

Delivery chutes are made in five colors, red, blue, green, yellow and white, to identify the contents of the load; this helps paratroopers or ground forces to assemble parts rapidly.

In the African campaign our Army found it practically impossible to salvage these chutes, for as soon as they hit the ground the natives were quick to retrieve them to make clothes from the gaily-colored material.

Some chutes are used for dropping exposed photograph film so that reconnaissance pilots can continue their flights and take more pictures while those sent to the ground are developed. Chutes for this purpose generally have distinctively-colored segments.

One use of chutes is for star shells, which dazzle the enemy as they descend, and as they brightly illuminate the terrain.

On Guadalcanal, honors went to rayon parachutes for placing fragmentation bombs where they would explode with best effect.

Jap anti-aircraft gunners were hidden in the trees. American planes roared over, dropping the bombs from only seventy-five feet above. From this low altitude the parachutes held the bombs up just long enough to give the planes time to get away before the explosions.

### *Versatile Fabric*

The blue and yellow reversible utility fabric used as an accessory on life rafts is not only wrapped in heavy-duty rayon when not in use, but it is made of high-strength rayon, the same type material used in flare chutes. The rafts themselves are often made of rubber-impregnated rayon twill.

Before our pilots go into battle, they have plenty of gunnery practice during their flight-training work.

A rayon target sleeve, similar in appearance to the wind-direction-finder stocking on a landing field, is attached behind a tow plane and is kept in a horizontal position by air currents flowing through it as the plane draws the target along its course.

Would-be fighter pilots fly back and forth, shooting machine-gun bullets at these sleeves, until they can score hits from any angle and at high speeds.

### *Aircraft Fuel Tanks*

Combat planes are equipped with self-sealing gasoline tanks—self-sealing because it is reported that a rayon fabric coated with a synthetic rubber seals up holes in the wake of high-powered machine-gun bullets. This stops fuel-leakage losses even though the outside metal covering be badly ripped.

Every pound saved in a fighting plane's equipment

*Strips of rayon form a camouflage net over a Marine 90 mm. anti-aircraft gun emplacement*





may be utilized in providing more armament, ammunition, gasoline capacity and higher effective horsepower. Rayon has the light weight needed, together with the necessary strength and tear resistance.

### ***Another Menace—Insects***

The Army surgeon who called a mosquito "as dangerous as a Stuka" knew what he was talking about. In the malaria-infested tropics the bite of a mosquito may be fatal. And of all the unpleasantness and actual hardships our men have to endure in battle in the desert, few are so demoralizing as the sand fly.

Curtain manufacturers, under contract to supply the armed forces with insect-netting, have developed a special sand fly net with triangular instead of rectangular mesh. The pestiferous sand flies cannot get through its small triangular holes.

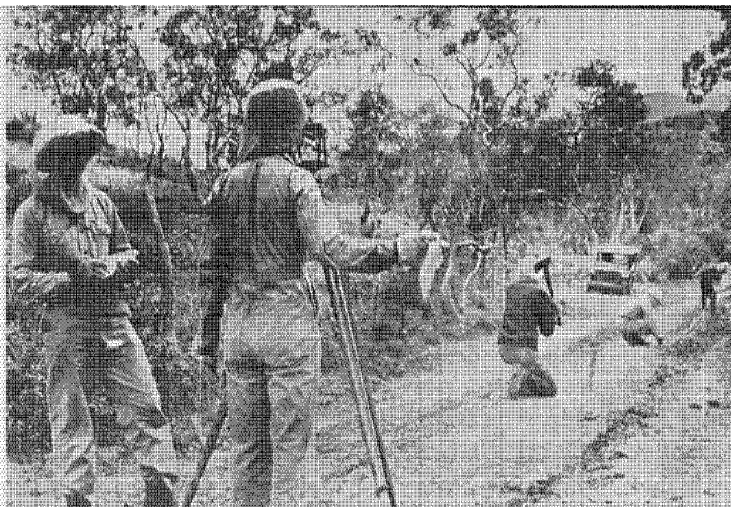
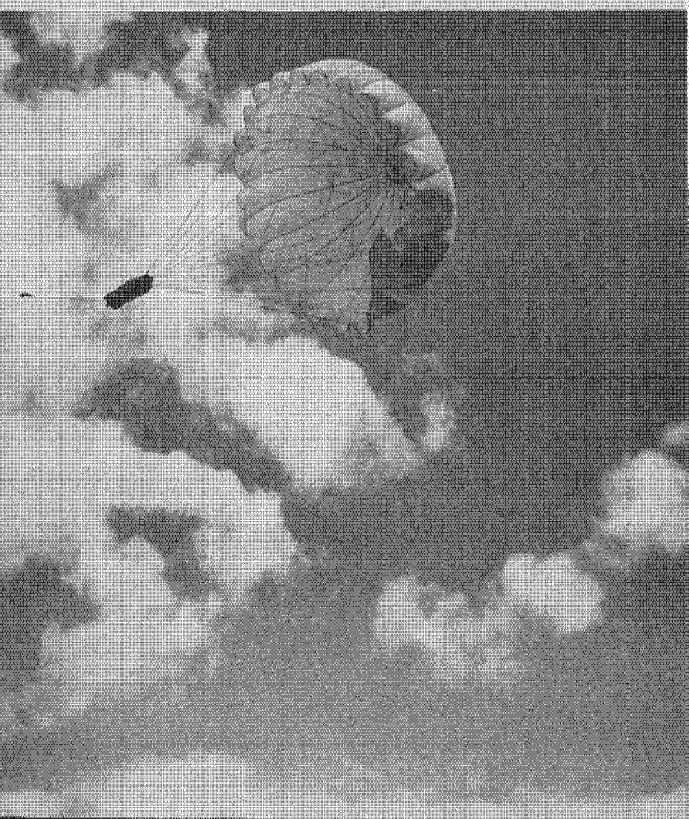
The Army needs millions of yards of this netting to protect our men in insect-infested areas. Much of it is made of mildew-proof rayon—in camouflage colors—and that, too, is part of the story back of the scarcity of rayon net curtains for civilians.

### ***But Don't Go Near the Water***

Fighting men get thirsty, and it is the Army doctors' responsibility to see that their water supplies are safeguarded, particularly in foreign countries.

Our soldiers are not allowed to drink from an untested spring or water hole. A number of methods of treating water are used. In one, a rubber-impregnated rayon bag is filled with any doubtful water, and, usually, chlorine is added to purify it. Safe water is drawn off

*Dropped from a plane, this rayon cargo parachute delivers food to waiting land forces*



*Seabees building a road at a South Pacific base are protected from insects by rayon mosquito nets*

into canteens from the four spigots at the bottom of the bag.

### ***Tow***

Plaited rayon tow has an important wartime use as a replacement for flax in packing pumps, rams, elevator plungers and other types of machinery where packing is required.

### ***Uniformly Important***

Since textiles were first made, their chief purpose has been to clothe mankind. Literally millions of yards of rayon go into Army and Navy uniforms. Rough battle conditions put a lot of wear and tear on clothes, and here again high-strength rayon can "take it" as few materials can.

Some of the garments made wholly or in part of rayon are: enlisted men's uniforms, olive drab raincoats and battle-dress trousers, ties, Navy kerchiefs, officers' work outfits, and shirts, WACs' underwear and officers' uniforms . . . to say nothing of accessory items such as chevrons and insignia, and helmet and coat linings.

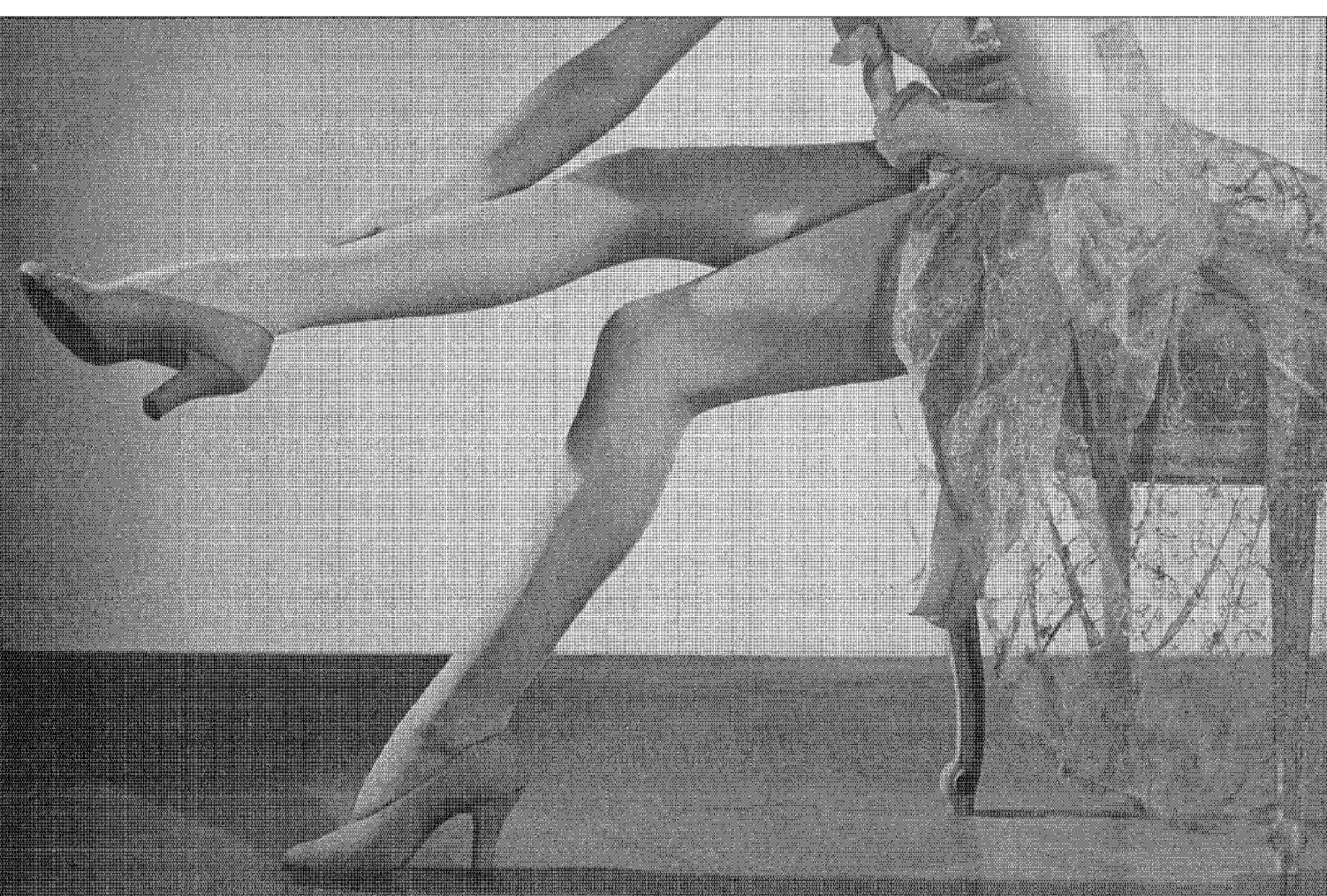
Our airborne infantry, the paratroopers, are clothed from neck to ankle in one-piece suits of rayon tackle twill, a tough, thin material. Its smooth, silk-like finish reduces to a minimum the dangers of "snags" from bushes and trees.

Rayon textiles in another form, still basically protective, appear in the linings of soldiers' snug sleeping bags and windproof mountain tents. The tent is tough, durable and so light that it adds little weight to a man's pack.

Waterproof tarpaulins made of coated rayon duck are also provided to shelter military equipment and supplies from damaging exposures to the elements. Similar tarpaulins are used for cockpit covers—and some of them are large enough to serve as temporary hangars for airplanes in the field.

Summing it up, these Du Pont-made rayon fibers, viscose and acetate rayon, and nylon, have made substantial and distinctive contributions to the war effort.





# NYLON

## *after the war*

By R. A. Ramsdell

TODAY, nylon yarn is going entirely into products used by the armed services. But when it returns completely for civilian use, our total hosiery yarn capacity will be sufficient to supply most of the hosiery industry. However, nylon stockings will not be plentiful until exhausted stocks are replenished.

In answer to the many questions that have been asked as to why nylon stockings are unavailable when occasionally other nylon articles are offered for sale, we would like to take this opportunity to explain that a small percentage of nylon parachute fabric came out in short lengths that were unsuitable for parachutes and some of it had minor imperfections. It is this fabric, released by the War Production Board, that is going into these few civilian articles.

This rejected fabric is too valuable to be sold as waste until it has been discarded after filling useful civilian needs. When it is finally worn out it can then be converted to raw nylon for war purposes if necessary, along with discarded nylon hosiery and remnants from parachutes. Du Pont's conversion plant for reclaiming this waste is now under construction and will be ready for operation soon.

Nylon's outstanding merits of uniformity, high strength, inherent elasticity, toughness, abrasion resistance, low moisture absorption, quick drying and ability to take a permanent "set" make it the most versatile yarn we know of today.

There will be a vast new field for nylon fabrics opened up by the new principle of pressure-setting. Knitted nylon fabrics treated by this method can be laundered and still remain at or return to their original texture and dimensions.

When the pile of upholstery fabrics is pressure-set it becomes crush-proof. The same is true of transparent velvets. This type of fabric can be washed without requiring brushing up. It does not mat, but returns to its original shape and appearance.

Another interesting phenomenon in nylon research is that which occurs when a nylon fabric is subjected to carefully-controlled dry heat of 400° F. during finishing. The fabric becomes softer, more resilient. Variations of this finishing process may even include embossing.

In fact, this whole realm of nylon fabric treatment is practically an untouched field, and one that offers a new era in fabric design.



# ENGINEERING *and* CONSTRUCTION

SOME DAY, historians will write the story of World War II. Presumably they will accent its military phases, for front-line activities are exciting and dramatic. But they will not overlook the part civilian armies played in carrying through the most monumental production program in all the world's history.

Before Munich the European countries, despite Mussolini's mouthings and Hitler's harsh threats, were still complacent. Munich brought them to the grim realization of their peril. The invasion of Poland began the sordid, tragic story of nations crushed by German might.

We Americans, too, were complacent, with the broad Atlantic between us and the European theater of war, and the broader Pacific on the other side. Not until Germany overpowered France, not until the debacle at Dunkirk, did we realize our own peril. And then, all too soon, Pearl Harbor catapulted us into the fighting war with the responsibility of producing ships, planes, tanks, guns, ammunition and other equipment and supplies, not only for our own military forces, but those

of our hard-pressed Allies overseas as well. This truly stupendous task had to be done quickly or the Axis powers would win.

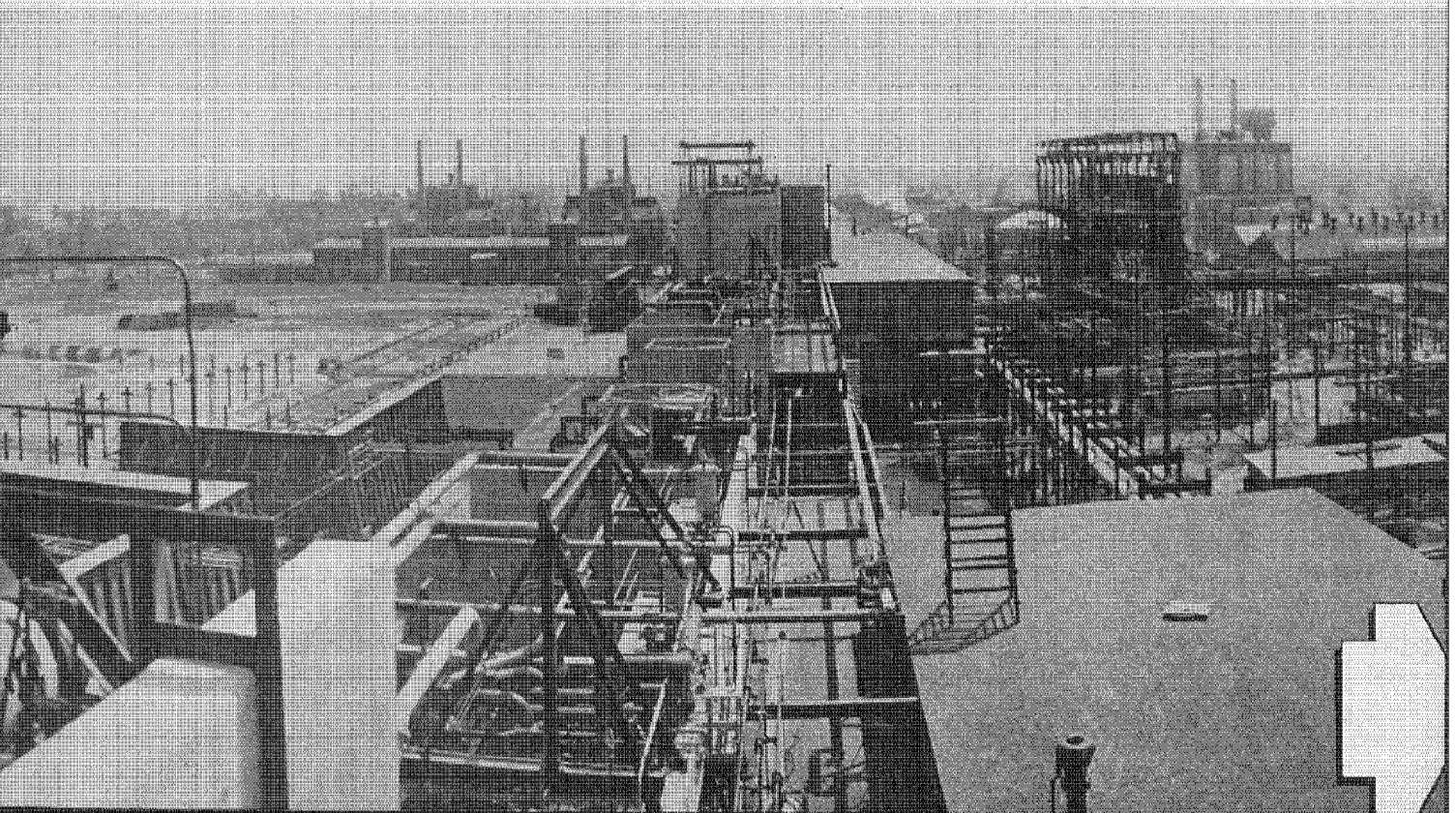
Neither Hitler nor Hirohito discounted America's resources or its potential power. But they said we could not stop their victorious armies. The American epitaph we were told would also read: "Too little, too late!" And for a time many people on this side of the Atlantic agreed with them.

Yes, we started late—as usual. We have never been ready for any war. It was, you will recall, "a long train of abuses and usurpations" that finally impelled our forefathers to fight for freedom 160-odd years ago. General Washington's poorly-equipped men often had to retreat for lack of ammunition. On many an occasion during the Revolutionary War, he was able to strike back only because his troops captured gunpowder from the enemy.

Seven score years ago the first U. S. Naval expedition to Mediterranean waters was carried through by those first fighting Marines. They taught the Barbary pirates a lesson with 22,000 pounds of gunpowder made in E. I. du Pont's first mill.

Since then American armed forces have always fought with Du Pont powder. Yet the fact remains that almost invariably at the outbreak of wars, American munition supplies have been inadequate to meet current needs. It is of record that at the outbreak of the Spanish-American War, powder supplies for our Navy were so low that our ships could not have remained in action for more than two hours.

Fortunately, we were somewhat better prepared for World War I, because we didn't have to get into it at the start. As late as October 1, 1914, Du Pont was operating only three small smokeless powder plants, Carney's Point, Haskell and Parlin, with a total annual capacity of 8,400,000 pounds of smokeless powder. Before the end of 1915, thanks to engineering and construc-





tion forces, the attained capacity rate of three plants had jumped to 200,000,000 pounds—an increase of 2,280 per cent. When the United States entered the war in April, 1917, these plants were capable of turning out nearly a million pounds of smokeless powder a day, not to mention a largely-increased capacity for manufacturing T.N.T. In short, DuPont supplied the Allied forces during World War I with almost 1,500,000,000 pounds of military explosives—this in addition to supplying dynamite and black powder for home-front needs, representing one-half of the nation's total war-time requirements.

"To accomplish this work, the Company employed at the peak more than 100,000 persons. It built, in addition to its war plants, 10,790 workmen's homes, which, with hotels, boarding-houses, women's dormitories and bunk-houses, were capable of housing 65,000 persons..."

The engineers built 150 miles of guarded fences; 100 miles of standard-gauge and 208 miles of narrow-gauge railroads; power houses capable of developing continuously 200,000 horsepower; pumping stations with a combined capacity greater than would be required to supply the daily water needs of the cities of Boston and Philadelphia.

This is part of the story of DuPont engineering, construction and production work during World War I. After the emergency was over the prospect of a permanent peace was so rosy that no one thought it necessary to maintain these properties. America went back to work in a world untroubled by wars.

DuPont promptly scrapped all but one of its war plants, and that exception was made at the request of the Government. This plant, sheared down to a fraction of its wartime size and manned by a skeleton force, soon became so small a production and sales factor that DuPont military explosives represented an almost negligible part of the Company's total business—often less

than two per cent—during the entire period between the first World War and the start of the second global one.

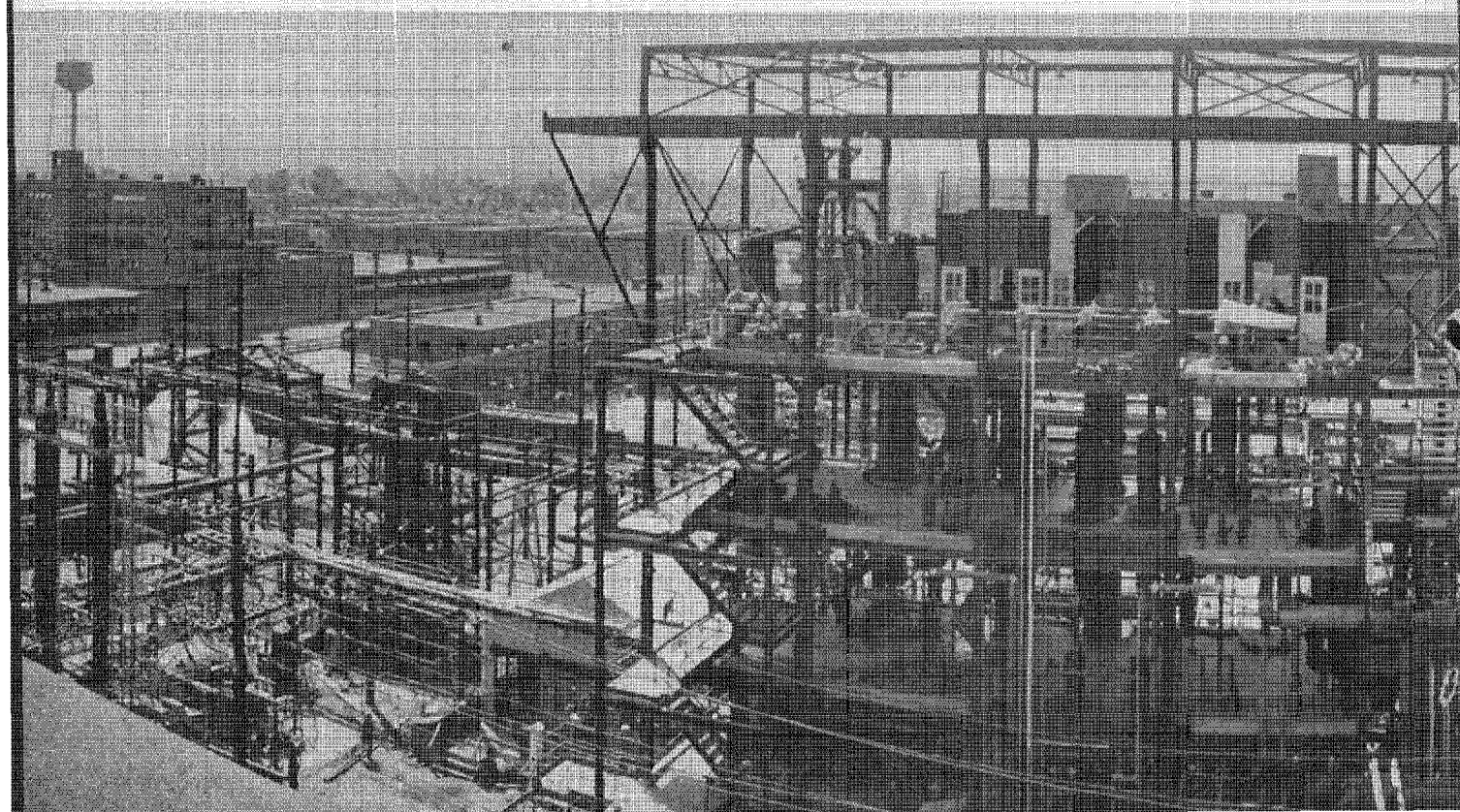
Most of that time DuPont engineering and construction forces were busy building new plants and expanding old plants in no way related to war activities. In the 30's there were times when there was little activity in the Engineering Department drafting rooms, and blue-prints on the tables were conspicuous by their absence.

That was the situation in the early 30's. Engineering work experienced a revival as the decade advanced, and it moved into high gear when the impact of Hitler's invasion of Poland in 1939 started our Government on the road to military preparedness for defense. Since then there have not been many idle moments on the American industrial front—certainly not in the DuPont organization.

Boyden Sparkes, writing for *The Saturday Evening Post*, late in 1942 presented one interesting, intimate picture of the supply situation in Washington, shortly after Judge Robert Patterson went into the War Department as Undersecretary to help in the emergency that became progressively more acute after the debacle at Dunkirk in 1940.

Again the military-supplies "cupboard was bare." Quoting the Judge, "We needed everything. We sorely needed the bread and butter of warfare—smokeless powder and T.N.T. What can you do without those things? Airplanes are no good without ammunition. Tanks, artillery, infantry, all your fighting men need explosives, else they cannot fight. Moreover, under our system the Army now supplies the Navy with its powder and T.N.T."

"However," the writer reports, "in the War Department there were specialists who knew how to get smokeless powder and T.N.T., if Congress would provide the money. Even before it did provide the money, though,





the telephone in the office of E. B. Yancey, general manager of the Explosives Department of the DuPont Company in Wilmington, Delaware, was ringing.

"General Harris, of the Army Ordnance Department, was calling, knowing the DuPonts were more experienced in the manufacture of explosives than anyone else in the country. Now, when the Government of the United States wanted powder and T.N.T., it was yelling.

" 'Come down to Washington,' said General Harris, asserting the privilege of an old friend. 'I want to see you.' Mr. Yancey, with F. W. Bradway, general assistant, went, and things began to happen."

The telephone conversation just quoted occurred on June 17, 1940. Congress provided funds for munitions production July 1 of that year, and the DuPont Company started at once to expand its engineering and construction organization. So far as plant facilities were concerned, DuPont was starting almost from scratch again—with one smokeless powder plant and one T.N.T. plant, both small, and for the most part manned by employees who had borne the brunt of making powder for the first World War, a mere skeleton force at that.

Military powder production in this country was still at low ebb as late as Dunkirk and the "blitz" of London. Hitler's war machine, in process of building for a decade, was fully implemented and going strong when Americans were just beginning to embark on a national defense program. The size and urgency of that job then became more clear.

Four years ago in June, DuPont engineering and construction forces started work on a plant for the Tennessee Powder Company, a British Corporation, and in September another for the United States Government. It was the beginning of a construction and operations program in which all American manufacturers of propellant powders and high explosives have

participated. DuPont's part in it cannot yet be told in detail, although stockholders' reports and some few magazine articles have revealed a part of the story.

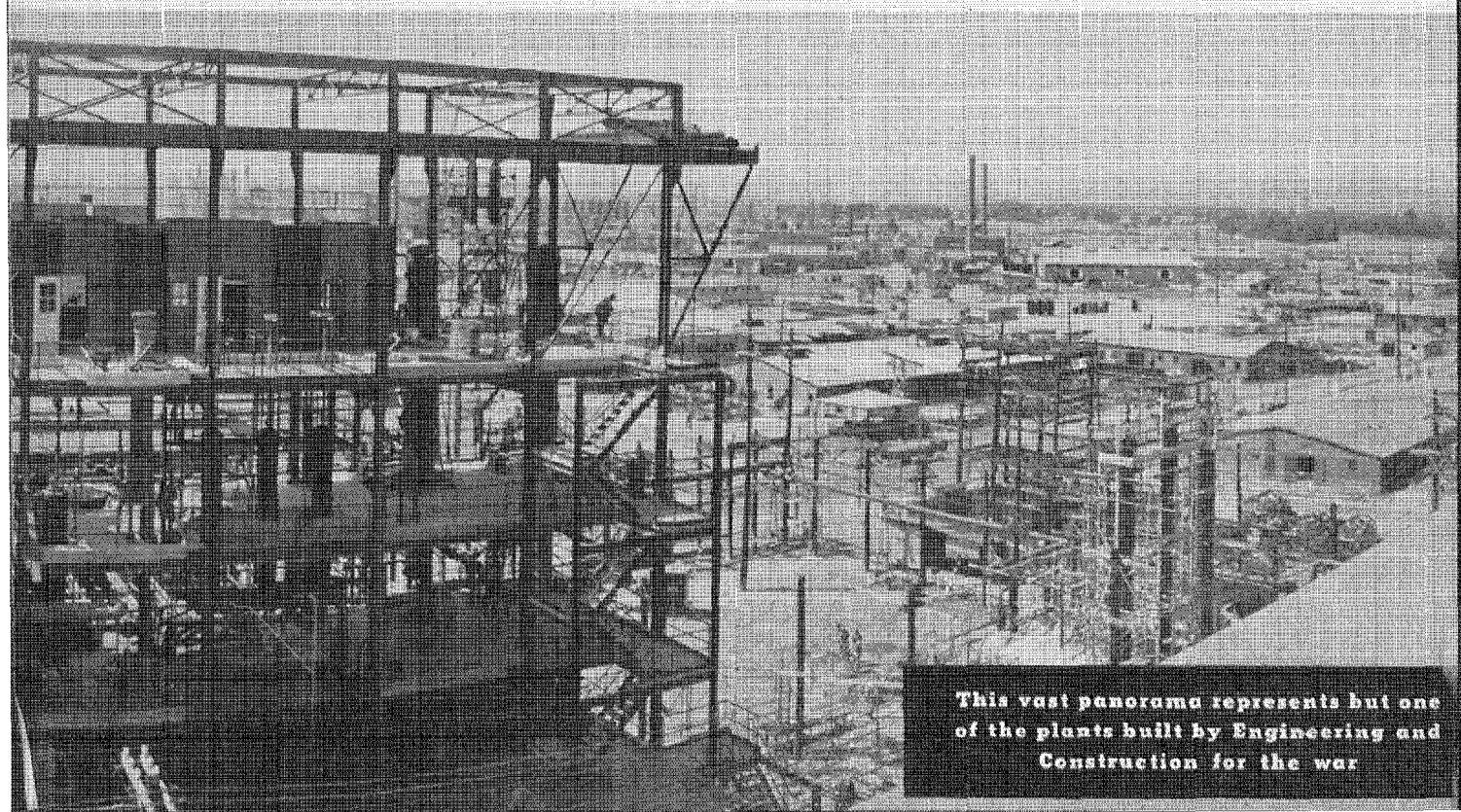
From the report for 1940: "The total number of Engineering Department's employees at the end of the year, including field forces and those employees in the Wilmington office, was 23,100 compared with 4,600 at the end of 1939 . . ."

From the 1941 report: Referring to a number of plant construction projects, we are told: "The plants are of various sizes. The cost of constructing the largest was more than \$100,000,000 and required an erecting force on the site of about 25,000 men. This particular plant began operations eight months after construction commenced and, including enlargements subsequently authorized, is now nearing completion. Several others have been completed in accordance with the initial contracts and are in operation, and these are now being enlarged. Still others are in the earlier stages of construction."

From the 1942 report: After referring to military smokeless powder, tetryl and T.N.T. as the chief explosives required in the nation's war effort, President Carpenter adds: "Though making up less than two per cent of the Company's peacetime business, their manufacture served to keep in training a group of some three hundred employees, who became the nucleus for the tremendously expanded force required in the Company's war production of these products.

"Today, growing from the 'know-how' and experience kept alive in this small group, the Company has performed for the Government in two years nearly twice as much engineering design and construction work as it did for itself and its clients on all commercial projects between the close of the first World War and the outbreak of this one. The volume of engineering and construction work is now about *seventeen* times that

*(Continued on Page Twenty-Four)*



**This vast panorama represents but one of the plants built by Engineering and Construction for the war**



# HEAVY CHEMICALS

## *For War*

**The men and women of Du Pont who make Heavy Chemicals are doing vital war work every bit as much as the workers making planes and guns. Heavy Chemicals derive their very name from the fact that industry uses them in heavy quantities. This is their story.**

*By George Albee*

IT TAKES a special kind of courage, a special kind of patriotism, to hold up your head proudly, when somebody asks you what you're doing to help win the war, and answer: "I'm making sulfuric acid." For not one person in a thousand realizes that sulfuric acid is a vital war weapon.

Thirteen of the Du Pont Company's Grasselli Chemicals Department plants make sulfuric acid. Six of them manufacture nothing else.

Why is it so important?

This acid is the most important manufacture of the entire chemical industry. It outranks any other manufactured chemical both in quantity and dollar value of production. Prewar production of this chemical alone in the United States was about eight million tons per year. Now production is up.

Sulfuric acid is to the chemical industry what steel is to the metal industry. It is essential to the production of a tremendous number of articles necessary in our daily life ranging from the food we eat, the clothes we wear and the automobiles we drive, to the many everyday articles which surround us.

You may ask, "How much sulfuric acid do I use?" You use about one hundred and twenty-five pounds a year, in various ways.

One-fourth of the country's prewar sulfuric acid production was consumed in the manufacture of fertilizers, and about thirty pounds are required to grow the agricultural products which you require each year. The average hundred-pound bag of mixed fertilizer requires at least twenty pounds of sulfuric acid for its manufacture. Food production for the armed forces and for lend-lease requirements demands sulfuric acid.

One-fourth of the country's prewar sulfuric acid production was consumed in the manufacture of petroleum products to be used as fuels and lubricants. In this war the movement of men and materials on the land, on the sea and in the air is based almost wholly upon petroleum products. That is the basis for your fuel-ration book.

Another fourth of the country's prewar sulfuric acid

production was consumed by the iron, steel, coke and metallurgical industries; and the remaining fourth by a wide variety of miscellaneous industries, including the manufacture of chemicals, paints and pigments, rayon, textiles and explosives.

You therefore used six ounces of sulfuric acid per day. It did not come to you in a bottle. You probably actually saw none of it; but it was used for you by the producers of the merchandise which you bought. It was as essential to your life and well-being as were the vitamins you consumed, most of which reached you in the food you ate rather than separately in the capsules which you may have taken.

These prewar uses have now become war uses, and on top of them the country has large requirements for sulfuric acid in the manufacture of explosives. About seventy pounds of sulfuric acid go into the manufacture of one hundred pounds of smokeless powder. About five pounds are consumed in the manufacture of one hundred pounds of TNT.

### *Muriatic Acid*

Muriatic acid is another big tonnage product in four plants of this important Du Pont Department. It finds a wide variety of uses in various industries. It is used by the steel and other metal industries for scale removal and cleaning in the manufacture of many metal products. It is used by the food industry for the manufacture of glucose and corn sugar from starch, and in the refining of cane sugar. It is essential to the manufacture of neoprene, Du Pont's chemical rubber, and also to the manufacture of tetraethyl lead, an essential petroleum fuel ingredient.

### *Salt Cake*

Salt cake is chemically manufactured sodium sulfate, and is an important crude material in two consuming industries: pulp and paper manufacture and glass manufacture. In the pulp and paper industry it is used to make the kraft-type paper which is widely employed for wrapping papers and for the manufacture of paper-



board shipping cases required for transporting innumerable items in the wartime economy. In the glass industry it is an ingredient in the glass batch. A tremendous new war demand has arisen for glass containers to replace prewar metal containers. The coffee or the can of beans in your cupboard is probably so packed.

### **Chlorosulfonic**

Chlorosulfonic acid is comparatively unknown to the general public. Indeed, it is only a name to many chemists. Yet it is manufactured by the Department in a volume of thousands of tons per year for critical war uses.

One of the most important of these uses is in the manufacture of sulfa drugs. While these drugs are less than ten years old, they have revolutionized the treatment of many diseases and the treatment of wounds.

A mixture of chlorosulfonic acid and liquid sulfur trioxide is also employed by the armed forces in the "F. S. Mixture" which creates smoke-screens. The Grasselli Chemicals Department is one of the leading manufacturers of both chlorosulfonic acid and this smoke-screen mixture.

### **Phosphates**

The Department is one of the largest manufacturers of sodium phosphates, operating two plants, one on the East Coast and one in the Middle West.

Monosodium phosphate is used to prevent boiler scale in steam power plants. Power for manufacturing is a most important and critical item in every war plant.

Disodium phosphate is produced on a scale of thousands of tons per year in this country. It has a variety of uses. About one-third of the production is consumed as an ingredient in the manufacture of three food products, processed cheese, evaporated milk and prepared cereals; one-third—like the monosodium phosphate previously mentioned—controls boiler scale in steam power plants, and one-third has a wide variety of miscellaneous uses, including textile dyeing and the manufacture of pharmaceuticals.

Sodium pyrophosphate is manufactured in large volume by the Department. It is an important ingredient in the manufacture of soaps and soap powders, increasing their cleansing power.

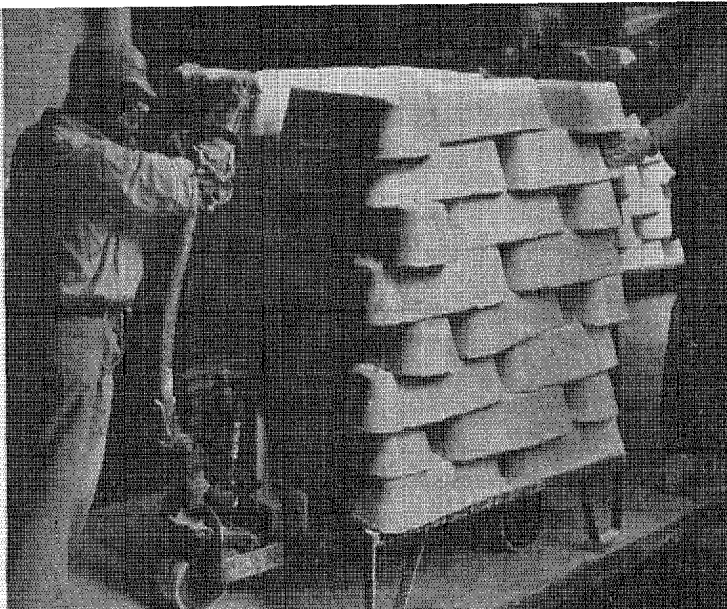
The "big" phosphate of them all, however, is trisodium phosphate, of which United States production alone was over 100,000 tons per year before the war. This commodity is an efficient and widely-used detergent. It is used in many industries in the form of a hot-water solution for the large-scale cleaning of parts and products during manufacture, particularly those made of metal. It is an important ingredient in many package cleaners sold to the general public.

Wartime has greatly increased the demand for these phosphates.

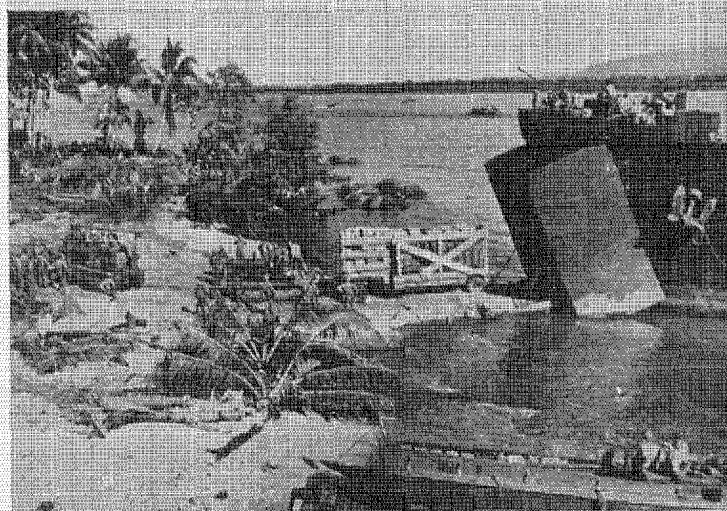
### **Zinc Chloride**

For many years Du Pont has been the largest manufacturer of zinc chloride, a product whose industrial uses are tremendously important in our wartime economy.

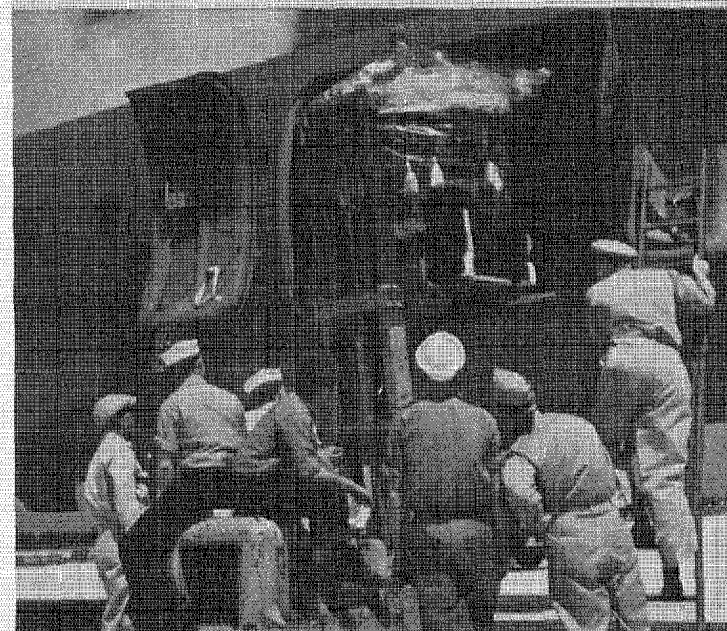
The steel industry and the metal fabricating industry are important consumers of zinc chloride. It is used



*Commercial aluminum sulfate in ingot form—used in water purification systems and in the sizing of paper*

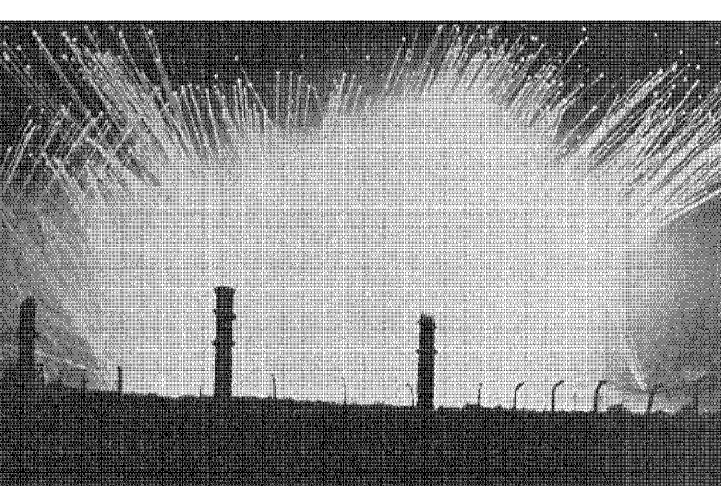


*An LST opens its great mouth to disgorge supplies for Bougainville—supplies often made with Heavy Chemicals*



*A 1,300-horsepower engine protected against moisture*





*Anti-aircraft guns blast at German night raiders—strontium nitrate marking the tracer bullets' course*

as a coating flux in the manufacture of hot-process tin plate, from which tin cans are made.

This compound is also the basis of most soldering fluxes used in the metal industries. Automobile radiators, mechanical refrigerators, dairy equipment and countless other articles of copper, brass and tin plate are mechanically soldered during manufacture with zinc chloride fluxes. Zinc chloride is an essential ingredient, too, in dry cells.

When paper and cardboard are treated under certain conditions with a strong zinc chloride solution and then compressed, vulcanized fiber is produced. This product in itself is the basis of an important industry. Vulcanized fiber has many uses and is a critical material in the war effort. It is used for electrical insulation, instrument panels, trunks and textile bobbins, among other things. Food-ration tokens are made of vulcanized fiber. So are extra fuel tanks for airplanes.

Zinc chloride and an improved modification known as chromated zinc chloride are important wood-preserving chemicals. They make wood resist decay, termite attack and, to an important degree, fire. Along our coastline we are guarded from enemy submarine attack by blimps. These blimps are housed in huge hangars made, many of them, not of steel but of treated wood. Loading platforms and wharf decking are also being made of treated wood. In the tropics the use of treated lumber is much more necessary than in continental United States, because there rot and insect attack proceed at a more rapid rate.

*Night practice with flame-throwers. Here, again, the path of the tracer bullets may be clearly seen*



### *Sal Ammoniac*

Ammonium chloride, otherwise known as sal ammoniac, and its companion product zinc ammonium chloride are important chemicals used by the steel industry as fluxes for coating steel with zinc in the hot-immersion process known as "galvanizing."

When steel is dipped in melted zinc, the zinc will not "wet" and stick to the steel unless it is treated with a chemical of this type. Sal ammoniac is used chiefly for sheet steel galvanizing, while zinc ammonium chloride is used chiefly for galvanizing pipe.

Galvanized steel products are important items in military construction and military materiel.

### *Laboratory Chemicals*

The Department manufactures a line of chemically-pure acids and ammonia for laboratory use. These acids include acetic, nitric, hydrochloric and sulfuric. Many manufacturing industries would be unable to function efficiently were it not for control of the processes and inspection of the products by laboratory methods. Laboratory chemicals are an important element in the production of war materials for this reason.

### *The Alums*

There are several chemicals in the group called the alums which represent an important area of the Department's manufacture.

The largest-volume product in the group is aluminum sulfate, which has two important uses. One use is as an ingredient in the sizing of paper. If paper were not sized, it would be absorbent like blotting paper and unsuitable for writing and for most packing and wrapping purposes.

The other important use is the purification of water. Many public water-treating plants employ aluminum sulfate as a purification chemical.

The Army, Navy and Marines are now using a mobile-type plant for treating water supplies, and DuPont has developed special lump-and-nut types of slow-dissolving ammonium alum for use in such units.

### *Barium Chloride*

Barium chloride consumption has increased greatly because of war demand. This commodity is an important ingredient in fluxes for making magnesium-alloy castings, and in heat-treating salts for hardening and increasing the strength of steel parts. It is used in the manufacturing of photographic printing papers and certain dry colors. It is used also as a purification agent in many other chemical manufactures.

### *Electroplating Chemicals*

The Department is an important manufacturer of chemicals for electroplating with cadmium, zinc, tin and lead.

Electroplated cadmium and electroplated zinc coatings impart rust resistance to steel products which greatly improve their durability, appearance and cost of maintenance. Innumerable metal articles and parts used in Army and Navy equipment demand these coatings.

Du Pont products for tin plating are used in the steel



industry in the large-scale manufacture of tin plate by continuous electrolytic processes—the Halogen Tin and Sodium Stannate processes. These require less tin than the older “hot dip” process.

### *Strontium Nitrate*

Du Pont has always been the leading manufacturer of strontium nitrate. This chemical gives an intense red color to a flame. Its principal prewar use was in the manufacture of fuses—emergency signals for railroads and trucks.

Since the war began, strontium nitrate has become an important ingredient in the manufacture of tracer bullets. The path of such a bullet is visible to the man firing the weapon because of its luminous red track. The Department's facilities for manufacturing strontium nitrate have been expanded.

uses. The WPB recently stated that approximately fifty per cent of our food and over fifteen per cent of our military *materiel* requires packing in folding or “set-up” boxes.

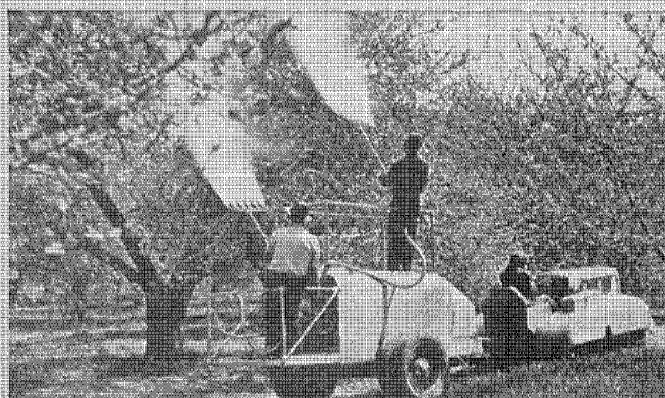
Sodium silicate is also the crude material employed in the manufacture of silica gel which is used as a catalyst in the manufacture of synthetic rubber and aviation gasoline, and as a drying agent in the packing of military equipment, to protect it from deterioration through moisture. A bag of silica gel placed within the container in which a metal part is packed absorbs the moisture inside and prevents rust.

A tremendous expansion in the production of coated welding rods has also called for increased tonnages of sodium silicate. Welding is now used to an unprecedented degree in the fabrication of ships, tanks, trucks and weapons.

*In the Grasselli Pest Control Laboratory . . . study*



*Spraying fruit trees controls the deadly infestations of plant diseases in the orchard . . . use*



*Full, abundant crops of foodstuffs . . . the result*



### *Sodium Silicate*

The Department is also an important manufacturer of sodium silicate. United States prewar consumption of this commodity alone was 650,000 tons per year. (Your per capita share of this consumption was ten pounds.)

Over half the normal consumption of sodium silicate is in two fields, the manufacture of paperboard shipping cases and the manufacture of soap. Years ago, it was easy to go into the grocery store and get an empty wooden box for home use. Today, the wooden box has almost disappeared from the grocery store and most other mercantile establishments which receive their goods in packages. The corrugated paper shipping case has become the common package for every conceivable variety of merchandise. Sodium silicate is a low-cost mineral adhesive used in tremendous tonnages for the machine manufacture of such cases.

In the manufacture of laundry soap, too, sodium silicate is an important ingredient. Tremendous tonnages are required. Sodium silicate also has a wide variety of general uses—in the manufacture of refractory cements, in the manufacture of welding rods, in water softening, and in other chemicals.

Most of these prewar uses have now become war

uses. The Department also manufactures potassium silicate, which has become an important ingredient in the manufacture of welding rods for electric welding.

In 1943 the Department brought out a new adhesive known as Du Pont Adhesive 77, which is used in the manufacture of super-quality paperboard boxes for packaging overseas shipments. While sodium silicate is a satisfactory and widely-used adhesive for corrugated paperboard boxes in ordinary transportation movements, for Army, Navy and lend-lease requirements the paper-box industry has developed a special weather-resistant container known as the V-box. Such a box is required for all sorts of shipments which may have to be unloaded under severe conditions. This new Du Pont adhesive is a synthetic organic product containing no sodium silicate.

### *Zinc*

A smelter in West Virginia manufactures metallic zinc, zinc dust and other related products. Zinc is one of the essential war metals. It is an important ingredient in brass, typical cartridge brass containing some thirty per cent of zinc and seventy per cent of copper. A wide variety of military *materiel* is manufactured from brass.

Zinc in cast form is used in the manufacture of many machine parts by die casting. Melted zinc alloy is fed

*(Continued on Page Twenty-Three)*



# A Safety Color Code FOR INDUSTRY ★

*By Robert A. Massey*

PERHAPS none of us fully appreciate the advantage of a uniform national code of traffic signals. Anywhere in the United States a red traffic light means "Stop," a yellow denotes "Caution" and green says, "Go." Imagine what bedlam there would be if green meant "Stop" in some states, indicated "Caution" in others and signaled "Proceed" in the remaining commonwealths. It would be confusion twice confounded.

And yet, very much the same confusion exists in mills, plants and factories today. In one mill red means danger, in another it indicates fire protection equipment, and we even know one plant where safety showers are painted red. One factory has its machine guards painted red—which would indicate that the very device itself is dangerous. Yellow, as well, has been given many widely different applications—some hazardous and some safe. This confusion exists not only between plants, but even in different parts of the same plant.

There is today no uniform or universal practice by industry in its adoption of color for safety, and some plants do not use color at all to indicate hazards or protective equipment.

Yet, surely the need for protecting workers through the identification of hazards is more important today than ever before because of the necessity of conserving available manpower. The need for building up strong visual associations with machines, equipment and surroundings will exist as long as there are plants in operation.

## *Color—A Universal Language*

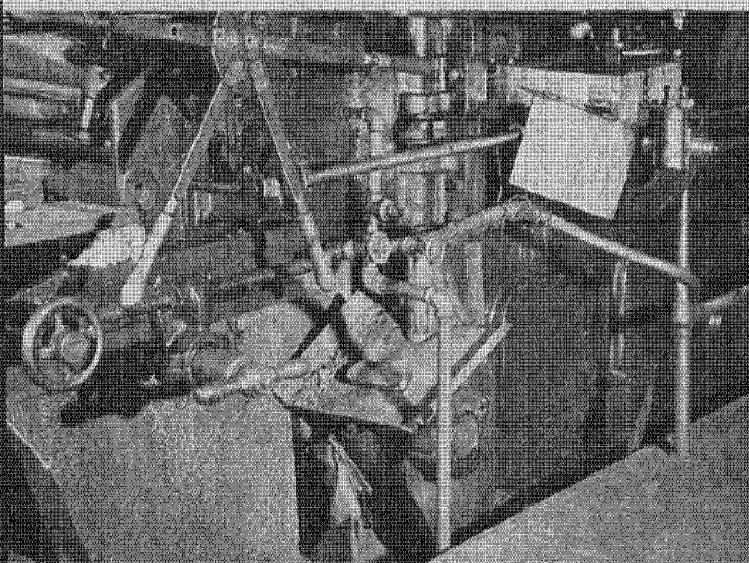
Color screams. It soothes. It irritates. It stimulates. It says, "Stop—Look—Take Care." It speaks a universal language to the mind through the eyes.

Color is important in railroad and traffic signal codes. It marks poisons, dangerous gases and explosives. It is used to identify piping. But color has not always been put to intelligent use to promote everyday industrial safety.

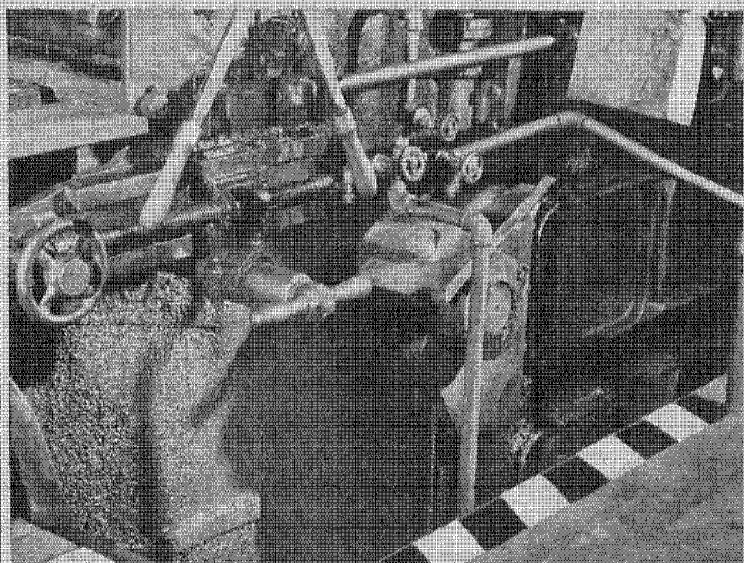
## *Logic Is Needed*

Color in a safety program should attract attention and call forth specific, predetermined meanings. And it should take into consideration the commonly recognized colors, which can be readily identified by word or name.

**WRONG**—An open, unmarked pit in front of a machine offers an easy place to break a leg



**RIGHT**—The bright black and yellow band in paint along the gutter is a warning signal





If color is to have sense and meaning, it must be used with purpose and direction. It should do more than merely attract attention. *A given color must mean a given thing.*

Identification based on color must respect also previous usage, if it is to do the best job. The associations of red with fire protection and of green with safety are both traditional, for instance, so we should keep them.

And colors that have high visibility under all lighting conditions should be given particular significance.

### **A Safety Color Code**

Some time ago, the Finishes Division of the Du Pont Company recognized the need for organizing the use of color for industrial safety on a uniform, scientific basis. With the assistance of H. L. Miner, manager of the Safety and Fire Protection Division of the Company,

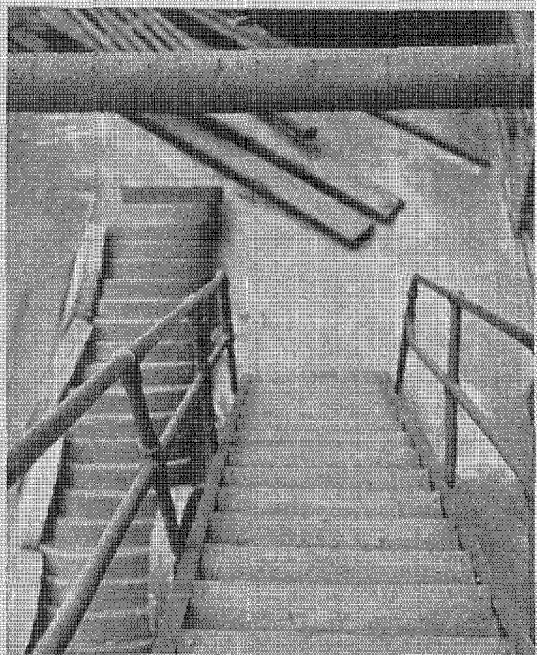
Extensions and applications of such a safety identification code may readily be made to industries of all types—the general principles being adaptable to any factory.

We suggest the following standards:

#### **High-Visibility Yellow**

Yellow has the highest visibility under practically all lighting conditions. It should therefore be used to mark "strike-against," stumbling, falling and tripping hazards.

Railings, curbing, the edges of floor pans, protruding parts, low beams, dead ends, trucking equipment, chain-hoist blocks, parts of conveyors at hazardous levels, the edges of loading platforms and pits, changes in floor elevation, approaches to stairways—these might best be painted yellow.



**WRONG**—Here a pipe across a stairway, unpainted, may cause concussion or a bad fall

**RIGHT**—But the same pipe, striped black and yellow, fairly screams warning: "Low Bridge"



and Faber Birren, eminent industrial color authority, this problem was thoroughly explored. DuPont now announces a new Safety Color Code for Industry which proposes a *uniform* system of color signals—a system based on sound scientific fact and research. It establishes certain standard colors to indicate accident hazards, identify protective equipment, and assure orderly factory arrangement and good housekeeping.

Six colors are recommended by DuPont as a basis for this general industrial safety color code: yellow, orange, green, red, blue, white (and black or gray). Each color should be used to indicate a distinct type of hazard or for other specific identification.

Where unusually strong attention-value is needed, alternate black and yellow stripe bars may be used.

#### **Alert Orange**

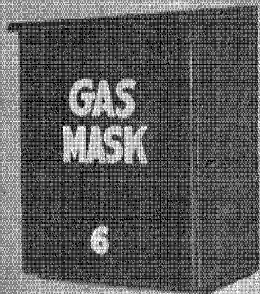
Orange is the color most likely to attract attention, psychologists tell us. For this reason, it should be used to indicate dangerous parts of machines or equipment—parts which might cut, crush or tear.

When machine guards can be opened or are removable, the inside part should be painted orange to attract attention to the hazard of unguarded, exposed moving parts. Painting of the exterior surfaces of machine guards should conform to the color of the body of the machine.



## ◀ GREEN

A green cross and, under it, a green cabinet plainly marked, show the location of a gas mask. Green traditionally stands for safety—as it does in this case.



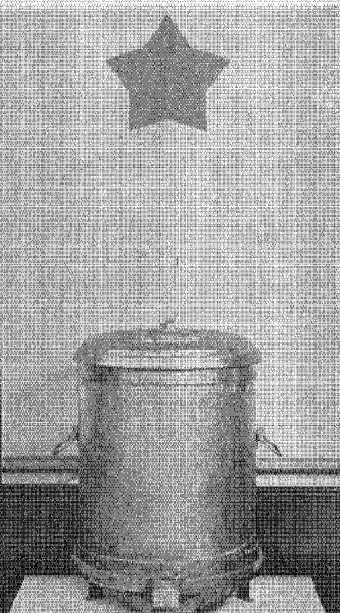
## ◀ GREEN

The traditional association of the color green with safety is used here in the green cross and in the lettering on the cabinet—here painted white.



## ◀ WHITE (or Gray)

A white (or gray) star and a matching painted panel on the floor call attention to the location of a metal container used in this instance to hold oily waste rags.



The coloring of control levers should be discouraged except where they introduce hazards. Painted control levers may distract the operator.

Orange may also be applied to the interior of switch-boxes or to other doors or enclosures, which should, for safety, be kept closed.

### *Safety Green*

Green is traditionally identified with safety. So it should be reserved for such identification.

Green markers might well be painted over doorways to first-aid rooms. Green should be universally used to identify first-aid kits, stretchers, cabinets for gas masks and goggles, respirators and other safety equipment.

### *Fire Protection Red*

Red has long been used to identify fire protection equipment. Its association is firmly established. It should be used for this purpose only.

So red would be best used, in a standard code, to identify all fire protection equipment. Areas should be painted on walls and pillars to locate extinguishers, hose connections and fire exits. Red squares painted on the floor under fire fighting apparatus or in front of fire doors will discourage littering.

Fire protection piping—sprinkler risers and lines, stand-pipe risers and connections, exposed fire mains—might be painted red throughout their entire length, or carry identifying bands or stripes of red. Fittings or couplings could be painted red, as well.

(The fusible links or release mechanism of sprinkler heads, fire doors and windows should not be painted, however. They might stick.)

### *Precaution Blue*

Blue has been used for many years to indicate caution. Blue signs and blue lanterns, for instance, are employed by the railroads to warn against moving a train of cars on which men are working.

Blue signs might be attached to machines shut down for repair, or unsafe equipment such as defective elevators, tools and ladders. Similarly, blue signs might be used to mark control valves liable to cause injury to men working in boilers, large mills, crushers, ovens, dryers, vaults, tanks, pits, etc.

Scaffolding, boxes, crates, which ought not to be moved, could likewise be marked with blue. It should be kept in mind that the proposed use of the color blue is to prevent the use of equipment which might endanger others.

### *Traffic White*

The sixth color, white (together with gray and black for indicated locations), while indirectly concerned with the prevention of personal injury, is important in any plant safety program. The brilliant colors (yellow, orange, green, red, blue) are reserved for identification which have vital significance. The more neutral white, gray and black, not so commanding to the attention, should be reserved for a lesser rôle.

White (on dark floors) and black (on light floors) may be used for traffic control to mark aisles, storage spaces, and so on. Where the aisle mark is near a hazard,



yellow should of course be used instead of white. Waste receptacles, rubbish boxes, cuspidors, containers for empty bottles could be white or gray.

Gray is perhaps the most practical color for such purposes. Where pronounced neatness and order are desired, containers or areas of walls, corners, or the floor under receptacles may be painted white.

### Markings, Symbols and Legends

To each color has been assigned a recognizable symbol. These symbols are: • **HIGH-VISIBILITY YELLOW:** Black and yellow stripes. • **ALERT ORANGE:** An arrow or triangle. • **SAFETY GREEN:** A cross. • **FIRE PROTECTION RED:** A square. • **PRECAUTION BLUE:** A solid circle. • **TRAFFIC WHITE (GRAY OR BLACK):** A star.

### Color Blindness

Color blindness usually involves the confusion of red and green. But the confusion of red, a symbol of fire protection, with green, safety, is not of major importance under the proposed standard code, because neither of the colors indicates hazards. Markings, symbols and lettered legends, especially in cases of color blindness, will further aid color identification.

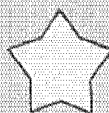
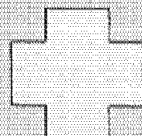
Yellow, orange and blue are distinguishable to color-blind people and appear distinct under all types of artificial illumination—incandescent, fluorescent or mercury—except sodium vapor lamps, which are seldom used.

### Summing Up

Colors rightly used should prove a valuable adjunct to the nation's safety program. Their effectiveness will depend upon the simplicity and uniformity of the plan.

The Safety Color Code is designed to: • Employ few colors, each distinct and readily recognized. • Establish specific and uniform meanings for each color.

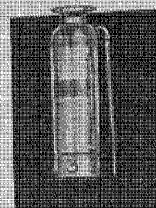
• Provide ready identification of hazards or conditions to aid in employee safety. • Reduce to a minimum the effort required to learn and retain color meanings. • Readily identify and locate fire protection and safety equipment. • Encourage good house-keeping and order.



The symbols—yellow in stripes, an orange arrow or triangle, a green cross, a red square, a blue circle—and a star to go with white, gray or black. Easy to read.

## RED ►

To every American youngster who ever chased a fire engine, red means "Fire." Here red-painted wall and floor panels mark the location of an extinguisher.



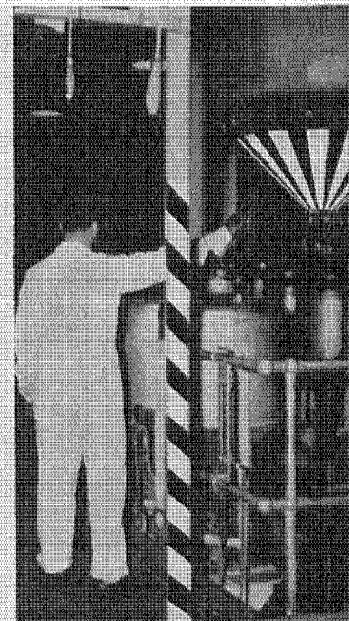
## YELLOW and BLACK ►

Yellow and black zebra-stripes, brilliantly visible under almost all lighting conditions, warn: "Pitch a curve here, son, or you'll bump that head of yours."



## YELLOW and BLACK ►

Another view of the yellow and black stripes at work. A dangerous overhead obstacle is plainly marked as a warning.



# AN END TO *Poison Ivy*

**D**U PONT "Ammate" Weed Killer, the recently-discovered safe and sure chemical for permanently eradicating poison ivy and many other noxious weeds, will be available in quantity for the first time this season.

This is distinctly good news for home owners, civic improvement groups, boys' camps, industrial plants and orchardists who have expressed a desire to obtain a quantity of this new chemical as reports of its weed-killing efficiency became known during the period of field testing.

"Ammate," when applied properly as a foliage spray on poison ivy, will kill permanently. Ragweed, poison oak and a host of other weeds (even certain trees) can be killed or controlled.

Based on ammonium sulfamate, "Ammate" offers outstanding advantages over chemicals hitherto used to combat the huge economic losses caused by weed pests.

It contains no poisonous ingredients. Browsing animals and pets need not be protected from foliage sprayed with "Ammate."

It is entirely free from fire or explosion hazards. Instead "Ammate" actually has inherent fire-retardant properties.

A gray, crystalline substance that is dissolved in water for use as a spray or applied to the soil, depending upon the type of weed being destroyed, "Ammate" exerts only a temporary sterilizing effect on soil. Treated areas may often be used for growing purposes during the same season.

"Ammate" thus is well adapted for home-owner use. The new weed killer already has proved itself a boon to fruit growers where the presence of ivy in orchards is a menace to spray crews and fruit pickers. Poison ivy has been eliminated with "Ammate" in community vacant lots, parks, roadsides, golf courses, around industrial plants, public swimming facilities and many other places



*To hay-fever sufferers this patch of ragweed needs no identification. ABOVE: The source of most hay-fever is being sprayed with Du Pont "Ammate"*



*The dead weeds are being raked up. "Ammate" kills ragweed in a matter of hours. One treatment is usually enough to end the creeping menace forever*



◀ *Poison ivy spreads like wild-fire. It is an economic menace in orchards, where it causes losses in man-hours on the part of spraying crews and fruit pickers*



▶ *"Ammate"-treated poison ivy is harmless; note man handling dead vines. "Ammate" causes no injury to bark of grown trees. Leaves must not be sprayed*





where the presence of poison ivy (or any other noxious weed) is undesirable.

Inquire at your local seed, fertilizer, insecticide, hardware or drug store for Du Pont "Ammate" Weed Killer. Follow directions on label carefully. For further information write the Grasselli Chemicals Department, E. I. du Pont de Nemours & Company (Inc.), Wilmington 98, Delaware.

## Heavy Chemicals for War

(Continued from Page 17)

continuously into a machine that molds, cools and discharges the metal as a finished, formed part, with no further machining required. (The carburetor, the door handles, the radiator grille on your car, the small parts of your outboard motor and the small parts of your washing machine were probably so manufactured.)

Die castings have now become an important element in the construction of military equipment. A jeep contains about twenty pounds of zinc. Larger military automotive transport units require from seventy to three hundred pounds of zinc. A large bomber may contain five hundred pounds of zinc, a "Liberty" ship propeller, eighteen thousand pounds.

### Agriculture

The Department manufactures a diversified line of products for agricultural use. These include the agricultural insecticides and fungicides, of which lead arsenate and calcium arsenate are the two most important tonnage items.

Phenothiazine, a comparatively new veterinary drug, is manufactured by the Department for use in destroying gastro-intestinal parasites in livestock, particularly sheep. This product is already in use in North Africa under the lend-lease administration. "Ammate" Weed Killer, an ammonium sulfamate product, is an important weed-destroying chemical manufactured only by Du Pont.

### And In Conclusion

The Department has also recently started the manufacture of a new and remarkable insecticide, "DDT." This is a new synthetic organic insecticide—the basis for the louse powder now used by the armed forces.

"Lorol" chloride, an important chemical for the synthetic rubber industry, is another product developed by the Department.

The men and women of this important branch of the Du Pont Company get none of the glamor. They win no medals. They do not have the thrill of building ships or making bombs—obvious "war jobs" which earn proud pats on the back from families and neighbors.

But, grimly and doggedly, day in and day out, they turn out materials of war without which our armed forces could not function!

This is the kind of courage, this is the kind of patriotism, you find in the Grasselli Chemicals Department of the Du Pont Company. Its men and women, like the men of the Navy's submarine patrols, constitute a Silent Service.

# What's New

AN INDUSTRIAL finish for home, school and office furniture, much better and tougher than present varnishes or lacquers, is promised after the war by the Finishes Division of the Du Pont Company. Designed for use as a base coat, it has been described as "unique." Its value lies in the extraordinary adhesion it provides for the top coat. This so-called "penetrating primer," by affording improved "anchorage," permits the use of higher scratch-resistant finishing lacquers. Such super-tough pyroxylin lacquers have long been available, but were impractical because a sufficiently-strong adhesive bond with a wood surface could not be obtained. This finish will not be available to the general public until after the war.

★ ★

UREA can replace effectively part of the protein supplements in the ration for cud-chewing animals. Work in which urea was used as a substitute for protein concentrates in the ration for cattle has been reported from Hawaii, Kansas, Massachusetts and Wisconsin Agricultural Experiment Stations, and for sheep from Illinois and New York Stations. In all cases, nitrogen supplied as urea was satisfactorily utilized by the animals.

★ ★

DU PONT LACQUERS are noted for their excellent adhesion properties. But there's one exception—a special lacquer which is used as a shop coat on the aluminum-alloy sheeting used in fabricating warplane bodies. Factory coated with aluminum oxide, its surface is susceptible to damage in handling so that a lacquer must be applied over it for protection during assembly operations. After the riveting, the painters' first job is to remove the lacquer. That is now an easy task for the film can be pulled off the surface as easily as if it were a piece of cellophane wrapped around a piece of candy. Poor adhesion is one of the special virtues of this quick-drying lacquer. Additional information may be obtained from the Fabrics and Finishes Department.

★ ★

DU PONT'S 35th Army-Navy "E" award was presented to the Wyandotte Plant in Wyandotte, Michigan, on February 24th for outstanding achievement in the production of chlorinated hydrocarbons used in the essential operation of degreasing metals that go into planes, tanks, trucks, guns and other weapons of war. The Wyandotte Plant is a unit of the Electrochemicals Department.

### Correction

IN REPORTING the Army-Navy "E" award to the Baton Rouge Plant—No. 30 in the list published on the inside back cover of the preceding number—the Electrochemicals Department should have been included with the Ethyl Corporation and the Organic Chemicals Department. We are informed this was a triple award.

## Engineering and Construction

(Continued from Page 13)

averaged annually for the entire Company between the two wars.

"DuPont has been given responsibility for work in connection with Government-owned ordnance projects in fourteen states, including extensive engineering services furnished to ordnance projects undertaken by other companies that lacked previous experience in such work. The scope of the program, changing rapidly with changing conditions, has expanded far beyond anything originally visualized. .

"The quantity of explosives contemplated in this program, and in large share now being delivered, is far greater than was manufactured by the entire American explosives industry for all of the country's earlier wars combined."

Boyden Sparkes, in the article previously cited, presented this interesting commentary on the work record:

"Surely the making of explosives is a strange art, far removed from other kinds of manufacturing operations. Yet this art, guarded and developed through two decades of neglect by small groups of men, has been swiftly expanded into an enormous industry.

"The powder operation has been one of the most satisfactory parts of the war-production program. If we had kept powder mills and T.N.T. plants of the last war in stand-by condition, we would have been better prepared for this war, but nothing is more clear today than the fact that you cannot keep an art in a stand-by condition. In 1942, because of advances in the art, to make X pounds of T.N.T. only a third as much plant is required, and cotton linters and nitrates are transformed into smokeless powder in less than half the time required at the beginning of the first World War."

Earlier in his story Mr. Sparkes, commenting on the speed with which plant-building operations were carried out, told his *Post* readers:

"The DuPont engineering force, leap-frogging steam-shovel men, carpenters, masons and plumbers from one site to another, kept 30,000 or more workmen busy creating these new facilities. This was an epic performance, and only a hint of the whole tale can be told now. To get a clear water from a muddy river, the engineers sank deep shafts, tunneled under the river and made of the river bed a filter. Another time, at another place, delay was threatened because they could not get steam boilers. The steam was needed both for processing and for power. So they ran steam locomotives into the plant, clamped the wheels to the rails, and they had a power plant."

These are typical instances of engineering resourcefulness in field operations, mentioned here because they have previously been reported in the public prints. Scores of other cases might be cited to show the celerity with which huge jobs were done both in the office and the field, despite the handicaps of lack of raw-material

supplies, transport difficulties and the fact that ordnance-plant sites are of necessity located a considerable distance from urban centers. Railroads, fence lines, water-supply systems, power houses, plant structures, roads, housing facilities for thousands of employes, schools, hospitals, recreation centers—all had to be provided. In short, more than a dozen industrial cities had to be established in months, not years. And this work was done in accordance with DuPont plans. In some cases the construction was handled by DuPont employes; in others, Government-employed contracting organizations built the plants under the joint supervision of Government and DuPont resident engineers. Altogether, as Mr. Sparkes says, "It was an epic performance." The complete story is yet to be told.

The design drawing and blue-print work at Wilmington headquarters alone required the services of the largest staff of engineers and draftsmen this Company ever employed—a staff so large that a special telephone directory had to be prepared for inter-office communications. Facilities for reproducing drawings, maps and the like were more than doubled. You will readily understand why the Engineering Department, as a whole, had to be greatly expanded, not only to provide the services required by the Government and all operating departments of the DuPont Company, but those of its subsidiaries as well. Notably, the physical expansion of Remington Arms Company plants, which enabled that organization to attain a six months' production capacity of small arms ammunition greater in quantity than was produced by the entire country throughout the four years of the first World War, in part reflects the helpful service of some four hundred supervisory and engineering employes of the DuPont Company.

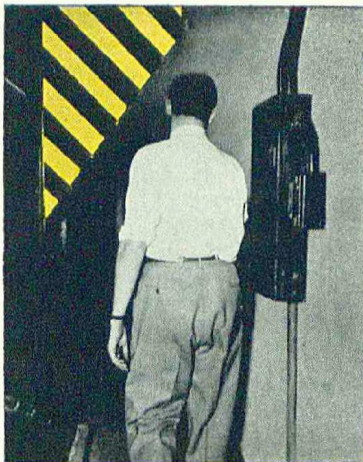
"The conversion and expansion of Remington Arms, DuPont subsidiary, to meet the urgencies of war, stand as a stupendous achievement." So declared *Fortune Magazine* in an article featuring "The Rise of the Foreman," in which it was pointed out that during the "phony-war" months, when the Company started making military cartridges on war orders, less than one-tenth of its employes were skilled in that field.

In the main it was carried through smoothly and efficiently because the Company's peacetime industries were staffed with experienced workers who could, with a little training, qualify for the emergency wartime work in supervisory and other capacities. And a well-rounded program of industrial training helped to fill the gaps.

At present, our nation's capacity to produce powder supplies for the armed forces is one bright spot in the picture. The engineering and construction forces of this Company and others are believed to be "well over the hump." This part of the battle of production has been won in a shorter time than any one believed possible three years ago.

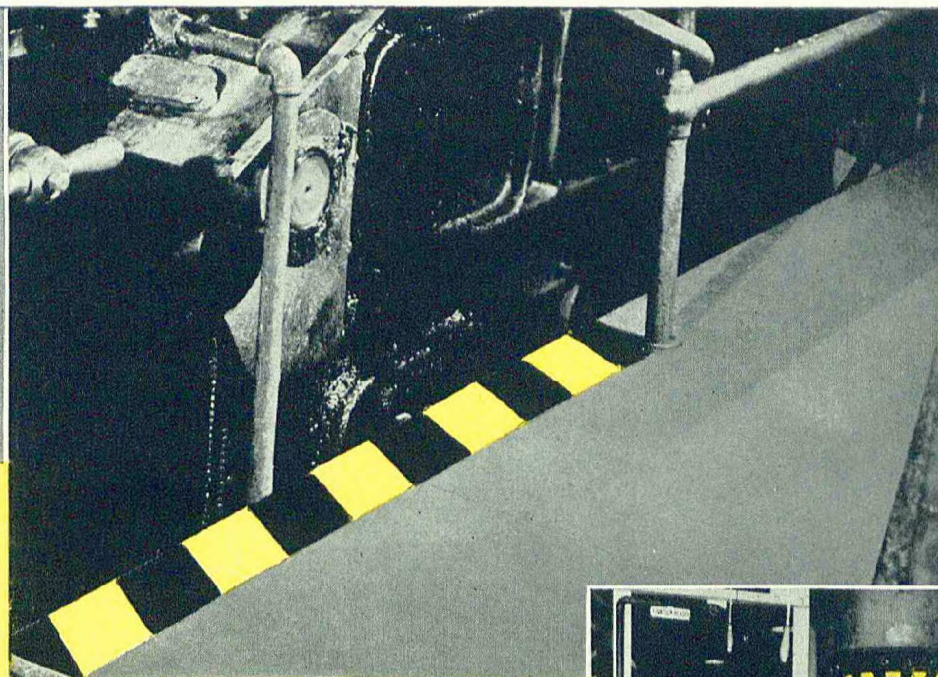
Today Army-Navy "E" pennants fly from the flag-staffs of thirty-five DuPont and Remington-operated plants in fourteen states. They all symbolize awards for outstanding achievement, and there is point in adding that some of them represent joint awards to plant-construction workers as well as to plant-operating workers.



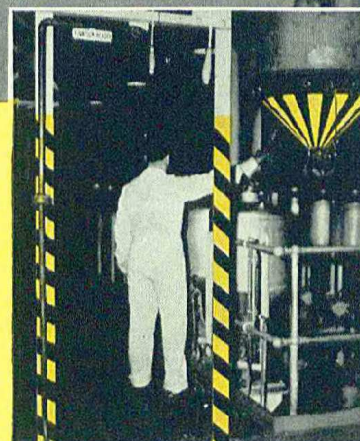


(Above) Overhead obstructions in passageways and aisles are easy to see and avoid when marked with alternate black and yellow bars according to the Safety Color Code.

(At Right) This open pit has been identified as a hazard by the markings of alternate black and yellow bars on the edge of the adjacent floor area.



## DU PONT PRESENTS A SAFETY COLOR CODE FOR INDUSTRY



Safety Color Code at Work. Alternate black and yellow bars, symbol of High Visibility Yellow in the Color Code, point out traveling overhead equipment and posts in the entrance to passageways.

**A uniform system of color signals with advantages recognized by leading safety engineers and proved by factory use. An adjunct to "Three Dimensional Seeing."**

Here is a plan to make color serve as a visual aid to safety. A simple method of applying six colors to warn of various industrial hazards and to cut industry's high accident toll . . . to mark first aid and fire protection equipment more clearly . . . stimulate good housekeeping in a plant . . . and guide the movements of rapidly moving workers in their daily jobs.

**WHAT THE SAFETY COLOR CODE IS.** It is a system for safety identification built around colors that are commonly recognized and have high visibility and attention value. Du Pont selected six standard colors, assigned names and symbols to them and gave them specific jobs to do. Here they are:

**High-Visibility Yellow:** To indicate strike-against, stumbling, or tripping hazards.

**Alert Orange:** To mark parts of machines that might cut or crush a worker.

**Safety Green:** To identify first aid equipment, dispensaries, and the location of safety devices.

**Fire-Protection Red:** To point out fire-protection equipment.

**Precaution Blue:** To warn workers against use of equipment under repair, or machinery that should not be started.

**Traffic White:** To mark aisles, storage places and waste receivers.

**ANY PLANT CAN USE THIS SYSTEM.** The principles of the Safety Color Code are adaptable to any factory, as a supplement to present guarding and protective equipment. The proof of this is in its use today in many plants

where it helps both experienced and green employees to keep alert and ready for any emergency.

The Code is a development of Du Pont and its industrial color consultant, working with leading safety engineers. It augments Du Pont "Three Dimensional Seeing," so important in highlighting working surfaces of machines. Every plant will profit by adoption of the Du Pont Safety Color Code.



**SEND THIS COUPON TODAY for the new booklet which tells a complete story of the Du Pont Safety Color Code. See how six standard colors can be used to make hazards less dangerous and reduce accidents. You will find it interesting and profitable reading.**



E. I. du Pont de Nemours & Co. (Inc.)  
Finishes Division, Dept. DM34  
Wilmington 98, Delaware

Send me your new booklet on the Safety Color Code.

Name

Title

Company

Address

City  State



# EAT IT UP!



## 15% OF FOOD IN AVERAGE AMERICAN HOME IS WASTED

(ACCORDING TO U. S. GOVERNMENT STATISTICS)

Two slices of bread wasted each week in each home is the equivalent of 2 million loaves! Actually, the food wasted in our homes would feed 5 million fighting men every day. Help prevent this waste by protecting and using every tiny bit of food in *your* home.\*



## HOW CELLOPHANE HELPS PREVENT WASTE

Fresh, tasty food is eaten up. Not wasted. But often food can lose its freshness *before* it gets to your home. Bread is a good example. That's why many bakers wrap their bread in moisture-proof Du Pont Cellophane—to *protect freshness*. (Keeping the loaf in its Cellophane wrapper continues the protection at home.) Du Pont Cellophane protects the freshness and flavor of many foods *you* buy for *your* family, just as it protects vital foods for our armed forces.



BETTER THINGS FOR BETTER LIVING  
... THROUGH CHEMISTRY

# DU PONT Cellophane