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The **What's New** magazine

DEATH OF A PROTON

—underground
search for clues
to an unstable
universe



Robot subs

—versatile craft for
deep, dangerous jobs



THERE'S NEVER BEEN A TRUCK LIKE IT BEFORE.



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With more head room than any import pickup cab provides, the spacious Chevy S-10 cab was made to enjoy. The standard S-10 seat is deep foam cushioned and angled 23° for carlike seating comfort.

A totally new, high-quality pickup. The new-size S-10 is an American-designed, American-built pickup with modern technology. It has

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Bigger payloads than many full-size pickups. The S-10 can carry a standard payload of 1000 lbs. That's a respectable chunk of freight. A Heavy-Duty Payload option with available V6 increases that payload capacity even more, up to a hefty 1500 lbs.

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Chevy S-10, with optional Tahoe trim, in Cinnamon Red.



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Use estimated MPG for comparisons. Your mileage may differ depending on speed, distance, weather. Mileage will be less in heavy city traffic. Actual highway mileage lower.

Some Chevrolet trucks are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your dealer for details.

Chevy S-10. There's never been a truck like it before. A great combination of features. High mileage. Optional V6. Quality assembly. Big payloads. Roomy cab. Smooth ride. The Chevy S-10 has all this and more. Lots more. The S-10's paint finish is brilliant. You can choose your cargo box in a 6-ft.-1-in. or 7-ft.-5-in. length. Plus

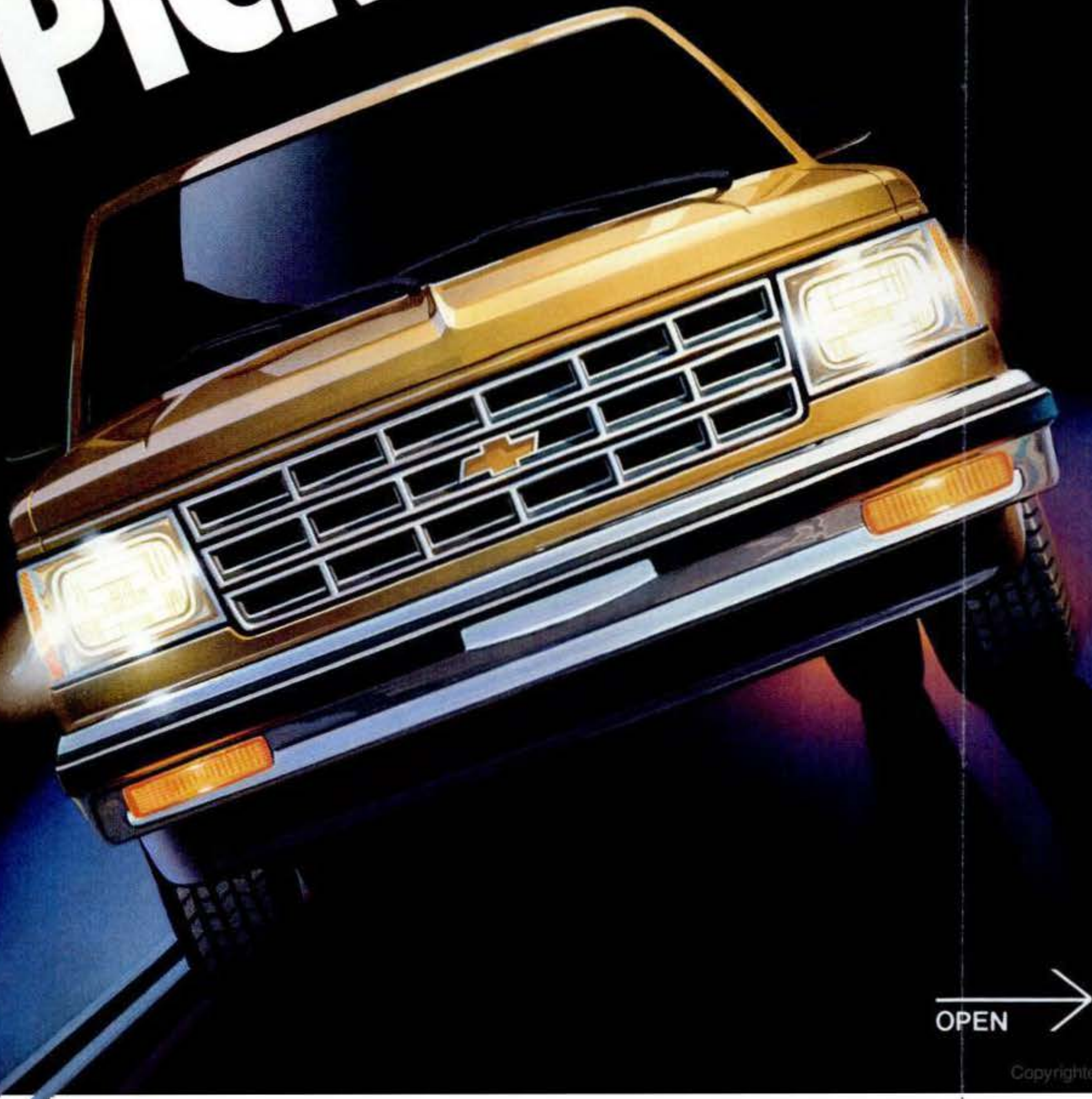
pick from three optional trim levels and ten exterior color choices. In short, the Chevy S-10 is a winner you should check out soon. There's never been a truck like it before!

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OPEN 

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EDITORIAL OFFICES 380 Madison Avenue, New York, N.Y. 10017

Published monthly by TIMES MIRROR MAGAZINES, INC., 380 Madison Avenue, New York, N.Y. 10017

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age paid at New York, N. Y., and additional mailing offices, publication number 493730. Popular Science is entered as second-class matter at the P.O. Dept., Canada. Microfilm editions are available from University Microfilms, Ann Arbor, Mich. 48106. **ADVERTISING OFFICES.** New York: 380 Madison Ave. (10017), Tel. 212-687-3000; Chicago: 875 N. Michigan Ave. (60611), Tel. 312-337-7717; Detroit: 19075 W. 10 Mile Rd., Southfield, Mich. (48075), Tel. 313-352-8333; Los Angeles (Pacific West Coast): 3550 Wilshire Blvd., Suite 908 (90005), Tel. 213-380-1936. *Mechanics and Handicraft* © Popular Science © Copyright © 1981 by Times Mirror Magazines, Inc. All rights reserved. Printed in U.S.A.

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Published monthly by
TIMES MIRROR MAGAZINES, INC.,
380 Madison Avenue, New York, N.Y. 10017
A Times Mirror Company

ISSN 0161-7370

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PS READERS TALK BACK

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Photovoltaic price tag

I know how anyone can save \$25,000 every year: Don't buy a new Mercedes. That makes as much sense as counting as a saving the non-purchase of a \$4,000 power-line spur ["Solar-Electric Home II," PS, Sept.]. And how can you simply dismiss the \$5,500 paid by the American taxpayer? In exchange for a monthly bill, Mr. Robinson got a complicated, maintenance-intensive, expensive, and vulnerable toy. You have a lot of gall to hold this up as an affordable scheme. Anything is affordable when you have free use of someone else's money.

Nick Schroeder, Albuquerque, N.M.

Your "Solar-Electric Home I" [PS, Sept.] overlooked the economic factors that will ultimately decide the fate of this or any other new technology. Even at the projected 1986 price of \$10,000, an annual interest income of \$2,000 is being foregone forever. That sum will buy a lot of anything, including fuel.

The other factor you neglected was the impact on the power grid of a large number of such houses. Presently, the utilities are able to run their equipment most efficiently because they are dealing with a predictable demand curve. The sudden surge of unwanted power forced on them when the sun appears will make station management more difficult and will result in only a small saving in fuel—much less than the mandated price of 7.8 cents per kilowatt-hour, since the costs of power-plant and distribution systems are not reduced, nor are the borrowing costs. The utilities still must be able to supply the peak demand, which usually occurs at supper time on a December evening—a time at which none of these panels will be producing a single watt.

Brian P. Beckett, Nepean, Ont.

Mash muffins

I didn't like the sound and tone of your "Great Gasohol Debate" [PS, July]. Ethanol production is the key to food and fuel for future generations. While you can eat



very few byproducts of oil, ethanol byproducts are fit for humans and livestock. The photo shows a batch of my brownies made with distiller's dried grain left over from ethanol production.

Pat Torgerson, Lambert, Mont.

Big tank

"The Search for Cheaper Hydrogen" [PS, Sept.] contends that hydrogen is a better fuel than gasoline because it has more than three times the energy content per pound. It fails to point out, however, that liquid hydrogen contains only one-third as much energy per unit volume as gasoline. You might want to calculate what volume fuel tank would be necessary to replace a 20-gallon gasoline tank on a given car.

Douglas C. Voorhees, Gainesville, Fla.

Early streamliners

Your otherwise informative article "Low-Drag Cars" [PS, Sept.] was incorrect in stating that the drag coefficient of the 1934-1937 Chrysler Airflow was never tested. A paper delivered to a 1941 meeting of the Society of Automotive Engineers by James C. Zeder, then Chrysler's chief engineer, explains how scale models were developed in a wind tunnel and how

Continued

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PS readers talk back

[Continued]

full-size-vehicle drag coefficients were obtained. Zeder's paper also told how changes made to a De Soto Airflow test car reduced its drag by 43 percent.

It may further interest you to know that I established the system explained in the article for the aerodynamic tuning of automobile clay models in wind tunnels 20 years ago for Ford Werke A.G. in Cologne, Germany. Likewise, 10 years ago, I was instrumental in establishing this system for Ford Design Center in Dearborn, Mich.

Frederick E. Hoadley, Dearborn, Mich.

Two other cars from the Airflow's period whose designers attempted unconven-

tional streamlining were Lincoln Zephyr and Pierce-Arrow Silver Arrow.

Paul T. Rafter, Chesterfield, Mo.

Stained glass

I recently got up the courage to try the procedure for ridding glass doors of between-pane fogging that you presented in the January 1980 issue. Dismantling the door did not turn out to be a great problem, but what I thought would be the simpler job—cleaning the glass—certainly did. I tried Windex, household ammonia, Amway chrome and glass cleaner, Easy-Off glass cleaner, soap and water, alcohol, Varsol,

and even some Gumout carburetor cleaner. Five hours later, the glass was as dirty as when I'd started. What gives?

Marion R. Poole, Raleigh, N.C.

Al Lees replies: "Perhaps you missed our follow-up on this fix in our September 1980 issue, but even in that reexamination the matter of interior staining did not come up. We now know that in some double-glazed units, the desiccant, if wetted, can create a caustic action on the glass. We have found (as you have) that nothing can remove this stain. Our procedure should be used for fogged windows only—to remove moisture. It is not practical for windows with a stain problem; nothing is—short of replacement."

Of chains and acres

I realize that the "square acre" that keeps cropping up in "Calcu-letter" [PS, Sept.] is hypothetical, but readers may be interested to learn how an acre is actually defined. The first thing to consider is the Gunter's chain, the land surveyor's standard measure until the advent of the calibrated steel tape (which, by the way, is still called a chain). The Gunter's chain was literally a chain 66 feet long, made of 100 equal-length links. Measurements in old land surveys were given in chains and links.

The other factor is the method of dividing land. A large rural area was divided into townships, six-mile-on-a-side squares. The next division was the section, which is one mile square. If you quarter a section, then quarter a quarter-section, you get the proverbial 40-acre square tract of land. Quarter a 40-acre tract and you get a 10-acre tract. Now halve this and you have a five-acre tract measuring 330 by 660 feet. Divide such a tract into five equal strips and you get parcels 132 by 330 feet—exactly one acre. This also equals 10 square chains. Since one square chain equals 4,356 sq. ft., one acre contains 43,560 sq. ft.

The point to ponder on a rainy afternoon is this: Which came first, the Gunter's chain or the acre?

Frank Gordan, Staten Island, N.Y.

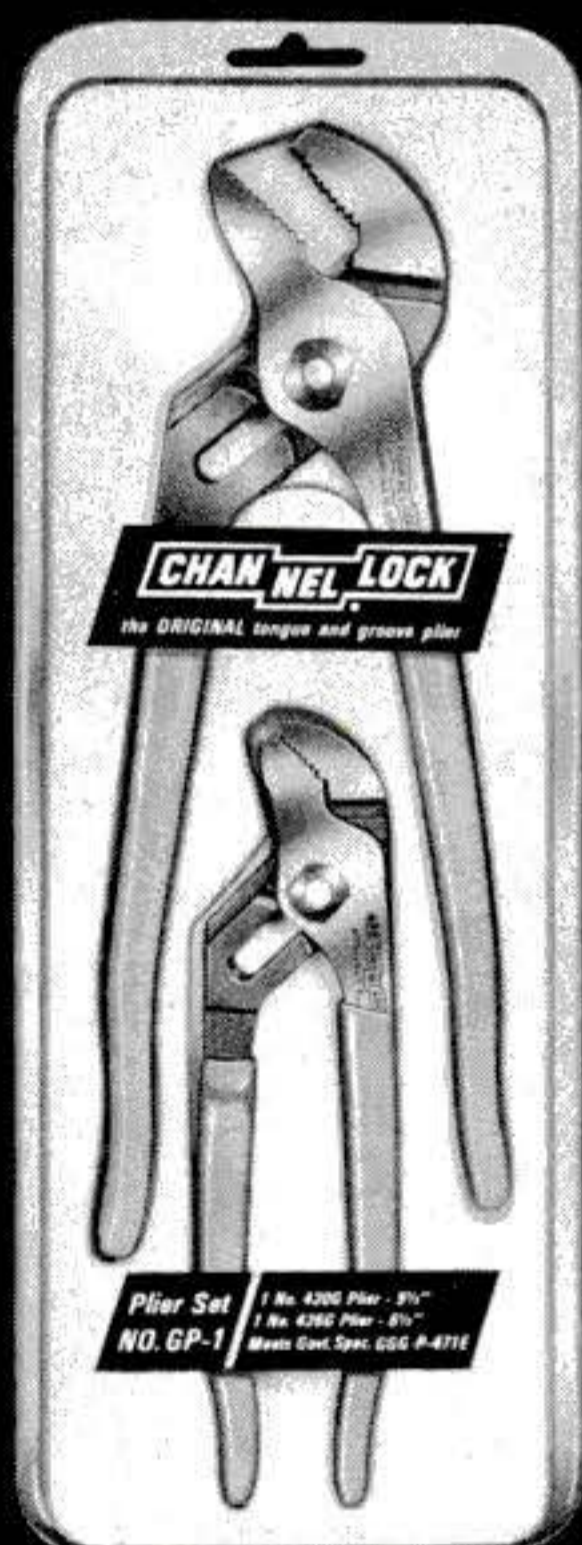
Lock 'em up

The best way to significantly reduce the \$20 billion annual cost of accidents on the highway is not by technology but by legislation ["Drunkmobile Tags Drunken Drivers," PS, May]. A 90-day mandatory jail term for drunken driving would do the trick, but our lawmakers refuse to pass such laws. Perhaps they are worried about having to spend three months in jail.

Sherman Roberts, La Crosse, Wis.

Corrections: Several errors crept into our August car test on plush imports. The caption with the lead photograph switched the identification of the Datsun Maxima and Toyota Cressida. Also, the specification table should have listed the Maxima as weighing 2,800 lbs. and having both front and rear disc brakes.

A Superb New Gift . . . Rich In Value, Modest in Cost



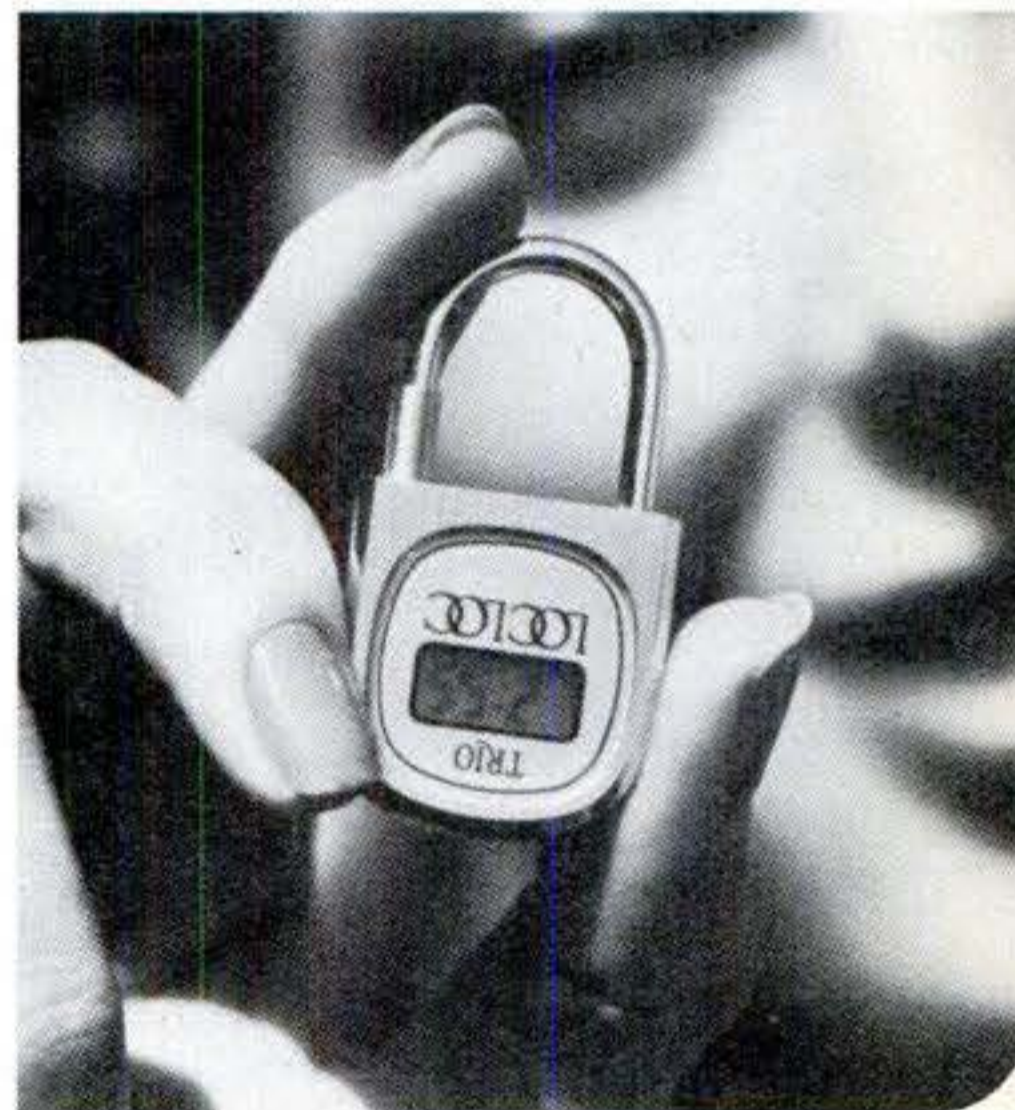
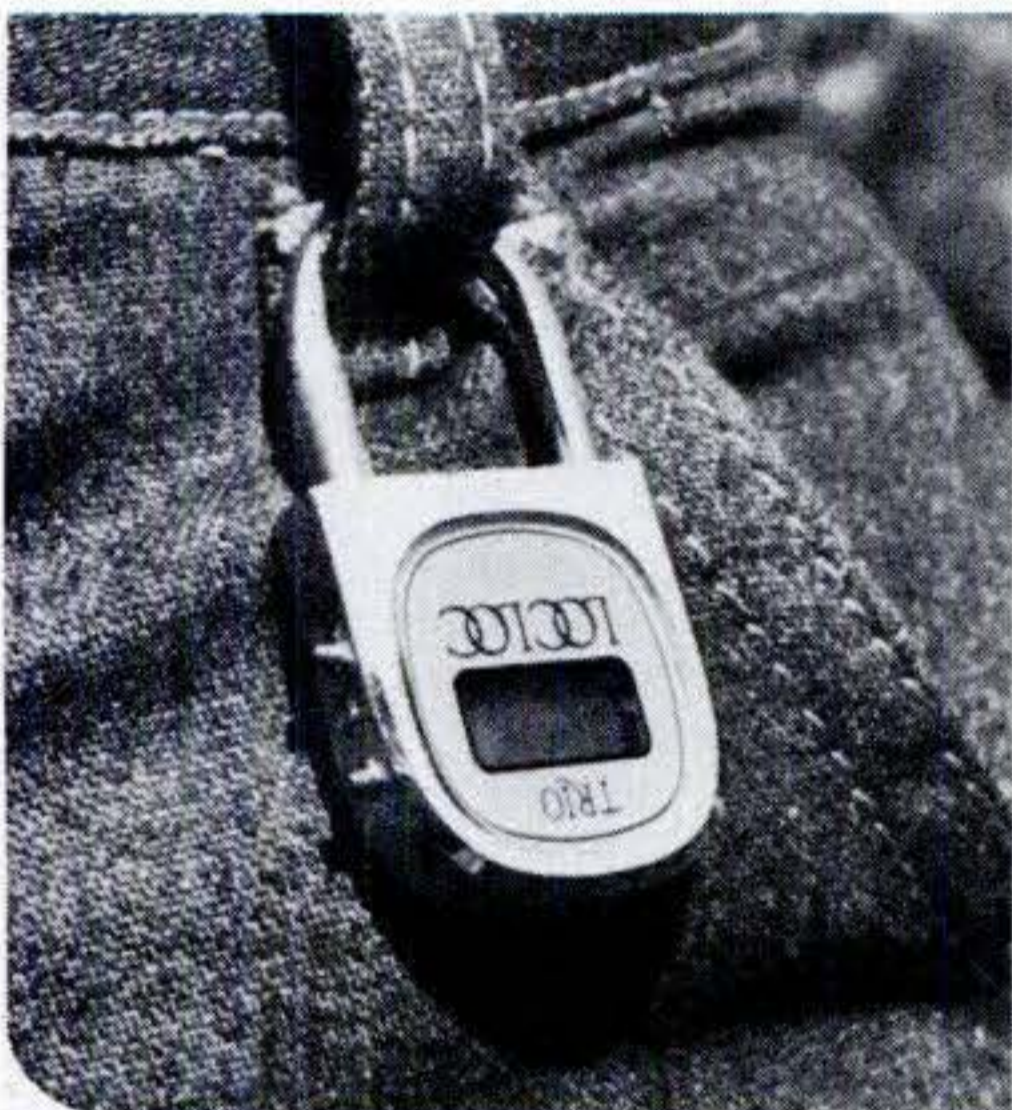
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The LocLoc is a full 5-function digital watch with night light—all housed in a solid brass case. The case is water resistant and comes in three textures: gold-tone, silver-tone, and anodized black.

Just twist the clasp on the lock and it opens. Then slip it over your belt loop.

nothing on your wrist and the convenience of always having the correct time at a glance.

Want more? The LocLoc comes in a see through vault-like container that fits into a denim drawstring tote bag. In fact, it's packaged as a perfect gift for both men and women—and for any age group.

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return it for a full refund, including your \$3.00 postage and handling charge. But if you really like it, order more for gifts or for your friends.

Each LocLoc has a one-year limited warranty. Your LocLoc was designed to take plenty of abuse. In fact, the case is actually housed in a solid brass lock. But if service is ever required, our service-by-mail center is as close as your mailbox. JS&A is America's premiere electronics company and a company built upon service.

If you're looking for a really innovative gift—one that you yourself will enjoy—order a LocLoc today.

JS&A PRODUCTS THAT

This One



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3
10
30

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DETROIT REPORT

By JIM DUNNE



Unmasked Ranger

Ford has released details of its compact Ranger pickup truck months early in order to take some of the sting out of the recent introduction of Chevrolet's S10 [PS, Oct.]. The two new trucks will compete for the same import-dominated part of the pickup market, and Ford doesn't want Chevy to get off to a running start. Ranger will be introduced in the spring as an '83 (note the license plate in the photo above) and will come in two wheelbases. There will be two four-cylinder engines—2.0 and 2.3 liters. Fuel economy will be Ranger's most important feature. Ford engineers are expecting EPA city economy in the high 20's and highway mileage in the high 30's. That would make Ranger competitive with the best of the imports.

I recently drove two versions of the Ranger: a short-wheelbase type with the two-liter engine and four-speed manual transmission, and one with the optional 2.3-liter engine and automatic transmission. Both seemed clearly superior to the imports in a number of areas, including performance, quietness, passenger room, and cargo-box utility. And with the husky base engine, the new truck seems to offer better performance than the imports or the base S10.

Rangers will have many similarities to standard Ford F-100 pickups, such as twin-beam front suspensions, double-wall cargo boxes, and a full range of dress-up and convenience options. Payloads will be 1,200 pounds for the base truck and 1,600 pounds for the heavy-duty version. (You must subtract from those figures the weights of driver, passenger, and such options as air conditioning to get the true working payload.) By comparison, the Japanese-made Courier that Ford pres-

ently sells has payload ratings of 900 and 1,400 lbs. (subject to the same weight compensation). The Ranger line will eventually include four-wheel-drive pickups and Broncos; and a 40+ mpg, 2.2-liter diesel engine made by Toyo Kogyo will be offered late next year as the premium mileage option.

Tiny cars

New cars are too expensive for many people, but there may be a solution. Ford is talking about 1,500-lb. cars that would use three-cylinder engines as small as 1.2 liters and would deliver 70 to 80 mpg for highway driving. Carrying capacity would be limited to just a driver and front-seat passenger, but cargo space could be excellent. Other manufacturers are also considering such cars as a way of getting more buyers back into the new-car market. Another move related to smaller cars is GM's recent acquisition of a five percent share in Suzuki, which sells cars in Japan far tinier than anything now sold here. Components and technology related to those cars might be of use to GM in manufacturing its future small cars. GM also owns 30+ percent of Isuzu, builder of Chevrolet LUV pickups. Further clouding of the GM-Japanese manufacturer relationship occurred when Suzuki and Isuzu exchanged large blocks of stock.

Goodbye, "iron horse"

Checker Motors Corp. is planning a new line of taxicabs to replace the familiar "iron horse" types that have been in production since 1956. The new cabs will have front-wheel drive and modern, angular styling, and will probably get 20 mpg—double the workday fuel economy of the

present models. Checker plans to begin production next fall and expects to have the new cars on the road early in 1983. By using front-drive, the wheelbase can be stretched from a base of 109 inches to 123 and 129 inches to accommodate five, seven, and eight passengers, respectively. Checker will cut weight from the present 4,000 down to 2,800 lbs. One big reason for the change is that the company buys all critical systems (engines, frames, suspensions, transmissions) from the major auto companies, so as old-style parts go out of production it must adapt to new designs. Checker builds about 3,500 cabs a year. About five percent are purchased by private owners.

1983 Fords: update

Even though Ford's 1983-model "Topaz" series of mid-size cars will be all new, the chassis description will have a familiar ring. The front-drive system will be the now-typical transverse layout. At the rear will be the same type of independent suspension that the Escort family uses, only bigger and stronger. In addition to the base 2.3-liter, four-cylinder engine, there will also be a V6, so fuel economy and performance should match that of the Chrysler K-cars. The Topaz series will replace the Ford Granada/Mercury Cougar (but not Cougar XR-7, which shares the Thunderbird body). Meanwhile, the full-size Ford LTD/Mercury Marquis will be restyled and moved down to the Granada/Cougar chassis. Styling for all four car lines will be completely new, with particular emphasis on aerodynamics—especially with the all-new mid-size cars.

Honda's free fender fix

Rusty fenders on many Honda Civics and Accords sold between 1975 and 1978 will be fixed free under a proposed consent order from the FTC. About 70,000 cars may be affected—10 percent of Honda sales during the period. The problem was caused by a fender design that trapped road dirt, salt, and moisture up under the sheet metal at the top of the fender, about two feet in front of the windshield. Repairs normally cost \$250 per fender including painting. Reimbursements will be restricted to owners living in 24 salt-belt states and the District of Columbia.

TBI boom

General Motors will build an estimated 40 percent of its 1985 cars with throttle-body fuel injection (TBI) as it zeros in on the ideal system for balancing emissions control and fuel economy. TBI meters fuel into a carburetor-resembling central mixing chamber (throttle body) from which it is distributed to the cylinders. It's simpler than carburetion and less expensive than other types of fuel injection. GM will use TBI on the 2.5-liter Pontiac four-cylinder engine for 1982, which means that it will be standard in all compact and mid-size GM cars. The system will also be standard on all 1982 Corvettes and V8 Camaros and Firebirds. A high-performance twin-injector system is planned for the V8's. [E]



Jeffrey of Arabia

Quick, describe Saudi Arabia!

Most people think of sand dunes, camels, oil wells in the desert. Oil prices, too.

Few would think of Little League baseball or 11-year-old Jeff Jaszczak of the Dhahran Steelers. But to people who work for us; Little League is an ordinary part of Saudi Arabian life.

We're Aramco, the Arabian American Oil Company. There are 13,000 North Americans in Saudi Arabia with us. And even though you hear a

lot of news about Saudi Arabia, there are things that might surprise you about our lives there.

1. We're doing something important. Aramco produces more oil than any other company. Badly needed oil. Including about 15 percent of the oil America imports.
2. The Saudi Government and Aramco are working together on some *incredibly* large energy projects. And on huge communication networks, electric utilities, and more.
3. Our people are glad to be in Saudi

Arabia with Aramco. They came for excellent pay and professional challenge.

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How the Pickup works: The front-wheel drive train.

When man first hooked up horses to plows and carts, he quickly discovered that pulling things was a lot easier than pushing them.

Yet after centuries of transportation, VW was the first to use a front-wheel drive train on a pickup truck.

By pulling its load instead of pushing it, the VW Pickup can pull its weight more

easily than equivalent trucks with rear-wheel drive. Up to half a ton. And, don't worry about what you carry. Its double-walled construction can handle anything you throw into it.



Nothing else
is a Volkswagen.

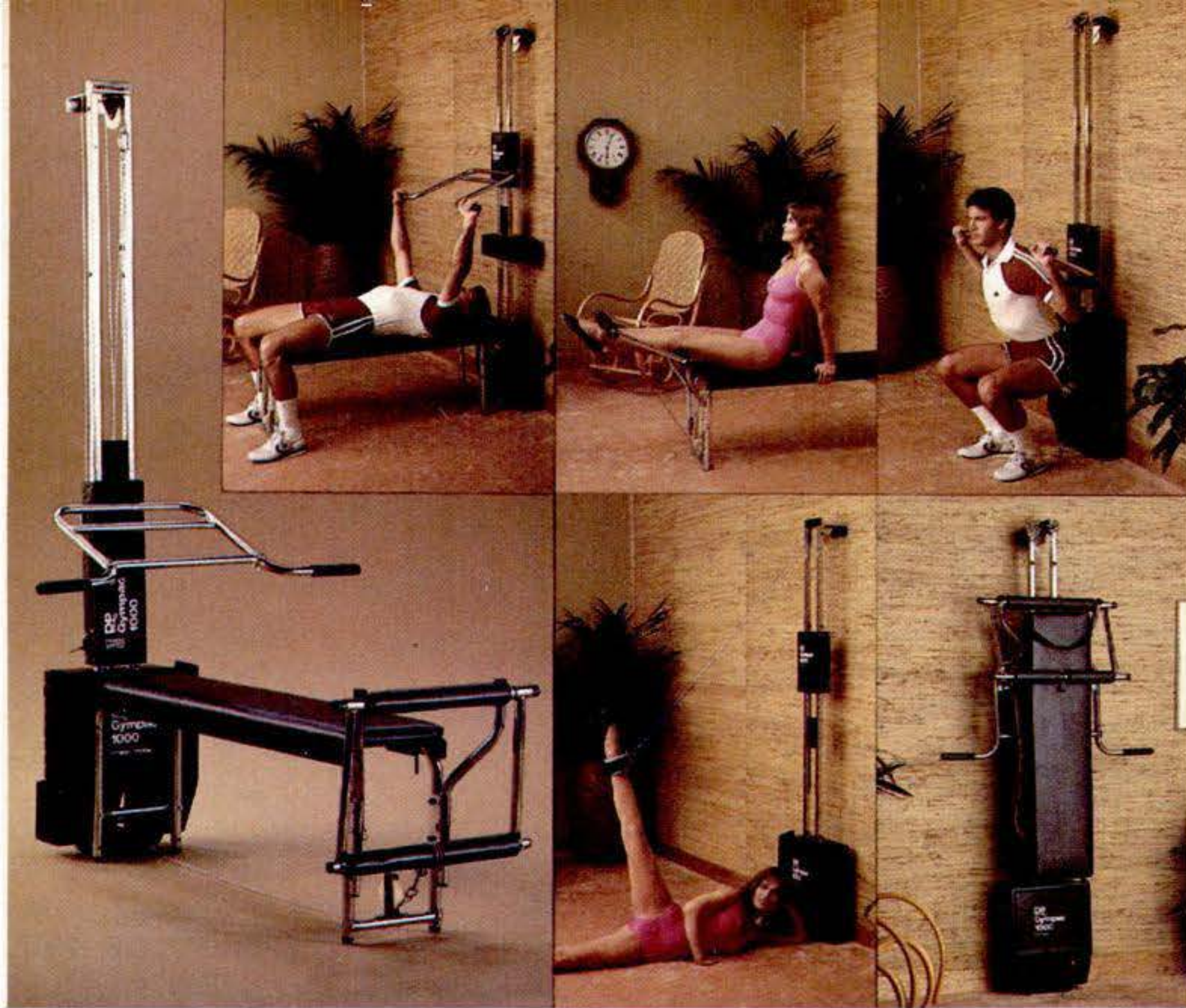
The VW Pickup has certain other advantages. Namely, excellent traction and exceptional directional control even on less than favorable road surfaces. Not to mention a steering and suspension system that gives it sports car-like handling.

The pickup also comes with VW's unique upshift light which tells you exactly when to shift for optimum mileage.

And, hooked up to VW's famous diesel horse, you can enjoy the best mileage to be found on a pickup, anywhere.

EPA 49 mpg highway estimate, and an estimated 42 mpg. (Use "estimated mpg" for comparisons. Your mileage may vary with weather, speed, and trip length. Actual highway mileage will probably be less.)

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Manufactured by the world's largest maker of fitness equipment, DP 1000 offers a full range of professional gym exercises—accommodating every conceivable exercise posture (even duplicates motions used in popular sports). Illustrated instructions show 50 simple exercises from heavy body building to general physical fitness. Women enjoy the figure shaping exercises.

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Assembles in minutes. Thick rubber wheels provide easy roll-away storage. Unfolded and wall mounted, it's 85" tall, 40" wide and 53" deep with bench extended. Folds up snug to the wall or

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Cable controller decodes computer broadcasts



It's merely a remote control for a cable-TV converter. But it has the startling potential to turn your TV set into a computer terminal. The 55 Plus system developed by Tocom, Inc. (Box 47066, Dallas, Tex. 75247), could make data-display TV [PS, Jan. '81] practical.

For years it's been possible to transmit computer-generated pages of text and graphics to the home TV set [PS, May '78]. But TV networks won't send out such data pages until TV sets can decode them. And set makers won't produce these "dumb terminal" TV's until teletext transmissions begin.

The 55 Plus system detours the dilemma. Basically an advanced cable controller, the unit has a microprocessor that permits special coding for "adult" programs and bills viewers for only those programs they watch. But the microprocessor can also decode digital data transmissions.

Using the vertical blanking interval (the black bar between pictures), each cable channel can carry about 100 pages of stock quotes, weather, and news. And that's on one-way cable. On a two-way system, the 55 Plus can link the viewer to outside computers for banking and shopping.

By last summer, 20 cable operators were using the 55 Plus system, and at least 50 others had ordered it. At least one firm, Dow Jones & Co., had announced plans for text transmission of its financial news wire to cable viewers.—S. Renner-Smith

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Don't Leave Your Home

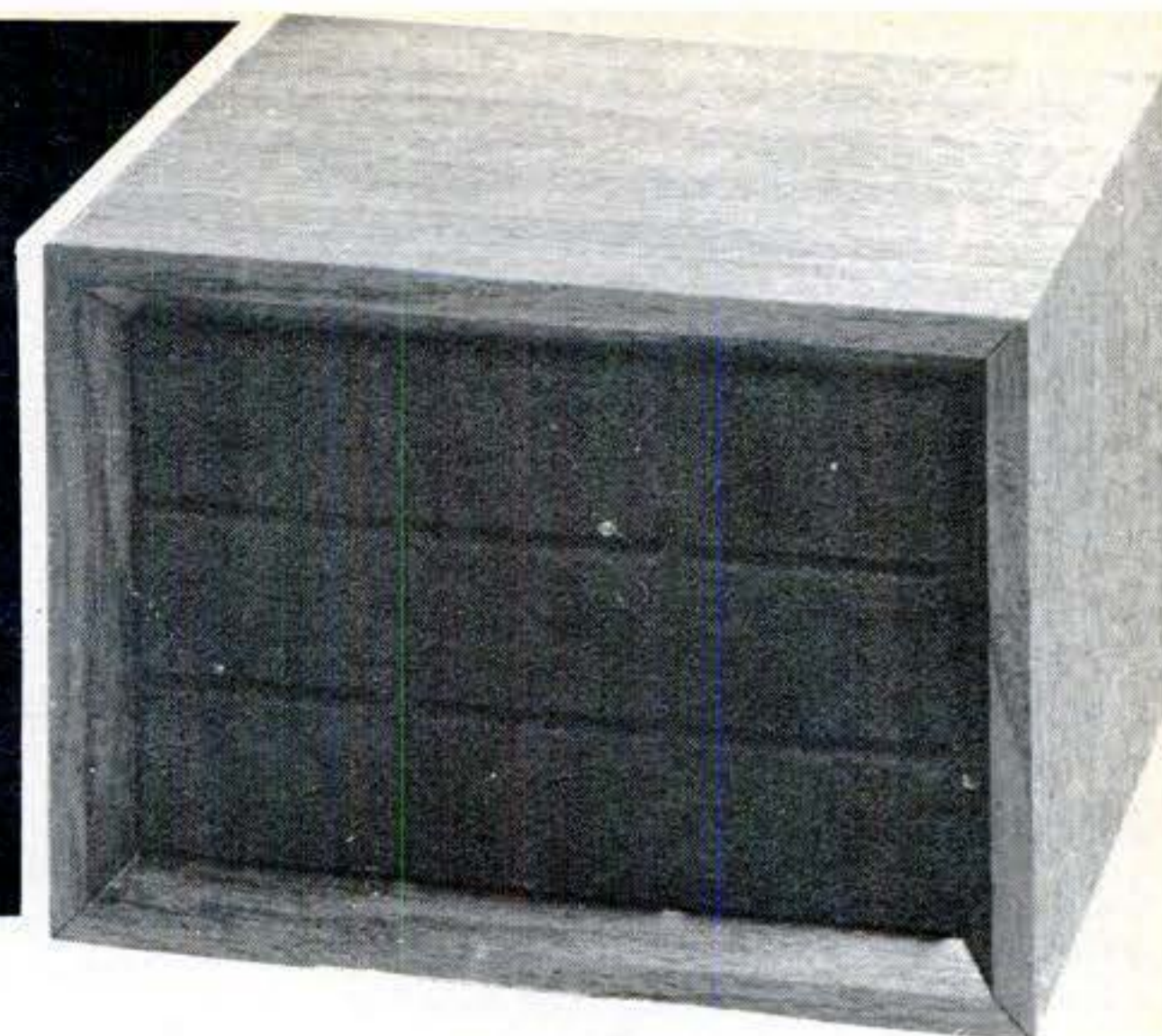
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The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6³/₄" x 9³/₄" x 8") and weighs less than 6¹/₂ pounds.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

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Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

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One year, 100% parts and labor when returned to factory post-paid. A five year extended warranty is available for a charge of \$25.00.

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The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from main alarm, they are available with 50 feet of wire for \$29.95. (Connecting terminals are provided on the back of the alarm).

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This is your opportunity to purchase an alarm system directly from the factory for only **\$239.95**. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days of receipt for a complete refund. To order your Guardex 8000 alarm, CALL TOLL FREE to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of **\$239.95** plus \$4.95 postage, handling and insurance. If you want the optional outside siren, add \$29.95. Optional outdoor 7" x 10" metal warning sign (stake not included) add \$9.95. (California residents add 6% sales tax.)

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The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc., terminals for connecting optional outside siren and back-up battery (battery not included); entry delay time control and sensitivity control.

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"SAY, SMOKEY—"

A clinic on cars by Smokey Yunick, America's most famous mechanic

Using oil?

I change oil in my 1972 Lincoln Continental every 4,000 miles. After the 78,000-mile oil change, the car used one quart of oil during the first 1,500 miles, then a quart every 500–600 miles thereafter. The same thing happened at the 82,000-mile oil change.

A check of the oil shows no sign of gas in it. I have taken the car to two auto mechanics, and both agreed it's not burning oil, because no smoke is coming out of the exhaust pipe. Both suggested I change brands of oil and use a straight 30W.

Prior to the 78,000-mile oil change the car used one to 1½ quarts of oil between changes. The engine and body are in showroom condition. Highway mileage averages between 15½ and 17 mpg.

Will changing brands and going to a 30W oil help?

Robert J. Miles, Danville, Va.

I doubt it. I believe you're burning oil. I suspect the rings are sticking. A cylinder-leakage test and crankcase-pressure check should give you a clue.

Wants to burn propane

I have a 1975 ¾-ton 4×4 Chevrolet Suburban with a 350-cu.-in. engine. I plan on keeping it as long as possible.

The engine now has gone 89,000 miles and is starting to use a little more oil than it used to. I want to rebuild the engine and modify it so it can burn gasoline or propane.

What is your opinion of using propane as fuel? And what steps should I take during the rebuild for the best results with the dual conversion?

M. Alvarez, Barstow, Calif.

Propane likes compression. Today's gas doesn't. So stick to 8.25:1 compression, tops. Propane is dry and tough on exhaust valves, so use premium-quality exhaust valves. It would be nice to have a manual spark control to accommodate the different burning characteristics of the two fuels. Autotronics in El Paso, Tex., makes a dandy.

Persistent ping

My 1980 Subaru DL Hatchback has been pinging for the past 10,000 miles. Subaru dealer mechanics can't find the cause. They have replaced the exhaust-manifold system (including the catalytic converter) as well as a temperature-activated switch, which is supposed to change both the vacuum to the carburetor and the timing when the engine is warmed up. The tim-

ing has to be retarded to three or four degrees BTDC from the spec setting of eight degrees plus or minus two degrees BTDC to eliminate the ping. It pings with both regular and premium gas. What do you suggest?

Edward J. Gobe, Harwinton, Conn.

Look for trouble in the ignition-advance system. You need to get rid of some advance when the load comes in. EGR works as a flame-speed reducer and helps detonation. Is your EGR working? If your carburetor leans out to the maximum under load, a little more fuel will calm things down.

Making the old new again

I am restoring a 1967 MGB. I would like to do a good job, but as economically as possible. Should I buy new front and rear springs, or can I have the old ones resprung? What would be the best approach for tightening the spokes on the spoked wheels? Could you give me a handle on where to obtain engine parts for my MG, besides the dealer?

Richard Lawton, Hampton Bays, N.Y.

Leaf springs can be re-arched satisfactorily by local spring companies. Coils cannot. Wire-wheel experts can be found at motorcycle shops, where mechanics true wheels all the time. Car-buff publications, such as Auto Week, have many ads for companies that deal in foreign and domestic sports-car parts.

Adding an oil cooler

I have a 1974 VW Beetle with air conditioning. My first engine blew up at 83,000 miles. Would an auxiliary oil cooler help? Many garage mechanics express no confidence in off-the-shelf coolers, since they use the existing oil pump (which may be undersize for an add-on unit).

John Butters, Rutherford, N.J.

If oil temperature runs over 275 degrees F, yes, an oil cooler will help.

Retrofit oil coolers properly sized and plumbed do not require an oil-pump change. It's important you do not create a pressure drop of over three or four psi. The size of the cooler lines and selection of fittings control the pressure drop. Avoid 90-degree fittings; they alone can drop pressure five pounds.

Keep the pressure high

My mechanic installed a seven-pound radiator pressure cap on my 1977 Chevrolet 305. He said he did it because he saw

some seepage and doing this would save me from future problems.

I know that years ago engineers raised the pressure in cooling systems to 15 pounds to raise the boiling point. In view of this, is a lower-pressure cap a good idea?

John Barkauskas, Tinley Park, Ill.

Higher pressures work better. For economy, you want to run as hot as you can, so you need 15–20 pounds of pressure. If you have small leaks, less pressure will help. But I'd rather fix the leaks and run hotter for top mileage and best engine performance.

Oil still good?

I have a 1979 Jeep CJ-7 with a 258-cu.-in. six-cylinder engine. Last year I decided to try a synthetic motor oil. The only oil I could find in my area was Mobil 1, so I chose that. Since I had to travel more than 40 miles just to buy the oil, I bought an extra quart, which I haven't used. I would like to know if this oil is still good. Can I use it when I change oil, or should I just throw it away?

Mark Bankovic, Saint Marys, Pa.

The ingredients in lubricating oils are supposed to stay in suspension indefinitely unless noted otherwise on the container. So I'd say the oil is still good. But shake the can a little before you use it.

Hot station wagon

I recently took a 2,500-mile trip from New York to Orlando, Fla., with my 1979 Ford Fairmont station wagon with 200-cu.-in. six-cylinder engine. We drove a nonstop 25-hour stretch going and returning with one-hour breaks for lunch and dinner. Upon returning, I noticed smoke was coming from underneath the car around and behind the automatic-transmission area. I found that I had lost one pint of transmission fluid. I took the car to the dealer, and they had to replace the front transmission seal.

I am planning to do a lot of vacation traveling with my wagon: Does continuous driving have any bad effects on the engine? On long trips should I stop off more often or take longer breaks—say, stop overnight to let the car cool down? I checked all the fluids before I left for the trip. How could I have prevented this costly repair to the transmission?

Andy C. Chin, Woodside, N.Y.

The trouble was heat. Add an oil cooler with sufficient capacity. Place it where it will receive minimum heat and maximum air flow.

Hard starting

I have a 1980 Dodge Mirada with 220-cu.-in. six that has 13,000 miles on the clock. The car runs well, looks nice, and would be pleasing except that it's hard to start in the morning or after it stands for several hours. I've been to the dealer several times; he adjusts the carburetor to specs and tells me to press down on the accel-

Continued

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It feels good in my hands, and it seems to glide right through even the toughest, greenest wood.

That's a real comforting thought. Because the more trees I cut, the better Christmas is going to be for all of us.



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"Say, Smokey—"

[Continued]

erator pedal once, turn on the ignition, let it crank, and then step on the pedal two or more times. That doesn't work—I have to pump the pedal with the starter cranking for it to start. Once the car cranks and runs awhile, it will start easily if not left standing long. Is there nothing more he can do?

The eight-cylinder Mirada my neighbor has starts easily. The dealer's carburetor specialist says that Chrysler six-cylinder engines are more difficult to start than eights. The car has had new plugs and been tuned up—to no avail.

Jack Stone, Oakland Park, Fla.

Hard cold-starting on 1980 models is no longer just caused by either spark or fuel. Emission controls are so deeply integrated, particularly in the cold-start mode, that it can be caused by other problems. It's much too complex for do-it-yourselfers. It takes a good dealer mechanic, heavy factory schooling, and much expensive equipment. Looks like you'll have to start with a factory-service representative or another dealer.

Hesitation blues

Ever since I bought my 1976 Dodge Aspen station wagon I have been experiencing a hesitation when accelerating, especially while driving in town. My Aspen is equipped with a 318-cu.-in. V8 and a Carter carburetor.

Cold winter weather only seems to make the problem worse. The one thing I have found that helps is adjusting the electronic assist on the choke. I've discovered that when the choke is made to open slower than normal, it reduces the hesitation. Of course, this has also reduced my gas mileage.

Last fall I had a good mechanic do a complete checkup, including tuneup, new choke, carb rebuild, and numerous adjustments. The timing and metering rods were set to improve performance. My problem was improved somewhat but not completely. In the process my gas mileage was again reduced. What do you think?

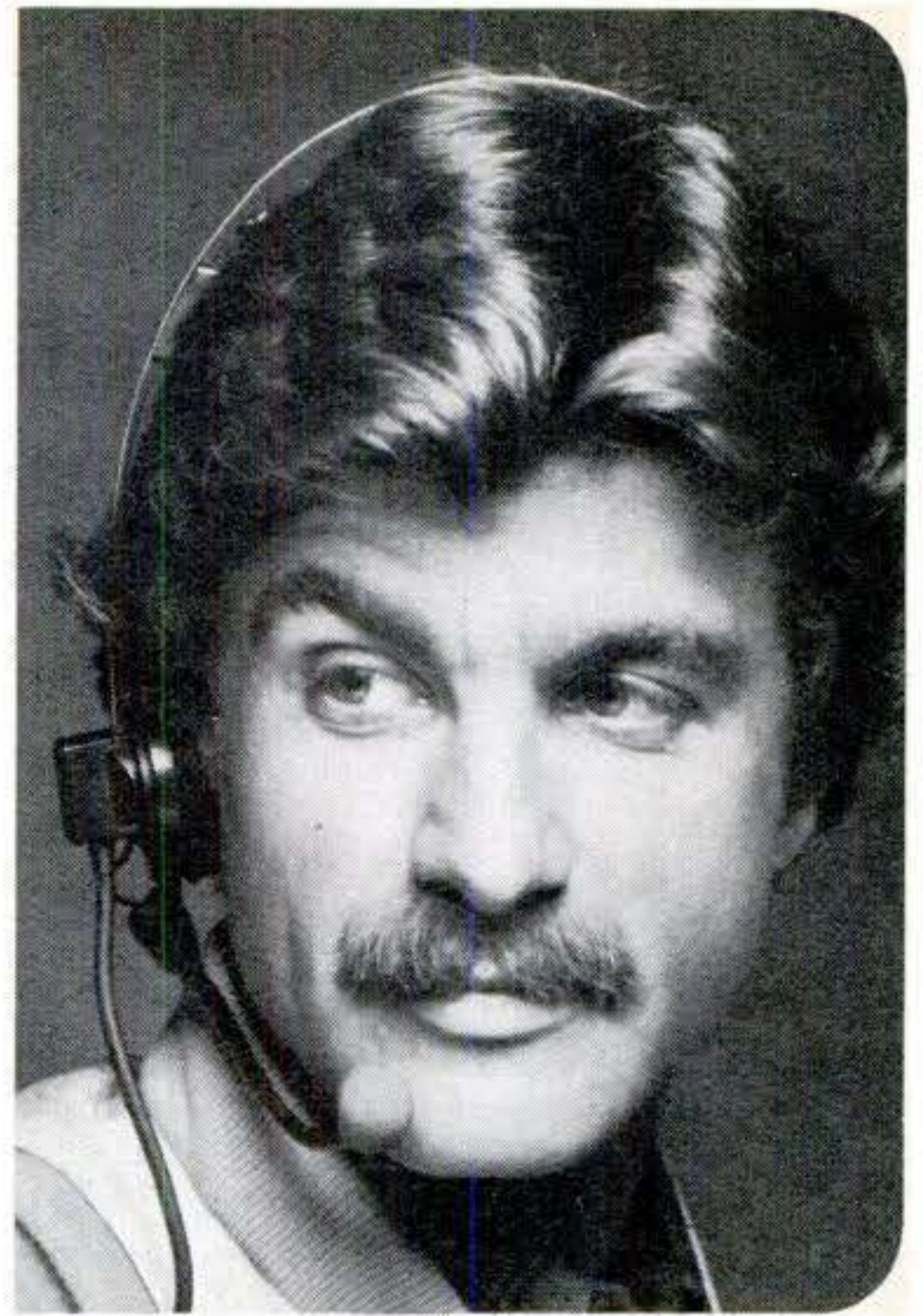
R. Scott Thiem, Mankato, Minn.

There are many possible causes, such as a problem with the EGR system, manifold-heat control system (too much carbon buildup), water-temperature sensors that may affect spark advance, the carburetor's preheated-air system, as well as such old-fashioned stuff as a weak accelerator pump, lean power system in the carb, late ignition timing, and bad wires or plugs.

Hard-to-find culprit

I have a '72 Chevrolet Caprice with the "big engine," that is, I believe it is the Mark IV, or the 402, engine. I have about 78,000 miles on it and have experienced no previous problems—except three or four water pumps and about the same number of fuel pumps. The engine has, since it was new, consumed about one quart of oil every 600-800 miles.

Continued
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TalkTalkTM *The world's first hands-free consumer mobile communication system lets you keep in touch while on the go.*

Do you remember the CB fad? Six years ago Americans jammed the air waves as everybody discovered the fun of personal communications.

But like all big fads, CB soon died. People hung up their mikes and gave CB back to the truckers who started the fad in the first place.

The personal communications fad is now back with an entirely new concept. TalkTalk is a headphone with a boom mike that lets you talk hands-free with someone else blocks away. Your voice activates a transmitter. When you stop talking, the transmitter automatically shuts off and you receive. The transmitter, receiver and power supply are located in a small case thinner than a pack of cigarettes which you wear clipped to your belt or placed in your pocket.

SAFER THAN HEADPHONES

You hear the receiver through an adjustable headphone which you comfortably wear over your right or left ear. This leaves one ear free to hear the sounds around you—much safer for outside activities than the popular stereo headphones.

You can now communicate, hands-free and in safety, while you cycle, hike, jog, work or play for up to one-half mile and all on a single 9-volt battery that lasts up to 8 hours of typical use. But there's much more.

An antenna circles the headphone so there's no ugly wire protruding from the top of your head and you keep your conversations private because the range is reduced to a block. But if you want to reach out to the unit's half mile range, simply unhook the antenna wire from its clamp and presto, you have an ugly wire protruding from the top of your head.

UNIT CAPTURES SIGNAL

TalkTalk was built in Japan with the same technology used in professional communication systems. For example, the system uses frequency modulation (FM) as opposed to the amplitude modulated signal used in CB. CB frequencies tend to get crowded—with powerful stations often talking on top of each other.

Not true with FM. The system's FM receiver uses a "capture effect," to reject all other signals letting you hear only the one signal closest to you. You capture a clear, crisp, easy-to-hear transmission. And since the Federal Communications Commission has set aside the TalkTalk's frequency of 49 megahertz for 100 milliwatt maximum power, no other higher power station will bury you. But wait, there's even more.

A voice-activated sensitivity switch lets you adjust your boom mike for all outside noise conditions—low for a motorcycle and medium or high for a bicycle. And a two-staged volume control lets you securely adjust the volume level with no fear of accidentally moving it.

You can keep the system's 6-ounce case in your vest pocket or clip it to your belt with its removable pager-styled clip. In fact, even the clip is impressive. It's a heavy-duty device that can be slipped off when you want to keep the unit in your pocket.

The boom portion of the mike is malleable. That means you can bend it in any direction and it will stay there. Wear the mike close to your mouth, far away, or even bend it out of the way completely.

Use your imagination. We used ours and came up with over 100 activities that make the TalkTalk useful or fun. Sure, the obvious ones like cycling, hiking, sports, work and play came easy. But how about using a pair in a shopping center to keep in touch? Or how about keeping in contact with your home while you walk the dog? TalkTalk can be used for outdoor treasure hunts, or by tour directors and ski instructors. The list goes on.

PLENTY OF UTILITY

And don't forget the surprise of contacting someone else on a TalkTalk like you used to on CB. If enough people use them, you'll be able to ride your bicycle down a path and meet other TalkTalkers as well. There are five separate channels to choose from. If you order a pair, we'll send you a matched frequency set. To order more on that frequency simply specify the frequency on your reorder form.

TalkTalk is manufactured by Standard Communications—an established manufacturer of professional two-way communications systems—assurance that your modest investment is well protected. The TalkTalk was designed for rugged use but if service is ever required, Standard's convenient service-by-mail center is as close as your mailbox.

To order your TalkTalk, send a check for **\$119.95** per unit (\$239.90 per pair) plus \$4.00 postage and insured delivery to the address below. Illinois residents please add 6% sales tax. Credit card buyers may call our toll-free number below. We'll send your TalkTalk complete with one 9-volt battery, headphone, transmitter/receiver, boom mike and complete instructions along with a one-year limited warranty.

GIVE IT A WORKOUT

When you receive your unit, really give it a workout. See how far you can transmit with the antenna up or down. Use it in a shopping center, on a bike ride or in your factory. See how comfortable it feels and how safe you feel with one ear free to hear outside sounds. Then decide if you want to keep it. If for any reason you are not satisfied, return your unit in its original condition within 30 days and we'll refund your money in full including \$4.00 postage and handling.

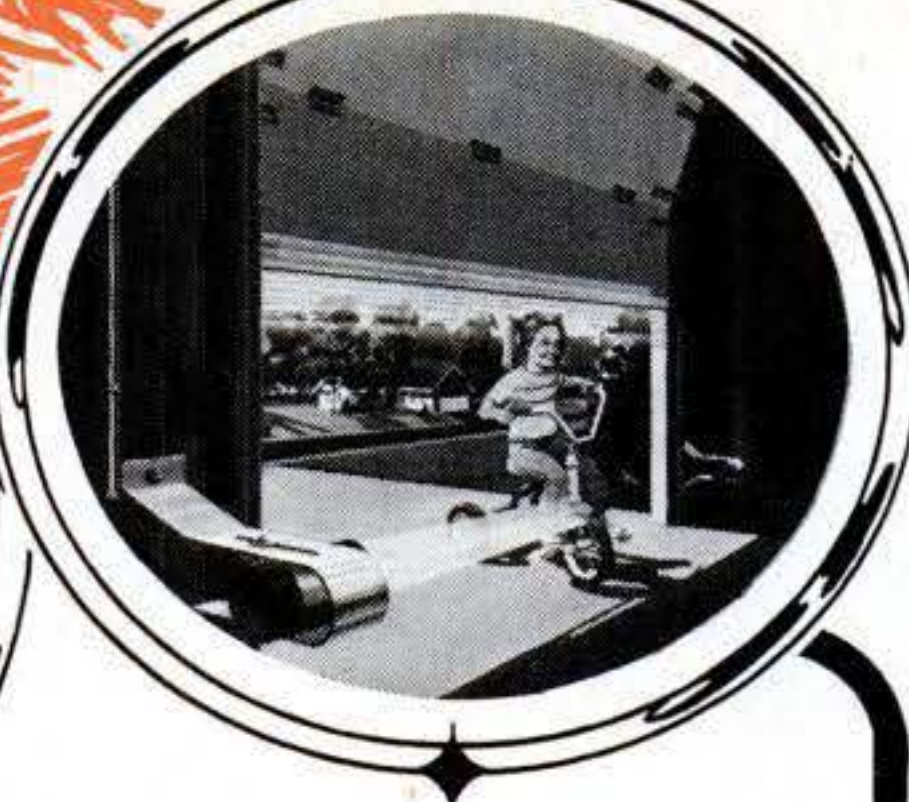
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"Say, Smokey—"

[Continued]

Recently I have found oil in the cooling system—not water in the oil, but oil in the water. I have tried the simpler, less expensive things first. That is:

(1) There was a suggestion that perhaps the antifreeze was old and therefore breaking down. I opened all the drains, flushed it for an extended period, and refilled it with water. I operated it for two or three days (about 50 or 60 miles), but the same problem occurred.

(2) Next I removed the radiator and had it cooked and checked for leaks. The transmission-cooler coil in the radiator was pressurized, but no leaks were found (the car has an automatic transmission).

(3) I thought, when the problem persisted after replacing the radiator, that the transmission coil might be leaking. I connected the transmission lines together with a hose, bypassing the cooler coil in the radiator. No change.

(4) I finally removed the heads (V8), had them planed, and had a valve job done. The heads were also magnafluxed and no cracks were found. No new valves were needed, and one head was off by 0.006 and the other by 0.008. I flushed the block when the heads were off, so most of the oily residue was expelled.

The engine was assembled and within a couple of weeks the same old problem appeared. Note that I did use gasket sealer on the studs and head gaskets as specified in the GM manual, but I don't attribute my problem to that because there is no oil under pressure going through the block into the heads. That is, the rocker arms and valves are oiled through the push rods. Please note that I also left the transmission lines connected together to bypass the transmission cooling coil in the radiator.

My only thought is that it must be a cracked block. But this would seem to suggest that the problem has to be where the water jacket and the oil passageways are adjacent. When the engine is running, the oil pressure is greater, and therefore oil could be forced into the water—but when the engine is shut off, the reverse is true. That is, the pressure in the cooling system should force the coolant into the oil. But there is no evidence of that.

Thomas Schaeffer, Shippenville, Pa.

I know of no standard or trick deal here, and I know the engine. My answer would be to pressure-check each side of the block, pressurizing the water section. Find a race-engine builder. He'll have a head plate and you can check each side separately. Use warm water at about 50 psi. Be careful not to exceed 50 psi.

Each month, Smokey Yunick answers questions on cars—family cars, high-performance models, and racing vehicles. Got a problem? Send it to: "Say, Smokey—", Popular Science, 380 Madison Ave., New York, N.Y. 10017. Smokey reads all letters, answering those he feels are of widest interest. Due the large volume of mail, Smokey cannot reply to letters that are not answered in his column.

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We'll give you tomorrow.

By ARTHUR FISHER



Aid for human flies

The Aliclimber, an English contribution to the building trades, is an ingenious solution to the problem of getting up and down the outsides of tall buildings. Its developers, Linden-Alimak Ltd., of Rushden, Northamptonshire, claim that it is cheaper to erect and faster to use than conventional scaffolding. The Aliclimber is basically a rack-and-pinion work platform that rides on steel-lattice masts, as shown in the photo above. The masts are installed at intervals of 7.5 meters (24.6 ft.), and the platform, up to 16 meters (52.5 ft.) long, climbs up the mast at a rate of nine meters (29.5 ft.) per minute, driven by its own electrically powered drive unit. The designers say two men can install an Aliclimber on a 20-story building in just one week.

A day on Neptune

You may have noticed one prominent aspect of astronomy textbooks: They are often obsolete, at least in some details, by the time they reach print. Take the planet Neptune. Astronomers have been trying for years to establish just how long a day

on Neptune is. A text with this year's copyright gives the period only as "15–20 hours." Now, however, astronomers at Kitt Peak National Observatory have narrowed Neptune's spin down to 18.2 hours, plus or minus 24 minutes.

Astronomers Michael J. S. Belton, Lloyd Wallace, and Sethanne Howard made the calculation on the basis of 300 observations in infrared light with Kitt Peak's 1.3-meter telescope. The research center is funded by the National Science Foundation.

Precise determination of the period of rotation is difficult because astronomers can observe only Neptune's cloud tops, which whirl around at varying speeds. Four times larger and 17 times more massive than Earth, Neptune remains one of the most mysterious of all the planets. It is the only one of the four Jovian (giant) planets for which no rings have yet been observed. It is 30 times farther from the sun than Earth, and is now the most distant planet. (Pluto's eccentric orbit has moved that outermost planet within Neptune's orbit.) An accurate estimate of Neptune's period of rotation will, astronomers hope, help dispel some of the mystery. It should give them a better understanding

of the forces that affect Neptune's atmosphere, and of its internal structure and chemical makeup. This information, in turn, may provide planetologists with clues to the origin of the solar system some 4.6 billion years ago.

Vive la difference!

Researchers at Penn State have concluded that women make poorer combat soldiers than men because of different levels of physical performance. They were studying the effects of differently designed backpacks and different loads on men and women of various body sizes. According to Richard C. Nelson, director of the university's biomechanics laboratory, "For men and women who are equally physically fit, we found two major things: Where high muscular force and rapid movements are involved, men perform far better when burdened with a heavy load. Moreover, the greater the load, the worse the women do. Except for running, the males did about 14 to 52 percent better than women, on average, when carrying 20 to 80 pounds. This is much greater than the 10 percent performance gap between world-class male and female athletes. The difference is the load." The men's superior performance is attributable to their greater size and higher ratio of lean muscle mass.

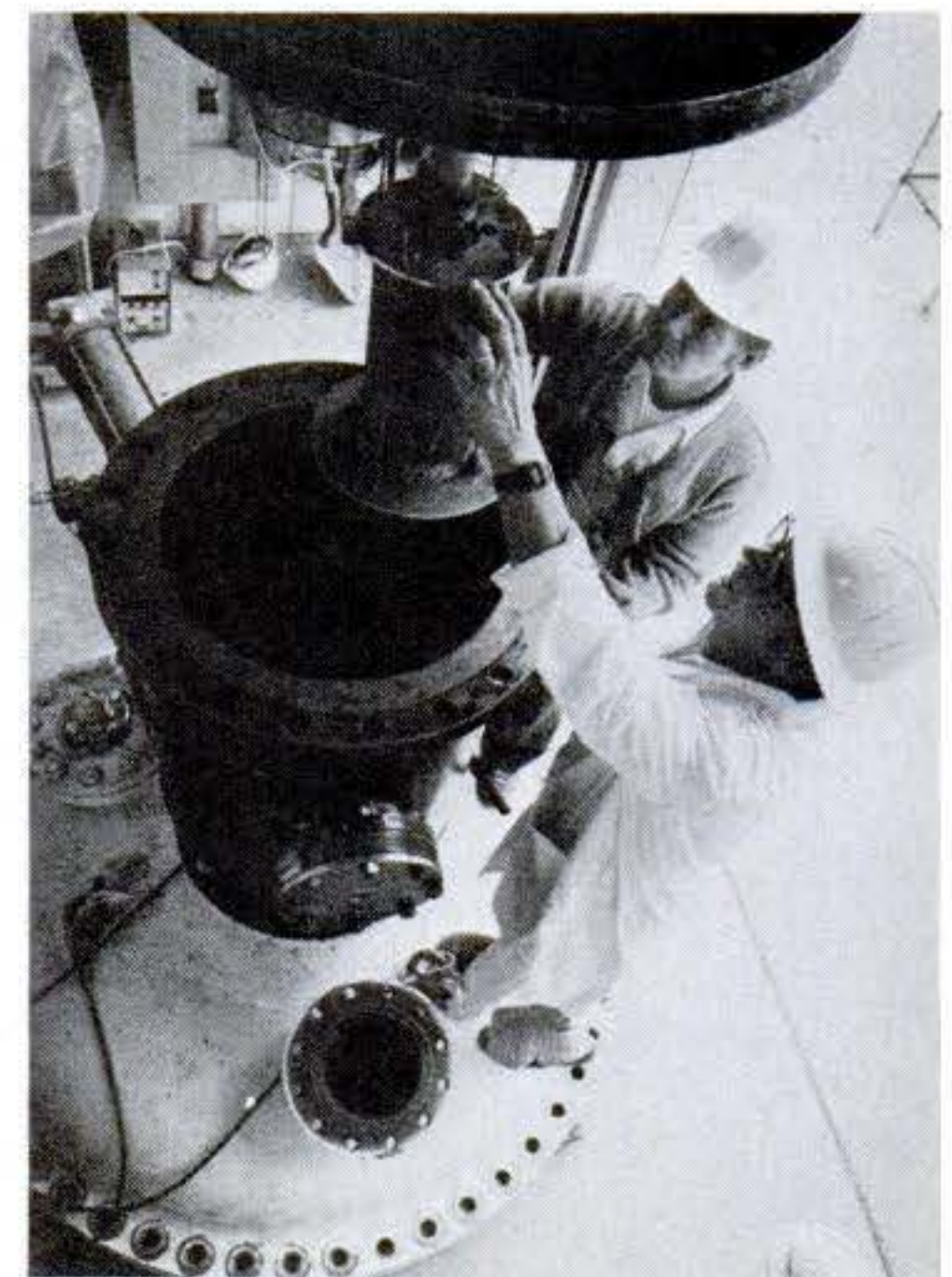
The Penn State study was paid for by the U.S. Army Natick Research and Development Command in Natick, Mass.

Nuclear-plant explosions

Using a special experimental device called a steam-explosion facility, shown in the photo below, experts at Sandia National Laboratories have found that the risk of radioactive material reaching the atmosphere after a hypothetical nuclear-power-plant steam explosion may be much lower than calculated from previous studies.

A steam explosion is created when water vaporizes rapidly and violently. Although chances of such an explosion

Continued



illegitimate child

Rip-off or spin-off, you've never heard sound like you'll hear from the headphones you can get for only \$5 pictured below. But there's a catch.



It was spawned by Sony. And, it's an entirely new technology. No more cheap paper speakers and heavy magnets. Sound is reproduced with such clarity and power that it will send shivers up and down your spine.

Sony's MDR-3 headphones sell for about \$50, and they've been worth it. Now you can have DAK's for only \$5. We challenge you to take them to your favorite Hi Fi store and compare them to Sony's. But there are 2 things you ought to know.

Thing One. If you can hear a difference, any difference at all, not only can you return them and get your money back, but we'll also give you a free gift for your trouble.

YOU'VE BEEN THERE BEFORE

You may already be familiar with the sound produced by these headphones. If you've ever sat in the very front row during a symphony concert, or right in the middle of a live jazz band, you know the spine tingling thrill of the full rich sound that envelops you.

If you sit even 10 rows back, you lose the feeling. You still listen to the music, but you can't touch or taste the sound.

It's only when you sit right up front that the sound is alive with electricity. It's the same sound you get with Sony's MDR-3s and DAK's \$5 stereophones.

ILLEGITIMATE CHILD

Not recognized by law as a lawful offspring. The technology is new. Up until the Sony featherweight headphones were introduced, most headphones were simply uncomfortable miniature speaker systems that you wore on your ears.

The Sony breakthrough was made possible by changing the cheap paper speaker cones to mylar diaphragms, and by using the powerful rare earth magnet Samarium to move the diaphragms.

The mylar diaphragms are much more accurate than paper and have a drastically improved dynamic range. The result is a headphone that weighs less than 2 ounces and yet produces 20-20,000hz

sounds better than a theater sized loud speaker system.

Sony fathered the technology for these headphones and obviously has no connection to DAK, but the technological heritage will become vividly apparent when you compare the sound of these marvelous headphones side by side. DAK's come with a full one year limited warranty.

THE CATCH

Thing two. Frankly we are losing our shirts on the headphones, but we're taking a gamble because we want you to try our audio cassettes.

In order to get the \$50 value pair of featherweight headphones for only \$5, we want you to try 10 DAK High Energy, Normal Bias 90 minute cassettes for only \$2.19 each.

DAK's price is less than half the price of the competition, and each cassette comes with a deluxe index insert card, a box and a one year guarantee.

You're very valuable to us in the form of future business. DAK has excited over 80,000 of you valuable customers with special bonuses like the headphones. We find most of you keep buying once you try our cassettes and our prices; and that's a gamble worth taking.

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We coat these liners with a new chemical called Molysulfide which drastically reduces friction within the cassette.

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ation for often played tapes.

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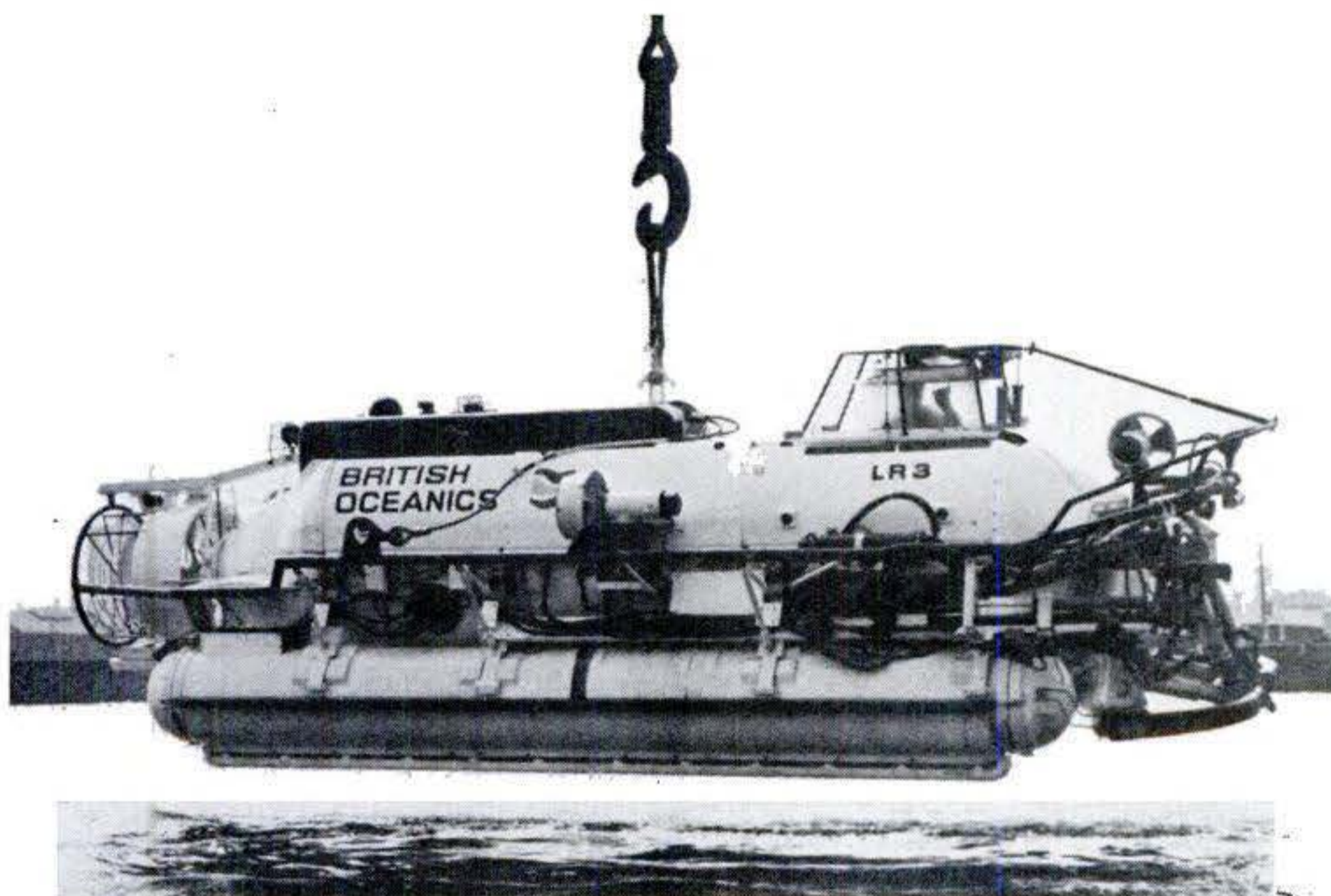
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DATSUN WE ARE DRIVEN

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[Continued]



are remote in modern power reactors, one could theoretically result from a number of abnormal conditions. These include, of course, the much-studied loss-of-coolant accident ["Atomic Energy Safety," PS, Sept. '73]. In such an accident, part of the reactor core would become exposed to air instead of water, allowing the radioactive fuel to soar to a temperature of about 5,000 degrees F instead of the normal 500 degrees. Then the fuel would drip molten debris into any cooling water left. This water could vaporize explosively, bursting the reactor's containment shield and spewing radioactive material into the atmosphere.

The Sandia studies, sponsored by the Nuclear Regulatory Commission, combine computer analysis with actual tests in which a steam explosion is simulated by dropping molten metals and metal oxides into water inside a specially designed, tall pressure chamber. Results of the studies, according to Dr. Marshall Berman, supervisor of Sandia's Reactor Safety Studies Division, "show the probability of a steam explosion breaching a power plant's containment may be 10 to 100 times less than estimated in earlier reactor-safety studies."

Cholesterol fighter

Heterozygous familial hypercholesterolemia is a jaw-breaking but precisely descriptive name for perhaps the most prevalent of all genetic diseases, striking about one in every 500 individuals. Its victims have an abnormally high level of serum cholesterol. As a result, men with this condition stand an 85 percent chance of getting a heart attack before they reach the age of 60. The disease is inherited, with its victims receiving one "bad" gene from one parent (heterozygous). (There is a one-in-a-million chance of receiving this gene from both parents—homozygous familial hypercholesterolemia. Children with this fortunately rare variety have died of heart attacks at the age of five years.)

Many cholesterol-lowering drugs have been developed in recent years and tested in controlled trials with varying results. Now a report in the authoritative *New England Journal of Medicine* details the preliminary success of a new drug, called compactin, which operates in a totally new and potentially more effective way than previous drugs. Developed by a team of Japanese researchers at the Sankyo Drug Co. from a broth of penicillin mold, compactin lowers only certain specific constituents of cholesterol, the so-called LDL's. These low-density lipoproteins have been indicted as the key element in heart-attack risk. The drug, tested with seven men suffering from heterozygous familial hypercholesterolemia, cut LDL's by an average of 29 percent, but did not reduce the component called HDL's, high-density lipoproteins. That result is very desirable, because high HDL levels have been linked with a low risk for heart disease.

More tests will be required before physicians can tell whether the new drug will also be effective in patients with noninherited forms of high cholesterol, the causes for which are still murky. And still more tests remain before compactin can be deemed safe enough for regular rather than experimental use.

Undersea diesel

The submersible in the photo above has a most unusual engine: a closed-cycle diesel that runs underwater without demanding large amounts of air to keep it operating. British scientists headed by Prof. Ray Thompson at Newcastle University developed the device, which relies on a micro-processor to control the recycling and chemical cleansing of exhaust gases. The process condenses water vapor and absorbs carbon dioxide. What's left is mostly nitrogen, hence the unit's name: "nitro-diesel." The engine could replace lead-acid batteries in underwater applications.

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ADVENTURES IN ALTERNATE ENERGY

A bimonthly sampling of projects PS readers have devised to conserve or replace fossil fuels

Vegetable oils as diesel fuel: running on peanuts



Could farmers grow their own fuel—without refining?

By HUGH WHITTED III

When the parking-lot attendant at a Miami hotel got a whiff of the exhaust from my Mercedes-Benz diesel, he asked a question I've been hearing a lot lately: "What are you burning in that thing?"

What I was burning, and what had fueled my car the 1,000 miles from my home in East Bend, N.C., was peanut oil. Actually, when the unmodified engine is under load its exhaust is clean and odorless, but it does give off something of a scorched cooking smell when idling.

I was in Miami to deliver a paper on the results of my research into the use of vegetable oils as substitutes for petroleum-derived diesel fuels. The tests have involved both the Mercedes and an International Harvester tractor equipped with a sophisticated computer and equipment to measure performance factors. In our work (funded by the Department of Energy and the

Yadkin County Corn Growers Assn., and assisted by interested area farmers) we have investigated the chemistry of vegetable oils, studied their effects on engines, and run actual road and field tests.

My conclusion? With some cautions (discussed later) and with some slight modifications to fuel-injection systems, certain vegetable oils—notably peanut and sunflower oils—perform well as diesel-fuel substitutes.

That would come as no surprise to Rudolph Diesel, the inventor of the compression-ignition engine. In a lecture to the Engineering Society of St. Louis in 1912 he commented on his

What the diesel makers say

The principal automotive diesel-engine manufacturers—Oldsmobile, Volkswagen, and Mercedes-Benz—are all doing their own research on alternative diesel fuels. None of them, however, recommends or authorizes use of experimental fuels in its engines. Use of any fuel other than No. 2 diesel fuel (with approved additives for cold-weather starting) could invalidate company warranties.

progress in operating his engines on castor oil, palm oil, and lard: "The use of vegetable oils for engine fuels may seem insignificant today, but such oil may in time become as important as the petroleum products of the present."

That time may not yet be here, but it's getting nearer. With the cost of oil certain to keep rising and the widespread efforts of plant geneticists to increase crop yields of oil-seed plants, the pendulum is already swinging. And for farmers, who could supply all their fuel needs by diverting only about 10 percent of their acreage to oil seeds, the economics may already favor vegetable oils.

Chemically, vegetable oils consist of long hydrocarbon chains, just as petroleum products do. However, vegetable-oil molecules are somewhat more complicated, having additional branches and some doubly bound carbon atoms instead of preferred single bonds of diesel fuel. A molecule containing only single bonds is said to be fully saturated; those containing one or more double bonds are mono- or polyunsaturated. The more saturated an oil is, the more readily it burns.

A good measure of saturation is an oil's ability to combine chemically with iodine, so the iodine number of an oil indicates its suitability as a diesel fuel. High-iodine-number oils, such as linseed oil, are poor fuels. Peanut and sunflower oils, on the other hand, have low iodine numbers, high cetane ratings, and high energy content (see table).

Actually, vegetable oils contain mixtures of molecules with differing degrees of saturation. The exact composition depends on a number of factors, including the growing climate. Oil from plants grown in warm climates has a higher degree of saturation, so southern-grown oils are better fuels than northern-grown ones.

There are several methods for using vegetable oils as fuel. The crude oils can be cracked and refined in a process that resembles the refining of petroleum. Or they can be chemically combined with alcohols, forming esters. Research in the U.S. and abroad has shown that both methods produce fuels that closely match diesel fuel's physical properties.

But our method—sometimes referred to as "squeeze it and go"—is to simply use the oil as extracted from a mechanical press. However, the oils' high viscosities and ignition temperatures can cause injection and misfiring problems at idle and part-load operation. We have avoided these problems by using dual-fuel systems

Continued



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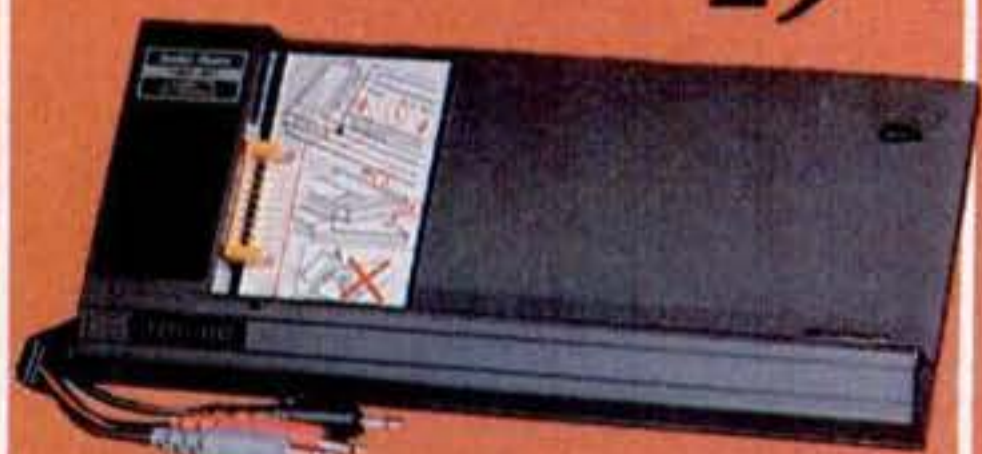
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answers with comments. The Edit and Debug mode make programming easier than it is with a programmable calculator. Inputting is simplified with the typewriter-style keyboard and separate 20-key numeric keypad. The LCD shows 24 characters with automatic scrolling and manual playback for longer lines. Another thing: memory is retained even when the power is off.

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Running on peanuts

[Continued]

(conventional diesel fuel is used during start-up and shutdown) and by preheating the vegetable-oil fuel before it's injected.

The dual-fuel arrangement also allows easy comparison of performance using various fuels. Average 25-to-65-mph acceleration times in the Mercedes have been three to four seconds slower with crude peanut oil than with No. 2 diesel fuel. Mileage tests at 55 mph have shown that the car gets 37.6 mpg with No. 2 fuel and 35.8 with peanut oil. But when we take into account the lower energy content of peanut oil, we find that the engine operates at the same thermal efficiency on either fuel.

The engines were fully examined after 5,000 miles of operation on vegetable oils. No cylinder wear or abnormal deposits have been observed. Nor has the lubrication oil exhibited any thickening.

These tests have shown that vegetable oil can be substituted for diesel fuel. However, I don't recommend that readers attempt to use such fuels without characterizing the fuel in accordance with ASTM fuel specifications and familiarizing themselves with the engine's combustion behav-

Diesel-fuel qualities of various oils

Oil	Cetane number	Energy content (Btu/lb.)	Iodine number
Corn	40.0	17,133	109-133
Cottonseed	38.0	16,825	105-114
Peanut	40.0	17,249	84-102
Soybean	37.0	16,920	127-138
Sunflower*	36.4	16,782	120-140
ASTM No. 1 D 40.0 (min.)		20,100	**
ASTM No. 2 D 40.0 (min.)		19,215	**

Note: Values vary. Cetane numbers furnished by USDA.

*Northern-grown

**Not applicable

ior and operating idiosyncrasies. If you simply fuel up at your store's cooking-oil shelf, be prepared to replace some expensive engine components. **E**

The author will send to PS readers a booklet containing information on vegetable-oil chemistry and extraction, fuel-system modifications and engine instrumentation, references, and more. Send \$6.90 to AG Fuels Research, Inc., Route 2, Box 444A, East Bend, N.C. 27018.

Your idea may bring you \$200

Every other month, we present a project developed by a PS reader and pay the inventor \$200. To enter, send us black-and-white glossies (one photo should show you demonstrating the device), plus a description and sketches. Include your name, address, and social-security number. No material can be returned unless you enclose a stamped, self-addressed envelope.

Since space won't permit us to present projects in detail, we'll expect inventors to answer any reasonable query from readers, if it's accompanied by a stamped envelope.

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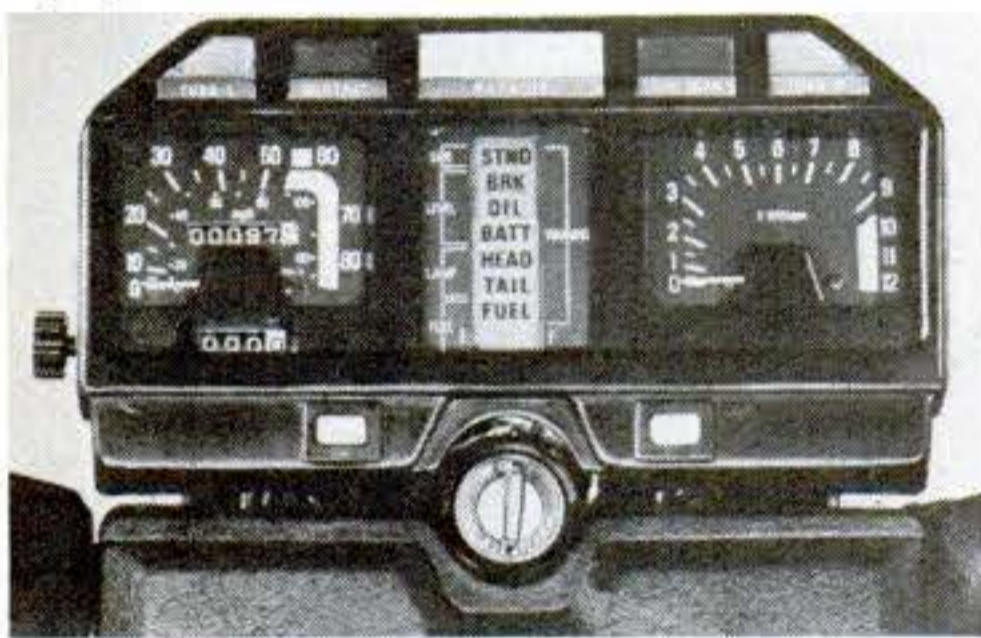


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MOTORCYCLING

By RAY HILL



Computerized motorcycle

Last year, the 750-cc motorcycle class consisted primarily of the Honda CB 750, Suzuki GS 750, and Kawasaki's KZ 750. The three machines were similar: DOHC four-cylinder engines, four carbs, chain drive. All handled well, were reliable, and had similar acceleration and top-speed capabilities—although the KZ 750 was generally acknowledged to be the best-handling, primarily because of its lighter weight.

This year Yamaha chose an interesting way to enter this highly competitive market. Instead of introducing another clone-like chain-drive 750, it brought out the Seca 750, a shaft-drive (no messy chain to oil or adjust). Even more important, it is the first production motorcycle to have a computerized monitoring system and an anti-dive front suspension. In addition, the four-cylinder DOHC engine has Yamaha's version of swirl combustion, which, the engineers maintain, improves both mileage and performance.

I've ridden the Seca 1,000 miles. The worst mileage I got was 40 mpg, and the best was in the low 50's—depending on how hard the bike was ridden. This is about what you would expect from the other Japanese 750's. The engine pulls strongly, especially in the low and middle ranges of the engine's power band.

Handling is good, but the ride is a bit on the harsh side, even when spring-preload and shock-damping positions are set at the full-soft mode.

The anti-dive suspension, while a first

for production motorcycles, works better on paper than on the road. The paper version: When the front brakes are applied, brake fluid forces a valve closed at the bottom of each fork leg. This reduces the flow of fork oil through each fork's compression-damping circuit, thereby preventing the forks from compressing as rapidly or as far as they would on a conventional machine. This makes the motorcycle more stable and easier to control, because the bike's steering geometry doesn't change as much as it normally would during braking.

The road version: I found that the forks seemed to compress about as far and as quickly as conventional forks if the brakes were applied quickly and hard—even when the anti-dive system was adjusted to its stiffest setting. (Adjustment is easy; just turn a screw in the bottom of each fork leg.) Under mild braking the forks do compress at a slightly slower rate, and perhaps not quite as far.

The problem is that a relief valve in each fork is designed to open when the front wheel hits a bump during braking so as to allow normal suspension movement. Hard braking generates enough force to open the relief valve, thereby reducing the effects of the anti-dive system. Whether this dilemma can ever be satisfactorily resolved on a street bike remains to be seen. But certainly Yamaha is to be congratulated on being the first to tackle the problem. Regardless, the twin front discs and rear drum brake work well. They stop the Seca quickly and predictably.

The Seca's computerized monitoring system is unique. A microcomputer (with the help of some sensors and an integrated-circuit board) monitors fluid levels (gas, engine oil, brake fluid, battery fluid). If one or more is low, a warning light flashes, and the appropriate display appears on the LCD panel. A low battery, for example, would result in BATT appearing on the panel, and a blinking warning light. The computer is also in touch with the headlight and taillight, and will warn you if a filament burns out.

If you're one of those people who can't remember to put the side stand up before you take off, the computer will warn you that the stand is down. And if that isn't enough, the engine will die when you engage first gear if the side stand isn't retracted, thanks to a special switch at the side stand.

Another excellent safety feature is the horn, one of the best (read loudest) I've heard on a production bike. It also has a distinct and pleasant tone. All motorcycles should come with a horn at least as good as this one.

One thing is certain. The Yamaha 750 is the most innovative 750-cc motorcycle on the market.

Suspension catalog

Here's a 22-page catalog with enough Mulholland shocks to fit nearly any street or off-road motorcycle. The catalog also devotes several pages to explaining how motorcycle suspension systems work. And if that's not enough, there's a list of components for rebuilding suspension systems. It's \$2 from Interpart Corp., 230 W. Rosecrans Ave., Gardena, Calif.

Picture clock

Got a favorite motorcycle picture? Perhaps of you sliding Old Paint through that favorite turn on the trail? If so, and you'd like to look at that picture and tell the time, too, you're in luck. For \$34.95, Pic-Clock, 1742 N. Pass Ave., Burbank, Calif. 91505, will put the picture on a clock. The clock measures 11 by 14 inches, and the picture occupies that entire area.

Missile update

For many, a motorcycle that can accelerate from zero to 120 mph in a quarter mile is too much. But for the experienced rider, owning such a machine can be the next best thing to getting a tax refund—especially if it handles well, gets mileage in the 40–55 mpg range, and has adjustable suspension for all riding conditions.

Such a machine exists. It's Suzuki's GS 1100. I've logged over 2,000 miles on a 1981 model and found only two things I don't like. The sensitive carburetors tend to give a jerky ride when the rider is trying to maintain a steady slow speed (which can be largely overcome by using very



precise throttle control). And you have to remove the handlebars to adjust fork-spring preload. These problems existed on last year's model, too.

Still, it's one of the most versatile motorcycles ever made. It works well as a touring bike riding two-up. My wife thinks it's one of the most comfortable bikes she's ridden as a passenger. It's equally at home at the drag strip, road-race course, on city streets filled with traffic, or winding back roads.

It will be interesting to see what Suzuki engineers do for 1982. If they get rid of the jerky carburetion and make the fork springs easy to adjust, they'll have something that's about as close to perfection as a production bike is likely to get. ■



How to pick a pocket.

To prove a point, we stitched together half a pair of the best-selling jeans and half a pair of JCPenney Plain Pockets.

The point is, both feel great, fit great. They even look alike.

Till you look at the pockets. The best seller's have a little extra stitching. And that can cost you extra.

Plain Pockets only cost you \$13.50. Which pocket should you pick? It's as plain as the pocket on your pants.

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YOU ALREADY OWN HALF OF THE WORLD'S MOST ADVANCED HOME ENTERTAINMENT SYSTEM.

You're already halfway to Magnavision® right now. Because all you have to do is plug it into your present color TV set.

Magnavision is a turntable. A video turntable as well as an audio one. It plays discs that show pictures on your TV. With stereo sound capability.

And what pictures. Magnavision delivers a picture that's clearer and crisper than video tape TV, even TV itself. And the Magnavision picture lasts, because the discs are impervious to wear.

See the buttons on the front of the Magnavision unit? They give you total control over what you watch and how you watch it. Consider the possibilities: Reverse. Slow motion. Individual frame-by-frame indexing. More. And you can exercise control from anywhere in the room, since Magnavision Model 8005 (shown here) gives you a full-feature remote control.

AMAZING: PICTURES WITH STEREO SOUND. Magnavision even gives you high-fidelity stereo sound.

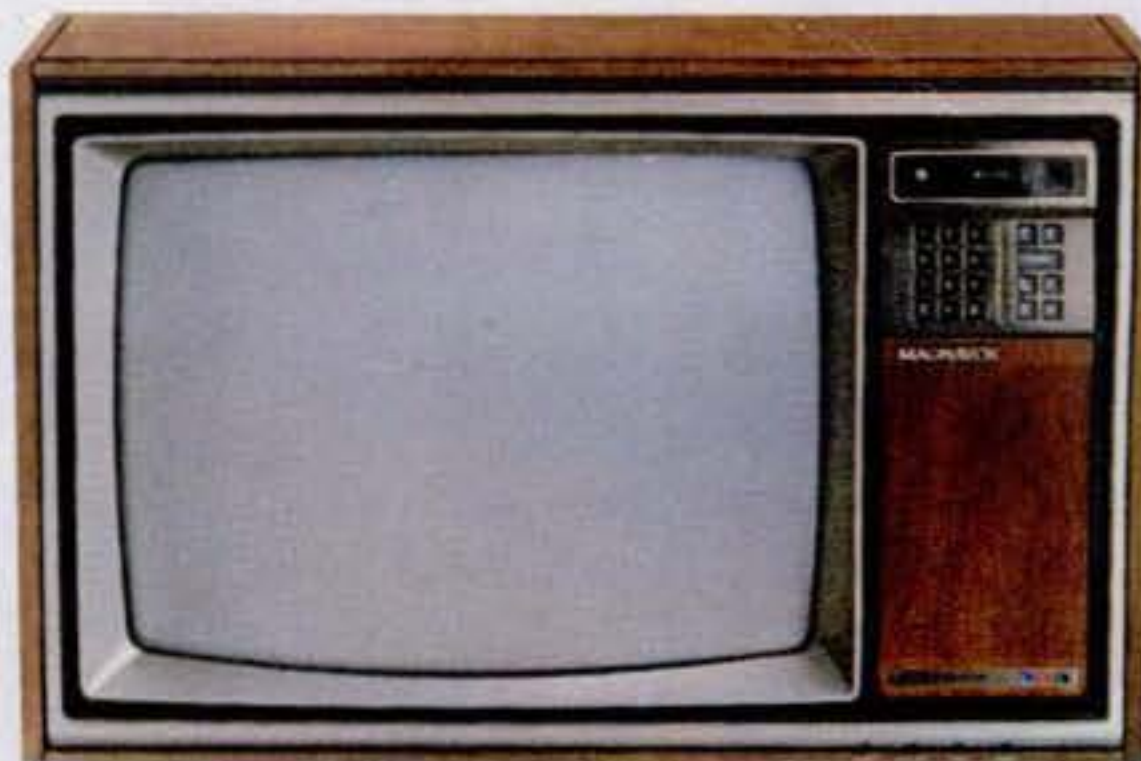
Just run it through your present stereo system and choose from one of the many stereo videodiscs (concerts, musicals, shows). You can't get stereo with video tape, and stereo TV is years away. Imagine, now you can see Liza Minnelli* for example, as well as hear her in stereo concert!

All of this wonderwork comes from Magnavision's laser-optical scanner. It is a beam of light that works like an audio player's "needle." But Magnavision's laser-optical scanner has none of the archaic limitations of a needle.

Magnavision is full of ideas. It can be a learning machine as well as an entertain-

ment source. Many of the discs are interactive. You can carry on a dialogue with them. *How To Watch Pro Football*†, *The First National Kidisc*†—games, puzzles, questions and answers for your children, *The Master Cooking Course*†, and *Jazzercise*† are just four examples.

You can put as many different kinds of programs on your television screen with Magnavision as you can imagine. Choose from over 120 videodisc albums now. They range from classic movies to new releases. From sports instruction to art gallery tours. From cartoons to concerts. And new programs are continually being developed exclusively for videodiscs.



So put your half of the world's most advanced home entertainment system together with Magnavision soon. For the name of your nearest dealer, please call toll-free 800-447-4700 (in Illinois, 800-322-4400).

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*Liza In Concert © Pioneer Artists™ †Optical Programming Associates ©

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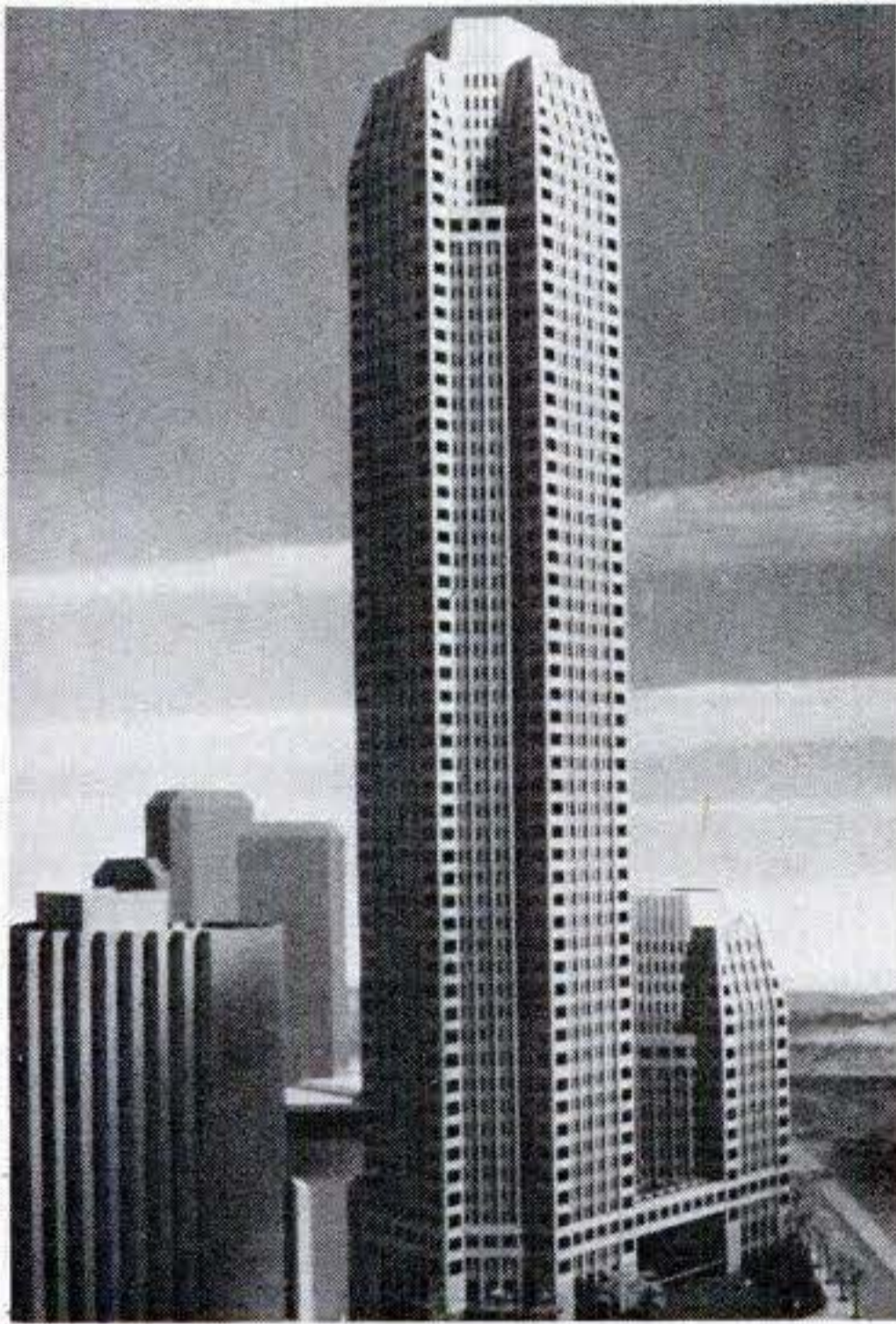
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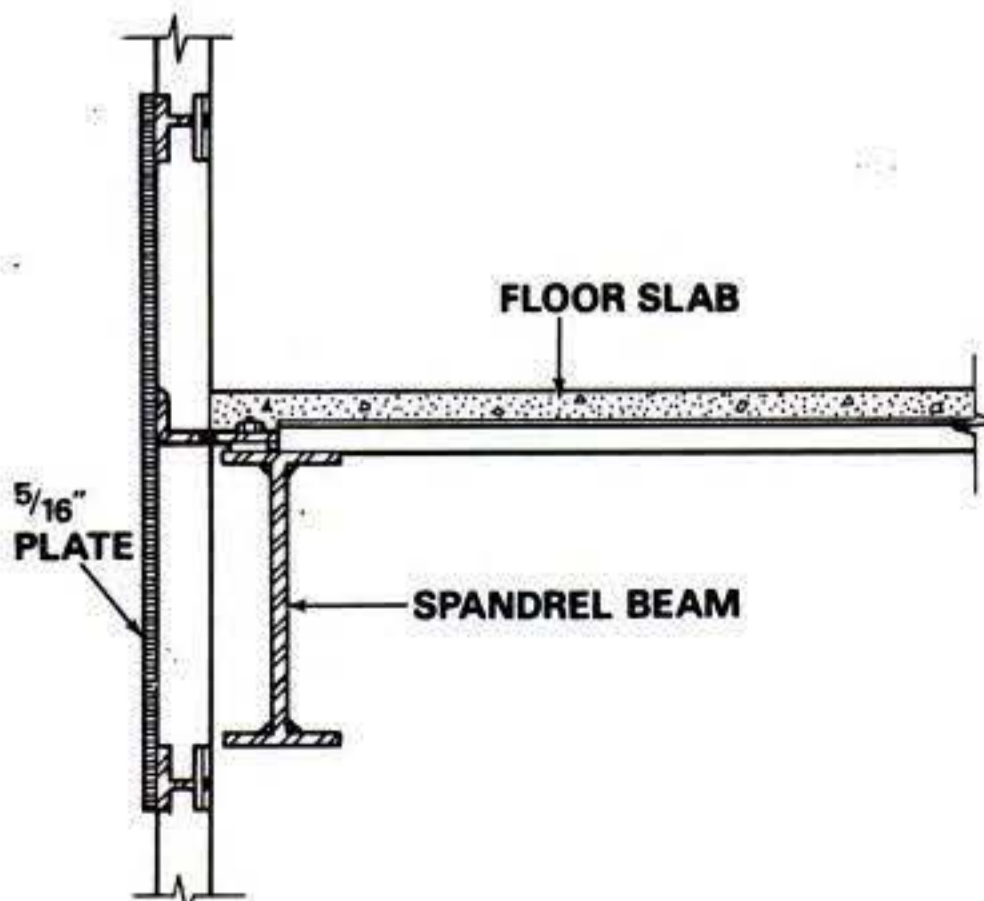
Steel wrapper will toughen office tower

A first-of-its-kind office tower going up in Pittsburgh, Pa., will have a stressed metal skin like an airplane for extra structural strength. With the unusual design, the builder also expects to trim costs by eliminating unneeded fireproofing.

An all-metal wrapping for a 54-story building isn't so surprising when you learn the builder is United States Steel Corp. The site for the new office tower is downtown Pittsburgh, across the street from the steel company's headquarters. The prime tenant will



Eight-sided Dravo Tower will have a stressed skin of painted steel. Cladding of steel plates will boost lateral structural rigidity of the 54-story building. Side-view detail (below) shows plate linked to spandrel beam and floor slab.



be the Dravo Corp., a major engineering firm.

The eight-sided Dravo Tower is built around a core of closely spaced vertical columns linked by horizontal spandrel beams. The external facade, or curtain wall, for this conventional frame does more than keep out the weather. A cladding of $\frac{1}{4}$ - and $\frac{5}{16}$ -inch-thick steel plates connected to the building frame provides special strength. It helps control building sway in high winds.

These steel plates are fabricated in huge sections three stories high and about 10 feet wide. Each section has six rectangular window openings; sections are anchored to the tower's columns, and vertical joints are concealed behind the column covers. New York's Lev Zetlin Associates, structural engineers, discovered that this stressed-steel-skin design for a major building required engineering analysis akin to airplane design. Engineers had to calculate how wind would bend and stress the steel cladding, how the $2\frac{1}{2}$ -by-six-foot window openings would affect the panels, and factor in temperature and elastic stress changes on the panels.

The building's frame columns are protected with a fireproof coating that prevents steel from weakening and collapsing in intense heat. But the external panels, since they're structurally designed to reduce only wind sway, do not require fireproofing. If a fire weakened most external panels it might cause the building to sway more than it is designed for, but the coated frame would prevent collapse. U.S. Steel estimates it can save about \$2 million by not fireproofing the steel panels. Such a saving could become a marketing advantage for similar building construction.

The architects, Welton Becket Associates (Santa Monica, Calif.), scaled and faceted the Dravo Tower to complement its neighbors, such as the historic courthouse and ultramodern U.S. Steel Building. The tower is scheduled to be completed in the spring of 1983, and even though it uses an advanced design concept, U.S. Steel claims that it will be as easy to build as a conventional curtain-wall building. —John Free

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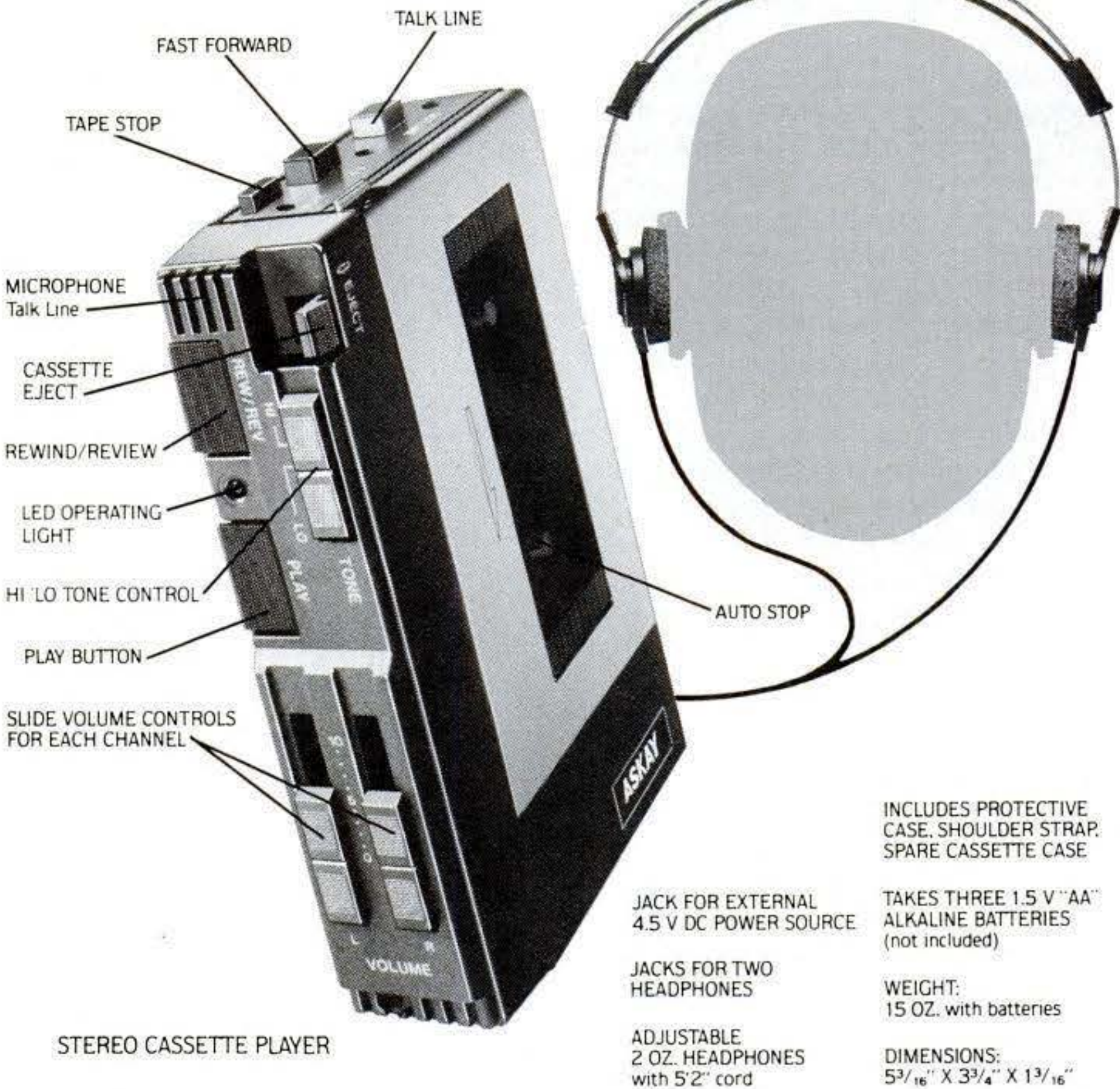
Yet it packs the staple driving power to penetrate hard woods! Perfect for those man-sized jobs like installing ceiling tile, insulation and weatherstripping! Features on/off safety lock, one-piece solid steel base. Uses 6 staple sizes: $\frac{1}{4}$ ", $\frac{5}{16}$ ", $\frac{3}{8}$ ", $\frac{1}{2}$ ", $\frac{9}{16}$ " and Ceiltile.



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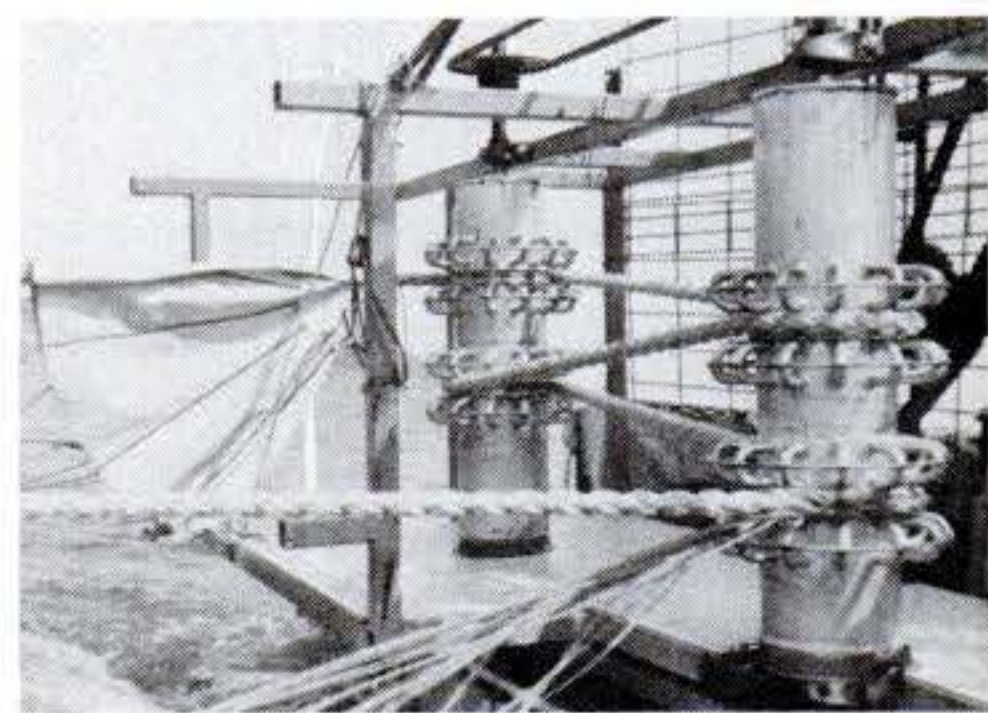
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Underwater sails — power at 1¢ per kWh



Parachute emerges from the water as loop turns wheels, powers generator.

Parachutes, each the size of a football field, billow; sea water fills them. Gliding in a 5.7-mile-dia. circle, they power a city just inland.

An alien landscape? No, the Gulf Stream, or any current of water where Gary Steelman can put his invention, the Steelman Loop, an almost home-spun way of generating electricity.

The Water Low-Velocity Energy Converter, or WLVEC, as Steelman calls it, uses the power of moving water just as a water wheel or an undersea turbine would [PS, Sept. '80]. The WLVEC consists of a loop to which huge parachutes or sails are attached [PS, May '75]. The loop is set in a current of water that fills the sails, driving them along. The sails close on the return journey. In turn, the loop drives the wheels of a barge-based generator.

Made of synthetics impervious to sea water and strong enough to withstand the strain of powerful ocean currents, the loop would operate at a depth of 100 feet, out of the way of shipping and storms, and send power to shore—as far as 200 miles away.

"Sounds great," you say, "but does it work?" Tests conducted off Cape Canaveral in Florida and again at Saylorville Lake in Des Moines, Iowa (where a moving barge provided the current), have shown remarkably favorable results. The device operated at about 96 percent mechanical efficiency and outperformed all expectations. Projected start-up costs of \$550 per kilowatt and 1¢ per kilowatt-hour for electricity compare favorably with other sources of electricity.

What's the potential energy production? The Florida Current alone has about 50 times the flow of the world's freshwater rivers combined. How feasible is it to extract that energy with the WLVEC? The final reports are now being written.—K. Brown



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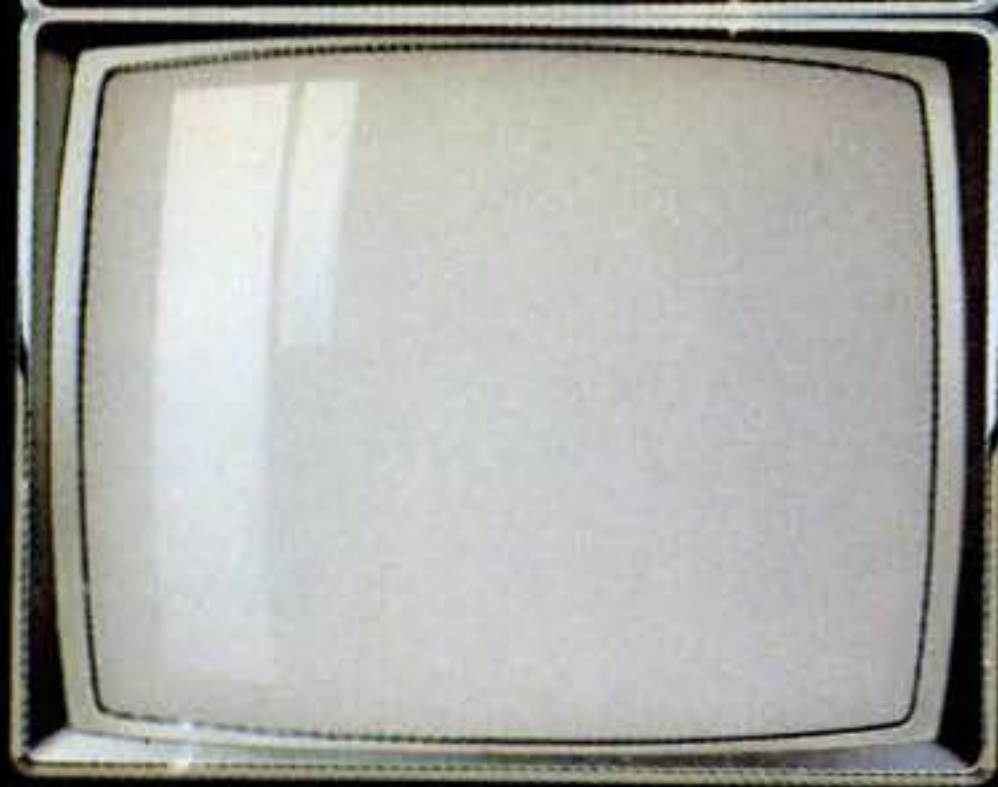
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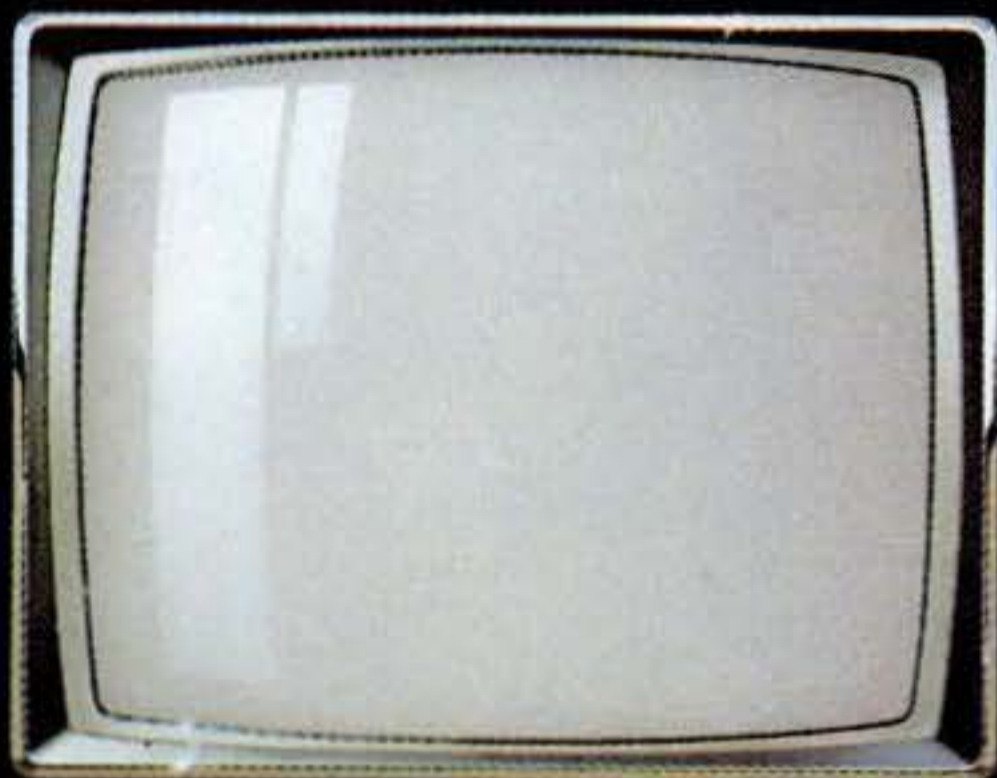
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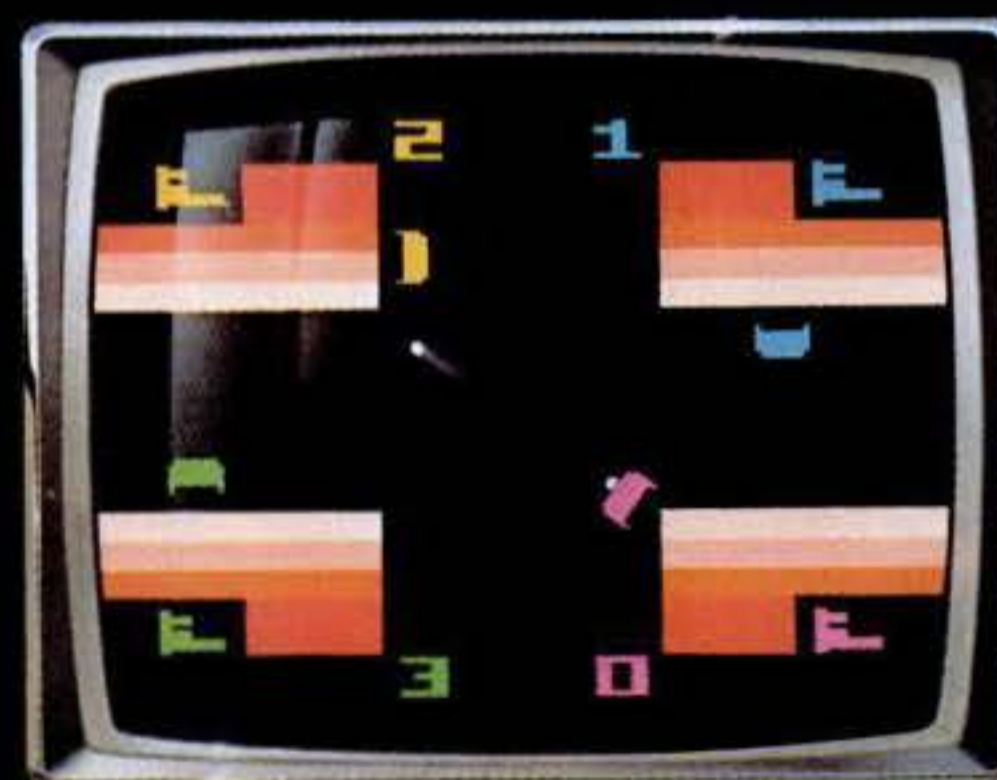
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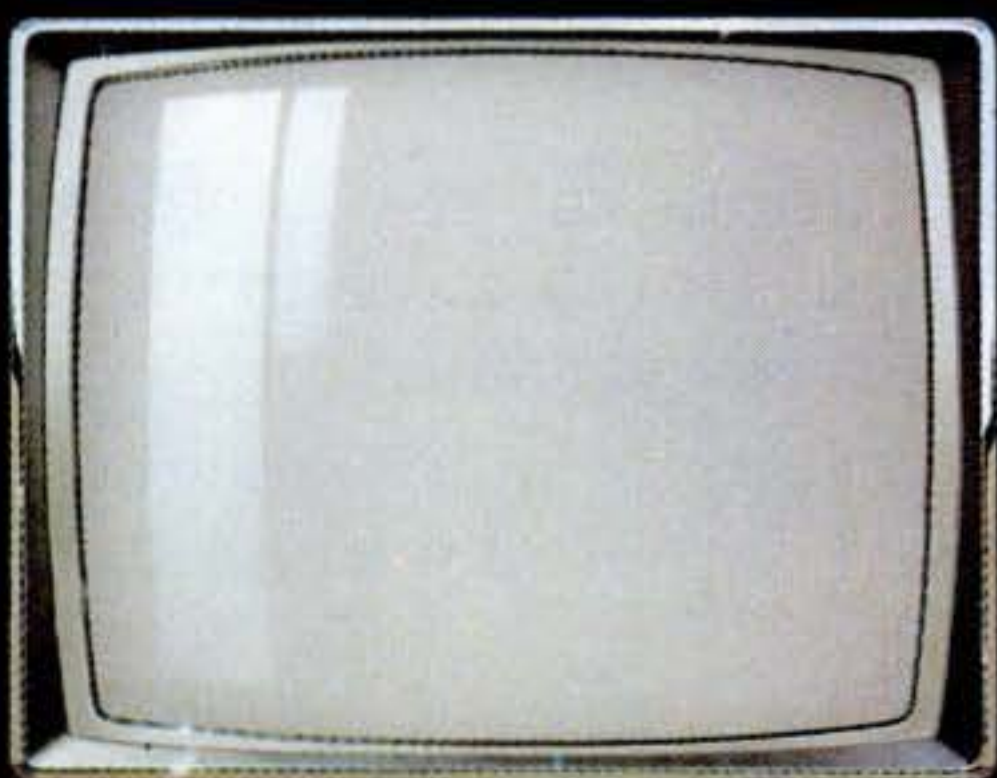
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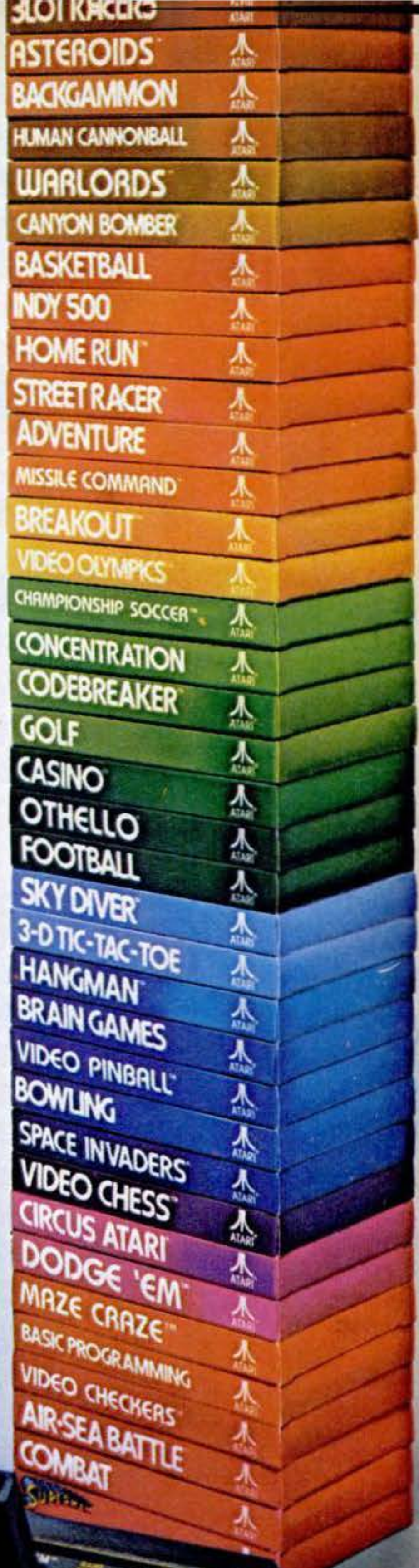
In 1980 ATARI invaded the minds of millions with Space Invaders.* It went on to become the single most popular video game in the world and thereby launched the space age game category.

Today ATARI Missile Command™ and Asteroids™ are the fastest selling home video games in the country. And

judging by its current success in the arcades, ATARI Pac Man** is slated for the same next year.



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Warning: The Surgeon General Has Determined
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Mid-price sports cars

Corvette vs. three top imports

By **JIM DUNNE** and **ED JACOBS**
PHOTOGRAPHS BY JOHN KEATING

Quick, name half a dozen of the world's most popular and desirable sports cars. If fantasy hasn't gotten the better of you, chances are that

your list includes the Chevrolet Corvette, Datsun 280-ZX Turbo, Mazda RX-7, and Porsche 924 Turbo. They're certainly among the liveliest and most sought-after mid-price sports cars.

While you may find the term "mid-
Continued

PS ratings— test report in a nutshell

The ratings are based on test results and measurements. Results should be read with the understanding that they reflect tests only on our sample cars. An excellent rating is 5 points; very good, 4; good, 3; fair, 2; poor, 1; very poor, 0.

	Chevrolet Corvette	Datsun 280-ZX Turbo	Mazda RX-7	Porsche 924 Turbo
Acceleration	5	5	5	5
Braking	2	2	1	2
Handling	3	5	5	5
Maneuverability	5	5	5	5
Quietness	0	1	0	0
Roominess	0*	0*	0*	1
Vision	4	3	5	5
Entry/exit ease	1	2	0	1
EPA economy	1	4	3	3
Ride comfort**	1	3	3	2

*No rear seat

**Authors' opinion



Sleek and spirited: Each of these sports cars has optional removable roof panels for open-air driving. Front to rear are Mazda RX-7, Datsun 280-ZX Turbo, Chevrolet Corvette, and Porsche 924 Turbo.



Corvette's smoky 60-mph panic stops were straight, but longest of all with cold brakes and second-longest hot.



Mazda RX-7 stopped straight and with little brake lockup, but stopping distances were second-longest cold, longest hot.



Datsun 280-ZX Turbo easily turned in top-rated performances in both the low-speed slalom and high-speed lane change.

PS car test & driving report

price" shocking when applied to cars costing upwards of \$20,000, that's just the way things are in the sports-car field. The ultra-exotics, for instance, have stratospheric six-figure price tags, and the two or three low-priced models are zeroing in on \$10,000.

Perhaps your "dream" list also included the new De Lorean [PS, July]. We planned to test one with this group, but De Lorean failed to supply a car in time despite several months' notice.

The four cars we tested performed pretty much as you'd expect. They were quick, responsive, generally quite agile—and just plain fun to drive. Even fuel economy has been improved this year (although a malfunction in our testing equipment prevented us from documenting by how much).

Varied engines

For all they have in common, there are major differences among these thoroughbreds. Engine type is one of the biggest. The most conventional is Corvette's big 5.7-liter (350 cu. in.) V8, a vintage design with the muscle to out-accelerate most contemporary cars. It has twice the torque of the Mazda RX-7, for example, and a third more than Datsun's 280-ZX Turbo.

But it was that torque—coupled with a 2.72:1 "economy" final-drive ratio and massive P255/60R15 tires—that ended our four-speed Corvette's test day. To get maximum acceleration with no engine bogging, it was necessary to use brutal 5,000-rpm drag-racing starts. On what was to have been the 'Vette's final run, the differential's pinion (input) shaft snapped cleanly in two. The moral: the four-speed Corvette isn't intended for drag-racing, so don't try it. (Testing was completed with an automatic-transmission model, which wouldn't affect the remaining tests.)

Another venerable engine is the

single-overhead-cam straight six in the Datsun 280-ZX Turbo. It's the same basic engine that has been in the Z-cars since their introduction a decade ago, but with new life breathed into it by turbocharging. The result is a smooth-running engine with the power to match the lighter Porsche 924 Turbo's acceleration.

The Porsche's engine is the smallest of the conventional types in this group, and seems to have benefited more from turbocharging than the Datsun's. It makes the 924 Turbo an impressively quick and responsive car, yet one that is still docile and well behaved around town. As a matter of fact, either of these turbo cars will chug along happily when driven conservatively, and will just as happily serve up plenty of power when it's needed.

The most unusual engine in this group is, of course, Mazda's tiny, turbine-smooth rotary. Now highly refined (and with the few undesirable idiosyncrasies of the mid-'70's long behind it), the Wankel is a free-revving engine with a wide power band that makes it about as much fun to drive as the turbos. It's also as docile, and is a bit more economical this year.

EPA fuel mileage (mph)

	Chevrolet Corvette	Datsun 280-ZX Turbo	Mazda RX-7	Porsche 924 Turbo
Highway	22	24	30	33
City	14	21	21	20
Calif. city	14	19	20	20

Realistically, it's probably best to consider all four of these cars as two-seaters. True, the Porsche does have vestigial rear seats, but they're really suited only for children and pets—or perhaps a picnic hamper. Fold down that seat, though, and you get a large, flat, open cargo space similar to that in both Mazda and Datsun.

Large flip-up hatchbacks on these three make cargo loading a comparative snap. Unfortunately, while the Corvette also uses the space behind its seats as the cargo area, it doesn't have a hatch. So you have to load luggage and cargo through the passenger compartment, passing it over the folded-down seats. (It's as awkward as it sounds.)

Continued



Differential failure during acceleration testing sidelined the manual-transmission

Corvette. It had to be pushed away on a floor jack because it would not roll.



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*Francis Boyden
Matamoras, Pennsylvania*

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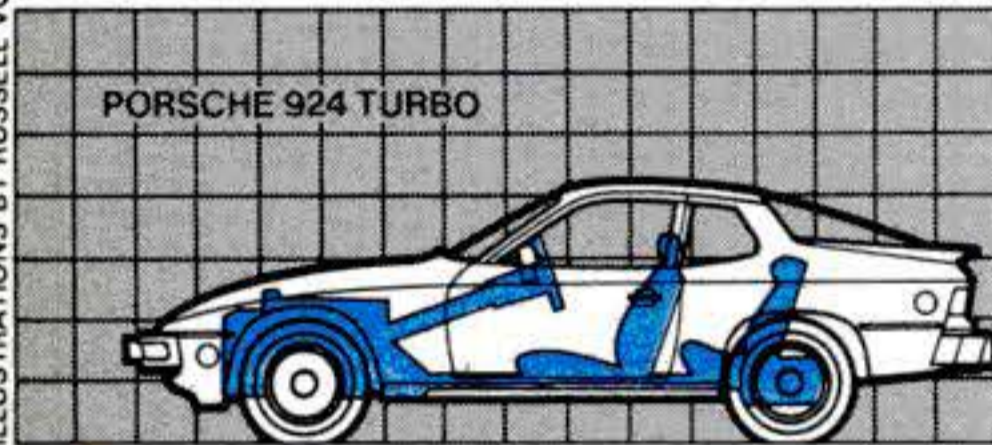
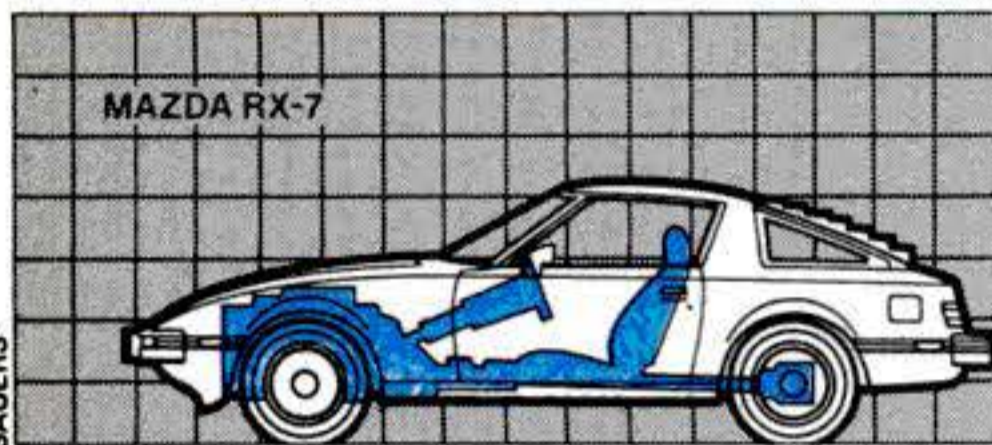
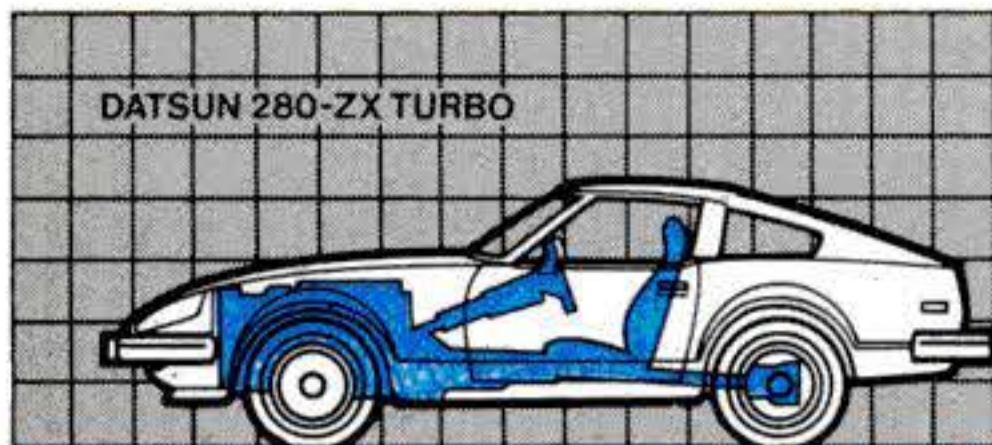
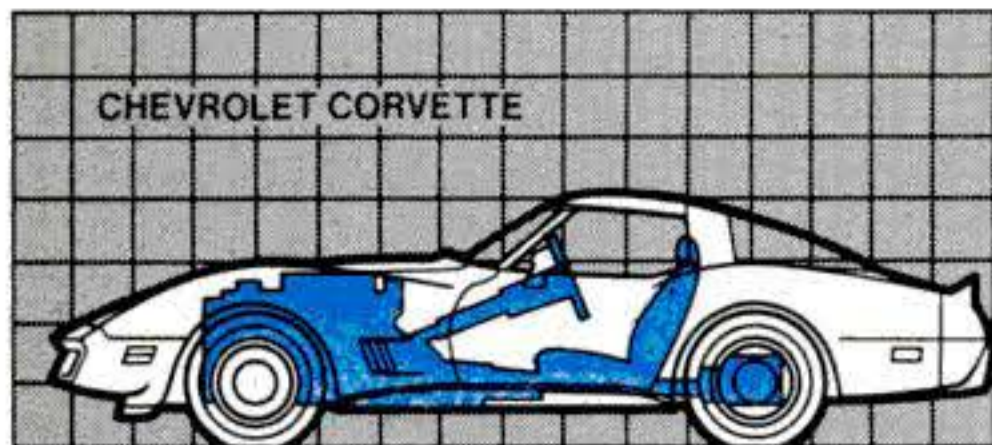


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ILLUSTRATIONS BY RUSSELL VON SAUERS

Heavyweight Corvette's much greater length is readily apparent in these scale drawings, but its 400-to-1,000-lb. greater weight is not. A 35-to-90-hp advantage helps make it quickest, however.

PS serviceability ratings

How easy is it to service these cars? To give you an approximation of how difficult it is for a typical person to perform various service operations, we examined each test vehicle. The numbers mean: 1, very difficult; 2, difficult; 3, average degree of difficulty; 4, easy; 5, very easy.

	Chevrolet	Datsun	Mazda	Porsche
Checking fluid levels				
Battery	4	5	5	5
Master cylinder	3	5	5	5
Windshield washer	5	5	5	5
Engine oil	2	3	3	4
Coolant	5	5	5	5
Checking the engine				
Spark plugs	1	5	3	3
Distributor	1	4	5	4
Carb adjustment	*	F.I.	*	F.I.
Oil filter	2	2	4	1
Oil fill	1	4	3	3
Replacing hoses				
Upper radiator hose	3	5	5	3
Lower radiator hose	1	3	4	3
Heater hoses	1	1	3	1
Changing bulbs				
Headlights	3	2	3	3
Taillights	3	3	3	3
Front running lights	3	3	3	3
Front parking lights	3	3	3	3
Front directionals	3	3	3	3
Rear directionals	3	3	3	3
Rear running lights	3	3	3	3
Checking fuses	4	4	4	4
Spare-tire accessibility	3	3	3	4
Changing belts	2	3	4	1

*Sealed

Chevrolet Corvette, Datsun 280-ZX Turbo, Mazda RX-7, and Porsche 924 Turbo—dimensions, specs, and test results

	Chevrolet Corvette	Datsun 280-ZX Turbo	Mazda RX-7	Porsche 924 Turbo
DIMENSIONS (inches)				
Wheelbase	98.0	91.3	95.0	94.5
Overall length	185.3	174.0	169.0	170.0
Overall height	48.1	51.0	50.0	50.2
Overall width	69.0	66.5	66.0	66.3
Track, F/R	58.7/59.5	54.5/54.3	56.0/55.0	55.9/54.8
Ground clearance	4.3	5.9	6.1	4.9
Front head room	36.2	34.0	34.0	35.8
Front hip room	49.9	40.0	40.0	51.6
Front leg room	42.1	41.0	47.0	45.2
Rear head room	—	—	—	32.9
Rear hip room	—	—	—	40.6
Rear leg room (min.)	—	—	—	13.6
Rear knee room (min.)	—	—	—	-0.8
Couple distance	—	—	—	10.0
SPECIFICATIONS				
Engine type	V8	SOHC 6	2-rotor Wankel	SOHC 4
Displacement (cu. in./L)	350/5.7	168/2.8	70/1.2	121/2.0
Compression ratio	8.2:1	7.4:1	9.4:1	8.0:1
Carburetion	4-bbl.	F.I.	4-bbl.	F.I.
Net hp @ rpm	190 @ 4,200	180 @ 5,600	100 @ 6,000	154 @ 5,500
Net torque @ rpm	280 @ 1,600	203 @ 2,800	105 @ 4,000	155 @ 3,300
Transmission	Four-speed manual	Three-speed automatic	Five-speed manual	Five-speed manual
Axle ratio	2.72:1	3.55:1	3.91:1	3.89:1
Tire make	Goodyear	Bridgestone	Bridgestone	Pirelli
Tire type	Eagle GT, radial	Potenza, radial	Steel Belted 70, radial	Cinturato CN36, radial
Tire size	P255/60R15	P205/60R15	185/70HR13	185/70VR15
Steering	Recirculating-ball, power	Rack-and-pinion, power	Recirculating-ball, manual	Rack-and-pinion, manual
Overall steering ratio	17.6:1	18.0:1	Variable, 17.0-20.1:1	19.2:1
Turns, lock to lock	2.6	3.5	3.7	4.0
Turn diameter (ft.)	40.4	32.2	31.5	30.8
Front suspension	Independent, unequal-length A-arms, coil springs	Independent, MacPherson struts	Independent, MacPherson struts	Independent, MacPherson struts
Rear suspension	Independent, transverse leaf spring, lateral struts	Independent, MacPherson struts	Solid axle, four control arms, coil springs	Independent, MacPherson struts
Front stabilizer-bar diameter (in.)	1.12	0.87	0.90	0.83
Rear stabilizer-bar diameter (in.)	0.44	0.79	0.70	None
Trailer towing (max. lbs.)	4,000	1,000	Not recommended	Not recommended
Trailer tongue weight (max. lbs.)	400	100	Not recommended	Not recommended
Brakes	Disc/disc, power	Disc/disc, power	Disc/drum, power	Disc/disc, power
Brake swept area (sq. in.)	498.3	n.a.	n.a.	n.a.
Fuel tank (gal.)	24.0	21.0	14.5	16.4
Cargo space (cu. ft.)	8.4	18.2	13.8	8.0
Liftover height (in.)	—	31.0	33.0	35.0
Curb weight (lbs.)	3,307	2,900	2,345	2,779
F/R weight distribution (%)	48/52	52/48	53/47	52/48
Basic price	\$16,258	\$16,999	\$11,395	\$21,500
Price as tested	\$19,000	\$17,419	\$12,785	\$22,940
Major options (over \$100) on test car	Aluminum wheels \$428, Eagle GT tires \$491, power locks \$145, rear defroster \$119, T-roof \$414, roof-panel carrier \$135, AM/FM-stereo-tape-CB \$750	Leather seats and automatic temperature control group \$420	A/C \$595, leather seats \$695, power windows \$100	G29 option group \$730, black metallic paint \$445
TEST RESULTS				
Acceleration (sec.)				
0-60 mph	8.4	9.8	11.8	9.5
25-70 mph	8.9	10.8	13.1	10.4
Brake test (cool) 60-0 mph				
Stopping distance (ft.)	170	161	162	160
Pedal pressure (lbs.)	50	135	84	100
Brake test (hot) 60-0 mph				
Stopping distance (ft.)	184	148	209	150
Pedal pressure (lbs.)	175	162	65	85
Interior noise @ 60 mph (dBA)	74	73	75	74
Handling test (mph)	59.5*	65.0+	65.0+	65.0+
Maneuverability test (mph)	27.6+*	27.6+	27.6+	27.6+

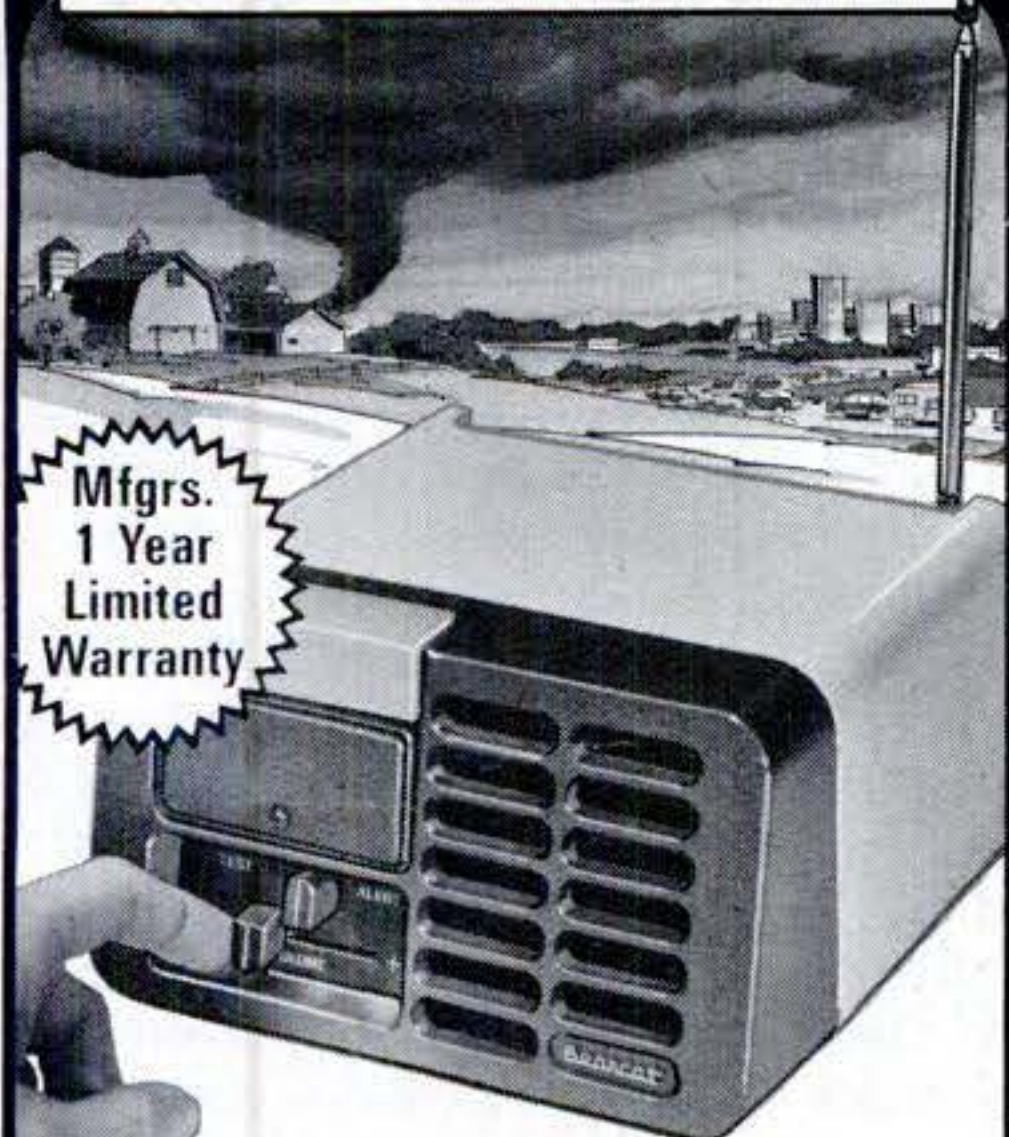
TEST CONDITIONS: Ambient temperature, 82°F; relative humidity, 75 percent; barometric pressure, 30.7 inches Hg
*With automatic transmission

Performance comparison with selected models

	Mpg (city driving)	Acceleration 0-60 mph (sec.)	Brakes 60-0 mph (hot) (ft.)	Handling (mph)	Maneuverability (mph)	Noise @ 60 mph (dBA)
1978 Chevrolet Corvette V8	14	9.4	145	64.7	27.6+	76
1980 Datsun 280-ZX SOHC 6	21	10.9	195	64.5	27.6+	75
1980 Fiat Spider 2000 in-line 4	22	12.2	178	62.4	27.6+	83
1980 Mazda RX-7 2-rotor Wankel	17	11.0	192	63.0	27.6+	78
1980 Porsche 924 Turbo SOHC 4	19	9.9	153	64.7	27.6+	76
1980 Triumph TR8 V8	14	9.9	173	60.0	27.6+	78

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- 8 hp. Briggs & Stratton 4-cycle gasoline engine!
- U.S. made, U.S. quality!
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The seats and driving positions are good in all four cars, and there is enough room for almost anyone to get comfortable. However, Corvette's wasp-waisted profile does limit interior space. But then Corvette has an excellent air conditioner; the systems in the other cars are only fair in really warm weather.

As you'd expect, instrument panels are well equipped. Datsun's, for instance, includes a combination oil-pressure-and-oil-temperature gauge right next to the boost gauge. One incongruous omission, however, is that the Porsche's panel doesn't have a

boost gauge. Avoiding unnecessary use of boost can mean significant fuel savings, and the gauge is the best means of monitoring boost.

Overall, both Porsche's and Corvette's interiors are more businesslike and functional. Mazda's interior is also functional, but with a more luxurious appearance. The Datsun leans even more heavily toward luxury, with many comforts and conveniences. Its high-tech flavor is heightened at night by excellent red-orange instrument illumination that's suggestive of a jet fighter's cockpit.

Controls are generally well placed

and easy to operate. However, while the shifters for the Porsche, Mazda, and Datsun all worked easily and crisply, Corvette's shifter was typically noisy and sloppy.

Performance

While convenience, luxury, cargo space, and even good fuel economy are pluses, in the final analysis it's performance and responsiveness that matter to enthusiasts.

Introduced nearly 20 years ago, Corvette's chassis is rather like an aging lion: It still has playful moments, and moves quickly and makes a lot of noise when you twist its tail, but it's become increasingly touchy. This touchiness comes in the form of deteriorating road manners. The car is fine in sedate touring, but in spirited driving or rapid maneuvering it darts and twitches maddeningly. All three '81 Corvettes we've driven (one of them for 1,000 miles in and around the Sierra Nevada mountains) have been like that, so it seems characteristic.

The transformation of the Datsun 280-ZX into the 280-ZX Turbo has worked wonders. Not only is there much more usable power, but the handling has also been substantially improved. The ZX's mushy suspension has been replaced by components better suited to a sports car, without spoiling smooth-road ride.

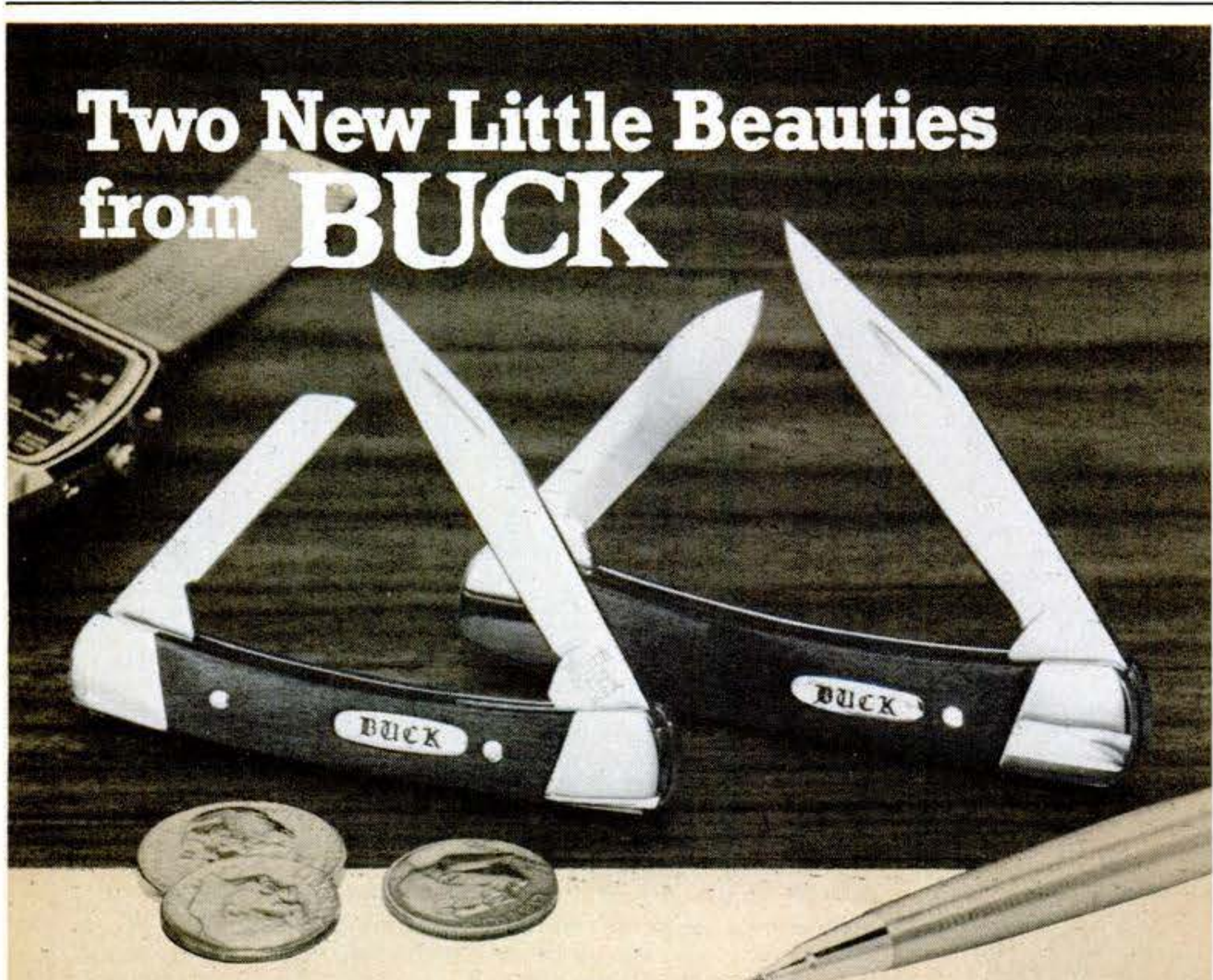
Our Mazda wasn't as quick as last year's model, perhaps because it was the heavier top-flight model, but it was still as much fun to drive. However, like every RX-7 we've tested, it clearly felt limited by less-than-ideal tires.

The 924 Turbo was fractionally quicker than last year's model—and was at least as enjoyable to drive. The car rides firmly, yet is well controlled without being harsh.

Our picks:

I feel like a kid turned loose in a candy store. I'll take the 280-ZX Turbo for its combination of macho image and soothing comfort for my non-macho muscles.—J. D.

The aging Corvette is a pale reflection of its much quicker and better mannered predecessors. I'll wait for the all-new '83. The interesting Datsun 280-ZX Turbo is miles ahead of the 280-ZX, especially in handling. Porsche's 924 Turbo is the best all-around blend of power, maneuverability, and handling, but it needs a more realistic price. For half the money you can get a Mazda RX-7 that's just as nice and nearly as much fun to drive. So it's the Mazda for me again this year.—E. J.



Two New Little Beauties from BUCK

Tiny but tough! That's probably the description of Buck's two newest pocket knives: The Pony, just 2 5/8" and the Yearling, only 3" when closed.

Each has stainless steel bolsters, non-rusting springs, and hollow-ground blades made from high-chrome, high-carbon steel that tests out at Rc 57-59.

Handle inserts are handsome birchwood, chemically treated to preserve their natural woodgrain beauty.

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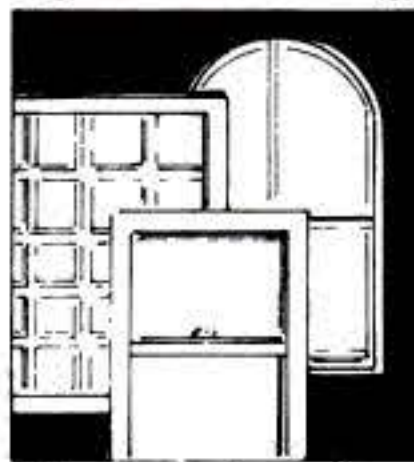
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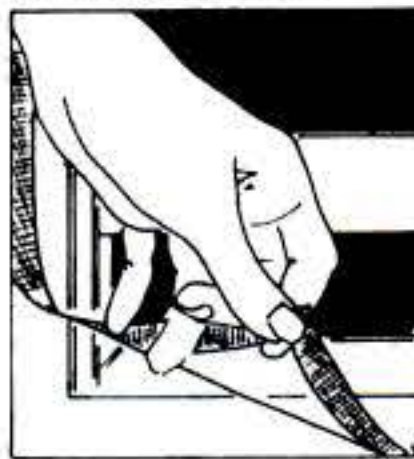
No other window kit available on the market today offers the amount of window coverage and **energy savings** of the **Torlite** system.



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- **Torlite** is 100% optically CLEAR. You don't even know it's on your window.
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- The **Torlite** system offers the same cost saving benefits for saving on your air conditioning costs.
- The sun's ultraviolet rays have a minimal effect on the **Torlite** film.
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You can test **Torlite** in your own home without risk. Trial test any two windows in your home. Compare the temperature and overall comfort. Should you feel that our system does not perform and you are convinced that it is not every bit as effective as we say, return the unused portion for a complete refund LESS POSTAGE.

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THROUGH THE VIEWFINDER



the settings for manual operation.

Another problem, but a more important one, is the difficulty, for eyeglass wearers, of seeing the whole viewfinder scene with the 28-mm lens. And the LED's sometimes seem to disappear momentarily. The camera takes a little bit of getting used to.

Prices: CLE with 40-mm normal lens, \$784;

28-mm lens, \$334; 90-mm lens, \$300; flash, \$92.

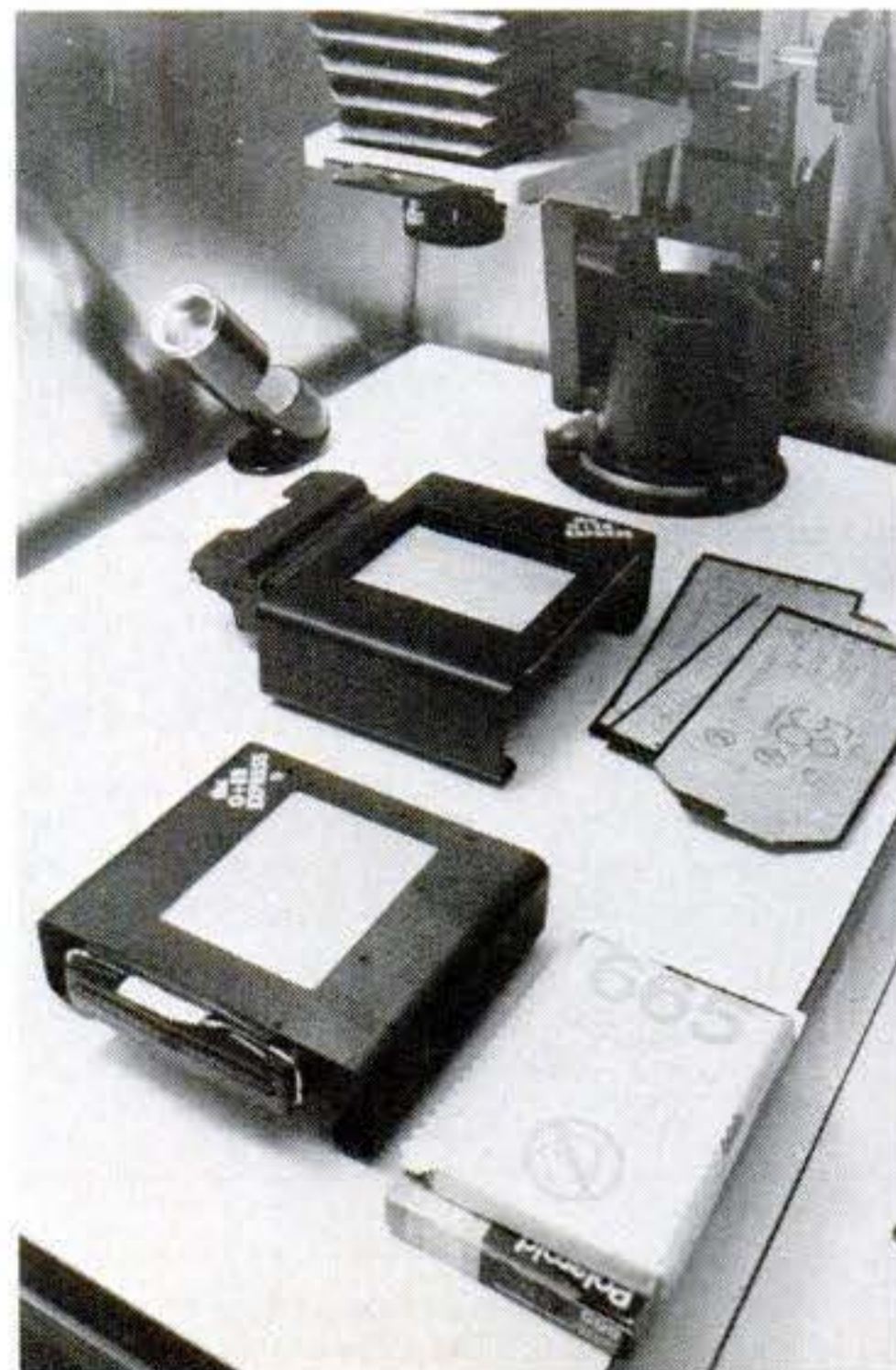
By EVERETT H. ORTNER

A year ago ["Photography in the '80's," PS, Dec. '80] I wrote about Minolta's plans to take over the Leica CL (originally a joint project with Leica), redesign it, and reintroduce it as the Minolta CLE. Now they've done it, and POPULAR SCIENCE has one. The CLE, like the CL, is a classy, small, light, 35-mm rangefinder camera with interchangeable lenses. It differs from the CL in offering automatic exposure (aperture preferred), LED's in the viewfinder, film-plane metering, electronically timed shutter speeds, and a dedicated flash tied into the camera's electronic systems. The 17-oz. camera and its remarkably featherweight lenses (4.8-oz. f/2.8 28-mm wide-angle, 3.7-oz. f/2 40-mm normal, 8.6-oz. f/4 90-mm tele) can all be carried in a small bag, or even in your pockets. Bright frame lines projected in the viewfinder, corresponding to the lens used, outline the picture area.

Exposure metering is at the film plane. A silicon photocell reads the light reflected off a mottled pattern on the shutter curtain at high speeds and off the film itself at slow speeds. The result is extremely accurate exposure on the automatic setting, with a range of speeds from $\frac{1}{2}$ to $\frac{1}{1000}$ second. You can also have manual exposure, but with some difficulty: You must meter the scene on "automatic," then make

Slides into prints

I've been turning some of my slides into instant prints lately, using the new Polaprinter slide copier. It's a simple device to use. You place the slide against a lighted preview panel, which enables you to make a choice between two possible croppings. Then you slip the slide into a slot, press a button, and pull out the exposed film



packet. In a minute (for color) or less (for b&w), your 3 $\frac{1}{4}$ -by-4 $\frac{1}{4}$ picture is complete. Controls enable you to vary exposure and contrast. An electronic flash inside gives you consistent exposures. And, of course, using Polaroid's pack films, you have not only a choice of Polacolor vs. b&w, but you also get, with Polaroid's 665 PN film, a negative with your positive print. Results? Pretty good—fine for most purposes, but not, in our judgment, comparable to high-quality prints from standard copy systems. Price: about \$500.

Another slide-to-print device in the PS darkroom is an O+ER easel that also uses Polaroid pack films. You position the easel under the enlarger, compose your picture, turn off the lights, and pull out the easel's dark slide to make an exposure. A big advantage of the O+ER unit is the freedom it offers in composing—you can enlarge any portion of the slide or copy the whole thing. The company, O+ER (11501 Sunset Hills Rd., Reston, Va. 22090), makes easels to take different Polaroid films, including 3 $\frac{1}{4}$ -by-4 $\frac{1}{4}$ and 4-by-5 pack films, SX-70, and 8-by-10 color-print film. Prices: from \$69.50 to \$249.50.

Modular super 8

"Fade in, fade out, slow-motion zoom, silhouetting, fade back—these are terms normal to professional filmmaking but not to amateur 8-mm movie cameras," reports PS Photographer John Keating, who spent some time trying out Bell & Howell's MS45 sound super 8 movie camera. "The camera combines low-cost, lightweight construction with microprocessor circuitry, and the result is the

[Continued on page 126]



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PS 3,000-MILE TEST

Chevrolet Cavalier

Following our track tests of GM J-cars for the September and November issues, we took to the road with a well equipped two-door, four-speed notch-back Chevrolet Cavalier. It spent half the test with our executive editor's family, running errands and making two trips to Washington, D.C. Then I took it for a lap around New York state and Lake Ontario (see map).

We found the Cavalier pleasingly comfortable and roomy, with good road manners and handling. But we also found so-so fuel economy and the same lack of usable power that has hobbled every J-car we've driven.

Overall economy for the test was 28.8 mpg. In a 20/80 city/highway driving mix, we obtained 30-31 mpg. Unfortunately, our first 55-mph high-

A man in a red cap and plaid shirt is shown in profile, smoking a cigarette and holding a large roll of blueprints. He is standing on a construction site with wooden framing visible in the background. The sky is blue with some clouds.

The first ultr

way cruising figures were ruined by a lazy service-station attendant, who did not completely fill the tank; and further slow cruising was precluded by the illness of my co-driver. However, cruising at 60–65 mph produced 30+ mpg; 65–70, 28+; and 70–80, 27+.

Like all J-cars, the Cavalier's Achilles' heel is its economy-only gearing. While the resulting lack of usable power is obvious enough in flat country, the car becomes maddeningly impotent in even gentle mountains. Engine woes included flat spots during acceleration, surging while cruising, stumbling and stalling when cold, and pronounced vibration at idle.

GM has recognized most of these J-car problems, however, and is changing to revised final-drive ratios and a modified "chip" in the car's computer for improved drivability. Fuel injection, livelier engines, and five-speeds are also coming.

Minor complaints: erroneous CHECK ENGINE warnings, glare on the major instruments in daylight, and a power-window switch that came adrift.

On the bright side, Cavalier's seats are comfortable and hold you in place well. The interior is surprisingly roomy, with a good driving position and excellent all-around vision. Trunk space is both generous and usable. The air conditioning worked

well, although the ventilation system always preheated the fresh air. Steering response was good, and the car always tracked well, even on crowned secondary roads and through torrential Canadian rainstorms.

Overall, Cavalier has the makings of a fine car and has realized much of its potential. Soon, it is hoped, its engine and drive-train shortcomings will be cured.—*Ed Jacobs*



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Turco offers three models to choose from. All are UL listed, and have double safety-shutoffs, removable fuel cartridges, and automatic igniters. And all come with a limited one year warranty.

For the name and location of the Turco dealer nearest you, call toll free: 1-800-851-8481. In Illinois call: 618-542-4781.

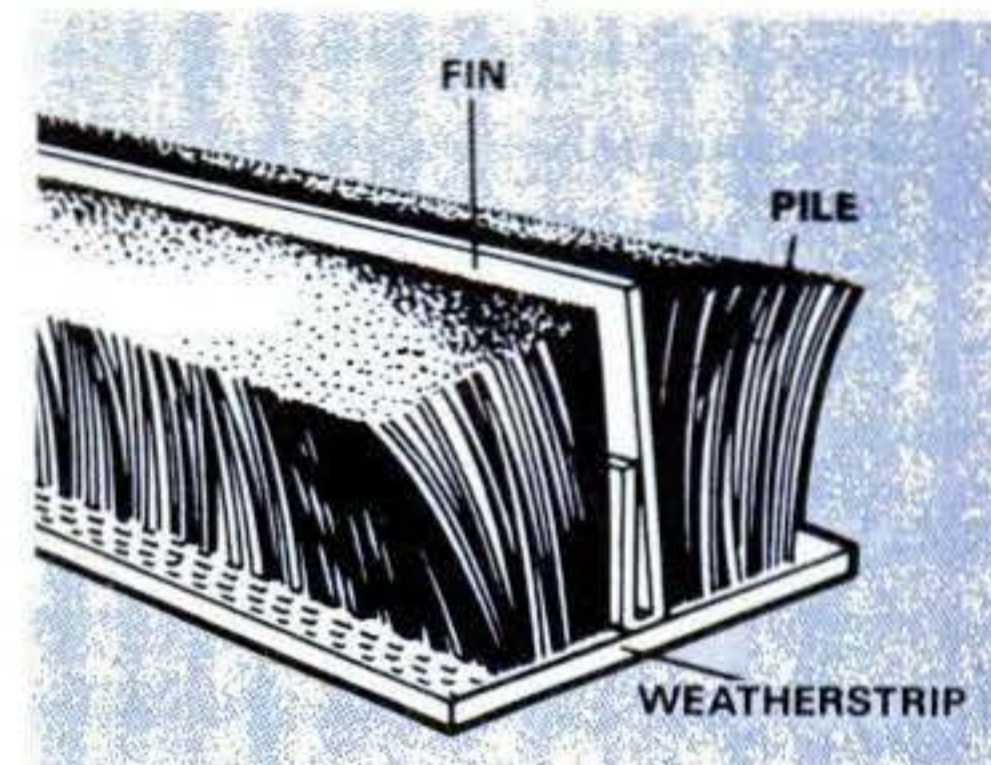
Under the limited warranty, Turco will replace or repair any parts that fail due to defects in material and workmanship for a period of one year from date of purchase, except for normal wear and tear items.



Turco

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Super-tight storm windows



Ideally, an old, leaking window should be replaced with a modern double- or triple-glazed unit. When that isn't possible, installing a storm window may have to suffice. A problem with many storm windows, though, is that their pile weatherstripping can let in air.

Several storm windows now on the market significantly reduce that air leakage with a new type of weatherstripping—Fin Seal. Like conventional storm-window weatherstripping, Fin Seal uses pile to keep the windows from rattling. But a flexible fin in the middle of the pile (see drawing) blocks out air that might otherwise leak through.

Its developer, Schlegel Corp., of Rochester, N.Y., says the average storm window leaks two cubic feet of air per minute for each foot of crack perimeter. Testing, Schlegel says, has shown that windows using Fin Seal leak one-fourth that amount.

To determine whether a storm window uses Fin Seal weatherstripping, check for the flexible fin in the middle of the pile.—Ray Hill



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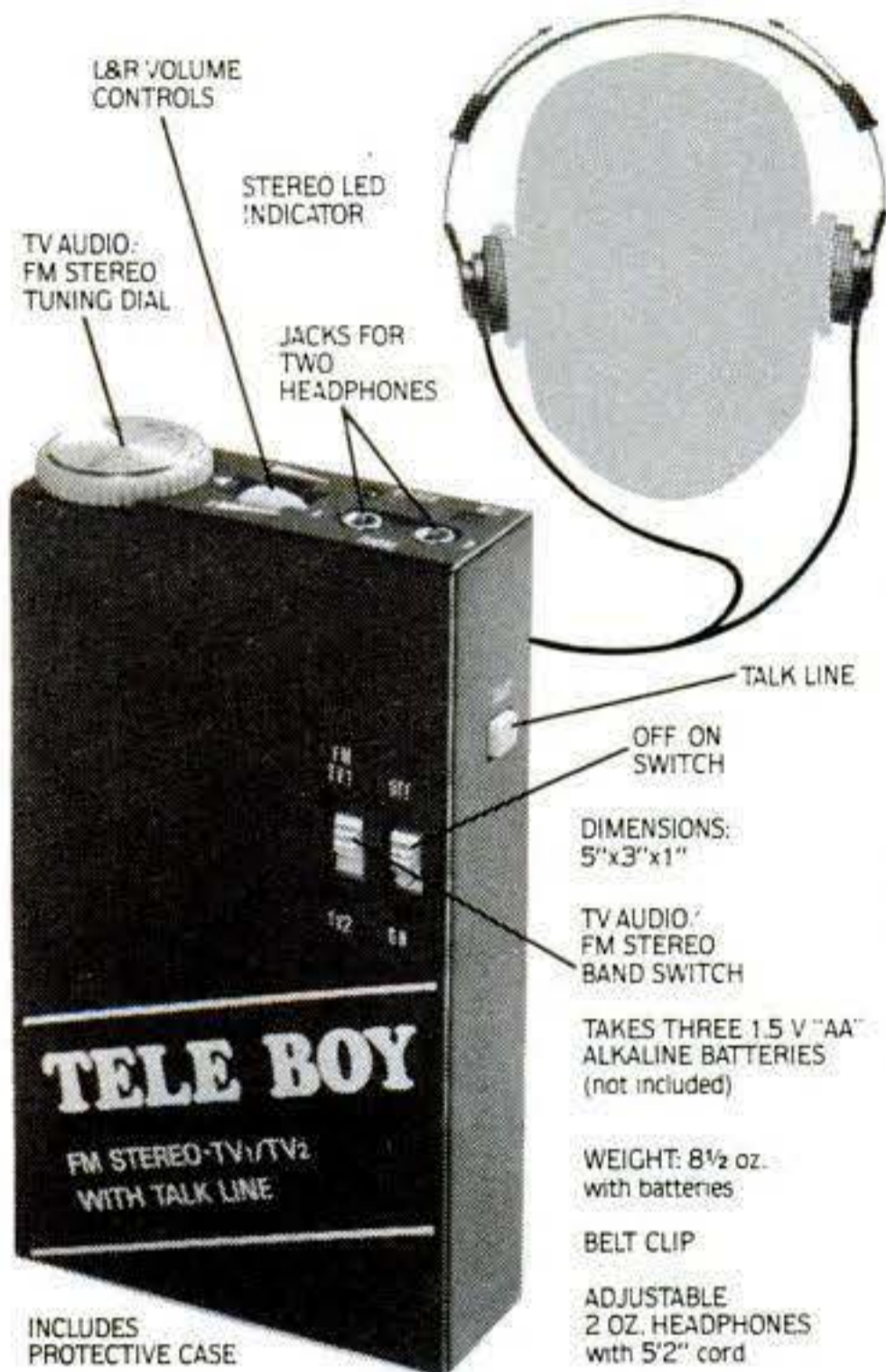


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Heat-storing ceiling



The costly heat that collects at ceiling level can be captured and recycled, it's claimed, if you line your ceiling with plastic pouches called HeatPacs. The pouches are filled with Glauber's salt (sodium sulfate decahydrate), a phase-change material that melts at room temperature, absorbing heat as it does so. When the temperature in the room drops, the Glauber's salt solidifies, releasing its heat. Seventy-three degrees F is the normal melting temperature for HeatPacs, but it can be varied from 60 to 88 degrees.

"The heat is radiated back to the room like an indoor sun and warms floors, people, and the interior. . .," says Colloidal Materials, Inc. (Box 696, Andover, Mass. 01810), maker of the HeatPac pouches.

You put HeatPacs in the ceiling below the insulation but above a facing and supporting layer. The company recommends aluminum tiles (or other highly conductive material) for this, or a slatted ceiling.

A HeatPac ceiling will store heat from any source. Solar radiation, for example, can be directed to the ceiling by a special blind (also sold by the company) and reradiated to the room at night or in cloudy weather. The ceiling is also effective in storing the heat from a wood stove or fireplace. It will then release the heat as you sleep—or simply let you build a fire less often. A bonus: HeatPac ceilings even out temperature extremes common to solar and wood heating systems, so your house should be more comfortable all the time. The company also touts HeatPac ceilings for heat storage with electric heat if your utility offers low off-peak rates.

HeatPacs measure 12 by 24 inches and cost \$3.75 each. They weigh five pounds per square foot, and must be installed horizontally.—V. E. Smay

Piezoelectric footprints track down ailments

Feet. They're a sore subject for more than half the adult population in the U.S. But a new device may help. It's called a piezoelectric footprint machine, and it's designed to measure accurately how pressure is distributed between your foot and shoe while standing, walking, and jumping.

"Until now there's been no way to measure the critical pressure points between foot and shoe, which can lead over time to foot problems," explained Dr. Peter R. Cavanagh, professor of biomechanics at Penn State and co-inventor of the machine. "Physicians examine the way people walk. They then try to prescribe a shoe or in-shoe device they hope will correct the problem."

With the footprint machine, a sole-shaped piece of silicone rubber inserted between the foot and shoe does the "watching." Inside, a mosaic of 500 ceramic square piezoelectric transducers produces separate electric charges when subjected to pressure. Each signal is sorted by a microprocessor and sent to a computer with a graphic display.

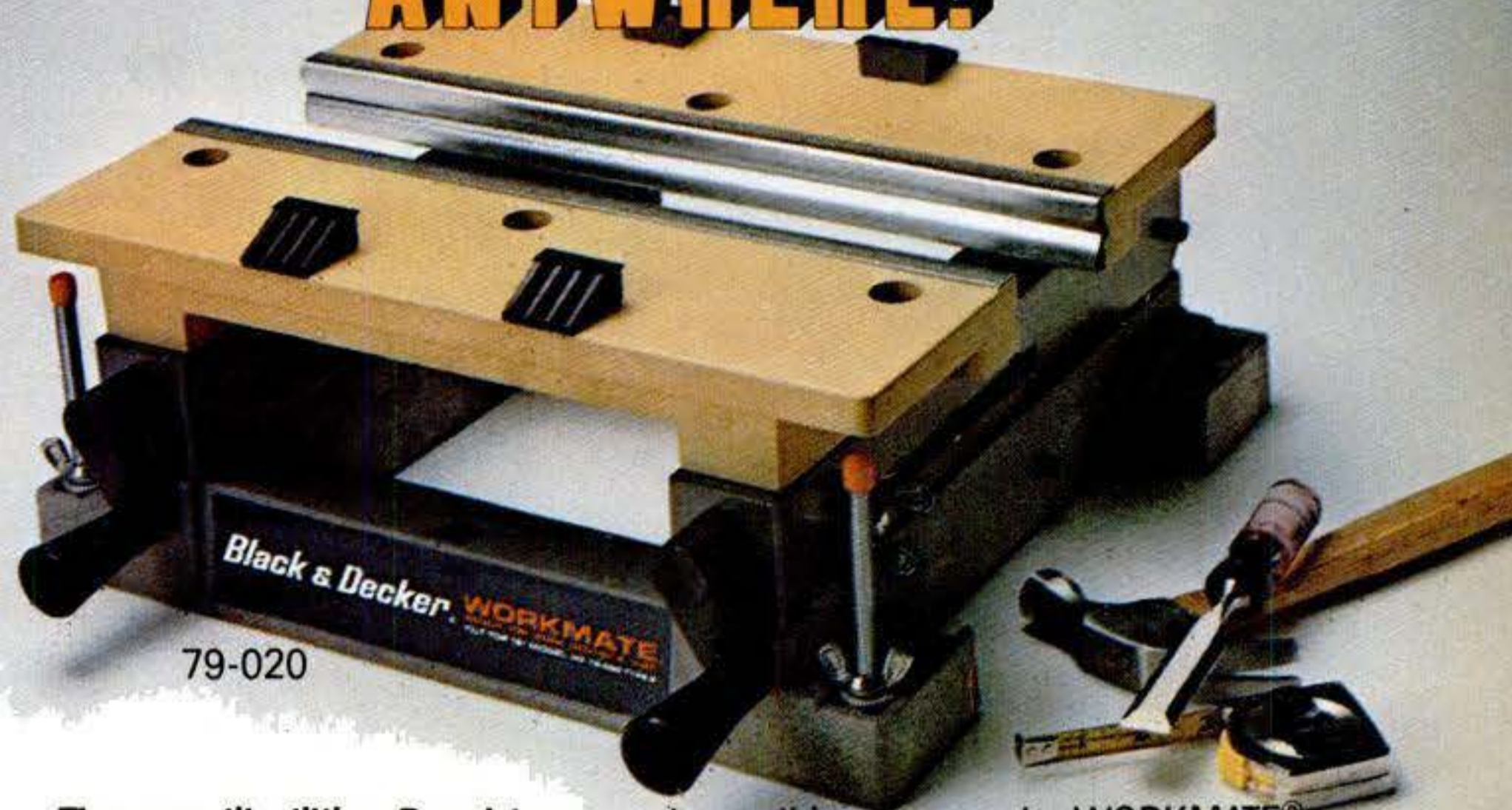
"The result," said Cavanagh, "is an animated film in which the foot and its pressure distribution appear in a three-dimensional wire-frame display. The peaks of pressure appear as mountains on the foot's surface. This makes detection of unusually high pressure spots relatively simple."

To diagnose a problem, your footprint portrait can be compared with that of a healthy foot or of someone with a specific foot disorder. "It takes the guesswork out of pinpointing existing or potential problem areas," added Cavanagh, "where there may be high pressure points on the sole."

The machine may be of particular help to some diabetics who suffer from ulcerations or lesions of the foot. This has been thought to be caused by abnormal pressure distribution.

The work, supported by the National Institutes of Health, is still in the development stage. But ultimately, according to Cavanagh, "we hope it will be possible to design and build relatively simple-to-use, inexpensive footprint machines for use in hospitals and doctors' offices worldwide." — *W. J. Hawkins*

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My name is Dr. George McCarty. I teach math at the University of California. I wrote this guidebook to cut through the confusion. It does just that — with worked-out examples, simple exercises and practical problems — all designed to work with precision and magic on your calculator!

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Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the **most advanced security system available for consumer use.** With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

The Perim-A-Tron™ is so easy to live with that pets can come and go through partly-open windows or sliding glass doors without triggering it, yet so vigilant that an intruder will set it off before he can enter.

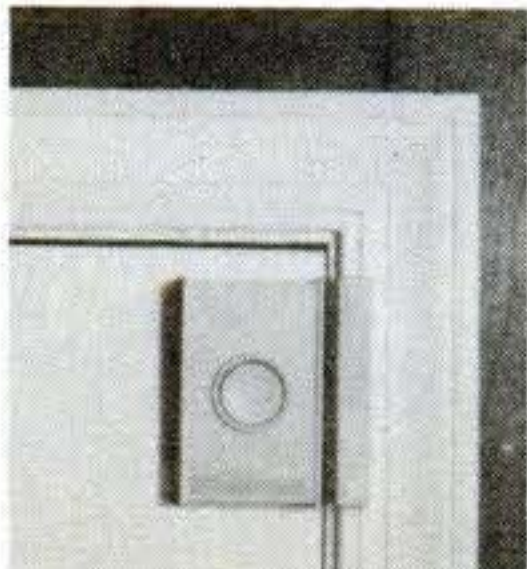
THOUSANDS OF OPTIONS

Perim-A-Tron's™ micro-computer lets you choose from thousands of three digit disarm codes. **Only you know your code.** But if your son's friend receives a "demonstration", you can easily change the code again...and again. You need no specially coded key which can be lost, misplaced, or stolen. The system even has two separate channels, each with its own distinct alarm sound. This feature allows you to zone your system. For example: Channel 1—house, Channel 2—garage, or Channel 1—doors, Channel 2—windows.

HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for



This photo shows a transmitter & magnet installed. If a break-in attempt occurs, the transmitter and magnet become separated triggering a wireless radio signal which activates the alarm. Installation takes only a few minutes and doesn't even require a screwdriver.



Perim-A-Tron's™ 20 button keyboard gives you protection a \$2,000 commercially installed system can't beat. Includes powerful remote horn.

10 minutes and scaring away the intruder, the system shuts off automatically and re-sets itself.

A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2½ second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is **highly resistant to false alarms because it is not sensitive to motion or sound.** Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack— all without setting off an alarm.

COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's **EXTRA PROTECTION DESIGN** lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost \$2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to \$200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines **pre-entry** protection with micro-electronic circuitry to provide the most protection at the lowest cost.

U.L. LISTED

The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a **burglary protection device**, a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

YOU BE THE JUDGE

We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 25 year reputation for satisfied customers.

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To order simply send your check for **\$199.95** plus \$5.65 for shipping and handling to the address below. Credit card holders can speed delivery of their system by using our toll-free number listed below. We will then promptly ship your Perim-A-Tron™ unit complete with easy-to-understand instructions and decals warning that the premises are protected. Additional transmitters are available for \$29.95 each, but one is not required for every door and window. Instead, magnetic contacts can be purchased and easily connected to the transmitter, allowing you to cover additional openings for as little as \$5 each. The instruction booklet is quite useful in helping you determine the correct combinations to protect your home or office at the lowest possible cost.

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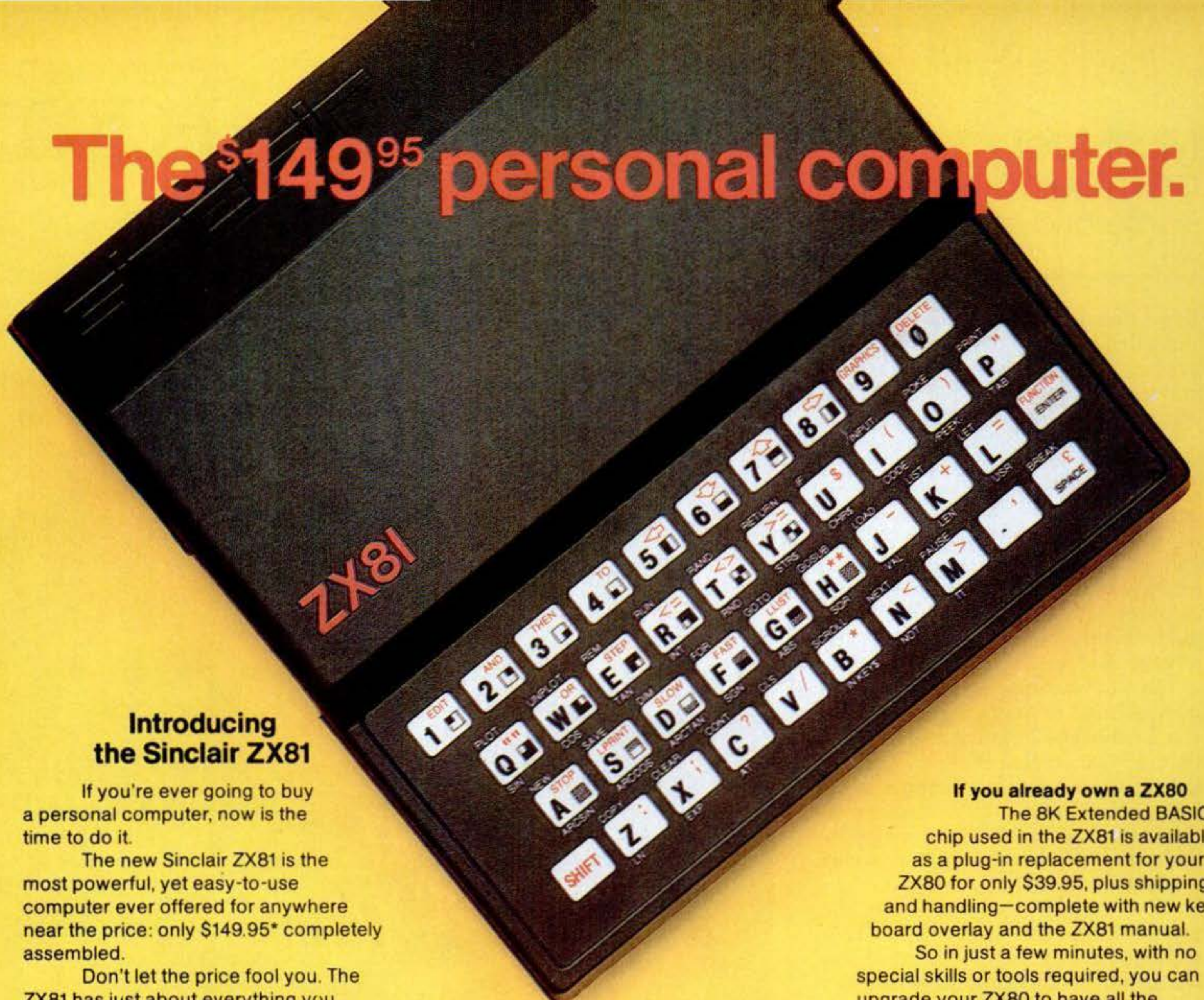
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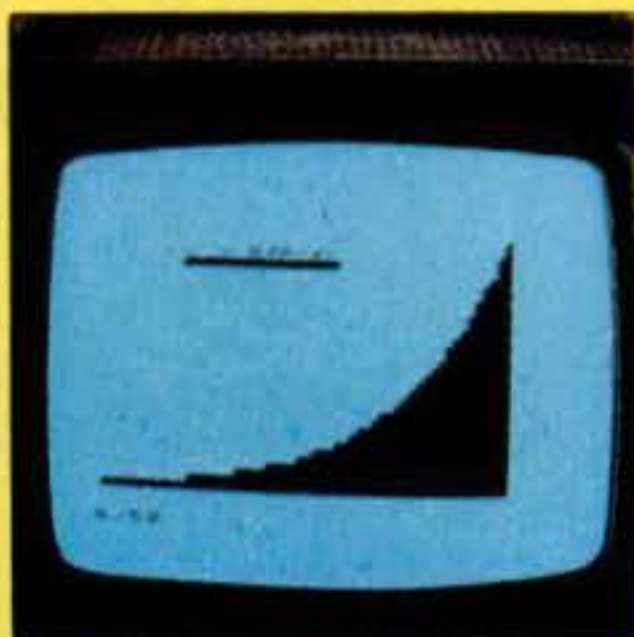
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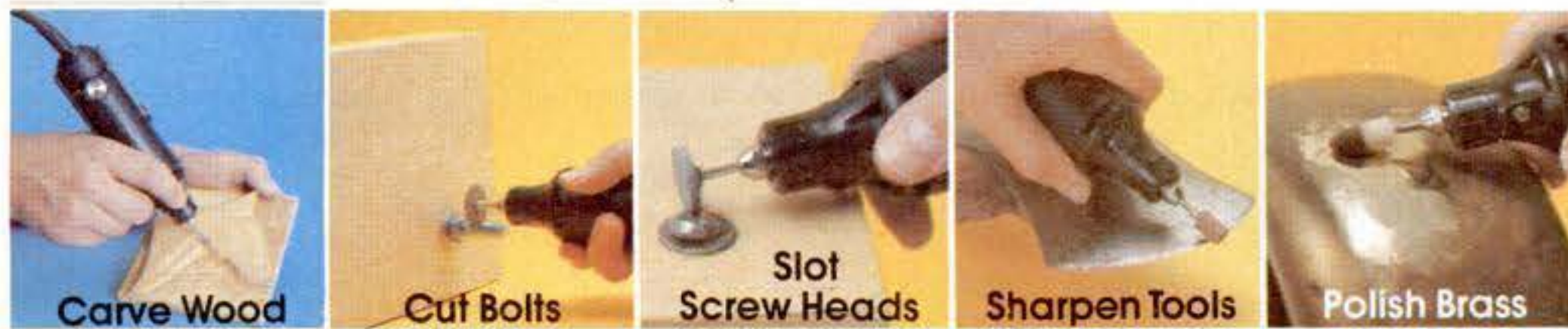
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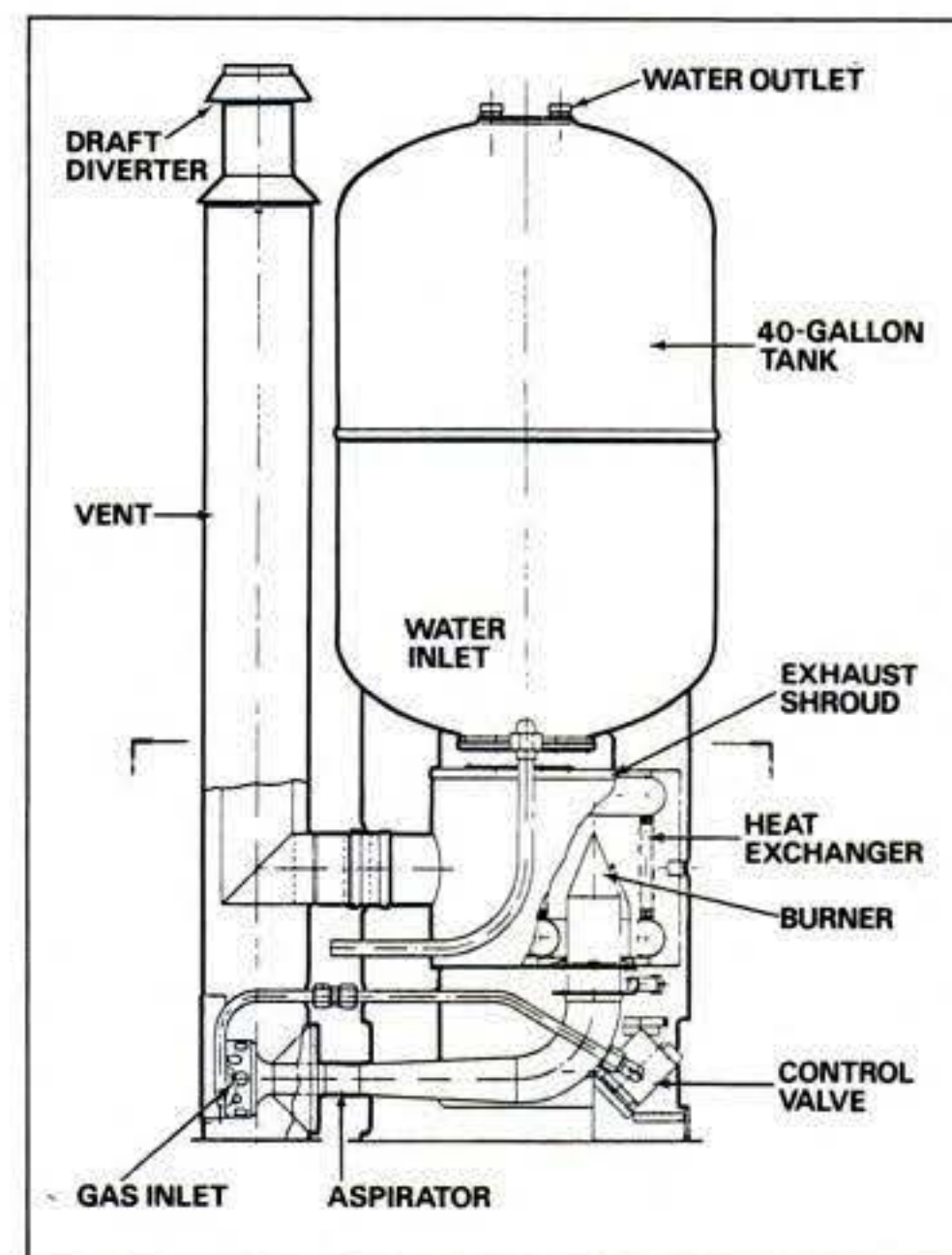
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DREMEL®



High-efficiency gas water heater



In a conventional gas water heater, the gas burns at the bottom of the tank and hot combustion products travel up through a baffled vent in the center of the tank, heating the surrounding water. Of course, not all of the heat gets transferred to the water; much of it goes out the flue. And even when the burner isn't on, that vent bleeds heat from the surrounding water.

A new gas-water-heater design improves efficiency by putting the vent stack beside the tank rather than inside it. Water is heated as it circulates through a copper heat exchanger above the burner. The exhaust gases pass out the adjacent vent. The prototype was developed by Advanced Mechanical Technology, Inc. and Amtrol, Inc. under a Department of Energy contract supervised by Oak Ridge National Laboratory.

Tests of the unit (with a temperature rise of 90 deg. F and an outlet temperature of 150 deg.) show 66 percent efficiency, compared with 51 percent for conventional gas heaters and 61 percent for high-efficiency models.

Initial price would be from \$115 to \$175 above conventional models, but lower gas consumption would recoup the outlay in three to six years. The design should also outlast conventional water heaters, whose glass-lined tanks usually leak in 10 or 11 years. This one has a polyethylene liner and should last 15 years. Fifteen prototypes will undergo further tests. If they prove successful, the next step is commercialization.—V. E. Smay

DODGE MINI RAM. MORE MILEAGE, RANGE AND SEATS THAN VW VANAGON FOR \$1325 LESS.



Who moves more people than VW for less money? It's Ram Tough Dodge's new Mini Ram Wagon.

Compare Dodge Mini Ram 250 to VW Vanagon—passenger seating, gasoline mileage, fuel capacity and range, horsepower and rear loading area. Mini Ram gives you more.

Then compare standard features like power steering and factory-installed options like air conditioning and your choice of 6 sound systems: all available in Mini Ram. Not in Vanagon.

Now compare price. Mini Ram costs \$1,325 less than Vanagon. For panel-side van buyers, there's a Dodge Van with the same performance, effi-

Here's how Mini Ram beats Vanagon

	Dodge Mini Ram Wagon 250	VW Vanagon
Sticker Price (MSRP)	\$9,365.00*	\$10,690.00*
EPA EST. MPG	19 MPG**	17 MPG**
Horsepower	95	67
Passenger Seating	8	7
Overall Length	178.9"	179.9"
Wheelbase	109.6"	95.8"
Fuel Capacity	36 gal.	15.9 gal.
EPA Est. Range	684 miles**	270 miles**
Side Door Width	49"	42"
Removable Rear Seat	Yes	No
Power Steering	Standard	Not Available
Color-Keyed Carpeting	Standard	\$410 with int. pkg.
Factory-Installed Air Conditioning	Option	Not Available

ciency and interior dimensions as Mini Ram Wagon at a price VW hasn't seen in years—just \$6,928*.

Underneath it all, Mini Ram is a Ram Tough Dodge Wagon. With the best rust protection of all wagons. There's 100% electro-coating, plus 370 sq. ft. of galvanized steel in critical areas... compared to VW's 4 sq. ft.

New Dodge Mini Ram Wagon. It does more than VW Vanagon and it does it for less. As a pure people mover, it just might be the best buy on the road today.

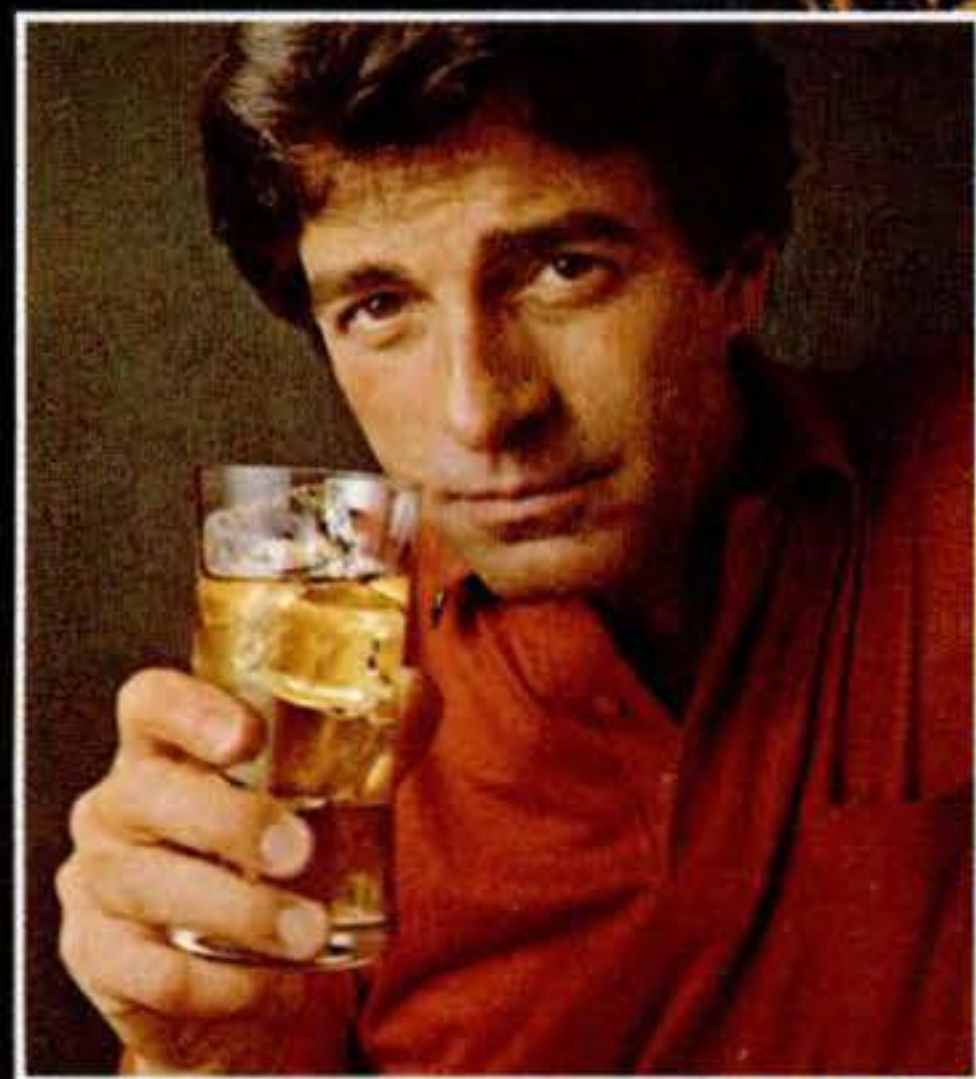


DODGE TRUCKS ARE RAM TOUGH

*Sticker price comparison, excluding title, taxes and destination charges, unadjusted for different levels of standard equipment. Whitewall tires \$85 extra. Prices and specifications as of October 1, 1981.

**Use these numbers for comparison. Your mileage and range may differ depending on speed, distance and weather. Calif. est. lower.

"I never knew gold rum tasted like this!"



If you're still drinking Canadian and soda...

it's because you haven't tasted gold rum and soda.

That's the reaction that's made Puerto Rican gold rum one of the most popular and fastest growing liquors in America today.

People try it once. Then again and again.

Either on the rocks, or with a dash of soda or your favorite mixer. Any way you try it, gold rum is a smooth alternative to bourbons, blends, Canadians—even scotch.

Try the delicious gold rums of Puerto Rico. The first sip will amaze you. The second will convert you.

Make sure the rum is from Puerto Rico.

Great rum has been made in Puerto Rico for almost five centuries. Our specialized skills and dedication result in rums of exceptional dryness and purity. No wonder over 88% of the rum sold in this country is Puerto Rican.

Look for the name Puerto Rico on the label. It's your assurance of excellence.



RUMS OF PUERTO RICO
Aged for smoothness and taste

With the world's increasing dependence on offshore oil, the marine-engineering field has been growing rapidly. Huge trade shows and scientific conferences draw thousands of experts each year to learn about all the new developments in building offshore drilling platforms, laying pipeline, and performing numerous other giant engineering projects while holding off the unforgiving environment of the open ocean.

Peter Britton, whose work you have seen regularly in *Popular Science* in recent years, is fascinated by this emerging story of ocean engineering, and has been following it closely and going to many of the conferences. He wrote the article on the giant new drilling rigs that appeared last January. Now he's discovered another little-known aspect of the field: the rapidly developing technique for building remotely controlled submersible vehicles that can do the dirty, dangerous jobs now often done by divers. Although they have been in use for only a short time, they've already chalked up some impressive accomplishments. Peter's story tells you about some of them, and about the technology that is making possible this new generation of robot subs.

We thought the new underseas vehicles were interesting enough to be featured on the cover. The painting was done by Dean Ellis, one of our most prolific cover artists.

New goals in space

West Coast Editor Jim Schefter, who covers space assignments regularly for *Popular Science*, files this report:

"The Space Operations Center (SOC) described in the October issue would be NASA's number-one priority for this decade under a plan being pushed by the Johnson Space Center. Center Director Christopher C. Kraft has committed JSC to pressing the concept in Washington and is receiving both technical and moral support from astronauts, aerospace companies, and observers who are increasingly concerned about the Soviet Union's demonstrated ability to orbit reusable, long-duration space stations.

"With adequate funding beginning next year, JSC believes that the first habitable elements of SOC could be orbiting Earth in 1987. Given the 'level funding' concept of recent years, which is generally blamed for restricting spending and causing many

of the Space Shuttle's delays, a more realistic date may be 1991.

"The astronaut corps, which now numbers about 80, is particularly encouraged by Kraft's decision. Many of the newer astronauts, including physicians and astronomers, find themselves spending more time becoming engineering generalists than in developing their specialties for use in space. SOC would change all that by providing a permanent, in-orbit facility where their talents could be more thoroughly used.

"Formal approval from NASA headquarters, where Deputy Administrator Hans Mark is an early SOC proponent, and from the White House is needed to move SOC from the paper stage to hardware development."

Superlenses

"The man you want to talk to about new lens technology is Duncan Moore, at the University of Rochester," two lens designers—separately—told Everett Ortner as he was researching his article on superlenses for this issue of *Popular Science*. And a new technology is indeed being brewed in the vats of the optics department at the university. What's coming out is a material called gradient-index glass. You get it by putting, for example, sodium-rich glass in a hot bath of melted lithium bromide. An ion exchange takes place, with lithium replacing the sodium. Result: a new kind of glass in which light rays can travel in a curved path *between* the lens surfaces instead of *at* the surfaces. "It takes a certain number of lens surfaces to correct certain types of aberrations," says Dr. Moore. "Gradient-index glass allows you to do a part of the correction *internally* and thus reduce the number of elements in a sophisticated system."

For more about superlenses, turn to the special photography section in this issue.

Big jackpot

Would you like to win \$140 million? That's the prize being considered by Congress for the first firm that can design and manufacture a car meeting certain specifications. The car would have to sell for \$6,000, get at least 80 miles per gallon in the city, hold four people and luggage, meet all federal safety and environmental

regulations, and have an average lifespan of 100,000 miles. Oh yes, and 100,000 of the cars must be built. The idea was suggested by the Battelle Memorial Institute, the world's largest independent research firm. A house subcommittee, investigating how the government can help advance automobile technology, has the idea under consideration.

Energy conservation

How much energy could we save if we really got serious about it? A study by the University of California's Lawrence Berkeley Laboratory says that energy use in homes and buildings could be cut in half by the turn of the century, using only the techniques we know today. The report estimates that we could save one barrel of oil for every \$10 we spend in making buildings more energy efficient. To put that another way, the authors point out, it's like buying oil at \$10 a barrel. And that's a bargain any way you figure it.

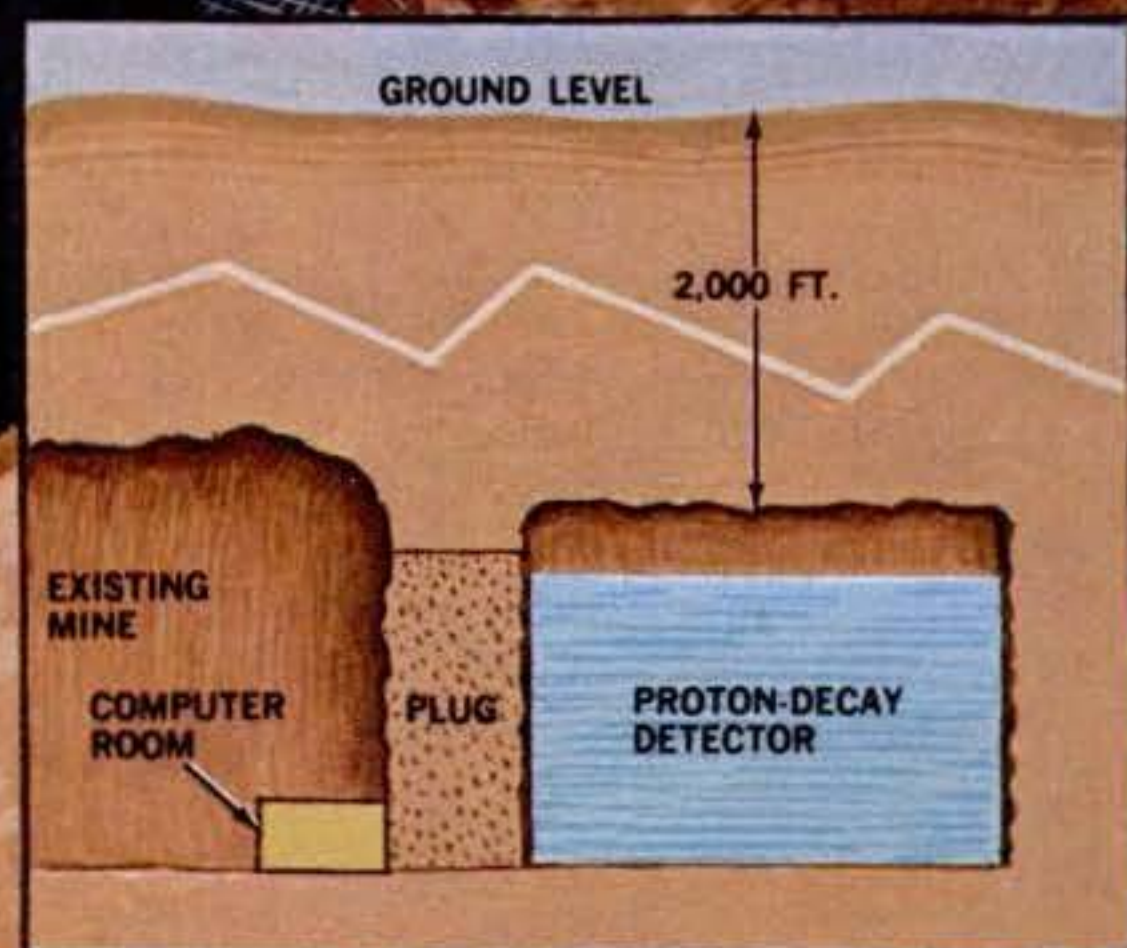
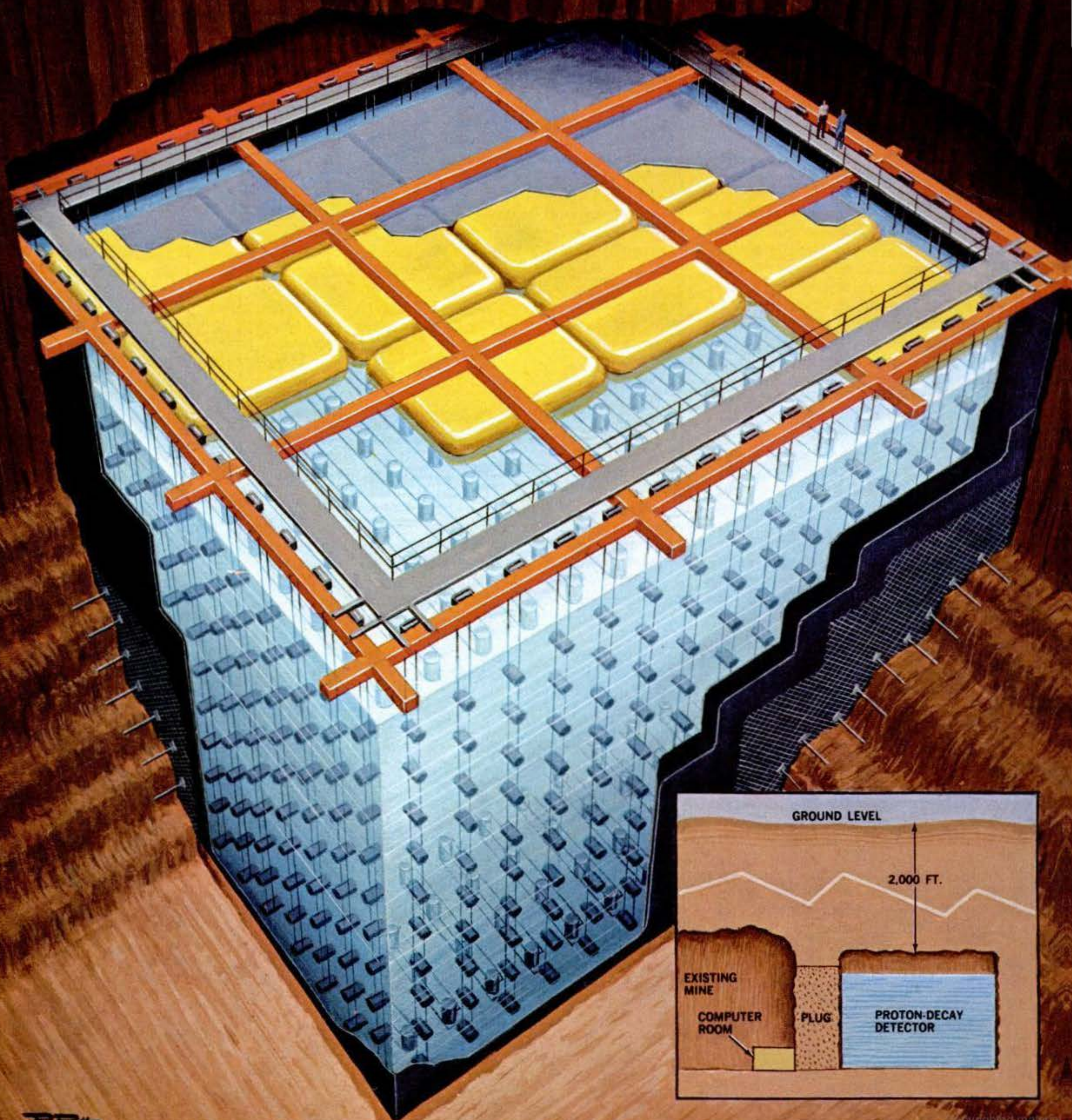
More prizes

I am constantly amazed by the number of prizes and awards *PS* writers and editors win for their writing. This month, news reached us that one of the most prestigious national awards has been won by Science and Engineering Editor Arthur Fisher. He has received the Howard A. Blakeslee Award of the American Heart Association, one of the oldest and most respected honors in journalism. Arthur received the award for a book of his just published by the Time/Life Library of Health. It is called *The Healthy Heart*, and reports what we know about heart disease and health and what we can do to prevent the former and encourage the latter. Arthur has won other awards including the Claude Bernard science-journalism award, and has been cited by the Deadline Club—a journalism organization—for excellence in science writing.



Editor-in-Chief

The underground search
for clues to an
**unstable
universe**



Signs of proton decay will put a new face on the nature of matter

By PETER GWYNNE
ILLUSTRATION BY RAY PIOCH

Dressed in coveralls, hard hat, and steel-tip boots, I slowly descended on a spider, the contraption that window washers use on the outsides of high-rise office buildings. But this was no window job. I was dropping down the inside of a plastic-lined, five-story-high pit carved out of a salt mine nearly half a mile beneath the shore of Lake Erie. Physicists and technicians there were preparing the pit for a watershed experiment that could reveal the true nature of the universe.

The experiment, one of many taking place in underground caverns around the world, seeks to confirm a theoretical prediction about protons, the positively charged components of the atomic nucleus. Until recently, physicists thought that protons survive unchanging to eternity. The very fact that humans and other matter on Earth do not glow with radioactivity is proof that the mass of most protons has not decayed into energy since the birth of the universe, an estimated 20 billion years ago.

But now, theorists working on the furthest frontiers of physical knowledge believe that the proton is not immortal. A typical one, they contend, splits asunder after about 10,000 billion, billion billion years— 10^{31} years in mathematical language. As one prominent theorist, Nobel laureate Sheldon Glashow of Harvard, puts it, "Diamonds may not be forever."

To the man in the street, 10^{31} years is hardly different from forever. Yet this extremely rare event, hellishly difficult to detect, could, if it is found to happen, have profound effects on the entire structure of theoretical physics that gives us some understanding of the universe. On the other hand, if experiments can conclusively rule out the possibility that it happens, then physicists will have to throw out most of what they think they know and start all over.

"It's a very simple question that we're trying to answer," said John Vander Velde, a University of Michigan physicist who is one of the leaders of the salt-mine experiment I visited.

In this prodigious pool of water almost half a mile beneath the dunes of Lake Erie, researchers might be able to catch up to 100 protons in the throes of decay during the coming year—if they're lucky and theorists' predictions are right.

"But it happens that the answer has very profound implications."

The scientists who come up with the first definitive evidence for proton decay will almost certainly earn a Nobel prize. And they will have brought science a giant step closer in its quest for a unified-field theory—a set of equations that would link the four known forces of nature.

Of these, electromagnetism and the weak nuclear force (which governs conventional radioactive decay) have been shown to be manifestations of the same force. Experts are now making spectacular progress in bringing into the scheme the strong nuclear force (which keeps atomic nuclei from tearing apart). Calculations by Howard Georgi, Helen Quinn, and Nobel laureate Steven Weinberg at Harvard suggest that those three forces become identical at enormously high ener-

“Experimentalists find it hard to resist near-impossible challenges. The race is on.”

gies. (How the fourth force, gravity, could fit remains elusive.)

At these awesome energies, the Harvard trio asserts, such strong-force-influenced particles as protons can change into weak-force-influenced particles such as electrons. Although the required conditions would have actually existed in the universe only during the first few seconds of the Big Bang, the fireball that started the cosmos, they have left a kind of fossil in the form of proton decay. However, since this decay is predicted to occur so infrequently, detecting it poses one of the most stirring challenges experimental scientists have ever faced.

Thus, the experiments designed to detect proton decay are exceedingly elaborate and expensive. Not even the most dedicated researchers can wait 10^{31} years to spot the sudden collapse of a few protons. The alternative is to observe a great many of them for a shorter period. Proton decay, if it happens at all, happens a little bit at a time. Among a batch of 10^{31} protons, theorists expect that one solitary proton will decay in a year.

Looking for one decay a year would be a futile occupation, especially since the signature of such a decay would look much the same as some other events that are expected. For example, bombardment of protons by high-

energy particles from space (cosmic rays) and other kinds of subnuclear decays would produce signals that could easily be confused with proton decay. Therefore, the experiments that are under way use samples containing 10 to 100 times that many protons and are performed deep underground to screen out the cosmic ray background as much as possible.

The cavern in the mine I explored, for example, will be filled with water containing 10^{33} protons—enough to yield 100 decays annually if the theorists are correct. Even so, the team of researchers from the University of Michigan, University of California at Irvine, and Brookhaven National Laboratory will have to be lucky as well as skillful to find positive evidence of proton decay. "We're trying to do an almost impossible task at the cutting edge of technology," co-principal investigator Larry Sulak says.

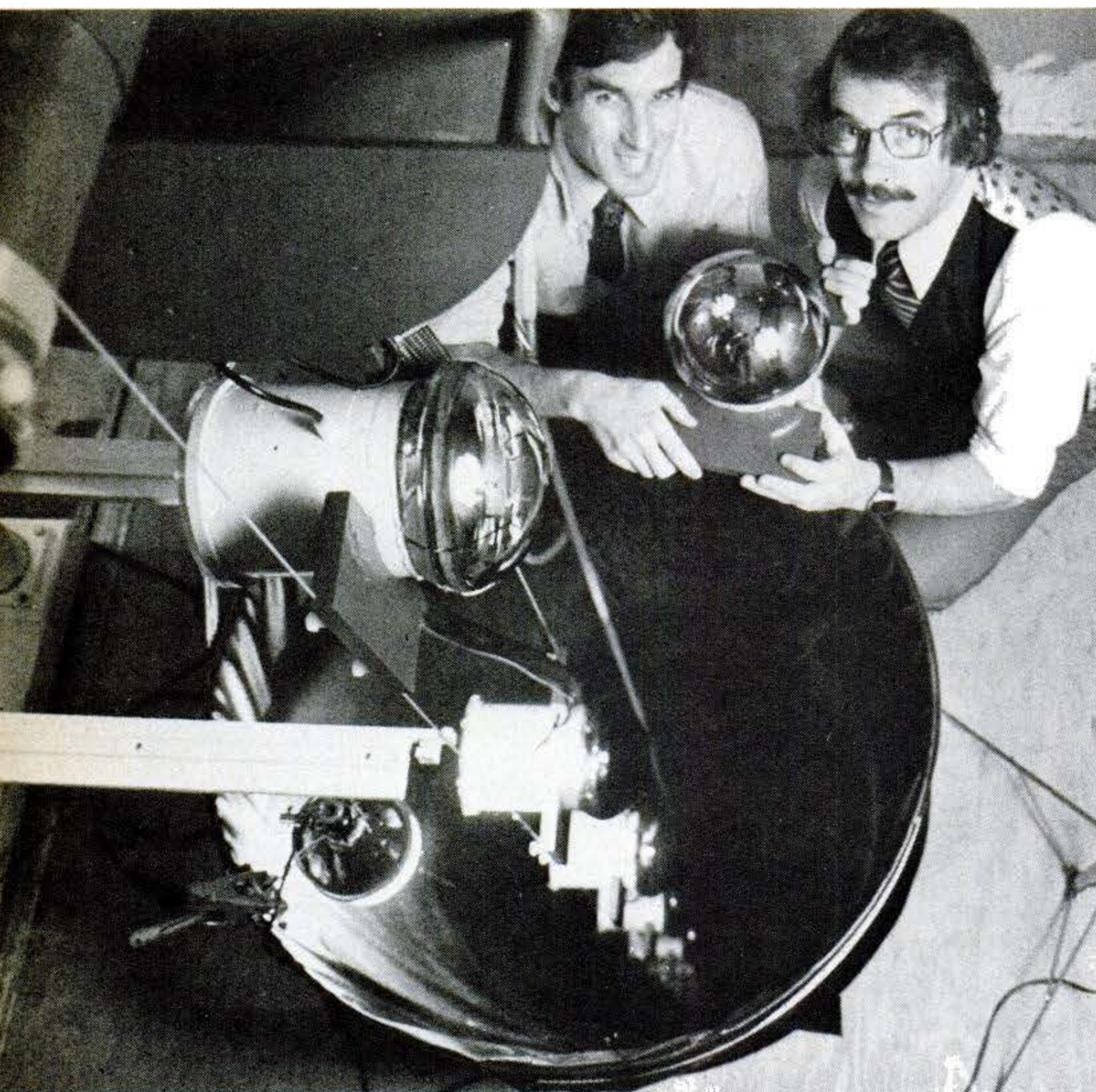
Experimental physicists find it hard to resist near-impossible challenges, and research teams around the world have joined the Michigan-California-Brookhaven group in a race to determine conclusively whether protons decay and, if so, to accurately measure their lifetime.

Physicists from Harvard, Purdue, and the University of Wisconsin are setting up a smaller version of the salt-mine experiment in the Silver King mine near Park City, Utah. Another similar setup but at a depth of almost a mile inside a mine in Homestake, S.D., has already been providing data for two years; so far, its University of Pennsylvania operators have made no claims. A fourth American experiment, run by researchers from the University of Minnesota and Argonne National Laboratory in an iron mine in northern Minnesota, uses a massive block of concrete (instead of water) as its source of protons.

In April of this year an Indian-Japanese team working with an iron slab buried 12,000 feet deep in the Kolar gold field south of Bombay reported evidence of two proton decays, but their data have been disputed. Other groups, in Russia's Baskan Valley and in the Mont Blanc tunnel, which links France and Italy, have also begun.

Any detector designed to spot proton decay involves compromises. The larger the source of protons chosen, the more difficult it becomes to bury it very deep in the ground. Therefore, experimental teams that opt for the greatest possible depth must use compact proton sources—slabs of concrete or iron. And because particles that proton decay might produce would not travel far in such materials, the detec-

Continued



String of photomultiplier tubes is tested by Michigan physicists in six-story, water-filled pipe inside a campus-building elevator shaft.

tors must be embedded in the slabs. The Michigan-California-Brookhaven group chose to sacrifice some depth to obtain a maximum volume of protons. Their reservoir is an astonishing 10,000 tons of water treated by a Culligan process to make it, according to Michigan physicist Jim Stone, "literally the purest water on Earth." Water of that purity is remarkably transparent. Peering down a cylindrical test tank holding such water in an unused elevator shaft at the University of Michigan, I could see to the bottom more clearly than in any Caribbean waters.

That much water obviously requires a large and strong tub. The experimental team first had to make a hole large enough to hold the container, then find suitable materials to store the water without leakage.

Cave of fortune

After a careful search for a suitable site, the team chose the Morton salt mine in Fairport, Ohio, partly because group co-leader Fred Reines had successfully performed experiments there before. But a whole new cavern would have to be dug out to accommodate the

tor shaft. Winches will permit removal of failed tubes from detector. Top and bottom tube arrays will be hung on frames.

prodigious pool. There the team hit on a piece of luck.

The Dosco Company, makers of automatic mining machines, wanted to demonstrate a new such mole to Morton. The companies agreed to test the device by using it to carve the needed 80-by-70-by-60-foot hole. Not only did the scientists have their hole dug much more cheaply than expected, they sold the salt obtained by the drilling to Morton for \$60,000.

Next came the problem of choosing the materials to line the cavity and contain the water. The group first sank huge rock bolts into the cavern walls to prevent large chunks of salt from breaking loose, then surrounded the area with wire mesh to hold back smaller pieces. Then they settled on the criteria for the tank lining. It had to be flexible enough to withstand the pressure of water forcing it against the mesh floor and walls, sturdy enough not to spring any leaks, and inert enough not to pollute the water.

They chose a high-density polyethylene made by the Schlegel Corp. of Rochester, N.Y. "You can take a screwdriver and slash down with all

your strength, and not scratch the material," Jim Stone told me as we walked along the springy floor of the already lined pit. Even with that proved strength, the researchers were cautious: They installed two 2½-mm-thick layers of the material.

It remained to choose a material for the top of the cavity, something that could support the weight of the equipment that would be attached to it yet be buoyant enough to float on the water. The team chose a reinforced rubber called Hypalon, made by Du Pont. Sixteen rafts of the material would form the cover. Shortly after my tour of inspection, the team planned to fill the pool, starting with the Hypalon rafts on the floor and letting them float as the water level rose.

Filling a cavern with 10,000 tons of water takes more time and effort than preparing the backyard swimming pool for summer. The group planned to run the purified water in through four horizontal sprinkler-type pipes around the floor of the cavern. It was estimated that the process would take 35 days if everything went perfectly.

Faster than light

However well prepared the pool may be, the detection of proton decay will depend on the perfect performance of the instruments installed in it. When protons in water decay, physicists believe, they produce electrically charged particles that travel through water faster than light does. (They don't travel faster than light in a vacuum, so they don't disobey Einstein's relativity theory.) The fast-moving particles will emit the equivalent of a sonic boom—a cone of bluish light called Cerenkov radiation. Detectors lining all six faces of the cavern will pick up these fleeting flashes of Cerenkov light, amplify them, and feed the data to computers in a control room in a cave adjacent to the pool.

The detectors are devices called photomultiplier tubes. When the experiment is ready to begin (before the end of this year), 2,048 of the five-inch-diameter hemispherical monitors will be lowered into the tank. That's a large number of tubes; in fact, the group purchased an entire year's supply—at \$235 apiece—from the British manufacturer EMI.

The team has tested the tubes extensively in what is called the "disco room"—a small, darkened laboratory on the Michigan campus containing a scaled-down version of the photomultiplier array that will line the walls of the water tank. Their response was tested by exposing them to bursts of diffuse light emitted by a small ball attached to the end of an optical fiber.

Computers checked the performance of each individual tube.

Plans to place the 2,048 tubes in the underground water tank posed a minor engineering problem. The main difficulty was their buoyancy; left to themselves, they would tend to float out of position. Larry Sulak solved that problem. The tubes are weighted with lead to give them neutral buoyancy. Strung in columns on inert nylon thread, they will be relatively easy to maneuver into place.

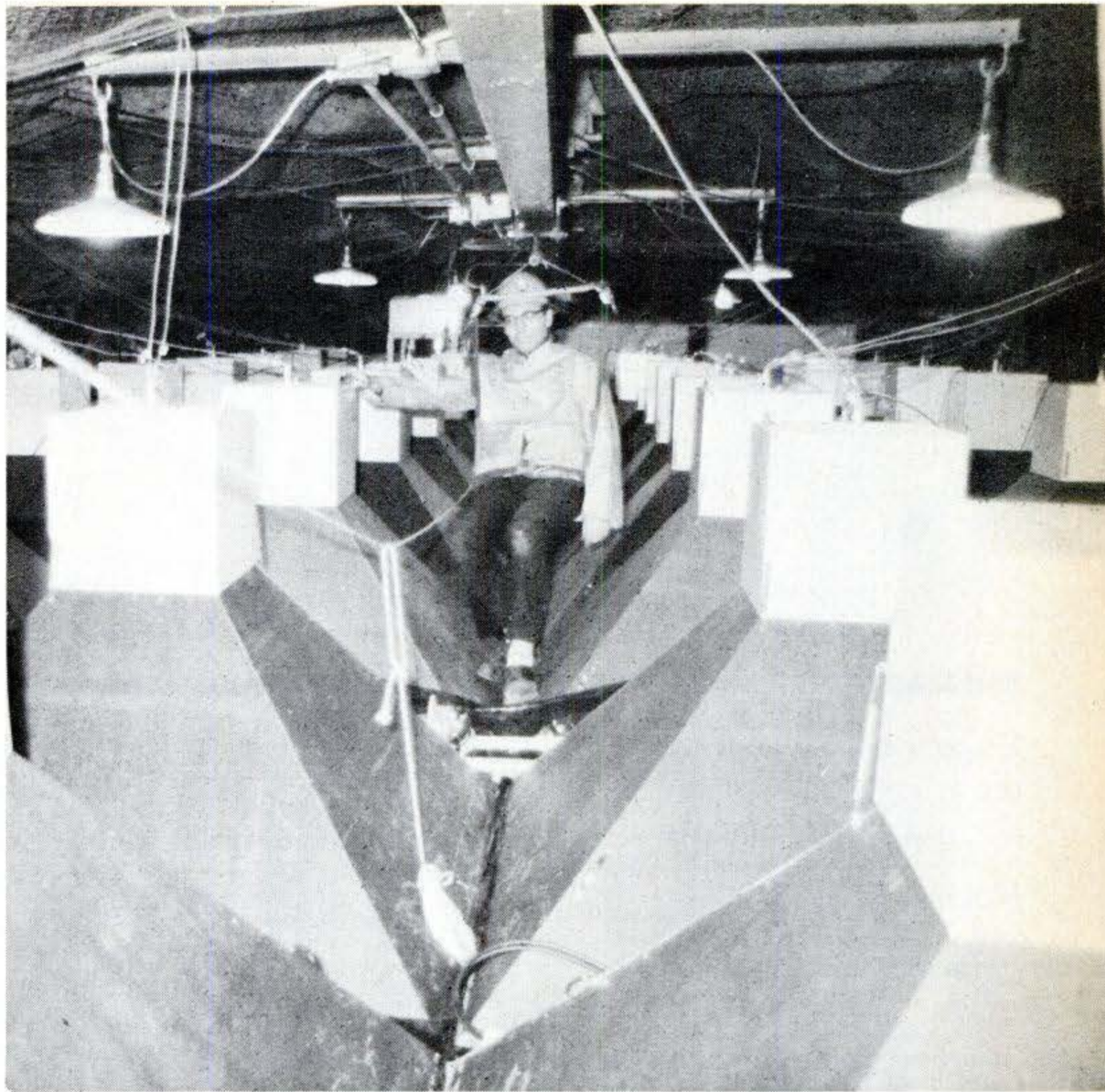
Reading the tracks

Having overcome the technical challenges, the researchers will soon face the scientific conundrum of differentiating proton decays from the myriad other subatomic events that leave similar fingerprints in the photomultiplier array. One major source of confusion is likely to stem from particles created when cosmic rays smash into atomic nuclei in the salt that surrounds the tank. Fortunately, those events should produce tracks only around the edges of the tank. Therefore, the team will ignore any "corner clippers" that show up within a few yards of the tank walls.

More difficult to diagnose will be collisions produced by neutrinos, penetrating particles that can travel through the entire Earth without interacting with anything, but that would occasionally also strike atoms in the pool. Team members feel confident that their computerized scanning techniques will be able to separate neutrino effects from proton decays, in part because they already know roughly the rate at which neutrinos should produce such events.

The cost of the experiment is as monumental as its size: \$3.2 million of Department of Energy funds. The researchers assert, however, that their device is not only a scientific bargain but one that is ahead of its time. "This is one experiment where America leads the world. That's why I joined the group," declared Tegid Wyn Jones, a Welshman from University College, London, who has come to Michigan to take part.

Certainly, the detector and similar devices around the world will offer immense scientific dividends if they work satisfactorily. If they measure the proton's lifetime, they will show that present theories about the nature of matter and the start of the universe are substantially correct. If the systems cannot spot any proton decays, they will cast grave doubts on those ideas. Either way, theorists are waiting eagerly while experimenters on three continents race to be first with the news. E



HANS COURANT

Looking for needles in underground haystacks: Kenneth Lande of Univ. of Pennsylvania inspects experiment 4,800 feet down (top). Water modules are below pyramids, which convey signals to detectors

in cubes. Minnesota experiment (bottom) uses block of heavy concrete as proton source, embedded with 3,456 gas-filled proportional tubes. Proton decay would ionize gas, cause electric pulse in tubes.

8,000-foot wind-power tower

Solar energy would create a 150-mph wind in this gigantic chimney

By **ERNEST F. BLASE**
and **JEROLD H. KLAIMON**
ILLUSTRATION BY DEAN ELLIS

You've been aware for miles of a gray tower looming on the desert horizon. The closer you get, the more awesome it is, dwarfing any structure you've seen or imagined.

Soon another mystery: The arid land has given way to rows of robust crops. Here's a gentle, cool breeze.

Suddenly the fields end, replaced by damp black asphalt. A brisk wind and a loud "whoosh, whoosh" suggest what this gargantuan structure is.

The tower is a windmill of sorts—an aeroelectric plant. It's a simple concept, despite the tower's great size. Water, piped from the sea, is pumped to the top of the 1½-mile-high, 900-foot-diameter tower and sprayed through atomizers. It evaporates, cooling the hot, dry air. This cooled, dense air falls down the chimney and drives 10 wind turbines, which generate electricity—2,500 megawatts at peak; about 1,000 MW average.

Such a mammoth windmill doesn't yet exist, but an El Segundo, Calif., engineering firm, Agbabian Associates, has been studying the concept since 1978. The idea actually dates to 1965, when Dr. Phillip Carlson was working on a desalination project at Lockheed. "It involved condensing water inside a chimney," he recalls. "We ran some calculations and found that, theoretically, we'd get out eight times the energy we put in to pump the water to the top of the chimney.

But, in 1965, there didn't seem to be any need for new energy sources."

By 1974 the need was apparent, so Carlson resurrected the concept. In 1978 he joined Agbabian Assoc.

Power in volume

A comparison with a hydroelectric power plant illustrates why an aeroelectric plant must be so large. The quantity of power produced by both systems depends on the volume, density, and velocity of the working fluid: water in the hydroelectric system, air in the aeroelectric. Since air is much less dense than water, an aeroelectric system requires about 1,500 times more air than a comparable hydroelectric plant uses water.

Some of the power produced would operate ancillary equipment, and there would be power and friction losses. These amount to proportionally less in larger systems—another reason to build them big.

The proposed 2,500-MW aeroelectric plant would use 140 million cubic feet of air per second, which would require 1,000 cubic feet of water per second. Only the ocean would serve.

The velocity of the air coming down the chimney depends on the temperature difference between the air on the inside and that on the outside. The hotter and drier the ambient air, the more it could be cooled by evaporation. Thus the greater the temperature difference, the greater the power output. Consequently, aeroelectric towers are proposed only for desert areas.

Because hotter, drier air results in greater power production, an aeroelectric plant would produce maximum power on summer days and the minimum on winter nights. That, coincidentally, matches the demand curve of most electric utilities.

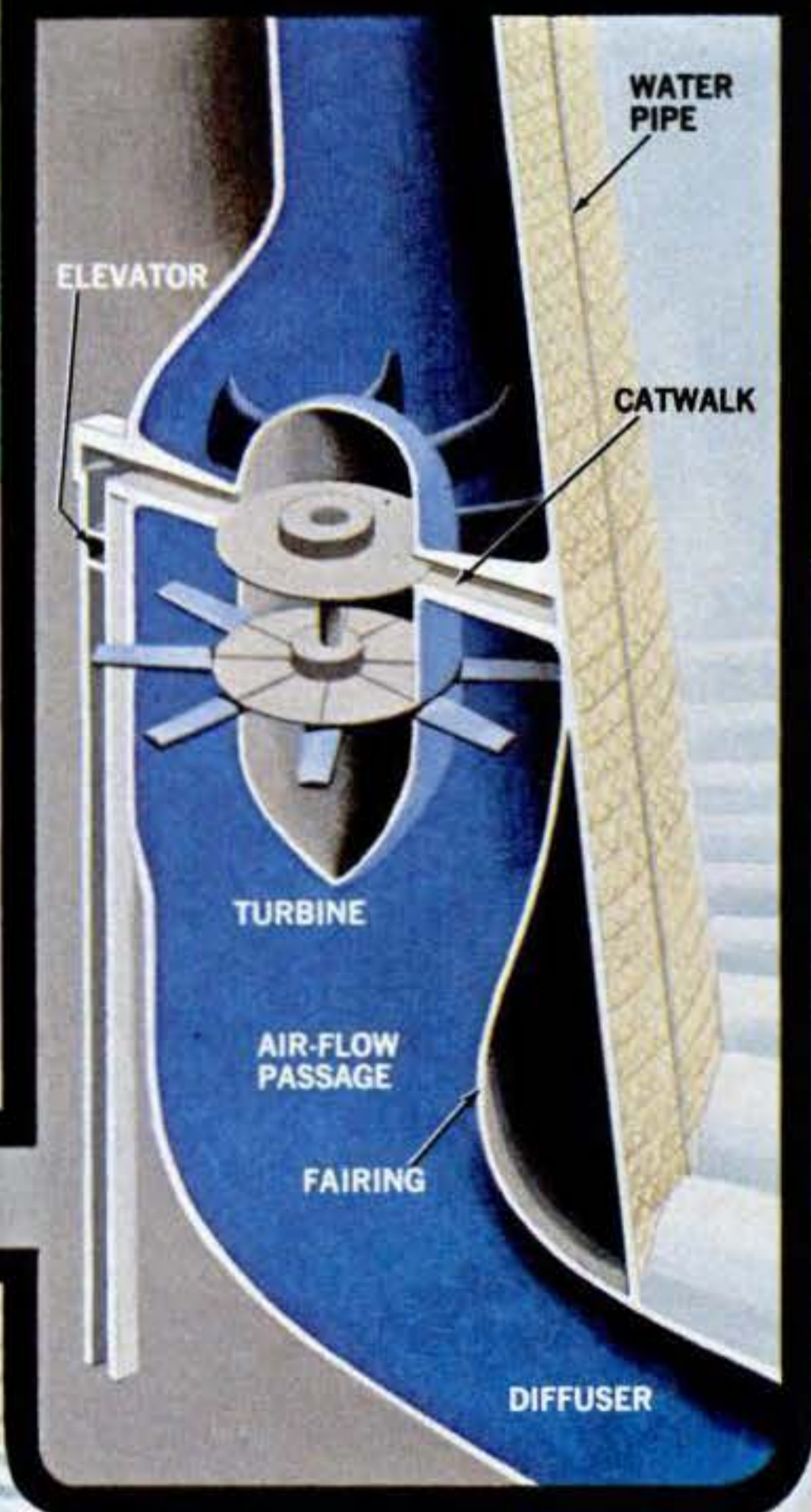
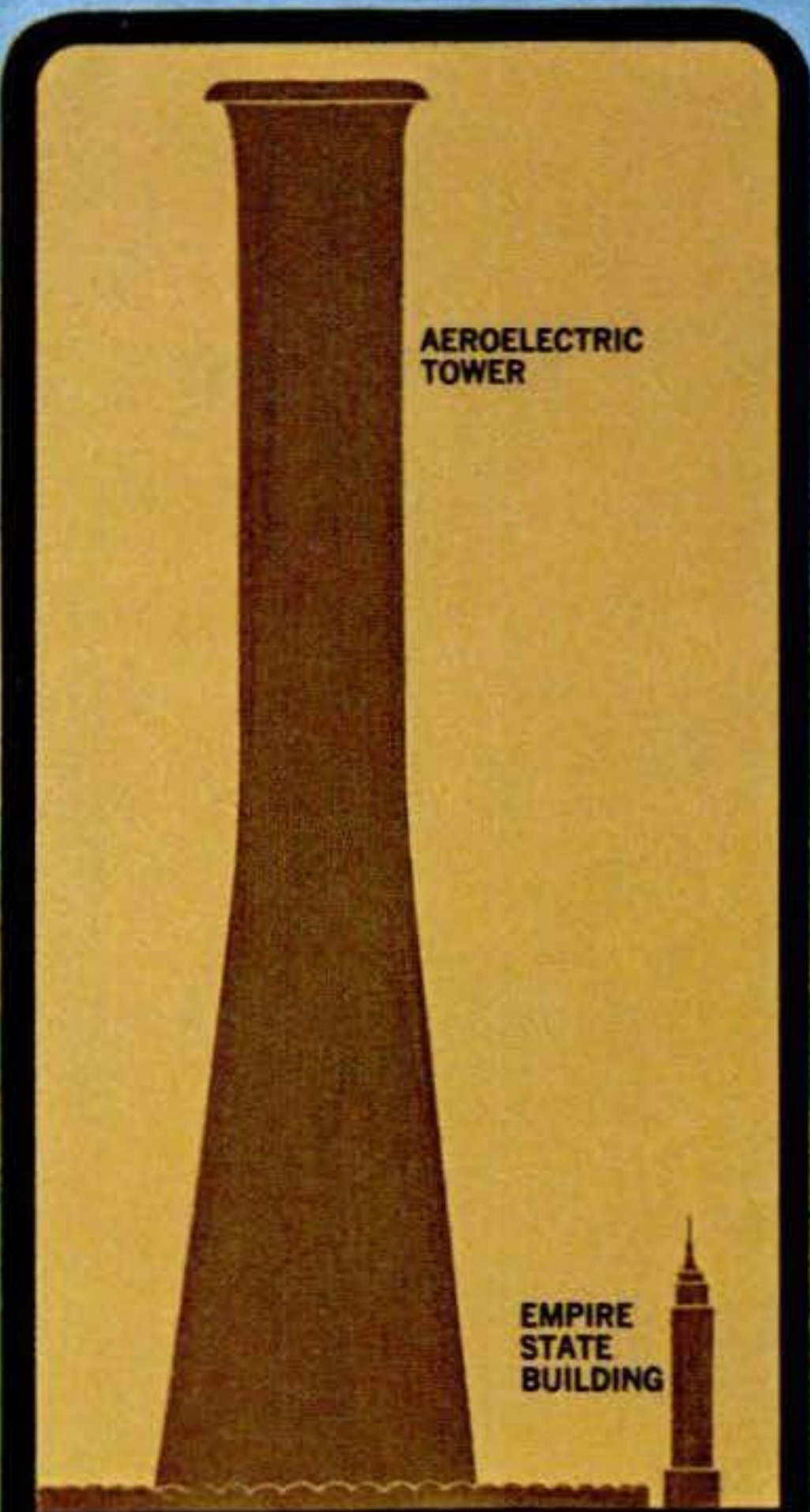
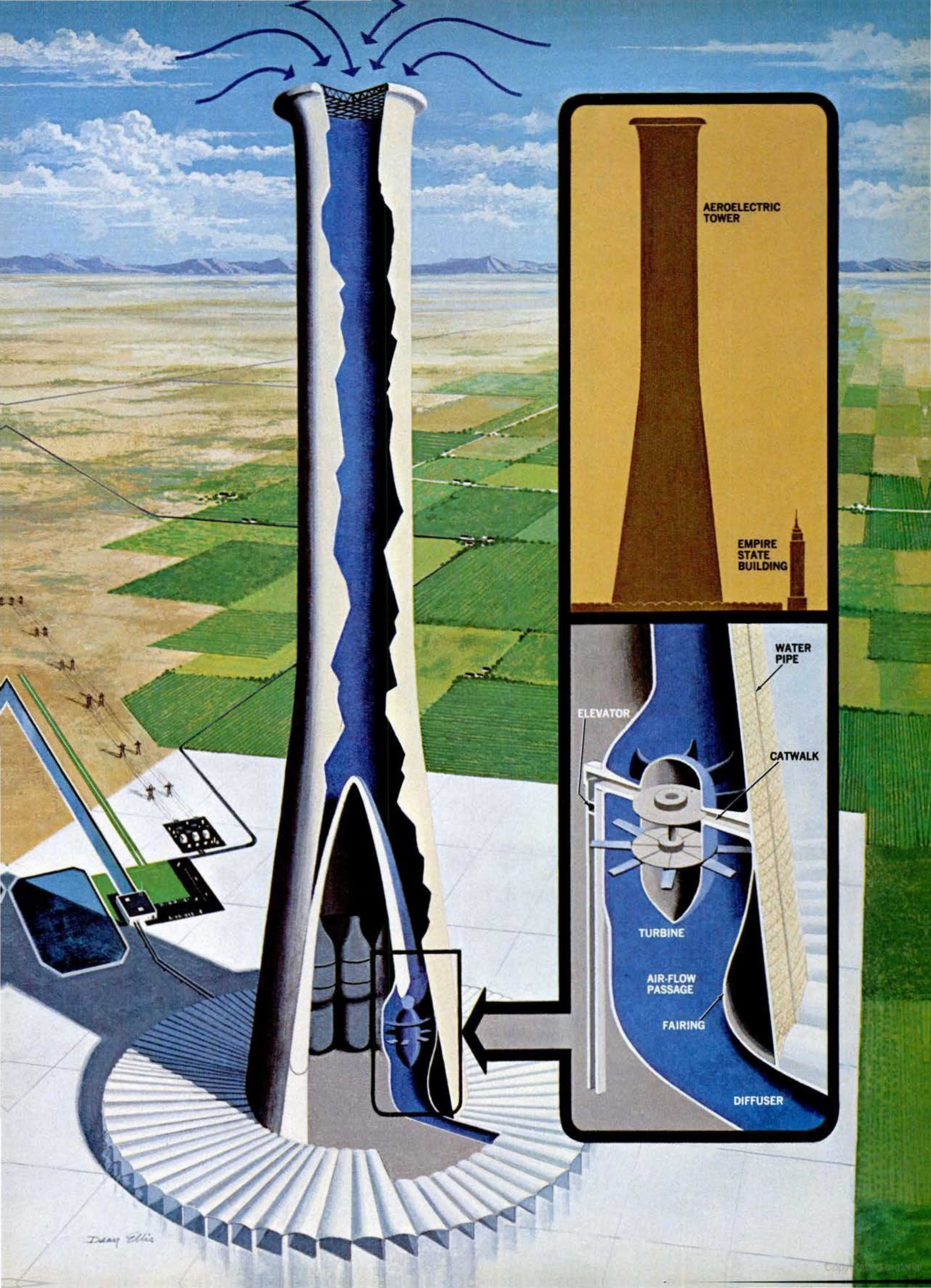
Agbabian admits that constructing an 8,000-foot tower presents a challenge. The current proposal calls for using prefabricated concrete modules with an inner wall only a foot thick strengthened by a lattice of concrete beams extending 30 feet out.

Just how much such a plant would cost is hard to say, but the company believes it would compare with other large power plants ("on the order of two billion dollars"). And it would be substantially less expensive to operate. The 2,500-MW tower would produce electricity at about one-third the cost of an oil-fired plant, Agbabian concludes, and significantly less than a coal or nuclear plant.

While an aeroelectric plant poses no known environmental hazards, it would certainly modify the microclimate. Air temperatures at the base of the tower would average about 30 degrees below ambient, and a 25-mph wind would blow out of the diffusers (the arched openings at the base of the tower). A salt-removal system is designed to take 99.9 percent of the salt from the sea water. The brine would collect in the diffusers and on the asphalt and be piped back to the sea.

The remaining moisture in the air would condense out at night as a very heavy dew, "... equal to 40 inches of rain per year near the chimney," says Carlson, "tapering to 20 inches three miles away."

Agbabian now has a \$5 million grant request ready for DOE. The funds would go for more studies and for a demonstration project that would use the Hoover Dam spillway as a simulated chimney. The next step would be a commercial plant: a 4,000-foot tower, 800 feet in diameter, producing 500 MW at peak power. **ES**

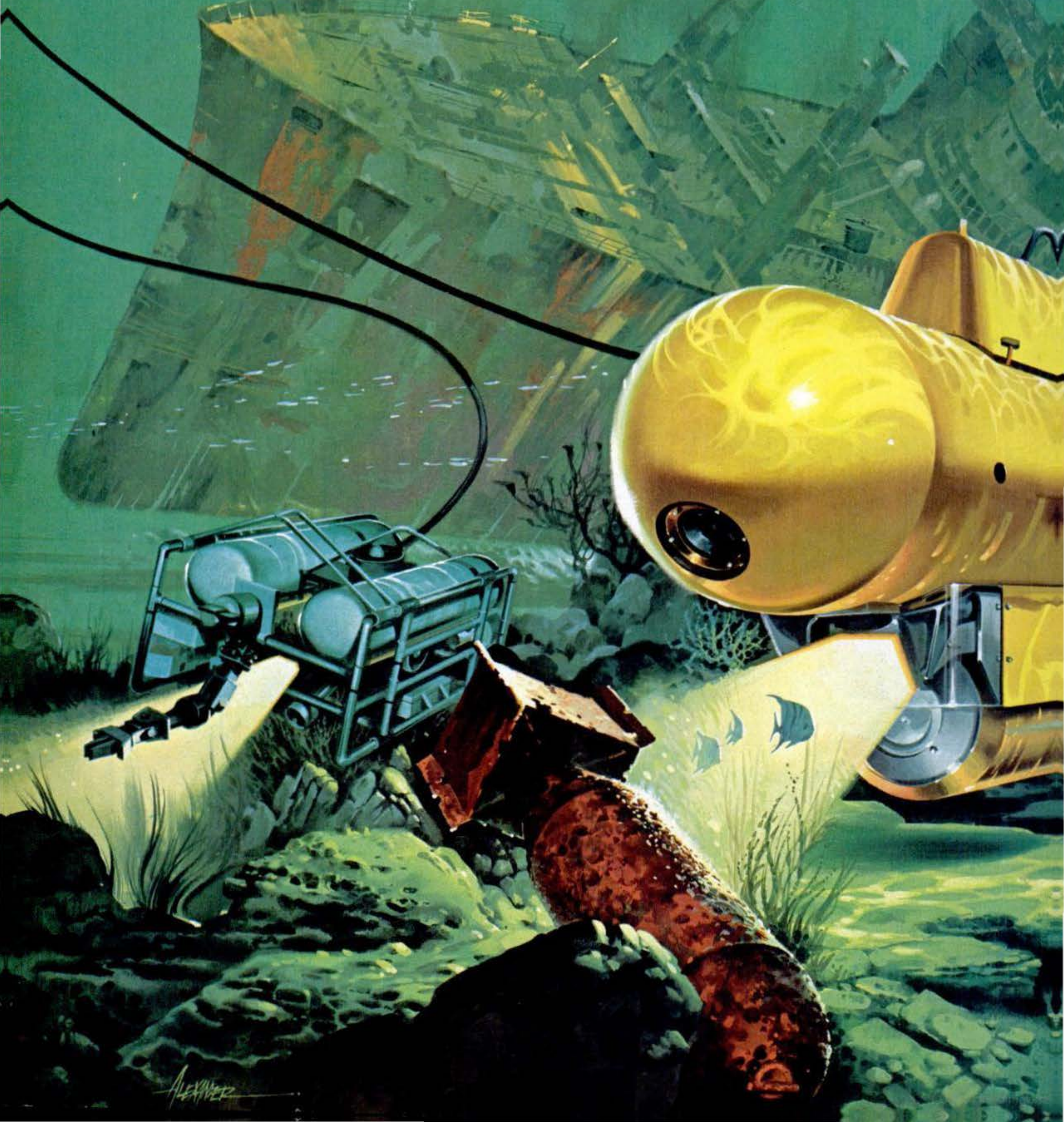


Doug Ellis

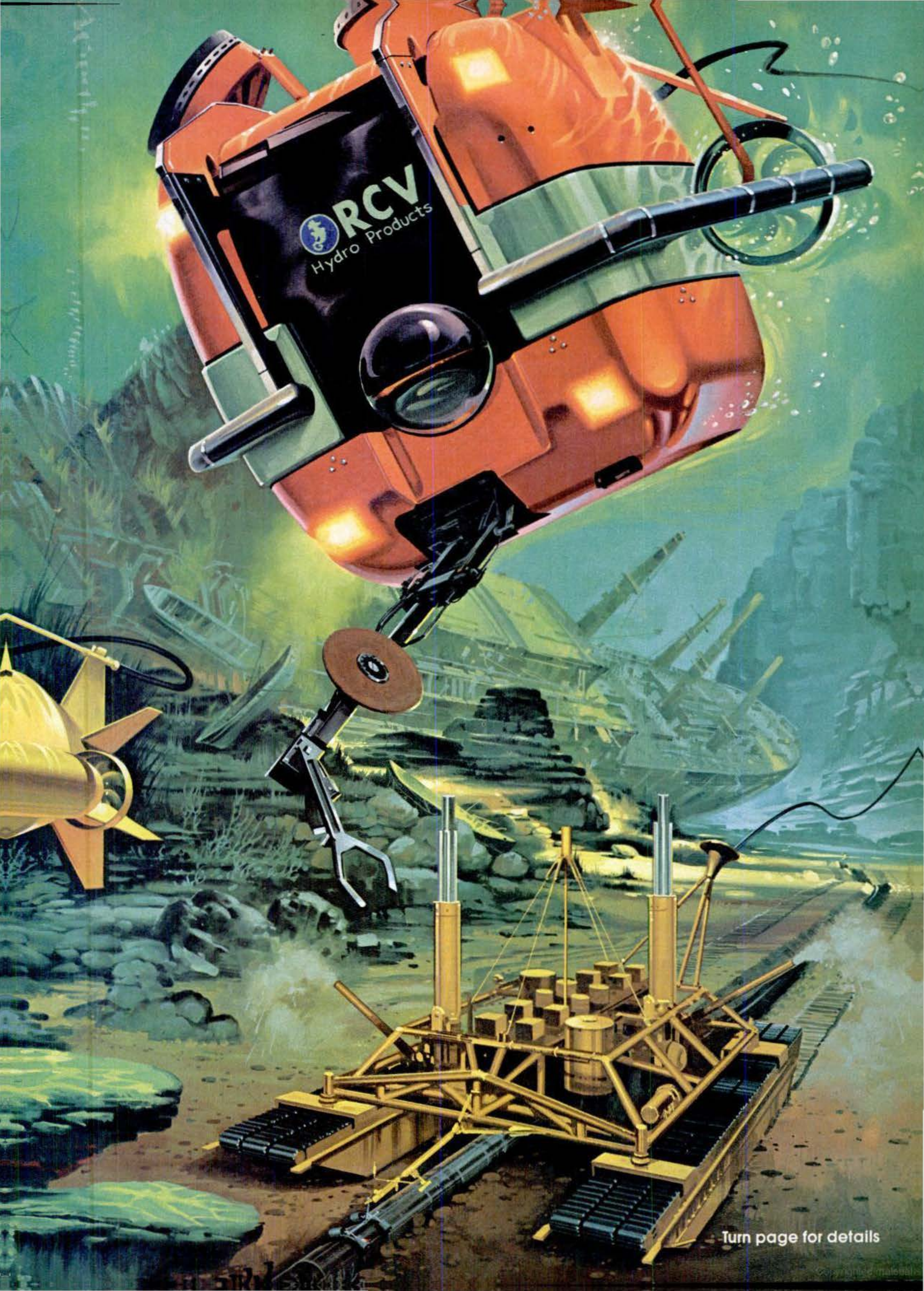
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Robot subs

trouble-shoot the deep



Alexander



RCV
Hydro Products

Turn page for details

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They plunge deeper, stay down longer, "see" better, find things faster, and ascend quicker than human divers

By **PETER BRITTON**

ILLUSTRATION BY PAUL ALEXANDER

On a humid Aug. 17, 1979, in the Gulf of Mexico, the sea is afire, fed by the 30,000 barrels of oil that have been gushing daily from the blowout at Ixtoc I well. Famed firefighter Red Adair desperately needs to know what's happening at the wellhead, 164 feet below. But the jetting vortex of oil and gas could trap a diver and tear him apart.

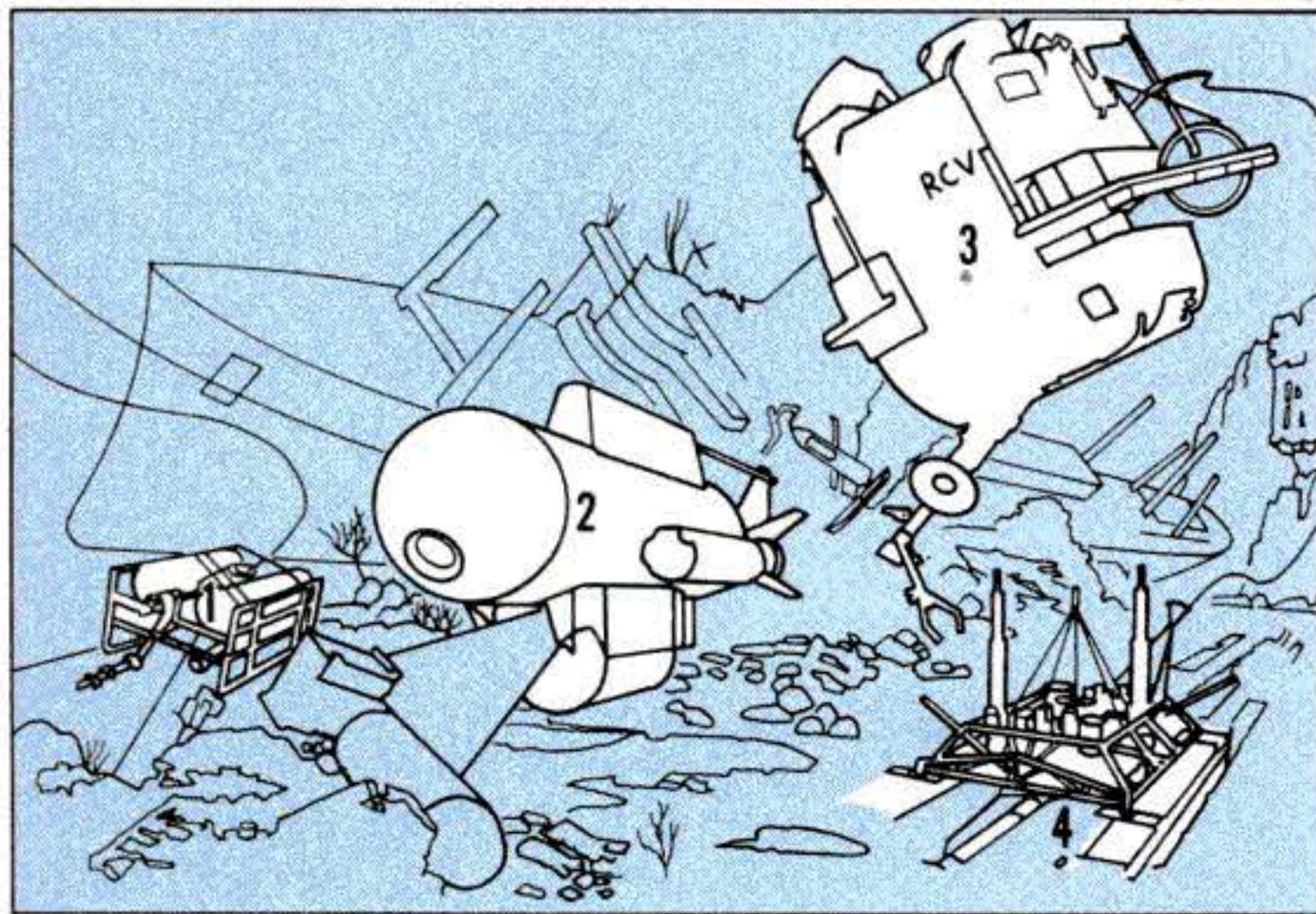
Adair calls for an RCV-225, a remote-controlled vehicle that goes where divers fear to tread water. Dubbed the "flying eyeball," the free-swimming vehicle sends live TV pictures topside via the tether that links it to the ship.

As Adair and other concerned oilmen watch a TV monitor in relative safety, the shipboard operator cautiously directs the 180-pound robot sub's descent into the maelstrom (see cover). The 25-inch-diameter, bright-orange sphere is made of tough foam filled with glass bubbles. Its Kevlar-reinforced umbilical line transmits power and instructions to the four electric thrusters that maneuver the craft. On command, the vehicle's low-light camera pans and tilts, showing the turbulent scene to the oilmen.

The firefighters know that this oddball machine can deliver—and is also expendable. Good thing, for seconds after the sub's bright halogen lights reveal a severely damaged wellhead hydraulic system, the little sub is swept away by the vicious flow and destroyed. But the pictures it transmitted are captured on videotape ready for study.

Not every remote-controlled sub has such a dramatic mission. But all do dangerous, dirty, expensive work.

● In August 1981, cameras aboard Sea Marc, an aluminum sled towed thousands of feet below a search ship, snap



1. Scouting a wreck, the Scorpio's 250-watt tungsten-quartz and thallium iodide TV lights reveal promise of salvage. A five-movement manipulator arm extends from the sub's bottom, ready to snatch up any floating treasure. Two flotation tanks mounted atop the seven-ft.-long aluminum frame give the Ametek Co. craft positive buoyancy; four thrusters control depth and heading. **2.** Battery-powered, side-mounted thrusters maneuver the French Navy's PAP-104 close to a bomb. A ship-controlled tether keeps the negatively buoyant vehicle from diving too fast. Once it releases its 250-lb. charge, the nine-ft.-long sub floats to the top. **3.** Big brother to the RCV-225 pictured on the cover, the four-ft.-long, buoyant-foam RCV-150 has four servo-controlled thrusters that automatically maintain depth and position. Both Hydro Products craft are launched from an open-frame, submersible "garage" that pays out tether cable. **4.** The hulking, 50-ft.-long MUT's hydraulic tracks crawl over two-ft.-high obstacles. The Brown & Root Co. sub lays 2,000 ft. of pipe an hour.

color photos of a large wreck off the coast of Newfoundland. The photos reveal an 11-ft. propeller. "It's definitely a propeller from the Titanic," asserts Jack Grimm, the expedition's leader. He vows to return next summer to attempt recovery of a fabled fortune in gold and jewels.

● In early 1981, an open-framed Scorpio explores the waters 150 miles off the coast of the Russian port of Murmansk. TV pictures from the free-swimming craft confirm that a wreck discovered 800 feet down is the British cruiser HMS Edinburgh. It was torpedoed in 1942 and sank with \$72 million in gold-bullion lend-lease payments aboard.

● In the spring of 1977, an RCV-225 descends 1,000 feet into the Gulf of Mexico. It hangs motionless for five full days, watching for movement from a disabled pile driver while a shipboard crew tries to fix its jammed controls.

● On a recent scouting trip through major French harbors, the PAP-104 mine neutralizer finds several sunken anti-ship mines from World War II (the exact number is classified). The PAP silently deposits an explosive charge near each, then withdraws to safety.

● By next spring, the 120-ton MUT bottom crawler should be creeping slowly along the Texas coast scooping out a 10-foot-deep trench for a 54-inch pipeline.

This growing family of robot subs is divided into four groups. Towed vehicles are powered and controlled via tethers linked to the mother ship. The craft generally are used for high-resolution still photography. Next come bottom crawlers, which may weigh more than 100 tons. They, too, receive communications and power through surface-linked umbilicals, but also have on-board motors to control forward and sideward movement. Another class of robot subs also has tethers, but can swim free, or "fly" in all directions. These highly maneuverable craft carry powerful lights, color-TV cameras, sonar, and even versatile gripper arms. The final group includes the few highly experimental, free-swimming, untethered vehicles. When perfected, these autonomous robots will have both power and programs on board. Or they may be controlled by as-yet-undeveloped water-transmitted communications, perhaps via laser. This group is still in the R&D stage. In fact, most of the robot subs working today are bottom crawlers and free-swimming flyers. Industry consultant Frank Busby reports that the number of flyers alone has grown from the 44 operating during 1975 to 396 in 1980.

Why this quick growth? The devices boost safety for divers who must work in progressively colder, deeper, and rougher waters as the search for oil and gas widens. The sub's TV camera lets shipboard operators act as "buddies," monitoring a diver's gear and watching for pitfalls. The sub's bright lights also illuminate the underwater scene 10 times better than a diver's hand light. And when the job gets too dangerous, the tethered vehicles can replace divers. The subs get cheaper to use as the work goes deeper: At 1,000 feet a diver's 10 minutes' worth of work can cost over \$100,000 (including support personnel); a remote-controlled craft costs about \$3,500 a day.

While today's robot subs are limited to the simplest manipulative tasks, they have plenty of jobs: inspecting structures, pipelines, and cables; placing and recovering instruments; setting explosives; clearing fouled lines; and surveying under ice. And they have problems: A carelessly operated or unlucky vehicle can literally tie its tether in knots, be swept away by currents, get caught in a ship's propellers, and, some say, simply be mistaken as a tasty mouthful by some cruising denizen of the deep.

Still, according to such insiders as Drew Michel, of Taylor Diving and Salvage (Belle Chasse, La.), the future of robot subs is extra bright. "There will always be a need for divers," he says. "But remote-controlled vehicles will get more sophisticated, smarter, and much stronger." ■

The big new splash from **small-scale hydropower**

An old energy source
is making a comeback
—but it's not a panacea

By E. F. LINDSLEY

I could almost feel the pulse of electric power as I stood inside a red-brick powerhouse on the Fishkill River at Beacon, N.Y. Outside, the river swept silently by, a fraction of its flow momentarily diverted to feed a hungry machine 22 feet below the gratings I stood on. There the river thrust powerfully against an ancient turbine that had been yoking the river's flow since 1917. Beside me loomed a massive old generator. Its thick copper busbars carried away 180 kilowatts of the river's power to supply part of the electricity needed at Texaco's Beacon Research Labs.

I'd asked to visit Texaco's little hydro plant just to get a feel for the nature and hardware of small hydropower. It's typical of hundreds of such plants hidden deep in the hills of the Northeast. And now, spurred by new legislation that permits independent power producers to sell to utilities, there has been a tremendous resurgence of interest in small hydro. Result: Old plants are being eagerly sought by hopeful restorers and entrepreneurs.

Even in the Far West, which is not dotted with abandoned small hydro plants, the contagious enthusiasm for small-scale hydro has prompted the exploration there of hundreds of potential but never-before-used sites.

Roughly speaking, a small hydropower plant generates up to 15 megawatts of electricity, with the average around five megawatts, providing ser-

Continued



vice for some 2,500 homes. Texaco's tiny 180-kW plant would serve about 90 homes. In contrast, Niagara's huge power plant, with a capacity of 219 megawatts, could serve more than 100,000 homes.

The national surge can be measured by the increase in the number of applications for federal permits, required for almost all hydro plants of more than 500 kilowatts (half a megawatt). In 1976 there were only seven such applications; in 1980, a whopping 675.

This enthusiasm is readily understandable, given the urgent national need to rely more heavily on renewable energy sources, coupled with the chance for profit by merely running water through a turbine and delivering electricity into a utility's power lines.

But the rush to small hydro needs to be examined critically, for many questions remain unanswered. Water experts, for example, are still debating the actual number of developable sites and thus the potential contribution of small hydro to the nation's overall energy scheme. Some experts also question whether the new Western sites will be as simple to develop as the established Eastern ones are to refurbish; they may require quite different technological approaches. Other experts warn that there may be safety

“The fact that a dam has performed adequately for years is not proof that it is structurally sound”

hazards in putting an old plant back to work. And environmentalists are worried lest new hydro installations will disrupt valuable fish and wildlife populations.

David Willer of Tudor Engineering, a leader in hydro evaluation in California, estimates that there are 2,100 usable hydro sites in the U.S. This closely matches a DOE estimate that 2,000 sites warrant serious study.

In contrast to these conservative estimates, the New England River Basin Commission counts 1,511 dam sites in Connecticut alone, of which 200 are potential power sources, and says that New York has 5,500 dams with 1,672 possible sites. The New York State Energy Master Plan calls for 1,050 megawatts from such hydro plants within 13 years. Time will establish which estimates are accu-

rate. Clearly, though, there is power waiting to be used.

This doesn't mean that small hydro is quick and easy, much less a major solution to our energy needs. DOE estimates that only 11 percent of all present U.S. generating capacity is hydro; and that figure includes the giant, multi-megawatt plants such as Niagara, Hoover, and Grand Coulee. DOE estimates that *small* hydro composes only five percent of that 11 percent total.

Still, building new small hydro facilities and restoring old ones could provide a significant contribution to our energy needs. The Army Corps of Engineers estimates the gross potential energy that could be derived from existing dams (not presently used for hydroelectric power) to be in the 18-to-25-billion-kWh range—equivalent to saving 80,000 to 140,000 barrels of oil per day.

Moreover, many of these dams are where they're needed most, in places where nearly all the nearby power plants are oil fired. Thus the prospects for old power plants being put back to work to save oil are particularly exciting in the Northeast.

But reworking an old dam that has been unused for years is risky. Repeated drawdowns and refillings set up massive forces. The collapse of such a dam could be disastrous.

In a guide to what it calls "facility integrity," the Corps of Engineers states, "... the fact that a dam has performed adequately for a number of years is not proof that it is structurally sound. In fact, the opposite may be true."

There are dozens of shapes and forms of dams, and even more ways to build them. Materials range from concrete to earth, stone, timber, brick, and various combinations. It's extremely difficult for even the most capable of engineers to assess the conditions inside and under a dam structure. When the history and construction records of an old dam are lost, extensive evaluation is called for, a safety measure not always taken as would-be entrepreneurs hastily reactivate old power plants.

The Great Falls dam in Paterson, N.J., is a good example of careful assessment of a dam's integrity. The dam, built between 1838 and 1840 of huge stone blocks, had deteriorated to the point that about 10 percent of the stone needed replacement. More important, the Corps of Engineers described the dam as having "... factors of safety below those generally accepted for sliding and overturning." In short, under some conditions the whole structure might start to slide

downstream, or simply lift and flip over.

The problem was the unknown condition of the "powerful clamps of iron" that originally anchored the structure to the stream bed. There was no way to inspect the ancient iron clamps. Perhaps they were sound; perhaps not. A new dam was considered, but the old one had strong scenic and historical value. The solution was to face the upstream side of the old dam with concrete doweled to the old stone and anchored into bedrock with steel.

It will be a few years before the Paterson plant feeds the grid again, but similar projects at Oneonta, N.Y., and Litchfield, Conn., are already on line.

Western hydro

Reactivating old hydro plants is just a part of the small-hydro picture. In the Far West few, if any, abandoned power plants are waiting to be refurbished. But there are hundreds of so-called water drops (on water-control dams and water-supply channels) that have never been used for power. One recently adapted to power generation is the Rollins Project on California's Bear River. It is now producing 12.7 megawatts.

Understanding how hydro technology differs from East to West requires a mind shift from picturesque wooded hills and natural water courses to often stark, open spaces with man-made channels, canals, and ditches. Great volumes of water are transported enormous distances, almost always downhill. Dams and impoundments are needed to slow and control the flow and to permit turning it on and off as needed. Such a dam is called a drop, and when you have a drop or difference in water level, plus a substantial volume of flow, you have the makings of a low-head hydro plant.

Can you, then, just call in the bulldozers and put in a turbine and generator at one end of the drop? Not necessarily, as I learned when I visited Tudor Engineering in San Francisco. Hugh Brown, who heads Tudor's hydro engineering, emphasized the most important fact about hydro plants, large and small—they're all site-specific. You have to do your designing backwards: "If you design a steam or diesel plant, you start out with the power output you want, and size your engine accordingly," Brown said. "With hydro, you start out with the water that's there, most of the time, and suit the turbine and generator to that source and location."

Water flow is usually subject to the whims of nature. If it is possible to back up an enormous impoundment of

water over a huge area, you may be able to store enough water to level out dry spells and build a plant with what the utilities call "firm capacity." This means you can always, or almost always, count on a known power output. Few such hydro storage systems exist, and the chances of constructing them today are almost nil because, especially in the East, it would require flooding whole areas devoted to other uses.

Thus nearly all small hydro outputs are based on "run-of-river" water availabilities. Seasonal changes and wet and dry years must be considered.

Deciding how much water is available most of the time requires searching back through whatever records you can dig out. In the case of the Great Falls, N.J., plant, firm daily average-flow records were available from 1897 through 1976. In more recently settled parts of the country you may not find records for more than 10 or 20 years. You may, in fact, find it necessary to study tree rings and other indirect evidence to make an educated guess. This is where engineering philosophy comes into play.

In spite of hydro's image of non-polluting purity, an engineer must consider very real environmental concerns when planning a new dam on a natural water course. Flooding a huge reservoir and then drawing it down can completely disrupt bird-breeding areas. Blocking a natural channel for fish migration may erase part of a major food resource. If the dam impoundment is deep and water is drawn from a low level, the water may leave the turbine colder than it was before the dam was built; that may harm aquatic life sensitive to temperature. Even passing the water through the turbine may temporarily alter the oxygen or nitrogen level for some distance downstream.

Suitable technology can probably cope with all or most such environmental threats, but the costs are so enormous that few such proposals ever pass the survey stages. Rarely, however, does small hydro encounter such serious obstacles, especially on existing sites or man-made water channels.

It became apparent as I talked with Hugh Brown, and later with Dr. John T. Quigley of the University of Wisconsin, that there was not much chance for small hydro to outgrow its basic limitations of run-of-river capacity. But wasn't it possible, I asked, that modern design could increase the outputs of small turbines? Wasn't there another 10 percent or 15 percent that might be squeezed out? Brown shook his head. "A turbine is a very

efficient device," he said. "We already get peak efficiencies of 91 or 92 percent. There's not much to gain."

Dr. Quigley, however, in his hydro-power course, argues that although the right turbine in the right application can be very efficient, "selection of a standard, off-the-shelf turbine may result in low efficiency." In short, all turbines are not equal all of the time.

The difference stems from the wide variations in turbine types and the even wider variety of possible configurations of their components. The stereotype of a huge bucket wheel sloshing and churning in the water from the old mill stream is a romantic figment; that's not the way modern—or old—hydropower turbines are built.

Even the old turbine at the Texaco plant on the Fishkill uses a 27-inch-diameter helical runner (turbine rotor). It's called a reaction, or Francis, turbine. Water enters control wickets and spiral guide vanes like inward-flowing wheel spokes, and, after passing through the turbine runner, leaves downward in a path parallel to

“All hydro plants are site-specific. There are no standard installations or pat answers”

the axis of the turbine. Francis turbines are great as long as the water head and flow stay within about 50 percent of the hoped-for availability. Below that, they lose efficiency. Thus, a run-of-river plant with wide variations in water depth and flow may not be best suited to a Francis.

In contrast, the Pelton turbine is an impulse type and is driven by a powerful jet of water impinging on a series of small, carefully contoured bucket wheels around the rim. The Pelton, with a flat efficiency curve, will do its job down to about 10-percent load, but it works best on high-head sites.

Still another, and novel, turbine resembles a squirrel-cage blower. Called a cross-flow, or Ossberger, turbine, it, too, looks good on efficiency over a wide range. But it's vulnerable to dirt and trash in the water. As Hugh Brown said, "All hydro plants are site-specific. There are no standard installations or pat answers."

While it may be possible to break turbines down into two or three broad categories, the variations that can be manufactured into each type are so

numerous that choosing the right one is a formidable task.

Ingenious ideas

Unwilling to be restricted to the conventional challenges of old or fairly routine plants, other engineers are pursuing approaches to hydropower never tried before. The great, navigable rivers of the U.S. present power potentials of unquestioned worth, but existing navigation locks, flood-control systems, tremendous variation in flows, and fish migration often make conventional hydro plants impossible. Dr. Quigley and the Corps of Engineers have been working on ingenious solutions ranging from retractable turbines to barge-mounted plants that can be moved or adjusted as weather, ice, and shipping traffic demand.

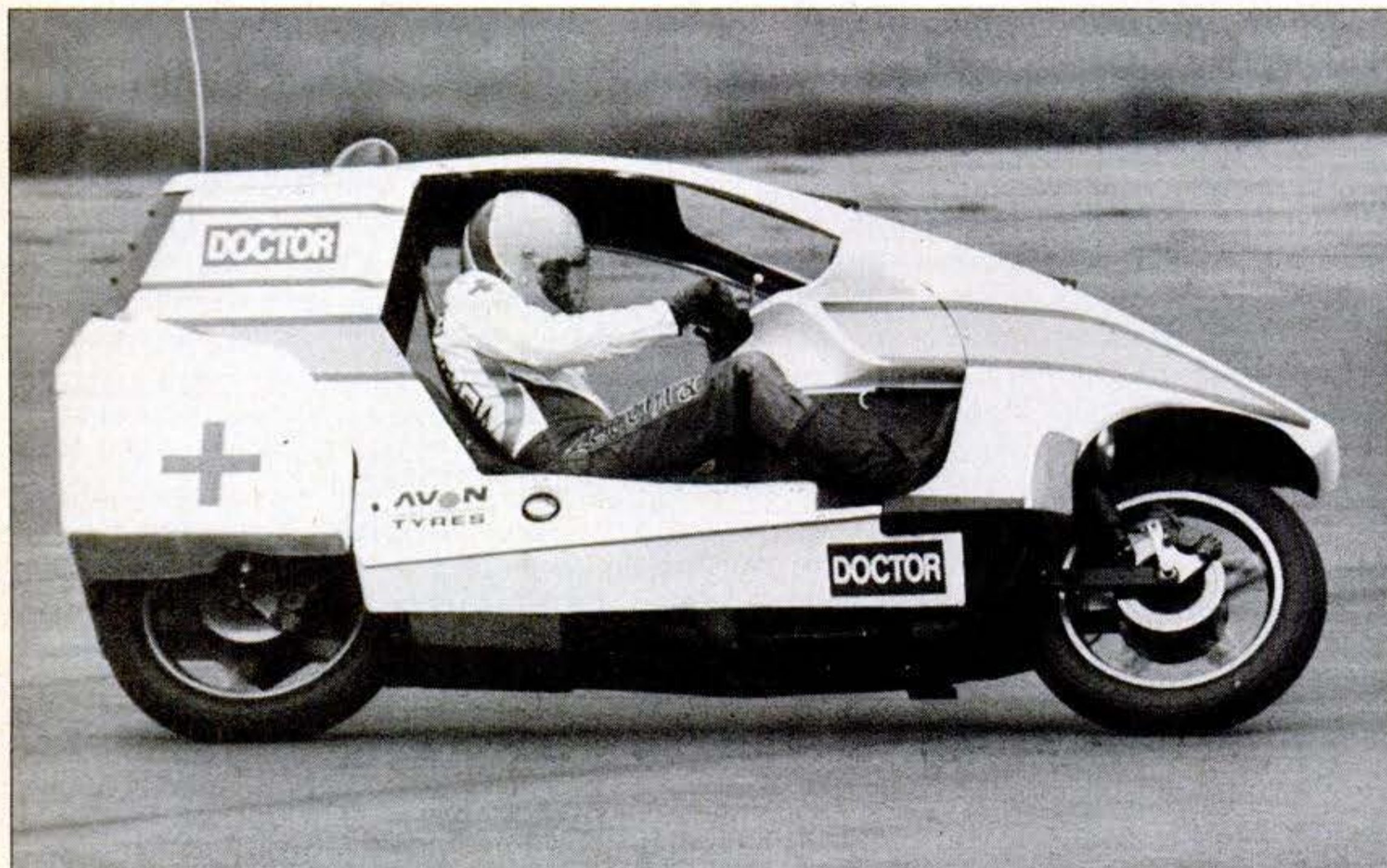
Still another idea comes from Dr. Conrad A. Lohutko of St. Louis University. He describes many natural streams with high heads but modest flow volumes, which run more or less parallel to larger rivers with ample volume but with constraints as to head, or the construction of future dams. Most of these streams are in New England. His solution is clever: He proposes pumping water from the large river to the smaller stream and building a series of dams on the stream for small hydropower. Thus, the river would, in a sense, serve as an impoundment. The first dam on the small stream would provide power to pump the water. The succeeding series of dams would produce power for the grid. Ultimately, the spent water would be returned to the main river, and overall flow would remain unchanged.

An even more exotic concept is advanced by Kenneth R. Broome, civil engineering manager for Gilbert Commonwealth, of Reading, Pa., an engineering firm involved in many hydro developments in the East. Broome foresees "prefabricating generating modules that could be strung together like beads on cables and suspended between concrete abutments on the river banks." He calls the scheme a modular hydro dam "... intended for stair-step installations on shallower rivers." The system would eliminate much of the massive excavation and water diversion needed to build conventional dams. And it would make disassembly easy during flood conditions or for repairs.

My conclusion about small hydro? Although it won't solve more than a small part of our power needs, it can contribute significantly in exactly those parts of the country where power is most needed. E

What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



Medi-cycle

Speeding to a crash, a doctor at the hazardous Isle of Mann motorcycle-racing circuit uses a modified British Quasar bike. A cover keeps out the weather and protects an oxygen tank, resuscitation kit, vacuum pump, splints, and bandages. Power is from a 750-cc engine.

Roof wrapper

Leaking roof? Workmen haul a cure—a 200,000-sq.-ft. sheet of rubber—onto a new Richmond, Va., shopping center. Goodyear's 100-by-24-ft. Ver-sigard sheets can be spliced to cover old roofing, or put on new buildings to cut material and labor costs, says the company.



Commuter plane

Jetstream 31's offer passengers low noise, and commuter airlines low maintenance plus top performance for high-temperature and -altitude airfields, says British Aerospace. Mall Airways, an American operator, has purchased two of the new 18-passenger, 300-mph twin turboprops.



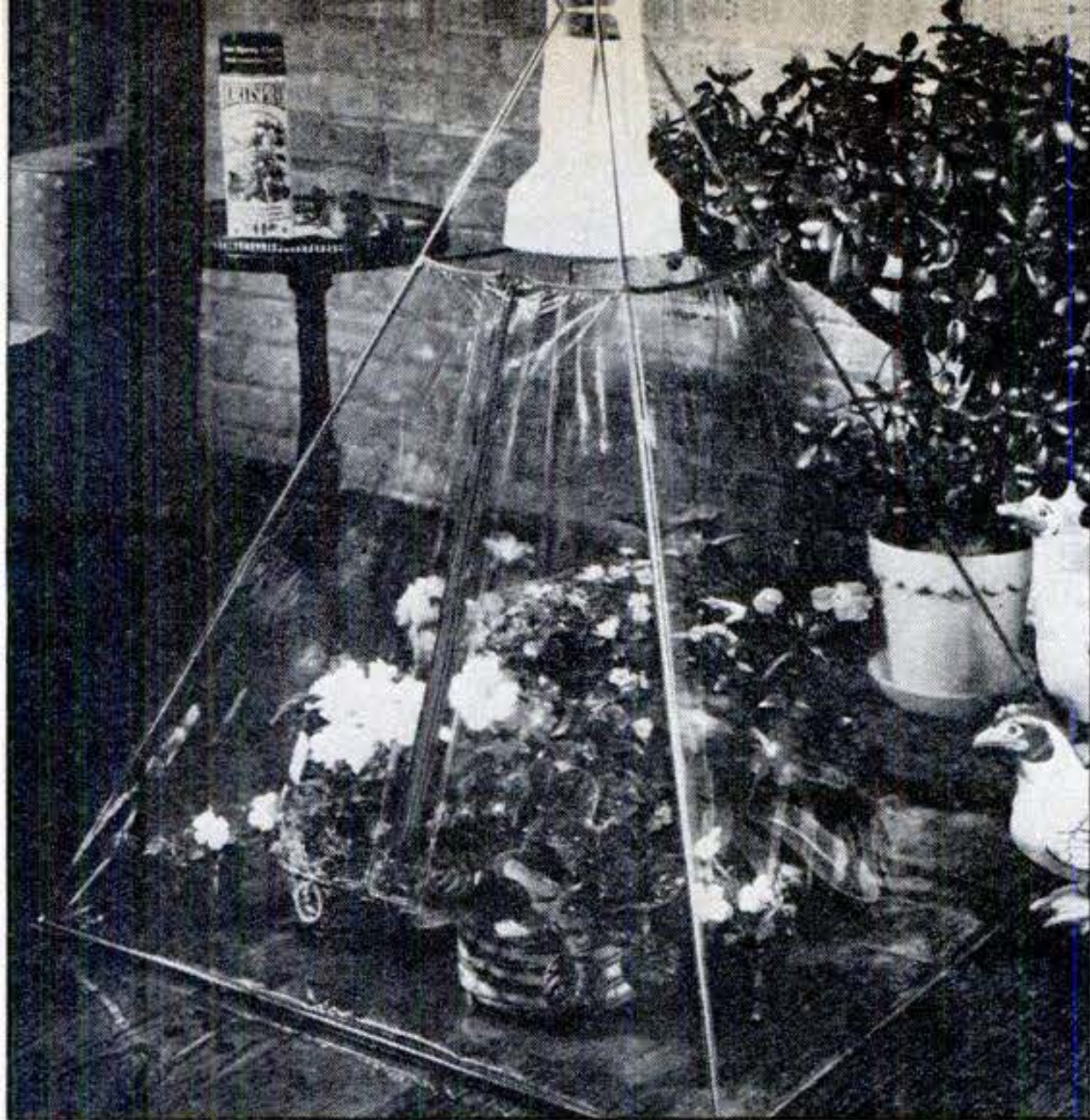
Three-inch reflector

Beginning amateur astronomers can set up this nine-pound telescope quickly. A three-inch f/6 mirror provides wide-angle views with a 30× lens. Other eyepieces are available. \$160. Edmund Scientific, 7082 Edscorp Bldg., 101 E. Gloucester Pike, Barrington, N.J. 08007.



Porsche 944

A four-cylinder engine with muscle—163 hp worth—powers the new Porsche 944. The big 2.5-liter engine accelerates a 944 to 100 mph in 22 seconds and provides 137-mph top speed. Low air resistance helps the sports car deliver 34-mpg fuel economy at 55 mph, says the manufacturer.



Indoor greenhouse

Lift a vent, squirt in Horti-spray, turn on the light—plants grow more efficiently in its Hortisphere, says The Hortecs Co. (Box 416, Lake Forest, Ill. 60045). Price: \$40. The spray can supplies carbon dioxide, water, and nutrient fertilizers, says Hortecs.

Nuclear sub

HMS Trafalger, a 272-ft.-long nuclear-powered submarine, slides into the water during her launch in northern England. The Vickers-built sub has a crew of 98 and is armed with torpedoes and underwater-launch, air-flight guided missiles. New insulating tiles cut running noise.

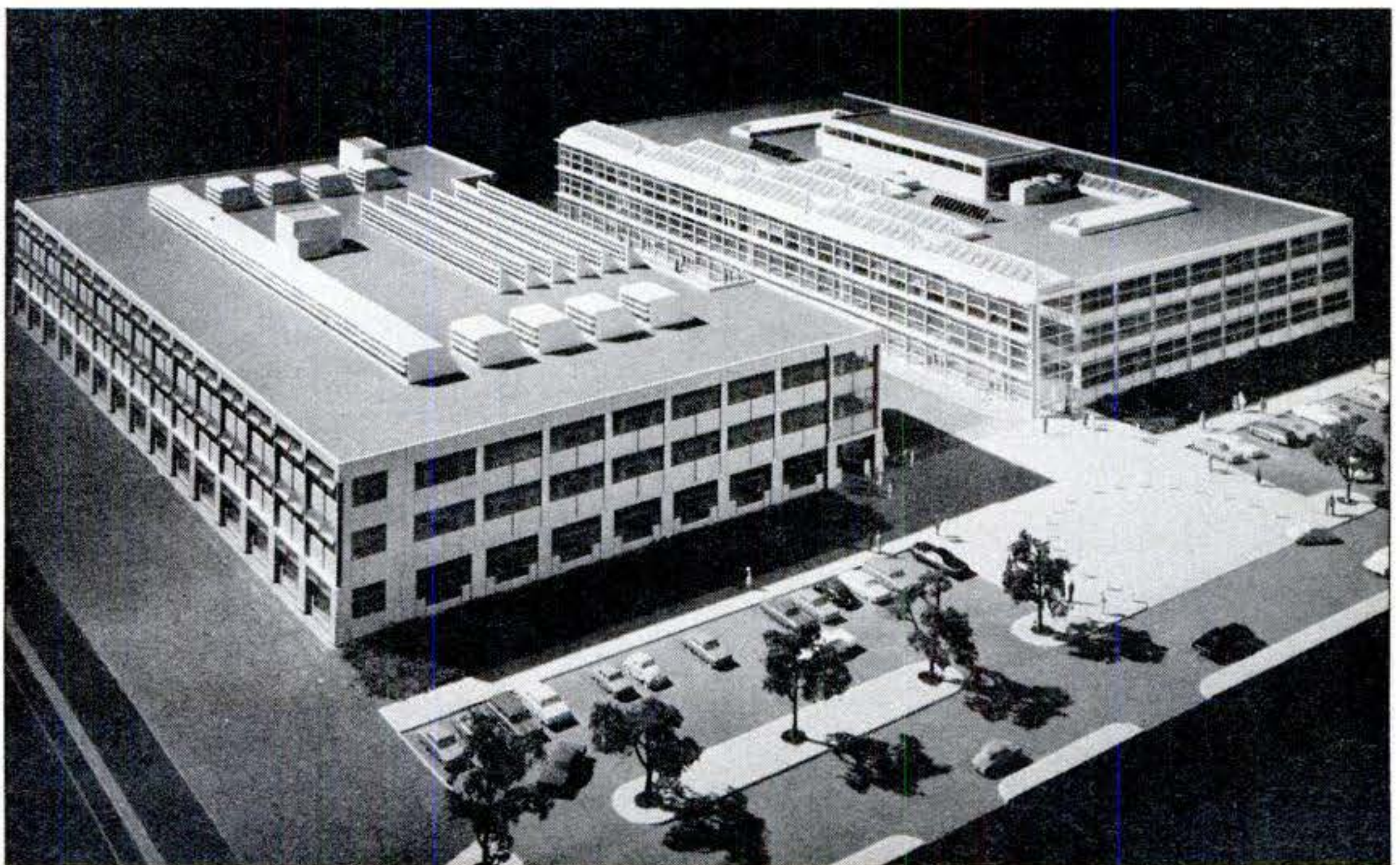


Mercedes turbos

For '82, the 300D sedan (above) and 300CD coupe from Mercedes-Benz have a turbocharged five-cylinder diesel engine. The turbo, plus a new transmission and rear axle, boosts both responsiveness and fuel economy, says the maker. Highway mileage is up 8.3 percent.

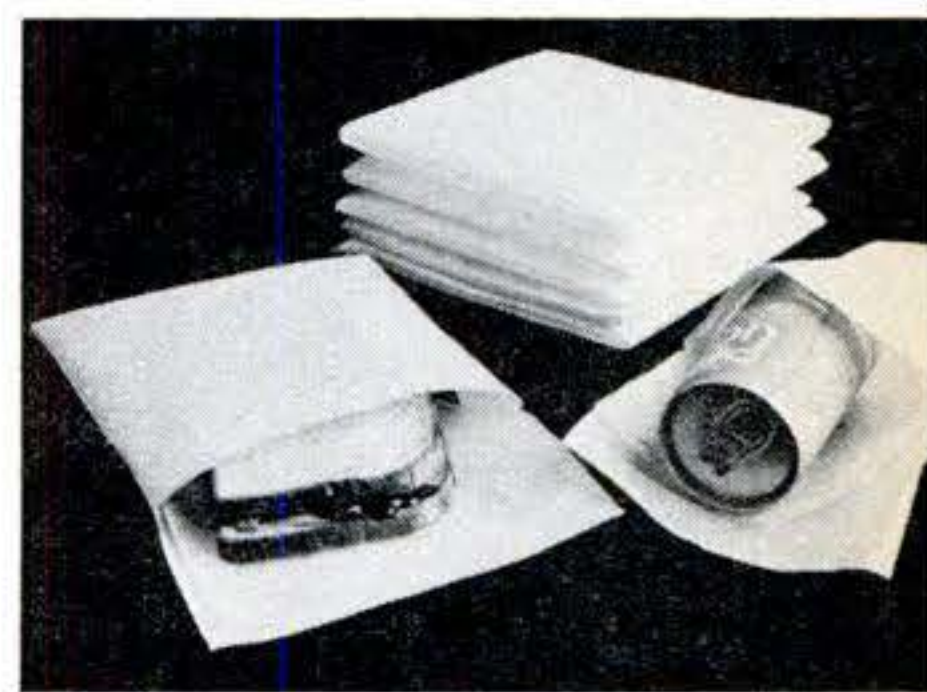
Icy offices

Storage ponds filled with ice will cool two Prudential Insurance buildings in Princeton, N.J. Both buildings, using different techniques, are designed for low year-round energy use. Heat exchangers will transfer building heat to melted water from ice made during the winter.



Insulated bags

Add an ice cube or two to these washable polyfoam bags for extra cooling time, says the maker. The insulated bags keep food warm or beverages cool. Five bags cost \$3.49; ten, \$6.49. Barrett Technology, Inc., Box 2096, Sunnyvale, Calif. 94087.



What's New



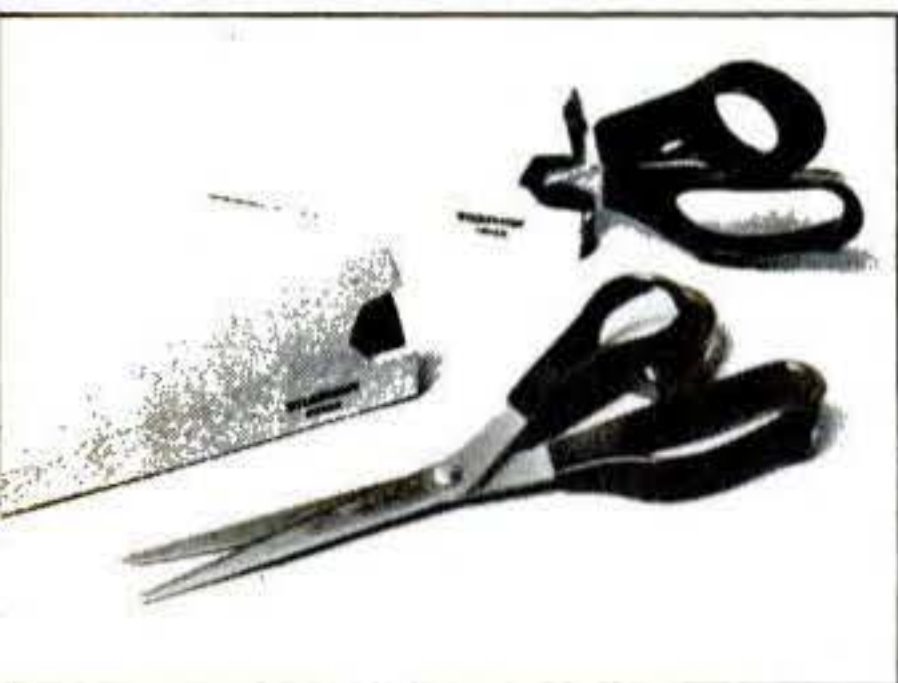
Competitive trainer

It doesn't fly (yet), but it competes. The mock-up of Fairchild's proposed Next Generation Trainer is touring Air Force bases so pilots and crew chiefs can study the design. Next spring, the Air Force will choose between this and four other proposed trainers.



Portable dish

It's only eight feet in diameter, yet RCA's high-frequency satellite antenna can transmit voice messages anywhere on earth. The 9,000-pound antenna can be airlifted to remote sites and set up in 30 minutes. The Defense Dept. will use the dishes to communicate via satellites orbiting the equator.



Self sharpener

Neatness pays. Remember to return these Wilkinson Sword scissors to the case, and the stainless shears will stay super-sharp. The case has a built-in, tungsten carbide sharpener that hones the blades from rivet to tip when the scissors are inserted and removed. \$15.



Handcycle

Rest your feet—and exercise your biceps—with this hand-powered tricycle. It has a three-speed hub, coaster brake, and adjustable seat. The basket carries 200 lbs. The \$495 bike is practical and fun for wheelchair users, says Palmer Ind., Box 707, Endicott, N.Y. 13760.

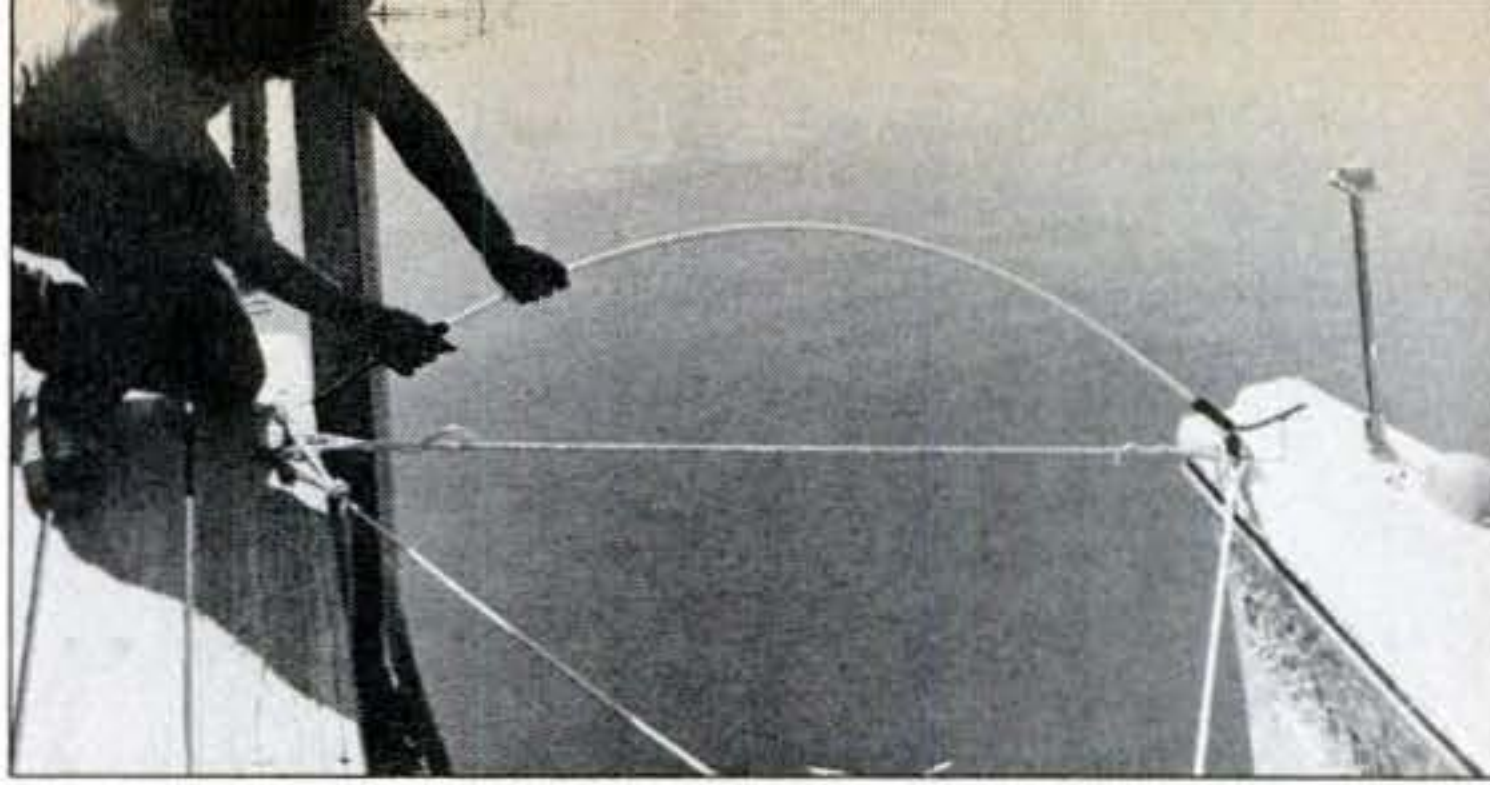
Leak detector

A portable door with attached vacuum pump, the Infiltrometer seals off a house, then creates negative pressure inside. A computer monitors the rate of outside-air seepage. Ener-Corp (359 Rte. 111, Smithtown, N.Y. 11787) uses the device when weather-sealing a house.



What's New IN BOATING

BY SUSAN RENNER-SMITH



Rub stopper

A flexible fiberglass rod at bow and stern keeps your boat away from the dock better than spring lines alone, says Marine Products, Inc. (5809 N. 50th St., Tampa, Fla. 33610). The fiberglass deflects the boat's movements and pushes it back in place. The Dock Standoff starts at \$90.



Three in one

It's a sailboat. No, it's a rowboat. A canoe? The 16½-ft. Saroca competes with—and often beats—each of these craft, claims Saroca Corp. (Rigby Rd., Scarborough, Maine 04074). Its high-performance, asymmetrically shaped fiberglass hull is foam-filled for stability. \$1,595.



Hotter Merc

To boost power without guzzling more gas, the latest Mercury V-200 has newly designed finger ports in the combustion chamber (inset). For better hot starts and smoother shifting, there's also a combination idle stabilizer and spark-advance module. \$5,900.

Versatile vehicle

Another three-in-one vessel, the Maverick hovercraft is boat, snowmobile, and ATV. Powered by a 440-cc engine, the 12-ft.-nine-in. craft hits 28 knots carrying a 350-lb. load over water. Over ice it's even faster. Price: \$4,995 from Alaska Hovercraft Inc., 5740 B St., Anchorage, Alaska 99502.



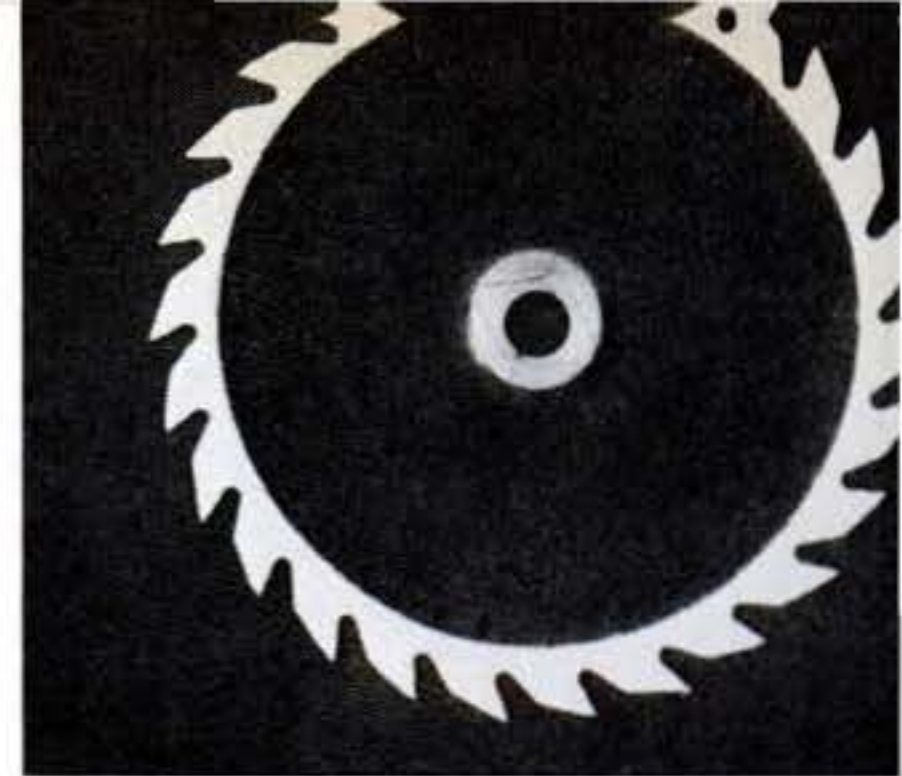
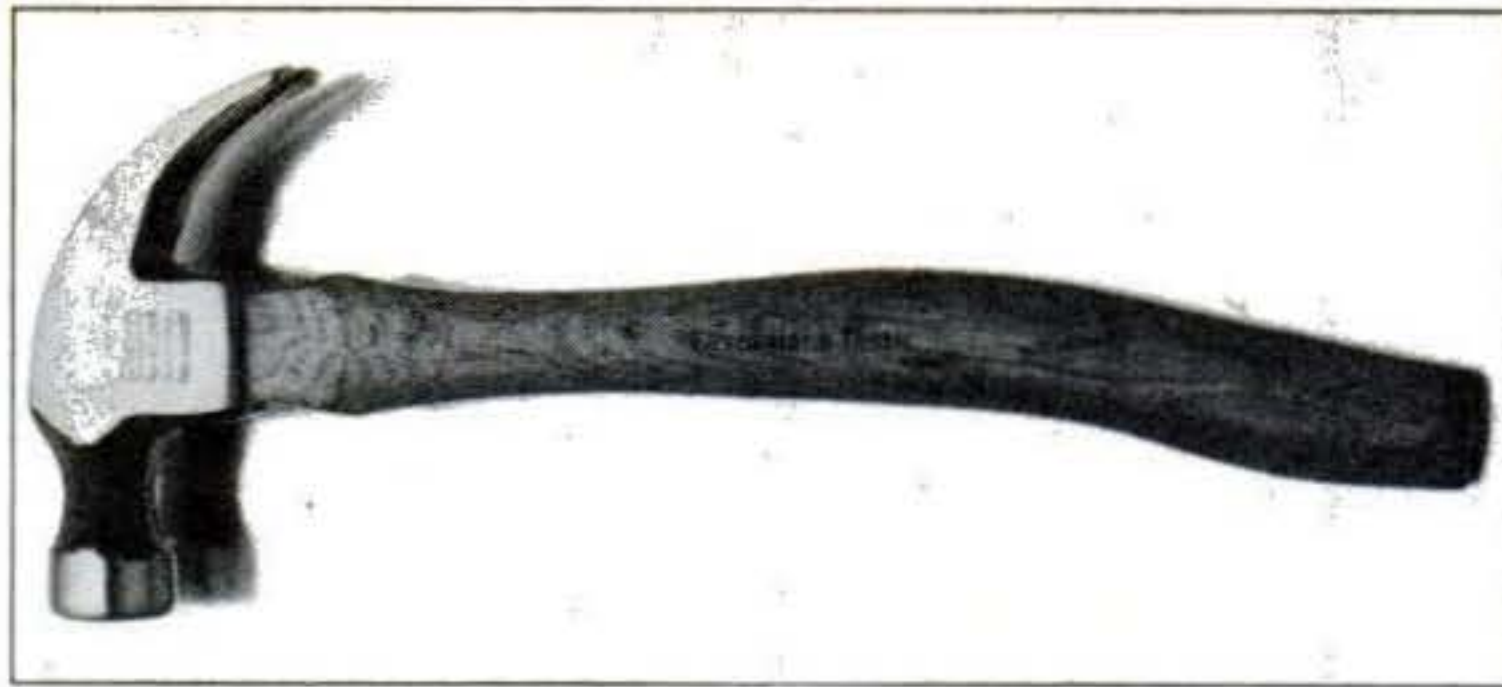
Sporting fisherman

When the helmsman is ready to fish, he just shoves his seat-back forward. Other standard features on the Huck Finn 175: built-in rod holders, bait well, and 48-qt. ice chest. The 17-ft.-six-in. center console costs \$3,143. Mark Twain Boats, Box 276, West Frankfort, Ill. 62896.

What's New

IN TOOLS

BY V. ELAINE SMAY



Handle with curves

A specially curved handle makes this hammer easier to grip and control. Result: greater comfort, less fatigue, faster work, says Easco Tools, Inc. (6721 Baymeadow Dr., Glen Burnie, Md. 21061). Its new Hand-Tastic hammers are about \$20 each.

Blade with abrasive

Sand as you saw with San-blade from Energyworks Corp. (149 Fifth Ave., New York, N.Y. 10010). Circular saw blades (steel or carbide-tip) have side panels of aluminum oxide guaranteed to last the life of the blade. Sizes: 5½ to 10 in.; prices: \$12.99 to \$37.99.



Two for the logs

Homelite's new gasoline-powered mid-size chain saw, the 240 (top), has a 2.4-cu.-in. engine, a vibration-isolation system, solid-state ignition, and automatic chain oiling. The 9.7-lb. saw comes with a 14-in. guide bar (\$240), a 16-in. bar (\$250), or an 18-in. bar (\$270). Stihl's 009 (above) is the quietest chain saw available (96 dBA at 8,500 rpm), says the company. Engine displacement: 2.3 cu. in.; weight: 7.9 lbs.; bar length: 10 in.; price: \$150. An automatic chain oiler is standard.

High-tech router

A digital LED display on Black & Decker's electronic router shows depth of cut—in inches or centimeters. Dado finished? The spring-loaded motor and bit retract two inches so the router can sit flat on its base. It sells in stores for around \$140.

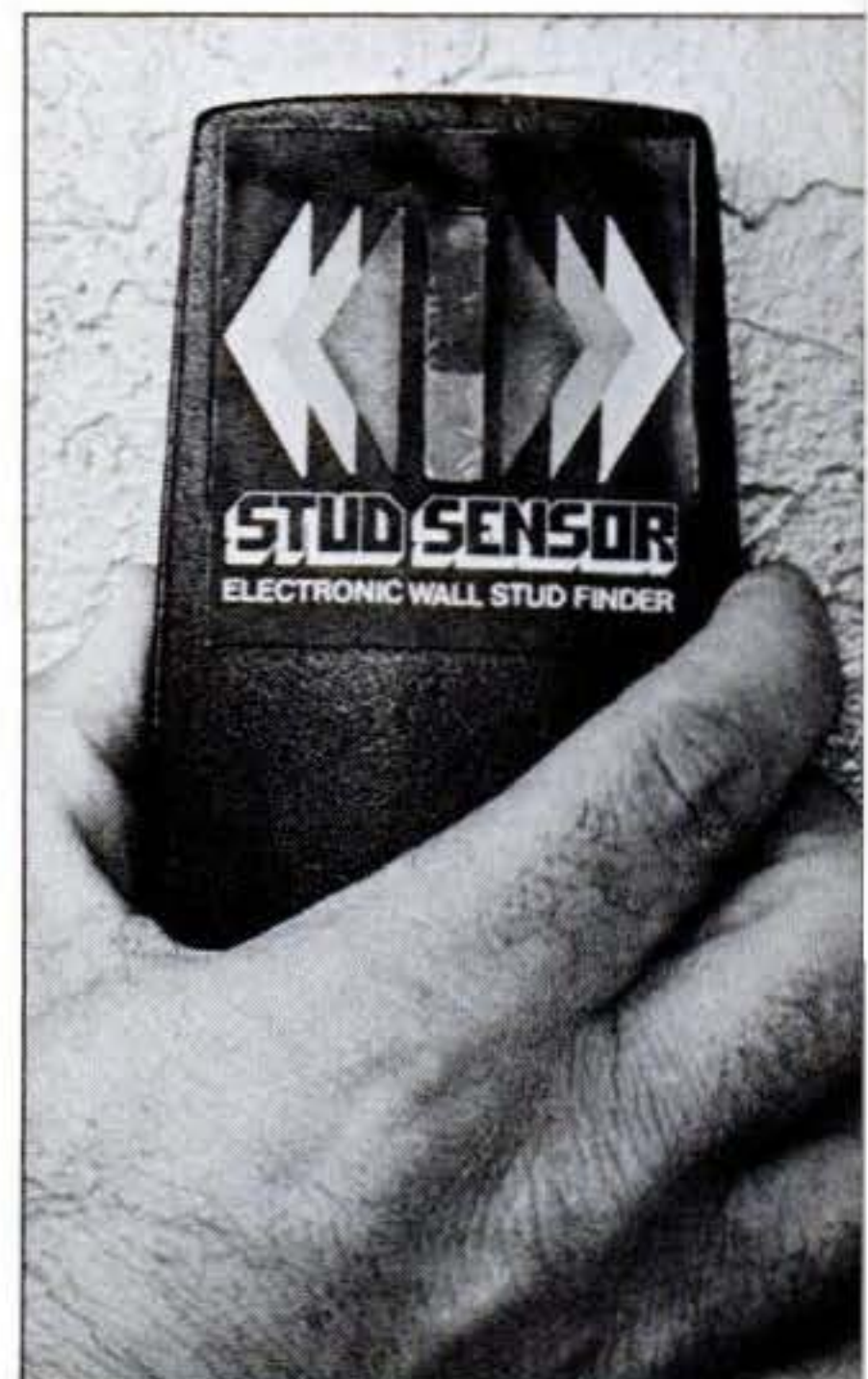
Ball-point hex key

Socket screws can be tricky to turn if access is limited. Balldriver tools (L-wrenches, screwdriver-style wrenches, power-tool bits) can turn them at angles up to 30 degrees. Maker: Bondhus Corp., Monticello, Minn. 55362.



Real stud finder

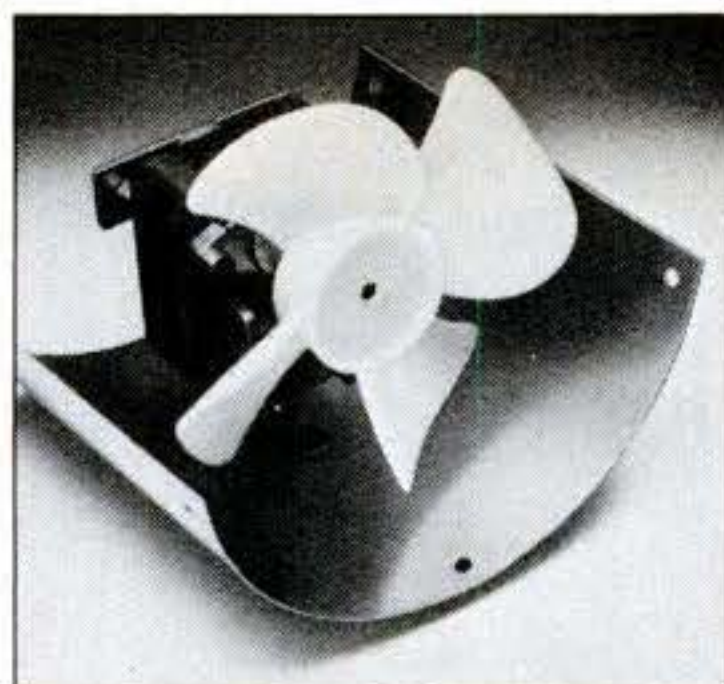
Electronic Stud Sensor from Zircon International (475 Vandell Way, Campbell, Calif. 95008) finds a stud by sensing a change in density of the wall material. (Most stud finders are magnetic and locate the *nails* in the stud, which may be off center.) It's \$20.



What's New

IN HOME IMPROVEMENT

BY SUSAN RENNER-SMITH



Duct fan

Designed for stubborn forced-air systems, the Energaire boosts air flow to the room that's always too cold. The 30-watt fan installs easily in ductwork, says maker (Tjernlund Prod., 1620 Terrace Dr., St. Paul, Minn. 55113), and uses far less energy than a space heater. \$23.

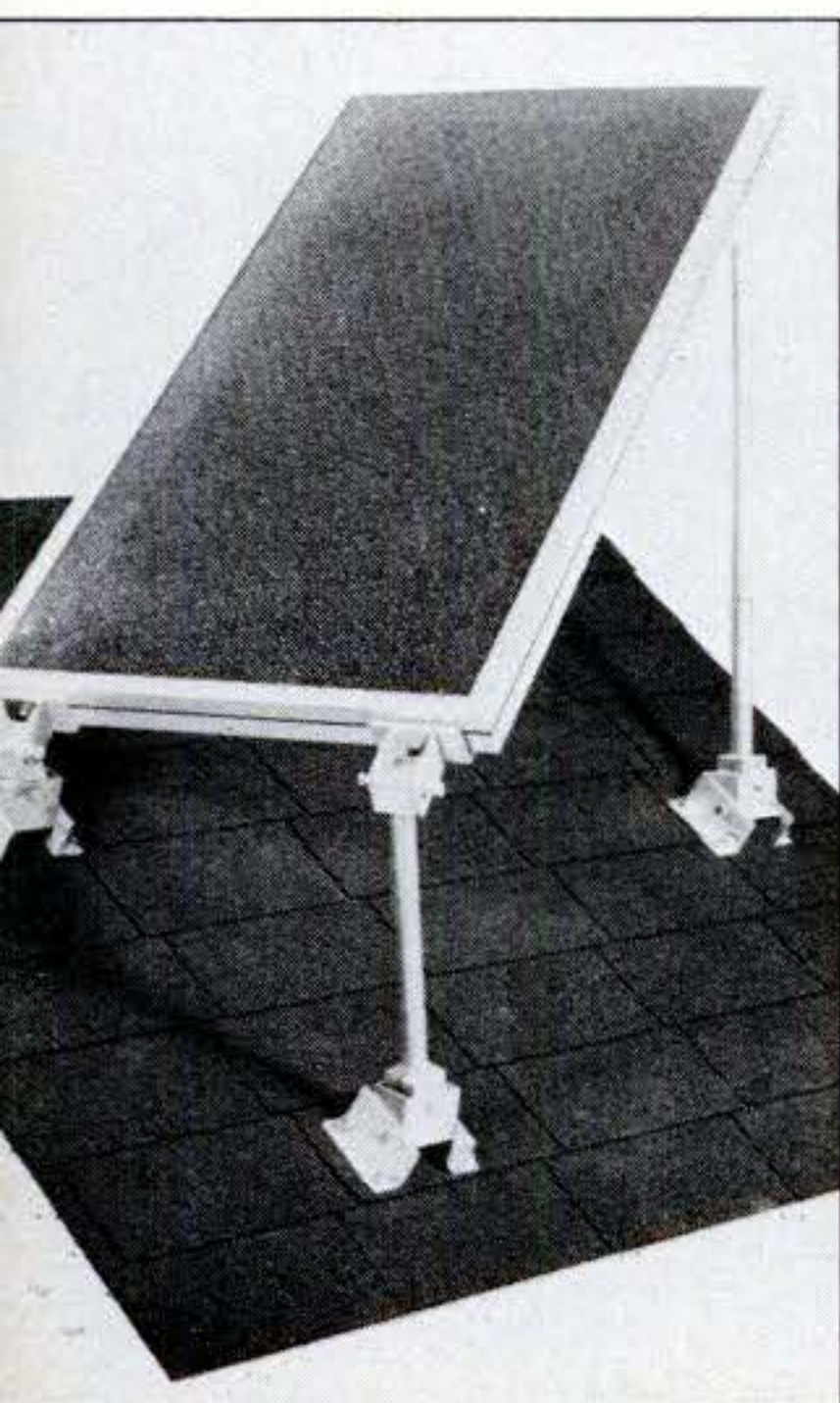
Skinny fridge

It fits in a 28-in.-wide niche, yet GE's new 15-cu.-ft. refrigerator stores as much food as a 30-in.-wide unit. The key is urethane foam—it insulates better than fiberglass, so a thinner layer can be used. The TBF15 also offers either a right- or left-opening door.



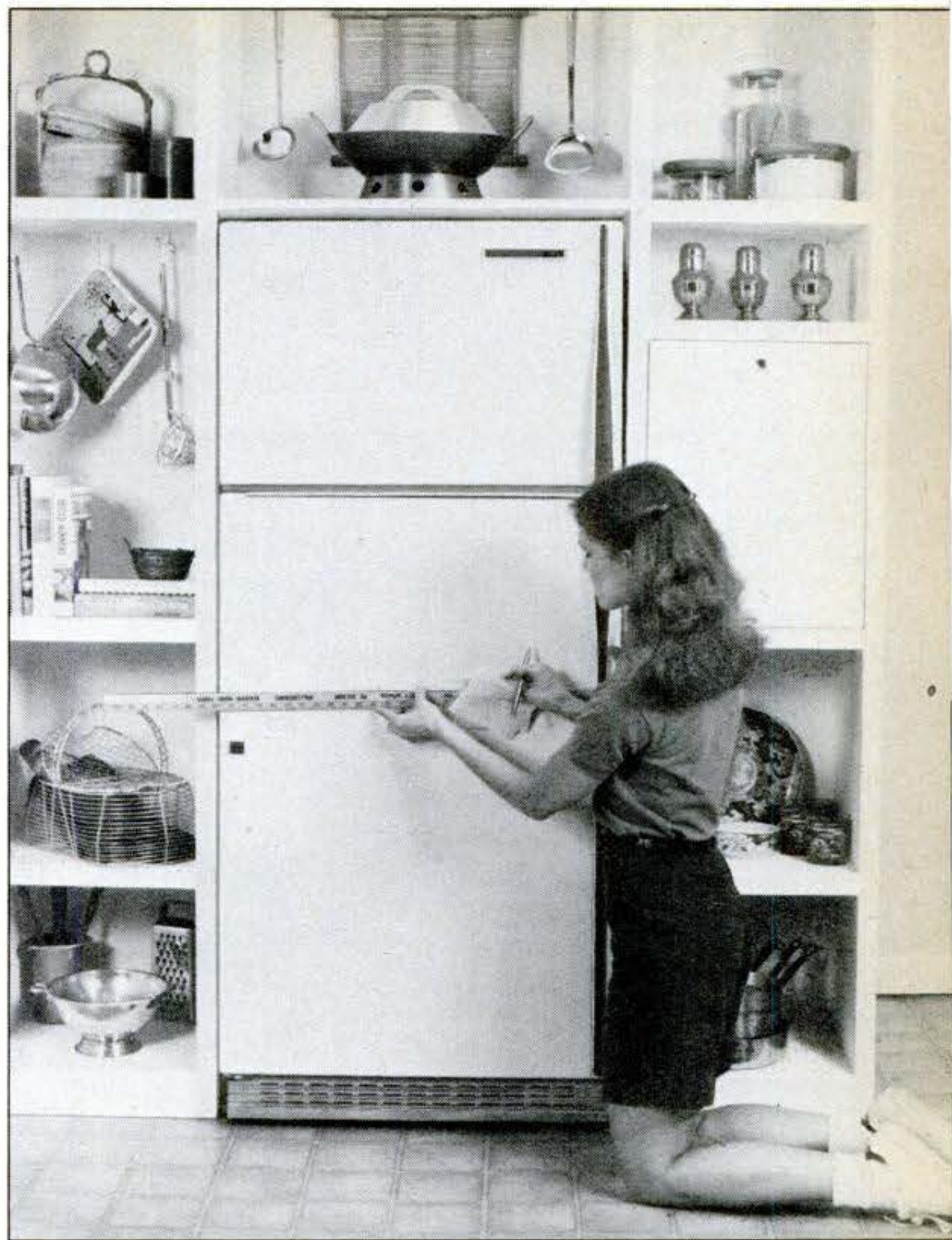
Two-trigger shovel

An extra trigger on the handle of this electric snow shovel makes attacking snow drifts easier. The triple-vane, foot-wide impeller pumps out even the wettest snow without clogging, says K&S Industries (Box 612, Fort Worth, Tex. 76101). The 16-lb. shovel costs about \$140.



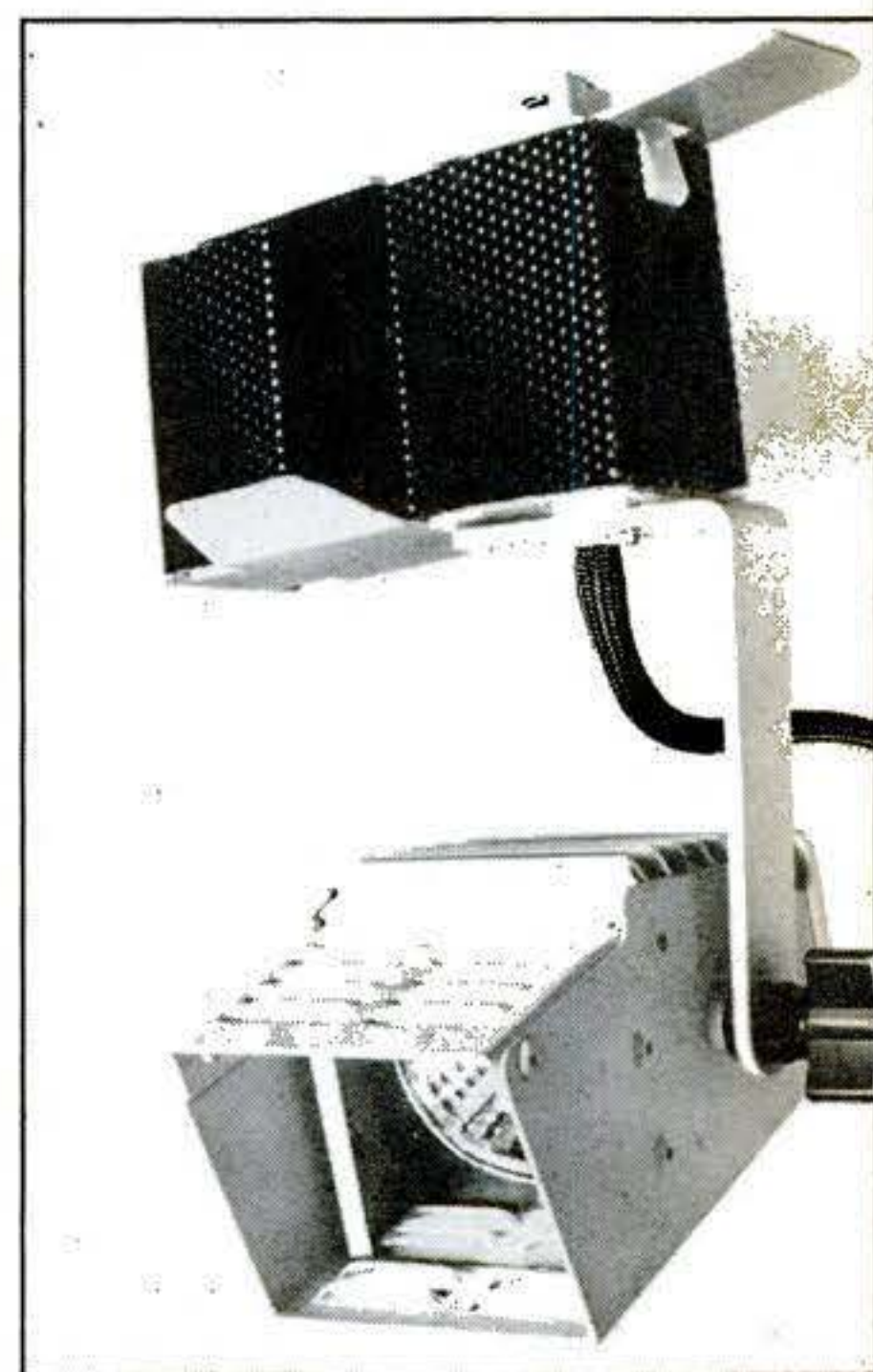
Solar mounts

You can install flat-plate solar collectors on almost any roof—despite pitch and orientation—with Sol-R-Mount. Its adjustable angles let you bolt galvanized-pipe legs (not included) to the collector and roof. About \$34 from Solar Warehouse, 140 Shrewsbury Ave., Red Bank, N.J. 07701.



Folding mirrors

Open these space-saving bi-fold doors and get a bonus—360-degree vision for grooming checks. Benchmark shatter-resistant mirrored doors come with tracks and hardware for do-it-yourself installation. General Prod. Co., Inc., Box 887, Fredericksburg, Va. 22401. About \$170.



Star light

Developed for film sound stages, this low-voltage light gives superior color fidelity, says Capri Lighting (7020 E. Slauson Ave., Los Angeles, Calif. 90040). Yet the 50-watt lamp generates little heat and uses 60 percent less energy than regular track lights. It's \$90 with transformer.

What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS



Electronic face

Smile. Your face is recorded and "freeze-framed" on the video display. Then other images are superimposed on the screen: mustache, eye-glasses, hair styles. You get to see the way you'd look . . . before you look that way. The Matsushita unit is used in Japanese beauty shops.



\$10,000 TV

There are only 100 of these 30-inch Trinitron TV sets in existence. That's how many Sony made to commemorate its 35th anniversary. It's the largest direct-view Trinitron tube made—and the most expensive: \$10,000 buys it (but that includes remote control).



Remote computing

Get to a phone and you can communicate with your computer—as long as you have this Lexicon (8355 Executive Center Dr., Miami, Fla. 33166) terminal. Everything you need is in one 8½-by-11-inch box: 59-key keyboard, five-by-seven-dot matrix printer, and full duplex modem. \$1,195.

Talking sign

A microprocessor and speech synthesizer are combined in this EXIT sign to determine what's wrong (power failure, fire, etc.) and tell you—in an authoritative voice—what to do in an emergency. It's about \$250 from Exit-U's, Inc., Box 285, Easton, Conn. 06612.



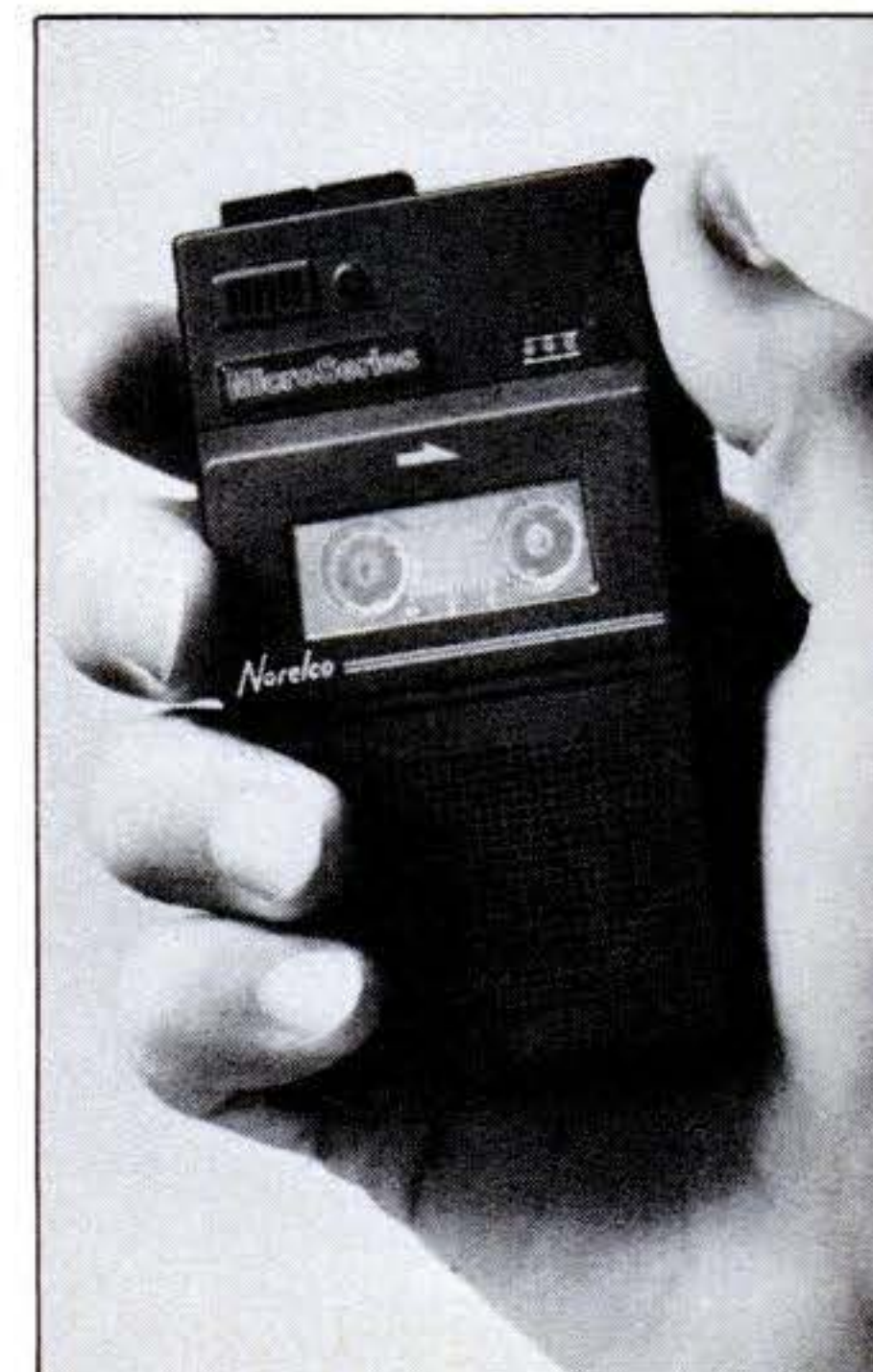
Smart switch

Use this wall switch to control the lights in a room for one day, and it remembers all the on-off times to duplicate them later. Result: The internal microprocessor makes your home look lived in. The switch (\$25 from Radio Shack) controls up to 500 watts.



Mini micro

Two speeds, digital tape counter, built-in speaker and mike, automatic playback after rewind, audible scan, auto-stop—and it runs on just two AA cells. More: The Nor-elco microcassette recorder easily fits in your palm. It's \$269.



What's New FOR YOUR CAR

BY ED JACOBS



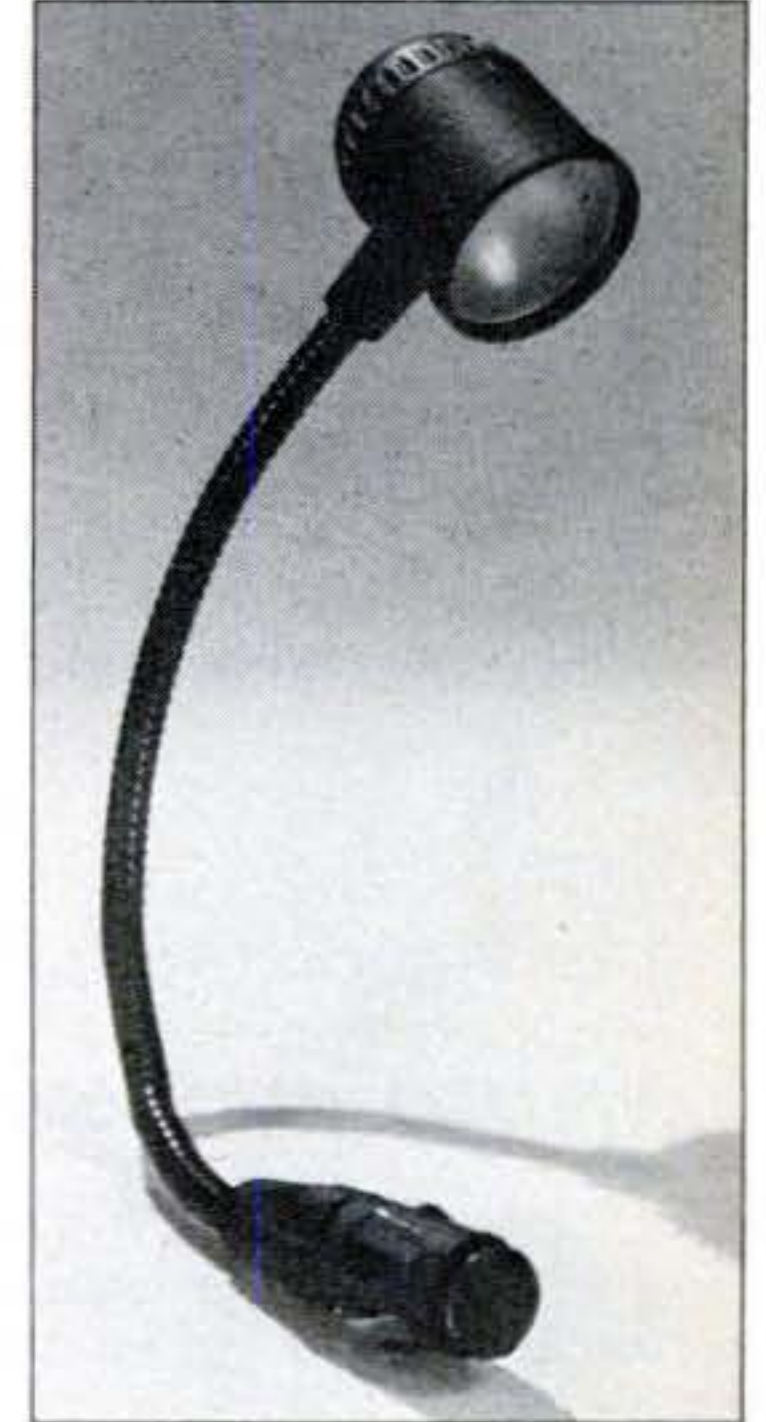
Instant chains

Slippery roads? These remote-controlled units drop down to whirl their chains under your driving tires and boost traction, then retract when not needed. They're made for pickups and larger trucks by AB Tydraul, Box 1063, 581 10 Linkoping, Sweden.



Heating cushion

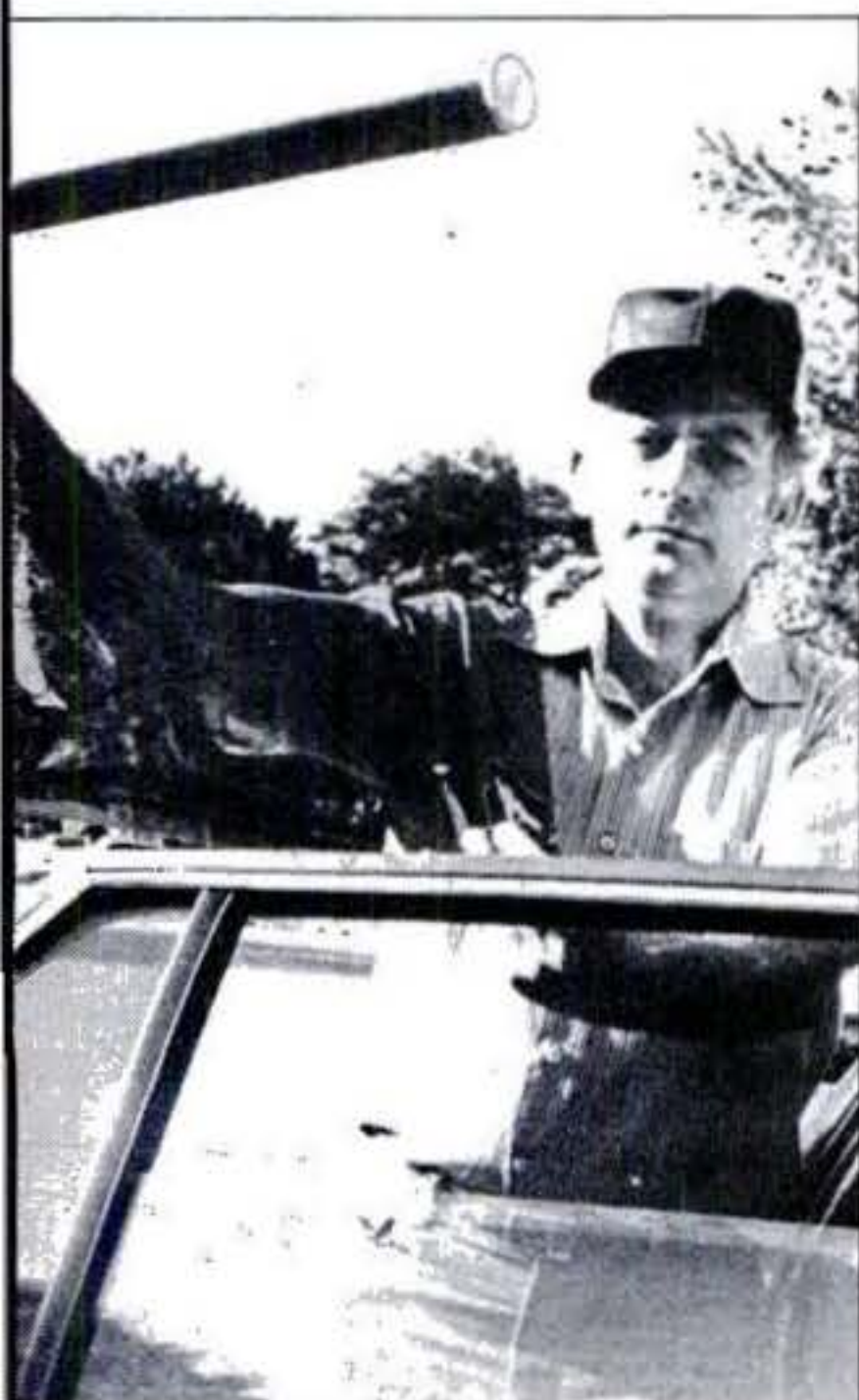
Kar Heat Kushion was designed by a physical therapist to relieve aching backs and tired muscles. It plugs into your cigarette lighter, has two heat ranges, thermostatic control, and a removable, washable cover. It's about \$40 from KHK, Inc., Box 1616-BP, Alvin, Tex.



Map light

The Copilot low-energy halogen light plugs into your vehicle's cigarette lighter. Its flexible neck can be pivoted in any direction so the light won't disturb the driver.

Price: \$14.95 at stores or from Osram Sales Corp., Box 7062, Newburgh, N.Y. 12550.



Swingin' spare

Instead of crawling under your pickup to release the spare, with E-Z Spare you just release a latch, crank down the spare, and swing it out. Cook's, Inc. (600 Diagonal St., Algona, Iowa 50511), offers a 90-day warranty, claims easy installation. Price: \$139.95.



DIY window tint

The same vaporized-metal-coated Scotchtint Sun Control film that architects use on building windows to keep down air-conditioning costs is available in DIY kits for cars and RV's. Kits cost \$29.98, and 3M says installation requires only a few simple tools.

Foam body filler

Polycell 500 is useful for repairing rusted body panels, but it can also be used as a filler to eliminate rattles and vibrations, according to W. R. Grace & Co. The foam expands as it cures and is said to be workable with ordinary tools. Price: \$9.95.



Videodiscs

— new alternatives
to movies at home

Grab the popcorn: Lots of new machines mean a new era in video entertainment

By WILLIAM J. HAWKINS

Look close. That record of *Saturday Night Fever* has all the songs from the movie. Wait. Look closer—that record is the movie.

It's a videodisc. Not only does it contain a sound track—it also contains the picture. Place it in a videodisc player connected to your TV set, and you get to see full-color, uncut, commercial-free movies—and more. Until recently, only two machines—Magnavox and Pioneer—have been available. But by the time you read this, over a dozen manufacturers should have units on store shelves, and many other makers plan to have systems within the next year (see table).

Sound good? It does to me, but for some, the jury is still out. They argue the price is too high for what you get, and stiff competition from videotape recorders, as well as incompatible disc formats, have helped confuse and alienate potential customers. True? Well, there's only one way to decide—and that's to see what the new players have to offer.

What you get

They're players only. Videodisc machines can't record. You buy a prerecorded video record—as you do an audio record—place it in the player, and watch its picture on your TV.

Prices for the new players range from \$430 to \$770 depending on the format, which determines the possible features. The format of the player is the technical way the video information is extracted off the disc. There are

currently two types: LV (laser vision) developed by MCA and Philips, and CED (capacitance electronics disc) by RCA. A third system, VHD (video high density), designed by Matsushita, JVC, and GE, is planned for June 1982.

The formats are incompatible—you can't buy an LV record and expect it to play on a CED machine, or vice versa. And, as you can see from the table, even manufacturers are divided over which system is best ["Video-disc Players," PS, July '80]. The fact is, each format has its own advantages.

The LV system, for example, uses a laser beam of light to "read" the information. Nothing mechanically touches the disc, so there's no wear or loss in picture quality over time. And, because of the way information can be placed on the disc, the unit has many special-effects capabilities.

Controls on the Magnavox player, for instance, allow you to vary the speed—forward or reverse—from 16 times normal down to still frame. And, in the still-frame position, it will hold one frame of the disc rock-steady on the screen for as long as you like.

The Pioneer laser disc player does that and a bit more. Each frame on the disc is electronically encoded with a number. That allows you to instantly find and display any frame at any time. To do it, you enter the frame number on a numeric key pad on the player and push a SEARCH button. In seconds the frame pops on the screen. It could be a picture of Bo Derek from her latest movie. Or, perhaps not as interesting but a lot more informative, it could be a chart of drill sizes from a how-to program disc. Sears has recently put its entire catalog on a disc. Pick one frame to see the newest radial-arm saw; press PLAY to see it in

action. The same idea is used for musical-concert discs: Each song can be chosen with a CHAPTER number button.

All this gives the LV machines great possibilities for a variety of future uses. There is a drawback, however: cost. The LV machines simply are more expensive than CED players—and low cost, along with simple operation, is the main idea behind the CED design.

The CED units are basically no more complicated than an audio record player. A turntable spins the record, a stylus tracks the grooves to extract the audio and video information. (The stylus is rated for about 500 plays and can be replaced in minutes at home. Cost: about \$75.)

The only delicate piece in the system is the record itself. Scratches or fingerprints could destroy your movie. To prevent it, the CED records come in a permanent plastic jacket. You slide the record-jacket and all—into the player. Then you pull the jacket back out. The record automatically stays in place on the internal turntable.

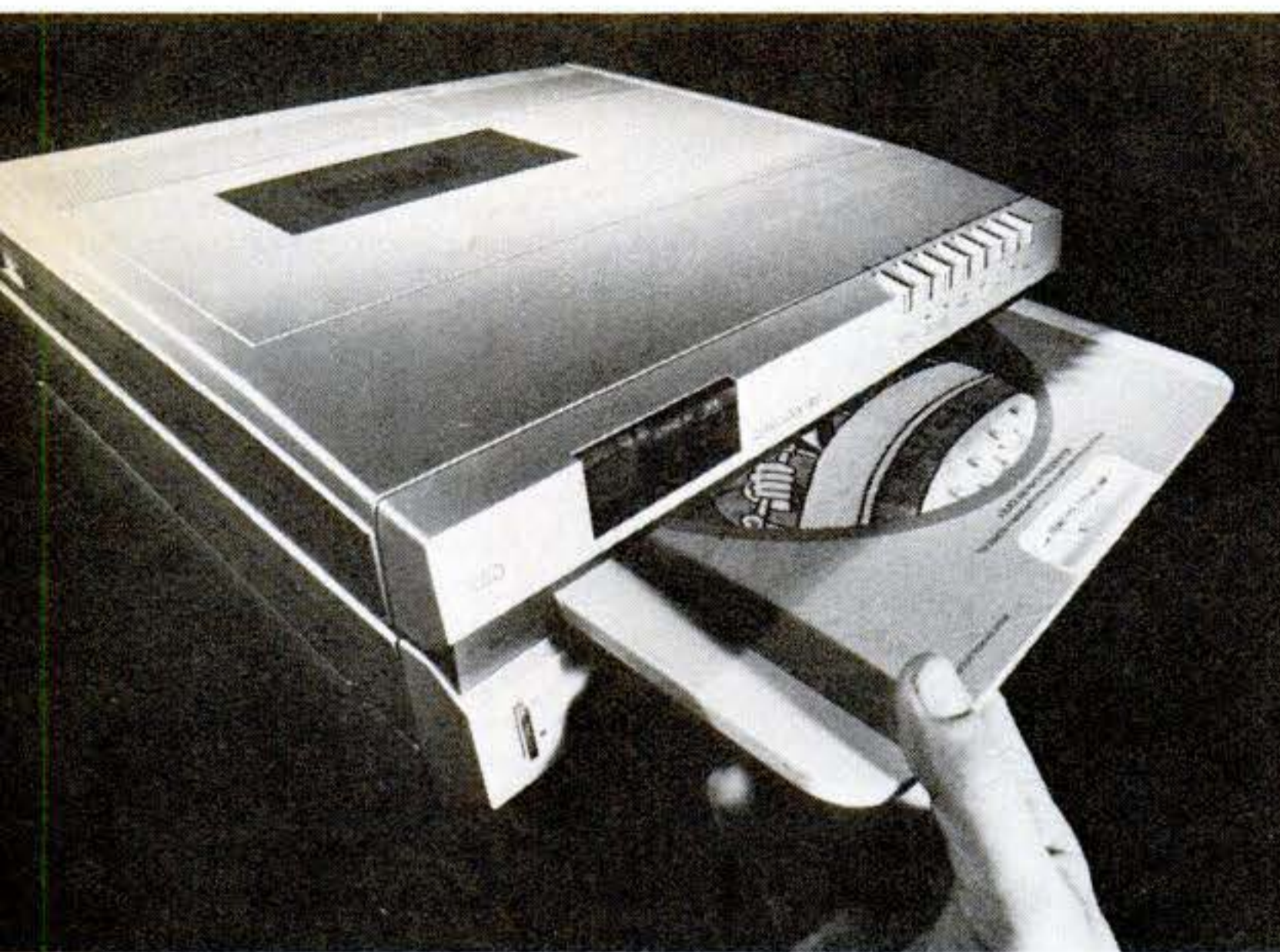
Because it is a record-in-a-groove system, you can't instantly scoot all over the disc. It takes a bit of button-pushing. The basic RCA model gives you two fast-forward and two reverse speeds. But you don't see the picture while using the fastest speed (approximately 120 times normal). Instead, a visual indicator shows the approximate minutes into the disc. The type of indicator used varies with the machine. Radio Shack, for instance, uses a sliding wand on a time scale (like tuning a radio). RCA, Zenith, and Sanyo use a digital display.

Once you're near the area of the show you want, you can "home in"

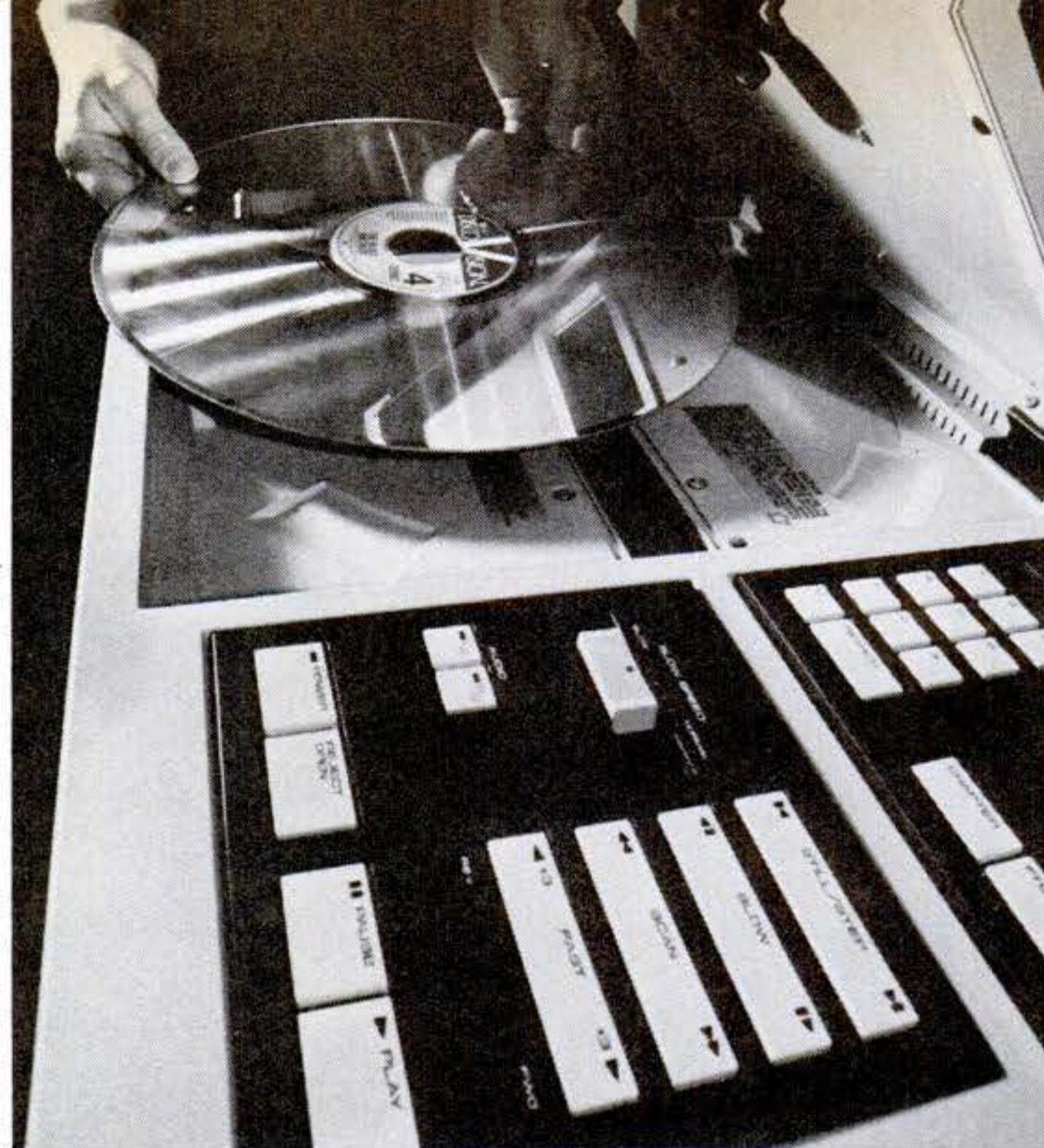
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A black and white advertisement for videodisc players. The image features a stack of six different models of videodisc players, arranged from top to bottom. To the left of the stack, a large videodisc is shown, with a smaller disc in front of it. The smaller disc has the words "DISCO" and "VISION" printed on it. The background is a light, textured surface. The text in the top right corner provides information about the players' features and lists the brands: Sanyo, Zenith, Radio Shack, RCA, Toshiba, Pioneer, and Magnavox.

New videodisc players offer excellent picture and sound quality. Units simply attach to TV antenna terminals. (Antenna is automatically switched to TV when player is turned off.) Some units have separate audio and video outputs for higher-quality signals when used with a projection TV and hi-fi. A few offer stereo. Remote control is optionally available on some. Top to bottom are: Sanyo, Zenith, Radio Shack, RCA, Toshiba, Pioneer, and Magnavox.



Square plastic record jacket contains round CED disc above. CED machines, like this Toshiba, play an hour per side. The Pioneer LV system, right, gets a half-hour per side in the normal mode. Extended-play discs in the LV system get an hour per side, but only the fast-scan feature will work on these shows.



with the slower-speed button (16 times normal speed). Now you get to see the picture, and with practice, you can stop within a scene or two of where you wish to be.

There are some variations to all this. Some brands, such as Hitachi and Sears, have cut the fast search down to 60 times normal but allow you to see the picture in both speeds. And still others, such as Toshiba, have two slower speeds with visual search and a third high speed (130 times normal) you use with the digital display.

Still-framing is a bit of a problem on CED machines since each revolution of the record contains four separate frames of picture information. The result on the Sanyo machine is a shaky still-framed picture (unless all four frames are nearly identical). The problem is solved another way by most other CED systems: they *don't have* a still-frame button. They have a PAUSE button that blanks the TV image.

Are they worth it?

Remember, videodisc players don't record. That makes videotape recorders—available for about \$100 more—their stiffest competition.

But with the videodisc player, you'll save money later—on the cost of the disc. A first-run movie is about \$30. That's not exactly cheap, but a prerecorded videotape of the same movie is at least twice that. Also, disc players offer more in special effects and, with the right discs, could be much more than just movie players. Instructional discs are available at present; future discs could mean an entirely new way of gaining information.

All this will hang on the programming material available. There is no

doubt in my mind that videodisc players will survive alongside videotape—just as audio discs and audio tape recorders can be companions in a hi-fi system. But now we're in the midst of a Catch-22. Programming developers are waiting for more videodisc players to be sold before they begin producing

more material, while videodisc buyers are waiting for a fuller library before they're willing to buy. And everybody's waiting to see what effect a third incompatible format will have this spring. Needless to say, for the videodisc to become a box-office smash, something has to give. **P 5**

Videodisc-player manufacturers—now and future

Manufacturer	Model	Format	Price (\$)	Controls						Output			Availability	Remarks
				Pause	Still	Slow	Fast	Random access	Remote	R.F.	Video	Audio		
Elmo	VEC 200	CED	500	✓	✓		2		✓	✓			Now	Stereo adapter jack
Fisher	U*	LV	U	✓	✓	✓	2	✓	✓	✓	✓	✓	March	
General Electric	U	VHD	U	✓	✓	✓	✓		U	✓	✓	✓	June	Variable speed
Gold Star	U	LV	U	✓	✓	✓	✓	U	✓	✓	✓	✓	End of '82	
Hitachi	VIP 1000	CED	530	✓			2		✓	✓	✓	✓	Now	Remote optional; two visual-search speeds
JVC	U	VHD	U	✓	✓	✓	✓	✓	✓	✓	✓	✓	June	Variable speed
Magnavox	8000 8005	LV LV	699 769	✓	✓	✓	✓		✓	✓	✓	✓	Now Now	Variable speed Variable speed
Montgomery Ward	10301	CED	430	✓	✓		2		✓	✓	✓	✓	Now	Stereo adaptable; remote control optional
NEC	U	VHD	U	✓	✓	✓	✓		✓	✓	✓	✓	June	Prototype info only
Panasonic	U	VHD	U	✓	✓	✓	2		✓	✓	✓	✓	June	Prototype info only
Pioneer	VP-1000	LV	749	✓	✓	✓	2	✓	✓	✓	✓	✓	Now	Variable speed
Quasar	U	VHD	U	✓	✓	✓	2		✓	✓	✓	✓	June	Prototype info only
Radio Shack	CED-1	CED	500	✓			2		✓	✓	✓	✓	Now	
RCA	SFT-100W	CED	500	✓			2			✓			Now	
Samsung	U	LV	U	✓	✓	✓	2	U	✓	✓	✓	✓	June	Prototype info only
Sanyo	VDR 3000	CED	500	✓	✓		3		✓	✓	✓	✓	Now	Comb filtering; direct-drive motor
Sears	5474 5478	CED CED	480 500	✓			2 2		✓	✓	✓	✓	Now Now	Two visual-search speeds
Sharp	U	VHD	U	✓	✓	✓	2	✓	✓	✓	✓	✓	June	Random access requires optional unit
Toshiba	VP-100	CED	525	✓	✓		3		✓	✓	✓	✓	Now	Stereo adapter jack
Zenith	VP-2000	CED	500	✓			2		✓				Now	

*Undecided

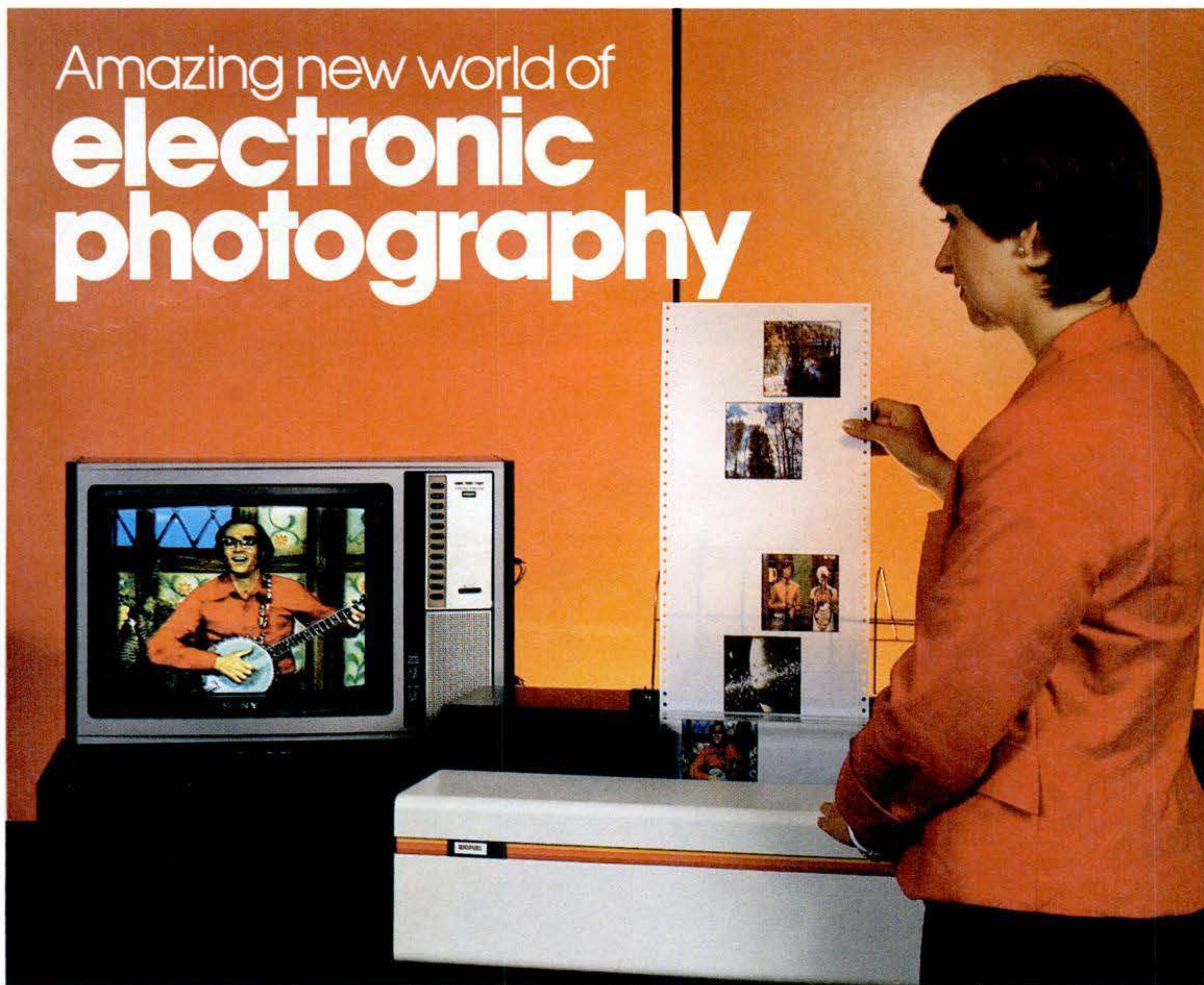
Beginning here: PS special photography section

Will electronic imaging and magnetic tape replace silver-based film in the camera of the future? For the amazing developments in electronic still photography, read the article starting below. On the pages following, you'll read about other fascinating developments: the new superlenses—some here now and others to come; the handy little clamshell 35's; the new flash units that tie into your camera's electronic systems; and Kodak's new Ektaflex no-mess color-print system.



PHOTOGRAPHY

Amazing new world of electronic photography



Plain-paper video printouts record standard TV images off the air. Biofuel, Inc., is planning a similar consumer-model printer.

Filmless cameras offer instant video snapshots—with low-cost home prints

By JOHN FREE

Sony Corporation chairman Akio Morita stepped before a press conference in Tokyo this summer. Something big was brewing. Tables nearby creaked with hardware: large color-TV monitors, a compact electronic "black box," a tiny portable TV—plus what looked like 35-mm SLR cameras.

First came a capsule history of video

and photography. Then the news: "Today we are announcing the world's first magnetic video camera," Morita said. Sony's newest miniaturized marvel is called Mavica. "We don't use film," he explained, holding up a credit-card-size package. "Instead we use this small Mavipak."

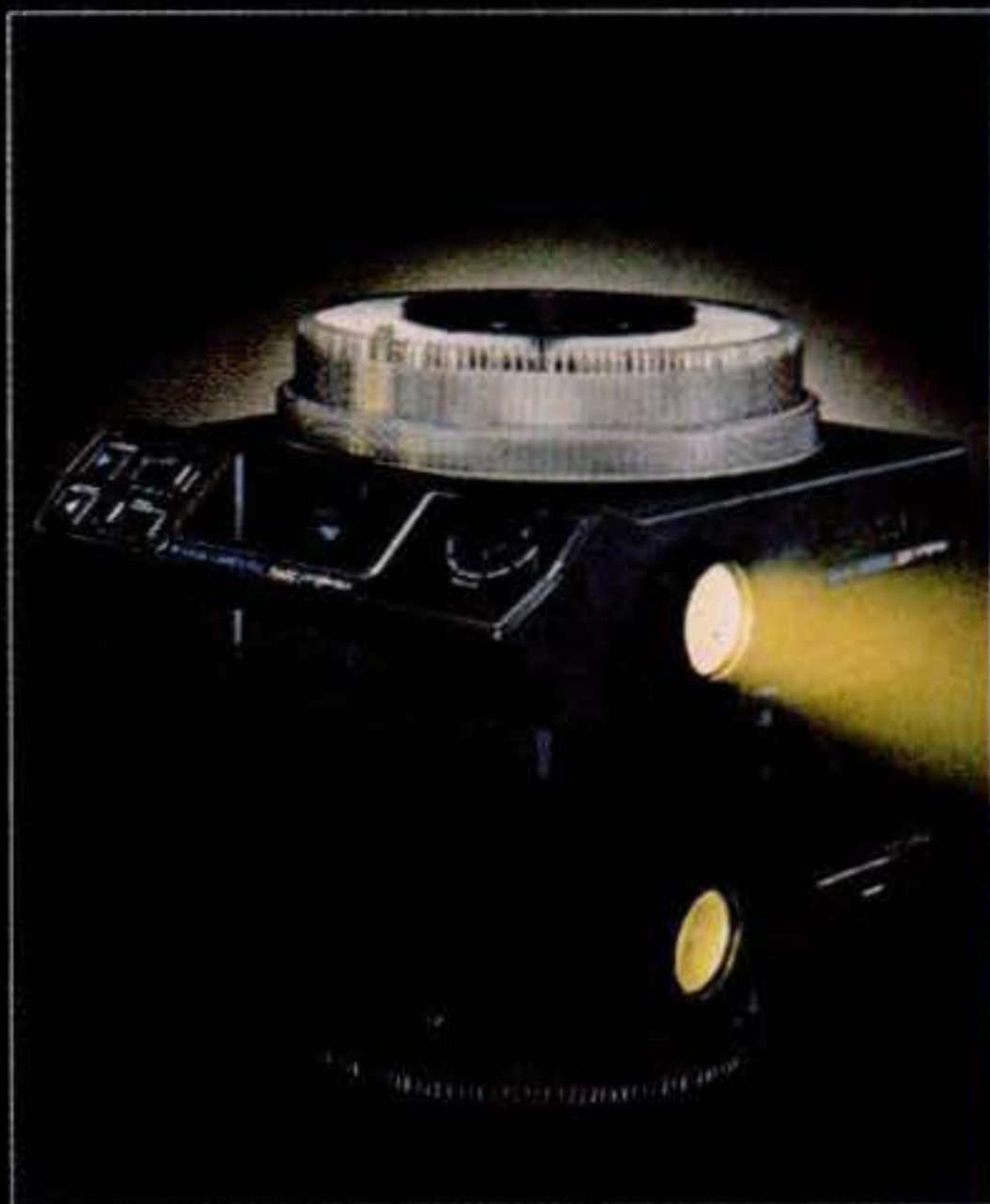
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SLIDE SHOW.

This Christmas get an entirely new view in slide projection. Our exclusive Slide-Scan™ built-in screen puts viewing slides right at your fingertips. Just remove the standard lens, pull out the Slide-Scan screen, and you're ready to preview, review, or just plain view your slides ... anywhere ... without putting up a projection screen!

Other new features include a conveniently located, illuminated control panel. Much longer lamp life (70 hours). And, on some models, a variable-speed auto-timer.

These new Carousel projectors make a terrific gift for anyone who



has a 35 mm camera. Because they give you a more uniform corner-to-center illumination. A manual select control, which lets you remove the tray when the power is off. And a rapid, reliable, automatic focus system on the top four models.

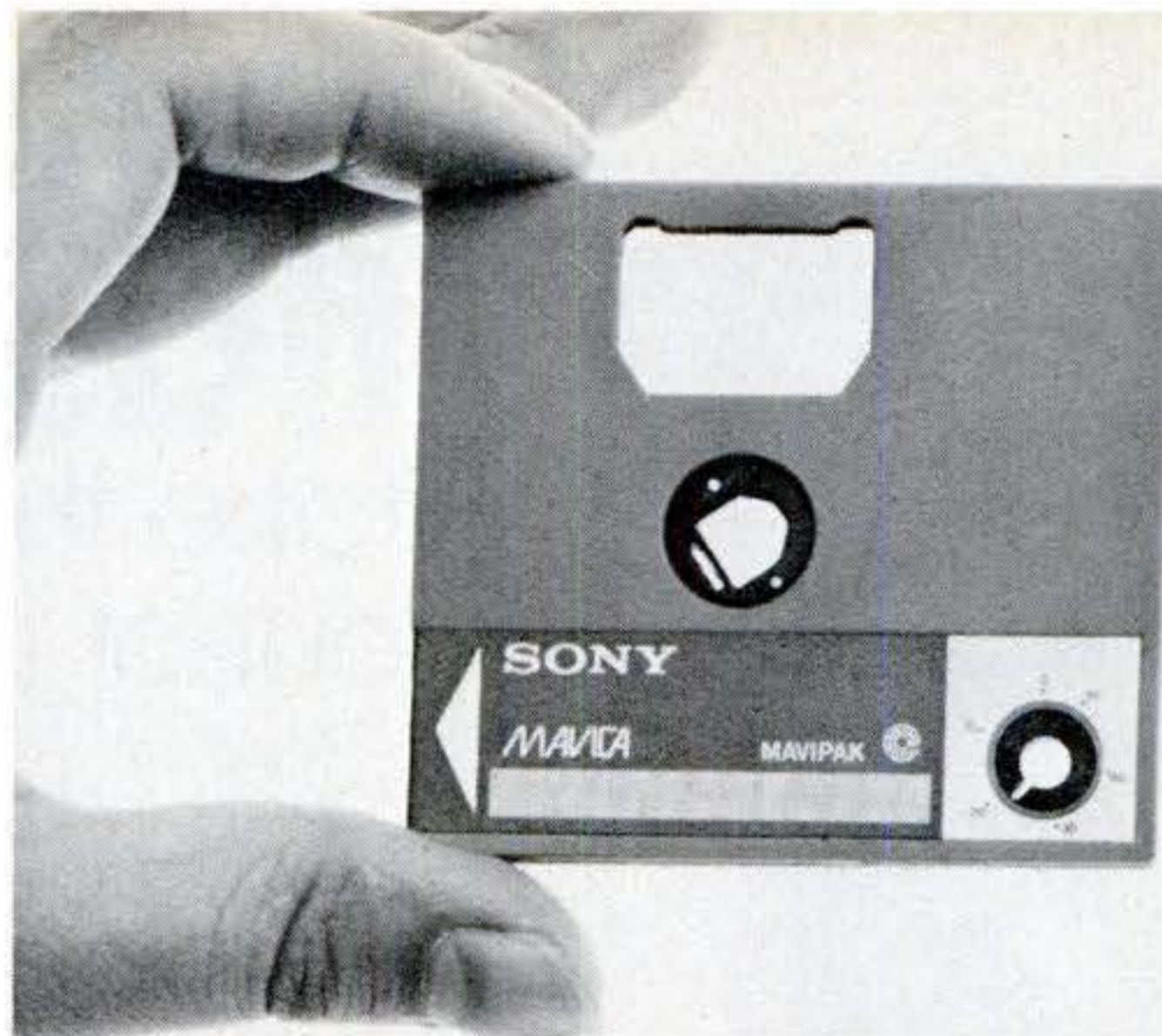
Add all this to regular features like dependable gravity feed, an Ektanar C projection lens, and a dark-screen shutter latch. Plus accessories such as a dissolve control and a sound-slide synchronizer. Then you'll know why the new Kodak Carousel projector makes such a great gift.

KODAK CAROUSEL® PROJECTORS
THE NEW BREED.

SIDE SHOW.



**THIS CHRISTMAS KODAK INTRODUCES
THE NEW BREED OF PROJECTORS
THAT GIVES YOU BOTH.**



Filmless video camera from Sony, called Mavica, looks like a standard 35-mm SLR but records images as video signals on tiny Mavipak magnetic discs (above, right). Mavica pictures (50 per disc) are viewed on TV through Mavipak playback adapter or converted to hard-copy video prints. Pictures can be sent by phone.

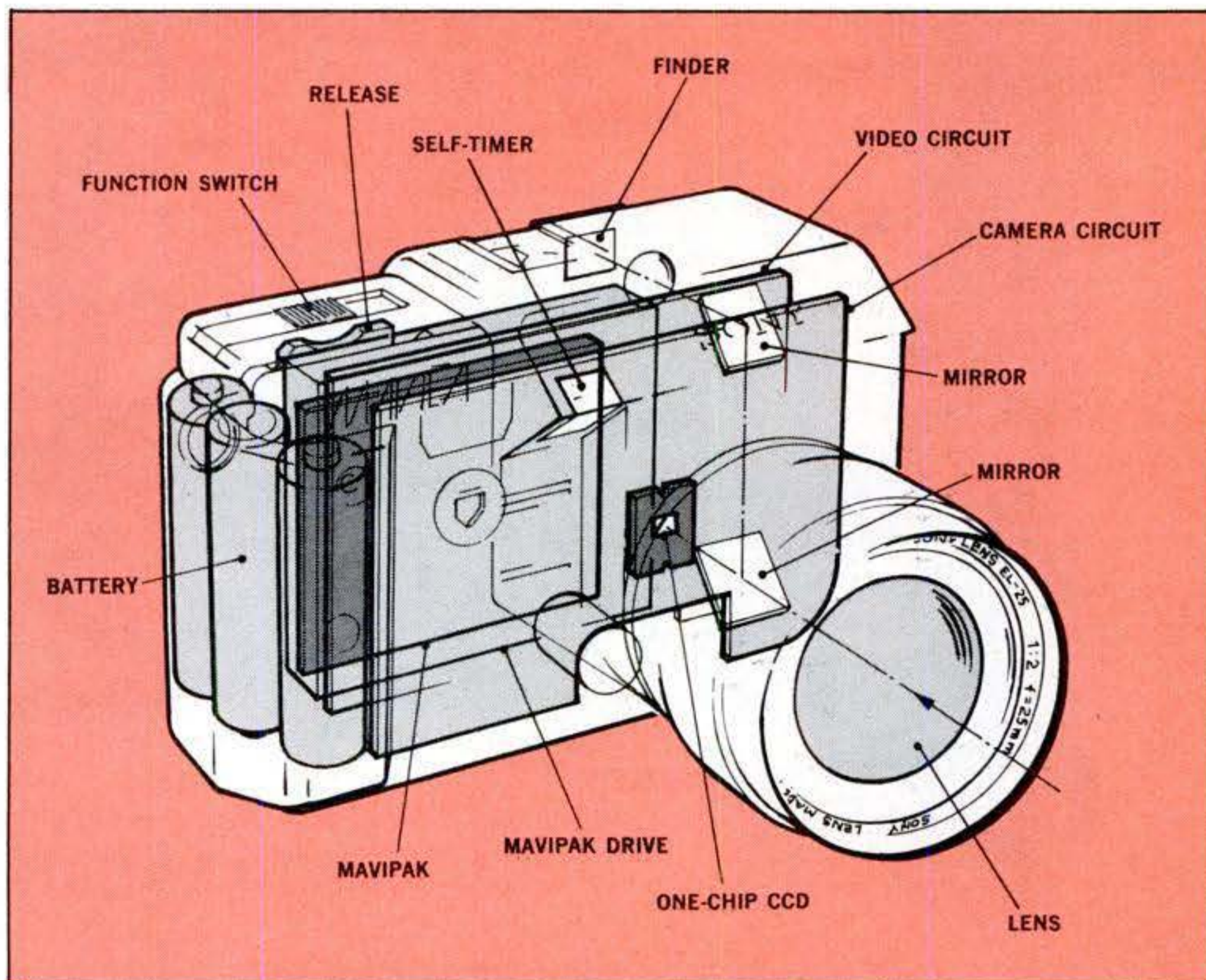
Charge-coupled device (CCD) converts image from lens into electronic signal for storage on Mavipak disc. Prototype Mavica has CCD with array of 570 horizontal and 470 vertical picture elements. CCD sensitivity is equal to 200-ASA film. Indoor/outdoor Mavica switch acts as filter to set color temperature.

A Mavipak is a 1 $\frac{3}{4}$ -inch-diameter magnetic disc that spins inside a Mavica camera (see diagram) to record "snapshots" as color video signals. A light-sensitive silicon chip converts images into signals.

"We'd like to show you some pictures we took outside," Morita said. A Mavipak disc was slipped into the black box, a turntable-size playback machine. Purple, yellow, red, and white flowers flashed by on the monitors. Sony says it is also developing a hard-copy printer for permanent pictures.

Mavica, called a "revolution in photographic history" by Morita, won't be sold for 15 to 24 months. By then, you may see more still-picture electronic cameras. Major camera companies and other electronics firms are developing filmless cameras, too. A related technology, portable VCR's and color-TV cameras [PS, Nov. '80], has already had a major impact on the eight-mm home-movie market.

Sony says it is not attempting to replace conventional film photography. Instead, it hopes to create a new form of home entertainment. The Mavica announcement comes just as other photographic techniques, not involving the electronic conversion of images but avoiding expensive silver



for film, are emerging ["Photography without Silver," PS, Dec. '80].

Steep hardware prices and limited picture sharpness compared with film could limit electronic photography based on standard-TV images. Sony's Mavica may cost about \$660; the playback unit would run about \$220.

Pictures themselves would be cheap. A Mavipak will cost about \$2.65, so snapshots viewed on TV are only pennies each. There's no estimated price yet for the printer. But if Sony adopts a plain-paper model, prints would be a fraction of the cost of standard photo enlargements.

How good are Mavica TV pictures? Sony says production models will have somewhat better pictures than its prototypes. These early Mavicas can capture 350 picture elements—350 lines of horizontal resolution—for each of the 483 scan lines on standard TV.

That's just over 169,000 picture elements (pixels), short of the 210,588 that each $\frac{1}{30}$ -second picture frame in a broadcast-quality color-TV signal can carry.

Even with picture-enhanced production Mavicas, this first electronic-photography entry can't approach the sharpness of film images. That would require storage of over a million pixels per picture frame. While Sony and other firms are developing high-resolution TV with this capability [PS, Nov.], special color-TV sets and professional tape recorders are needed.

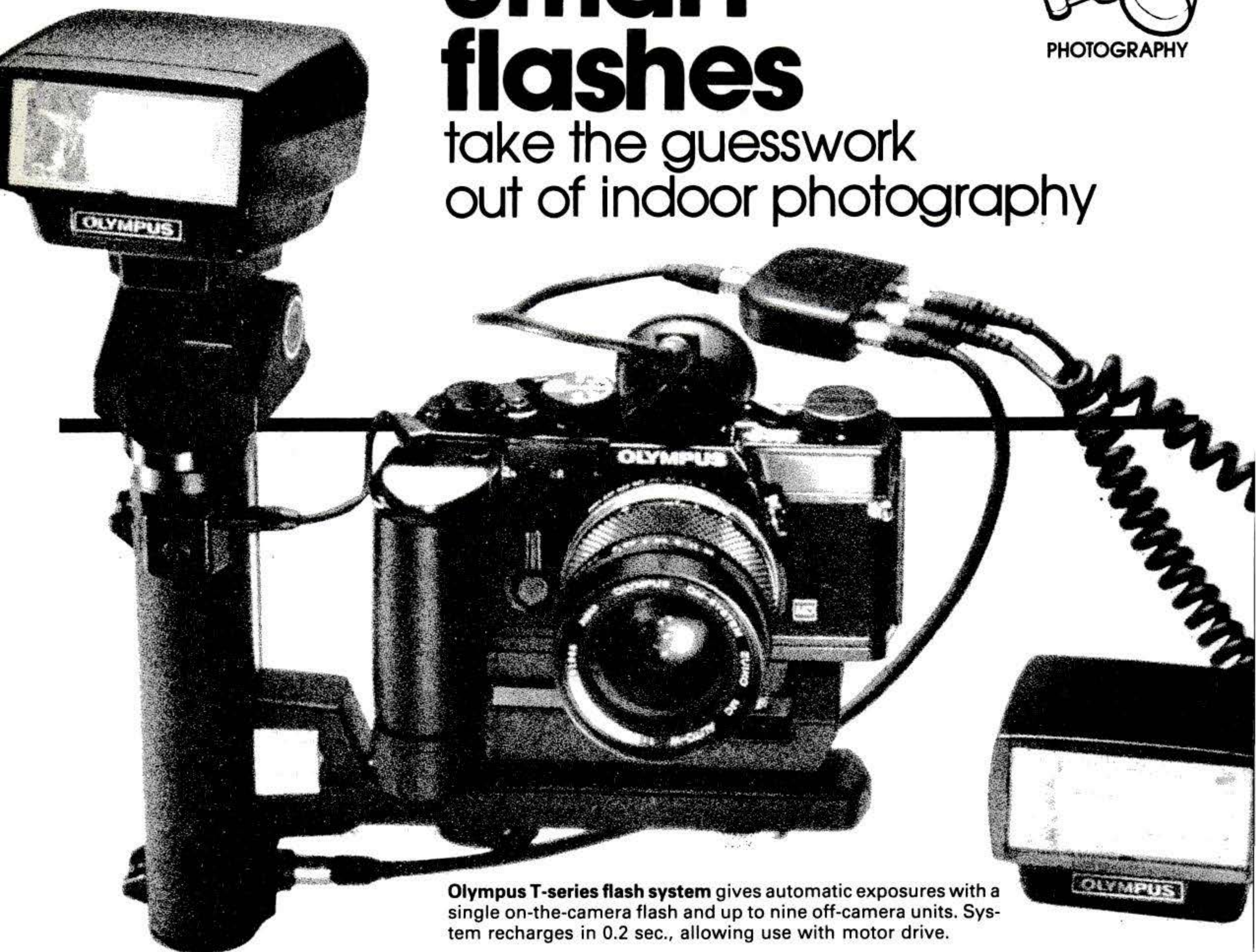
Sony has engineered its Mavica with top-grade color sets in mind: An optical filter for the imaging (CCD) chip, similar to filters in ordinary one-tube TV cameras, breaks the lens image into separate color signals for processing by the camera's video cir-

[Continued on page 124]



Smart flashes

take the guesswork out of indoor photography



Olympus T-series flash system gives automatic exposures with a single on-the-camera flash and up to nine off-camera units. System recharges in 0.2 sec., allowing use with motor drive.

Mated to an electronic camera, dedicated units blink and beep for perfect shots

By **DAVE SAGARIN**

I have a new flash attachment sitting on my 35-mm camera. I turn it on, set the distance range, and ignore it. Anything the flash needs to tell me (such as when it's ready to flash), it can tell me in the camera's viewfinder. Anything it needs from the camera (such as a shutter-speed setting that provides good synchronization), it attends to by itself. It will automatically compensate for lighter or darker subjects, giving pretty good exposure anywhere within the range I set. Because it ties into the camera's electronic system, it is called "dedicated."

Until recently, each dedicated unit was not only designed for a specific camera or camera system, but was made by the camera maker, and was carefully guarded by patents. Now, because of a Japanese court decision, such independent flash makers as Sunpak, Vivitar, and Metz have leaped into the dedicated field, creating circuits that mate with those of the cameras and adding features that, often, aren't available in the camera makers' units.

Let's examine the actual operation of one dedicated flash unit with one modern automatic camera: the Canon Speedlite 199A with the Canon A-1. Clip the unit into the camera's hot shoe. Turn it on. When it is charged, a ready light glows and a little F (for flash, I presume) blinks in the viewfinder. The flash sets shutter speed (whether the camera is in aperture- or shutter-priority mode) at 1/60 sec. This is the X-synch speed for this shutter; that is, the fastest speed at which the shutter curtains are still fully open for an instant. (At speeds faster than this, the second curtain will have started to close before the first curtain is fully open, and the brief-duration flash can't expose the entire image area.)

Select one of three distance ranges (near, middle, far) on the back of the flash. This will select an aperture setting for the lens, ensuring that neither too much nor too little light will be available for proper exposure over a given distance range. Once the range is set, any subject within that range (say, 3½ to 15 feet from the camera) will be properly exposed. The automatic operation of the flash will compensate for variations of distance and brightness within the range.

The viewfinder displays the aperture and shutter-speed settings. After each flash, the F will blink when the unit



has recharged. So, after having made just one setting—the distance range—you no longer have to look at or think about the flashes (unless you wish to move much closer or farther away). A confidence light glows green on the flash unit after the shot to confirm that illumination has been adequate.

When a camera manufacturer makes a dedicated flash for its own camera system, it can hard-wire the features; the flash need work only through one hot shoe and mesh with one electronic system. Imagine the difficulties of making dedicated flash units that, to be profitable, must be sold at prices lower than the camera makers', offer at least comparable features, and work with a number of staggeringly different designs. Nonetheless, the independent flash makers have done just that, though in different ways.

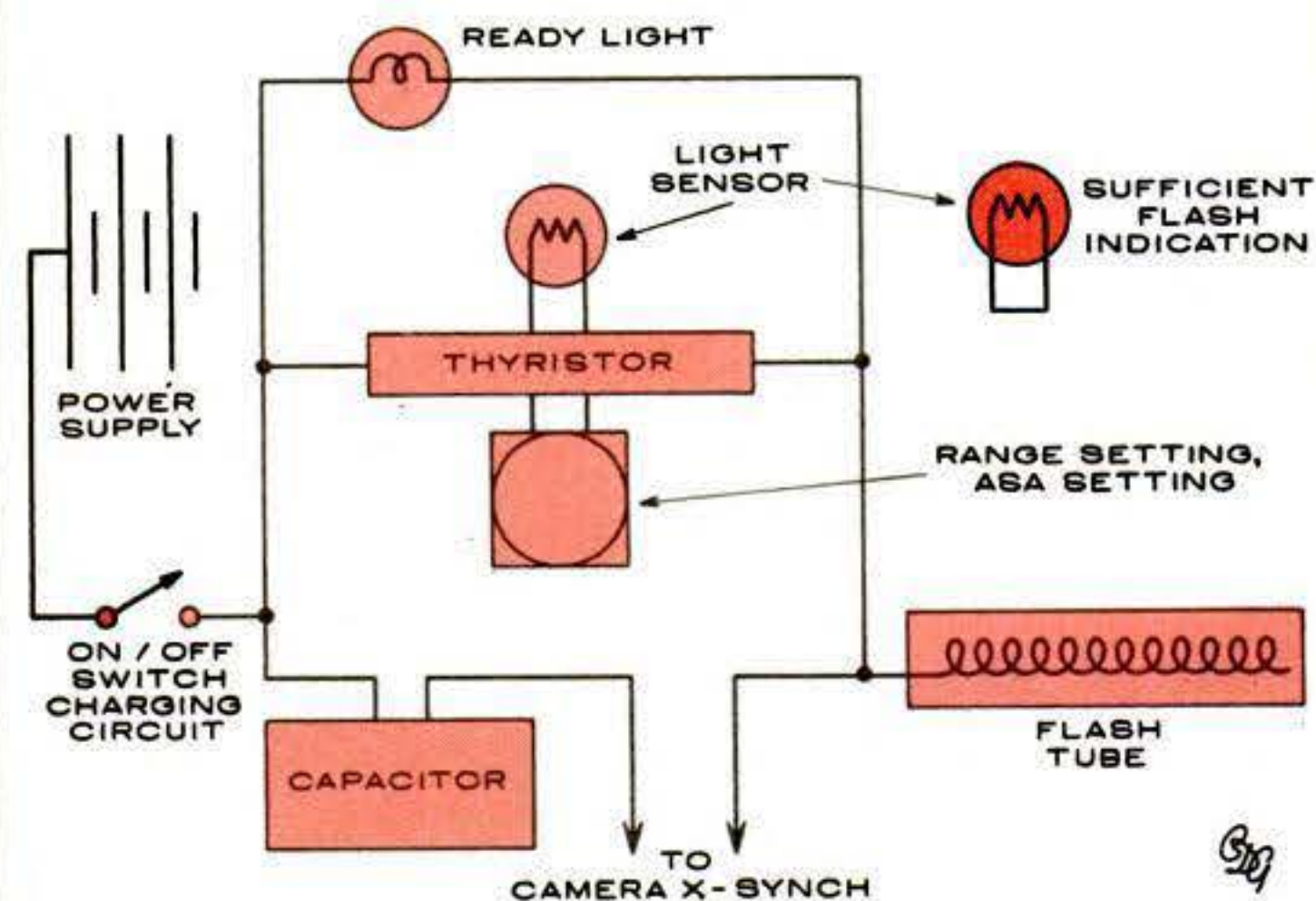
One of the most interesting of the "multi-dedicated" flash systems is the 3500 from Vivitar. You buy two pieces: One is the basic electronic-flash unit; the other is the module that fits your automatic camera. The mediating circuitry is in this base module, and the camera clips into it. One clever feature of the 3500 is the audible ready signal (a little "beep-beep") and audible confirmation of flash (a steady beep). These are useful whether or not this information is also displayed in your viewfinder.

Vivitar's 3500 flash (top) fits all major SLR's, offers many accessories: HVP-1 battery pack, lens filter adapter, MFS-1 macro flash sensor (on lens), remote flash trigger, pistol grip, Charge 50 with power supply, nicad battery pack, regular and wide-angle filters, diffuser, camera adapter modules. Sunpak's Auto Zoom 3600 system (above) works with most SLR's.

Sunpak meets the challenge of dedication in a similar way: with clip-on modules that mate the flash head with different camera electronic systems. Alfon, another independent, offers flash units that mate with all cameras but are more limited in their ability to operate all the systems.

Continued

Evolution of the modern flash



The burst of light called electronic flash results when high-voltage DC is dumped into a gas-filled tube from a capacitor (see drawing). Early units charged up the capacitor; you pressed the shutter release and got a full-power discharge. The first level of control over the light output came from using banks of capacitors—you switched in one-fourth, one-half, or all of them to get a proportional flash. That's still how it's done in studio-size units. But little shoe-mount flashes don't have room for banks of capacitors. They achieve a measure of control by adding a light sensor. When sufficient illumination has been given to the subject, the sensor diverts the balance of the charge away from the flash tube. This wastes power, of course, because you are still fully discharging the capacitor with each shot, and have to wait for the full recycle time before taking another.

Using small electronic-flash devices of this type was very complicated for the advancing amateur, however. There were a number of calculations that had to be made, including the use of guide numbers, aperture and shutter-speed settings on the camera, as well as aperture and film-speed settings on the flash unit. If the subject was moving, aperture changes had to be made to accommodate varying distances. Bounce flash, frequently a more pleasing type of lighting, was still more difficult for the amateur to use, what with varying reflectivities of walls and ceilings and varying distances to them.

The thyristor circuit, along with other refinements, gave us the present generation of "automatic" flash units. It permits dumping the excess charge back into the capacitor. Less-than-full-power flashes are of shorter duration, use only the power required, and offer shorter recycle times. Another feature of these units is "confirmation," usually in the form of an LED that glows when enough light is returned from the subject for proper exposure.—D. S.

A caution here that concerns all units: Before you buy an independent flash unit for your modern SLR, read its instruction manual to make sure that it will do all the things you wish it to.

It isn't just little shoe-mount units that are dedicated. The Metz 45 CT-5 and 60 CT-2 are powerful "potato-masher" units (named for their appearance, you understand) commonly used by wedding photographers and journalists who need more power, faster recycling time, and more flashes—and who are willing to pay the price in cost, awkwardness, and weight. The Metz units employ multi-pin connectors (different versions for different camera systems) and have a microprocessor and associated hardware built in. This, in conjunction with the connector cords, provides dedication with a number of popular 35-mm SLR models.

What can you expect in future systems? The newly introduced Ricoh XR-7 camera provides an ingenious refinement in automation that suggests new directions: The lens, as you focus, tells the flash what the distance is, saving you the nuisance of setting it (and remembering to reset it every time you use the flash).

Canon's introduction of an auto-focus zoom lens leads us to hope for automation of an angle of coverage of the flash for use with zoom lenses. Some present flash units do "zoom" to match the lens angle of view—wide or tele—but that's another thing you have to remember and do.

The possibility of automation here has not been lost on G. Bruce Shomler, executive vice-president of Vivitar Corp. "The next step in dedicated flash units will be the increasing interchange of information among parts of the system," he says. For instance, the flash will match itself to the zoom setting of the lens, or the camera will warn you if you're trying to focus on an object too far away for proper illumination.

New flash developments, of course, depend to a large extent on new camera developments. Major changes in the near future? Not according to Fred Handsman, vice-president of Alfon: "The flash is limited by what the camera can do; we'll have to see a new generation of SLR's before we can add more features to flash units."

Gary Stone, senior product manager for Sunpak, disagrees. For the future, he says, how about "utilizing laser technology for high-speed yet controlled lighting?"

But closer in the evolutionary future, Stone sees smaller flash units: "Maybe even as small as a credit card . . . with computers to provide all kinds of lighting control automatically, such as fill flash." In fact, says Stone, tomorrow's flash units may even "measure and control both light and exposure for the attached cameras." E 5

Some representative flash units—how they compare

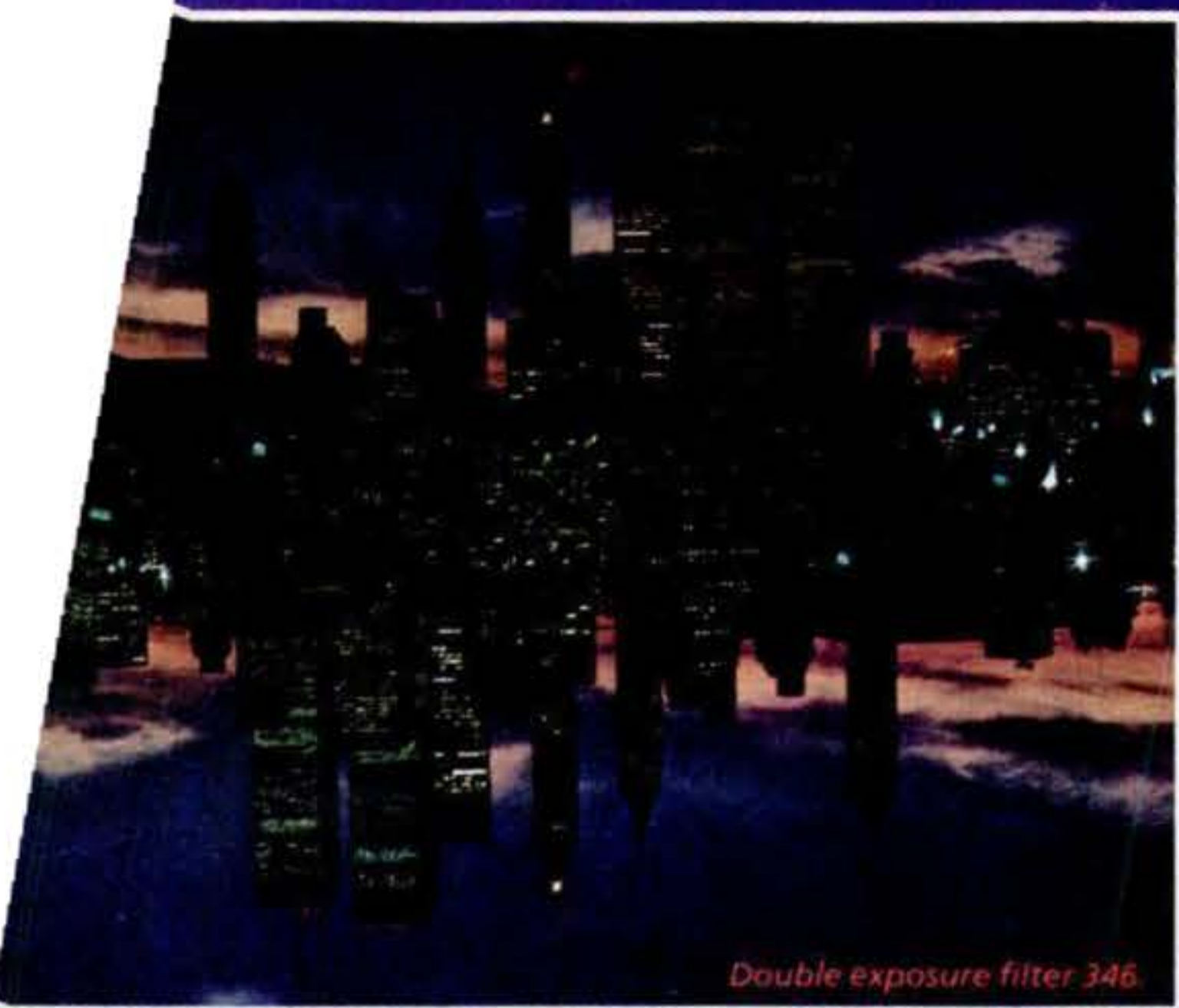
Brand name	Model designation	Price (\$)	Guide number (ft. at ASA 100)	No. of ranges	Dedicated with	Special features
CAMERA MANUFACTURERS' DEDICATED FLASH UNITS						
Canon	199A	167	84	3	A-series	
Contax	TLA 30	166	100	2	137 MD, 139	TTL control*
Mamiya	MZ 18R	n.a.	60	**	ZE-series	Coupled lens info.
Minolta	132X	80	104	2	XD and XG	
Nikon	SB-12	145	80	8	F-3	TTL control
Olympus	T-32	154	104	3	OM-2	TTL control
Pentax	AF280T	155	90	2	LX	TTL control
INDEPENDENT MANUFACTURERS' DEDICATED FLASH UNITS						
Alfon	680	100	100	2	Canon, Nikon, Minolta, Pentax via direct setting	
Lenmar	FFD40	65	80	2	Most major SLR's via modules	
Metz	45 CT-5	460	148	6	Canon, Contax/Yashica, Minolta, Nikon, Olympus via adapter cables	
Sunpak	422 D	132	100	3	Most major SLR's via modules	
Toshiba	30TB-CD	100	100	3	Canon, Nikon, Minolta	
Vivitar	3500	135	80	3	Most major SLR's via modules	

*Through-the-lens control

**Continuous

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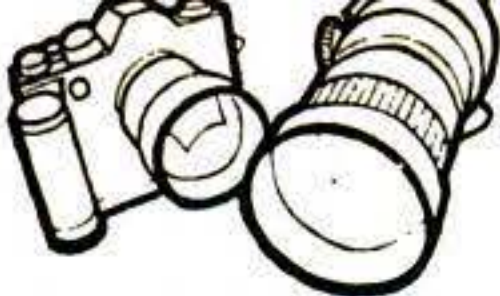
STATE

ZIP

Please allow 4-6 weeks for delivery.

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PS-12



PHOTOGRAPHY

New from Kodak: one-dip color prints

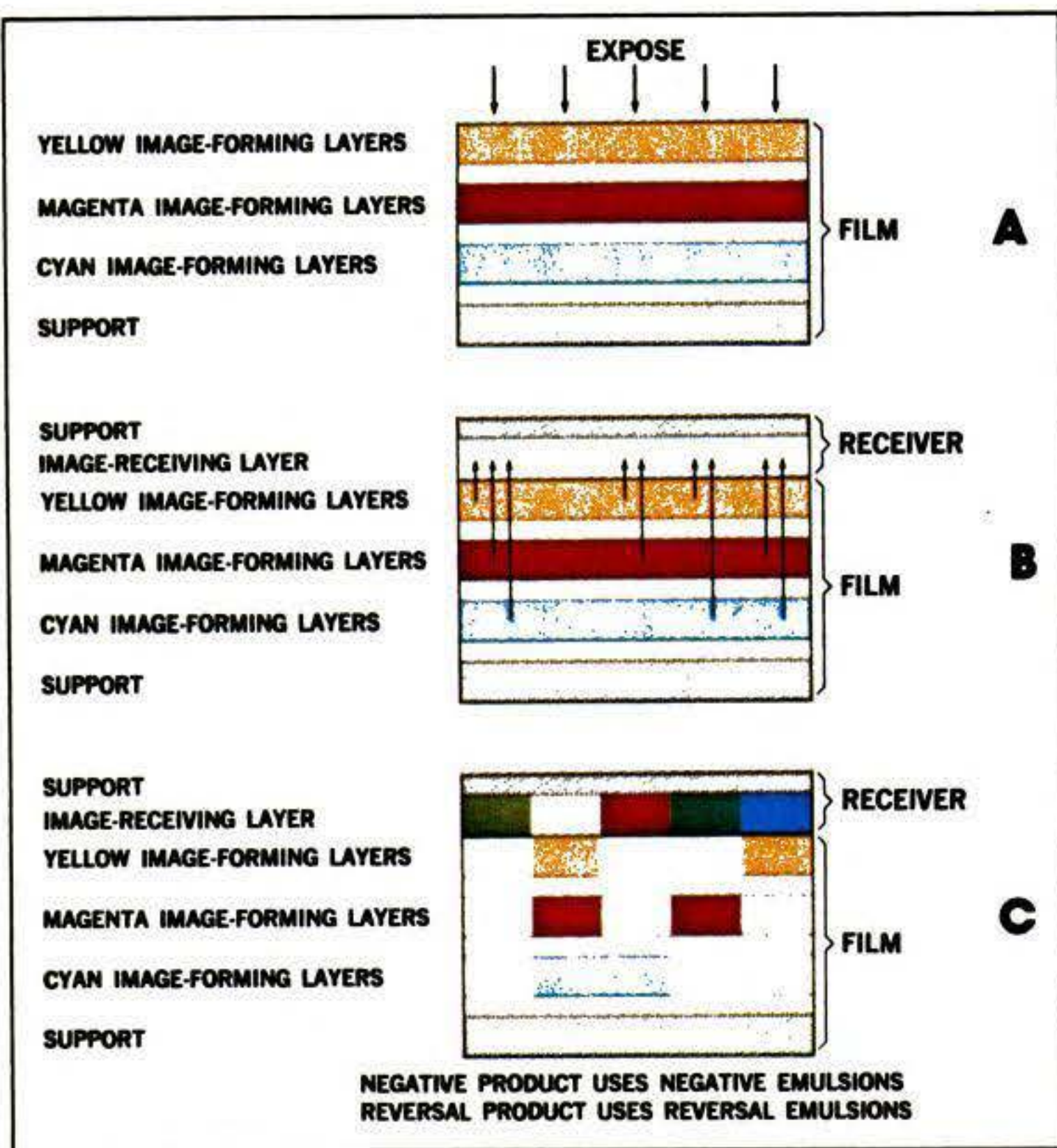
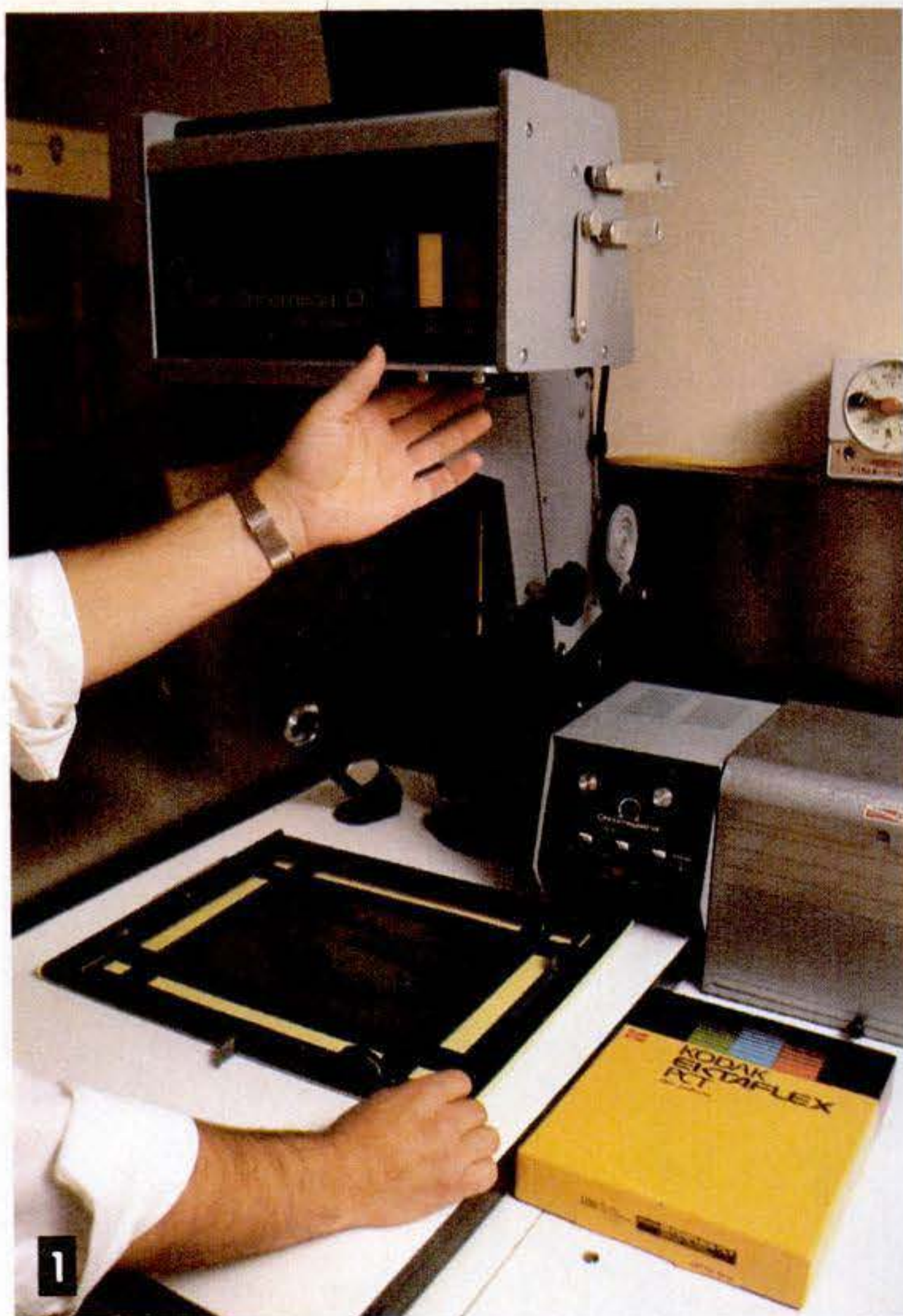
Just load, soak, laminate, and peel. No plumbing, mixing, or print washing

By JOHN FREE

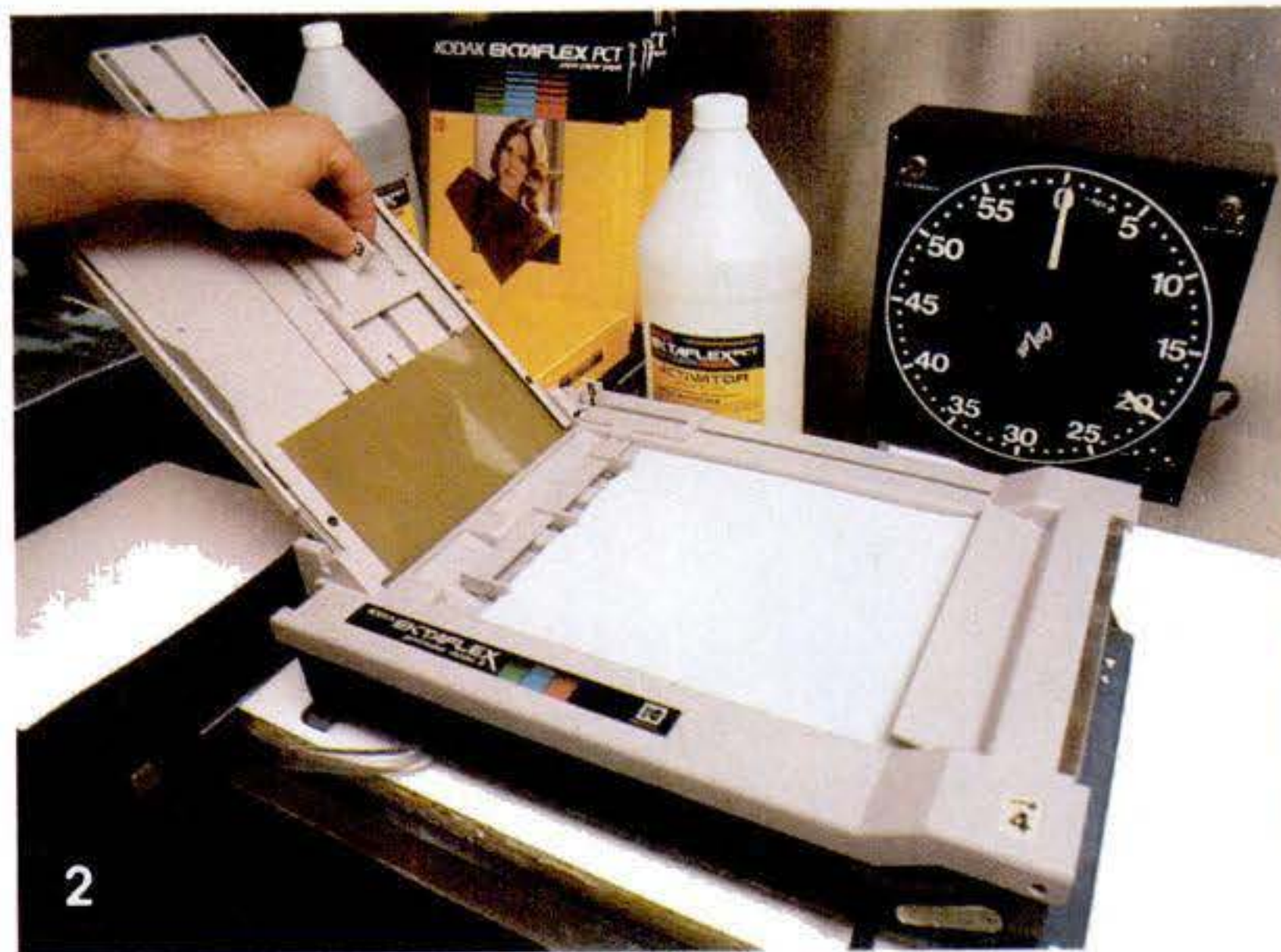
PHOTOS BY JOHN KEATING

Expose a film sheet. Soak it in a developer for about 20 seconds. Sandwich the film to print paper. Wait six to 15 minutes. Presto: Peel off a sharp, saturated-color photographic print.

Sound familiar? Like, for instance, a slow-poke instant camera?



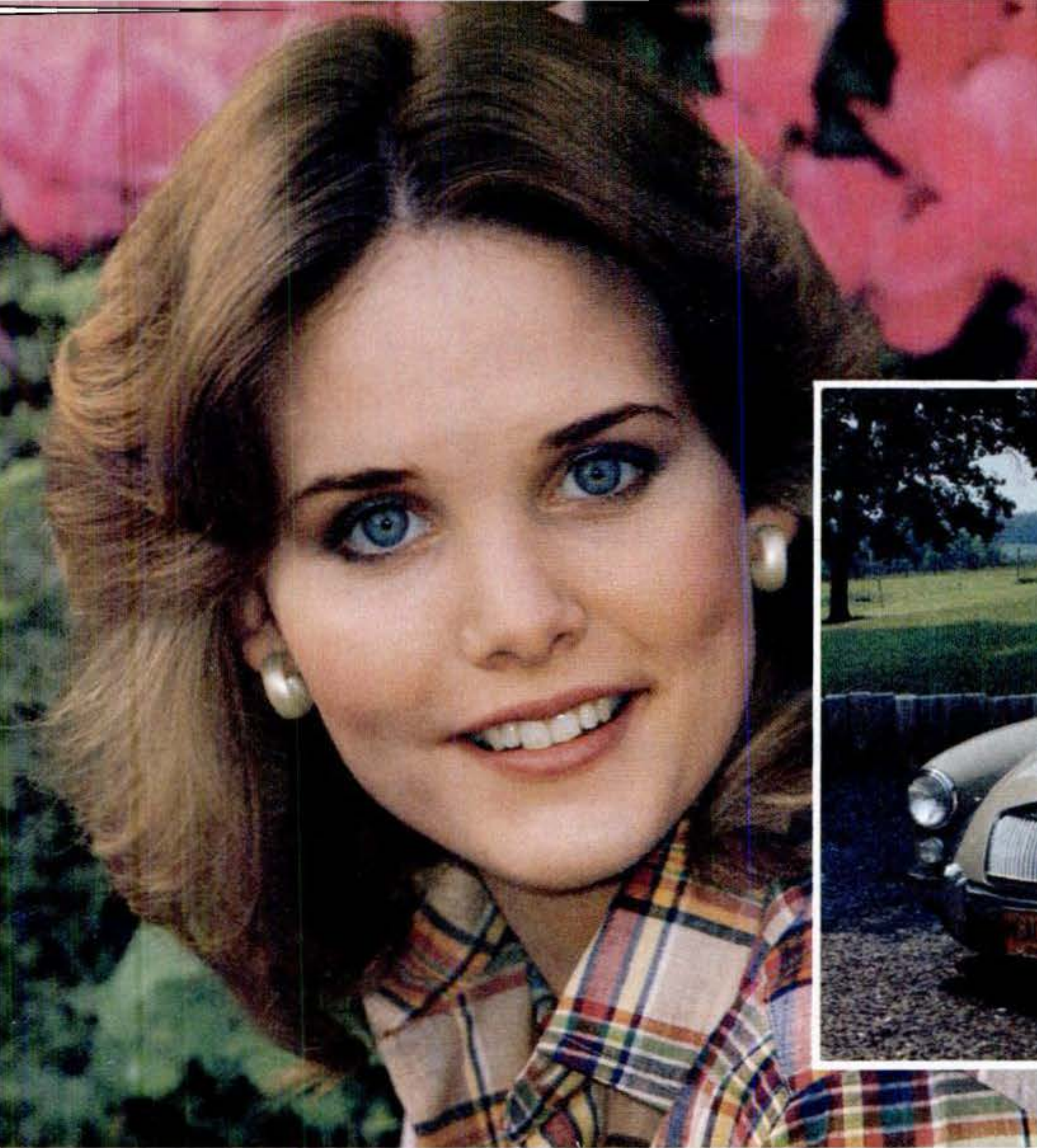
Ektaflex PCT (photo color transfer) film is exposed in a color enlarger (A), activating emulsion grains in separate yellow, magenta, and cyan image-forming layers. Film is then processed in activator solution and laminated to receiver paper (B). Activator fluid produces oxidized developers in each color layer that react with dye releasers next to each exposed spot. Further reactions free colored dyes that move through film structure, creating an image on the print that's chemically fixed in place (C).



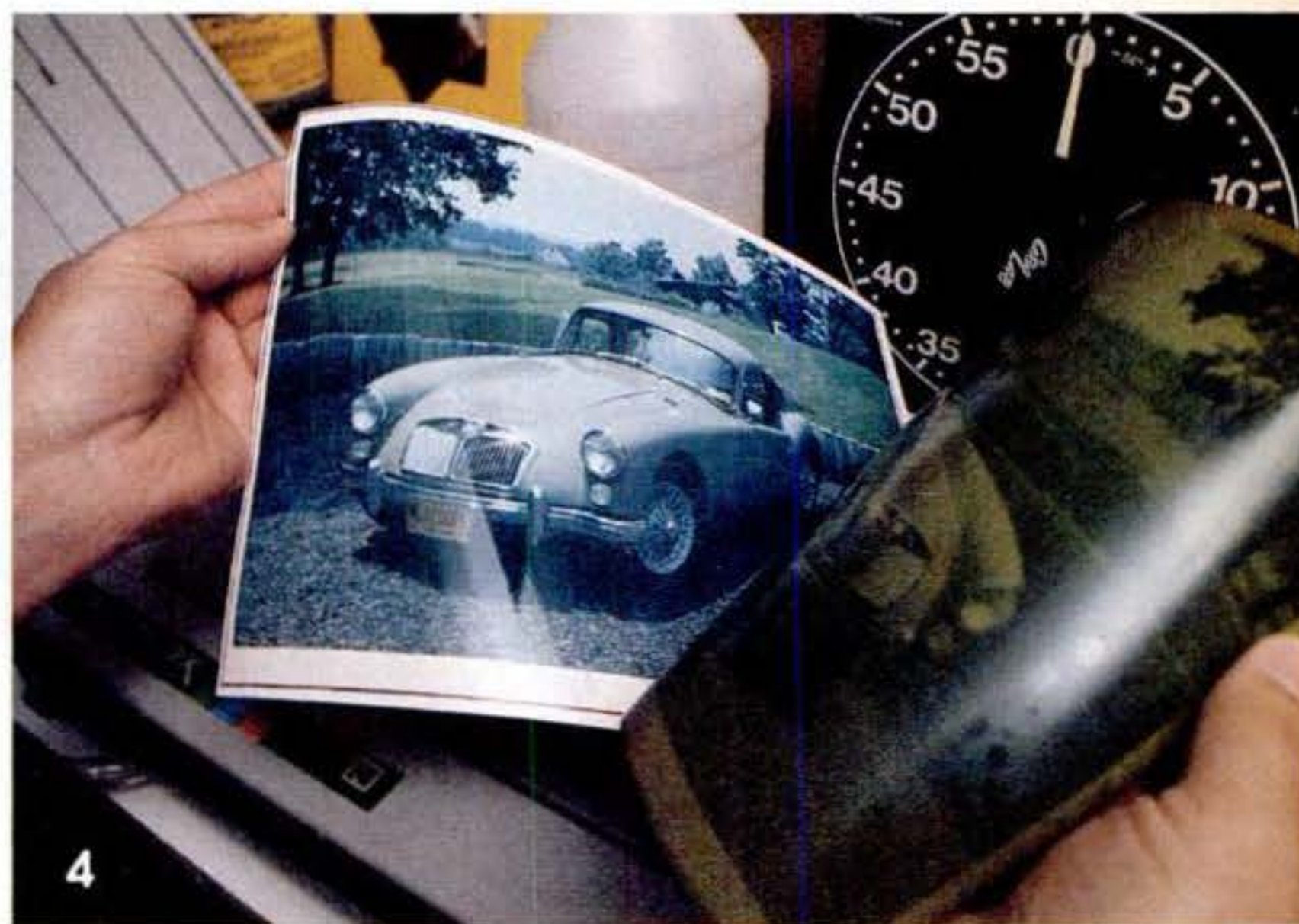
It should. This is the processing sequence for Kodak's revolutionary new Ektaflex system that makes color enlargements from negatives or slides. It draws heavily from instant color-film technology (see figure, left).

Based on a \$135 printmaker machine, special films, paper, and chemical activator, Ektaflex lets darkroom hobbyists turn out pro-quality color prints quickly. It's a one-dip process that transfers dye images in the film to special paper.

There are no critical processing times and temperatures or long mixing of chemicals—steps that have discouraged amateur photographers from color processing. With Ektaflex you don't even need running water. What you will



Finished prints, such as portrait of woman at left and PS Art Director Dave Houser's classic 1960 MGA 1600 (below), exhibit bright, accurate colors.



need, though, is the know-how to juggle color filters, exposure times, and f-stops to expose the film in your darkroom. You'll have purple or green test prints until you acquire the knack of accurate color balancing.

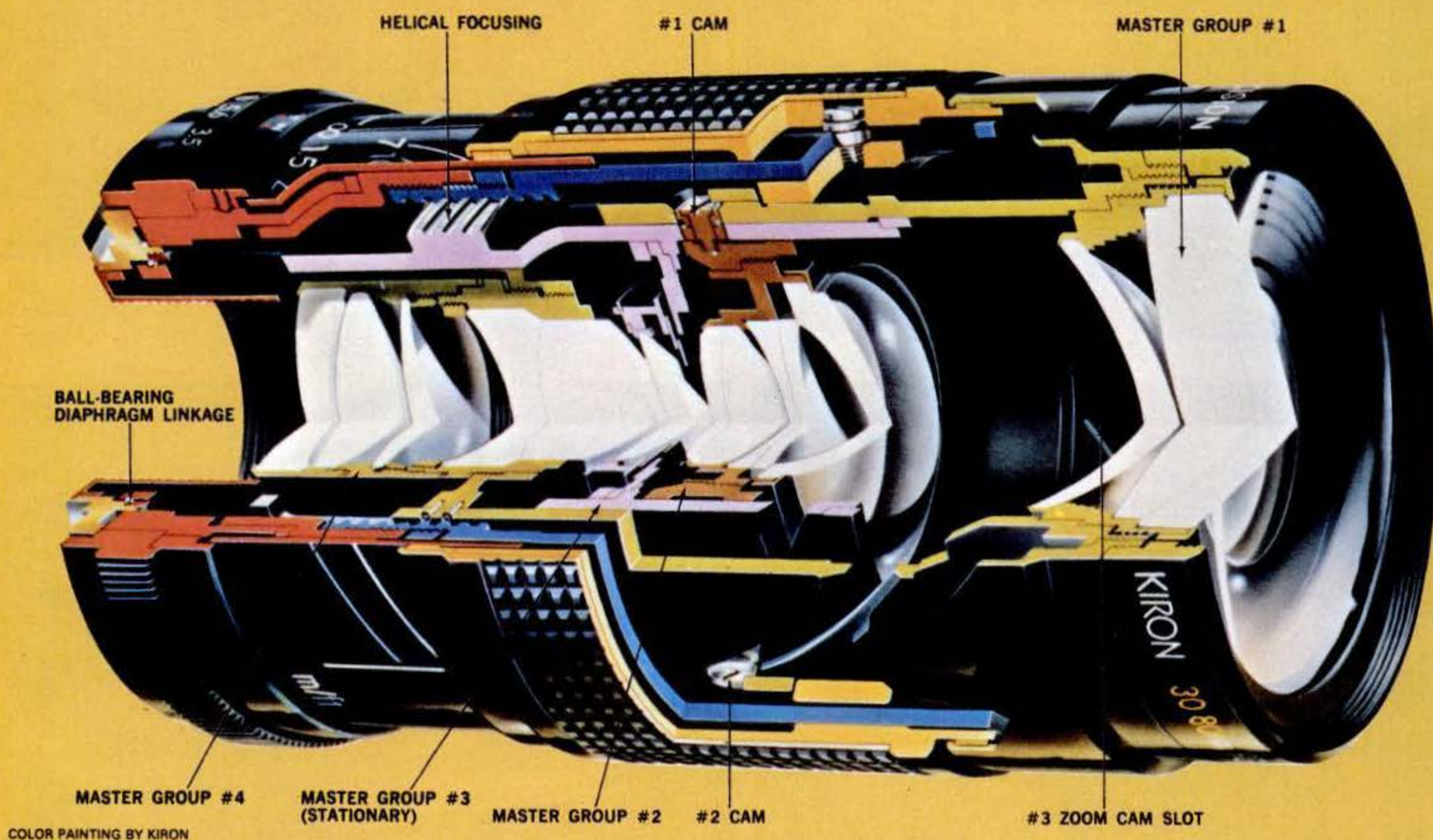
But Ektaflex is forgiving. "Everything is *about*," says PS Picture Editor John Keating, referring to its time and temperature tolerances. "That's the beauty of it."

This relatively simple and speedy processing is costly—some 40 to 100 percent more than other home color-print methods. A three-quart bottle of activator, good for 75 eight-by-10-inch prints, is \$8.90. Paper is 34 cents a sheet in 100-sheet packs at this size. Film the same size is \$1.58 per sheet in 100-sheet packs. **PS**

Printing sequence starts with exposure of one of two Ektaflex films to either a color negative or transparency (1). Numbered glow-in-the-dark handle on the model 8 printmaker immerses exposed film in tray of activator solution (2). After 20 seconds the film and a sheet of Ektaflex paper (loaded on top of the printmaker earlier) are laminated together: Turning a handle and pushing film-advance knob advances both sheets through rollers (3). Dye image in film is transferred to paper; after about six minutes the print is peeled off (4). A small fan or hair dryer speeds three-minute drying time. Highly caustic activator fluid should be loaded into printmaker using rubber gloves, safety glasses, and darkroom apron. Activator lasts a year if it is loaded back into the bottle through a valved drain tube. Use in the tray cannot exceed 72 hours.



Now they're designing the next generation of **superlenses**



COLOR PAINTING BY KIRON



Kiron's 30-80-mm f/3.5-4.5 macro-zoom lens typifies new breed of moderately priced moderate-wide-angle-to-tele lenses. As outer zoom sleeve is pulled back (toward 30-mm focal length), lens group #2 moves forward in complex cam-guided nonlinear path. When zoom sleeve is pushed forward (toward 80 mm), lens group moves back. Turning knurled focusing ring moves the whole sleeve, along with front master group, in helically threaded mount: forward for close focusing, back for infinity. The lens has variable focus—the focus shifts as it's zoomed, and lens must be re-focused. By strictest standards, it is thus not a true zoom. The f/3.5-4.5 indicates variable aperture, changing with focal length. "Variables" are for economy, do not affect quality of optical performance.

The zoom boom goes on, with new materials and new technologies

By EVERETT H. ORTNER

"We haven't made one yet—it's 1985 technology—but with gradient-index glass you could replace the six elements of a standard 50-mm-focal-length lens for a 35-mm camera with two elements," says Dr. Duncan Moore, associate professor of optics at the University of Rochester.

"You're going to see bigger zoom spreads than ever in the not-so-distant future—let's say 100 to 500. And you'll see zoom mirror lenses of 400 and 500 to 800 mm," says Ron Gelman, vice-president of AIC Photo, distributor of Soligor lenses.

"It's our belief that plastic-and-glass hybrids, particularly employing aspheric elements, are the way of the future," says Lee Gopadze, product manager for optics of Vivitar Corp.

"I don't think the world is ready for an injection-molded plastic zoom lens, but we're ready to take a look at some components, such as an aspheric element," says Dr. William T. Plummer, director of optical engineering for the Polaroid Corp.

How close to reality are these predictions? With minor exceptions, lens experts see two major trends in the next decade:

- A continuation of the boom in zoom lenses, with a steady broadening of zoom ranges, and an accompanying lessening of interest in single-focal-length lenses. "Within five years, all your fixed-focal-length lenses, except for teles and superwides, are going to be collector's items," predicts Paul Ellis, senior vice-president of Kiron Corp., American subsidiary of the Japanese lens maker.

- The development of extraordinary new materials and technologies that may make obsolete the glasses and technologies that go into today's fine lenses.

Together, the continuing improvement of zoom lenses and the development of new ways of making them promise a generation of superlenses with capabilities that no expert dares to predict. "It's wide open," says one. "A new world."

The world of zooms

The current widest-angle zoom is the Sigma 21-35. The longest-focal-length zoom is Nikon's 360-1,200. The lens with the most extreme zoom ratio (6:1) is Nikon's 50-300. If you could have one lens that would par-take of all those characteristics—

extend from superwide to supertele, and have a reasonably large aperture—you'd never need another lens. But you probably couldn't carry it. And you probably wouldn't want to pay for it.

"We can design very exotic lenses," says designer Ellis Betensky. "The problem is designing them small enough, light enough, and inexpensive enough so the consumer will want them. When people are willing to pay \$500 and up for extreme zooms, tell them to write in and we'll make them."

Wide-angle zooms are a particular problem. "It's hard to correct the aberrations of a superwide lens," Betensky says. "When you zoom them, the cost goes up, for a lens with a relatively limited demand."

“Diaphragms might be composed of liquid crystals, which darken with a low-voltage current”

Cost is a major factor, Ron Gelman of AIC agrees. Nonetheless, his company has been able to bring in some astonishing performers at very reasonable prices. Among the newest are a 24-45 and a 28-55, both with variable maximum apertures of f/3.5-4.5. Soligor also has an f/3.5 35-140—a pacesetter for the last two years, up to now the only lens on the market that can go from true wide angle to true telephoto.

Another imaginative product is Soligor's brand-new Dualfocal line: non-zooming lenses with two focal lengths. The advantage: economy. For not much more than you'd pay for a 28-mm lens, you also get 35-mm. With the 85, you also get 135. And, says Gelman, "We're working on combining wide angle and telephoto in one lens. You'll be seeing it in the future."

You'll also be seeing, it seems likely, zooming "cats"—catadioptric lenses combining mirror and refracting elements. Pentax will be first, this coming spring, with an f/8-12 400-600-mm zoom cat. How it works has not been revealed, nor has its price—"probably an arm and a leg," ruefully says Barry H. Goldberg, Pentax manager of national consumer affairs.

Why a cat? Cats pack an enormous number of millimeters of focal length into a compact, if fat, package. Their principal disadvantage: a fixed (dia-

phragmless) and usually small maximum aperture.

Although lenses are a sensational bargain in today's inflationary world—better and smaller, and at prices generally very close to what they were 10 years ago—there's no question that as they grow more complex, they also cost more to produce, unless . . .

Unless cheaper and simpler materials and technologies become available. In this connection, two words spring to the lips of many lens experts: "aspherics" and "plastics."

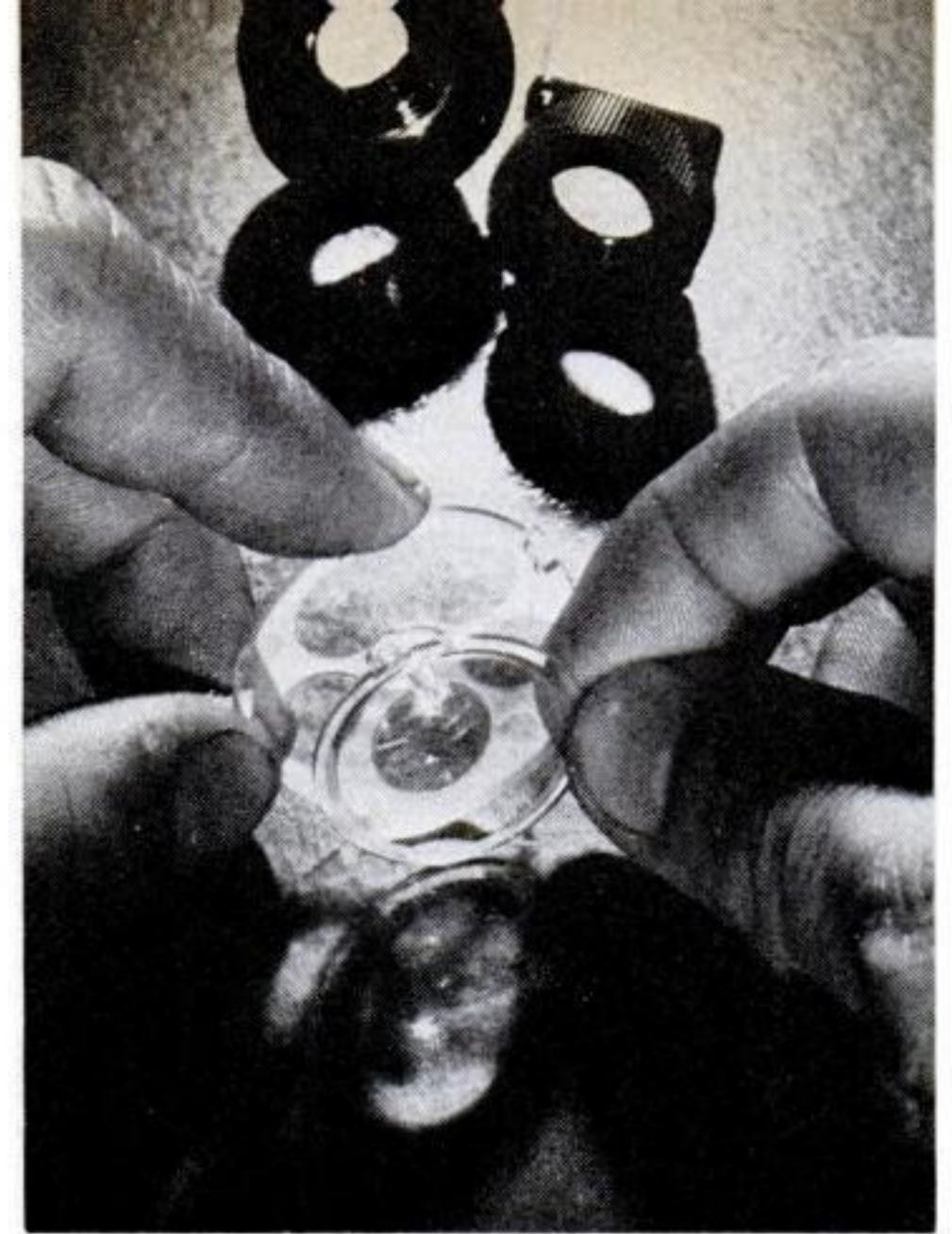
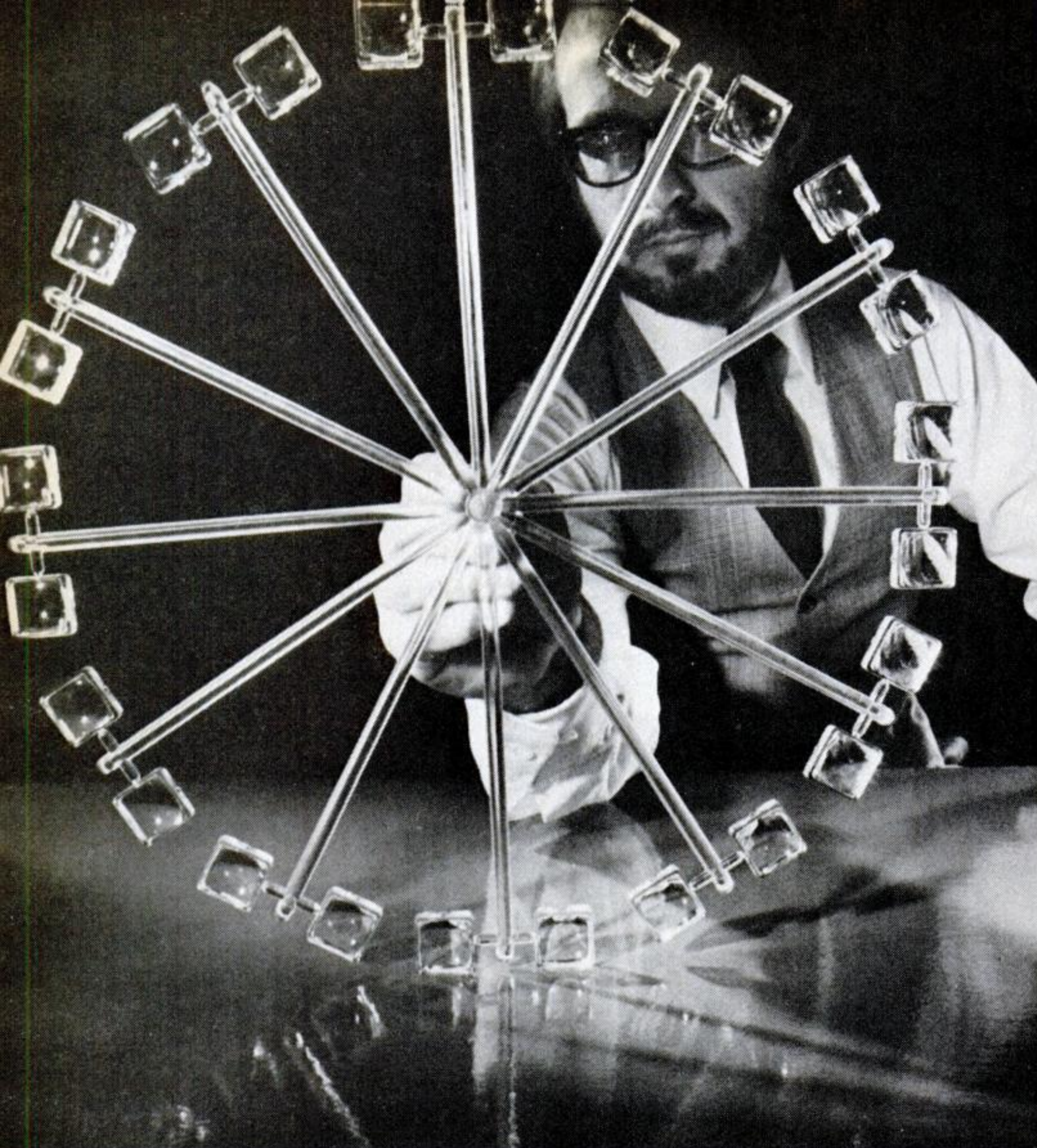
For hundreds of years, glass lenses have been produced the same way: by grinding. But grinding in the traditional way, by passing an abrasive material over glass in a spherical arc, produces a lens with a spherical surface. And spherical surfaces produce spherical aberrations—light rays passing through the lens in any place but the center come to a focus at a point nearer the lens than on-center rays. Aspheric lenses—typically with flattened outer surfaces around a spherical center—solve the problem and eliminate the need for the extra aberration-corrective elements that spherical lenses need. But aspherics are expensive—it wasn't until 1965 that Leitz discovered how to mass-produce them (for its famous and costly 50-mm f/1.2 Noctilux).

Aspherics can be *molded*, however, as simply as any other shape—in plastic. Indeed, reports William Plummer, Polaroid has even molded double aspheres—lenses with two aspherical surfaces—for night-vision devices. And Polaroid is talking to camera companies right now about making components for their lenses. "We're looking at the possibilities of glass-and-plastic hybrids," says Eugene F. Marckini, Polaroid's manager of commercial optics. "In a zoom lens, with as many as 18 glass elements, aspheres might eliminate several elements." Also, says Marckini, the ability of a plastic lens to be fashioned for mechanical as well as optical service—with notches and grooves—gives it an extra value. "That's being considered by a lot of people."

Is there a problem of lens expansion and contraction with temperature changes? Not up to 160 deg. F, says Plummer. What about scratches? Not inside a lens barrel, he says.

"Plastics have their place," says Nikon's Richard LoPinto. That place up to now is in the polycarbonate external barrel and diaphragm ring of Nikon's inexpensive Series E lenses. Only glass, says LoPinto, can offer the speed and quality of Nikon's two new

Continued



Plastic lenses by Polaroid can be molded to shapes impossible with glass. Disc above from new 660 camera has molded into it four different lenses that supplement prime meniscus lens in foreground. Notches around its edge serve as latching points, stopping its rotation at point of sharpest focus (determined by ultrasonic system). "The lens has some of the characteristics of a flywheel," says Polaroid's Dr. William T. Plummer, "so we had to tune it mechanically while we were tuning it optically." Polaroid molds lenses in large arrays (left) completely finished, snaps them off for use. Company also molds plastic mounts (above, rear) to fine tolerances. Still, its SX-70 lens is glass.

teles: an $f/1.4$ 85-mm and an $f/1.8$ 105. Both use Nikon's ED—extra-low dispersion—glass for, claims LoPinto, near-apochromatic performance. "Apos" are corrected for the three primary colors.

"Right now, nobody in the industry that produces 35-mm lenses is using

plastic," says Minolta Product Manager John J. Jonny. "The problems with plastics once you go to fast optics are crucial. But I'm sure," he adds, "that research into plastics is part of every company's direction."

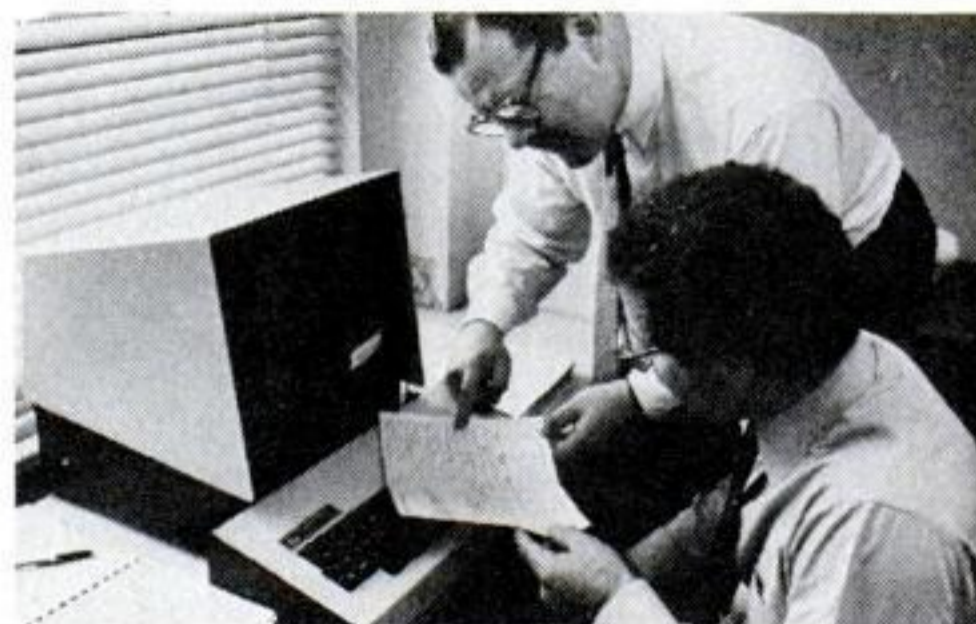
"Future lenses will be made of gradient-index glass," one designer told

me. "And the man to talk to about that is Duncan Moore at the University of Rochester." Moore has another way to produce aspheric surfaces.

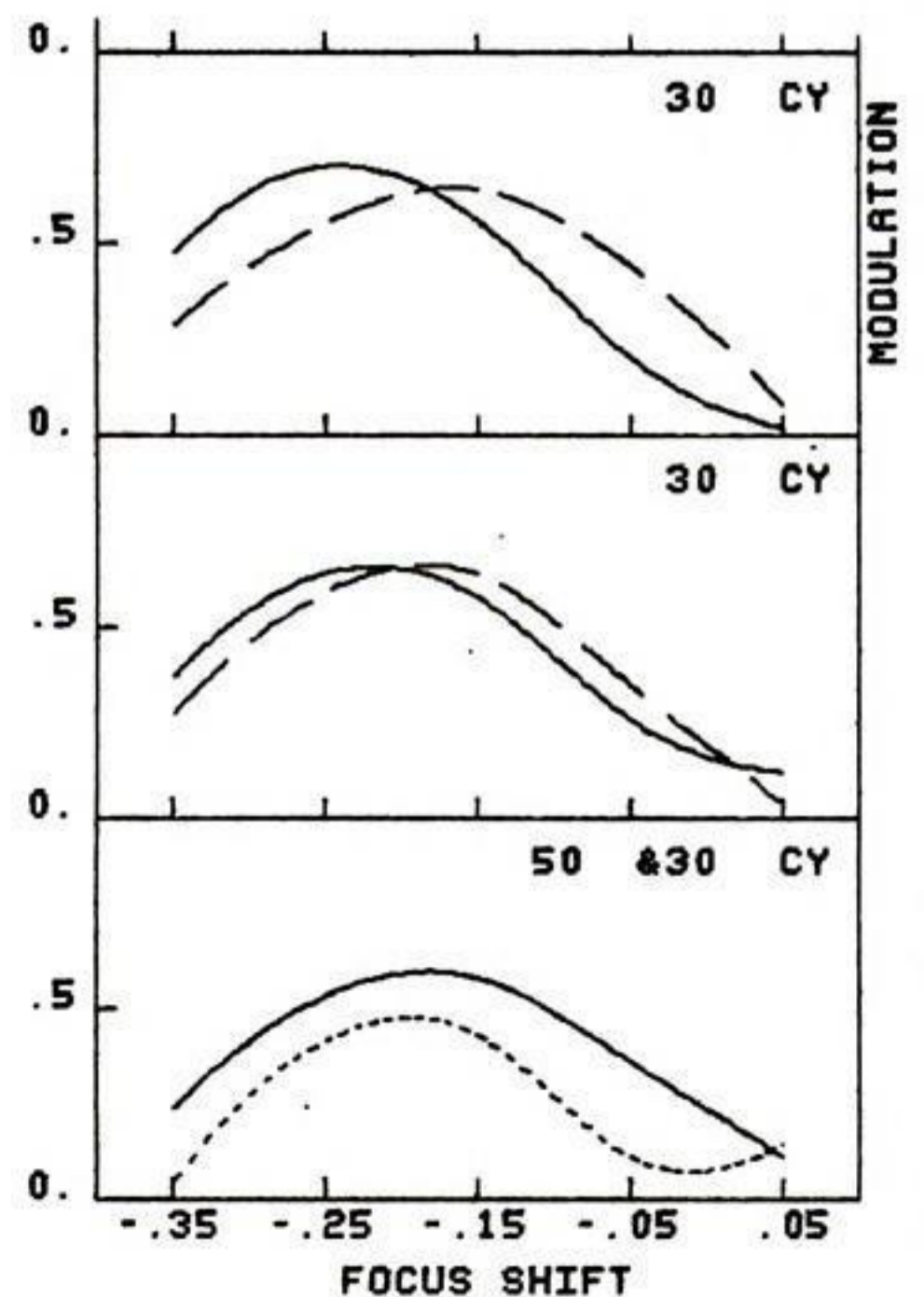
In standard glass, light moves in straight lines between the surfaces, bending at each surface. In gradient-index glass, says Moore, the "index of

Designing a lens

Ellis Betensky is a rare bird in the United States. He is a lens designer. From the offices of his company, Opcon Associates, in Cincinnati and New York, flow designs for lenses ranging from the fat plastic cylinders that one client, U.S. Precision, molds for Japanese makers of projection-TV sets, to exotic zoom lenses that you'll be buying for your camera five years from now. He has designed lenses for calculators, copying machines, and microfilm readers. He designed telescopes for Skylab. And for the last 10 years he has been designing lenses for Vivitar, among them its prestigious Series 1 line. Betensky has no lens-grinding machines. His tool is the computer (right, with Betensky, and author Ortner behind him). It analyzes, in excruciating detail, how well a lens design will perform. It makes drawings, prints out pages of figures, charts light paths, aberrations, distortions, contrast. A tiny part of one chart, at right, shows



MTF—modulation transfer function, or contrast performance—of Vivitar's newest 80–200 zoom lens: on axis (lowest box), 35% toward corner (center box), and 70% toward corner. "CY"—cycles—is number of paired lines per millimeter the "lens" is trying to distinguish as it is being focused (here at focal length of 81.86 mm). Curves show percent of contrast (vertical scale) for performance on radius (solid line) from picture center and on tangent (dotted line) to radial lines. Ideally, the two lines would cross at about the center.





New hot zooms scheduled for introduction by Tokina include (left) f/3.5-4.5 35-200-mm for extraordinary zoom ratio of 5.7:1. It's 4.8 in. long, weighs 26 oz. At right: f/4-5.6 50-250 zoom is 5.4 in. long, weighs 22 oz. Prices: not yet set.



Unique zoom cat by Pentax covers 400-600-mm range. It has variable f/8-12 aperture, measures four in. (at 400 mm), and weighs 26½ oz. It focuses to a close 10 feet. Screw-in filters at rear control light. Introduction: spring, 1982.



Fast 350-mm cat from Tamron has f/5.6 aperture, continuous focusing to 43 in. for a 1:2.5 image-object ratio. It's three in. long, weighs 19 oz. Coming next from Tamron: a 1,000-mm cat lens that will double as a 20x-60x zoom telescope.

refraction varies . . . *within* the lens, and the light ray can go in a curved path between surfaces." Result: "A part of the aberration correction can be done *internally*, reducing the number of elements in a sophisticated lens system."

The glass is prepared by ion exchange. Moore puts a cylinder of glass rich in, say, sodium in a hot bath with melted lithium bromide. In a few days, lithium ions diffuse through the glass, replacing sodium. Moore cuts a lens blank out of the cylinder, grinds and polishes it, and an extraordinary product with new properties has been created. Will you see it in an American lens? No, says Moore. "We have no way of transferring the technology in this country because there is no industry here now making high-technology lenses." But Japan will have a gradient-index lens by 1983, he says, from Canon or Pentax.

What else does the future hold in store? Radically new non-mechanical diaphragms, predict the experts. For example:

- They might be made of photochromic glass, like the Corning Sun-Sensor material, automatically lightening in darkness, darkening in bright light.

- They might be composed of liquid crystals, which darken with a low-voltage current (although right now they don't get light or dark enough). "A lot of work is being done on this, both in Japan and the U.S.," says Vivitar's Lee Gopadze.

- They might be controlled by tiny flat linear motors in the lens itself, suggests Alan Kessler, Soligor product manager.

For lenses in general, Ron Gelman of AIC Photo sums up the future best: "Every time I have a meeting with the president of my company, he starts off by asking, 'Well, when are you going to have a 25-to-400-mm lens I can sell for \$150?'"



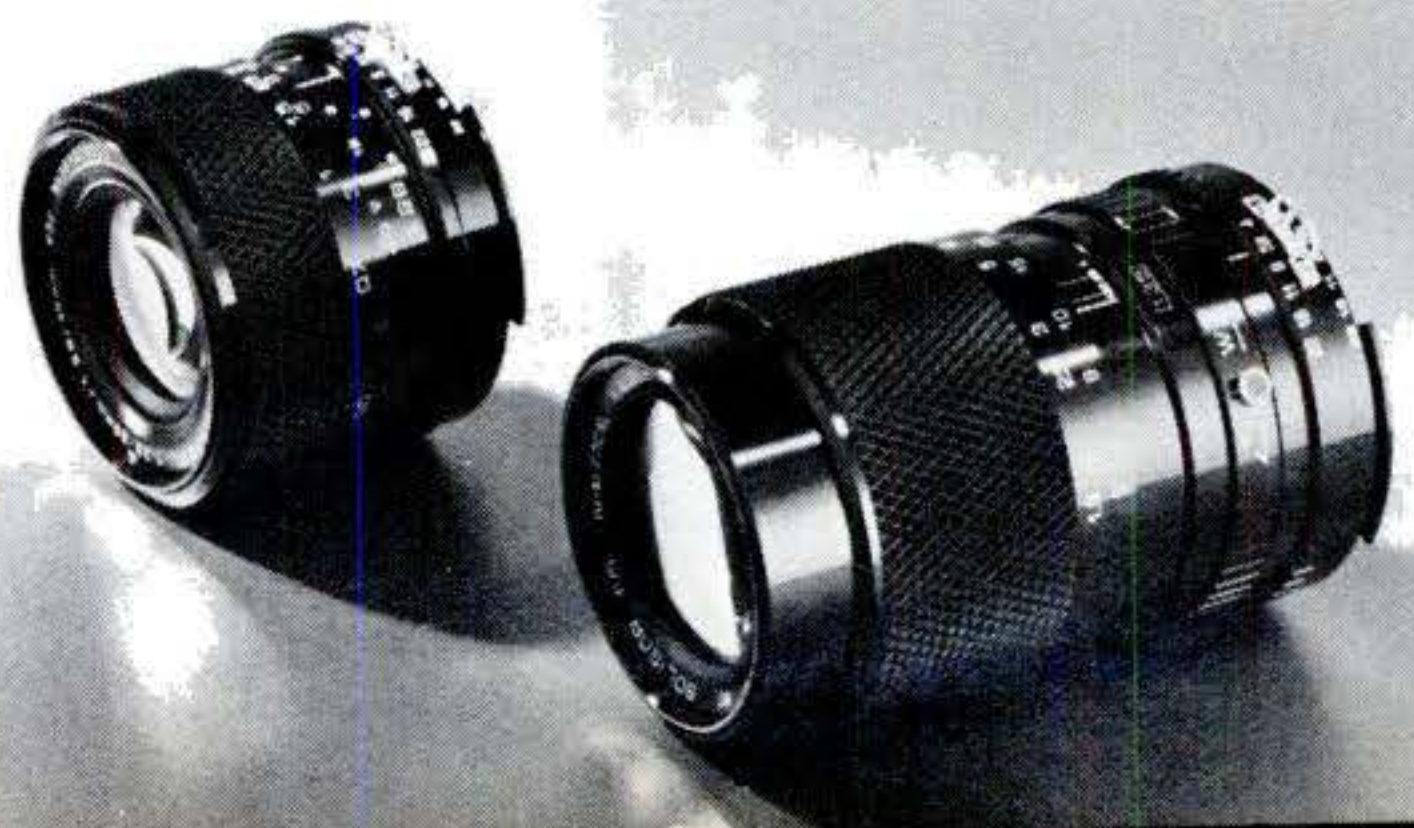
Autofocus f/2 50-mm lens by Ricoh is self-contained. It's powered by two AAA cells, bayonets into Ricoh K-type mount. A switch permits disengaging AF system for closer focusing: 20 in. instead of 39.



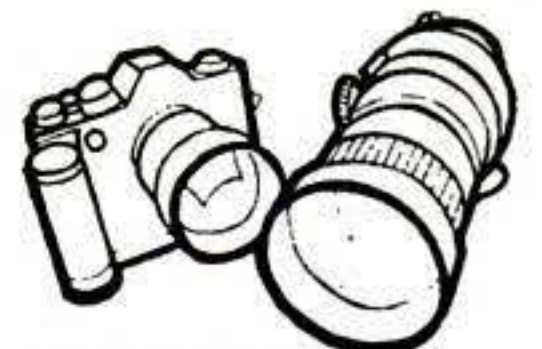
Autofocus f/4 35-70-mm zoom by Canon uses "solid-state triangulation system." It measures light from subject on charge-coupled device, computes distance, and orders motor to focus lens. About \$600.



Two zoom champs are the Sigma f/3.5-4 21-35-mm (widest-angle) listing for \$600, and Nikon f/4.5 50-300 (at 6:1, greatest zoom ratio) with list price of \$3,085. Nikon, like Leica and Olympus, does not have cost-saving variable maximum aperture. List price is often twice selling price.



Two-fers—two focal lengths for the price of one—are featured in Soligor's new Dualfocal lenses. The f/3.5-3.8 28+35 wide angle lists for \$179. The f/4 85+135 telephoto is \$199. Coming next: a Dualfocal wide-angle/tele combination.



PHOTOGRAPHY

Pocket 35's

Clamshell
cameras
go anywhere

They're compact
and cute, but don't
think of them as toys

By **ED JACOBS**
PHOTO BY GREG SHARKO

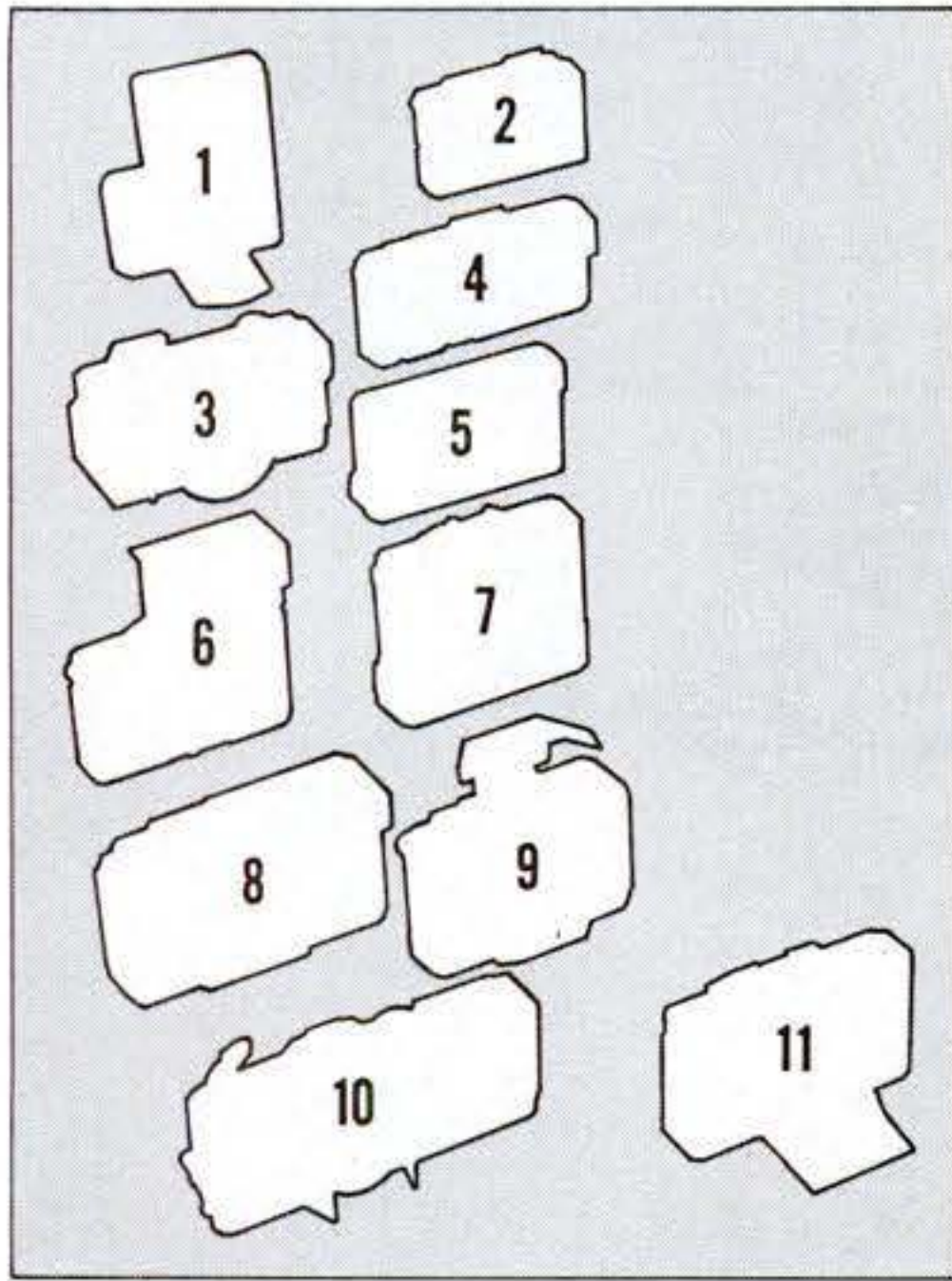
Most of us have done it: missed that once-in-a-lifetime shot just because we didn't have a camera along at the magic moment.

There's no need for that. Handy little cameras have been around for generations in various shapes and formats. The most popular, the 110 format, spurred 50 million camera sales in its first five years.

But while the 110 format delivers good pictures, anything a 110 can do, a 35-mm camera can do better. The variety of cameras, accessories, and films available in the 35-mm format is staggering. And with four times the film area per exposure, 35-mm picture quality is vastly superior.

Although camera weight and price once may have been 110 advantages,





Key to pocket 35's: 1. Minox 35GT with FC35 flash; 2. Olympus XA2, variant of the XA; 3. Fujica HD-S, weather-tight but not submersible; 4. Olympus XA with optional flash; 5. Mamiya U, with self-timer; 6. Cosina CX-1 with CX-11 flash; 7. Cosina CX-2 with optional CX-W power winder; 8. Keystone Everflash 3570, with fixed-focus lens; 9. Hanimex 35 Micro Flash, with manual shutter; 10. Chinon Bellami, with optional flash; 11. Ricoh FF-1s, with manual shutter control for flash.

they're fast fading. There's a new generation of pocket-sized, full-frame 35's that's compact, versatile, lightweight, and protected from dust and weather so they can go almost anywhere. They can even cost less than some of their 110 cousins.

Inspired by the Minox 35GL in 1976, this new generation ranges from 35-mm box cameras to sophisticated electronically controlled models. One even has power-winder and deep-sea capabilities. Many professional photographers carry them for spontaneous "grab" shots when they don't feel like toting their heavier equipment. About the only thing that limits the versatility of the compact 35's is their noninterchangeable medium-wide-angle lenses.

They're called clamshell cameras because they fold up, slide shutters, or close barn doors over their lenses for protection. The one non-clamshell here, the Fujica HD-S, has a watertight case and a four-mm-thick shield in front of the lens. But while you needn't fear raindrops, you can't take it underwater. You *can* take the Cosina CX-M down to 160 ft. It's really a CX-2 (the fancier twin of the CX-1) with a power winder, underwater housing, and special accessories.

Another pair of look-alikes is the Olympus XA and XA2. The more sophisticated XA is the lone camera with rangefinder focusing. The Quantaray Clamshell 35 and Keystone Everflash 3570 have fixed-focus lenses; all of the others use distance-approximating zone focus with symbols or range marks.

Flash units for the cameras shown are almost evenly divided between built-in and accessory units. The Chinon Bellami and the two Olympus models have side-mounted flashes; the other four use top-mounted units.

Unless you have really large hands, you should find these cameras easy to hold and operate. Routine changes of some of the tiny controls can be a bit annoying, however. And some people aren't going to like the thumbwheel film advances on some cameras.

Prices? Simpler cameras such as the preset-shutter Keystone and Quantaray list for less than \$60. The Hanimex 35 Micro Flash, with a manual shutter, is about \$120. Sophisticated cameras with electronically controlled shutters, such as the Mamiya U and Ricoh FF-1s, list for \$200 or more. But sizable discounts are available for most. **PS**

Comparing pocket 35's

Model	Dimensions (in)	Weight (oz)	Focal length (mm)	Aperture	Shutter speeds	Flash	Focus type	Auto exposure	Exposure counter	Self-timer	Battery check	Price
Chinon Bellami Anniversary Edition	4.13×2.48×1.29	8.8	35 mm F/2.8	25-400	1/8-1/1,000	Accessory	Zone	Yes	Yes	No	Yes	\$192
Cosina CX-1	4.05×2.60×1.67	7.6	33 mm F/3.5	25-400	2-1/500	Accessory	Zone	Yes	Yes	No	Yes	\$152
Cosina CX-2	4.05×2.60×1.67	7.9	35 mm F/2.8	25-400	2-1/500	Accessory	Zone	Yes	Yes	Yes	Yes	\$199
Fujica HD-S	5.50×3.16×2.46	15.2	38 mm F/2.8	64-400	1/8-1/500	Built-in	Zone	Yes	Yes	Yes	No	\$264.20
Keystone Everflash 3570	4.88×3.00×1.88	9.0	37 mm F/5.6	100, 400	1/125	Built-in	Fixed	Fixed	Yes	No	No	\$56.95
Hanimex 35 Micro Flash	4.00×2.78×1.65	6.7	32 mm F/2.8	64-400	1/60-1/180	Built-in	Zone	Manual	Yes	No	No	\$119.95
Mamiya U	4.53×2.65×1.88	7.8	34 mm F/2.8	25-400	1/8-1/500	Built-in	Zone	Yes	Yes	Yes	No	\$199.99
Minox 35 GT	3.94×2.40×1.20	6.7	35 mm F/2.8	25-800	30-1/500	Accessory	Zone	Yes	Yes	Yes	Yes	\$255
Olympus XA	4.00×2.54×1.60	7.9	35 mm F/2.8	25-800	10-1/500	Accessory	Rangefinder	Yes	Yes	Yes	Yes	\$250
Olympus XA2	4.00×2.60×1.60	7.1	35 mm F/3.5	25-800	2-1/750	Accessory	Zone	Yes	Yes	Yes	Yes	\$160
Quantaray Clamshell 35 (not shown)	4.25×2.75×1.13	9.5	38 mm F/5.6	100, 400	1/125, 1/250	Built-in	Fixed	Fixed	Yes	No	No	\$59.95
Ricoh FF-1s	4.21×2.56×1.42	7.9	35 mm F/2.8	25-400	2-1/500	Accessory	Zone	Yes	Yes	Yes	No	\$221



'82 snowmobiles

—hotter engines, softer rides

Sleek new Liquifire model from John Deere has a new clutch (inset) that the company claims improves longevity and dependability. The clutch has fan vanes on the outer diameter to break up stable air. Deere says this creates a low-pressure area behind the vanes that pulls high-velocity air across the drive belt, low-

ering its temperature by 15 to 18 degrees. Thus belt life is lengthened. In addition, the new clutch spreads forces over a larger area to make the part more durable. The Liquifire has a 436-cc liquid-cooled engine and CD ignition; it's also quite a lightweight at 412 lbs. It has a 7.75-gal. fuel tank and costs \$3,999.

By HERBERT SHULDINER

Once there were more than 100 snowmobile makers. Now only five remain: Bombardier (Ski-Doo and Moto Ski), John Deere, Kawasaki, Polaris, and Yamaha. These survivors offer a 1982 lineup that features engineering innovations designed to overcome the difficulties produced by the tightly enclosed engine areas needed to quiet these machines. New designs provide better cooling for engines and transmissions. This helps increase power and the longevity of the hard-working components. P 5



Powerful Interceptor 550 has the most horsepower of any model ever offered by Kawasaki snowmobiles. Wide-tracked machine also has a new baffle system that channels cool air to clutch and transmission belt to improve reliability. \$3,799.



Direct-drive transmission helps Polaris Cutlass SS get more pickup and, at the same time, better fuel efficiency. The Cutlass SS is powered by a 432-cc fan-cooled engine and comes with a complete complement of gauges. Price is \$2,749.

New workhorse model from Bombardier is the Ski-Doo Nordik. It's designed for Arctic and deep-snow use. An extra-long 124-in. track gives it a ground pressure of only 0.357 psi, providing excellent flotation in deep powder. The Nordik comes with a standard tow hitch for attaching an optional cargo-carrying toboggan. A 368.3-cc fan-cooled twin cylinder powers the Nordik, and it has a gear ratio designed to provide more torque at low rpm. The Canadian-built Nordik model costs \$2,599.

Cutaway of high-powered Yamaha SRX500F reveals new long-travel rear suspension. Also new for 1982 on this model is a clutch with an open sheave cap to provide better cooling. Yamaha also says clutch weights, pins, and collars have been changed to increase contact area. Displacement of the SRX engine has been increased from 440 cc to 500 cc for greater power, though Yamaha declines to specify actual horsepower. The Japanese import has a list price of \$4,098.



You can look the sparrow straight in the eye from 250 feet and you can see it blink.

The breakthrough optical technology of **Slim Jims Roof Prism Binoculars** will open a whole new world of visual adventure for you.

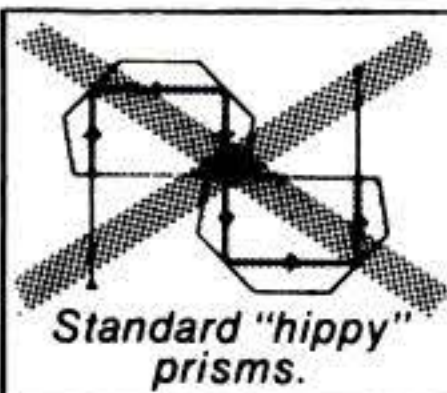
When you first look through *Slim Jims Binoculars*, you will gasp in delight. You have never seen the world so close and so bright, and with every detail so clearly discernible. It will seem almost unbelievable to you that a binocular as small and as light could hold that much optical power.

What makes this "miracle" possible?

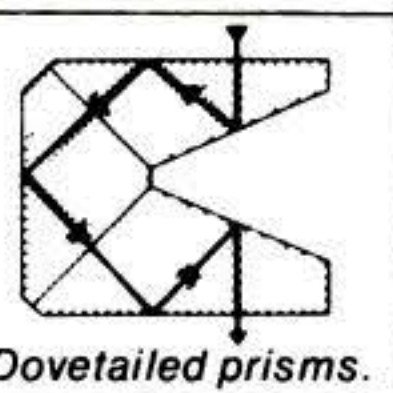
Roof Prisms: Breakthrough In Optical Technology.

One of the most important developments in optical technology took place about fifteen years ago. German optical scientists had been working for years on a totally new concept in binoculars. After many unsuccessful designs, they finally succeeded in creating the roof prism binocular.

The most visible difference between a roof prism binocular and a standard binocular is that of size and shape. A standard binocular has the ungainly "hippy" appearance that, for generations, had been associated with quality binoculars. The reason for this shape, and the substantial bulk and weight that go with this construction, is the way in which a ray of light passes through the prism assembly. In a roof prism binocular, the prisms are dovetailed in such a way that the axis of sight forms a straight line. In accomplishing that, it was possible to reduce significantly the size and weight of binoculars of any given power. Or, conversely, with this advanced construction, you can pack a whole lot more power and performance into a binocular of any given size and weight.



Standard "hippy" prisms.



Dovetailed prisms.

But there are many other advantages to roof prism binoculars, as compared to standard binoculars, besides the economies in bulk and weight. Here are some of the most important:

- Image quality is substantially improved over the entire area of the visual field.
- Luminosity is greatly enhanced.
- Resolving power is substantially sharpened.
- Viewing area is much increased.
- Chromatic correction is brought to near perfection.

So, quite obviously, the development of the roof prism binocular was a great improvement, you might even call it a "breakthrough". But there was one thing very wrong with it: German roof prism binoculars were so expensive that almost nobody could afford them. They were something for the super rich.



\$99

able by the advanced technology of roof prisms.

them into your pocket or purse. And you'll use them for all occasions when you want to see things really well and close up — in the theater, in the great outdoors, and for any sports event.

You Get Every Quality Feature.

Here are some of the quality features that you will get with 8x21 *Slim Jims Binoculars*:

- Rugged construction, sealed against dust and moisture.
- All optical precision elements are hard-coated for maximum light transmission and for protection against scratches.
- Chromatic correction is perfect.
- Absolute planarity (absence of "pincushion" and "doughnut") and perfect alignment.
- Superb resolving power and contrast.
- Center focus, with diopter adjustment.
- Fold-back rubber eyecups give maximum viewing angle to eyeglass wearers.
- Amazing wide-angle field of 366 feet at 1,000 yards!

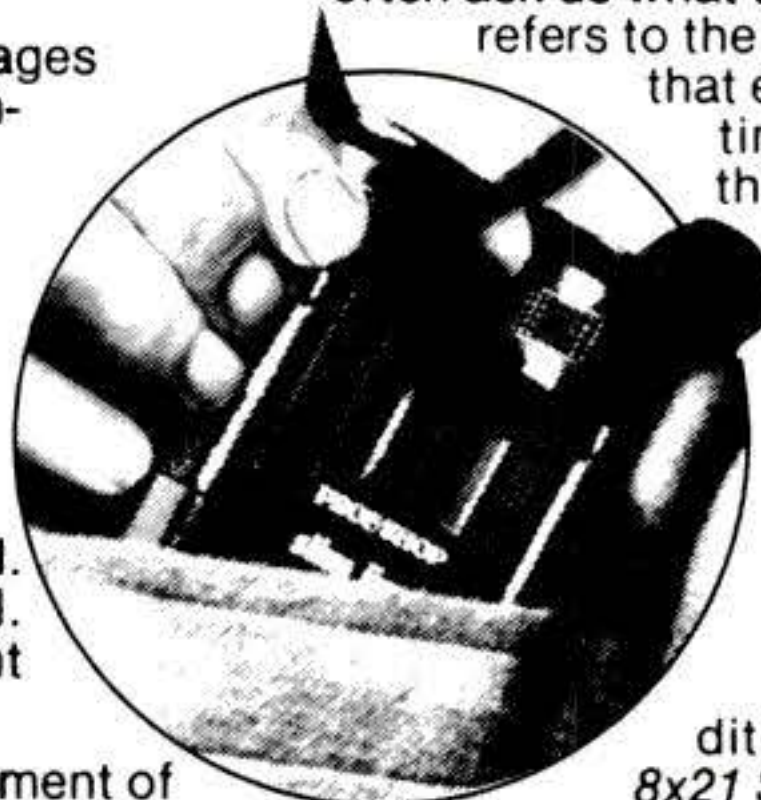
Slim Jims are so small that they fit easily in your coat pocket, and they weigh just 9 oz. Yet they pack the "optical wallop" of binoculars twice their size. This is made possible

The Resourceful Japanese Made Roof Prisms Practical.

That's where the resourceful Japanese made their move. They had already established a great tradition in optical excellence. They had bested their German teachers in microscopes, telescopes, and 35mm cameras. So now they directed their talents to the further improvement of roof prism binoculars. One of Japan's finest optical designers developed a line of roof prism binoculars that in mechanical detail and optical performance compares favorably with its German prototype.

We import these superb binoculars into the United States and distribute them in this country. Our customers quickly nicknamed them *Slim Jims*. The name is appropriate and it stuck. It expresses well the slimness of the lines and the elegance of the styling.

Slim Jims are "8x21" binoculars. People often ask us what the numbers mean. "8" refers to the magnification. It means that everything looks eight times as large as it would through the naked eye, or that it looks as though you were eight times closer. "21" is the diameter of the objective lenses in millimeters. It is a measure



of luminosity and of ability to view under poor light conditions. Lightweight 8x21 *Slim Jims* are the perfect binoculars for almost any activity and for almost any viewing condition.

Slim Jims, as a result of their superb roof prism construction, are small and light. They measure only 4x3" and weigh just 9 ozs. You can slip

All This At An Unbelievable Price.

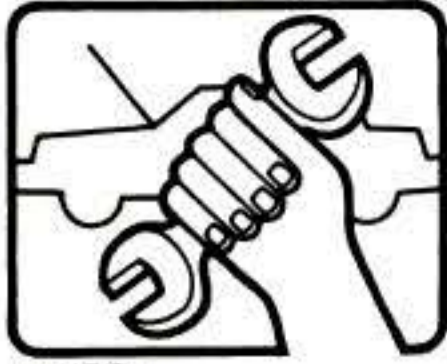
The best surprise, perhaps, about *Slim Jims* is the price. In performance, construction, and appearance, *Slim Jims* can hold their own with their German counterparts. Yet, *Slim Jims* cost only \$99, less than a third of what you would have to pay for an equivalent pair of German roof prism binoculars. This low price is made possible by the superb production and control technology of the Japanese manufacturer, by the large production runs, and by the fact that we import these binoculars directly and sell them directly to you, the ultimate user. We eliminate approximately three layers of profit. But there is not the slightest compromise with quality. *Slim Jims 8x21* are as good as any roof prism binoculars you can buy — at any price!

You can buy 8x21 *Slim Jims* with full confidence. Take them to the theater, to any sports event, and to the great outdoors and use them at our risk. You have unquestioned 2-week return privilege and 1-year guarantee for manufacturer's defects. There is so much to see out there, so many sparrows and other birds to observe and so much else to enjoy. Why should you deprive yourself of all that visual adventure for even another day? Order your *Slim Jims 8x21 Binoculars* today!

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AUTO
MAINTENANCE

Trouble-shooting your car's **AIR system**

The air-injection reaction system controls emissions. If it malfunctions, it can also affect performance

By **RAY HILL**

DRAWINGS BY GENE THOMPSON

You take your foot off the gas and your car backfires as if firecrackers were going off in the exhaust system. This and other problems can occur if the air-injection reaction (AIR) system fails. Little-understood but very important, the AIR components inject air into the hot-exhaust stream. This causes most of the unburned hydrocarbons to ignite, reducing the pollution that leaves the tailpipe.

When something goes wrong, backfiring, burned hoses, and poor engine performance can result. Inspecting the AIR system periodically can decrease the chances of a problem occurring. And if something does happen, knowing how to trouble-shoot the system can enable you to fix it. Here's what you need to know:

There are two kinds of AIR systems. One forces air into the exhaust with a belt-driven pump; the other uses exhaust-manifold vacuum to draw air in. If an engine doesn't need much air to meet emission specs, a vacuum system is used. If it needs a lot of air, a pump is installed. (Accompanying drawings show how the two systems differ.) Either system should be given a physical once a year, and at every tuneup.

Checking a pump system

Follow these procedures to inspect an AIR system that uses a pump:

Look at the pump drive belt. The

belt's sides and bottom should not be chipped, cracked, glazed, or frayed. Replace the belt if any of these problems exist. Belt tension should be at the spec called for in the shop manual. If you don't have a belt-tension gauge, the belt should be adjusted so it doesn't have more than a total movement of $\frac{1}{2}$ inch when grasped midway between two pulleys and moved up and down.

Check pump output. Remove the outlet hose from the back of the pump. Hold your hand near the pump outlet. With the transmission in park (neutral with a manual shift) and the parking brake on, have a friend start the car and accelerate engine speed to about 1,500 rpm. You should feel air coming out at idle, and the flow should increase in strength when the engine speeds up. If this happens, reconnect the hose—the pump's okay. If not, and the drive belt is properly tensioned, the pump is bad. Replace it.

(If your pump has the diverter valve attached directly to it, remove the valve's output hose from the check valve and check the output from the end of the hose.)

When buying a replacement AIR pump, be sure to get one made for your car's make, year, and engine size. Different pumps can put out different amounts of air. It's important that yours produces the amount the manufacturer intended.

(Instead of using a centrifugal vane filter, some foreign-car pumps may use a replaceable paper filter. This filter should be replaced as recommended in the car's service manual for optimal performance.)

Inspect hoses. Check all air hoses that run from the AIR pump. Replace any that are brittle, severely cracked, or otherwise damaged. Be sure each is

tightly connected. If a hose needs replacing, use only the special high-temperature hose made for AIR systems.

Look at all vacuum hoses. Most systems have a single vacuum line that is connected at the diverter valve. Some, however, may have more than one vacuum line. Be sure that any vacuum hose is connected tightly at both ends. Replace a vacuum hose that is loose or damaged.

Check the diverter valve. With the engine idling and at operating temperature, remove the vacuum line from the diverter valve. You should feel suction at the end of the line when you place your finger over it.

If no suction is felt at idle, have a friend accelerate past idle. Some diverter valves do not get vacuum at idle. (If your diverter valve has more than one vacuum hose, check your shop manual to see which one triggers the diverter valve.) If there still is no vacuum, determine why. If the hose is okay, it may have been inadvertently attached to the wrong vacuum tap. Or if it's attached to the carb, the vacuum passageway in the carb may be plugged.

Reconnect the vacuum line, and be sure all other lines are connected to the diverter valve. Disconnect the diverter valve's air-delivery line from the check valve. Hold your hand over the end of the hose and have a friend accelerate the engine to about 2,500 rpm and quickly release the throttle. Air flow out the end of the hose should increase during acceleration and stop momentarily when the throttle is released. If air flow doesn't stop, the diverter valve is bad. You have to replace it.

Inspect the check valve. With the output hose still disconnected from

the check valve, hold your hand over the valve opening while increasing engine speed moderately. If you feel hot exhaust gases coming out (don't burn your hand), the valve is bad. Replace it. If you feel nothing, the valve is okay. Reconnect the hose.

Check the air manifold. Many cars use a metal manifold with a runner to each exhaust port. In others the air-delivery passageways are cast in the head. In those cars with the external manifold, inspect it and the runners for leaks.

A leak will sound like an exhaust-system leak. If you have trouble locating it, spray soapy water around each air-manifold connection. A leak will cause bubbles. Tighten any connection that's leaking. When spraying, be careful not to get any water in the AIR pump.

If there's no leak at a connection, spray the entire manifold. On older cars the manifold tends to corrode, and eventually a hole can develop. Once you find the hole, you may be able to make a temporary repair by wrapping it with aluminum foil, held in place with a screw clamp. A permanent fix is to replace the manifold.

Don't remove the air-injector manifold as part of a normal inspection. But if the car fails an emissions test, the engine is tuned properly, and previous checks reveal no problems, take it off and check for carbon buildup. Chances are it's clogged and is not allowing enough air to get into the exhaust system.

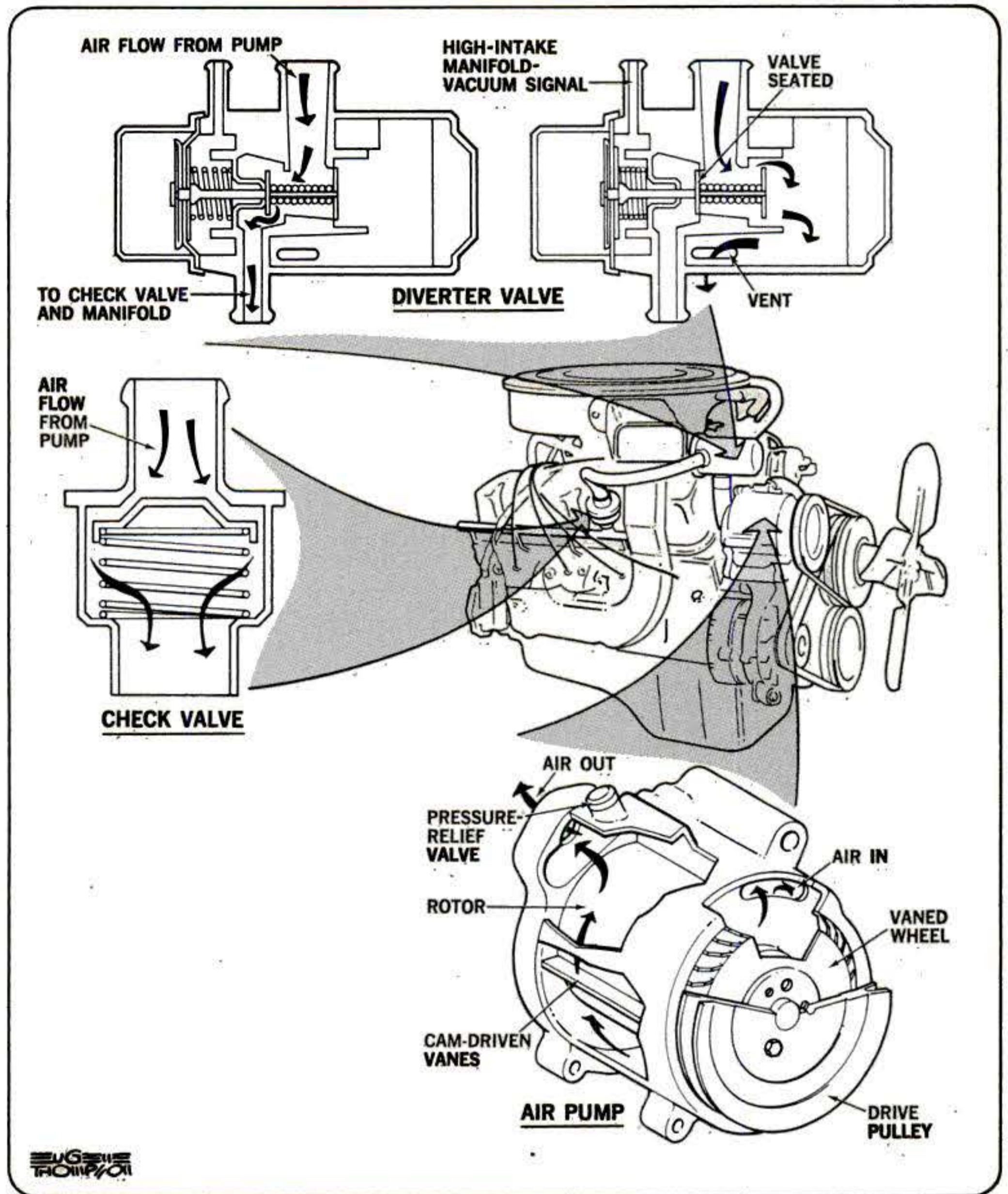
Checking pulsed-air systems

It's easier to inspect an AIR system that doesn't use a pump. Basically there are two types—those that use a single check valve, and those that use multiple check valves (see accompanying drawings). Inspection procedures are similar for both.

Check the condition of the hoses. Replace any that are charred, cracked, or broken. Some of the hoses in pulsed-air systems may not use a hose clamp. If so, and the hose is loose at its connection, you can probably tighten it by adding a screw-type hose clamp.

Inspect the check valve. In a single-check-valve system, remove the hose from the air-cleaner side of the check valve. With the engine idling, place a piece of paper over the end of the hose. Vacuum should hold the paper in place. If not, the check valve is bad. Replace it. Accelerate engine speed, holding your hand over the hose open-

Continued



The AIR system's job is to reduce emissions by injecting air (using a pump) into the exhaust stream. This oxidizes the unburned fuel, turning most of it into carbon dioxide and water. The AIR pump is belt-driven. A vaned wheel behind the pump's drive pulley acts as a centrifugal filter: Spinning vanes deflect foreign particles away from the pump's inlet. A two-vane rotor spinning inside an elliptical housing draws in air and forces it through the pump outlet to the diverter valve, which, except during deceleration, directs the air through a one-way check valve into the exhaust manifold. (Without the check valve, hot exhaust gases could travel up into the AIR system, possibly damaging hoses and other components. Exhaust gases would also try to enter the system if the drive belt broke, or if exhaust pressure exceeded AIR pump pressure.)

In some cars the AIR pump may force air into only the exhaust manifold, as it does in our example here. In others it may force the air into the exhaust manifold during engine warm-up, then to the catalytic converter after the engine reaches operating temperature. (A pressure-relief valve on the pump opens at high pump speeds to prevent too much air being forced into the

exhaust manifold. In some cars the pressure-relief valve may be on the diverter valve instead of the pump.) Regardless of where the air goes into the exhaust stream, its job is the same: to oxidize unburned fuel.

During deceleration the amount of unburned fuel in the exhaust stream increases considerably. If air were pumped into the exhaust then, backfiring would occur. To prevent this, engine vacuum (which is strongest during deceleration) moves a diaphragm inside the diverter valve, redirecting the air from the AIR pump to the atmosphere. (In some cars, instead of directing the air to the outside, the diverter valve redirects it to the intake manifold or the air cleaner, leaning out the fuel mixture.)

The diverter valve is sometimes called an air-bypass valve, air-management valve, air-switching valve, or gulp valve. Most cars have only one vacuum line going to the diverter valve. Some later-model cars, however, may have more than one. In these, the diverter valve works the same way, but is triggered in a slightly different manner (check shop manual for vacuum-hose routing and method of triggering).

ing at the same time. You should feel nothing. If you feel hot exhaust gases, replace the check valve.

With a system that has multiple check valves, use a vacuum pump to check each valve individually, pumping up the vacuum to the amount specified in the shop manual. If the pump reading doesn't decrease as specified, the valve must be replaced.

Trouble-shooting

Performing the preceding inspection rituals once a year and at every

tuneup will likely catch a problem before it develops. If not, diagnosing AIR-system problems isn't difficult. Some common problems follow, together with explanations of what you should do about them.

Backfiring during deceleration. This happens only with AIR systems that use a pump. It's a sure sign the diverter valve isn't doing its job—diverting the air away from the exhaust during deceleration. The amount of unburned fuel in the exhaust increases greatly during de-

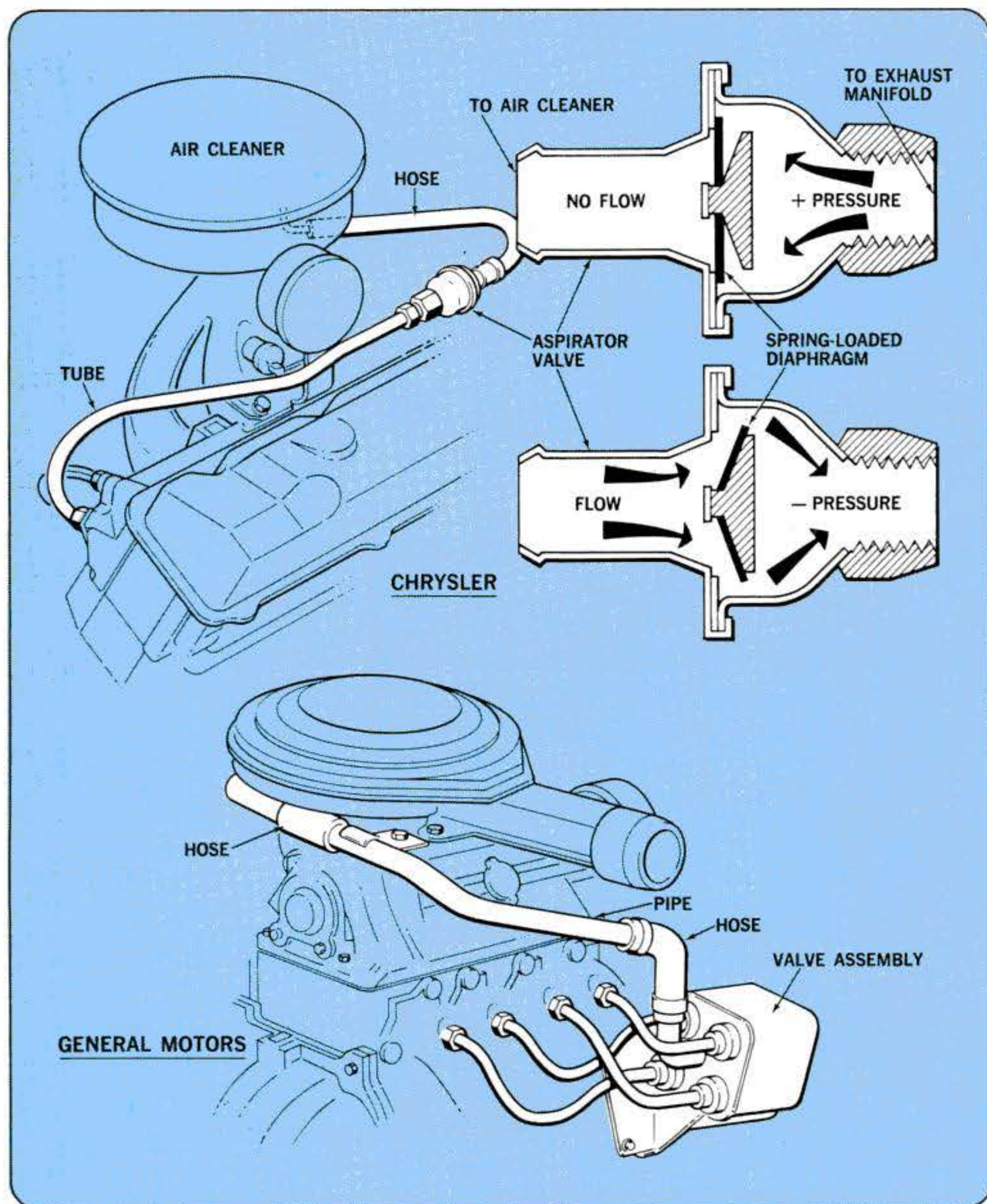
celeration. If air continues to be injected, combustion becomes strong enough to cause backfiring. Your job is to determine whether the diverter valve is bad or whether it's simply not getting a vacuum signal during deceleration.

To find out, remove the diverter valve's vacuum-trigger hose from the diverter valve. Attach a vacuum gauge to the hose. At idle or at off-idle the gauge should show manifold vacuum. For example, if manifold vacuum on your particular car is 18 inches, then the reading at the end of the trigger hose should also be 18 inches. If the gauge reads correctly and the hose doesn't leak at the diverter-valve connection, the valve is bad. It must be replaced. If there is little or no vacuum at the end of the hose, determine why (broken hose or loose connection, for instance).

Frozen pump. Sometimes an AIR pump's bearings fail, and the pump seizes. If this happens, your only option is to replace the pump. First, though, determine whether or not the bearing failure was due to a faulty check valve. If the check valve is letting hot exhaust gases up into the pump, this will cause the new pump to fail, too. Bearings don't work well when their lube is melted away. Inspect the valve using the procedures mentioned earlier.

Charred air-delivery hoses. When this happens, you know the check valve is bad—without even testing it. The hot exhaust gases are flowing back past the valve, burning the hoses. Replace the valve, and replace any damaged hoses.

Surging or poor performance. This can be caused by a lot of things—vacuum leaks, poor compression, ignition problems, and so on. But if your car has a pulsed-air system, a faulty check valve or valves will allow exhaust gases to enter the carb through the air cleaner, causing poor drivability. **P 5**



Some AIR systems do not use an air pump to force air into the exhaust stream. Instead, they let the vacuum in the exhaust manifold draw in air. The vacuum is created by negative exhaust-gas pulsations, hence the term "pulsed air." Chrysler's system works this way: At idle speeds and just off idle, when vacuum is highest in the exhaust manifold, air is sucked from the air cleaner through the aspirator valve (which doubles as a check valve) into the exhaust manifold. At high-

er engine speeds there is little vacuum in the exhaust manifold, but there is positive pressure from the exhaust gases rushing through the manifold. This closes the aspirator valve, preventing the hot gases from traveling up into the air cleaner. GM's pulsed-air system works in a similar fashion, except that instead of having one check valve, as the Chrysler system does, it has a check valve for each cylinder. The check valves are usually housed in a single unit, as shown at lower right.

Draftproof for winter

Now's the time to check for cold air leaks around windshield, windows, door handles, and weatherstripping. Close all windows and vents, then turn your car's heater-blower on high. Run water from a garden hose in a gentle stream over areas of potential leaks so that air bubbles can pinpoint them. Mark each with a piece of tape so you can seal it later when the car dries off.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Lights Kings, 9 mg. "tar", 0.7 mg. nicotine; Lights 100's, 8 mg.
"tar", 0.8 mg. nicotine av. per cigarette, FTC Report May '81.

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*The low 'tar' with
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RALEIGH LIGHTS

STORAGE
from
SCRATCH

In our September issue we kicked off a new series of home-improvement projects that create storage where none existed. These built-ins and add-ons can be adapted to any house or apartment that's short on closet and cabinet space. In this month's installment we focus on a room that can use all the storage space it can get—here are three different approaches to tucking things away in your kitchen.

Appliance and wine rack

By AL LEES

Those Mondrianlike doors on that colorful kitchen closet, facing page, aren't what you think. Only the two skinny ones are conventional hinged panels; the other two are spring-roller window shades—and one of them is mounted upside down (turn page for installation tips).

My kitchen needed utility storage in a hurry, and because it's all very crisp and white I designed the simplest shelf unit I could, keeping the lines clean, but introducing panels of bold color. A honeycomb sheet-metal wine rack set the dimensions for the lower-left compartment—but posed a problem: This wall faces a sunny window, so the stored wine would have to be protected from the light and heat of direct exposure. Rigid panel doors on compartments of this size are clumsy—and cut off cooling air flow. Besides, racked wine makes a fine display when solar protection isn't required, so I wanted a cover I could quickly dispense with. A colorful shade, mounted backwards to minimize the roller, proved ideal.

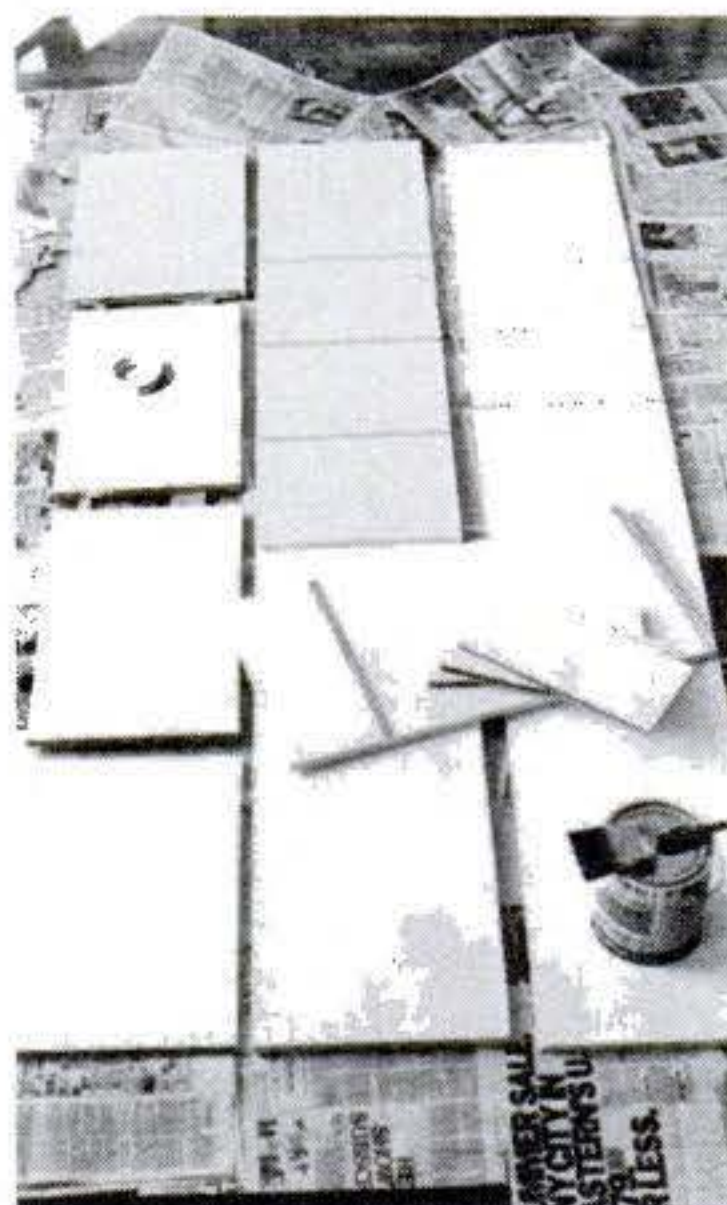
It then seemed logical to give the upper compartment the same treatment—except that my shelf unit stands eight feet tall, lifting a top-mounted roller out of reach. I contacted Joanna Western Mills (a manufacturer of quality window shades) for advice, and learned of its special kit that would let me mount this shade low and raise it with cords and pulleys, as I'm doing in the second color photo. So the two Joanna shades you see are: for the wine rack, a heavyweight, opaque textured vinyl called Stockbridge (the color is "toast"); the Bottom Up is a Viking custom shade in light gold.

The problem with most built-in compartmentalized storage is complexity of construction. Here, I've kept the shelf assembly so simple you can do the whole job with hand tools. I used 3/4-inch panels (particleboard for the uprights, plywood for the shelves), assembled with glued-and-screwed butt joints—no rabbets or grooves; and the structure is tied into the end wall by means of metal L-brackets anchored with expansion fasteners (Molly bolts).

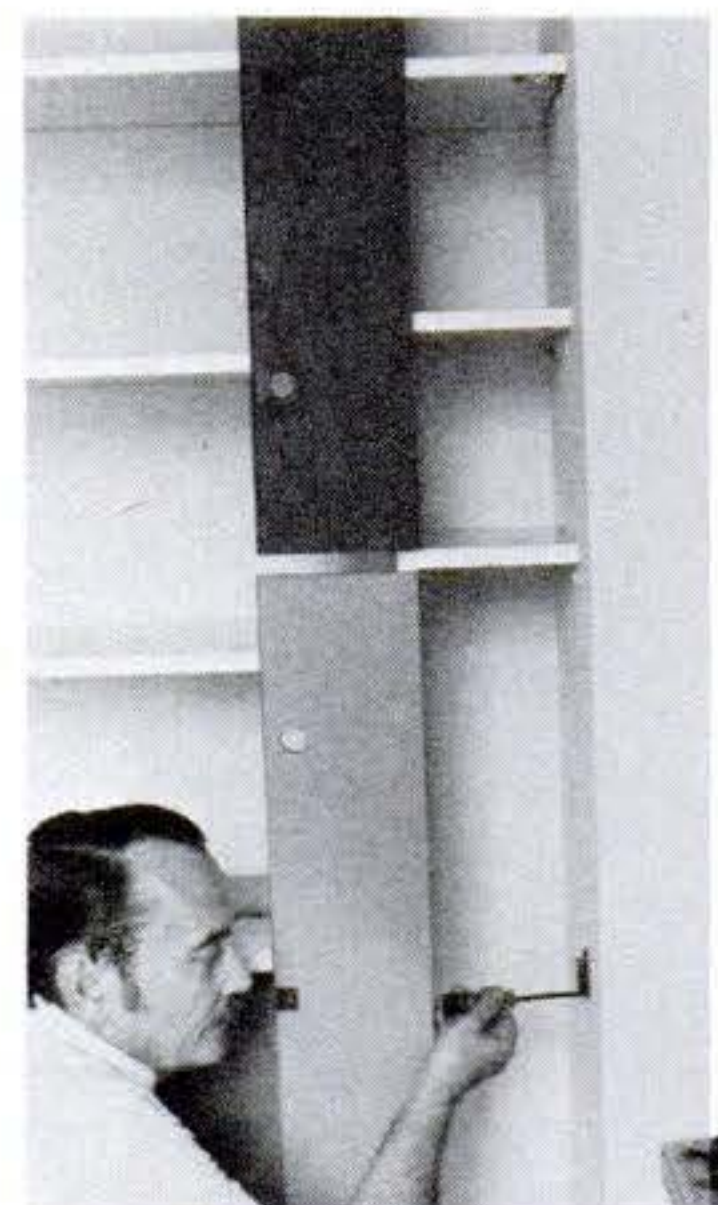
The 5/8-inch-plywood doors for the two skinny compartments shouldn't be cut until the shelving unit is in place—you want a neat fit against that end wall. To avoid cutting hinge gains, I surface-mounted with brass flat-head screws—1 1/2-inch No. 6 for attaching the leaves to the edge of the particleboard upright. Note that the broom-closet door has no stop strip. It simply closes against two wall-mounted magnetic catches. **03**

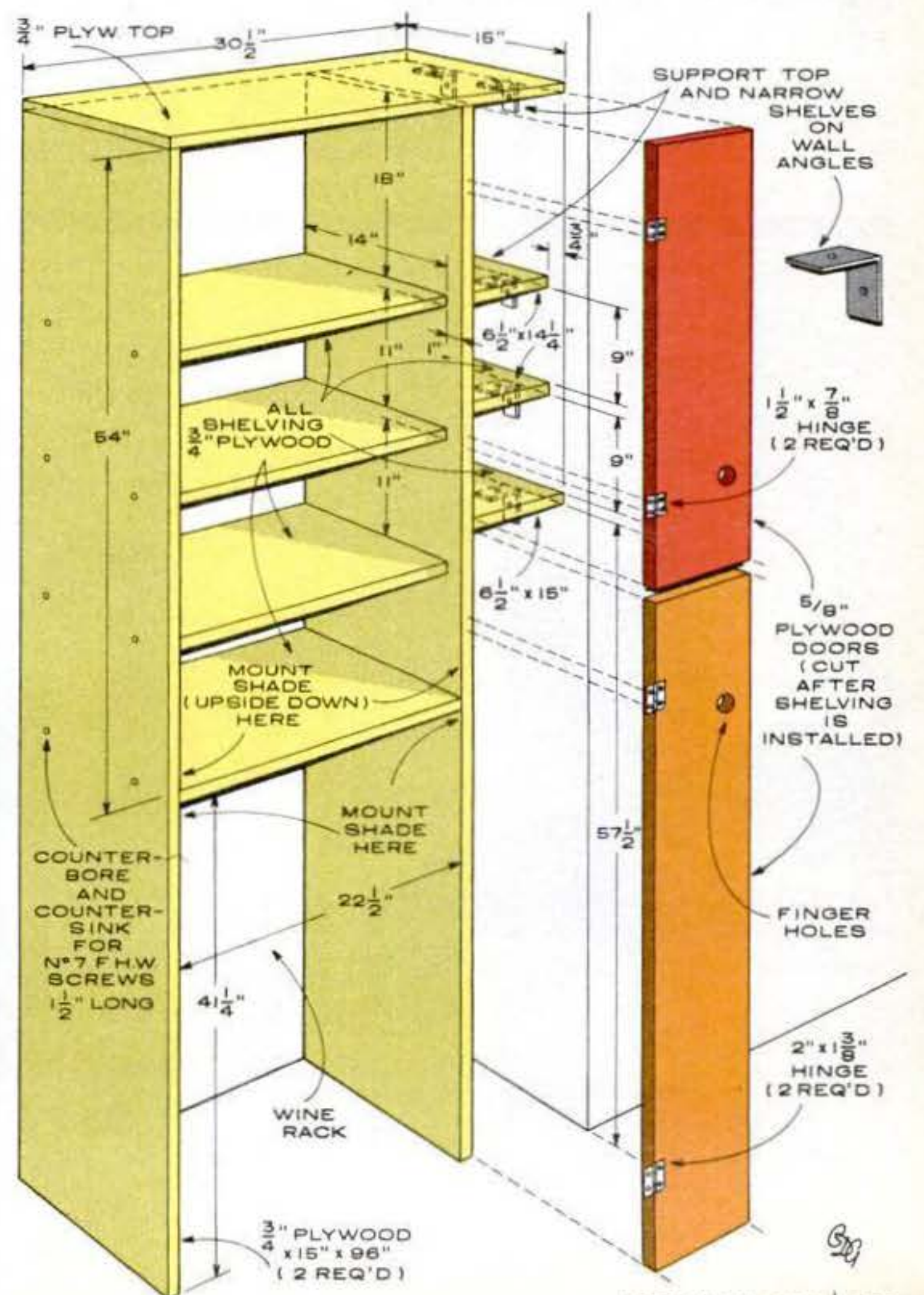
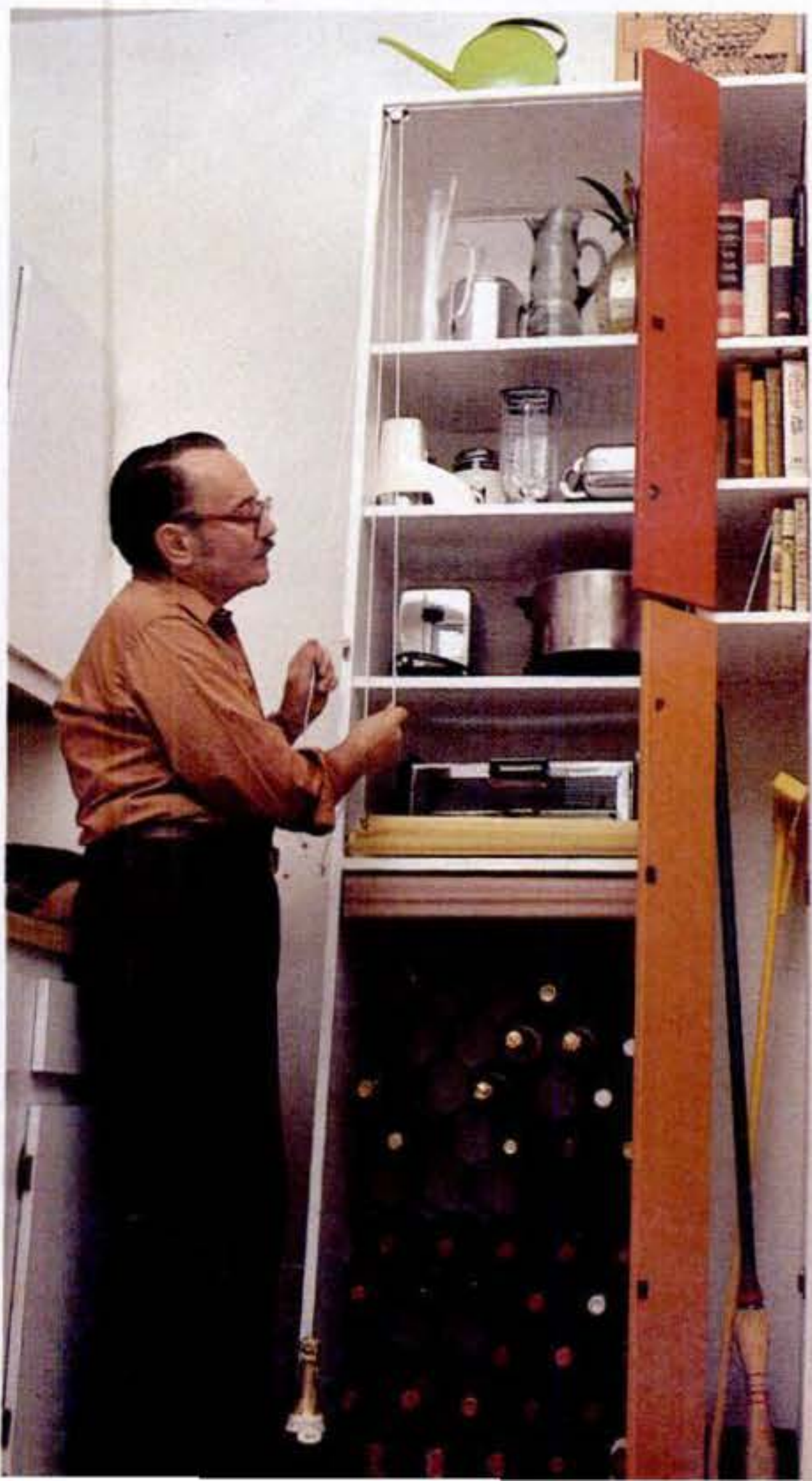


Closetless kitchen offered ample cabinet space but no place to store mops and brooms, bulky appliances, cookbooks—or author's growing wine collection. Tucking super-simple rack in wall niche solved all problems. Note window-shade doors.



Butt joints, fastened with glue and screws, simplified assembly of rack's 10 panels. Note that when shelves and uprights were painted, joint lines and edges to be glued were skipped (left). Plywood doors for right-hand sections use magnetic catches.

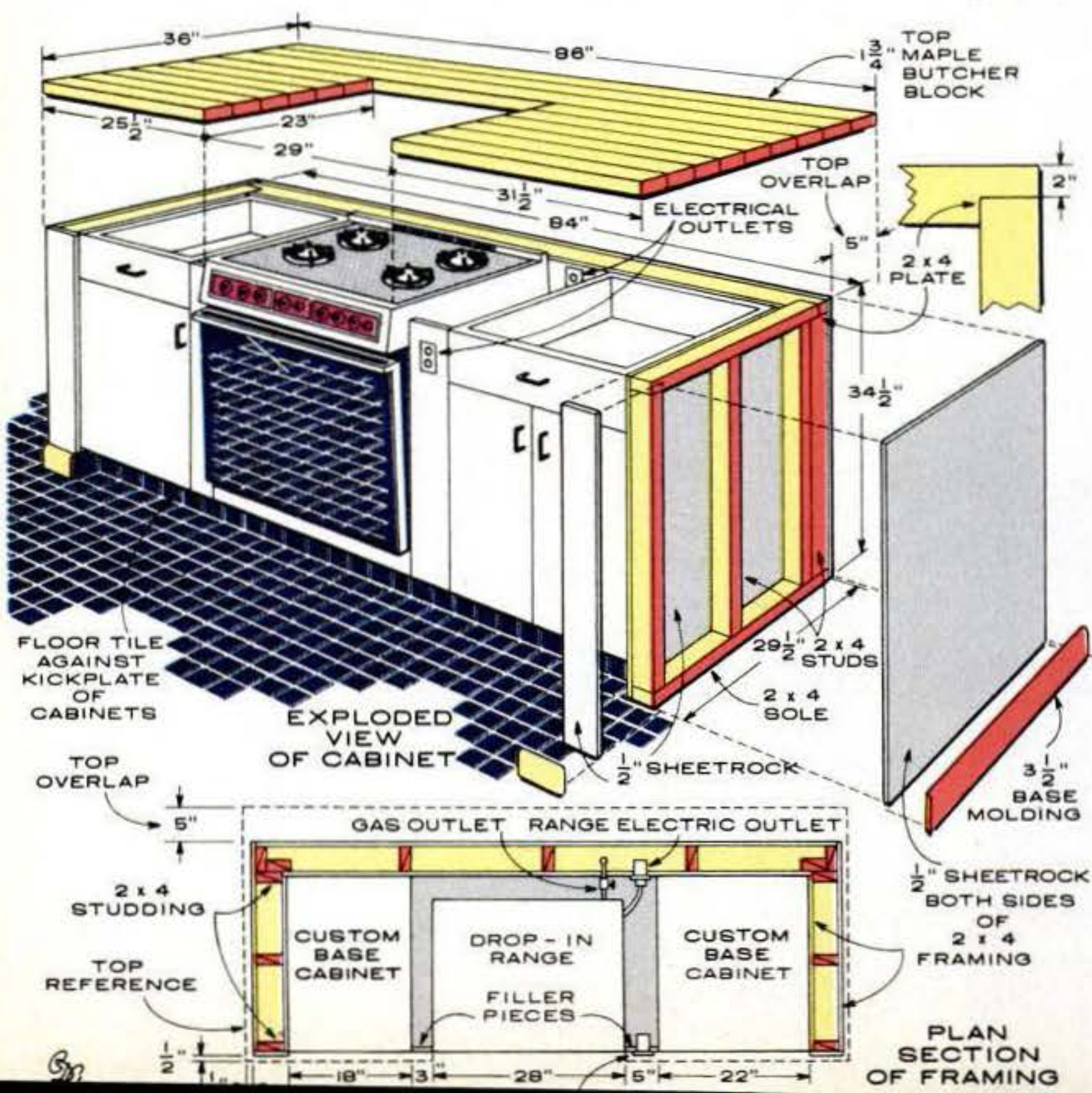






STORAGE
from
SCRATCH

Kitchen island



Sleek sides of this island face a dining area (upper photo); the business side (above) shows off its generous and handy storage. Drawing at left shows construction.

By **RICHARD STEPLER**
PHOTOS BY JOHN KEATING

This island is my kitchen's centerpiece. Topped by a massive three-by-seven-foot chunk of butcher block, it holds a lot of cooking gear in two standard kitchen base cabinets; one has slide-out shelves (lower photo, facing page) for handy storage of pots and pans next to the island's drop-in range. (We used custom-built cabinets; you could substitute knock-down versions [PS, Sept. '79], sized to fit inside the island.)

The range is positioned slightly off-center to provide generous space for food preparation to one side. There's a six-inch overhang on one side of the island; with bar stools it doubles as an eating area. The island's sleek, off-white enameled sides face the dining area, screening the unfinished sides and backs of the cabinets within.

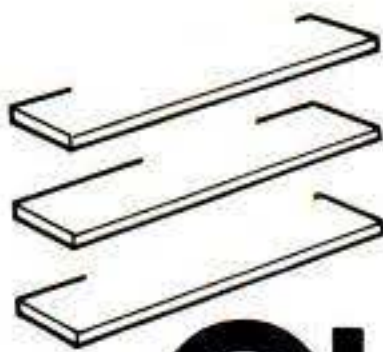
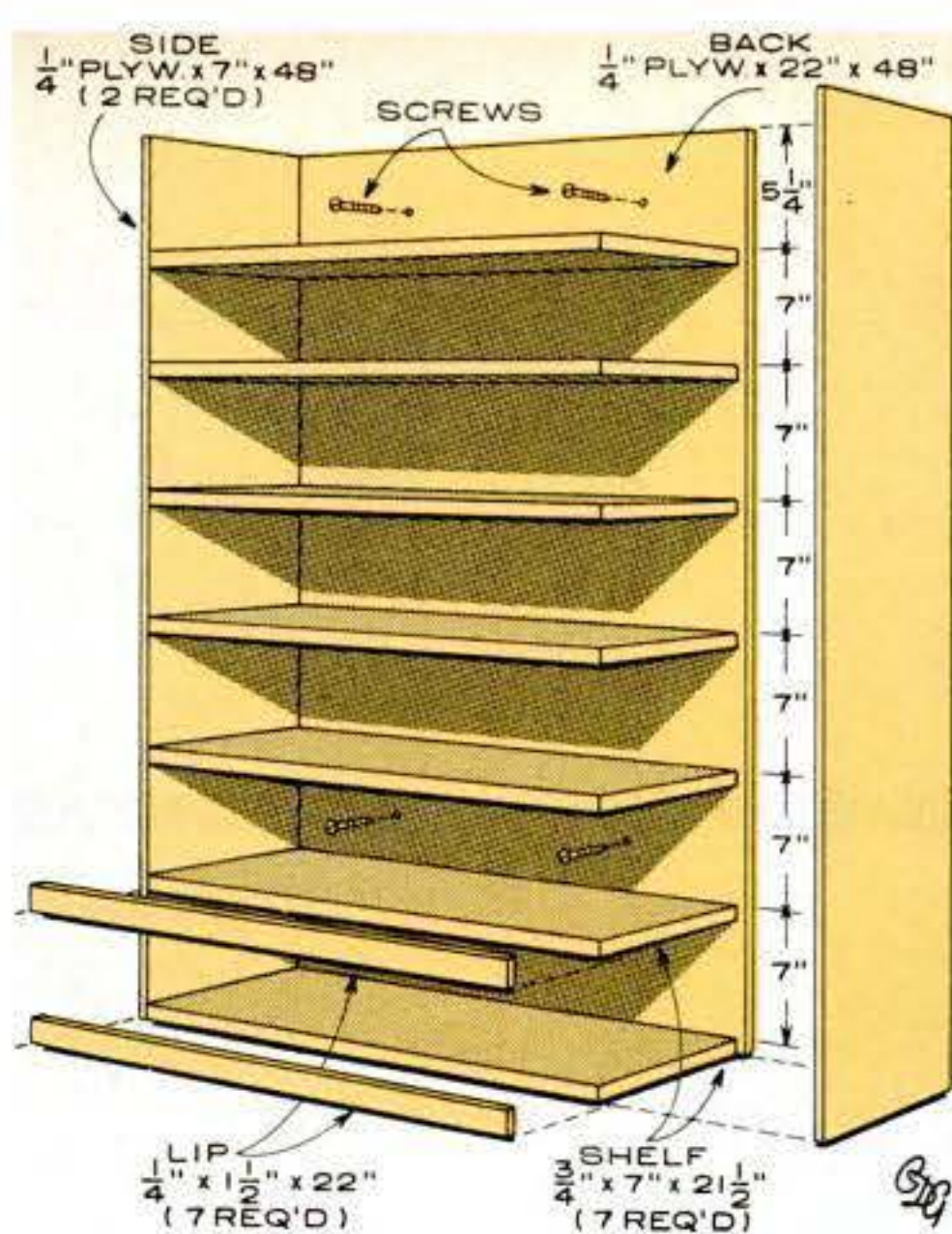
Since the island divides the kitchen from our dining area, the chef isn't left out when dinner guests arrive. In keeping with the "stage center" aspect of the island, the work top is lighted by three 75-watt track-mounted floodlights, controlled by a dimmer.

Putting it together

Construction begins with the 2x4 framing: We built it in three sections, shimmed and nailed square to the floor (see drawing). Next, we attached the butcher-block top; our supplier cut the range opening for us—highly recommended since rock-hard maple is no joy to saw. Shim and level the top if necessary; this is especially important when you're installing a range that hangs from the counter top (you don't want your omelets to slip to one side of the pan!). Predrill holes for screws and attach the butcher-block top from the underside of the upper framing members. A power screwdriver such as Skil's Boar Gun ["Power Screwdriving: The Best Way to Do All Your Fastening Jobs," PS, May] makes this task a lot easier.

We faced both sides of the 2x4 framing with 1/2-inch-thick drywall. We reinforced outside corners with metal beading before we taped the drywall. (Tip: If you're not an experienced taper, a damp sponge helps to even the joint compound.)

Next we pulled up old flooring and ran gas and electric service between floor joists. The two base cabinets and filler strips needed for the range go in next; we placed an electric outlet in one filler strip, convenient to the work area. The drop-in range really does—once it's hooked up to the gas line and plugged into a second electric outlet inside the island. P 5



Closest-door pantry

By **LOUIS HOCHMAN**

In today's compact homes, the old-time pantry has been eliminated. So canned and packaged goods must be stored in deep cabinets below and above counters and appliances, often forcing the hapless cook to crouch uncomfortably or climb a precarious step stool to reach needed items.

Yet if you have a closet near the kitchen—or even a basement stair—you can convert the door into a serviceable mini-pantry by adding this shelf unit to the back surface.

Mine has seven shelves spaced 6 1/4 inches apart and is simply attached to the door with four wood screws

through the back panel of 1/4-inch plywood. Narrow plywood strips, nailed across the front edges of the shelves, create a lip that keeps stored items from being jostled off when the door is opened and closed.

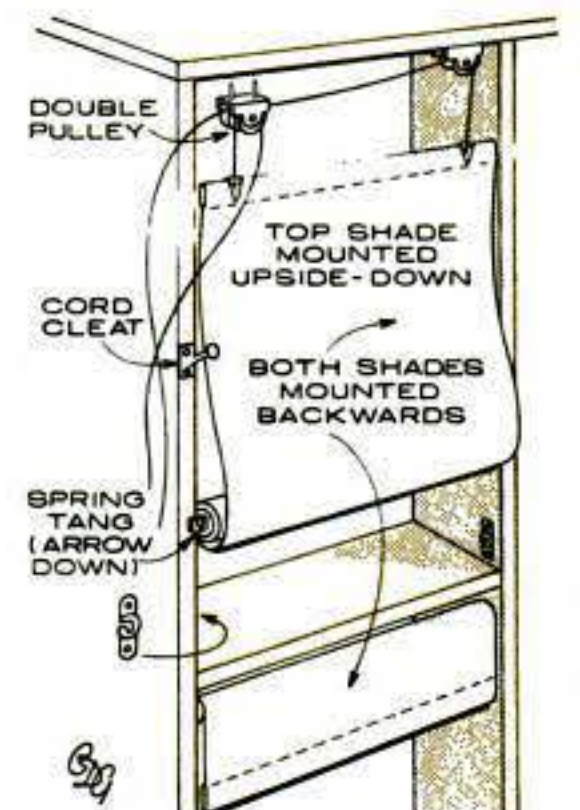
For easy cleaning with a damp cloth or sponge, you'll want to seal all surfaces with varnish or a quality enamel before the unit is mounted.

A major advantage of this type of shallow-shelf storage is that your supplies can be inventoried at a glance. Since everything shows, you can tell at once exactly what needs replenishing. You might even want to add smaller units to the backs of some of your cabinet doors. P 5



Mounting an upside-down shade

The appliance rack that begins this section calls for a special shade since you can't mount a regular one upside down. The shade must be under constant tension, since it has only two positions—all the way up or down. Constant-tension rollers are available in custom lines, such as Joanna Western Mills Viking; Joanna calls this mounting a Bottom Up shade and offers a kit with brackets, pulleys, cord, cord cleat, and instructions. (If you can't find a local dealer, write Joanna at 2141 S. Jefferson St., Chicago, Ill. 60616.) Two metal clips snap onto the shade slat for attaching the cords. Cords pass up over their respective pulleys, screwed under the top shelf. One cord is long enough to pass across to the second pulley, to join the first on its way down to the cord cleat where they're both secured.



SHOP TALK

By AL LEES



Twelve books of Christmas

On the 12 days of Christmas, my true love gave to me (listed in the order the books are seen above; all are paperbacks except those designated "hardbound"):

- One from Stephen Green Press, Box 1000, Brattleboro, Vt. 05301: *Central Heating with Wood and Coal* by Larry Gay, 114 pages, \$8.95. The subtitle, "Using solid fuel for heat and domestic hot water," tells it, and author Gay—a technical consultant in home energy—has the right credentials.

- Two from Garden Way, Charlotte, Vt. 05445 (each \$8.95—add \$1 postage if ordering direct): *Build your Own Low-Cost Log Home* by Roger Hard, 200 pages; and *Low-Cost Green Lumber Construction* by Leigh Seddon, 164 pages. These books beat the high cost of lumber. Whether you build from scratch (felling and peeling your own trees) or from a pre-cut kit, the first covers all details of log construction. The second alerts you to all the advantages—and a few hazards—of building with native lumber from local mills, instead of costly kiln-dried.

- Three from Sunset Books, Menlo Park, Calif. 94025: *Do-It-Yourself Energy-Saving Projects*, 96 pages, \$3.95; *Do-It-Yourself Roofing and Siding*, 120 pages, \$4.95; and *Basic Masonry Illustrated*, 96 pages, \$4.95. The first reads like a summary of everything PS has published in the past five years on how to increase your home's energy efficiency. It's a well-organized manual of easy-to-do projects. The other two books are closer to the Sunset formula: lots of how-to sketches set off from a portfolio of glamorous color photos of the results you can expect, if you

pay close attention to those instructions.

- Two from Time-Life Books, 777 Duke St., Alexandria, Va. 22314 (both lavishly illustrated, 136-page hardbounds at \$10.95): *Fireplaces and Wood Stoves*, and *Porches and Patios*. They're the latest in Time-Life's successful Home Repair and Improvement series, featuring those familiar super-clear line drawings. The first book tells you how to heat efficiently with wood, how to buy and stack it—even how to build your own brick fireplace. The second heralds the return of the porch, and shows how to add one, or screen in the one you have; patios and decks are also touched on, as is outdoor furniture.

- From the author, Charlie Plumb, 731 Sherman St., Denver, Colo. 80203: *How You Can Make Battery-Operated Clocks Easily*, 48 pages, \$4.95. Here's a light-hearted but thorough guide to creating self-contained clocks of many designs—from scratch or by converting a variety of objects. My favorite is the quintessential grandfather clock on the book's last page: It's a life-size, nattily dressed gramps, complete with wig, fedora—and a gold watch.

- From Consumer Guide, 3841 W. Oakton St., Skokie, Ill. 60076: *Complete Book of Prefabs, Kits, and Manufactured Houses*, 160 pages, \$7.95. More than a handsome catalog of factory-made homes, this manual offers tips on financing and site preparation—plus a Sunset-like portfolio of color photos.

- From Goodheart-Willcox, 123 W. Taft Dr., South Holland, Ill. 60473: *Upholstering Methods* by Fred W. Zimmerman, 192 pages, \$12 hardbound. Created as an introductory text for vocational schools, this profusely illustrated book covers pro-

cedures for stripping and repairing frames, right through choosing and installing padding and fabric covers. Ignore those end-of-chapter review questions and it's a fine how-to book for the home workbench.

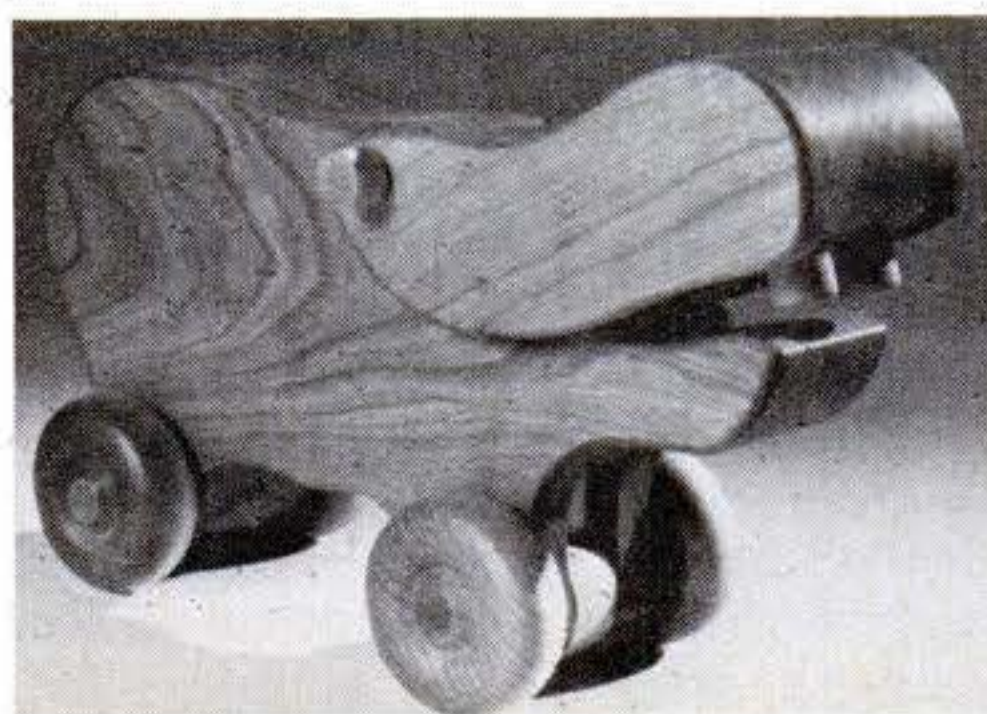
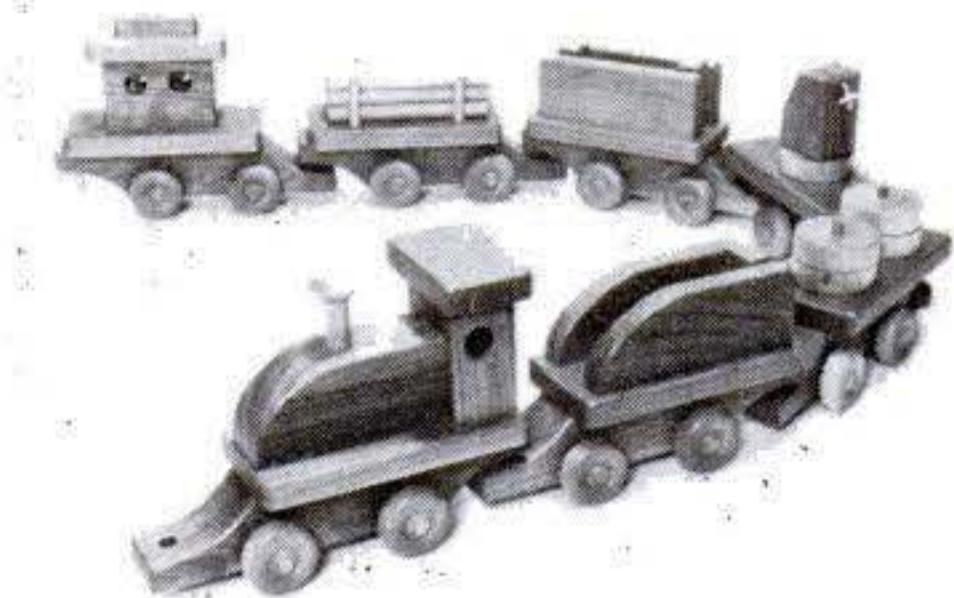
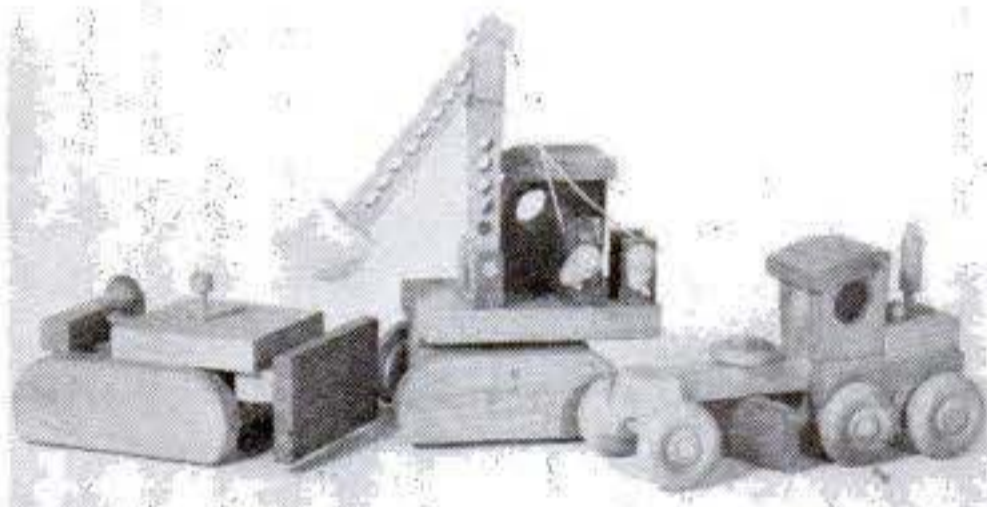
- From Tab Books, Blue Ridge Summit, Pa. 17214: *Designing and Building Your Own Stereo Furniture* by Carl W. Spencer, 384 pages, \$9.95. More cabinets and component racks from the designer of the stereo tower we detailed in last February's issue; lots of informative photos, but no dimensioned plans.

Any of these twelve books will make a gift that's eminently more practical than a partridge in a pear tree.

For your North Pole annex

This time of year, many a home workshop across the land turns into an annex for that giant toyshop up north. Few gifts under the tree will mean as much as play gear you've made at your own bench. If you find yourself without patterns, don't despair: Toy Designs, Box 441-PS, Newton, Iowa 50208, promises fast service. Full-size, ready-to-trace plans for the bulldozer, steam shovel, and grader in the first photo below are \$5.50. Or patterns plus all turnings—wheels, axles, pegs, and people—are \$12.25. A catalog of 50 plans is free with either order (\$1 separate).

Another source for plans and parts is Cherry Tree Toys, 67131 Mills Rd., St. Clairsville, Ohio 43950; catalog \$1. Michael Murphy, there, designed the train and the hippo (whose mouth opens as he rolls along the floor). P 5



IF FUEL BILLS ARE PUTTING YOU IN THE RED, THINK PINK.

If you haven't added an extra layer of Owens-Corning's pink *Fiberglas*® Insulation up in your attic in the last five years, you probably should.*

Estimates are that fully half the houses in America are underinsulated for today's high fuel bills. Not to mention tomorrow's!

Check other spots around your house, too. Under floors in unheated garages and crawl spaces. Walls exposed to cold or heat.

Then put your house in the pink—with America's best-selling insulation.

*Savings vary. Find seller's fact sheet on Higher R-values mean greater insulation power.

out why in the R-values.

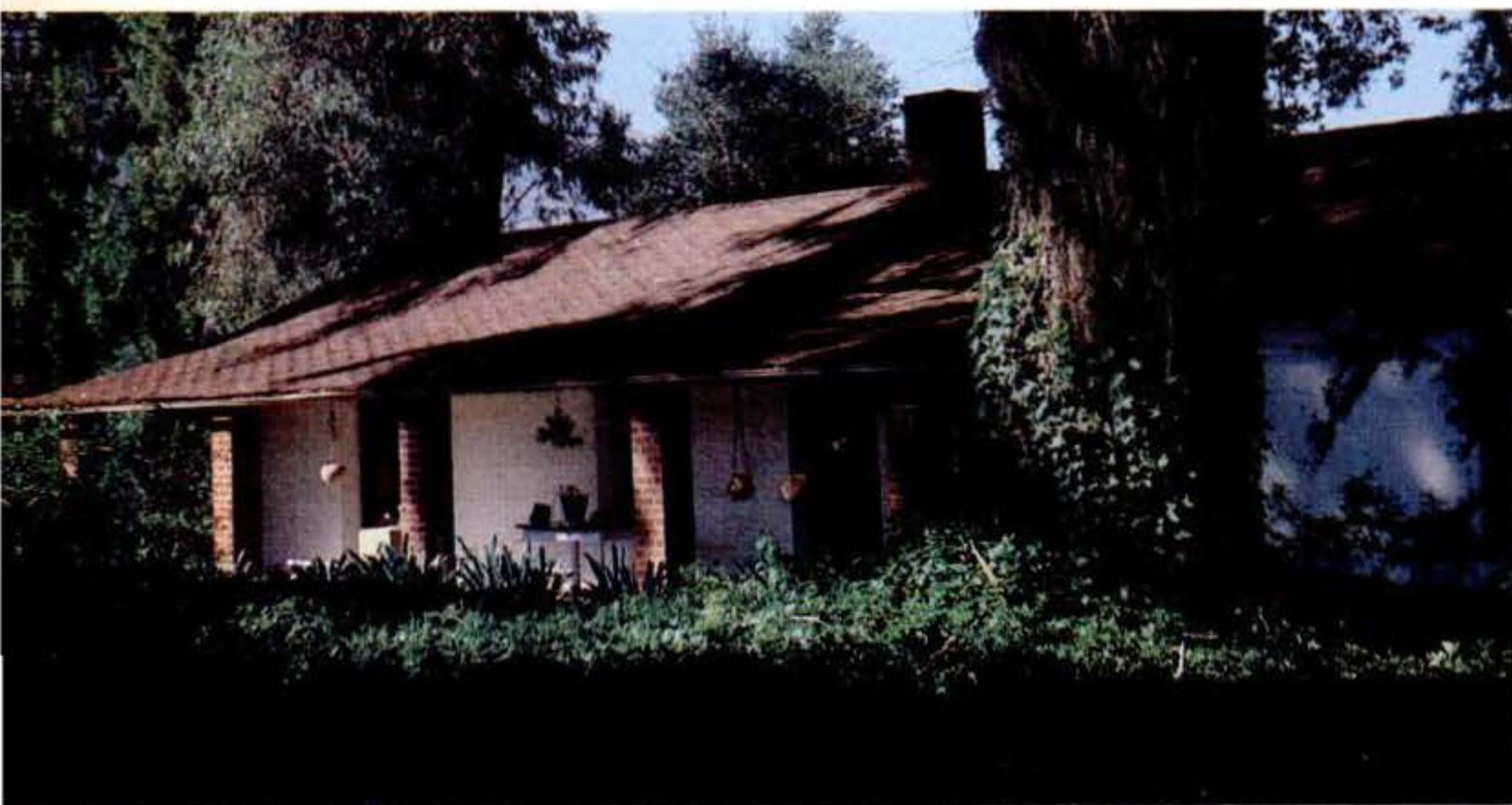
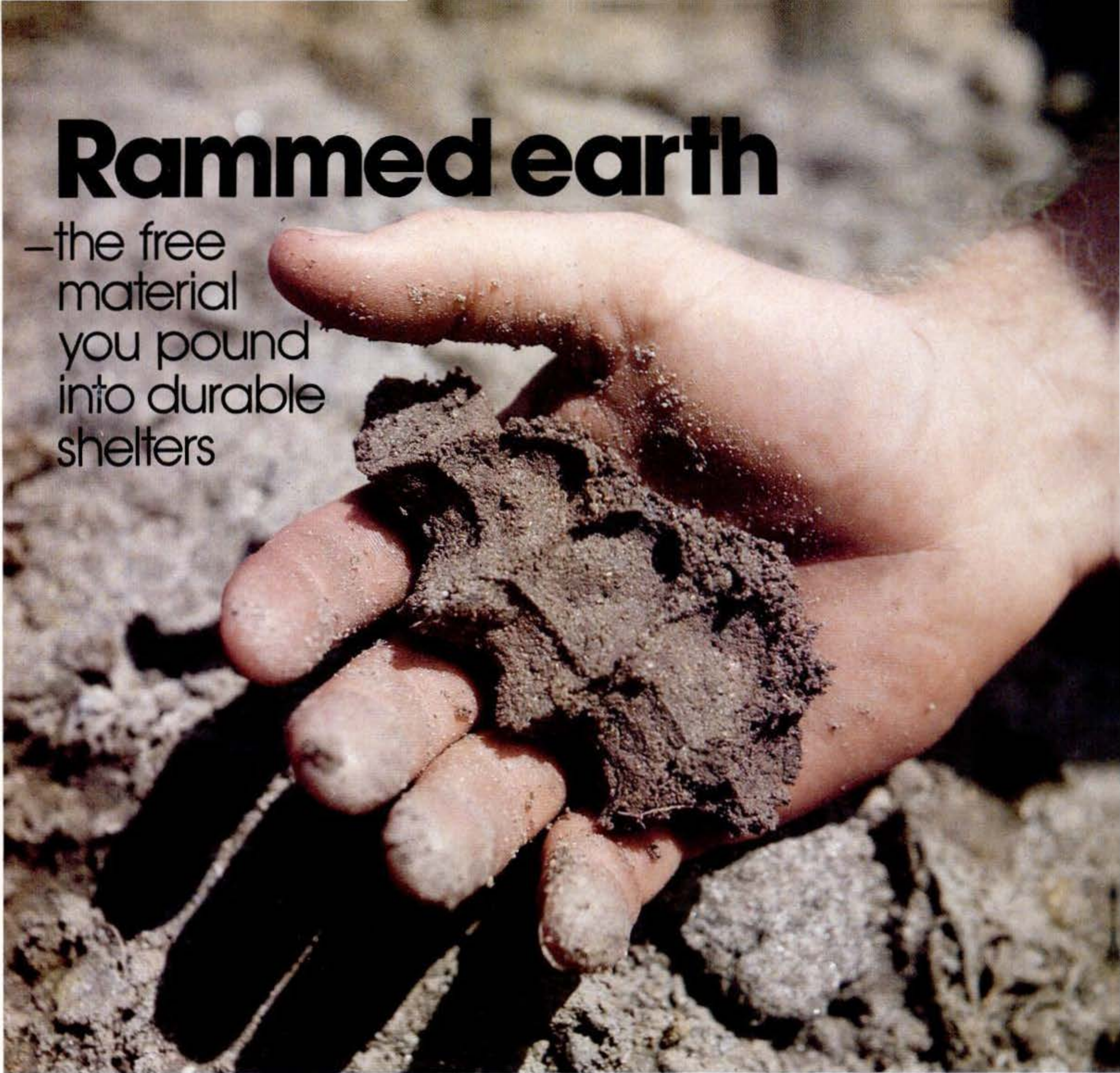


OWENS/CORNING
FIBERGLAS
TRADEMARK

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Rammed earth

—the free material you pound into durable shelters



Rammed-earth house above, built by Millard Beemer in 1940, still has smooth, sturdy walls. Beemer is seen in 40-year-old photo, next page, at building site

standing next to precast concrete form used as door jamb. For recent photo at right, author set up a form for a test wall, here being packed with a hand tamper.



Protected from rain, these earth walls will last a hundred years

By **RICHARD DAY**

PHOTOS BY ELEANOR BEEMER AND THE AUTHOR

After 40 years, Millard Beemer's rammed-earth house still keeps its secret: It looks like many other ranch-style homes in California. But Beemer built it using nothing but soil—dirt—to make his strong, fireproof walls.

To make a rammed-earth structure, soil is usually dug up at the building site, shoveled into a form, and tamped down—rammed—to make the walls. You won't believe it until you try it, but earth becomes magically hard if it is packed tightly in a form. You can kick a rammed-earth wall, pound on it, even back your car into it, yet the wall will remain intact and hard.

While the material in rammed-earth construction is absolutely free, getting it from terra to firma does take a lot of doing. Besides inspecting Beemer's home and investigating other rammed-earth houses, I made my own form and did some tamping. The work was hard but the results were satisfyingly the same: a good structural wall. Rammed earth makes an ideal do-it-yourself building material for large and small projects. But before building a whole house, it's a good idea to attempt something smaller—

a garage, storage shed, or workshop.

Earth construction has been used by almost all civilizations. The Romans may have introduced the ramming technique to France, where rammed earth has been widely used. The French now call it *pisé de terre*, or just *pisé*. In the U.S., a flurry of rammed-earth construction took place in the 1940's. Interest fell off after the war, when building materials became abundant and cheap. But with today's inflated costs, *pisé* may be ready to be born again. Compared with other earth-building methods, such as adobe, cob, or sod, rammed earth uses labor more efficiently and should give longer-lasting results.

Rammed earth boasts many projects more than 40 years old, and some in Europe are in their second century. In the U.S., rammed earth seems best suited to rural and suburban settings. In a city, *pisé* is viewed as substandard and in fact suffers from a "What? Me live in a dirt house?" prejudice.

A rammed-earth wall is about 40 percent cheaper to build than a standard stud wall, including labor. Interior partition walls of rammed earth are perfectly clean after they are smoothed and painted, and they're sound resistant, too.

Rammed earth has other advantages: The heavy walls provide lots of thermal mass for soaking up solar heat in winter, yet they insulate the interior from summer temperatures.

Rammed earth is an excellent material for climates that have large daily temperature variations. A rammed-earth house at Clemson University stays about 15 degrees cooler in summer and 12 degrees warmer in winter than a nearby house of hollow tile.

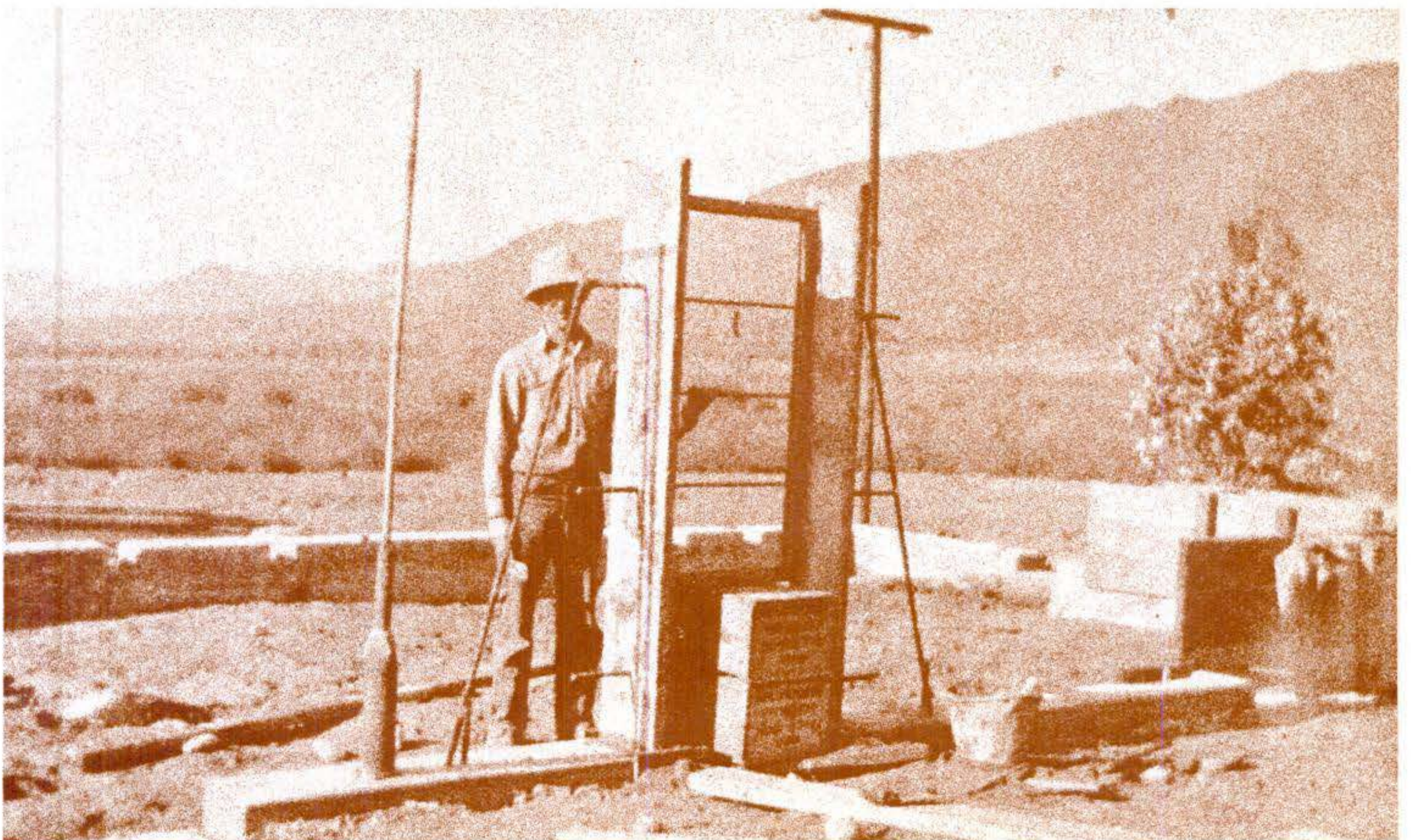
Rammed earth needs minimal protection from water erosion; otherwise, wind-driven rain, sprinklers, or a leaky downspout can carry the wall away grain by grain. For this reason, rammed-earth buildings should be painted and have wide, overhanging eaves. Ants may also tunnel into an earth wall, so must be discouraged by periodic spraying of insecticide.

You may need an exemption from a city or county building code to erect a large rammed-earth structure. But that reflects more sorely on our codes than on rammed earth. Compressive (crushing) strengths of 300 to 350 psi and more are typical of rammed earth. While this is less than one-tenth the strength of good concrete, it's hard enough, theoretically, to support a rammed-earth wall 200 feet tall.

What makes rammed earth so hard? Like the hardening of concrete, it's still not completely understood. It's probably the work of colloids. These are particles of soil as small as 0.0004 inch that cement the larger, tightly packed particles together.

Before you begin to build your own project, you must find out whether your soil is suitable. An ideal soil for

Continued



Here the lowest. There the lowest. Everywhere the lowest. Who's really the lowest?

All these different brands of cigarettes, each claiming to be the lowest in tar.

Just who are you supposed to believe?

Well, we say, why should a tar-conscious smoker have to put up with this kind of confusion?

Why should you have to do research in order to find out if

you can trust the "lowest" tar claims of your cigarette?

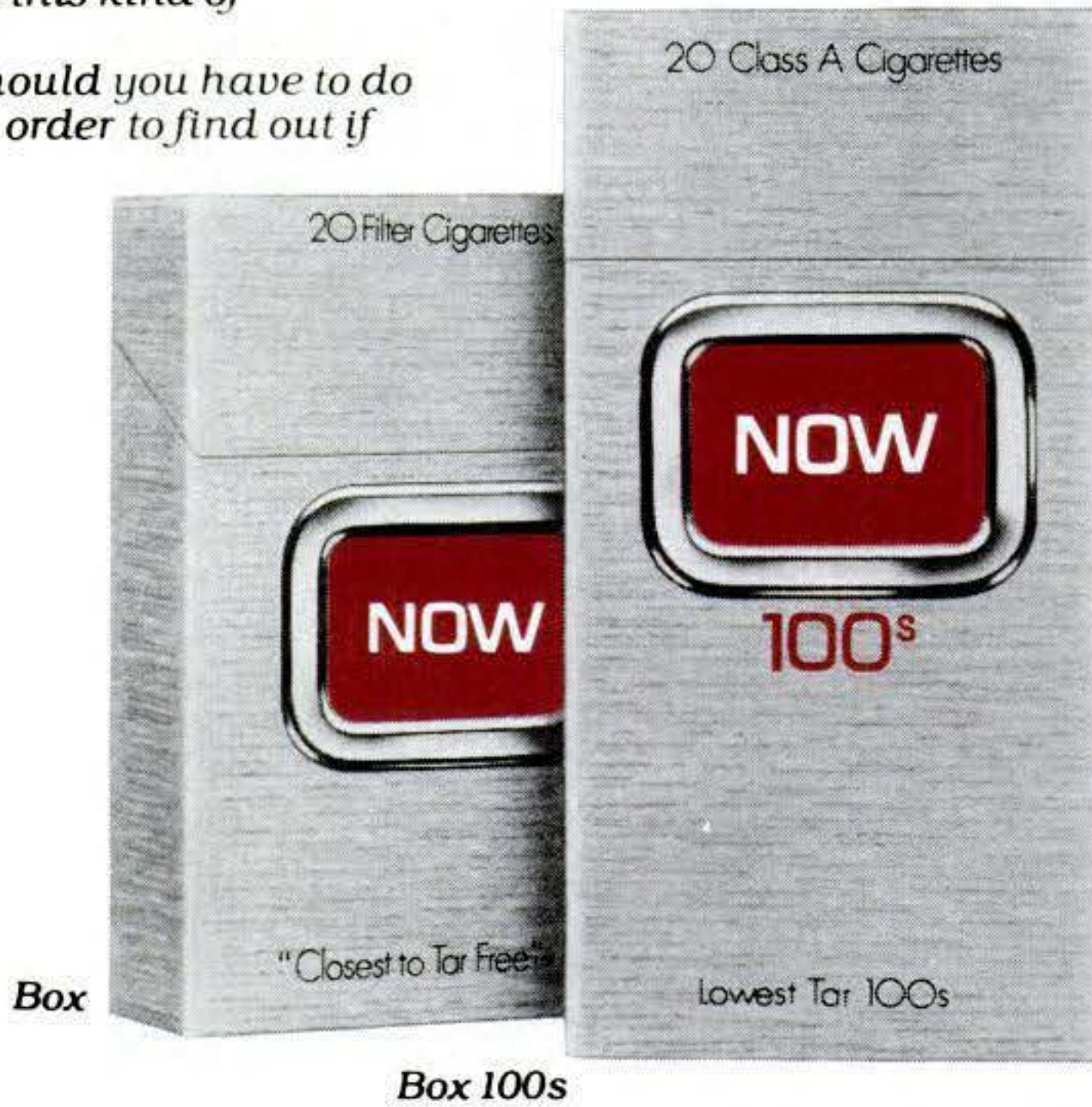
So we've done the research for you. We've assembled the tar level numbers of all the leading cigarettes that say they're the lowest.

And the results are right here in the chart below—which can light up the situation before you light up another cigarette.

See for yourself what's what. (And what isn't.)

Numbers don't lie.

And they prove there's only one Ultra Lowest Tar™ brand—Now.



**NUMBERS DON'T LIE.
NO CIGARETTE, IN ANY SIZE,
IS LOWER IN TAR THAN NOW.**

	80's box	85's soft pack	100's box	100's soft pack
NOW	Less than 0.01mg	1mg	Less than 0.01mg	2mg
CARLTON	Less than 0.01mg	1mg*	1mg	5mg
CAMBRIDGE	Less than 0.1mg	1mg	—	4mg
BARCLAY	1mg	1mg	—	3mg

All tar numbers are av. per cigarette by FTC method, except the one asterisked (*) which is av. per cigarette by FTC Report May '81.

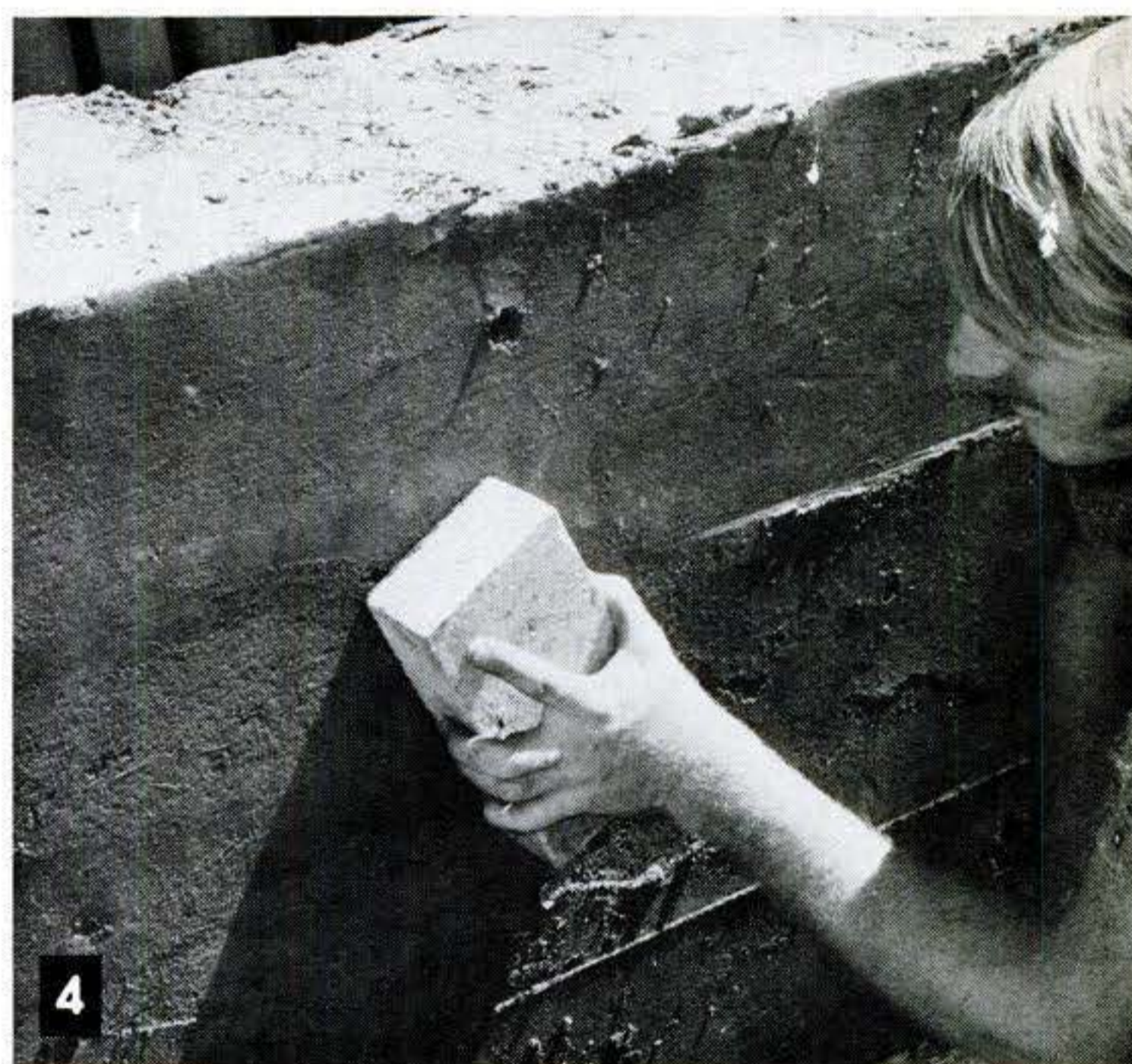
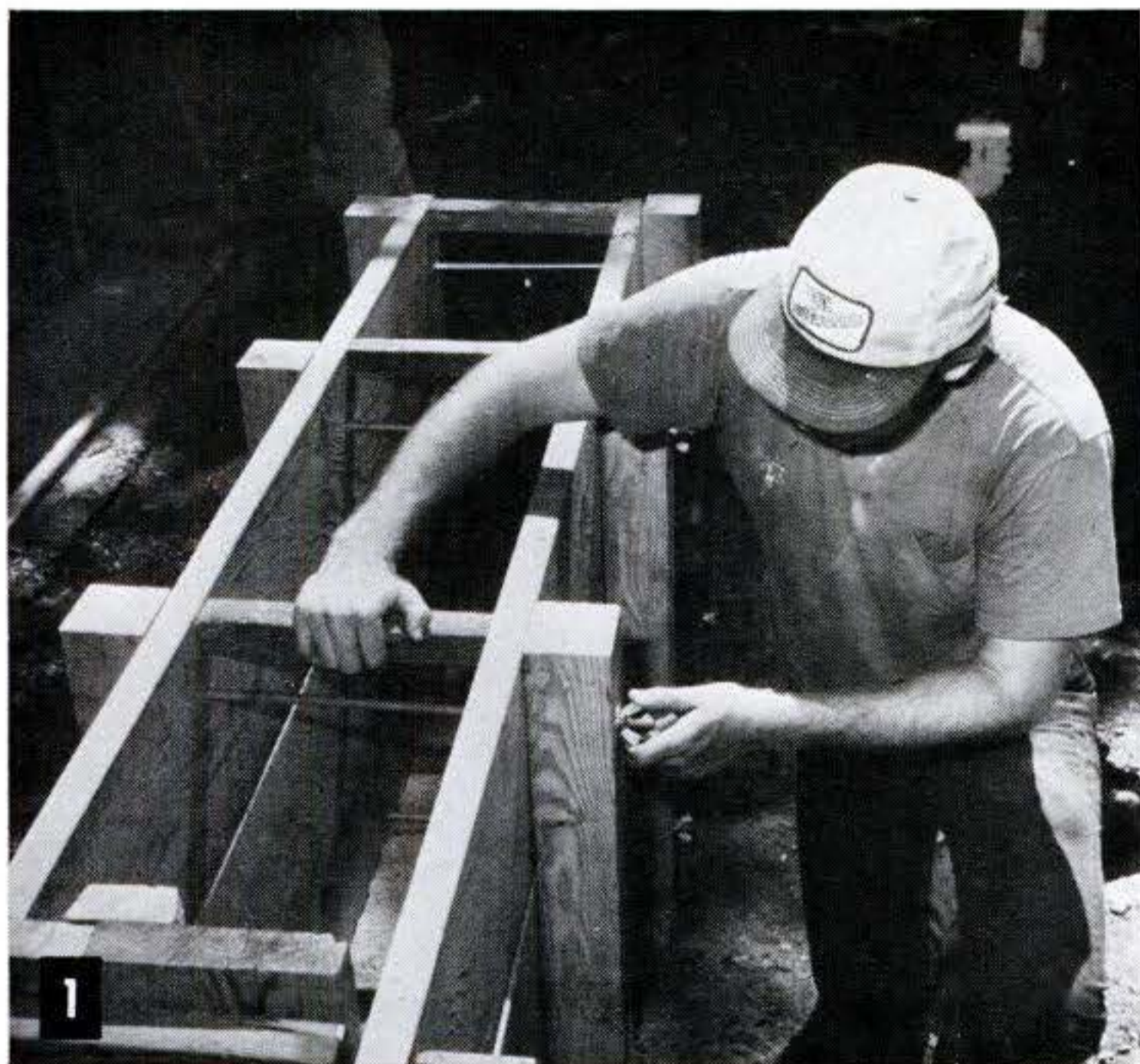
NOW

The Lowest

The lowest in tar of all brands.

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

BOX, BOX 100's: Less than 0.01 mg. "tar", 0.001 mg. nicotine, SOFT PACK 85's FILTER, MENTHOL: 1 mg. "tar", 0.1 mg. nicotine, SOFT PACK 100's FILTER, MENTHOL: 2 mg. "tar", 0.2 mg. nicotine, av. per cigarette by FTC method.



Steps in rammed-earth-wall construction: Form is built atop a concrete foundation (1); loose soil at optimum moisture content

is shoveled into the form (2) and tamped (3). After the form is removed, wall can be smoothed by rubbing it with a brick (4).

rammed earth contains 25 to 40 percent silt and clay, and the remainder sand or small stone.

Look for a soil that makes hard walking paths or deep, hard ruts after a rain. When dry, your dirt shouldn't be friable. Friable soil can't be rolled between your fingers into a rope, and it easily breaks apart in your hand. Other soils to avoid are pure clay without sand and black dirt, and other soils with organic matter. If the soil smells musty when damp, stay away from it. Few topsoils are suitable for *pisé*, but many lower soils are good. A high-clay soil can sometimes be improved by adding sand. But that involves the extra work of mixing.

An engineering or soil laboratory can test a soil for you, but a quick

home test is fine for a small project. Fill a quart measure with your soil and pour it into a large pail or tub. Flush the fine material over the side with water while stirring, as if panning for gold. If from one-fourth to three-fourths of the original sample is left, your soil is a winner. Soil with too little aggregate tends to shrink, producing cracks.

An even surer test is to build a wood form and make a few sample blocks. Let them dry for several weeks, then subject one to a hard spray, as from a shower head turned on full. If the sample shows no surface pitting after two hours of that torture, the soil is well suited for building—even in an area with more than 50 inches of rainfall a year. If it pits more than a half-inch

deep, the wall will need protection from rain. You must reject the soil if cracks form in the sample blocks.

Basic building tools for a rammed-earth project include shovels, a wheelbarrow, planks for a ramp, and the forms (see drawing). You can make your own hand tamper. It should weigh eight pounds or more and have about a 10-square-inch surface. I made one out of one-inch pipe and a piece of three-by-three-inch plate steel. If you have a large project, you won't regret renting a power tamper.

Prepare the stockpile of soil ahead of time near the project and make sure you have enough soil to complete the job. Tamping will reduce the pile's volume by about 40 percent.

[Continued on page 121]

Slate your sills



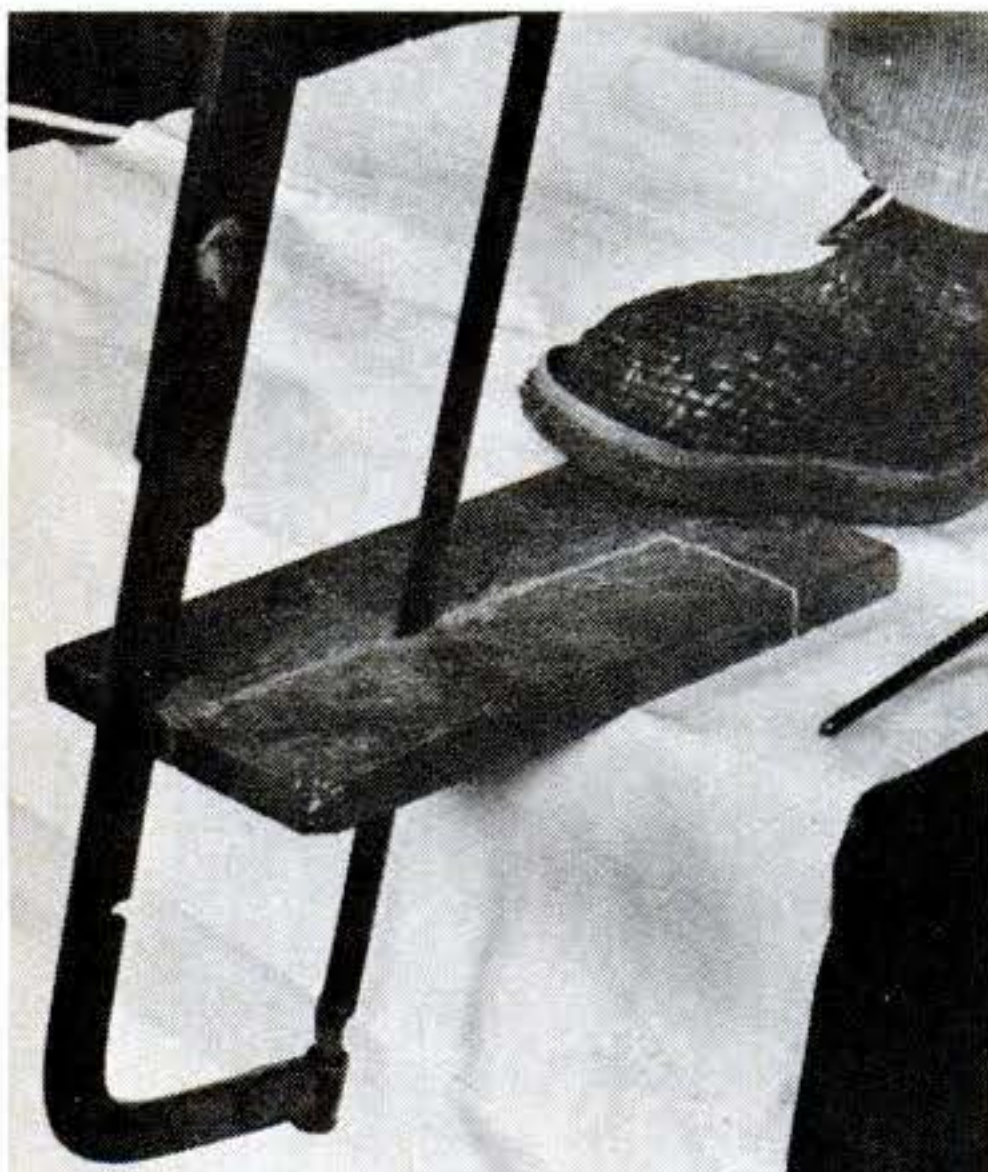
Installation kit (flanking carton of tile, here) consists of: 11-lb. bag of grout, pint cans of two epoxy components, canvas

grout bag with nozzle, and (lying on top of it) mixing bit, steel scribe, and 1/4-in.-notched adhesive spreader.

Elegance and permanence —packaged flooring brings both to your windowsills

By AL LEES

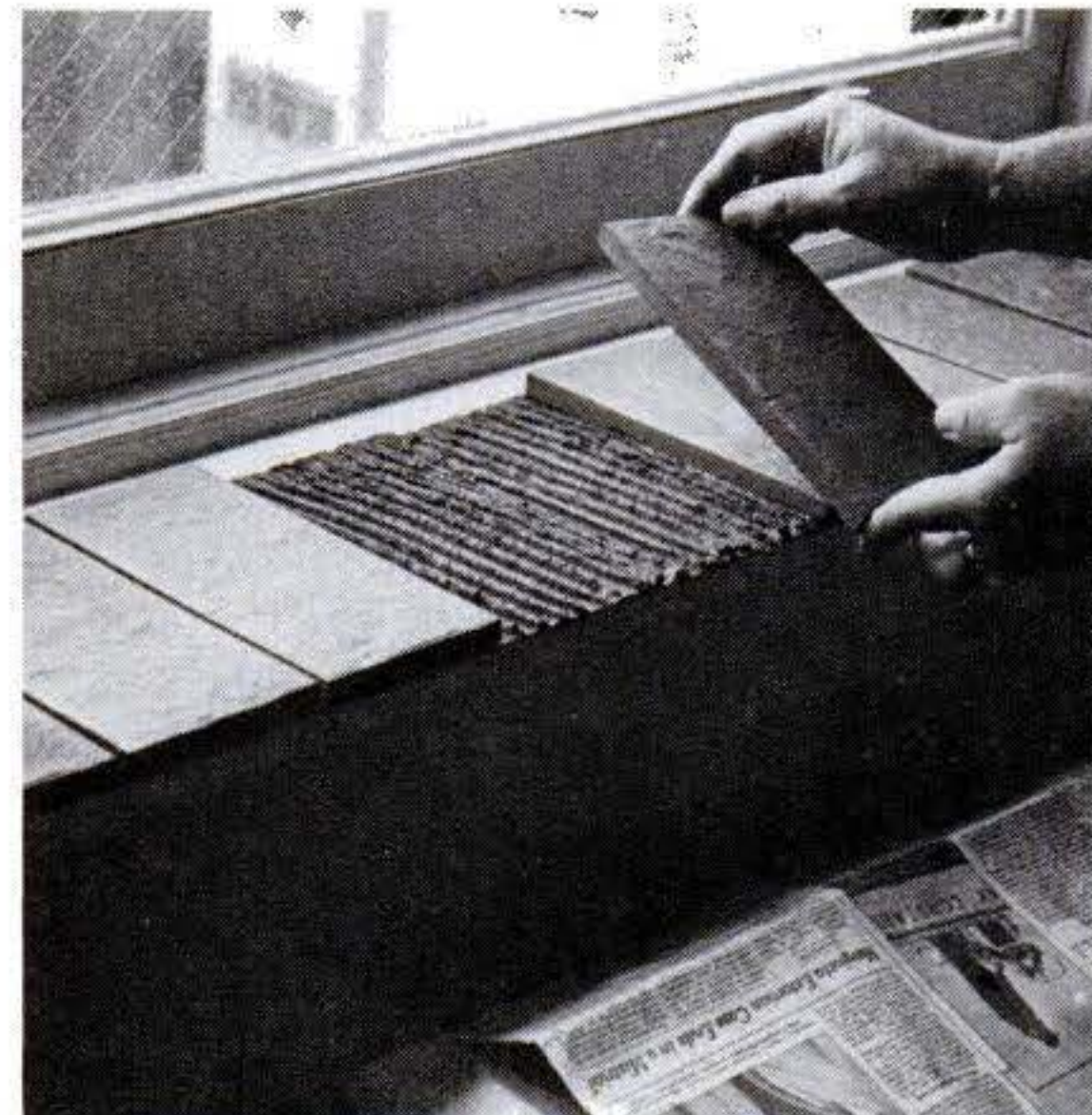
Window seats and sills in fine old homes were often surfaced with slate to make them impervious to inevitable wettings when the sash was raised for air. The discontinued practice makes fresh sense today: Not only is slate an ideal sill for house plants that must be watered regularly (I grew a gardenful of vegetable seedlings on my new slate sills last spring), it can also contribute to room heat by soaking up solar warmth that continues to move up the glass long after the sun has left the window. In addition, slate adds elegance to modern decor.



To trim a tile, you usually score with scribe, then break across a straightedge. But our project called for L-shape, so we cut as deep as possible with hacksaw.



Dry run lets you space tiles for least trimming (we needed L-shape on one end only). Grout-line widths are adjustable. Mark positions before picking up tiles.



After spreading adhesive on the sill and striking it off with a notched spreader, replace tiles as before, pushing each firmly into the ridges of adhesive.



But where do you find small pieces of it today? Back in our November '79 issue we announced a new product for do-it-yourselfers: an all-mineral, non-ceramic, cement-based paving tile that had just been developed by Z-Brick, a major maker of ersatz masonry wall coverings. We even showed a step-by-step installation of one of the paving styles—rectangular “slate”—in a herringbone pattern.

Months later, when the painted wooden sills of my loft's industrial windows became stained and flaked by water leakage, I remembered Z-Brick's slate and decided to try a windowsill application. It worked out so well, I've now done all my windows and can recommend the tile for any sill deep enough to take them. (For shallower sills than the one shown, tiles could be turned lengthwise, but the effect will be less attractive. Each

tile could, of course, be trimmed shorter, but it complicates the job; more on that later.)

The installation can't be described as easy—especially if you want matching black grout lines, as I did. (Grout also comes in natural and brown colors; it's used twice: to thicken the adhesive and fill the joint lines.)

Clear instructions are printed on both Z-Brick's tile cartons and grout bags. All basic steps for a floor application apply to windowsills except that surface preparation will probably be minimal. In my case, I had to scrape off all flaking and blistered paint to present a sound surface for attachment. The adhesive is a two-part epoxy: You mix the curing agent into the resin (a two-gallon plastic bucket is best), then sift in dry grout.

Included in the kit is a triangular mixing rod for chucking into an electric drill—but don't try to use it with a drill that lacks a variable-speed trigger: You'll want to start out slow. The stuff's thick enough to wrench the drill out of your hands if you hit the mix with a sudden burst of speed.

You want it fluid, so if you pour in too much dry grout, add a little water. The mix should be a thick paste that will spread easily with a trowel but leave firm ridges from the notched spreader.

As for the manufactured flooring itself, I'd like to be able to report that it's easier to work with than the natural slate or quarry tile it's meant to replace. But where trimming to fit is concerned, these tiles are at least as unyielding. I wanted to notch the end tiles to an L-shape that would follow the lip of the sill beyond the window recess (see photos). Z-Brick's instructions blithely say to use the scribe (supplied in the installation kit,

as shown) to etch a groove in the tile surface, then break over a straight-edge.

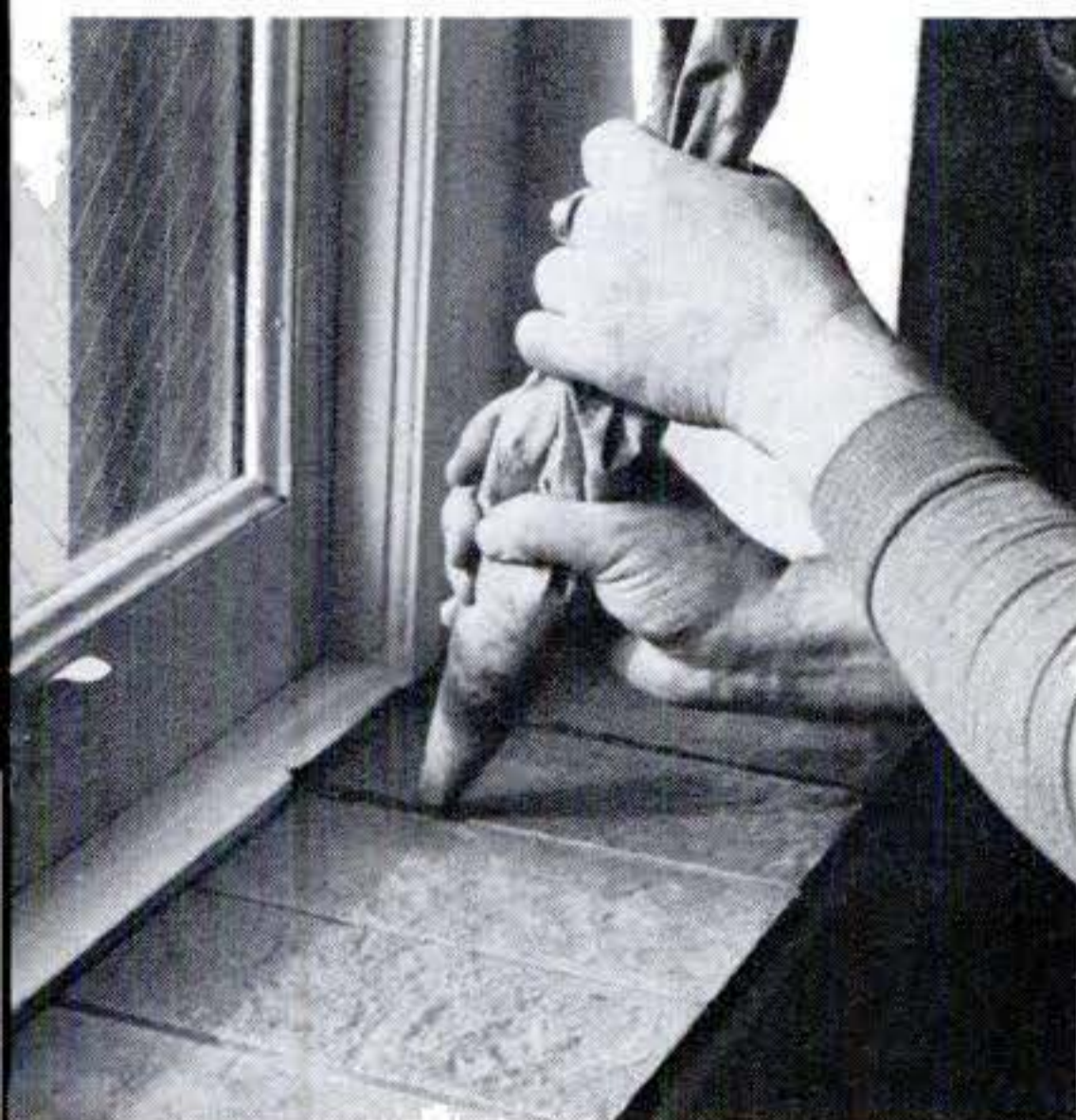
For a notch, then, it seemed reasonable to hacksaw in the full depth of the short cut, then scribe and break the long side of the notch to meet this cut. No way: The first tile I tried this on shattered in four pieces when pressure was applied. So, with the next tile, I again cut the short side, then sawed as far along the long side as the hacksaw frame would permit (bottom photo, far left), scoring the balance of that side as deeply as possible with the scribe. (If you have a metal-cutting band saw, of course, the complete notch could be cut in two passes.) Even with a sharp blade—and it doesn't stay that way long—this dense material is tedious to cut by hand, so I had some sweat-equity invested in that tile by the time I carefully supported the section to be saved (by aligning it atop a matching L-shaped straightedge) so I could tap along the few inches of the uncut scribe line. Again, the tile shattered.

How many for your job?

Count on some wastage. The tiles are roughly ½ inch thick and measure 3¾ by 7¾ inches. They're packed 18 per box. Once they're firmly embedded in the epoxy, they're about as durable a surfacing as you can get. But until then, they're so brittle that breakage in shipping can be a problem. Several of the tiles in the cartons I received were broken across the center. I'd suggest you open all cartons in the store and check the upper edges for telltale cracks.

Z-Brick's recommended technique for grouting involves a tapered cloth bag with a conical metal nozzle inside the tip (much like a pastry-cook's frosting applicator). It's an ideal process for little jobs like window sills. You can mix small batches to load into the bag (I kept mine to about 2½ lbs. of dry mix and a cup of water; larger batches tended to set up before the grout could be squeezed into the joint gaps, clogging the nozzle). Surprisingly, however, this system is intended for floor grouting—and it strikes me as tedious in the extreme for anything but a tiny foyer or powder room. For bigger areas, I'd stick with the old system of dumping a batch of mortar on the tiles and troweling it flat to force it into joint gaps.

You can find a full line of Z-Brick products at most home centers. If yours doesn't carry the flooring line, write Z-Brick at Woodinville, Wash. 98072. Or you might settle for one of the masonrylike wall coverings your store carries. After all, brick sills are attractive, too. P 5



Joint gaps are filled with freshly mixed grout dumped into conical bag and squeezed through nozzle. Keep moist sponge handy to wipe excess grout.



Radars Clairvoyance

New extras make this unusual device irresistible.

Radars clairvoyance is our term for the ability to receive signals beyond the range of ordinary radar detectors; beyond mere line-of-sight. What may initially seem like magic is actually solid engineering. The result is truly unique—the ESCORT® radar warning receiver.

Magical range

Anyone who has used a conventional radar detector knows that they don't work over hills, around corners, or from behind. ESCORT does. Its uncanny sensitivity enables it to pick up radar traps 3 to 5 times farther than common detectors. It detects the thinly scattered residue of a radar beam like the glow of headlights on a dark, foggy road. You don't need to be in the direct beam. Conventional detectors do. Plus, ESCORT's extraordinary range doesn't come at the expense of more false alarms. In fact, ESCORT has fewer types and sources of false alarms than do the lower technology units. Here's how we do it.

The technical elements

ESCORT's secret weapon is its superheterodyne receiving circuitry. The technique was invented by Signal Corps Capt. Edwin H. Armstrong in the military's quest for more sensitive receiving equipment. ESCORT's Varactor-Tuned Gunn Oscillator singles out X and K band (10.525 and 24.150GHz) radar frequencies for close, careful, and timely examination. Only ESCORT uses this costly, exacting component.

Critical information

ESCORT also gives you an important insight that others don't. Smooth, accurate signal strength information. A soothing, variable rate beep reacts to radar like a Geiger counter while an illuminated meter registers fine gradations. In order to match the depth of ESCORT's range, their smooth and precise actions can express a faint glimmer as well as an intense radar beam. At the instant of contact you'll know if the radar is miles away or right next to you. You'll also hear a different sound depending on the radar band being received. K band doesn't travel as far, so its sound is more urgent. Only ESCORT lets you know.

The right stuff

ESCORT looks and feels right. Its inconspicuous size (1.5H x 5.25W x 5D), cigar lighter power connector and hook and loop or visor clip mounting make installation easy, flexible, and attractive. The aural alarm is volume adjustable and the alert lamp is photoelectrically dimmed after dark to preserve your night vision. And, a unique city/highway switch adjusts X-band sensitivity for fewer

distractions from radar burglar alarms that share the police frequency.

Made in Cincinnati

Another nice thing about owning an ESCORT is that you deal directly with the factory. You get the advantage of speaking with the most knowledgeable experts available and saving us both money at the same time. Further, in the unlikely event that your ESCORT ever needs repair, our service professionals are at your personal disposal. Everything you need is only a phone call or parcel delivery away.



FREE!
New
carrying case
and
visor clip

Corroborating evidence

CAR and DRIVER . . . "Ranked according to performance, the ESCORT is first choice . . . it looks like precision equipment, has a convenient visor mount, and has the most informative warning system of any unit on the market . . . the ESCORT boasts the most careful and clever planning, the most pleasing packaging, and the most solid construction of the lot."

BMWCCA ROUNDEL . . . "The volume control has a 'silky' feel to it; in fact the entire unit does. If you want the best, this is it. There is nothing else like it."

PLAYBOY . . . "ESCORT radar detectors . . . (are) generally acknowledged to be the finest, most sensitive, most uncompromising effort at high technology in the field."

PENTHOUSE . . . "ESCORT's performance stood out like an F-15 in a covey of Sabrejets."

AUTOWEEK . . . "The ESCORT detector by Cincinnati

Microwave . . . is still the most sensitive, versatile detector of the lot."

Try our A/B test

We're so sure that you'll find ESCORT tops in performance and value that we'll give you 30 days to test it for yourself. If you're not absolutely satisfied, we'll refund your purchase as well as pay for your postage costs to return it. We suggest that you try an ESCORT and any other detector of your choice. Test them both for 30 days and return the one you don't like. We're not worried because we know which one you'll keep. As further insurance for your investment, ESCORT comes with a full one year limited warranty on both parts and labor. This doesn't worry us either because ESCORT has a reputation for reliability. We know that once you try an ESCORT, radar will never be the same again. So go ahead and do it. Order today.

How to get one

Just send the following to the address below:

- Your name and complete street address.
- How many ESCORTs you want.
- Any special shipping instructions.
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Rammed earth

[Continued from page 117]

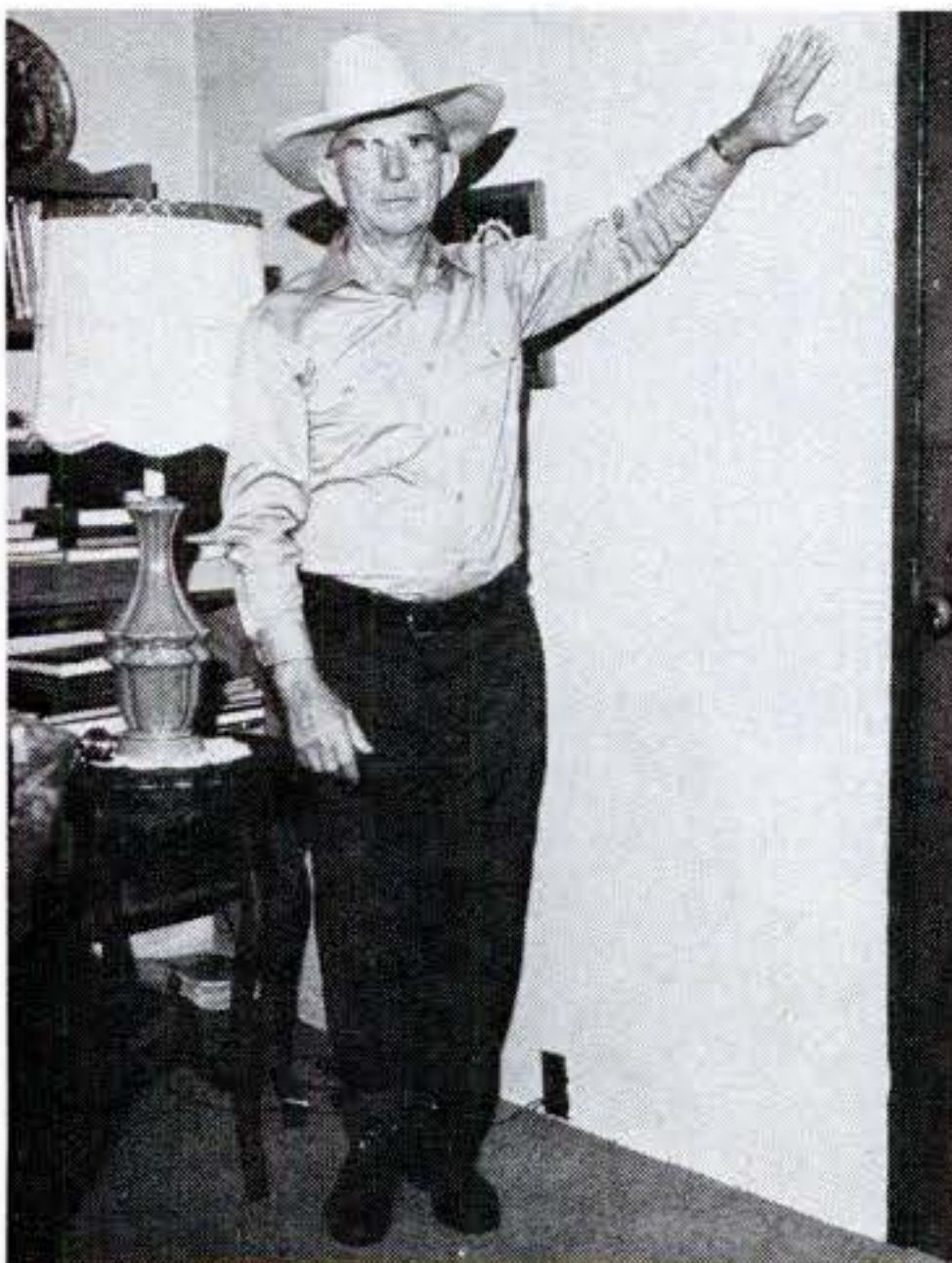
Always build a rammed-earth wall on a concrete footing as wide as the wall, which should be at least 12 inches thick for most jobs. Extending above grade at least a foot, the footing prevents erosion from ground moisture and splashed rain.

Level and plumb the form on the footing, then toss about four inches of loose soil into the form. Tamp it solid. At first the tamper will make a dull thud. When it produces a clear ring, you know you've tamped enough. The ideal loose-fill depth is one dimension of the tamper's edge plus one inch.

Spread the next layer of loose soil and tamp it, repeating the process until you have filled the form. Pull out the tie bolts and move the form to the next location, working around the perimeter. When moving forms to the top of an earth section, scratch the top of the already-tamped surface and dampen it if it's dry. This prevents compaction planes from forming. Some people use small steel rebars or mesh in *pisé*, but note that only vertical bars can help—horizontal members vibrate loose under tamping.

The form's bolt holes are filled with moist soil with 10 percent portland cement mixed in, so-called cement-stabilized soil ["Soil Cement," PS, Sept. '73]. All door and window openings are carried to the top of the wall using treated wood or precast concrete forms for the jambs and lintels. Avoid running wires and pipes through earth walls—condensation forming on cold pipes will weaken the wall. Use any conventional roofing system.

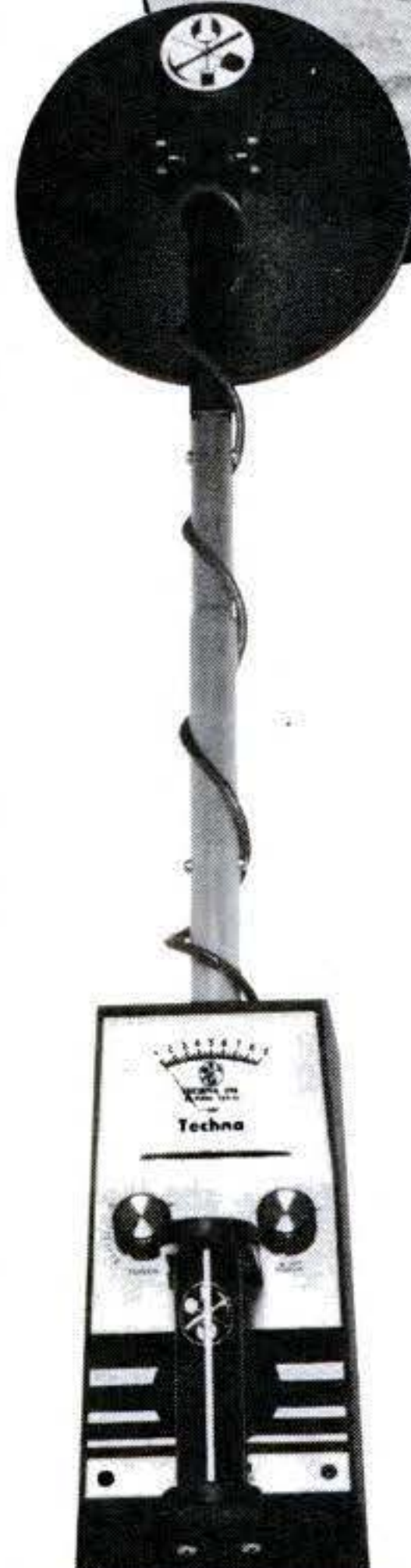
Continued



Beemer stands beside still-smooth rammed-earth wall in this recent photo.



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Rammed earth

[Continued]

Removing forms is easier if the wood is coated with crankcase oil or soap. The wall surface will have the same texture as the form lumber, so a high-density plywood form liner will produce a smoother wall. As you can imagine, extra help during construction is a boon. A crew of three seems to be about right: two rammers and one earth mover. A three-man crew can hand-tamp about 70 square feet of 14-in.-thick wall in a day. Power equipment triples the rate of production.

The more you pack the dirt, the stronger the wall. A condition that soil engineers call optimum moisture content in the soil permits greatest compaction. Each soil has its own optimum moisture content, usually between seven and 14 percent. At optimum moisture, a good-packing soil will look dry.

The person doing the tamping will have little doubt about the proper wetness. But as a test, squeeze some soil in your hand. It should look fairly dry yet hold together, as in the lead photo. Dropped from waist height it should break apart. A wet soil is rubbery, and the tamper sticks to it; dry soil is difficult to compact, and its surface will flake. The usual temptation is to add more water than necessary. Avoid it. Also, cover your pile of soil during a rain to keep it dry. You must also cover the wall from rain while work progresses. In cold climates the wall should have time to dry before freezing occurs.

There is a great variety of opinion about how best to treat the finished

wall surface, ranging from coats of linseed oil mixed with diesel to stucco and other cement mixtures. While the 1940's methods are still good today, you should get excellent results simply by rolling on a primer and one or more coats of latex paint.

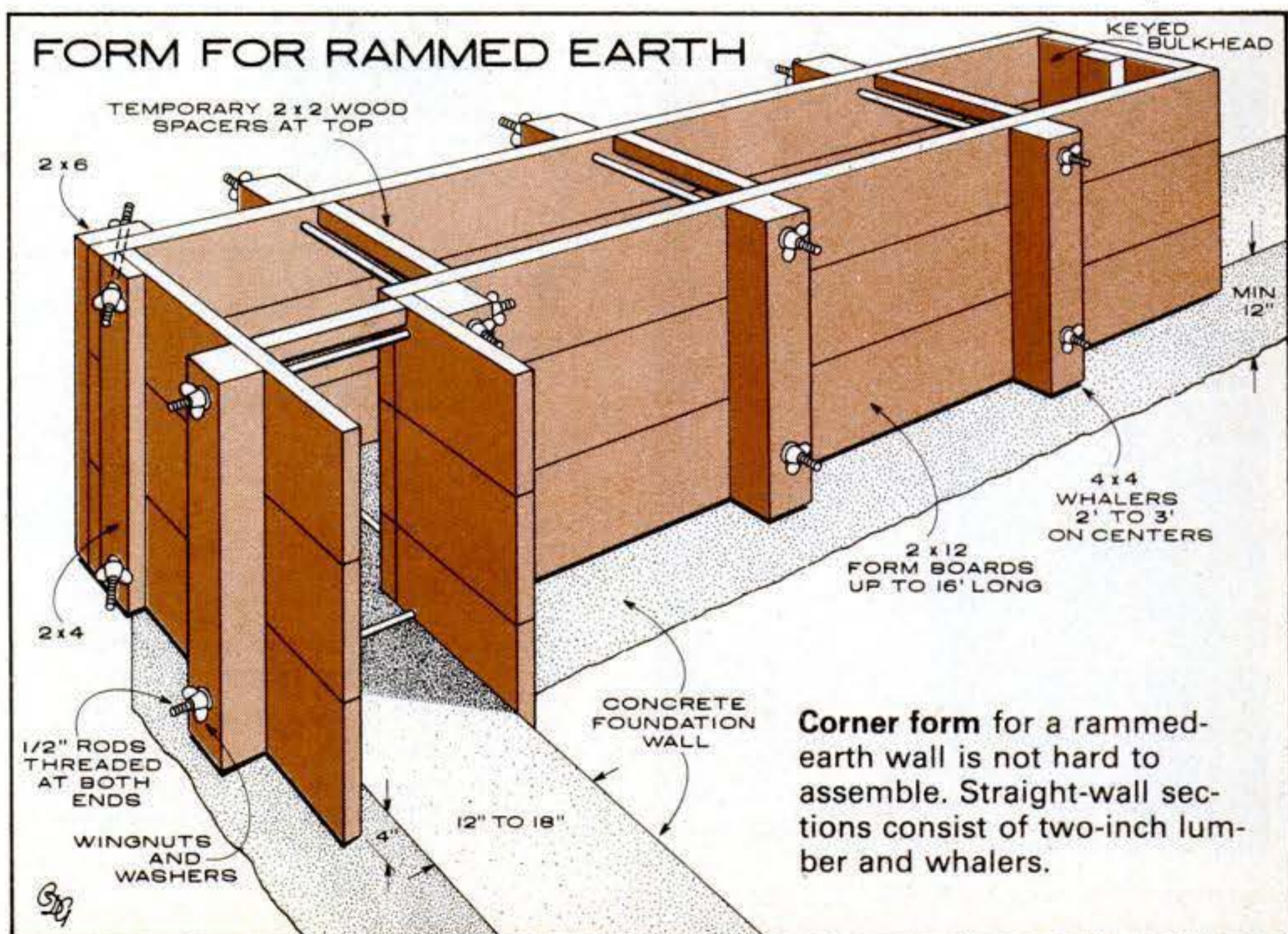
Rammed earth has excellent thermal mass, but its insulating properties are not sufficient for most areas, considering today's home-energy costs. Several alternatives are possible: Insulation board can be put in the middle of the rammed-earth wall or nailed to the outside wall (yes, you can nail into rammed earth). Or you can build a double wall and fill between with loose insulation.

I've presented enough technique so you can proceed with a small project. If you'd like to build a house or other big project, order the information kit listed below or consult the listed sources. P 5

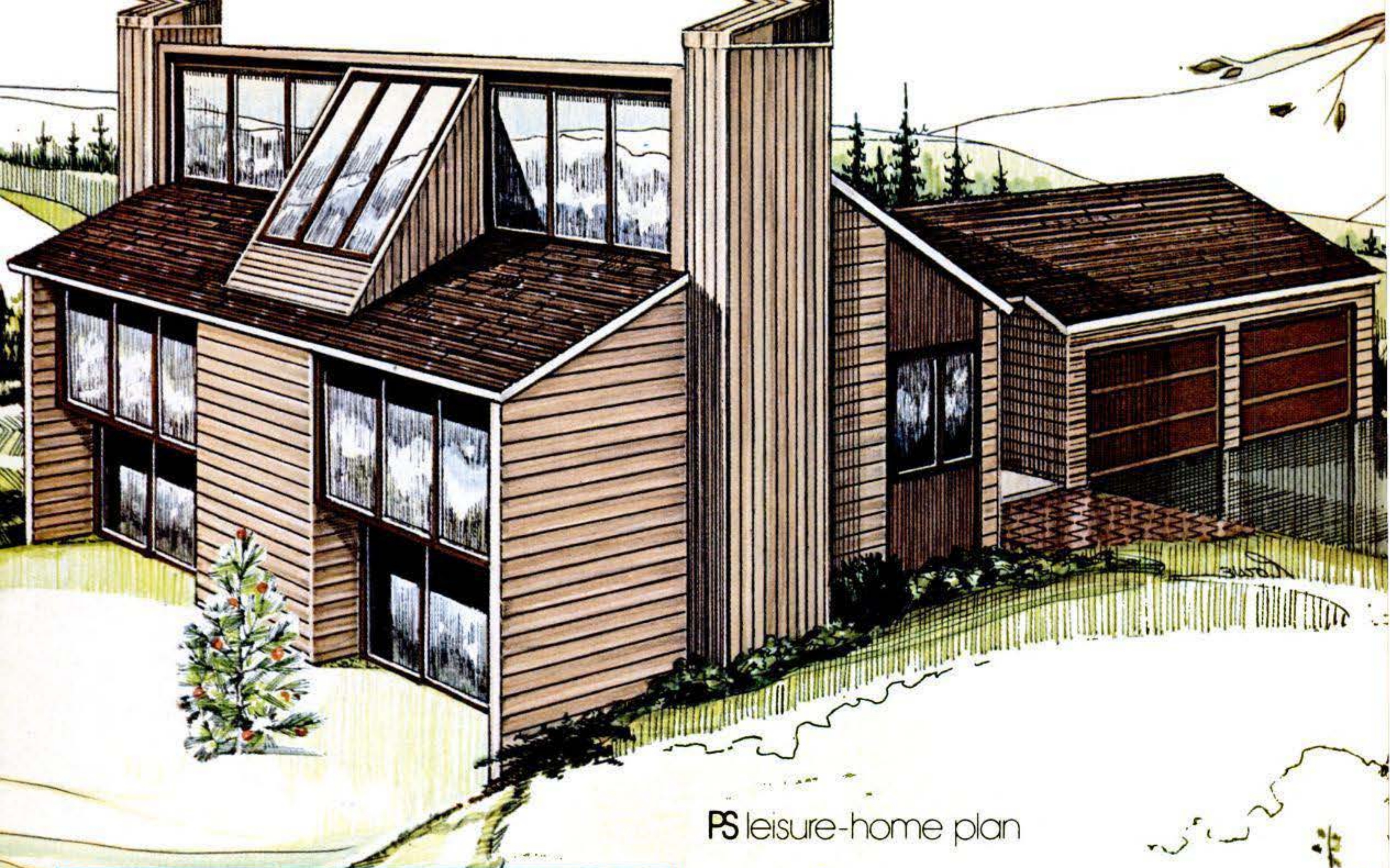
FOR MORE INFORMATION

****Adobe Construction*, J. D. Long, Calif. Agric. Exp. Sta. Bull. No. 472, 1946; *Earth for Homes*, U.S. Housing and Home Finance Agency, 1956; *Earthen Home Construction*, Lyle A. Wolfskill, et al., Tex. Transp. Inst. Bull. No. 18, 1962; *Handbook for Building Homes of Earth*, Lyle A. Wolfskill, et al., U.S. Dept. of HUD, Div. of Internal Affairs (AID book); *Manual on Stabilized Soil Construction for Housing*, Robert Fitzmaurice, U.N. Sales No. 58.II.H.4, 1958; *Rammed Earth Building Construction*, H. E. Glenn, Clemson College Eng. Exp. Sta. Bull. No. 3, May 1943, revised and reprinted May 1951; *The Rammed Earth House*, Anthony F. Merrill, Harper & Brothers, 1947; *Rammed Earth Walls for Buildings*, M. C. Betts and T. A. H. Miller, USDA Farmers' Bull. No. 1500, 1926, rev. 1937; *Rammed Earth Walls for Farm Buildings*, Ralph L. Patty and L. W. Minium, South Dakota Agric. Exp. Sta. Bull. No. 277, 1933, rev. 1938 and 1945. This material may be available at your local public library.

*For \$35, the author will furnish photocopies of marked sources, which he considers the best. Send your check to Richard Day, Box 614, Palomar Mountain CA 92060.



Corner form for a rammed-earth wall is not hard to assemble. Straight-wall sections consist of two-inch lumber and whalers.



PS leisure-home plan

Passive/active solar

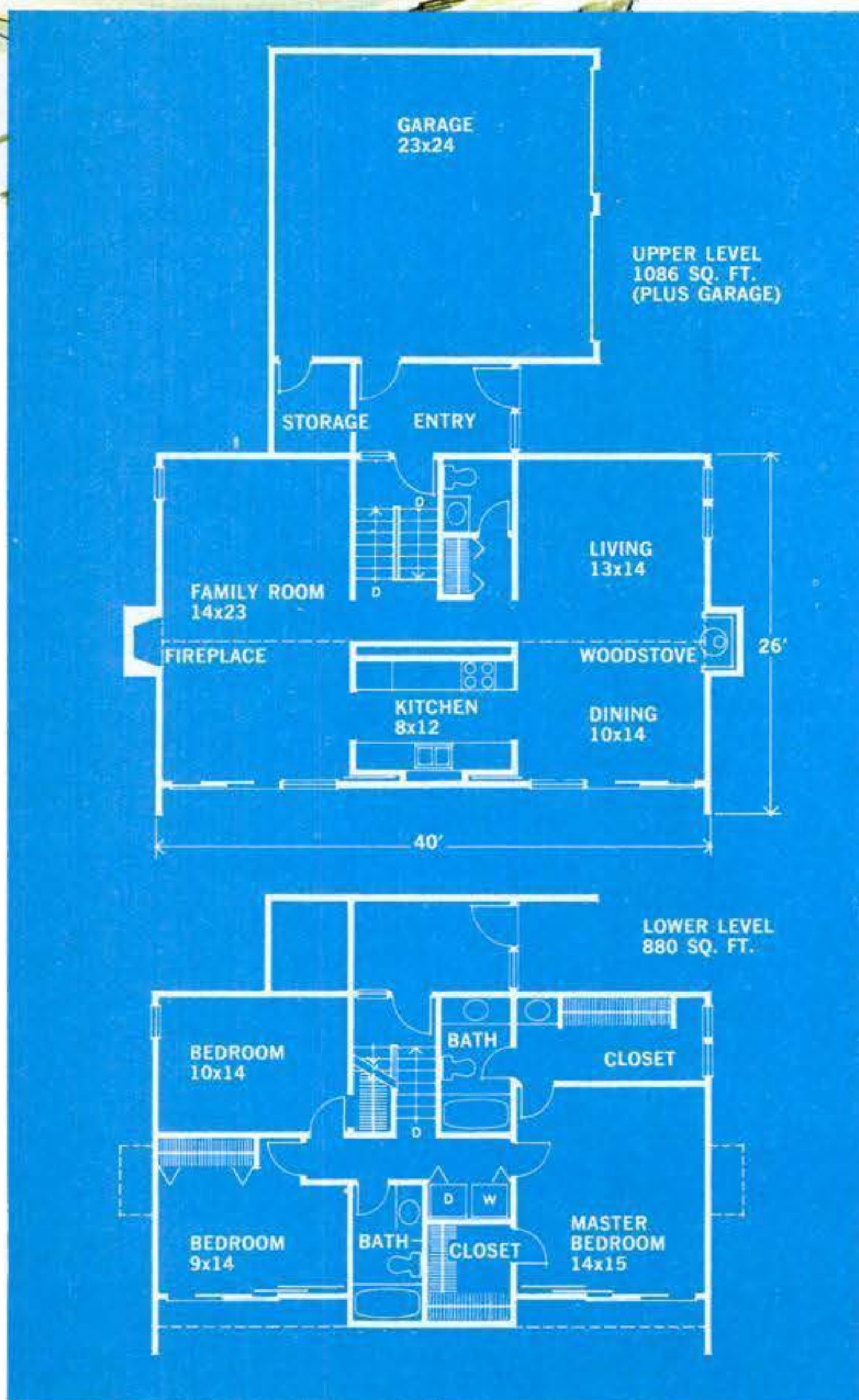
By AL LEES

The south face of this house says it all: It's designed to soak up all the solar heat it's exposed to. Ideal as a mountain retreat or ski lodge, this V-PAC design is versatile enough to adapt to other vacation settings. That central collector—intended to supply most of the home's hot water—is optional. If you prefer an all-passive solar home, just extend those clerestory windows the full distance, from chimney to chimney (the siding-sheathed chase on the left contains the flue for a heat-circulating fireplace; the one on the right for a wood stove).

Those big clerestory windows let the sun heat up masonry-veneer walls in the upper-story activity rooms. After sunset, these walls continue to radiate heat, keeping this level cozy until it's time to descend to the ground-floor bedrooms. The two-story glass wall offers further solar gain—especially if you pave the floor inside those windows with brick or slate. Insulated sliding shutters stack to the sides of these windows and cover all glass areas at night (note pockets provided for these on upper-level floor plan).

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Construction plans for the Passive/Active Solar (VPS #55) are \$55 a set, \$75 for three sets, \$20 for each extra set. Add a postage charge of \$2.50 in the continental U.S., \$3.50 elsewhere. V-PAC Collection (plans catalog) is \$5. Send check to Vacation Plans Service, Box 622, Princeton, N.J. 08540 (U.S. funds only). To charge orders on MasterCard or Visa call (609) 924-9655. V-PAC Council is a group of building-material manufacturers promoting quality leisure-home design.





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Electronic photography

[Continued from page 89]

cuit and storage on the Mavipak disc. Mavica has a nonstandard red-green-blue (RGB) signal-encoding system that enhances resolution. The camera records twice as much color information (one MHz) and, overall, 50 percent more picture information than most home VCR's. But few receivers in homes or on the market can display superior-resolution TV.

While Sony didn't demonstrate the feature, it says a Mavica could also double as a motion-picture camera for VCR's.

Sony's competition

Sony apparently thinks its hard-copy printer will be superior to a model being planned by Biofuel, Inc. (Costa Mesa, Calif.), and Ramtek Corp. (Santa Clara, Calif.). Biofuel's printer would be a spinoff of an industrial model (see color photo).

According to Biofuel, it could make TV-quality pictures up to eight by 10 inches on plain paper. The Biofuel printer would use a 100-print cassette for four-color printing. Biofuel says it uses "unique energy modulation of pins that are raster scanned [like TV images] over paper" to make prints.

Polaroid, in a patent application for an all-electronic camera, is more precise about a printing mechanism to be built into its camera. A printing head has three tiny needles that pierce a so-called transfer sheet atop high-quality plain paper. The transfer sheet has a series of cyan, magenta, and yellow pigment stripes. Colored-dot size on the print paper depends on the amplitude of the signals energizing the needles.

Printing paper and a transfer pigment sheet would be inside a slip-in magazine for the camera. Prints would be made on a cylindrical drum and the transfer sheet advanced to unused stripes for each new print.

Polaroid's design also calls for one or more CCD imaging chips, plus separate RGB signal processing. A tiny built-in tape recorder, using tape perhaps only 1/8 inch wide, would store separate red, green, and blue picture signals. And most remarkably, Polaroid's camera would have a built-in flat-screen TV [PS, June] for previewing pictures stored in its memory.

Industry observers expect film to remain the dominant photographic medium throughout the 1980's. But as electronic techniques for storing and displaying high-resolution video images are improved, film will see stiff competition.

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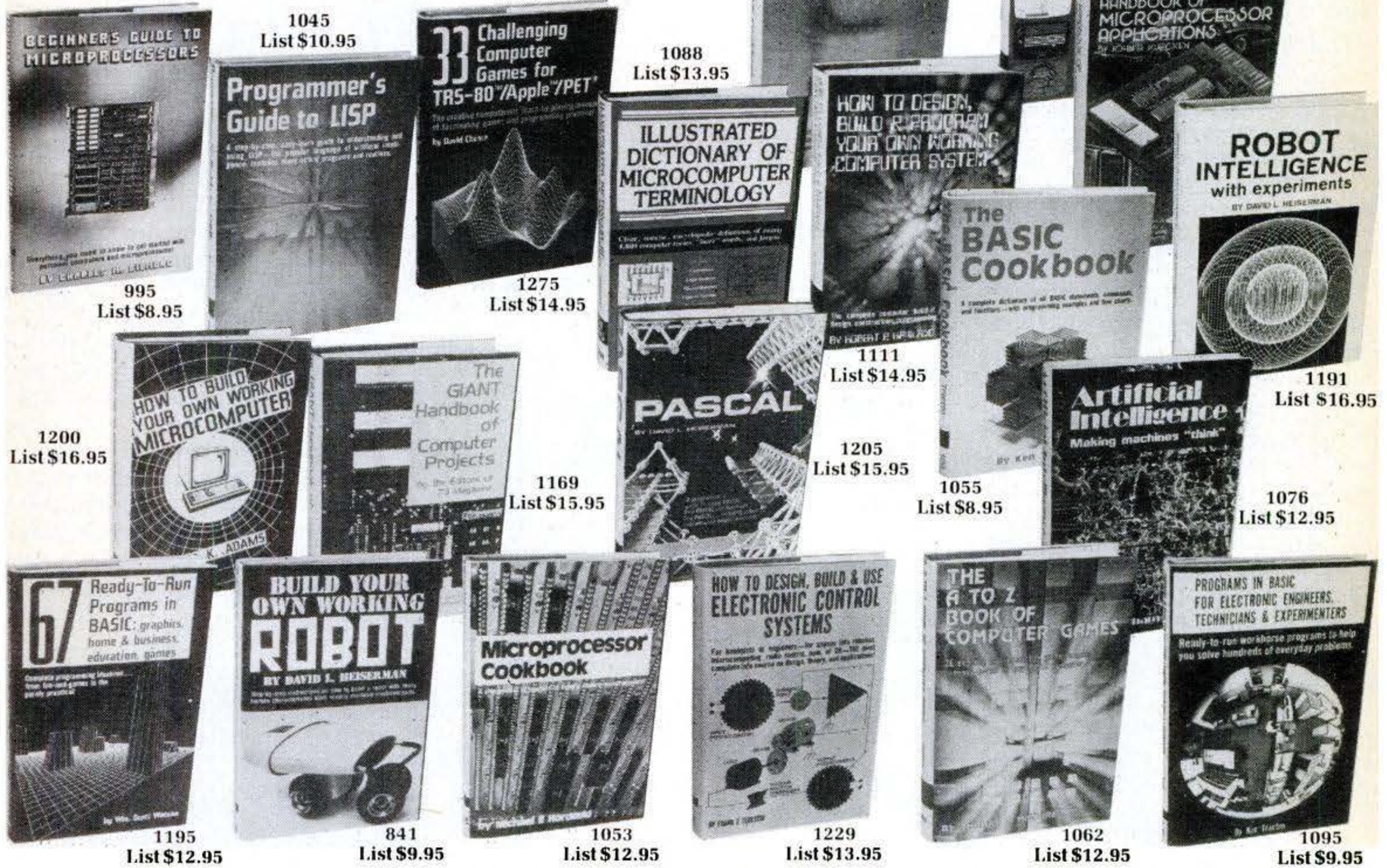
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Through the viewfinder

[Continued from page 46]



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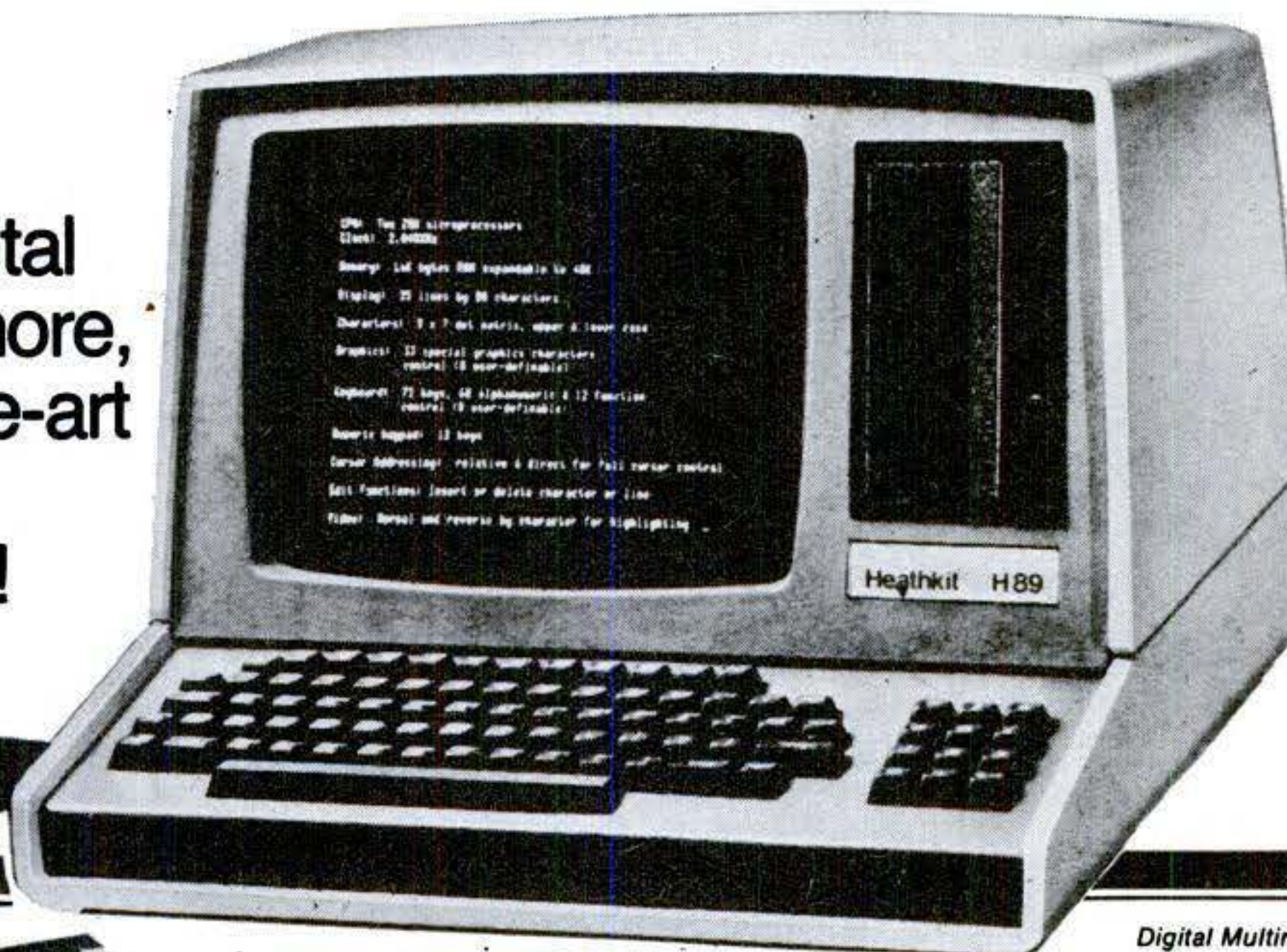
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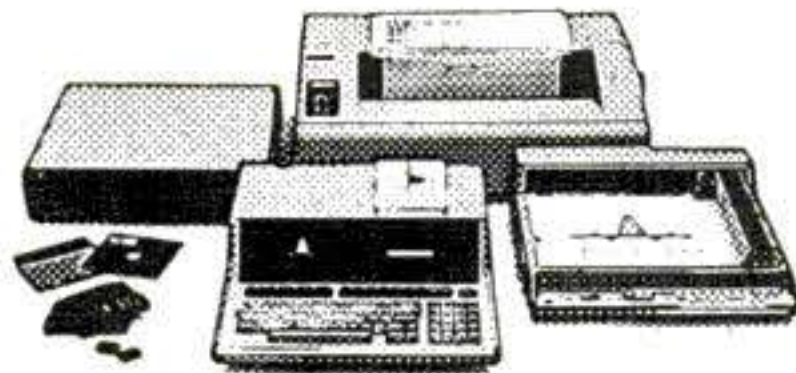
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HOUSEPOWER CLINIC

By EVAN POWELL

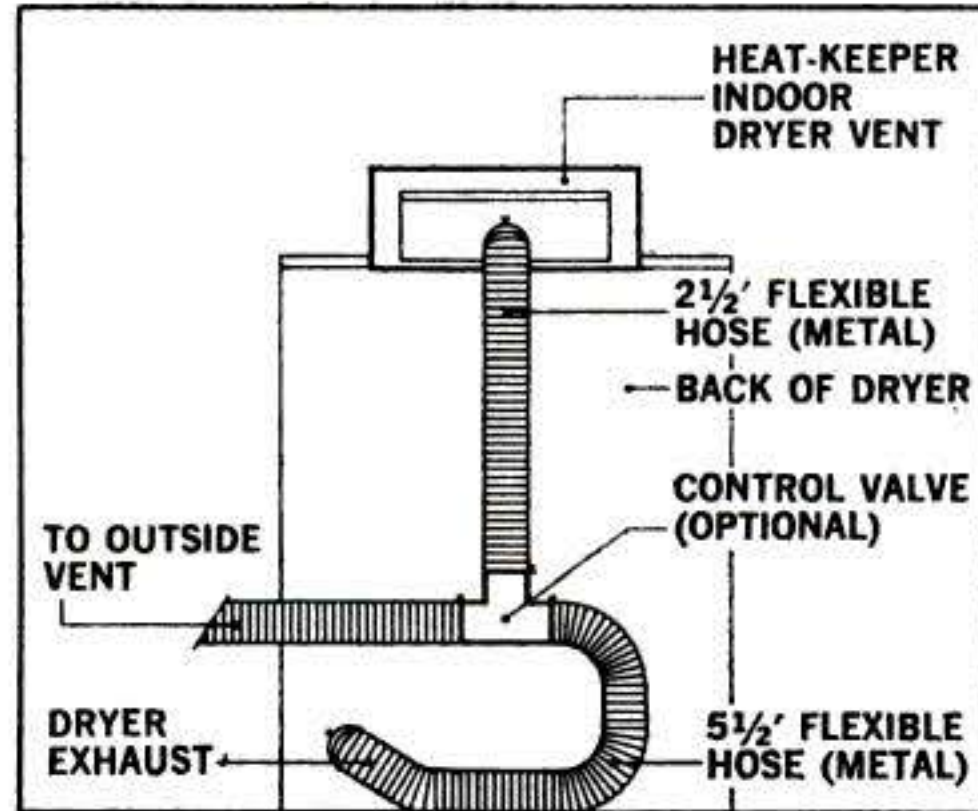
Heat-recovery basics

Heat recovery is an often-overlooked way to reduce winter fuel bills. All kinds of appliances and functions around the house produce heat; the trick is to retain it and put it where it will do some good.

We covered indoor dryer venting in November 1978. Numerous sources, including Oak Ridge National Laboratories and the Department of Energy, confirm that this practice can add desirable heat and moisture when the air from the laundry room is circulated to the rest of the house.

Several indoor-venting systems are now on the market. One of the best values I've found is the Heat-Keeper, manufactured by Lowe Energy Products, Inc. (Box 94013, Schaumburg, Ill. 60194). It holds a standard 10-by-20-by-one-inch furnace filter and attaches to a four-inch dryer vent. I use an optional vent valve that lets me divert the exhaust outdoors in summer and indoors, through the Heat-Keeper, in winter.

Performance has been very good. I've found no abnormal restriction of air flow as long as I change the filter when lint builds up to about 1/8 inch (as the



instructions suggest), and I've encountered no lint problems in the area. I recommend using metal rather than plastic vent hose when flexible hose is used.

Recovering heat and moisture from a dryer is easy. Recovering them from bath water is even easier: Just leave the water in the tub overnight or until it cools to room temperature. A typical 30-gallon bath yields 8,640 Btu by the time the water reaches room temperature. That's about 43 cents worth of electricity.

'Tis the season

I did my Christmas shopping in several parts of the country last year, but wherever I went I found dangerous, crudely made holiday lights. The quality of Christ-

mas lights might seem unimportant since they're used for only a short time each year, but just the opposite is true. They're often on for 12 to 16 hours at a time, far longer than most lights. And they may be used near highly flammable material: dry evergreen.

To minimize the risk Christmas lights can pose, buy only those that have been tested by Underwriters Laboratories and bear the UL tag. Follow the manufacturer's instructions, which include cautions about the number of lights that can be used on one circuit and their designation for indoor or outdoor use.

Look for damaged or broken wires or sockets and loose connections; don't use lights with a defect. Replace a burned-out bulb with a new one; never stick a screwdriver into the socket. That old trick was sometimes done with series-wired light strings, but it will short-circuit modern parallel-wired sets—and it's extremely hazardous. Avoid putting lights on a metallic tree; use spotlights instead.

Q&A Refrigerator rehab

I'm having a problem with the through-the-door ice dispenser on my GE refrigerator. The passageway in the door jams and ice spills into the freezer. After I remove the ice the dispenser works for a few weeks, then it clogs again.

Also, I need to replace the refrigerator door gasket. The old one rubbed against the cabinet and twisted, then finally wore through. How do I avoid this?

Bill Jenkins, St. Paul, Minn.

The GE ice dispenser has a mechanical time delay to allow the ice chute to clear before closing. If it closes too soon, so much ice accumulates that the chute heater can't melt it.

To check, GE recommends that you open the freezer door and momentarily hold, then release, the ice cradle about 10 times. If the duct door closes too fast (almost immediately) after the cradle is released, replace the time delay.

If you encounter gasket scrubbing when installing the new one, check to be sure the door is correctly adjusted. If the problem persists, use GE's WR 97X210 lubricant, applying it directly to the sealing surface. Don't use a conventional silicone lubricant—silicone can migrate to door switches and cause contact failure.

Cooktop cleaning care

I have a Hotpoint electric range that is only six years old, and I have had to replace

three top burners. The problem is the connections where the units plug in. They burn and rust and soon won't heat at all. The serviceman suggested I might be spilling grease into the connections, but I'm sure I would know if I were, and I clean my range thoroughly.

Jane Terry
Wilmington, Del.

Your conscientious cleaning may be part of the problem. Those terminal connections on plug-in units carry a lot of current; if they become loose or damaged, heat can deteriorate the connection further, and the result will be arcing and burning, which will eventually destroy the connection.

First, examine the receptacles where the burners plug in. If they're damaged they can cause a replacement element to fail. Compounding the problem is the fact that plug-in elements are seldom put back in the same burner after cleaning, and a faulty unit or receptacle terminal can affect the others.

Finally, when cleaning your cooktop, don't raise the units any farther than necessary to remove them. Lifting them too high can reduce the spring tension and result in poor contact. And don't clean the area around the receptacles or insert a damp cloth under the cooktop unless the range is unplugged.

Fast-working dryer

My Maytag D408 dryer has a timer that does not advance at regular intervals. Recently the dryer started shutting off too soon (10 minutes or so after starting)—while the clothes were still wet. Is the timer the problem or is it something else?

Dave Biggers
Augusta, Ga.

It's probably something else: a thermostat. The AUTO-DRY control on this model indirectly measures the dryness of the load by using a cycling thermostat with two sets of contacts: One turns on the heater until a preset temperature is reached; the other set of contacts turns the timer motor on—but only when the heater is off.

When a lot of moisture is present, as with a heavy load or at the beginning of a cycle, heat builds up slowly because of evaporation. As the load becomes drier, the thermostat cycles the heating element off and the timer on more frequently. That's why the timer seems to be working erratically.

Assuming you have been using the regular cycle, try using the permanent-press cycle, which uses a different thermostat. If the dryer operates correctly on permanent press, you probably have a defective thermostat—much less expensive than a new timer. Another cause could be a blocked exhaust vent.

Got a home-equipment problem? Write to Evan Powell/Housepower, Chestnut Mountain, Route 1, Box 322A, Travelers Rest, S.C. 29690, giving appliance make and model number. Unpublished questions cannot be answered by mail.

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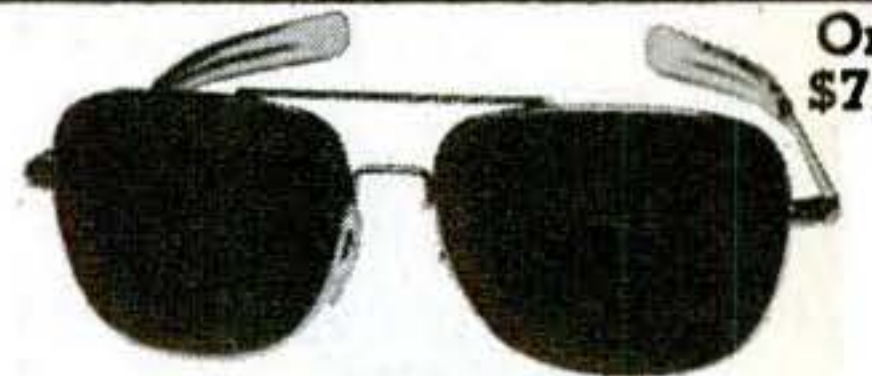
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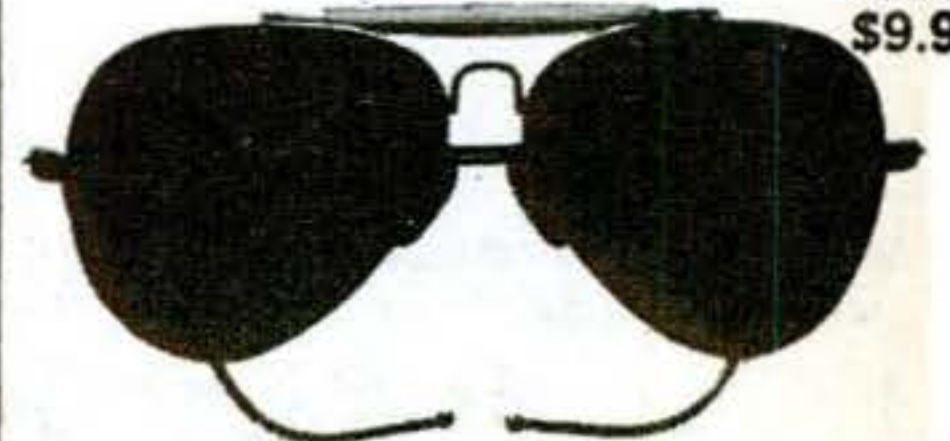
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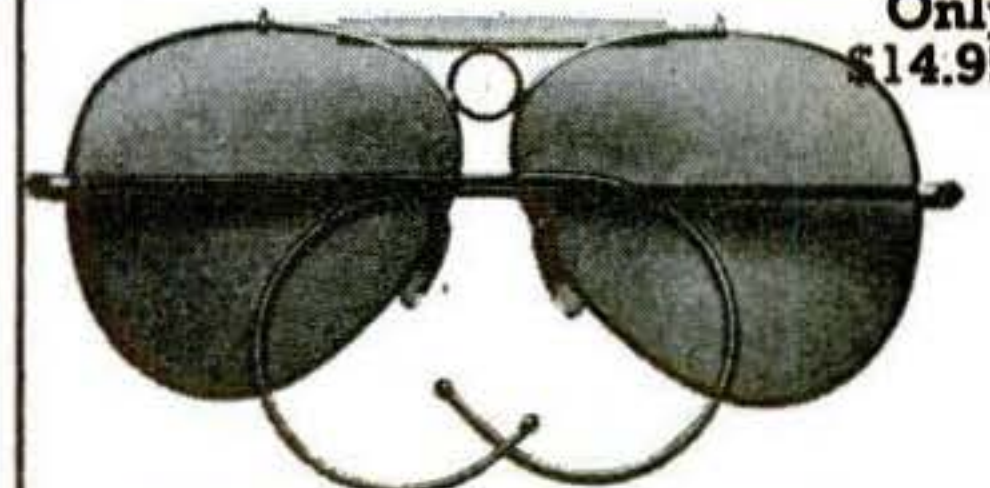
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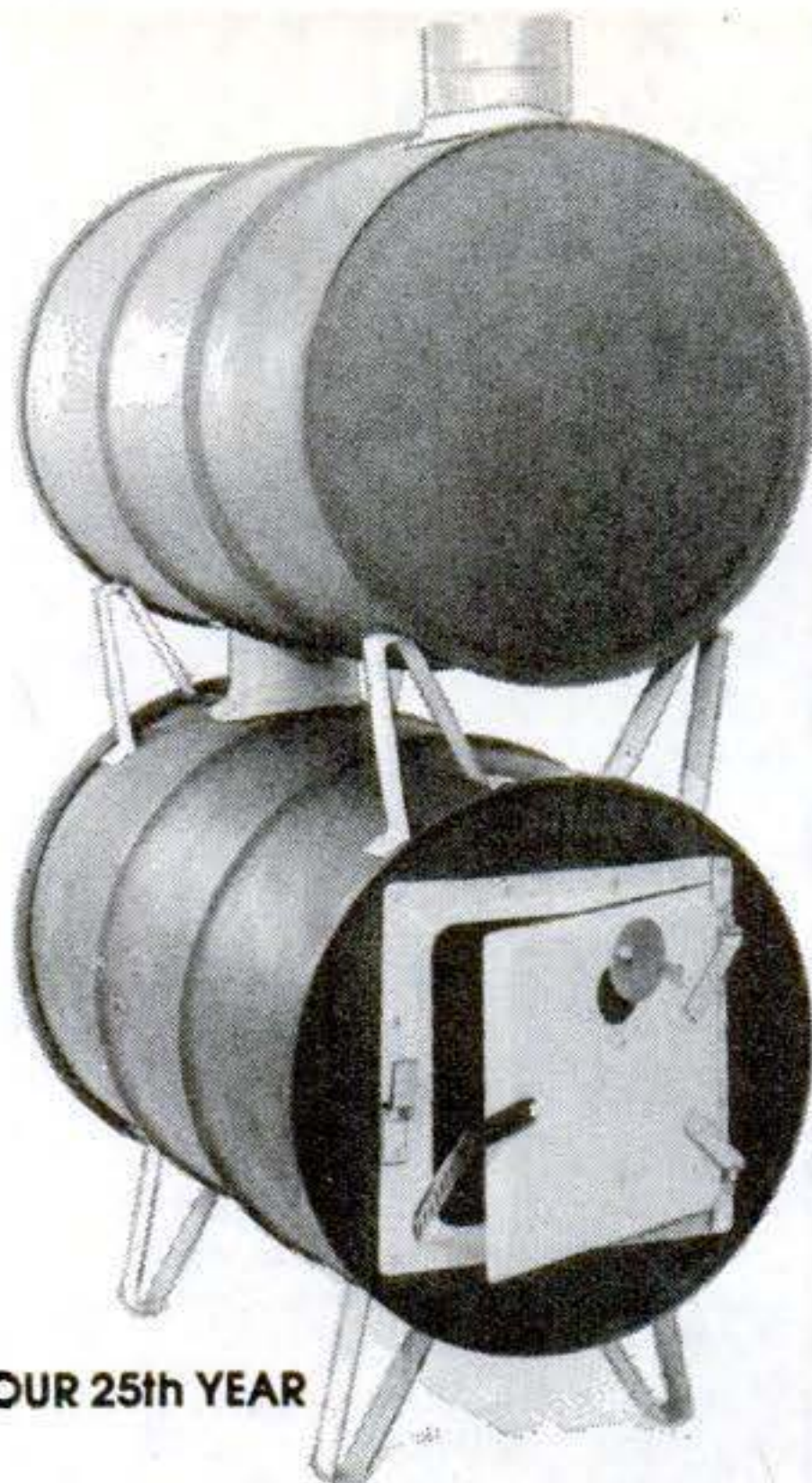
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OUR 25th
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SCRAM™ is a home-size version of the commercial pest control device that's safe for people, pets and the ecology. Try it in your home for 30 days.



SCRAM™ is small and unobtrusive--rugged, hi-impact case has black finish with brushed silver face. Measures only 3-1/2" x 4" x 3-1/2". Weighs about a pound.

It happens every year. Cool, autumn months drive flying, creeping, crawling pests into your home. What do you do? Fight an endless battle using dangerous traps, poisons or sprays? Or shell out good money for high-priced exterminators? Well--here's an ingenious new space-age "Pied Piper" that will eliminate common household pests--and keep them out!

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SCRAM™ is a home-size version of an electronic pest control device that's used by professional exterminators. It's heart is a special quartz crystal speaker that sends out ultrasonic waves on varying frequencies (so the pests can't develop an immunity to it). You can't hear it. Neither can your pets. But mice, rats, roaches and other pests can. And the message they get is unmistakable: SCRAM!

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Note: In spite of some claims, studies indicate that ultrasound is not effective in controlling bats or spiders.

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design means there's no maintenance--ever.

IT WON'T HARM CHILDREN, PETS, OR THE ECOLOGY.

Best of all, there's no danger. A leading university tested it and found it absolutely safe for humans--even children--and pets. And it's harmless to the ecology. There's no mess--no traps to empty and reset, no dead vermin to dispose of. (They leave under their own power!) And SCRAM's™ ultrasonic waves will positively not have any effect on burglar alarm systems, fire or smoke detectors, garage doors, TV reception or any other electronic devices.

SCRAM™ is the perfect pest protection. It will keep pests from inhabiting and nesting in vacation homes, campers, and boats both during the summer and off-season. Use it to control pests where food is kept or stored. Commercial versions have been used for years by exterminators, restaurants, and farmers. Hard-to-seal areas, such as garages, toolsheds and farm outbuildings benefit most from SCRAM's™ ultrasonic protection.

THE PRICE MAKES IT PRACTICAL.

Until recently, prices of ultrasonic units were high--close to \$200 in some cases. Only professional pest control companies used them and demand was low. But now the secret is out. Availability of lower cost components, particularly quartz crystal speakers, resulted in lower priced units. Now clean, electronic pest control is practical for everyone. SCRAM™ costs just \$49.95 (plus \$2.85 shipping and handling) but is as effective as units costing four to five times the price!

GET READY FOR THE WINTER PEST INVASION. TRY SCRAM™ FOR 30 DAYS AT NO RISK.

Now's the time to order. Pretty soon the

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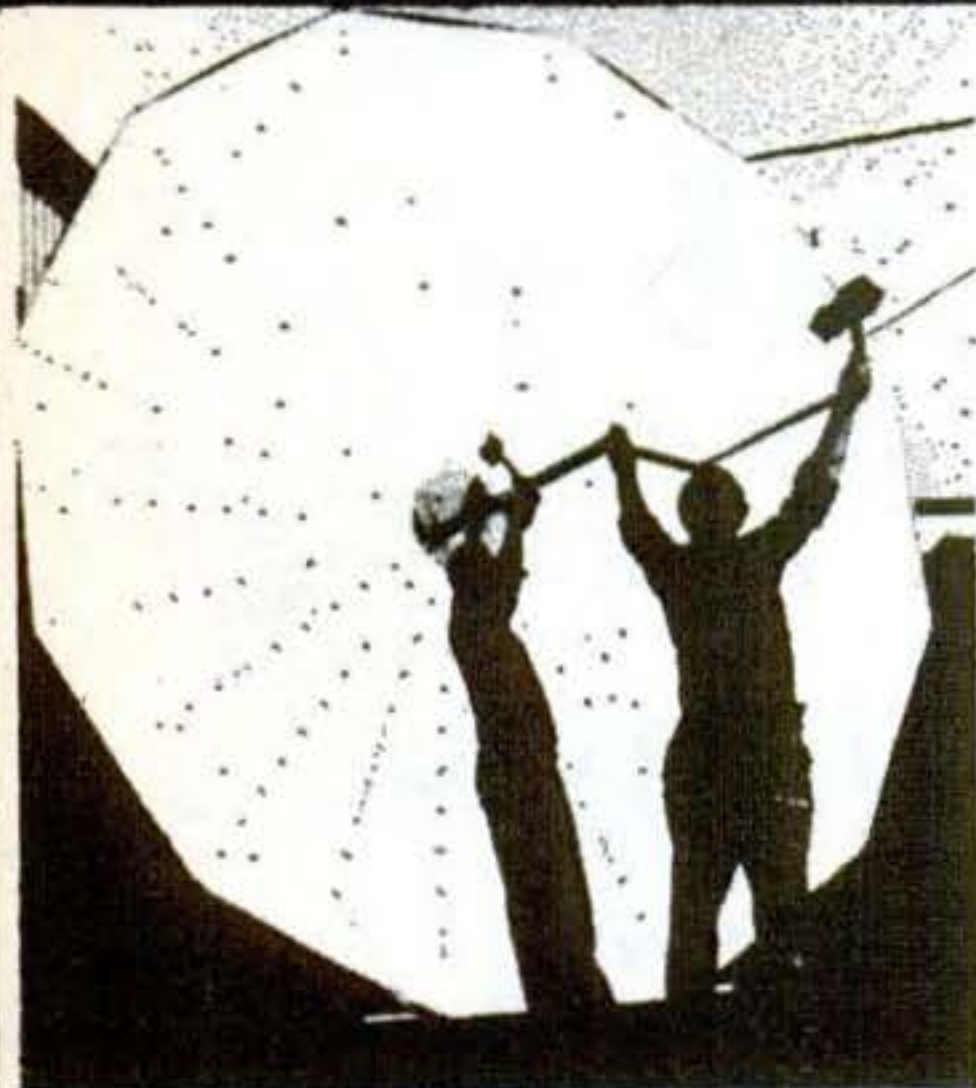
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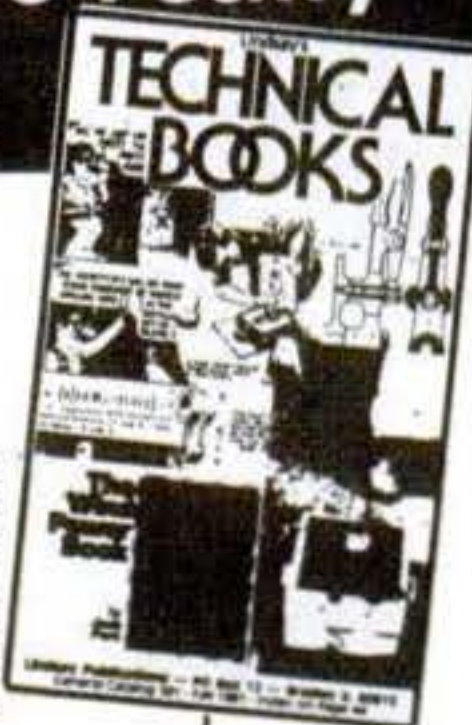
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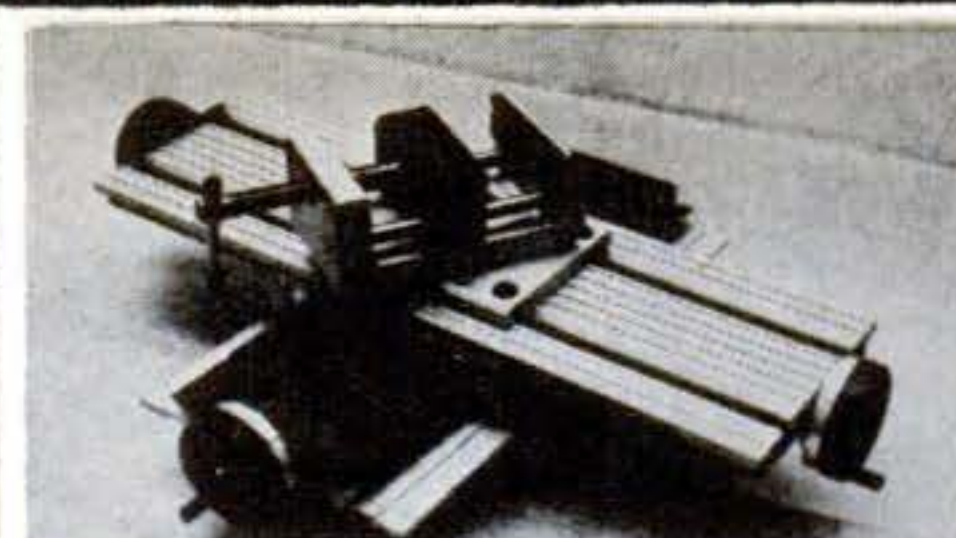
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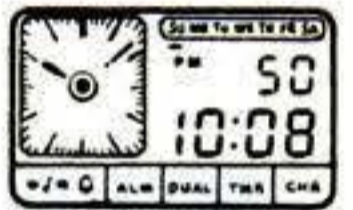
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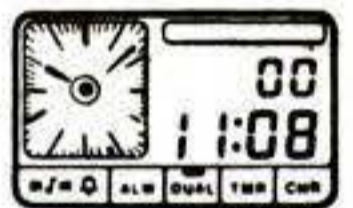
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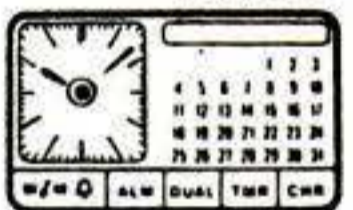
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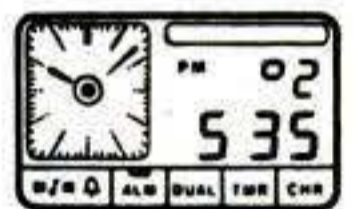
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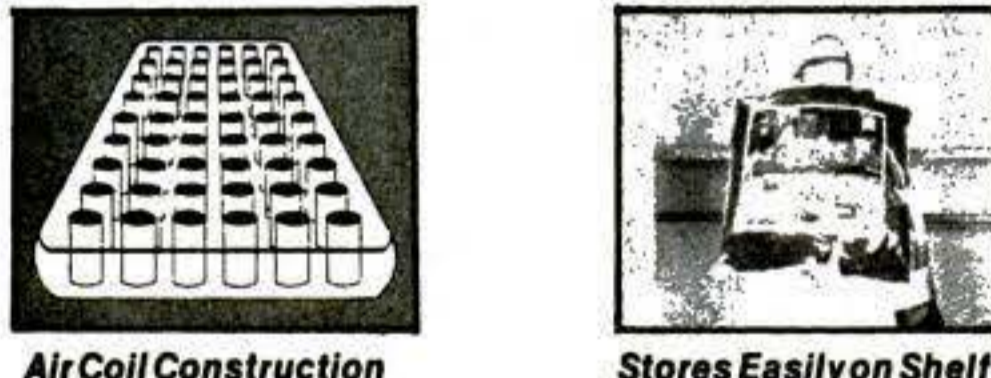
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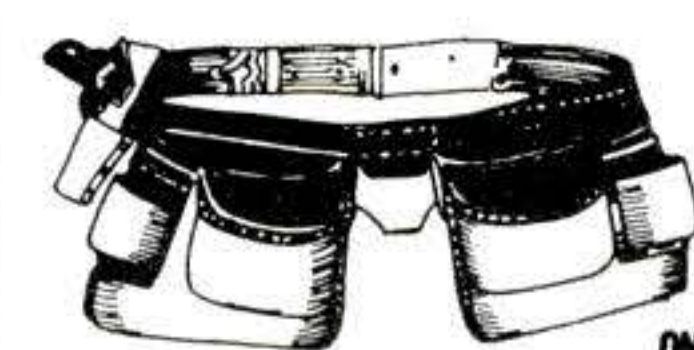
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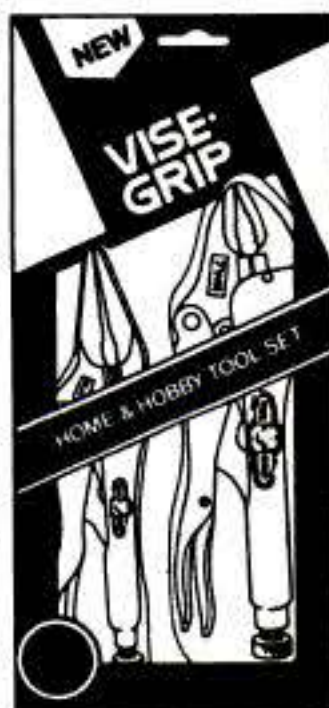
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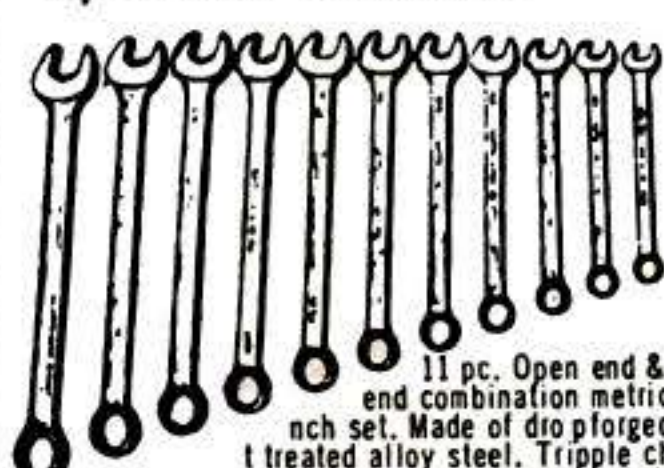


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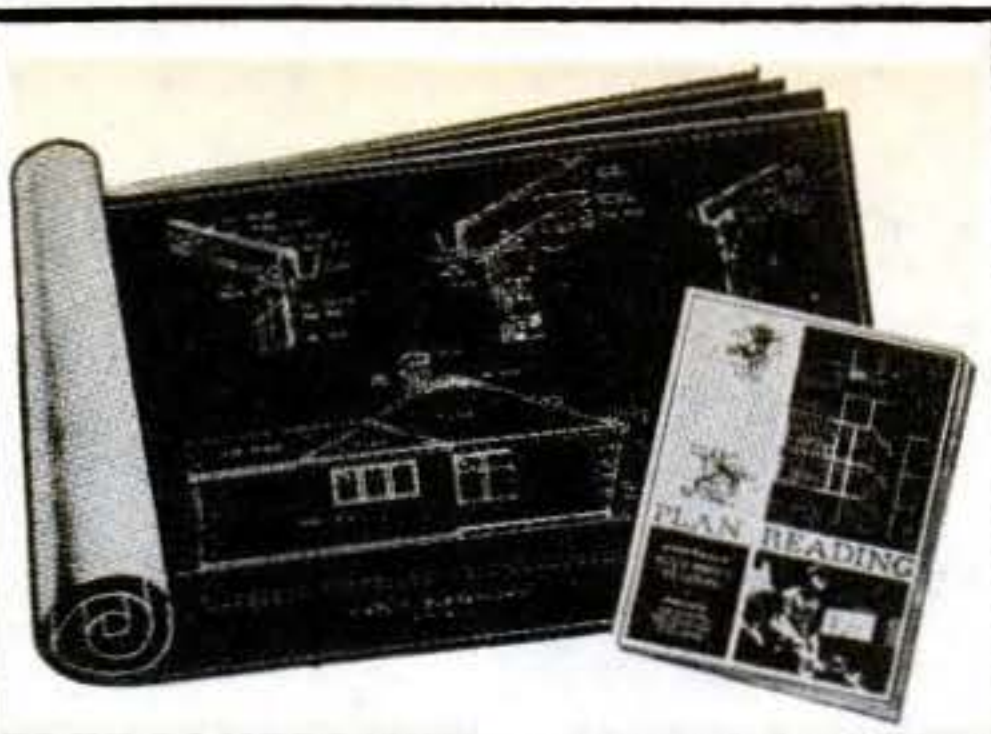


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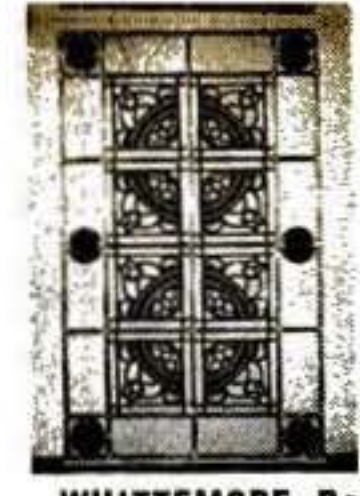
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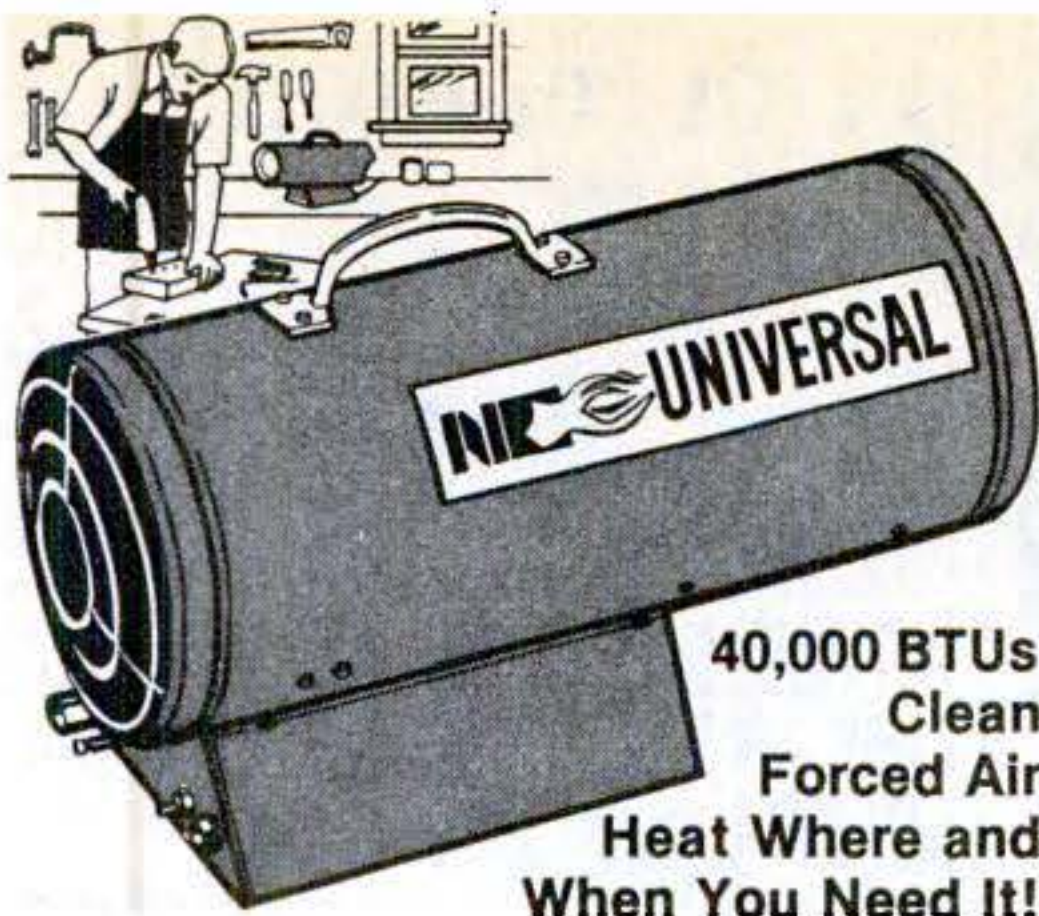
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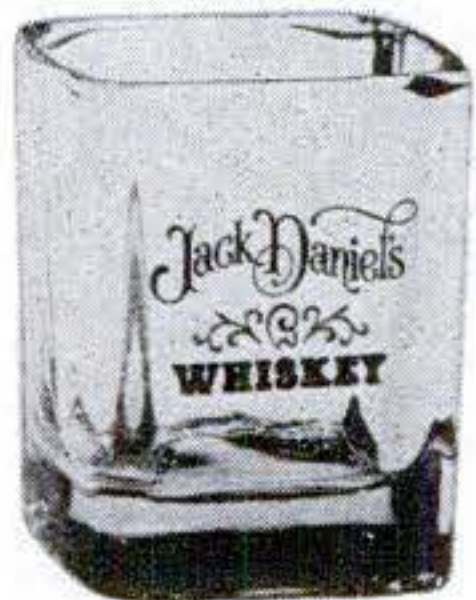
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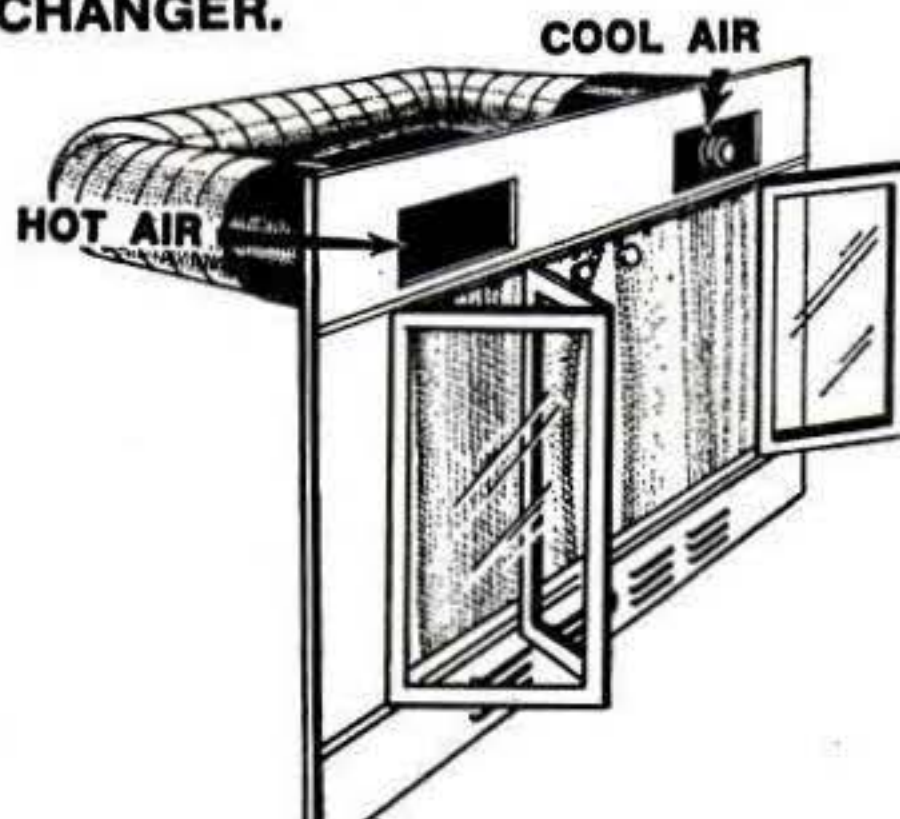
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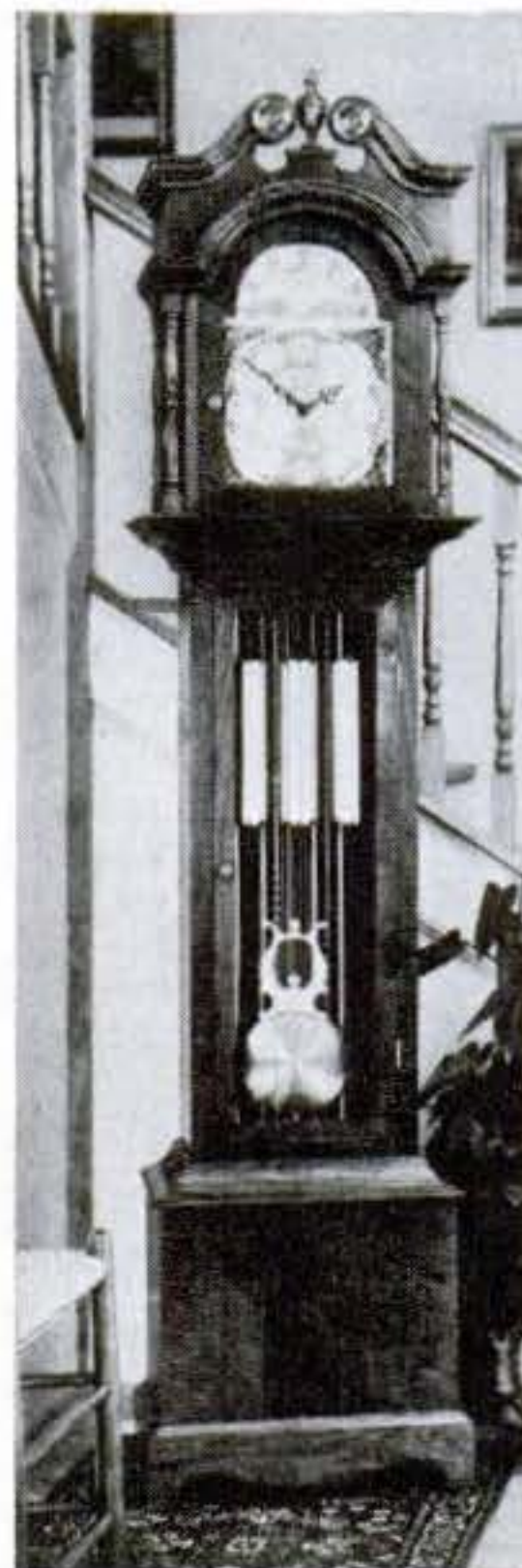
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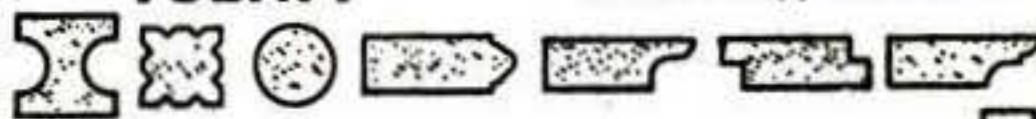
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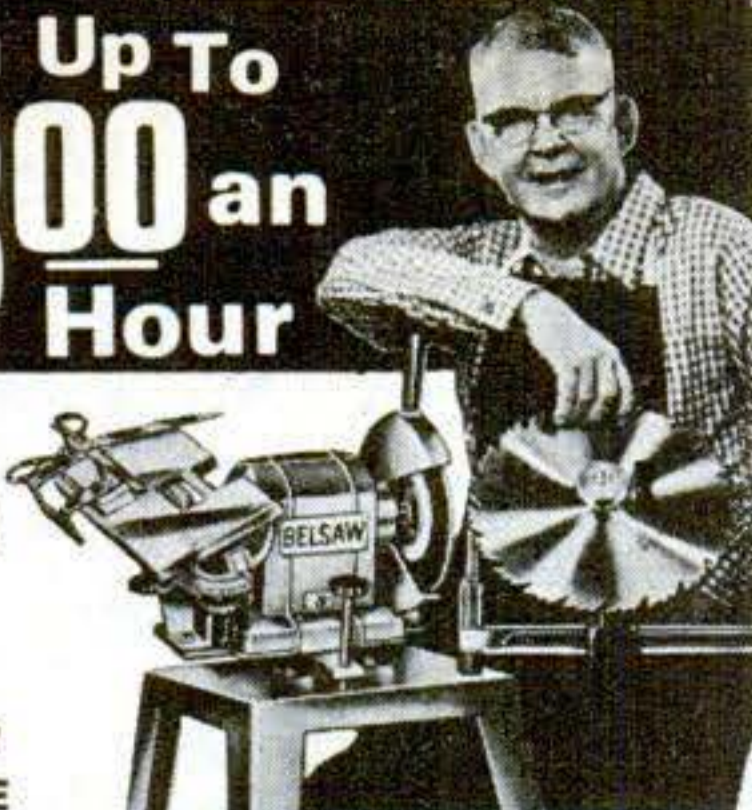
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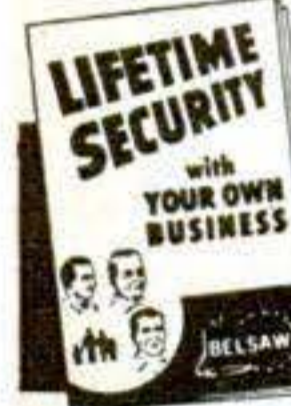


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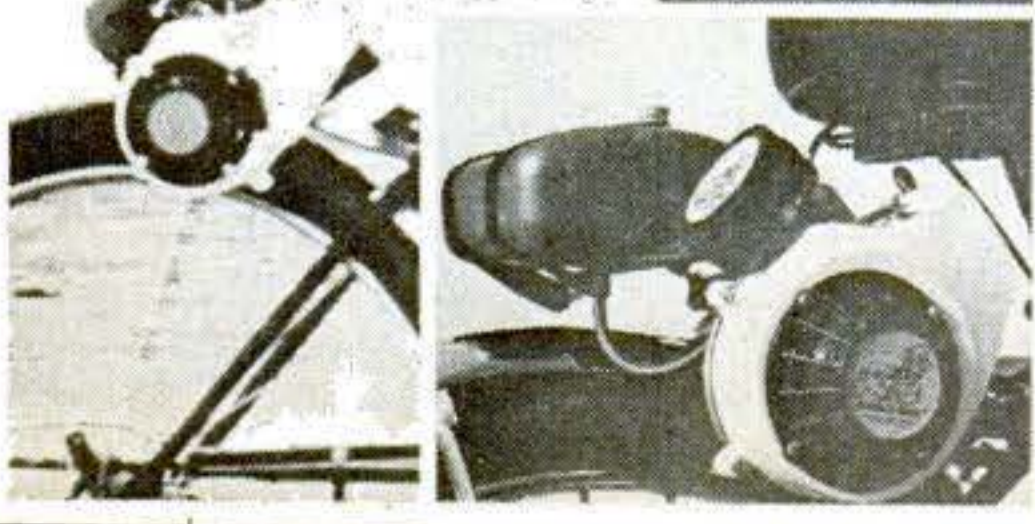
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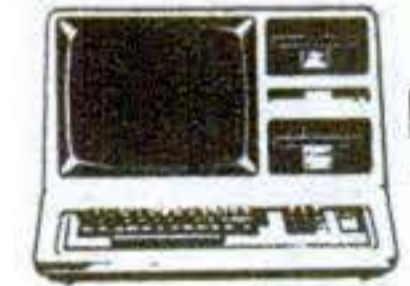


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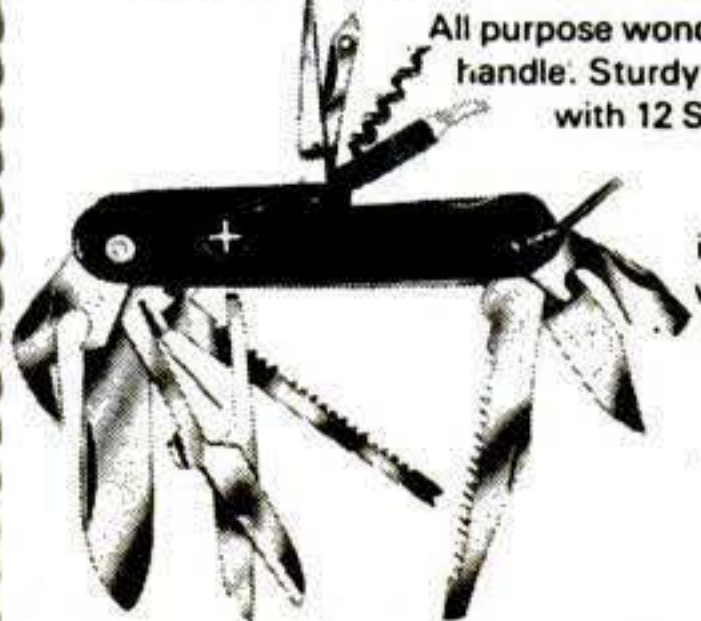
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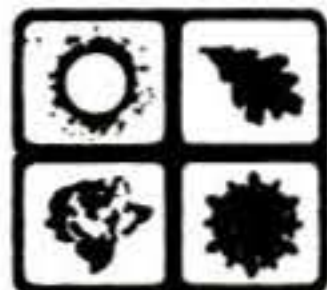


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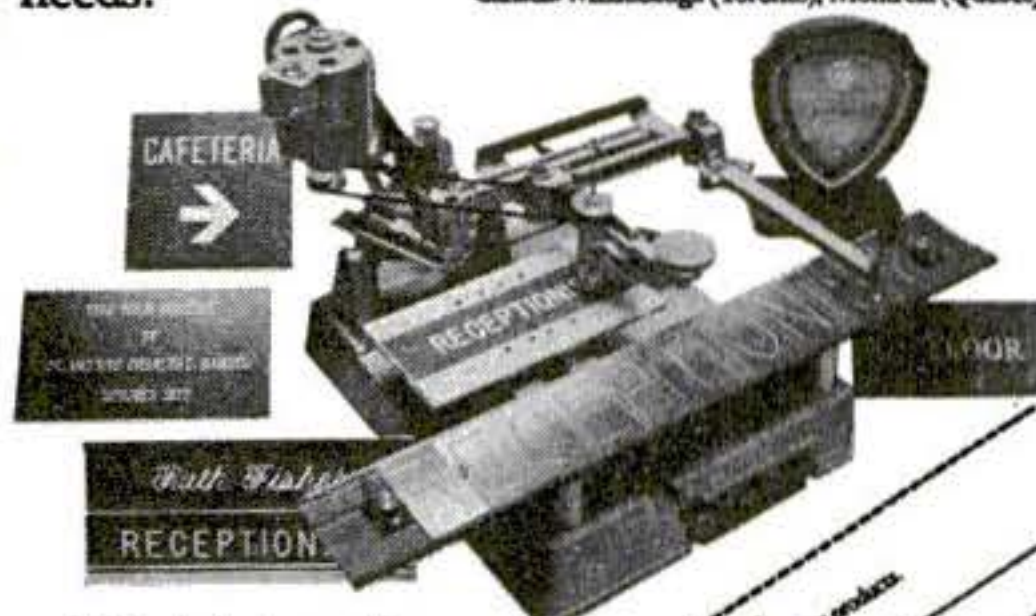
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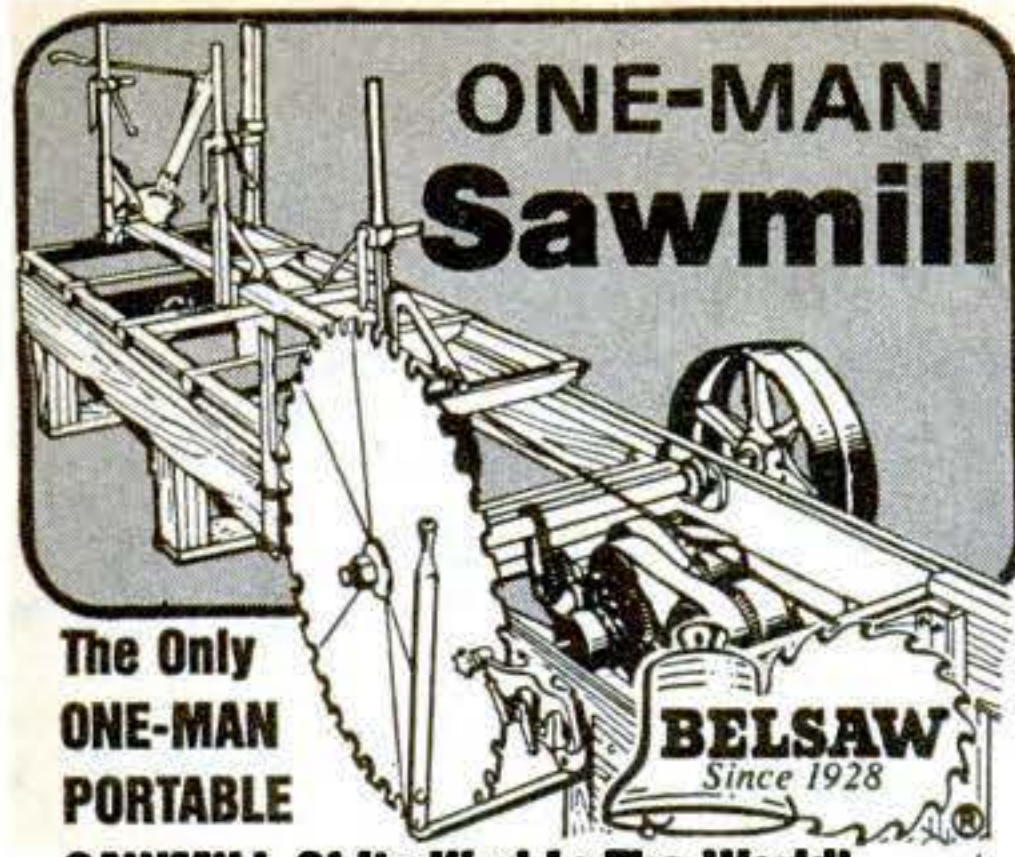
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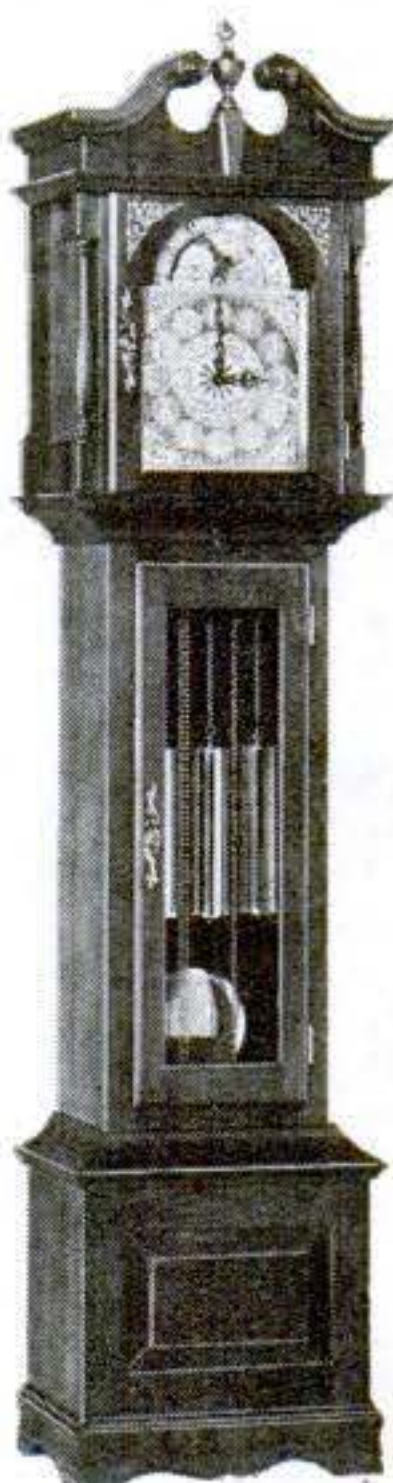
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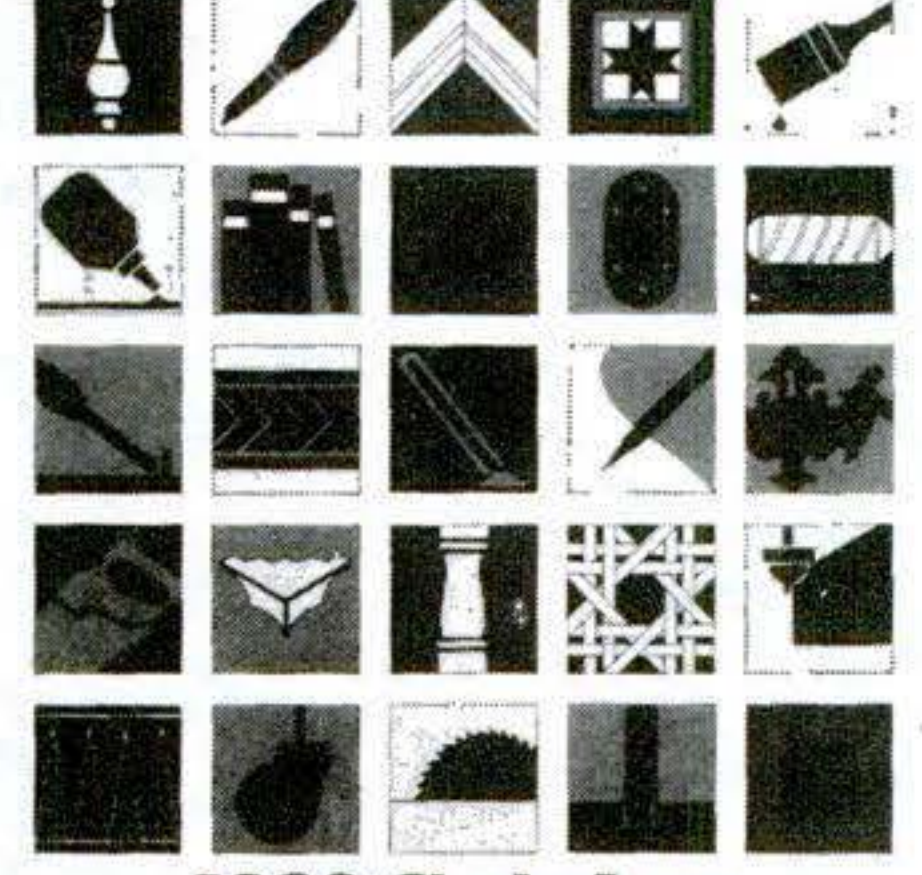
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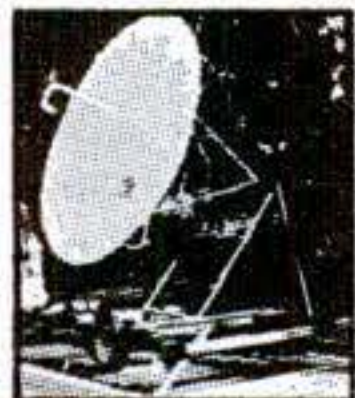
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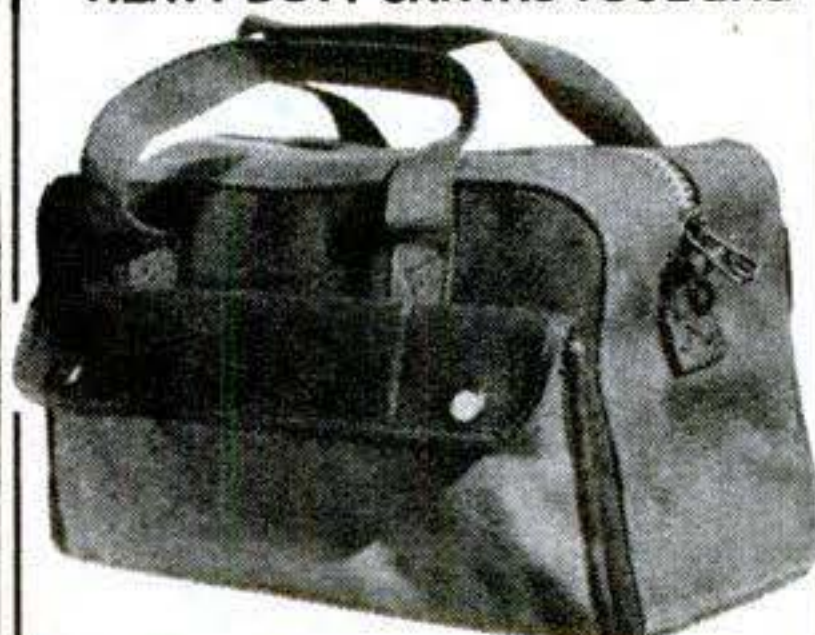
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Statement of Ownership, Management and Circulation (Required by 39 U.S.C. 3685)

- Title of Publication: **POPULAR SCIENCE**
1A. Publication No.: 493730
- Date of Filing: Oct. 1, 1981
- Frequency of issue: Monthly
3A. No. of issues published annually: 12
3B. Annual Subscription Price: \$13.94
- Location of known office of publication: 380 Madison Avenue, New York, N.Y. 10017.
- Location of the Headquarters or General Business offices of the publishers: 380 Madison Avenue, New York, N.Y. 10017.
- Names and complete addresses of publisher, editor, and managing editor: Publisher, Terence E. Moyes, 380 Madison Ave., New York, N.Y. 10017; Editor-in-Chief, C. P. Gilmore, 380 Madison Ave., New York, N.Y. 10017; Managing Editor, Herbert Shuldiner, 380 Madison Ave., New York, N.Y. 10017.
- Owner: Times Mirror Magazines, Inc., 380 Madison Avenue, New York, N.Y. 10017; The Times Mirror Company, Times Mirror Square, Los Angeles, Calif. 90053.
- Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None.
- Relates to non-profit organizations and

does not apply.

- Extent and nature of circulation: A. Total no. copies printed (Net Press Run): Average no. copies each issue during preceding 12 months, 2,138,795. Actual no. copies of single issue published nearest to filing date, 2,067,554. B. Paid Circulation: 1. Sales through dealers and carriers, street vendors and counter sales: Average no. copies each issue during preceding 12 months, 280,919. Actual no. copies of single issue published nearest to filing date, 249,953. 2. Mail subscriptions: Average no. copies each issue during preceding 12 months, 1,610,619; Actual no. copies of single issue published nearest to filing date, 1,511,440. C. Total Paid Circulation (Sum of 10B1 and 10B2): Average no. copies each issue during preceding 12 months, 1,891,538; Actual no. copies of single issue published nearest to filing date, 1,761,393. D. Free distribution by mail, carrier or other means, samples, complimentary and other free copies: Average no. copies each issue during preceding 12 months, 6,870; Actual no. copies of single issue published nearest to filing date, 7,072. E. Total distribution (Sum of C and D): Average no. copies each issue during preceding 12 months, 1,898,408; Actual no. copies of single issue published nearest to filing date, 1,768,465. F. Copies not distributed: 1. Office use, left over, unaccounted, spoiled after

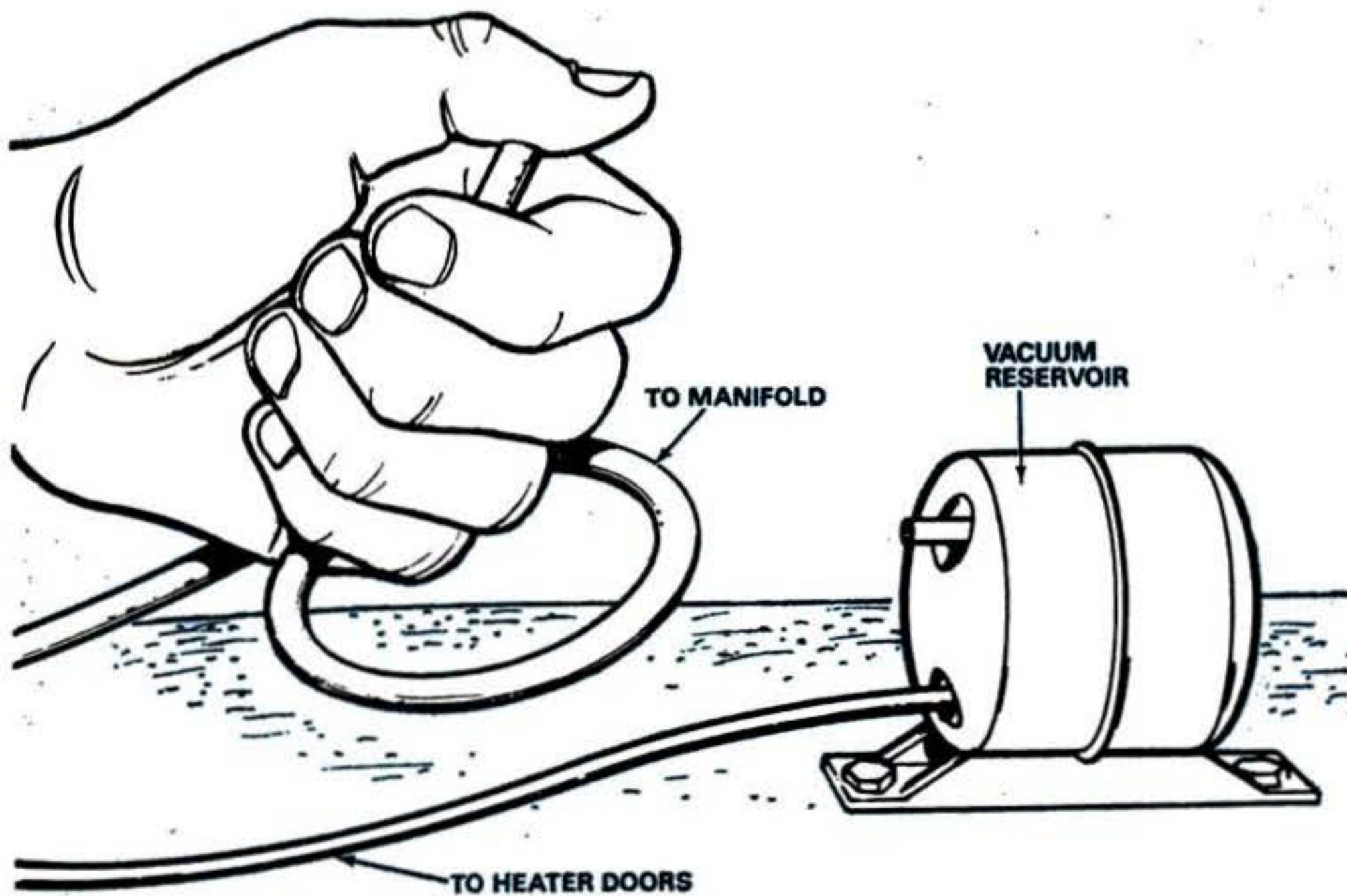
printing: Average no. copies each issue during preceding 12 months, 9,380; Actual no. copies of single issue published nearest to filing date, 49,135. 2. Returns from News Agents: Average no. copies each issue during preceding 12 months, 231,007; Actual no. copies of single issue published nearest to filing date, 249,954. G. Total (Sum of E, F1 and 2—should equal net press run shown in A): Average no. copies each issue during preceding 12 months, 2,138,795; Actual no. copies of single issue published nearest to filing date, 2,067,554.

11. I certify that the statements made by me above are correct and complete. (Signed) E. MacFarlan Moore, Vice-President.

12. For completion by publishers mailing at the regular rates (Section 132.121, Postal Service Manual) 39 U.S.C. 3626 provides in pertinent part: "No person who would have been entitled to mail matter under former section 4359 of this title shall mail such matter at the rates provided under this subsection unless he files annually with the Postal Service a written request for permission to mail matter at such rates." In accordance with the provisions of this statute, I hereby request permission to mail the publication named in item 1 at the phased postage rates presently authorized by 39 U.S.C. 3626. (Signed) E. MacFarlan Moore, Vice-President.

TAKING CARE OF YOUR CAR

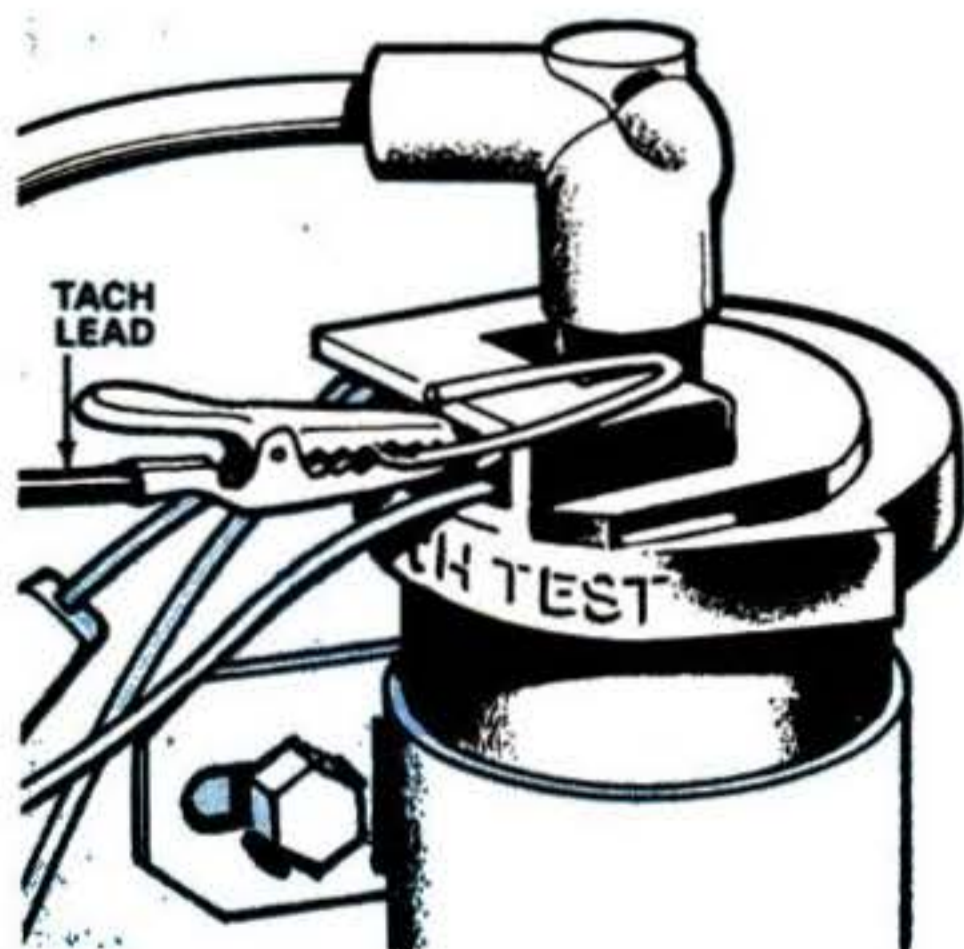
By RAY HILL



Leaking vacuum reservoir can cause engine to run roughly

When a power-balance test indicates a dead cylinder, yet all cylinders have good compression and healthy spark, your problem may be a vacuum leak. Many cars use a vacuum reservoir to control heater doors. If the reservoir cracks, it can cause loss of vacuum. To check the reservoir, remove the vacuum line that runs to the intake manifold and plug the end of the line with your finger. If the engine now

runs smoothly, reconnect that vacuum line. Disconnect the vacuum line that runs from the reservoir to the heater doors. Plug the open line tap. If the engine runs smoothly again, the problem is a vacuum leak somewhere between the reservoir and the heater doors. If the engine continues to run roughly, the reservoir is cracked. Replace the reservoir, or use epoxy to repair the crack.



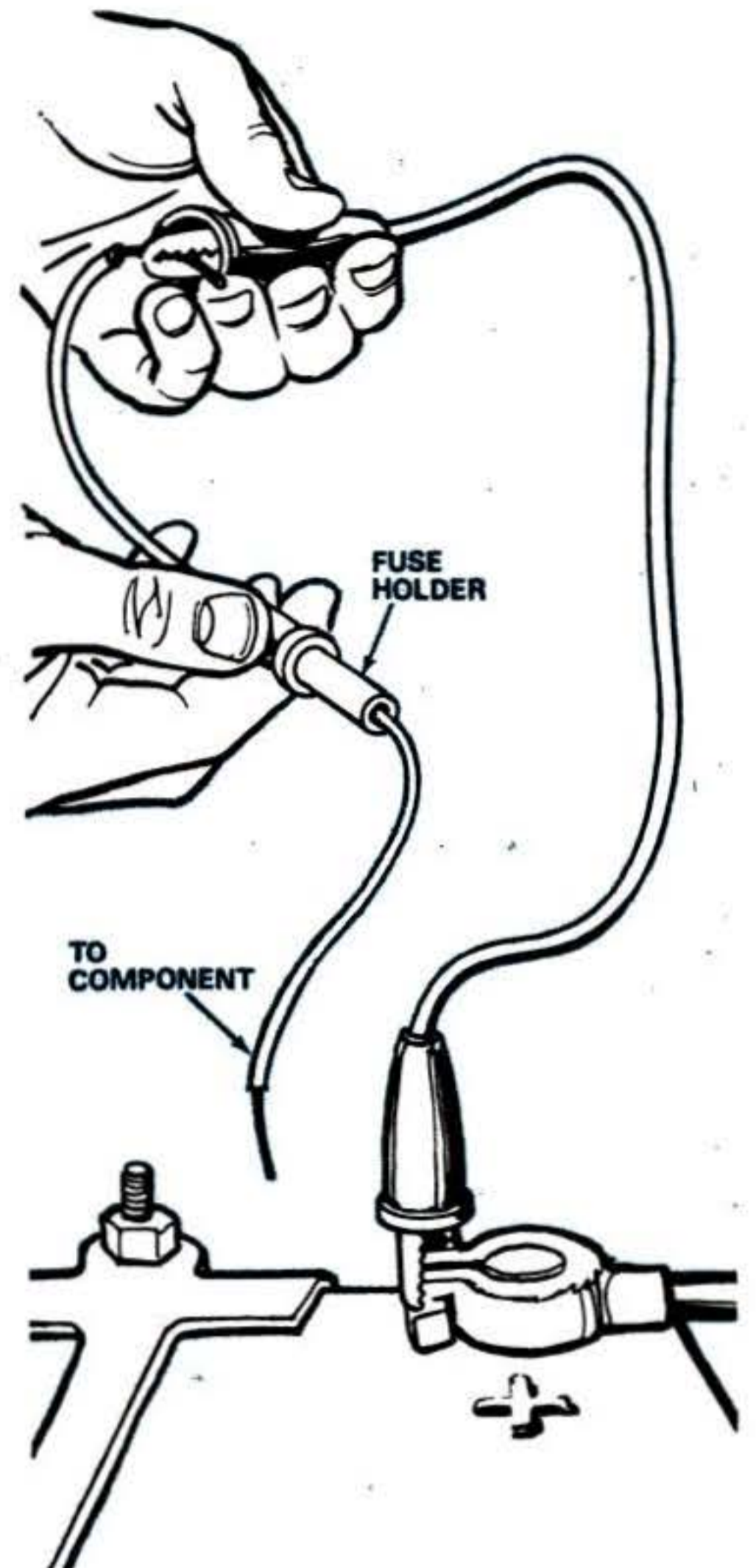
Tachometer hookup

To hook up a tach to Ford cars with electronic ignition, you can't clip the positive tachometer lead to the negative coil lead as you normally would. To solve this problem, insert a paper clip into the slot labeled "tach test," and clip the tachometer lead to the paper clip.



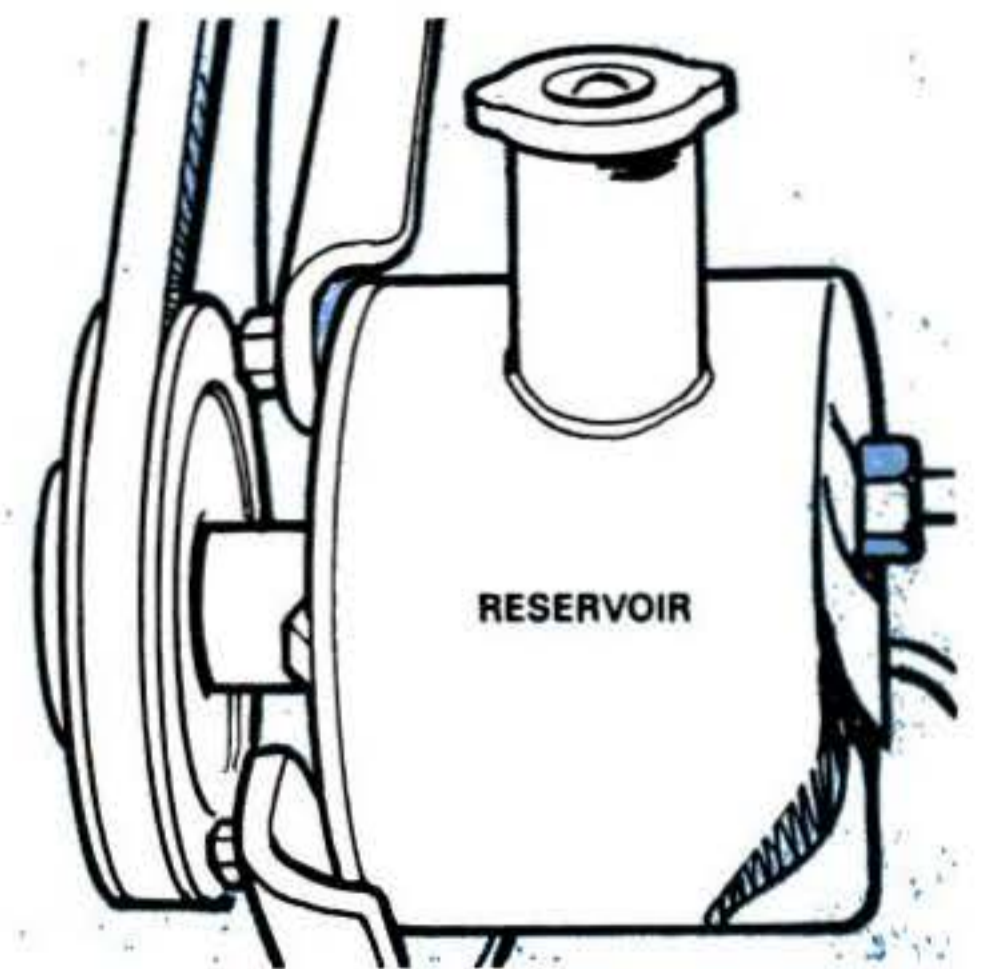
Checking a clutch fan

Many radiator fans are clutch controlled. Such a fan only spins below a particular engine rpm. To check the fan the engine should be turned off. Try to turn the fan by hand. If it turns more than five times or won't spin at all, the clutch is defective. It must be replaced.



Fuse keeps blowing

A fuse that repeatedly keeps blowing may be caused by a bad component or a short circuit. To test the component, disconnect its feed wire. In its place, connect a fuse (with the correct amperage rating for the circuit) in line with a jumper wire as shown above. Turn the component on. If the fuse blows, you know the component is bad; if it doesn't blow, then the problem is in the circuit.



Tightening power-steering belt

Never pry against the power-steering-pump reservoir when tightening its belt. The pump's sheet-metal reservoir can easily be damaged by a pry bar, possibly causing a leak. To apply belt tension, pull on the pump with your hand, or use the pump's pry-bar slot (if it has one).

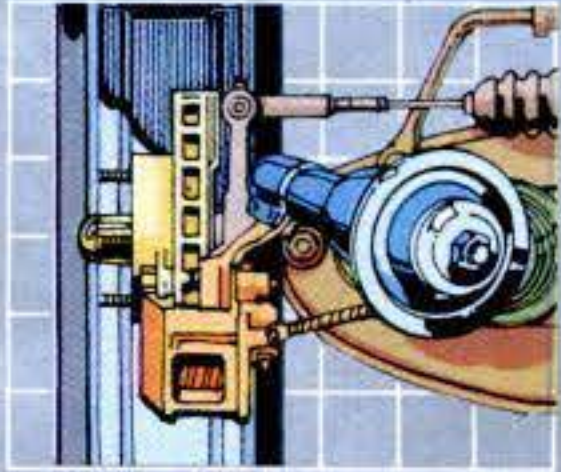
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*\$6419. Comparison of Aug. 1, 1981, sticker price of a 1981 to a 1982 base model Fairmont Futura four-door.

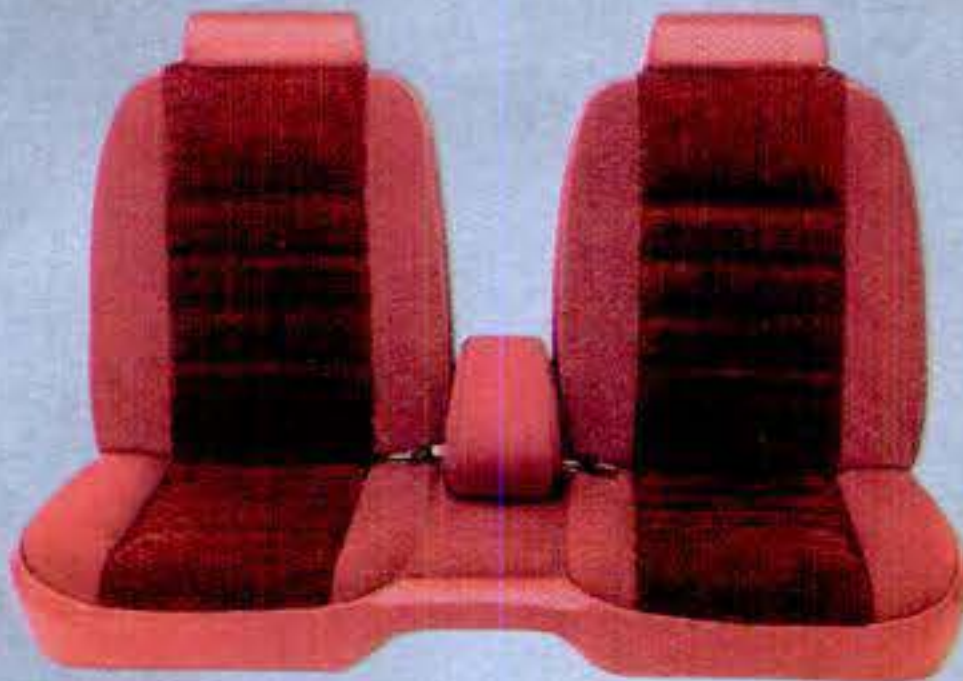


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