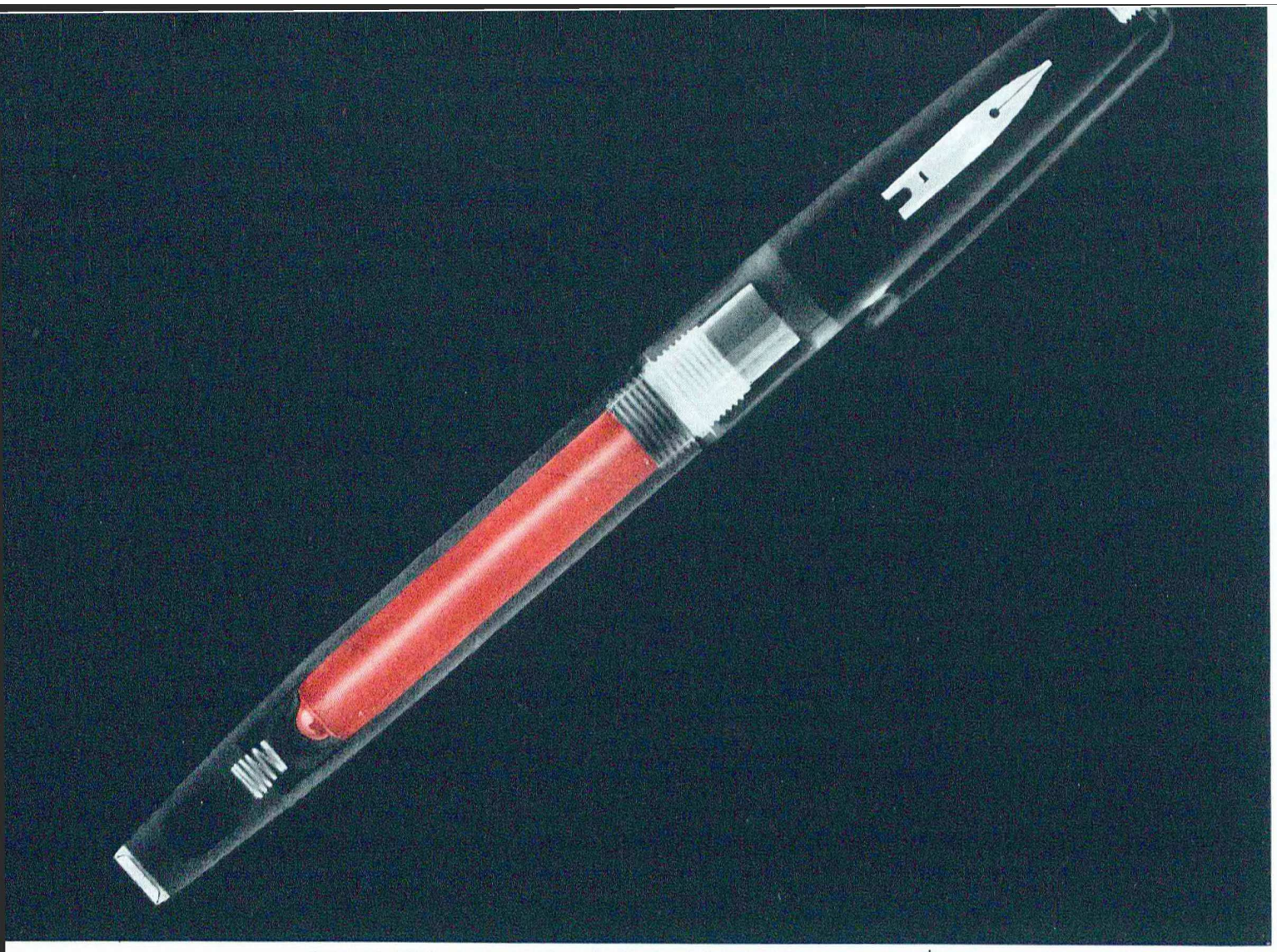
magazine

METALS FOR A NEW AGE



DUPONT



Coating of a TFE-fluorocarbon resin is used on filler barrel of the Parker 61 pen, a product of The Parker Pen Co., Janesville, Wisconsin

THE INSIDE STORY: How a finish put an end to an inky problem

The inner barrel of the new Parker Pen is dipped into ink and fills by capillary action. Puzzling to the designers at first was how to make it easy to clean the wet barrel. *Solution:* A coating of a TFE resin sheds the ink so well that it is not necessary to wipe the cell case.

Unless special techniques are used, nothing sticks with any strength to a TFE-fluorocarbon resin surface. Moreover, TFE resins resist heat to 500° F., are unaffected by almost all chemicals, and have lower coefficients of friction than any other solid material.

Special techniques can however be used to bond TFE resins. Sheets of TFE resins are often applied via these techniques to hoppers, conveyors and chemical vats. The exposed surfaces of the resins remain slippery and "anti-adhesive."

We recently issued a 20-page illustrated booklet entitled "TEFLON TFE-Fluorocarbon Resins in Mechanical Applications," packed with facts on uses of TFE resins. Send for your copy today. **E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room T-392D, Du Pont Building, Wilmington 98, Delaware.**

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TFE-FLUOROCARBON RESINS

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.



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UP FROM THE RANKS

Our scientific friends have nice, neat classifications for different types of research, ranging from "fundamental" to "product improvement," but sometimes we fall back on our own unscientific descriptions.

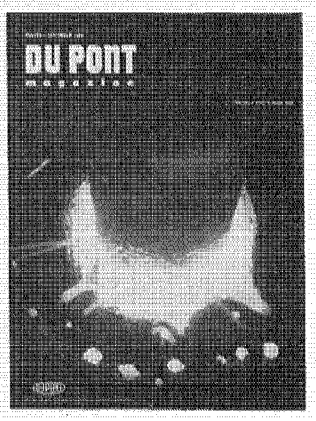
For example, we may picture Du Pont products marching along, each a distinct personality but at the same time remarkably close to its comrades in ranks. Once in a while a new laboratory-spawned giant—a moistureproof cellophane, a nylon or a neoprene—sweeps by. Sometimes the cadence varies, and there are stragglers. But for the most part the ranks wheel past to the drumbeats of customer demand and competition.

What brought on this flight of imagery? We ran across the sketch above when cleaning out our art files and were reminded of the occasion, back in 1953, when we told how American housewives were turning in great numbers to the new powdered laundry bleaches.

This was brought about, we said, by a Du Pont product, sodium perborate, a solid and convenient form of hydrogen peroxide that we had long supplied to textile mills for bleaching fabrics. The drawing is equally pertinent today for, on page 19 of this issue, we announce still another chemical for bleaching and cleaning—a new and improved one for milady. Time—and the Du Pont product parade—marches on!

OUR COVER

On this month's cover you're peering through Ted Adams' camera lens into—stick with us now—an inert gas-vacuum consumable electrode arc melting furnace. That white stuff is a molten mixture of niobium, titanium and molybdenum. Its temperature is about 5100°F. and it's held in a water-cooled copper crucible: Out of the furnace will come an ingot for forging or extruding.



The shot was made at the Du Pont Pigments Laboratory, Experimental Station, Wilmington. Here metallurgist E. M. Mahla and his fellows are working to develop alloys that will be useful at temperatures up to 2200°F. Would-be space travelers and earthbound industrialists alike have a stake in their progress, and so do you and I. Bert Mahla tells why on the next three pages.

STAFF

James H. McCormick, *Editorial Supervisor*

Emily Heine, *Associate Editor*

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METALS FOR A NEW AGE

For the want of superior structural metals our technologists face frustrating limits, says this scientist. He and his associates are dedicated to closing the gap.

By DR. ELBERT M. MAHLA

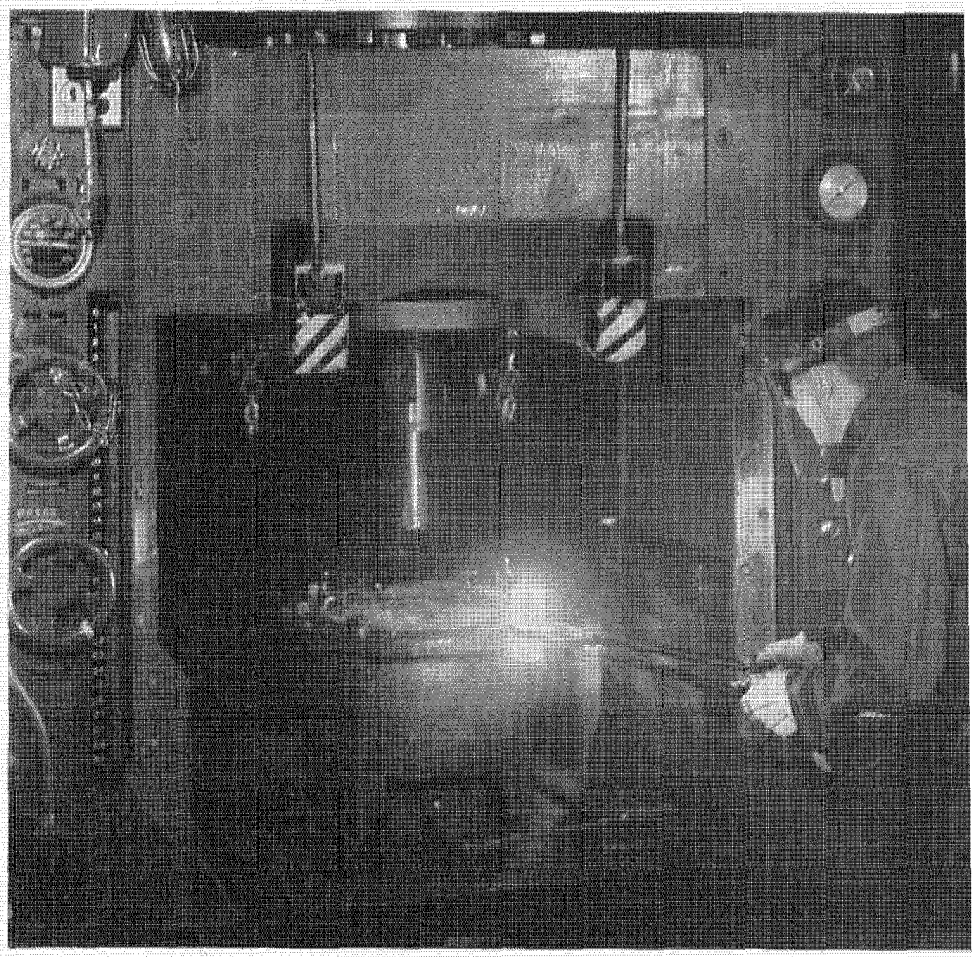
Here in the Wilmington laboratory of the Du Pont Pigments Dept. and in similar labs around the country, chemists and metallurgists are chipping away stubbornly at one of the biggest obstacles confronting our technology.

The problem is simply that the capability of our metals is rapidly falling behind the demands we place on them. We can design space vehicles and draw up plans for atomic power plants and chemical process equipment more efficient than any we now have, but the plans won't get off the paper until we have structural metals that will withstand higher temperatures, that won't absorb neutrons and will survive other extreme conditions.

We know of new metals and alloys that possess the qualities we're after, but most of them are not yet available commercially. Industry needs them in the form of sheet, foil, bar, wire, plate, tubing and forgings with useful engineering ductility and strength; it needs them at a reasonable price and it needs them as soon as possible.

CHEMICAL FRONTIERS

This is the third in a series of articles on specific research areas in which Du Pont scientists are active. Earlier stories have dealt with fluorine chemicals and products for the solar energy field. Our author this month is a metallurgist and assistant director of the Pigments Laboratory at the Du Pont Experimental Station in Wilmington.

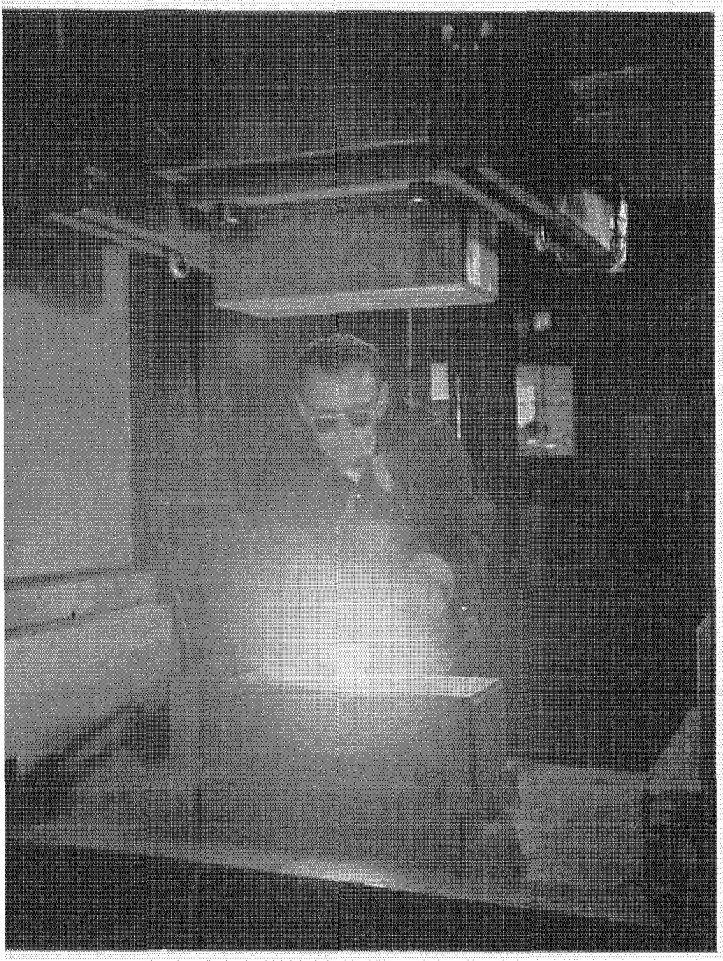


After an ingot is made of a niobium alloy in furnace (see front cover), it can be heated again and extruded in this 300-ton press at Du Pont Experimental Station. Here it's made into a shape useful for testing.

The metals we have our sights on are titanium, zirconium, chromium, niobium, molybdenum, tantalum and tungsten. These high melting point (refractory) elements possess unique high-temperature strength, corrosion resistance and nuclear properties. They will perform as base metals in the alloys of the future, much as iron is the base of today's steel.

The refractory metals are not available now at attractive prices because they can't be produced by the age-old pyrometallurgical processes of smelting and slag refining. Instead, highly specialized chemical processes are necessary to win them from their ores. This, of course, is where the chemical industry comes in. Its job is to develop economical reduction and metalworking processes.

The task is formidable. The metals we're talking about are so chemically active in the molten state that there are no practical refractories to contain them. Not only that, they are extremely sensitive to contamination by oxygen, nitrogen and hydrogen. Ten parts per million of nitrogen, for example, make chromium brittle, and two parts per million of oxygen do the same to molybdenum. After we perform the chemistry required to make them pure enough to be ductile and useful, we must somehow shape them without contaminating them all over again.



Here the same press is used to forge an experimental alloy. Du Pont is doing research on both titanium and niobium. Success, says Mahla, could benefit both the civil and the military.

Here at Du Pont we are working currently on refining and forming processes for titanium and niobium. The present commercial method for making titanium involves its reduction from ore to metal sponge in a batch process. The sponge is then melted, alloyed and formed into mill products. This is an expensive method and explains the high cost of titanium alloys. We're trying to improve the process in order to lower costs and broaden the market for titanium mill products.

We also are working with metallic niobium. Its alloys promise to have sufficient strength and oxidation resistance to be useful at temperatures up to 2200°F. This holds out the prospect of more efficient gas turbine engines, since performance is geared to temperature. Today's operating engines have almost reached the upper limits of metals now in use, roughly 1700°F.

Niobium's reluctance to absorb neutrons makes it an excellent candidate for atomic energy application, too. Scientists anticipate that its alloys will allow new atomic piles to operate at higher efficiency, thus lowering the cost of atomic power.

In order to establish a raw material source for niobium-based alloys, we have prospected for, discovered and bought a large deposit of niobium ore in Colorado. This will assure a continuing supply of the alloys for defense and for industry.

Under an agreement with Thompson Ramo Wooldridge Inc., of Cleveland, we are centering our research effort on the refining and alloying of niobium, while Thompson is developing fabrication techniques in its capacity as a leading manufacturer of gas turbine buckets and aircraft engine components.

What are some of the specific benefits we might expect from having refractory metal alloys available commercially? Well, the chemical industry itself would gain importantly. Corrosion-resistant alloys could revolutionize processes. The cost of many synthetic chemical products could be lowered and their markets expanded. New products not now feasible—because plant equipment would literally dissolve in the corrosive process stream—could become practical.

New alloys capable of operating for brief periods at temperatures up to 3000°F. would help solve problems of re-entry from space. The Air Force, as a matter of fact, is specifying a niobium alloy skin for components of a re-entry vehicle now under development. As the use of niobium and other refractory metals grows, fasteners with the same high-temperature properties will be required. The Du Pont Explosives Dept., which supplies blind explosive rivets to the aircraft and missile industry, already is evaluating the new alloys for possible use in fasteners to meet flight needs of tomorrow.

I mentioned earlier the predicted role of niobium alloys in atomic power generation. Similar alloys capable of raising the operating temperature of conventional power-generating equipment 1000°F. would also help ex-

tend our fossil fuel supplies. With higher temperatures we could extract more power from the same amount of fuel.

In order to implement its metals program the Pigments Dept. has equipped a research laboratory and small semi-works at the Experimental Station Laboratory near Wilmington. Here small prototype equipment reproduces the processes for extraction, melting and conversion to mill products of the metals. Some stages operate under an almost total vacuum while others operate at pressures up to 80,000 pounds per square inch. Tools are at hand to explore the technology for making such mill shapes as rod, sheet and tubing from refractory metals. This facility serves as a prototype for the full-sized equipment that will be necessary to produce large quantities of these materials on a commercial basis.

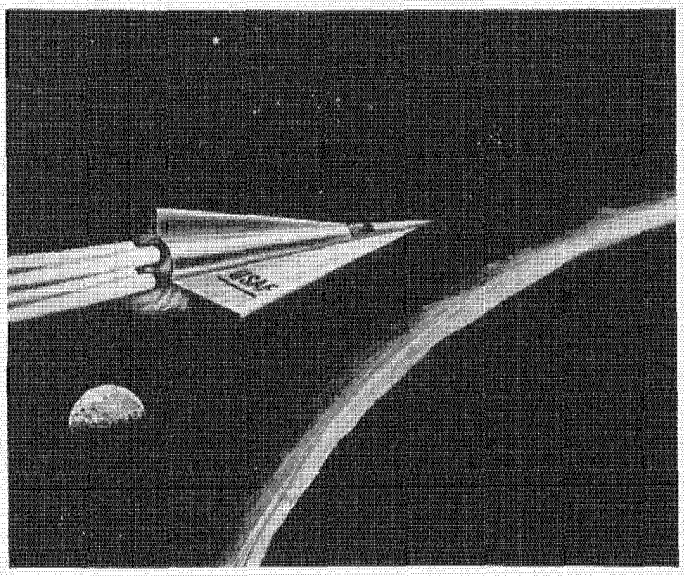
Here are examples of the problems we face in working with these materials:

The temperature at which many of the alloys should be worked exceeds the melting point of common metal-working tools. The tools must be made to do their work exceptionally fast or they must be artificially cooled. Conversely, if we devise means of protecting common tools from melting and still work these alloys at high temperatures in air, we run the risk of embrittling the work piece by contamination.

One of the most important tools for research in the refractory metals field is the analytical facility that has been developed at the Experimental Station. Here we use gas analysis techniques capable of analyzing parts per million of oxygen, hydrogen and nitrogen. The compositions of alloys are determined by classical wet methods and by the instrumental methods of emission spectrography and x-ray emission spectroscopy. Furthermore, unique separating technologies such as ion exchange and chromatography are commonly employed in the preparation of analytical samples.

Facilities for the study of surface phenomena in metals, particularly as related to oxidation, are important in alloy development, too. We use button furnaces with precision atmosphere control to prepare exploratory samples. When we develop alloys with useful properties in this way, we scale up directly to 3-inch diameter ingots in an inert gas-vacuum consumable electrode arc melting furnace. In this furnace an electrode prepared from the metal or alloy to be melted is burned off into a water-cooled copper crucible much as an electrode is burned off in joining two metals. The melting proceeds in a closed system under a low pressure of inert gas to prevent contamination, and the electrode is converted to a solid ingot. These then are turned into useful mill products through forging or extrusion on a 300-ton press. We also have rolling mill facilities for producing sheets up to ten inches wide.

Success in refractory metals requires furnaces for the heat treatment of products. At the Experimental Station small prototype furnaces designed to operate either under inert or vacuum atmospheres are an essential part of the facility. The most sophisticated of these operates up to 4000°F., and a variety of others capable of 3200°F. also are used routinely in our development programs.



Drawing at right shows one concept of a space re-entry vehicle. The Air Force is considering niobium alloy for part of such a vehicle now under development. Below, author Mahla and research supervisor Kelyth Jones discuss a proposed design of wing leading-edge fabricated by Thompson Ramo Wooldridge Inc. Material finally chosen must stand 3000°F. for brief periods.



Finally, we have testing equipment to evaluate the mechanical performance of these new refractory alloys at both room temperature and very high temperatures. The equipment carries out tensile testing, creep and stress rupture testing, hot hardness and sheet cupping tests. Additional equipment at the Du Pont Engineering Research Laboratory supplements Pigments' facilities, and provides other machines for fatigue testing, hydrostatic pressure testing and special-purpose tests designed to prove the value of materials for special applications.

All of this equipment—and more still to come—provides the tools required in this relatively new field of endeavor. We feel that Du Pont is now prepared to contribute in an important way to the advancement of metallurgy and of our whole technology.



◀ "Slacks of 'Dacron' and 'Orlon' can be tied in knots but the wrinkles don't last. Some golfing customers have 16 pairs. Hunters brag about knit shirts of 'Orlon' that they wash and dry overnight." Geo. Greenwald, right, Frankenberger's, Charleston, W. Va.



"Skiers from New York want bold colors while New Hampshire natives prefer quiet shades in sportswear. Sweaters of 'Orlon' are terrific." Bud McQuade, left, McQuade's stores, N. H. and Mass.

INSIDE LOOK AT OUTERWEAR

"Men down our way have conservative tastes in clothes," the West Virginia buyer said reflectively. "But the interest in sportswear is tremendous." This interest, high in all parts of the country despite varying regional preferences, helps explain why a record-breaking six thousand members of the National Association of Men's Sportswear Buyers turned out for the May market in New York City. To decide—six months in advance—what styles of sports shirts, slacks, sweaters, jackets and suburban coats to offer American males this fall, they talked with clothing manufacturers and examined hundreds of garments.

Continental styling, the buyers found, is showing up in sportswear in the form of no-belt trousers, dropped or floating shoulders and shawl collars. Sweaters are shaggy and bulky, often with a handknit look. Pile fabrics that look like fur are coming on fast. Suburban coats are going to new lengths (38 to 40 inches or more).

For brisk fall days, the buyers wanted garments that are warm but lightweight, and stylish but practical. Often, they found, these clothes contain one or more Du Pont fibers—"Dacron" polyester fiber, "Orlon" acrylic fiber or nylon. The accompanying picture captions report what some representative NAMSB members had to say about the impact of these fibers on men's sportswear.

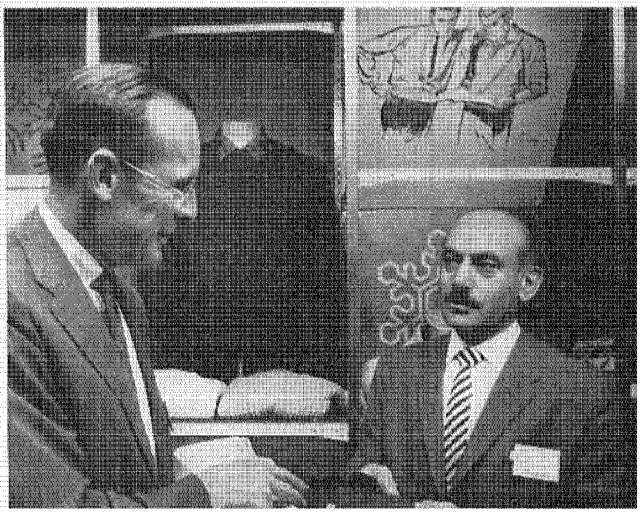


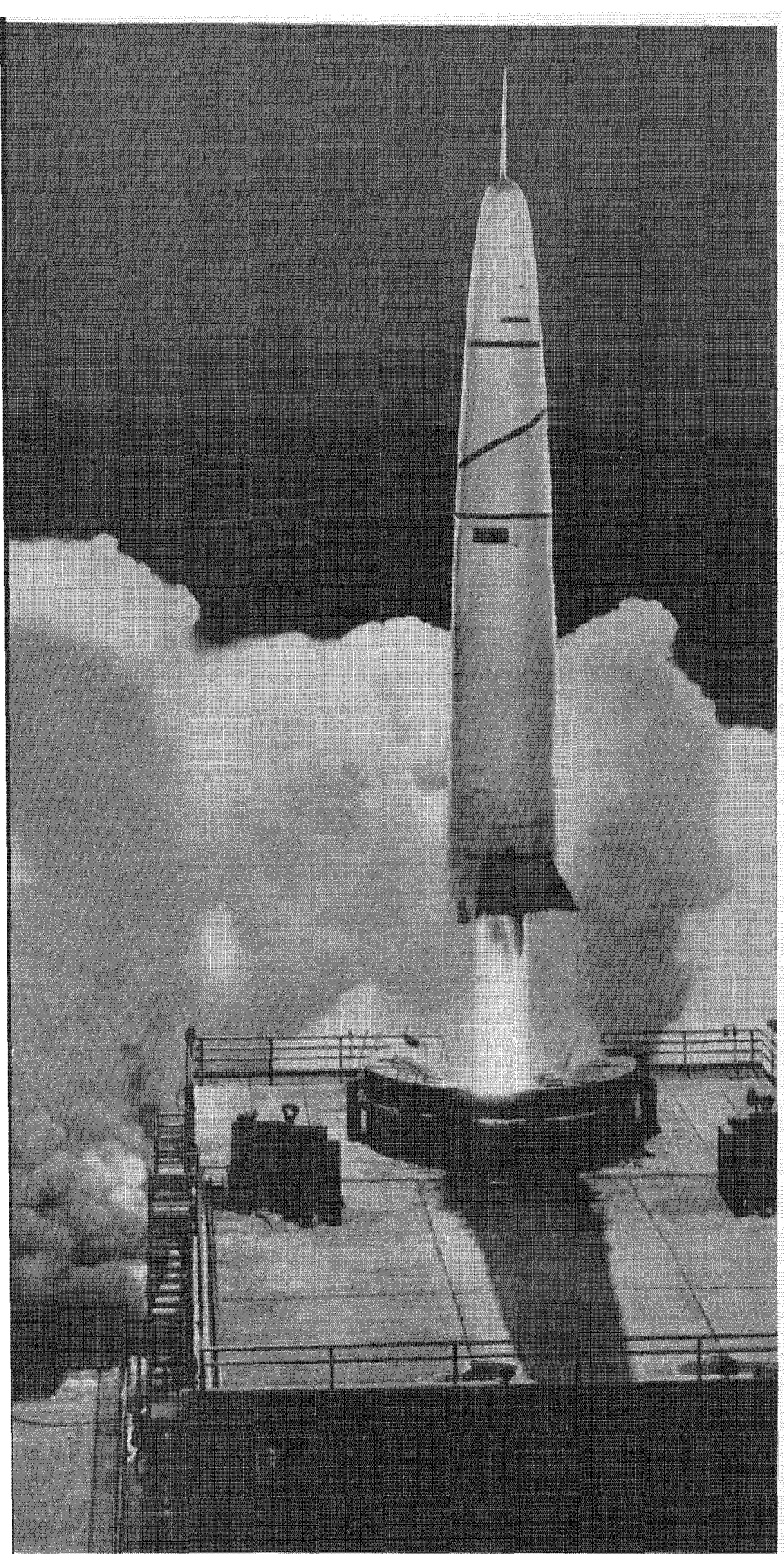
"Sportsmen in the Lake Michigan region ask for the newest and best fabrics. In summer we outfit them for boating and fishing, in winter for ice skating and hunting. Du Pont fibers are popular." John Hosler, Hosler's, Muskegon, Mich.

"'The Abominable Snowman' we call this parkacoat of 'Orlon'. We expect it to go over big in fashion-conscious Midwest." William Holman, manufacturer, Lakeland Sportswear, Sheboygan, Wis.



"American styling is extremely popular in South Africa. The durability of garments made of synthetic fibers appeals to travelers." Lionel Ostrotsky, right, Erling's, Johannesburg. ▶





Du Pont coated fabrics go

FR

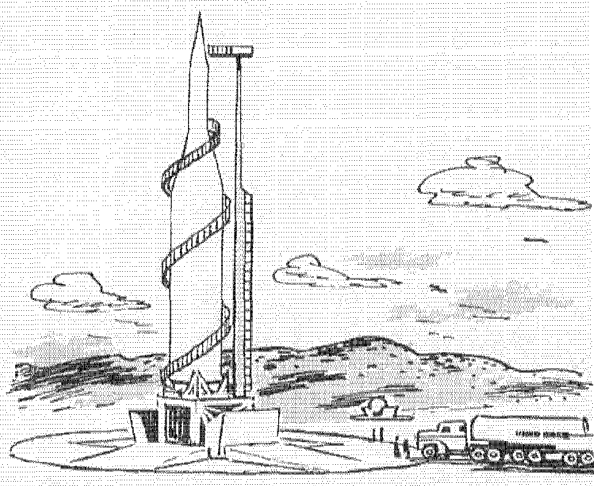
By WILLIAM MANN

"When it comes to selecting missile materials we don't have just an ordinary bear by the tail," said a rocket engineer recently. "We have a roaring comet and we can't relax for an instant."

This young scientist was referring to the spiraling race that has developed between different segments of the missile industry. First, there is a constant urge to find more powerful propellants to hurl greater loads into the sky —higher, farther and faster. Once a new propellant with increased jet velocity is discovered, there is an immediate call for new construction materials—materials tough enough to withstand the corrosive attack of the new fuels, as well as higher temperatures, deeper cold, or both.

The chemicals of greatest current interest to the missile industry are the very light elements skimmed from the top of the periodic table and compounds formed from them. Among these are intensely cold liquefied gases such as hydrogen, oxygen, ozone and fluorine, hydrogen peroxide at high concentrations once considered impossible to make and store safely; red and white fuming nitric acid; and the vastly inflammatory boron hydrides.

A fair share of the demands for new missile construction materials filters through to the development men at Du Pont's Fabrics Division plant at Fairfield, Conn. These men are well equipped to deal with the varied requirements of hundreds of possible fuel and oxidizer combinations. About 400 coated fabric products are regularly supplied, and a large number of others are tailored to fill customers' needs.



"This temporary structure (staircase to service some rockets) is enclosed in a coated fabric that must resist the effects of accidentally splashed propellants. 'Armalon' was chosen for this use."

AIRFIELD TO OUTER SPACE...AND BACK

A look at some missile problems that have been solved with the help of Fairfield products might properly start with protective clothing for the technicians who handle propellants. Liquid oxygen (LOX) is a superior oxidizer, probably the most popular one in missile use. But LOX must be stored and maintained below –297°F., its boiling point. Needed: a fabric that would neither catch fire if accidentally splashed with active oxidizers like oxygen, nor become embrittled by low temperatures. After tests, Fairfield came up with "Fairprene" 84-001 coated fabric. The fabric in this case is made of "Dacron" polyester fiber and the coating is "Viton" synthetic rubber, a fluorocarbon notable for its ability to withstand temperature extremes. Protective clothing made from this material successfully resists liquid oxygen, hydrofluoric acid and other powerful chemicals.

Suitably dressed in such garments, a technician may be called upon to climb the spiral staircase used to service some types of rockets. This temporary structure is enclosed in a coated fabric that must also resist the effects of accidentally splashed propellants. Du Pont "Armalon" TFE-fluorocarbon resin coated glass fabric was chosen for this important use.

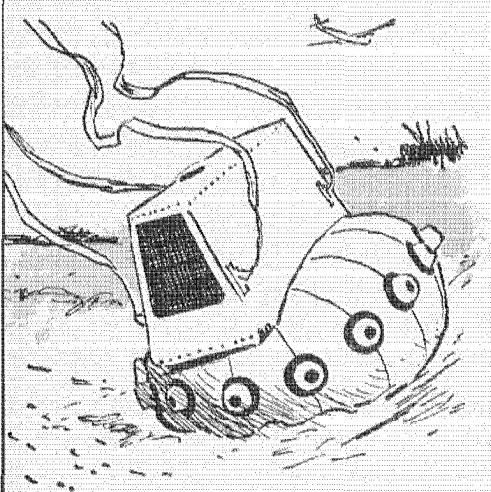
At the base of a rocket, near the exit nozzle and the underground launching platform, even more severe conditions were encountered. In addition to possible splashing by liquid gases, a curtain at this point was exposed to the highly corrosive combustion products that gush out at 2000 to 3000°F., and considerable pressure from the surge of blast-off gases. Base curtains made of "Fairprene" glass fabric coated on both sides with "Viton" and with a heat-resistant glass fabric outer surface were supplied for this important application.

Inside the rocket itself, conditions are not likely to improve. Gaskets that don't catch fire, and above all don't cause pure hydrogen peroxide or LOX to detonate, can contribute a good deal to the success of a launching. "Armalon" TFE-fluorocarbon fiber felt—"Teflon" fibers impregnated with "Teflon" resin—makes gaskets that operate successfully in missiles from –350°F. to 500°F.

Fairfield's "Armalon" TFE-fluorocarbon resin coated glass fabrics are also applied to the manufacture of wire and cable for use in hot spots in rockets and missile electronic systems. The specifications call for operation at temperatures up to 500°F. Both single ply materials and laminates of "Armalon" also are being used as the insulation in rotating electrical equipment, which is miniaturized and must withstand high temperatures.

The work of missile men is only half done until the supporting radar and other tracking devices have done their part, too, and here Fairfield products have also helped. "Fairprene" in the form of a nylon fabric coated with white "Hypalon" synthetic rubber is used as an air shelter and radome material, where the unit covers missiles or ground support equipment, often under extreme climatic conditions in the Arctic. Fairfield products perform reliably in the frigid upper atmosphere, too—in the tail section of a captive balloon used in elevated atomic test explosions, for instance.

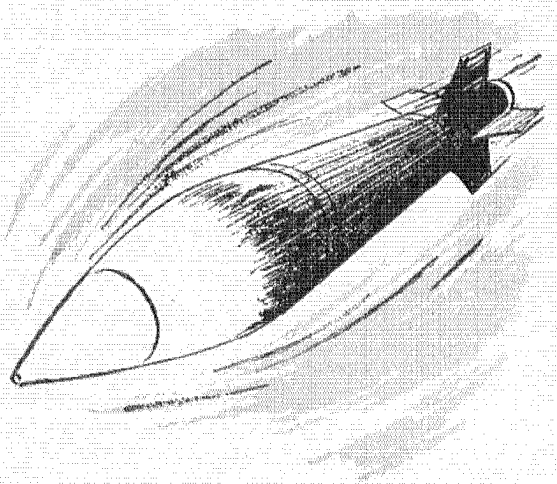
For space traveling parachutes that go up compression-packed in the nose cones of missiles, where they must stand up to extreme temperature variations; for rugged air-bags that cushion the impact of a heavy object returning from outer space; for covers on booster bottles holding the solid propellant used to help guide a missile; for dozens of still classified applications that are preparing mankind for the Space Age, rocket engineers have learned that it pays to call on Du Pont's Fairfield plant.



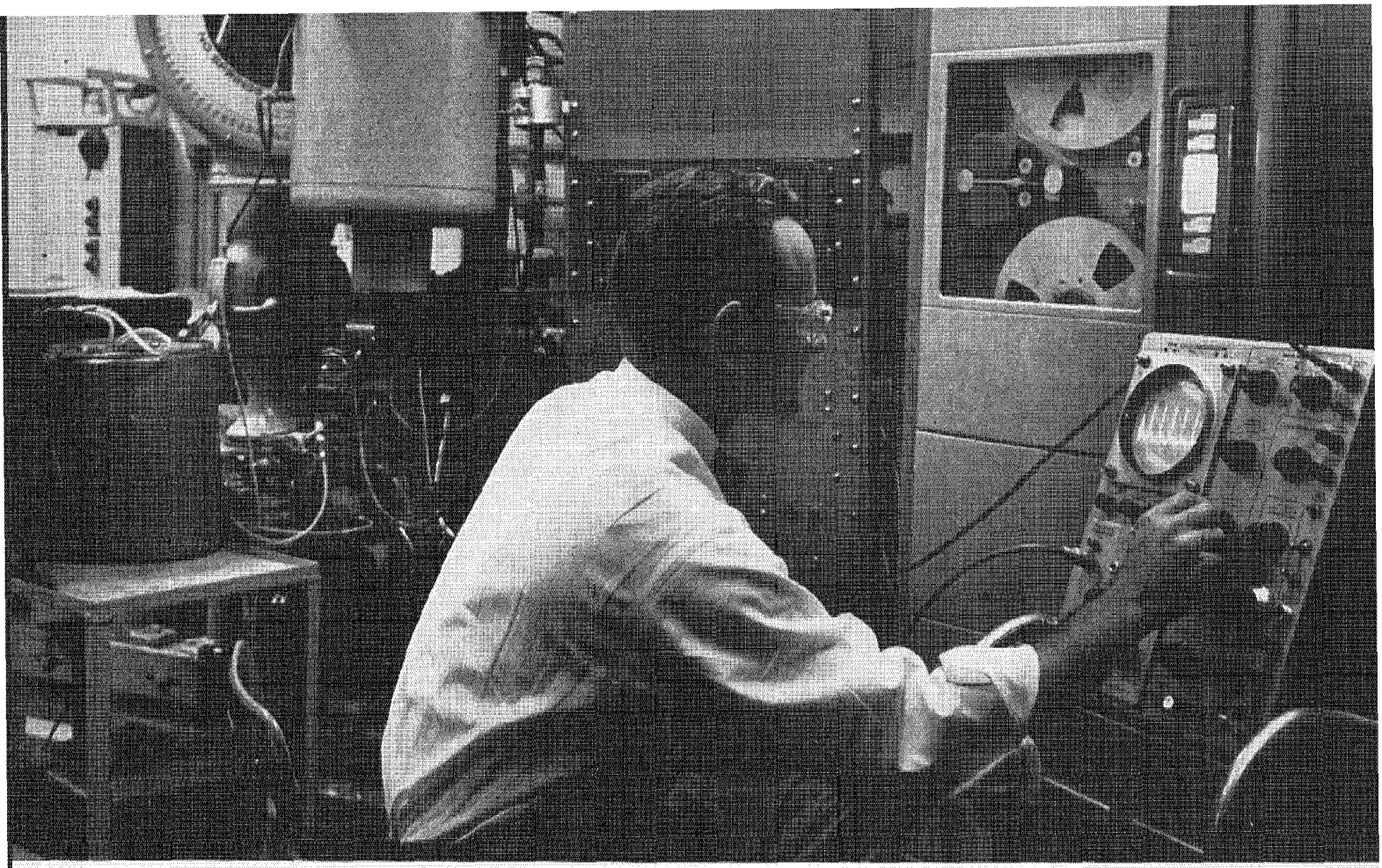
or fabrics "for rugged air-bags that cushion the mpact of heavy object returning from outer space . both rocket and missile engineers have found pays to call on Du Pont's Fairfield plant."



"Protective clothing made of 'Fairprene' 84-001 ('Dacron' fiber coated with 'Viton' synthetic rubber) successfully resists liquid oxygen, hydrofluoric acid, other powerful chemicals."



"Fairfield's 'Armalon' TFE-fluorocarbon resin coated glass fabrics are applied to manufacture of wire and cable for use in hot spots both in rockets and in missile electronic systems."



This Du Pont-developed equipment measures and records data on surface ignition in auto engines.

For the car in your future

. . . are a variety of new developments at the Du Pont Petroleum Laboratory. New facilities will make the lab's work more fruitful.

By W. B. TALMAN

At the Deepwater, N. J., site where the hush-hush Manhattan Project was once carried on, Du Pont has just spent a million and a quarter dollars to increase the facilities of its Petroleum Laboratory for research on fuels and on chemical additives to improve the performance of petroleum products.

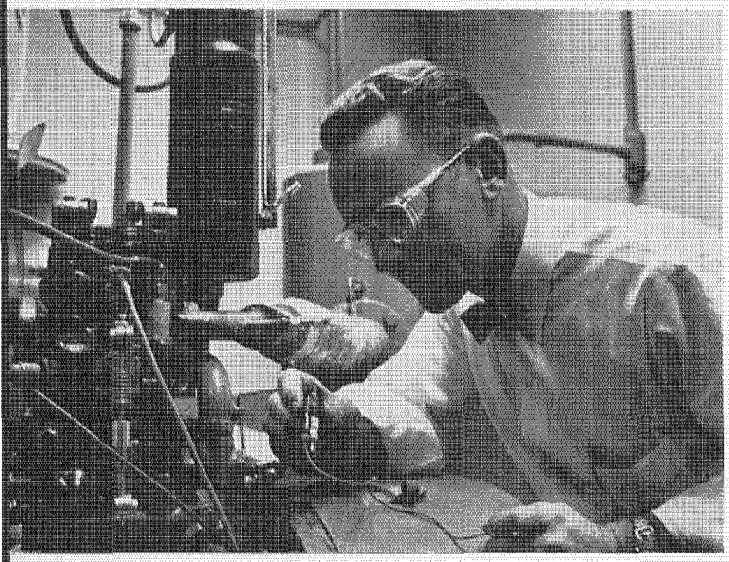
Far from being secret, the Du Pont lab's explorations into the fuel and engine problems of the future are widely published not only for the benefit of the makers of fuels and lubricants but also to aid the aircraft and auto industries.

Recently, for example, Petchem engineers devised an instrument for detecting and studying today's number one combustion villain, surface ignition. The instrument precisely measures the rate at which gasoline burns in automobile engines and records it on magnetic tape for analysis. The equipment is so sensitive that differences in burning times of as little as five millionths of a second can be measured. Previously, it was impractical to do much more than guess at the degree of surface ignition in cars, since it is difficult to gauge and study.

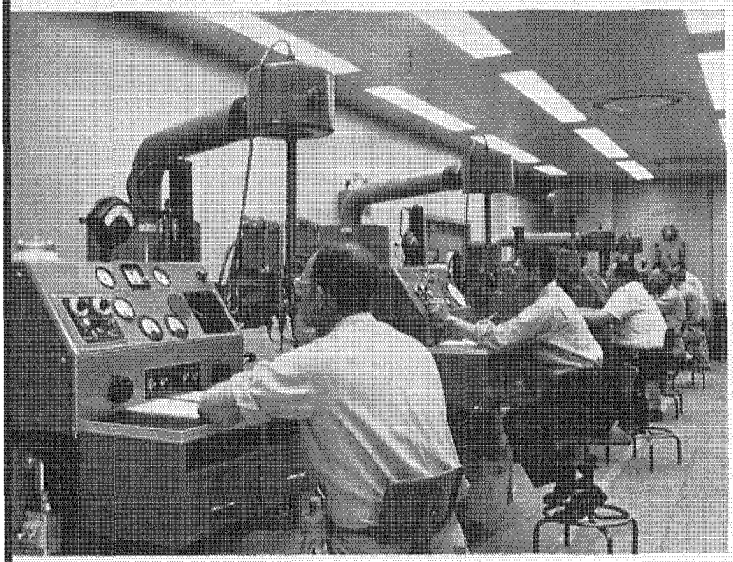
Naturally enough, the makers of fuels and auto engines are interested in the new surface ignition detector. They'll have a chance to build their own when Du Pont supplies the blueprints, as it plans to do.

Meanwhile, the search goes on at the Petroleum Laboratory for better additives for gasolines, diesel fuels, lubricating oils and fuel oils. Data supplied by advanced electronic equipment such as that for surface ignition detection is one tool of the researchers. Du Pont scientists and engineers also carry on fundamental chemical research and exhaustive laboratory and field evaluations as they seek to come up with the "new and better."

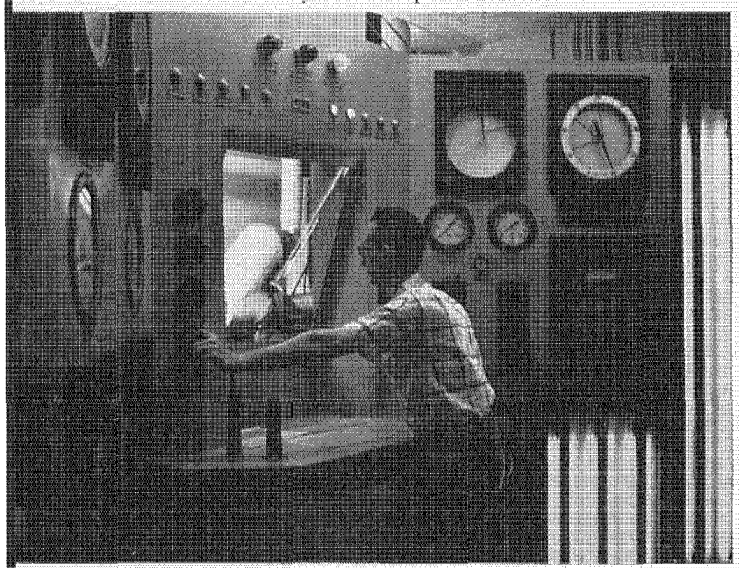
Problems from customers normally go to the lab-trained technical manager in one of Du Pont's five sales



Another tool of Petroleum Laboratory engineers used to learn about prevalence of surface ignition: special spark plug pressure pickup.



Battery of knock test engines is used by Petchem in making semi-annual octane number survey from samples collected all over U.S.A.



The Petroleum Laboratory staff studies fuel problems of jets, too. This special instrument burns jet fuel in same manner as jet plane.

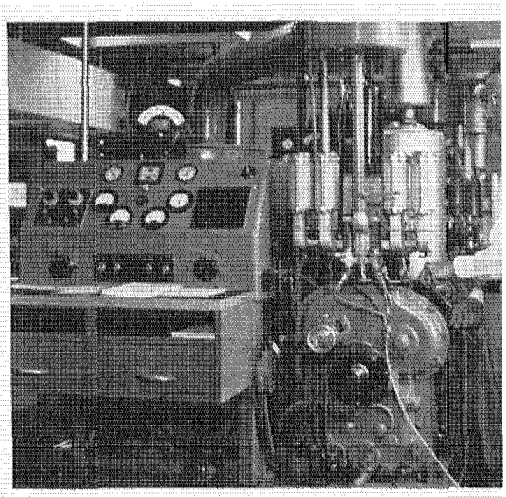
regions, and many queries are handled in the Petchem regional labs. Larger questions or those involving broad research are forwarded to the New Jersey laboratory. In addition, scientists in laboratories of other Du Pont departments can be, and often are, consulted. For instance, Petchem called on the Fabrics and Finishes Dept. lab at Fairfield, Conn., to evaluate the effect of a new gasoline additive on the life of fuel-pump diaphragms. Another time they worked with Explosives Dept. scientists on the development of thermally stable high-temperature synthetic lubricants for jet engines.

Du Pont's advanced electronic computers are available to customers to estimate the capabilities of their refineries. Such linear programing can determine the most efficient way to blend the various types of gasoline base stocks produced by modern refinery processing. Figures from one such programing operation showed a refiner that a product he was selling for $5 a barrel could be blended in another way to be worth nearer $6. In an industry where profits sometimes depend on the third place after the decimal point, such aid is often welcome.

The Petchem lab has given birth to a noteworthy range of products that are contributing to more efficient use of fuels and lubricants. One, an additive for diesel fuel oil, minimizes the formation of sludge in storage tanks and in injection nozzles. Another protects fuels from the harmful catalytic effects of copper and copper alloys. A third example is an aviation fuel additive that inhibits corrosion.

Search for new additives is backed up by testing to insure that new products will work the way they should, be easy to use, and not have undesirable side effects. Let's look at the example of gasoline additives. These complex chemicals must be compatible with other materials in the gasoline and be effective under all types of driving conditions. This also means additives must do their work in gasoline for engines that are factory fresh or almost ready for the junk yard. To make sure that Du Pont gasoline additives measure up, thousands of miles of road testing, followed by detailed engine inspections, are routine. Even rear bumpers of the test cars are checked to make sure the additives didn't cause corrosion.

This engine-to-rear-bumper thoroughness—this blending of human brains and machine brawn necessary to prove out a gasoline additive—is typical of the Petroleum Laboratory's applied research. Its scientists and engineers will know how to use their new facilities to make the car in your future run longer and better.



Besides New Jersey lab, Petchem maintains five regional laboratories to help solve problems of company's customers.

HOW BEST TO TRAIN OUR SCIENTISTS?

Americans have raised this question often in the two years since Sputnik. But it has been a major concern for much longer in academic and industrial circles.

Ever since 1918 Du Pont has given money to encourage the advanced study of science in American universities. Originally, this aid was in the form of predoctoral fellowships. About ten years ago grants for fundamental scientific research were added.

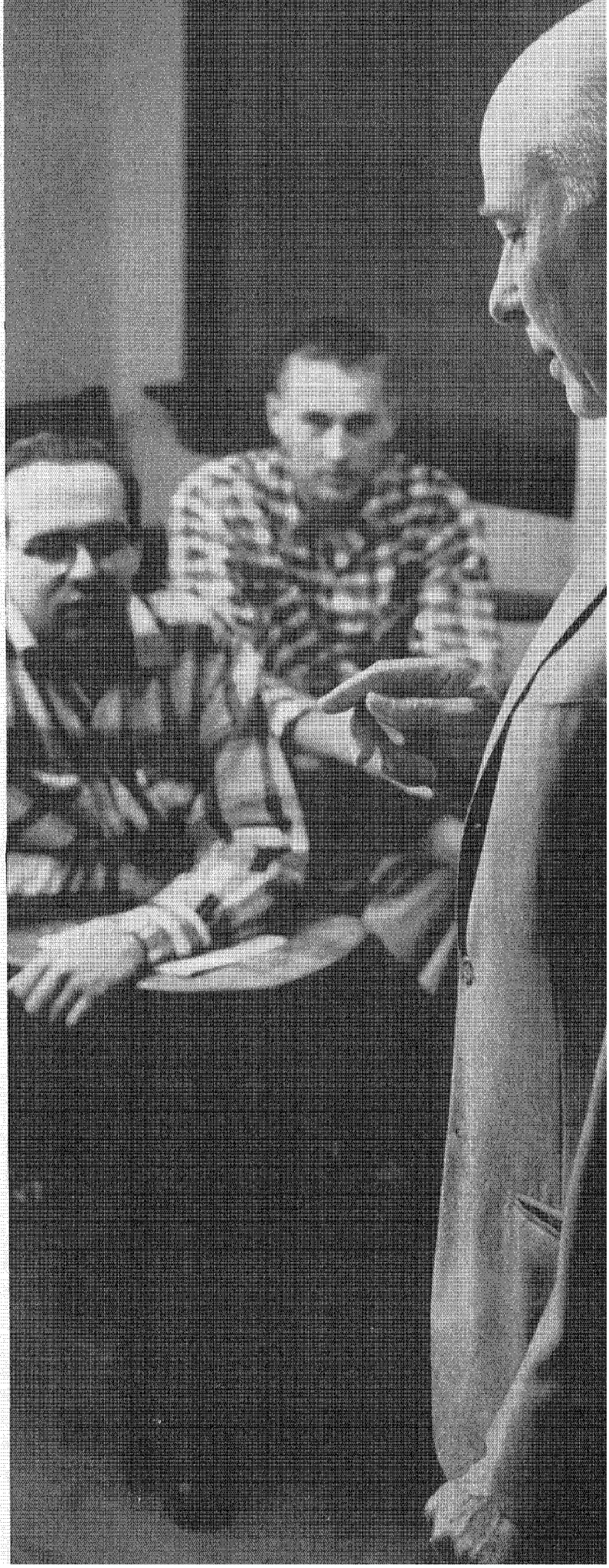
Then, in 1953, the company launched a new program aimed at strengthening the undergraduate education of scientists and engineers. This fall, each of 76 liberal arts colleges will use a Du Pont grant of $2,500 to support the teaching of chemistry and an additional $1,500 for other liberal arts subjects. Twenty-three privately controlled universities have accepted $4,000 grants for courses that contribute to scientific and engineering education. Within these broad frameworks, the schools may use the money as they see fit.

Such a grant last year helped Dr. Donald Hatch Andrews, right, revamp the freshman chemistry course at The Johns Hopkins University. What this involved is told on the next three pages. The man who follows most closely what the schools are doing with the grants is Dr. Julian Hill, executive secretary of Du Pont's Committee on Educational Aid.

"The money is used for a variety of purposes," he said the other day. "Much of it goes to buy laboratory and demonstration equipment and a lesser amount for books and library materials. The funds also help reimburse faculty members for summer research or travel to scientific meetings, and pay undergraduates for teaching or research assistance."

Du Pont made a number of other grants to aid teaching during the 1959-60 academic year. These include: $3,000 each to 12 medical schools to support education and research in biochemistry; $184,000 for 46 postgraduate teaching assistantships, mostly in chemistry, at 42 universities; and $80,000 for fellowships and scholarships for prospective high school science and mathematics teachers. Total contributions in this area were $696,000.

In emphasizing teaching, Du Pont has not neglected its older purpose of encouraging research. Unrestricted grants to 36 universities and colleges for fundamental scientific studies this year added up to $450,000, bringing the company's total aid-to-education effort to nearly $1.2 million.



Donald Hatch Andrews, director of revised Hopkins chemistry course, taught freshmen for first time.



Robert Abernethy disliked high school chemistry, but found the Johns Hopkins course "wonderful."

Split 325 freshmen into 12 sections according to background and ability. Cut down on laboratory hours by emphasizing a few major experiments. Introduce modern thermodynamics and quantum mechanics, along with the traditional laws of gases and temperatures. That's Johns Hopkins'

New formula for freshman chemistry

By LEO GEIER

Robert Abernethy pushed his long frame back from the laboratory table, looking intent as he answered my question.

"I'm studying the photoconductivity of germanium crystals. Right now I'm using alpha and beta particles to determine the change in the ability of the crystals to conduct electricity at different temperatures."

Abernethy is not a research chemist, nor even a graduate student. The day I talked with him he was winding up his freshman year at The Johns Hopkins University in Baltimore, Md., where he was one of six special students conducting original research as part of a radically new freshman chemistry program.

"In many ways, the quality of research being done by these students is as good as that being accomplished by the average graduate student," says Professor Donald Hatch Andrews, director of the program. An eminent research chemist, Dr. Andrews taught freshmen last year for the first time in more than 30 years on the faculty.

The new Johns Hopkins course is the result of more than three years of study, planning and inventive revision. At the start, students were divided into sections according to background and ability. They found themselves spending fewer hours in the lab than freshmen usually do, but working with more advanced laboratory equipment. Lectures and lab sessions were coordinated and experiments closely related. New teaching aids helped students master an updated chemistry course that included a look at thermodynamics and quantum mechanics.

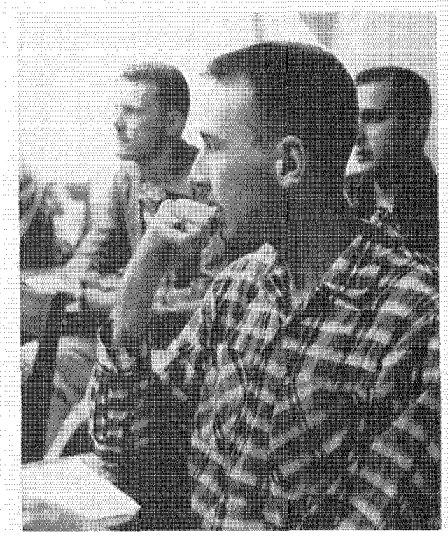
Financial support from the National Science Foundation helped with special laboratory apparatus and teaching aids. With National Science Foundation funds, too, a report on the program will be published for chemistry teachers in U. S. secondary schools and colleges. But it was an unrestricted grant of $4,000 from Du Pont, one of 96 made by the company in 1958 to improve undergraduate teaching in colleges and universities, that got the new course under way.

"We were ready to go but didn't have the money," explained university provost P. Stewart Macaulay. "The Du Pont grant made it possible, without undue drain on other university resources, to organize and start the new course."

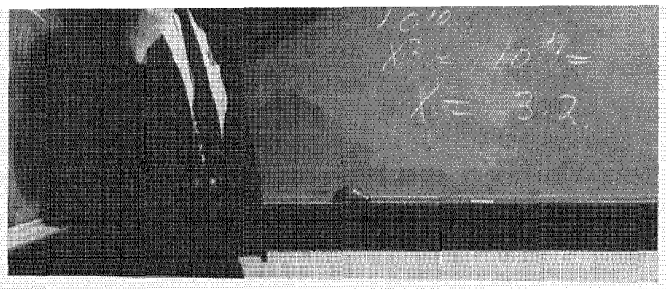
To Dr. Andrews it seemed high time for a change. "Since the spring of 1955 I had been thinking about ways to bring our teaching program up to date," he recalls. "With all the advances in understanding the atom and thermodynamics, I thought we should give the boys a more mature approach to the subjects."

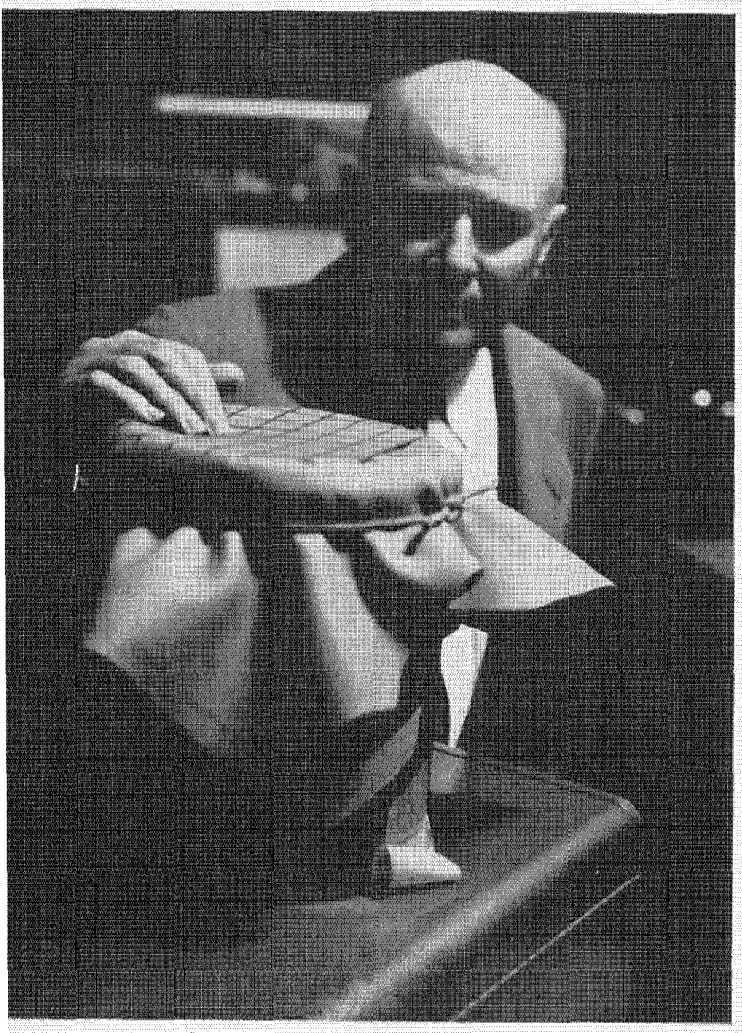
Dr. Andrews was one of the first to appreciate the coming importance of atomic energy. Several years before World War II he was called to Washington



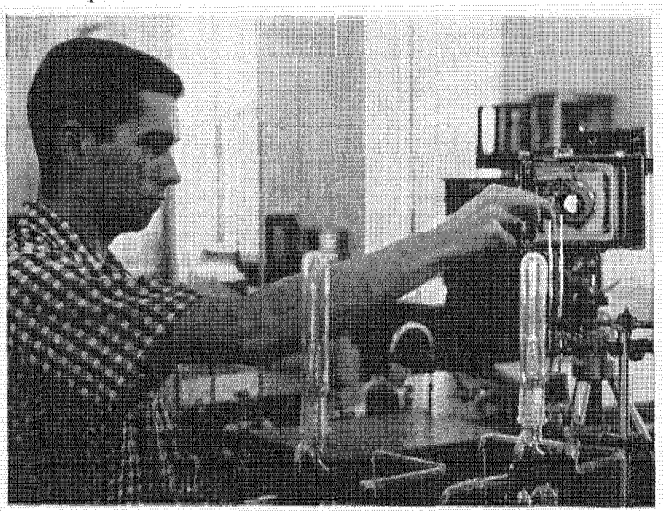


Students heard lectures on thermodynamics, quantum mechanics with varying reactions.





A musician, Dr. Andrews is intrigued by vibrations. He took high-speed movies of this drumhead's fluctuations, shows them in slow motion. Wave patterns illustrate behavior of waves in matter.



Robert Gammon, one of six students doing independent research, photographs flames of methane-air mixtures to find flame velocities.

to describe the possibilities of atomic fission to a group of high-ranki Navy officers; he's credited with being the first to interest the Navy in tl general subject.

Now 61, Dr. Andrews has been a full professor at Hopkins since was 32. Devoting most of his time to research, he early made importa discoveries in his special area of low-temperature studies. More recent the development of his servo-calorimeter made it possible to measu record and compute precise heat-capacity changes so complicated th they had not been attempted before.

But until last fall he had taught only senior and graduate courses, a only one class in any one year. Hence it was a radical change for him turn his attention to the teaching of freshman chemistry. His first step this direction was taken late in 1955 when 35 high school and colle teachers of chemistry were invited to Baltimore for a two-day discussi of the problems of educating chemists.

"This conference convinced me even more that something needed be done," Dr. Andrews says. "Some interesting ideas came out of the d cussions, and we got good tips from men at Amherst, Colby, Bat Washington and Lee, and Western Maryland."

This initial enthusiasm prompted a week-long conference in Octob 1957 under the sponsorship of the National Science Foundation. There t goal was a unified approach to chemistry instruction from the high scho level all the way through graduate training.

By this time ideas for the new freshman course at Hopkins were b ginning to jell. The chemistry faculty had been on the road visiting mo than one hundred prep schools, colleges and universities. Dr. Andrew himself saw more than 30.

OTHER SCHOOLS SUPPLY IDEAS

"Amherst has an outstanding program of coordinating chemistry wi both math and physics," he explained. Brown University's focus on t chemistry of carbon was studied. At Tufts he found a new approach wi emphasis on the chemical bond. And prep schools were making shifts, to Cranbrook had a special projects program. Thatcher School in Californ and Loomis in Connecticut were cooperating with the aircraft industry research into basic problems of missiles and rockets.

Dr. Andrew set about designing a freshman program that would com bine the best of each with still other innovations. With a new associat Dr. Richard J. Kokes, and some enthusiastic graduate students, he set work devising teaching aids, new experiments, new apparatus.

To accompany the coming revolution in the lab, a new textbook b Andrews and Kokes was taking shape. Ready in mimeographed form wh classes opened last fall, it covered some material never before included freshman chemistry. One area was thermodynamics, a subject former reserved for seniors and graduate students. The other was the fundament ideas of quantum mechanics, even though students at this level don't ha the mathematical background to understand its fine points.

Registration brought 325 freshman chemistry students, who were d vided into 12 sections—three advanced, six average and three for those wh needed extra help. The three slower sections had as few as 15 in a class s they could get more attention. In the lab the boys spent only three hours week instead of six doing experiments. The other three were devoted t discussion of past experiments and those coming up.

The experiments themselves were more advanced than tradition freshman ones and, while there were fewer of them, they were close related. "We spent a month experimenting to find the properties of gases, Dr. Andrews explained, "then several weeks on heat experiments."

Each student built his own cloud chamber, where he traced for himse the tracks left by exploding uranium atoms. "We used a glass vacuum sy tem to measure vapor pressure, the rates of diffusion, and the combinatio of benzene with hydrogen," reported Ronald Friant, 18, of Johnstown, P

The coordination of lab with lecture is new. "As far as I know it's standard practice across the country to use a textbook by one author and a lab manual by another," Dr. Andrews said. The Andrews-Kokes text and lab manual will be lithoprinted for this year's classes. Improvements and revisions will continue, and the work will be in print for use by other schools in 1961.

Dr. Andrews spent hours in the barn of his country home to develop the first technique for visualizing the movement of atoms and molecules. To simulate this most fundamental action of matter, he hung colored models of molecules from the ceiling on threads and then shot color movies of them.

Other ingenious techniques went into other teaching aids. Multi-exposures of spinning dots of light from pen flashlights revolving on a mechanical wheel represent the basic movement of electrons. High-speed movies of a drumhead, a musical string and a balloon filled with water being vibrated on a loudspeaker cone demonstrate simply the relationship of harmonic frequencies and types of vibration that correspond to atomic vibration.

Perhaps the most exciting feature of the new program is the independent research launched by some of the more advanced students. After Christmas vacation 15 of the top freshmen were given the chance to submit proposals for special projects. Six students were picked, and during the second semester were excused from regular lab work.

"I would never have had a chance to do research like this anywhere else," exclaimed Mical Mershon, 19, of Cockeysville, Md. His project, supervised by Dr. Channing Wilson of the Baltimore Gas and Electric Company, is concerned with absorption refrigeration.

...THE TRICKS AND FRUSTRATIONS OF RESEARCH

Mershon and the other five found themselves learning both the tricks and the frustrations of research, not the least important of which, one said, is "Anything that *can* go wrong *will* go wrong."

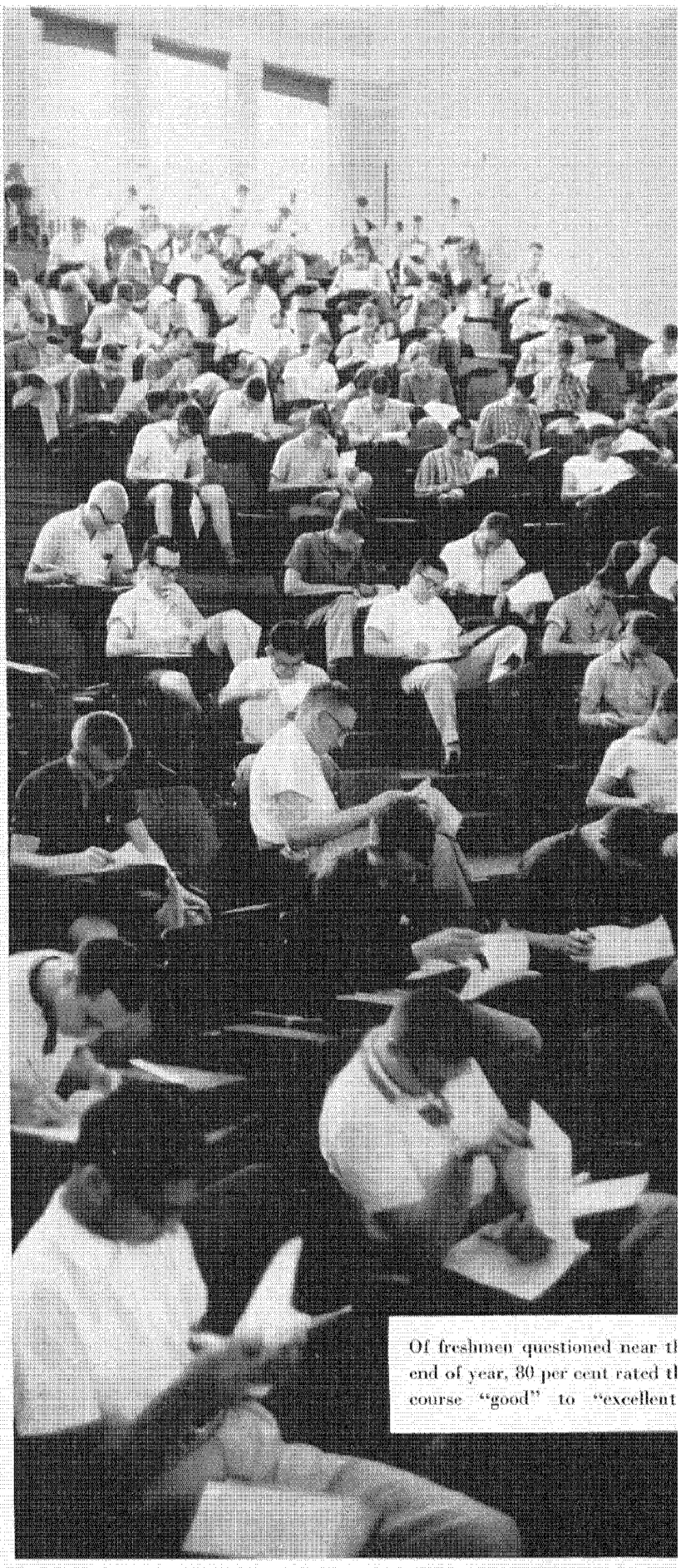
A high point of the whole program as far as the students were concerned seemed to be the presence of Professor Andrews. "He can sense the problems of the freshman," commented Bob Abernethy. "He can put himself in our shoes and really understand how we feel. I hated high school chemistry," he added, "but this is wonderful. We really get a feeling for the fundamental principles."

The new program rated well among the students. Answering a questionnaire, they said they found the course interesting and stimulating. Many volunteered the feeling that they got more out of it than their friends at other schools. Eighty per cent checked "good" or "excellent" as their over-all impression, and even students who thought they might fail rated the program "fair" to "excellent."

"The whole program is going far better than we dared hope for when we started," Dr. Andrews said. He went on to explain that the change is forcing revision of other Hopkins chemistry courses. Physical chemistry and analytical chemistry will have to change to keep pace with the advanced level of freshman teaching.

Some adjustments in the program will be made this fall. "For one thing, we hope to increase faculty participation," Dr. Andrews explained. "We want to move more toward coordinating our courses with physics, mathematics and even biology."

Results of the new program will be made available nationally through articles in professional journals and papers at professional society meetings. "We also want more conferences with secondary school chemistry teachers as well as other college and university teachers," says Dr. Andrews. "Freshman chemistry mustn't ever be a static thing in a day when changes in scientific knowledge come so rapidly."



Of freshmen questioned near th
end of year, 80 per cent rated th
course "good" to "excellent

Vis

The "girl next do

HOLLYWOOD, CALIF.

In some companies, word that the boss's wife was about to take a more active part in the business might cause consternation in the ranks. Not so at Four Star Productions, Inc., where the boss is Dick Powell and where his wife, June Allyson, is recognized as an asset to any theatrical enterprise.

Four Star, one of the busiest makers of filmed series for television, will use Miss Allyson's services this season in the new "Du Pont Show with June Allyson." The weekly series will be launched on CBS-TV September 21 (10:30-11 p.m. E.D.T.) sponsored by Du Pont's Textile Fibers Dept.

The five-foot-one, 99-pound Miss Allyson will be hostess-narrator and will star in nine of the productions. This marks her TV debut on a regular basis, although she has starred in more than 30 motion pictures and won an Academy Award nomination for her vivid performance in "The Shrike" with José Ferrer. Some of her other memorable pictures: "The Glen Miller Story," "Strategic Air Command" and "Interlude."



June Allyson, with daughter Pamela and son Ricky, takes a walk on family's 50-acre ranch between Beverly Hills and Pacific Ocean. Miss Allyson, with producer-husband Dick Powell, will put on new Du Pont TV show this fall.



Home life of a star can be noisy at times. The youngsters also love horses and sports.

with June

untless movies opens a new dramatic series on TV next month for Du Pont

Miss Allyson conveys the enthusiasm she feels for her new venture: "Our stories will have the same maturity and good taste as those on the 'Du Pont Show of the Month.' Instead of portraying a continuing character, I'll play a variety of roles—everything from the disillusioned wife of a washed-up prize fighter to a conniving socialite.

"The shows will be about contemporary America. One touch I especially like will be the unusual introductions. American artists have been commissioned to create original paintings and sculptures for the show. As the hostess, I'll use one each week to introduce the story. Then the camera will move to an extreme close-up of the art form and dissolve to the dramatic action."

Acting as executive producer of the series is veteran star-director-producer Dick Powell. The two have been married 14 years and are the parents of two children, Ricky, 8, and Pamela, 11.

In her husky voice—actor Van Johnson calls it "the million-dollar laryngitis"—Miss Allyson says, "People naturally assume that if you're working for your husband, everything's a breeze. *That's* a laugh!—He directed and produced 'You Can't Run Away From It,' in which I starred for Columbia Pictures several years ago. It was strictly a professional relationship between Dick and me. I didn't even have lunch with him during the filming.

"There was just one difference in having Dick instead of someone else as the producer. I was more prompt than I would have been for anyone else. I didn't want people to think I was being coddled, so I worked even harder than I normally would have."

The Powell-Allyson story began in 1944 on the set for "Meet the People," in which both were acting. The two were married the next summer and now live in a ranch house in Mandeville Canyon between Beverly Hills and the Pacific Ocean. Situated on a knoll, the house commands a panorama of rugged hills and plunging canyons.

30 COWS, 15 SHEEP AND 6 HORSES

Grazing over part of the 50-acre ranch are 30 black angus cows, 15 sheep and 6 horses. "Those are to keep my husband and children happy," Miss Allyson quickly points out. "I love the seclusion of the ranch but I'm not too fond of all the livestock, especially when they break out of the pasture and decide to use the swimming pool for a watering hole."

But she does have a fondness for dogs—a fondness in full evidence. Besides three poodles there is a Labrador retriever and "a lovable mutt of questionable origin."

Young Pamela has her father's love for horses and has won several ribbons for her riding. From his mother, a former swimming champion and expert tennis player, Ricky has inherited an enthusiasm for sports and is an avid baseball fan and player.

The Powells generally spend their evenings quietly with their children. They entertain infrequently, and when they do the guests usually are old family friends like the David Nivens, Charles Boyers, Edgar Bergens and Leonard Firestones. A typical evening is informal and often features an outdoor barbecue of Powell-grown beefsteak.

Wildlife often makes the evenings the most exciting part of the day for the children. Frequently deer slip out of the hills and pass through the yard on their way to water at the lake about a hundred yards from the house. On rare occasions the cry of a bobcat cuts the quiet night.

From their canyon, it's an hour's drive to the studio in North Hollywood. "That means getting up at 5 every morning and getting home at 7 in the evening," laments Miss Allyson. "But then," she adds, "Dick's been doing it for years now and it hasn't had any serious effects. He thrives on work, in fact."

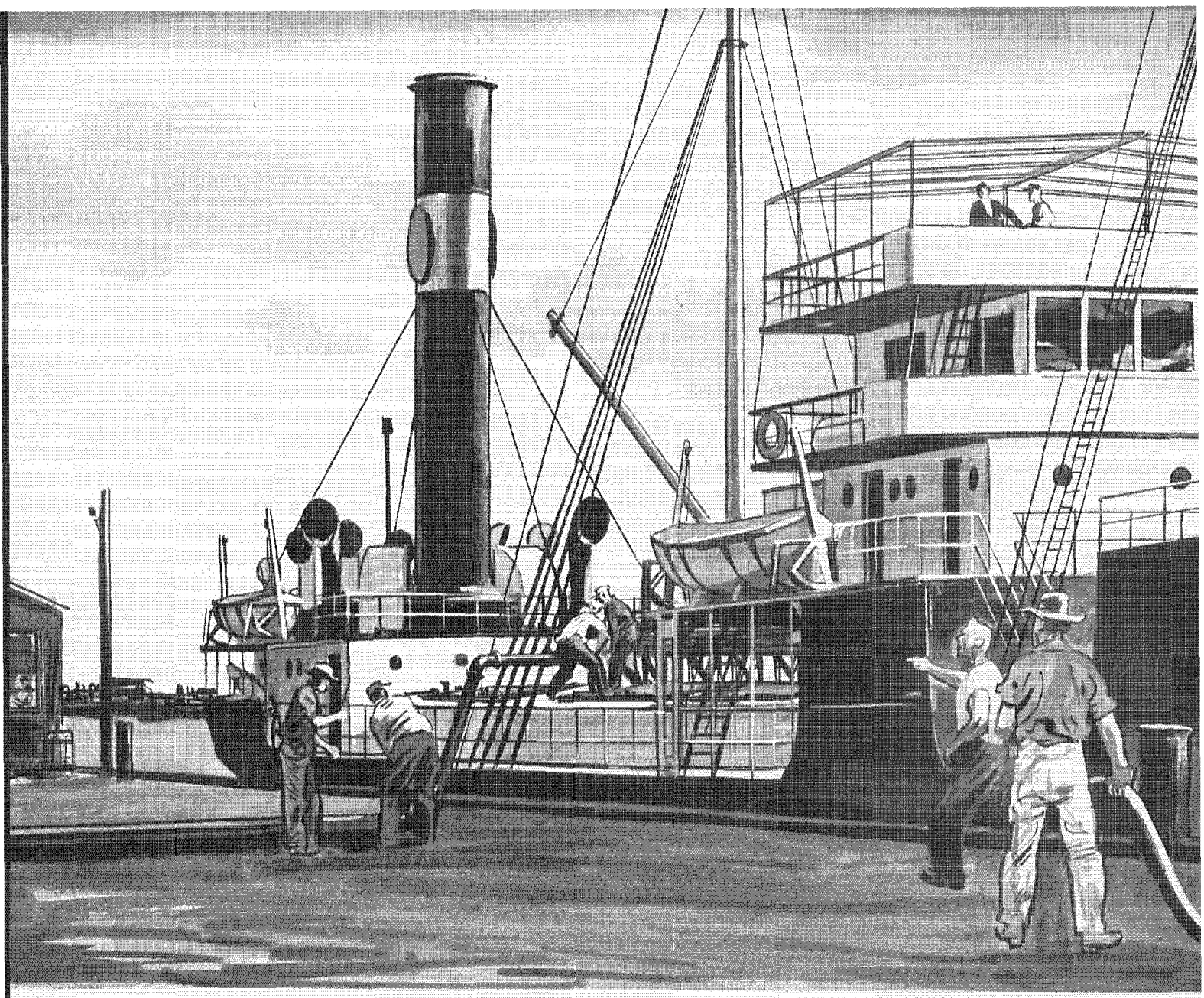
As president of Four Star Productions, Inc., Powell has built the company into a major producer of television shows. Besides "Dick Powell's Zane Grey Theatre," of which he is host and occasionally a star, the company will have six series on the air for the 1959-60 season.

Will he be as coldly professional about his wife's new series as he was when he directed and produced her movie?

"Well," he smiles, "maybe I've mellowed a bit. I can't allow the show to take me away from all my other obligations, but I think I'll be able to fit in a lunch hour with June occasionally."

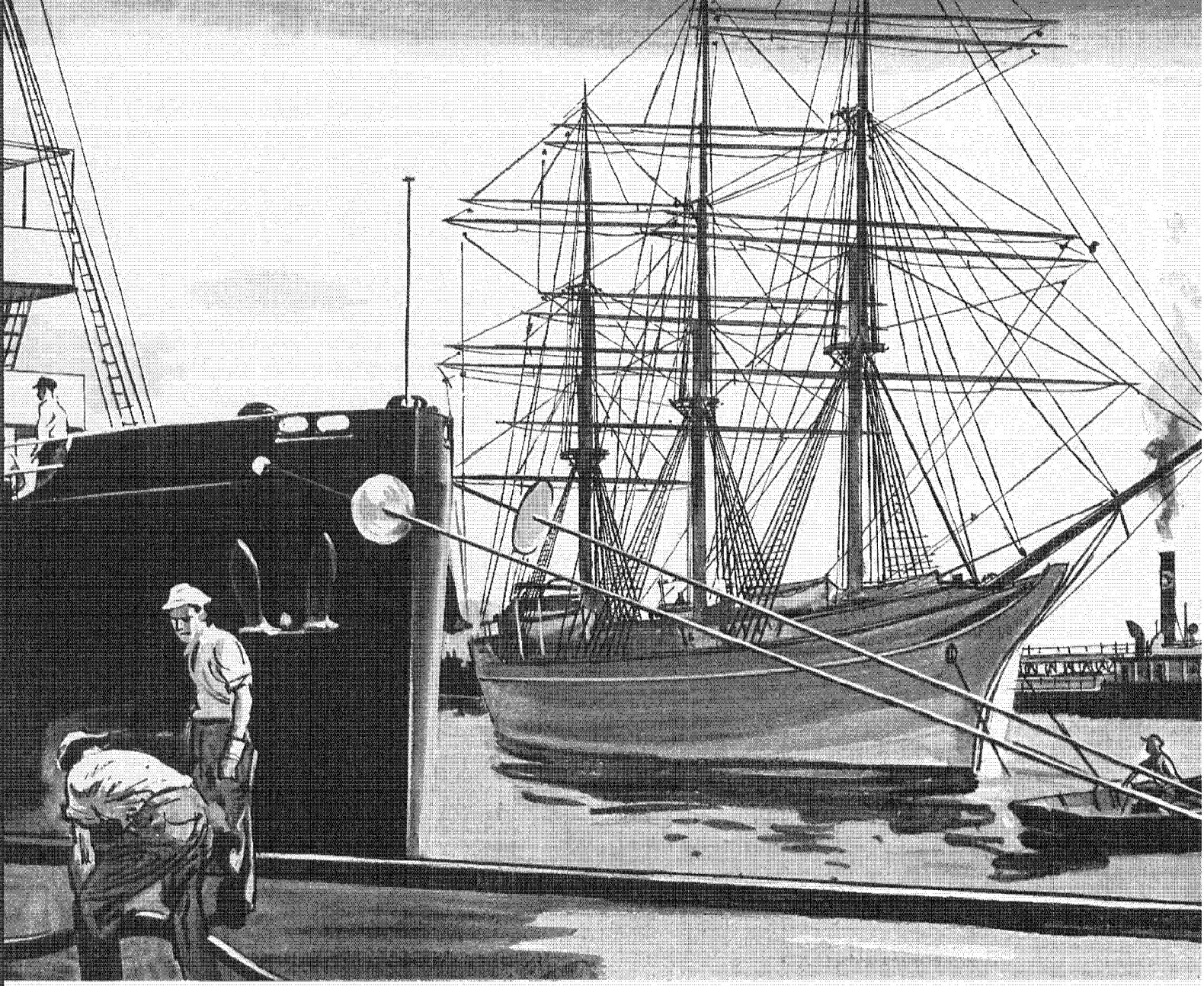


At the recent Chicago Home Furnishings Show, June Allyson ar
Dick Powell learn first hand about the use of Du Pont fibers
home items. Here they discuss designs and colors in carpetin



Both sailing and steam vessels carried Texas oil in the early 1900's. Ship slowly loads crude (left) and takes on water (right).

Men had struck oil in East Texas and were beginning to refine it, as the first articles in this historical series have related. They then faced the huge problem of moving the oil to market, a story that's dramatic in quite another way. It's told here by a Texan who spent two years recording the recollections of men who lived the state's oil history. The four-part series, of which this is the third, is presented by the Du Pont Petroleum Chemicals Division as a salute to the oil industry's one hundredth anniversary.



TANKERS TO TEXAS

By WILLIAM A. OWENS

In 1901, when gushers began blowing in on the Texas coast, petroleum products were used chiefly for lamp oil or kerosine. But Beaumont oil, as the low gravity crude from Spindletop was called, showed an unfavorable yield of kerosine under analysis.

Oil men saw that it would have to be used for fuel if it was to be used at all. Accordingly, a locomotive on the Houston and Texas Central Railroad was converted into an oil burner at Beaumont in 1901. The same year, fuel oil was used to fire boilers in Louisiana sugar cane refineries.

Once the commercial value of the oil was proved, the problem of transportation became critical. When oil was discovered at Spindletop the only storage tank in the whole area was one that J. S. Cullinan had built at Sabine to receive oil shipped down by tank car from Corsicana. No matter how fast tanks were built, oil overflowed them.

Pennsylvania producers had solved the transportation

problem by building tank cars and pipelines. A pipeline from Beaumont, Texas, to New York City or any of the big eastern markets was unthinkable in those days. Railroads were slow, and there were not enough tank cars to supply the demand. Empty cars of all types got sidetracked and lost for days or even weeks at a time. Men lost fortunes because they could not get tank cars from some remote siding fast enough. They lined grain cars with tin to convert them. They even appealed to governmental authority to make the railroads furnish tank cars. Ex-Governor Jim Hogg, who had a large part in the creation of the Texas Railroad Commission, expressed the opinion that the railroads should be forced to supply such cars.

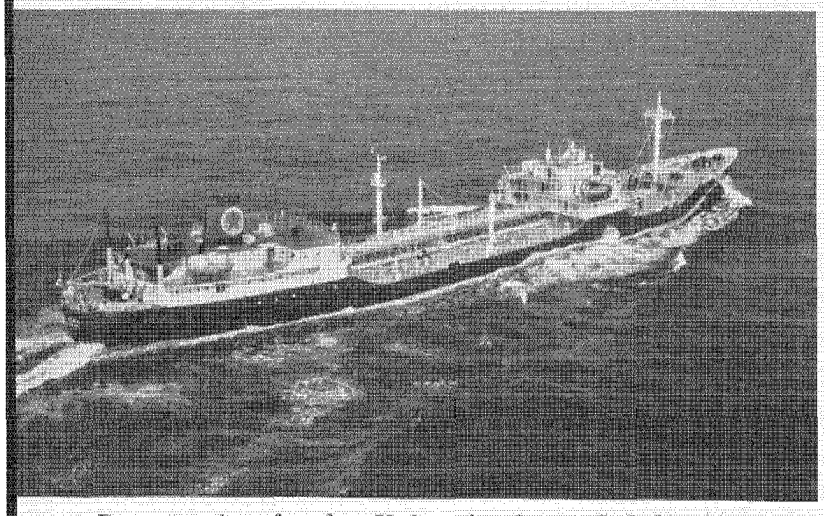
Jim Hogg notwithstanding, the fact remained that there were not enough tank cars to go around. Water transportation seemed the only answer, but oil tankers for loading bulk oil were every bit as scarce.

Transportation of oil by water had started in 1860 at Oil Creek in Pennsylvania. Wooden barges lined with tar and caulked with oakum were loaded with oil and floated down the creek. The first transoceanic shipment of oil consisted of five barrels sent from Philadelphia to London in 1861. The first bulk tanker was loaded with oil in Canada, but sank in the Gulf of St. Lawrence before reaching the Atlantic.

Seaworthy tankers were still in short supply when oil was discovered at Spindletop in January 1901. The first one to take oil from a Texas port, Standard Oil's *Atlas*, didn't leave Sabine Pass until March 1902.

To ease the shortage, shippers converted wooden sailing vessels into tankers by oilproofing the holds. Although steam was steadily displacing sail, these windjammer tankers served proudly. A famous one was the *Thomas W. Lawson*, 385 feet long and the only schooner to boast seven masts. Originally a coal carrier, she was changed to a tanker about 1903 and spent several years moving Texas oil to Philadelphia.

In addition, steam cargo vessels were rapidly converted to oil tankers. The names of some of them—*Northtown*, *Northman* and *Northwestern*—are still remembered by oldtimers at Sabine Pass and Port Arthur. These ships had been built on the Great Lakes to carry wheat from Chicago to Europe. Soon after the boom began at Spindletop they were leased from the Northwestern Steamship Co. by the James W. Elwell Co., reconverted at a shipyard in Newark, N. J., and chartered by Standard Oil.



Representative of modern U. S. tanker fleets is S. S. *New York*, owned by Texaco, Inc. Deadweight capacity is over 19,000 tons.

These were small ships of about 3,000 tons. Each had four holds, with big hatches for loading grain, coal and lumber. In the conversion these holds had to be divided by longitudinal bulkheads. Otherwise, the massive shift of liquid cargo in a storm could capsize the ship.

The vessels were small enough to take the depth of water at Sabine Pass, about 19 feet. Later, when the channel was deepened, the ships were cut in two and made 25 per cent larger by adding 50-foot sections. For stability, they ordinarily left Atlantic ports about half full of water ballast. As they approached Sabine, they began to pump it out. Though the Gulf was normally smooth, the captain had to know how fast to pump to maintain the safety of the ship and at the same time arrive in Sabine ready to take on oil.

The standard order was that a tanker should not be in port more than 24 hours. When things went well, that was easy enough. They did not always go well.

The pipeline that ran from Spindletop to the storage tanks at Sabine passed through marshes infested with snakes, alligators and mosquitoes. The telephone line between the two places was improvised and not very reliable. Sometimes when the pumps on the tanker went wrong, the pumper back at Spindletop went on pumping, not hearing the telephone. Though the captain, ringing desperately the while, would shut off his pumps gradually, the pipeline out in the marshes would buckle and there would be a delay until it could be repaired.

BARGES IN TOW . . . OR MOLASSES BELOW

At times the demand for oil was so great that the tankers took seagoing barges in tow. These increased the danger of foundering, especially during hurricane season. At other times demand dwindled so much that the ships had to be used for other purposes. Sometimes they went by Cuba and filled their tanks with molasses.

Life on the tankers was hard and dull. The sailors could expect nine or ten days at sea for every one in port. Sabine was no mecca for them. There was a narrow boardwalk leading from the dock to the three or four saloons in town. Rarely was there time for the men to get as far away as Beaumont. All too frequently they drank themselves to stupefaction in the saloons and staggered back to ship. At least one drunk sailor fell from the boardwalk and died before he was found, bitten to death by mosquitoes.

By the end of World War I the sailing vessel tanker had gone out of existence. Coal burners gave way to oil burners, and tankers achieved a standard size of about 10,000 tons. Then came World War II, and tankers grew tremendously in both numbers and size. U. S. yards turned out 525 vessels of the Tanker 2 type alone, each over 16,000 tons deadweight. Their success coupled with man's ever-increasing demand for oil led, late in the forties, to super tankers. With capacities of 28,000 to 30,000 tons, these giants could carry seven or eight times as much as the first coastal tankers. Large tankers under the American flag today range over 50,000 tons deadweight.

The Texas coast, where tankers were a rarity 50 years ago, is today the head of the world's greatest tanker trade route. Tankers are the backbone of America's merchant marine, and the world tanker fleet totals 2,954 vessels, an increase of 55 per cent since World War II.

The result of several years' work and more than a million dollar research investment, Du Pont "Oxone" steps into the marketplace billed as . . .

A NEW AND BETTER BLEACH

A jaunty chick, paddling along in an eggshell, is beaming down from store shelves throughout the country this month as new Bon Ami household cleanser achieves national distribution.

The modernized chick trademark—his predecessor merely stood next to his abandoned eggshell—isn't the only thing new about the cleanser. It's also the first nationally advertised consumer product to contain Du Pont "Oxone" monopersulfate compound, a new and more powerful oxygen bleach.

Bon Ami management says it chose "Oxone" not only because it does an excellent job of bleaching but because it's essentially odorless. Thus the company could add a bleaching property to the cleanser that "hasn't scratched yet" without also adding the unpleasant odor of chlorine. The addition of "Oxone" was no whim, either. This marks the first change in product formula in the 75-year history of the Connecticut company.

The change is apparently sitting well with loyal users of the cleanser. Wrote one:

"Congratulations on your new Bon Ami cleanser with 'Oxone'. I particularly want to thank you for the 'no odor' feature. I have in the past used cleansers with nauseating odors of bleach which I found most objectionable. Many women would appreciate it if you'd make a point of this in your ads."

It happens that "Oxone" is being brought to consumers first in a cleanser, but it's expected to be even more important as a laundry bleach. The Du Pont chemists who developed it describe it as the only truly effective bleach that is safe to use on all fabrics. It is "outstandingly better" than other oxygen-based bleaches in removing stains and keeping fabrics white, they say, yet is just as safe for all natural and synthetic fibers, all washfast colored cottons and resin-finished cottons.

This marks no sudden Du Pont interest in home bleaches, incidentally. The company's introduction of sodium perborate to the makers of home laundry products in the early fifties helped establish the dry bleach market in the United States. As has been the case with sodium perborate, Du Pont plans to sell "Oxone" to customers who will in turn formulate it into dry laundry bleaches, household cleansers and so on.

The quest for "Oxone" began at Du Pont's Niagara Falls laboratory in 1954 when consumer demand for a better oxygen bleach in dry form reached a new high. Potassium monopersulfate turned out to be the best compound the staff studied from the viewpoint of both effectiveness and stability.

Then came the job of evaluating it. Chemists figuratively doffed their smocks and donned housewives' aprons. A washer and dryer were moved into the lab and tea towels were bought, parceled out to employees and returned regularly for laundering and bleaching. In later test programs, chemists prowled church bazaars to pick up second-hand clothes for comparative bleaching and gave the new product to a hotel laundry and a housewives' panel for testing. Results were so uniformly good that they led to the decision to produce "Oxone" commercially.

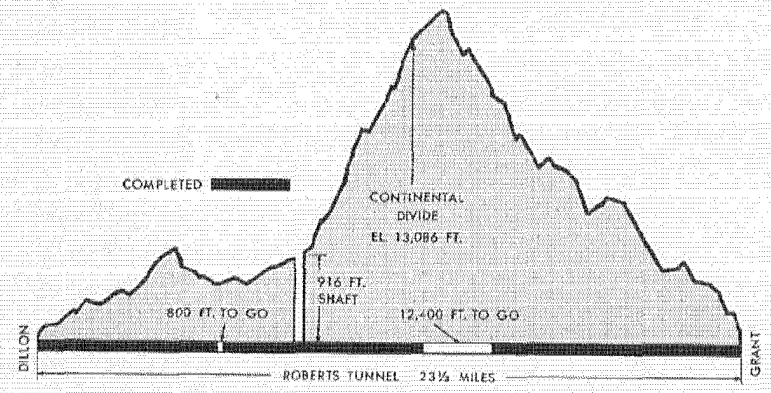


First nationally advertised product to contain the new Du Pont bleach i Bon Ami cleanser. Fact that "Oxone" is odorless was important point



New "Oxone" compound is easy on dyes. This Navy blue dress was cut in two. Faded half held by Du Pont's Gordon Jenkins was bleached with a dry chlorine product, while the unfaded half was bleached in "Oxone".

In addition to Bon Ami, A&P "Bright Sail" cleanser and "du-rite" home laundry bleach, which is marketed in the Baltimore-Washington area, also are being formulated with the new Du Pont compound. As production increases —commercial manufacture of "Oxone" began only a few weeks ago at Memphis—other home laundry bleaches containing the new product will become available nationally.



GIVE M

. . . is Denver's theme song as it watches a 23-mile-long water tunnel being driven under the Continental Divide. It's the city's latest answer to a Providence that placed it high and dry.

Denver's new source of water is snow on these peaks seen from west portal of Roberts Tunnel.

MOUNTAIN WATER

By MALCOLM BELLAIRS *and* KARL WERLINE

Nobody knows better than Denver's water commissioners that Colorado's water is more precious than all of its gold. Right now the commission is in the middle of a $101-million expansion program that makes the point pretty clear.

Located in a semi-arid region, Denver is able to grow only as fast as it can slake the thirst of its citizens and its industries. Foresighted public officials recognized this fact as long as 40 years ago. Surveys at the time showed that development of the eastern watershed of the adjacent Rockies could take care of the city's needs for several years. But one imaginative engineering firm went on to point out that, should the need arise, vast supplies also could be brought from the western watershed on the other side of the Continental Divide, some 70 miles from Denver. It named as sources the Fraser, Williams Fork and Blue rivers, headwaters of the Colorado.

Today that 40-year-old suggestion is being followed once again in the latest addition to Denver's water system —the $50-million, 23-mile-long Harold D. Roberts Tunnel. The fourth and longest tunnel in a unique transmountain system, it will carry enough water to let the area served by the Denver water system double its present population of 650,000.

The tunnel will tap a storage reservoir to be constructed near Dillon on the western slope of the Continental Divide, pierce the Divide on a dogleg route, and connect with the North Fork of the South Platte River. From there the water will flow through an improved river channel and be impounded in existing terminal reservoirs located southwest of Denver.

To speed the job, the tunnel is being drilled and blasted from four faces. Work began in 1956 at the east and west portals. Also, a shaft 916 feet deep was sunk about nine miles east of Dillon on the tunnel route, and crews began drilling and blasting in opposite directions from its base. At the moment, there are less than five miles to go.

Paradoxically, one of the tunnel's biggest problems has been water. It has delayed progress repeatedly on the west portal while workers fought to seal it off and pump it out. Earth also threatens to squeeze in from the sides and bottom. This has forced the Blue River Constructors, the combine of six companies working on the job, to shore the tunnel with steel.

The rock through which the men are boring is sometimes rough on even tungsten carbide drill bits. This is where the tunnel man's standby, Du Pont "Gelex" 2 dynamite, comes in. It is successfully breaking the ground so that each round "pulls bottom." The more work the dynamite does, of course, the easier for the mucking crews.

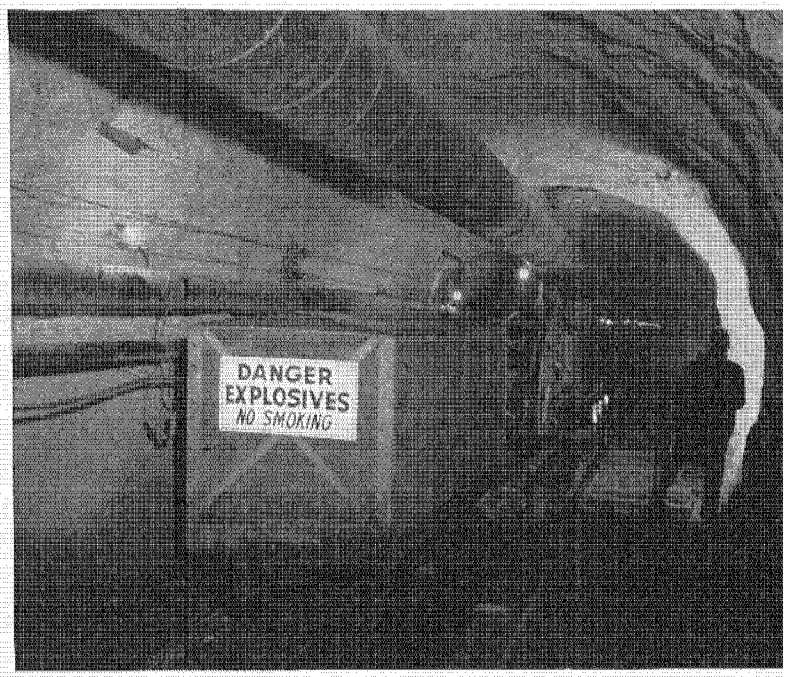
Forty-six holes are drilled and loaded at a time. After the 200 to 250 pounds of dynamite are fired, a powerful fan outside the tunnel sucks out dust and gases. Then the fan is reversed to blow in 10,000 cubic feet of fresh air a minute. Since "Gelex" produces a minimum of noxious fumes when it explodes, the tunnel men can return to the face in a few minutes to begin hauling out the approximately 34 cubic yards of well-fragmented muck left by each blast.

When the blasting is completed the end of this year, the tunnel will be concrete-lined to a smooth inside diameter of 10 feet 3 inches. That will be big enough to handle more than 150,000 acre-feet of water a year—or almost five trillion gallons. This is about 80 per cent of the capacity of the entire eastern watershed and transmountain system now supplying the city.

With its intake at an elevation of 8,845 feet, the new tunnel will fall 178 feet on its eastward course through the mountains. Operated under pressure, water pouring out at the east portal will eventually drive a 6,000-kilowatt electric generator before it finally spills into the South Platte system and races toward the city.

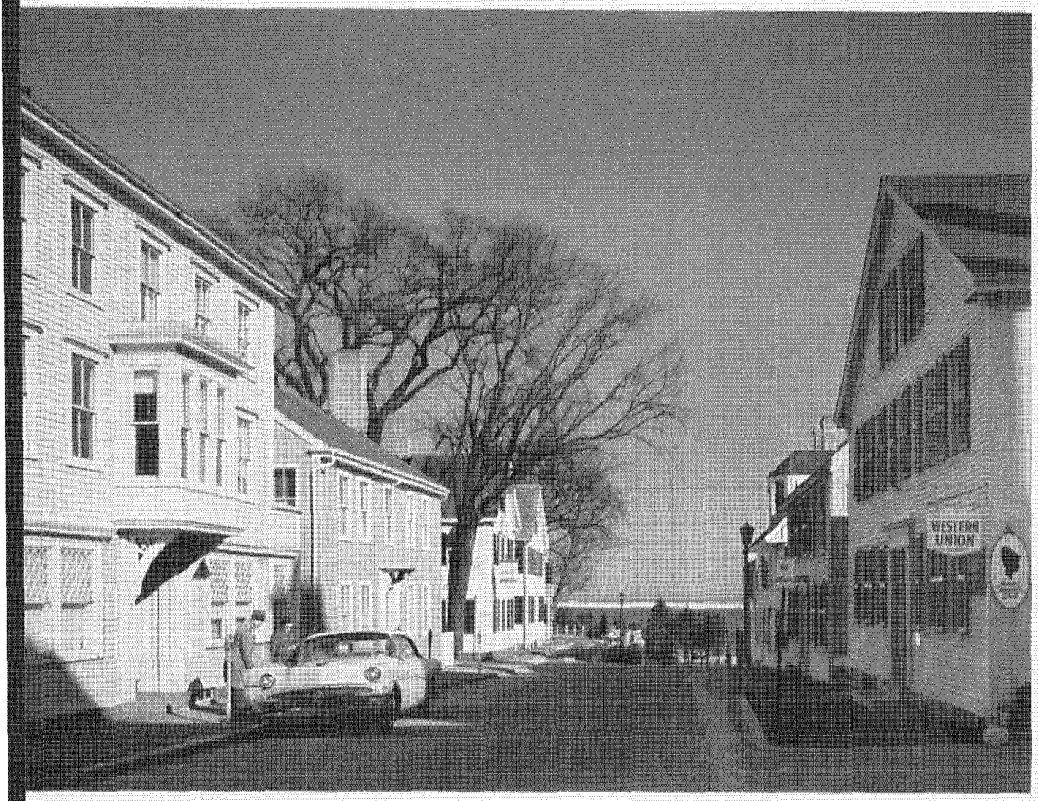
The tunnel is the latest link in an extensive chain that now has a potential capacity of about 184,000 acre-feet of water a year. Runoff from the annual snowpack is tapped from streams a mile to two miles above sea level. Transmountain water also comes through the Moffat and Jones Pass Tunnels. Five huge mountain reservoirs collect runoff water, and high-capacity conduits carry raw water to filter plants for purification. From there a complex system of booster pumping plants feeds the water to Denver homes and places of business.

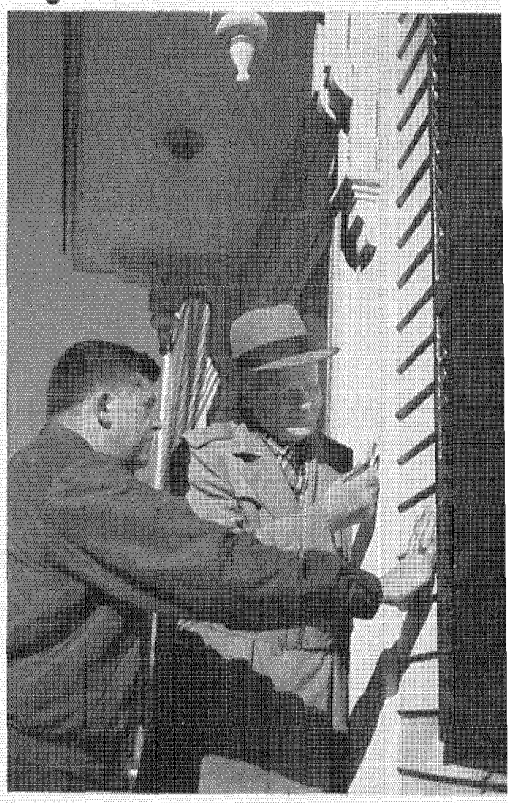
By 1962, when the Roberts Tunnel is completed, the city will be set to stave off thirst until the year 2000 at least. Latest estimates place Denver's population in 1975 at the million mark, well within the capacity of the city's expanded water system.



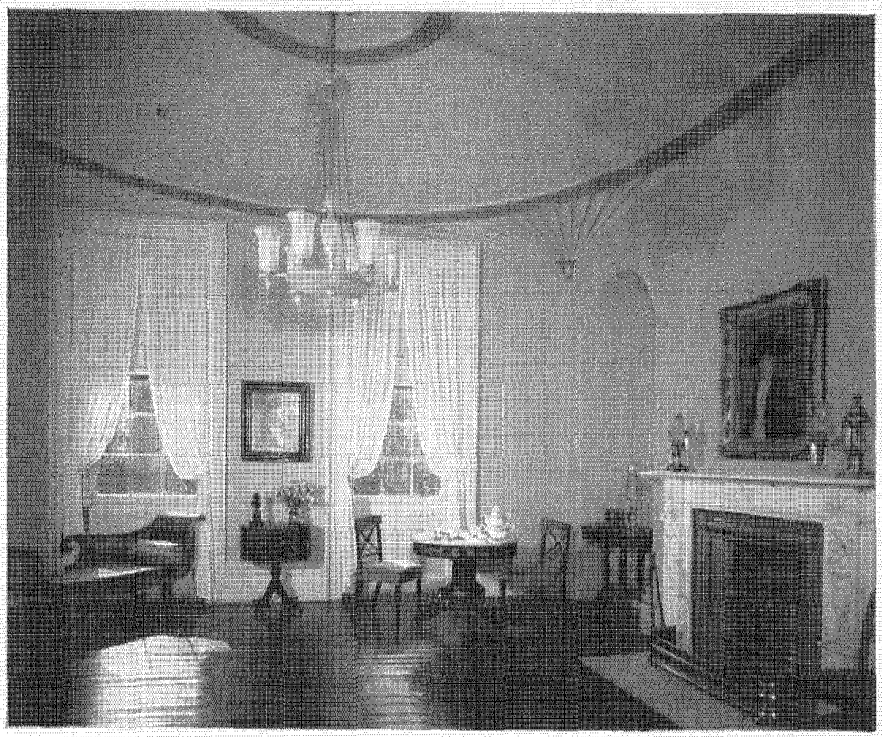
Du Pont dynamite enters east portal on its way to the working face. Relatively smooth tunnel will be made even smoother with concrete.

History around u





The Pilgrims laid out First St. in Plymouth, Mass., soon after they landed in December 1620, measuring plots for 19 families. Their tiny, thatch-roofed houses, built of hewn planks, not logs, are long gone. The street, renamed Leyden in 1823, looks like this today. Du Pont paints are used on most of the old houses pictured. Finishes Division representative Carl Fahlstrom, right, and Alton Giovanetti, Du Pont paint dealer, examine one of the homes for weathering.



Owens-Thomas House Museum, Savannah, Ga., built 1816-19 by a young English architect, William Jay, is outstanding example of English Regency style. Lafayette once spoke from the balcony. Authentic period colors were used in small salon, right, and other rooms. Matches in Du Pont paints were made by Jack Rabey, Stephen Rabey's Sons.

American history is an increasingly popular subject with vacationers. But few present-day visitors to our many historic buildings ever know the painstaking effort required to preserve these links with the past.

"There's definite distinction between restoring a building—that is, bringing it back to its original appearance—and reconstructing with new materials one that has been destroyed," explains restoration architect Walter M. Macomber of the Washington, D. C., firm of Macomber & Peter. "Restoration is carried out as inconspicuously as possible: visitors often aren't aware that work is in progress.

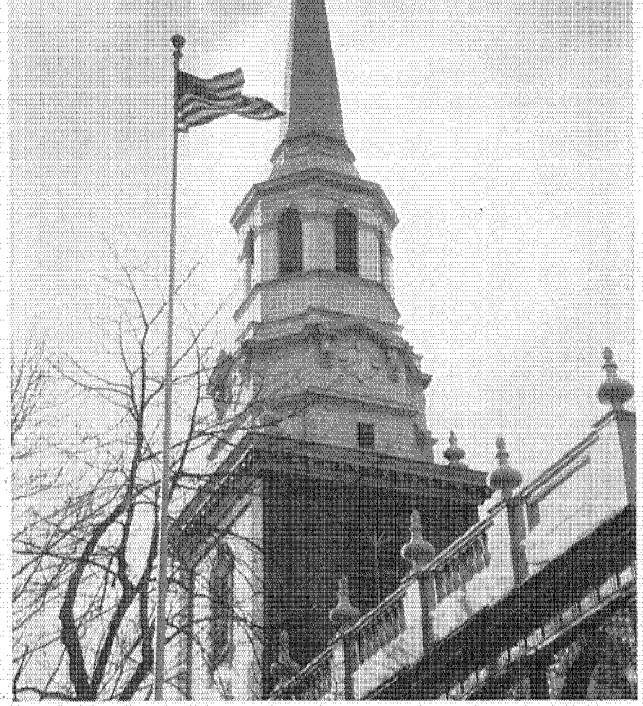
"In restoring the mansion banquet room at Mount Vernon several years ago, many layers of paint were uncovered before we found the original shades. These, we knew, had been applied according to General Washington's own instructions outlined in a letter to his manager.

"Research in Washington's bedroom showed positive evidence that the walls were whitewashed originally. During our research a splinter from a chair rail, long since removed, was discovered between the wall studs. This carried the original paint, a soft green grey seen on the woodwork of this room today.

"At Mount Vernon, Wheatland in Lancaster, Pa., and Tate House in Portland, Me., I used 'Dulux' finishes because of their fine appearance and ease of application."

An unusual amount of color research also went into the restoration of the Owens-Thomas House Museum in Savannah, Ga., after it became part of the Telfair Academy of Arts and Sciences in 1951. Mrs. Lydia Powell of the American Wing of the Metropolitan Museum in New York City directed studies to find true Regency colors, which were then matched in Du Pont paints. Visitors frequently comment on the beauty of the rooms and their colors.

Achieving just the right shade is obviously important. But the Du Pont Finishes Division is equally concerned about providing paints that last well both indoors and out. Among the thousands of visitors to historic buildings, in fact, are Du Pont represenatatives who make it their job to keep track of how well the company's paints are preserving the cherished symbols of America's past.



At Christ Church, Philadelphia, members of the Continental Congress heard a sermon in 1775 suggesting resistance to alien rule. Ben Franklin had helped arrange lotteries to finance tower and 200-foot steeple, which dominated the city in 1750's. Today ivory Du Pont House Paint protects the exterior wood.



Known as America's oldest hotel, the Beekman Arms at Rhinebeck, N. Y., 60 miles south of Albany, has been operating since 1700. George Washington heads list of famous men who have slept here. Early deeds, leases and land grants are displayed in the lobby.



The First White House of the Confederacy, Montgomery, Ala., was home to President Jefferson Davis from his inauguration in 1861 until the government was shifted to Richmond. Furniture and personal belongings of the Davis family are on display. The house, which was built about 1825, is painted white with red chimneys and bright green shutters.

Brushes filled with "Tynex" nylon filaments help fruit and vegetable packers . . .

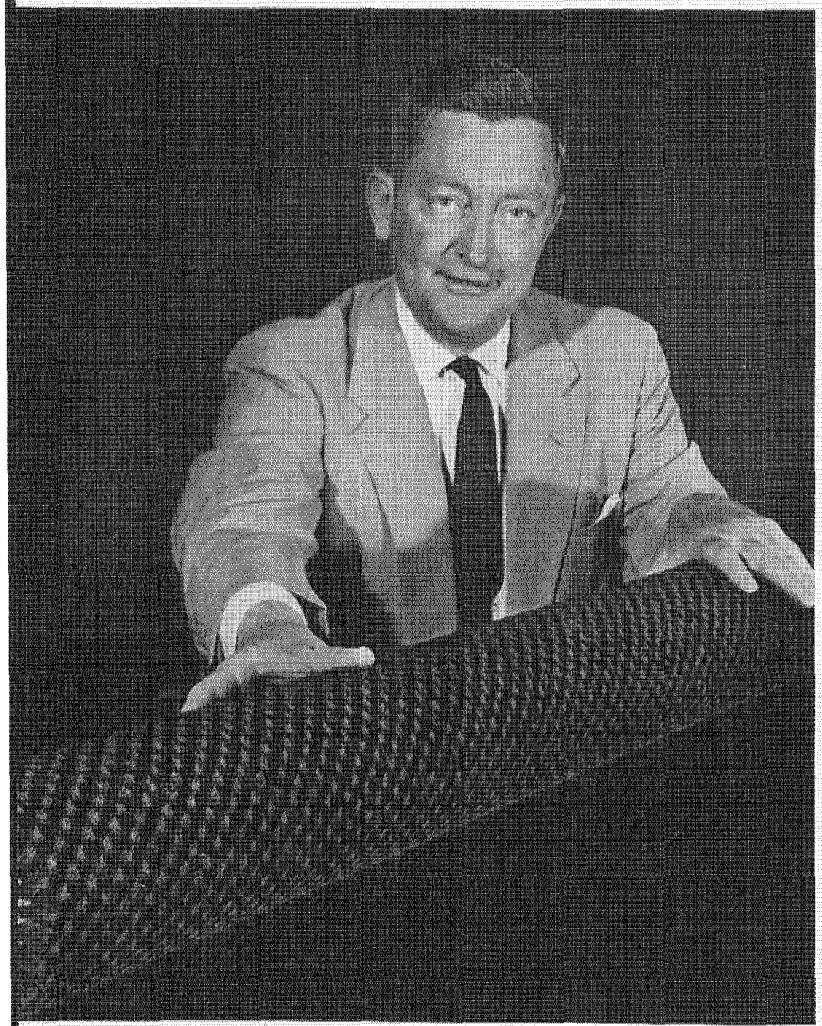
BRUSH UP ON PROFITS

By JAMES H. McCORMICK

"If it's a fruit or vegetable, round or cylindrical, someone can work out a way to clean it with a brush containing 'Tynex' filaments," asserted Bob Wiggins, Du Pont's Mr. Industrial Brushes.

He pulled a salesman's call report from his stack of correspondence. "Here's the sort of thing I mean," he said. " 'Frank Smith & Sons of Carleton, Mich., wash and polish all their vegetables, including about one hundred bushels of green peppers an hour. They wash melons, too.' "

Virtually all citrus is washed before being shipped to market or processed for canned or frozen juice, Wiggins went on. Within the last ten years this practice has spread from apples and avocados to such "strange-as-it-may-seem" examples as dates and olives. The vegetable category includes tomatoes, potatoes, eggplants, carrots, turnips, onions and squash.



Du Pont's Mr. Industrial Brushes, Bob Wiggins, with a typical tool of his trade—a brush filled with "Tynex" for washing fruit, nuts or vegetables.

"Incidentally," Wiggins continued, "have you ever seen anything less appetizing than a home-grown cucumber that has been around for a couple of days? Cucumbers you buy at a store won't often wrinkle like that; they've been washed and then waxed to hold their natural moisture content and color and to protect them from mold."

The big reason for this recent interest in sprucing up produce?

"It's the housewife," Wiggins said. "She may drive a Cadillac, Imperial or a Continental, but she most likely does her own food shopping. And when she picks fruit and vegetables, she not only wants them clean, she wants them to look fresh and appetizing and washing accomplishes this."

Washing involves dunking the produce in water containing a cleaning agent and then passing it through, under or over power-driven brushes that loosen and remove dirt, insecticides and the like. A spray of pure water usually completes the automatic operation. Pure, edible wax is then often brushed on, and still more brushes give the produce a glossy polish.

The companies that make cleaning brushes have tried just about every logical material for bristles, including rubber, tampico, palmetto, horsehair and various plastics. In most cases, Wiggins explained, they have found that long-lasting Du Pont "Tynex" nylon filament is the best.

"Here's a report, for example, on a mid-Florida packing firm," he said. "Fiber X will wash 750,000 crates of citrus fruit as an average before it becomes unusable. Brushes filled with 'Tynex' have washed more than four million crates. How many more, they'll have to wait and see.

"And listen to this one on Florida's largest citrus juice processor, Pasco Packing: 'A brush of "Tynex" was taken out of a washer after three years' service because the end fittings of metal had worn out. The fitting was replaced and the brush put back in service because the "Tynex" showed no substantial evidence of wear.'

"Pasco has all seven of its 20-brush-washing lines completely equipped with brushes filled with 'Tynex'. Plant engineer Don Wiggins—no relation to me—figures the life expectancy of brushes of 'Tynex' is about 48 times that of the brush previously used. Pasco replaced its previous brushes about every seven or eight weeks, and anticipates a four-year life for those of 'Tynex'. The saving is close to $12,000 a year."

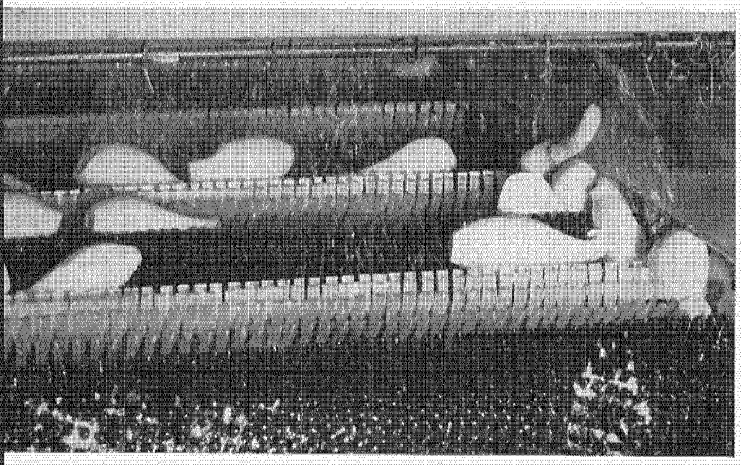
Potatoes, Wiggins pointed out, presented another success story. From interviews with Russell Paul, packing house superintendent of the California Potato Growers in Shafter, Calif., he read these comments:

" 'Brushes filled with "Tynex" have been in use five years and have scrubbed more than three million pounds of long white potatoes.

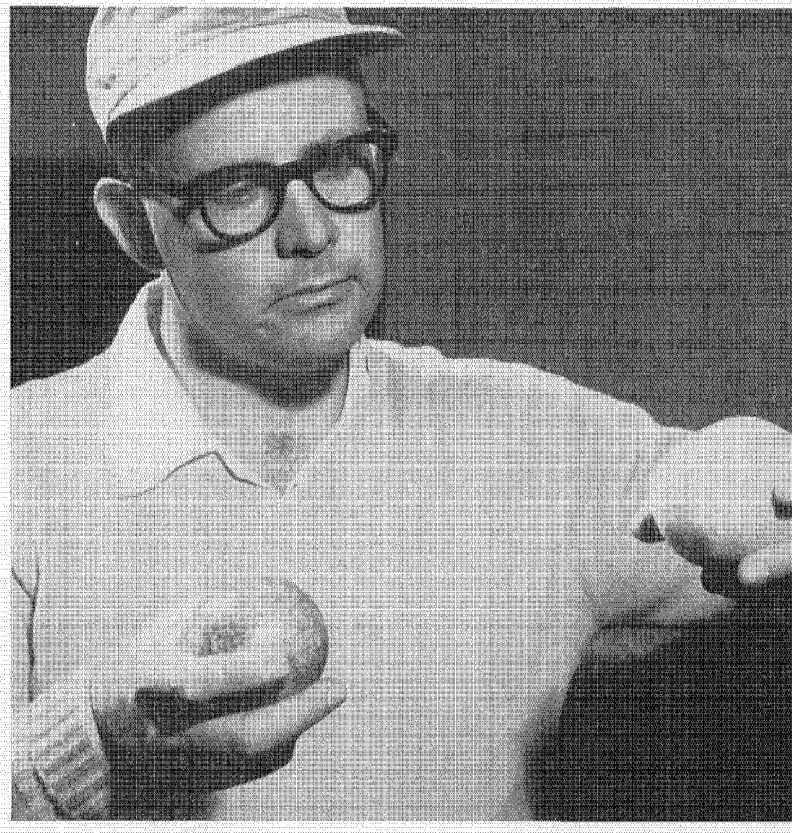
" 'They don't soften even during the summer, when temperatures average 103° in the shade and the filaments

endure the grinding action of clay, sand, loam and gumbo up to 24 hours a day. The improvement over former bristles is considerable. Major savings are through less maintenance and fewer replacements.' "

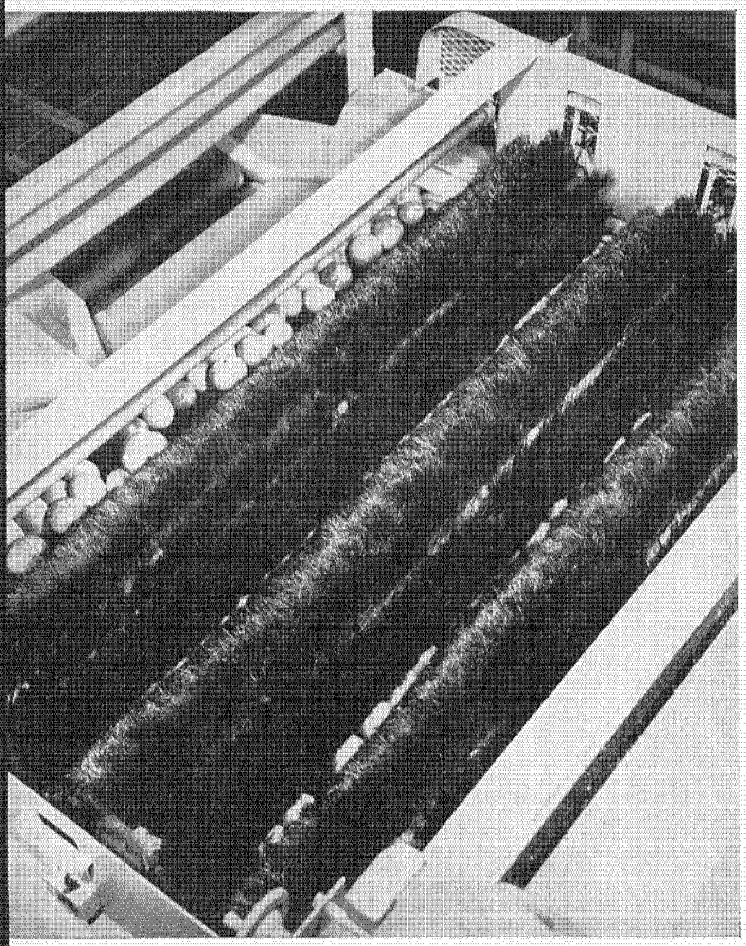
Wiggins paused and stared reflectively at the ceiling. "People come up with some wonderful ideas," he said. "The other day I heard about a California machinery maker who is experimenting with a very soft 'Tynex' filament for cleaning strawberries. Guess I'll have to go out there and see how they're doing. California's a nice place to go this time of year, too."



Series of long cylindrical brushes filled with clear "Tynex" nylon filaments scrub squash as it moves briskly along the washing line.



Brushes of "Tynex" save $12,000 yearly for one processor and make scrubbed oranges, right, almost 100% more attractive than uncleaned ones



Tomatoes get their faces washed. Stiffness of "Tynex" filaments varies: very soft "Tynex" is even being tried for cleaning strawberries.

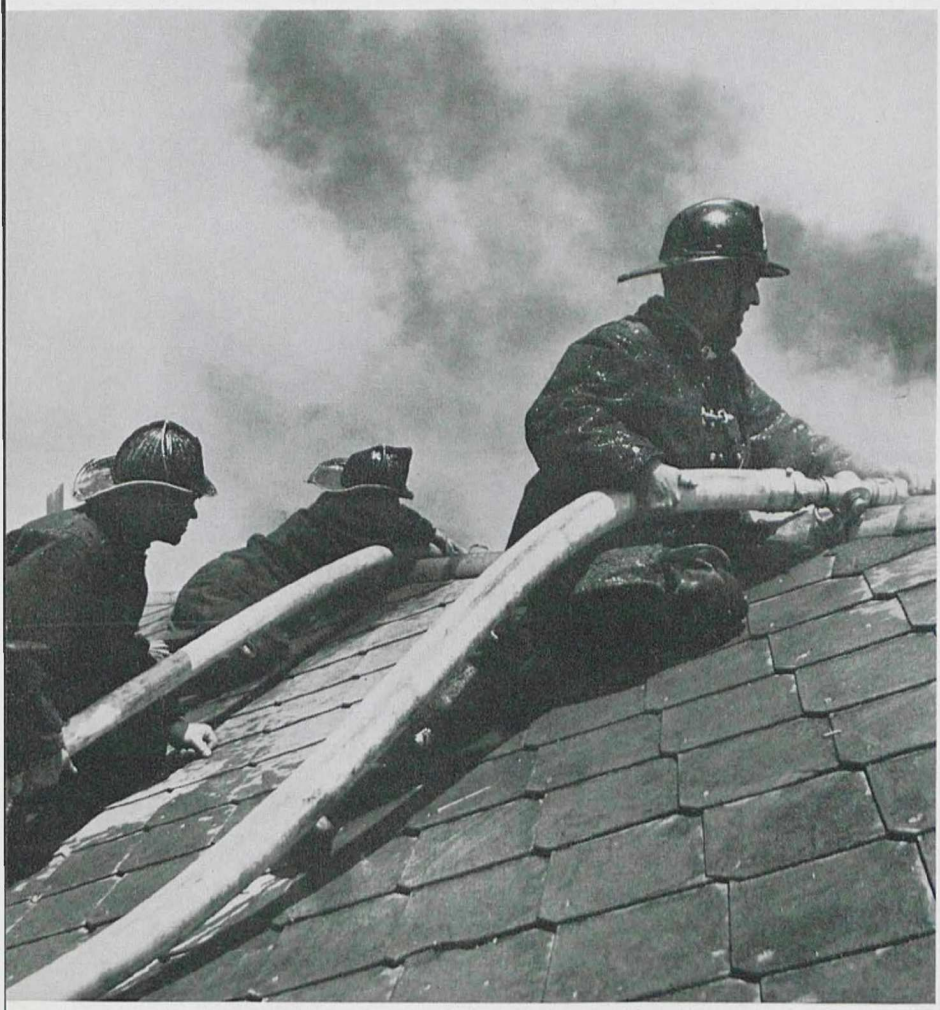


Such brushes filled with "Tynex" filaments have been in use five years and have scrubbed more than 3 million pounds of long white potatoes

Fast friend for firemen

Report for industrial and municipal fire departments: new hose of 100 per cent "Dacron" polyester fiber handles easily and dries quickly

By EMILY HEINE



Wilmington, Del., firemen move in on roof-top blaze, dragging hose of "Dacron". Lightweight and flexible, it saves time when seconds count. Since double jacketing is woven entirely of "Dacron", hose isn't attacked by mildew and hence doesn't need to be dried.

The volunteer firemen who founded America's first fire hose company in Philadelphia in 1803 placed great emphasis on preparedness. They met two or three times a week to drill, polish brass and clean their hose, which was made of sewn leather.

Modern firemen, although they may have to spend more time on training, can now spend much less on hose maintenance. A major improvement in firefighting equipment is the increased use in recent years of "Dacron" polyester fiber as the load-carrying filler cords in combination jacketing fabrics that offer lighter weight, flexibility and easier handling. Hose with jacketing made entirely of "Dacron", the newest type on the market, resists abrasion, chemicals, oil and mildew, and requires almost no care, not even drying. This is expected to be a particular boon to volunteer fire companies, whose numbers have kept pace in recent years with the rush to suburbia.

But cost-conscious city and industrial fire departments also stand to gain. Here, for instance, is a report from Rochester, N.Y., where 3,200 feet of the new hose have been in Fire Bureau service just over a year.

"The greatest advantage is that fire companies can return to duty after a fire in a much shorter time because the hose doesn't have to be dried or changed," says deputy fire chief John F. Hurley. "This is particularly important during multiple-alarm fires because of the amount of equipment off duty."

Hose of "Dacron" also lightens the work for men assigned to the central hose depot, Hurley points out. "The new hose receives no maintenance whatsoever. It's simply recoupled after use and replaced on the pumpers," he explains. "Cotton hose must go to the depots for cleaning and drying before it's returned to the fire stations. This means that each station must have a reserve load of hose available." While the new hose is still considered experimental, he concludes, the Rochester Bureau of Fire is "very happy with the results to date."

"Dacron" has been used for about six years as the load-carrying filler cord in jacketing; in such constructions, the warp is cotton. Completing the hose is a liner, often of Du Pont neoprene synthetic rubber, and sometimes the jacketing is impregnated with neoprene as well.

Size for size, fire hose cords of "Dacron" are about three times as strong as cotton ones.

Fewer and/or smaller cords can be used to meet the desired test pressure strength, which runs as high as 400 to 600 pounds per square inch. Smaller cords, in turn, make hose with less bulk and more flexibility. Typically, 1,200 feet fit into the space taken up by 900 feet of all-cotton hose. Moreover, a 50-foot length of hose of "Dacron" weighs about ten pounds less than cotton, wet or dry. Its mildew resistance is important to firemen, especially those in warm, humid areas.

The widespread adoption of "Dacron" showed up in a survey conducted last year by *Fire Engineering* magazine. More than two-thirds of the municipal fire departments that reported had some hose with the Du Pont fiber in the jackets.

The experience of Knoxville, Tenn., is representative. Fire chief Roy Conner bought new hose back in 1955 when "Dacron" and cotton still cost much more than all-cotton. He states that the highest priced hose he ever bought has turned out to be one of the department's most economical moves. Until 1955, all-cotton hose was used exclusively. Then, hunting a product that would last longer, Conner ordered hose of "Dacron" and cotton. All hose is tested at a pressure of 200 pounds per square inch twice a year in contrast to the standard once-a-year check. During these sessions about 5,000 feet—17 per cent of the inventory—used to fail. To date not a single section of "Dacron" and cotton has needed replacement.

Similar glowing reports emanate from a variety of industrial sources. At Potlatch Forests, Inc., Lewiston, Idaho, for instance, 600 feet of the hose are still going strong after service life 16 times that of the ordinary variety. The hose has a 2½-inch neoprene tube, a jacket of "Dacron" and a neoprene cover. It needs all this to survive under conditions that fire chief C. O. Bing calls "as tough as there are anywhere"—exposure to lime rock, salt cake, acids and "black liquor," the caustic solution used in pulp manufacture. Most of the time the hose is simply stored in two small sheds. But for four years, in a spot where hose previously had lasted three months, it has served faithfully when needed. "We rely on it," says Bing succinctly, giving it the ultimate endorsement in a fire fighter's vocabulary.

. . . ON LAND AND ON SEA

Ashland Oil & Refining Co., Ashland, Ky., has bought more than 10,000 feet of hose jacketed with "Dacron" in the last couple of years. It's used in oil refineries and terminals and aboard company-operated boats and tankers.

"No attempt is made to baby this hose," says safety engineer John Carson. "We drag it through oil, mud, snow or anything standing between us and a fire."

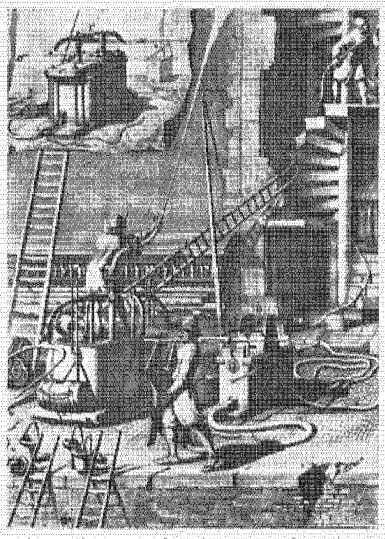
A few months ago *Occupational Hazards* magazine and Du Pont jointly queried 6,000 industrial plants about their use of fire hose. Two facts emerged clearly in the early returns: first, industry uses an amazing amount of fire hose, yet apparently doesn't spend much time deciding what kind is best for its needs; second, not even half maintain the minimum requirements for testing hose.

At least two of the plants keep more than seven miles of fire hose; a chemical plant in Texas has ten and the average is around 4,000 feet. For replacements, about half of the plants lean toward 100 per cent "Dacron" or "Dacron" and cotton.

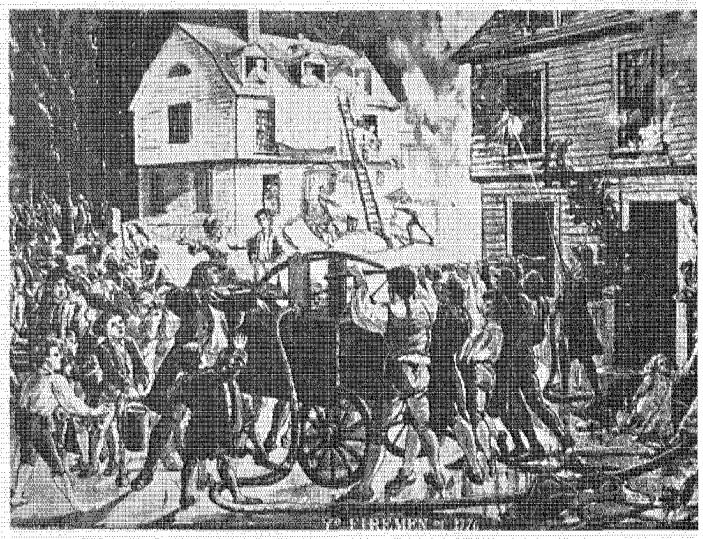
Yet notes on many questionnaires said, "We know nothing about hose except the kind we've always used." This means that managements may be investing as much as $30,000 in fire hose without finding out anything much more about it than the catalog number and the price.

For details on hose jacketed with "Dacron", write Du Pont's Textile Fibers Dept., Nemours 5520-M, for descriptive brochures on both industrial and municipal fire hose.

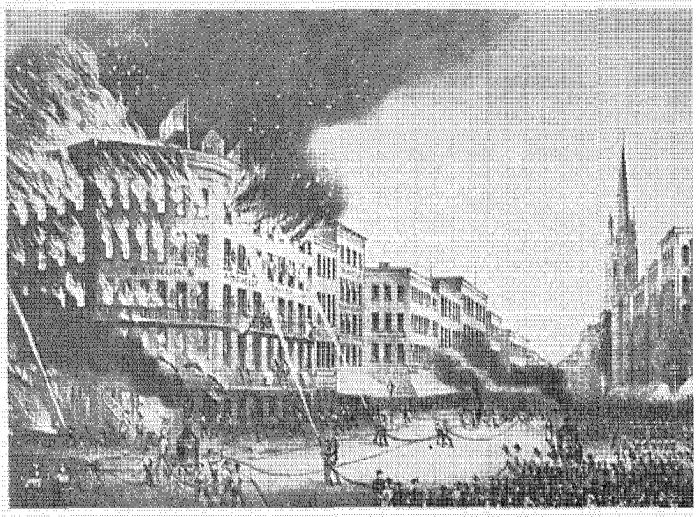
The ancient Greeks, who tried ox gut for fire hose, started the long search for better materials . . .



Experimenting after much of Amsterdam burned in 1672, the Van der Heide cousins invented leather fire hose.



The volunteer firemen fought blazes heroically in early America, but often battled each other with equal fervor.



About time Barnum's Museum burned in 1864, the costly, cumbersome leather hose started to give way to fabric.

FILM SHORTS

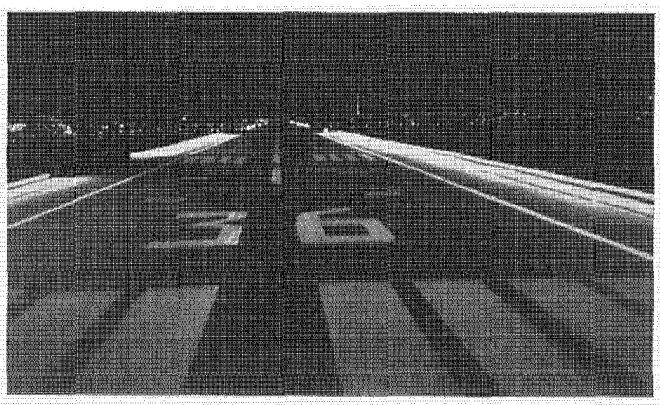
. . . starring "Mylar"

When you think of "Mylar" polyester film—and management and engineers in most industries seem to at one time or another—you're likely to associate the hard-working transparent film with one of its best-known uses. As electrical insulation, for example, or as a base for recording tape and metallic yarn, or drafting film, or even in stationery supplies and greenhouses.

Here's a sampling of other jobs it does, less well-known, perhaps, but of no mean importance. Perhaps the range and variety of this collection will suggest "Mylar" for that new product of yours. Du Pont product development specialists hope it does; they're ready to lend a hand.

• • •

The modern trend to slimness is now being reflected in men's wallets, too. Buxton Inc., for instance, has a convertible model featuring window inserts and pass holders of "Mylar" that are both stronger and thinner than those of the film formerly used.



Airport reflectors, lettering, decorative trim and signs are bright new spots for this tough Du Pont film. For instance, the new runway lighting system at the Washington National Airport has metalized "Mylar" bonded to aluminum both to give maximum reflection from powerful, eight-foot-long lighting fixtures and to protect the metal from dulling corrosion. The "Dynasyl" reflectors were made by Ruscoe of Akron for Sylvania Electric.

• • •

Home decorators, including the do-it-yourself variety, are buying rolls of metalized "Mylar" tape with an adhesive back to trim such different objects as telephones, shelves, book ends and mail boxes. The tape is sold by Minnesota Mining and Mfg. Co., St. Paul, Minn., Coating Products, Englewood, N.J., Wendor Metalizing Corp., Brooklyn, N.Y., and Fasson Division of Avery Paper Co., Painesville, Ohio.

IT'S NEW

• Field tests of "Lucite" 147 acrylic resin have been consistently successful, and the new extrusion grade plastic is now in commerical production, says Du Pont's Polychemicals Dept. Designed especially for the sign and lighting industries, "Lucite" 147 offers clarity, strength and beauty plus superior resistance to crazing from solvents, cleaning agents.



• This stylish ensemble is made in a flat knit of "Orlon" acrylic fiber by Geist & Geist of New York City. It and the other travel clothes selected for the 15-city tour of the Queen of New York's Summer Festival are of DuPont fibers. The wardrobe was chosen because of its light weight, resistance to wrinkling when packed and other ease-of-care features.

• The Du Pont Textile Fibers Dept. has started to produce three new rayon products. "Super Cordura" Type 272-F high tenacity rayon yarn, the first successful adhesive-finished rayon, is designed for reinforcing mechanical rubber goods and can be processed on conventional equipment. "Ondulé" random slubbed rayon yarn is going into draperies, casements, dresswear and sportswear; "Civona" hollow filament rayon yarn is being used in women's hats.

• Two new and improved synthetic rubbers have been announced by Du Pont. A new type of neoprene latex, Type 400, can be made into products with twice the heat resistance, three times the tear strength and 15 times the ozone resistance possible with previous neoprene latices. One promising use is as a binder for natural and synthetic fibers. "Hypalon" 40 synthetic rubber has improved processability and better physical properties, especially higher strength, that suit it for wire jackets, hose covers, coated fabrics, other industrial uses.

Two sheets of "Mylar" team up back to back in a new method for preparing drawings or printed matter for reproduction. Both the positive master and the tracing carbon are sheets of the film. Impressions put a positive carbon image on the matte side of the positive and leave a negative effect on the carbon sheet, thus producing positive and negative masters simultaneously. The manufacturer, Columbia Ribbon & Carbon, Glen Cove, N.Y., says many types of duplicating and reproduction machines can make unusually sharp, clean copies from these masters.

• • •

The Eagle Pencil Co. faced a problem in printing on their pencils. The film carrier in the roll leaf for the stamping frequently broke, causing expensive down time and sub-par printing. Solution: a film carrier of "Mylar" that not only didn't break on stamping machines but also permitted the use of sharper dies and stamping around corners. A longer roll of the thinner gauge "Mylar" could be put on the machine, too, reducing down time for roll changes.

• • •

Shelving of "Mylar", initially used for better display and stacking of soft drinks, now supports stacks of all types of merchandise. The new shelving, developed by Mead Packaging of Atlanta, is secured to the back of a rack and automatically rolls back out of sight as shoppers remove items from the stack. This leaves the remaining stock fully and attractively displayed and gives retailers more efficient use of their display space. The roll tension is permanently built in, the film resists soiling, is easy to clean, and is tough enough to withstand years of hard usage.



Most sailboat skippers, whether they sail for relaxation or competition, are as interested in trying out a new material as an epicure is in experiencing a new taste. Quite a few recently have bought or made transparent sails of "Mylar" on the basis of the film's great strength, light weight and tear resistance.

• Fishermen sold on "Stren" monofilament spinning line will welcome two new related products—"Stren" knotless tapered leaders and "Stren" leader material. The leaders come in sizes 6X through 6/5. The packs of level leader material have test strengths ranging from 2 to 30 pounds.

• A Du Pont process for depositing a level undercoating of copper on metal improves the appearance of chromium finish by hiding polish marks and other imperfections. The new level copper plating process, easily adapted to most electroplating operations, is based on a combination of special chemical additives and variations in current, the Electrochemicals Dept. explains.

• Nose cone instruments of Atlas and Thor missiles are embedded in urethane foam spheres that withstand impact up to 45,000 times force of gravity, dampen rocket vibration and re-entry shock. Hard foam forms outer shell and base for heavy parts; soft foam surrounds smaller instruments. "Hylene" organic isocyanates are key ingredient of foams.

• These three Du Pont booklets are free for the asking:

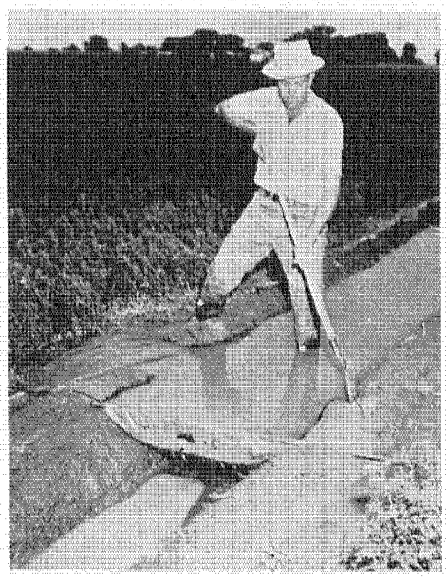
The professional photographer and the serious amateur alike will find a new 24-page booklet on Du Pont photographic papers helpful in selecting the proper paper, curing common printing problems, etc.

Apparel industry management will want a brochure detailing advantages of synthetic thread in synthetic fiber clothing.

The chemical industry and others operating under extreme conditions will be interested in a Fabrics Division booklet on "Armalon" TFE-fluorocarbon impregnated felt for gasketing.

• Remington's big game rifle, the bolt-action, center-fire Model 725, is now being made in two additional calibers, .222 and .244, for varmint and small game hunting. The rifle continues to be made in the high-powered .280, .30/06 and .270 calibers.

• A new product that cooks meat from the inside out is on the market. The sealed-tube device, containing "Freon-12" refrigerant, pipes cooking heat deep inside a roast or fowl and reduces cooking time, shrinking and loss of natural juices. Manufacturer is Thermo Pin Corp. of America, Box 406, Mineola, N. Y.



• Farmers and ranchers say neoprene-coated nylon irrigation dams are superior to those made of natural fibers, wood, dirt or sandbags. Because a neoprene-nylon dam is stronger and doesn't rot while in the ditch or in storage, users estimate that it can outwear at least three of canvas. Made in 25 sizes by Colorado Tent and Awning Co., Denver.



"Before the wide eyes of fifth graders, he began to draw out the film as a long, white cord."

Instant nylon

Almost as soon as Dr. Paul Morgan, left, poured the second of two clear liquids into the beaker, a milky film began to form between the layers. Before the wide eyes of fifth graders, he began to draw out the film as a long, white cord. When he explains his experiment to children, Dr. Morgan calls it the "nylon rope trick." His fellow chemists also know it as "interfacial polycondensation."

The remarkable thing about the demonstration is the way it fascinates both students and scientists. Dr. Morgan first performed the demonstration publicly last summer for chemists at the Gordon Research Conference on Polymers of the American Association for the Advancement of Science and, a little later, at a national American Chemical Society meeting. Both times it was greeted with enthusiasm and astonishment. Since then hundreds of people—school children and teachers as well as scientists—have seen the demonstration. More than 50 Delaware student groups watched it as part of a lecture on polymers worked out by the state's A. C. S. section.

A recipe for the nylon rope experiment is as follows: Place in a clean beaker a solution of 1.5 ml. sebacoyl chloride in 50 ml. perchlorethylene (the familiar dry cleaning solvent). Carefully pour into this a solution of 4.0 g. sodium carbonate and 2.2 g. hexamethylenediamine in 50 ml. water. When the film forms, grasp it at the center with rod or tongs and start pulling. You can make it self-propelling by setting the beaker up high and starting three or four feet of film flowing over a glass rod.

The method works not only for nylons (polyamides) but for polyurethanes and polyesters as well. While this experiment is relatively safe, only a person familiar with chemical reactions should attempt to perform it. The rope of polymer film should not be handled carelessly with the bare hands until it has been washed.

Interfacial polymerization appeals to chemists because it's a convenient laboratory short-cut. The commonly used procedures involve subjecting slow-reacting polymer intermediates to high temperatures and high or low pressures for anywhere from 4 to 24 hours. Interfacial polymerization, on the other hand, is speedy and doesn't call for ingredients of unusual purity, exact measurements or particular reaction conditions.

"To a chemist, interfacial polymerization means not only much saving in time and effort but also many intermediates considered useless in the past can be converted to polymers with new and interesting properties," explains Dr. Morgan. He and other Du Pont chemists have written more than a dozen papers for technical audiences, giving more details on the versatile process that embodies both an attractive gimmick and a sound laboratory tool.

Saving money with heavy fuel oils

. . . is easier if Fuel Oil Additive No. 2 is used, according to this report from industry

Managements, searching for cheaper and easier-to-use fuels, have learned that there is no one best answer. Today a substantial number of companies, however, have found heavy fuel oils the best answer to their heating and power needs. But the stuff is no unalloyed blessing. Power system problems like sludging, fouling, coking and ashing have come along with these oils, printing wrinkles on the brows of businessmen.

In terms of cost, the No. 1 problem with heavy fuel is sludging, which can occur in storage tanks or in the fuel lines. It can spell double trouble—the expense of cleaning the fouled equipment and the loss of heating value represented by the sludge.

Fouling of strainers and preheater equipment also can cost more than a pretty penny—for less efficient heat transfer, for down time to clean the equipment and for more frequent replacement of strainers. Coking and ashing are two other thieves, the former wasting BTUs with improper burning and the latter requiring down time to clean boiler tubes and air preheaters.

In spite of these problems heavy oils usually are a good fuel bargain, particularly when Du Pont Fuel Oil Additive No. 2 is poured in to improve efficiency of operation. The additive, on the market for five years, is now being sold (in 15- and 55-gal. drums) for users to treat their own fuel. More than 20 Du Pont plants have adopted FOA-2 to improve their power efficiency. "We've found," one plant manager said, "that a little money for FOA-2 saves a lot more on maintenance."

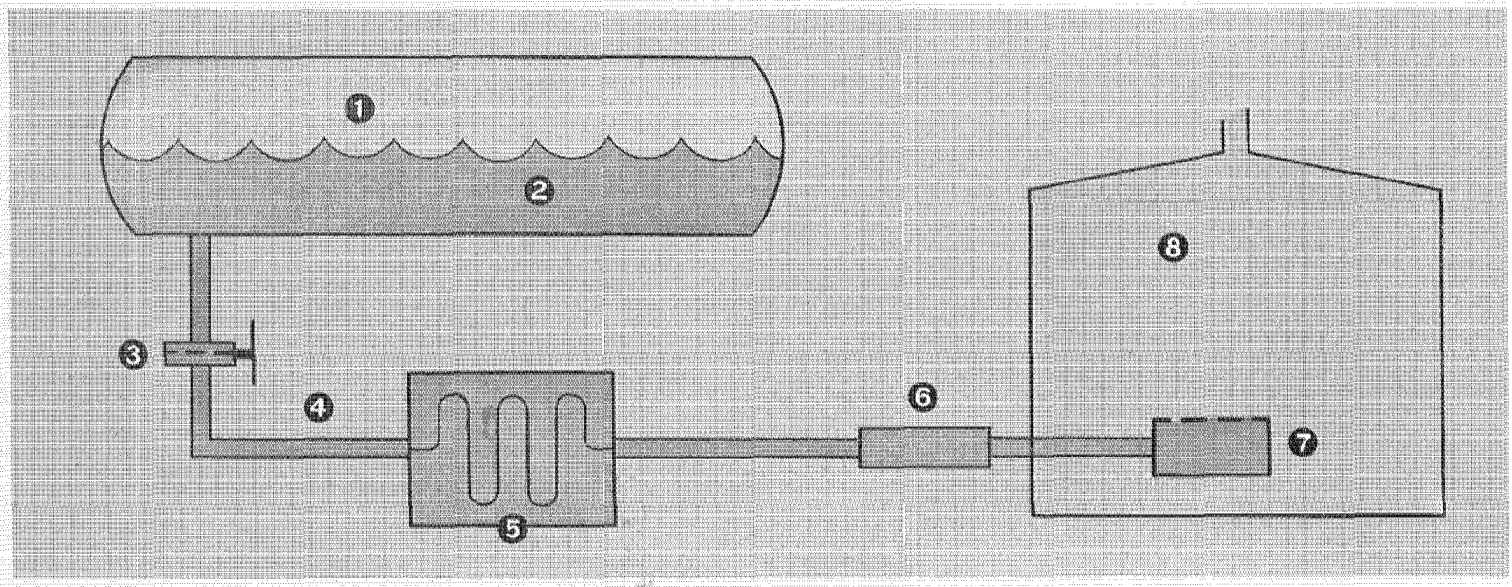
An Eastern manufacturing plant using residual oil, for example, had sludge build up on its preheaters, costing $1,600 a year to remove. When it was time for another cleanout, about $1,000 worth of FOA-2, at a dosage of 45 lbs. per 1,000 barrels of residual, was added to the fuel. In a month, the heaters were inspected and found to be almost metal clean.

A steel plant, using No. 6 oil, found sludge a foot deep in its storage tank. The 11,000 gallons of oil remaining in the tank were treated with FOA-2, the fuel was circulated, and then temporarily pumped to a tankcar so the storage tank could be cleaned. But only one inch of sludge remained; the rest had been dispersed in the fuel and was all ready to burn along with the oil.

FOA-2 HELPS AUTOMATED OPERATION

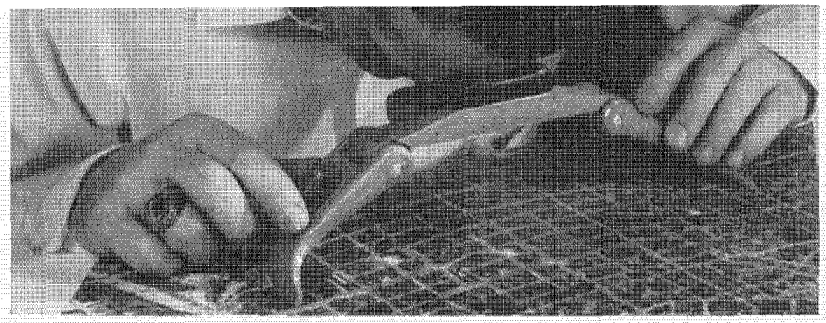
National Vulcanized Fibre had recently installed a new automated and highly instrumented boiler in their Newark, Del., plant. To keep operational difficulties to a minimum, they determined to see for themselves if FOA-2 could help with the burning of No. 6 residual. They found that the Du Pont additive aided in reducing deposits in storage and maintained the clean burner tips so essential to automated operation.

Their test ran two months, and they summarized results as follows: "Efficiency increased from 80.0 per cent to 81.3 per cent, saving about $2,000. Deducting $1,000 for the sizable amount of FOA-2 needed to clean up a year's backlog of sludge, we still saved $1,000, plus getting cleaner, more dependable operation. We now use half a pound of the Du Pont additive in every thousand gallons of fuel to keep the system clean and running smoothly."



FOA-2 In Your Heavy Fuel Oil Burning System

1 • Minimizes Incompatibility Troubles
2-4-5 • Reduces—Removes Sludge
3-6 • Prevents Plugging
7-8 • Lightens Deposits



Aerial mappers have been using "Cronapaque" because it holds its size and has remarkable durability.

A NEW PHOTO PRINT FILM

. . . offers aerial mappers and others the advantages of "Cronar" in a new form

Take transparent "Cronar" polyester photographic film base, white-coat the underside, put a high speed variable contrast emulsion on the topside, and you should have a product that photogrammetrists and industrial photographers can employ to good effect.

That's how Du Pont figured it, and that's how it's turning out, according to Victor M. Salter of the Photo Products Dept. The new product is called "Cronapaque" print film. It is semi-opaque, produces crisp prints of a rich black, holds its size, lies flat, is flexible and has unexcelled strength. Since it has the same emulsion as high speed "Varigam" variable contrast photographic paper, it is printed similarly. Colored filters are used to adapt it to negatives of varying contrast.

One of the first reports on "Cronapaque" comes from George D. Hardy, vice president and general manager of International Aerial Mapping Co., San Antonio.

"When the first ten-foot roll was available, we made an aerial mosaic for the Texas Highway Dept.," says Hardy. "Both the Austin and Fort Worth offices of the department were so pleased that we've been asked to substitute 'Cronapaque' in the future for the usual cloth-mounted paper mosaics."

The highway people like the fact that "Cronapaque" can be held accurately to scale, Hardy goes on to say. Errors were bound to crop up in the process of printing aerial photos on paper and mounting the prints on cloth. They also appreciate the ability of the new print film to survive the rough handling it gets in the field.

"We're using 'Cronapaque', too, for printed mosaics displayed at public hearings on highway locations," Hardy explains. "Since the surface takes ink well, we can indicate on the photo where the proposed highway is to run."

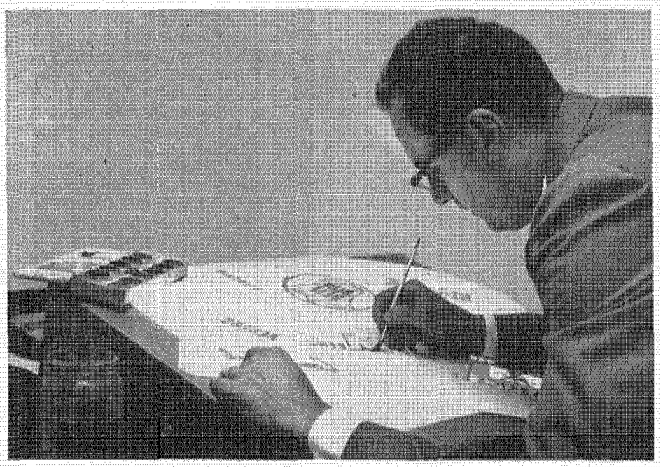
Even though "Cronapaque" costs more than the double-weight papers formerly used for mosaics, the new method is proving cheaper because no cloth backing is needed and labor is reduced, Hardy concludes.

Vic Salter gave us a brief rundown on the product's other uses. In exhibits, since it is translucent, "Cronapaque" can be viewed either by reflected or transmitted light. The back of the print can be colored and a viewer will see a black-and-white print by reflected light and a color photo when the print is lighted from behind. The "Cronapaque" print film can be mounted in place with staples, too; it needs no additional protection for indoor use.

Because it doesn't yellow or embrittle with age, "Cronapaque" is ideal for historical reproductions or other photos that must last, Salter pointed out. Its strength and flexibility also suit it for membership cards, drivers' licenses and other documents.

If users of photographic materials—and that undoubtedly includes your company—don't come up with many more ideas for using "Cronapaque", Salter says he'll certainly miss his guess.

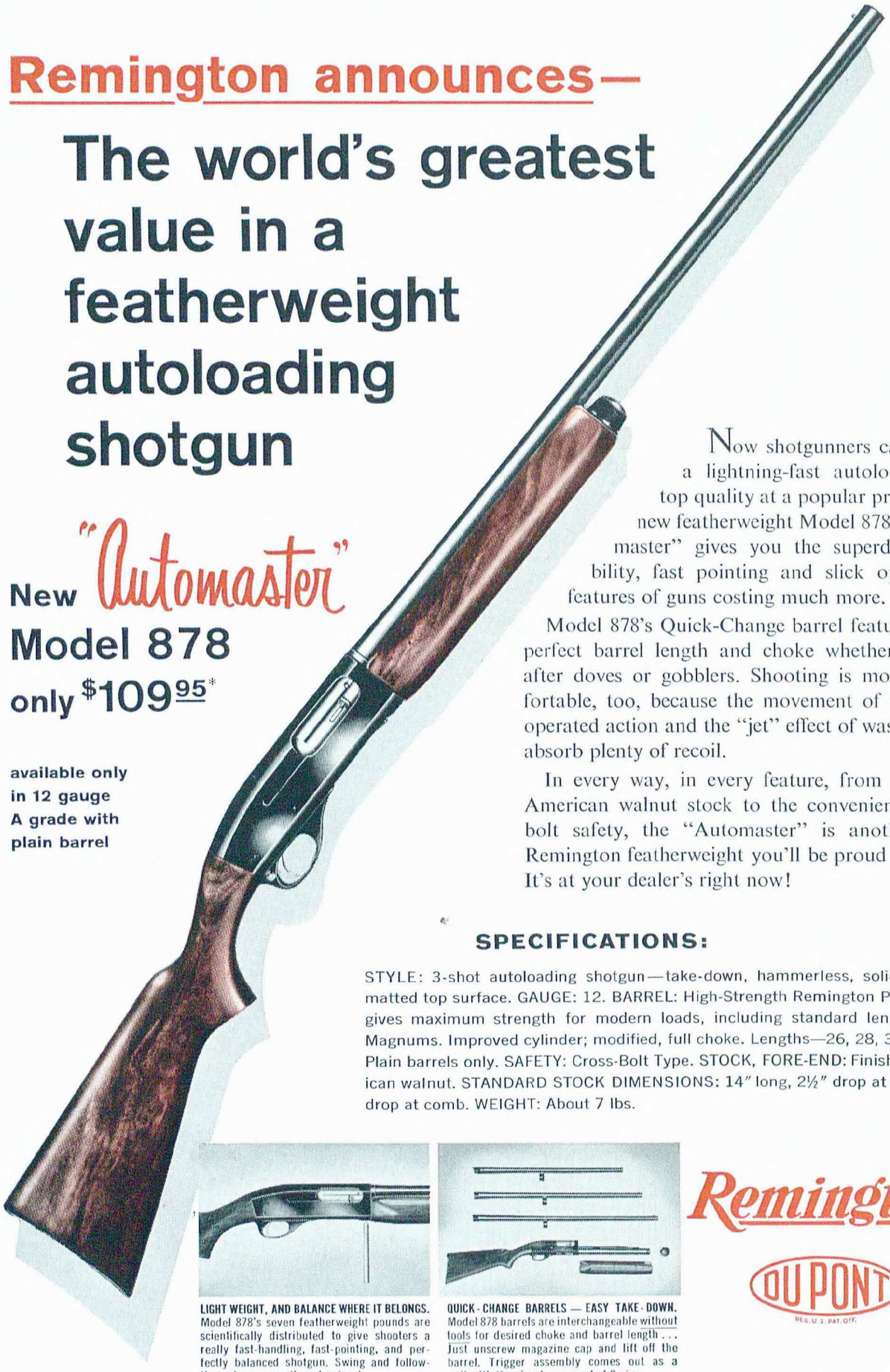
Ideal for exhibits, "Cronapaque" takes colors well, diffuses light evenly, can be mounted as is because it doesn't tear.





Remington announces—

The world's greatest value in a featherweight autoloading shotgun



New "Automaster" Model 878 only $109.95*

available only in 12 gauge A grade with plain barrel

Now shotgunners can have a lightning-fast autoloader of top quality at a popular price. The new featherweight Model 878 "Automaster" gives you the superdependability, fast pointing and slick operating features of guns costing much more.

Model 878's Quick-Change barrel features give perfect barrel length and choke whether you're after doves or gobblers. Shooting is more comfortable, too, because the movement of the gas-operated action and the "jet" effect of waste gases absorb plenty of recoil.

In every way, in every feature, from the fine American walnut stock to the convenient cross-bolt safety, the "Automaster" is another fine Remington featherweight you'll be proud to own. It's at your dealer's right now!

SPECIFICATIONS:

STYLE: 3-shot autoloading shotgun—take-down, hammerless, solid breech, matted top surface. GAUGE: 12. BARREL: High-Strength Remington Proof Steel gives maximum strength for modern loads, including standard length (2¾") Magnums. Improved cylinder; modified, full choke. Lengths—26, 28, 30 inches. Plain barrels only. SAFETY: Cross-Bolt Type. STOCK, FORE-END: Finished American walnut. STANDARD STOCK DIMENSIONS: 14" long, 2½" drop at heel, 1⅝" drop at comb. WEIGHT: About 7 lbs.

LIGHT WEIGHT, AND BALANCE WHERE IT BELONGS. Model 878's seven featherweight pounds are scientifically distributed to give shooters a really fast-handling, fast-pointing, and perfectly balanced shotgun. Swing and follow-through are smooth and natural.

QUICK-CHANGE BARRELS — EASY TAKE-DOWN. Model 878 barrels are interchangeable without tools for desired choke and barrel length . . . Just unscrew magazine cap and lift off the barrel. Trigger assembly comes out as a unit with the simple removal of 2 pins.

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*Price subject to change without notice.

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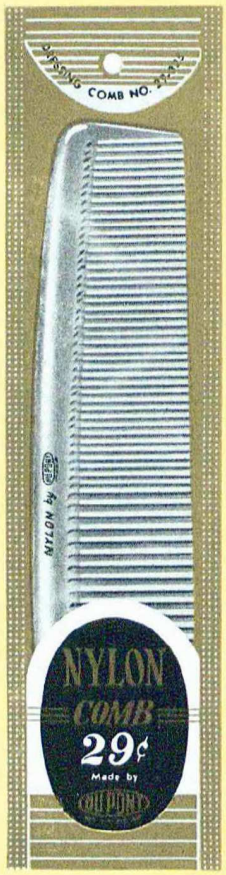
No. 29-885
Narrow Dressing Comb



No. 29-785
Purse Comb



No. 25-685
Pocket Comb



No. 29-325
Dressing Comb

No. 29-428
Curl Comb





No. 25-686
Pocket Comb

NYLON WINS TOP SPOT IN COMB MARKET

First it was wood and shell—then rubber, metal and plastics. NOW AMERICANS SPEND MORE MONEY ON NYLON COMBS THAN ON THOSE MADE OF ANY OTHER MATERIAL. They choose nylon combs for their long life . . . their economy . . . and their good looks. Du Pont nylon combs are made in natural, pink, blue, turquoise and black, and in styles for every member of the family and for every need. Each is sold in its own distinctive and colorful film package. Look for them—and Du Pont toothbrushes, too—in drug, department and variety stores.

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BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*