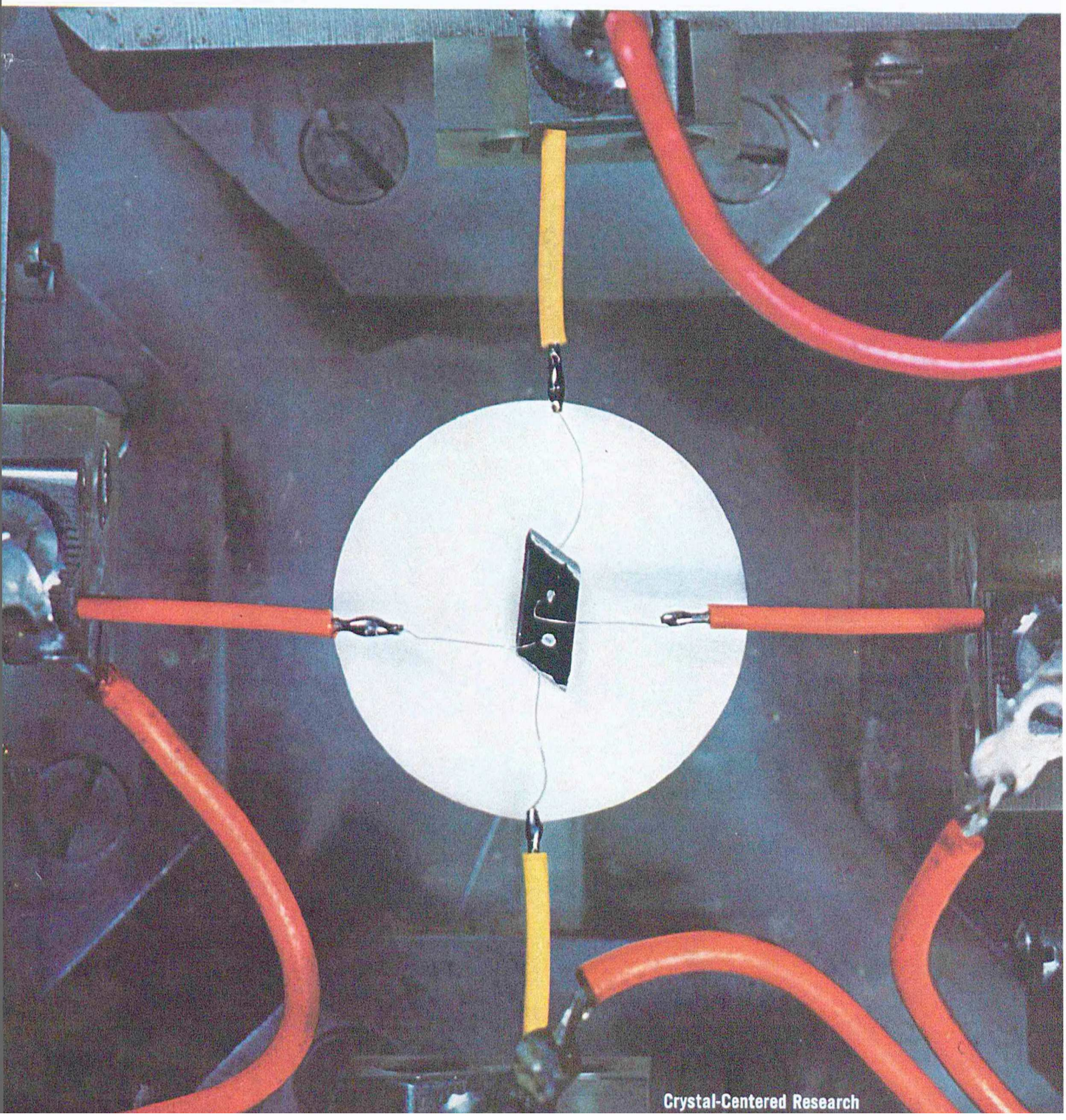
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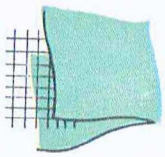
Crystal-Centered Research



And her Mommy's right, too . . . women all over America are discovering that Du Pont Sponge Cloth is ideal for washing dishes, wiping up spills, cleaning woodwork, and shining windows. It's the modern cleaning aid to make all housecleaning easier.

It's a *cloth* as well as a *sponge* . . . wipes like a soft, soft cloth—absorbs like a thirsty, thirsty sponge. Sponge Cloth is soft and absorbent . . . rinses out clean and sweet-smelling . . . and gives you the luxury of lint-free cleaning, too.

It's easy to hold, easy to wipe with, and you can wring it out as hard as you like. An exclusive feature . . . a web of strong reinforcing fibers . . . gives the new Du Pont Sponge Cloth extra resistance to tearing, adds extra service life. Actually . . . the Du Pont Sponge Cloth improves with use.



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F & F Department, Household Specialties Sales

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Better Things for Better Living . . . *through Chemistry*

May-June 1961 Vol. 55 No. 3

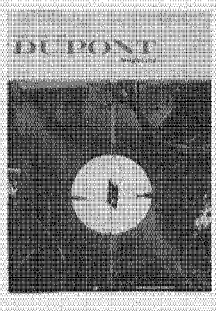
DU PONT magazine

William C. Halley, *Editor*
Emily Heine, *Associate Editor*
Jack D. Hunter, *Associate Editor*
Bruce C. Wendle, *Editorial Assistant*

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THE COVER



That shiny black crystal occupies the center of our cover because it's a center of attention in Du Pont's Central Research Dept. It belongs to a series of solid organic compounds derived from 7,7,8,8-tetracyanoquinodimethan. What intrigues the Du Pont scientists is that several TCNQ derivatives have extremely high electrical conductivities—higher, in fact, than have been reported for any other organic compound. For more about the techniques of growing ultrapure single crystals, determining electrical resistivity (pictured) and otherwise studying their behavior and structure, see page 2. Solid state physics, by the way, isn't a new interest to Central Research men. They have explored such special areas as semiconductors, electroluminescence and magnetic resonance since shortly after World War II. A new physical research laboratory, scheduled to open this summer at the Wilmington Experimental Station, will help advance these and other studies, which include ferromagnetism, crystal physics and molecular structure and bonding.

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Wooing a Heart Attack?

Du Pont study finds that higher pay and more problems don't necessarily mean that you are

It's a popular notion that the greater a man's salary and responsibility the more liable he is to suffer a heart attack.

Not so, according to a three-year study of 89,000 employees recently completed by two members of the Du Pont Company's Medical Division.

As a matter of fact, report Dr. Sidney Pell, biostatistician, and Dr. C. A. D'Alonzo, assistant medical director, heart attacks occur more frequently in lower-paid male corporate employees than they do among those whose salaries and responsibilities are greater.

In an article appearing in a recent issue of the *Journal of the American Medical Association*, the specialists note:

"Our data are inconsistent with the idea that the increased responsibility of men at the upper levels of management increases their susceptibility to coronary heart disease. Although stress may be an important factor in the development of the disease, the level of job responsibility is not necessarily an indicator of the degree of stress to which an individual is subjected."

The authors report that during the three-year period, 653 employees had "an initial acute myocardial infarction"—a first heart attack. The incidence rate was much greater in men than in women, but the difference between the rates decreased with increasing age. They found that the chances of an attack were about the same at work, at home, on vacation or elsewhere. Only 5.4 per cent of the patients were indulging in unusual physical exertion at the time of the attack. The case fatality rate was 31.4 per cent, and the probability of survival decreased as age increased.

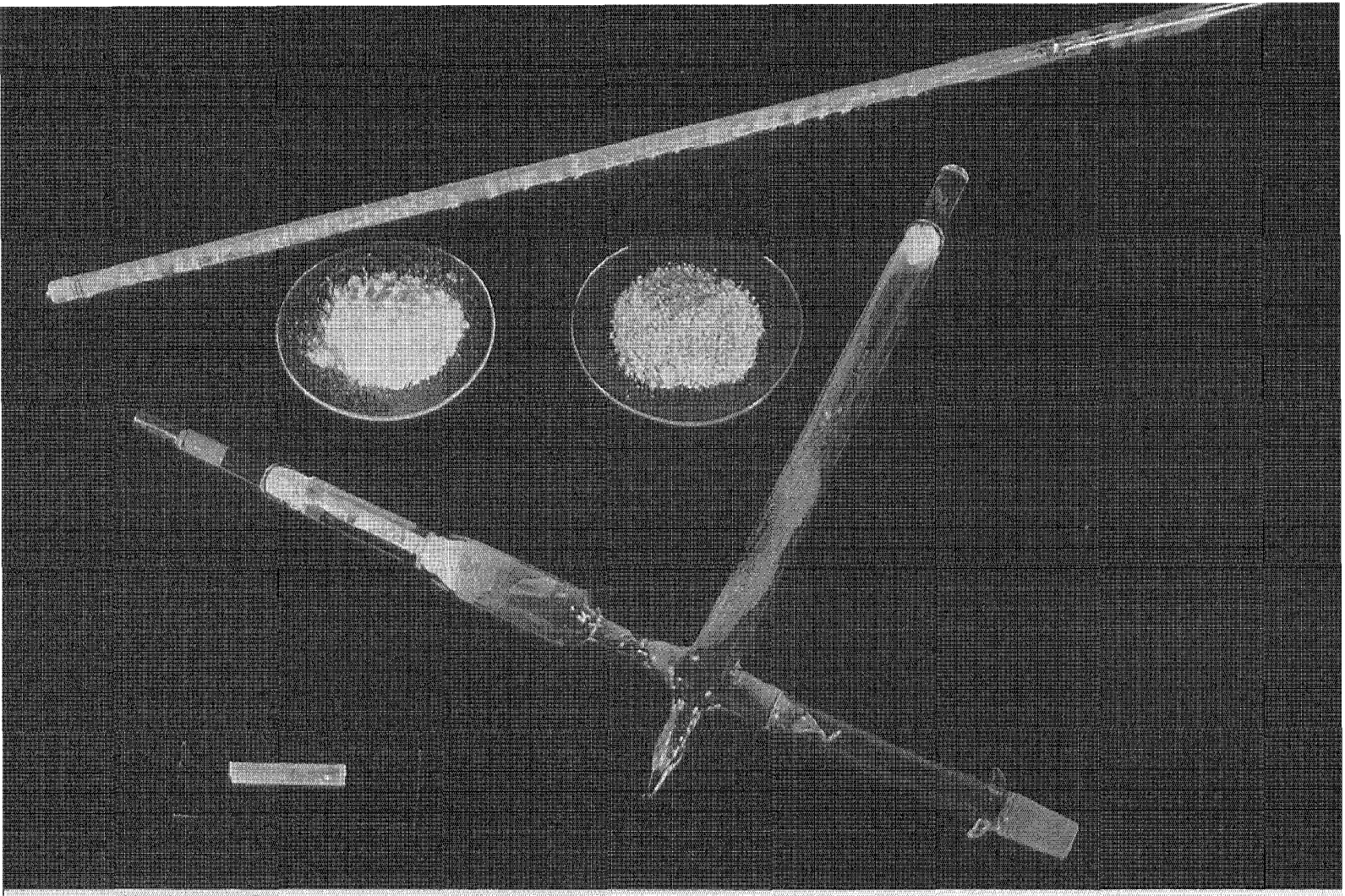
The individuals covered in the study ranged from 17 through 64 years of age. There were 75,301 men and 13,788 women. Most lived in the Middle Atlantic and Southeastern states. Drs. Pell and D'Alonzo divided male employees into five groups on an economic and job responsibility basis to determine the relationship between heart attacks and occupation.

They found that the incidence of heart attacks was lowest among the highest salary group: 2 for each 1,000 persons per year. In the next highest salary group, the rate was 2.4 per 1,000, and in the two lower-salaried groups, the rates rose to 3.8 and to 4 per 1,000. The fifth group comprised wage roll employees of skilled, semi-skilled and unskilled classification. The rate for this group was 2.9 per 1,000, and as a group "they are more physically active than those in the others."

"There is little doubt," the authors said, "that the occupational categories herein defined delineate groups with differing susceptibilities to coronary heart disease." However, their data proved contrary to the common belief that top executives suffer most.

How do Drs. Pell and D'Alonzo account for this?

"It is conceivable that, in choosing persons to assume greater responsibilities, supervisors and managers may tend to select the better-adjusted individuals, who by virtue of their personality and physical state are better able to cope with life's stresses in general."



Anthracene crystal (foreground) was zone refined to exceptional purity in tubes to permit accurate study of its electrical properties.

Why They Study Strange Organic Solids

An exciting new avenue of solid state physics may lead Du Pont scientists to a deeper understanding of the structure of matter

By Emily Heine

The still life above might well be called "A Study in Nines." It shows a common organic chemical, anthracene, in various stages of purity and illustrates the complex steps needed to create an ultrapure single crystal (short rod in foreground).

Mathematically, this quest for purity means going from a material that's 99 per cent pure to one that's 99.9999 per cent pure. Actually adding those nines, however, is a two-week process that includes hours of delicate work for Dr. Gilbert Sloan, a chemist in Du Pont's Central Research Dept. The yellowish crystals are standard commercial material. Chromatography tacks on the first extra 9. Sloan then places the white crystals in a zone refining tube (top), which he passes through a heated coil. He adapted the technique some years ago from that used to produce ultrapure silicon for electronic devices; as far as he knows it was the first use of modern zone refining techniques to purify organic materials. Twenty-five or 30 passes—a week's activity—reduce the level of all known organic impurities to one part per million.

Sloan then transfers the material to the specially designed, cross-shaped piece of glassware, a combination zone refiner and crystallizing tube. He passes it through the zone refiner about ten more times, seals off the impurities and shifts the anthracene to the other tube, which goes into a gradient furnace. There it's lowered at what Sloan calls the "reckless rate of an inch a day" from a hot upper region to a colder one. If he's lucky, this business will induce a single crystal to grow in the small glass spiral. It takes about ten days for such a crystal to reach the size pictured and cool to room temperature.

A single crystal is a solid throughout which the atoms

or molecules are arranged in a regularly repeating pattern. Sizes of single crystals may vary considerably. But whether it's a rod the length of a household match or a paper-thin slice, the crystal's properties remain the same. Most crystalline solids are made up of tiny single crystals called grains and are said to be polycrystalline. Researchers dealing with such materials can seldom be sure whether the physical effects they observe are due to inherent properties or to boundaries between the grains. This difficulty is eliminated with single crystals.

In fact, single crystals of singular purity have played a major role in the dramatic success of modern solid state physics research. Fundamental studies of silicon in this form began only about 20 years ago and were swiftly followed by practical applications in the transistor and a number of other miniaturized components that have revolutionized electronics.

The scientists who studied ultrapure silicon discovered that some of its electrical properties were markedly different from those observed earlier. Dr. Glen Kepler, the Du Pont physicist who first investigated Sloan's exceptionally pure anthracene crystals, found himself in a similar position. A number of papers have been published since the electrical conductivity of anthracene was first studied in the early 1900's. But Kepler's report for the first time defined the mobility of the electrical charge carriers.

Kepler painstakingly measured the drift mobility of electrons and holes (the places vacated when electrons move out of a molecule) using a technique known as "pulsed photoconductivity." He found that the charge carriers are not produced in the interior of the crystals but at the surface, either directly by photons or by excitons that migrate to the surface.

Several years before Kepler began his experiments, Dr. Richard Merrifield had engaged in theoretical studies of energy transfer in molecular solids. These studies showed that unusual behavior could be expected in organic crystals and stimulated the start of experimental research in this field.

"Interest in solid state physics has grown tremendously in the last ten years and is now widespread," Merrifield explains. "As a result of many investigations of the electronic properties of solids, scientists are becoming able to relate the properties of a material to its structure and so understand the role structure plays in controlling them.

"Of necessity, the men who first explored this discipline concentrated on simple inorganic materials so as not to introduce unnecessary complexities. Their approach proved remarkably fruitful. We wondered what we could gain from applying these same principles to organic solids — materials that haven't been studied thoroughly because of their inherent complexity.

"Even a decade ago this wouldn't have been feasible, because the concepts and experimental techniques weren't available. Now, however, there is a well-laid base for us to build on.

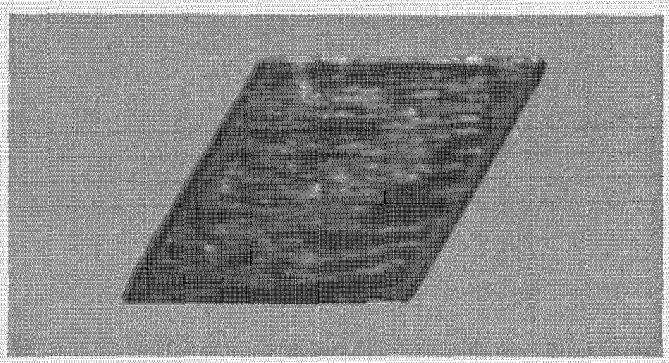
"Our goal is to understand the electronic structure of organic solids — to reach the same depth of understanding that others have of silicon. Our faith is twofold: that through this approach we will gain a better understanding of the properties of these materials and that, ultimately, we will find new ways to use them."

The success with anthracene encouraged similar investigations of cyanocarbons, a new class of organic compounds discovered by other Central Research scientists. Among those studied were anion radical derivatives of 7,7,8,8-tetracyanoquinodimethan (TCNQ), a compound first synthesized by Dr. D. S. Acker. The work was re-

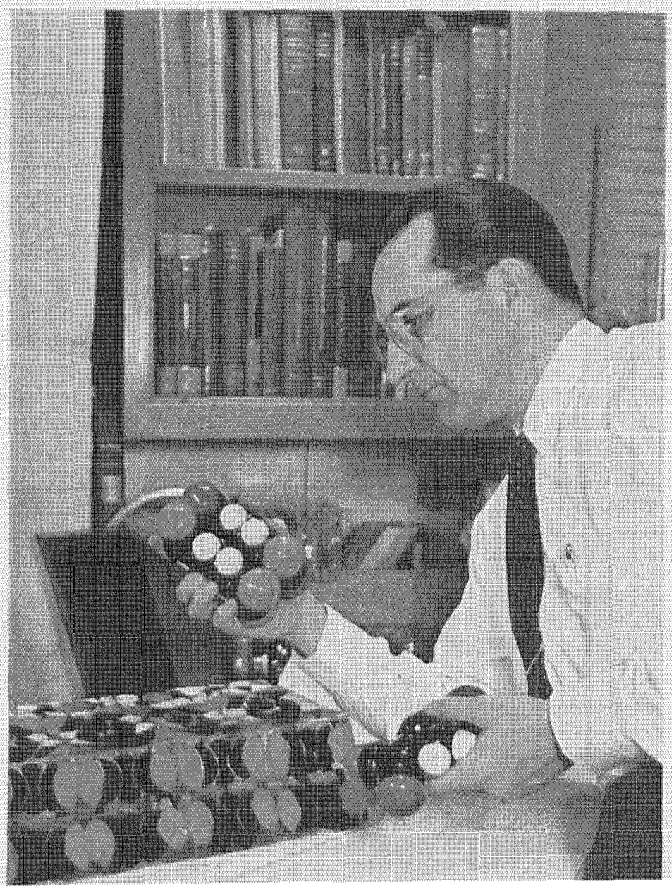
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Single crystal of tetracyanoquinodimethan (TCNQ) compound looks much like coal speck (left). Magnification 100 times (below) reveals characteristic etch pits.



Shoe-box-size model of crystal made by Paul Arthur, Jr., helps in relating physical behavior of a TCNQ derivative to its structure.



ported recently in the *Journal of the American Chemical Society* by him and Drs. R. E. Benson, R. J. Harder, W. R. Hertler, Walter Mahler, L. R. Melby and W. E. Mochel.

One of the first determinations was of electrical resistivity. To their surprise, the scientists found some of the TCNQ derivatives were extremely low in resistivity. Several, in fact, were far lower than any previously reported organic compound. (Most organics are in the range from 10^{10} to 10^{14} ohm centimeters. Hyperpure silicon has a resistivity of about 1,000 ohm cm. Some of the TCNQ series range from 0.01 to 100 ohm cm.)

With the discovery of their unusually high electrical conductivity, interest in the TCNQ derivatives mounted rapidly. Now, a couple of years later, the Du Pont scientists have piled up an impressive amount of data on the behavior of TCNQ compounds.

As with anthracene, an important step is to obtain pure samples not only of TCNQ itself but, in time, of each of its promising derivatives. These compounds present particularly stubborn problems to Gilbert Sloan. They cannot be purified by zone refining because they don't melt without decomposing. Hence less powerful purification means, such as gradient sublimation and recrystallization, must be used. Because these methods aren't as powerful, it has been extremely difficult to obtain pure samples.

There are other complications. The scientists have little hope of understanding the electronic structure of the new materials without first knowing their crystal structure. But the crystal structure, in turn, is so complex that standard x-ray diffraction techniques don't give a complete picture. Dr. Paul Arthur, Jr., supplements the x-ray results with chemical knowledge of the structure of molecules to gain a better understanding.

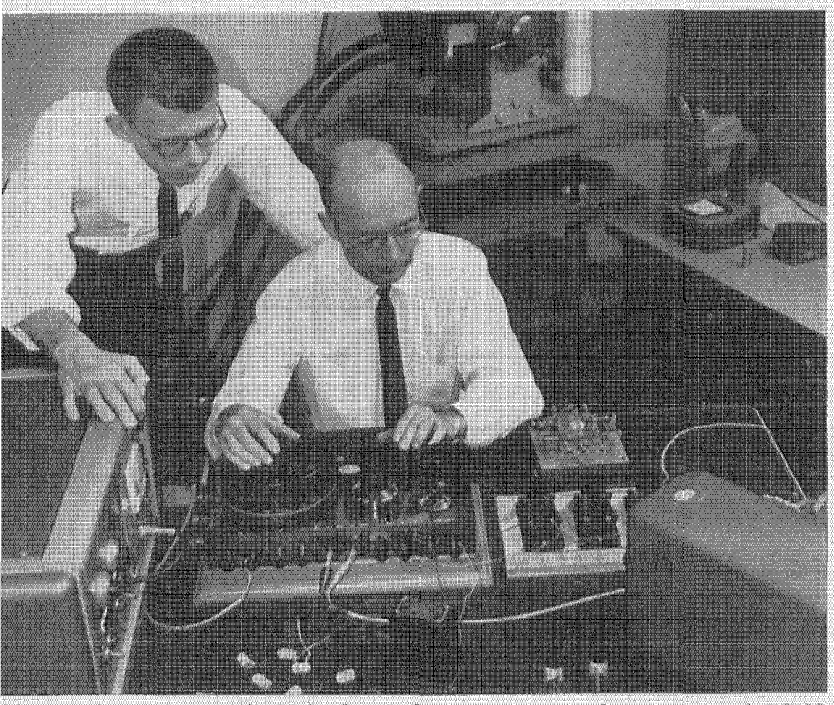
Many of the TCNQ derivatives can be classed as semiconductors according to the old, and still common, definition in terms of electrical conductivity. That is, their current carrying capacity is between insulators on the one extreme and metals on the other. A more modern definition of a semiconductor, however, is in terms of electronic structure: it's a material in which electrons normally are bound to fixed positions in the crystal and therefore are not free to carry electricity. But the bonds are relatively weak and can be broken by light or a higher temperature. External agents, thus, alter the behavior and control the electrical properties. By this definition, the TCNQ derivatives probably shouldn't be called semiconductors because, although their electronic structures have not been fully worked out, their mechanism of conduction does appear to be quite different.

Heat Stimulates Carriers

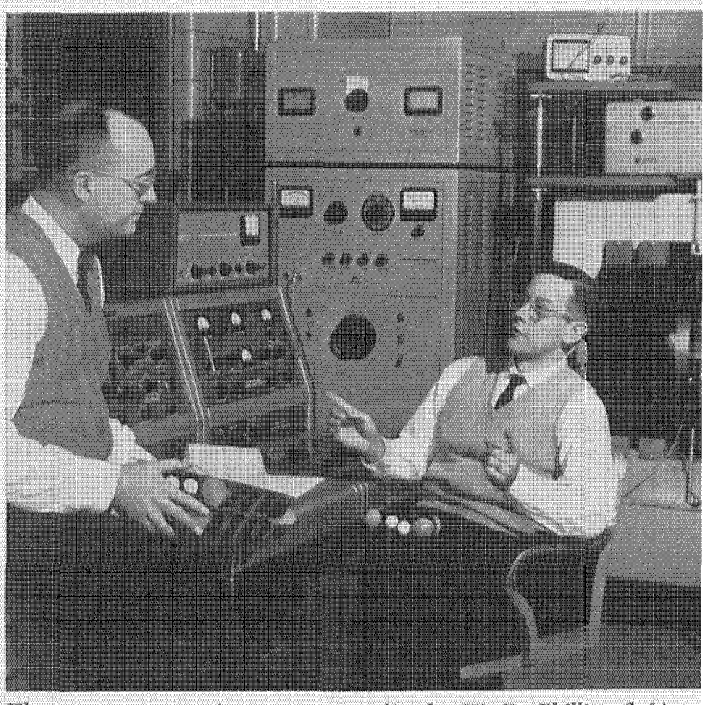
Attempts to generate current carriers by light flashes, so effective with anthracene, have not succeeded as yet with the TCNQ derivatives. The carriers' movement in response to thermal stimulation, however, is detectable and offers clues about how conduction functions. "But," ponders Dr. Jan Siemons, who is studying the thermal behavior of the carriers, "are we recording a few electrons moving fast or many moving slowly?"

Another research line being followed involves measuring the magnetic properties of crystals. This is proving a powerful experimental tool for learning about the state of their charge carriers. (The word magnetic, it's important to note, is not used here in the sense familiar to most people. What a schoolboy knows as "magnetism" a physicist calls "ferromagnetism"—magnetic behavior like iron's. Some of the TCNQ compounds are attracted, as iron is, by a magnetic field; the attraction is much weaker, however, and so they are called "paramagnetic.")

The most unexpected finding so far, Glen Kepler says,



Extremely high electrical conductivity is characteristic of TCNQ derivative studied by R. E. Merrifield (left) and R. G. Kepler.



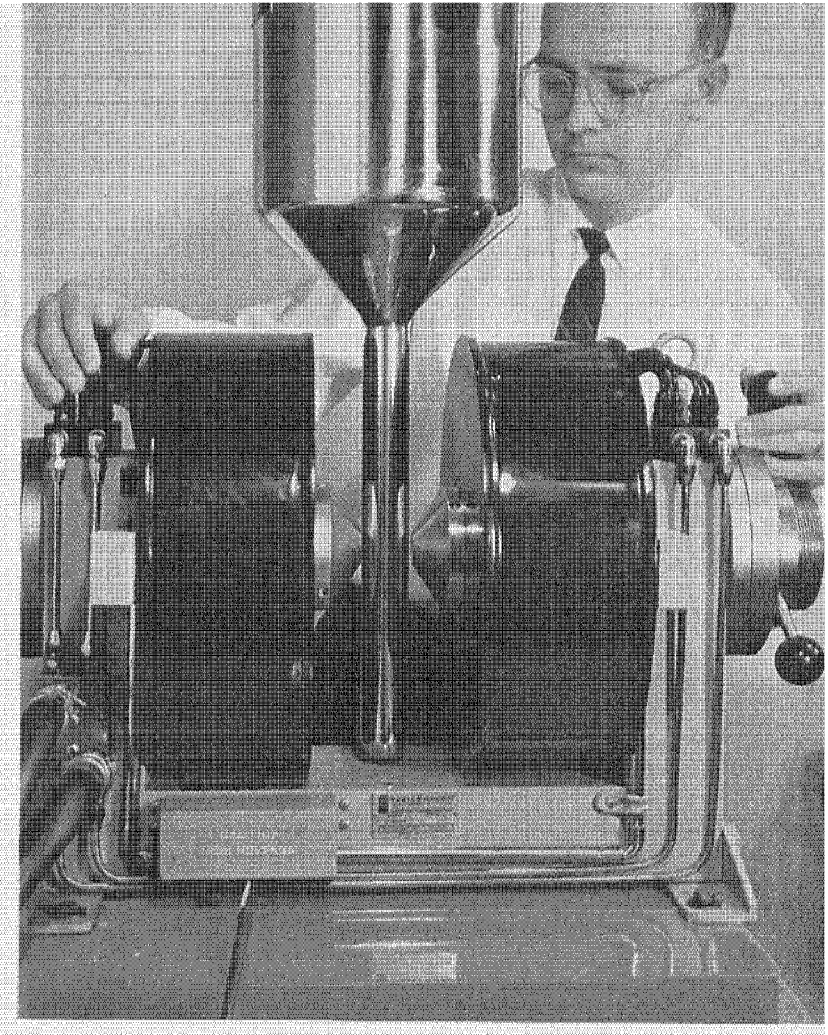
Electron paramagnetic resonance studies by W. D. Phillips (left) an D. B. Chesnut show whether electrons in TCNQ compounds are paire

is that a number of the TCNQ derivatives have the electronic structure of metals instead of semiconductors. This conclusion is confirmed by their electrical conductivity properties: the ones that appear to have the electronic structure of metals have by far the highest electrical conductivity. Interestingly, too, their electrical conductivity is essentially independent of temperature. In semiconductors, on the other hand, the electrical conductivity is strongly influenced by temperature.

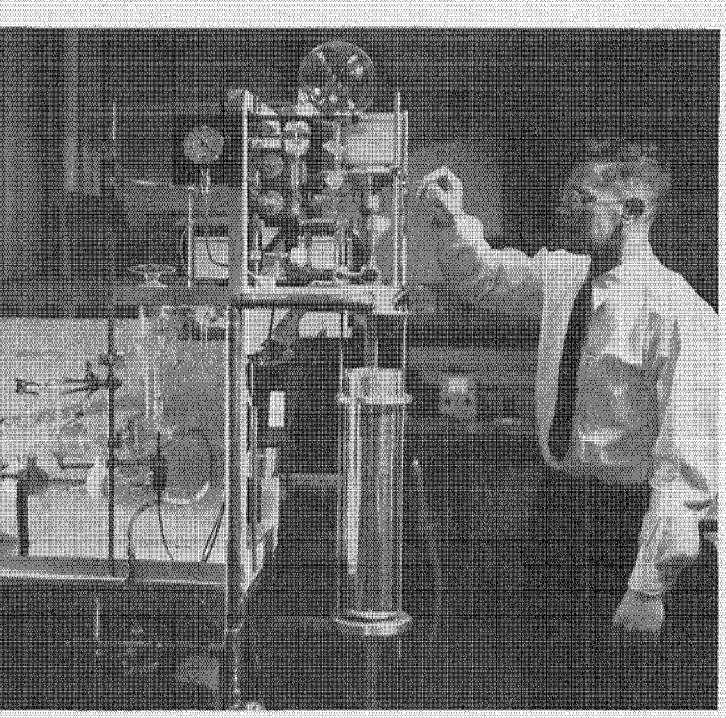
A phenomenon known as electron paramagnetic resonance offers a way of looking at the magnetic properties of individual electrons. Drs. W. D. Phillips and Donald Chesnut have published results of their use of this relatively new technique. The electronic structures of solids that contain partially filled energy bands, they explain, can be profoundly influenced by exchange coupling of the electrons. If the exchange energy is small, the material behaves as a degenerate electronic system; if the exchange energy becomes large compared to the band width, the electronic structure will be drastically altered.

What will come from all this effort? Two things, the Du Pont scientists hope. First, they will be contributing to the fundamental understanding of the structure of organic materials. Techniques practiced and refined in their laboratories may well find application elsewhere in the building of new materials to precise specifications.

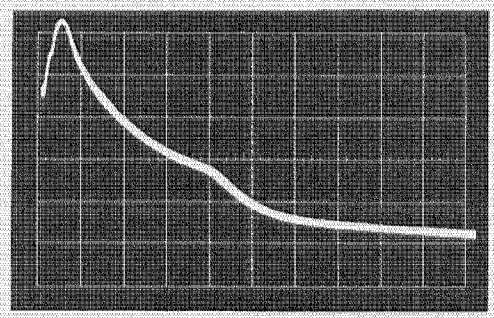
Second, it's possible that they are laying the groundwork for an entirely new electronics industry. From single crystals of the TCNQ compounds may come new components for energy control and energy transfer circuits. That day, however, is far in the future. For the present, the men must proceed without a clear understanding of how or where the materials eventually may become practical. But that, traditionally, is the direction and distinction of pure science.

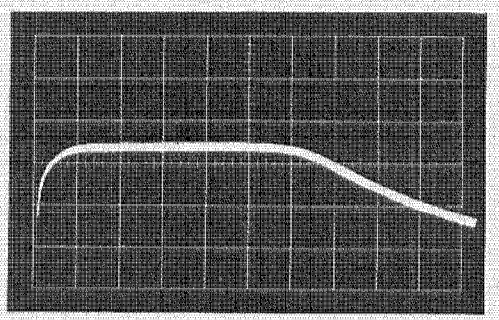


Susceptibility of TCNQ derivative to magnetic field at very low temperatures is studied. Shiny Dewar flask keeps liquid helium cool.

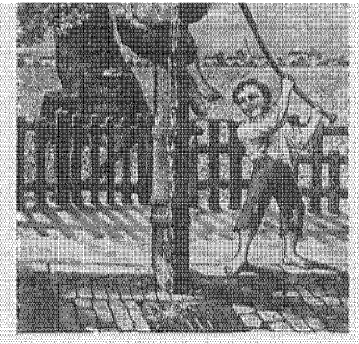


Thermoelectric properties of TCNQ derivatives are observed by Jan Siemons to gain added information about their electronic structure.





Generated by pulse of light, electrical charge carriers move through anthracene crystal. Impurities cause a jagged pattern (above). The "square" pulse (below) indicates high purity.



THE CHANGING WORL

"Delrin" acetal resin is a welcome addition to the growing pump industry where a large variety of applications calls for a constant flow of new pump designs

"See this rotary pump?" asked the engineer, picking up a small pump housing made of a hard, white material. "Ten years ago pump designers and manufacturers would have been pretty dubious about a pump made of plastic. From the days of grandmother's old cast iron house pump, metal has been the 'material of construction' in the industry.

"But 'Delrin'," he went on to say, "is changing the ancient pattern. Through new models especially designed for the new thermoplastic, manufacturing costs are being cut and pump performance improved—no small contribution in a world of dishwashers, suburban and agricultural water wells, boats and crop spraying equipment. All are dependent upon efficient, low-cost, corrosion-resistant pumping mechanisms."

With the tremendous growth of the pump industry (over seven million water systems have been sold since 1950) manufacturers were quick to see the possibilities in lightweight, durable, corrosion-resistant "Delrin" when it was introduced in 1959.

Now after only two years, a number of pumps using "Delrin" are already on the market.

One of these, the uniquely designed rotary pump manufactured by Planet Products Corp., of Chicago, was marketed for the "inventor-engineer." Made almost entirely of "Delrin", the pump is presently undergoing extensive field tests by over 50 pump-using companies.

"The Planet pump was first designed in metal," says Paul A. Lee, executive vice president of Planet, "but with the advent of 'Delrin', we redirected the program to utilize the plastic's advantages. The material was chosen because it has dimensional stability; durability comparable to most metals; a high chemical resistance and light weight. At this point in our production, we are satisfied that we are able to deliver a pump that has high precision, flexibility because of design, and a potential price economy."

For use with such liquids as water (temperatures up to 200°F.), petroleum products and solvents, the new thermoplastic is especially well suited. Lighter in weight than similar parts of copper, brass or other alloys, one-piece pump components of "Delrin" can be molded with substantial cost savings as a result of design simplifications. Until now sand casting of metal parts and expensive finishing operations made corrosion-resistant pump components extremely costly; but equivalent parts of "Delrin" can be mass produced economically by injection molding.

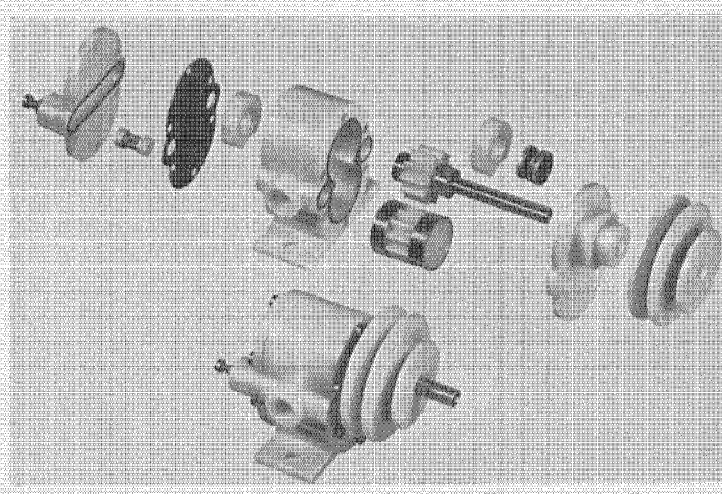
Careful control of weight distribution, a problem with all precision machinery, has always required numerous finishing operations when parts were of metal—an added cost not found in the accurately molded parts of "Delrin".

"Another important factor," says Robert E. Dolman, one of Du Pont's design engineers, "is the smooth, hard, nonfouling surface that 'Delrin' gives to pump parts—a surface that prevents mineral build-up and can be used for nonlubricated bearings."

Several pump companies have recently made the switch to "Delrin" for pump impellers, diffusers and other components. Clayton Mark and Co., Evanston, Ill., for example, has been marketing a shallow-well jet pump for approximately one year (see venturi and volute assembly in photograph). "Through the use of 'Delrin'," comments Lee S. Tillery, product sales manager for the company, "we've definitely reduced the material cost of these parts, and performance in capacity and pressure has increased five to ten per cent."

Another company using "Delrin" for pump components is the Red Jacket Manufacturing Co., of Davenport, Iowa. In their new "Custom Submerga", a pump designed to operate in the bottom of a well far below ground level, as many as 21 stages of "Delrin" provide the necessary lift to bring water up from a deep-well system.

The enthusiasm of manufacturers seems to be shared by users and jobbers as well. When Flint and Walling of Kendallville, Ind., asked jobbers to report on the results



Planet rotary gear pump features "Delrin" for all major parts. Low friction cuts horsepower requirements as much as 50 per cent.

OF PUMPS

they have had with their new Flintex Submersible (impellers and diffusers of "Delrin"), the following typified the replies: Richert Pump Distributors, Inc., Milwaukee, reported, "Components made of 'Delrin' have a tendency to operate more quietly than those of metal." Sam Klain & Son, Indianapolis, found that parts of "Delrin" in pumps had less iron and calcium pick-up than metal parts. And A. J. Boatwright & Son, Ypsilanti, Mich., noted that lighter weight of moving parts of "Delrin" gave vibration-free performance resulting in quiet operation.

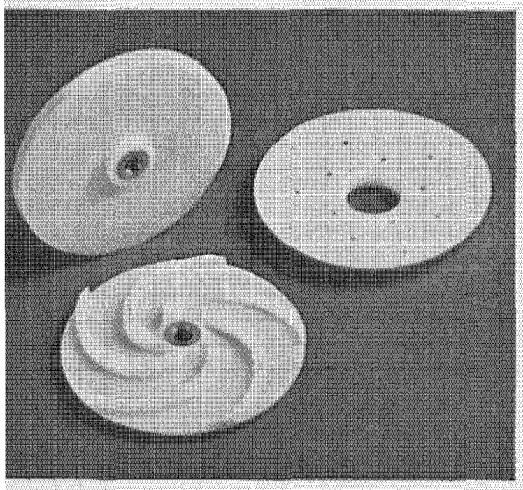
Another new pump, a high-vacuum hand model of "Delrin" manufactured by Tokheim Corp., Fort Wayne, Ind., is designed for safe and efficient handling of petroleum products. Operation depends upon the extreme resistance of "Delrin" to organic solvents such as alcohols, aromatics, glycols, and petroleum solvents. Life tests by Tokheim showed that the hand pump would successfully pump "Stoddard" petroleum solvent over one million cycles without wear, corrosion or solvent attack.

All of the pumps featured on this page capitalize in varying degrees on such properties of "Delrin" as its high structural strength, low friction between parts, stiffness, chemical resistance and excellent fatigue life when subjected to a wide range of temperatures and environments.

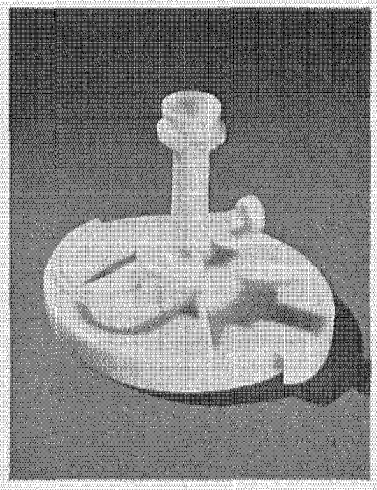
"Such properties, plus success to date, promise new uses, designs and major changes in the world of pumps," says one manufacturer. Pumps will look less and less like grandmother's squeaky old house apparatus. They'll be more versatile, too, doing jobs ranging all the way from cooling, spraying and general purpose handling of farm chemicals to cleaning your automobile's windshield.



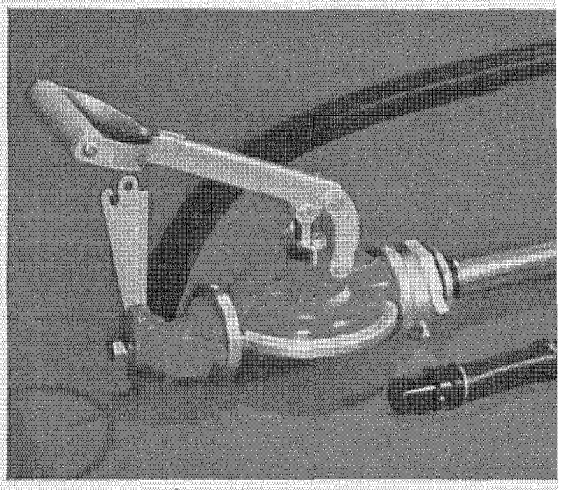
Flint and Walling Flintex submersible pump is installed in depths of a newly dug water well. Pump has 48 separate parts of "Delrin".



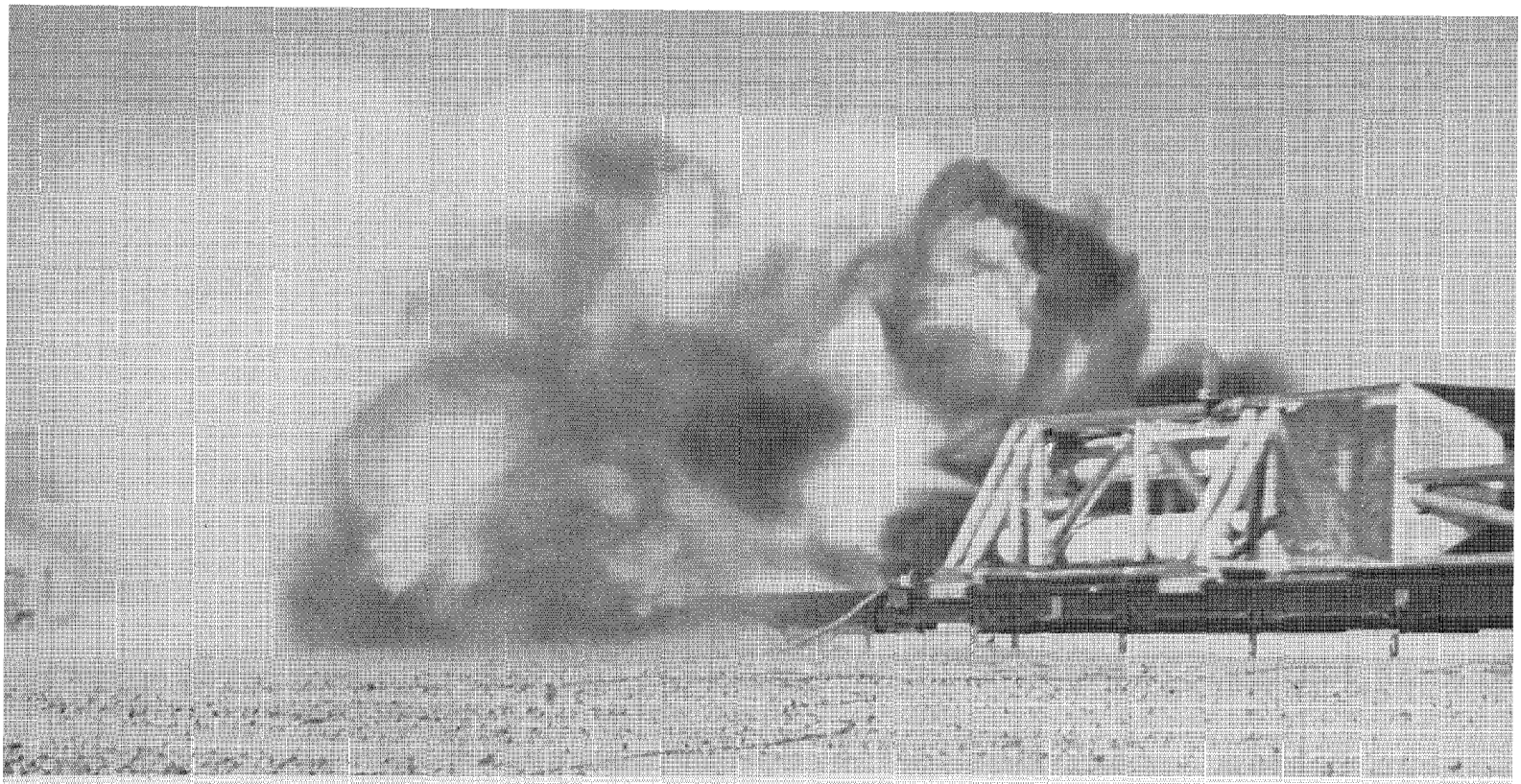
ection-molded impellers used on Red Jacket "Trail-zer" jet pump cut production cost by one-third.



Volute housing and venturi assembly replace parts that were once of metal.



Tokheim general purpose hand pump has rugged lightweight body design of colored "Delrin".



When Sandia scientists study the missile in its natural habitat, Du Pont photo products go to work . . .

BY THE ROCKE

By JACK D. HUNTER

Albuquerque, New Mexic

The rails trace glimmering twin streaks across 3,000 fee of dun-colored desert. The vast mesa is motionless, excep for the idle wandering of a clump of tumbleweed and th shifting shadows of cumulus clouds on the flanks of th snow capped Sandia Mountain Range.

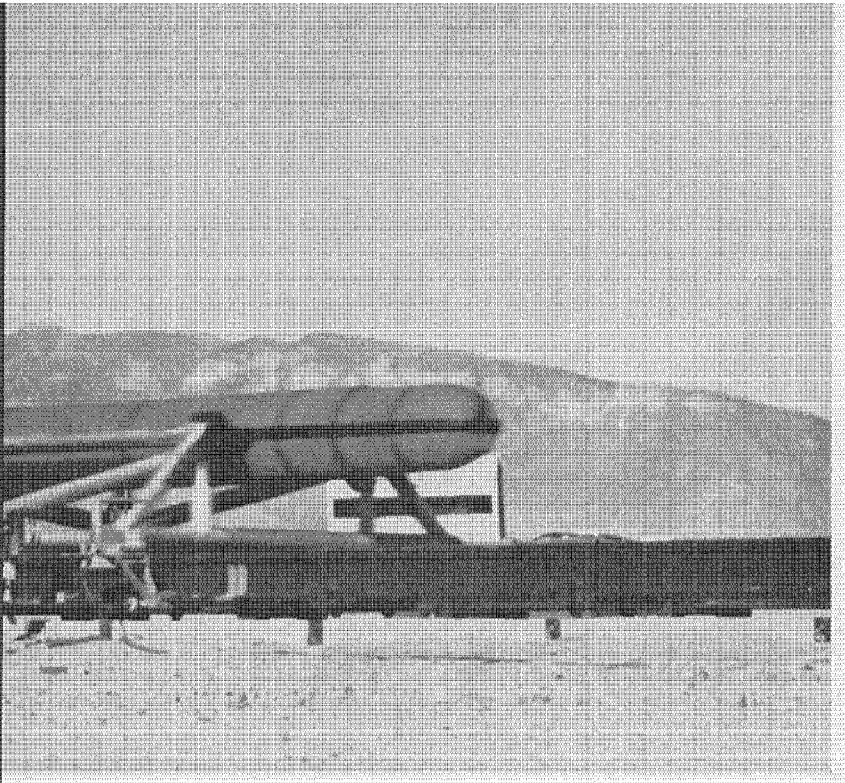
Suddenly, at the far end of the track, there is a bark ing explosion, muffled thunder and a ball of flame. Almos faster than the eye can register, a dart-shaped objec trailing fire, screams along the course, and, in a fina cacophony, disintegrates against a concrete target.

Fragments of torn metal and wiring are all that re main of the components or systems that have been designe as integral parts of a U. S. nuclear weapon. The item have undergone an "environmental test," and their per formance, recorded on film and magnetic tape, will b studied for months to come by scientists and engineer charged with research and development in ordnance phase of nuclear weapons design.

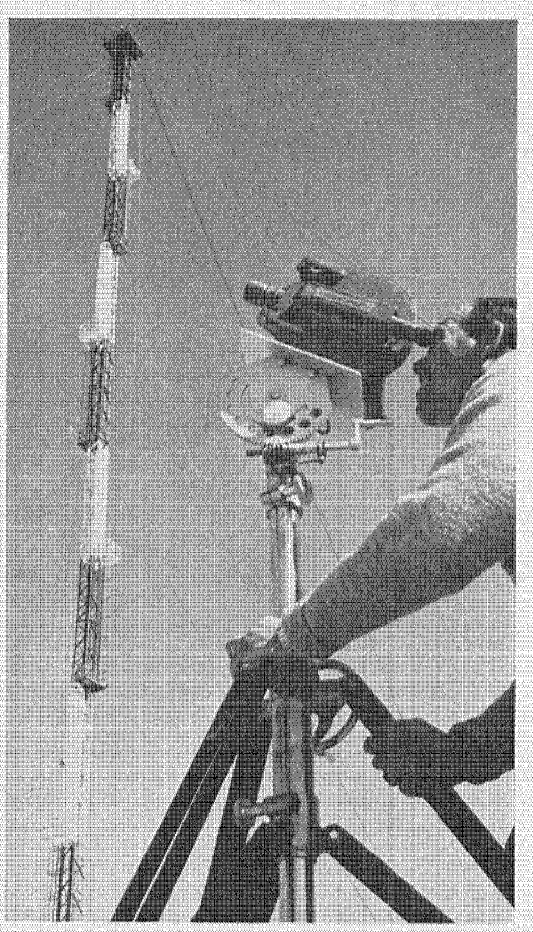
Such tests of acceleration and impact are routine o the rocket sled track and on the 300-foot drop tower op erated here by the Sandia Corporation, a prime contracto of the Atomic Energy Commission. Sandia's job is to de sign, develop, and monitor production of all non-nuclea components and systems necessary to make an AEC nu clear explosive assembly a useful weapon for the nation military services.



Rocket sled firings are recorded by battery of movie cameras mounted near track's impact area.



SLED'S FLARE



Sandia photographer sights high speed camera to record data on missile drop from 300-foot tower.

The success of Sandia's environmental tests of speed and impact on weapons systems and components depends largely on the efficiency and capabilities of recording devices. Some of these receive and record signals from telemetering transmitters which ride with the test vehicles and report on operation of the parts in the microseconds of acceleration or impact; others register series of events that occur much too fast for the human senses to perceive.

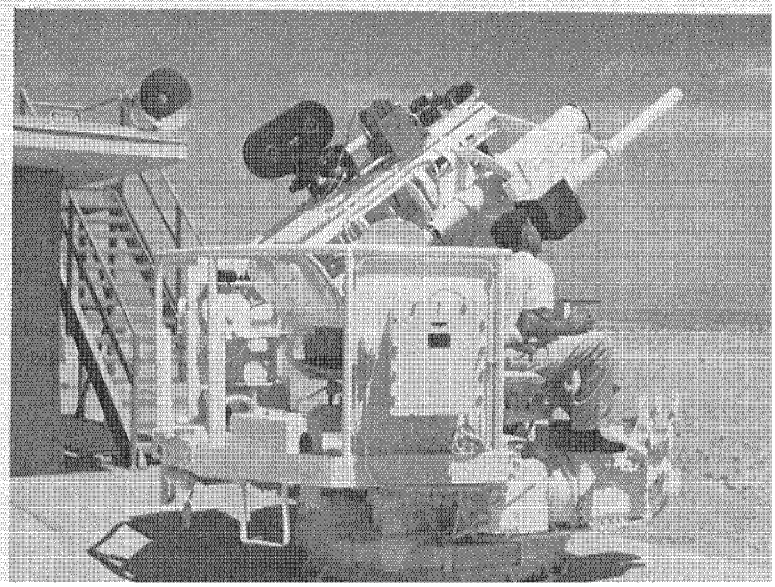
High on the list of such devices relied upon by Sandia's engineers in recording test data is the high speed motion picture camera. Loaded with film, such as Du Pont's High Speed Rapid Reversal Film, Type 931, and "fired" at rates ranging from 100 to as many as 16,000 pictures per second, Sandia's cameras provide a total and permanent history of packages that may have lived and died at three times the speed of sound.

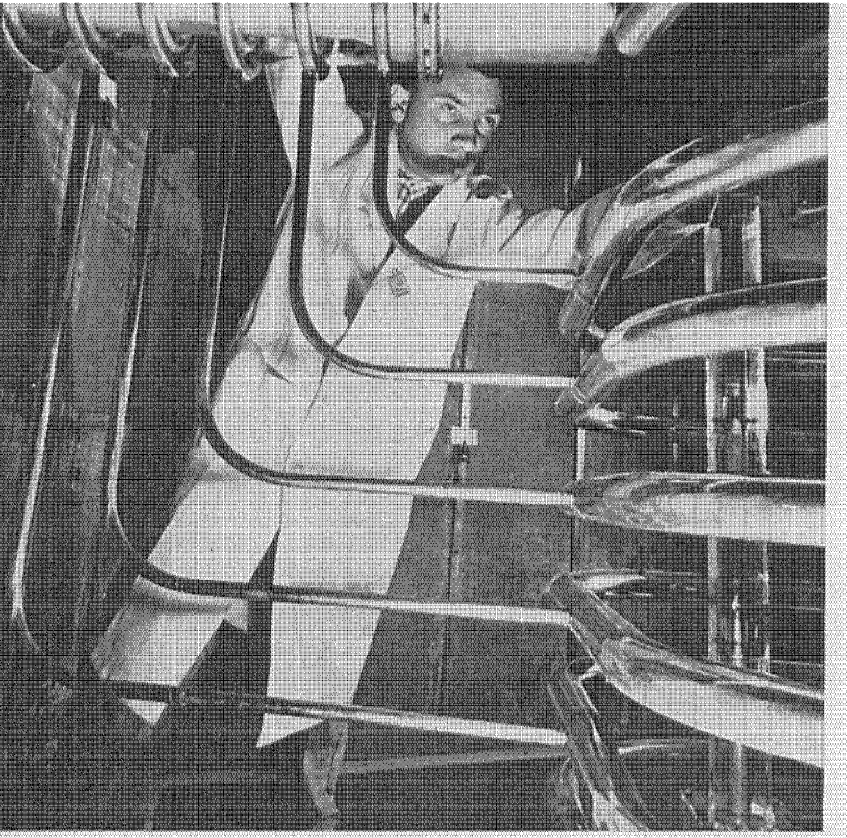
Henry G. Sweeney, slight, soft-spoken supervisor of the dozen specialists who make up Sandia's Technical Photography Section, says: "In many of our tests, there is no second chance. When materials or components are sent along the rocket sled track or dropped from a tower or high-flying aircraft, things happen too fast for the eye to catch. With high speed motion pictures, we can review the performance and even the destruction of a test package inch-by-inch, microsecond-by-microsecond. The importance of reliable, high-quality film in such cases is self-evident."

But high speed motion pictures are only one recording tool used by Sandia in the broad spectrum of its studies, which fall into seven major categories. In one, scientists conduct research into fields related to nuclear weapons, such as physical sciences, mathematics and aerodynamics. In another, components are designed for weapons in the process of design or yet to be conceived. In a third, systems engineers produce the weapon that will be compatible with

continued

Downward course of aircraft-dropped missiles is followed by telescope-sighted cameras, which record every instant of action.





Badge-like Dosimeter Film Packets are worn in area of Sandia's Cockroft-Walton accelerator as radiation-sensitive safety devices.

the proposed application—aircraft, missiles, ships or land combat. Non-nuclear testing of materials, components, systems and weapons shapes during and after development constitutes another area of activity, while other categories involve manufacturing development, reliability and quality, and field engineering and training of military personnel who operate and maintain nuclear weapons.

In virtually all of these fields Sandia makes liberal use of Du Pont photo products. One area of component and materials testing, for example, involves the effects of nuclear radiation. To protect personnel engaged in these studies and to provide detailed "exposure records" for them, Sandia's Industrial Hygiene and Health Physics Division uses Du Pont Dosimeter Film Packets. These badge-like devices are worn by men who work around facilities such as the Van de Graaff accelerator and a 1000-curie radioactive cobalt source for generation of intense gamma radiation. Dosimeter packets are also "planted" at strategic spots in components or around test facilities to serve as silent sentinels against hazardous radiation. Du Pont's Type 558 Dosimeter film provides the all-around coverage and the vital data needed to assess radiation and possible radiation environments.

Five of Sandia's major divisions use substantial quantities of Du Pont photorecording paper, in grades from Lino-Writ 1 to Lino-Writ 4. To translate shock waves, vibration, telemetering signals and other energies into permanent visual records, data transmitted, for instance, by a test missile in flight are picked up electronically; then information is relayed to an oscilloscope, which changes impulses into a beam of light. The light patterns are traced on the Lino-Writ so they can be interpreted—immediately after the missile's travel for "quick-look" information, or later for detailed study.

Printed circuitry, according to N. A. Cordova, a Sandia specialist in the field, "is fundamental to successful nuclear weapons design." He says it would be impossible to manufacture a compact weapons package without such circuitry, since if conventional wiring and component systems were used, "your package could end up with dimensions like those of the *Queen Elizabeth*."

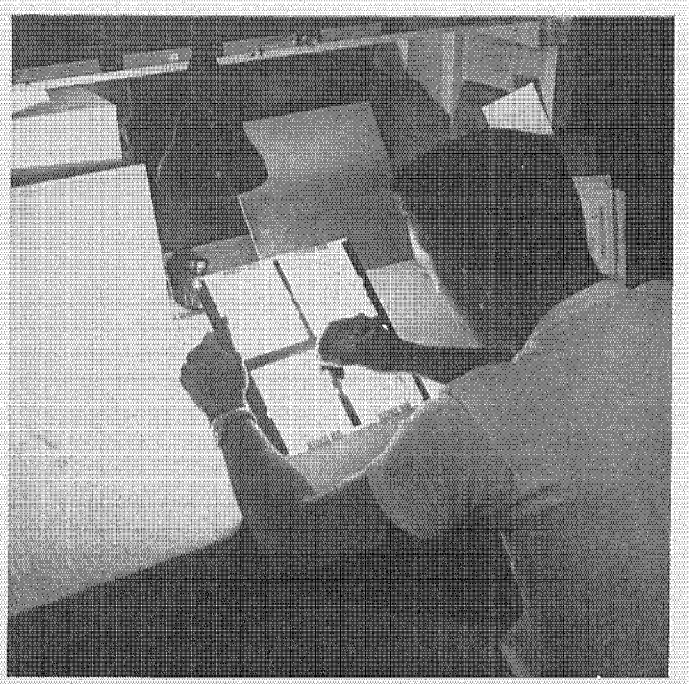
The answer is to draw the electronic circuit required for a specific job, make a master copy of it with "Cronaflex" Direct Positive Film, produce a negative of it in miniature with "Cronar" Ortho A Litho Film, then "shoot" the circuit in actual-use size with a highly calibrated camera. After etching on a sensitive copper plate, the circuit design has been miniaturized sufficiently to take its place in a highly compact projectile.

Miniaturization the Key . . .

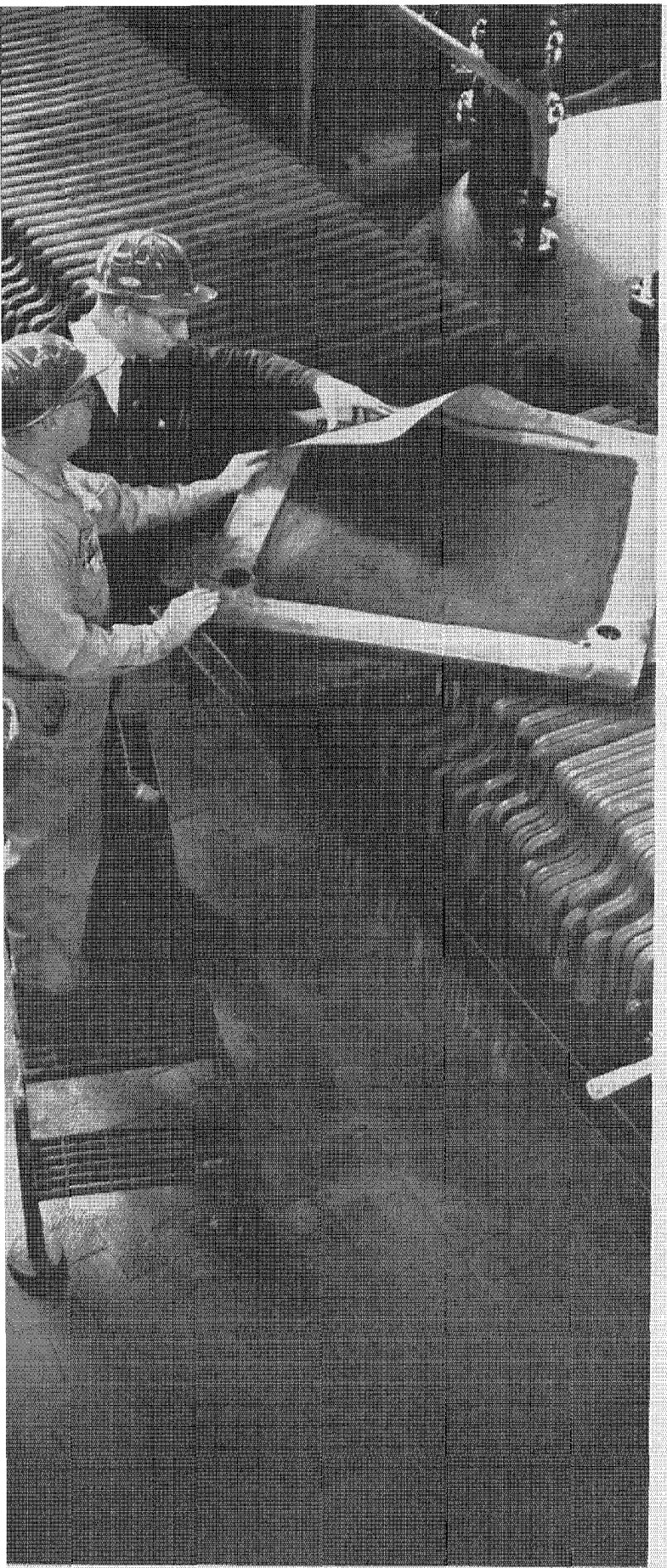
Cordova says miniaturization is the key not only to peak performance of nuclear weapons, but also in the relaying of data from test vehicles. As a broadly drawn example: "Say you want to study the effect of enormous speeds on time itself. Why launch a grandfather's clock, when a lady's wristwatch will give you all the data you seek and more?"

About 7,700 men and women are engaged in Sandia's operations at Albuquerque, at the Tonopah, Nev., Test Range and at the Livermore Laboratory in Livermore, Calif. The corporation itself is a subsidiary of Western Electric Company and conducts its operation for AEC under a nonprofit, no-fee contract as a public service.

Sandia's job is weaponizing a nuclear device developed by the AEC's nuclear research laboratories. As one Sandia official puts it, "This job would be many times more difficult, if not impossible, without the extra sense organs provided by photo products."

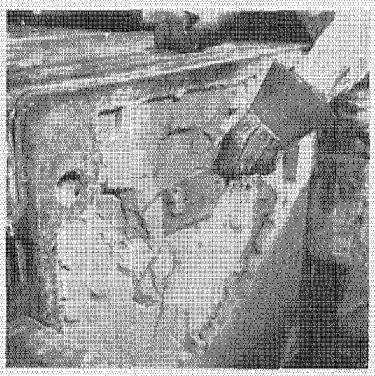


Printed circuitry has been brought to high degree of perfection by Sandia laboratories. Miniaturization is prime need in missiles.



Tough filter cloth of "Dacron", used in plate and frame filters to recover dyes from liquid stream, gets thorough inspection before installation.

A Filter Man's Filter



New nonwoven materials of "Dacron" polyester fiber last longer, reduce costs and solve filtration problems that once gave filter men endless trouble

By Bruce C. Wendle

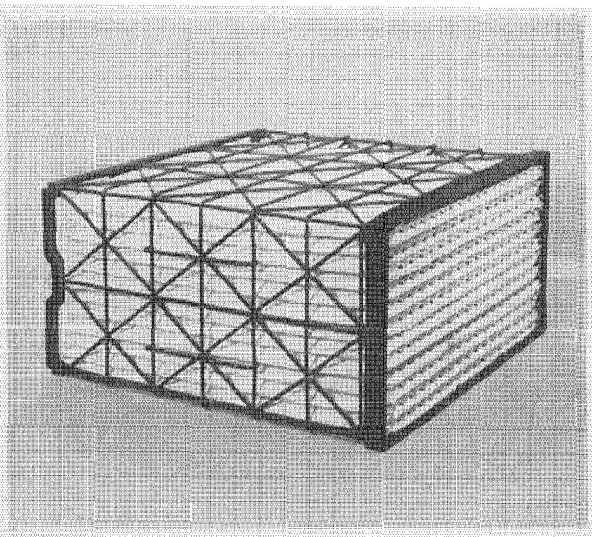
The removal of solids from a liquid or gas stream is a problem that has vexed mankind from the cradle days of Western civilization. Just as the Greeks and Romans continually pressed for better ways to purify water, wine and olive oil, so modern industry endlessly probes better methods of filtration—ways to purify products, separate chemicals, cleanse the air man breathes.

Until recently, the prime material for the filtration of gases and liquids in industry has been woven fabrics of natural fibers such as cotton. Fabrics of synthetic fibers were used only when their durability and efficiency justified their high cost.

Now, however, the development of an efficient, low-cost, nonwoven material of "Dacron" polyester fiber is causing a stir among filtration specialists. Du Pont research men, working closely with manufacturers of industrial filtering media, have come up with a method by which "Dacron" and other synthetic fibers can be processed into an inexpensive, highly efficient felt material that withstands the high pressures, corrosive liquids and severe use common to industrial filtering operations.

Felt itself, of course, is not new. The original process for making it dates from ancient times, when Asian nomads found that the heat, pressure and moisture generated under the saddles they rode converted their wool saddle blankets into a tough, matted fabric. Feltmakers have used a variation of this phenomenon ever since by rubbing wool batting in the presence of steam, then compacting it to the desired density under blows of huge hammers. However, no fibers other than wool, hair and fur have ever been

continued





Air filter unit for new 50-ton M-60 tank has 12 felt layers of "Dacron" . . . cleans air flowing into tank engine, a critical factor in dusty terrain.

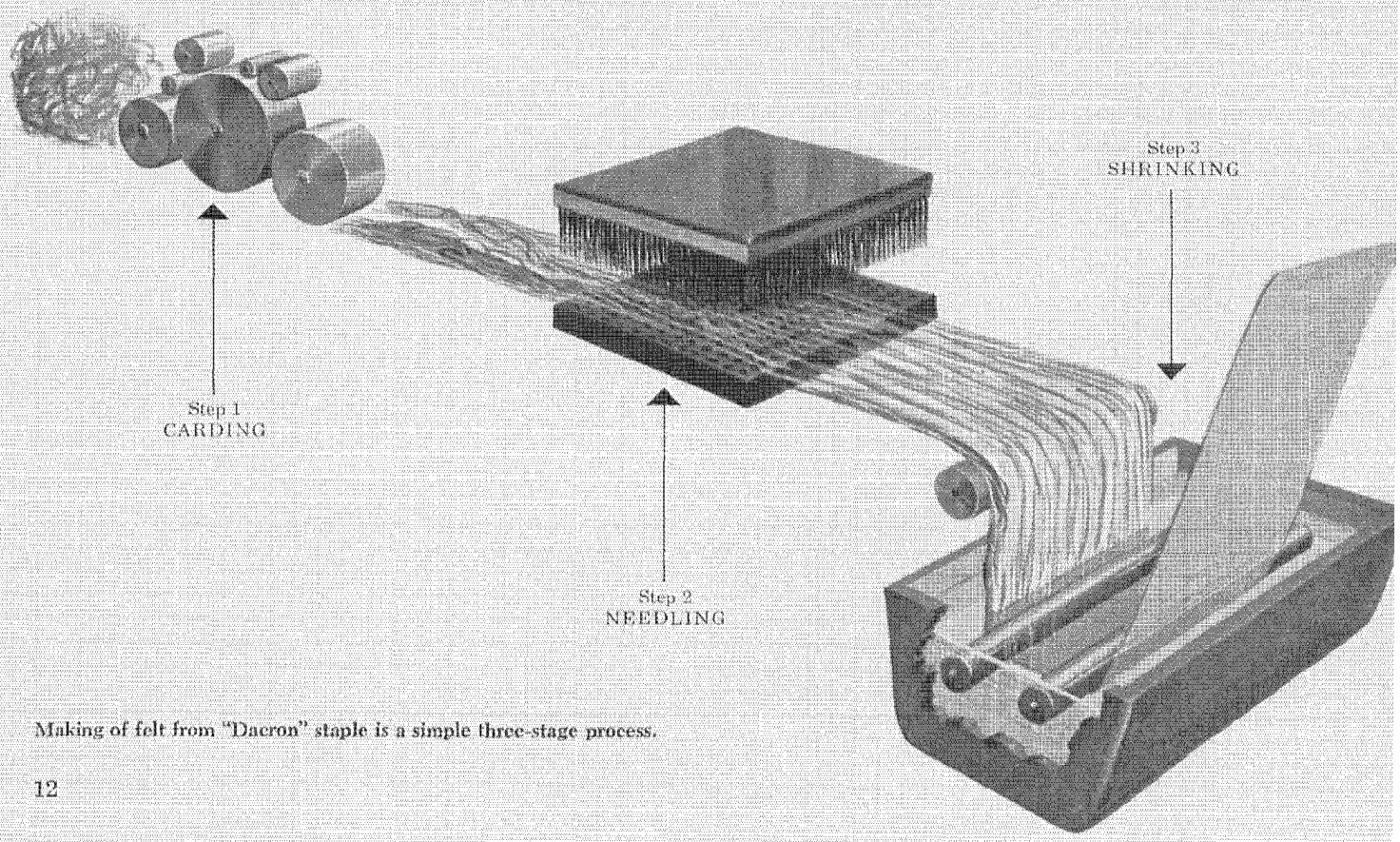
found to work in this process, and felts of these materials will not stand up well under the rigors of modern filtration. Synthetic fibers, which have the necessary strength, have neither the scaly surface nor related properties required to knit together under such conditions.

Says Dr. H. G. Lauterbach, a Du Pont research scientist, "In seeking a technique whereby we might construct a felt-like material from man-made fibers, we turned to a needle-punching process in which a carded batting of 'Dacron' is run through a bank of barbed needles set in a reciprocating head (see diagram). The head moves up and down as the fiber batt passes beneath, causing entanglement of the fiber. The needle-punched batt is then run through a hot liquid bath which shrinks the fibers and draws the fabric together. By adjusting soaking time and temperature of the bath, the thickness and density of the felt can be controlled by processors."

This method has been highly successful for most synthetics and has allowed felt companies to offer a wide selection of nonwoven fabrics.

By refining the needling process and using mixtures as well as single-fiber types, feltmakers are now turning out products that may well alter the felt market significantly. Karl Del Porte, filtration products division manager for the American Felt Co., Glenville, Conn., says, "If the success of current tests is a true indicator of the market potential, we envision a bright future for filter media of synthetic fibers. In fact, we've recently set up a separate division within our company to handle the growth brought about by the interest in these materials."

Del Porte cited felts of "Dacron" that are under test: "In the sugar cane industry, the felt is being used on



Making of felt from "Dacron" staple is a simple three-stage process.

rotary vacuum filters to purify heavy sugar syrup. In Grants, N. M., a subsidiary of Anaconda Copper is using filter cloths of 'Dacron' to separate 'yellow cake' (uranium oxide) from strong acidic solutions. And in Stamford, Conn., the use of these materials is saving the Silberline Co. large sums in the filtration of aluminum pigments."

Du Pont itself is finding plenty of advantages in the use of felts made of "Dacron". At its dye plant in Deepwater, N. J., the dye, in suspension with strong, corrosive liquids, is retrieved by passing the mixture through huge plate and frame filters.

Formerly, most filtrations were made with fabrics of natural fibers, but Sheldon Musicante, production supervisor, noted that a sizable amount of color was being lost through the cloths on the presses. He undertook a search for a better filtration medium.

60 Types of Felts . . .

By working with a felt manufacturer, Musicante developed successful uses of nylon felt cloth in a number of wet filtration processes, but nylon felts are limited in the filtration of acidic liquids. Therefore, he tested some 60 different types of felts of "Dacron" from nine mills. Impressed with work being done by American Felt, he inaugurated a series of cooperative tests with that company, experiments that ultimately gave him the filter cloth he wanted and enabled American Felt to add a first-rate filter material to its "Feutron" product line. Musicante found that the felt filter of "Dacron" costs only half as much as available competitive products and lasts about 12 times longer than filter cloths of natural fiber. Furthermore, the amount of dye lost through the filters has been cut in half.

In air filtration, the new nonwoven felts have also found ready acceptance. "Troyfelt", a felt of "Dacron" produced by Troy Mills of New Hampshire, is currently being used on the air cleaner of the new Chrysler-built U. S. Army M-60 tank. In this application, the filter medium had to provide almost 100 per cent filtering efficiency in "zero visibility" dust conditions, operate in ambient air temperatures from −65°F. to 125°F., and withstand oil, moisture, rot and mildew.

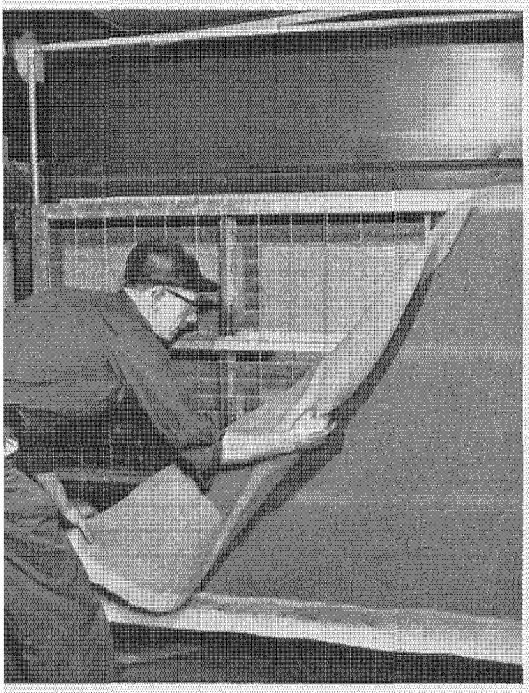
A number of different materials were tested, including nonwoven felts of wool, synthetics and cotton and woven fabrics of wool, cotton, glass and synthetics. Test evaluations showed that "Troyfelt" performed best.

Besides meeting the required specifications, "Troyfelt" showed long operating life, uniform strength and efficient cleaning action—characteristics that point to large-scale future use in air cleaners for heavy construction equipment.

While nonwoven felts are one of the newest additions to filtration materials, a random bonded batting of "Dacron" is also gaining wide acceptance in industrial and domestic air filtration; in warm air heating and air conditioning installations.

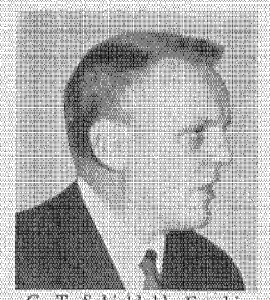
Produced by such companies as Microtron Corp. of Charlotte, N. C., the nonwoven batt filters of pure synthetic fibers are helping to ease the $7.5 billion annual cost of air pollution, and reduce the effect of heavy concentrations of dust and dirt particles on industrial processes. By varying the blend composition, weight, denier and arrangement of the fibers, Microtron is able to offer a filter medium that is effective, economical, and versatile enough to do jobs across a broad spectrum. On the West Coast, for instance, Boeing Aircraft Corp. uses the "Micromat" blanket filter to keep air around freshly painted aircraft clean and dust-free. In North Carolina, a cigarette manufacturer uses the filter to remove heavy dust concentrations from production areas. On the home front, Microtron's easy-to-handle mats of "Dacron" are filtering the air going into warm air heating units and air conditioners.

In sum, wherever filtration is an important process, "Dacron" polyester fiber is a newcomer that's truly becoming a filter man's filter.

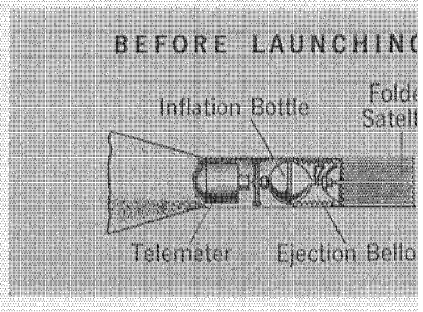




Blanket air filter of "Dacron" is quickly removed and replaced . . . keeps over a million cubic feet of air in this aircraft painting hangar clean and dust-free.



G. T. Schjeldahl: For his product, the sky's no limit



Everybody knew that "Mylar" polyester film was tough. But the most vivid demonstration came when one imaginative man showed how to take it

From Gas Range to Satelloon

If the National Aeronautics and Space Administration has its way, the empty reaches beyond our sky will some day be speckled with objects of many sizes and extraordinary shapes—inflated satellites called satelloons, probing the black void like long-distance human sense organs.

Already aloft are Echo I, a 100-foot inflated satellite that is broadening global communications, and Explorer IX (right) a smaller but intricate sister device calculated to give new understanding of air density and drag conditions at the rim of deep space.

The space balloon concept, a U. S. first, is no more extraordinary than some of the factors that made it work —factors that include a fantastically tough film, a common table knife, the gas burner of a kitchen range, and the insatiable curiosity of a youthful, crew-cut inventor named Gilmore T. Schjeldahl, who likes to experiment with films.

Schjeldahl, as a North Dakotan whose main assets were a degree in biochemistry and an honorable discharge from the Army, landed a job with a Chicago meat packing company after World War II. Assigned to practical packaging problems ("because I'm fairly strong on mechanics and not so strong on abstracts, I guess"), he soon decided that the Du Pont polyethylene resins used by the packer had "extraordinary adaptability." He became so sold on this he eventually set up his own company in Northfield, Minn., to explore and capitalize on some of the uses he envisioned for such materials.

Kitchen Table Research

"One thing that engrossed me," he says, "was a side-weld concept of sealing polyethylene film, and I set out to test it. I spent many an hour in the kitchen of my home heating a table knife over the gas burner of our range. I'd heat the knife, and without lab equipment, I became pretty good at figuring the temperature of the knife by smell. Then I'd apply the heated knife to a couple of pieces of film for a certain dwell time in order to form the seal. I'd vary the temperature and hold the dwell time constant; then I'd vary the dwell time and hold the temperature constant. I made some rough graphs on optimum conditions for sealing with a heated knife. The data I gathered this way served as the primary foundation for an operation that today employs many of the 200 people who turn out Schjeldahl products."

Several years ago, when "Mylar" was a newcomer to the film field, Schjeldahl was "entranced" with "this amazingly tough stuff" and "challenged" by the search for the best ways to seal it. "Following extensive research on more sophisticated versions of the table knife experiments in heat sealing, I focused on a resin I found would seal 'Mylar' in a most satisfying manner."

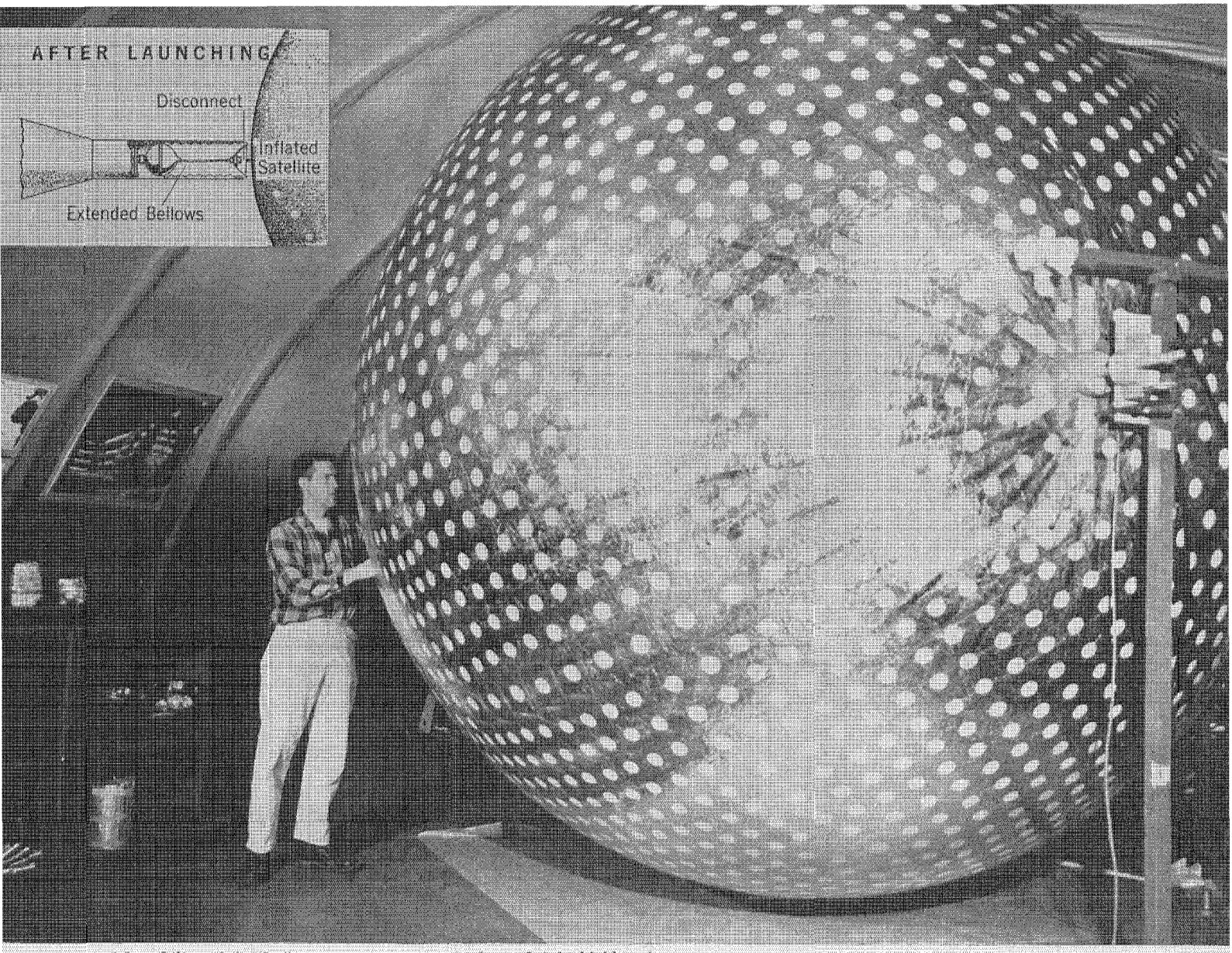
Stalled Project Rescued

Meanwhile, NASA was planning Echo I, but the project had come to a halt because the agency could find no way to seal the panels of the big balloon of "Mylar" so as to withstand the extremes of pressure and temperature found in space. Somebody recalled that Schjeldahl had been investigating sealings of "Mylar". NASA placed a call to Northfield.

Schjeldahl says: "In less than six weeks we not only developed a tape-adhesive system which would withstand space abuse but we also had built special fabricating equipment to do the job. We were able, because of our early spadework with 'Mylar', to make a quick turn into their problem and come up with the right answer."

With satelloons a proven concept, Schjeldahl is turning to even more ambitious schemes involving "Mylar". He's most enthusiastic about an inflatable rigidized space sphere, which, like Echo, can be used as a passive reflector of radio waves. A balloon like Echo ultimately loses its radio-reflecting contours after long bombardment by meteorites. Schjeldahl envisions a balloon that will, after inflation, take on a rigid shape "in any of a variety of ways—by foam, by photochemical means, by solar radiation, or by tensilizing metal foils, so that they can remain aloof to hostile elements."

In Echo II, which the firm already has under way, the



Adaptability of "Mylar", NASA inflation principle, and Schjeldahl sealing techniques have produced satelloons like Explorer IX.

"Mylar" will be sandwiched between two layers of aluminum foil, then tensilized. Aloft, it will become an unwrinkled sphere with no need of the sustaining inflating agent required by Echo I.

Schjeldahl adds he's convinced that "whenever a large shape in space is required, it can best be achieved by means of 'satelloons' shot up in small compact packages. Once in orbit, these small packages can become massive, rigid structures." Presumably (there are security wraps on the projects) it is such work that NASA has asked his company to undertake.

Drifting Weather Stations

Schjeldahl also has his eye on a sophisticated weather reporting system featuring a moving grid of super-pressure balloons made of "Mylar" riding at constant altitudes and relaying weather data as they drift around the world.

"Today, the conventional method is like searching for a needle in a haystack," Schjeldahl says. "One balloon is sent straight up, telemetering data as it rises to the point of bursting. I see a method in which a whole system of balloons are set adrift at various altitudes. Their telemetering equipment can be diffused throughout their skin and information can be relayed to ground stations as they ride along with the weather."

Schjeldahl and his employees literally work in a "test tube." On his 15-acre plant site he has erected two air-supported structures of laminations of "Mylar"—one, 540 feet long, that houses the world's longest balloon fabricating table. He believes the toughness of the Du Pont film makes it ideal for structural purposes and is practicing his preachments in this field.

Schjeldahl makes short shrift of those who "picture big companies as bogey-men." He says, "About the time I was trying to get under way the Du Pont film people opened their doors wide, placed laboratory facilities at my disposal, and helped me in a great many ways. Most of all, they gave me encouragement when I was most discouraged. Their help bridged the tremendous gap between a guy with ideas and a guy with a business."



Gun-Land's Most Adaptable Family

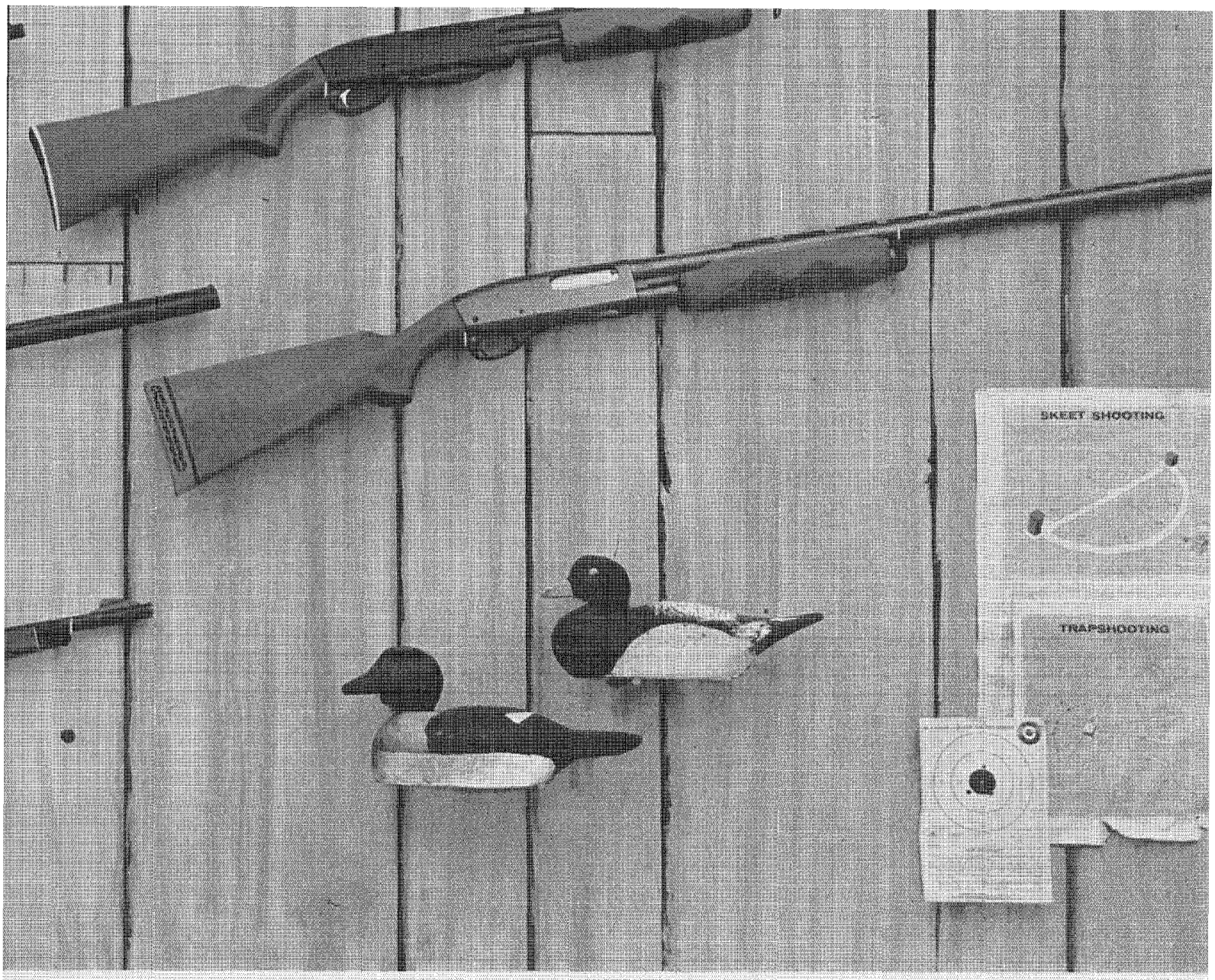
Parade of new Remington models helps shooters diversify their skills at bargain prices

On Maryland's Eastern Shore last fall, a pair of hunte
were returning to their car from the duck blinds. Tl
hunting had been good, and both had knocked down the
limits. A Labrador retriever, ranging the field ahea
suddenly flushed a covey of quail from some thick cove

"Too bad we don't have open cylinder barrels on the
muskets," said one. "We could have some more sport."

"Hold on a minute," said the other. "I'll build us
least one quail gun in a jiffy and we'll give it a whirl."

His companion's doubtful expression changed to
pleased grin as, in a few easy motions, he unscrewed tl
magazine cap and removed the 30-inch full choke barr
from his Remington "Sportsman" 58 autoloading shotgu
Taking a 26-inch open cylinder barrel from the car trun
he slid it into the gun's receiver and replaced the magazi
cap. With a few twists of the wrist, he had converted h



Two high power rifles, two shotguns and 22 rifle with similarity of line characterize "family of guns" concept pioneered by Remington.

duck gun for quail shooting. Whistling to the dog and picking up a box of No. 8 shells, the two were soon on the way back to see if they could find the covey.

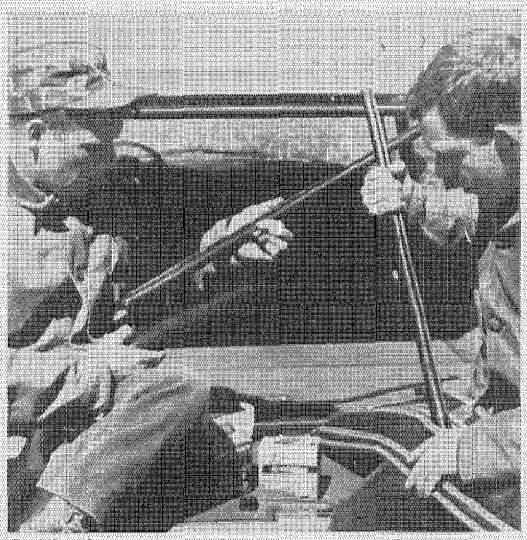
Such vignettes, which can happen wherever shooters gather today, were practically unheard of prior to 1950. But thanks to a "family of guns" concept pioneered by Remington Arms Company, Inc., there has been a major breakthrough in sporting arms manufacture. As a result, shooters can use the same basic shotgun for several different types of game merely by changing barrels. No special tools are needed and no special fitting is necessary. A barrel of different choke and length can be fitted to the same stock and receiver with ease.

Moreover, Remington, by applying mass production techniques to a manufacturing process that for centuries had been limited to handwork by craftsmen, has been able to produce shotguns and rifles whose parts have a high degree of interchangeability. As a result, they can offer the shooter a shotgun, a high-power rifle, or a 22 caliber rifle—all with a similar look and feel. Furthermore, throughout the gun types and their models and classes, parts can be replaced with no need for factory fitting or gunsmith's attention.

Starting in 1948 with two new high power rifles as parents, the "family" since has grown to include: three bolt action center fire rifles, two autoloading shotguns, a slide action high power rifle, two gas-operated autoloading shotguns, two autoloading 22 caliber rim fire rifles and a bolt action 22 caliber rim fire rifle.

An important beneficiary of this development is the shotgun shooter like those on the Eastern Shore who wants to use the same basic gun for more than one type of game.

continued



Quick change from duck gun to quail gun begins when hunter removes 30-inch full choke barrel.



Upland game, such as quail, calls for 26-inch open cylinder barrel, which slides into receiver with ease.



Transition complete, magazine cap is replaced and shooter's familiar duck gun is ready for new function.

For example, a sportsman may want to do a little waterfowl and upland game hunting, some trap shooting, and perhaps some deer hunting using rifled slug loads. Before Remington's "family of guns" came along, he would have had to equip himself with at least two and possibly three separate shotguns—one for trap and waterfowl, one for upland game and one for deer. Today he can select a good basic shotgun, buy two extra barrels, and be in business.

Important Savings Possible

In terms of economics, here's the way it stacks up: With his Remington gun and two extra barrels, the price tag is about half what it would be for three separate guns. In terms of comfort and convenience, he's even further ahead, since he does all his shooting with a gun stock that handles and feels the same under all conditions.

In developing and producing its new models, Remington keeps a careful balance between tradition and innovation. Gun enthusiasts have a great fondness for warm woods, metals with rich sheen, classic lines and styles, and Remington goes to considerable lengths to reward these esthetic tastes. But shooters also demand lighter weight guns capable of taking heavier loads; so, to meet these sometimes incompatible requirements, Remington's engineers have devised some new approaches.

Their answer: new materials, new designs, new techniques which (although at first glance seem alien to the gunmaking art) can be adapted to offer the tradition-minded shooter the most in performance and appearance.

For example, there was a time when the idea of using anything but wood and steel to make a rifle would cause a gunsmith to turn pale. You make a gun with any other materials, he'd say, and you've got an item that gun fans just won't buy. Remington wasn't so sure, and began to experiment. As a result, the company today is producing and has sold thousands of its "Nylon 66" autoloading 22 caliber rifles. With all but its barrel and a few functioning parts made of "Zytel" structural nylon, the rifle has set new standards for light weight, accuracy, resistance to shock and abrasion, and ease of handling. Furthermore, the "Nylon 66" has the warm feel and graceful lines of the most expensive traditional sporting arm.

New Alloys for Barrels

Aluminum alloys, too, are providing lightweight and rustproof gun parts. Remington is even using this material in combination with steel to make gun barrels—long the exclusive province of steel alone. Aside from weight and performance advantages, the aluminum alloys permit the production of guns with a wide range of colors calculated to appeal to nontraditionalists.

But Remington engineers seem solidly agreed that the major accomplishment of their industry in recent times has been the "family of guns" concept. This development has given a new direction to gun manufacturing, and has also, by bringing lower prices, introduced shooting as a gratifying recreation to thousands of Americans.

How Does Your Garden Grow?

With the help of chemicals, probably. Here are Du Pont's latest recommendations

Found: a garden sprayer that's both handy to use and versatile enough for practically any spraying job. That's the word from thousands of gardeners who tried the new Du Pont Sprayer last year. It actually is three sprayers in one, they note, because of its interchangeable nozzles.

Each package of a Du Pont garden chemical tells which nozzle will provide just the right spray. For instance, if you want to apply five gallons of Garden Insecticide, you measure five tablespoonfuls into the sprayer jar (left) and fill to the top with water. Using the five-gallon nozzle, you attach the sprayer to the end of a garden hose. It sucks up the proper amount of the mixture, combines it with water from the hose and distributes it evenly.



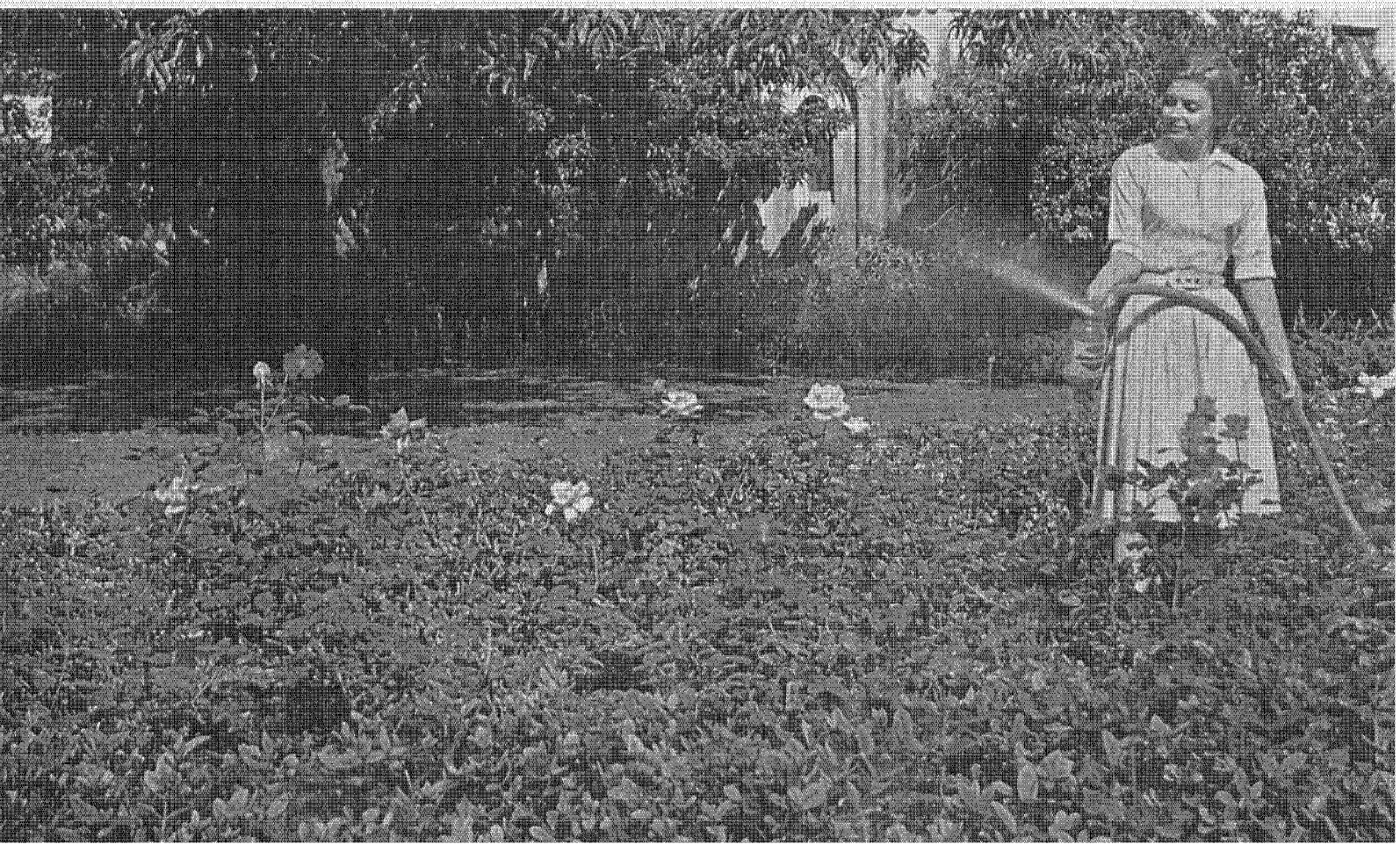
One Du Pont Garden Sprayer and three nozzles equip a gardener for most spraying jobs. Glass jar is plastic coated for shatter resistance.

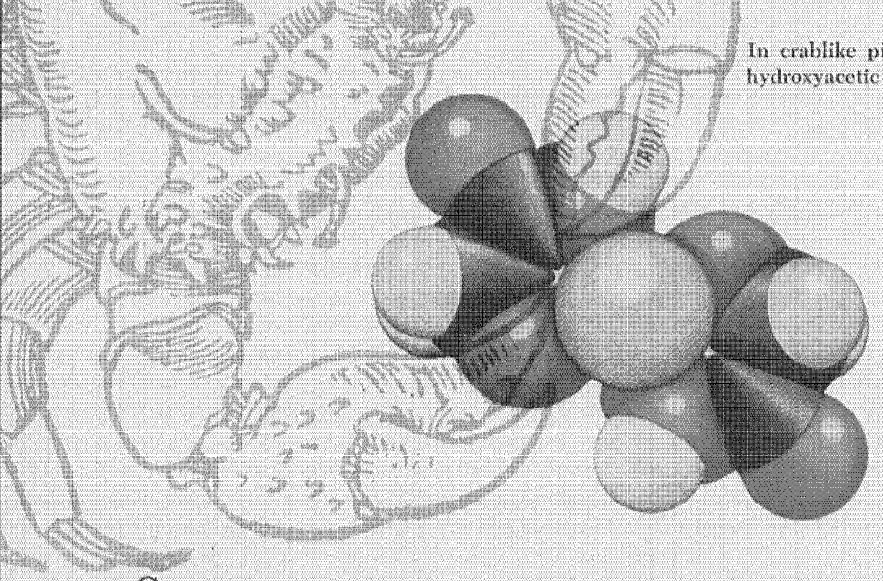
Garden Insecticide has won many friends in its three years of commercial life. It's a combination of two of the most effective insecticides known—fast-acting malathion, which goes after sucking insects, and long-lasting methoxychlor, which gets the chewing varieties.

What about lawn insects—grubs, cutworms, ants and the like? Du Pont 72% Chlordane gets rid of them safely and efficiently. It's good also for stopping crabgrass before it starts. If this pest is already flourishing, however, the best bet is Du Pont Crabgrass Killer. For all other lawn weeds, Du Pont Lawn Weed Killer is recommended.

Roses may look like the picture of health (below), but even so they are vulnerable to sneak attacks by insects, disease, mites and mildew. Du Pont Rose Insecticide and Fungicide is a good all-round protectant. Many a modern gardener ponders the old saw about an ounce of prevention being worth a pound of cure and goes quietly ahead with this sort of "preventive gardening."

Easily applied with the Du Pont Garden Sprayer, Rose Insecticide and Fungicide protects against wide range of plant pests.





In crablike pincer movement, molecule of hydroxyacetic acid clutches metallic ion.

Chemical Clav

New research points up hydroxyacetic ac

. . . from dissolving scale and destro

Cost-conscious engineers in a string of industries—oil, missiles, chemical processing, atomic energy, leather, metal forming—may profit from a direct encounter with hydroxyacetic, an acid seldom faced outside a chemistry book. That's the judgment of development men in Du Pont's Industrial and Biochemicals Dept., based on new research findings.

Hydroxyacetic acid, oftentimes called glycolic acid, has appeared in scientific literature for more than 100 years. Chemists know it as $HOCH_2COOH$, first and simplest of the hydroxy carboxylic acids, a class that also includes such familiar acids as citric and lactic.

"People often are surprised to hear that anyone sells hydroxyacetic acid," says Lynn McLaughlin of I&B's development and service group. "Our process for making ethylene glycol, the base of 'Zerex' antifreeze, gives us hydroxy as an intermediate. The commercial product is a technical grade, 70 per cent aqueous solution.

"Uses? Right now the biggest is in cleansers for removing milkstone deposits from dairy equipment. Some wool dyers find it an excellent replacement for acetic because it isn't lost in boiling as acetic is. Tanners use it in several ways—in the deliming process, for instance, when they want especially high-quality leathers. Still, since hydroxyacetic is among the cheapest organic acids, we figured it should be better known."

Accordingly, Du Pont research men undertook a rather extensive re-evaluation of hydroxyacetic's abilities. They came up with considerable data—corrosion rates on a variety of metals, for example—and a number of possible new applications. By now most of these ideas have been tested in industry, with favorable results as noted. A letter to the *Du Pont Magazine* editor will bring you more details.

One of hydroxyacetic's most attractive properties is its ability to change the behavior of metallic ions, such as ferric iron, by clutching them in a complex. Both the carboxyl group (COOH) and the primary hydroxyl group (OH) are involved in this pincer movement. The process —called chelation from the Greek word *chele*, the claw of a crab—has gained markedly in importance in the last decade. The idea, however, is an ancient one; naturally occurring citric acid was used as a complexing agent some 2,000 years ago.

Citric, synthetic now, is still a popular chelating agent, although an expensive one. Du Pont research men report that hydroxyacetic, which costs about one-third as much, frequently can be substituted wholly or in part.

In preventing the precipitation of ferric iron, minimum cost per unit of iron can be attained at a mol ratio of 80 per cent hydroxy to 20 per cent citric. At present prices, the cost of materials will be only 57 per cent that of straight citric.

Besides being less expensive, hydroxyacetic acid shows greater versatility as a worker than many other chelating acids. A good example of what might be called its multi-functional nature is its application in deep water wells. Such wells frequently are plugged by a deposit—chiefly ferric hydroxide—that precipitates as a gooey mass on the intake screen. Iron-oxidizing bacteria play a major role in creating this problem.

The normal technique for getting rid of such deposits calls first for pumping in hydrochloric acid to acidify the well and dissolve the iron deposits. Next a chelating agent is added to keep the iron in solution. It's pumped out and sodium hypochlorite goes in to kill bacteria. All of these needs may be met in a simple one-shot treatment with hydroxyacetic acid.

Serves in Secondary Oil Recovery

Another new job for hydroxyacetic has turned up in the oil industry, where the technique known as secondary recovery is being used increasingly to get petroleum from old wells. The cheapest and most common method is simply to push millions of barrels of water into the oil pools under high pressure. This is called "water-flooding" and it's capable of bringing up as much as 50 per cent of the oil in a pool.

When wells are located where water is scarce, as they frequently are, water is recycled. Or, sometimes, briny water is used. In a couple of common situations, then, oilmen need a chelating agent to control iron and calcium scale. They can substitute hydroxyacetic acid for currently used materials at a considerable saving.

Du Pont's Engineering Test Center recently completed studies of "vapor-cleaning" of new pipelines with high velocity steam and acid to remove mill scale and rust. The engineers found a 20 per cent solution of hydroxyacetic both safe for the metal and effective as a cleaner.

Preliminary investigations suggest hydroxyacetic as a candidate for certain types of decontamination cleaning necessary at atomic energy installations. Chemical process

with Extra Bite

unusual ability to do several things at once

bacteria to forming complexes with metals

equipment generally is cleaned in three separate stages, the last to remove niobium oxides. The subtler hydroxyacetic might well replace the brute force of the present reagent, a combination of 3 per cent hydrofluoric and 20 per cent nitric acids that is very corrosive to stainless steel. Hydroxyacetic also is being tested for reactor loops, now usually cleaned in a two solution, two-step process—alkaline permanganate to "condition" the residues, followed by dibasic ammonium citrate.

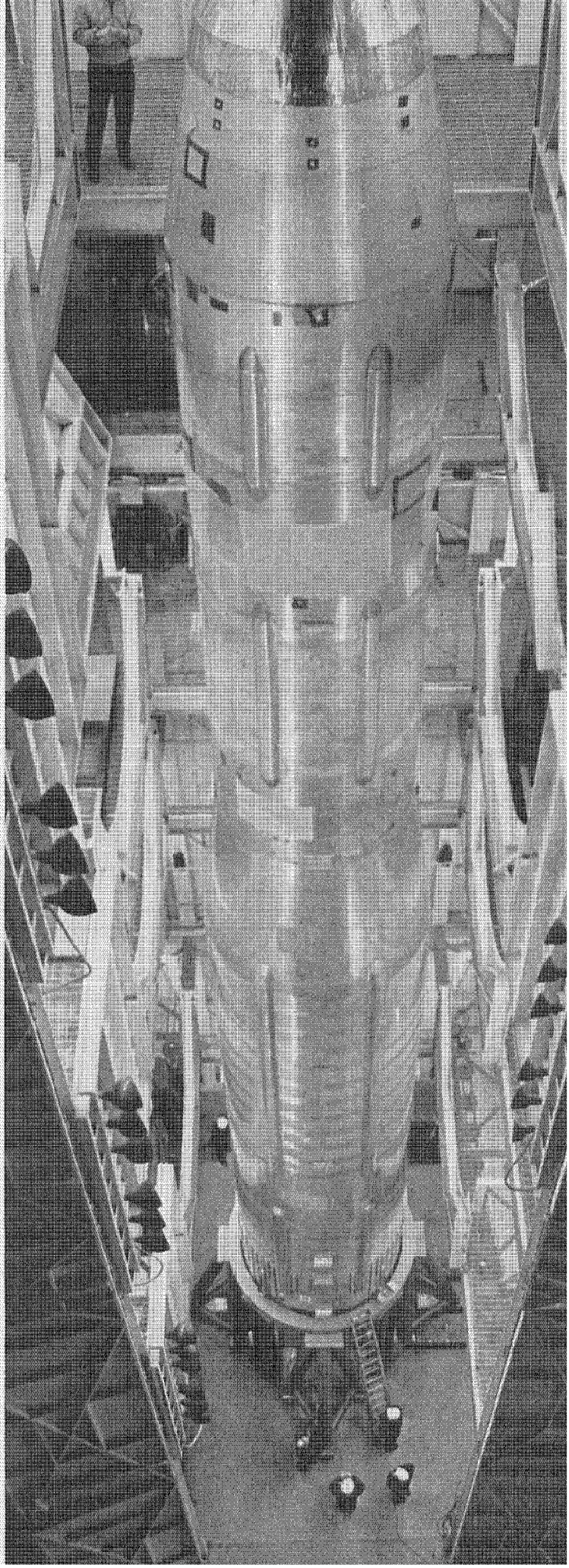
Aerojet General Corp. has developed a formulation based on hydroxyacetic acid for neutralizing and cleaning residual Aerozine 50 from the fuel system of the Air Force's Titan II missile. Each engine is test fired several times before acceptance by the customer, and any fuel or oxidant residue, if left in the engine after operation, would reduce engine reliability.

Aerojet wanted a material that would neutralize Aerozine 50 (a hydrazine-type fuel), be economical to use and not corrosive to the engine construction materials. Du Pont ran special corrosion studies to assure the compatibility of hydroxyacetic with these materials. Aerojet tested its cleaning performance, found it satisfactory and the material now promises to have an expanded use in the missile.

Hydroxyacetic has been successfully substituted for acetic in the pickling of nonferrous metal sheet. Loss of acid from volatilization at high temperatures was thus eliminated and exposure of workers to acid fumes greatly reduced. It seems likely that hydroxy might replace acetic for similar reasons in a great number of applications.

While hydroxyacetic is an old performer in the leather industry, one of its newest uses is in this field. A chromium complex salt of it, tris-hydroxyacetatochromiate, is proving an effective and exceptionally rapid tanning agent. Hides have good "letting out" characteristics, giving greater surface area from a pound of leather. Tanning can be carried out at a higher pH level in the same equipment used for other chrome agents.

This, of course, is a step beyond the main business under investigation, hydroxyacetic itself. But it does speak as a final character witness for hydroxy. By offering extra service at reasonable rates, this special chelating agent stands ready to grab assignments just about anywhere.

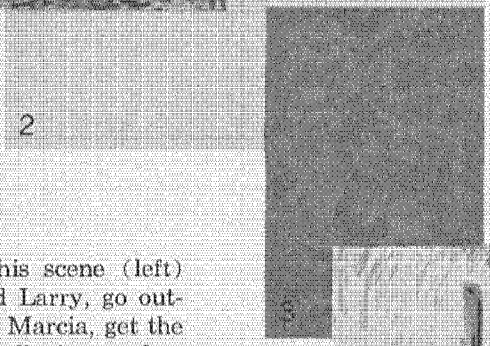


Missiles of Titan family (right) are test fired several times before use. Hydroxyacetic acid cleans residues from Titan II fuel system.

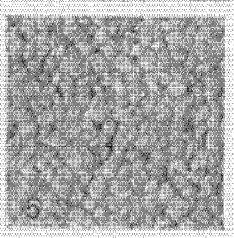


Living Room You Can Live In









1. Nylon upholstery by Cohn-Hall-Marx Co.
2. Du Pont "Lucite" wall paint, sandy beige
3. Nylon upholstery by Schumacher
4. Chiffon casement fabric of "Dacron", Pastorale by The Georgia Co.
5. Carpet of "Orlon" acrylic fiber and modacrylics, Country by Alexander Smith

The first reaction of most parents at this scene (left) would be something like this: "Mike and Larry, go outdoors if you're going to act like that. And Marcia, get the dog off the sofa." This approach undoubtedly is sound.

What the picture suggests is that *if* the kids wrestle in this living room, the furnishings will be none the worse. Even spilled milk, imminent here, isn't something to cry about. In short, this is a living room you can live in.

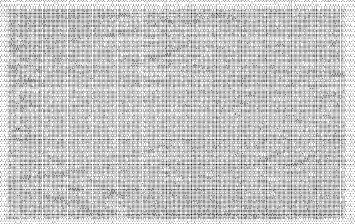
The explanation is simple. The carpet, curtains and upholstery are all made with Du Pont nylon or "Dacron" polyester, fibers well-known for their sturdiness and good cleanability. The muted luster of Du Pont 501 Carpet Nylon, for instance, gives both a rich appearance and resistance to soiling. Nylon is one of the easier fibers to clean, since it has a smooth surface that releases dirt and dust readily. Moreover, it outwears by several times any other fiber in carpets of equal construction. The batiste casements are 100 per cent "Dacron". Although sheer and fragile looking, they can be washed many times without losing their crispness and drape.

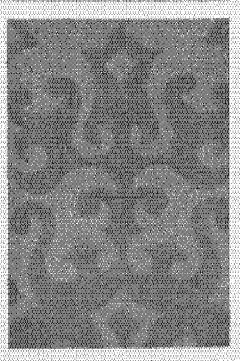
Heritage Furniture, Inc., High Point, N. C., maker of all the furniture pictured, chose fabrics of 100 per cent Du Pont nylon for the upholstered pieces. These fine damasks, which match the transitional mood of the furniture, point up the fact that nylon makes possible many types of upholstery fabrics never before considered practical for family living rooms.

The well-constructed sofa will keep its shape and good appearance through years of hard use. Its cushions are Heritage's special "Equation I" construction—"Dacron" polyester fiberfill over a core of urethane foam made with Du Pont "Hylene" organic isocyanates. Result: exceptional comfort and a gentle resilience that assures a neat look.

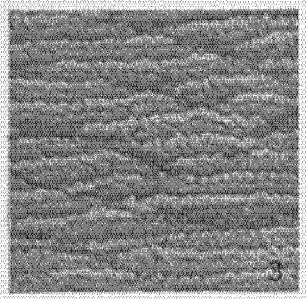
Decorators call this furniture style transitional because it is inspired partly, but not wholly, by the past. Swatches at the right suggest one of many alternate schemes. But whether your tastes are strict traditional or stark modern, it's no trick to find just the right color and texture in nylon upholstery fabrics. Drapery and casement fabrics of "Dacron" are similarly varied.

The simple meaning of a room like this? Some families currently do their "living" in a "family room," while the "living room" waits idly for more formal occasions, as the parlor once did. What's suggested here is a place of style without pretense, of comfort without dowdiness, of grace without fragility—a thoroughly livable living room.



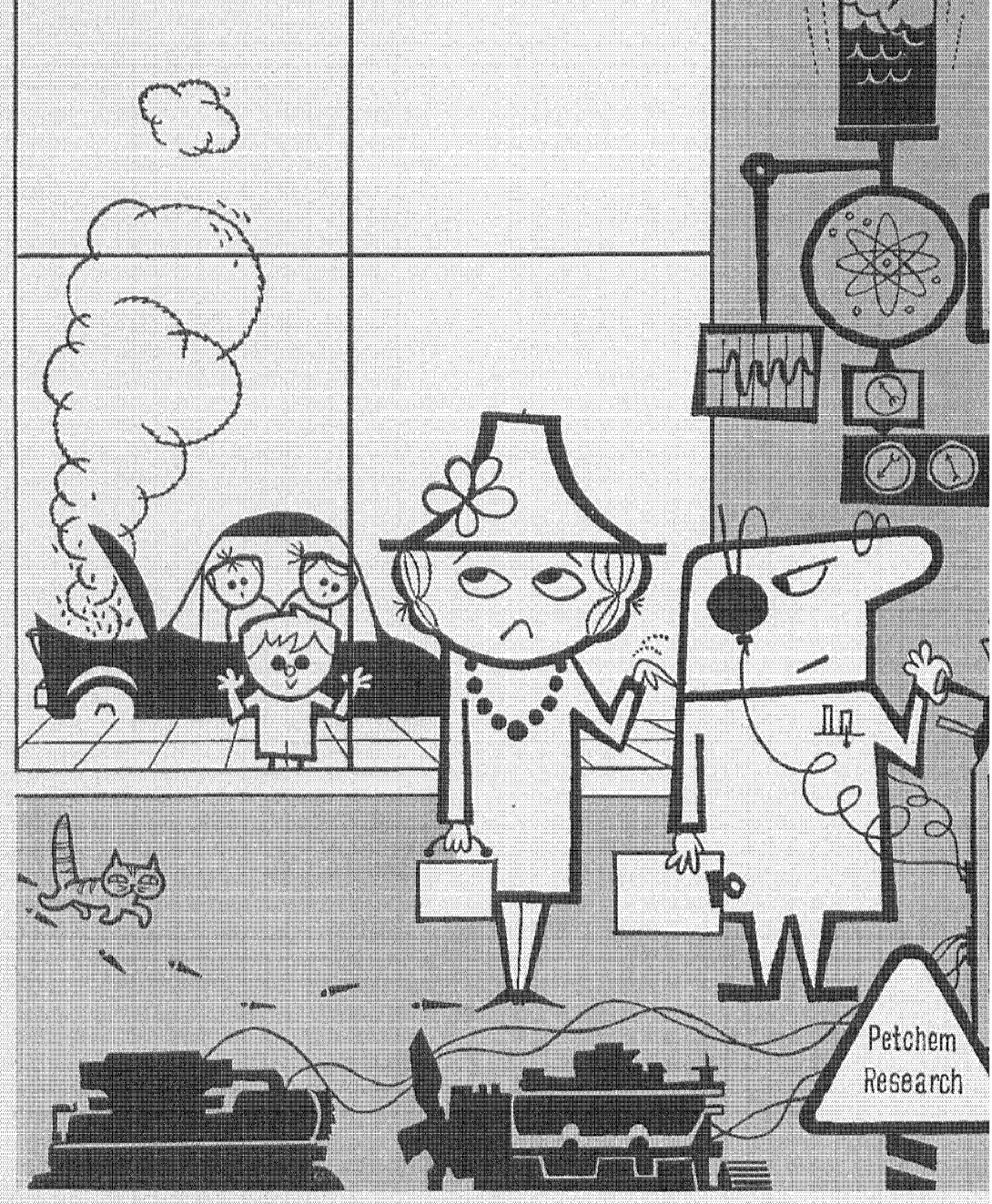






1. Batiste casement fabric of "Dacron", Tendril by Cohn-Hall-Marx Co.
2. Du Pont "Lucite" wall paint, summer blue
3. Carpet of Du Pont 501 Carpet Nylon, Happy Day by James Lees

"Dear, the Car's Been Acting Funny Lately"



By Paul H. Richard
Automotive Division Head
Du Pont Petroleum Laboratory

With auto vacation time coming up, we asked a petroleum chemicals expert how he keeps his car in shape. Here's his report—which reveals that fuel men, too, are mortal

Today was a rough day:

1. The laboratory wasn't getting the proper flame speed values from the electronic computer print-out, due to some fouling of the ion gaps in an experimental engine;

2. We had some problems with correction factors for octane requirements with changes in the barometer, humidity and temperature;

3. We became involved in an electronic ignition system that may last the life of your future auto;

4. My wife said, "Paul, vacation's coming up and the car's been acting funny lately."

If you think the last problem was the most difficult to tackle, you're absolutely right. It's not that Thelma, bless her heart, isn't sensible about important things like the family car. It's simply that I always get so confused when I try to pin down exactly what she means by "funny."

"Well," she explains, "the car makes a funny knocking sound. Not all the time, but only when I come up the little hill after I turn off the main highway."

"What kind of gas did you buy the last time?"

"The kind that gives red stamps where the nice man pumps up the kids' bicycle tires and sends us a Christmas card ever since we had our chains put on that day we got caught in the blizzard after Thanksgiving the year the TV set blew its tube."

Translation: Regular grade. Diagnosis: Simple fuel knock or "ping." Remedy: Ask the nice man with red stamps to put premium grade in the car.

Understand, I'm not making fun of Thelma, or any woman driver for that matter. Men can be every bit as thoughtless in their treatment of cars, and most women learn about cars from men anyhow. And one false impression most of us—men or women—seem to share is the idea that vacation time is really the only time we need worry much about our car's health. It's generally thought that a long trip represents the hardest type of service for an automobile. Actually the reverse is true.

Everyday stop-and-go driving, under all conditions of weather and traffic, is harder on a car and its engine than the steady, summer operation on open highways. Yet a recent Delaware survey revealed that more motorists bought premium and super-premium gasolines for driving on turnpikes than they purchased for city driving. Moreover, they were getting grease jobs and changing oil just prior to a turnpike trip when it's much wiser and more desirable to take care of these details on a regular basis while operating around the home town.

A Premium Diet . . .

If your car needs "premium," it should live on such a diet the year round. Premium grade gasolines have higher octane numbers, which give more resistance to knock. Also, they contain additives that prevent spark plug misfiring, carburetor icing and gumming. (Octane levels are achieved through lead compounds manufactured by Du Pont—tetraethyl lead, tetramethyl lead and "Tetramix" antiknock compounds—and are added to the gasoline by petroleum refiners.)

Other additives likely to be included in today's automotive fuels are several types of antioxidants, metal deactivators, rust preventives, carburetor anti-icing agents, carburetor detergents, anti-spark plug fouling agents, and dyes. You can't buy a gasoline with all of these additives, but some brands contain as many as five.

One of my neighbors with an older car declines to use premium, saying it's like feeding champagne to a beer drinker. He argues that high octane gasoline will burn out his engine. This is wrong. Actually, all gasolines contain about the same amount of energy per gallon and burn at about the same temperature. Therefore, an engine designed for regular fuel will not suffer from use of higher grades. In fact, under some conditions, such as stop-and-go driving or when the carburetor may ice up, the other features of premium fuel may be advantageous.

A word about oil. Many motorists are puzzled when they find heavy-duty oil getting dirty soon after an oil change. This is because detergent oils pick up dirt throughout the engine and retain it in suspension so that it can be drained out at the next oil change. When heavy-duty oil discolors, rejoice. It's simply doing its job.

When to Change Oil . . .

Thelma, incidentally, pointed out not too long ago that on our vacation trip last year I drove some 1,800 miles without changing the oil—asserting with a raised eyebrow that the way she got it, oil should be changed every 1,000 miles. Quite true for half the year, I agreed, but all my driving was on highways in summertime. Motorists should plan on changing oil every 1,000 miles or every month in winter, and every 2,000 miles or two months in summer. Wear-preventing properties of oil are used up faster in winter and in stop-and-go driving. Also, the best grades of oil give less knock with the same gasoline, more fuel economy, and more protection against engine wear. Economically, consistent use of best oil grades represents only one per cent of the cost of operating the average car.

Cold morning start-ups, too, seem to generate confusion and argument among car owners. Some claim that the car should be allowed to idle for five or ten minutes on such mornings before it's asked to go to work. Others are steadfast in their belief that a car is ready to go as soon as the engine turns over. In general, I side with the latter. However, it's better not to call for full power and maximum speed from an engine until it warms up. It's the same in baseball: a pitcher is ready to pitch as soon as he gets to the mound, but he usually waits until he's warmed up before he pegs his fastest ball.

One of the interesting things about many car owners is the way we cling to outmoded operating practices. A typical case is that of the motorist who cruises along in an ultra-modern car with the headlights burning in broad daylight. Somewhere in the dim past he learned that during long trips batteries tend to overcharge, and, in such circumstances, headlights should be turned on to use up some of this excess electrical energy. That was good practice in the days cars had fixed generator charging rates, but I'm afraid it went out with the "Dipsy Doodle." All cars have been equipped for years with voltage regulators; these automatically regulate the amount of energy the generator produces and maintain the battery in its proper condition under all power demands. When the engine has been started, the heater turned on, the radio played, and so on, there will be a high degree of charge. But on a long trip, there will be little or no charge.

Never Bleed Tires . . .

Oddly enough, superstitions and half-truths about cars spare no one. For example, a friend of mine, an engineer with an admirable record of achievement, clung to the fact that the pressure in an automobile tire increases during a long drive on a summer day. Therefore, before heading his fully loaded station wagon west for a trip to California, he decided to let some of the air out of his tires to counter this pressure build-up.

The resulting increase in tire heat was disastrous to his pocketbook: he had to buy three tires between Michigan and the West Coast to replace those that had blown out. He should, of course, have left the tire pressure at its recommended value, or even have increased it by several pounds, particularly if he intended to drive at sustained high speeds.

No matter what kind of car you drive—be it chromium-plated and measured in yards, or a fugitive from the Smithsonian—there is one practice that will assure you miles of pleasant driving. This is to make a regular habit of stopping by the neighborhood service station, not merely to fill up with gasoline and attend to oil and grease, but to have the experienced man there cast an eye at things under the hood and elsewhere around the car's potential trouble spots.

There's no percentage in letting a car go to rack and ruin for most of the year and then to treat it like a wealthy relative just before that long vacation trip. It's much cheaper and wiser to baby the family transportation throughout the year. Then, when you head down the road for the bright sun and open skies, the car will be just as ready for new and exciting adventures as you are.

Your car will be, anyway. Not necessarily mine.

In orchard country, using brushes of "Tynex"

They Polish the Peach

Marshallville, Georgia

You don't have to live in an orchard to know that one of the most beautiful objects in nature is the Georgia peach.

But if you're from a peach country town like this, you'll know the fruit doesn't turn up plump and gleaming in your supermarket by accident. Defuzzing, cleaning off soil and bringing out peaches' natural beauty without bruising or costly production delays is a delicate and oft-expensive task.

But Chase and Company of Georgia, which handles, counts and sells 400-500 carloads of peaches annually, is expecting far fewer problems than usual as it heads into the June-July harvest season. For last year at the Perless Packing House here, largest of six Chase operations, the traditional dry brush method of cleaning peaches gave way to a new technique—a thoroughgoing wet-wash. Installed were two machines from Durand Machinery Co., Woodbury, Ga., featuring a battery of 48-inch brushes of "Tynex" nylon filament which cleaned the peaches under a constant spray of water. This radically different cleaning system was made possible because brushes of "Tynex" do not soften or lose their effectiveness when wet.

"The brushes are soft and don't bruise the fruit, but they're also firm and springy enough to defuzz the peaches completely, and brush away residue," says Robert Reely, president and sales manager of Chase. "Most important, they stay stiff and flexible despite being deluged with water. High humidity, which used to prevent good defuzzing, has no effect on 'Tynex', and its performance on heavily fuzzed peaches is far superior to dry brushing."

The result: "Well," says Dave Rumph, who with Mrs. Celletta Grice owns the Marshallville installation, "we estimate savings on the first day of operation sufficient to pay for installing the new method."

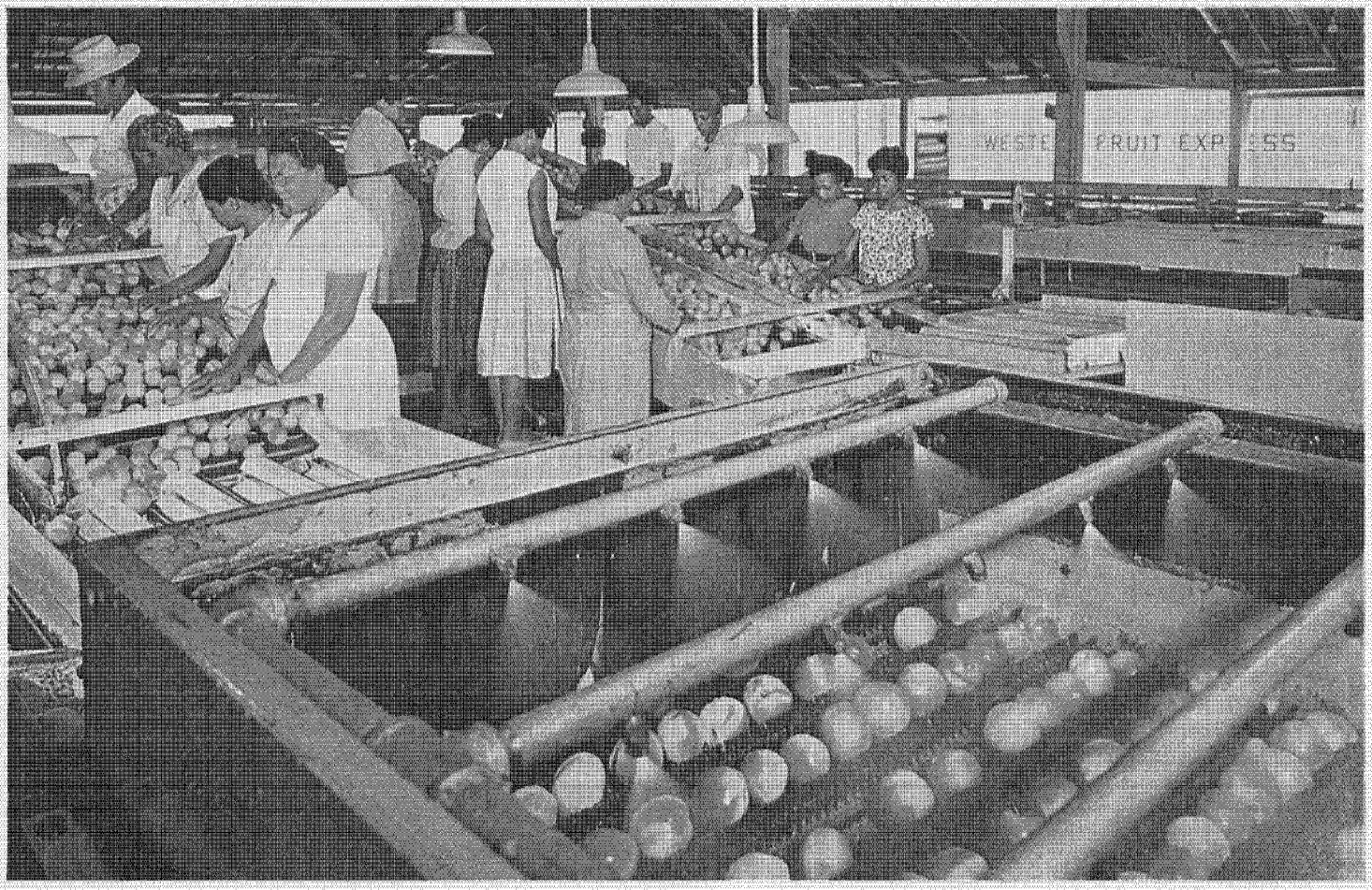
If your job is to process fruit from 80,000 trees in 1,000 acres of orchards as efficiently as possible, the wet-wash adds up to a kind of breakthrough. Frequent rains, for example, used to be a major harvest-time headache. If the peaches got wet in the field or on the trucks, they had to be dried before they could be cleaned by dry brush machines. If the fruit became muddy, it couldn't be used at all; dry brushes just increased the smear. If peaches were ripe and soft, they would break open and mat the brushes, spreading goo over the other peaches in the lot.

Thus wet peaches had to be placed under large fans to dry, while workers stood by waiting for six or eight hours. Wet-washing with "Tynex" ended this costly problem. Wet peaches, even muddy ones, were brought right into the packing house and cleaned without shutdowns.

Nor were there production delays caused by brushes that wore out in less than the two-month harvesting period. When we visited the packers, the brushes of "Tynex" had washed over 50,000 bushels with no sign of wear—and they made it easily through the rest of the season without replacements. "Even though the brushes were used ten



Freshly picked peaches leave Georgia orchard for cleansing bath.



Once-shunned water is now welcome in packers new wet-wash technique. Under constant spray, peaches pass over stiff brush rows of "Tynex".

hours a day, they didn't require any cleaning or attention —a considerable maintenance savings," says Reely.

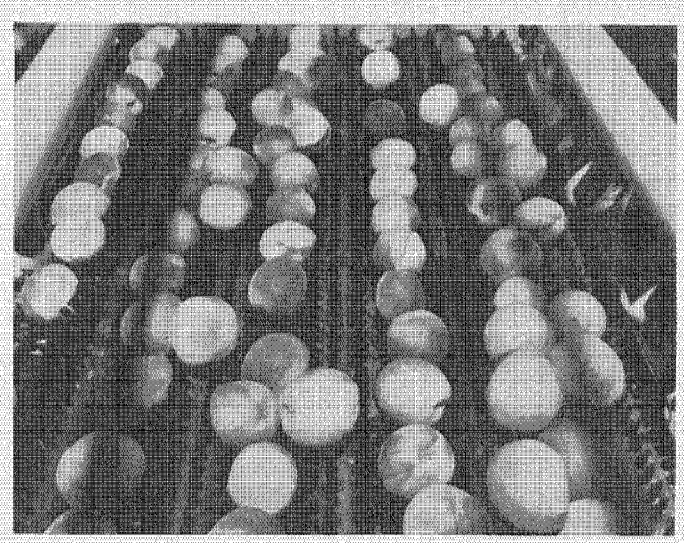
Washing peaches with "Tynex" also eliminated a serious problem with peach fuzz. Under the dry brush method, fuzz was forced into a hopper by a blower, and the hoppers had to be emptied frequently. Accumulation of peach fuzz was a serious fire hazard; smoking in the sheds was prohibited. Also, despite all efforts of processors, fuzz would sometimes escape and cause skin irritation or "fuzz itch" among workers. The introduction of water wiped out these problems.

So this season, peaches will come in from the fields and be dumped into the washers. There a continuous water spray will bathe them as they pass over brushes with arrow-straight tufts of "Tynex" mounted in wooden cores. Washed, the peaches will move on to sizing racks and along belts to packers who put them in crates or baskets. Then belts will take them to the hydrocooler where the temperature is lowered sufficiently for the peaches to be placed in refrigerated cars for shipment.

Here, too, Chase and Company found a saving. Fresh-picked under the summer sun, peaches were hot and used to be still warm when they went into the cooler. The new washing process cools them, and Dave Rumph estimates savings in ice for the cooler more than covers the cost of water used to wash the peaches.

The proof, of course, is always in the selling. Sums up Reely, "I would say that acceptance of our peaches last year was the best it has ever been. Washing them brought out their natural color and gave them a better finish.

"The new method's so effective and shows such savings that I predict all peach packers will adopt the wet-washing system soon." As any brush salesman will tell you, that's a peach of a sentiment.

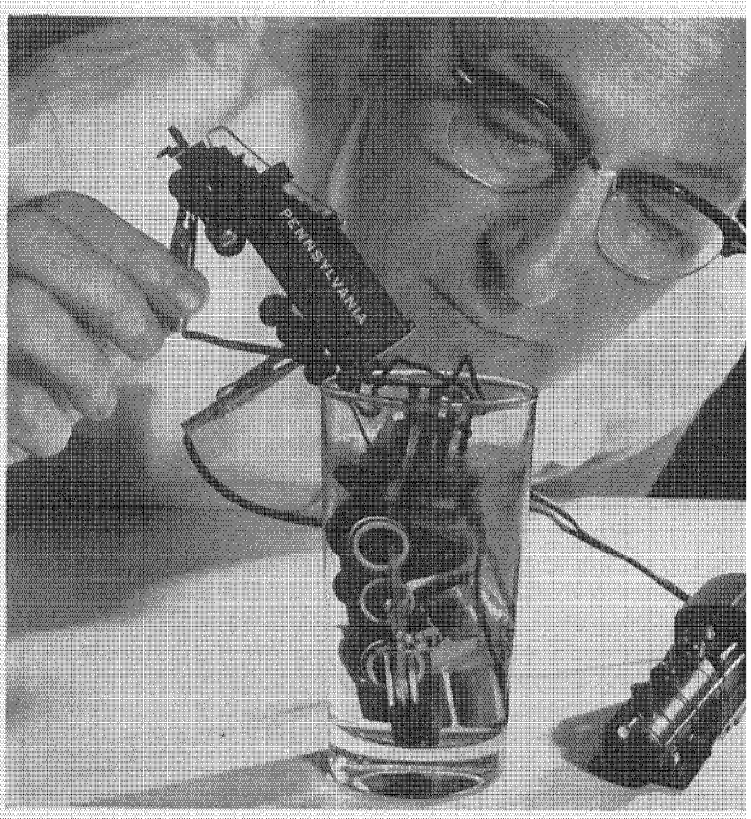


Georgia packers found brushes of "Tynex" lasted the season through, didn't soften when wet, cleaned and defuzzed fruit without bruising.

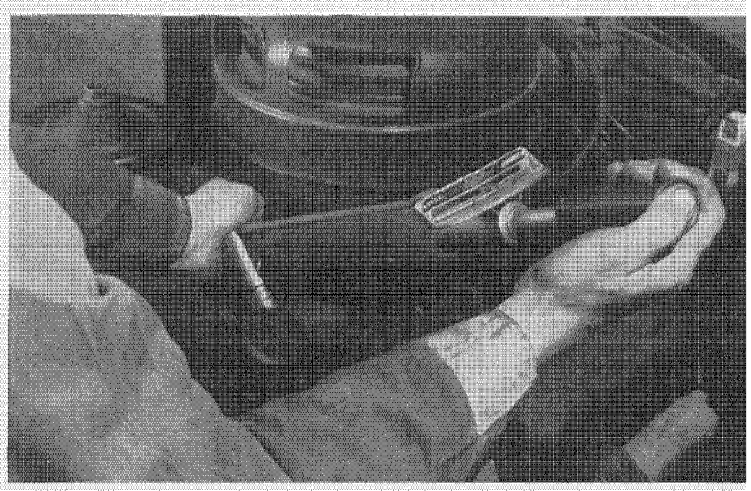
WHAT'S NEW



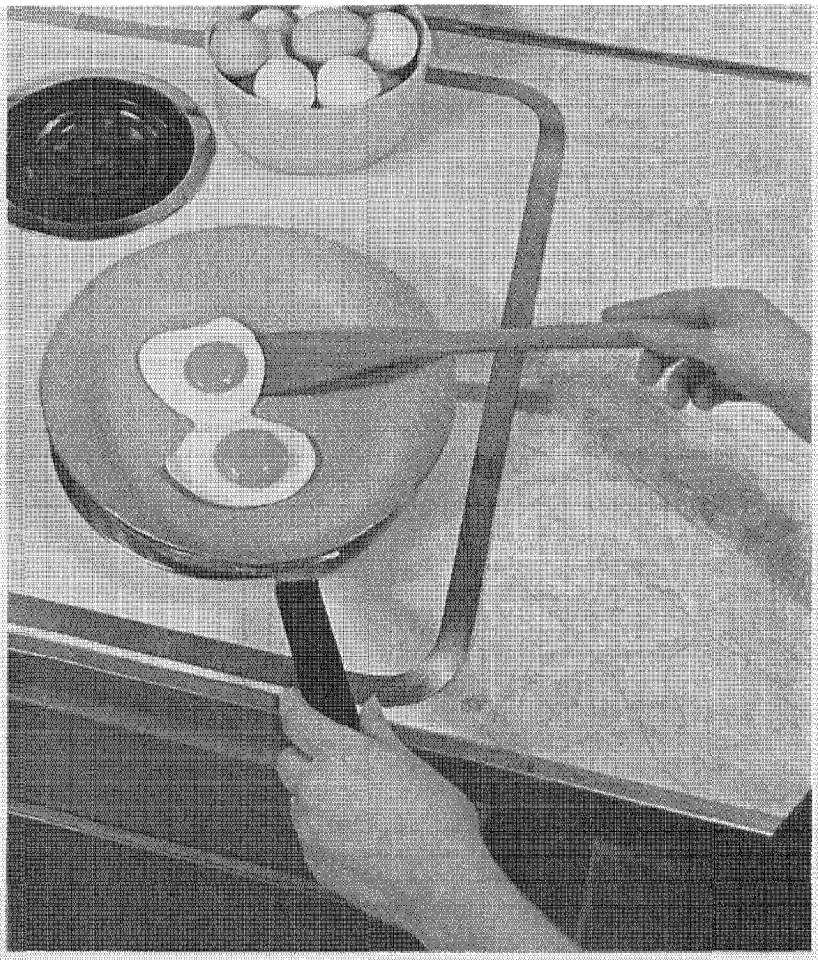
For all of its light marine lines of Du Pont nylon and "Dacron" polyester fiber, Synthetic Ropes, Inc., of Chester, Pa., has announced a two-year performance guarantee, unique in the rope-making industry. Used for mooring, anchoring and rigging lines, ropes will be replaced by the cordage company if they fail within two years due to defective construction or fiber quality.



Hard-to-clean pieces of equipment, such as this miniature train engine, can now be cleaned with a nontoxic, nonflammable "Freon" solvent that will not harm plastics, electrical insulation or paints. Marketed as "En-Irt" by Kyle Products Co., Wilmington 3, Del., the solvent is nonconductive, making it possible to clean small motors by running them submerged in the liquid. It can also be used to clean paintings, photographic films or slides, book edges or covers, and to check watermarks on stamps.

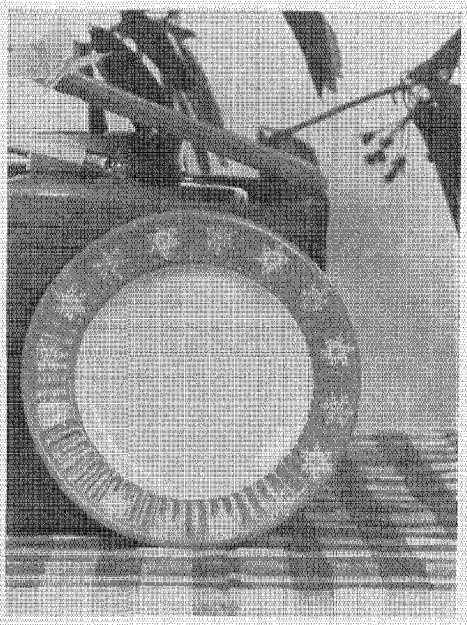


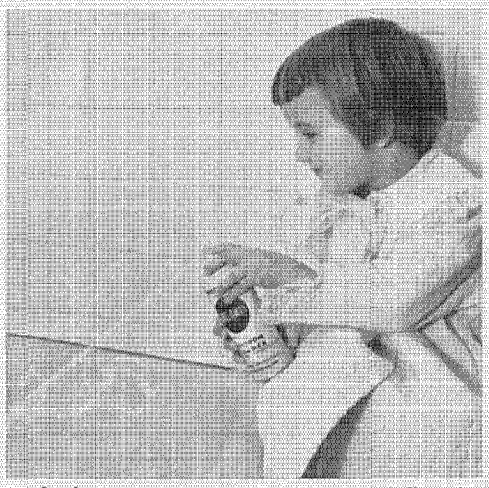
New torque wrench designed to give peak readings of compression, tension and torsion load when tightening bolts, nuts, screws or other fasteners, features an indicator or memory finger of "Delrin" acetal resin. Manufactured by P. A. Sturtevant Co., Addison, Ill., the wrench allows the user to put just the right amount of pressure on a fastener, such as an engine manifold bolt. The carefully molded parts of "Delrin" used in the indicator assembly are the first spring applications of their type ever designed in plastic.



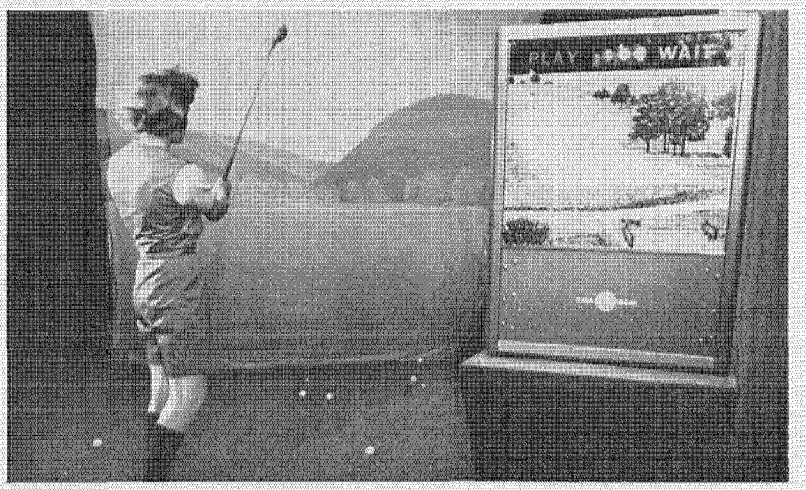
Fatless frying is possible with this new fry pan, thanks to a nonstick surface of "Teflon" TFE-fluorocarbon resin. Called the "T-Fal", the pan is one of the first consumer products utilizing "Teflon". Conventional in appearance, the pan is shallow, round, ten inches in diameter and made of aluminum. The extremely slick surface of "Teflon" is adhered to the aluminum by a special process, making it easy to clean. The only precautions necessary are to use a wooden spatula and moderate heat. Distributor is T-Fal Corp., Baltimore.

Paper tableware coated with "Alathon" polyethylene resin keeps plates from going soggy and limp from succulent food juices. Made by C. A. Reed Co., Williamsport, Pa., the plates have a thin coating of polyethylene which gives a china-like gloss, resists moisture and keeps plates rigid and tough.





Bathtub ring remover, a new "Aeromagic" push-button cleanser by General Aerosols, Inc., Shelton, Conn., cleans enamel, porcelain and metal surfaces with a minimum of rubbing. The foam cleanser is easy to apply; dispensing pressure is provided by "Freon" propellent made by Du Pont's Organic Chemicals Dept.



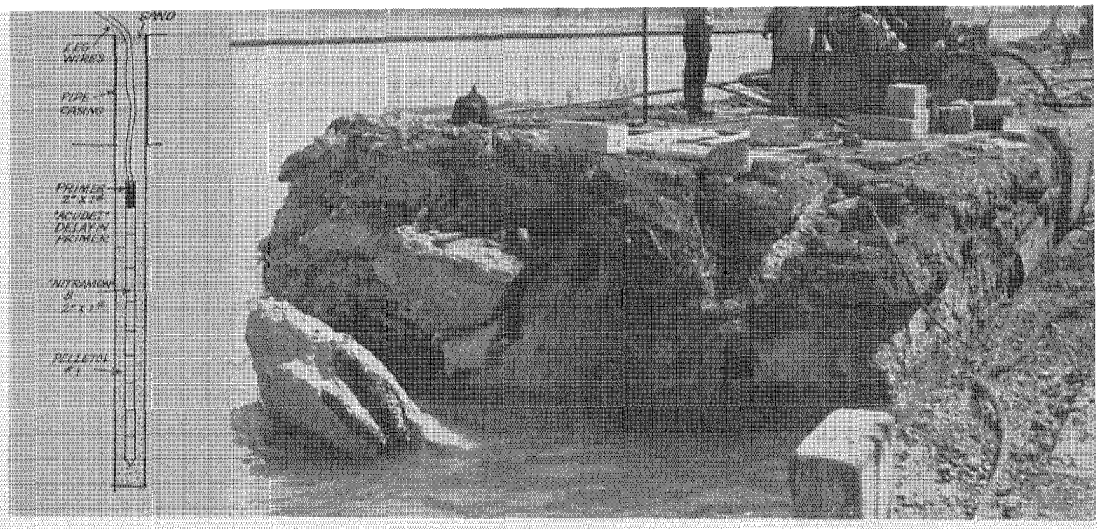
An indoor electronic golf course, invented by a staff of New York engineers, enables the professional or duffer to play a round of golf in his own home or at a public range. Heart of the Golf-o-Tron indoor range, invented by S & M Products Co., Inc., is a small electronic computer which indicates to the golfer the direction and distance shots hit into a nylon net would have traveled on an actual fairway. The nylon net, nine feet four inches in height and 12 feet in width, gives the necessary elasticity to resist the severe impact of the golf ball.

The Island Nobody Wanted

In the middle of the world's busiest canal lay an island. The job: remove it, without holding up the daily flow of more than a million tons of freight



Great Lakes ore boats slipped cautiously past Bridge Island on their way through the Soo Locks. Overhead lift bridge ended island's usefulness.



Chopping away island, track mounted drill cuts through sandstone platform, preparing blasting holes to be loaded according to drawing (left).

Sault Ste. Marie, Michigan

The lozenge-shaped island had to go. Although it supported a railroad bridge between the U. S. and Canada, it also effectively corked the south channel of the St. Marys Falls Canal.

The canal, better known as the Soo, is the world's greatest ship highway. On an average day, 90 vessels move through its huge locks. They carry copper, lumber, fish, limestone and coal as well as 75 per cent of the U. S.'s iron ore. Among masters of the big freighters, annoyance mounted at the navigational hazard and traffic impediment represented by the clump of sandstone, gravel and concrete.

The U. S. Army Corps of Engineers, authorized to eliminate it, saw at once that the project would not be routine. Removal had to be completed without stopping traffic. It was like asking a golfer to chip a ball out of a mud puddle without getting his slacks wet.

Today the island is nothing but a memory, and the ships glide easily over the spot they once passed in time-consuming caution. How this change was accomplished is a story of careful planning by specialists, judicious selection of Du Pont explosives and skillful blasting techniques.

The island's one reason for being was as a center foundation for a rotating railroad bridge. The first step, then, was to replace the old bridge with a vertical lift type and condemn the island.

Once this was done, the Engineers awarded a contract to remove the island to the Great Lakes Dredge and Dock Co. of Chicago.

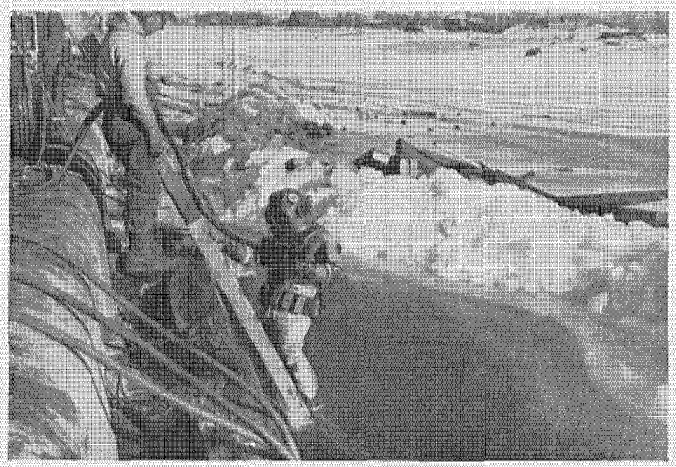
Superintendent M. E. (Mel) Lemmerhirt began a study to determine the best method. From a personal examination and engineers' reports, he learned that the island consisted of a solid stratified sandstone platform rising 20 feet from the canal floor. A concrete rim 11 feet wide and 7 feet deep ran around the outside edge, with several feet protruding from the canal's surface; an overburden of dirt, gravel and broken sandstone filled the center portion. The island was 1,000 feet long, 10 feet wide at the ends, and 73 feet wide in the center. Ice blocks the canal four months a year, so it was essential to keep freight moving the rest of the time. The island would have to be removed without closing the waterway.

Late in 1959 Lemmerhirt was ready. Highly trained blasting crews moved in with their track-mounted drill and floating drill barge, a rig used for underwater drilling.

Preliminary blasting took place in November. Later, after the ice brought traffic to a standstill, three divers worked in the freezing water to remove rock projections and fillets that had built up along the canal wall adjacent to the island.

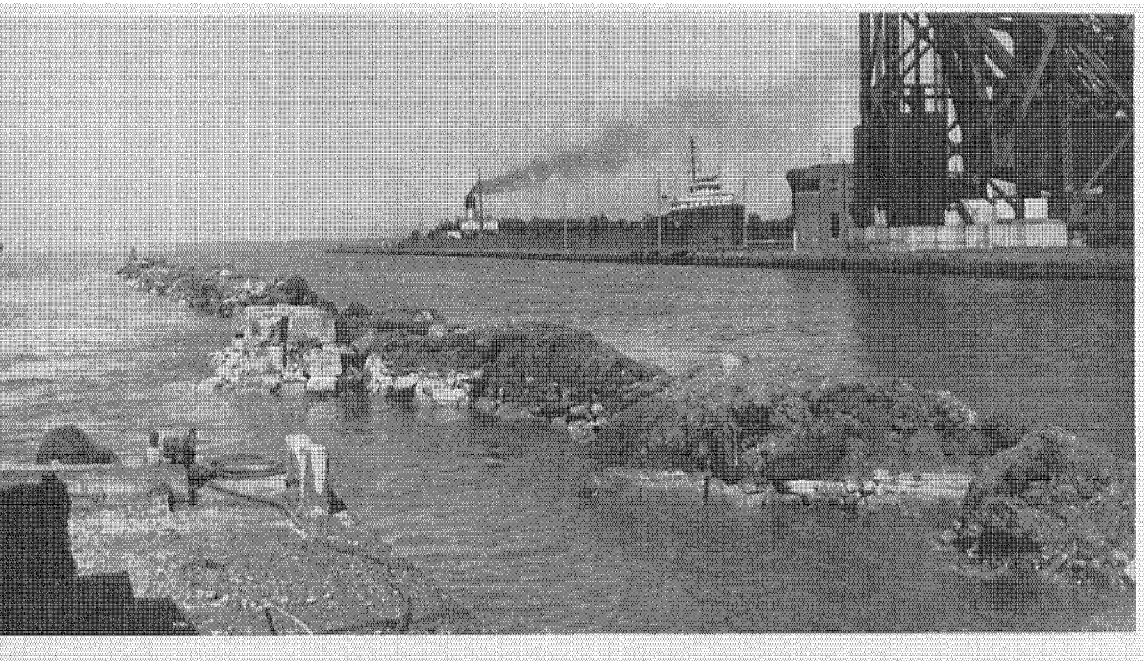
With the spring thaw, blasting crews went back to work on the island itself. There were plenty of problems. For one thing, passing ships had to be protected. Furthermore, storage of explosives was limited by strict government regulations. Large amounts of dynamite would necessitate many expensive trips from the island to a safe storage area hundreds of feet away. Explosives also had to resist water, which quickly filled freshly drilled holes.

R. C. Sherman, Du Pont's explosives man, recommended using "Nitramon" S blasting agent and free-running Pelletol 1. "Nitramon" S, a very stable blasting agent that can be detonated only by a specially constructed primer, is packaged in cans. These can be screwed together forming a rigid charge that would easily go into the deep blasting holes. Due to the stability of these agents,



Winter ice closed the big channel and divers were sent down into the freezing water to remove rock projections from sides of canal.

continued



Pile of sandstone rubble and cement that was once Bridge Island awaits the dredge. This was the last half of the 100-foot island. Only the underwater portion of the rock platform remained to be blasted and removed.

blasting crews could keep a substantial supply of explosives in a floating magazine tied to the eastern end of the island. Both recommendations were accepted and Du Pont explosives were used exclusively throughout the project.

A Tight Little Island . . .

As blasting proceeded, many shooting problems developed. The island's concrete rim had been constructed in 30-foot sections with filling between. Steel dowels pegged the sections to the sandstone foundation, and when one section was blasted, it moved the adjoining one. This forced blasting crews to drill only one section at a time.

"Loading conditions are tough," commented Sherman in a report. "Drilling into the concrete is no problem, but where the overburden begins, a 3½-inch hole is drilled down to the rock and a pipe casing put in place to hold back loose material. A three-inch hole is then drilled through the casing to a depth of 27 feet.

"When the drill stem is removed, a loading pole is dropped in to see if the hole remains open. In some cases small layers of sandstone float out, blocking the hole, and the drill must be called back to clean it.

"When the hole is clear, the canned 'Nitramon' S, complete with 'Acudet' delay and primer, is loaded and the Pelletol 1 is poured in. The remaining space is then stemmed with sand."

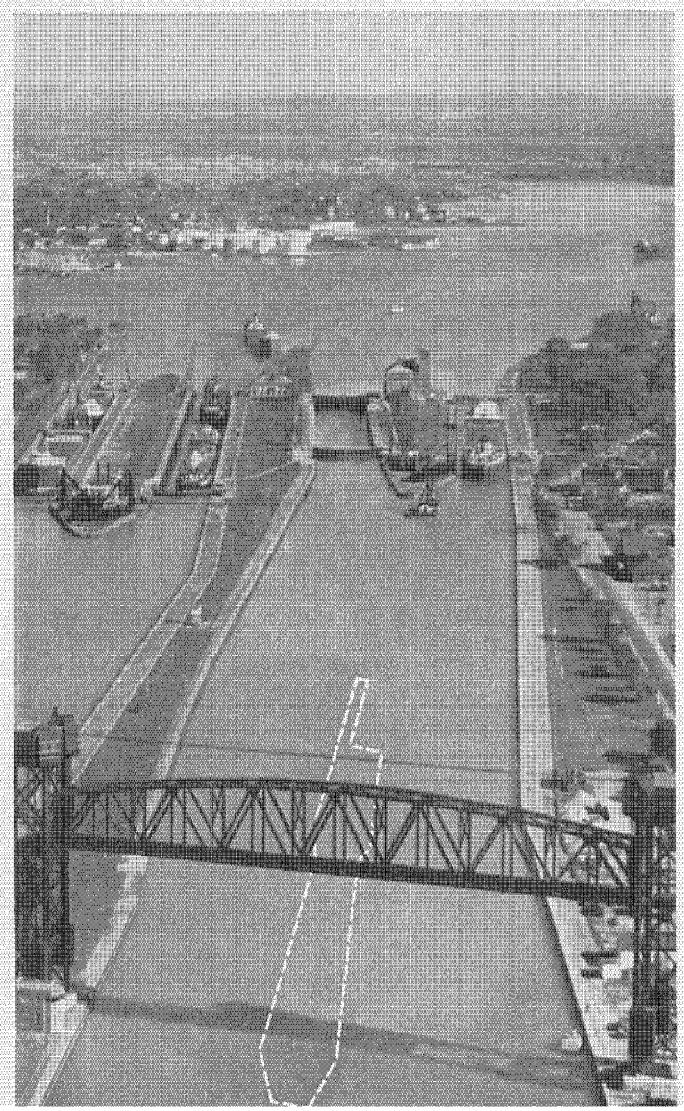
To subdue flying debris, mats were used over the charge area, and special care was used in placing the charge. All blasts were checked with a seismograph to assure minimum vibration.

The destruction of the island was carefully planned by Lemmerhirt and his men so that a traffic route was kept open at all times. The first phase, started in November, consisted of blasting the northern three-quarters of the island to a depth of 20 feet. Ships were routed around the southern side while this was being carried out. The blasted section was then removed with a dredge, and the drill barge moved in to drill the underwater section. Holes were drilled to a depth of 35 feet below water level. After the shot, the dredge again moved in and cleared the channel.

When removal of the northern section was complete, traffic shifted to that side and the remaining portion was drilled, blasted and removed in a similar fashion.

Today Bridge Island remains a special sort of memory for the explosives men who removed it—for it's not often, they say, that you get to remove an island.

Canal traffic now has open water the full length of the channel. Dotted line indicates the original position of the removed island.



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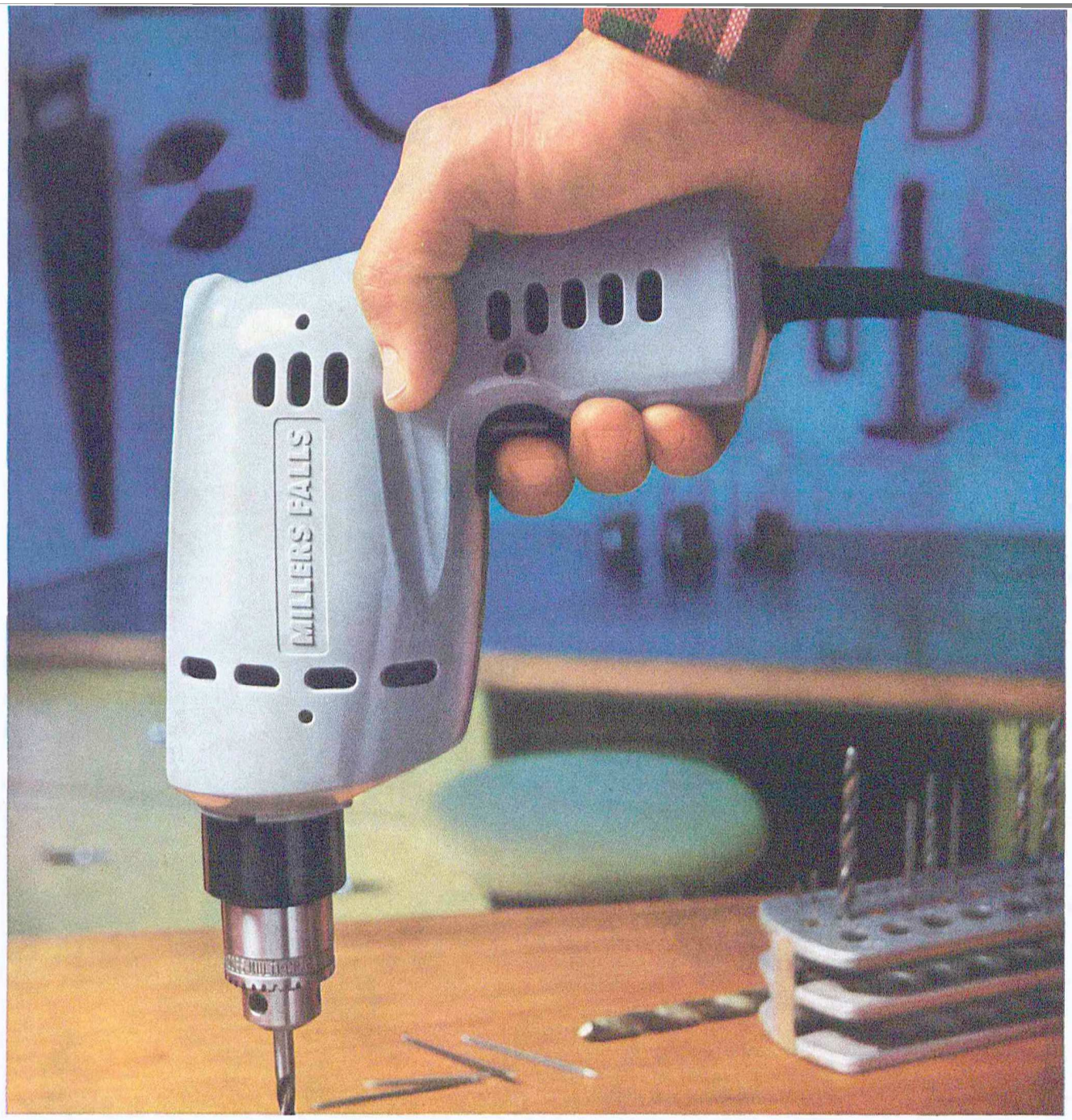


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