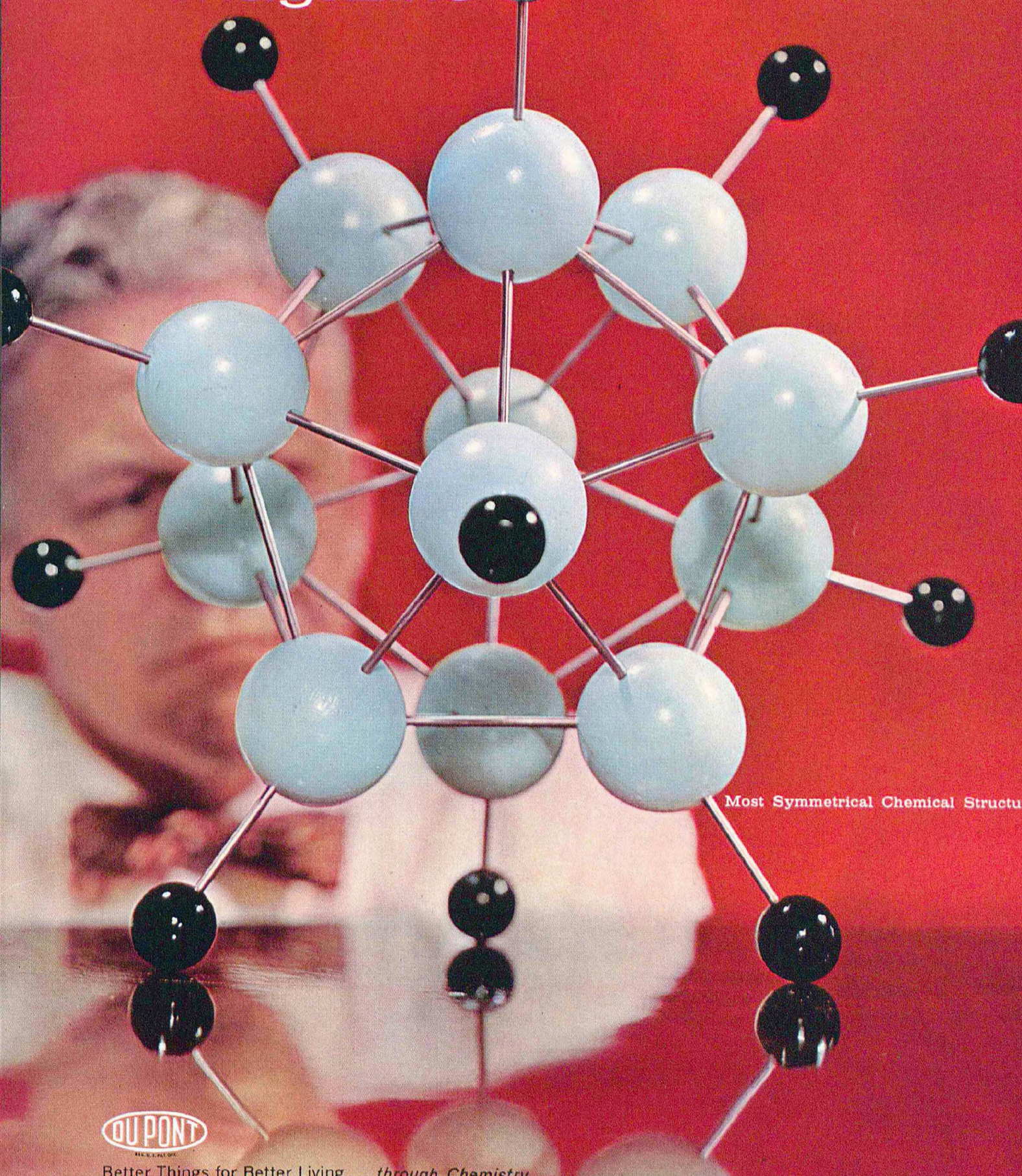




Most Symmetrical Chemical Structure



Better Things for Better Living . . . through Chemistry

In industry, theory leads to application, but it's a strong awareness of the vice versa that causes Du Pont to view basic and applied research as

Chemistry's Inseparable Twins

The surrealistic dumbbell at left is a hundredfold enlargement of sintered boundaries of "Teflon" fluorocarbon resin, straining to near-rupture to demonstrate the chemical's fusion into solid form. This polarized photomicrographic technique was developed by Dr. John F. Lontz of Du Pont's Plastics Dept. to show how a seemingly intractable resin like "Teflon" enters a stage in which it can be translated into tough engineering materials for mechanical, electrical and chemical applications.

The pictured fusion also symbolizes, in its way, the equally solid link between basic research and its applications. "Teflon", for example, is 25 years old and has found myriad applications in industry. But Dr. Lontz and his colleagues still conduct basic research to learn more about the fundamental properties and behavior of the fluorocarbon family of chemicals. Meanwhile and elsewhere, a vast program of applied research and development seeks to pinpoint even more useful products in which the chemical can be used. And so it goes with virtually every Du Pont undertaking: theory and application are inseparable.

This was underscored recently when Dr. Samuel Lenher, a Du Pont vice president, accepted on behalf of the company the Industrial Science Achievement Award of the American Association for the Advancement of Science. The AAAS cited Du Pont for its work in the field of fluorocarbon polymers, and Dr. Lenher described the work as a classic case history in which a fundamental research discovery and useful commercial applications have been harnessed in tandem.

Said Dr. Lenher: "Over the years Du Pont has been blessed with a certain amount of success both in the laboratory and in the market place. If I were asked to give a single reason for that success, I would say that it lies in this point of view: We regard the pursuit of fundamental research and its application in industry not as antagonistic or essentially separate, but as brothers and colleagues. Accomplishment or discovery in each field reinforces and fortifies the other."

Long before "Teflon" was discovered, Du Pont had accumulated a large amount of fundamental knowledge about fluorinated hydrocarbons and condensation polymers. It also had an "advanced understanding of free radical reactions"—the mechanism which explains the fluorocarbon polymer-

ization process—and the company "was an enthusiastic student of fluorine chemistry." All this set the stage for the day in 1938 when Dr. Roy Plunkett, a Du Pont research chemist, reported that a new gas, when compressed in a heavy-walled metal cylinder, changed into a unique white solid. The material resisted exposure to almost every known chemical. Its surface was so slick almost nothing would stick to it. Soldering irons wouldn't melt it; electric arcs wouldn't char it; moisture didn't affect it. This was "Teflon" fluorocarbon resin.

Had it not been for the company's prior experience in related fields, Dr. Lenher said, the significance of Dr. Plunkett's observation might have been lost on Du Pont, and Dr. Plunkett might not have been working in that field at all.

Dr. Lenher said the virtues of the material almost killed it. There was no way to dissolve it. Because of its high melting point, ordinary molding equipment wouldn't handle it. Because it was superslippy, it couldn't be laminated or bonded to anything. Nonetheless, Du Pont managed to devise means to turn these peculiarities into workable assets and to make many technological advances:

A technique to polymerize TFE to produce molecules of predictable, controllable weight; a method to form TFE into a fiber which can be spun and woven into a fabric; molding and sintering techniques to make possible predetermined shapes which can be machined like castings; the development of etching and adhesive techniques for TFE; creation of a group of fluoroelastomers; and the discovery of telomer chemistry.

These, in turn, have led to a list of products that today range from no-stick coatings in cookware to artificial blood vessels and valves in the human body; from spaceship components to building materials.

All this, as with many scientific advances, could appear to stem from a "lucky break" in the research lab. But Dr. Lenher quickly entered a disclaimer: "There is a lot more at work here than the whim of fate. In science one is always working with probabilities, but that does not mean research is as accidental as a dice game."

To illustrate his point, Dr. Lenher cited the story of the research man who pointed to a famed colleague and said: "That man really has uncanny luck, and the harder he works the luckier he gets."



DU PONT

magazine

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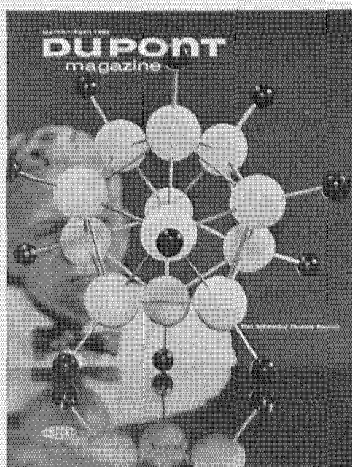
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THE COVER. The long road from basic chemical research to commercial product reality is by now a familiar theme to regular *Du Pont Magazine* readers. On the facing page, we look back over more than 25 years' exploration in the broad field of fluorine chemistry, a classic example of this sort of endeavor. Our cover and a related article look ahead to another large—and largely unknown—area that eventually may rank among the most exciting and signifi-

cant ever investigated systematically by Du Pont scientists.

The most symmetrical chemical structure, formally known as dodecahydrotetradecaborate (-2), is one of two stable boron-hydrogen compounds that are getting a lot of attention from the company's scientists. See page 30 for more about this work and a better look at Dr. Henry C. Miller, who obligingly faded into the background to let the model's symmetry have full aesthetic play.

EDITOR WILLIAM C. HALLEY • ASSOCIATE EDITORS EMILY HEINE • JACK D. HUNTER • HARRY E. DAVIS

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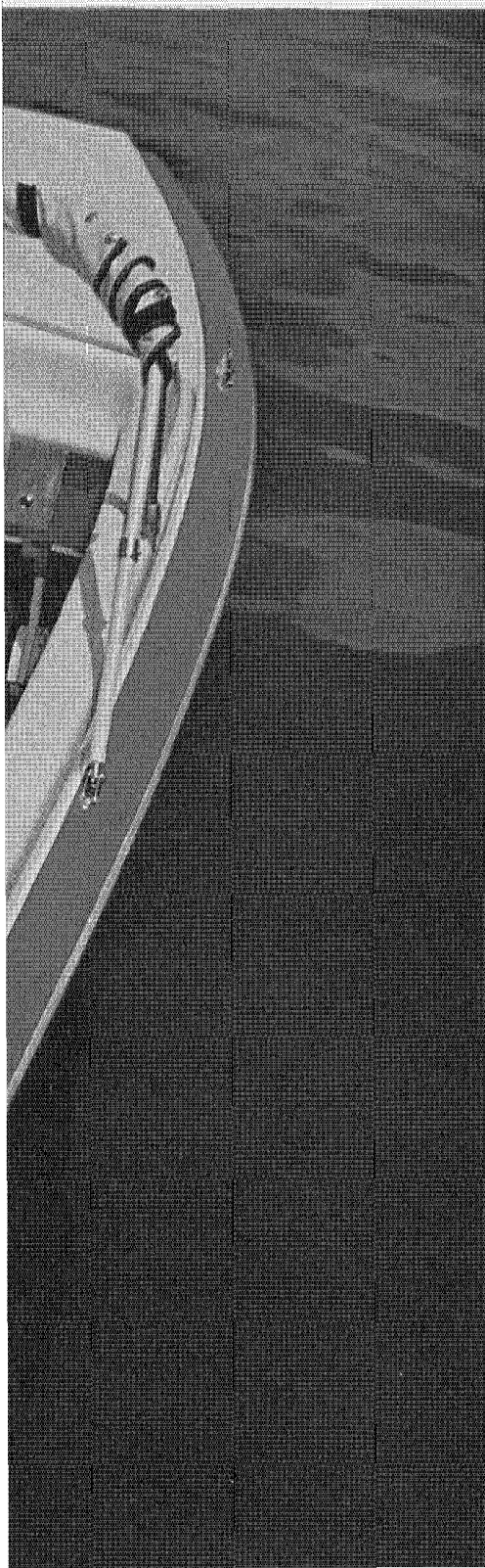
Photo Credits: Alexander Henderson, Cover; Traveler Manufacturing Co., page 2; Signode Steel Strapping Co., pages 5, 6, 7; Larry Keighley, page 8; Gates Engineering Co., pages 9 (bottom), 10; MCA, Inc., pages 12, 13, 14, 15; James Dallas, pages 16, 17; Frank G. Hough Co., page 20; *Rock Products* magazine, page 22; Goodyear Aircraft Corp.'s Arizona Division, page 32.

*Americans were never so boat-happy,
and a big reason is the use of
Du Pont vinyl fabrics by manufacturers
producing the*

BIG WAVE ON



DREAM BOATS



There is nothing — absolutely nothing — half so much worth doing as simply messing about in boats . . . or with boats . . . In or out of 'em, it doesn't matter.

So wrote British author-philosopher Kenneth Grahame in 1908, and from statistics compiled along teeming U.S. shore lines and waterways, today there are at least 40 million Americans who couldn't agree more.

Pleasure boating, now rated the leading U.S. participation sport, has increased some ten per cent annually since 1949 to where it now commands consumer spending in excess of \$2.5 billion a year. This formidable sum goes not only for the purchase of boats but also for accessories, care and storage for some 8 million craft—including 4.1 million outboard motorboats, 842,000 inboard and auxiliary-powered sailboats, 516,000 purely sailing boats, and 2.5 million rowing craft.

With each year's growth in the national preoccupation with boating comes a spate of markets for new businesses and long-established ones. There are 1,150 U.S. yacht and boat clubs with water front facilities and more than 4,000 boat yards and marinas. Marinas alone are growing at an annual rate of 50 or more. Most of these centers form brisk outlets for a wide range of merchandise related to the boater and his needs: gasoline, oil, paint, rope, first-aid kits, marine hardware, fishing gear, diving equipment, water skis—even groceries, seagoing clothing and accommodations with the uniquely American appellation, "boatels."

Manufacturers, of course, are not letting this lively commerce go unnoted. (Du Pont, for example, markets a score of marine products in its "7 Seas" line, ranging from bilge cleaners to boat wax, all of which are over-the-counter items at water front retail outlets.) Moreover, there are many businesses almost entirely oriented on boating whose sales have moved into the multimillion dollar brackets during the last decade.

Due to this vigor, changes have been many and rapid in boat manufacture. Perhaps the most notable is the trend toward more comfort and eye appeal in pleasure craft. Until a few years ago, recreational boats more often than not arrived at showrooms devoid of all but minimal interior upholstery and styling. Uppermost in the boater's mind was boat performance, and it was this area of design that predominated in the boat builder's thinking. So long as basic seat upholstery held up fairly well in use, who cared if it looked somewhat drab?

As have so many other aspects of U.S. life, this began to change in direct proportion to the growth of feminine interest in the subject. The greater the distaff's interest in boating and allied recreations, the more its say in the family's selection of craft; the more the woman's say, the more the manufacturer sought to curry her favor by enlivening hues and textures he offered her.

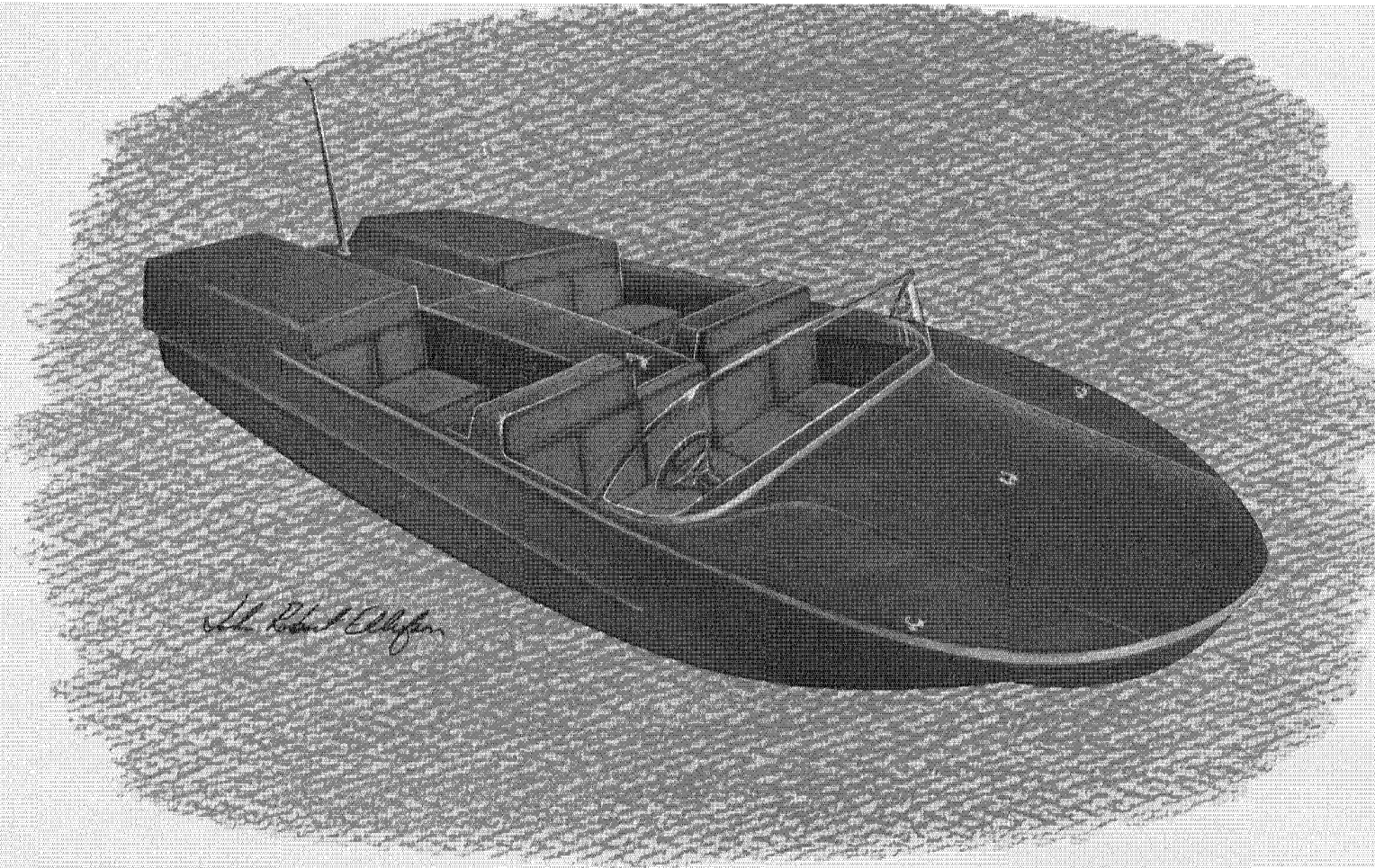
This female influence was not worked in a void, of course. Manufacturers had long known that little more could be done to make dramatic improvements in hull design, planing characteristics and other engineering features. Therefore, the most apparent plus-factor that could capture more sales in face of heated competition was a colorful and well-coordinated luxury-type interior for even the most modestly priced boat. Like Detroit's car makers, the boat-building fraternity was recognizing that a slick interior could be the decisive element in transforming a family's showroom visit from mere reconnaissance into a hard cash purchase.

But where auto makers could justify the high cost of tooling up for varied model treatments, most boat producers were compelled to seek outside help to achieve comparable distinction among boat models without comparable tooling expense for each design. Therefore, they began to look to specialists in the field of interior design and styling who were already geared to handle the custom-type work required.

Prominent among these specialists is Stearns Manufacturing Co. of St. Cloud, Minn., whose character has altered in pace

continued

Back-to-back "Siesta" seats and trim in Du Pont vinyl coated marine fabrics were styled by Stearns for Traveler's "Centaur" runabout.



Black, twin inboard-outboard fiber glass job with ski and tackle storage and red Du Pont vinyl interior trim is one Bob Ellefson designed as his personal dream boat. Such a craft, less engines, would sell for about \$3,000.

with changes in the boat industry itself. When it was formed in 1941, Stearns specialized in tenting and other sporting goods. Today its engineers, stylists, design and production staff are concentrating nearly all their talents on the coordinated custom styling of boat interiors. So proficient have they become in this, Stearns is candidly aspiring to assume an influence akin to that which interior stylists have won in the automotive industry. Many industry observers see Stearns as well on its way toward this goal.

Says Maurice H. O'Link, president of Stearns: "As early as 1949, it was apparent to us that custom treatment of boat interiors could transform a routine craft into a distinctive one. We took a few personal boats into our plant and developed some ideas for 'in-fitting' of plastic-type fabrics—not only for seats but also for flooring, decking, side-wall paneling and headlining. A prominent boat manufacturer, for whom we had been making convertible boat tops, was sufficiently impressed with our experimental interiors to ask us to submit specific proposals for the interior fitting of some of his models. He was our first client for coordinated boat interiors, and remains one of our best today."

From there on, Stearns's "in-fitting" concept caught the fancy of many boat builders, and business waxed to a volume that

recently sent the firm into a plant expansion program so urgent it was launched in the depths of a Minnesota winter.

O'Link and his colleagues have drawn heavily on Du Pont vinyl coated marine fabrics to provide the practicality and eye appeal needed for boat interiors. The vinyls have been specifically designed for nautical installations. Made of fabric-supported vinyl, they can be applied to wood, metal or fiber glass for decorative, durable protection of exposed surfaces—at the same time eliminating much of the work, time and expense of traditional maintenance. They have high weather resistance, are easily cleaned, and are impervious to spray, surf, gasoline and oil. Their colors are fade resistant.

Du Pont's line of marine coated fabrics includes plank-type decking material in mahogany, white, teakwood and bleached teak colors that satisfy the eye of the traditionalist while providing a firmness of footing that exceeds that of other surfaces when wet. There's also a custom vinyl for decking which Du Pont makes to order upon receipt of the manufacturer's specifications. A combination of elegant color and laminated white band, the material has been adopted by several leading boat makers for high-quality craft. It has the same properties as the other coated fabrics—its vinyl surface

is nonabsorbent, minimizing the mildew problem; it's easily installed, lasts for years.

Du Pont vinyls adapt readily to Stearns' dielectric seaming process, in which the fabric is joined in a high-temperature weld that does away with sewing. Not only does the melt-joining provide a high degree of water tightness but also a means by which touches such as company crests can be inserted.

Backing up Stearns and other firms whenever they want special technical guidance and styling counsel is J. R. Ellefson, an industrial designer on Du Pont's Fabrics and Finishes Dept. staff. Says he: "As auto makers have discovered, boat builders are finding that vinyl coated fabrics offer an especially flexibility in design potentials. With vinyls they can achieve interiors in which all textures, colors and patterns in ship side panels, flooring and upholstery are coordinated and space-related to hull and deck treatments."

Adds Stearns's O'Link: "The day is rapidly disappearing in which a boat builder flicks through a swatch book, picks out a color he likes, then asks his upholsterer to make up a few seats. Today, if he has no interior design staff of his own, he comes to people like us to do the job right. With the kinds of fabrics Du Pont supplies, our specialists can give him not only the seats but a stem-to-stern dream boat."

Now there's an effective way to protect packages that shrink, settle or telescope during shipment. It's

A Strapping That Stays Tight

The salesman's quick demonstration of "Dymax" was so startling that they took him to the vice president of purchasing. "Do it for *him*," they said.

First the salesman put a thick phone book on the shining desk top. Then around both desk and book he ran a length of the new strapping, which he drew tight and sealed with hand tools. "Now watch," he said.

Suddenly he snatched out the phone book, and the strapping went "Whack!" on the desk top. Instead of being loose, as traditional straps would be, the new product had drawn itself as tight as though the salesman had strapped the desk alone.

"Wow!" said the vice president. "When can we start using it?"

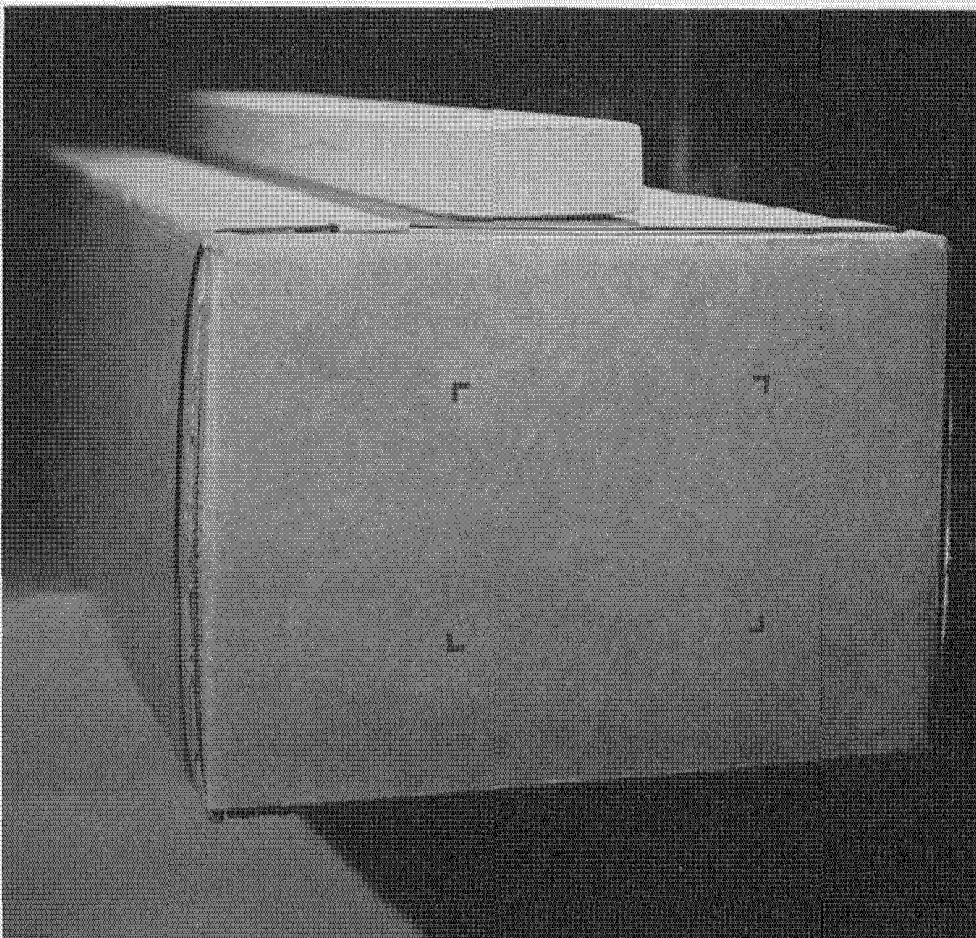
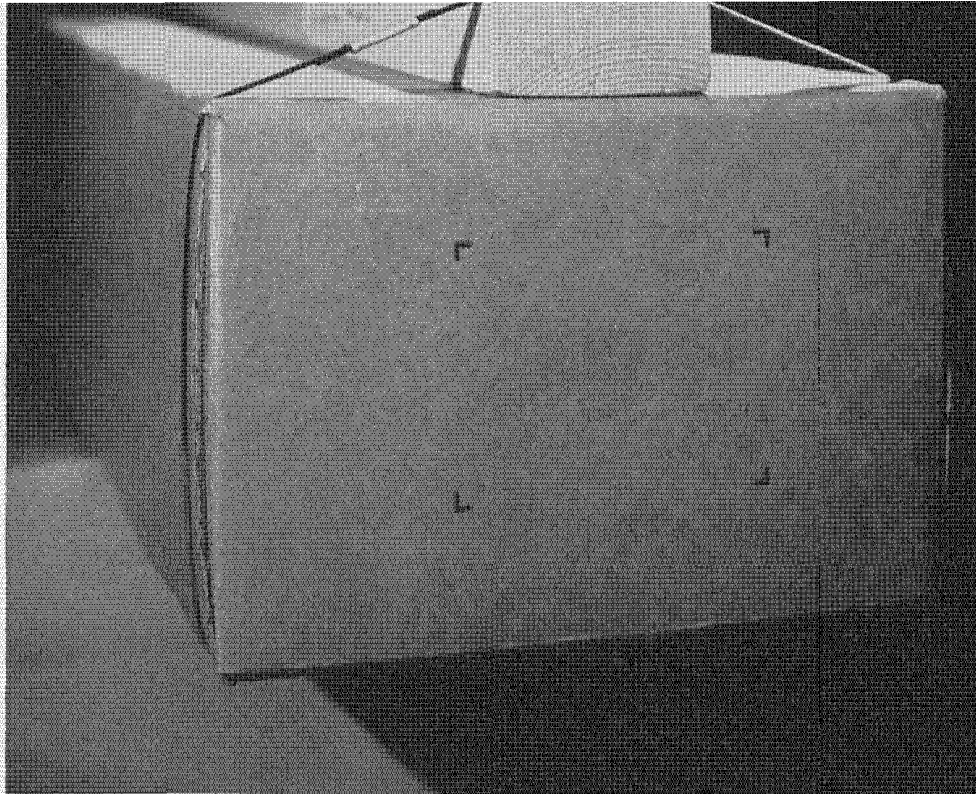
"I'm not selling—just informing," gulped the salesman. "We're still in semiworks."

"That's your problem," the official said.

The instantaneous welcome for "Dymax" dramatized industry's long-felt need for a strapping that will stay tight around packages that change dimensions under the stress and pounding of transport. And field tests indicate that with "Dymax", the Signode Steel Strapping Co. of Chicago has expanded its line with a product that performs better than rope, twine, pressure-sensitive tape, reinforced tape, rayon and other nonmetallic materials in a wide variety of strapping and binding applications—and better than steel in a number of areas.

In full commercial production by this spring, "Dymax" is a joint development of

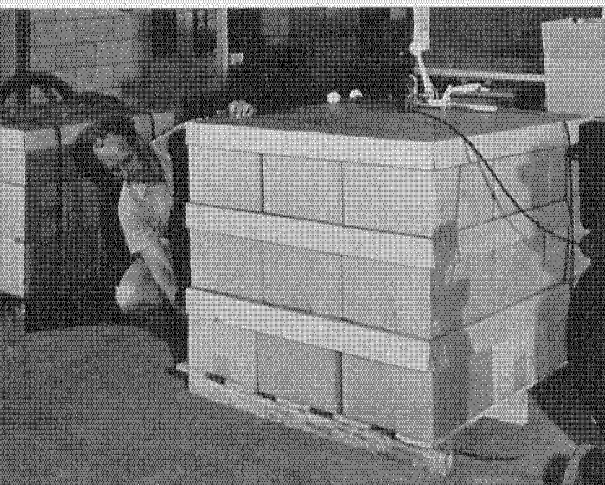
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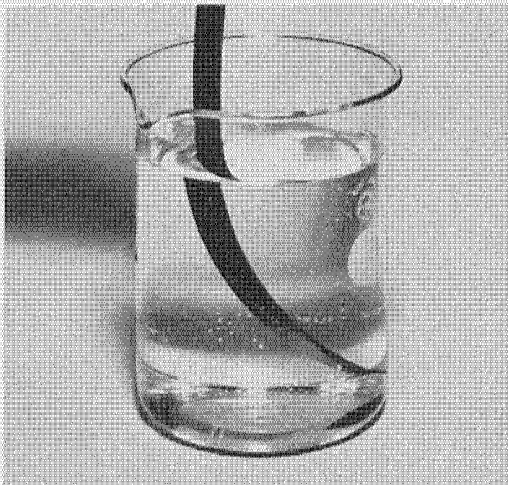
How "Dymax" tightens to protect packages that shrink in transit is illustrated when strapping (top photo) is tensioned over 2x4. When board is removed (below), "Dymax" contracts immediately to the new package dimension, thus continues to protect contents.

A Strapping That Stays Tight

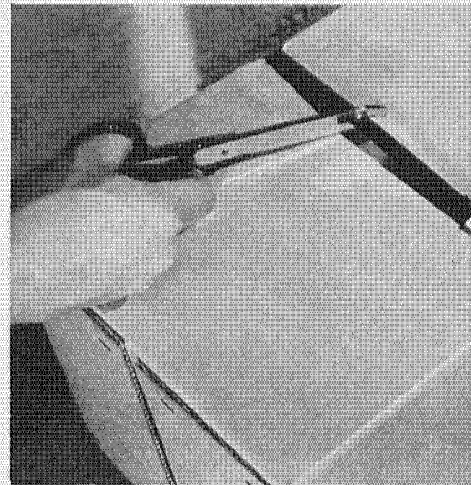
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Because it's stiff, "Dymax" strapping is easily fed through pallets of industrial cartons or bags.



Unaffected by moisture, "Dymax" doesn't rust, stain or disintegrate when wet, also resists oils, solvents.



"Dymax" is easily removed from incoming packages, can be cut off with household scissors.

Signode and Du Pont, based on a versatile Du Pont plastics family called "Dymetrol" continuous precision forms of nylon. In "Dymax", the material's molecular structure is oriented to combine unusually high strength with resilience.

Result is that although tensile strength of "Dymax" is 60,000 psi, about twice that of other nonmetallic strapping. Signode's new product stays tight on the package or carton. If a package crushes, fatigues or compresses under the banging and dropping of transport, "Dymax" shrinks correspondingly. Acting like a powerful spring, it stretches about five per cent when it is tensioned around a package; as a package shrinks, the strapping simply returns to its original length, i.e., changes dimensions with the package, thus staying tight.

Signode, a pioneer strapping firm and an industry leader for 50 years, has field-tested "Dymax" on nearly 100 products that tend to shift in transport, including palletized cartons of die-cast parts, heater elements, hi-fi components, fluorescent fixtures, coils of wire, fiber glass doors, gas meters and gasoline engines.

"Dymax" has also performed successfully with a dozen Du Pont products, ranging from cartons of synthetic fibers to sacks of pigments. Success with bagged materials is especially significant; these always settle in shipment, and, before "Dymax", straps therefore loosened. "Dymax" hugged sacks and kept hugging.

A nonmetallic strapping, says Signode president J. M. Moon, is a logical expansion for his fast-growing firm, whose sales last

year were seven times the 1946 figure. Growth has always come to Signode from engineering, from devising better packaging and shipping techniques and new ways to use strapping. When the firm was born in 1913, for example, the steel strapping business consisted of modest numbers of strips nailed around the ends of wooden boxes as replacements for split willow wands. Nearly all commodities were packed in bales, bags, baskets, barrels or wooden boxes; corrugated boxes were in infancy, disdainfully referred to by wooden boxmakers as "substitute containers."

Technology Came First

Signode's initial contribution was technological: it introduced the first practical tool to apply steel strap under tension, made possible lighter lumber in boxes and opened the way for new kinds of industrial packages. Since then, President Moon estimates, his firm has developed 1,000 different tools, each tailored for specific packaging jobs, and ranging from \$15 tensioners to quarter-million-dollar fully automatic, high-speed packaging complexes. Coupled with a search for new tools and straps, Signode emphasized systematic laboratory and field research on every phase of materials handling, loading and shipping.

In the post World War II period, palletizing and the fork lift truck wrought a kind of revolution in materials handling. They swelled the market for strapping, but they also revealed that the traditional material, steel, would not do everything. Steel's great tensile strength—100,000 psi and upward—

is unsurpassed for sharp or heavy metal, heavy stuff, bricks or freight car dunnage. But the metal has little resilience. If a material of the type that settles or shrinks in transit, the steel strapping loosens.

"To us," says President Moon, "it became apparent that the next big jump forward would be a strapping to do jobs where steel couldn't be used to best advantage."

Signode packaging engineer Robert I. Kehoe began what turned out to be three years of evaluation, development and field testing of a dozen nonmetallic materials. "Not until we came upon 'Dymetrol', however, did we find what we wanted," Kehoe recalls. "It had twice the strength of rayon material; its smoothness allowed 30 to 50 per cent more tension to be transmitted around package corners; and it had backbone enough to be fed through pallets."

In addition to 15 per cent ultimate elongation, compared to 2 per cent for cold-rolled steel, "Dymax" has the extraordinary property of 100 per cent recovery—which is what it follows shrinking package contours. "Elongation," explains Bob Kehoe, "also adds impact resistance—about twice that of other materials. If a package is dropped or banged pretty hard, 'Dymax' gives slightly then returns. But it's not likely to break."

"Dymax" also rang the Signode bell because it shapes itself firmly over irregularly shaped packages and has a smooth surface that reduces indentation on corners. Thus it can be used directly on painted products or against delicate hardware parts without cutting into their surfaces.

"Once a package arrives safely at its de-

tion, the strapping's handling and disposal characteristics reap the customer raves," Kehoe says. "Dymax" can be cut off a package with ordinary scissors (a marketing plus for consumer packages, incidentally), or with knife or strap cutter. And the traditional problem of disposing of used strapping disappears: "Dymax" can be burned, chopped up, baled or thrown away with paper waste."

In storage, too, the product has notable advantages. Because it's a homogeneous, noncorroding material, it doesn't rust, is thereby nonstaining; it doesn't disintegrate when wet, and it resists oils, greases and most organic solvents. Its light weight saves not only tare weight but space as well: one 42-pound coil of "Dymax" strapping contains nearly as much footage as three 100-pound coils of the same size steel strapping. Thus fewer coils must be stored.

Initially, Signode is offering "Dymax" in four breakload strengths, 475, 630, 790 and 950 pounds. Also available are custom seals and two types of tensioning tools, a rack-and-pinion and a continuous take-up model that includes an air-powered version. High-speed automatic machines like those

offered for steel are under development.

Where can the resilience of "Dymax" contribute to solving packaging problems? Signode's Bob Kehoe and aides foresee applications in palletized boxes and bags; in products subject to surface damage, such as highly polished metals and millwork; food and corrugated container products; consumer items where ease of strapping disposal is advantageous; miscellaneous department store uses, such as bundling packages; specialty items like hides for the tanning industry; rugs and rolls of carpeting; textiles and elastomers; finished clothing; general use with compressible or shrinkable materials such as roofing rolls or wax slabs.

If the past is any guide, though, such a catalog is incomplete, says Signode's Kehoe. "Advances in strapping always bring applications you can't anticipate. Thus we welcome opportunities to provide data, run tests or consult on packaging or shipping problems. The product is attractive, strong, efficient and its price is competitive with both steel and nonmetallic bindings. Most of all—excuse my fervor—I want to be sure to mention that 'Dymax' is a strapping that stays tight."



Photographed in Belgium after 3,000-mile trip, these containers of fabrics were battered and had telescoped. Resilient "Dymax" strapping, however, remained tight, still fitted snugly over cartons.

SIGNODE
Dymax
PAT. APPLD FOR

Signode offers
"Dymax" in four
breakload strengths:
475, 630, 790
and 950 pounds.

HANGING A 2-ACRE

Du Pont neoprene synthetic rubber forms an elastic, weatherproof seal on a roof that refuses to lie still

Chantilly, Va.

An imaginative, window-seat air traveler approaching Washington, D.C.'s new Dulles International Airport gets the illusion that strung in the clearing below his plane is a great hammock of Paul Bunyan proportions.

The hammock is the graceful concave roof of the jet port's \$15.5 million terminal designed by the late Eero Saarinen and acclaimed an architectural masterpiece. From a height of some 65 feet on the front side, the roof dips gently to 28 feet at its lowest point, then arches up again to 40 feet on the field side. Covering a 600- by 150-foot main concourse, the roof has neither conventional massive trusses nor internal pillars for support. Its four-million-pound dead weight is suspended entirely on steel cables looped between sloping concrete "trees" or columns.

This design, as any sailor could predict, is prone to considerable movement. And herein lay the challenge to its builders: erect the 2-acre roof with materials flexible enough to sway without tearing or stretching, yet solid enough to keep out the weather.

The answer was dense, elastic sheets of Du Pont neoprene synthetic rubber. Unrolled like giant carpets, the sheeting was overlapped the length of the roof, forming a complete watertight seal. It was secured with a neoprene-base adhesive, except at critical expansion joints where an adhesive deposit would hamper movement. Thus, the sheeting fits firmly on the sides of each joint but rests unattached over it.

Trademarked "Gacoflex", the sheeting was supplied by Gates Engineering Co., Wilmington, Del., a pioneer in elastomeric roofing systems. It was specified for the Dulles Airport by Saarinen, who had recommended the "Gacoflex" system earlier on a huge ice skating rink in New Haven, Conn.

Available in 110-foot rolls, the sheeting is one-sixteenth inch thick and 42 inches wide. It doesn't become brittle in temperatures as low as -40°F., nor does it soften and stretch at readings as high as 200°F. Neoprene is impervious to water, unscathed by sunlight, resists degrading ozone in the

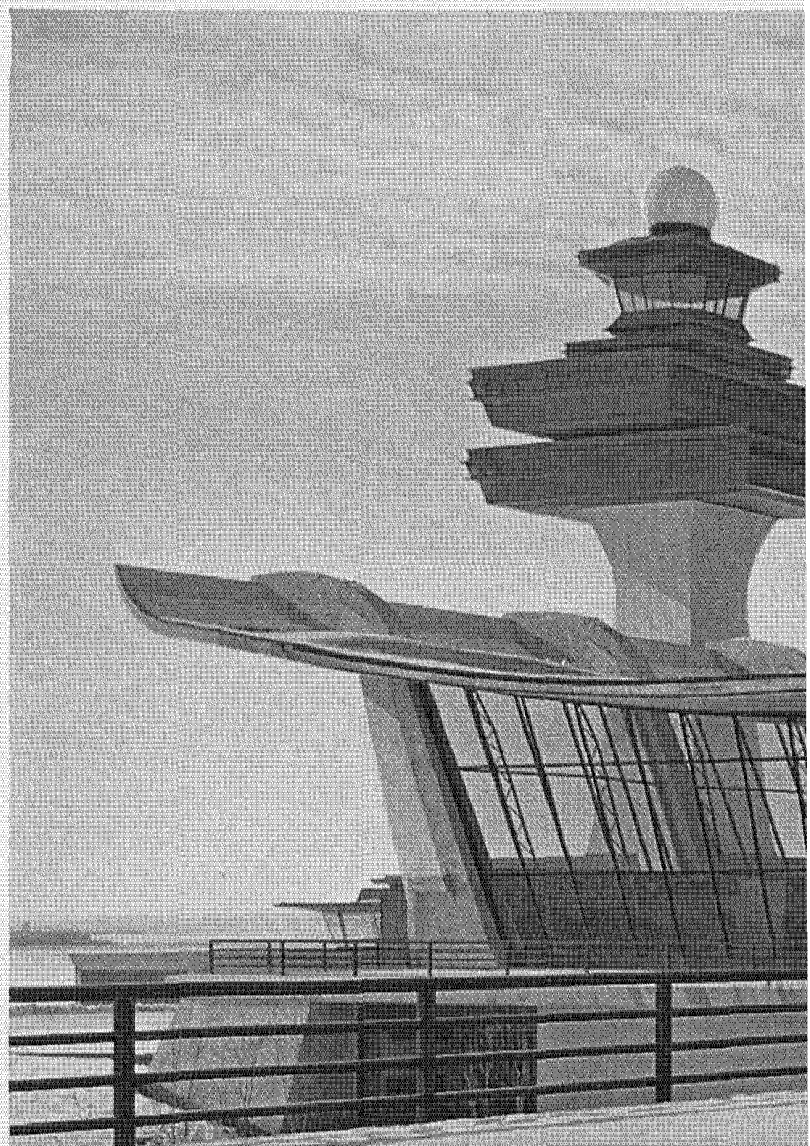
atmosphere and won't propagate flame. It has a tested tensile strength of 2,000 psi.

"Roofers applied our sheeting to tongue-and-groove boards on the skating rink, but the Dulles job was concrete," relates Roland Disney, president of Gates. "So to test out the new conditions, we built a mock-up of the terminal roof with a concrete panel from the job site. Quickly we learned that the concrete was pretreated; thus to get a good adhesive bond we would have to etch all the surfaces. To be safe, we tested a series of adhesives; in the end we settled on our standard cold-bond neoprene adhesive."

Construction of the terminal began with

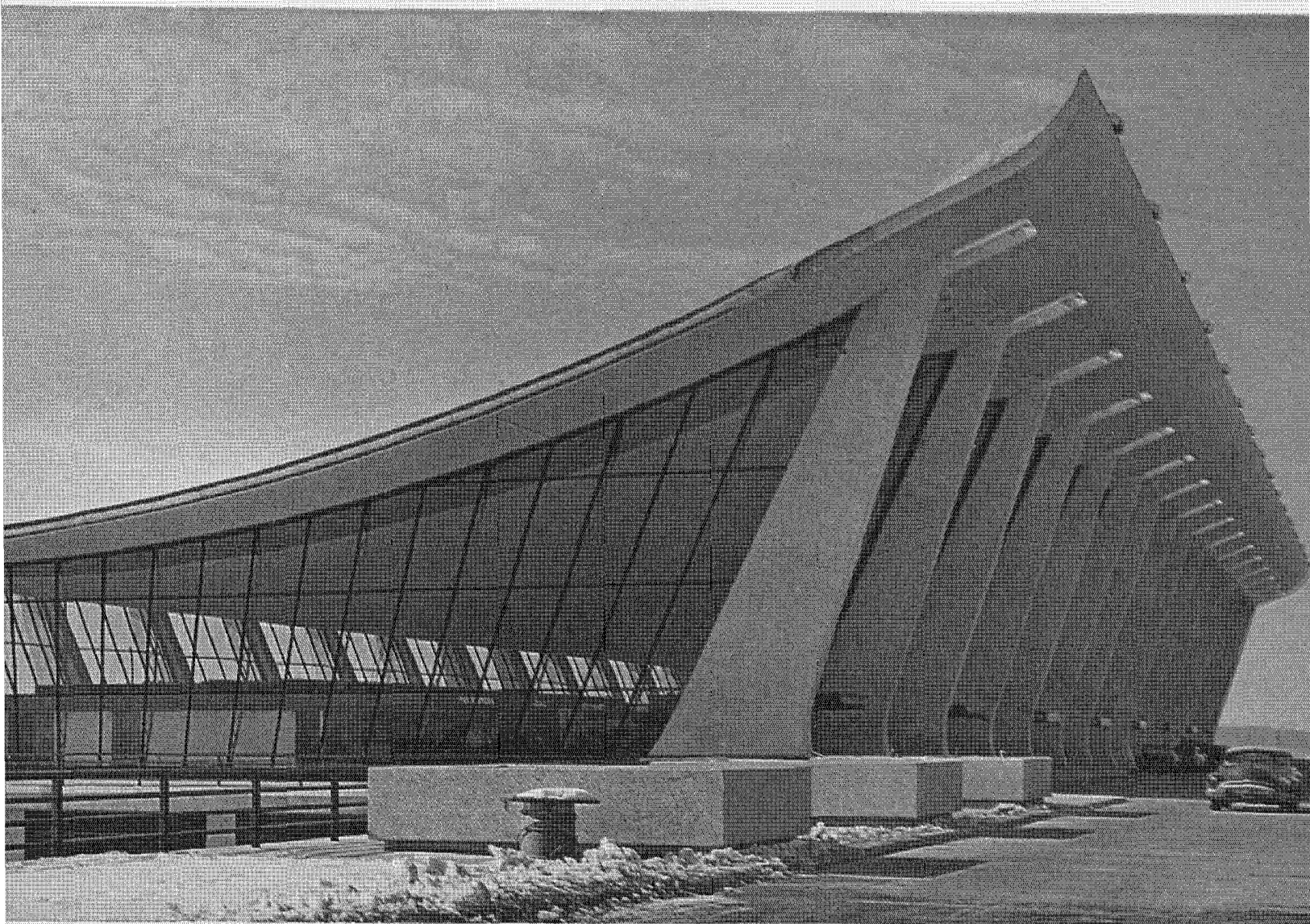
workers pouring 32 pylon footings, each containing 60 cubic yards of concrete. From these sprang up columns made of 16 tons of reinforcing steel and 210 tons of concrete. The columns leaned outward to counteract the stress of the suspended roof.

With the concrete "trees" in place, workers then strung between them one-inch zinc-coated bridge cables, each tested to 60 tons minimum breaking strength, and encased them in concrete ribs for extra resistance to vibration. Spaces between the strands were covered with lightweight, precast concrete slabs held in place by projecting steel bars fitting over the cables.



Dulles International Airport

HAMMOCK



hammock-shaped roof, weatherproofed with neoprene, has no conventional trusses or internal pillars for support.

After the concrete had set, crews of Warren-Ehret Co., Philadelphia roofing contractors, moved in to lay down the neoprene sheeting. The steep pitch of the roof prohibited the use of mechanical adhesive spreaders; the thick liquid had to go on with hand rollers. Several precautions were essential: concrete slabs had to be free of dust, dirt and moisture, and care had to be taken not to clog expansion joints located every 3½ feet. As the crews secured the neoprene, they overlapped sheets three inches on the sides and six inches at the ends. Each sheet was pressed into place with hand rollers to insure a watertight fit.

continued



Long sheets of neoprene were adhered to the concave roof to form a seal tight enough to keep out the weather but elastic enough to withstand incessant up-and-down sway.



Terminal's elevated auto ramps were built by sandwiching sheets of neoprene between slabs of concrete. Neoprene provides a waterproof layer in the ramps which form a roof over a row of underground offices and storage rooms. Final step on the roof, right, was rolling on colored coating of "Hypalon" synthetic rubber to match roof to terrazzo-like concrete pillars.

"The crews hadn't been on the job very long when we got conclusive evidence that the sheets were sticking securely," recalls Disney. "High winds were forecast one evening, so the roofers placed five-gallon pails of sand along the unfinished edges to hold them down. Next morning the pails had been scattered by the gusts, but not a bit of sheeting had worked loose."

In small sections located between the protruding columns and the roof's edge, a fluid waterproofing system was more adaptable. These areas, forming a narrow strip the length of the roof, were constructed of heavy-poured concrete without expansion joints. Here, Gates's "Gacoflex" liquid neoprene was rolled on to a thickness of 15 mils.

The final step was to coat the roof with "Hypalon" synthetic rubber, colored to match the concrete columns and give the terminal the appearance of being constructed of one homogeneous material.

"The terminal's color was almost as unusual as its shape, and spurred our most



painstaking color-matching effort to date," recalls Disney. "To get a terrazzo effect, the columns had been bushhammered, exposing white dolomite aggregate and light gray concrete. We matched compound after compound before we hit on the right color. However, the experience proved one thing to us: "You can match 'Hypalon' to just about any color an architect can dream up."

Gates's experience with "Hypalon" also revealed that the colored coating would have

to be quick-drying or its solvents would work into the sheeting, causing it to wrinkle and pucker. Thus, Gates produced a finishing coat with a special blend of rapidly evaporating solvents.

Like the neoprene adhesive, "Hypalon" had to be rolled on by hand. It was applied to a thickness of four mils, and in addition to color, provided extra weatherproofing.

In any roofing job, it's important to keep down the weight of materials. It's significant to note that the neoprene and "Hypalon" roofing system at Dulles adds only 55 pounds of dead weight per 100 square feet. This compares to 500 pounds for a conventional built-up system of three or four plies of roofing felt crowned with a layer of gravel.

In all, 2,000 gallons of "Hypalon" and about 130,000 square feet of neoprene sheeting went on the Dulles roof. On the ground level, an equal amount of neoprene sheeting was used in an unusual waterproofing job for the automobile approach ramps. Roofing beneath the built-up ramps were designed for office and storage space; water from the overhead roads had to be kept out. Thus the ramps became a sandwich: a base layer of concrete, a middle membrane of neoprene, and the visible, top layer of concrete.

In finished form, Dulles Airport offers an impressive first view of the U.S. to foreign dignitaries and tourists. In addition to its striking silhouette, the structure is also unique because it is only one-third as large as terminals at airports handling comparable traffic.

Reason is the much publicized innovation of mobile lounges, waiting rooms on wheels each transporting 90 to 100 passengers, and from a jet aircraft apron a half-mile away. The lounges eliminate the need for "satellite" terminals for each airline using the airport and for "fingers," the sprawling corridors that lead to distant gate positions. Thus, the lounges protect travelers from weather and noise, while marking an end to the traditional hike from ticket counters to waiting planes.

Architect Saarinen died before his most famous creation was completed. But his spontaneous reaction on a visit during construction is echoed daily by those who see the finished product, "Boy, we've really got something here."

"Design a shotgun that will shoot like no other shotgun ever produced. Make a gun that any shooter—novice or expert—can shoot better with, can be proud to show his friends, and can expect to outlast his lifetime. You have no limits on the design to use."

So went management's instructions to engineers and marketing staffers of Remington Arms Co., Inc., four years ago. For an industrial force long accustomed to producing quality guns (example: since 1953, Remington automatic shotguns have won more national skeet championships than all other brands combined), the mission was akin to gilding a lily, but it was tackled unblinkingly.

Last month the nation's gun dealers began to stock up on the fruit of the intervening effort: the Remington Model 1100—a gas-operated, 12-gauge, five-shot automatic which, with magnum loads, has up to 40 per cent less recoil than other automatics and more than 50 per cent less than "fixed action" models. Endurance tests, one of which involved firing more than a half-million shotshells of all kinds, established the gun's

impact areas, a new, long barrel extension and a new receiver.

A precision action timing system equalizes bolt velocity automatically for either light or heavy loads, making manual adjustment unnecessary. Gas for operating the action is taken off nearer the chamber, where pressures are higher and more consistent than has been customary; thus a smaller orifice can be used. Moreover, the piston is located outside of the magazine tube instead of inside, a feature that permits freer venting of excess gas. Aside from operating improvements, this results in reduced carbon deposits in the orifice and on the gas cylinder—making for the cleanest operation of any automatic shotgun.

The Model 1100's action spring is located in the stock, where there's plenty of room to accommodate a spring design that facilitates manual opening. Loading is made easier,

too, with a new type spring for the magazine, which holds four shots (five-shot total capacity when an additional shell is carried in the chamber). A three-shot plug is furnished for hunting migratory waterfowl.

Takedown, or disassembly, of the new gun is simple. The barrel can be removed with the action open or closed, and the fore-end can be removed separately if desired. Barrels of different chokes and lengths can be interchanged within gauges without special fittings or tools.

To build the shooter's pride of ownership, Remington has provided a number of custom touches to the gun's over-all appearance. The receiver and bolt are inscribed with scrolls and the stock and fore-end are checkered with a fleur-de-lis pattern. The stock has a full grip with custom style cap, and both grip cap and butt plate are provided with decorative white spacers. The grip cap has an inlaid white diamond pattern. A new, more durable wood finish as tough as that used on bowling pins was developed especially for the gun, and a new, high-gloss, rust-resistant finish is used on metal parts.

Gail Evans, Remington's director of sales, says: "In 1963, the Model 1100 will be available in 12 gauge, chambered for either 2¾-inch or 3-inch shells, in a full variety of barrel lengths and chokes with plain or ventilated rib barrels. It will be offered in 16 and 20 gauges in 1964."

*In trap and skeet
or in the field,
this new Remington shotgun
aims to make*

Every Shooter a Big Shot

shooting life to be as much as seven times longer than other automatics on the market.

The gun's qualities have inspired Remington to claim that it will help any shooter become a better shot.

To devise such a gun, Remington engineers first reviewed their fundamentals, starting with the shooter himself. There are many human factors that contribute to poor marksmanship when moving targets are involved: i.e., bad pointing, flinching, failure to swing and follow-through. Training and practice can overcome these. But the gun itself can play a powerful role in helping the shooter improve his skill. Balance, if properly located, helps him in his swing and follow-through; and recoil, if lessened, eliminates his tendency to flinch on the first shot and to be distractedly uncomfortable on subsequent shots. It was in these areas that Remington focused its attention.

Utilizing many features contributing to the fine balance of earlier automatics, the Model 1100 began to take shape. Then, to achieve maximum endurance and dramatic recoil reduction, Remington engineers designed further refinements, such as buffered

Is the "world's movie capital" finished? Not at all, say these producers, who, with quality film and sound business methods, are

Staging Hollywood's Comeback

By JACK D. HUNTER

Hollywood, Calif.

As the assembly on the Hollywood set at right hushes for the director's signal to begin action, it symbolizes an omnipresent irony that attends the motion picture industry: i.e., it can cost \$2 million to run about \$9,000 worth of film through a camera.

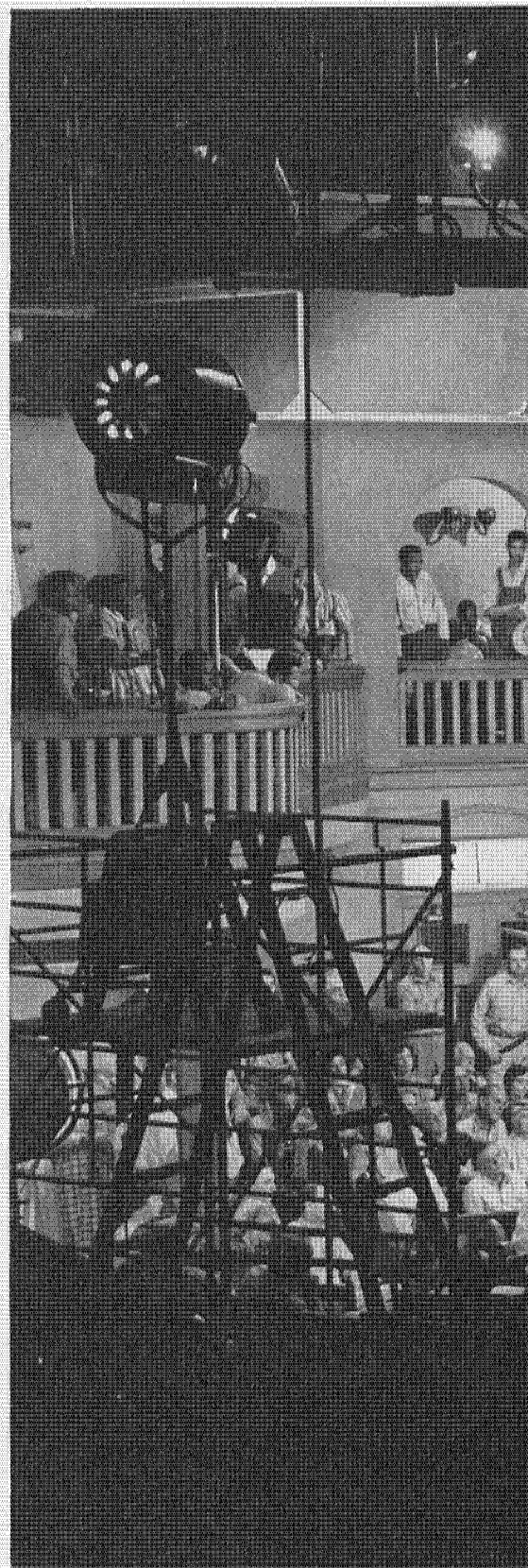
In this instance, for example, nearly 200 men and women and their supporting forces were engaged for eight hours while cameras recorded some three minutes' usable footage in the courtroom sequence of Universal's "To Kill a Mockingbird," now in its opening run in New York's Radio City Music Hall. Cost of the day's work: \$12,000. Cost of the day's total exposed film: \$200.

Restaging this one scene, had it been lost due to faulty performance of the 4,000 feet of film consumed to capture it, could have cost more than all the film used for the entire picture. Thus for producers, although cost reductions are today becoming a major preoccupation in the industry, film is one item which permits no compromise. They're willing now, as always, to pay top dollar for film of maximum integrity and reliability. And in film, top dollar is cheap.

Hollywood lavishness, of course, has become legend, due mainly to the fact that in the old days the industry seemed to regard waste as a way of life. For example, pictures often would be launched with only half-finished scripts, causing delays in production while directors waited for new pages of script to come through; there'd be frequent junking of expensive sequences when scenarios took whimsical turns along more promising avenues; costly reshooting resulted when trial-and-error techniques proved to be mostly error. Rationalization in those days was easy: the market was hungry enough to assure a return that would make such costs negligible by comparison.

Today it's still routine to marshal a staggering array of talent, technology and money to record a slice of human experience—be it pathos or hilarity or a shade between—on a 10,000-foot strip of cellulose acetate. But with soaring costs, the competition of other modes of entertainment and myriad other pressures, producers are considering every

continued



Staging Hollywood's Comeback

continued

gambit likely to cut profit-eroding waste from their ventures.

Sailing fast with the brisk winds of economy blowing through Hollywood these days are Universal Pictures, producers of feature movies, and Revue Productions, makers of TV films. Both are affiliates of MCA, Inc., and both are winning wide recognition for their successful defiance of long-standing predictions that cost-belabored Hollywood is finished as the world's movie capital.

Dedicated to the thesis that there's nothing wrong with Hollywood that hardheaded business methods won't cure, Universal and Revue operate what is generally conceded to be the industry's busiest and most efficient studio. Universal City, the 407-acre plot in Hollywood that serves as their base, has as many as 15 units constantly engaged in shooting features and TV films.

Revue now has 13 separate TV series in work, ranging from the half-hour "McHale's Navy" to the 90-minute "The Virginian." These fill 12 hours of TV network time every week for 39 weeks, and some of the shows run a full 52 weeks. In terms of running time, this exceeds all of the theatrical features turned out by all Hollywood studios combined. Augmenting this activity, Universal plans this year to produce even more than the 12 feature movies it turned out in 1962.

Albert Dorskind, MCA vice president, points out that Universal City's full schedule is typical of the business methods being applied by the studio. Says he: "Just as in any other business, a movie plant operates efficiently only when it works at capacity."

To implement this philosophy, Dorskind and his MCA colleagues have instituted reforms considered only academically in the industry's cost-be-hanged years. Among them: advance planning in everything—nary a camera whirs until the script is complete to the "End" signature; not a set is occupied until all lighting has been rigged beforehand; not a scene is shot on location if one of the studio's exterior sets (western streets, small town business area, European street, three lakes, a 30-foot waterfall are typical of these) can be used; expensive action scenes are eliminated from TV films if adroit handling of dialogue will achieve the same results. The tightening-up seeps into every corner of Universal City's operations, so with this value-received-for-dollar-spent attitude to guide them, Universal and Revue cinematographers find it not only logical but also consistent to demand the highest quality films.

To make a feature picture, from 150,000 to 175,000 feet of negative are exposed, with about 10,000 feet being retained in the final

edited version. The ratio is somewhat better in the filming of an average half-hour TV show (running time: 24 minutes, not counting commercials), with roughly 15,000 feet of negative exposed and 2,160 feet retained in the final, polished version.

The appreciable difference between the amounts of film used to make theatrical features and TV shows stems primarily from the severe timing restrictions that govern television. TV shows must be of a precise length to meet station or network programming. Also, if a producer is to make a profit, budgets and schedules must be tight, since the return from TV films is limited. A feature picture, on the other hand, can run any reasonable length the producer deems necessary to tell the story adequately; shooting schedules and budgets can be more flexible,



because if the picture is a hit the returns can be very large.

In Revue's TV shows the director must O.K. any scene played reasonably well and then go on to the next so that the rigid scheduling can be met. At Universal, however, a feature director can reshoot several times and from various camera angles if he feels that by doing so the scene will be improved.

In any event, the assembling and editing of a picture is a considerable task. Ordinarily the film editor makes a "rough cut" as shooting progresses. Final editing is done after shooting has been completed, with the producer and director making the final decision on what remains in the finished picture.

There are, of course, many types of film, each designed for a particular type of pho-

Film editor Terry Morse uses moviola to select scenes that will survive the "rough cut" of 150,000 feet of film used to make Universal feature.

tography. For instance, William Wade, head of the Revue camera department, always specifies Du Pont Superior II black and white negative when ordering Du Pont film for Revue's TV shows. "This film stock is low in grain and high in the qualities demanded for professional motion picture work," he says. "It gives good reproduction of flesh tones and shadow detail and has a linear gray scale—highly important qualities in our business. It also gives exceptional tonal separation and photographs light colors and specular highlights with a minimum of halation, or flare."

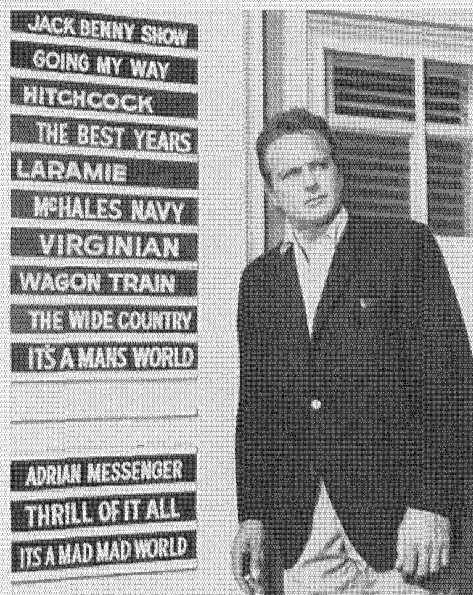
Wade says he's looking forward to using Du Pont's new Superior III fast emulsion negative. "We've tested this film and it's excellent," he says. "Its principal advantage is that less light is necessary to achieve comparable exposure. Thus with the same amount of illumination on a set, we have the advantage of being able to use an F stop with a resulting increase in depth of field. And if we shoot a close-up where added depth isn't needed, we can use considerably less light—a break for actors who find working under a battery of hot lights to be tough going."

Wade points out that today's film is far superior to that of a couple of decades ago. "Today's film has better resolution and is vastly improved in speed, reproduction and grain structure. It's also less susceptible to scratching and static, two things that caused us great trouble in the old days. And it has far more stability in the face of temperature changes. This is very important, particularly when a picture is being shot on location where we may run into high or low temperature extremes."

Technical advantages such as this help them minimize the risk of catastrophic retakes, MCA officials point out, and consequently help form the bedrock on which Universal and Revue are shaping their answers to the prophets of doom.

Says Albert Dorskind: "We firmly believe the future is extremely bright for both the motion picture and TV industries." For proof he points to the \$10 million spent over the past three years to expand and improve facilities at Universal City, including the building of nine new sound stages (the only such construction undertaken in Hollywood in the past decade), and to the additional \$10 million to be invested in other improvements now on MCA's drafting board.

As Dorskind sees it, "This expansion not only is conclusive evidence of our faith in the industry's future, but also demonstrates our conviction that Hollywood will continue to be the movie capital of the world."



Revue star Jason Evers pauses at studio's call board which reveals busyness of the Universal City lot on that day.



MCA economizes with local backgrounds, dialogue "plot bridges." Montgomery Clift plays "Freud" from handy visitors' bench near studio's main entrance, while Ernest Borgnine's monologue covers plot twist too expensive to film.





*Cellophane began to make
visual noises 40 years ago,
but it was a quarter century
before meat markets heard.
As though it were yesterday*

I Remember the Butcher's Straw Hat

By WILLIAM HALLEY

If you are old enough to remember Joe Louis's two-minute conquest of Max Schmeling, you remember that the butcher wore a hat, most frequently a straw skimmer. The hat prevented colds and, some said, brain damage as, dodging the dangling meathooks, the meat carver trundled back and forth into the cooler.

There was sawdust, too, and the agony of waiting behind the indecisive lady who tried on every meat in the store; a bystander threatening to turn vegetarian; a little boy crying "Bingo!" when his number finally came up.

You may even recall a *Saturday Evening Post* cover in which the thumb of an elderly, sweet-faced lady ardently pushed the scale upward while the butcher's, with equal dedication, pushed it down.

The death knell to this slice of Americana sounded 40 years ago when Du Pont built a plant at Buffalo, N.Y., to make cellophane. But the tolling bell didn't carry to butcher shops and meat departments for a quarter century, and there were reasons.

Cellophane, invented by a Swiss who sought to keep wine stains off tablecloths, had little but a name when Du Pont set out to make it. A *Du Pont Magazine* writer of 1923 admitted that his readers had probably never heard of this "Remarkable New Wood Product," but assured them it was beautiful and useful for candy, "good cigars" and "fancy packages," i.e., expensive ones. He seemed equally pleased that milliners could make hats of it. A promoter of the time, afraid the public might not get the point, beat the drum with a sledge by calling cellophane "the transparent paper you can see through."

"For us, beauty *had* to be utility," a Du Pont veteran recalls. "Cellophane wasn't easy to make, it provided little protection and it cost \$2.65 a pound. Outside of that, we had no problems."

The laboratories worked feverishly on a functional film. But not until 1927 did Dr. W. H. Charch develop the moistureproof cellophane that, coupled with salesman-

The image of the old-time butcher is fading into folklore as films with incredibly varied properties have been tailored to package nearly every kind of meat for self-service.

continued

I Remember the Butcher's Straw Hat

continued

primers, sparked an explosion in groceries.

A few firms like Swift & Co. had begun to wrap bacon in cellophane as early as 1926. And H. C. Bohack, a Long Island food chain, had nursed a brilliant idea for centralized packaging of chops, steaks and roasts. Such evidence convinced a 1930 *Du Pont Magazine* writer that self-service meats were here.

He was dead wrong. For example: Anyone in his right mind knew that the relationship between butcher and housewife was as delicate as that between physician and patient. Do not disturb. Besides, there was too much else doing.

An Adjective is Born

Not only could you fly across the country in an awe-inspiring 48 hours, but such pioneers as Piggly Wiggly and King Kullen had followed the lead of Hollywood press agents and invented the "super-market." In deserted garages, rough, ready and dirt-floored, food stores bloomed with a two-point selling philosophy: "Pile It High and Sell It Cheap." The trend was as clear as cellophane: there were about 94 "supers" in 1932, 1,200 in 1934. People carried and (after a technological breakthrough) wheeled baskets along grocery shelves and bought in fantastic quantities.

Recalls Dr. Nelson Allen, who now heads Film Dept.'s packaging market development and customer service, "We like to think that packaging films put over self-service merchandising. Maybe self-service merchandising put over packaging films. At any rate, the two came down the road together at just the right time."

The right time for all save meat, that is. Elsewhere, moistureproof cellophane was on candy, cookies and tobacco; what's more, it was a national craze to boot. Even exotic dancers took dubious cover under it. In the writer's area of the boondocks, a traveling revue called "Girls In Cellophane" resuscitated the old Bison Theatre with a special "Family Night," which Father said was a misnomer.

Fontaine Fox and other cartoonists made cellophane jokes. In a smash Broadway show, a boy indicated his girl was the ultimate with a refrain, "You're the top, You're cellophane!"

And belts proliferated, woven of cigar tubes. Into Du Pont Sales offices on the 10th floor of a New York building strode a proud father who flung open a window to display his son's handiwork: a cellophane belt that stretched all the way to the street.

But although the nation had plenty of

good cellophane-wrapped smokes, there wasn't much doing in the meat business.

In 1935, Du Pont put the finger on impulse buying with its first national survey of consumers. Some 24 per cent of all grocery purchases, it found, were not planned when the housewife entered the store. This powerful medicine, obsoleting the shopping list, led to new emphasis on visual packages to capture unplanned purchases. Work proceeded on printable films, printing techniques, machines for automatic processing and sealing. Cellophane, it seemed, was everywhere.

But not in meat departments. Bohack's original idea, to butcher centrally, then send to branch stores only the cuts fancied by their individual trades, showed why: What were you going to wrap the stuff in? Each meat had its own properties, to maintain which a film would have to be tailored. What's more, there weren't even any refrigerated cases suitable for self-service. Most experts felt the economics of self-service meats would be great if possible. They didn't look possible.

But World War II and its personnel shortages fed the growing industry doubts that the meat department was permanently immune to self-service. When, of necessity, some West Coast supers tried prepackaged meats, sales volume jumped as much as 50 per cent in a few months. The moral seemed to be that the housewife *could* be won over; that an ancient bottleneck could be eliminated; that self-service could make available a much broader selection of meats.

One president of a large food chain has recalled other forces behind self-service meats, among them "the pent-up indignation carried over from the war period, the waiting, the favoritism, the indifference and sometimes rudeness of wartime meat personnel. In addition, labeled, full-vision packages were appealing to postwar brides; unlike the lampooned mess sergeant, they were sensitive about their limited knowledge of cuts and cookery and the fact that they didn't know short ribs from pork chops."

Du Pont's Nelson Allen vividly recalls his 1945 order: full speed ahead on films for meats. The problems were intricate. When the shopper looks at fresh meats, she wants to see the rich, red color called "bloom." Actually, beef has a purplish cast when first cut; the color we associate with it is due to the reaction of oxygen in the air with myoglobin in the meat cells. So: Oxygen had to pass through the film.

But beef is 80 to 85 per cent water; this couldn't escape or meat would dry out. Thus

the task was to produce a film with low permeability to water but high permeability to oxygen.

With processed or cured meats—frankfurters, bologna or ham—the case was different. Ham's pink color fades if both light and oxygen are present. You can't do without light; so a film that admitted light but kept out oxygen was developed.

By 1946, with several basic film types available. Film men set out to chart a workable in-store technique for prepackaging meats. Papermakers were asked to find molded trays that were neither nonabsorbent nor too absorbent, but just right. A new, so-called virgin pulp tray emerged.

With precision weighing now crucial, manufacturers were asked to develop scales far more accurate than existing models.

Labeling devices, sealing irons and plates, and wrapping machines had to be perfected.

Refrigeration companies produced open display cases, hitherto unknown.

Because existing fluorescent light washed the color out of meat, the so-called "soft-white" lights were born.

All told, Nelson Allen estimates, a dozen industries besides the food chains and Du Pont Film men labored on the technology. Then, after field testing, an extensive Du Pont survey probed what first consumers did and didn't like about prepackaged meat. They liked "You see what you're getting," "You can walk away without buying" and "Cleanliness." "No flies," said some. What consumers didn't like: "Grade isn't marked" or "Fat and bone underneath."

A Book is Born

Out of some two years' work emerged a Du Pont book, "How to Prepackage Meats for Self-Service," that became a kind of bible. It defined, step-by-step, every self-service meat procedure from buying equipment and training employees to labeling and cost control. The response was fantastic: in a few weeks thousands were distributed.

Underlying all was the zeal of pioneer cellophane salesmen, many of whom had championed meat self-service for years. Now, sensing victory, they worked like men possessed. Robert R. Smith, Film Dept. director of marketing, recalls accompanying one large chain's officers to a new store opening. "Our salesman had spent a solid month helping to set up the meat department. Now, on opening day, lady shoppers were tapping on the window and calling for the premiere to start. But 'Don't open those doors yet, I'm not ready!' called our salesman. Finally, after watching him fussing

endlessly to get the meat display perfect, the chain vice president turned to me, shook his head sadly and said, 'Heaven help the first woman who lays a hand on that display.'"

The die was cast. How would the shopper react? A Du Pont veteran recalls an early visit to Boston for a self-service meat opening. In walked a bejeweled, exquisitely garbed woman. "Watch this one's reactions," the store manager urged.

The woman strolled along the case, her expression aloof. Then suddenly, she picked up a steak the size of a door mat and flapped it over her minked arm. "Self-service is in," cried the gleeful manager.

New Films Are Born

The principle was in, but Film men quickly found that no cellophane, procedure or fond idea remained sacrosanct for long. The field, quite simply, grew and changed too rapidly. In 1946, only 28 supermarkets featured complete meat self-service; today the store that doesn't is the exception. Along with baked goods, meat became a major market for cellophane, but experience showed there was no such thing as an all-purpose film. Thus film types multiplied, changed and improved in a steady trend toward lighter, more durable, higher yield products. Most recent example: MSAD-88 cellophane, an improved, extra-strong film for wrapping

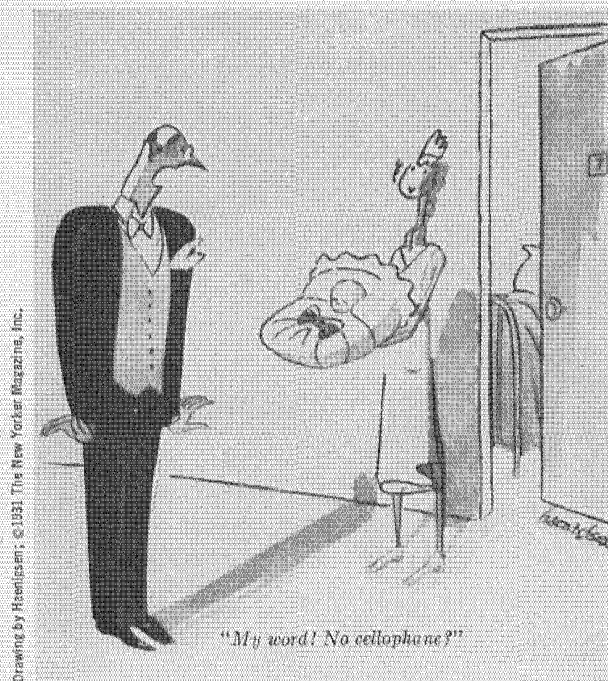
heavy, sharp, bony cuts of meat weighing over two pounds. The tough film reduces wrinkling, puckering or limpness, yet has the high luster of its cousin, MSAD-80, used on cuts of meat under two pounds.

Even the traditional mode of marketing cellophane for meats has changed with the times. As the housewife accepted self-service, and stores and film uses multiplied, so did the problems of serving individual meat departments. Accordingly, Du Pont has turned to a network of strategically located authorized distributors who sell Du Pont films to this vital segment of the market. As local sources of supply, these independent merchants give almost daily attention to servicing cellophane users; provide warehousing and maintain the extensive inventory of films that stores need on short notice; keep customers abreast of new cellophane developments and help them use the film more profitably.

In the supermarkets of tomorrow, predicts H. D. Chickering, sales manager for Du Pont packaging films, other changes, new films and different cellophanes will undoubtedly be seen. In fact, you may even begin to see more of the butcher: in some new stores, windows are replacing mirrors over the meat displays.

One memento will probably be missing. There won't be a straw hat in the place.

30 Years of Cellophane as reflected in *The New Yorker*



1931



1962



MISSOURI'S LIMESTONE

*A new Du Pont
blasting system helps
lower costs and
improve the safety of
men extracting
rock from cavernous
rooms inside
Bethany Falls ledge*

By HARRY E. DAVIS

One day in the late 1920's, employees of Stewart Sand & Materials Co. blasted a chink into a hillside of limestone near Independence, Mo. To trace the progress of that fissure today, a visitor to the mine must wind his way through a honeycomb of subterranean rooms covering more than three-quarters of a square mile.

And by the end of this year, the already vast underground quarry will be 12 acres roomier. The Kansas City mining firm estimates it will burrow at least that far to extract over 600,000 tons of stone. The stone will find uses ranging from coarse aggregate for concrete roads to finely pulverized powder for agricultural spreading. So tremendous are the mine's reserves that the company can continue its current pace of

hollowing out the countryside for 15 years.

The rich deposit is in the heart of Missouri's Bethany Falls ledge, a layer of high quality limestone forming a north-south semicircle around Kansas City. Because of its size, quality and proximity to end users the ledge early attracted some 20 operations similar to Stewart's, each one contributing to the state's cavernous limestone cellar.

By the same token, the cluster of quarries has contributed to still another local condition, this one more frustrating than fascinating—namely, a history of limestone selling prices almost as rigid as rock itself. Prices were further frozen by the fact that almost all the ledge's outpouring is directed at the same geographical market.

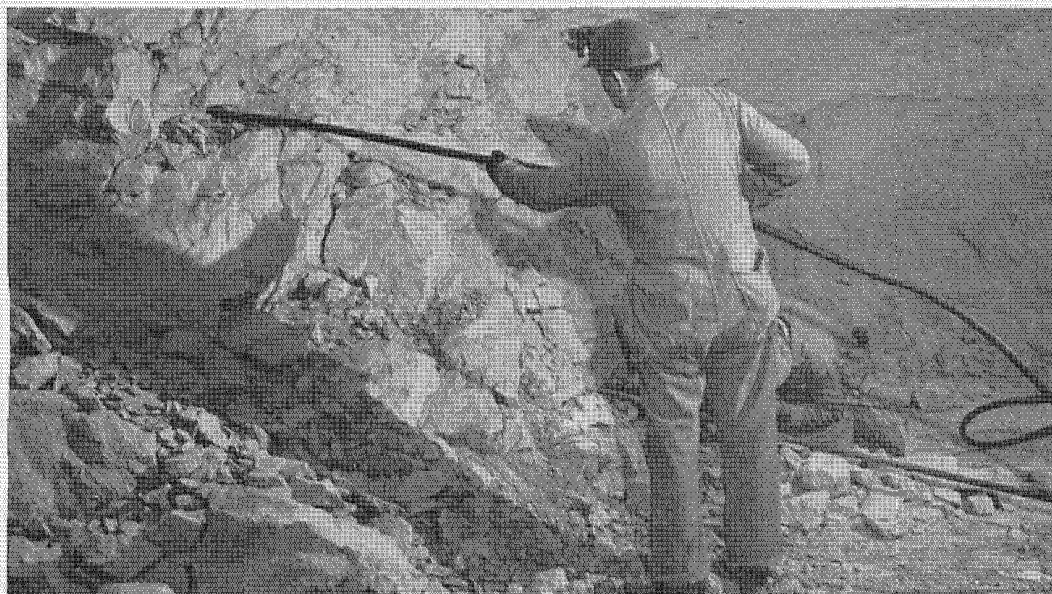
"When I came to work here 30 years ago



CELLAR

Spacious rooms of solid rock are blasted open 60 feet underground as Stewart Sand & Materials Co. mines rich limestone buried in the hills near Independence, Mo.

Preparing to rip loose some 400 tons of stone, workmen pour "Nilite" 303 into a Du Pont Airloader, which feeds the blasting agent into rock pneumatically, below. "Nilite" has cut Stewart's costs a nickel a ton.



a ton of crushed stone sold for only 15 cents less than it does today," recalls Ernest L. Childs, Stewart mine superintendent. "By comparison, material costs have gone up roughly 50 per cent in the past ten years. Wages have increased nearly 75 per cent in the same period, and as much as 45 cents an hour just since 1960."

Thus, with outgo creeping dangerously close to its income, Stewart set out to take several notches in its corporate money belt. A major step was beefing up its mining equipment to turn out more rock in less time. This included introducing seven self-propelled drilling rigs built to Stewart's specifications and twin rubber-tired loaders.

The twin loaders, equipped with 4½-cubic yard buckets, replaced a pair of

1-cubic yard electric shovels. The new loaders' greater productivity, speed and mobility have cut loading and hauling costs 3½ cents a ton, says Childs.

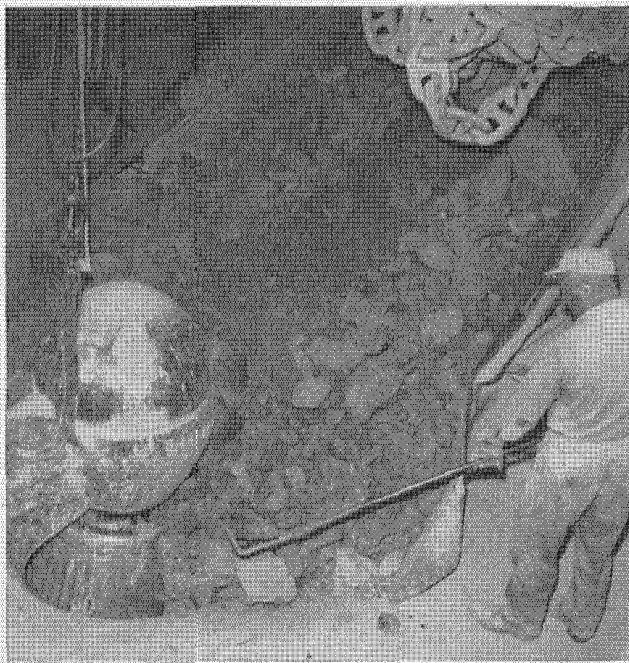
Now an even greater savings is being realized with the mine's newest ally against dwindling profits—a more efficient method of blasting called the Du Pont AS/4 System. The system's economical ammonium nitrate blasting agent saves Stewart nearly a nickel a ton over an earlier system using dynamite, reports Childs. At the current rate of production, this is about \$30,000 annually. Moreover, as the "AS" (antistatic) in its name implies, the system provides employees maximum safety against static electricity hazards associated with pneumatic loading and bottom priming boreholes with electric

blasting caps.

The system is a complete explosives package, offering static-resistant electric caps, two antistatic loaders, conductive loading hoses, a variety of primers and "Nilite" 303 blasting agent. Based on results of Du Pont tests for static electricity in 23 different mines, the system's components provide a conductive path through which static charges, generated by rapid movement of blasting agent solids, pass into the rock face and dissipate. Thus, charges do not build up on the operator, blasting agent container or in the borehole. The result is a significant reduction of the possibility for sudden discharge of static voltages sufficient to prematurely detonate the caps during loading.

This means that under virtually all min-

continued



Primary crusher handles 300 tons of raw rock an hour with good breakage provided by "Nilite" and MS Delay electric caps.

ing conditions, operators can bottom prime (caps inserted before blasting agent) for maximum performance, as long as nonconductive borehole liners aren't used. As an extra margin of safety, however, Du Pont offers an easy-to-use slide rule for calculating safe levels of conductivity in a loading area by using readily available temperature and relative humidity readings.

Stewart's choice of components offered by the system consists of MS Delay electric

caps, Hi-Cap #2 primer, the Du Pont Air-loader and factory-mixed "Nilite" 303. To prepare for a shot, the special drilling rigs sink 44 strategically placed holes with 1 3/4-inch diameters. The holes form a V pattern in the rock face and vary in depth from 12 to 14 feet. They extend from about 6 inches below the mine roof to practically even with the floor.

Each hole is quickly filled with 8 to 10 pounds of "Nilite" 303 with the Airloader,

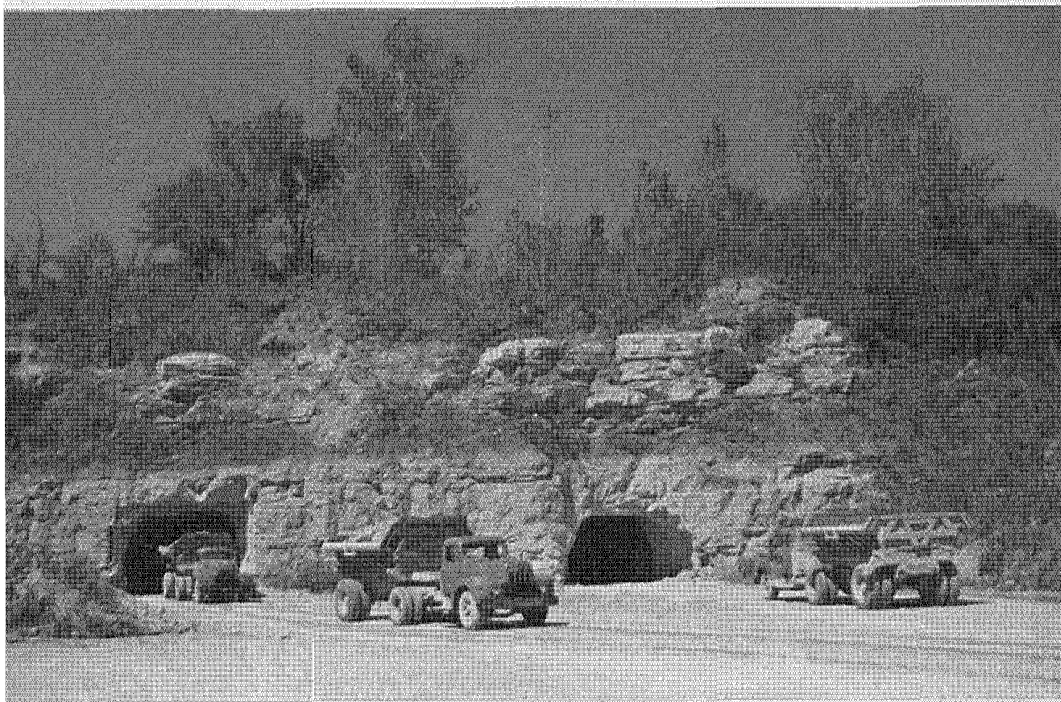
which has the capacity to move 80 pounds of blasting agent a minute. Detonation begins at the center of the V pattern, where the triggers are instantaneous electric caps. The shot moves out toward the sides at from 25- to 50-millisecond delay intervals; the maximum delay is 300 milliseconds.

How does the system perform? Says Childs: "The combination of 'Nilite' 303 and electric caps gives us slightly better breakage than we got with dynamite, and there is less bootlegging, the part of the rock face that doesn't fall after the round."

Each round or detonation brings down 400 to 450 tons of rock. The rock face is shot to carve out 36- to 40-foot-wide rooms with 17 1/2-foot ceilings. Twenty-four foot-square rock pillars are left standing to support the 60 feet of overburden between the mine and the surface.

Between five and ten rooms are shot every day. Picking up after the blasting crews, but working safely several rooms in arrears, are the loaders and a fleet of 14-ton trucks. The current loading area is so deep in the hills that the ponderous trucks must churn more than a mile before crawling out of the hill to dump their stone at the crushing and screening facilities outside.

According to Childs, the next move to streamline costs will be replacing the trucks' 14-ton side dumpers with 20-ton capacity bodies. "We also have a few other ideas under our hats for whittling costs," he says. "And the way it looks, we may even beat our nickel-a-ton savings with the new blasting system, once our people become more familiar with using it."



Trucks churn a mile through one-way tunnels to get rock outside for processing.



W. C. Skilling (in front of chart) meets with Retail Section. At his right are J. M. Wright (planning) and, next, T. H. McNeill (field group).

As the U.S. changes, so does retailing...and this takes Du Pont Textile Fibers representatives

From Miami to Mont Tremblant



Buying office executive T. R. Fiddler discusses new knits with P. T. Sullivan, Du Pont.

The beaches of Miami and the ski slopes of Mont Tremblant, highest of Canada's Laurentians, are separated both by 1,800 miles and, in the winter, about 50°F. Marketing activities as varied as the resorts themselves recently drew representatives of Du Pont's Textile Fibers Dept. to them.

In Florida, the Du Pont people helped Burdine's department stores present the first extensive collection of swimwear made with "Lycra" spandex fiber. At Mont Tremblant, they played host to 26 college students, who gathered to discuss what well-dressed young men will wear next fall.

Such activities point up a new Du Pont emphasis on retail store programs and, in turn, distinct changes in these stores.

"Television and jet-age travel help make Americans aware of new fashions much faster than formerly," says T. Robert Fiddler, vice president and general merchandise manager of Frederick Atkins Co., New York City, a merchandising and research organization with 40 leading stores as mem-

bers. "One result is that department stores are stepping up their fashion merchandising programs. The attitude toward special promotions, I've observed, is changing from apathy to interest."

As such things go, the Burdine's promotion was fairly elaborate. The store sent a flock of pretty girls to model swimwear at the opening day of Hialeah Park. It floated balloons advertising "Lycra" above crowded beaches. Some 30 windows and a series of newspaper ads called attention to the featured merchandise. There was additional modeling in the stores' tearooms.

Dorothy Lund, a member of The Merchandising Group, which represents Du Pont to retailers in some 50 cities across the country, helped Burdine's lay the groundwork. Janet Crawford, sales training coordinator for the Textile Fibers Dept., visited each of Burdine's six stores to tell clerks about the fiber's strong points.

By the end of the week, a waggish observer could report that "Lycra" had made

continued

From Miami to Mont Tremblant

continued

a big splash. Burdine's had stocked—and sold—substantial quantities of the featured swimwear. Coming several months before northern stores promote such merchandise, the Florida experience could serve as a barometer for other retailers.

Retail store promotions, of course, are by no means new. But thoroughness and coordinated effort, as typified by the Burdine's promotion, have increased markedly in the last few years. So has the participation of fiber producers like Du Pont in activities of this sort.

"Retail stores are an essential link in the long chain that carries fiber from our plants to consumers," explains William C. Skilling, manager of Du Pont's recently formed Retail Marketing Section. "Our customers, of course, are yarn spinners and fabric producers, and we have worked closely with them since the 1920's. Later we began to work with converters—companies that dye and finish fabrics—and with garment manufacturers. At each level, our general goal has been the same: wise use of our fibers to create garments that offer both style and something extra in performance.

Profusion... Confusion

"The proliferation of fibers and fiber blends in the last 15 years has been enough to confuse textile experts, let alone consumers. Realizing the need for basic fiber education, we began sending sales training representatives to stores. Our participation in store buying and selling programs is a natural extension of this effort.

"The new speed at which fashion moves makes it essential to improve communication at all levels of the textile industry," Skilling points out. "One approach is illustrated by our conference at Mont Tremblant. We view this meeting of campus style leaders as an important step in reaching the young men's market.

"Another way is through our field men and TMG representatives, who watch retail trends across the country and tell us what new or improved fibers and fabrics store buyers want. This information exchange works in both directions. Back in September, for instance, our people called on 215 stores in 52 major cities to present style and fabric information related to the spring/summer 1963 suit, slack and sport coat mar-



New blend of 80% "Orlon" and 20% linen gives a pleasantly firm, dry feel to Travel Knits Premier. Washable, as are all of the garments pictured, these knit separates need no blocking.

ket. When the buyers came to the New York market a few weeks later, they knew what was available in Du Pont fibers and where to look for it.*

"Sales training is another essential facet of improved communication. For instance, we discovered retailers needed help in explaining the unique features of sweaters of 'Orlon Sayelle' bi-component acrylic fiber. It looks and feels so much like wool that, at first, some women didn't believe such sweaters would actually thrive on machine washing and drying. We developed a training program to clarify this point and gave it to more than 10,000 sales people and buyers in some 60 cities."

What's ahead? Skilling looks beyond specific retail programs, sales training sessions and fabric-fashion presentations to what he calls "creative retail marketing."

He describes one step in this direction:

"A store buyer tells us what sort of styling he'd like to see in, say, sweater shirts. 'Orlon' acrylic and 'Antron' nylon. He and the Du Pont representative then go to the knitter to translate ideas into garments. There are pitfalls, sure. The knitter may find the styling leads impractical. The buyer may not like his own idea when he sees it. But in the main, we believe this approach is sound one.

"To put our function quite simply, we're trying to find ways to help the retail community do a better job of buying and selling merchandise in Du Pont fibers. The response from our activities so far has convinced us that stores and their customers are hungry for straightforward information on fiber fabrics and merchandise. Our aim is to help them get it."

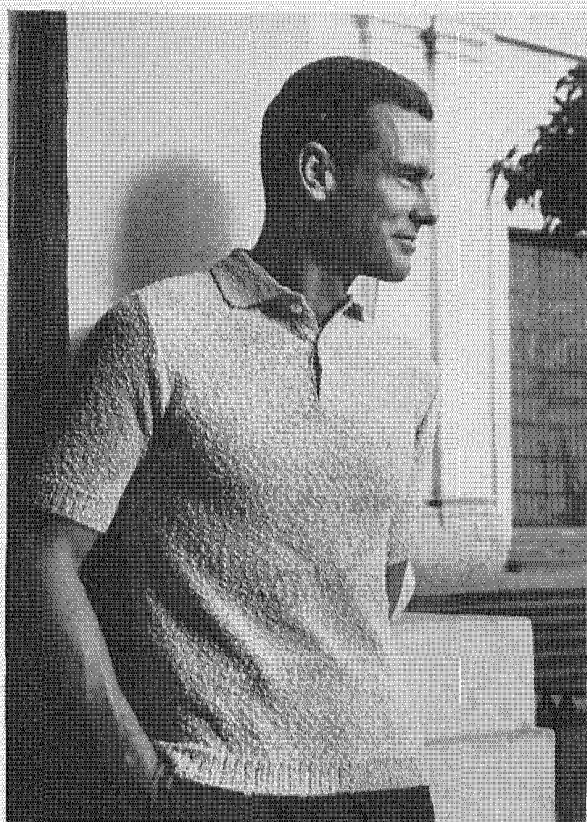
*Some of spring's other new fabric-fashion ideas involving Du Pont fibers are illustrated on these pages.



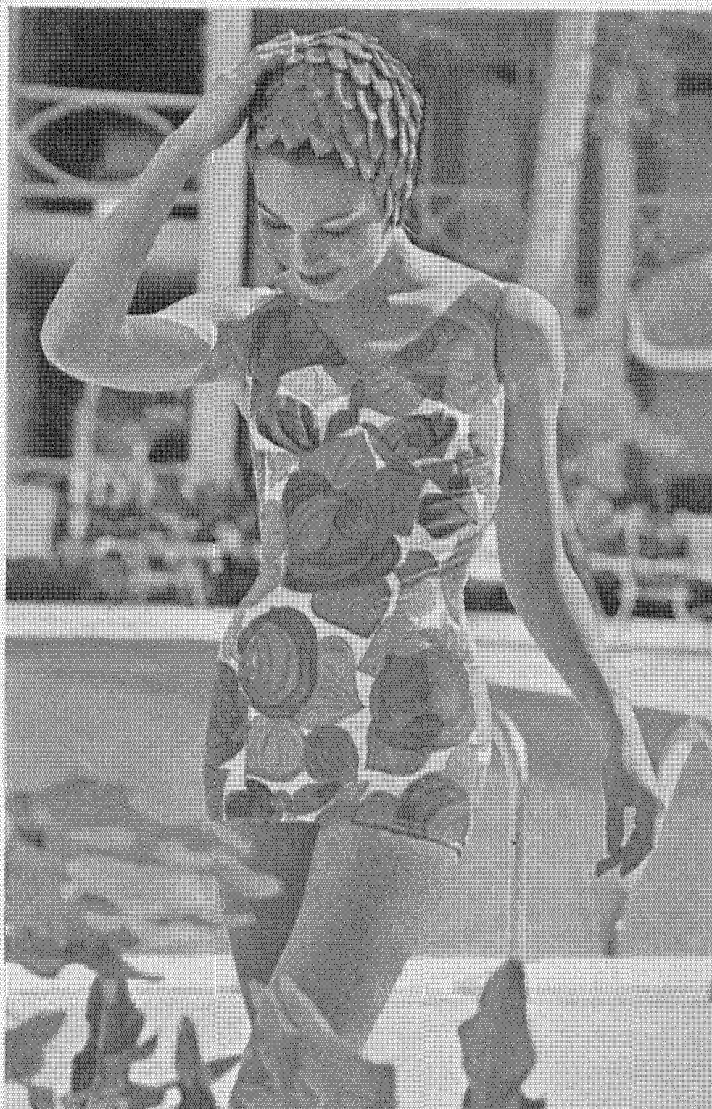
Robert Lewis chose chambray of 65% "Dacron", 35% cotton for nautical jacket. Interlining is a Scott Foam laminate, made with Du Pont "Hylene" organic isocyanate.



News in knits: a fabric that looks like traditional denim, yet is softer and more pliable because it's 100% "Orlon". This outfit, by Talbott, is among new styles called Travel Knits because they use double-knit fabrics of Du Pont fibers.



This knit, David Church's variation on the popular "ventilated" theme, owes its fresh, linen look to a nubby blend of "Orlon" acrylic fiber and "Antron" trilobal nylon.



More plentiful supplies of "Lycra" spandex fiber mean it will be more generally available in 1963 swimwear. This suit, by Rose Marie Reid, is an open-weave fabric of "Dacron", "Lycra", nylon.

These new DuPont polymers behave usefully at temperatures of 500° to 800°F., well beyond the normal range of organic materials

THEY LIKE IT HOT

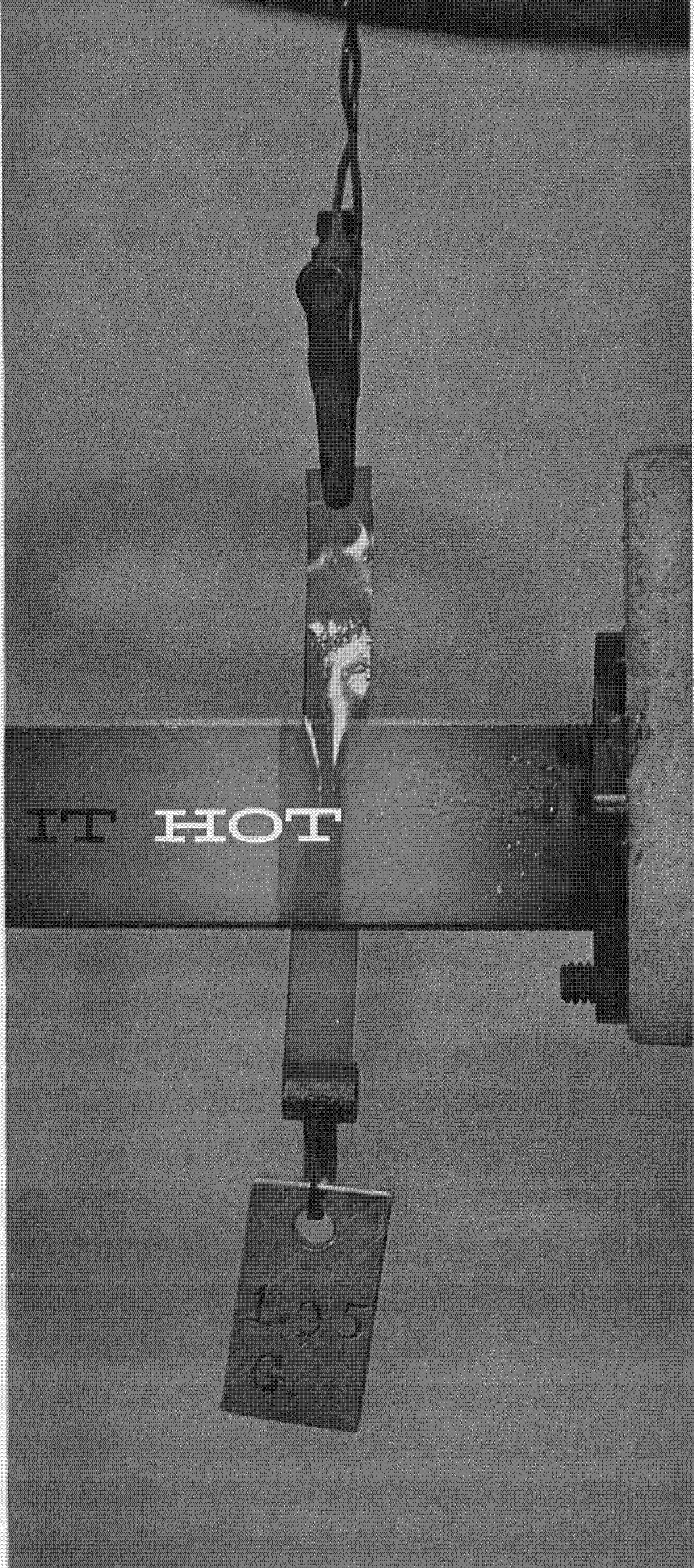
By EMILY HEINE

The metal bar glows cherry red and the recorder connected to it shows a temperature of 1025°F. A piece of aluminum foil melts a few seconds after it touches the bar. The strip of amber-colored film next to it, however, hangs on for more than ten minutes before, charred, it drops apart.

This "hot-rod" demonstration — more properly known as the Du Pont Zero Strength Temperature Test — is especially helpful to scientists in studying materials that don't melt, even at unusually high temperatures. Specifically, it determines the degree of heat that causes a polymer film to fail in exactly five seconds under a tensile load of 20 pounds per square inch. The particular film in question eventually exhibited a zero strength temperature of 1470°F.

Nearby, in another Du Pont laboratory, a technician blasts a dark-brown disc with a plasma jet. Although the flame reaches a temperature of 10,000°F., the disc retains its shape. The jet cuts through a steel disc of similar thickness in less than half the time it takes to burn through this one.

H film and SP polymer, as these new Du Pont materials are designated experimentally, present an array of properties



New H film attracts interest because it offers outstanding thermal stability, mechanical strength and excellent electrical properties.

never before encountered in a single organic polymer. Chemically, they are aromatic polyimides, derived from the reaction of pyromellitic dianhydride with aromatic diamines. Physically, they are exceptionally tough and resistant to abrasion, radiation and many chemicals; they also have excellent electrical properties. But their principal distinction is that they keep these properties at temperatures that other organic materials can't tolerate. Thus they boost the ceiling for plastics to the 800°F. range from a previous top of about 550°F.

"Just about the only thing wrong with H film is that there isn't enough of it to match the interest it has generated," says Dr. C. E. Sroog, development manager of the Film Dept.'s research and development division.

"Right now, the supply is limited to what an experimental facility can turn out. This situation will be eased, however, when a pilot plant is completed in 1964. Despite the present limitation, we are actively exploring H film's potentialities in a number of applications."

"This product appears unique in meeting stringent market demands," says Dr. A. B. Ness, new product manager of Film's sales division. "By moving directly from a laboratory operation to prototype manufacturing facilities, we are trying to shorten the time required for commercialization."

The Plastics Dept. has no such supply problem. Polymer SP for test marketing is made in a small-lot manufacturing operation at the Du Pont Experimental Station.

"We are eager to know more about how SP performs in extreme environments before we decide on the final product form and build a full-scale plant," explains Ray Campbell, marketing manager.

Three other Du Pont polyimide products are already available commercially. Offered by the Fabrics and Finishes Dept. for Class H insulation of electrical equipment, they are "Pyre-M. L." wire enamel for magnet wire; "Pyre-M. L." coated glass fabric for slot liners; and "Pyre-M. L." insulating varnish for entire assemblies. This system was described more fully in the September-October 1962 *Du Pont Magazine*. Since then, F&F has begun plans for a full-scale plant, to meet rapidly growing demand.

Du Pont scientists have been investigating the field of polyimide chemistry for many years. Research men in the Plastics Dept. (then called Polychemicals) early found polymers that offered a real advance in high-temperature properties. But, not surprisingly, the aromatic polyimides, which were the most resistant to heat, also were most resistant to melting. This meant that they couldn't be molded, extruded or cast by conventional plastic techniques. When efforts to get these "intractable" polymers into a useful shape proved fruitless, the scientists turned to the aliphatic branch of the family.

The Film Dept., too, was interested in thermally stable materials, specifically in a film that would be useful at temperatures beyond the limit of "Mylar" polyester film.

"Theoretical considerations and the earlier work in the Polychemicals Dept. pointed to aromatic polyimides, despite their intractability," recalls Dr. Hugh W. Gray, director of the Film Dept.'s research laboratory at the Experimental Station. "Our first breakthrough was a test-tube method for making bits of film about an inch square. They resisted high temperatures pretty well, but flexing, unless it was very gentle, made them fall apart.

"Intensified effort finally resulted in a couple of key discoveries that allowed us to produce bigger pieces of film that were very tough. These put us over the hump, so far as product properties were concerned."

"The success with a film encouraged us to take another look at the aromatic polyimides in the light of our own interests," says Dr. William Calkins, now the Plastics Dept.'s new ventures research manager. "We called our material SP—short for 'super polymer'—because of its outstanding properties.

"We found, for instance, that samples maintained over half of their tensile strength after 1,000 hours of exposure to air at temperatures of 572°F. In another test, the material stood up for a short period under 932°F. heat. It was more resistant to creep, or cold-flow, than any thermoplastic we knew of. Our main problem, and it was a considerable one, was to find a way to fabricate solid shapes from the raw polymer. The development progressed gradually from pieces the size of a poker chip to large billets and bars, which could be machined.

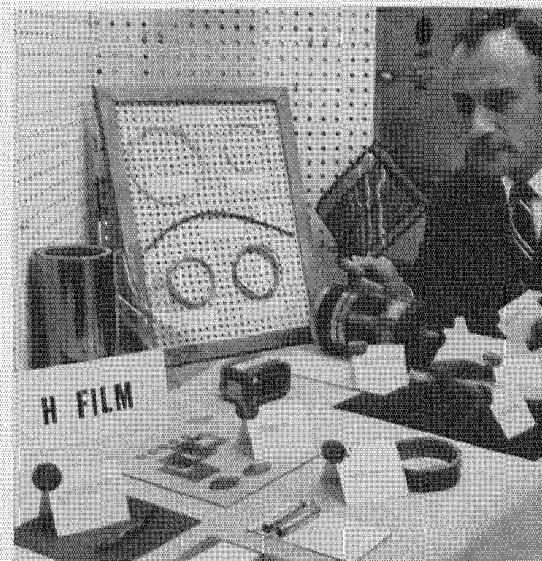
"Now, we're able to manufacture specific parts in their final shape. But we're still refining our methods and expect to continue doing so for quite some time. Because the technology is of such a critical nature, we plan to make the finished parts in our own shops. This, of course, represents a distinct departure from the Du Pont pattern of marketing plastics in powder or pellet form."

Ray Campbell, marketing manager, sees SP as a specialized material that can be ex-

continued



Drs. C. E. Sroog, C. E. Berr and H. W. Gray recall early H film test that showed heat resistance.



Field tests of H film in varied applications are arranged by R. S. Mallouk and his men.

THEY LIKE IT HOT

continued

tremely helpful in a number of difficult applications. Potential uses, he says, include mechanical parts in rotating or sliding contact with metals, where elimination of lubricants may be advantageous; mechanical or electrical parts for service where radiation levels are high; and mechanical or electrical parts to be used continuously at up to 482°F. or intermittently up to 932°F.

Campbell emphasizes the difficulty of assigning precise temperature limits to a material like SP.

"Continuous high-temperature service in air is far more severe than intermittent high-temperature service in an inert atmosphere.

We would far rather have a designer tell us our product is better than we say it is than hear that it didn't meet expectations. For this reason, we stay on the conservative side in setting performance standards.

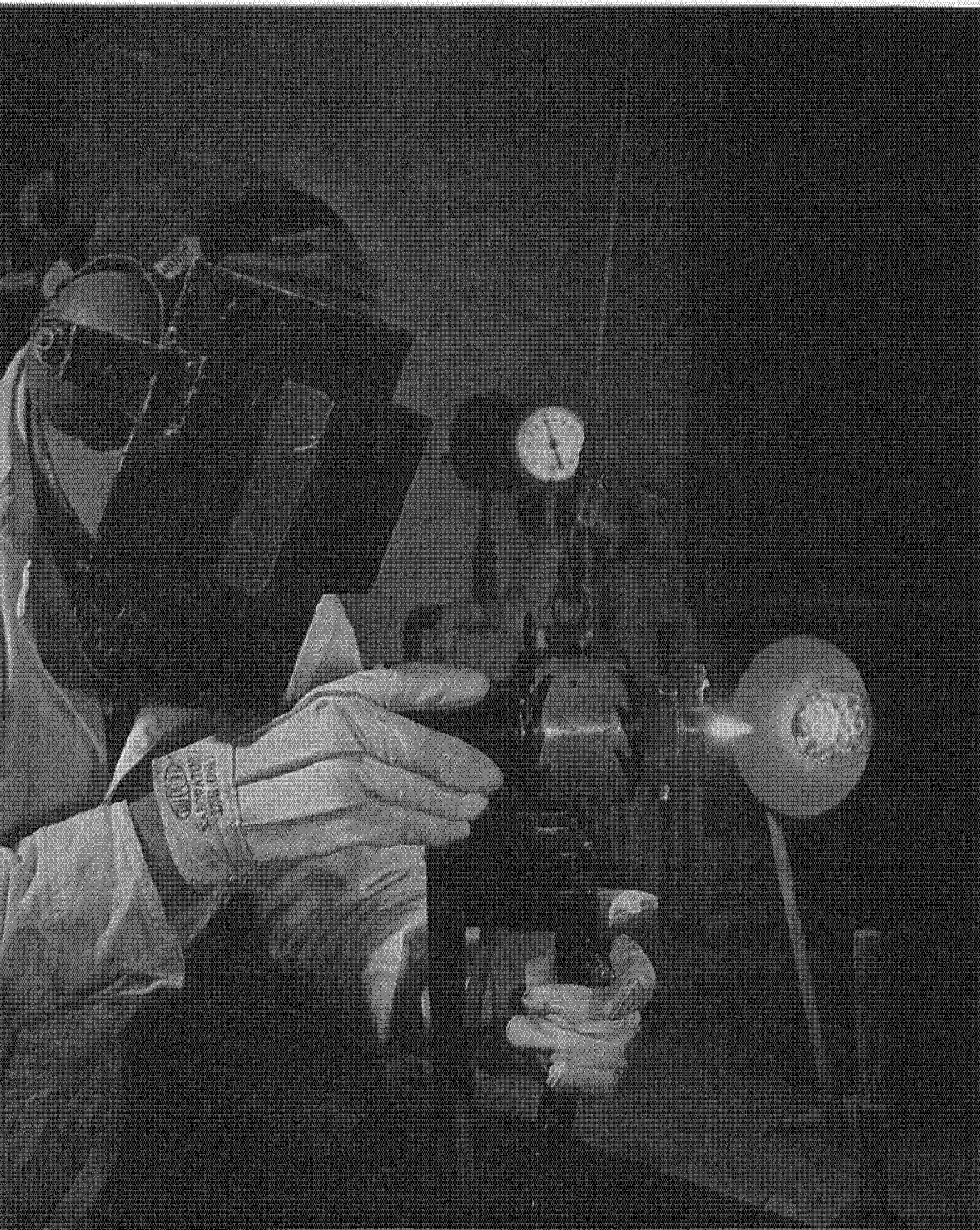
"As a beginning," Campbell says, "we are concentrating on two quite different areas—first, mechanical parts for service under extreme conditions and, second, diamond grinding wheels with SP as the binder. We're offering flat wheels in diameters from six to ten inches and in varying thicknesses and diamond concentrations. We're developing cup wheels and flared ones, too."

Using one of the new flat wheels, main-

tenance men at a textile fiber plant are able for the first time to regrind the cutting surface of the short staple cutter without removing the blades. Previously, they were unable to grind in one step the three different materials—carbide, brass and steel—that make up the cutter because the wheel filled in with brass particles; this "loading" produced a poor cutting surface that could create excessive heat and ruin the carbide. By making it unnecessary to remove the blades, the SP wheel also eliminated another operation—rebalancing the cutter after the blades were reattached.

"The grinding wheels we're making today are considerably better than the ones we introduced some months ago," Campbell points out. "Our first evaluations showed some weak points as well as strong ones and we went back to the laboratory for improvements. We had fabricating problems, too. Making a wheel with an SP binder is quite different from making other types of diamond wheels. In fact, we even ran into trouble when we tried to scale-up from experimental to production-type wheels.

"Our current program calls for placing the wheels in as many different types of grinding operations as we can. The most recent evaluations suggest that our wheels have some outstanding characteristics when compared to even the best competitive ones. The pattern still isn't clear, though, because



Polyimide disc keeps its shape in 10,000°F. flame of plasma jet. Parts made from this new Du Pont resin are superior in heat resistance to any unfilled organic material known.



Retainer ring of SP for ball bearing that can serve at 600°F. is checked by Frank Starn.

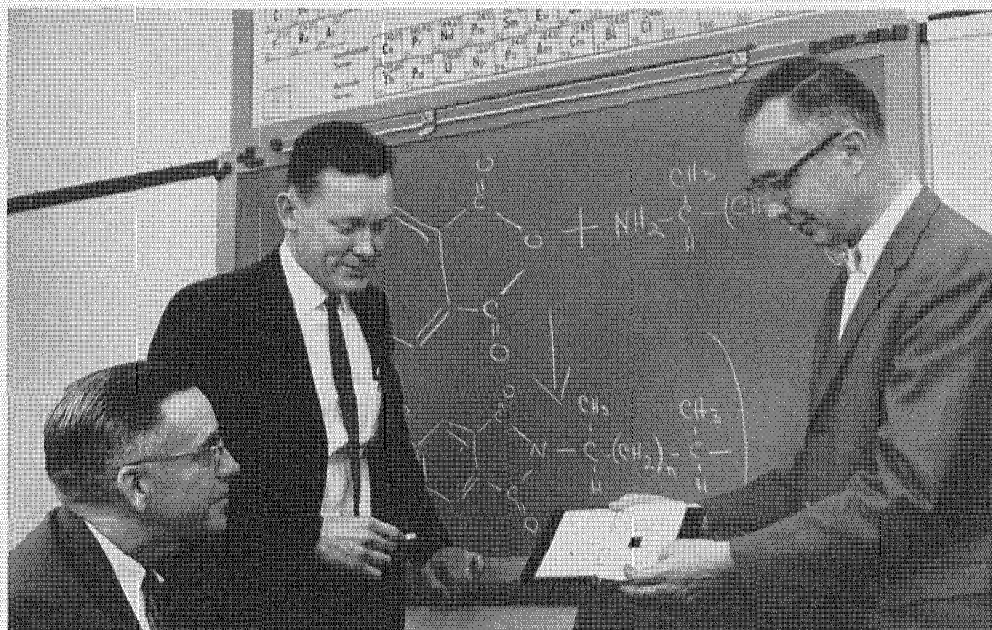
our wheels seem to perform better under some conditions than others. More tests are essential."

Considerable progress has been made in mechanical goods, Campbell believes.

"We have sold a number of different types of parts and have had some encouraging re-orders," he reports. "For instance, we are making vanes for a new type of high output compressor. SP was chosen, after evaluation of a number of materials, because of its outstanding resistance to wear under tough operating conditions—high temperature, high load, high speed. We also have sold valve seats for gaseous service and are evaluating SP for such finished products as seals, gaskets, piston rings and fasteners.

"SP looks especially promising as a material for the retainers used in ball bearings to keep the balls from running into each other. Tests on high-speed equipment at the Naval Air Material Center in Philadelphia suggest that the new bearings are capable of operating in the 600° to 700°F. range.

"This represents quite a radical advance in bearings, and designers will have to decide how to use them best. Logical spots, of course, are aircraft and rocket engines that now have to be cooled around the bearings. Ultimately, use of SP would permit weight savings by making such cooling equipment unnecessary. The radiation resistance of SP also is of interest in aerospace applications."



Tiny sample prepared by Dr. I. M. Robinson, right, was first sign that polyimides had promise as plastics. Visiting Dr. W. F. Gresham, left, who directed studies, he and Dr. W. M. Edwards, who made key discoveries, recall early days.

R. S. Mallouk, group manager, is optimistic about applications for H film in the electrical industry. As armature insulation on heavy-duty, form-wound motors, thin H film tapes have consistently outperformed the mica flake tapes currently used. Since much thinner insulation is possible because of H film's toughness and dielectric strength, the way is open to the construction of mo-

tors with greater output and lower running temperatures. In aircraft motors and generators, temperatures above 570°F. are reached during temporary overloads. H film insulation—slot, phase and motor—has stood up well in such service, he reports.

H film seems uniquely suited for aerospace service because it can withstand high doses of radiation as well as extreme temperatures—both the cold of outer space and high heat from air friction during supersonic flight. The greatest excitement so far has stemmed from a wire wrap that's a composite of heat-sealable H film and Du Pont "Teflon" FEP-fluorocarbon film. This combination is half the thickness and weight of currently used insulations.

Mallouk notes, too, that it's possible to lay down printed circuits on H film and then dip the entire circuit in molten solder to form the connections. The new film also may make possible magnetic tapes that will preserve stored information even if the recorder goes through a fire or is sunk deep underground for geological surveying.

In the early research stage, Sroog says, are such applications as these: fire-resistant surfaces for wood and other materials; flat heaters that could be attached like wallpaper inside living room baseboard units; and heaters that provide more even temperatures in ovens and make them easier to clean. These will take some time to develop.

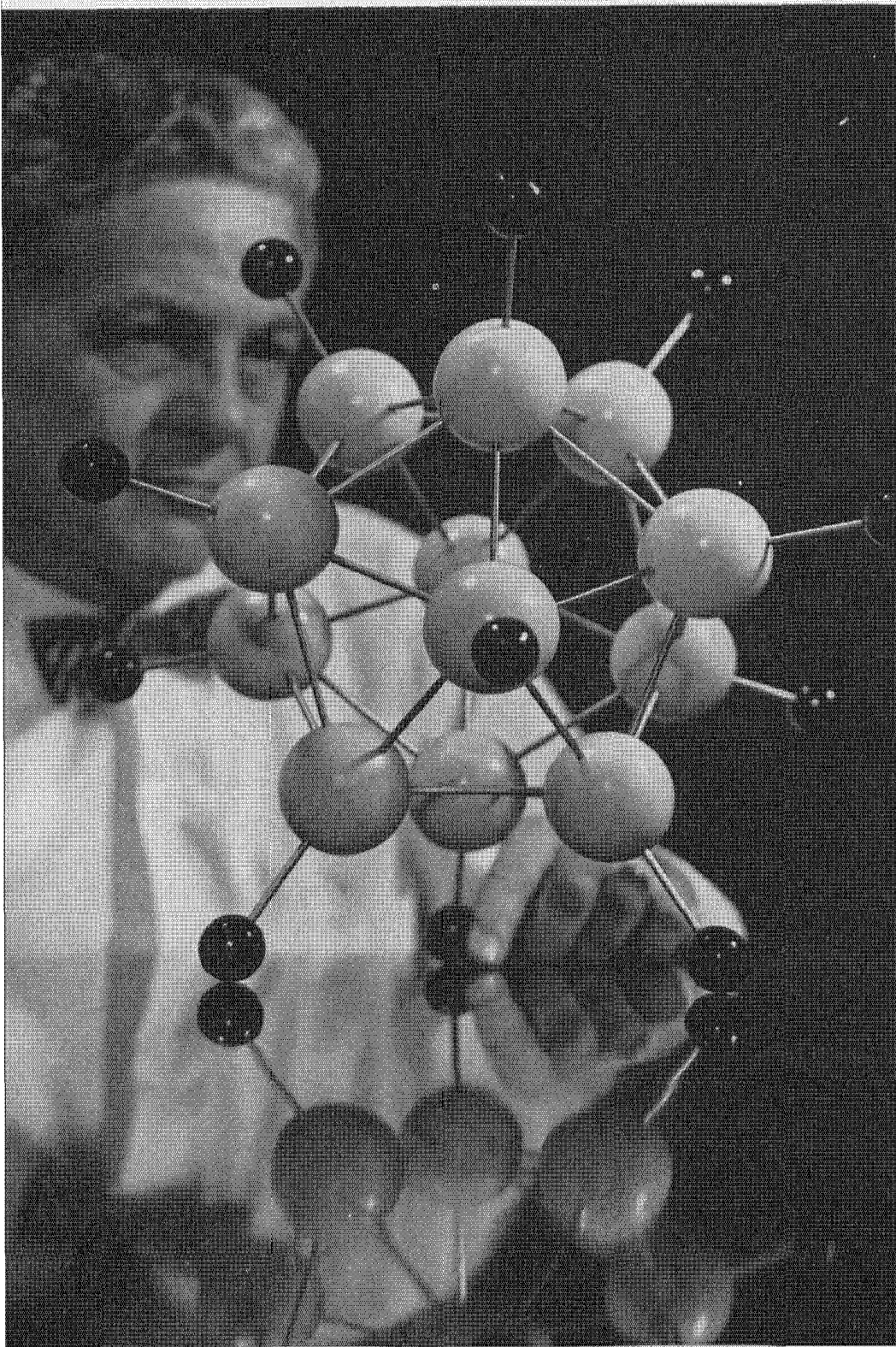
H film and polymer SP are exciting in themselves and for their promising applications. But they are of broader significance, too, as a clear example of how a diverse group of materials emerges from common research beginnings.



Finished products made of polyimide resin are now being test marketed by Plastics Dept. Among them are seals, gaskets, piston rings, fasteners, valve seats, and vanes for a new compressor.

CORNUCOPIA

Du Pont scientists have found a new area of inorganic che



Dr. Henry C. Miller is one of the discoverers of this most symmetrical chemical species.

The chemical model that Dr. Henry C. Miller holds, left, is uniquely appealing from both a scientific and an aesthetic standpoint. In fact, it is a sort of bridge between these often far-apart ways of looking at the world of matter.

It represents a new group of 12 atoms of boron and 12 of hydrogen, which is formally known as dodecahydrododecaborane (-2). (The double minus indicates that it has two extra electrons, making it a negative ion, or anion.) Structurally, it's an icosahedron, with a boron atom at each vertex of the 20 equilateral triangles that are its faces. No other chemical compound is so symmetrical.

To an artist, symmetry means excellence of proportion. Most people find something satisfying about this model's classic balance. A chemist, however, attaches more specific meanings to the word. He speaks of points, planes and axes of symmetry. (A molecule has a plane of symmetry if it can be divided into halves that are the mirror images of each other.) Spectroscopists and crystallographers, in particular, are interested in symmetry as it relates to the structure of a molecule and hence to its behavior.

$B_{12}H_{12}^{2-}$ has 15 planes of symmetry. It also is loaded with axes of symmetry—six fivefold axes, ten threefold ones and at least 15 that are twofold. (Suppose you have the model before you and find you can rotate it to four different positions from the starting point without a change in the appearance. It has a fivefold axis.) All told, $B_{12}H_{12}^{2-}$ has 120 symmetry operations. Its structure was established at Harvard University by an x-ray diffraction study.

This symmetry has practical significance because it indicates resonance or stabilization of the structure, a highly desirable trait that is conspicuously lacking in most boron-hydrogen compounds. Many of these ignite and flame spontaneously in air and react readily with water. In contrast, $B_{12}H_{12}^{2-}$ is very stable in air and in the presence of strong bases, strong acids and oxidizing agents.

The reactive nature of boron-hydrogen compounds was, until recently, one of the main reasons scientists were interested in them. During the 1950's, they were extensively investigated because of their potentialities as high-energy aircraft fuels. By about 1958, the boron "super-fuels" b

for inorganic chemists

at, in scope and diversity, is comparable to the enormous field of organic chemistry derived from benzene

gan to look less spectacularly promising and much of the Government-sponsored research was dropped.

Chemists in Du Pont's Central Research Dept. long had had a general interest in boron chemistry because they saw fairly broad opportunities in it. Reasoning—and hoping—that stable boron hydrides could be found, they kept on searching.

One day, Dr. Walter H. Knoth tried a reaction that gave him a product with unexpected properties. Infrared analysis showed it to be a boron hydride, but it certainly didn't behave like one. True, it reacted rather violently with concentrated nitric acid, as boranes will, but a strange, blood-red color appeared. Moreover, the material failed completely to do what any normal boron hydride did—reduce silver nitrate to metallic silver, a blackish precipitate. Instead, it formed insoluble silver salts.

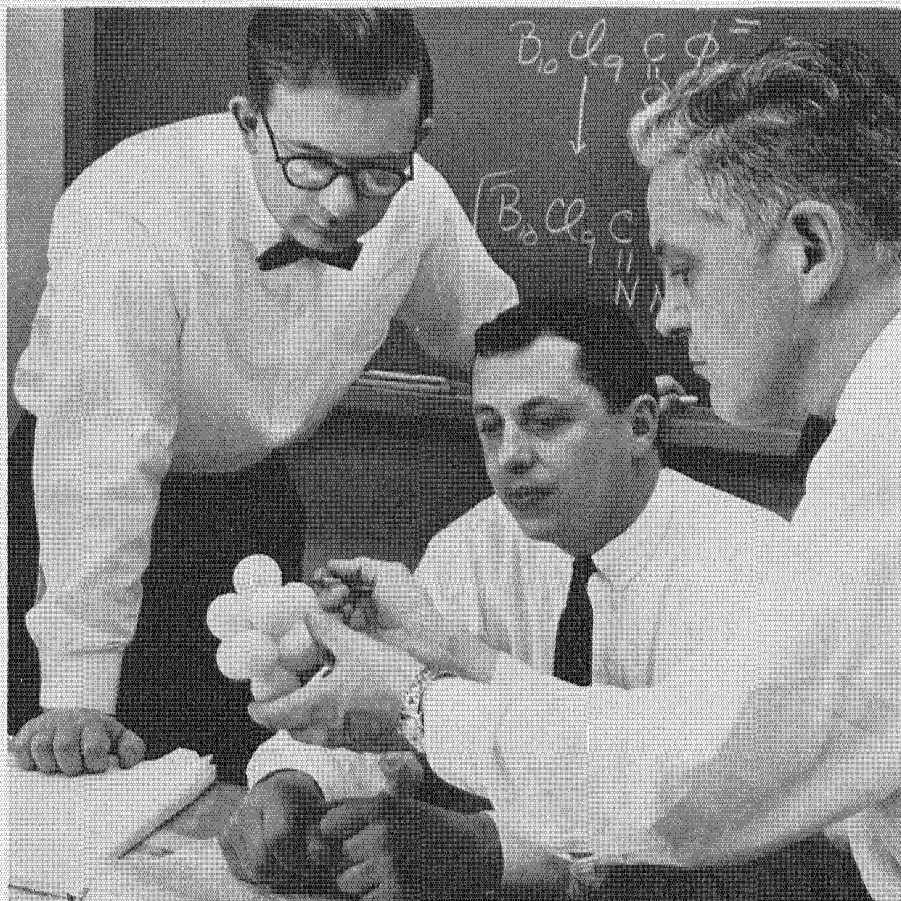
What Knoth had found was $B_{10}H_{10}^{=}$, or decahydrodecaborate (-2). He tried substitution reactions—replacing one or more hydrogen atoms with a halogen such as chlorine—and got derivatives. This success was unique. Most boron-halogen bonds won't hold up in water. Halogen derivatives of Knoth's material could be made in it.

While Knoth was studying the first derivatives, Miller and Dr. Earl L. Muetterties were trying to find new boron cage structures. They discovered $B_{12}H_{12}^{=}$.

It was Knoth who first recognized that the stable borane anions could become the parents of an almost unending stream of stable offspring. What has emerged since then is a major new field of inorganic chemistry that, in scope and diversity, is comparable to the enormous organic chemistry derived from benzene. The fact that the spatial relationship of the atoms is three-dimensional instead of two-dimensional, as it is in benzene derivatives, adds to the appeal.

"Much of the chemistry of these species approximately parallels that of benzene," Knoth says. "We have found many differences, however. Reactions frequently don't give analogous products when applied to these boron hydrides and to benzene. Also, we have made some derivatives that have no counterpart in benzene chemistry. Nonetheless, the prior knowledge of organic substitution chemistry has been invaluable."

The derivative chemistry first explored by



Studying stable boranes are, from left, Drs. W. H. Knoth, E. L. Muetterties, Miller.

Knoth, Miller and Muetterties, with Dr. D. C. England, Dr. J. C. Sauer and Dr. G. W. Parshall, was described in a communication published in the *Journal of the American Chemical Society*, March 20, 1962. More detailed articles will follow.

The chemists reported that all of the halogens react smoothly with aqueous or alcoholic solutions of the anions to give a series of products in which some or all of the hydrogen atoms are replaced with halogens. Some of these derivatives are isolated in the form of salts, others as crystalline hydrated acids that are comparable to sulfuric in strength. $B_{12}H_{12}^{=}$ has been nitrated with nitric acid under controlled conditions.

$B_{10}H_{10}^{=}$, like $B_{12}H_{12}^{=}$, has a cage-like structure—a closed polyhedron with electrons inside. But with only one fourfold axis, it doesn't approach $B_{12}H_{12}^{=}$ in sym-

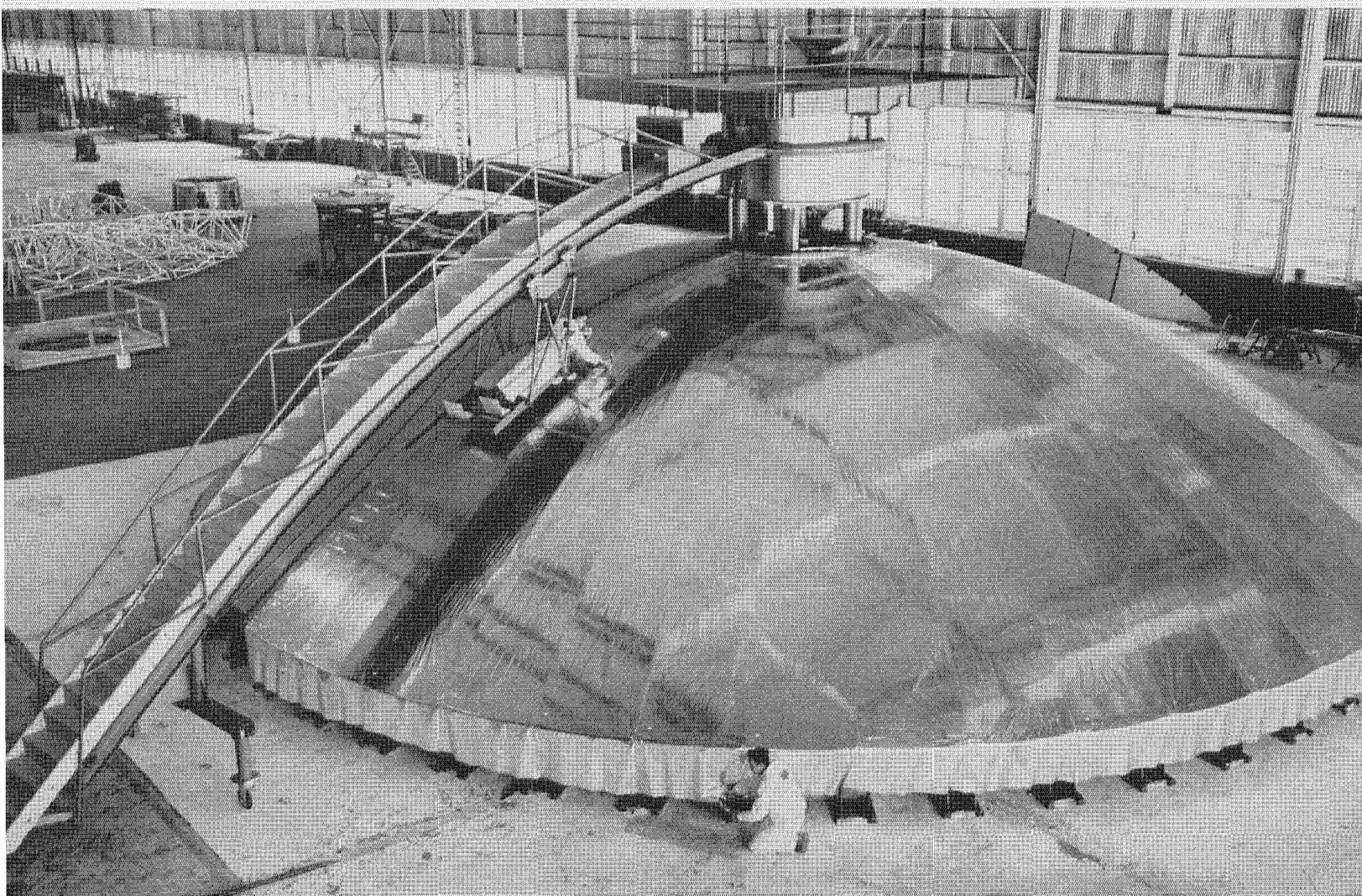
metry. As a result, its substitution products have a more complex stereochemistry.

"We know of no other inorganic chemistry that approaches this in versatility and stability," says Muetterties. "We are continuing to study both anions and their derivatives rather extensively and also looking for additional stable boranes. We're still so much in the early research stage that it's premature to talk about commercial applications for these materials, although they look promising."

Muetterties points out that much also remains to be learned of the bonding—the manner in which electrons are arranged—and of the mechanisms by which derivatives are formed.

"These new stable anions present a great challenge to both theorists and experimentists," he concludes.

WHAT'S



World's largest solar reflector: Electric power for manned space stations may come from giant solar reflectors like this 45-foot, 400-pound (when foam rigidized), full-scale model built by Goodyear Aircraft Corporation's Arizona Division. Tracking the sun, the mirrors could converge enough solar rays on an energy converter to produce 15 kilowatts of power, adequate to supply three modern homes. Aluminized gores of "Mylar" polyester film form a reflective surface tough enough to withstand inflation in space.



Transistorized blasting machine Du Pont SS-1000 Blasting Machine with solid state circuitry and six standard "D" (1.5 volt) flashlight batteries reduces costly replacement of battery packs and electrolytic capacitors. Made by Scintilla Division of Bendix Corp. the machines are lighter and smaller than earlier condenser discharge models and have a capacity of 1,000 electric blasting caps in parallel series

NEW

● New industrial reinforcing materials:

A new concept in nonwoven structures of Du Pont nylon yarn now offers unusual strength-to-weight ratios in reinforced vinyl laminates and for coated, packaging, laminated and construction products. The nylon scrim provides the vinyl materials with four times more tear resistance and 10 to 20 per cent greater tensile strength than conventional 18x18 woven nylon fabric of equal weight, says manufacturer, Toscony, Inc., Passaic, N.J.

● More rapid industrial radiography:

Examining circumferential weldments of pressure vessels, pipes and tubing, using short lengths of film, is eliminated with a new Du Pont "Screen Day Pack," a disposable dispenser loaded with 100-foot lengths of "Cronar" Type 506 and Type 510 Industrial X-ray Film. The dispenser-film assembly permits a quick and complete 360-degree exposure at one time. It also provides the advantage of film sandwiched between layers of lead intensifying screens. The dispenser is available from the Photo Products Dept. in 35 mm, 70 mm, 3½- and 5-inch film widths.

● Improves car engine performance:

Newcomer to the Du Pont Automotive Specialties line of car-care products is Golden "7" engine conditioner, which prevents motor oil from thinning at high operating temperatures. Golden "7" eliminates oil burning and excessive smoking, helps reduce engine wear, quiets noisy valves and increases oil pressure.

● Keeps grounds out of coffee:

Re-usable filters for percolator or dripolator coffee pots are being marketed by American Machine & Foundry Co., Springdale, Conn. Made of glass fabric coated with "Teflon" TFE-fluorocarbon resin, the filters fit all strainer baskets up to four inches, resist stains and are odorless and tasteless.

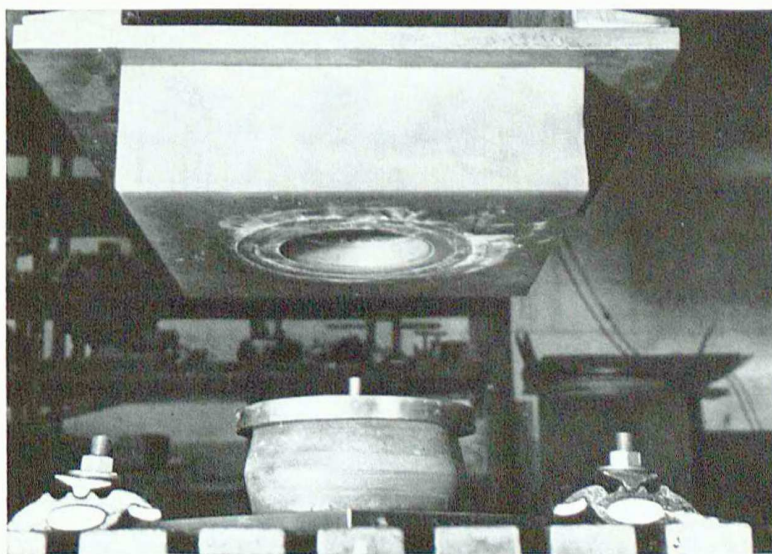
● Faster fastening with nails:

The first magazine-loaded pneumatic nailer to drive 8d and 6d nails, the Paslode Gun-Nailer, has been developed by Paslode Co., division of Signode Steel Strapping Co., Skokie, Ill. Tough strips of "Mylar" polyester film hold the nails in clips for magazine loading. Available in both hand-held and long-handled walking models, Gun-Nailer offers practical on-the-job speed of 3,600 nails per hour.



Tougher tires for two-wheelers: U.S. Rubber Co., New York, has expanded its use of Du Pont nylon tire cord from automotive tires to its popular U.S. Royal line of bicycle tires. As it does for passenger cars and trucks, nylon will offer bicycle owners tires with improved overall strength, better resistance to fatigue and moisture, and the ability to take heavy impact.

Palm-size power drill: Compact Electric Drill by Thor Power Tool Co., Aurora, Ill., is half the size and weight of standard one-quarter inch drills, because of a "capsule" DC motor and a transistorlike diode that converts 115V AC to DC inside the handle. The handle and trigger are made of "Zytel" 105 nylon resin for strength, electrical and heat insulation, color, dimensional stability and production economy.



Economical mar-free metal drawing: Need for chrome-plated tools is minimized and die machining time cut in half with a new metal-forming system featuring draw dies and pressure pads of "Adiprene" urethane rubber. Developed by Kaufmann Tool and Engineering Corp., Chicago, the system forms polished, coated or photoprinted metal without blemishes. Kaufmann offers "Adiprene" as finished tooling or in various hardnesses for custom forming.



... IN CHURCHES

... IN SCHOOLS

... IN COMMERCIAL BUILDINGS

... IN MOTELS

Flat, corrugated or sandwich-type reinforced panels made with 100% LUCITE[®] are attractive, functional, practical

Transparent, translucent and opaque panels made with 100% LUCITE acrylic sirup are now available in a wide variety of patterns and colors.

These panels make effective use of natural and fluorescent lighting to illuminate the interiors of factories, commercial buildings, schools, motels and churches. Their installed cost is less than glass and sash, and they also reduce daytime illumination costs. Panels made with 100% LUCITE are the most weather-resistant reinforced plastic panels available... their resistance to mois-

ture and sunlight is unsurpassed. For example, outdoor signs made from LUCITE have endured exposure to moisture and sunlight for more than 20 years — and they're still in service. In other words, panels made from LUCITE retain their color, gloss and light-transmission qualities far longer

than any other reinforced plastic panel. For more information about reinforced panels made with 100% LUCITE acrylic sirup, write: Du Pont Company, Department AR-O, Room 2507L, Wilmington 98, Delaware.

PLASTICS DEPARTMENT



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