

AUGUST 1981 \$1.25

Popular Mechanics

9 COMPLETE
PLANS IN
THIS ISSUE



'Park bench' furniture
to make for your yard

**PM's ECONOMY
CAR ROAD TEST:**
Readers pick
their favorites

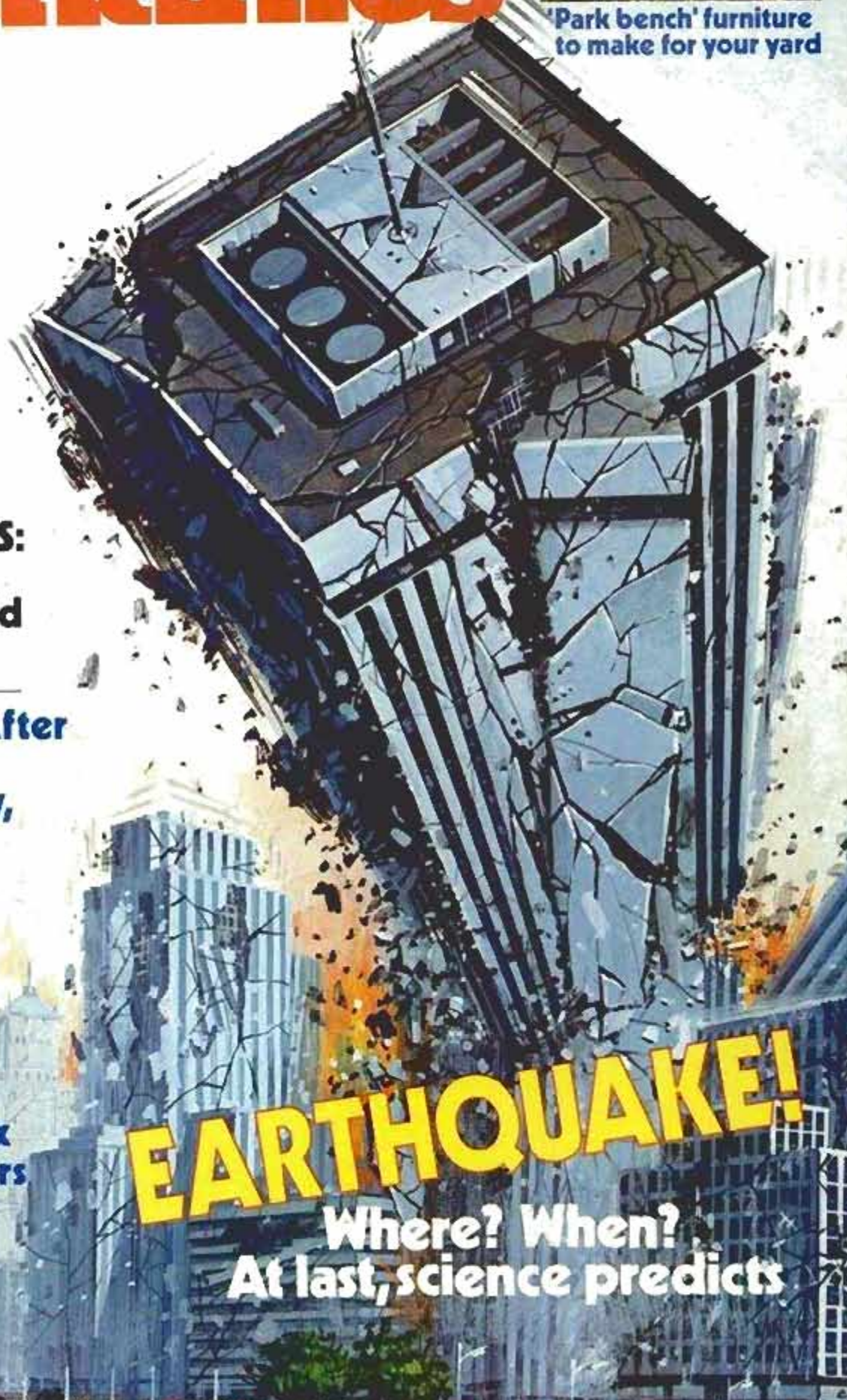
**NEW VIDEO DISC
SYSTEMS:**
Here's how all 3
work and what
each does best

OUTDOOR PLANS:
Arbors, trellises
and a gate to build
in your yard

OLDS CUTLASS: After
1,075,000 miles,
happy owners say,
'Everybody
should buy one!'

**An expert shows
how to repair
wicker furniture**

PLANS: Make an
in-ground sandbox
for your youngsters



EARTHQUAKE!

Where? When?
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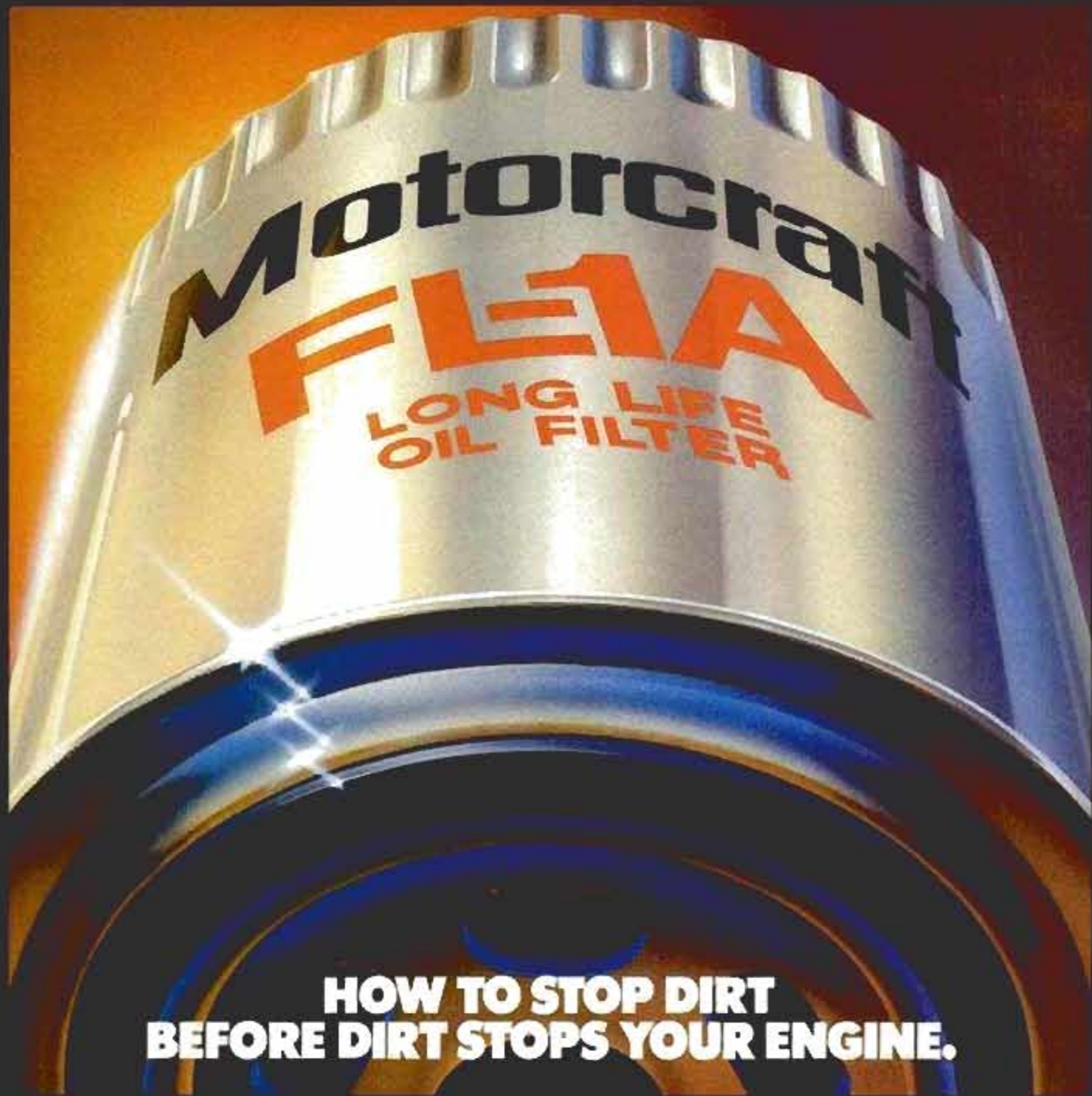
This One



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reinforced fibers, Motorcraft FL-1A Oil Filters trap more dirt ... last longer ... than any other leading filter.

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On the cover

Scientists working hard on the development of a reliable earthquake prediction system are racing against the increasing odds for a cataclysmic "seismic event" that could involve a major American city. Story begins on page 70

—PM painting by Ed Valigursky

Popular Mechanics®

AUGUST 1981

CONTENTS

VOLUME 156 NUMBER 2

INTERNATIONAL EDITIONS: CARIBBEAN, ITALY, MEXICO, SOUTHERN HEMISPHERE

Special features:

PM Exclusive: 'Real people' road test of top economy cars

Find out how drivers with everyday needs for comfort and economy feel about small cars from Detroit and overseas.

65

Which new videodisc is best for you?

PM tells how each works and what it does best.

78

Make expert repairs on wicker furniture

Now very much in style, wicker is going from the attic to the living room. Here's how to put it back in shape.

93

PM Owners Report: Oldsmobile Cutlass

Despite a few grumbles about lower power, Cutlass owners agree that it deserves to be America's bestselling car.

74

Outdoor plans

Complete in this issue, PM plans help you build arbors, trellises and a gate.

88

... Plus, "park bench" style outdoor furniture.

94

... and an in-ground sandbox for youngsters to enjoy.

87

Automobiles and bikes

- 12 Imports and Motorsports
- 39 Car Clinic
- 44 Detroit Listening Post
- 49 The PM Garage
- 53 Saturday Mechanic:
Troubleshooting Ford's Solid State Ignition System—Part 2
- 65 PM's "real people" road test of economy cars
- 74 PM Owners Report:
Oldsmobile Cutlass
- 80 How they bring Baja to the 50-yard line
- 119 Smart electric GT
- 138 Car stereo: Three you can install

Science and engineering

- 10 Science Worldwide
- 58 The real China syndrome
- 70 How science forecasts the killer quakes
- 117 Explosive trap to lure enemy torpedoes
- 117 Radio to foil rustlers
- 117 Columbia goes to work
- 118 Would you drink to this?
- 118 Food to go-go
- 118 Underground heat tap
- 118 A hot issue
- 118 The power that will be
- 120 Science builds a bone

Boating and outdoors

- 62 All Outdoors
- 62 Getting an edge on outdoor tools
- 84 Silhouettes—better than bull's-eyes for shooting
- 86 Boat that hides a dinghy in her bustle

Photography

- 24 Photo hints
- 134 Build this panoramic photo stand

Shop and crafts

- 26, 27, 115 Hints from readers
- 30 Workshop Minicourse:
Household finish carpentry
- 43 PM Workbench
- 50 New Now for home and shop
- 87 In-ground sandbox you can build in one session
- 88 5 yard structures that improve your view
- 93 How to repair wicker the way experts do
- 94 Build PM's "park bench" furniture

Home and yard

- 6 Homeowners' Clinic
- 25 Solar collector panels you can install yourself
- 32 Homebuilt furnace burns garbage to heat your home
- 46 Appliance Clinic
- 92 You can be your own landscape architect
- 132 5 energy-saving ideas from readers
- 135 Portable band saw lets you mill your own lumber
- 137 PM looks at glazier point driver

Electronics, radio and TV

- 28 PM Electronics Monitor
- 76 New computer animation fools the eye
- 78 PM compares the three new videodisc systems
- 120 Stereo on the road
- 138 Car stereo: Three you can install

Aviation

- 119 Chopper simulator

Every month

- 8 Letters
- 16 Notes from the Editor
- 21 PM Briefs
- 117 Tech Lines

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POPULAR MECHANICS (ISSN 0032-4568) is published monthly by The Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A. Subscription prices: United States and Possessions, \$9.97 for one year; \$18.97 for two years; \$33.97 for three years. Canada and all other countries, add \$4.00 for each year. Controlled circulation postage paid at New York, N.Y., and additional mailing offices. Authorized as second-class mail by the Post Office Department, Ottawa, and for payment of postage in cash. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 20, 1950, C 1961 by The Hearst Corporation. All rights reserved. Printed in U.S.A.

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Editorial offices: 224 West 57th St., New York, N.Y. 10019. We cannot be responsible for loss of unsolicited queries, manuscripts, or photos. For return, they must be accompanied by adequate postage.

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Published by The Hearst Corporation

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POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 959 Eighth Avenue, New York, N.Y. 10019, U.S.A. Frank A. Bennack Jr., President; Randolph A. Hearst, Chairman; Harrison A. Mitrack, Treasurer; Harvey L. Lipton, Vice President and Secretary; Hearst Magazines Division: Gilbert C. Maurer, President; K. Robert Brink, Executive Vice President and General Manager; Raymond J. Petersen, Executive Vice President; Thomas J. Hughes, Resident Controller; William S. Campbell, Vice President, Director of Circulation.

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Removes water— fights gas-line freeze.

Water gets into your gas tank through condensation and, sometimes, by contamination at the pump. This water can cause poor engine performance and, in cold weather, gas-line freeze.

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Inhibits rust.

Even a little rust can cause serious fuel system problems. It can clog your fuel filter, or block your carburetor jet. This can mean hard starting, plus stalling and sputtering.

But STP Gas Treatment has a special rust and corrosion inhibitor designed to prevent these problems. Both these steel bars were soaked in gasoline plus water. But the bar on the right—the one without the rust—was protected by STP Gas Treatment. No wonder it's the Driver's Edge.



UNTREATED TREATED

Cleans carburetors and keeps them clean.

Normal engine heat and oxidation cause gum and varnish to build up. These deposits can clog openings, reduce tolerances and harm engine efficiency.

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metal surfaces which works to prevent gum and varnish molecules from getting a toehold. And second, it surrounds these molecules with a stick-proof coating so they can pass harmlessly through the fuel system.



UNTREATED TREATED

The carburetor sleeve on the left shows fouling and deposit accumulation. The one on the right—the one that still looks like new—was protected by STP Gas Treatment. Which would you want in your engine?

Saves gas.

A dirty carburetor lessens your engine's operating efficiency, reduces mileage, wastes gas.



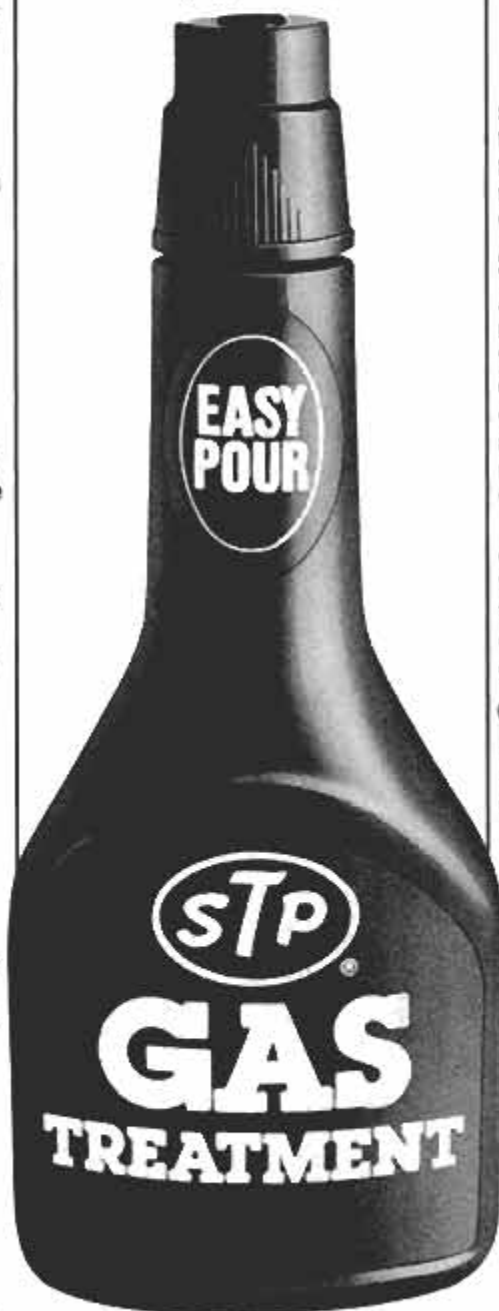
But STP Gas Treatment cleans carburetors, intake valves and manifolds, too. And, used regularly, **keeps** them clean. Net results: improved engine efficiency and important gas savings.

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STP Gas Treatment **does it all.** Removes water, fights gas-line freeze, cleans carburetors, saves gas. That's why it **outsells them all.**

The driver's edge.



HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Corroding gas jets

The particles I'm enclosing came from the top of the burner on my gas-fired water heater. Some of this deposit fell on the pilot light and shut off the unit. Most of it falls on the gas jets and blocks the openings. Where does this come from and how can I prevent it?—C. Havenstein, Zion, Ill.

The flakes appear to be rust particles, a product of oxidation caused by the burning gases. Burning fuel produces water vapor, which may lead to rusting and flaking of the metal. If this is blocking your gas jets, it's a potentially dangerous situation. In addition, rusting usually precedes tank failure and water leaks. I'd replace the heater.

Frozen paint

I have several gallons of latex paint that froze last winter. Now little globules like cottage cheese are in the paint. Can I break these up so I can use the paint again?—George J. Schumm, Manito, Ill.

A chemist adviser at Sherwin Williams says that freezing and thawing destroys latex emulsion. Even if it could be whipped back into a viscous material, it would be no good. Sorry, George, throw it out.

Paneling a sitting room

Now that my husband has retired, I would like to turn a bedroom that's no longer used into a sitting room. The room is cold. Will paneling the outside walls help keep it warmer? It's on the first floor and faces north.

The house is 40 years old and of typical construction for that time (brick on cinder block with plastered interior walls). There's a warm-air supply register on the inside wall, but no return-air vent. Would we be wasting our money by paneling the room?—Mrs. Mary Witmeyer, Reading, Pa.

Paneling alone wouldn't help you warm the room that much. The chart which follows will give you the insulating values of a few building materials. The numbers given represent the R-value of the different materials. R (thermal resistance) is the measure of the ability of a building material or section to resist heat flow. The higher the number, the greater the resistance. For instance, to achieve an R-19 ceiling may require varying thicknesses or layers of insulation, depending on

the type of insulation you select.

Not knowing the exact makeup of your walls, I would guess they're between R-3.6 and R-4.0. By comparison, a wood-sided frame house with full insulation in the walls would have an R-value of about 14.3.

If you added 1 in. of extruded rigid polystyrene foam such as Styrofoam, topped with 1/4-in.-thick panel-

INSULATION RATINGS

Material	R-value
Fiberglass batt	
3 1/2" thick	13*
2 1/4" thick	7*
Styrofoam	
1" thick	5.41*
3/4" thick	4.10*
Wood paneling	
1/4" thick	0.31*
Cement block, air space, brick veneer	3.63*

*ASHRAE Handbook of Fundamentals
*Dow Chemical Insulation Systems

ing, you'd increase your wall's thermal resistance to about R-9.35.

Of course, you'll have to extend all window and door jambs, and re-mount your electrical boxes. Given your situation, I think it's worth it.

No matter what you decide, you should trim the bottom of your door at least 1 in., to compensate for the lack of a return-air register.

Porous brick wall

A few years ago, I converted my carport into a den and installed a zero-clearance Heatilator fireplace on the outside wall. I had brick masons install a single-wall chimney around the insulated flue pipe. Now, if it rains for more than an hour, water drips out between the brick facing and the metal fireplace front, running onto the floor and under my carpet. All the joints are caulked and the flashing has been checked.

I experimented with a garden hose by squirting water on the brick wall below the roof line. About 15 minutes later, water began to drip inside. Are bricks that porous? I need help.—Bob Crawley, Thomaston, Ga.

Yes, Bob, bricks are porous. How-

ever, you should double check the joints and flashing, as porosity in bricks shouldn't show so quickly. Cover the top of the chimney and the flue pipe with sheet plastic to see if the wash where the flue meets the brick isn't properly sealed. Then spray water on the chimney again. If it doesn't leak, the water is dripping from the concrete wash at the junction of the flue and chimney top.

Caulk all visible cracks and liberally apply one of the sealers listed below. *Note:* Place a *Don't Light* sign in the fireplace while you perform the test.

The Brick Institute of America (BIA), 1750 Old Meadow Rd., McLean, Va. 22102, suggests either of two waterproofing coatings to seal the brick. Both surpass the more common 5-percent silicone treatment. One brand is White Roc 7, formulated from a patented blend of polymeric resins. This clear liquid can be sprayed, rolled or brushed on. Coverage, depending on the porosity of the brick, varies from 150 to 250 sq. ft. per gal.

The manufacturer recommends two coats. Follow the directions on the can regarding gloves, goggles and ventilation. White Roc 7 sells for about \$8 per gal., but the smallest quantity is a 5-gal. drum. If your local lumberyard or paint dealer doesn't stock it, write to Sonneborn Contech, Building Products Div., 7711 Computer Ave., Minneapolis, Minn. 55435, for the nearest dealer.

BIA also suggests Thompson's Water Seal, available in 1-gal. cans for about \$15. Write to E.A. Thompson Co., 703 Market St., Suite 2007, San Francisco, Calif. 94103, if you can't find it locally.

Thoroclear 777 is another clear, silicone-based water repellent. It's made by Thoro System Products. Cost varies with location, but suggested retail price is about \$10.50 per gal. **PM**

Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send order(s) to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.



BY JOHN GAVNOR

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LETTERS TO THE EDITOR

Greatest sea rescue?

I was impressed by your coverage of the *Prinsendam* disaster (*The Prinsendam Fire: History's Greatest Sea Rescue*, page 102, Apr. '81). However, the rescue, while indeed miraculous, was not "history's greatest sea rescue." Other rescues eclipse the *Prinsendam* fire in terms of numbers of people saved. In 1912, 705 were rescued from the *Titanic*; in 1956, more than 1,600 aboard the *Andrea Doria* were saved.

While much of the success of the *Prinsendam* rescue is attributable to the Coast Guard's always-splendid work, I can't help feeling that the passengers also owe their lives, in great part, to improved safety measures that were a direct outgrowth of the *Titanic* tragedy. The triumph of the rescue gives hope that the 1,500 who lost their lives aboard the *Titanic* did not die in vain—that humanity can, in fact, learn from its mistakes.

CHARLES HASS
PRESIDENT
TITANIC HISTORICAL SOCIETY
RANDOLPH, N.J.

While the *Prinsendam* disaster involved fewer survivors—524—it was the first large-scale, modern-day rescue operation in which not a single life was lost. In this sense, we felt it could be justifiably called "history's greatest sea rescue."

Standing the test of time

At the age of 17, 56 years ago, I built the bench saw shown in your February 1925 issue (*Making an 8-Inch Bench Saw*, page 336). I made it in a machine-shop course in high school. We still use this saw in some of our shop work today. Thought you might like to know.

O. H. CALDWELL
CALDWELL ELECTRIC SHOP INC.
WACO, TEX.

We do like to know. Many thanks. This has been a popular project over the years, and we still receive requests for copies of the article. For those interested, they're \$1.25 post-paid from *Popular Mechanics*, Box 1014, Radio City Station, New York, N.Y. 10101.

Still plenty fast

Your article on magnetic railguns (*Tech Front Lines*, page 126, Apr. '81) confirmed my calculations regard-

ing the fantastic speeds they could reach. One aspect not discussed, however, is that magnetic projectiles would actually have to be slowed down to avoid their burning up because of air friction.

Would this reduce their usefulness? In outer space, of course, with no friction, their speeds would theoretically be unlimited.

JAMES GARDEN JR.
CLAIRTON, PA.

The speed at which air friction becomes a problem is so far above the muzzle velocities of conventional weapons that a railgun could still offer tremendous gains in striking power, even under atmospheric conditions. Scientists are not yet talking about the gun's use in space, but its theoretical potential is awesome indeed.

PM's contemporary toolbox

I am enclosing a photo (below) of my version of your contemporary toolbox (*Build PM's Contemporary Tool-*



PM's contemporary toolbox, made by reader Kildahl, with shoulder strap for carrying.

box: It'll Be an Heirloom, page 116, Nov. '80). I used oak for the top, birch for the drawer fronts and pine for the sides.

Thanks for a great idea!

TOM KILDAHL
AUGUSTA, WIS.

And thanks to you for letting us know about it.

Generating your own power

We read with great interest your article *Now: Energy By the Bucket From Back-Yard Powerplants*, page 122, Feb. '81). It should encourage many Americans to explore the hydropower potential that has gone unutilized for too long.

The author wisely advised developers to be cognizant of the roles of fish and wildlife agencies. Under

federal law, all persons who seek permits, licenses or exemptions for hydroelectric facilities must consult federal and state fish and wildlife authorities.

Your readers would benefit from an awareness of this. It would be unfortunate if they encountered needless and costly delays because they acted without full knowledge of their responsibilities.

WILLIAM E. KNAPP
U. S. FISH AND WILDLIFE SERVICE
NEWTON CORNER, MASS.

We were pleased to see your article on back-yard hydropower. We recognize the benefits of such systems and are actively encouraging our customers to develop small hydroelectric facilities.

We strongly advise interested parties to contact their utility prior to selecting equipment, in order to identify the utility's interconnection requirements and thus avoid costly mistakes.

J.M. STEARNS
PACIFIC GAS AND ELECTRIC CO.
SAN FRANCISCO

Putting an end to pinging

When my '79 Buick Regal 301 V8 started to ping, I recalled the item "Zinging it to pinging" in your February '81 *Car Clinic* (page 52). Sure enough, the thermostatic air-cleaner (TAC) sensor was kaput, causing the flap valve to remain closed all the time.

As soon as I replaced the sensor, the ping disappeared. Thanks for saving me the cost of a garage repair.

PAUL EBERHART
WEST HEMPSTEAD, N.Y.

Seeing in the dark

I had to laugh at the Army's picture of a spotting scope on a .50-caliber machine gun (*Tech Front Lines*, page 104, Jan. '81). Have you ever been around when a .50-cal. was fired? I wouldn't make bets on the guy's accuracy.

JACK G. GUSKE
WASHTUCNA, WASH.

The scope is a special image intensifier, not a conventional telescopic sight. It's designed to enhance dim-light images electronically to detect an enemy in darkness. The images it gives, however shaky, should be better than nothing—we'd bet on it. PM

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WORK CLOTHING. THE GENUINE ARTICLE. SINCE 1895.

SCIENCE WORLDWIDE

Treatment before birth

An analysis of amniotic fluid revealed that the 16-week-old fetus carried by Mrs. Debra Whitmore was in trouble.

Doctors suspected there was a one-in-four chance that the baby would suffer a rare, life-threatening metabolic disease that would cause acids to accumulate in the baby's body. The amniocentesis—extraction of a small amount of fluid from the uterus for analysis—confirmed that the fetus needed extra biotin, one of the vitamin B group of vitamins.

The doctors, at the University of California, San Francisco, waited until Mrs. Whitmore was 23½ weeks pregnant. Then they began giving her large quantities of biotin, hoping that it would travel to the fetus.

The baby was born four days before Christmas last year. The regimen had worked: Newborn Nicole Whitmore had no symptoms of the biotin disorder.

First families

The recovery of well-preserved 7,700-year-old human skeletons has raised hope that a barren area of Peruvian coastline could be converted today to useful farmland.

Analysis of the skeletons yields a surprisingly complete picture of life in the oldest known village in the Western Hemisphere, about 55 kilometers south of Lima. Preservation in the arid desert has been so complete that many of the 220 skeletons



Skeletons of two males, aged 40 and 19, were found at an ancient site near Lima.



Space Telescope mirror gets quality-control inspection. Shuttle launch is due in 1985.

have skin, hair and intestinal contents intact. So anthropologists, led by Robert Benfer of the University of Missouri, have been able to deduce what villagers ate.

Until now, theory held that they hunted and gathered food without cultivating it themselves. But the new research suggests that village families did some farming of maize, squash and peanuts.

They weren't very skilled in manipulating their land, Benfer concludes: They gradually destroyed shrubs and trees, and turned increasingly to seafood.

Evidence that early inhabitants—and not climate changes—destroyed local vegetation raises hope that the area could be reclaimed for farming today. And that could be good news for the millions of Andeans who have migrated to the coast during the last decade.

The nearly perfect mirror

The mirror you see above has been polished to near perfection in preparation for its unveiling in space in the middle of the decade.

The mirror is the centerpiece of the Space Telescope, an orbiting observatory that should be able to probe space seven times farther from Earth than we have ever seen with land-based optical telescopes. (See *How We'll Peer Back to the Beginning of Time*, page 87, Feb. '79.)

Polishing at Perkin-Elmer's Optical Technology Div. in Connecticut brought every point on the surface to within one millionth of an inch of an ideal surface. In orbit 310 miles

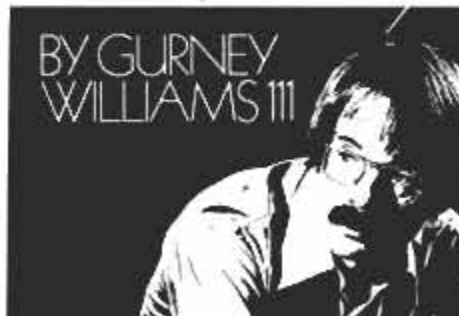
up, the 94-inch-diameter primary mirror will reflect light onto a secondary mirror, which will focus the light at a point about a quarter the diameter of a human hair.

The turtle mystery

Sea turtles, lumbering survivors of the dinosaur era, have long been surrounded by mystery. They hatch in bulb-shaped nests dug by their mothers in beach sand, crawl to the surf and set out to sea. And then—the mystery—they just disappear. They're not seen again until the females return to the beach to deliver their eggs. Where do they go?

Recently, the University of Georgia's *Research Reporter* announced that the mystery had been solved. By attaching tiny radio transmitters to the young turtles, scientists from the University and other organizations were able to track the young after they had plunged into the ocean froth. The path led directly into a nearby river, and then into salt-marsh creeks. There, the hatchlings blend into the dark brown mud.

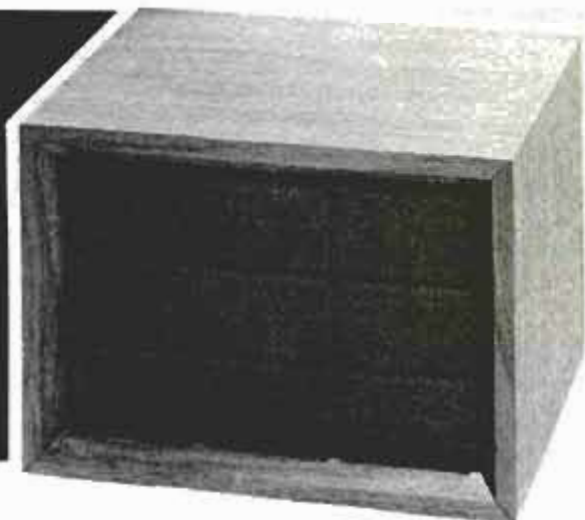
The research underlines the importance of marshy areas as nurseries for sea animals. **PM**



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Turns On Lights Automatically
Powerful Electronic Siren



Low Cost Computerized Burglar Alarm System Home - Office - Business

NO INSTALLATION

Just plug the Guardex 8000 alarm system in, make two simple control adjustments to suit your particular building and it works! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and what most alarms miss... your roof, walls and floors.

HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, prying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

TURNS ON LIGHTS AUTOMATICALLY

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected, (it can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.

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.



The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6 3/4" x 9 3/4" x 8") and weighs less than 6 1/2 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.

BATTERY BACK-UP

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.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

WARRANTY

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.

OUTSIDE SIREN

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).

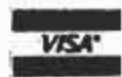
30 DAY NO RISK TRIAL

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.)

(If you require more information, call during California business hours, Monday - Friday).

Dealer Inquiries Invited

CALL TOLL FREE
(800) 423-5499



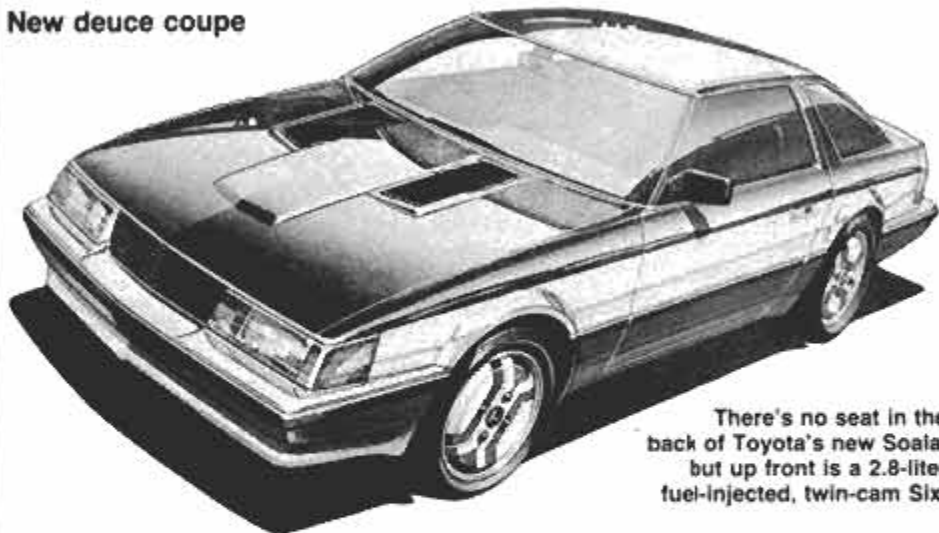
California residents:
(213) 889-1414 collect.

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IMPORTS & MOTORSPORTS

New deuce coupe



There's no seat in the back of Toyota's new Soala, but up front is a 2.8-liter fuel-injected, twin-cam Six.

Phooney on mothers-in-law, fie on back-seat drivers and forget car pools and kids! Two-seater fever is spreading, and Toyota will be next out with its sports car for nonbreeding pairs. Since power is expected to be 170 horses, Toyota's emphasis will be clearly on performance. Pontiac's P-car, too, even though GM refers to it as a "commuter car," will get a hefty amount of push and shove from a midships-mounted engine. When it joins the two-seater lineup next year, it'll find the field getting crowded: The Fiat X1-9, Mazda RX-7 and Corvette will be among the old faces; Ford EXP and Mercury LN-7 will still be fresh and Toyota's Soala will be fresher yet.

There's nothing new about two-seaters, of course. Remember the AMC AMX—circa 1968? Nice one. Remember how Beetle back seats were replaced with platforms? When owners needed room for four, they just bolted the seat back in. What'll owners of the new two-seaters do? Well, maybe the new customizing job will be . . . rumble seats.

Speaking of customizing

I've seen lots of terrific custom jobs on Rabbits, but this one is right off the wall: a weird, but impeccable,

personalization by Peter Utler, a German car nut who can now camp in the six-foot cargo bed.

Shock treatments

You're right if you think a guy has to be crazy to be a rally driver. If you don't wind up hanging upside down in your safety harness, you've gotten off easy: just a couple hundred miles getting kicked in the behind. John Buffum, four-time North American Rally champion, is one of

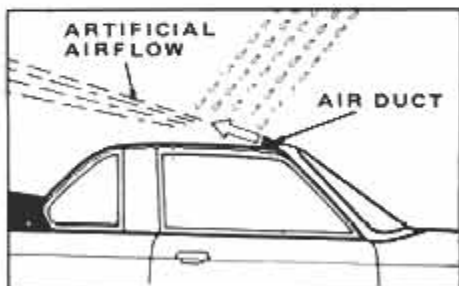


Buffum is taking out bounce with Boges, the crazies who knows how to take his lumps; he'll be taking them a little differently this year: He's switched to front-wheel drive, pilot-

ing an Audi 4000 that's being sponsored by Boge, a well-known shock-absorber name in Europe, but new to the United States.

Raindrops and teardrops

At BMW's Aero-Thermal Test Center near Munich, there are three wind tunnels—two for climate and engine-cooling tests and one for aerodynamics. Research gets a high priority at this company whose cars are now being copied even by Cadillac (with the Cimarron). But BMW is also a company with a sense of



Can BMW blow away rain with this setup?

humor: In England, where BMW cabriolets (open-top cars) are sold, an ad for a "new development" appeared (on April Fools' Day). Air pumped up through the windshield pillars from an underhood blower is forced out through jets in the cowlings above the sun visors. Why not, we say! For keeping dry, it's no more complicated than the hydraulic plumbing for old convertible tops.

Meanwhile, back in the wind tunnel, the search for slithery shapes goes on. BMW's best so far has a drag coefficient (Cd) of .19, pretty close to that of a teardrop. You wouldn't be crying over gas mileage if you could drive this one.

FM



Smooth BMW, but wing mirrors will ruin it.

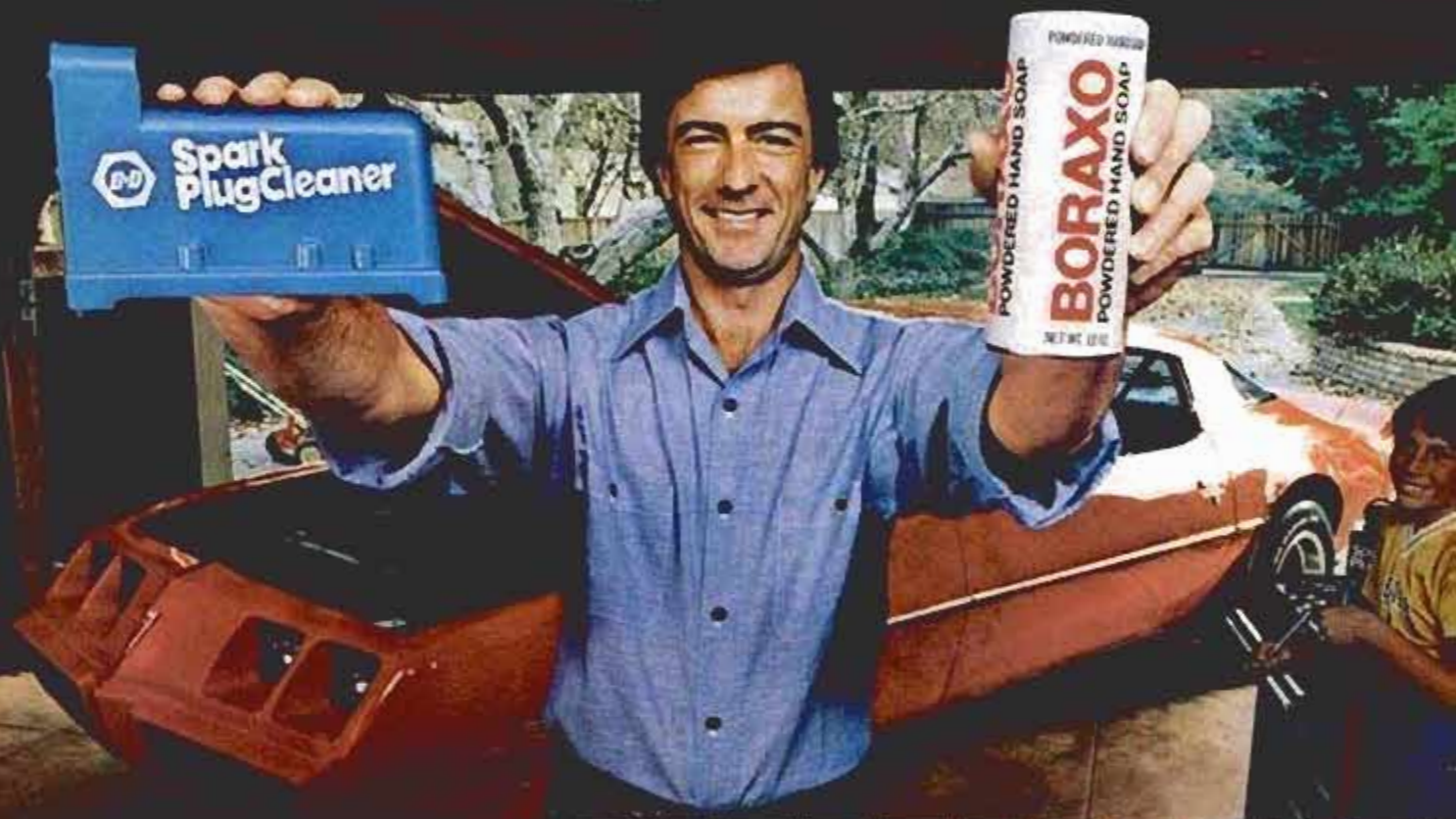


Six-wheel Rabbit is a wonderful aberration of a German car buff.

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1. Trim, then peel the UPC code from the BORAXO container.
2. Cut off the top flap from the box of Spark Plug Cleaner (including model #9514).
3. Fill in your name and address on the form below.
4. Send these items with a copy of your Spark Plug Cleaner sales receipt to: Spark Plug Cleaner Rebate Offer, P.O. Box 9345, St. Paul, MINN 55193.

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(Allow 6 weeks for rebate.) Offer expires Dec. 31, 1981. Postmark no later than Jan. 31, 1982.

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10. Win a trip to Milwaukee for The Real Taste of Beer - Pabst Blue Ribbon

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OFFICIAL RULES - NO PURCHASE NECESSARY: 1. On the official entry blank, circle the number of the real taste trip you want to win. In lieu of the official entry blank, you may write that number on a plain piece of 3"x5" paper. Print your name, address and zip code on your entry. 2. Sweepstakes ends September 30, 1981. To qualify, all entries must be received by October 15, 1981. Enter as often as you wish, but there can be only one winning entry per family. You may enter only one sweepstakes per envelope, and each envelope must be mailed separately to Pabst Blue Ribbon Real Taste of America Sweepstakes, P.O. Box 1018, Rankin, PA 17372. 3. IMPORTANT: ALSO TO QUALIFY, YOU MUST WRITE THE NUMBER OF THE REAL TASTE TRIP YOU ARE ENTERING ON THE OUTSIDE OF THE ENVELOPE IN THE LOWER LEFT HAND CORNER. 4. Winners will be selected by random drawing from among all entries received. Random drawings will be under the supervision of JASP Incorporated, an independent judging organization whose decisions are final on all matters relating to this offer. 5. This sweepstakes is open to residents of the United States who are of legal malt beverage drinking age in their state at the time of the entry, except the following are not eligible to participate in the sweepstakes: employees of Pabst Brewing Company and its subsidiary companies, employees of advertising agencies and other agents of Pabst Brewing Company; employees of

Ribbon AMERICA SWEEPSTAKES



9. Win a trip to Maine for Real Maine Lobster

8. Win a trip to New York City for a Real New York Strip Steak

7. Win a trip to Chicago for Real Deep Dish Pizza

6. Win a trip to New Orleans for Real Creole Cooking

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Circle the number of the Real Taste Trip you want to win:

- | | |
|--|---|
| 1. Alaska for Alaskan King Crab | 6. New Orleans for Creole Cooking |
| 2. San Francisco for Sour Dough Bread | 7. Chicago for Deep Dish Pizza |
| 3. Maui for a Hawaiian Luau | 8. New York for a Strip Steak |
| 4. Montana for a Barbecue | 9. Maine for Lobster |
| 5. San Antonio for Texas Chili | 10. Milwaukee for The Real Taste of Beer |

PABST BLUE RIBBON REAL TASTE OF AMERICA SWEEPSTAKES
P.O. Box 1018 Ronks, PA 17572

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Important: You must write the number of the Real Taste Trip you are entering on the outside of the envelope in the lower left hand corner.

Real Taste Of Beer.

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J&S Incorporated, the families of all such employees, alcoholic beverage licensees and their employees and families. Offer void in the following states or wherever prohibited, taxed or otherwise restricted: Alabama, Colorado, Kentucky, Maine, Missouri, Ohio, Pennsylvania, Texas, Utah, Vermont, Virginia and Washington. 5. All qualified entries received will be entered into the Sweepstakes. 7. No substitution for prizes will be permitted. Taxes on prizes are the responsibility of the prize winner. 8. Odds of winning will be determined by number of entries. 9. For a list of major prize winners, send a separate self-addressed, stamped envelope to: Pabst Blue Ribbon Real Taste of America Sweepstakes, P.O. Box 1022, Ronks, PA, 17572. You must be of legal adult beverage drinking age at the time of entry. **DESCRIPTION OF PRIZES:** 1. Ten First Place Prizes: All trips are for two adults of legal adult beverage drinking age for five days/four nights from city of origin. Expenses covered are roundtrip, first class air fare, deluxe hotel accommodations, double occupancy, transfers from airport to hotel and return to destination city, plus \$500 in spending money. 2. One-Hundred Second Place Prizes: A deluxe assortment of food and food related items with an approximate retail value of \$100 shipped postpaid. 3. One-Thousand Third Place Prizes: An assortment of food and food related items with an approximate retail value of \$25 shipped postpaid.

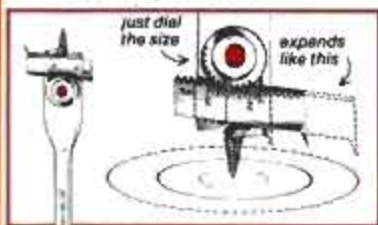


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NOTES FROM THE EDITOR

John A. Jillette

One thing I've just learned about testing cars: The easiest way is simply to have one lone auto editor drive a car and then write about it.

But it's a lot more fun—even if more strenuous—to put together a panel of drivers who are representative of the car owners we quote each month in the *PM Owners Reports*.

That's what the auto editors did for our economy car test (page 65). The idea: Let the would-be owners critique the cars *before* they bought.

It took the full two days of one weekend for the 12 drivers on the panel to do all the required driving and record their comments. In fact, the finale went on into early Monday morning.

How close to real-life driving was our test? "Well," groaned Auto Editor Tony Assenza, "the panel drivers had two flat tires, a broken fan belt, and one car got dinged in the parking lot. And, by the way, Chief, Rich and I managed to roll one when we went screeching around the pylons. Is that a big enough slice of real life?"



Drivers head toward cars in slow-motion LeMans start.



In left-hand photo, Rich Taylor briefs drivers, while Laurle Ann Devereaux keeps the cars camera-ready.



Dunlop (left) with fellow OSS agent Pierce Ellis in Burma. After war, Dunlop became a free-lance writer; Ellis, a book editor.

Richard Dunlop, longtime *PM* contributor and author of *The Real China Syndrome* (page 58), is an old China hand whose first visit to the Orient was anything but a travel agent's dream. Recruited by the Office of Strategic Services (OSS), Dunlop went to Burma in 1944 where he operated with local Kachin guerrillas behind Japanese lines. Harassing the invaders and finally engaging in fierce infantry combat, the American-Kachin Rangers helped drive out the Japanese and open the Burma Road to China. In 1945, Dunlop continued with the OSS in China. His recent book, *Behind Japanese Lines* (Rand McNally, \$12.95), describes these exciting experiences. **PM**

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As part of your training, you assemble and keep NRI's 25" (diagonal) color TV. It's complete with built-in digital tuning that lets you program an entire evening's entertainment. As you build it, you study circuit operation stage by stage, see how electronic faults can be detected and corrected, get practical bench experience that gives you extra confidence.

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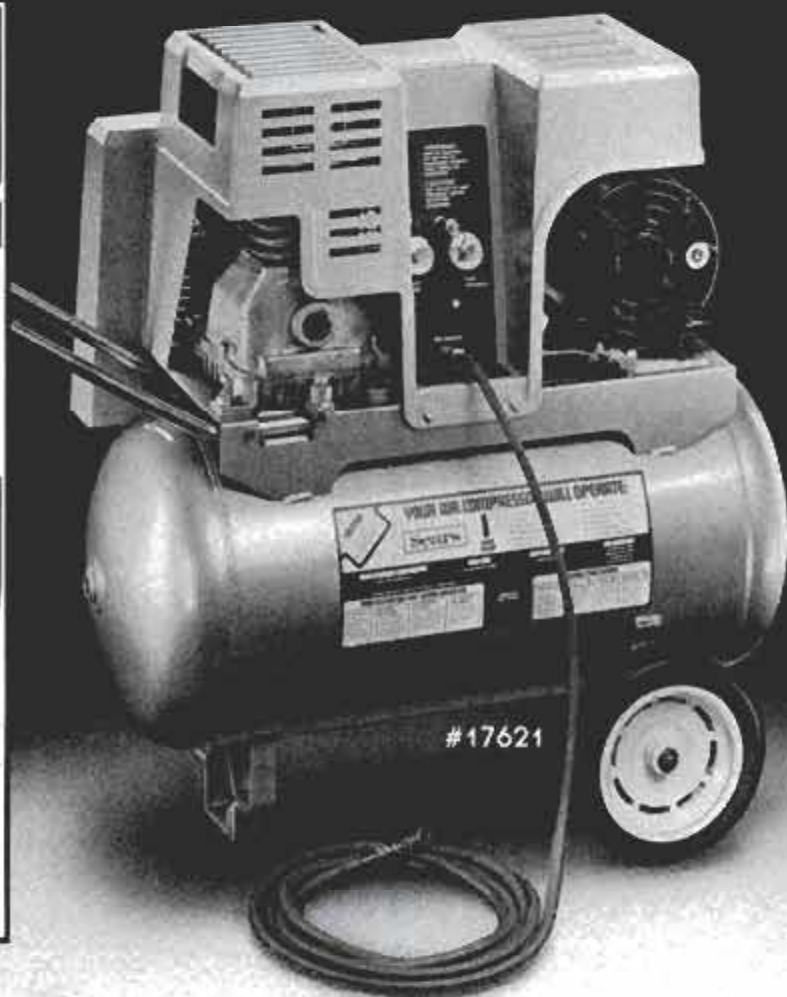
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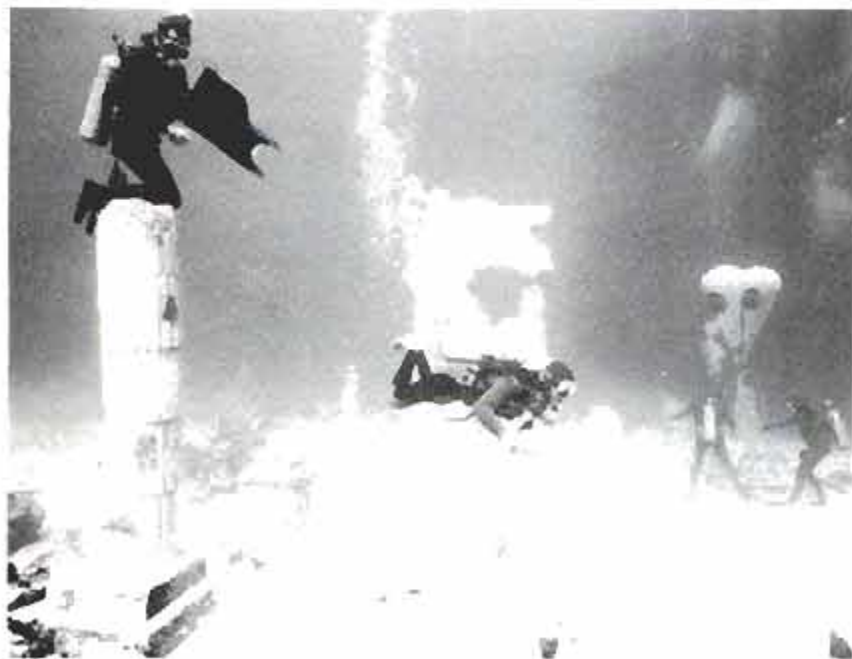
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PM's Whatsit

Turning now to undersea geography, we are asking you to absorb whatever you can find in the way of clues in the scene above and to guess which, among the following, is the approximate sea the undersea scene is under: Arabian; Ionian; Caribbean; Caspian. Correct answer on following page.



PM follow-up: Another chapter in the MiG story

When we published a history of the Soviets' Mikoyan-Gurevich (MiG) aeronautical design bureau three years ago (see *The Ultimate Airplane Killer*, page 72, July '78), there was some necessary speculation concerning current frontline air-superiority (fighter) aircraft. Up to then, to our knowledge, the McDonnell-Douglas F-15, deployed by the USAF and other Free World forces, and the MiG-25 Foxbat, hottest operational fighter in the Soviet Bloc, had never tangled directly in combat with definitive result. That may no longer be the case.

Information derived from several separate, unofficial (nonmilitary) sources indicates that in late April/early May an Israeli F-15 took out a Foxbat operating out of Syria (nationality of pilot undetermined). Details are sketchy, but include the following: The MiG-25 was a reconnaissance version capable of a top speed exceeding Mach 3; it was hit over Israeli airspace by an AIM-7 Sparrow (radar-directed) missile, the latest versions of which are carried by F-15s and have a range of 30 miles or more. Break-up of the Foxbat was evidenced on radar, although it hit the ground back in Syria.

Without a leg to stand on

Bar-stool racing, once the sport of a few lonely pioneers, has matured into another American institution—at least in Modesto, Calif., where these photos were taken by Bill Auda. The Motorized Bar Stool Racing Assn. of America regulates both equipment (8-volt storage battery powering an automotive starter) and demeanor (no hard liquor in or around the pits). That doesn't keep the ambitious racer from adding spoilers and air dams, of course, and some of the current rigs look as if they came out of Jim Hall's racing shop.

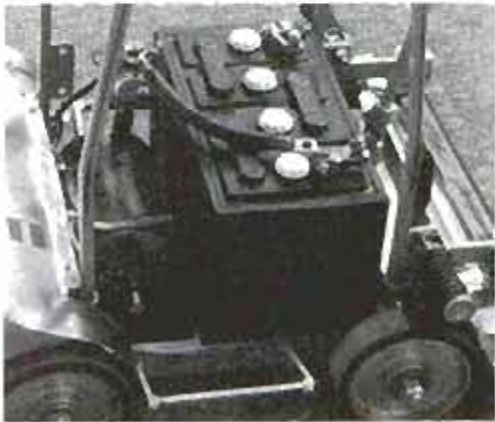
But an entry-level machine can be put together for \$100, Auda tells us, and the 1980 national champ weaved around the course on a basement-built stool without benefit of advanced aerodynamic aids.



Right way.



Wrong way.



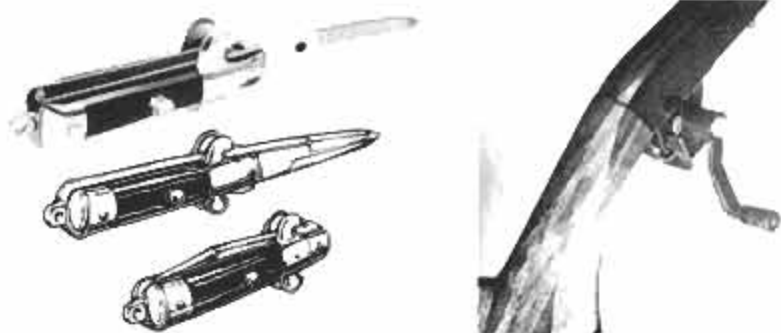
Under the hood.

IPM BRIEFS



Whatsit revealed

The answer: the Caribbean. The best clue is the clarity of the water, not the apparent archaeology. As can be seen in the accompanying photo, the divers are erecting the ruins, not uncovering them. It is part of an elaborate underwater set, built off Nassau, in the Bahamas, for the United Artists movie, For Your Eyes Only, starring Roger Moore as—who else?—James Bond. Now being released in theaters, the film includes some of the most spectacular underwater cinematography ever brought to the surface.



Proof positive that not all new ideas are good

The decade has hardly begun, of course, but among the ideas whose time may have already come and gone in the 1980s are the following: a ballpoint pen that looks like a switchblade knife; a plastic hand crank to provide rapid fire from a semiautomatic .22 rifle; heavy-duty containers for burying coins or other valuables in the backyard—just think, in only a year \$1,000 could be worth \$750.



Tips for prop-stoppers

Here's an unusual photo contest that sounds like fun: The Aviation Hall of Fame of New Jersey, headquartered at Teterboro Airport, is calling for entries that best illustrate "the spirit of

flight." It's open to professionals and amateurs; prints (8x10 minimum size) and color slides will be judged, and the deadline is Sept. 30. Winners will receive free vacations, cameras and other merchandise through several sponsoring firms. An entry fee of \$2.50 should accompany submissions (as many photos as you care to send) addressed to: Photo Contest Headquarters, Custom Pilot Shop, 500 Industrial Ave., Teterboro, N.J. 07608. (Fees will be turned over to an aviation museum fund.)

Pictures of all types of aircraft are eligible, but most will probably be of fixed-wing airplanes—which aren't as easy to photograph as many people think they are. Against an all-sky background, airplane shots are often unexciting; yet it's tough to "pose" a flying machine against the right backdrop. Pros who do it for a living offer this tip: To get a complete propeller arc, shoot at a shutter speed of 1/60 second or slower. If you need a faster shutter to negate camera or subject movement, you'll have to settle for a blur or partial arc, which will depend on the rpm of the propeller. But if you shoot faster than 1/500, you may stop the prop entirely—definitely the wrong stuff when it comes to evoking the spirit of flight.

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Solid-state, electronic mini-computer lets you program up to 5 separate cycles at one time. Even if you program cycles in wrong order, the oven will perform them in the proper sequence!

PROGRAMMABLE DELAYED COOKING! Leave the house for up to 12 hours and oven will start all your programmed instructions BEFORE you return!

PATENTED BEAM STIRRER! For more even distribution of microwaves and more thorough cooking.

LARGE CAPACITY! Big 1.3 cu. ft. interior can hold an 18 lb. turkey. Can cook an entire meal at one time.

ELECTRONIC DIGITAL TIMER! Set cooking time for a few seconds or up to 99 minutes, 99 seconds. The five second buzzer signals completion of cycle.

10 SEPARATE POWER LEVELS! For every type of cooking need... from slow all the way to fast.

COMPARE WITH TOP BRANDS!

Compare all the wonderful features of this superb oven with top-rated models by Amana or Litton. Then compare our low liquidation price! That's how to prove to yourself what a sensational value this is!

For your added assurance of quality and performance, this deluxe Omega microwave oven meets the strict requirements of U.S. Dept. of Health, Education & Welfare; Natl. Sanitation Foundation; Underwriters Laboratories; Canadian Standards Assn.



700 WATTS COOKING POWER!

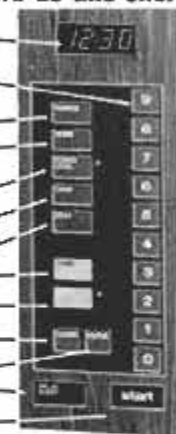
BROWNS MEAT, TOO!
When cooked about 15 minutes or more.

CAN COOK A WHOLE MEAL AT ONE TIME!
Uses normal house current. Plugs into 15 amp., 110-120V outlet. Must be 3-prong grounded outlet for proper performance.

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Programmable 110° to 200° F.

We have liquidated over 9000 microwave ovens by Caloric (made by Amana), Panasonic, Tappan, Toshiba. But NEVER have we offered such a sensational bargain on a microwave oven as superb as this one!

- L.E.D. DIGITAL DISPLAY:** Shows time of day, cooking time, power level at your command
- NUMBER SELECTION:** Tap the ones you want for cooking time, power level, meat probe temperature, time of day
- SIMMER:** For medium energy.
- WARM:** For lowest power setting on sauces, yeast bread, to soften butter and cheese, to keep foods warm
- POWER LEVEL:** Tap it before selecting any of 10 different power levels.
- TEMPERATURE PROBE:** Tap it before setting desired temp. for meat probe
- REST:** Lets time pass between cycles
- THAW:** Uses 50% of power for thawing or for cooking delicate foods.
- COOK:** Produces 700 watts power for fastest cooking cycle.
- CLEAR:** Cancels out any information you previously programmed.
- CLOCK:** Tap it to display time of day
- DELAY:** To delay start of your cooking instructions up to 12 hours if desired
- START:** Just tap to start the functions you programmed.



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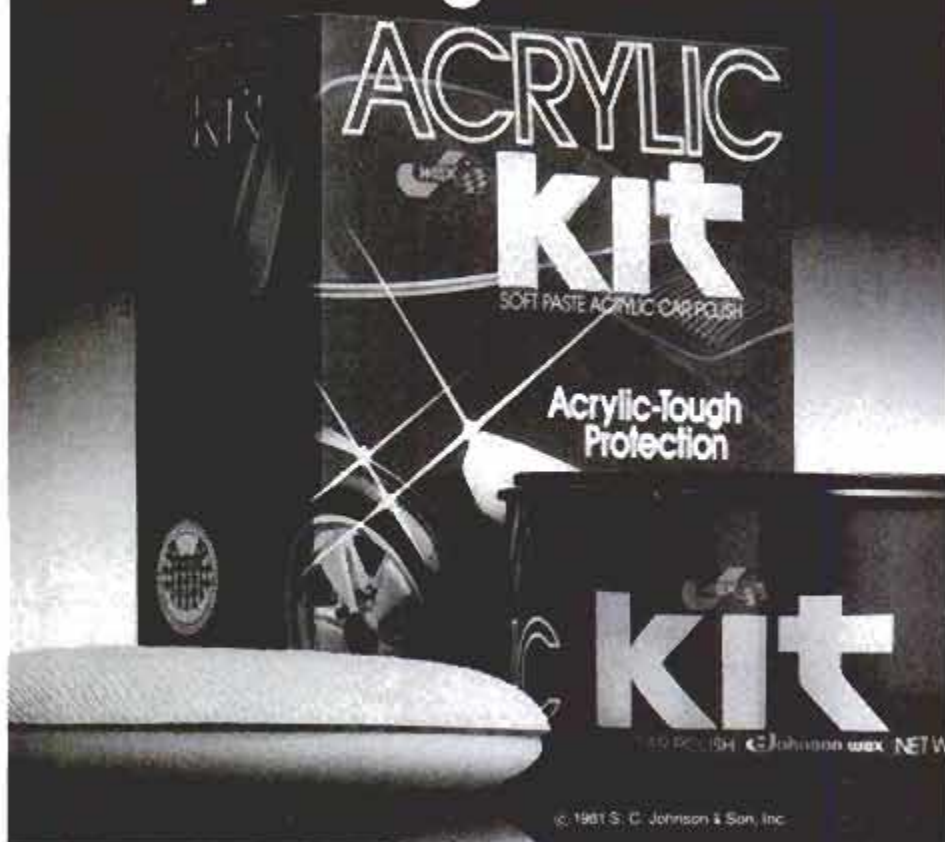
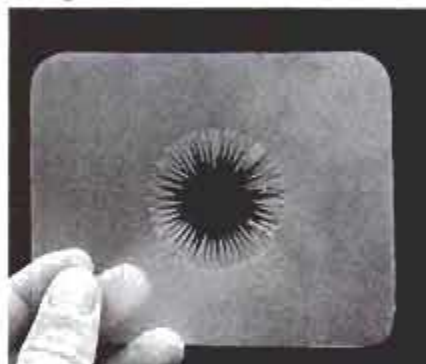


PHOTO HINTS

Bring home the bacon



A vignetter is a handy photo accessory. This one was made from a frosted piece of plastic—from a bacon package. Draw concentric 1- and 2-inch circles, cut them out with a penknife and overlap them. Or try other shapes and cost-free materials.

—Wayne Fugate

In the box



Enlarger lenses must be kept away from dust and grime. Discarded Band-Aid boxes work great. They take standard 50-mm and 75-mm lenses which are used with 35-mm and 6×6-cm films.

—Robert Hertzberg

Quick way to dry



If you need to dry stainless-steel developing reels in a big hurry so you can develop more rolls in a short time, here's how: A small toaster oven (on low) will dry them in minutes.

—Robert Hertzberg

Jock Itch is a fungus.

Cruex® kills it.



Read and follow label directions.

It's a medical fact: the painful itching, chafing, burning rash of Jock Itch is caused by a fungus that can't be killed by non-medicated powders, creams, or salves.

You need Cruex antifungal medicine. Its active ingredient is medically proven to kill Jock Itch fungus. And Cruex soothes the itching, chafing and burning.

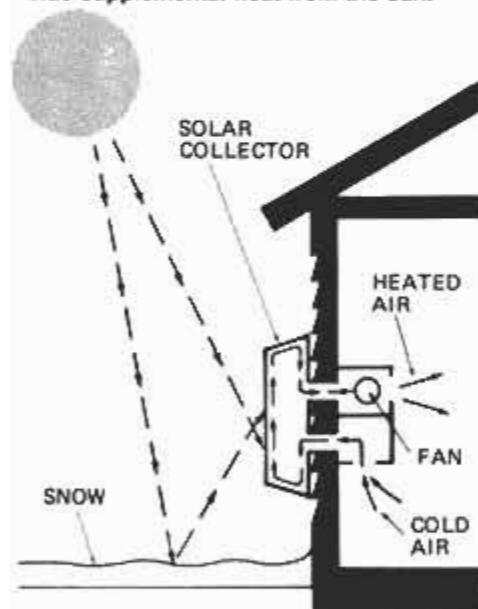
Get fast relief and kill Jock Itch fungus—with Cruex. From the makers of Desenex®

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Solar collector panels you can install yourself



Two-story home has a solar panel mounted vertically at the second-story level to provide supplemental heat from the sun.



This solar collector panel is designed to be installed by the homeowner. The sun's rays are absorbed by the panel, and the heat is transferred indoors by a fan when the panel temperature reaches 85°F.

The fan also draws cool room air into the panel for reheating. When the temperature drops to 75°F., the fan automatically stops. A kit with a 4x8-ft. panel, fan and installation accessories is \$860 from LPC Inc., New Richland, Minn. 56072. A 4 x 10-ft. panel kit is \$950. **PM**

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The Dartmouth

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HINTS FROM READERS

Salvaging a sink rack



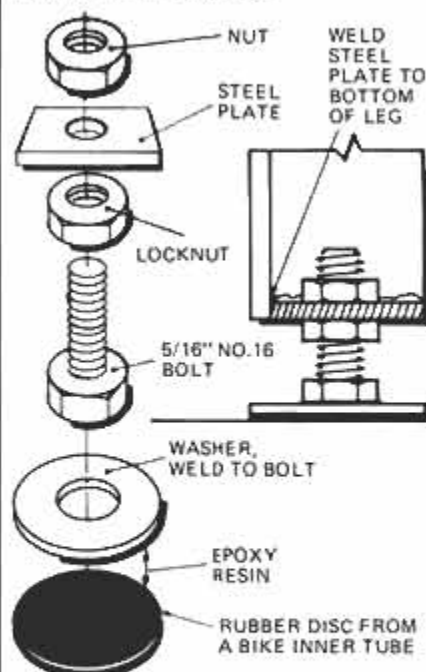
Recently, I lost one of the "feet" from an otherwise perfectly usable sink dish rack. I made a new foot from a short length of garden hose. After filling the hose with a small wooden plug, I secured it to the rack with rubber cement. The rack now stands level.

—Walter E. Burton

Vinegar loosens bolt

If you don't have any penetrating oil on hand, use household vinegar to loosen a rusted bolt or nut.—Lane Olinghouse

Power-tool levelers



I put these levelers on the feet of all my stationary tools so they can be adjusted absolutely level. The rubber cushions absorb vibration.—Jay Wallace



THE LESS YOU USE YOUR CAR THE MORE YOUR ENGINE NEEDS RISLONE!

Engines used for stop and go trips, or run for less than half an hour at a time, form crankcase sludge! Sludge plugs oil filters and oil passages. It can block the oil pump screen so that working parts may starve for oil!

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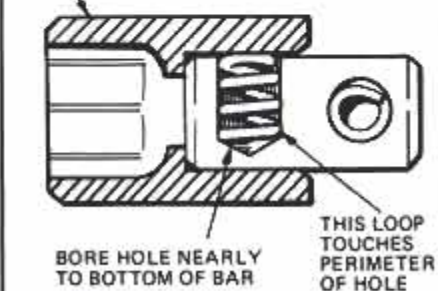
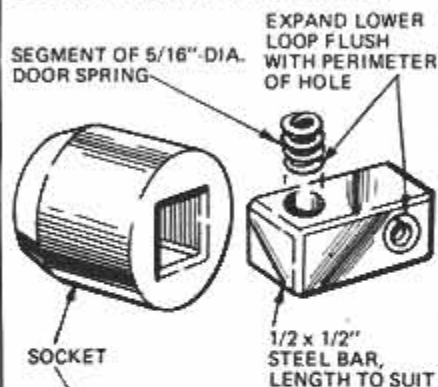
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HINTS FROM READERS

Socket-wrench extender bar



Extender bar with springs (arrows) joins two sockets; it can also join a ratchet-wrench handle to a socket.

Make your own socket-wrench extensions with $\frac{1}{2} \times \frac{1}{2}$ -in. steel bar; they can include a spring locking arrangement similar to the ball-and-spring design on commercial extenders. It connects sockets to your ratchet-wrench handle or joins two sockets.

Cut steel bar to required length and bore holes near the ends for the coil springs. I used $\frac{5}{16}$ -in.-dia. screen-door springs. Stretch the springs to separate coils, making them compression springs. Bend the loop at the outer end of each spring so a smooth part of it will bear against socket walls. Enlarge the other spring end slightly with a punch, so it fits tightly in its hole.

To insert bar in a socket, press in projecting spring to clear socket edge.—Walter E. Burton

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The sharpening business allows you to get started with only a minimum investment, requiring little space and effort for a successful operation. It lets you build and expand as fast, or as slowly as you like. You pocket most of the money you take in, because there are exceptionally high profits with no investment in merchandise.

If you need only \$200 or \$400 extra income each month, a sharpening business is ideal for spare time. The additional dollars can be SPENT for more of the good things of life. Or they can be SAVED in a rainy-day fund that the family can bank on.

More sharpening businesses are needed every year

As original equipment continues to climb in cost, owners are becoming more concerned that the equipment be maintained so that it performs like new. This means more companies, contractors, carpenters and home owners are having their old saw blades and tools resharpened many times. Where in the past, they would have replaced them with new blades or tools. This is where you

can step in with the much needed service of sharpening saws and practically any kind of tool.

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PM ELECTRONICS MONITOR

Shopping the future

The new summer catalog from Sears contains children's wear, women's apparel, appliances and everything else you might expect. But the catalog we saw has no pages—it's a videodisc.

The disc will play on the laser-light players now marketed by Pioneer. The catalog is completely interactive and takes full advantage of this new video technology.

The disc contains still-life pictures, indexes and live-action shows. All frames can be reached in seconds from anywhere on the disc, because the Pioneer player has pushbutton search capabilities.

You might start a typical viewing session by keying up the index onto the TV screen using the video player's pushbuttons. Women's wear, for example, would be listed in the index by frame numbers. Then you'd just go to those frames. But first, you might want to watch one of the three fashion shows on the disc. The back of the album tells you what disc "chapters" are fashion shows, so a quick touch on the keyboard can have you gazing raptly at lovely models sporting Sears' various lines.

The production and direction on



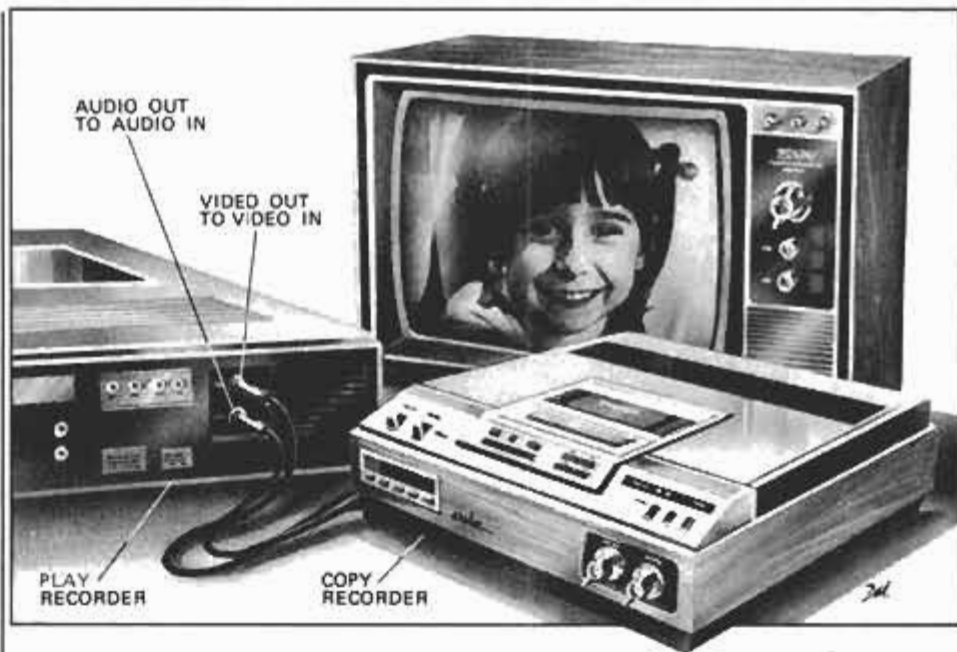
Talk-Back is new learning, entertainment computer using Walt Disney's Mickey Mouse. It's \$139.95 from Unisonics.

this disc, by the way, are top-notch, with special effects and interesting photographic techniques. It's not like watching a commercial.

The album sleeve tells you how to order from the catalog. It even details various postal regulations.

The catalog is one of the first applications of the vast capabilities of the new laser-disc systems. This is not passive entertainment: It's active involvement through interactive video.

Today a catalog; but the future may bring bright, laser-light presen-



Getting your signals crossed

People who own noncompatible VHS and Beta videotape recorders often assume that they cannot copy video cassettes from one format to the other. After all, they reason, you can't play a VHS tape on a Beta player—or vice versa. But you can copy: All that you have to do is

attach the video output of the machine playing the tape to the video input of the machine that you want to copy on. Follow the same procedure with the audio inputs and outputs. Tape formats do differ—but the video and audio signals are the same.

tations for education, entertainment, home helps and other fields.

Teaching with turtles

Texas Instruments has been considered the sleeping giant of the home-computer industry with its TI-99/4 personal computer. What we just saw in New York has convinced us that the giant is on the move.

A new language program—called LOGOS—is the best learning program we have seen to teach kids about computers. The program lets even 3-year-olds put the TI-99/4 through complex and colorful maneuvers.

A triangle on screen is termed a "turtle." With simple inputs on the keyboard, a child can manipulate this turtle. By telling it things like "Rt 30 FD 10" (meaning, turn right 30° and take 10 "turtle steps") he can have the turtle leave colored lines behind it as it moves. Movement is fast and smooth, so stars, pentagons and other designs quickly become interleaving, kaleidoscopic displays.

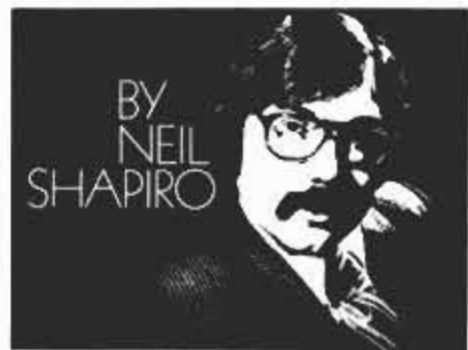
The LOGOS program also comes with predefined shapes called "sprites." A sprite (be it an airplane or a truck) can move all over the screen by using the turtle commands. Students can also design their own sprite shapes.

One program, designed for preschoolers, displays "sprites" that look like cartoon heads, arms, legs and torsos. Using just a few keys, a child can mix or match his or her own little, graphic people.

The manual, we are told, will be extensive enough in some parts that an adult will be able to learn recognized Piaget teaching methods. These methods could then be used for at-home education using LOGOS. Other parts of the manual will be at a fourth-grade reading level, so many kids will be able to teach themselves.

Computers are being used in an ever-increasing number of schools. Now, Texas Instruments has taken the fun aspects of learning and packaged them into its TI-99/4 computer—they're hoping you'll bring the system home.

PM



Gas Saver Tested & Patented

DENVER—The Copley News Service reported that United States Patents have now been issued to Wm. Trevas-kis, California veteran electrical engineer, for his Vapor-Jet® brand water vapor injector.

Trevaskis has developed what amounts to a 20 cents per gallon "rebate" potential on gasoline, by designing a low-cost injector for automobiles, light trucks, vans and recreational vehicles.

The Vapor-Jet® system has test results showing miles per gallon improvement of 17.3 per cent on Trevaskis' 1971 Ford Galaxy and 13.3 per cent on his 1973 Olds Starfire.

Water injectors were developed to a highly refined state during World War II, to give combat planes increased speed and extended range. However, up to now, the low price of gas and the high cost and extremely difficult installation required for earlier injectors combined to make them unattractive.

The Vapor-Jet® has an unconditional 60 day guarantee.

How does the Vapor-Jet® system work?

Vapor-Jet® operates very simply with no moving parts to wear out. It uses engine vacuum to pull outside air through a reservoir containing a water/methanol mixture which is attached to the car under the hood. This causes the fluid to bubble and a mist to form in the upper part of the reservoir. This mist is then drawn by vacuum through a hose which is connected to any intake manifold suction hose. This connection is made very simply by our exclusive hypodermic-like injector nozzle which contains a regulator to allow just the right amount of mist to pass into the combustion chamber.

The introduction of this mist into the fuel air mixture has a cooling effect that increases the mixture density, extends the burning rate, and improves combustion efficiency. This eliminates ping (predetonation) and dieseling (after running of motor). Since steam is a good cleaner it also helps dissolve carbon deposits on the spark plugs and cylinder walls of older vehicles and helps prevent carbon buildup in new ones.

How much mileage increase can be expected?

This varies from car to car. Independent testing on Trevaskis' car obtained improvements from 13.3% to 17.3%.

Will Vapor-Jet® fit all cars and is it



easy to install?

Yes. Vapor-Jet® is easily installed on all domestic and foreign cars, vans, light trucks, R.V.s, campers, motor homes, and small boats. It will work on fuel injection, lean burn cars and cars with turbo chargers and super chargers and rotary engines. It will also work with unleaded gas, gasohol, or propane burning cars. The same kit fits all cars and contains everything needed. Simple installation instructions with a diagram are included and even a novice should be able to install it in less than 15 minutes. Simply take an ice pick or drill and make a small hole through any intake manifold suction hose (i.e.; PCV hose, brake assist hose, vacuum advance hose, etc.). Screw the injector nozzle into the hole, mount the reservoir by means of the bracket and screw supplied and connect the reservoir to the injector nozzle by means of the hose supplied. If you don't want to install it yourself most service stations will for a few bucks.

Can Vapor-Jet® damage my engine or cause rust?

Absolutely not! Vapor-Jet® cools down the fuel air mixture giving a better burn and suppresses ping thus aiding your engine. The mist that enters into

the engine turns immediately into vapor and exits out the exhaust.

What is the purpose of the methanol V.I.M. (Vapor Injector Mix) and how long does it last?

The reservoir measures 3½" x 5½" x 7½" and holds just under ½ gallon. A full reservoir should last about 1,000 miles. Methanol (wood alcohol) is mixed with water mainly to prevent freezing and to keep the injector nozzle clean in non-freezing weather. The cost of methanol is minimal (about \$5 a gallon). One gallon will last 8,000 miles. Sources of methanol are chemical supply houses, paint stores and drug stores. Substitutes are gas line antifreezes that contain methanol such as "Heet".

For purchase, or further information, write or call Progressive Energy Corp., 3148 So. York, Englewood, CO 80110, (303) 762-1385, or call toll free (800) 525-8624. Dealerships available.

(Offer void in CA.)

Enclose \$29.95 + \$3.00 shipping and handling.

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Name _____ Exp. Date _____

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60-day money-back guarantee

WORKSHOP MINICOURSE

HOUSEHOLD FINISH CARPENTRY

Many of the little tasks that a homeowner does in the course of do-it-yourself projects go unnoticed. Subflooring is hidden by finish flooring or carpet, plasterboard joints are papered over, and so forth. If your work happens to be a bit careless on such jobs, it makes little difference. But that isn't the case with finish carpentry. Here, everybody gets to see what kind of craftsman you are.

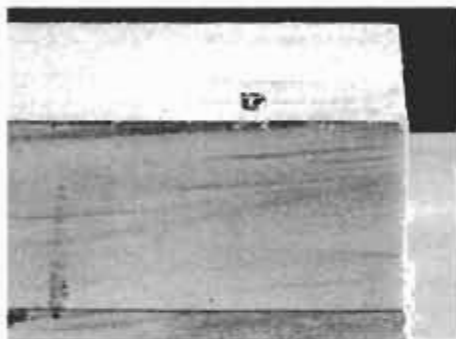
So take time to master the basics shown on this page. Next month, we'll run other professional carpentry tricks that will upgrade your finish carpentry. **PM**



Basically, two types of nails are used in house carpentry—the common nail (left) and the finishing nail. The latter features a small cupped head for easy setting.



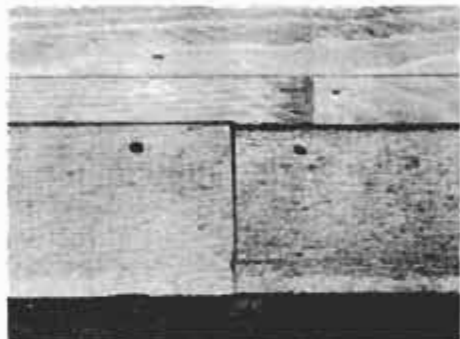
To drive a finishing nail, grasp it between thumb and index finger and start nail with several light taps of the hammer.



You should never drive a finishing nail home with your hammer. Instead, stop driving the nail when it is about 1/4 in. above the wood surface, as shown here.



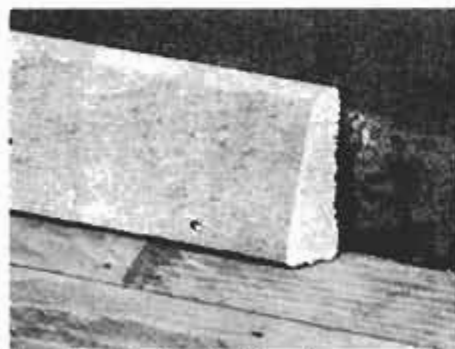
Position a 1/2-in. nailset in the head's dimple and set the nail with one or two sharp raps of the hammer. Hold the set securely so that it won't "dance" out of the nailhead and cause damage to the wood.



The wrong way to install a long run of baseboard—with square-cut ends simply abutted, as shown here. Such careless joinery is a sure indication of inferior workmanship.



Instead, make joints in long runs using a miter. Use a miterbox for accurate cuts.



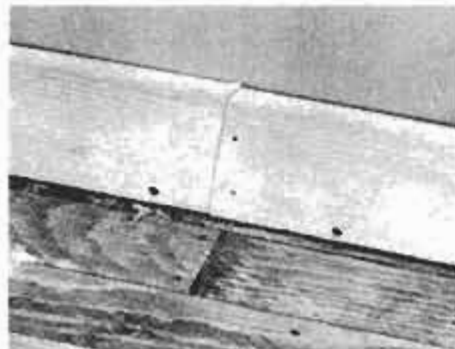
The first strip installed has the open miter.



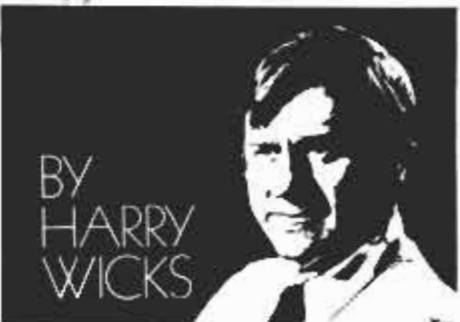
You should apply glue to the miter surfaces and then install the second mitered piece.



Secure miter joint with a couple of 3d (1 1/4-in.) nails through the joint, as shown here.



Close the finished joint tightly, and it will stay that way without ever opening up.



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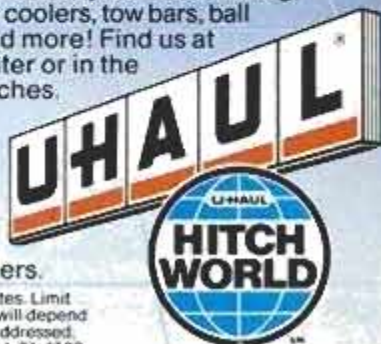
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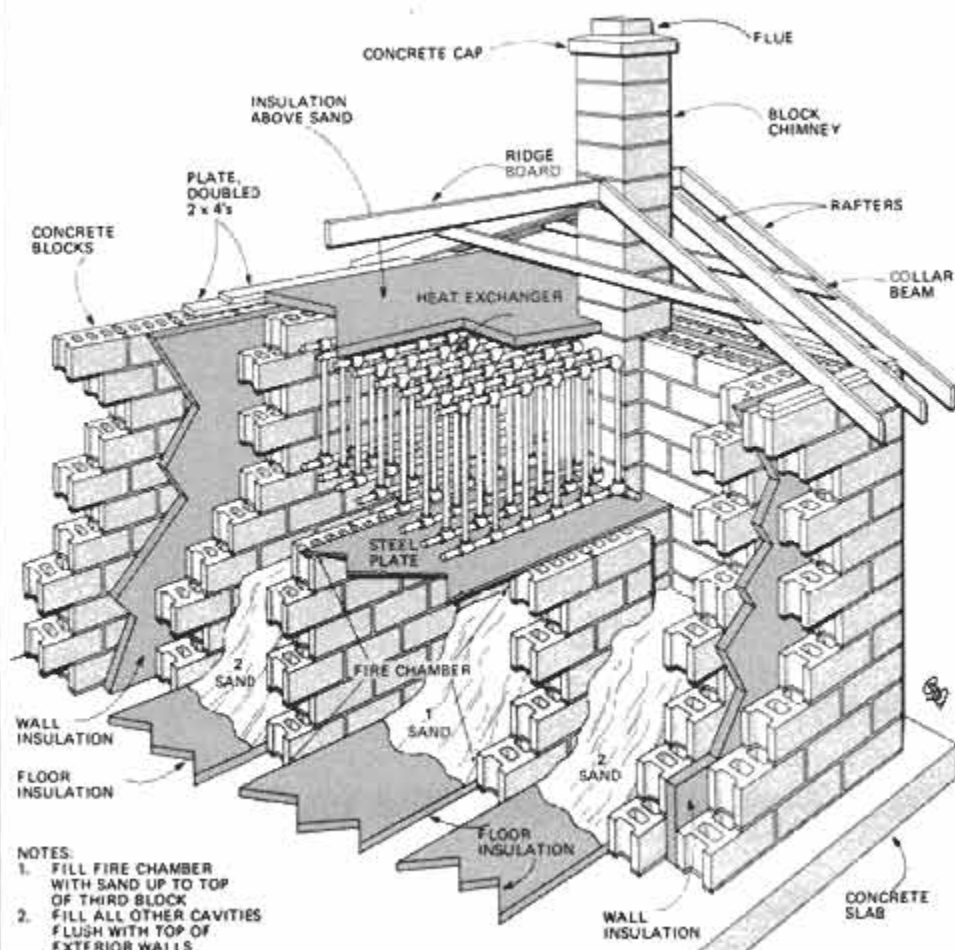


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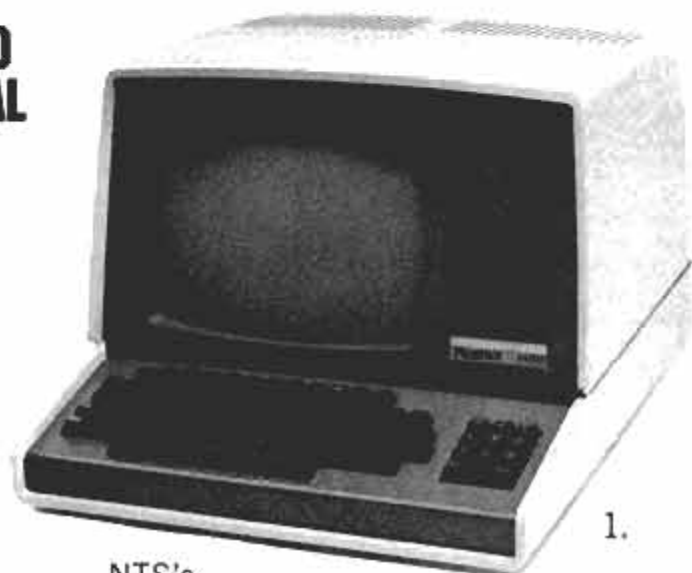
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CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



In the limelight

A Chicago television station recently presented a program concerning the Volkswagen Rabbit, Scirocco and Dasher. According to the report, these cars are experiencing engine failure. I own a 1979 Rabbit which has been driven only 3,500 miles. If the report is true, can you tell me what I can do, if anything, to protect my Rabbit engine?—Ron Bock, Country Club Hills, Ill.

There is a problem, which has led to a lawsuit against Volkswagen by the Federal Trade Commission (FTC). The suit alleges that VW failed to warn customers about "the potential for engine, valve and cylinder head repair related to high oil consumption on 1974 through at least 1979 VW and Audi water-cooled engines."

The FTC claims that excessive oil consumption (one quart every 200 to 600 miles) begins to show up when cars are driven 20,000 to 40,000 miles. Since oil capacity of the VW engine is only 3.2 quarts, rapid consumption which is not detected leads to complete depletion and, subsequently, to engine seizure and extensive valve and cylinder damage. Repairs cost as much as \$2,000.

But enough about the problem. What about prevention? Now that you've been warned, the most important precaution, obviously, is to check engine oil level often—such as every time you fill the fuel tank. If oil consumption suddenly shows a sharp increase, replace valve-stem seals with an improved seal (part No. 035109675), which has been issued by VW. The original valve-stem seals appear to be at the root of this problem. They have a tendency to lose resiliency when subjected to engine heat for prolonged periods. When seals dry out, they can't keep oil from flowing into cylinders where it is burned. If the improved seals fail to control oil consumption, the next step is to replace valve guides.

For those who have experienced engine damage, they have to stand

the cost of engine repairs. If the FTC suit is successful, they may be reimbursed. At this point, however, VW denies liability and states that the company "has not violated any law, either in designing, manufacturing, selling or servicing its vehicles."

GKN re FWD CV

In your Saturday Mechanic article, Servicing Detroit's Front-Wheel-Drive Generation (page 53, Apr. '81), you suggested that although the Chrysler K-car and Ford-Mercury Escort-Lynx don't call for inspection of drive-axle boots, the GM X-car 30,000-mile inspection schedule should be followed for all makes of cars. This is excellent advice on which I would like to expand.

The constant velocity (CV) joints which these boots protect may well be GKN (Guest, Kean and Nettlefolds) joints. GKN is the world's largest manufacturer of CV joints and axle driveshafts, and we are proud of the reputation our products enjoy.

CV joints at each end of the two front-drive axles are the key components that make front-wheel drive tolerable for the driver and vehicle. By comparison with universal joints in a conventional propeller shaft, CV

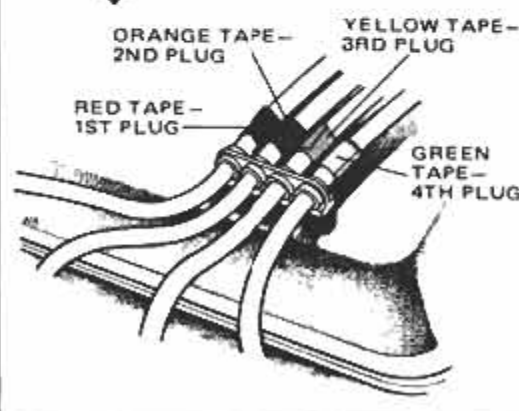
joints are very sophisticated, sensitive and costly. If they remain well lubricated and protected from dirt and other contaminants, they will deliver many thousands of miles of trouble-free performance. However, joints are dependent on the protective rubber boots to retain lubricant and to shield them from contamination. Boots are, all too often, the Achilles heel of CV joints. Their clamps may loosen or flying stones may puncture the rubber. In any case, lubricant escapes and dirt enters.

Therefore, boot inspection is important—in our opinion, much more frequently than every 30,000 miles. We advocate that car owners inspect drive-axle boots every time the car is on a lift. Danger signals are usually obvious and include loose clamps, a visible tear in a boot or grease spray in the vicinity of the CV joint. Repairs should be immediate and entail:

- Removing the axle driveshaft from the car.
- Removing and discarding the boot and clamps.
- Cleaning off old lubricant.
- Inspecting the CV joint for damage.

If much lubricant has escaped or dirt has entered the CV joint, a new CV joint will be required. Otherwise, fresh lubricant, a new boot and new retaining clamps must be fitted to the joint. Lubricant, boot and clamps must all be to manufacturer's specifications. Lubricant contains special additives, rubber is specially compounded and clamps are designed to exert enough, but not severe, clamping pressure. Never use screw-type hose clamps—they will damage the boot.

I hope this explanation assists
(Please turn to page 40)



Rainbow under your hood

From Athens, Tex., Rev. William Harris writes, "I have a method for identifying sparkplug cables, so I can reattach them correctly to their respective sparkplugs. When I was in high school, one of the things I memorized was the order of colors of the spectrum: red, orange, yellow, green, blue and violet. I've used this since then to mark the order of sparkplug cables on my cars. My method is more or less permanent.

"When I buy a car, I attach a strip of colored electrical tape to each cable; red to No. 1 cable; orange tape to No. 2 cable; yellow to No. 3; green to No. 4; blue to No. 5, violet to No. 6. This way, I don't have to fool around with attaching and detaching clothespins. The tape stays neatly in place."

By clothespins, Rev. Harris refers to the numbered clothespin method of identifying cables described in articles we've published throughout the years. He has a good suggestion—if you aren't color-blind.

CAR CLINIC

(Continued from page 39)

your readers in keeping the CV joints of their front-wheel-drive cars trouble-free—Daniel W. Hazebrook, Director of Engineering, Automotive Components Inc., Southfield, Mich.

It should, Mr. Hazebrook. Thanks for the information.

The connector connection

Like clockwork, the sensor of my 1976 CJ5 Jeep electronic ignition system fails once a year. Please help. I've checked everything.—Ed Montgomery, no address.

Everything? Probably not. The connector that plugs the sensor into the connector of the ignition wiring harness has been the weak link in this system. If you haven't treated this as the cause of your problem, you haven't checked "everything."

The sensor itself usually isn't to blame. Instead, it's the connector which may be corroding. A combination of road vibration and corrosion interrupts the circuit between the sensor and rest of the ignition, causing the engine to stall. When you replace the sensor, you eliminate the problem for a while, because the connector is part of the sensor

assembly. However, as soon as the connector of the new sensor begins to corrode, the problem returns.

You can get rid of this trouble once and for all by getting rid of the connector. Cut off the connector that's part of the sensor assembly. Also cut off the connector that's part of the ignition wiring harness. Strip insulation from wires. Then, solder wires together; that is, solder one of the sensor assembly wires to one of the harness wires. It doesn't matter which wire you solder to which wire.

This is an a.c. (alternating current) circuit, so polarity isn't a factor. Finally, wrap wires with electrical tape.

Incline decline

My 1978 Chevrolet van (350-cu.-in. V8 engine with four-barrel carburetor) suffers from fuel starvation in high places. The condition began on a trip out West last summer and is getting worse. The engine dies when the van climbs hills, but invariably on getting back to a level area, it runs

Stop the contortions

Have you ever noticed the contortions that some drivers go through in order to get change out of their pockets when they come to a toll booth?

Phil Ginsberg, who runs Quality Auto Seat Covers in Brooklyn, N.Y., has—and those contortions have kept his shop busy fixing broken seat backs for years.

Phil says, "The main culprit for broken seat backs is the driver putting all his weight against the back of the seat and pushing against the floor, while reaching for change. I don't mind the business, but to me it's an unnecessary repair that could be avoided if people just got their change ready."

We agree, Phil. The next time we go through contortions, we'll be certain to remember your advice.

PM CAR CARE
TIP



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fine. I've replaced the fuel pump, but this hasn't helped. Do you have a solution?—T.H. Callahan, Atlanta.

Try a new fuel hose (part No. 14010036). The original hose, which isn't reinforced, gets soft as it gets older. It reaches a point at which it collapses when subjected to the increased vacuum developed by the engine pulling the van uphill. This cuts off the flow of fuel to the engine. Unlike the original, the new hose is reinforced and resists vacuum.

Hard sell?

I own a 1978 Toyota Corolla liftback. The salesman who sold me the car told me to use a Toyota oil filter because of some sort of valve which enables quicker circulation of oil when the engine is started. Is this a ploy to encourage purchase of Toyota parts?—Charles Bettencourt, Swansea, Mass.

A Toyota oil filter has an oil-retention valve, which covers the inlet holes in the filter when the engine is turned off. This keeps oil in the filter instead of letting it drain back into the crankcase. Upon restarting, the engine therefore doesn't have to wait for oil to be pumped from the crankcase. The engine receives immediate lubrication.

Many oil filters other than Toyota's also have this feature, but there are others that don't. A Toyota engineer says: "We recommend the Toyota oil filter, because we know it has the oil-retention valve."

'Dipsepsia'

I have a problem with my 1979 Chrysler New Yorker. According to specs, the engine requires five quarts of oil. I put in only four after an oil change, started the engine and let it run so I could check for leaks. The dipstick showed that the oil level was over the word FULL. Could I have gotten the wrong dipstick?—W.E. Zeigler, Sapulpa, Okla.

Yep. Or you could have a wrong or improperly positioned dipstick tube. Ask a dealer to let you compare your dipstick with a similar one. If the markings line up, have a new dipstick tube put in. If the markings don't line up, get a new dipstick or re-mark the old one.

GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

SERVICE TIPS

■ Ford reports that it has solved the problem of an oil leak around the oil filter of 1978 Couriers with 1.8-liter engines and 1979-81 Couriers with 2.0-liter engines.

Just use the newly issued Motorcraft FL-752 oil filter, rather than the filter called for in your manual (Motorcraft FL-295). The new filter provides increased gasket contact with the engine mounting pad, sealing off the leak as a result.

■ Check the lower radiator hose on 1981 AMC Spirits and Concords with four-cylinder engines to see if the hose is hitting the front stabilizer bar or frame side sill. If the hose is being rubbed, drain the cooling system and disconnect the hose from the radiator. Then cut 1½ in. from the end of the hose and reconnect it.

■ You may find the oil-fill cap of your 1981 Ramcharger, Trailduster or Dodge D or W model truck (318- or 360-cu.-in. V8 engine) tough to reach. If so, install an oil filler extension tube (part No. 4773223) and new cap (part No. 2960622). Dodge dealers have these parts or can get them for you.

■ Here's a diesel engine caution from GM: Never bypass the glow-plug relay of the fast-glow control system to test the relay or the glow plugs. Jumping the relay to energize the glow plugs bypasses the internal circuitry which controls the temperature relationship of the plugs. This will cause them to burn out. ☞



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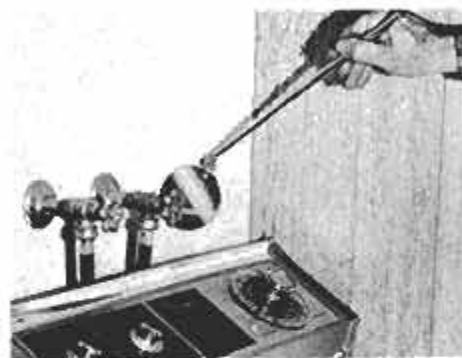


Housing is chromed, zinc-aluminum alloy.

Inspection mirror

This inspection aid comes with three interchangeable, unbreakable mirrors sized at 1 1/4 x 2 in., 2 x 3 1/4 in., and 3 3/4 in. diameter. The telescoping handle extends and locks in any position from 10 to 26 in. to keep hands and head out of dangerous areas.

Made by Steinen of Carolina Inc., 2308 Airport Rd., Kinston, N.C. 28501, it's \$10.99, plus \$2 for shipping and handling. —H.W.

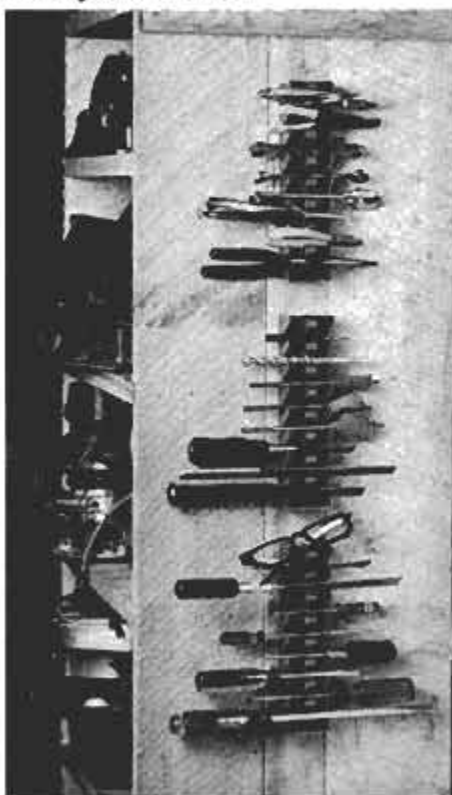


Mirror makes many hard-to-reach inspections, such as checking appliances, easier.



Ball-joint design ensures easy adjustment.

Handy tool holder



Racks can be used vertically or horizontally on a wall and flat inside a tool drawer.



Tools are held fast by tension of the clip.

The Spanger tool holder eliminates the awkwardness of storing small tools on perforated hardboard. The tempered-steel spring clips hold tools of up to 1/2 in. in diameter onto the 20-gauge, cold-rolled-steel chassis. Each unit is coated with a tool-box-red epoxy to prevent rust. Made by Hotchkiss Development Co., 451 Cedar Hill Dr., San Rafael, Calif. 94903, they're \$3.99 at hardware stores. —Joseph R. Provey

Drywall clips

The Prest-On Drywall Corner Fastener is a 24-gauge, galvanized steel clip that eliminates the need for wooden backing (nailers) at inside corners.

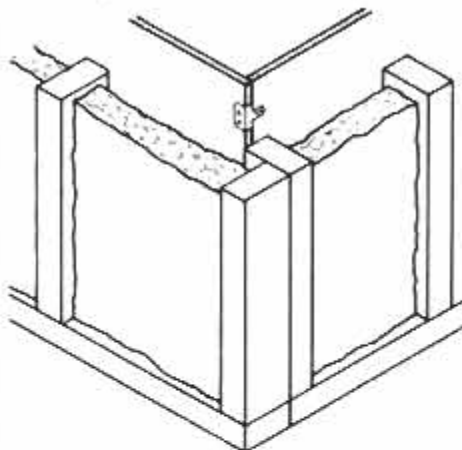
The 3/8-, 1/2-, or 3/4-in.-thick clips slide over the edge of the same sized drywall sheet. They allow you to secure the panel by nailing the clips to the first stud of the adjacent wall (see drawing).

The manufacturer claims that the clips can save you approximately 11 to 15 percent in framing lumber. A package of 500 costs \$45 at lumberyards.

They're made by Prest-On Co., Div. of ConlaB, Box 156, Libertyville, Ill. 60048. —Steve Willson



Handy drywall clips eliminate the need for installing nailers on the inside corners.



Update on PM's vacation home

In our article *PM's Vacation Home: Add-Ons Turn a Ready-Made into a Sunlit Retreat* (page 106, April '81), the siding used was Champion Wind Ridge Prefinished Siding. It's made by Champion International Corp., Building Products Div., 1 Champion Plaza, Stamford, Conn. 06921. **PM**

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

DETROIT LISTENING POST

New Ford every six months

The front-wheel-drive Ford Escort and Mercury Lynx, introduced a year ago, and the Escort-based EXP/LN-7 sporty coupes that followed this spring are only the tip of Ford Motor Co.'s new-product iceberg. The company plans to unveil at least one new model every six months between now and 1985.

For '82, Ford has scheduled a five-door hatchback Escort/Lynx and a new, smaller Lincoln Continental based on the current T-Bird/XR-7 platform. Slated for next spring is the Ford Ranger four-cylinder minipickup, which features an optional Japanese-built diesel engine. The following fall, the Mustang/Capri will get a swoopy aerodynamic redesign and more efficient power train.

Spring 1983 will bring Ford's second fwd series, code-named Topaz and built on a stretched Escort/Lynx platform. At about 2,200 pounds and 170 inches overall on a 99-inch wheelbase, it will replace the rear-drive Fairmont Zephyr; it's intended to go head-to-head with the famous "alphabet" cars, GM's X and J and Chrysler's K. There will also be a pair of very aerodynamic and (from what we hear) radically styled new specialty coupes, still rear-drive, to supersede the current T-Bird/XR-7. About this time, too, Ford probably will drop its current rear-drive LTD/Marquis and transfer those names to face-lifted Granada/Cougars.

That brings us up to fall 1983 ('84 models). Scheduled to slide into this slot is an all-new, Japanese-built mini—probably produced by Ford-affiliate Toyo Kogyo, maker of Mazda cars and trucks—which may beat GM's homebuilt S-car mini to market.

Spring 1984 should see downsized Mark and Town Car luxury liners on the rear-drive T-Bird/XR-7 chassis, featuring an innovative BMW-Steyr six-cylinder diesel engine option. The following year should bring downsized fwd "family" cars at last, also with the BMW-Steyr diesel.

Chrysler plans bared

Not long after Chrysler announced it had built its last rear-drive car in this country (the St. Louis plant has been converted to luxury K-car production, leaving only the Windsor, Ont., facility assembling rear-drive

cars), the folks there invited me over to see some future products—no cameras allowed.

Next month, they'll pull the wraps off the "Super Ks," the new fwd Chrysler LeBaron and Dodge 400. With front styling leaning toward Imperial, combined with plush interiors and luxury-look padded roofs, opera windows and coach lamps, these will be a "few hundred bucks north" of the regular Ks they're based on. The convertible version of the Chrysler (see *The Once and Future Convertible*, page 72, July '81) should be ready by next spring. There's also a downsized New Yorker, basically a retouched version of today's rear-drive LeBaron four-door with limo-style roof, plus a matched set of Omni/Horizon coupe-based minitrucks for '82.

Two nice K-based cars are planned for '83: a very formal, New Yorker-roofed luxury four-door and a stunning sport coupe that looks like the offspring of a Mustang and a Porsche 928. Code-named K-24, the latter will likely be turbocharged and will compete with GM's new Camaro/Firebird. This will be the last year for Chrysler's holdout rear-drive cars, the Mirada/Cordoba/Imperial personal luxury coupes.

For '84, there will be some nicely styled fwd personal coupes, also K-based, to take on the likes of GM's Monte Carlo/Grand Prix series and Ford's T-Bird/XR-7. Also on the horizon is a fwd minivan that "casts the same shadow as a Pinto," but carries seven people and "does everything the current van will do." It, too, is built on the K platform. Also slated for '84 is a new Mitsubishi-built fwd minicar.

And we know of plans for another small fwd pickup and revamped K-cars for '85, plus an Omni/Horizon replacement and another new mid-size car for '86. Chrysler has its master plan and its products laid out right through mid-decade.

Buick sports and electric cars?

Remember the GM L-cars, the "Porsche-like," J-based, high-performance sport jobs that might have been in Olds and Buick showrooms shortly had they not fallen victim to budget tightening? Well, Buick's taking another look at its little-developed L drawings for ideas on a two-seat sports car for the mid-'80s. It will have a plastic body (like Pon-

tiac's coming mid-engine P-car) and will cost about \$20,000.

Led by dynamic ex-engineer Lloyd Reuss, Buick Div. also could be chosen to produce GM's planned electric car. Barring substantial technical breakthroughs in the next few years, it looks as if the EV will cost twice as much to build as most production cars. If so, it will be priced above a lot of folks' heads and would make more sense as a Buick model than, say, a Chevrolet.

More power for '82

Look for the beginning of a trend toward better performing engines for U.S. cars this fall, thanks to a combination of technical development and EPA's slightly easier-to-meet emissions standards. Chevy, for one, will have a 96-hp, 2.0-liter optional engine for the J-cars that should give better pep with equal or better fuel economy than the standard 1.8-liter Four. Pontiac will add throttle-body fuel injection (TBI) to its workhorse 2.5-liter Four. It will appear in '82 X-cars and as the base engine in the smaller Camaro/Firebird and fwd intermediates due this November. And Chrysler (which will stick with the VW 1.7-liter Four for its Omni/Horizon cars, instead of switching to a Peugeot 1.6, as was rumored earlier, has squeezed a bit more power out of its 2.2-liter four-cylinder for '82.

Slippery Fords coming

Ford's vice-president of styling, Donald Kopka, expects that firm to be producing some of the slipperiest bodies ever to come out of Detroit by the '84 model year. Ford plans to finish the wind tunnel it abandoned after it ran into financial problems. Most of Ford's aero studies have been conducted at a rented wind tunnel in Georgia. **FM**



HOW TO DRILL A BACKYARD WATER WELL

BILL HARRINGTON

I've been drilling water wells in Oklahoma for about 15 years.

When I first saw the ad that claims a man can drill his own water well with a Hydra-Drill, I was extremely skeptical. I thought to myself — how can that be? That's impossible. It takes a big engine, it takes a big rig to drill a water well. But my curiosity kept nagging me, so I sent off for the information.

My daughter's boyfriend is a well driller over in Arizona. I showed him the Hydra-Drill literature. His first reaction was "I don't believe it. I don't believe a 3 hp. drill can do the same thing my 100 hp. drill does." But the more I studied it, the more it sounded like a good idea.

A WATER SHORTAGE

Another thing on my mind was the drought. We're having the worst drought here since the dustbowl days back in the '30s. A lot of towns around here all the way over to Tulsa are running short of water, and some of them have started water rationing. It's very hard on a lot of people, but business is good for well drillers. I'd been thinking about buying another drill and putting my son Robert in business. He's 18 years old, and he'd never worked on a drill before. I decided he could learn with a Hydra-Drill.

EASY SET UP

Now when I started out in the drilling business 15 years ago, I had a big drill that just about worked me to death. Later, I got a rotary drill. It was easier to operate, but it took a day and a half to set up and drill a well in this area. You can't imagine how I felt when they delivered our Hydra-Drill. It was so compact, very simple. Robert and a young friend of his took it out and set it up in just a few minutes.

OUR FIRST HYDRA-DRILL WELL

The day we went out to drill our first well with the Hydra-Drill, I was all fixed to work with the boys and give them plenty of advice. However, it was a very hot day — about 100 degrees — and once they got started drilling I could see they didn't need me standing right there, so I went over and sat down in the shade of a tree. In about an hour, they came over and I asked them if they were taking a break, and they said no, they had just finished drilling the well.

It was amazing. They had drilled down forty-seven and a half feet and hit a layer of beautiful, coarse sand — the kind that produces good water and a lot of it. They had drilled that well in less time than it takes me just to set up my big drill.



PHOTO BY TONY JACOBY

Later, I figured they had drilled that well with less than one gallon of gas. My big drill would burn up at least fifteen gallons of gas for that job!

MAKES MONEY

The next day we drilled a well 115 feet deep through rock, and it went fast too. The Hydra-Drill really takes the hard work out of it. It's fast and economical, and that's what it takes to make money drilling wells.

Also the Hydra-Drill is so portable we can set up and drill anywhere. In the past, I've lost out on some jobs because people were afraid my big drill would tear up their yard. With the Hydra-Drill, we can drill without tearing up anything or making a mess. This is a big selling point to my customers.

I'm just grateful to have this Hydra-Drill. I've got my son started in a good business he can make some money with. If I had bought another big drill, it would cost thousands of dollars, and that is just ridiculous because the Hydra-Drill does the job just as good. In fact, I figure we earned enough to pay for the Hydra-Drill the first week. From here on, we're in the blue chips.

GOOD, PURE WATER

I believe anyone can drill a well with a Hydra-Drill. Even if they just wanted to drill their own well, they'd save money. It's simple and it's easy if they just read the instructions. And the best part about it is that you get good, pure water without all those chemicals in it, and the water costs you, say 5 cents for a thousand gallons. You certainly can't buy city water for that. And it's a great feeling to have all the water you want even when

the city is rationing water to everyone else.

The man who invented the Hydra-Drill really knew what he was doing. Modern technology is a wonderful thing, isn't it?

NOTE: Popular Mechanics' readers can get a big, fully illustrated information kit on the Hydra-Drill including a booklet, "How to Drill Your Own Well." The information kit is available free, without obligation. Requests should be addressed to DeepRock Mfg. Co., 5459 Anderson Road, Opelika, AL 36802.

ONE MAN WELL DRILLER

SAVE HUNDREDS OF DOLLARS

For less than \$1 per ft. you can drill a water well in your backyard next weekend!

Have all the pure, fresh water you want FREE! The HYDRA-DRILL drills water wells 50 to 200 feet deep. Easy to operate as a power lawn mower!



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Opelika, Alabama 36802

Please mail your free information kit immediately. I understand there is no obligation and no salesman will call.

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Zip _____

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APPLIANCE CLINK

QUESTIONS ANSWERED

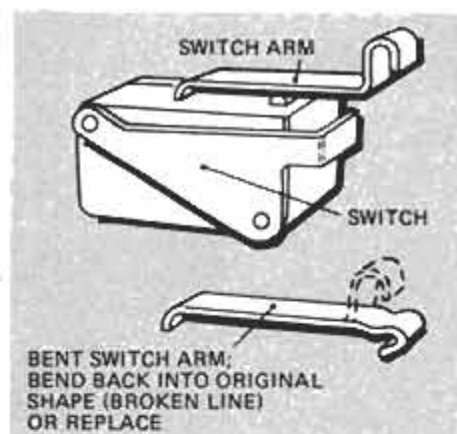
Ice cube connection

I own a Sears Model 106.7670860 refrigerator-freezer with an automatic ice maker. The problem is that the crescent-shaped ice cubes stick together. They often jam the auger drum which delivers them. What is the matter with my ice maker?—Irv Friedman, Charleston, S.C.

Some ice makers have an adjustment screw which you turn to reduce the inflow of water. Improper adjustment can cause the condition that you describe. However, your particular machine operates differently.

Your problem can be traced to one of three things: a bent lever on the microswitch, a sheared pin on the timer cam gear, or a defective water inlet valve.

First check the microswitch. Pull out the ice tray to expose the roller-belt assembly. Excess water-loading can cause this belt to get out of synchronization, catching the switch arm in a notch and bending it. If this has happened, straighten the switch



An ice maker won't work properly if the microswitch has a bent lever. Excessive water on belt assembly causes this. See text for proper way to check ice maker.

arm. If not, check the pin on the timer cam gear and replace it if it's sheared.

If you still have trouble, disconnect the water inlet line at the ice maker and rig a pan to catch the flow. These units are preset to fill for four seconds. Time the inflow. If it takes more than four seconds, replace the inflow valve, which is located at the bottom in back of your machine.

There is no possible adjustment on such valves: Either they work or they don't.

Recoiling

I would like some information on a gas-stove cooktop with a pilot-free ignition. My spark coil lasted only one year. When I replaced it, I found that the old one had been connected incorrectly. The white wire was going through the switch to the coil and to the L-terminal. When I put in the new coil, I connected the black wire through the switch to the coil and terminal. This way, it sparks twice as fast. Could this cause the coil to burn? The unit is Sears Model 103-3347911.—Merv Corwin, Lake Isabella, Calif.

In our opinion, hooking up the replacement properly isn't going to burn the coil. In these systems, there are basically two electrode assemblies, one for each pair of burners. No matter which valve is turned to start, both electrodes—one on each side—will be activated. The module produces a high voltage (about 15 kilovolts), using a capacitor discharge into a pulse transformer, and sends impulses to the electrodes at the rate of two sparks per second. All electrodes will spark simultaneously when any valve on the unit is turned to the LIGHT position.

Water falls on wiring

I own a Frigidaire refrigerator Model FPCD-186TNR. During the defrost cycle, in addition to water draining into the drain pan, I have noticed water draining from two wire-harness channels on each side of the refrigerator in front, just underneath the door. Sooner or later, I am afraid this water will cause an electrical problem within the refrigerator. What steps can I take to correct this problem?—Jim Moretti, Greenville, R.I.

It sounds as if your problem may be in the area of the cellular polystyrene divider, which is located underneath the freezer coil. Apparently some of this divider has disintegrated or broken away (it looks like popcorn) and has blocked part of the drain hole.

When the refrigerator goes into the defrost cycle, all the water isn't being channeled to the proper area. Some of the water is flooding over the sides of the divider and getting into the insulation. My suggestion is to have a qualified service technician replace the divider and clean the drain line.

Overheated heaters

Our 8-year-old General Electric side-by-side refrigerator-freezer, Model TFF 19DPB, burns up its pair of defrost heaters about every 2½ years. This has happened three times now, and the wires are always mangled-looking. What can I do to prevent this?—Joseph M. Hill, Port Richey, Fla.

First, it sounds like your thermostat may not be functioning properly. This is located in the same compartment as the heating elements. The thermostat may be in the ON mode too long; if so, it should be replaced. You can check this with a voltmeter if you have one. Exact voltage readings will vary according to model and year. However, the unit shouldn't be on longer than it takes to melt the ice from the coils.

If this doesn't work, check the defrost timer located directly behind the frost grille under your refrigerator. See that it moves freely through the divisions designated for the defrost cycle.

Also, your defrost circulation system fan could be involved in this problem. Check it by hand to make sure that it rotates freely.

Case of the sometimes siphon

I own a Sears Kenmore automatic washing machine, model No. 110.7014624. It has begun to siphon when the rinse cycle is on, but not during the wash cycle. I raised the standpipe 6 in. over the recommended minimum, but it didn't help. Could the timer be the culprit?—Harry A. Carlson, Lufkin, Tex.

Most likely, the timer is the culprit. However, before you replace it, do the following: Check the hose filters at the fill-end of your fill lines. Then be sure to check the filters at the other end of the hoses, too. (Many people don't know about these and assume that the only filters are at the ends that connect to the house lines.) Be sure that both sets of filters in both lines—hot and cold—are not clogged. If they are obstructed, they can restrict water input and cause the siphoning problem you describe. Otherwise, replace your machine's timer. **PM**

If you have a question about any appliance, send it, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

LOW-COST LIFE INSURANCE FOR YOUR CAR.



Not so long ago, it was easy to buy an economy car for two or three thousand dollars.

Today, you're lucky to find one for *five* thousand. And replacement engines haven't gotten any cheaper, either.

So it makes sense to change your oil and put in a new Fram oil filter *at least* as often as your owner's manual tells you to.

After all, a new Fram oil filter doesn't cost much. A new engine does.

But, the choice is yours.

You can pay a little now.

Or a lot later.



Fram and Autolite are Bendix Companies
Fram Corporation, Providence, Rhode Island 02916

THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Tachometer tap for HEI

Throw away the makeshift paper clip and wire arrangement that you fabricated for hooking up a tachometer to the High Energy Ignition (HEI) distributor of GM cars.

Now there's Tach Tap—a lead made expressly for the HEI system. The Tach Tap terminal is connected to the tach terminal in the HEI distributor cap. A tachometer can then be connected to the bare wire located at the looped end of the Tach Tap.

Tach Tap is available in a package of two for \$4.95 from Borroughs Tool and Equipment Corp., 2429 North Burdick St., Kalamazoo, Mich. 49007.—*Mort Schultz*

Add-a-toot horn

If yours is one of those cars with just one horn—one anemic, bleating horn—take heart! Signal-tone now offers a compact, sturdy, loud horn,



Powerful replacement horn wires easily into the existing horn circuit of your car.

with either high or low tuning. You wire it into your single-horn harness by following a supplied diagram.

The Signal-tone Model ST-139, which I installed in the family's one-horn Fairmont, makes the car finally sound right.

The single horn lists for \$9.25, a pair for \$18.25, plus shipping. If your local auto store doesn't carry them,

write Signal-tone Corp., Dept. PM, 946 Frisbie St., Cadillac, Mich. 49601.—*M.L.*

X-car strut compressor

The coil spring on the MacPherson strut of General Motors X-cars is big and strong, and the little compressors designed for imports are not suitable for it. In fact, the small compressors can be a real problem if they seize up from the overload.



Heavy-duty MacPherson-strut spring compressor is for larger springs of GM X-cars.

Now there's a heavy-duty model designed specifically for the X-car. It has three rods (not just two), and each one threads through a double hook that pulls up on the spring.

The tool is sold at auto parts stores, where it lists for \$100. It's made by S & G Tool Aid Corp., 43 East Alpine St., Newark, N.J. 07114.—*Paul Weissler*

Stud saver

If the threads at the outer ends of wheel studs get dinged, you've got a real problem: The lug nuts won't thread on. This is a big headache with a front-drive car, as pulling the hub is time-consuming.

The maker of Heli-Coil inserts for threaded holes has an ingenious



Two-piece die restores damaged threads of a wheel stud without removing the stud.

answer: a die made in two halves that can be mated inboard of the damaged end, where the threads are usually in good shape. The die has a hex-shaped collar. Once you assemble it, you just fit a 1/16-inch spark-plug socket on the hex and unthread the die. As it unthreads, it reforms the mashed threads.

Called Sav-A-Stud, the dies are available individually in several sizes at about \$10 each, as well as in kits.

Kit prices start at about \$38. From Heli-Coil Products, Shelter Rock Lane, Danbury, Conn. 06810.

—*Paul Weissler*

Battery tester

As any professional mechanic can tell you, the only way to test a battery is with a load on it. Unfortunately, testers with adjustable loads (to permit you to dial in the load appropriate for the capacity of the battery) are very expensive.

Now there's an inexpensive bat-

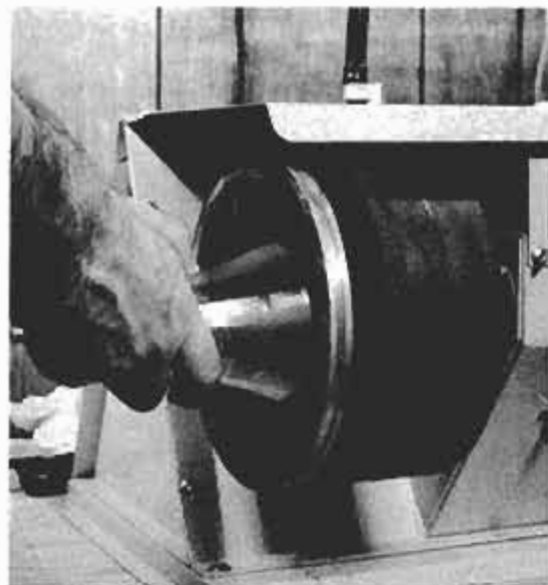


Compact battery tester will put a load on the battery and also test cranking voltage.

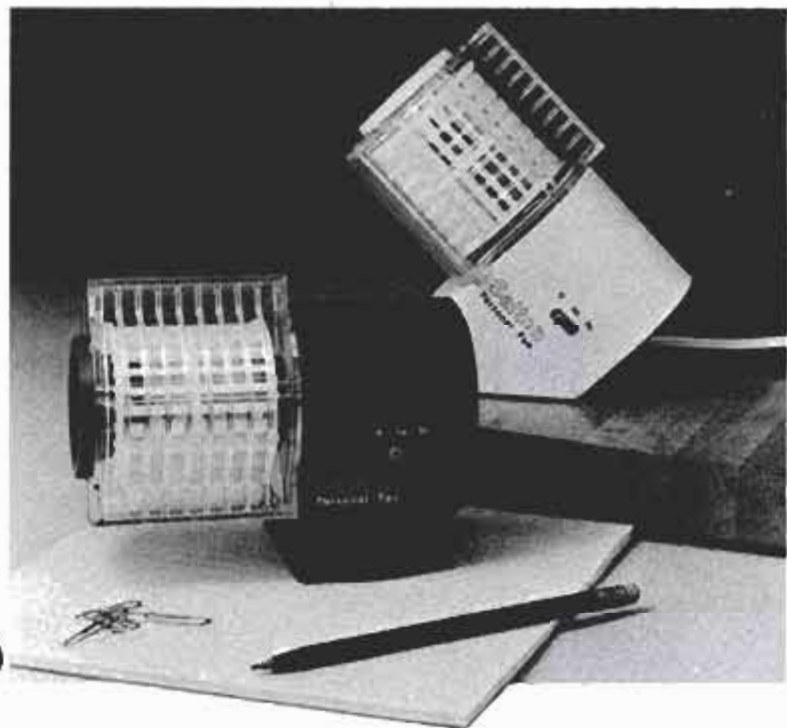
tery tester (it's a form of voltmeter) with a fixed load that can be placed on the battery during the test. You just flip a switch and the load goes into the circuit.

The tester is \$79 list, and it is also designed to check cranking voltage (as a starting-system test) and charging-system voltage. The tester is sold in auto parts stores. It's manufactured by Milton Industries Inc., 4500 West Cortland St., Chicago, Ill. 60639.—*Paul Weissler*

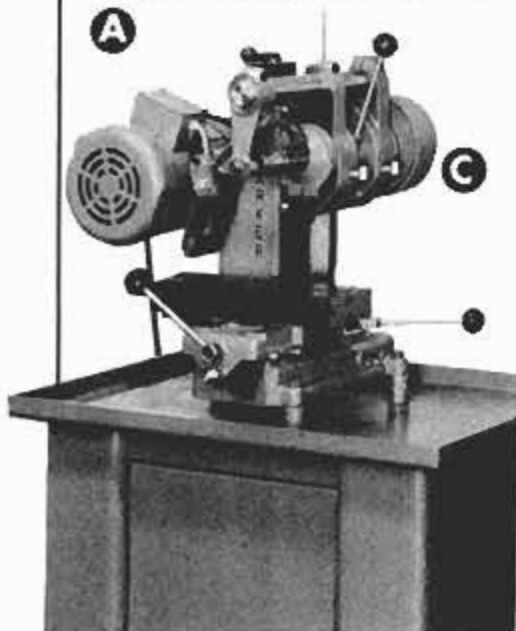
NEW NOW for home and shop



A



B



C

D

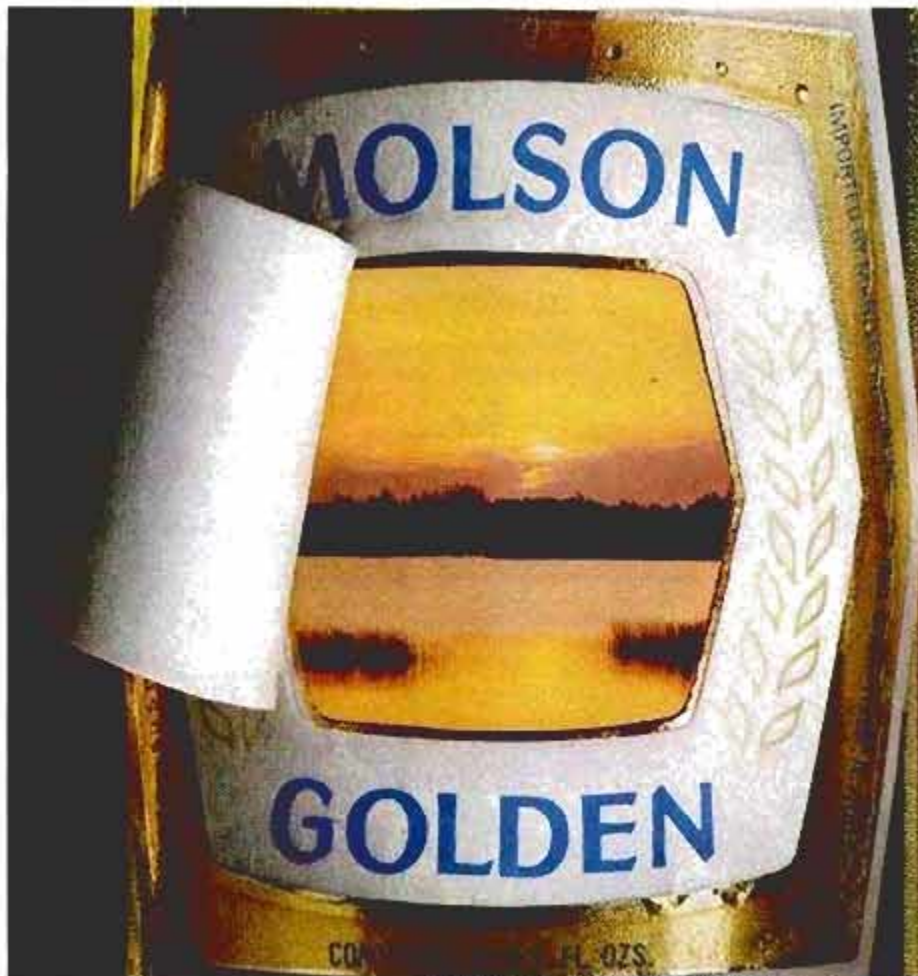
A The Antique Glass Restoration Center was designed to make repairs of expensive glassware easier. The tool weighs 46 lbs. and measures 12 x 12 x 20 in. The 1/3-hp motor drives two 3 x 8-in. drums and two 8-in. discs, one of which can be replaced by a molded goblet-finishing cone. Assorted abrasive belts, discs, cones and directions, and prices for extra abrasives are included. The package is \$398, plus shipping, from Raytech Industries Inc., Box 6, Stafford Industrial Park, Stafford Springs, Conn. 06076.

B A light and versatile personal fan designed to direct air flow only where cooling is desired is now available. The 1 1/2-lb. fan has an 8-ft. cord and measures 3 x 4 x 6 1/2 in. The UL-approved unit has a protective grille covering a plastic impeller and can be positioned vertically, horizontally, diagonally, or hung from the wall. In dark brown or white, it retails for \$25 at department stores. An air freshener attachment is an additional \$5. The Personal Fan is made by Salton Inc., 1260 Zerega Ave., Bronx, N.Y. 10462.

C Here's a professional-quality milling machine intended for the home workshop. The maker claims that this mill, used successfully in industry for years, will allow home handymen to make small metal parts accurately. The mill, which has a 1/2-hp motor with adjustable rpm, weighs 160 lbs. and measures 20 x 23 x 24 in. The cost is \$1,100; the freight is COD. A metal base cabinet is offered for \$399 and other milling accessories are available. Order from the Barker Milling Machine Co., 34302 Melinz Pkwy., Eastlake, Ohio 44094.

D Luma-Stick is a portable, plug-in fluorescent light fixture that's installed with only two mounting screws. The 24-in.-long, white-plastic unit is UL approved and comes with a 6-ft. cord and a white-light lamp. According to the maker, it is more than 2 1/2 times as efficient as incandescent lighting, while providing equivalent illumination. It can also accommodate plant-light and black-light lamps. The unit sells for \$17 at hardware stores and home centers. Replacement lamps cost \$4.50. It's made by Westinghouse Electric Corp., Gateway Center, Pittsburgh, Pa. 15222.





Thirsting
for the best
of Canada?

**Make
sure
it's
Molson.**



BREWED AND BOTTLED IN CANADA; imported by Martlet Importing Co., Inc., Great Neck, N.Y.

You can tell this power company where to go.



To the campsite, worksite, cabin or beach. Aboard a boat, on a camper, in a pickup or trailer. Anywhere you've got the need, Kawasaki can give you the power. Dependable, quiet, economical power, from the easy-toting KG550.

This 36.6-pound lightweight is small in price, yet big on features. Circuit-breaker protection means there's no fuses to replace. And individual AC & DC outlets allow you to charge your car battery and run other electrical needs simultaneously.

Ask your local Kawasaki dealer about the KG550 or one of the other Kawasaki Portable Generators. He's listed in the Yellow Pages.

Kawasaki
Portable Generators

From 500 to 2900 watts.

Did you say $\frac{1}{3}$ less tar?

Pall Mall Light 100's.
A third less tar than
the leading filter
king, and still
great taste.

Pall Mall
Light 100s 10mg. tar 0.8mg. nic.

Leading filter king 16mg. tar 1.1mg. nic.

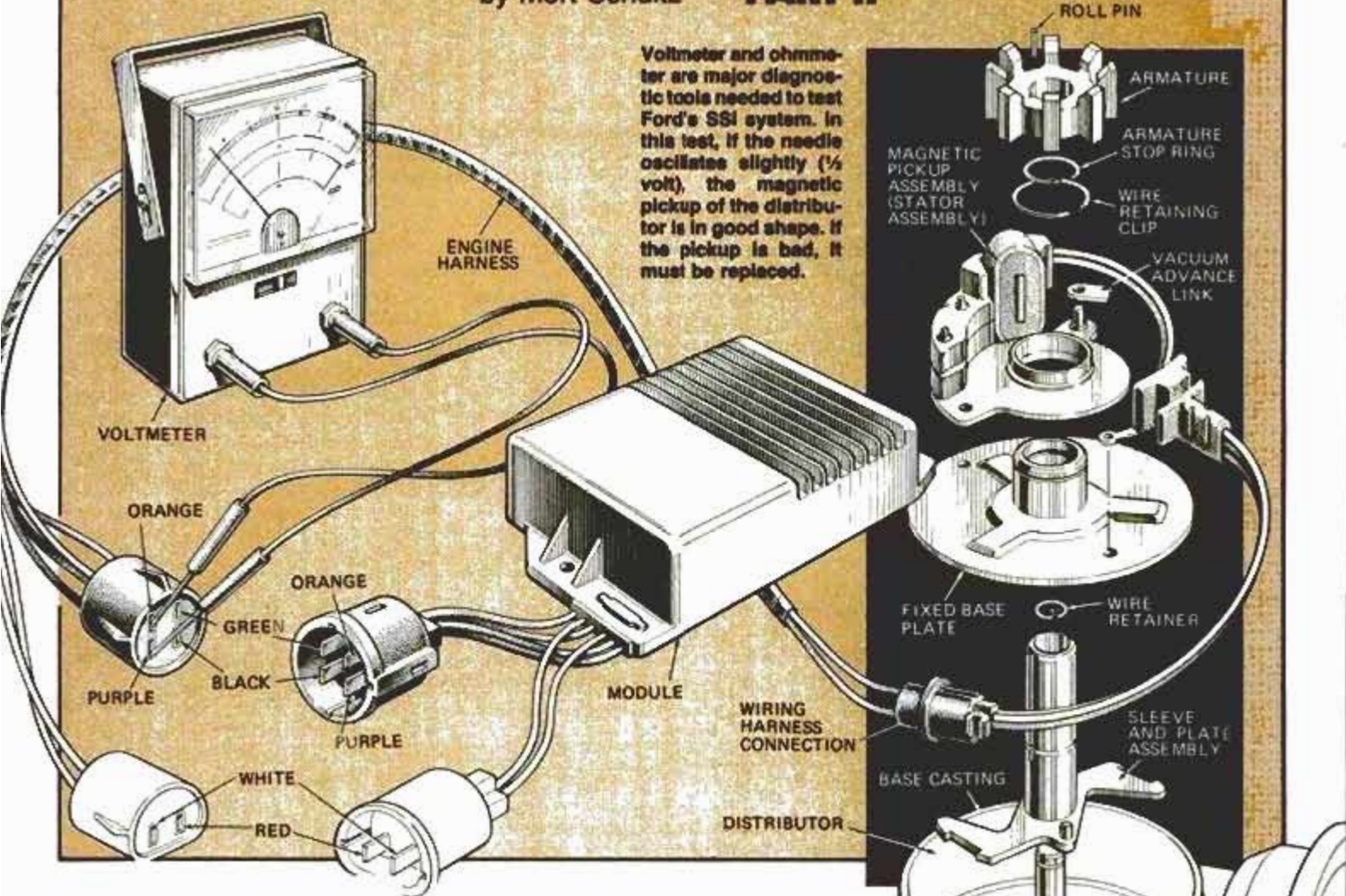
Lowest brand
less than 0.01mg. tar 0.002mg. nic.

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

10 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.

Troubleshooting Ford's Solid State Ignition System

by Mort Schultz **PART II**



Voltmeter and ohmmeter are major diagnostic tools needed to test Ford's SSI system. In this test, if the needle oscillates slightly ($\frac{1}{4}$ volt), the magnetic pickup of the distributor is in good shape. If the pickup is bad, it must be replaced.

Armed with only a straight pin, paper clip, modified sparkplug, jumper wire, ohmmeter and voltmeter, you're able to do what mechanics in Ford and Lincoln-Mercury agencies do with test equipment costing thousands of dollars—troubleshoot the Solid State Ignition (SSI) system. Last month, in Part I, we explained how to use these everyday items to test the following parts of the SSI system when hard starting or engine missing occurs:

- Secondary circuit, which consists of high-tension cables, distributor cap, rotor and sparkplugs.
- Primary circuit (an overall test).
- The part of the primary circuit which includes the neutral safety switch of a car which has an automatic transmission, START side of the

ignition switch, starter circuit, battery and wires connecting these parts.

■ The part of the primary circuit which includes the ON side of the ignition switch, battery-to-ignition switch circuit and wires connecting these parts.

■ Ignition switch-to-ignition coil circuit and the ignition coil itself.

In this issue, we'll explain how to test the rest of the SSI primary circuit in Ford Motor Company cars and trucks that don't have Electronic Engine Control (EEC) and Micro-processor Control Units.

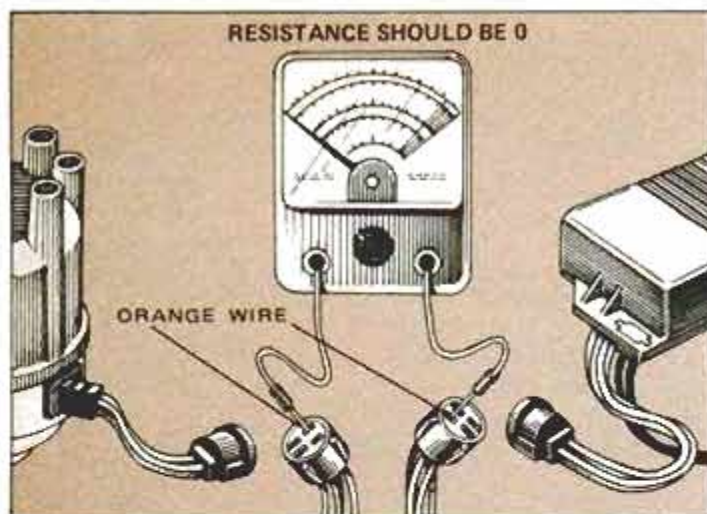
Magnetic pickup and distributor-to-ignition module harness test

Before starting this test, take two precautions:

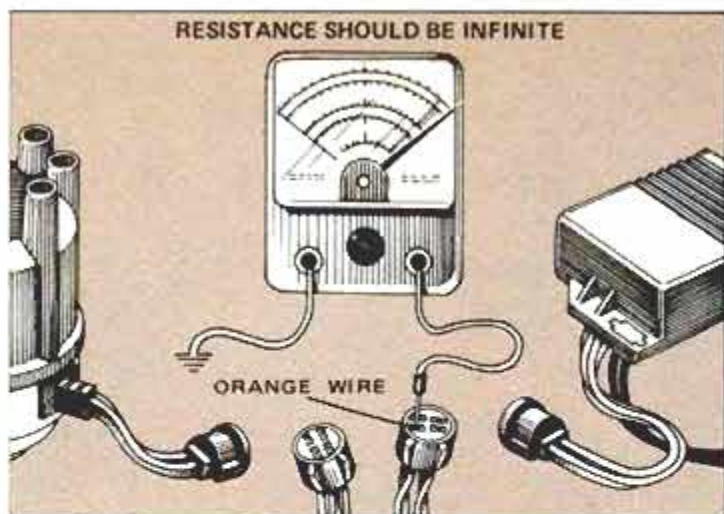
First: Don't use a voltmeter combined with a dwellmeter or a digital volt/ohmmeter for this test. Readings that you get from them may be inaccurate.

Second: This test involves cranking the engine. If your car has a catalytic converter, this action may damage it. Therefore, disconnect the hose from the outlet of the air bypass valve, which is a part of the Thermactor catalytic converter system. This reduces the possibility that raw fuel will burn in the catalytic converter.

Find the air bypass valve by trac-



This procedure tests the integrity of the wiring harness between the distributor and the module. Connect the leads of ohmmeter as shown above. The resistance should be equal to zero.



In this test of the wiring harness, the resistance of the orange wire should be infinite. If the harness doesn't pass either of these two tests, the entire harness must be replaced.

ing the air supply hose from the air pump. After performing the test (or as soon as you get the engine started again), run the engine for three minutes with the air bypass valve hose disconnected. This will clear out any excess fuel from the exhaust system.

Perform the test as follows:

1. Pull apart the distributor-to-ignition module connector that is closest to the ignition module. The ignition module is that part of the SSI system which serves as a switch to shut off the primary circuit when the ignition coil is ready to discharge its energy to the sparkplugs. Note that there are two other connectors. The one you have to work with supports a wiring harness coming from the distributor that has purple- and orange-colored wires.

2. Attach a voltmeter to the slots of the connector to which the orange and purple wires are connected. Attach the positive (+) lead of the voltmeter to the slot supporting the orange wire and attach the negative (-)

lead of the voltmeter to the slot supporting the purple wire.

3. Set the voltmeter on its lowest scale and crank the engine. If the voltmeter needle oscillates slightly ($\frac{1}{2}$ volt), this indicates that the magnetic-pickup assembly in the distributor is sending voltage pulses to the ignition module, and the distributor and distributor-to-ignition circuit are okay. Turn your attention to the ignition-module circuit. If there is no oscillation, continue this test.

4. At the distributor end of the wiring harness you've been working with, pull apart the other connector. This frees the wiring harness from both the distributor and ignition module so you can test the orange and purple wires for short and open circuits.

5. Attach one lead of an ohmmeter to the slot of a connector supporting the orange wire. Attach the other lead of the ohmmeter to the slot of the other connector supporting the other end of the orange wire. The

ohmmeter should register a reading of zero resistance.

6. Disconnect the ohmmeter lead from the connector which is nearest the distributor and attach this lead to a ground. Leave the other lead attached to the slot of the other connector that supports the orange wire. The ohmmeter needle should now register a reading of infinity.

7. Repeat steps 5 and 6, this time testing the purple wire. Based on the results you get, do one of the following:

■ If resistance in steps 5 and 6 is not zero and infinity, respectively, for both the orange and purple wires, replace the distributor-to-ignition module wiring harness.

Important: When you connect the wiring harness, make sure connectors are attached properly. The orange wire of the harness must be joined to the orange wires emanating from the distributor and ignition module. Similarly, purple wires must attach to one another. If you reverse wires, attaching purple to orange, ignition timing will be off by $22\frac{1}{4}^\circ$.

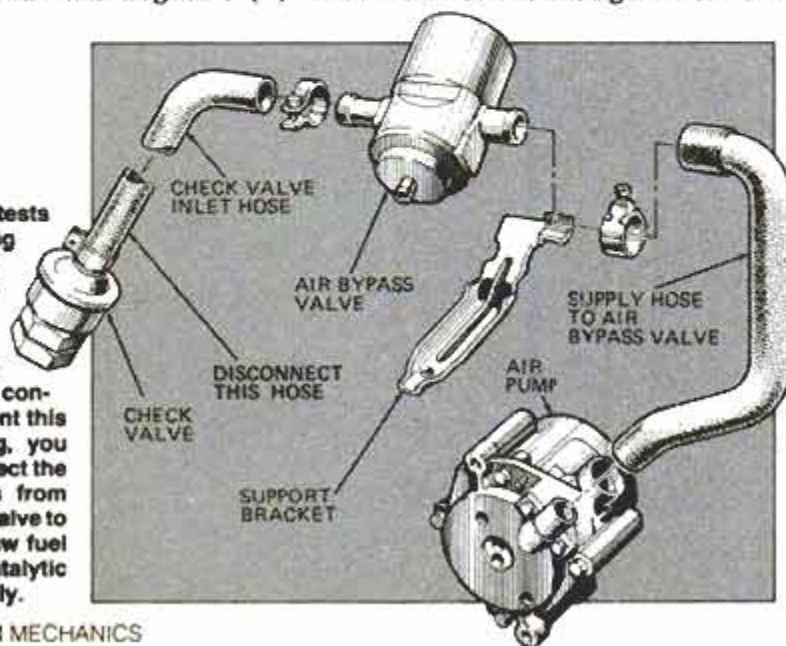
■ If resistance in steps 5 and 6 is zero and infinity, respectively, for both the orange and purple wires, replace the magnetic-pickup assembly in the distributor. The reason you didn't get a voltmeter reading in step 3 is that the magnetic-pickup assembly is defective. The magnetic-pickup assembly is supposed to provide voltage pulses to the ignition module. Without these pulses, voltage will not be delivered to sparkplugs.

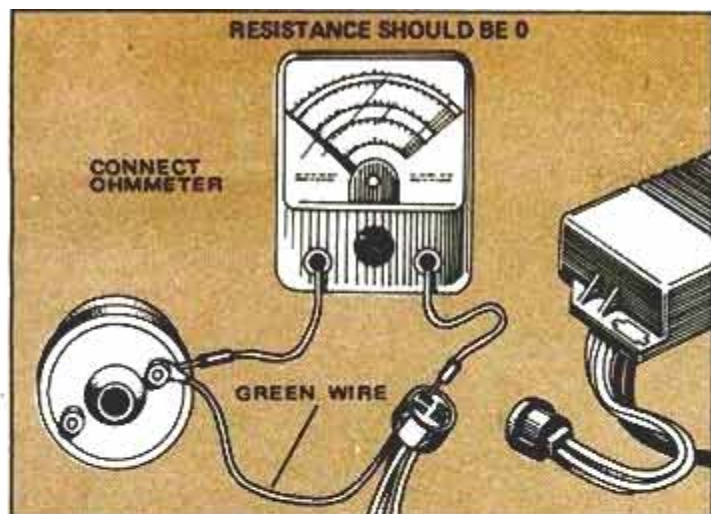
Replacing the magnetic-pickup assembly

Follow this procedure to replace the magnetic pickup:

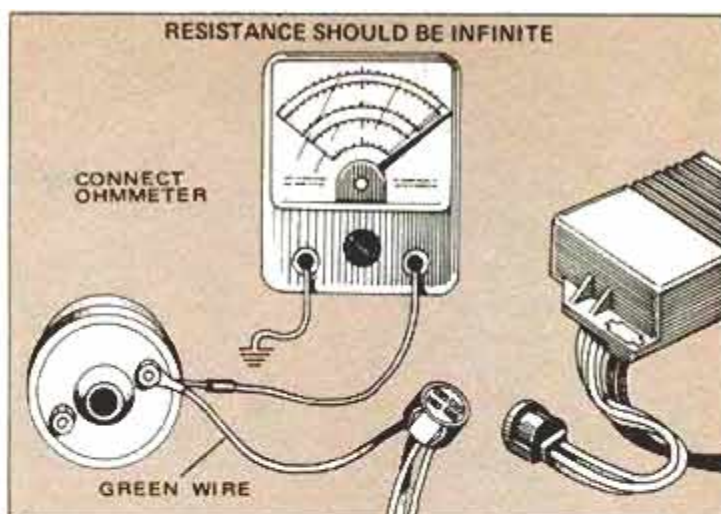
■ Remove the distributor cap, dis-

Because these tests involve cranking of the engine, without allowing it to start, raw fuel may be pumped into the catalytic converter. To prevent this from happening, you should disconnect the hose that runs from the air-bypass valve to check valve. Raw fuel can destroy a catalytic converter quickly.





This procedure tests the integrity of the green wire in the wiring harness. Attach the ohmmeter as shown. Resistance in this case should be zero. If it's not, replace the harness.



A further test of the green wire is conducted above. Attach the ohmmeter as shown. In this case, the resistance should be infinite. If the harness fails this test, replace it.

tributor-cap adapter (if there is one) and the rotor.

■ Place screwdrivers on both sides of the armature and lift the armature from the sleeve and plate assembly. Retrieve the small roll pin

and armature stop ring that keep the armature in place on the sleeve and plate assembly.

■ Pry off the wire-retaining clip from the annular groove of the fixed base plate.

■ Pry off the small snap ring that holds the vacuum advance link to the magnetic-pickup assembly.

■ Undo the ground screw from the link that serves as the magnetic-pickup assembly ground.

■ Remove the magnetic-pickup assembly.

■ Install the new magnetic-pickup assembly in the same spot as the old unit, sliding its wiring harness through the slot in the side of the distributor housing. Reattach parts in reverse order. To seat the armature securely, place the roll pin firmly in the slot in the armature and the corresponding slot in the sleeve and plate assembly. If the roll pin falls from place, it will cause the ignition timing to be thrown off.

Testing the Ignition module

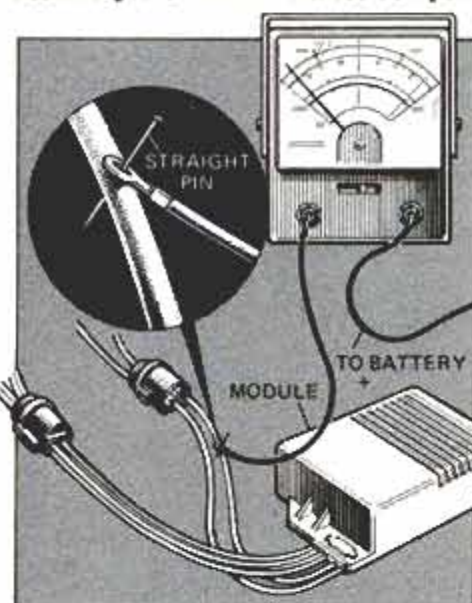
This series of tests checks the ground circuit between the ignition module and distributor, and the circuit between the ignition module and ignition coil. If these two circuits meet test requirements, the ignition module itself may be faulty.

Test the ground circuit between the ignition module and distributor as follows:

1. Pull apart the distributor-to-ignition module connector that is closest to the ignition module. In addition to orange and purple wires, a black ground wire is also attached to this connector except in 1974 models.

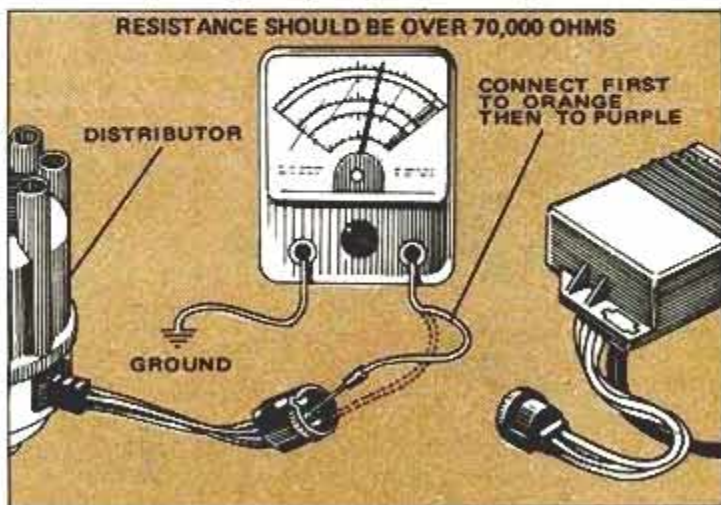
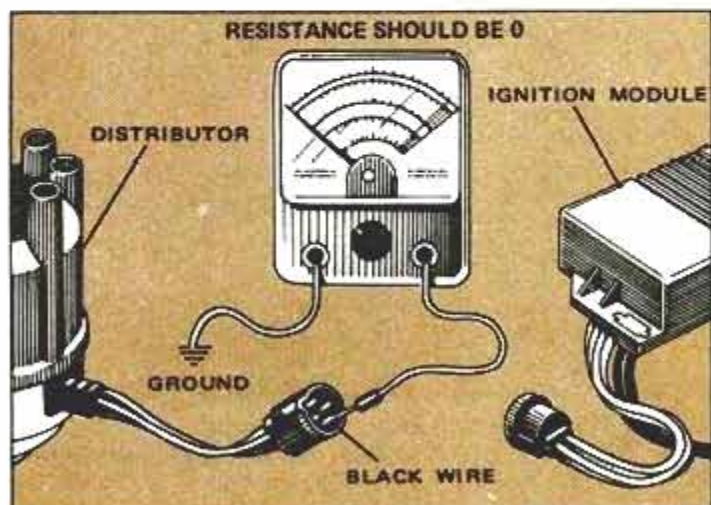
2. Connect one lead of an ohmmeter to the terminal of the connector holding the black wire. Connect the other ohmmeter lead to ground.

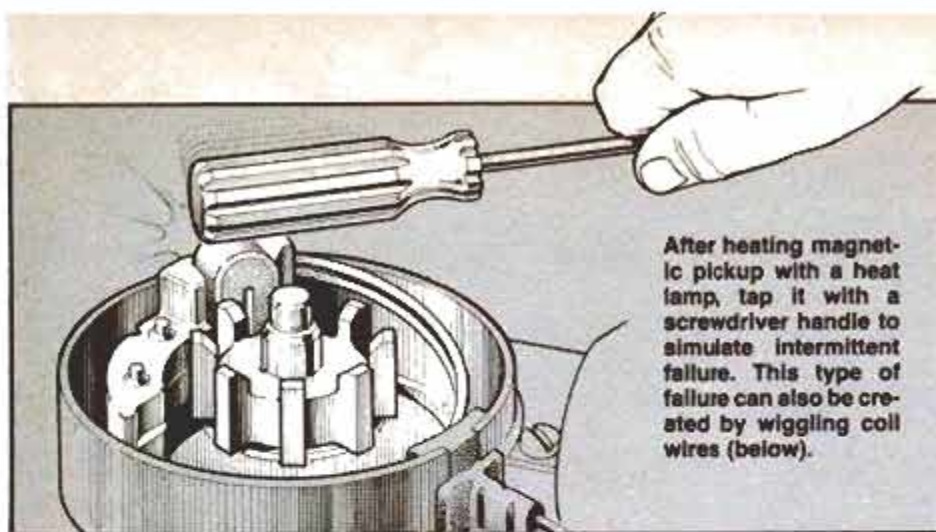
3. With the ohmmeter set to its lowest scale, read the meter. It should show zero resistance. If it does, proceed with the test. However, if resistance is more than zero, inspect the



Test above measures voltage drop across the module. Test below checks the ground circuit between the ignition module and the distributor. The resistance in this case should be zero.

This procedure tests for a short between the orange and purple wires coming from the magnetic pickup. If resistance isn't over 70,000 ohms, the magnetic pickup should be replaced.





After heating magnetic pickup with a heat lamp, tap it with a screwdriver handle to simulate intermittent failure. This type of failure can also be created by wiggling coil wires (below).

magnetic-pickup ground screw in the distributor. A loose or cross-threaded ground screw, or a dirty or corroded connecting point, is probably causing the trouble you've been having.

Test the circuit between the ignition module and ignition coil as follows:

1. Find the circuit wire (green) between the ignition coil and ignition module. Disconnect the wire at the ignition module by pulling apart the connector supporting the wire.

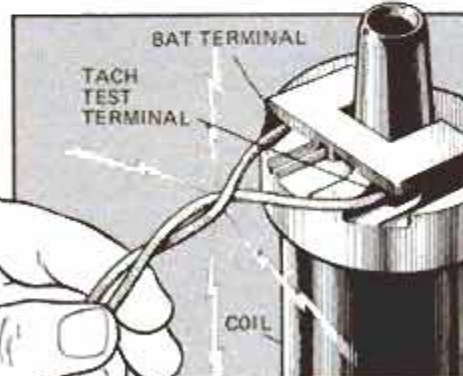
2. Attach an ohmmeter lead to the slot of the connector holding the green wire. Attach the other ohmmeter lead to the ignition-coil terminal holding the other end of the green wire. If the ohmmeter doesn't show zero resistance, replace the wiring harness.

3. Continue the test by disconnecting the green wire from the ignition-coil terminal. Connect one lead of the ohmmeter to this end of the wire. Connect the other lead of the ohmmeter to ground. If the ohmmeter doesn't show a reading of infinity, replace the wiring harness.

If all circuits have passed tests to this point, and you've tested the fuel system for the cause of the trouble, the next step is to try a new ignition module. This is the only way to verify that your problem is being caused by a bad module.

Those Intermittent problems

Often, the toughest problem to diagnose occurs when the engine starts and runs okay, but stalls as you're driving. This means that road conditions are causing certain components to malfunction. Poor road conditions are generally responsible for two automotive problems: vibration and engine heat. Obviously, you can't trace the problem while the car is moving. Therefore, you must try to duplicate these road conditions while the car is parked. To determine whether the trouble is being caused by a component of the SSI system, do the following:



■ With the engine running, try to get it to stall by wiggling wires at the ignition coil, ignition module and distributor. If the engine stalls, a loose connection may be the cause, or the particular wire that you were shaking may be the culprit.

If the engine stalls, try reattaching the particular wire more securely. If that fails to cure the problem, replace the wire.

■ With the engine off, remove the distributor cap and rotor, and check the magnetic-pickup ground connection for looseness and corrosion. Then place a 250-w. heat lamp an inch or so from the top of the magnetic-pickup assembly. Turn it on. The heat from the lamp will duplicate the conditions that engine heat will have on the component.

While the magnetic pickup heats up (apply heat for 10 minutes), disconnect the distributor-to-ignition module connector at the distributor and attach an ohmmeter to the parallel blades of the connector half attached to the distributor. As the magnetic pickup reaches operating temperature, tap it with the handle of a screwdriver. If the ohmmeter shows a reading of less than 400 ohms or more than 1,000 ohms, replace the magnetic-pickup assembly. It is either shorting out or developing an open circuit under normal engine operating temperature conditions.

■ With the distributor reassembled, place a 250-w. heat lamp approxi-

mately 1 inch from the ignition module. Turn on the lamp and start the engine.

As the ignition module gets hot, tap it with the handle of a screwdriver. If the engine stalls, replace the ignition module. It is probably defective.

Caution: If you let the ignition module heat up to more than 212° F., you may damage it. To avoid this possibility, let a few drops of water fall on the module after heating it for five minutes. If the water drops sizzle, remove the heat lamp. Repeat this procedure every two minutes until you determine whether the ignition module is the cause of engine stalling.

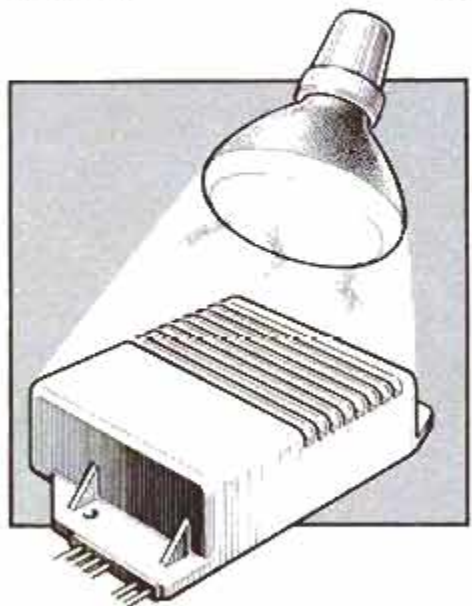
If the tests just described fail to reveal the cause of the problem, make a more thorough check of the magnetic-pickup assembly as follows:

1. Warm up the engine or run it until it quits.

2. Test the orange and purple wires of the distributor-to-ignition module wiring harness as described in "Magnetic pickup and distributor-to-ignition module harness test," on page 53.

3. With the ignition switch off, pull apart the distributor-to-ignition module connector at the distributor. Test the connector half that is attached to the distributor. To do this, connect one lead of an ohmmeter to the blade of the connector holding the orange wire. Connect the other ohmmeter lead to ground. Then test the purple wire using the same procedure.

If the ohmmeter doesn't show a reading of over 70,000 ohms for each wire, replace the magnetic-pickup assembly.



A heat lamp is also used to warm up the module. This procedure duplicates the effects of engine heat on the component.

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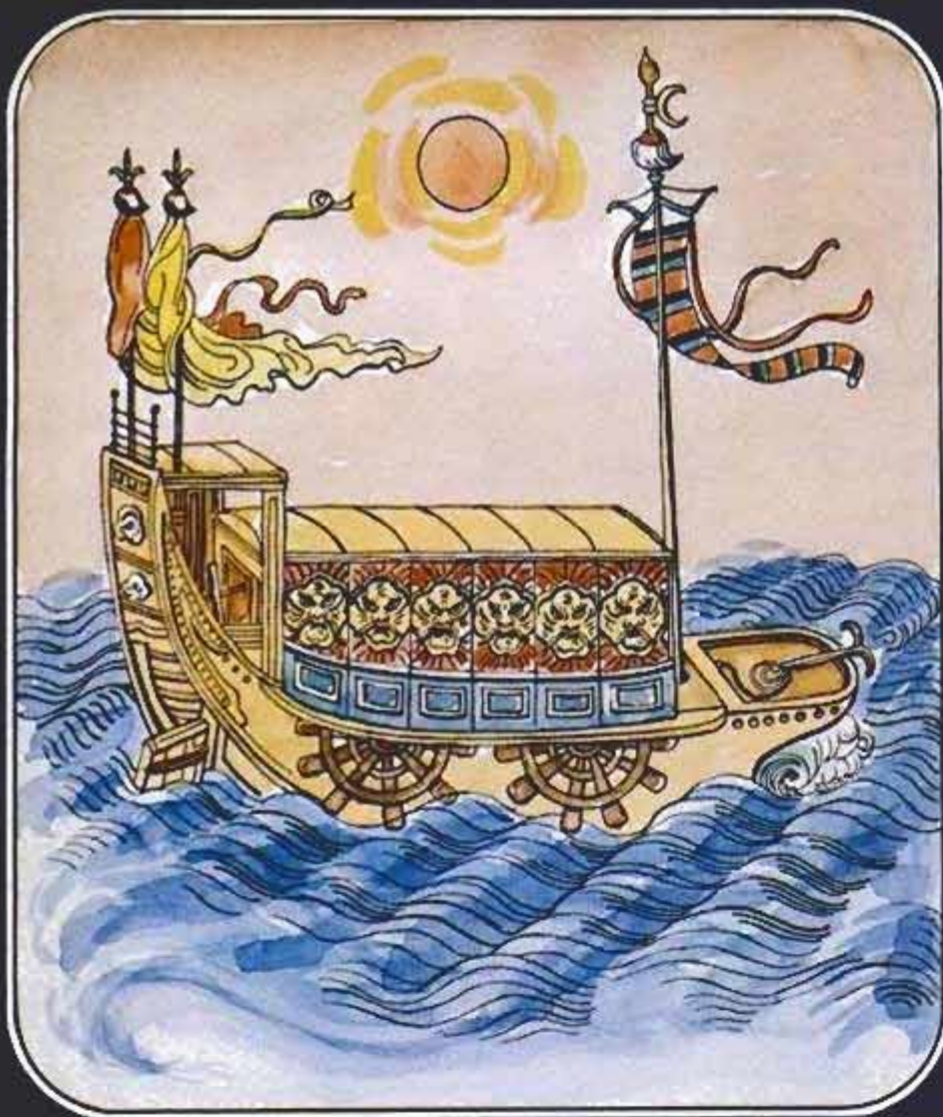


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By the year 1000, the Chinese had developed such mechanical marvels as the paddlewheel ship. Manpowered treadmills inside drove the paddles.

the vast variety and sophistication of ancient Chinese inventions that range from the first wheelbarrows to suspension bridges, "airconditioning" systems, robots, seismographs, paddlewheel ships, the compass, and even designs for aircraft operated by rotary blades similar to today's helicopters.

Even the Chinese invention of gunpowder is not given its true importance, because most people in the West think that the Chinese only made firecrackers in order to celebrate holidays and scare away devils. The earliest known recorded formula for gunpowder is in a Taoist writing of the 9th century. By the 11th century the Chinese had filled bamboo casings with gunpowder to make effective hand grenades, and a hundred years later their war junks were equipped with catapults to hurl exploding bombs at enemies. By the 16th century, launchers mounted on wheels were rolled into place to send incendiary rockets screaming into battle. Back in the 11th century the Chinese also used a terrifying flamethrower that was fed from a tank of naphtha operated by a piston pump.

The first paper was created in the Imperial Workshops at Peking by the eunuch Tsai Lun in A.D. 105. For 700 years paper was a Chinese monopoly, but then Arabs captured an adventurous Chinese papermaker who had traveled far from his homeland. At the time, Arab science was at its height, and soon Arab papermaking was widespread. Three hundred years later, papermaking was introduced into Europe

The real China syndrome

Improved relations with the West can make China technology's master again.

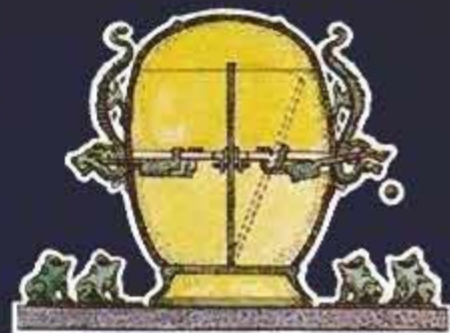
by Richard Dunlop



Shaking off the ideological deep-freeze that for years stopped all significant research and development, mainland China is today eagerly seeking Western technology and know-how. When Deputy Chairman Deng Xiaoping journeyed to the United States to "normalize" relations with the world's most advanced industrial democracy, he made it a point to

visit some of the leading American factories and laboratories. Now Chinese students are flocking to technical schools in the United States and Europe. All of this is highly ironic, because in the long view of history China has been one of the world's leaders in the advancement of scientific and technological knowledge.

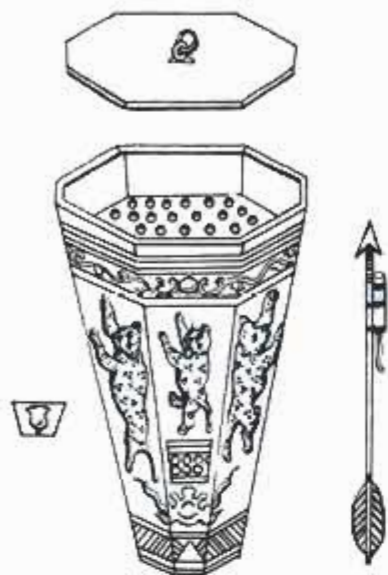
Most Americans know that the Chinese invented such things as papermaking, printing and gunpowder, but they have no idea of



Earth tremors as far as 400 miles away set off this early "seismograph" (see text).

by crusaders returning from Palestine, where they had learned the art from their Islamic foes. However, it was centuries before paper was in common use in the West.

Printing was developed perhaps 700 years after the invention of paper. Block printing was established by the 9th century, and by the 11th century the Chinese were manufacturing movable porcelain type. Pi Sheng, the inventor of type, at first formed each Chinese character out of clay. Later, porcelain and then tin were used to form the type. The type was glued onto an iron plate to make up the writing. When the printing



Rocket-powered arrows were often shot from elaborate cases; large crossbows, poison-gas bombs were other weapons.

run was completed, the plate could be heated so that the type was loosened and could be reused.

Once there was paper, Chinese scholars began to cover it with mathematical formulas. They employed quadratic equations and algebra more than 2000 years ago. They calculated in units and tens centuries before this kind of knowledge spread to India and then to the West, through the conquests of Alexander the Great. As early as the 1st century B.C., Chinese craftsmen were employing sliding calipers graduated in decimals. The Chinese invented the abacus about the time of Christ, and even today a skilled operator can subtract, add and divide *faster* on the machine than you or I can on an electronic calculating machine (the calculator is faster only in multiplication problems).

Mapmaking also was an early Chinese pursuit. Chang Heng, who lived

(Please turn to page 60)

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from A.D. 78 to A.D. 139, was a mathematician and astronomer, as well as a government official. He introduced the grid system of coordinates to cartography. Then in 267 P'ei Hsu, minister of works, laid down the first principles of scientific cartography. These included the use of scale founded on graduated divisions of rectangular grids to make precise relationships between the different parts of the map, and the method of pacing off the sides of a right triangle to arrive at the length of the third side when the ground was too rough for actual physical measurement.

Using these principles, a map 30 feet long and 35 feet high, called "Map of both Chinese and Barbarian Peoples within the Four Seas," was drawn in 807. Chinese scientific expeditions had been sent in all directions to make field observations, and the map covered the whole of Asia. During the same period the first relief maps were produced, showing contour lines, and a Mercator-like projection based on astronomical observations was made. (Such a projection would only be made by a people who *knew* that the world was round.) The Chinese also placed North at the top of their maps and produced the oldest known printed map in 1155.

The 'South-Pointing Spoon'

The Chinese invented the compass, or as they called it, the "South-Pointing Spoon." In 1044 Sung Dynasty armies used the compass to find their way. A sliver of iron, 2 inches long and half an inch wide with a point at one end, was placed on top of the still water in a bowl without breaking the surface tension. Soon the Chinese not only had floating, but dry-pivoted compasses. In the 15th century Admiral Cheng Ho divided the compass into 24 points, subdivided by three to provide 72 subdivisions; this enabled him to set an accurate course on his voyages as far from home as East Africa.

The Chinese also invented watertight compartments for ships—possibly inspired by the sections in a bamboo shoot—and created the sculling oar, multiple sails made of mat and arranged in a way to capture the maximum force of the wind, as well as treadmill-operated paddlewheels. In the Sung Period the Chinese Navy had warships powered by 23 such paddlewheels, 11 on each side and one at the stern. By A.D. 1100, each ship carried a crew of from 200 to 300 men—including archers firing the Chinese-invented

magazine crossbow. Catapults on board hurled bombs and grenades.

Chang Heng, who introduced the grid system of coordinates to cartography, also invented a seismograph known as the "Bronze Earthquake Indicating Instrument." Eight dragon heads, each holding a bronze ball in its mouth, were ranged in a circle facing eight bronze toads, each corresponding to a prime division of the compass. If an earthquake occurred even as far as 400 miles away, a finely balanced pendulum would be moved to open the mouth of the dragon nearest to it. The dragon would spit the ball at the corresponding toad to determine the direction of the tremor.

The lowly wheelbarrow was a Chinese invention. Gen. Chuko Liang created it in the 3rd century to transport supplies for his army. He called it the "Wooden Ox" and the "Gliding Horse." The breast-strap harness, which is used around the world today for draft animals, was invented by the Chinese so that their vehicles could carry larger and heavier loads than those of the Greeks and Romans, which used the "throat-and-girth" harness.

The Chinese also adapted the toe stirrup of India to produce a foot stirrup in the 2nd century B.C., 1000 years before it became known in the West (and lent a decided advantage to the triumphant Norman invaders at England's Battle Of Hastings in 1066).

The Iron Age came early to China, and by the 4th century B.C. cast iron was being produced by double-acting piston bellows operated by man- or water power. Cast-iron hoes,

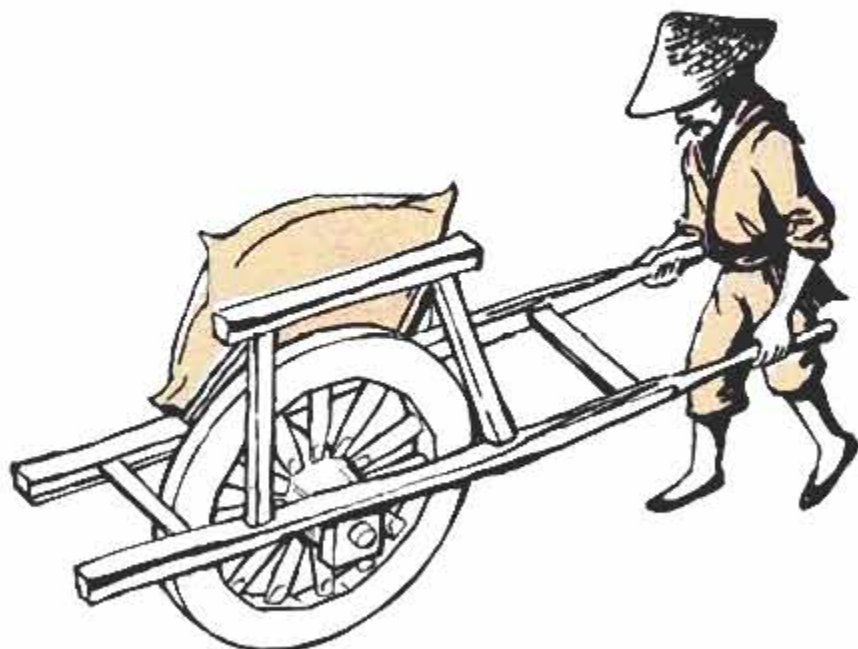
plowshares, axes, swords and picks were in common use. In the 6th century, what American metallurgists now know as the Siemens-Martin method of fusion was developed to heat wrought cast iron together to equalize the carbon content and produce steel. Soon, steel bits were being used to drill wells up to 2000 feet deep to bring salt-bearing brine to the surface through bamboo piping. Manpower was used, with some workers turning the drill, while others drove it into the ground by leaping on and off a beam, pivoted so that it acted like a hammer. The brine was evaporated in shallow iron pans to make salt. In Szechuan, as early as the 2nd century B.C., the Chinese had sunk deep wells to bring up natural gas. Petroleum fields have been recently rediscovered, which could make China an energy-rich nation.

The Chinese also built the first iron suspension bridges up to 300 feet long over ravines and canals as early as the 7th century. They also constructed single-span stone bridges over rivers long before they were first built in Europe.

The West invented eyeglasses, but the Chinese invented sunglasses. They first made them of smoky quartz, to be worn by judges who wished to hide their feelings as they heard the evidence placed before them at a trial. Farmers in the field used screens of yak hair to shelter their eyes from the sun, and made plates of bone or horn with a small slit to peer through.

Porcelain was a Chinese invention, and to this day fine porcelain is

(Please turn to page 128)



Single-wheel barrow in its simplest form; many variations of this invention existed.



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Shown smaller than actual size. Overall height: 7 inches.

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Advance ordering deadline:
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For the first time in its history, the National Wildlife Federation has commissioned the creation of a collection of original sculptures portraying North America's great wildlife.

Inaugurating this historic collection will be a superb sculpture of the American buffalo, entitled *Thunder on the Plains*. Finely detailed, crafted in cold-cast bronze and meticulously hand-finished, it is a brilliant study of the bison and an impressive work of art.

This new and original work has been created for the National Wildlife Federation by one of North America's most gifted wildlife sculptors—Chapel. It portrays the bison in full charge—wheeling in mid-stride past a clump of prairie sage. The ominous crescent horns, the flaring nostrils, the surprising agility of its powerful body—all are captured with an artistry that is completely true to nature. A quality valued throughout the long tradition of bronze animal sculpture.

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Thunder on the Plains is available in a limited edition—reserved exclusively for those who order from the Federation's first collection of original wildlife sculptures during 1981. The appointed issuing agent, The Franklin Gallery, will fulfill all valid orders, and then the edition will be permanently closed. A Certificate of Authenticity from the National Wildlife Federation will accompany each sculpture.

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ALL OUTDOORS

New sea monster

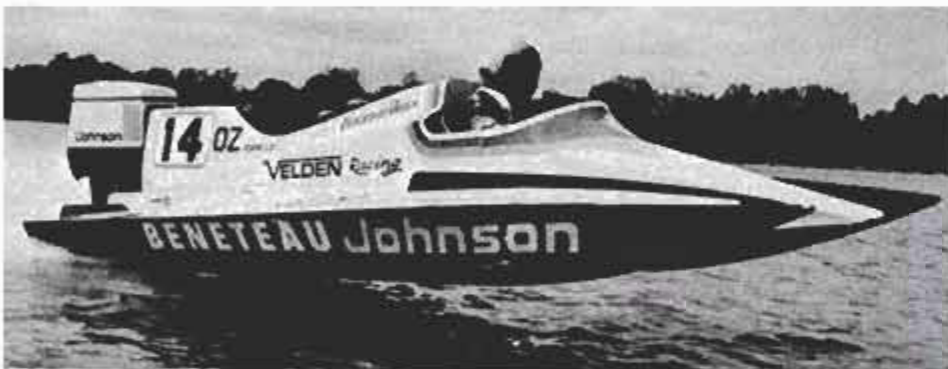
The most powerful production outboard motor ever built has been unveiled by Outboard Marine Corp. Ever since Mercury topped Evinrude's and Johnson's 235s with a 300-hp muscle machine a couple of years ago, there have been rumors that OMC would come roaring back.

Now it's happened, and the new 3.5-liter (214-cu.-in.) mill will first take on the racing circuit with a herd of horsepower. Harnessing seven more inches of displacement than the big Merc, this biggest Johnson-Evinrude is certainly well over 300 hp and, in its current racing mode, may be closer to an astounding 400. (OMC won't reveal the rated hp.) It is also the first V8 outboard ever built, with two banks of four loop-scavenged cylinders set at 90° to each other in the aluminum block. Cast-iron sleeves line each cylinder to enclose the high-rpm pistons; 16 carburetor throats—two per cylinder—feed the fuel.

Initially, the V8 may campaign at select European racing events, since it qualifies for the Union of Interna-

tional Motorboating's Formula I unlimited class, Charles Strang, OMC's president, told PM in an exclusive interview. Probably the world's leading proponent of two-cycle power, Strang is a former president of the American Power Boat Assn., as well as a noted outboard engineer and racing driver. The new engine's added displacement, Strang explains, is coupled with a highly tuned, integral exhaust system to provide the high horsepower; the streamlined gear case that handles it uses a dual-pinion gearing system similar to that on smaller, high-performance Evinrudes and Johnsons.

Top speed is also a secret, but since Evinrude racing driver Renato Molinari topped 140 mph on straightaways last year in Norway to win the world championship with a V6 engine, the new V8 can undoubtedly go faster. Yet straight-line speed, says OMC director of racing Jack Leek, may be getting less important than an engine's ability to maintain winning position all the way around the course—just as it is with cars. To add to a driver's performance control, the new V8 has an



Newest and biggest outboard, the Johnson model of the 3.5-liter V8 is rigged on a pickle-fork, Formula I tunnel hull, above. Evinrude's racing model of it is at left.

integrated power lift, as well as power trim, so the motor can be raised or lowered on the transom by remote control. This positions a racing propeller at optimum depth and angle for various conditions.

The first of the Johnson and Evinrude V8s will be sold to qualified racing drivers. However, a standard version of this compact but powerful machine should be in the works once suitable boats are available.

New how-far meter

Outdoorsmen are always looking for the best in equipment items, and



For pocket or belt, the Sanyo calculator/pedometer can count paces and distance.

recently we think we've found one for measuring distances hiked. It's a pocket calculator called the Sanyo Marathon CX 7250H that can also be programmed easily for walking, jogging or running. My normal stride is 26 inches, which is .0004104 of a mile, the instructions tell me. This goes into the calculator/pedometer memory, and the clever unit uses it to keep a continuous total in decimal parts of miles (or kilometers, if you prefer), while it's turned on in your pocket or clipped conveniently to your belt. It is so sensitive that Sanyo recommends turning off the counter during bumpy train and airplane rides. Accuracy is estimated at ± 5 percent, probably close enough to use with a topo map to find the right trail home, or calculate calories expended.

A year ago, this pedometer cost \$60. Now it's much less at many pocket calculator shops, or \$24.95 from Sheldon Bender Assoc., 7 Faulkner Lane, Dix Hills, N.Y. 11746.

Recently we found we had walked .2816 miles over the Atlantic while wandering the roomy 747 cabin during a smooth Braniff flight from Dallas to London, and later climbed a bonnie brae 2.196 miles above the fine fishing waters of Loch Lomond. The gadget is useful—and fun. **PM**



Lose 4-6 inches of bulging fat!

Let the Waist Belt System reduce a combination of your waist and hips, scientifically!

That's right! 4-6 inches starting the very first day! Science has known about this principle for years. In fact, right now, professional and amateur athletes the world over are using it in their training programs. Many famous entertainers who have to trim down fast rely on this method. Now you can use your body's own heat to melt away inches in areas of specific fluid retention like the waist and hips. And... Waist Belt comes with its own 5 minute exercise program for you to shed unwanted pounds and lose unsightly inches even more rapidly.

Real People Lose Pounds and Inches!

Here are the impressive stories (all sworn and notarized) of a few outstanding users. Everyone may not do as well, but if they can do this well, just think how many pounds and inches you will lose quickly with the Waist Belt System!



Mr. Douglas Fink—Asheville, N.C.
"I lost 6 inches in 16 days! I've worn it to work, playing softball, tennis, exercising, and just about anything I want to do. My weight dropped 16 pounds! I lost 4 inches from my waist alone!"

Mrs. Mildred C. Cable—Land O'Lakes, Fla.
"I went from a size 20 1/2 dress down to a 12! I tried every method. With Waist Belt, the exercise program and a sensible diet, I lost 52 pounds! I lost 8 inches from my waist and 11 inches from my hips!"

Dr. J. Lee Briers—New Castle, Delaware
"I lost 5" from my waist and 6" from my hips over a 12 day period averaging 10 minutes per day. My weight loss was 18 lbs."

Robert N. Nilsen—Mechanicsburg, Pa.
"I lost 9 pounds and 4 inches off my waist in 2 weeks! It's just unbelievable that it took so little time and effort!"

Don't Hold Fat In... Lose It!

If you want to go even further, the Waist Belt System will do it with you. Our rubberized construction allows Waist Belt to adjust to your new size as you shrink away. And your waistline, hips, and other problem areas will continue to shrink when you use the Waist Belt System to eat plans that won't leave you hungry. You can use it as often as you need it to keep those inches off.

Melt Away Inches or Pay Nothing!

We will take the risks! Try the Waist Belt System for a full 60 days. That's right 60 days. Simply use it as directed whenever you need it and we guarantee that you will lose excess pounds and unsightly inches.

In fact, you will be totally delighted or just return it for a prompt refund of your purchase price, no questions asked. The risk is ours, so order now, and start losing pounds and inches fast!

© 1981 Manufactured exclusively for The Weight Report Corp.

Waistbelt System, Dept. AMM 130

235 W. Haviland Lane Stamford, CT. 06903

Sirs: I have enclosed my check, m.o., M.C. or Visa info. Please send me the Super Action Waist Belt System which I may use for 60 days at no risk. If for any reason I am not satisfied, I'll return it for a prompt refund, no questions asked! N.Y. res. add sales tax.

Please give us your waist size: Men's _____ Women's _____
_____ Rush 1 belt at \$14.99 plus \$1.50 p&h.
(Save \$3) _____ Rush 2 belts at \$27.99 plus \$2 p&h.

Name _____
Address _____
City _____
State _____ Zip _____
Code#107 Canadian residents add 25%. Send to 280 Havelock St. Suite 202 Toronto M6H 3B9

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Now you can have your very own Analyzer, and it's all computerized with LED readouts. No mechanical parts to cause trouble. You never have to rely on unreliable mechanics again. With our Car Computer you know if you really do need a charge or a car battery, and you'll know it conveniently in advance. Stores compactly in your glove compartment. Ideal for cars, vans, campers, trucks.



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You must be completely satisfied with the way Car Computer checks your entire electrical system or send it back anytime in the next 5 years for an immediate refund of your purchase price.

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Tech/Direct, Dept. TMM 130
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Sirs: I have enclosed my check or m.o. for \$12.95 plus \$1.50 p&h. (N.Y. residents add sales tax). Please rush me my mini-radio which I may use for a full 30 days. If I am not totally satisfied, I may return it for a full refund.

(Save \$3) Rush me 2 radios at \$23.95 plus \$2 p&h.

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Address _____
City _____
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Solidox
outfit welds,
brazes,
solders...**

**and
sometimes
even mends
a broken
heart.**



Here's a handy tool that handles jobs you couldn't do before. It's the Solidox, the original solid oxygen torch. It welds, brazes, solders and easily cuts $\frac{3}{4}$ -inch bolts and $\frac{1}{4}$ -inch flat steel. You'll find hundreds of uses for it.

Weighing just under 7 pounds, it's easy to carry and easy to use. It has a single valve control. Oxygen is developed from safe oxygen pellets—color-coded for easy identification—and then combined with propane or high-temperature fuel to produce a 5,000-degree flame.

The Solidox comes completely assembled and ready to use. Operating instructions are printed on the torch, and in minutes you'll be putting your new tool to good use.

Get a new flame in your life — the Solidox. On sale August 17 through August 29 at over 1,800 K mart stores across the U.S.A.

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PM'S REAL PEOPLE ROAD TEST OF ECONOMY CARS

This time, our staff editors took the back seat and let the 'real' experts—the buyers—choose the cars they'd like to own.

Faced with an order form, what car would you pick to live with for the next four or five years? Thousands of Americans are facing this decision every day, and more and more of them are opting for fuel-efficient economy cars. But which economy car to buy? How much of a sacrifice, if any, will you have to make in room, comfort and options?

We decided to find out. Our "real people" road test allowed a mixed group of typical Americans to test the leading economy cars on the market, give us their opinions of the cars and, after two days behind the wheel, tell us which car they would pick for their own.

These typical Americans wrote this car test and what they have to say should shake up Detroit.

We didn't expect to find out what we did. Our group of testers was so diverse, our group of little cars so apparently uniform, that we were afraid each tester would prefer a different car, and the whole thing would lead nowhere. Fat chance. Our test group's conclusion is overwhelming, decisive and beyond question.

Our request was simple. To be as fair as possible, we asked each manufacturer to supply a four-door sedan—or three-door hatchback if its economy car isn't available as a four-door—optioned out



After two grueling days of testing, our group of nonprofessional testers came up with some interesting observations and startling conclusions on the state of the art of the economy car.

Produced by
the PM Auto Dept.
Test: Pam Taylor
Photo: Jim Houghton
Styling: Dixie

Lorraine Moscow on the Omni—
"Perhaps Chrysler should consider another field, instead of cars."



FIAT STRADA

DODGE COLT

MAZDA GLC

RENAULT LECAR

VW RABBIT

SUBARU GL

CHEVY CHEVETTE

MERCURY LYNX

HONDA CIVIC

TOYOTA TERCEL

DATSUN 310GX

to come as close as possible to a \$7,000 price. Since base price on most of these cars is between \$5,500 and \$6,500, we anticipated enough leeway to add an AM/FM radio or deluxe interior without every option. We also asked for a manual transmission—five-speed if available—for fuel economy and performance.

What we got was a group of seven four-door sedans and five three-door hatchbacks, all but one with the desired standard transmission. Price was something else again. The average price tag was \$6,725.75—just where we wanted it—but the



John DeGraw on the LeCar—

"When you hit the brakes, it feels like you'll be thrown out the windshield and get run over by your car."

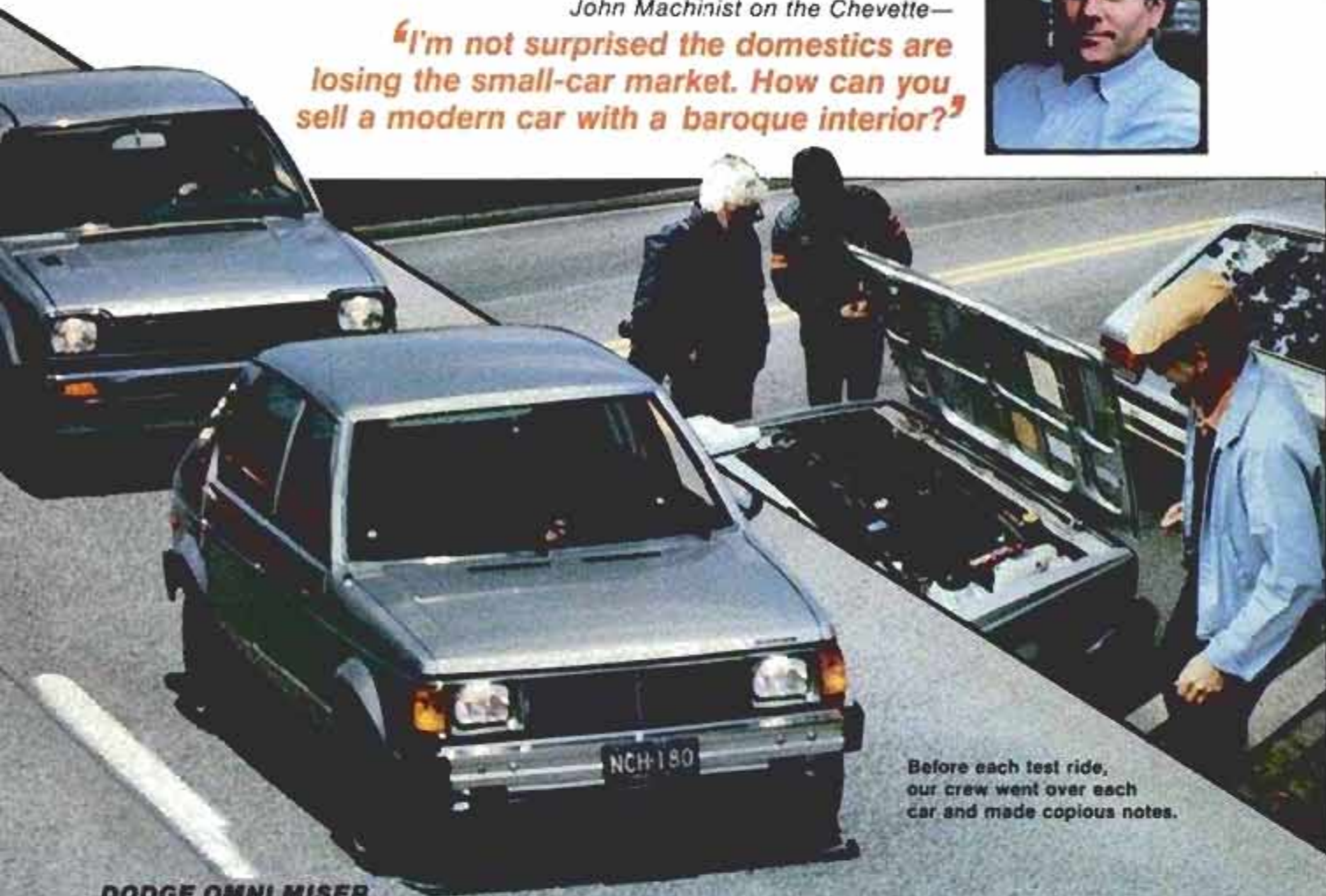
Inevitable problems cropped up: Here we replace flat on the Toyota.





For the urban test loop, cars were sent off through the moon-cratered streets of Manhattan, the ultimate test of suspensions. Testers (above right) compare impressions of the cars.

*John Machinist on the Chevette—
"I'm not surprised the domestics are losing the small-car market. How can you sell a modern car with a baroque interior?"*



Before each test ride, our crew went over each car and made copious notes.

DODGE OMNI MISER

prices ranged from \$5,495 for a relatively stripped Mazda GLC to \$8,008 for a Mercury Lynx which had everything.

It didn't matter. The automatic-equipped car won overall, despite our testers' dislike of the transmission. The two least expensive cars finished fourth and fifth; the two most expensive cars finished ninth and tenth. Our testers didn't know the prices, and compared the cars head to head. Obviously, those expensive options couldn't mask deficiencies in the cars themselves.

If \$8,008 seems like a lot of money for an economy car—or if even \$5,495 seems excessive—welcome to the era of Supply Side Economics. Realistically, you have to spend at least \$6,000 to buy a new car today, by the time you get done with taxes, dealer prep and all the other hidden charges. What we also learned from our testing is that you don't have to spend much more than that to buy the car which is the best—perfectly acceptable as the only transportation for a "one-car" family.

While we specified cars as similar as possible, we

THE CARS THEY'D BUY



Gerard Moringiello on the Subaru—
“Excellent styling. It looks like something costing twice as much.”



Karen Meyer on the Honda—
“What a value. It feels like an expensive sports car.”

wanted our drivers to represent a cross section of American society ...a broad spectrum of different ages, sexes, sizes and preferences in cars. We collected eight men and five women (one couple elected to drive together, cast one vote and give us the passenger's point of view, as well). From a high-school student to a retiree,

mute is less than a mile, from a garage mechanic to a real estate magnate, we covered the gamut.

Their own cars range from a well-used Volkswagen Beetle to a Cadillac Sedan DeVille, from a milestone Volvo P-1800 to a 454 Chevy Stepside 4x4. One is still driving the 1951 Plymouth she bought new, another has owned 54

cars in the last decade, and one has not only given up his car, but his house as well, and lives in a Winnebago.

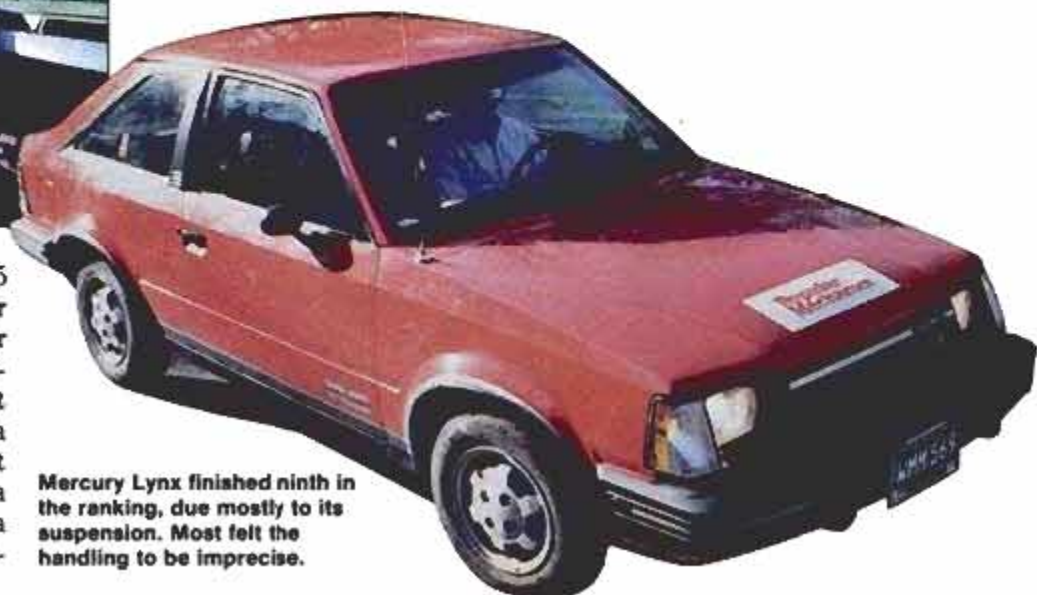
“Our goal,” we told them, “is to get your impressions of these cars and boil that information down into a meaningful article which will tell Popular Mechanics readers which car they might buy.



Malcolm Davies on the Lynx—
“Why, if this car looks so great, did it completely turn me off?”

from 5-foot-2 to 6-foot-3, from 105 pounds to 200 plus, from a car enthusiast/ex-racer to a jogger who tolerates cars as an evil necessity, from a 17-year-old who just built his first car from a wreck to a small-town mayor who forgot which pedal was the clutch, from a police chief who drives 10 hours a day to a clerk whose daily com-

Mercury Lynx finished ninth in the ranking, due mostly to its suspension. Most felt the handling to be imprecise.



PM's car testers, occupations and family cars are, from left: Karen Meyer, editorial assistant (Volvo P-1800); John Machinist, architect (Mustang Cobra); Jean Constantine, graphic designer (Honda Civic); John DeGraw, auto-parts manager (Chevy pickup); Lorraine Moscow, mayor/retired schoolteacher (Volvo 242); James Merola,

auto-body repairman (Chevy Malibu); Gerard Moringiello, auto mechanic (Cadillac Coupe DeVille); Malcolm Davies, real estate investor (BMW 733i); Bill Frech, book editor (Winnebago) and Anne Wenholtz, hospital administrator (VW Beetle); Mary Polinsky, town clerk (1951 Plymouth); Louie Washington, police chief (BMW sedan); Joshua Colwell, student (BMW 1600).



SUBARU GL—2 votes

VW RABBIT—1 vote

FIAT STRADA—1 vote

We want your honest opinions. It doesn't matter what the other testers may prefer, you should rank the cars the way you see them. There is no right or wrong answer. Please relate the cars to your own needs and driving habits."

PM tested all 12 cars at Englishtown (N.J.) Raceway Park: quarter-mile acceleration, braking, 700-foot slalom, skidpad and interior sound level. We created a parking index, which adds overall length and turning circle to give a pretty good idea of how convenient these little scooters would be in town; and an interior-space index, which measures the cubic

(Please turn to page 123)



James Merola on the Mazda—

"It looks nice, but there's a lot of torque steer and it needs stickier tires and better shocks."

Mazda GLC came in fourth in the ranking. It was praised for excellent interior space and sharp, contemporary styling. Some felt it could have handled better.



CHART 1: PM'S ECONOMY CAR TEST—RESULTS AND RANKING

	TESTERS' COMBINED RANKING			PRICE	FUEL	INTERIOR	PARKING	SHOPPING-
	City	Country	Total	(as tested)	ECONOMY	SPACE	INDEX	BAG INDEX
Honda Civic four-door	21	21	42	\$6,699	25.28	138.48	47.38	32
Subaru four-door GL	34	29	63	\$7,445	25.29	137.16	52.96	21
Volkswagen Rabbit LS	38	40	78	\$7,355	26.99	129.31	45.27	20
Mazda GLC	64	58	122	\$5,495	27.69	153.24	43.97	30
Dodge Colt	71	68	139	\$5,711	29.89	141.83	52.07	21
Toyota Tercel	82	80	162	\$6,038	28.61	143.51	54.19	33
Fiat Strada	95	87	182	\$6,500	26.88	151.52	51.48	30
Renault LeCar GTL	91	104	195	\$6,165	26.99	129.31	41.89	21
Mercury Lynx RS	104	95	199	\$8,008	26.43	151.02	54.77	28
Chevrolet Chevette	102	99	201	\$7,453	25.61	135.03	48.65	28
Datsun 310GX	101	110	211	\$7,319	28.48	148.51	51.51	28
Dodge Omni Miser	136	141	277	\$6,521	24.81	138.94	51.52	26

Ranking is the subjective opinion of our testers and is similar to a golf score—the lower the number, the higher the ranking.

The lowest possible number a car can get is 12; that is, if each tester gives it a score of 1. The highest number is 144, with each tester scoring it last (giving it a 12). The total score combines both days of testing—a day in the city and a day in the country.

Interior-space index is (front headroom × front elbowroom × front legroom) plus (rear headroom × rear elbowroom × rear

legroom) divided by 1,000, with front seat set at 40 inches of legroom.

Parking index is (car length × circle-turning diameter) divided by 1,000.

Shopping-bag index is obtained by placing standard-sized grocery bags in the trunk/cargo area with rear seats folded.

In the Subaru and Honda, which are notchbacks, one row of bags was put on the back seat.

How science forecasts the killer quakes

Suddenly, everyone is trying to read the future in a crustal ball. But veteran researchers don't recommend heading for the hills unless an earthquake prediction passes a few scientific tests.

by Gurney Williams III SCIENCE EDITOR

Scientists struggling to understand the mysterious rhythm of earthquakes work amid an erratic drumbeat of predictions.

"Send me a seismometer," one man wrote the U.S. Geological Survey in Washington, "and I will stare into it and tell you when the quakes are coming."

Stock market analyst Joseph Granville of Florida sent psychological shock waves rippling through California with his prediction that an earthquake would strike Los Angeles on Friday, April 8, this year at 5:31 a.m. The California Institute of Technology, a center for rigorous research into quakes, got 100 calls a day from people frightened about the Granville pronouncement. Friday, April 8, passed without a rumble or bump.

Occasionally, startling and controversial predictions come from legitimate scientists themselves. Earlier this year, a Chinese meteorologist earned international publicity when he forecast that a rare alignment of the solar system's nine planets in 1982 would cause natural disasters over the next 20 years. Other Chinese scientists were skeptical about the prophecy. In the United States, two government scientists with good credentials created an international flap when they predicted violent earthquakes due in Peru this month. Fellow scientists have dismissed the prediction.

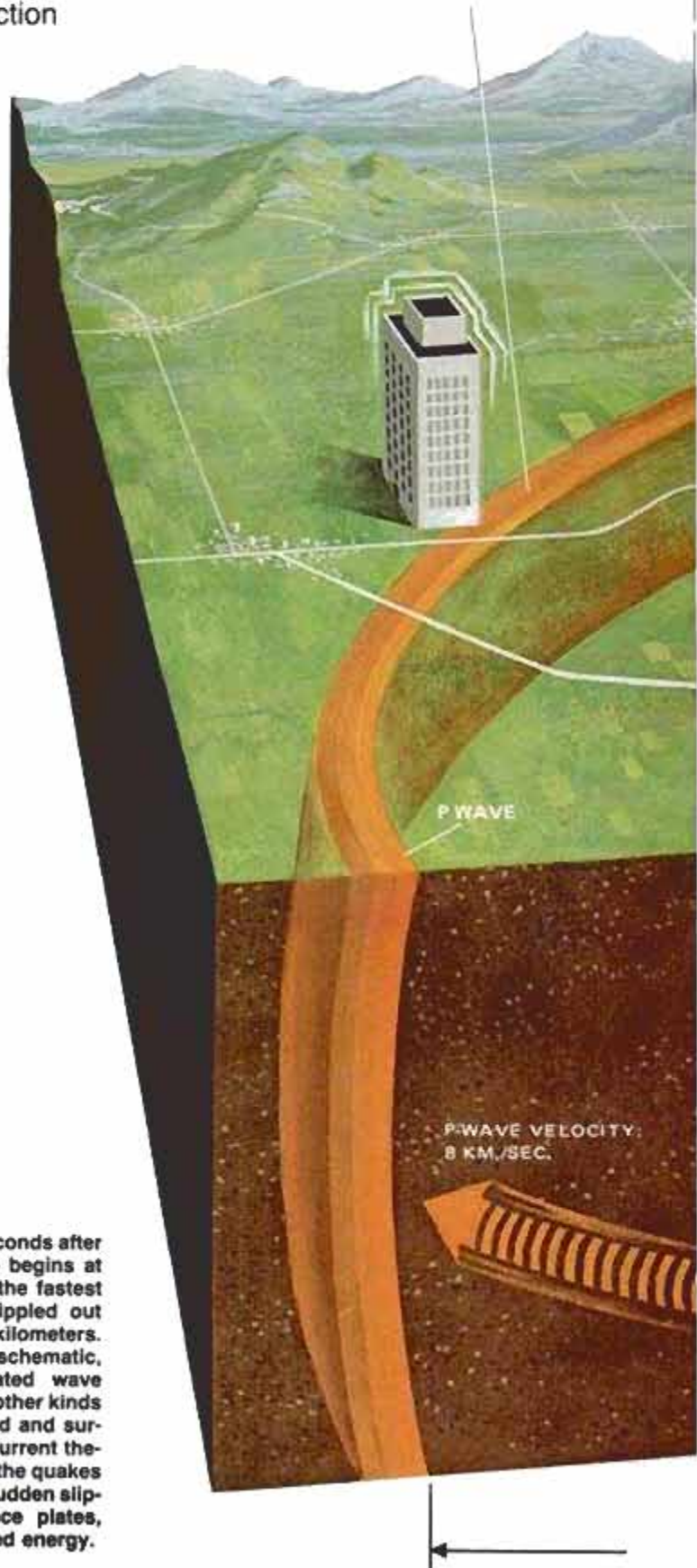
Stirring the crackpot

More often, the seismic seers are amateurs. Their grim predictions have fallen like rain, ever since scientists began trying to predict quakes seriously some 15 years ago. "Of course, the more we talk about earthquake prediction in the scientific sense, the more nonscientists get the idea that they, too, should try it," said Clarence Allen, a professor of geology and geophysics at Cal Tech. "We stimulate our own crackpot or lunatic fringe out there."

Most predictions by amateurs are flatly wrong. A few years ago, researchers John Derr and Roger Hunter at the U.S. Geological Survey in Denver evaluated some 2,500 predictions from astrologers, dreamers, ama-

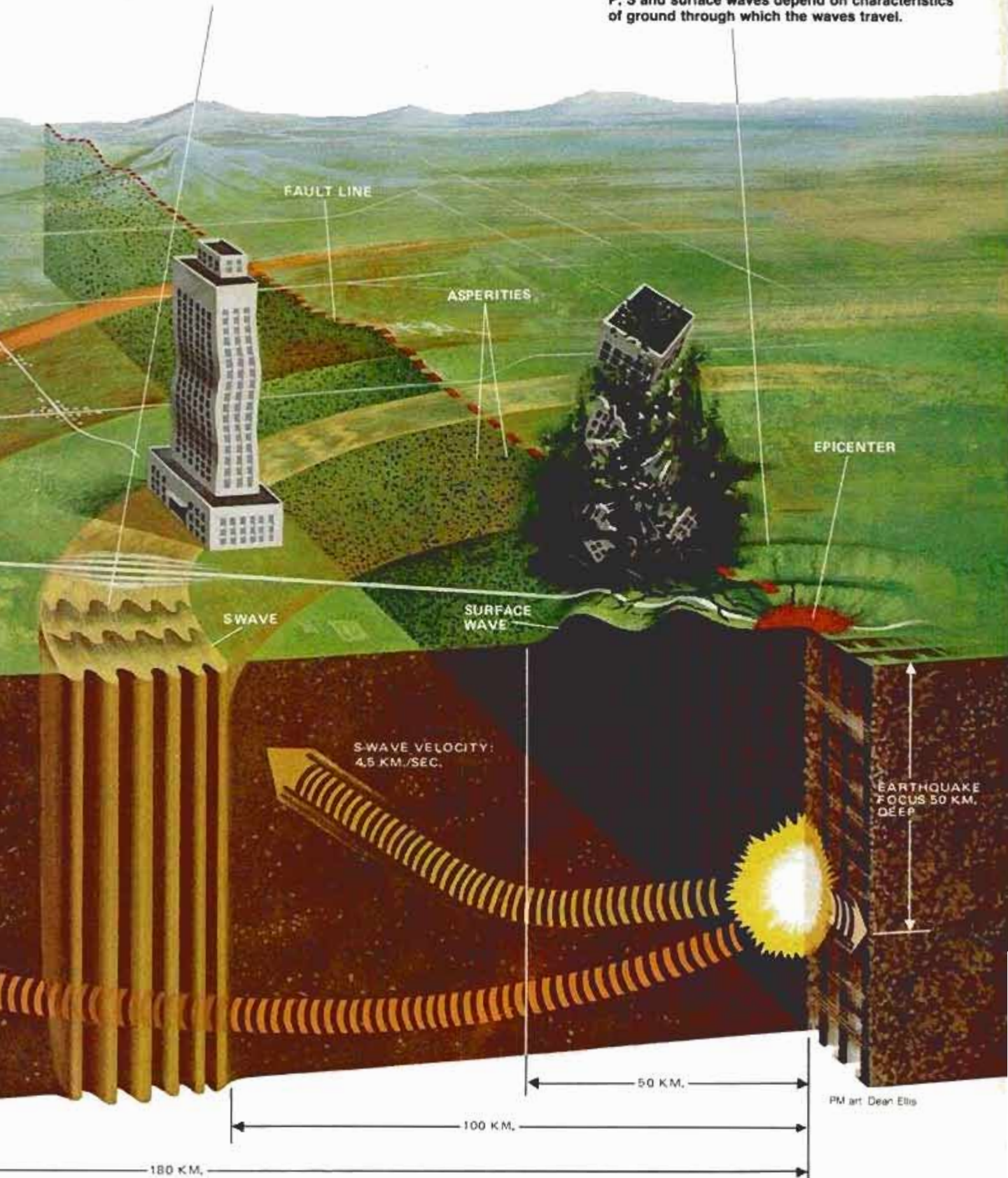
Roughly 20 seconds after an earthquake begins at the fault line, the fastest waves have rippled out almost 200 kilometers. A simplified schematic, with exaggerated wave forms, shows other kinds of underground and surface motion. Current theory holds that the quakes result from a sudden slippage of surface plates, releasing stored energy.

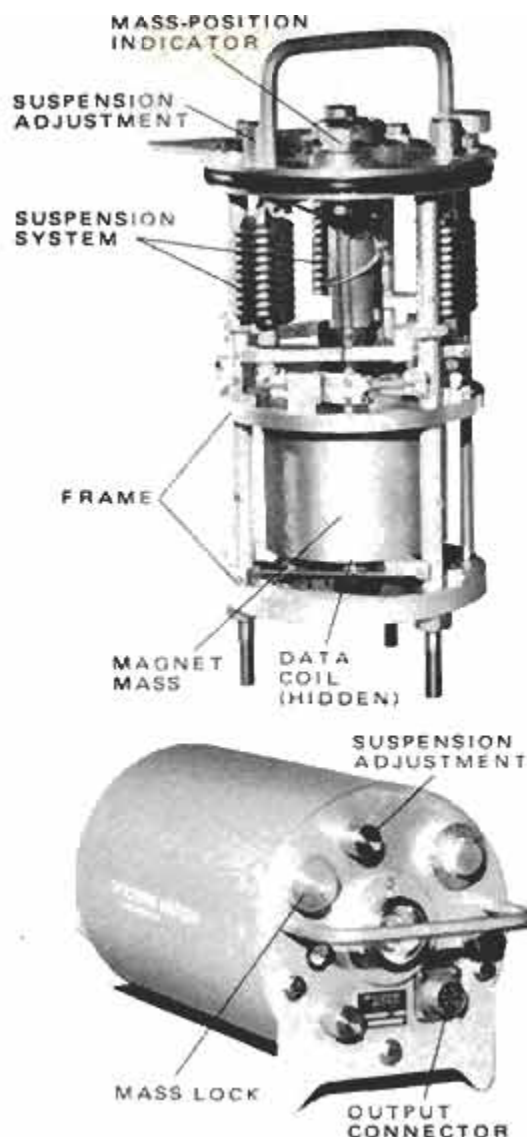
1 Fastest of waves rippling from quake focus, P wave (primary or pressure) acts like a blast of sound, pushing and pulling earth and rattling objects on surface.



2 S (shear or secondary) waves cause movement of particles perpendicular to wave direction. S waves whip buildings side to side. One prediction system compares speeds of P and S waves in small tremors.

3 High-amplitude, slow-moving surface waves take different forms—some horizontal, some vertical. Surface waves can cause most damage. Speeds of P, S and surface waves depend on characteristics of ground through which the waves travel.





Teledyne Geotech seismometer (\$1,650) converts tremors into electrical signals.

teur scientists, psychics and religious visionaries. They took into account the likelihood that each prediction might come true by chance alone. They checked quake activity as the times for each prediction passed. And they assigned scores based on what happened, which wasn't much: Only one predictor had statistically significant scores.

But despite the flurry of tyros' prediction-by-press-release, the real science of earthquake forecasting is remarkably healthy. While amateurs read their tea leaves, researchers have learned new skills in reading patterns in seismic activity, and designating areas where quakes are likely to occur. In the last decade, they've picked up interesting data on the relationship between radioactive radon gas released by the earth and strain changes preceding quakes. Best of all, scientists have built a modest, but improving, record of successful forecasts—about a dozen so far (see map on facing page).

The classic success story came out of the Liaoning Province in north-

east China during the middle 1970s.

The bizarre incidents began in June 1974. Tremors shifted from place to place throughout the province. Water levels in wells rose and fell as if locked to some odd underground tide. Animals acted strangely.

Then, in early February 1975, a tremor was felt in a previously quiet area. Seven followed the next day, and more on the day after that. This was the sequence:

7:00 p.m., February 3: Earthquake scientists called an emergency conference to warn authorities that a very strong quake would probably strike shortly.

2:00 p.m., February 4: Tremors had leveled off, but scientists stuck to their prediction. Local residents were told to expect a major earthquake within two days. People closed their shops. Evacuation began.

6:00 p.m., February 4: The government issued a warning to the residents of one village: "A strong earthquake will probably occur tonight. We insist that all people leave their homes and all animals leave their stables. The people from the cinema team will show four feature films outside for us tonight."

7:36 p.m., February 4: A major earthquake, measured at 7.3 on the Richter scale, wracked the province. Some 90 percent of the buildings in Haicheng County were destroyed. The prediction had probably saved tens of thousands of lives.

'Gapings of the Earth'

Scientists agree that their track record in making such predictions (specifying precise time, location and magnitude) depends on understanding the causes of earthquakes,

and on burying of ancient myths.

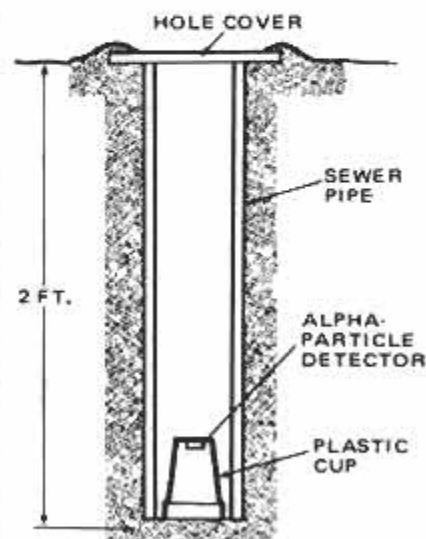
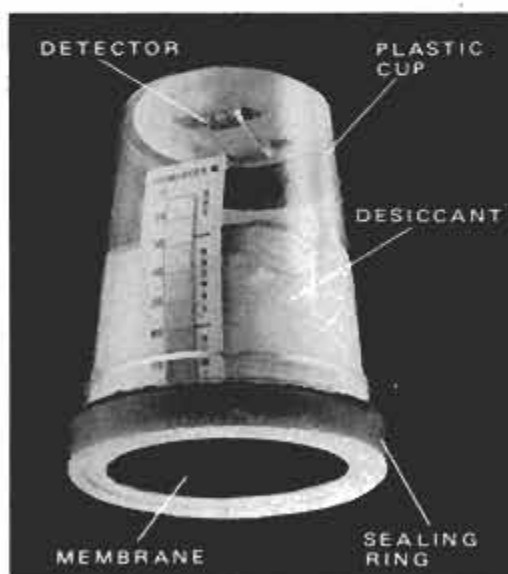
The misconceptions die hard. Back in the 17th century, a Moravian educator named John Amos Comenius gave his readers a concise—and highly inaccurate—explanation of quakes. "A Wind under Ground causeth an Earthquake," he wrote. "An Earthquake causeth gapings of the Earth (and falls of Houses)."

Well into this century, people continued to believe that during a quake, the ground swallows up people or buildings. After the great San Francisco earthquake 75 years ago (Richter magnitude 8.3; devastatingly powerful), a Marin County farmer called in reporters who gaped at a cow's tail sticking up from the ground. A crevice had devoured the cow, the farmer told the gullible reporters. Years later, the real story came out. The cow had died before the quake, and the farmer had buried it with its tail in the air to get some publicity.

"The biggest danger is having something fall on you," said Roger Stewart of the U.S. Geological Survey, who longs to be out in an empty field near the epicenter of an earthquake. "If you're outside, away from buildings, all you have to do is stay low and enjoy the ride."

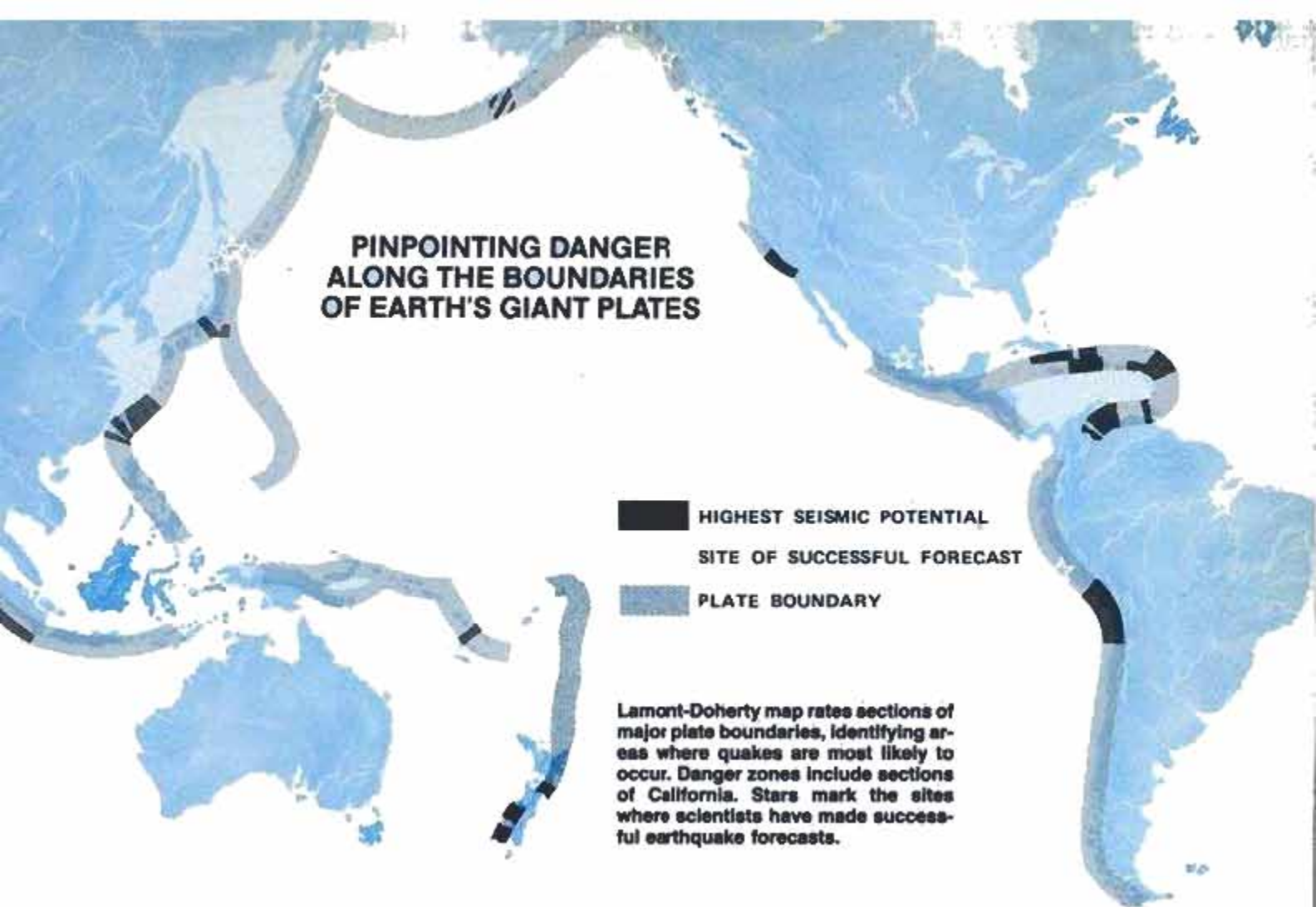
In the middle of a roiling field, Stewart would also try to analyze what was going on underground, which is not nearly so simple as the subterranean windstorm reported by Comenius.

Currently accepted theory holds that earthquakes occur because of movement at the boundaries—fault lines—between huge plates, jigsaw-puzzle-like parts of the earth's crust. Movement patterns are complicated and there are several scenarios which quakes can follow. In



Radon detector, from Robert L. Fleischer of General Electric, is a simple plastic cup (left) housing plastic patch sensitive to radioactivity. It costs just a few dollars.

PINPOINTING DANGER ALONG THE BOUNDARIES OF EARTH'S GIANT PLATES



Lamont-Doherty map rates sections of major plate boundaries, identifying areas where quakes are most likely to occur. Danger zones include sections of California. Stars mark the sites where scientists have made successful earthquake forecasts.

one scenario, plates glide horizontally past each other at the rate of a few centimeters a year. Sometimes the rough surfaces of the plates—the bumps are called asperities—snag. The snags stop slippage. Pressure builds up until asperities crack up, unlocking the plates. The earthquake results from a sudden lurching of plates at the fault line.

Scene in southern Italy, following quake in November 1980, suggests devastating power when plates suddenly move. Thousands died. Scientific predictions can save lives.



Photo: Associated Press

According to Stewart, when the fracture occurs, people some distance from the quake feel several different kinds of waves, each with its own distinctive rhythm. First come the P (primary or pressure) waves, comparable in form to sound waves that travel through a steel bar when a hammer taps one end.

"If you hear a rumbling, then a

bump, you know that was a P wave." Stewart notes. Lagging behind—at roughly half the speed—are S (shear or secondary) waves, comparable to the side-to-side, up-and-down motion of a plucked guitar string. These also radiate underground. They tend to make objects on the surface move back and forth, as well as up and down. Finally, slowest of all, surface waves snake and undulate on top of the ground. Some move horizontally, some vertically. Surface waves and shear waves, Stewart says, "are the ones that tear buildings down."

False starts, blind alleys

There is general agreement today on how earthquakes occur and the kinds of waves they produce. Scientists have wrestled for years with the problem of using this knowledge of underground turmoil to predict the big ones.

Soviet scientists raised hopes in the 1960s with a simple approach. It was based on comparing the speeds of P and S waves during small, harmless tremors. They suggested that before a big quake, the ratio of the two velocities changed. P waves slowed down relative to S waves, perhaps as a result of cracks in

(Please turn to page 102)

One reason Cutlass continues to out-sell all other domestic cars is that it gives the customer more than just the Oldsmobile name—a lot of styling at a very competitive price.

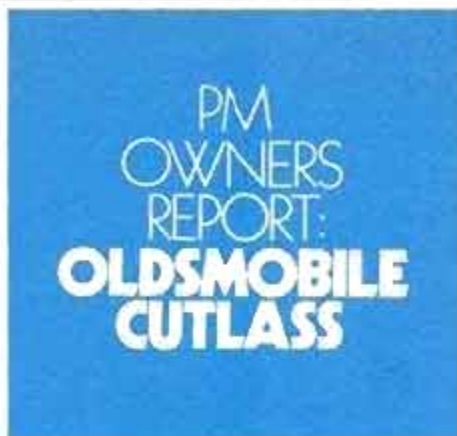
The Supreme coupe, which traditionally captures more than half of all Cutlass sales, costs roughly \$215 more than Chevrolet's Monte Carlo. And while both coupes share the same body (the GM A-Special shell), Olds designers seem to come up with more shopper-pleasing lines.

Styling emerged as the main reason most owners chose Cutlasses. Styling



Handling and steering response are good for a big car, say many Cutlass owners.

also topped their list of best liked features. Yet styling wasn't the only reason buyers selected Cutlasses. Here's a cross section of reasons:



"We liked what we saw," noted a South Carolina mechanic, "and so far, we've been enjoying what we got."

An Illinois dentist: "We liked the Cutlass's looks, but what clinched it was the deal. The Olds dealer gave us a better trade-in on our 1978 Monte Carlo than the Chevy dealer offered."

A Texas home builder: "I bought this Cutlass strictly for its resale value. While I personally preferred the Buick Regal's styling, I knew the Cutlass would sell more readily and bring a better price in the end."

An Ohio bank-card clerk: "I'd owned a 1978 Cutlass before and had gotten rid of it for a small foreign car. I couldn't stand that, so I traded for the Supreme this year."

A Florida shoe-store owner: "We needed a medium-sized diesel wagon for good fuel mileage and accessibility to the cargo deck."

And an Illinois retiree told us, "I was attracted by the body styling, handling and quick pickup."

Comfort, handling, economy and ride were all high on our respondents' lists of well-liked Cutlass attributes. A Texas trucking supervisor observed, "The four-door Cruiser wagon is very roomy and comfortable, with a smooth ride. And so far, it has needed less maintenance than my BMW with the same number of miles."

A Wisconsin teacher: "Good long-distance fuel mileage with the V6. I'm getting 25 to 30 mpg on the highway and 18 to 20 around town. The Cutlass is also very



Most popular Cutlass engine choice, V6, is criticized for being underpowered.

BY MICHAEL LAMM WEST COAST EDITOR

Delighted owners say it deserves to be the best selling car on the market



Seat-belt design could be better.

Engine cited as very reliable.

Owners pleased with excellent handling.

PM photos: John Lamm

dependable—it's never failed to start in Wisconsin's coldest weather!"

A Michigan tool-and-die foreman: "I especially appreciate the coupe's style and ease of handling. I also like the comfort and roominess compared to smaller cars. It's the right size."

An Illinois civil engineer: "I've got the Supreme Brougham with the 4.3-liter V8. I am very pleased with the smooth ride, the trunk is large compared to the overall size of the car and it's deep enough to hold grocery bags. This car has good visibility and I like the dashboard layout."

Praises outweighed complaints by a significant margin. Among those who did complain, lack of horsepower bothered 10.7 percent, prompting a Texas engineering technician to write, "Bring back the gasoline 350 (5.7) V8! The Cutlass feels underpowered compared to previous models I've owned."

Oldsmobile does offer a 5.7-liter V8 for the Cutlass, but it's a diesel. Only 6.5 percent of the owners we surveyed had chosen that engine. Among those, the most popular body style was, by far, the four-door station wagon. By and large, Cutlass diesel owners expressed satisfaction with their cars' fuel economy (23.0 to 29.5 mpg) and noise levels, yet a few did grumble about acceleration.

Just over half our owners had experienced mechanical problems: 50.9 percent, to be exact. That's not an especially

good showing. Ford's 1981 Granada and Esort needed considerably fewer repairs, as did the Dodge Aries, Imperial, and Cadillac V8-6-4. Among imports, the Toyota Starlet showed far more reliability than the Cutlass—only 17.8 percent of its owners reported mechanical difficulties.

Nor does the Cutlass live up to owner

(Please turn to page 126)



Although pleased with its interior space and comfort, some find quality lacking.

The nation's bestseller

The 1980 Olds Cutlass again topped America's automotive bestseller list, an honor the nameplate has held for several years. This 1981 model, though, marks the last of the Cutlass's rear-drive sedans and wagons, because a new generation of front-wheel-drive replacements is due for 1982. So is a new, optional, diesel 4.3-liter V6.

The coming fwd change, however, excludes the Cutlass Supreme coupes, which will stick with the present GM A-Special body plan until 1983, at least.

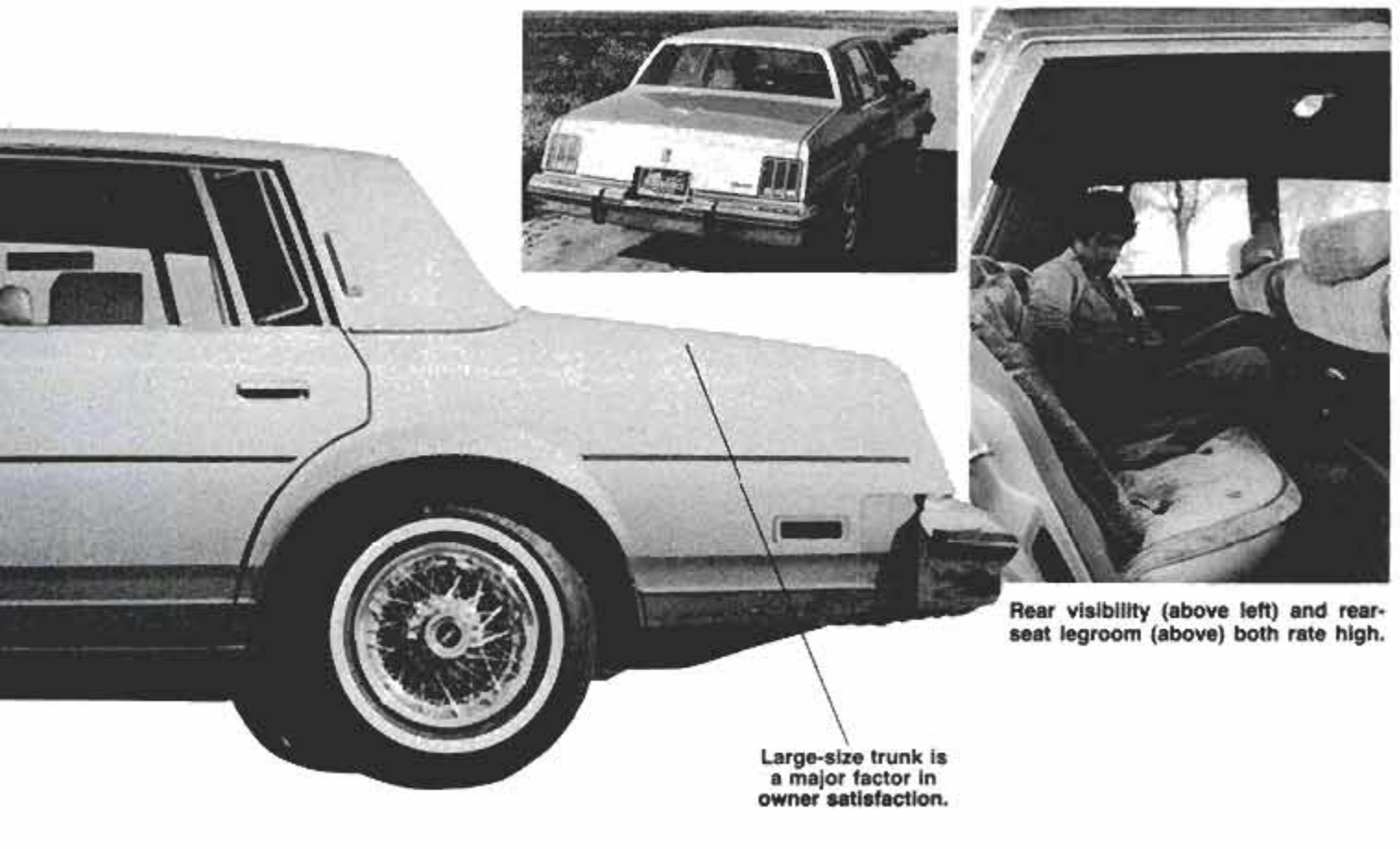
The '81 Cutlass comes in three body styles: coupe, four-door sedan, and four-door wagon. There are eight Cutlass models in all: Supreme, Supreme Brougham, and Calais coupes; base, LS, and Brougham sedans; and Cruiser and Brougham wagons.

All list the 3.8-liter (231-cu.-in.) V6 as standard equipment, with 4.3 and 5.0 gasoline V8s plus the Olds 5.7-liter diesel V8 optional. Base Cutlasses are equipped with the manual three-speed stick standard, but all other models come with clutch torque-converter automatics.

Standard equipment depends on which model you choose. Top-liners like the Calais coupe and the Broughams include such goodies as power steering, front and rear stabilizer bars, and extra insulation.

Recent changes in body design have resulted in 15 percent less aerodynamic drag, greater distinction between models, and better visibility over more sloping hoods and decklids.

A NATIONWIDE SURVEY BASED ON 1,075,178 OWNER-DRIVEN MILES



Large-size trunk is a major factor in owner satisfaction.

Rear visibility (above left) and rear-seat legroom (above) both rate high.

New computer animation fools the eye

Expensive movie sets and special effects are being replaced by eye-catching, realistic-looking images generated by a computer.

by Neil Shapiro

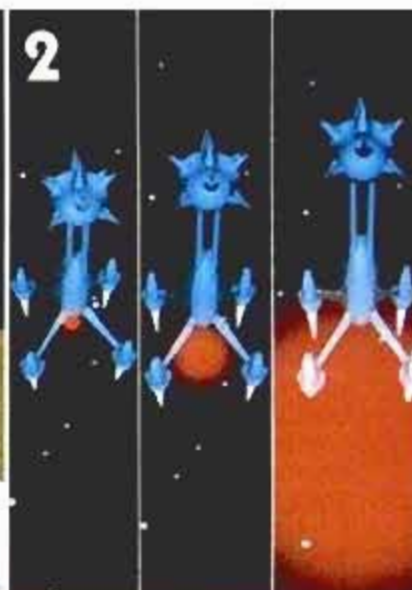
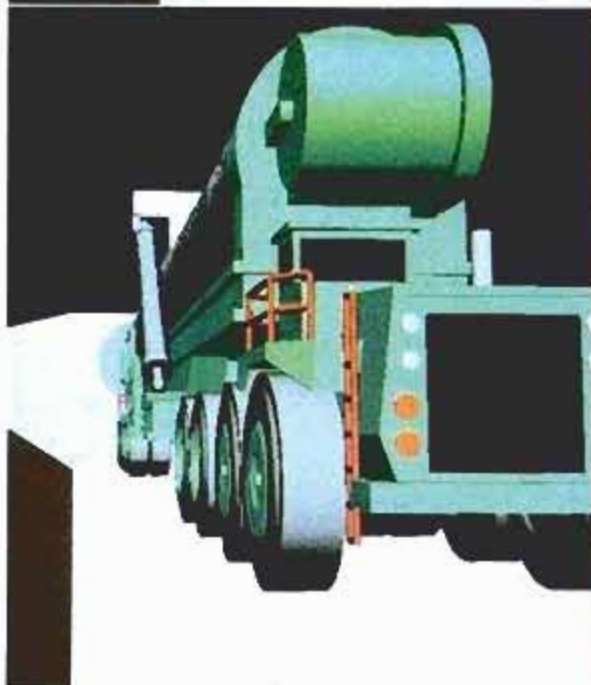
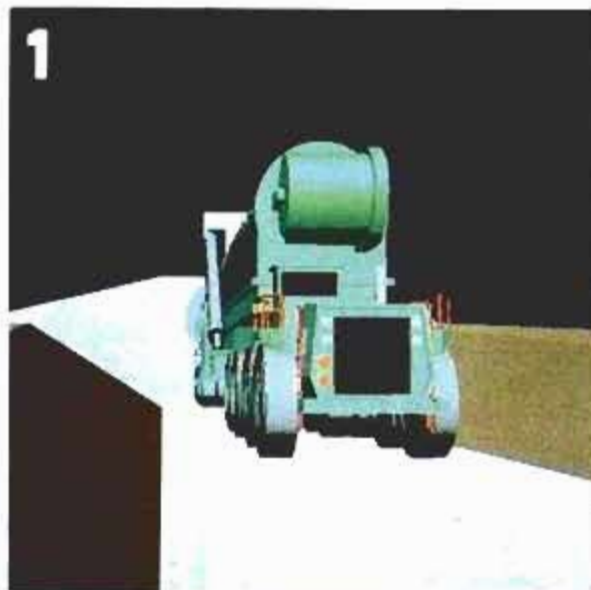
ELECTRONICS EDITOR

Bright, coruscating images spin across your TV screen. These fantastically detailed, animated images would take thousands of artist-hours to produce in old-fashioned, draw-every-frame animation studios.

But, today, new computer animators are cutting that time by more than 90 percent. And the animation can be done so well, so true to life, that many Hollywood studios are

(Please turn to page 108)

A programmer inputs primitives—building-block shapes, right, below—to computer.

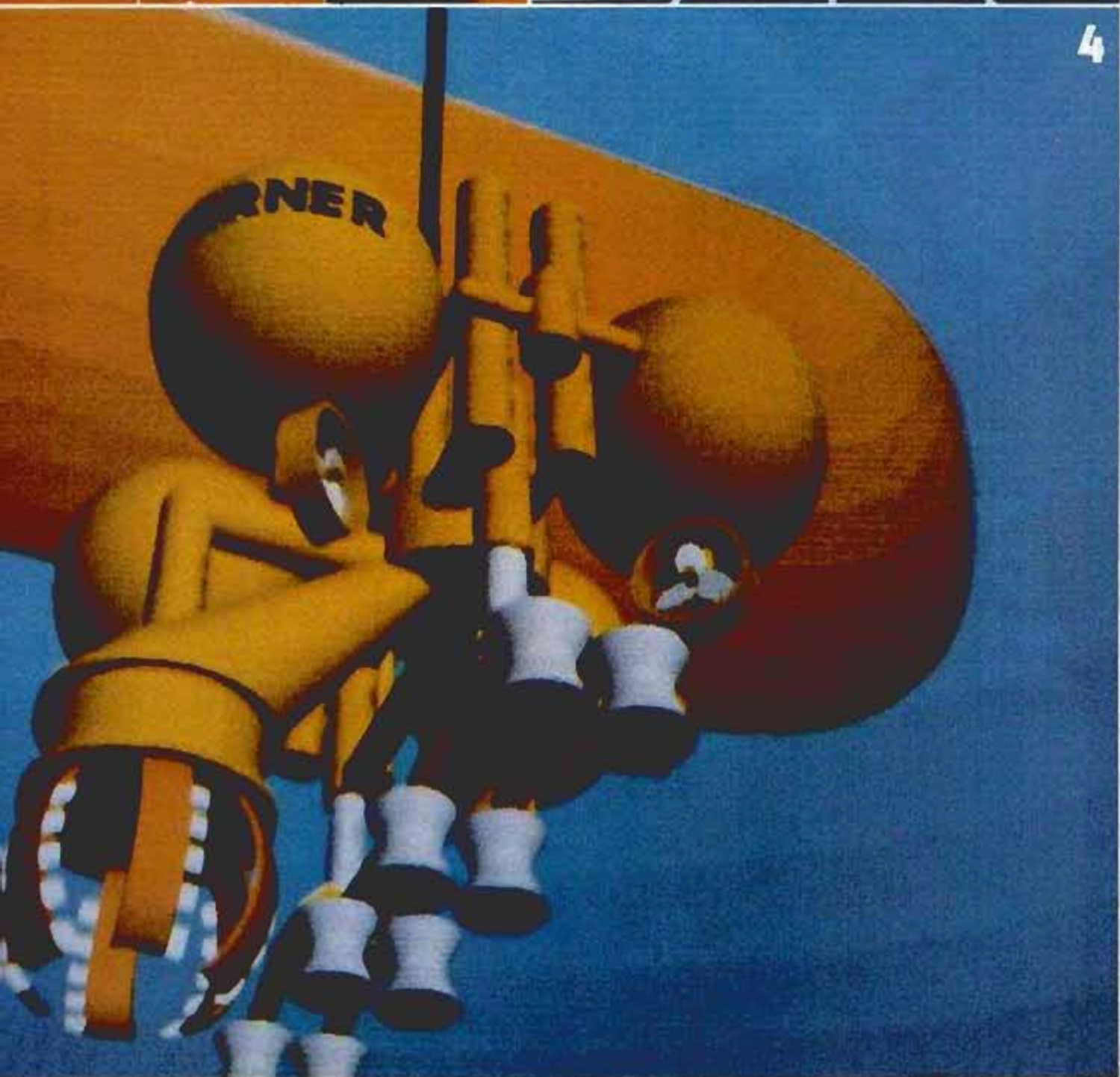
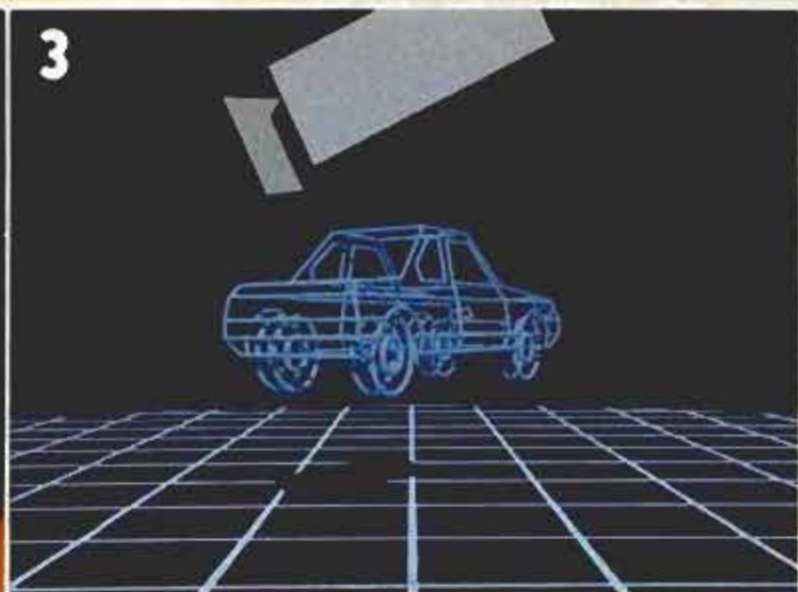
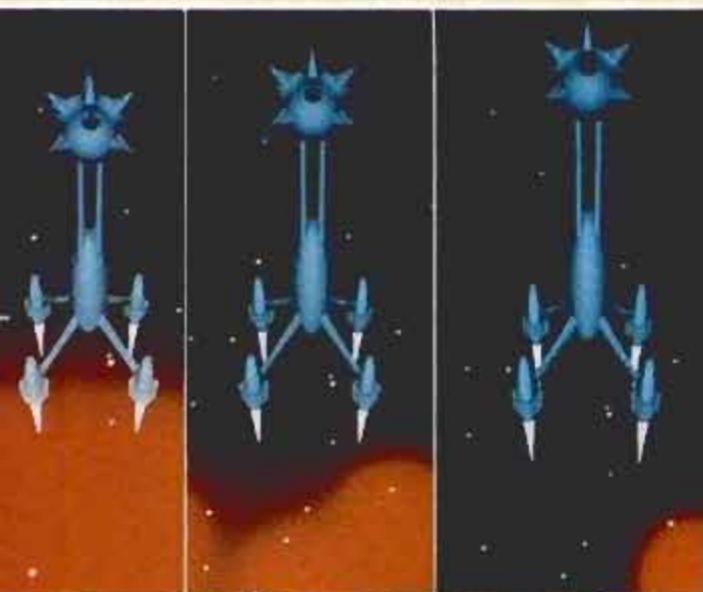


1 The truck sequence illustrates how the computer can zoom in on a complex figure to show great detail.

2 Movie studios looking for spaceships and other fantasy effects may soon turn to computer animation, instead of expensive models.

3 Here's a still from a TV commercial for recent auto shows in various cities. Animation sequence shows the car being packaged in the box floating above it.

4 Large picture shows the incredible resolution of detail computer is capable of. Picture is a conception of an undersea trawler.

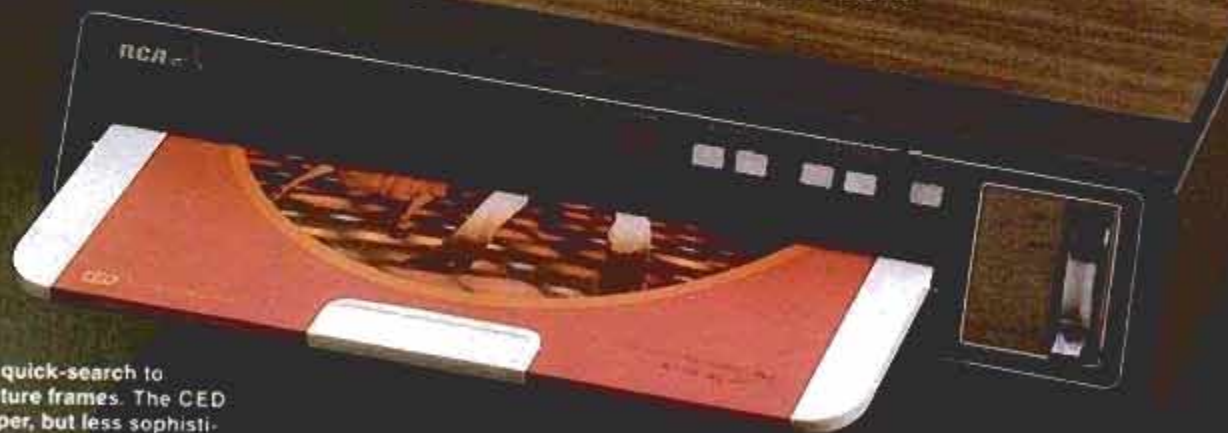




Magnavox Model 8000 (laser)

PM COMPARES THE THREE NEW VIDEODISC SYSTEMS

Players you can buy now use three different methods to play discs.
Here's what's good—and bad—about each.



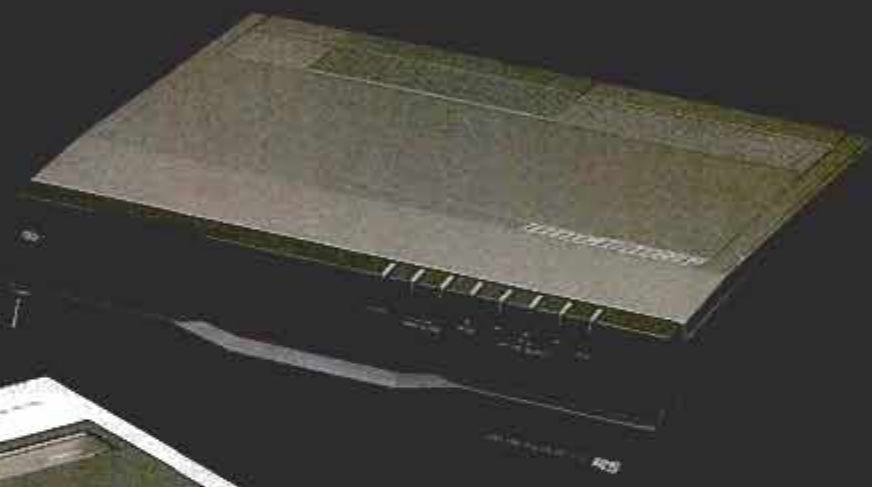
Laser units offer quick-search to any of 54,000 picture frames. The CED players are cheaper, but less sophisticated. New VHD players combine some of the laser abilities with lower costs.

RCA SelectaVision Model SFT100 (CED)

GE videodisc prototype (VHD)



Elmo Video Disc Player VEC-200 (CED)



Pioneer LaserDisc Model VP1000 (laser)



by Neil Shapiro ELECTRONICS EDITOR

Round and round spin the three new videodisc systems, and the arguments for and against each one can be as dizzying as a ride on a runaway merry-go-round. Before you plunk down a good bit of money, here's what you should know. And even if you're not in the market, stay tuned: These videodisc machines use some fascinating technology.

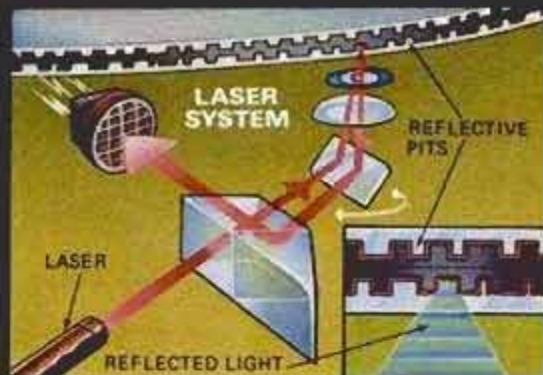
Videodisc manufacturers are using three different systems. All three will bring movies and other visual entertainment to your home TV. They are all playback only (so far, no videodiscs can record). But their similarities end there. A disc from one system will not play on a different system.

The first system that came out was
(Please turn to page 111)

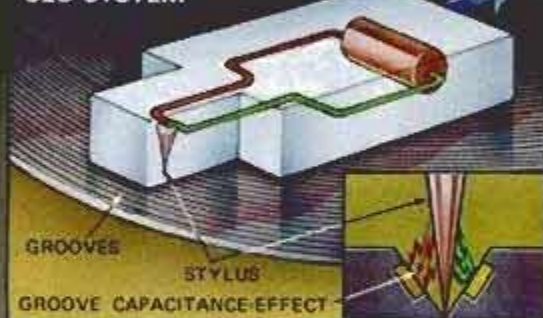
Laser system reflects laser light from pits on videodisc's mirror-finish surface. Amount of reflection controls the video signal. There is no stylus, hence no disc wear occurs.

CED, or Capacitance Electronic Disc, was designed by RCA. Stylus rides in groove and capacitance effect picks up video signal. Some players, such as Elmo Model VEC-200, also offer stereo sound outputs.

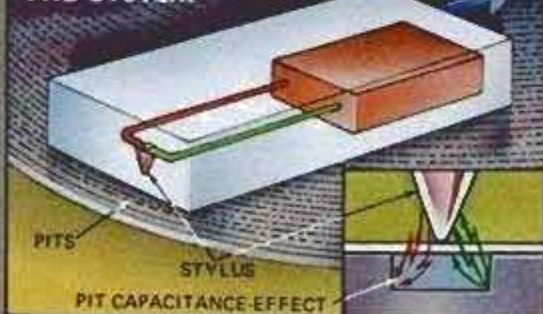
VHD stands for Video High Density. Information is read from capacitance pits of coated disc by a stylus that just touches the surface lightly.



CED SYSTEM



VHD SYSTEM



How they bring Baja

When fans can't trek into the wilderness to see an off-road race, promoters bring the race to the fans.

by Steven Parker

Off-road racing is probably one of the most exciting motorsports events ever to hit the racing world. It got its start in the early 1950s, when

loosely knit groups of ex-circle track and road racers held unofficial races from Southern California to Mexico and back. Running brutishly powerful, but fairly unsophisticated, American cars on the dirt roads and cart tracks of Mexico, these early races were held mainly for fun—as an excuse for some good friends to share some thrills and chills in the wilderness.

Inevitably, when the competitive nature of

these racers surfaced, the machinery became more refined, the racing got serious and better organized. Finally, this amalgam of freewheeling racers and their grab bag of racing machines evolved into the Baja 1000, the Grand Prix of Motocross and the various off-road endurance races.

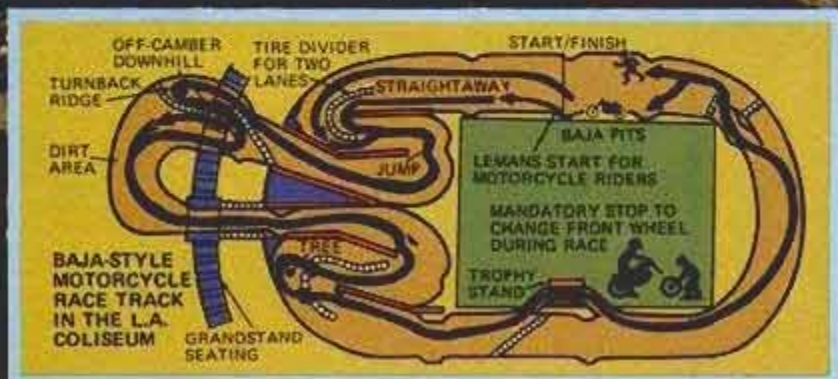
Desert racing had come into its own by the '60s, with a fully sanctioned series, sponsors, serious racers, state-of-the-art

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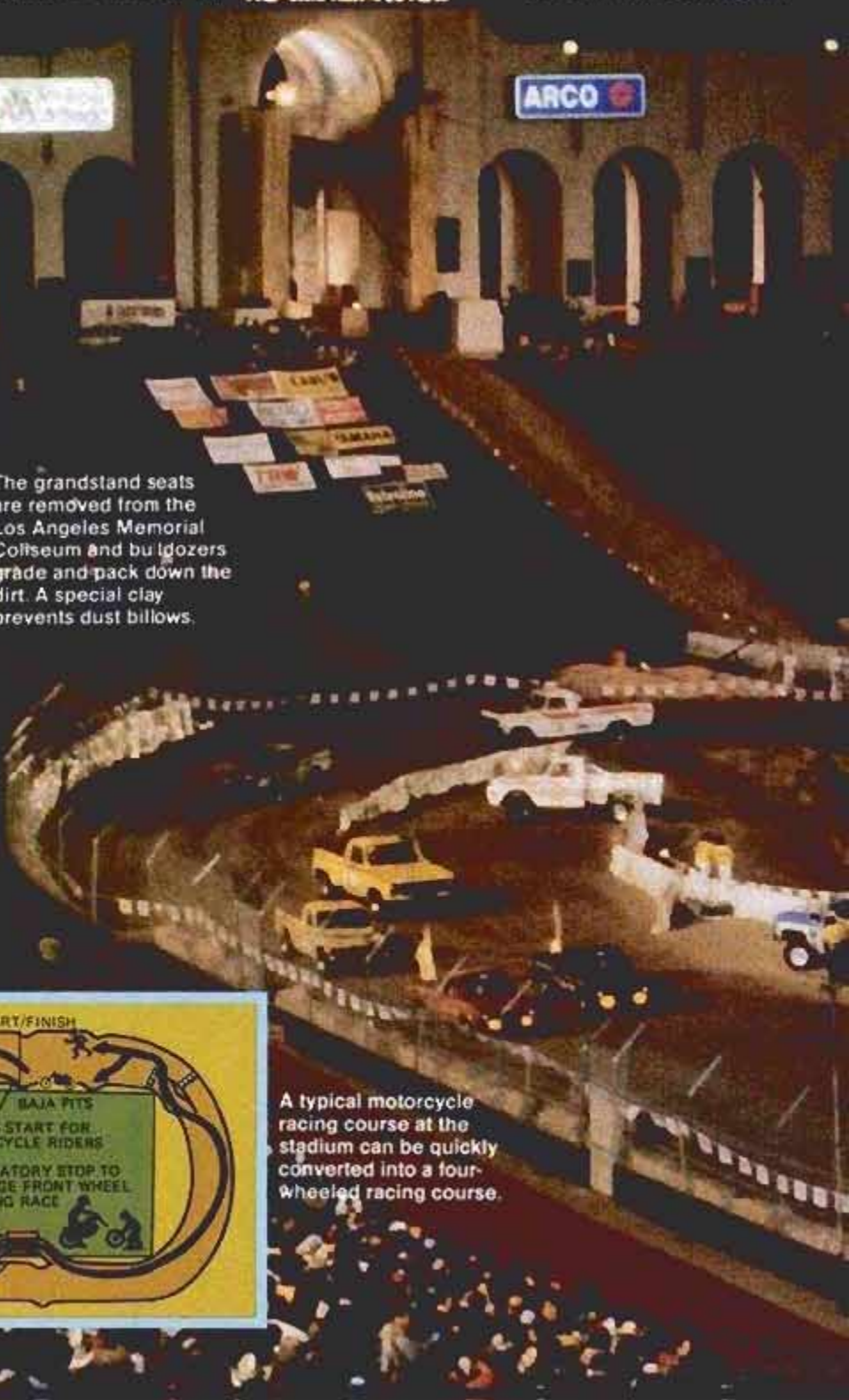


PHOTO: David Goble, Trakside Photographic

The grandstand seats are removed from the Los Angeles Memorial Coliseum and bulldozers grade and pack down the dirt. A special clay prevents dust billows.



A typical motorcycle racing course at the stadium can be quickly converted into a four-wheeled racing course.

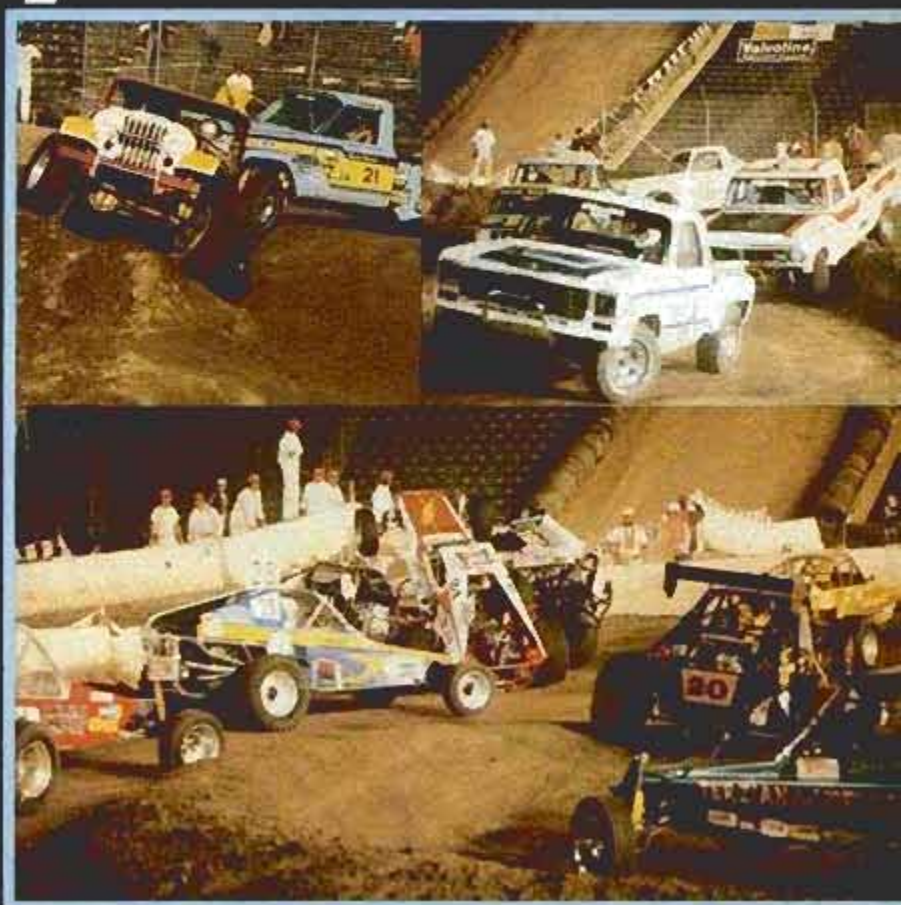


to the 50-yard line

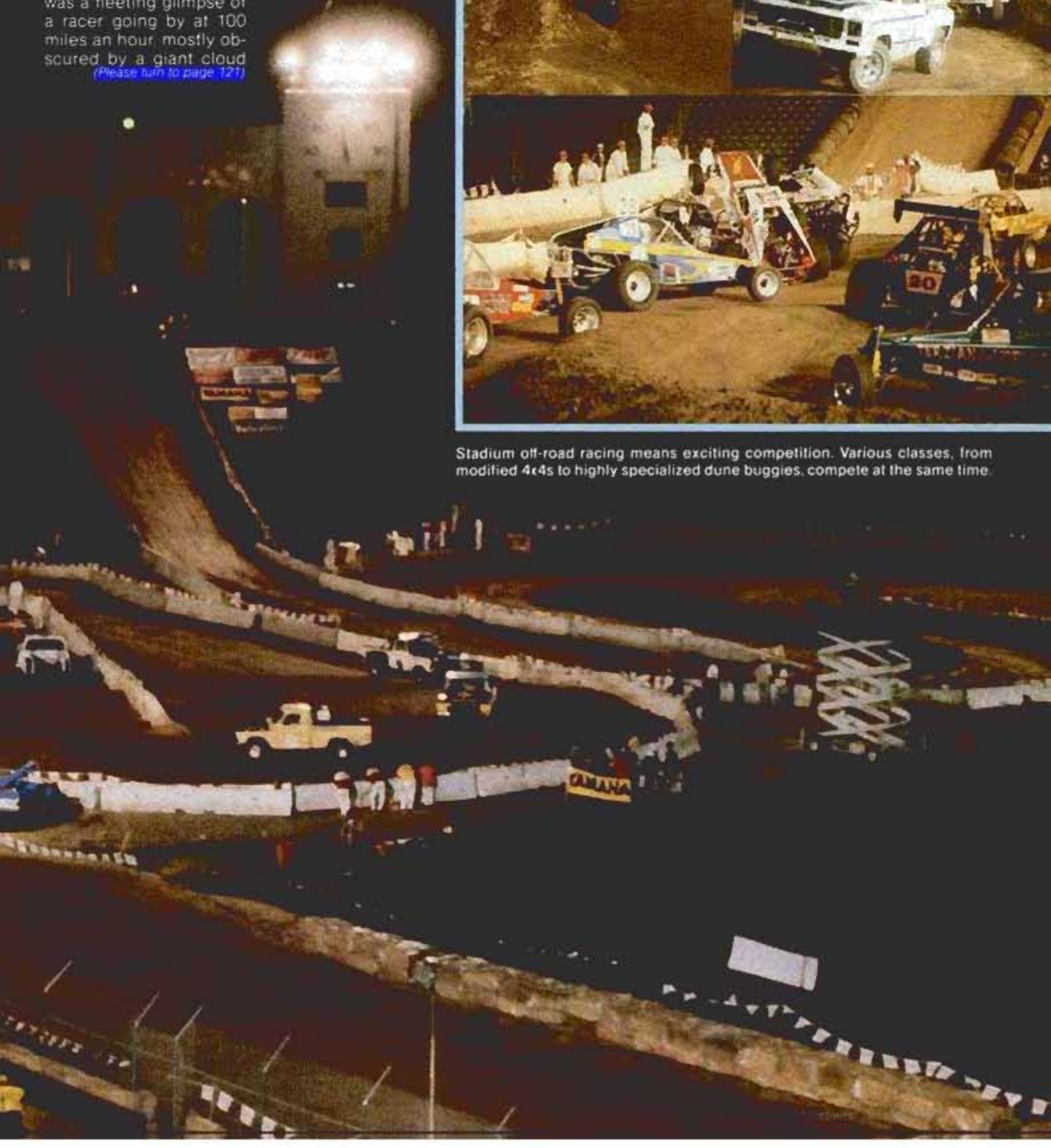
racing machines and a lot of media attention. The one thing that was missing, however, was spectators.

Only the die-hard enthusiasts, with lots of time and money, could afford to travel hundreds of miles into the Baja Peninsula to watch a race. And what they did see when they got there was a fleeting glimpse of a racer going by at 100 miles an hour, mostly obscured by a giant cloud

(Please turn to page 121)



Stadium off-road racing means exciting competition. Various classes, from modified 4x4s to highly specialized dune buggies, compete at the same time.



Getting an edge on outdoor tools

Here's a sharp method for making a point or sharpening a blade afield.

by Bob Stearns

Stowed in a fishing vest, hunting jacket or backpack, a file like the Red Devil No. 3915 paint-scraper sharpener can be pulled out when needed to put a fast edge or point on fishhooks or tools.

An extra-sharp point can make all the difference in hooking a bony-mouthed trophy, but hooks and gaffs aren't the only edged and pointed tools that are essential outdoors.

A wide variety of knives, axes, hatchets and machetes also play an important role. Yet many sportsmen don't seem to know about the new techniques that can make sharpening easier.

No competent fishing guide or charter-boat skipper would set off without the means for resharpening hooks, gaffs and filleting knives. Nor would a professional hunting guide be caught in the woods without a keen blade and an implement to sharpen it. Yet many anglers fish with dull hooks, or go afield with a knife barely capable of skinning out warm butter.

And how do you chop firewood with a dull ax? With great difficulty and considerable danger. Not only are dull cutting tools ineffective, but they can bounce or skid away from the impact point. It's easy to get careless with a dull edge and try to overcome poor cutting by applying extra pressure. The result can be a nasty cut. Blades can be honed on a



How sharp? Slide the point of the fishhook lightly across your fingernail. If the hook snags, it should also catch a fish.



For putting a piercing point on a gaff, you may find strokes toward the tip, unlike knife-blade sharpening, will work best.



Glue to the back of your fishing-pliers holster a small sheath to hold a tungsten ignition-point file with shortened tang.



In the field, with no whetstone available, the tiny ignition-point file can smooth nicks and resharpen a fillet-knife blade.



Fit a spare ignition file into a pocket of your fishing vest. Tang has been broken off to shorten it and a tape handle added.



The skilled hands of famous knife maker Al Buck, of Buck Knives, stroke the cutting edge toward the stone for a keen blade.

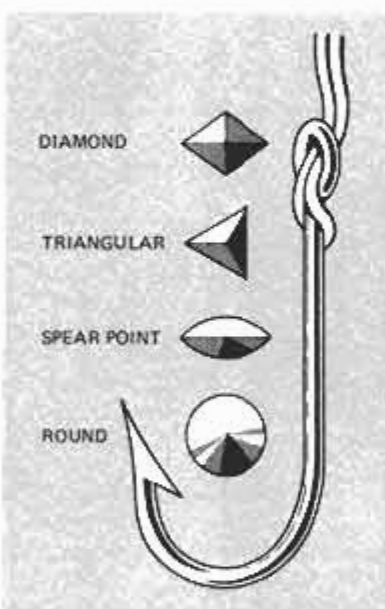


Even a rock will serve as a makeshift whetstone. Using a dull knife or ax requires extra pressure that may endanger the user.

wheel or large stone at home, but that's often not practical afield or offshore, and hooks need special treatment. Here's what has worked for me.

Unquestionably, the best tool for sharpening fishhooks is a file. Hooks usually don't come from the manufacturer as sharp as they should be, and the same sometimes applies to knives and axes. The right file cuts metal faster than any stone, even a diamond-dust hone. The file also shapes cutting edges along the sides of the point, something that's almost impossible with any stone.

You'll get arguments about the most effective shape of a point. Pop-



Popular cutting shapes for hooks.

ular with professional guides and knowledgeable anglers are the diamond shape, triangular cut, spear point and round shape. All except the round have sharp cutting edges along the sides of the hook point that enable it to push its way through tough bone and cartilage. I like the diamond, since four cutting edges should be better than three, and use it on all hooks except those too small to accept four cutting edges. Then it's either a spear point or round shape (if it's so small that any shaping would weaken it).

How sharp is "sharp"? Long ago, a charter-boat skipper advised that the best way to test a hook is with your fingernail, not the tip of your finger. If the point isn't sharp

enough to "hang" on the hard surface of the back of your nail when sliding it across with only slight pressure, then it certainly isn't sharp enough to "hang" inside the hard mouth of a fish.

The best hook sharpener

Some years ago, famous outdoorsman Lefty Kreh discovered the ideal hook sharpener: a Red Devil No. 3915 file, from the Red Devil Co., Union, N.J. This particular file was designed for sharpening the tough blades of paint scrapers. It's at most hardware stores for around \$4, and occasionally in tackle shops. Dick Schotter, director of engineering for Red Devil, describes the No. 3915 as a "machinist general-purpose" model, capable of filing almost anything.

Unlike other files, it's unusual in appearance—rectangular rather than tapered—8¼ inches long by ¼ inch wide, and with both surfaces flat. Because it has a large tang (handle), it's easy to grip firmly and apply with lots of pressure. The fine teeth can cut anything short of an extremely hard-tempered knife blade; even on this you can touch up nicks if the knife was properly sharpened.

Even tougher is the tiny file I carry in a sheath glued to the underside of my fishing-pliers holster. Called an "ignition" or "tungsten" point file (the Nicholson No. 02381 is an example), this mini costs only about a dollar.

I also keep one in my fishing vest, plus several spares in the tackle box. It's 5¼ inches long by ⅛ inch wide. I usually break 1½ inches off the 2¼-inch tang, leaving a ¼-inch handle. Slipping a length of small-diameter rubber or plastic tubing over this makes a good handle.

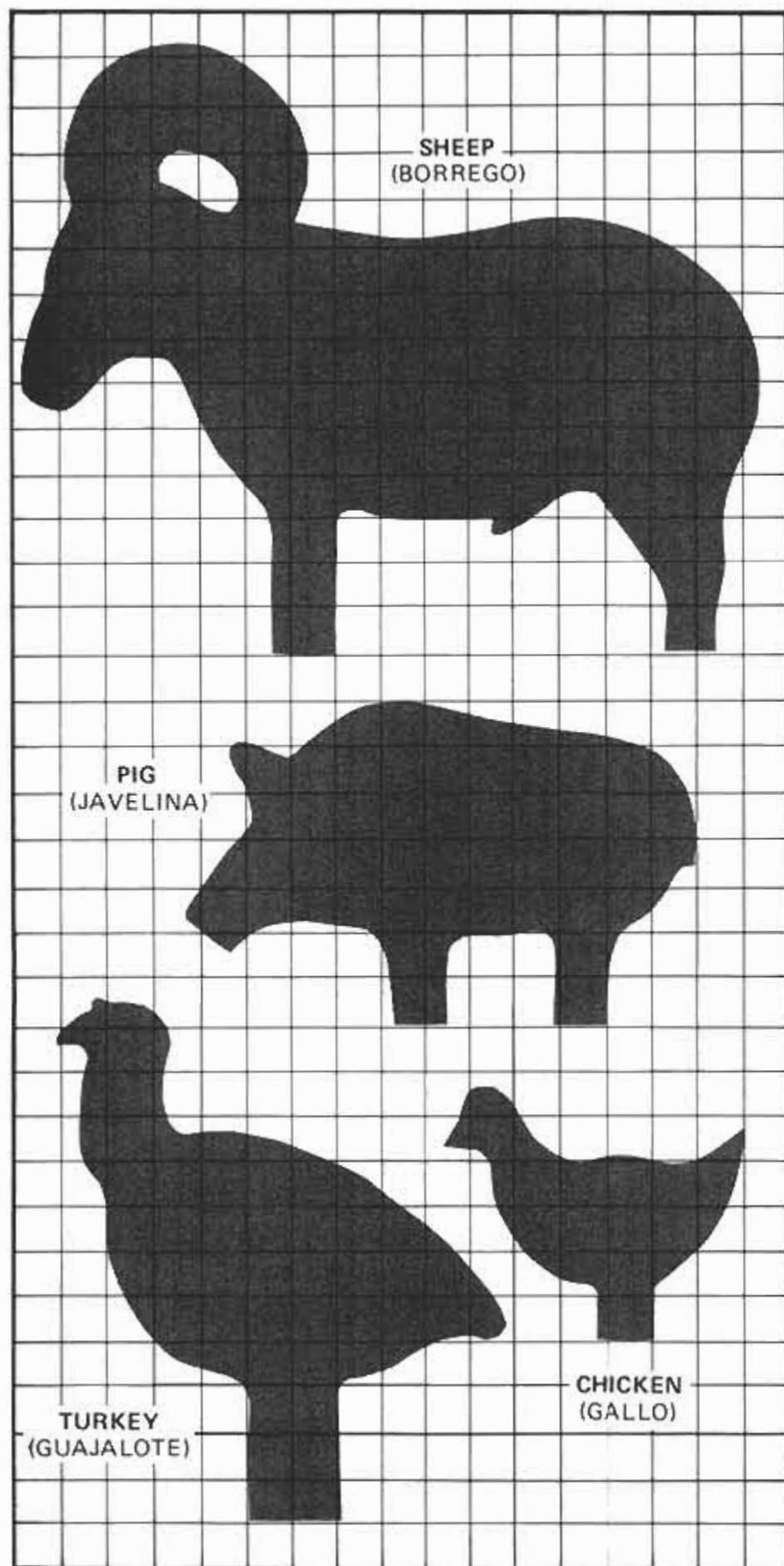
This ignition-point file can sharpen small hooks, right down to a No. 20 dry fly. Because it is designed for use on tungsten—a very hard metal—it will also smooth the toughest steel in any knife blade.

The files mentioned are ideal for the outdoorsman because they're lighter and more compact than a sharpening stone, and virtually unbreakable, as well. However, they can't produce quite the ultimate, even sharpness that's possible at home with a good stone. For cutting tools, the best approach is to carefully sharpen all tools before setting out. Then use the files to restore sharpness and smooth rough edges dulled with use, as well as point up hooks.

Because a file works best when the pressure stroke is toward the work,

(Please turn to page 131)

Silhouettes—better than



Newly imported from Mexico, *siluetas metalicas* set up heavy steel targets to test sharpshooters in a new sport.

by Angus Laidlaw

Silhouette shooting is the fastest-growing shooting sport to hit the United States since shotgunners started working out on clay pigeons before the turn of the century. As in trap and skeet, both the marksman and the spectators can see the target hit. There is no fooling around measuring invisible holes in a distant target to see who won. Instead, it's the clang of a hit, and the target either falls off its stand or doesn't fall, and doesn't count. Competition and scoring are simple, and you can even make your own targets.

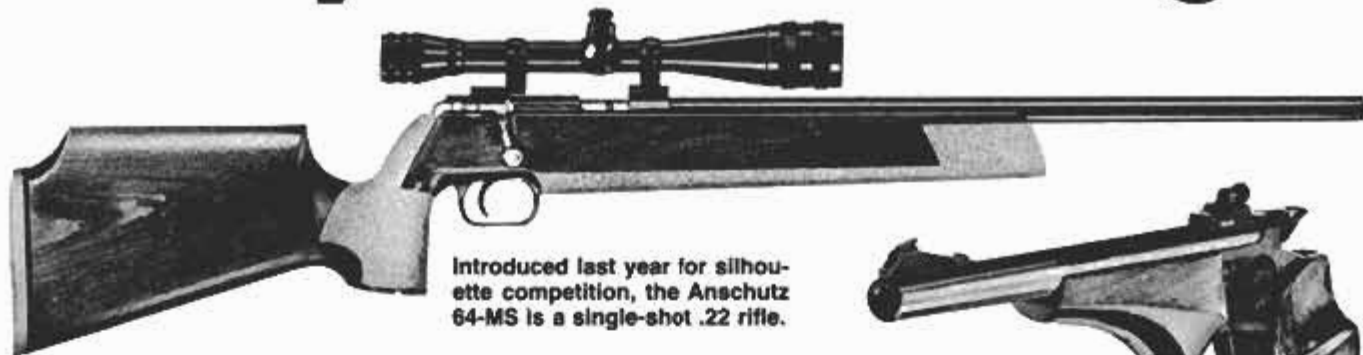
Siluetas Metalicas came north from Mexico in the '60s and really took hold in the late '70s. Now there are matches fired in nearly every state, and more ranges are utilizing silhouette stands than ever before.

The shooting is special. A horned-sheep cutout standing in a heat mirage 500 meters away shimmers against the cross hairs of your rifle scope. You are standing, firing off-hand, and there is no sling to steady the rifle. You take a breath, waver, let it out, breathe again, hold it, squeeze off a shot. The rifle roars and recoils. Then comes the clear clang of the bullet hitting steel. Your coach, watching through his

Make your own targets

For high-power-rifle and long-range-pistol targets, draw a grid of 2-inch squares on a large sheet of wrapping paper. Onto each square, draw the animal outline as shown at left. Once the profile is completed, cut it out, mount it on a sheet of hard steel as specified in the text, and trace the outline on the metal for cutting. For a handgun hunter's pistol range, transcribe the silhouettes in the same way to a grid of 1-inch squares. Squares of approximately $\frac{3}{8}$ inch on each side will provide a grid for the cutouts for a smallbore and rimfire rifle range. Stands for the targets should be 2 to 3 feet high so a target can fall free to the ground to show a hit. Grader blade sections can be welded atop lengths of 2-inch pipe protected with heavy angle-iron to protect the uprights. Wooden stands can also be used, but they'll get shot up quickly.

bull's-eyes for shooting



Introduced last year for silhouette competition, the Anschutz 64-MS is a single-shot .22 rifle.



Thompson/Center Contender with its new Williams sights comes in choice of 15 single-shot sizes.



The 10½-inch barrel of the Ruger New Model Super Blackhawk .44 Magnum makes it a real favorite for production matches.



Remington's XP-100 single-shot, bolt-action 7-mm silhouette pistol has a 15-inch barrel and Buck Rogers look.

spotting scope, has already seen the 50-pound ram wobble before tottering majestically to the ground.

The 10 rams you fire on are the farthest, heaviest and most difficult of the steel silhouettes in the 40-shot competition course. With targets arranged in banks of five, you start by shooting at ten ½-inch-steel chicken (gallo or gallina) silhouettes at 200 meters (218.8 yards), move back to the pig or wild boar (javelina) at 300 meters (328.2 yards), then to the turkey (guajalote) at 385 meters (421 yards), and finish with the 500-meter (546.8 yards) ram or sheep (borrego).

Competition at all levels

Not every shooter has a high-power rifle, however, or a 500-meter range—nearly 5½ football fields laid end to end. So the sport has been adapted for almost every other type of firearm, from handguns to muzzleloaders, with formal and informal events for all levels of skill and equipment. Even air-rifle enthusiasts have gotten into the act, plinking with BBs at miniature rams from 50 meters.

Handgunners were the first to follow the long-gun enthusiasts, shooting at the full-size and full-weight

silhouettes. But the rams were moved in to 200 meters, the turkeys to 150, javelina to 100 and the chickens to 50 meters—though it takes a heavy bullet from a powerful pistol to knock over a ½-inch-steel chicken at 50 meters or a 50-pound ram at 200.

Miniature iron animals turned up on ¼-scale silhouette ranges for .22 rimfire riflemen, with the rams at 100 meters, turkeys at 77, javelina at 60, and the chickens at 40. Even shotgunners now shoot silhouette matches. They use 12-gauge rifled slugs on full-sized rams at 100 yards.

But muzzleloaders fire on a different set of targets. There are crows at 50 yards, groundhogs at 100, buffalo at 150, turkeys at 175 and bears rearing up at 200. The bear measures 13 inches wide by 35 inches high and stands on a 4×6-inch base. Targets are made of ¼-inch steel plate, and it takes a solid hit from a .50-caliber or larger rifle to topple one. Hitting high helps.

Rules are specific

Special rules govern what kinds of guns can be used in each match. High-power silhouette rifles, for instance, require a bore of 6 mm or

larger and a weight of not more than 10 pounds, 2 ounces (including sights), while the stocks cannot exceed certain dimensions. No slings are permitted and shooters may not wear supportive clothing like target-rifle jackets.

The pistol rules separate production arms from the special jobs. An unlimited class lets the equipment enthusiasts have a free hand, and some rifles and pistols can get pretty exotic. Single-shot handguns, many with bolt actions like rifles, have practically taken over the unlimited class. These Buck Rogers specials may be finely tuned custom guns costing several thousand dollars, or production items that start at several hundred. Many shoot nonfactory cartridges loaded by the contestants.

Even shooters using standard rifles and handguns often load most of their own ammo as a matter of cost and efficiency. By handloading, a high-power rifle cartridge can be assembled for about 20 cents and with a bullet not available in a commercial load. Factory ammo can cost 50 cents a round or more.

Any shooter who wants to set up a range for .22s can order a ¼-scale

(Please turn to page 110)

Boat that hides a dinghy in her bustle

To get to shore, the crews of larger yachts must tow or stow a dinghy. Either way, the little tender is exposed to rough weather astern or on deck. But now Hunter Marine, Box 1030, Alachua, Fla. 32615, has built a 54-foot sailboat for cruising with a trapdoor transom that stores the dink safely out of sight.

The reverse-slant transom provides a broad boarding platform for swimmers, or a landing stage for hauling the tender out of the water and into its watertight compartment. When the 6-foot-draft sloop anchors offshore, launching the small boat is equally easy for a row into the village dock or beach.

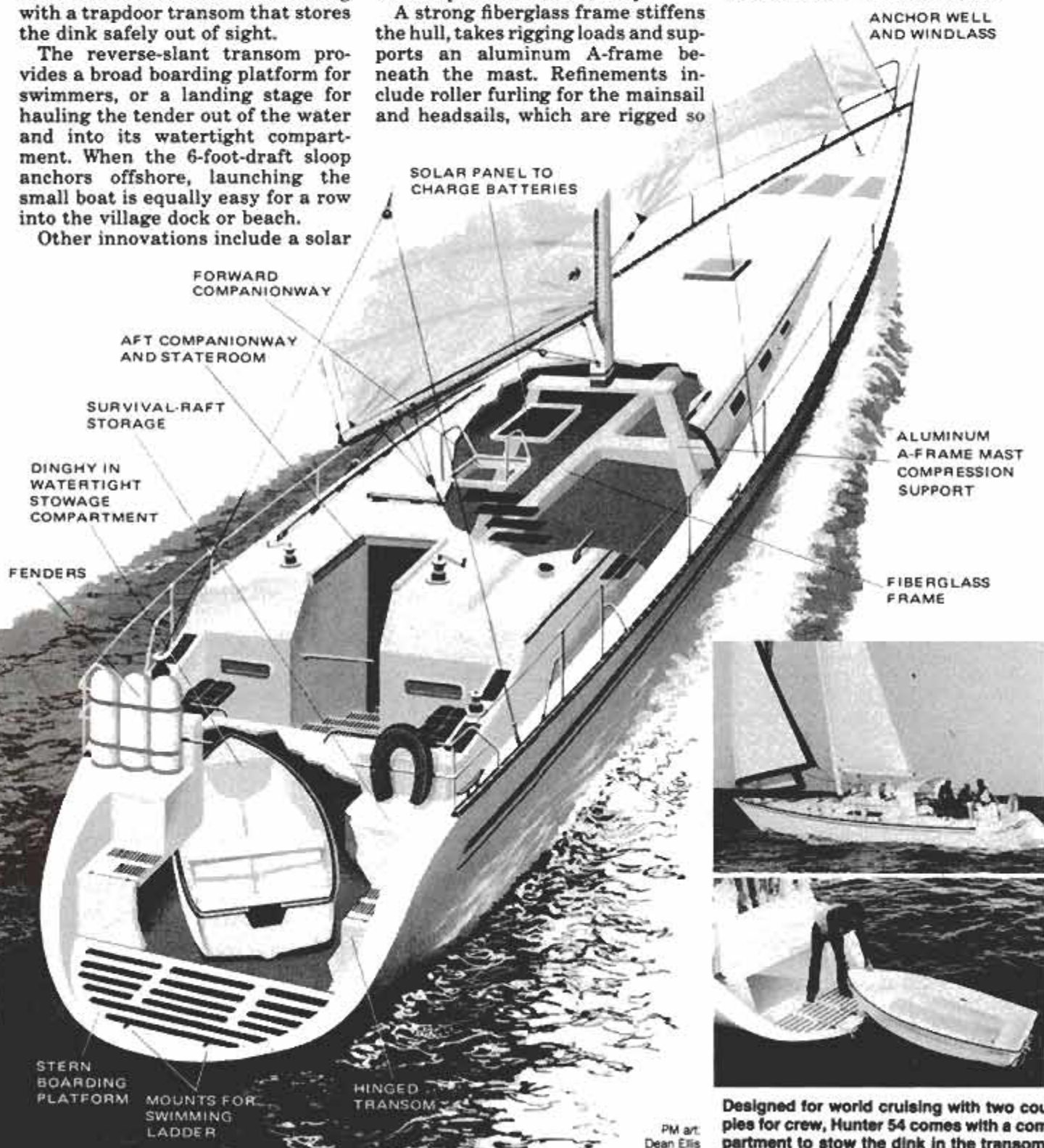
Other innovations include a solar

panel on deck to keep the batteries charged and a built-in cockpit compartment for a six-man survival raft. Fore and aft of the midship salon are staterooms with individual companionways from the deck, so two couples can cruise easily.

A strong fiberglass frame stiffens the hull, takes rigging loads and supports an aluminum A-frame beneath the mast. Refinements include roller furling for the mainsail and headsails, which are rigged so

that they can be self-trimming.

A prototype has been tested for three years, 10,000 miles and two trans-Atlantic passages, and the builders claim their Hunter 54 can sail almost anywhere with speed and comfort.—Bill McKeown



Designed for world cruising with two couples for crew, Hunter 54 comes with a compartment to stow the dink in the transom.

PM art.
Dean Ellis

In-ground sandbox you can build in one session

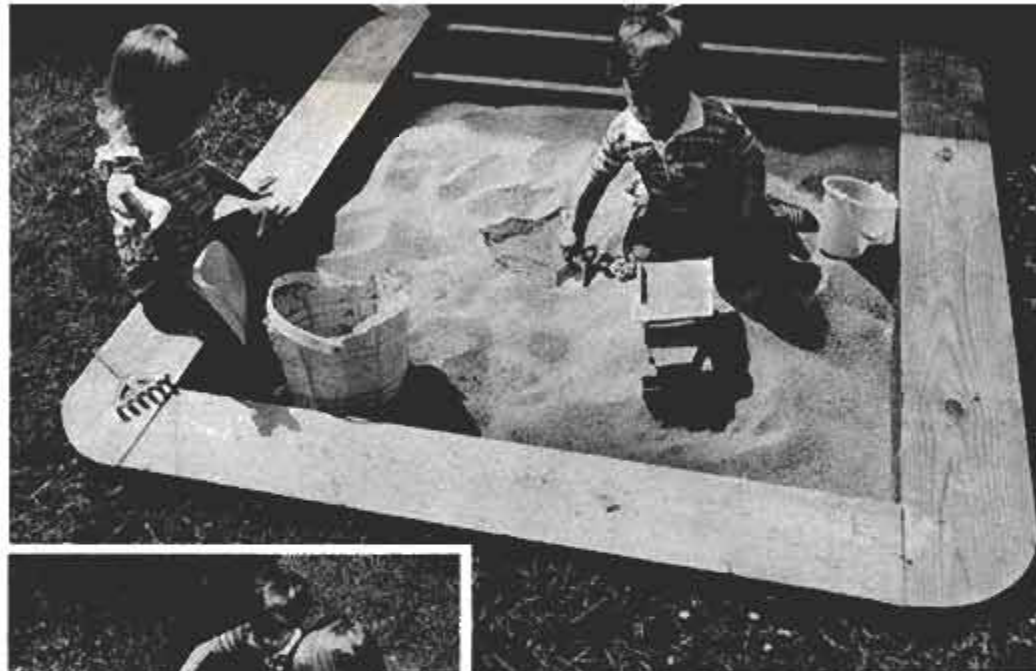
Sand has always given toddlers endless fascination. It provides one of the safest playtime activities your child can pursue—and one of the most restful ones for parents.

The attractive box shown here is a snap to build. Simple in design, it is also unobtrusive because it's sunk flush with the ground. We used pressure-treated lumber without any finish.

Cut the pieces for the box according to the dimensions given in the drawing below. Note that the sides are joined with edge-lap (interlocking) joints. Take the time to cut the joints carefully for a good snug fit. Your 2x8 stock thickness may run a little more or less than 1½ in. Adjust the width of the edge-lap cuts to suit.

After all cuts are made, round over all exposed edges and sand out any rough spots or nicks. This will prevent any chance of splintering.

Dig a hole and lower the assembled frame into place. Backfill with soil around the outside of the frame. Then attach the seats. By leaving a small space between the seat bottom and the ground outside, it's easy to cover the box with a heavy-duty, plastic dropcloth. Simply tuck the



Our sandbox is sized for two youngsters, though it will hold one or two more. A built-in toy box along one side provides handy storage for toys after a play session.



Before adding sand, lay in a slate bottom to prevent soil from mixing with the sand.

cloth under the seat edges. This helps to keep the sand dry and discourages use of the box by neighborhood cats.

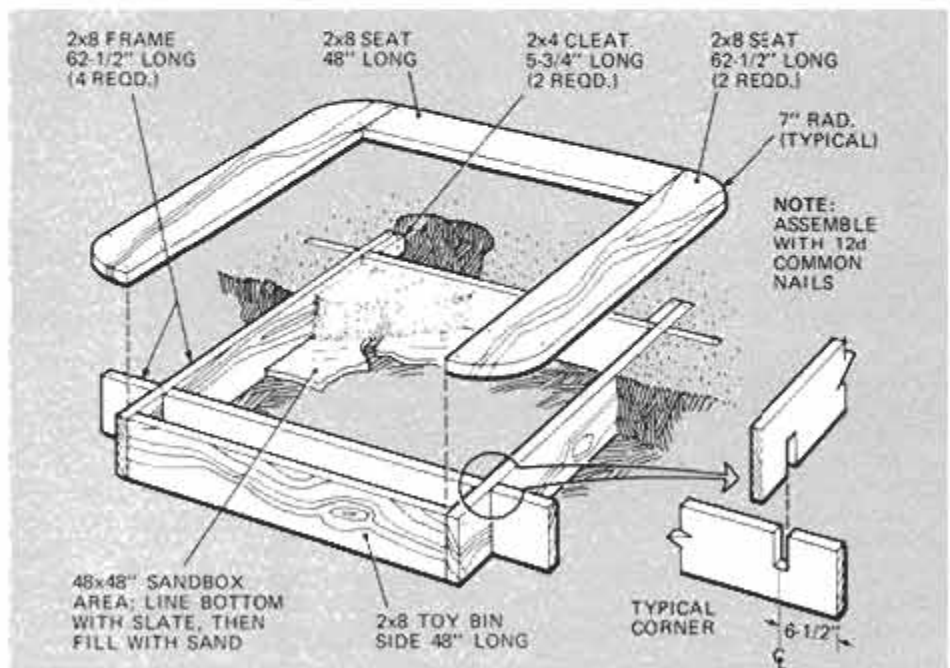
Before adding the sand, install a slate bottom. Make sure you round over any sharp edges with a coarse file.—*Joseph R. Provey and Conrad Stowers*



The in-ground box holds five to seven 60-pound bags of sterilized, sandbox sand.



Design permits use of mower right next to the sandbox by riding on the seat as shown.



5 yard structures that improve your view

Build these handsome outdoor projects that will brighten up your landscape.



Our roundup of outdoor building projects features good designs from across the country. The projects suggest a broad range of ways to get more enjoyment from, and add to the appearance of, your property. Directions for duplicating all five ideas are given on the following pages.

Each project adds a new element to its setting: The walkway and overhead trellis (project No. 1) have a dramatic appearance, with clean, sweeping lines. The feeling of linearity in the small garden screen (project

No. 2) is tempered by its miniature size and the small $\frac{3}{4}$ x $\frac{3}{4}$ -in. vertical strips interrupted by 4x4 posts. A traditional lattice fence (project No. 3) assumes an air of solidarity given to it by its 6-ft. height and massive 4x8 posts. The arch trellis (project No. 4) and entry gate (project No. 5), both painted white, have a fresh, country appearance.

By making minor adaptations, such as a change in wood or finish used, you can modify the projects to blend with your existing yard structures.



3



5

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1 Walkway and overhead trellis

The walkway-trellis shown on the facing page leads to the front entrance of a home. Built of garden-grade redwood and finished with a clear, water-repellent finish (with mildewcide), the structure has a soft, pleasing, buckskin tan color.

The frame consists of 4x4 posts and 2x6 beams,

- 1 A redwood walkway and overhead trellis add drama to this home's entrance and provide a sunbreak for shade.
- 2 An easy-to-build cedar screen serves as a backdrop for picturesque plantings and shuts out the world beyond.
- 3 Lattice fence has a dainty look to complement flowers, yet it's built of materials that will last for years.
- 4 This arch trellis can brighten even the smallest yard. Instructions for bending the wooden arch are in text.
- 5 A country gate provides access through a tall hedge or picket fence and adds a homey touch to the yard entry.

canted at the ends. *Construction heart* (all heartwood) is recommended for the posts, joists, headers and all near-ground applications. *Construction common* (which contains sapwood) is good for decking, beams, louvers and blocking.

Set the posts securely into the ground on a stone or concrete base (see drawing below). Backfill the hole with tamped gravel and sand to provide drainage, then pour a concrete collar. Floor joists and headers are 2x6s fastened to the posts. Beams are fastened to the posts with 1/4x7-in. carriage bolts. *Note:* To avoid ugly rust stains, all nails and hardware should be corrosion-resistant. Use stainless-steel, aluminum-alloy or top-quality hot-dipped, galvanized fastenings.

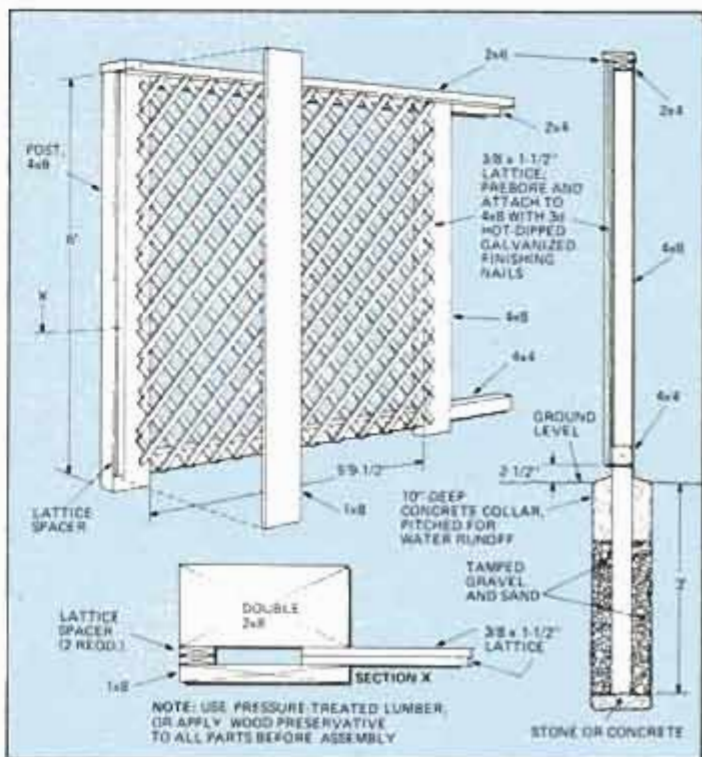
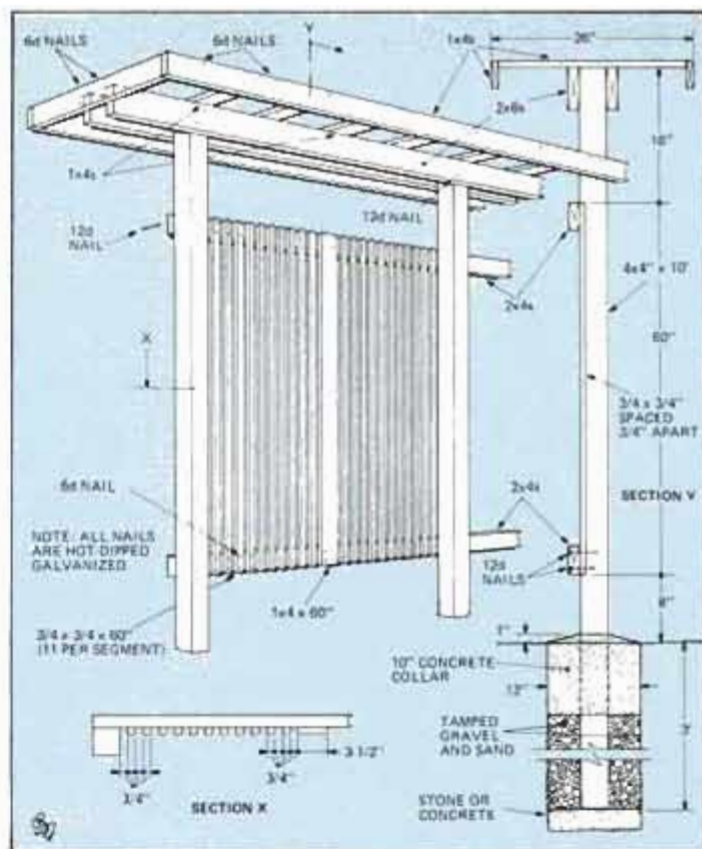
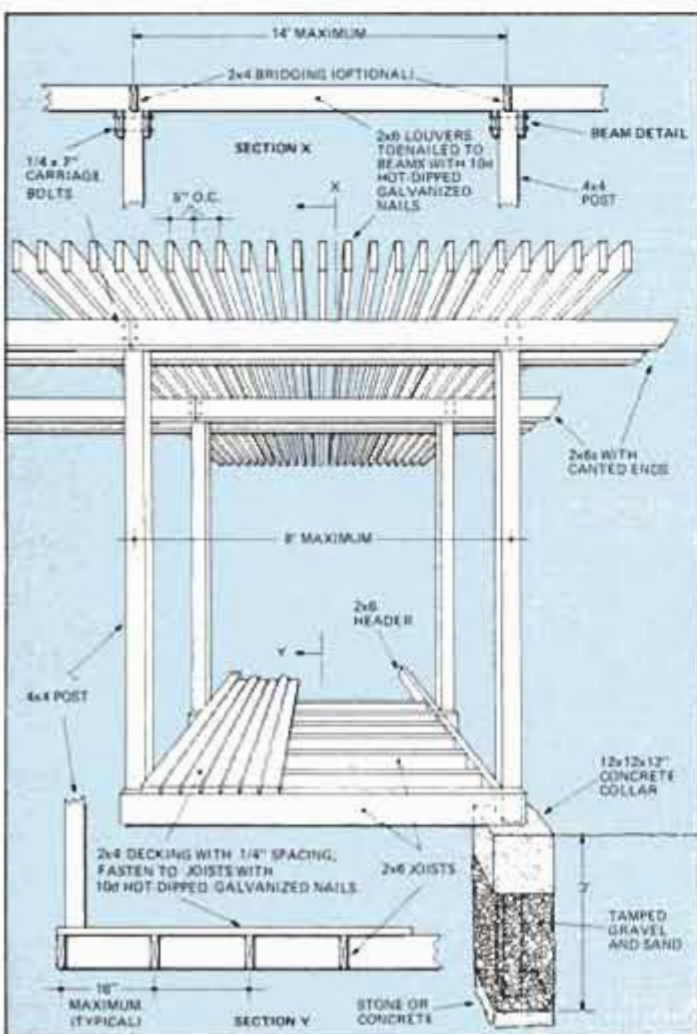
Toenail 2x6 louvers to the beams with 10d hot-dipped, galvanized nails. To prevent any chance of twist in the louvers, you can fasten 2x6 bridging between the louvers at 8-ft. intervals, if you like.

Space 2x4 decking members 1/4 in. apart to allow drainage; attach them to the joists with 10d nails.

2 Cedar screen

The free-standing cedar screen provides partial sun protection for delicate flowers. Although the treatment at top has the appearance of a roof, the top is actually open. It consists of spaced 1x4s to allow the sun's rays to shine on nearby plantings and to provide drainage.

Secure the posts in footings, as shown in the drawing (upper right). Cut the 2x4 rails, the vertical slatlike members and the center 1x4 vertical to size. Lay out the vertical members on the rails. When they are properly spaced, prebore and attach the slats to the rails with 6d nails. Fasten the rails to the posts.



To build the top, first fasten the two 2x6 joists to the posts. Attach the edge 1x4s to the joists and to each other. Cut the 1x4 outboard pieces to length and attach them in place.

3 Lattice fence

A stately lattice fence (painted white) is one attractive way to ensure back-yard privacy. Pressure-treated wood is the first choice of material for this and the following projects, because of its resistance to decay and insect infestation.

If you select conventional lumber, treat the posts by filling a 55-gal. drum with copper naphthenate solution

to a depth somewhat higher than the 3-ft. depth of the post holes. Stand the posts in the drum and let them soak for a day or two.

You can treat railings and lattice with a brush-on coat of wood preservative. *Note:* Check the label for toxicity of the preservative. Make sure you select one that is intended for treating garden structures located near plantings. Later, when the wood is dry, you can finish the parts with a quality, exterior water-base paint.

Cut all vertical parts—2×8s, 1×8s and lattice spacers—to size. Horizontal members can be cut to suit on site. To lay out the fence, stretch a mason's line taut between nails on top of the end markers. (*Note:* Check local codes and ordinances beforehand for the minimum distance your fence must be from your property line.) Drive in markers at intervals where posts will be installed later.

Set the end posts first at the desired height. See the suggested footing in the drawing (lower right on facing page). Check both planes for plumb with a carpenter's level. Use a line level with tape measure or ruler to level the height of the final end post.

Dig holes for the intermediate posts. Again, stretch a mason's line between nails in the tops of the end posts

lumber, as previously detailed. The trellis and gate can be finished with exterior water-base paint for long-lasting results.

Cut required parts for the trellis as shown in the drawing below. The top arch is made by cutting V-shaped notches ½ in. wide by 2½ in. deep into the arch members. Cuts should be spaced on 3½-in. centers and at 85° angles. Soak these two spines in water until their 62½-in. lengths can be bent without splitting.

Join the arch members and trellis posts with half-lap joints, waterproof glue and wood screws. Temporarily brace the setup to prevent movement until the glue dries. Fill in any enlarged notches with sawdust and waterproof glue or waterproof wood filler, such as Plastic Wood.

Using a posthole digger, install the trellis posts in the ground. The smaller the hole diameter, the easier post placement and backfilling will be. Attach horizontal cross members, making sure they are evenly spaced and parallel. Sand wood filler smooth and paint.

5 Gate

The gate has an arched member (upper rail) that is bent in a manner similar to that used for the trellis

arch. Consult the drawing to note the differences in dimension and technique before you begin work. Keep in mind that both gate posts, particularly the one on which the gate is hinged, receive considerable stress. Do install the sturdy footing shown.

Keep the posts parallel and plumb while pouring concrete. Diagonal braces nailed to stakes will help. You can bend the arched rail as shown. However, you can also cut it, along with the diagonal and lower rail, from exterior-grade ¾-in. plywood if you fill the edges with Plastic Wood and apply paint.

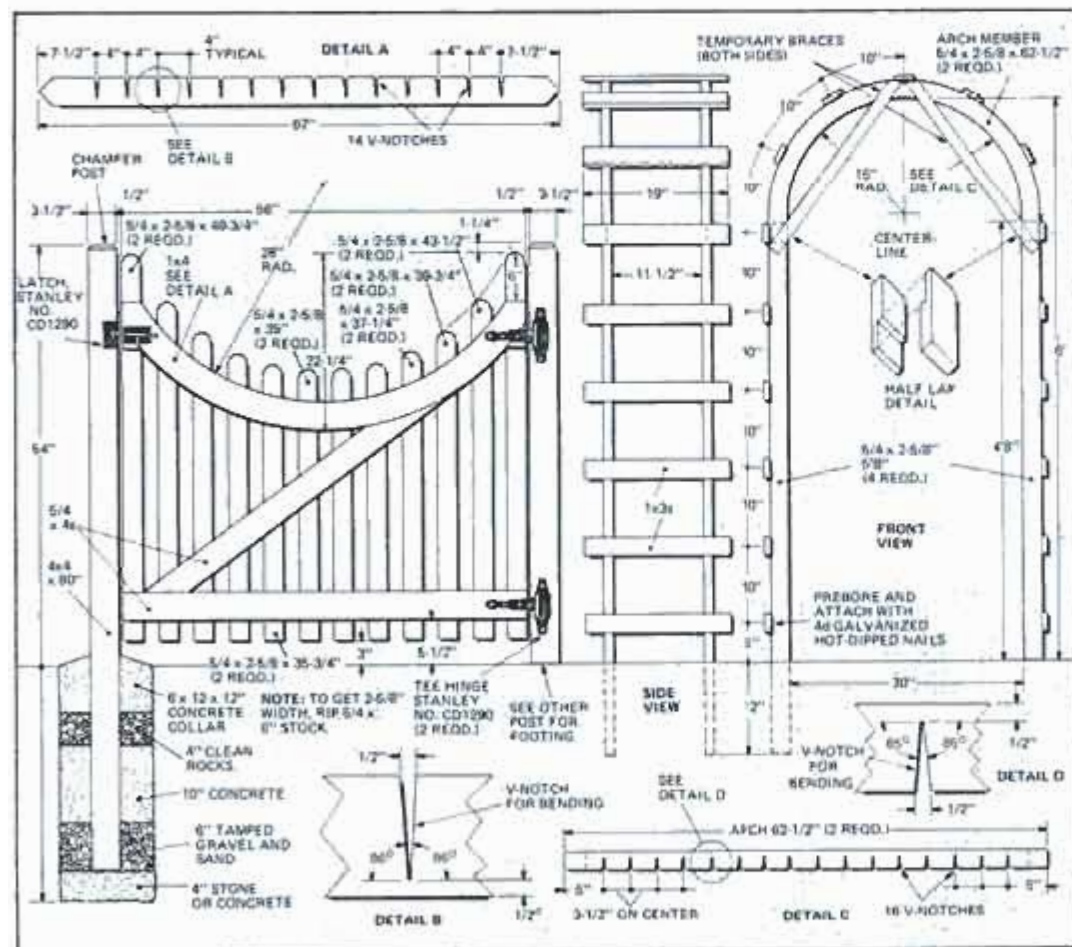
Begin by cutting the vertical gate slats at least 1 in. oversize, except for the two end slats; then round the tops and sand to a uniform contour. Cut the bottom rail to size; then nail the two end slats in place with 6d hot-dipped, galvanized finishing nails. Turn the assembly over and tack on a temporary brace to stabilize the tops; also add

a diagonal brace after the structure is squared.

Turn the assembly back over and nail the arched rail in place. Now, space the remaining slats evenly on the assembly, attaching them to the arched rail first. This will ensure that the same reveal above the arch occurs throughout construction.

Next, position the oversized diagonal. Remove temporary braces and trace the angle cut on the bottom of the brace and the curved cut where the brace intersects the arch. The brace should fit snugly. Nail it to the slats. Attach blocking on the two end slats before boring for top hinge and latch. Finish the gate before hanging it.

—Penelope Spangler, Assistant Home and Shop Editor



to keep the heights and front edges of intermediate posts in alignment.

Cut and attach the bottom 4×4 rail and the upper 2×4 rail. Cut lattice strips, test fit and mark lattice placement on posts, then prebore holes. Spacer blocks can help you gauge lattice placement. Attach vertical lattice spacers to the posts. Cut and attach the vertical 1×8 facing board to the spacers and end lattice. Complete by attaching the top 2×6 rail.

4 Arch trellis

Both the trellis and the gate which follows can be built of pressure-treated wood; or you can treat regular

You can be your own landscape architect

A dollar's worth of paper can save you hundreds in landscaping fees.

You can make your own landscape plans, even if you can't draw a straight line. The key is to draw preliminary plans on graph paper, where the hard part—making right angles and measuring off areas—is already provided by the squares.

You'll need both graph and tracing paper; they're available at stationery stores. Buy graph paper that has 8 or 10 squares per inch, and a good-quality tracing paper.

Make a rough sketch of your house and grounds, that is, a "floor plan" on scrap paper, so you'll have a place to record the measurements you make. After walking the grounds and taking strategic measurements, you are ready to begin.

1. On graph paper, make an accurate drawing of your house and yard to scale. For example, let one square equal 1 ft. Include dimensions on the drawing. These boundaries are reference points for the plan.

2. Draw in the details. Note windows and doors, existing plants, outdoor structures and overhead obstacles such as telephone lines. The more detailed you make the drawing, the better your planning aid.

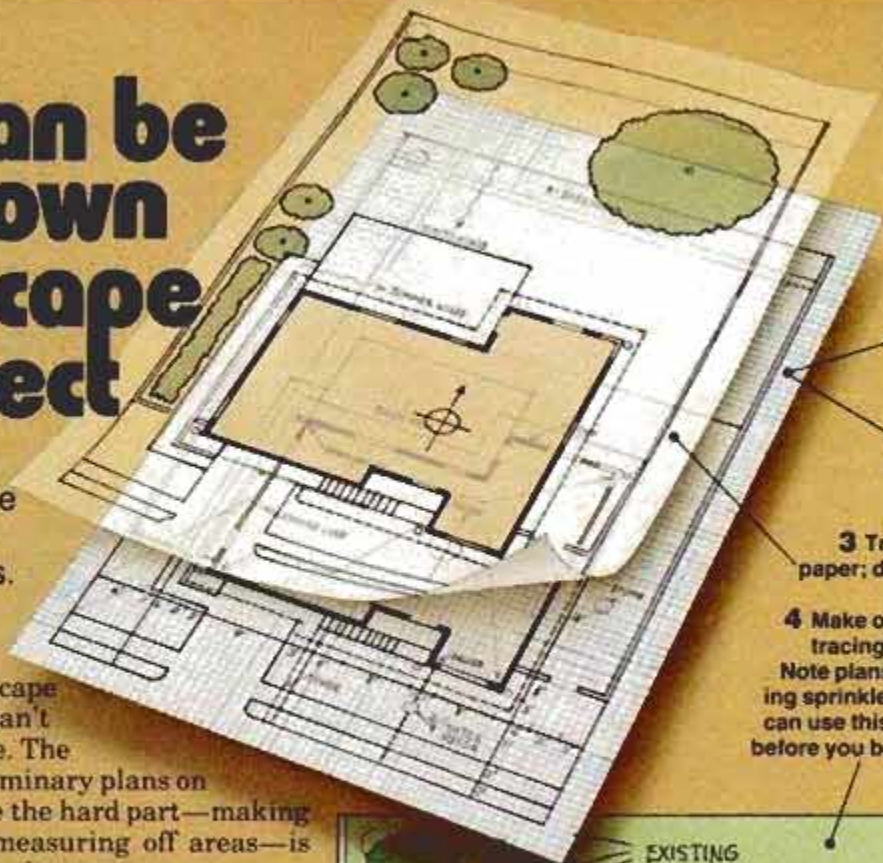
3. Copy the drawing on tracing paper, eliminating dimensions. This is your master plan.

4. Run the master drawing through a duplicating machine and use the copies to draw in future projects. Planning your projects on paper first will help you avoid planting a tree under a telephone wire or in front of a window. —*Andrew Mauck*

Checklist of drawing details

To help you focus on the details necessary to make your drawing a valuable tool, here's a beginning list of items that should be represented on it.

- | | |
|--|---|
| <input type="checkbox"/> Downspouts, roof overhang | <input type="checkbox"/> Rises, depressions |
| <input type="checkbox"/> Doors and windows | <input type="checkbox"/> Shady areas |
| <input type="checkbox"/> Water meter | <input type="checkbox"/> Wind directions |
| <input type="checkbox"/> Underground pipes, sewer | <input type="checkbox"/> North |
| <input type="checkbox"/> Power and telephone lines | <input type="checkbox"/> Scale (e.g., 1/4" = 1'-0") |
| <input type="checkbox"/> Walkways and driveways | <input type="checkbox"/> Property line |
| <input type="checkbox"/> Fences and gates | <input type="checkbox"/> Existing greenery |

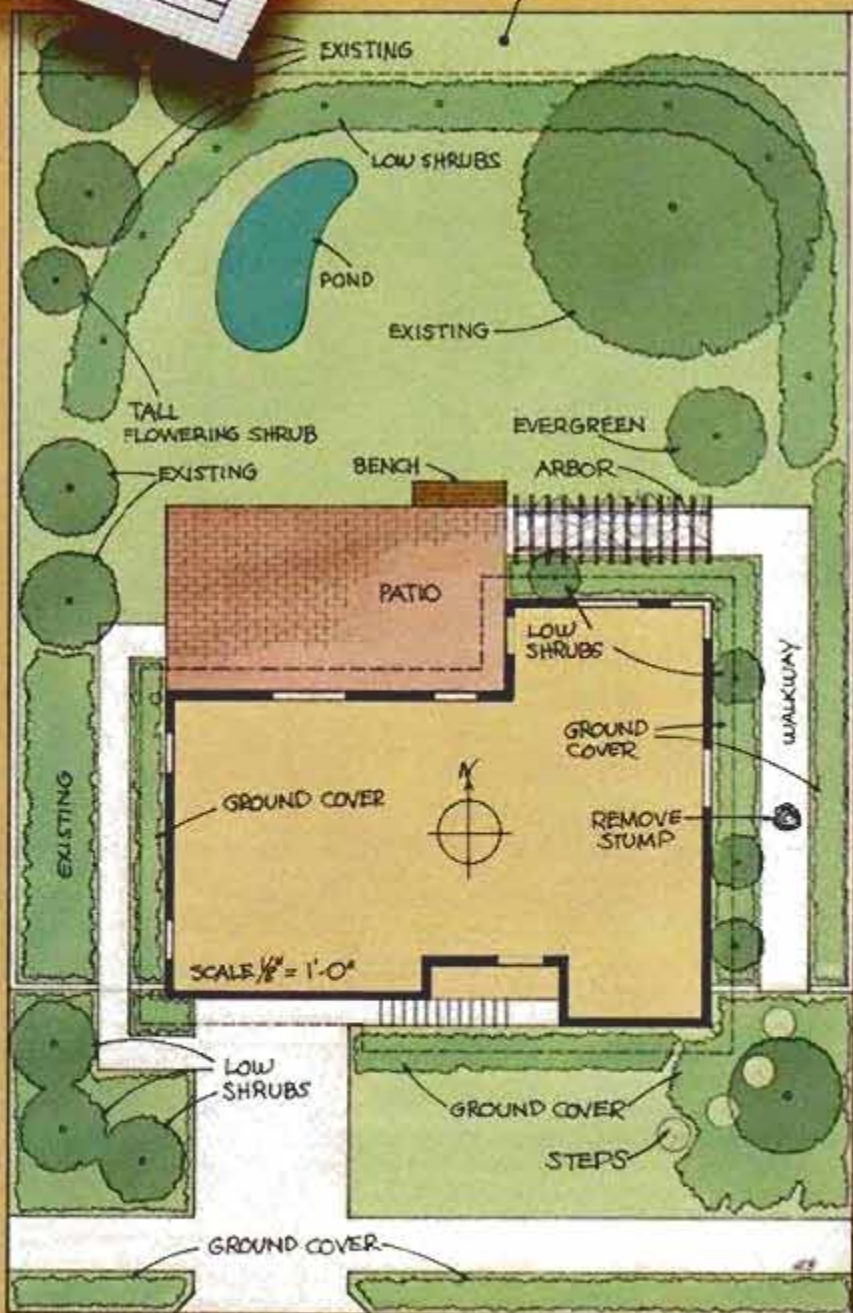


1 Make an accurate, dimensioned drawing of yard and house on graph paper.

2 Add as much detail as possible, such as location of existing plants, the patio area and yard structures.

3 Trace over drawing on tracing paper; don't add the measurements.

4 Make one or more duplicates of the tracing and draw in future projects. Note plans for laying concrete, installing sprinklers and planting shrubs. You can use this plan to work out the snags, before you begin the actual landscaping.



Not long ago, the wicker chair pictured below was in sad shape. We wondered if it could be repaired and, if it could, whether we could show do-it-yourselfers how to repair their own wicker chairs.

The answer to both questions is "yes." We contacted David Alford, a wicker craftsman in New York, who put this chair back into shape in less than eight hours. The steps he took follow. With perhaps \$10 worth of materials and some patience, you, too, will be able to convert a wicker wreck into usable furniture.

First, buy reed and cane that

(Please turn to page 100)

How to repair wicker the way experts do

A master craftsman shares his secrets for making old furniture look like new.

by John Ingersoll



Handsome willow Bar Harbor lady's chair suffered major damage, including a large gap in right side (inset). Repairs were made with rattan.

Build PM's 'park bench' furniture

We've designed a back-yard furniture suite based upon the familiar park bench of yesteryear.

By Rosario Capotosto and Harry Wicks





Starting with the familiar-looking park bench, we've created an original patio furniture set that home craftsmen can duplicate. For a look of sheer elegance, we used oak for the wooden slats; the metal portions of the pieces are fashioned of $\frac{3}{16}$ by $1\frac{1}{2}$ -in. hot-rolled mild steel—a metal that you can work with.

The set consists of a bench, two chairs, a dining-sized table and a plant stand. The furniture is comfortable to use, easy to make and relatively inexpensive—in short, a nice project for a weekend workshopper to tackle.

If you have never worked with and bent metal before, you needn't be concerned. The fabrication procedures we have worked out have been especially tailored to meet the needs of a beginning metalworker. All the bending is done with simple, homemade jigs. Plans for making the jigs and infor-



Furniture is built of oak and strips of mild steel. Countersunk nuts and bolts join the parts.

mation on using them are given on the following pages.

The oak slats are $\frac{13}{16}$ in. thick—just as the wood comes from the lumberyard. You can buy the metal at a local iron-supply house, welding shop or from an ornamental iron worker. When you buy the metal strips, make certain you specify *mild steel* because anything that is tougher won't bend readily in the jigs we have designed.

To give an estimate of what the materials for the furniture should cost you (a difficult task in these times of almost daily price changes), the park bench and table shown cost approximately \$35 each to produce. Each chair ran about \$10 less. The plant stand can be built for under \$15. All prices can vary somewhat depending upon area, of course.

Where to start

Begin by making the three bending jigs shown. The curved sections can be cut with either jig, band or sabre saw. If, during the cutting, any irregular bumps are cut on the edge, make certain you smooth them out.

using a rasp and sandpaper—or you will transfer the bumps to the metal.

Use a strong hinge

The long right-angle bender is made with a door hinge mounted back side up between two lengths of 2×4 stock. It is *very important* that you select a strong hinge. While developing the prototype jig, we dis-

covered that the quality of several unknown-brand hinges was poor: They fractured behind the knuckles when subjected to the force that was required to make the bends in the steel.

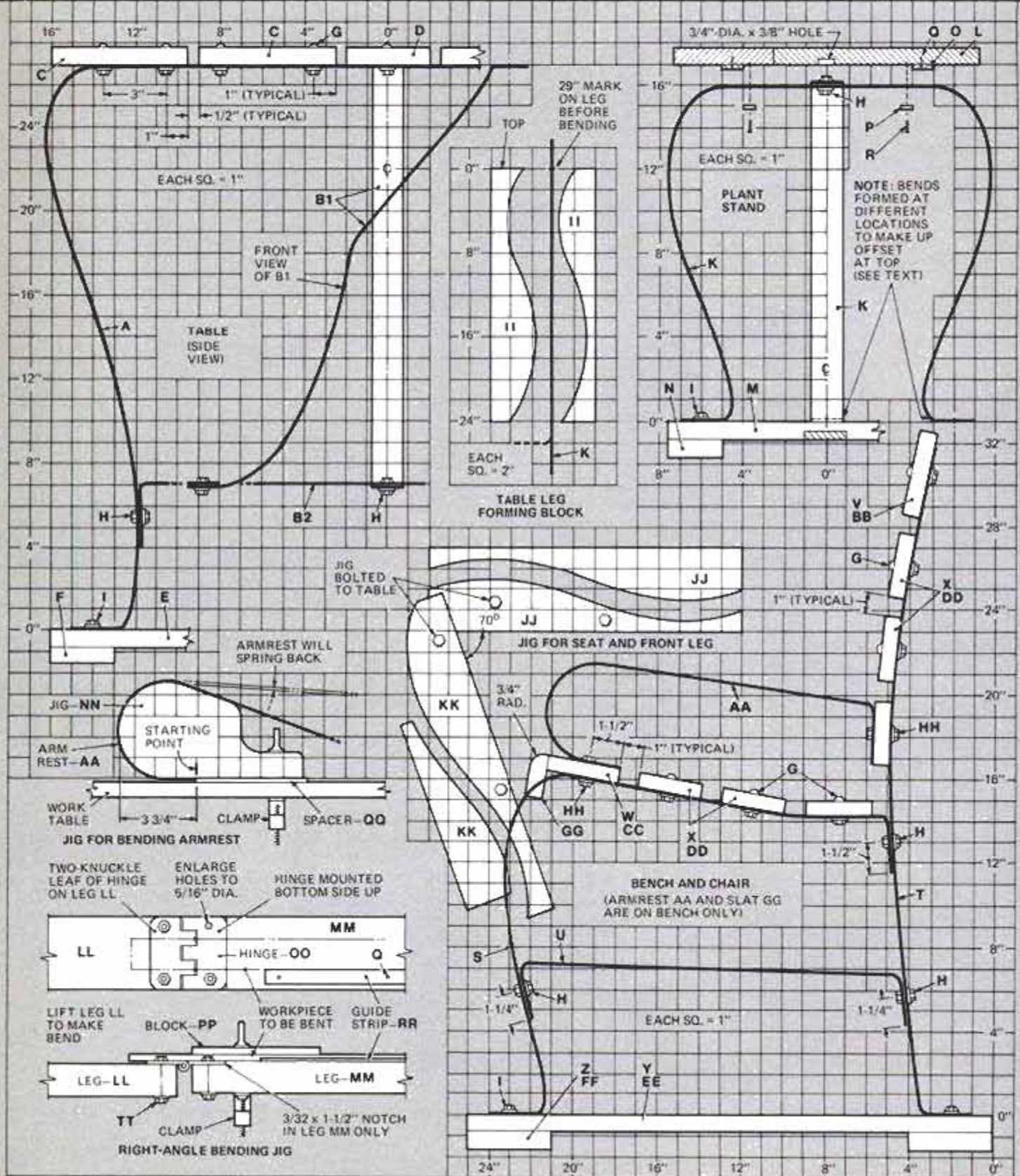
Stanley's 3½ × 3½-in. round corner hinge, No. 758, worked perfectly and is the hinge that we recommend.

If you have trouble obtaining this

one, you can substitute Stanley's No. 742 or 741.

The latter is the one that is most commonly available. All three are made of the same high-quality tough steel.

Rebore the two outer holes in each leaf to permit insertion of 5/16-in. bolts. Attach the two-knuckle leaf to the shorter length of 2×4, as indicated in the drawing.



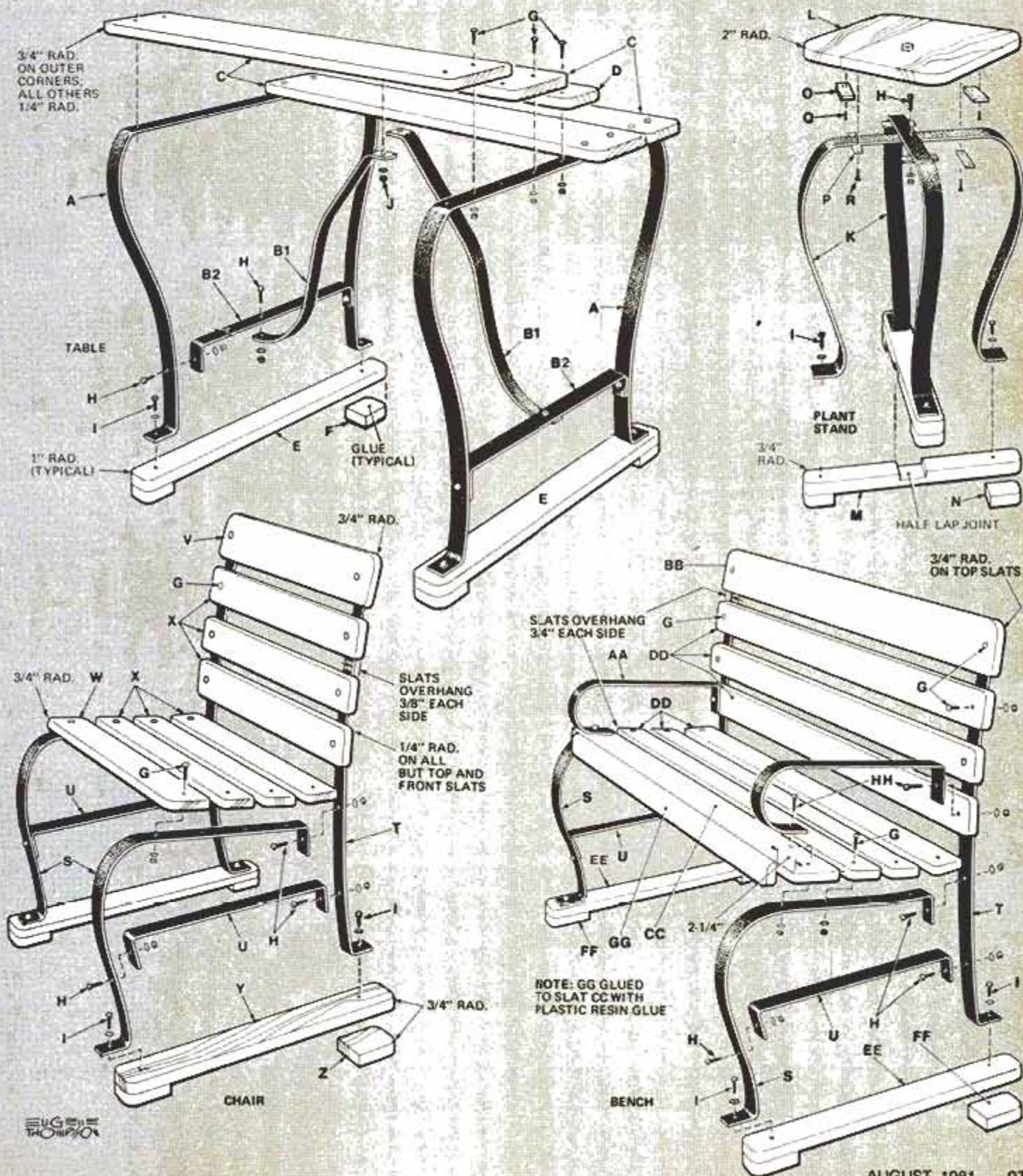
The bench

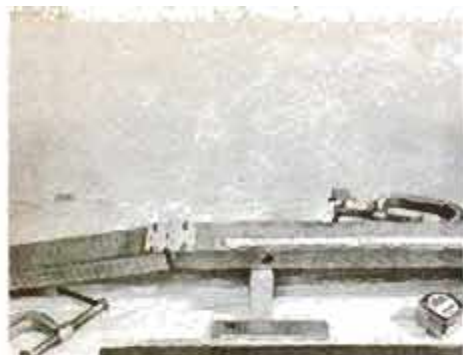
Cut a strip of steel 38 in. long to form the front-leg/seat section. Make a grease-pencil mark $2\frac{1}{4}$ in. from one end. Place the mark over the center of the hinge. Clamp the strip to the long 2x4 together with a piece of $\frac{3}{8} \times 1\frac{1}{2} \times 5$ -in. steel (or use two pieces of scrap $\frac{3}{16}$ -in. working stock). Place this hold-down block $\frac{1}{2}$ in. from the bend mark. Clamp firm-

ly, close to the hinge, then lift the jig's short leg to form the bend.

Next, bolt the two sections of the leg/seat formers to a scrap board. Place the strip against the lower section, position the mating block, then squeeze with clamps. With the clamps in place, bend the strip around the corner by hand. Do not form the seat curve yet. Instead, make a mark for the small radius

bend at the end of the former-block. Remove the strip from the jig and place it in the hinged bender. Locate the mark 1 in. from the center of the hinge (toward the long 2x4) and make the bend. Return the strip to the curved jig, and use clamps to form the seat curve. Centerlines marked on the jig pieces will aid alignment. Note that the fixed sections of the jig are positioned at an

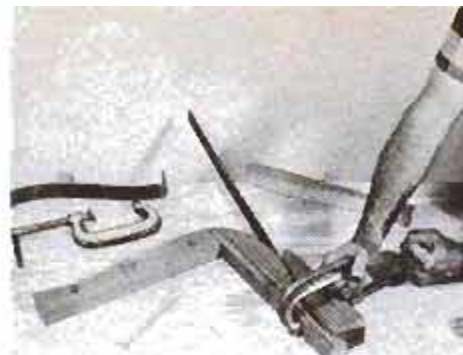




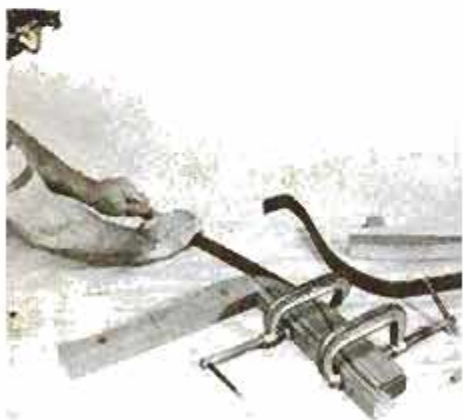
1 To make small-radius bender, attach a hinge, upside down, between 2x4s. Two-knuckle leaf goes on short 2x4.



2 Clamp strip to be bent between the hinge and a steel hold-down block. To ensure a true bend, use a wood guide strip.



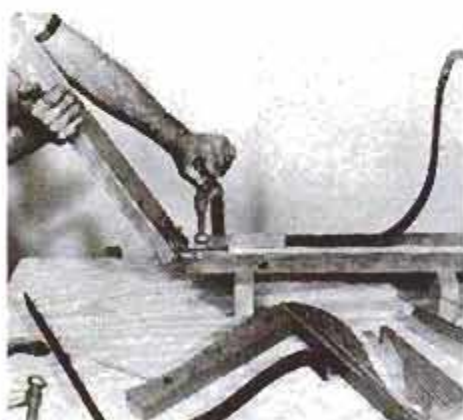
3 Squeeze mating curved blocks together to make leg's front contour. Small bend at end is formed while strip is straight.



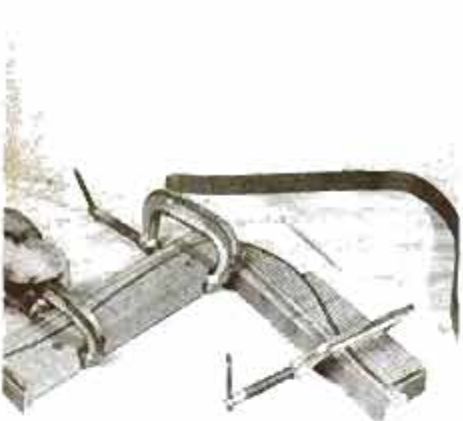
4 The strip is further bent around the corner by hand. Be sure that you keep the strip's edge flat against the worktable.



5 Hold strip against former blocks, then mark the block end. Temporarily remove the strip and transfer it to the other jig.



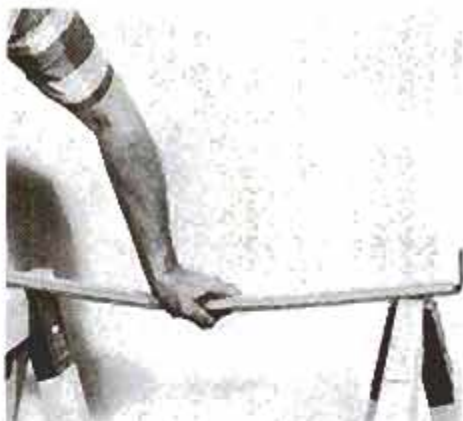
6 Next, make the small radius bend. This view shows why the seat contour must not be bent until this operation is completed.



7 Return the strip to the contour jig, then apply pressure by squeezing the clamps to complete forming the strip.



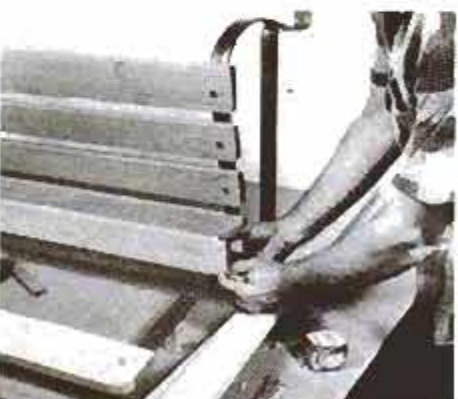
8 Clamp the armrest-former jig vertically to worktable. Use a bar clamp over the high spot to prevent the block from lifting. Remove the clamp after the bend is started. Grasp the strip low, as shown.



9 Use a strip of plywood and two saw-horses to fashion the large-radius, gentle curve for the rear legs of the bench.



10 Drill holes in the uprights, then clamp all pieces together to mark the hole locations in the abutting pieces.



11 Paint the metal frame and bolt heads before assembly. Attach legs to base, then insert the slats. Armrests go on last.

exaggerated angle to each other. This allows for spring-back.

A full-size sketch of the side view of the bench is helpful for checking bends. Use the enlarging-with-squares method to make the drawing.

To make the lower brace, use a strip 23 in. long. Mark bending lines $2\frac{1}{2}$ in. from each end. Center the mark over the hinge knuckles, clamp and make the bend.

The back upright is bent freehand because a jig of appropriate size would waste quite a bit of lumber. Use a 34-in. length of stock. Make the small-radius bend first, then

place a strip of 1/2 x 2-in. plywood over the metal and put it over two sawhorses.

You should apply downward hand pressure at the center to obtain an even curve. Check the bend against the drawing.

(Note: This "jig" is more trial-and-error method than actual jig. For example, you can coax the curve required by moving the horses closer together and shifting the strip accordingly. The point is, you should only exert a small amount of pressure at one time; be sure to check the curve against the drawing frequently, as well.)

The armrest is made with a 25-in. strip. Before forming the large curve, make a bend mark 3 in. from the other end.

Then clamp the armrest forming-block vertically to the work table over a piece of scrap strip. Slide the end of the work strip into the gap as shown in the drawing on page 96.

Use a bar clamp over the high point of the jig to hold it down during the initial phase of the bending. Bend the strip upward by hand, then remove the bar clamp and continue the bend. Transfer the piece to the right-angle jig and make the small-radius bend.

Mark the uprights for hole locations, then center punch and drill 1/4-in.-dia. holes. Clamp the lower brace and armrest in place to accurately mark aligning hole centers. Scraps of wood the same thickness as the slats should be used as spacers when clamping the armrest in place.

Cut the wood stock to length, then rip to the necessary widths. Highly water-resistant plastic resin glue is used to join the 2-in. strip to the front slat and to make the base feet.

Apply metal primer and two coats of satin finish paint to the metal before final assembly. Krylon products will do the job; they are tough and quick drying. Also paint the bolts and screws for attaching the wood before final assembly.

To obtain a lasting clear finish to the wood, apply three coats of a quality weatherproof topcoat such as UGL Imperial ZAR.

Planter

The legs for the planter are formed using the same jigs as for the bench, except the second part of the forming jig is not used. Since the legs cross over each other at the top, one set of legs is made slightly longer to make up the offset. This is accomplished by making the small-radius bends for the feet of differing dimensions.

Make a mark 1 1/2 in. in from each

end on one strip and 1 1/4 in. from the ends on the other. Place these marks over the knuckle of the hinge and make the bends.

Position and clamp the strip in the curve-forming jig so the corner of the small radius is 1 in. from the bottom end of the jig.

You should take up on the clamp to form the curve, then make the upper bend by hand while the strip is still clamped in place. Drill a hole for a 1/4 x 1-in. bolt through the top center of both pieces. Also drill holes for 1/4 x 1 1/2-in. lagscrews in the feet.

Cut the top from a piece of 11 1/2-in.-wide oak stock. Bore a blind 1/4-in. hole 3/8 in. deep in the bottom center to allow clearance for the bolt head.

MATERIALS LIST—YARD FURNITURE

Key	No.	Size and description (use)
TABLE		
A	2	3/16 x 1 1/2 x 90" steel (leg)
B	4	3/16 x 1 1/2 x 28" steel (brace)
C	4	1 3/4 x 6 1/2 x 36" oak (slat)
D	1	1 3/4 x 4 x 36" oak (middle slat)
E	2	1 3/4 x 3 x 32" oak (base)
F	4	1 3/4 x 3 x 3" oak (base foot)
G	18	1/4 x 1 1/4" carriage bolt, nut and lockwasher
H	6	1/4 x 1" machine bolt, nut and lockwasher
I	4	1/4 x 1 1/2" lagcrew and lockwasher
J	2	1/4 x 7/8" lagcrew and lockwasher
PLANT STAND		
K	2	3/16 x 1 1/2 x 48" steel (leg)
L	1	1 3/4 x 11 1/2 x 11 1/2" oak (top)
M	2	1 3/4 x 2 x 15" oak (base)
N	4	1 3/4 x 2 x 2 1/2" oak (base foot)
O	2	3/4 x 1 x 3" wood shim
P	4	1/2 x 3" mending plate
Q	4	1/2" brads
R	8	1" No. 8 fl screws
H	1	1/4 x 1" machine bolt, nut and lockwasher
I	4	1/4 x 1 1/2" lagcrew and lockwasher
CHAIR		
S	2	3/16 x 1 1/2 x 38" steel (leg)
T	2	3/16 x 1 1/2 x 34" steel (back support and leg)
U	2	3/16 x 1 1/2 x 23" steel (brace)
V	1	1 3/4 x 4 x 18" oak (top slat)
W	1	1 3/4 x 3 1/2 x 18" oak (front slat)
X	6	1 3/4 x 3 x 18" oak (slat)
Y	2	1 3/4 x 2 x 24" oak (base)
Z	4	1 3/4 x 2 x 3" oak (base foot)
G	18	1/4 x 1 1/4" carriage bolt, nut and lockwasher
H	6	1/4 x 1" machine bolt, nut and lockwasher
I	4	1/4 x 1 1/2" lagcrew and lockwasher
BENCH		
S	2	3/16 x 1 1/2 x 38" steel (leg)
T	2	3/16 x 1 1/2 x 34" steel (back support and leg)
AA	2	3/16 x 1 1/2 x 25" steel (arm rest)
U	2	3/16 x 1 1/2 x 23" steel (leg brace)
BB	1	1 3/4 x 4 x 43" oak (top slat)
CC	1	1 3/4 x 3 1/2 x 43" oak (front slat)
DD	6	1 3/4 x 3 x 43" oak (slats)
EE	2	1 3/4 x 3 x 25" oak (base)
FF	4	1 3/4 x 3 x 4" oak (base foot)
GG	1	1 3/4 x 2 x 38 1/2" oak (skirt)
G	12	1/4 x 1 1/4" carriage bolt, nut and lockwasher
HH	4	1/4 x 1 1/2" machine bolt, nut and lockwasher
H	6	1/4 x 1" machine bolt, nut and lockwasher
I	4	1/4 x 1 1/2" lagcrew and lockwasher
JIGS		
II	1	1 1/2 x 5 1/2 x 24" fr (cut as shown)
JJ	1	1 1/2 x 3 1/2 x 15" fr (cut as shown)
KK	1	1 1/2 x 3 1/2 x 18" fr (cut as shown)
LL	1	1 1/2 x 3 1/2 x 24" fr
MM	1	1 1/2 x 3 1/2 x 38" fr
NN	1	1 3/4 x 5 x 9" oak (cut as shown)
OO	1	3/2 x 3 1/2" wrought steel hinge Stanley No. 758 (or Stanley No. 741)
PP	1	3/8 x 1 1/2 x 6" steel
OQ	1	3/16 x 1 1/2 x 6" steel
RR	1	1/4 x 3/4 x 20" fr
SS	4	1" No. 8 fl screws
TT	4	3/16 x 2" machine bolt, nut washer

The legs are secured to the top by bridging 3-in. mending plates over each leg section. Use two 1/4-in.-thick wood strips, nailed in place, to shim the gaps resulting from the overlap. The base is made with two pieces of stock as shown.

Table

A different forming jig is required for the table legs. Make it by cutting an "S" curve through a 24-in. piece of 2x6 lumber as shown.

Cut two pieces of strip 90 in. long, then make marks at 2 1/4 in. and at 29 in. in from each end.

You form the bends for the feet by setting the 2 1/4-in. mark over the hinge knuckle. Next, place the strip between the formers so the 29-in. mark lines up with the top edge of the blocks. Use two clamps to form the curve. With the clamps still engaged, make the upper bend by hand.

Four 28-in. lengths of steel are required for the table braces. To make the lower horizontals, make bending marks 2 1/4 in. in from each end; place the strip with the mark over the hinge knuckle and make the bend.

The curved braces are made using the chair-leg jig and a vise. Start by making the right angle bends 2 1/4 in. from the end. Then place the small bent end of the piece in a vise and make a slight return bend by hand. Form the sweeping curve in the chair-leg jig, using only the larger section. Clamp the flat end of the strip against the convex portion of the block and make the bend by hand.

Note that throughout the various projects the angle of the feet will have to be fine-adjusted after the curves have been formed. Secure the pieces in the vise and bend by trial and error to get the feet into the correct plane.

Bore the holes for the bolts and screws as indicated in the drawing, then cut the wood to size.

The next step is to connect the braces; now lay out the tabletop slats on the work table, bottom side up and spaced 1/2 in. apart. Place the metal frame onto the slats and mark the center holes for the carriage bolts.

Be sure to prime and paint the bolt heads before installation. Also varnish all surfaces of the woodwork before assembly.

Chair

The chairs are made in the same manner as the bench, but with the armrests excluded. Also, the stiffener strip under the front slat is not required.

HOW TO REPAIR WICKER

(Continued from page 93)

match the missing strands. Several wicker suppliers are listed at the end of this article. *Note:* Wicker is an inclusive word that refers to rattan (a tough vine considered tops as wicker), bamboo, willow, buri from the back of palm leaves, rush from cattails and fiber rush, which is twisted kraft paper.

Repairs are often made with sturdy rattan reeds and cane. Reeds are

full rounds, split half-rounds or flat oval. Rounds and half-rounds are used to weave chair arms, chair-back rims and areas where a thick weave is needed for a little extra support.

Cane is flatter. Cane and flat oval reeds are used to wrap chair legs and cross-supports; cane is also used to weave seats.

To prepare your purchase order, measure the diameter of the reeds and the width of the cane in the damaged areas. Reed sizes for weaving

range from $\frac{1}{64}$ to $\frac{1}{4}$ in. dia. They're sold by the pound at \$5 to \$6 each.

Cane width is measured in millimeters (25 $\frac{1}{2}$ mm to the inch). Wrapping cane ranges from 1 $\frac{1}{4}$ mm ($\frac{1}{16}$ in.) to 6 $\frac{1}{2}$ mm ($\frac{1}{4}$ in.). If you send a sample of the old material when you order, some suppliers, for example, H.H. Perkins Co., will try to match it.

Before you begin work, soak the reed and cane in water for 24 hours to make them supple. Also, sponge or hose down the piece you want to



Some helpful tools of the trade include (from left to right): upholsterer's hammer, needle-nose pliers, bent-nose pliers (good for getting in between reeds), wire cutters, razor knife, narrow-blade chisel, screwdriver and liquid hide glue.



Before renovation, the sagging seat and broken braid of this chair would have led many to toss it into the trash. However, skilled workmanship extended its lifetime.



The wicker specialist begins repair by wetting down the old wicker with a sponge. Meanwhile, coils of new rattan are soaking in water so they will become pliable.



To raise and fasten a sagging seat, bore a hole in the leg and seat frame and secure parts with a wood screw. The wicker repair that follows reinforces the joint.



Choosing round reeds the same size as those in the crosshatching on the side of the chair, Alford will weave the top ends into the arm braid. Here, the sharpened reed end is inserted, ready to be woven.



Work the sharpened reed end through the arm, pull it taut and crimp it with needle-nose pliers at the point where it appears above the arm. Keep crimped with pliers and bend the reed in a U-shape. It is now ready to reinsert through the arm.



Work the reed through the arm and pull it taut from below. Then clip the tail of the reed. The position of the ends, as shown here, is vital to the chair design.



After crosshatching is restored, crimp the reed nearest the leg in a V-shape and nail it to the leg. You will cover the nail later, when the leg is wrapped with cane.



The unclipped reed ends at the bottom of the completed crossing will become a part of the skirt design. These bend back to match the direction of the skirt rim. Note that the unclipped reed ends overlap two courses and underlap two courses.

repair (or stick it under the shower for 10 minutes).

Study the weaves and braids carefully. When you begin work, cut, wrap, weave and clip the reeds and cane as shown here. Nail sparingly to secure the end of a long cane wrap or the last reed in a braid. Use small flathead tacks.

Use clear liquid hide glue to secure the wedged reeds. Apply it after you finish an area, or after you've completed the piece and made all final adjustments.

When the glue and damp reeds dry, paint the restored wicker with polyurethane or any other quality, fast-drying spray paint. Use a power sprayer or spray paint in a can. Where the weaving serves as the base and the glue secures the weaving, generously applied paint acts as a sort of "glue."

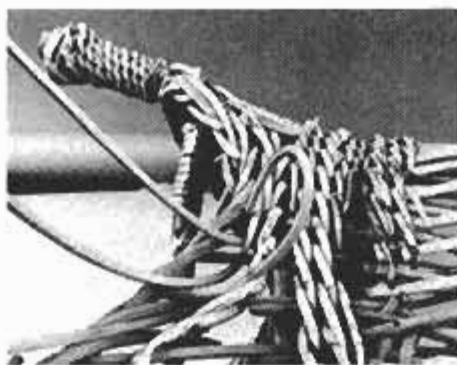
Once a year, re-soak the wicker in water for 5 or 10 minutes so it won't become too brittle. If it's used outdoors, let the rain soak it. Store wicker indoors in cold weather. **PM**

WICKER SUPPLIERS

- Cane & Basket Supply Co., 1283 South Cochran Ave., Los Angeles, Calif. 90019.
Albert Constantine and Son Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461; catalog, \$1.
Craftsman Wood Service Co., 1735 Cortland Ct., Addison, Ill. 60101; catalog, 50 cents.
The Otto Gerda Co., 82 Wall St., New York, N.Y. 10005; catalog, free.
Newell Workshop, 19 Blaine Ave., Hinsdale, Ill. 60521; brochure, free.
Peerless Rattan, 45 Indian Lane E., Towaco, N.J. 07082; catalog, free.
The H.H. Perkins Co., 10 South Bradley Rd., Woodbridge, Conn. 06525; catalog, reedcraft book, \$1.
Veterans Caning Shop, 550 West 35th St., New York, N.Y. 10001; leaflet, free.



As new reeds are woven into the skirt, the rim begins to thicken and the skirt pattern begins to develop some shape.



Three fresh reeds are backed into the braid of the skirt rim. The braid pattern is simple: outside strand over center strand, then other outside strand over center strand. But note that the strands are woven under and over the vertical reeds.



After finishing the braid-and-weave design for the skirt, clip the reed ends that poke out from below the braid.



Any missing reeds in the back rim weave are replaced with short reed lengths. These are backed into the weave, crimped, bent and then pulled back through the braid. The ends should be clipped from below rim.



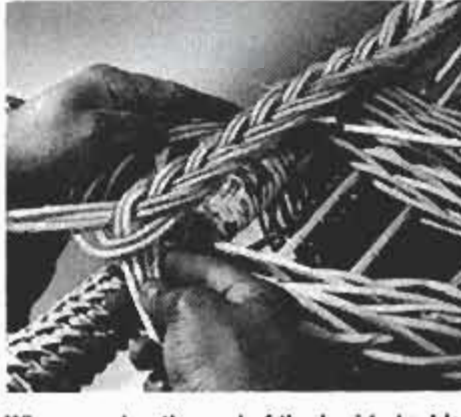
If you wait until repairs are completed before applying clear liquid hide glue, you can make corrections to rattan, if needed.



A leg is rewrapped with cane strands. A double wrapping goes around the V-shaped reed at the point where it abuts the leg.



Decorative leg braid is woven with 10 strands handled in pairs. First, the outermost pair of strands on one side overlaps the two adjacent inner pairs (photo above, left). Next, the outermost pair on the opposite side overlaps two adjacent pairs (above, right). Repeat.



When nearing the end of the braid, double back the last two pairs, working them beneath the braid, so after they're clipped, no ends will show on the finished work.

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small pieces of rock put under pressure in a laboratory. Now, questions began to fly. Why did he feel he could extrapolate from a single, solid piece of rock to the separate plates in the earth in Peru? Why hadn't he published anything to show how he had arrived at his predicted quake dates? And what did the equations he flashed at the council really prove?

The press conference hosted by the council the following day was devastating to Brady's prediction. "None of the members of the council would have serious reservations about being present personally in Lima at the times of predicted earthquakes," the council's statement read.

No scientist we interviewed was happy with the hearing. "It was a very difficult and unhappy situation," Allen said, "and not the way science is usually done." Among other thorny problems: What if there is an earthquake in Lima this month? The area is active, and might let loose, even if Brady's reasoning is wrong.

"I don't like this idea of telling people their predictions aren't valid," Allen concluded, "because you stick your neck out about as far in one direction as they do in the other." Brady could not be reached for comment.

Electronic ears to the ground

The job of predicting—or judging predictions—creates novel public relations problems for scientists unaccustomed to notoriety, if not fame. The real work of prediction, though, goes on far from the public eye, in labs and libraries, computer centers and desolate field stations. Often, the scientist's primary job is to wait, mechanical ears to the ground, for the fruitful moments when the ground begins to shake loose useful data.

And sometimes, the wait is more prosaic still: for

(Please turn to page 105)

HOW SCIENCE FORECASTS KILLER QUAKE

(Continued from page 73)

underground rock. The approach, however, was a little too simple. After a few initial successes, researchers discovered that the Russian system didn't work very often.

Probably the most famous and controversial prediction in recent years was the theory of Brian Brady of the U.S. Bureau of Mines and William Spence of the U.S. Geological Survey. They announced that two immense earthquakes would occur on the coast of Peru at about the time you're reading this. As concern grew in Lima earlier this year, a relatively new committee, organized by the U.S. Geological Survey, met in a windowless auditorium in Golden, Colo., to give Brady and Spence a hearing. The assembly's purpose was to ascertain whether the prediction was sound enough to justify the alarm that had spread throughout Peru. The grim news had reportedly caused some Peruvians to plan to move, and had prompted civil defense agencies to stock up on body bags.

During the first day of the extraordinary session, the U.S. National Earthquake Prediction Evaluation Council, chaired by Clarence Allen, proceeded gingerly. Brady—chief spokesman for the position he and Spence held—presented hours of evidence. He got a pillow-soft, polite response from the blue-ribbon group of a dozen scientists facing him.

"I laid down a heavy hand on the committee," Allen told us later, "saying, 'This guy's got to be given a chance to talk, no matter how much you want to barge in.'"

The following morning, though, the committee began to open up. Brady had based the prediction on studies of

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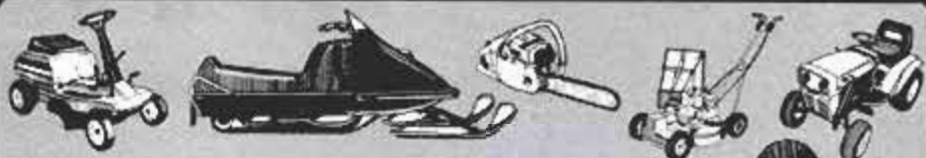
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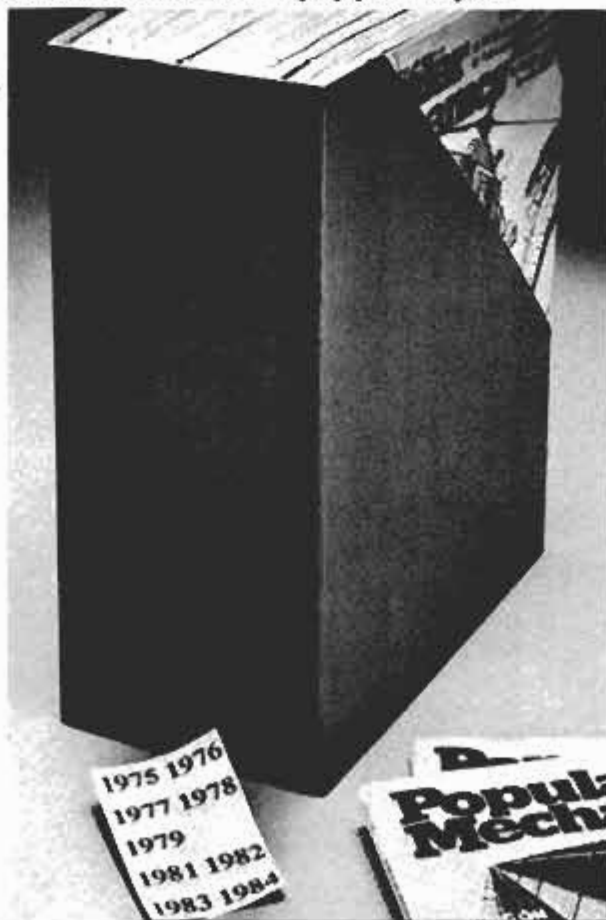
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KILLER QUAKES

(Continued from page 102)

funding. I. Selwyn Sacks of Washington, D.C.'s Carnegie Institution, has his own ideas about Peru. When we interviewed him, he was awaiting more than half a million dollars in funding to carry them out.

Unlike Brady, Sacks contends that there are insufficient data right now about low-level seismicity—minor earthquakes—to discern a pattern in Peru. "We've set up seismic-monitoring stations, about 15 at a time, for certain periods, in 1965, 1969, and 1971," he said. "But not on a continuous basis. Certainly a large earthquake is due. Whether we've got one year or three years, I don't know, but you've got to start sometime. You must have stations in hard-to-reach places—in the jungle and mountains."

Sacks wants to install sets of seismometers at 15 remote sites in central Peru. The seismometers themselves are basically simple devices. They're little more than a magnet suspended near a coil in a casing that's about the size of two beer cans, laid end to end. When the ground jiggles the magnet, the current resulting in the coil flows through measuring instruments. The greater the tremor, the greater the current.

Each of the stations would feed seismometric data into microwave transmitters, powered by solar photovoltaic cells. A central station in Lima would snare transmissions and feed them to a computer programmed to recognize earthquakes. Sacks' goal: to store away enough data on the location and size of small quakes to recognize the kinds of patterns that might permit the prediction of a major event.

Other gear developed to foresee the seismic future costs little more than the price of a few feet of sewer pipe. For the past five or six years, Dr. Robert L. Fleischer of GE's

Physical Chemistry Laboratory has been measuring changes in the flow of radon gas from Earth. He has detected tantalizing signs of a possible relationship between this flow and underground strain.

Radon is a colorless, odorless, radioactive element, which is released by uranium and carried in air. Fleischer's theory is that strain in one part of the earth—the buildup of pressure as plates snag before a quake—can increase strain hundreds or thousands of miles away. And that can either squeeze radon from the ground or, at least, change its pattern of release.

Fleischer's monitoring stations consist of plastic cups (used commercially for packaging candied fruits) each buried about 60 centimeters deep in a protective shell of sewer pipe. At the closed end of the cup, a

(Please turn to page 106)



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KILLER QUAKES

(Continued from page 105)

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Reading signs in the past

Looking into the future, for other scientists, means probing the past. William McCann, a researcher at Lamont-Doherty Geological Observatory of Columbia University in New York, was browsing through an old tome one night in the observatory's library when he found a nugget of information about Alaska's seismic history. Buried between the worn, purple covers of a 1912 Geological Survey report were some startling narratives of a violent earthquake in 1900.

"Heavy earthquake 2:17 a.m.," one account began. "The vibration was so strong, it broke loose from the walls of the office a case of drawers and threw them across the room; a man sleeping in the next room to me was thrown from bed. I would have suffered likewise had I not caught myself. The cattle got scared and ran and bellowed; the dogs howled; the natives got scared and left their homes, believing the world was at an end, and ran to the church."

Accounts like these have helped McCann and others create a kind of seismic road map (see page 73) of the boundary between plates, with warning signs over potentially hazardous sections.

These danger zones are called "seismic gaps." In a theory now backed by growing evidence, these gaps are segments of plate boundaries where large quakes have struck in the past—as evidenced by narrative accounts like the one above—but where there has been no seismic activity within 30 years.

Simply identifying these ominous gaps, where strain may be growing, does not yield a hard prediction. But it can help experts develop a forecast, specifying a general location and rough time frame.

One such gap, for example, was identified along 320 kilometers of Alaska coast in 1971 by scientists John Kelleher, Lynn Sykes and Jack Oliver. A large quake struck the region in 1972, and another in 1979. But large sections of the designated coast remained quiet. Researchers foresee more trouble in the gap.

Every one of the researchers we talked to wants to be there, manning the gaps, measuring the violent rhythms, collecting the data on which life-saving predictions rest, when the next big one hits. **PMC**

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NEW COMPUTER ANIMATION

(Continued from page 76)

considering this type of work for movies, rather than building expensive sets or elaborate models.

The numbers game

It doesn't matter whether the finished product will be a TV station's call letters floating ethereally in space, or a starship flashing through the sky—the finished image first appears in the artist's imagination. Then it must be put into a language



The computer "paints" an image onto a screen. A camera, which hangs above the screen, captures the image on film.

that the powerful computers can understand and work with. The artist designs the master frame—the computer does the rest.

The artist's master frame might be a wire skeleton of a car, for instance. Using just the information in the original image, the computer must rotate, scale and show that car from all angles.

But you cannot simply show a computer a sketch and say "take it from here." Everything must be translated into numbers.

Magi Inc. (who supplied the images featured in this article) uses a system of building-block "primitives." Complex shapes—giant ants, undersea vehicles and thousands of others—are all made from smaller, standardized shapes. The primitives are the pieces that make up the visual puzzle.

An artist first decides how to construct his scene by putting together the various primitive shapes that the computer already knows how to draw. Each primitive shape (such as a box or a wedge, a right circular cylinder or a right-angle wedge) must be individually calculated. At this point, the artist doubles as a programmer.

All the primitive shapes are located by means of complex coordinates. These coordinates are fed into the computer. The artist doesn't see his

finished product until the computer is done with it—all he has is his rough sketch and a very long string of coded numbers. But to this new breed of artist/programmer, those numbers are as descriptive as a pen and ink detail.

From the computer viewpoint

The numbers are punched into the computer. The computer adds the shapes together and begins to modify and work on the data. For one thing, special lighting effects are simulated so that the finished picture will have texture and shading.

Then, the first frame is "painted" on film. The computer controls a dot of intense, colored light that moves on a screen similar to a TV set's picture tube. But unlike a TV, the image doesn't remain visible for human eyes to appreciate. Instead, a camera hangs above the screen with its shutter held wide open. The moving light from the screen below exposes the film.

At this point, the artist/programmer may take a look at the image by projecting that piece of film or having a transparency made from it. If all is well, the computer program continues—and here the real magic begins.

The images are moved—the mathematical coordinates are modified by the program—and new frames are painted. The film sequence is composed, frame by frame, with no further human intervention, until completion.

Images look great

Each frame can take a different amount of time to "paint" onto film. The more detailed the picture, the greater its resolution, and the longer the process takes. A highly detailed frame can take 20 minutes or more to compute, but it might have taken a staff of noncomputerized animators a full day or more.

The results can be startling: Eerie, monstrous trucks move through a landscape of sodden colors; skeletons of cars fly through the air and pop into shipping crates. And some of it looks so real, you may have to remember that you're watching computer animation, not photography from some distant galaxy.

Indeed, these fascinating images will be showing up in many of Hollywood's latest creations. You will be able to judge for yourself when you watch Walt Disney's upcoming feature movie *T.R.O.N.* Many of *T.R.O.N.*'s futuristic sets and events exist only in the silicon memory banks of Magi Inc.'s computers in Elmsford, N.Y.

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SILHOUETTE SHOOTING

(Continued from page 85)

target set—one pig, chicken, turkey and ram—in 1/16-inch steel. It's available as a premium offer through Remington Arms dealers for \$10.95, plus the end flaps from a 500-round carton of Remington .22s, or by writing Metallic Silhouette Offer, Remington Arms Co., Bridgeport, Conn. 06602. Silhouettes in all sizes are available from Texan Reloaders, 444 Cips St., Watseka, Ill. 60970. A full-size ram for rifle and pistol competition costs \$75, plus shipping, for example, and shipping a 50-pound ram can come high.

Get steel from a pro

You can make your own silhouettes from the outlines shown here and sheet steel obtained from jobbers who supply heavy engineering and highway construction trades. The best steel is ASTM A-514, sold under a variety of trade names by every large steel maker.

The animal shape is flame-cut, and the foot pads are welded on with E-110XX or E-120XX electrodes, using the stringer-bead technique. Take care not to soften the metal by overheating during cutting or welding.

High-power-rifle and long-range-pistol silhouettes are 1/2-inch thick for chickens and pigs, 3/8-inch for turkeys and rams. Small-bore rifle targets may be 1/16- or 1/8-inch thick. Anything thinner gets bent up by bullets, and thicker steel may not be knocked down by even a good hit at 100 meters.

Feet are made from the same steel. High-power-rifle chicken feet measure 3x4 inches, 2x4 for each leg of the pig, 3x8 for turkeys, 4x5 for each leg of the ram. For the hunter-pistol class, all feet are 2x4 inches, and the pig can have both feet welded to a single 2-inch-wide strip. For 1/2-scale targets used with .22s, all feet should be 1 inch wide by 2 inches long.

Obtaining more information

For competition and target details, write to the National Rifle Assn., 1600 Rhode Island Ave., Washington, D.C. 20036. It also has rules for .22, air rifle and pistol matches in all classes. The International Handgun Metallic Silhouette Assn., Box 1609, Idaho Falls, Idaho 83401, has divisions in almost every state and runs an active match program. For black-powder shooters, information is available from the National Muzzle Loading Rifle Assn., Box 67, Friendship, Ind. 47021.



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THREE VIDEO DISC SYSTEMS

(Continued from page 79)

the laser-light videodisc from Magnavox. The format is now employed by the Pioneer LaserDisc machine, as well.

Recently, RCA began selling its new CED machine. CED stands for Capacitance Electronic Disc. Radio Shack, and others, are ready to join these CED ranks.

And finally, manufacturers such as GE and Panasonic are poised to release the VHD or Video High Density disc.

The scorecard in the videodisc war pits VHD versus laser versus CED—and you might be the loser if you buy the wrong one. In five years or so, it's unlikely that you'll still be able

to buy discs for all three systems.

The laser system uses a laser beam focused through a series of mirrors and prisms. The laser light comes from underneath the disc. The disc itself is made of a highly reflective substance. Hundreds of thousands of microscopic pits on the disc reflect the laser light. The computerized videodisc machine then "reads" these reflections and converts them to a TV picture.

There is no needle to wear out. The discs cannot be harmed by fingerprints or anything but deep scratches, since the laser reads the pits, which are protected by a tough, transparent coating. The discs themselves are capable of storing up to 54,000 frames of pictures—or other information.

RCA's new CED system is much like an audio record player. The disc is grooved plastic—but these grooves are quite delicate. Each one is dozens of times narrower than the grooves on a standard record. The needle, or stylus, is microscopic, so small a human hair looks like a log by comparison.

In the groove

This tiny stylus rides in the grooves, making gentle contact. The contact is just enough so that the capacitance effect between the stylus and the groove walls can carry electrically encoded information that describes what the picture should look like.

Both the record and stylus are

(Please turn to page 113)

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THREE VIDEODISC SYSTEMS

(Continued from page 111)

subject to wear, so the record is protected by a thick, plastic jacket. You play a CED disc by sliding the jacket-encased record into a slot, then pulling out the jacket. The disc stays in the machine. After the play, you use the jacket to pick up and remove the disc.

The Pioneer laser system numbers each frame on the disc, so that you can use a keyboard to select the exact frame picture you want to see. Both the Pioneer and Magnavox machines let you stop on one frame (freeze-frame) for as long as you like.

But the RCA system, with its thousands of delicate grooves and its minuscule stylus, cannot do either of these things. You can't jump from one place on the disc to another, nor can you have freeze-frame, since playing one groove repeatedly would wear out both the picture groove and the needle.

But the RCA system has one great advantage over the laser—price. It's more than \$100 cheaper than the Magnavox and more than \$200 cheaper than the Pioneer.

The VHD system, which has not yet been released, combines some of the good features of both the laser and the CED. It uses a capacitance effect, but with microscopically sized pits on the disc. Because there are no grooves, this system also lets you have freeze-frame and random access to any frame you want.

Revolution or just revolving?

Just what should a videodisc machine be capable of doing? If the answer is simply to play a movie from beginning to end, then the least expensive system that accomplishes this would be "best." In that case, RCA would stand tall with its inexpensive CED machines.

But the laser and VHD systems can bring about a true video revolution—if there should be any market for it.

The revolution is called interactive video. By using the go-to-any-picture, random-access capability, a whole new breed of videodiscs may be created. Interactive discs are more than movies—they are experiences.

A video teacher

For educational, in-home uses, an interactive disc can teach a concept. Then, according to the answers keyed in, it can direct the student to study other areas on the disc. Or the art lover may soon be able to take a

(Please turn to page 114)

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THREE VIDEODISC SYSTEMS

(Continued from page 113)

walk through some of the world's greatest art galleries—all on one videodisc that can store up to 54,000 pictures.

Even some typical consumer devices may change—Sears, for example, has just brought out a catalog on a laser videodisc in a limited, experimental trial run.

The laser system has already demonstrated some of the capabilities of interactive video with discs such as *How to Watch Pro Football* and *First National Kidsdisc*. The VHD disc should be capable of the same sort of thing.

As the VHD has not yet been released by any manufacturer, we cannot say for certain, but it appears that it will have the laser's interactive capabilities. However, it will also be subject to some of the wear problems that exist in the CED system.

Long-term outlook

Buying a videodisc machine today is a difficult consumer decision. And the choice today's buyers make will most surely affect the industry for years to come.

If all you want are home movies—if you don't care about slow-motion and freeze-frame—then the CED system is probably for you. But remember that you will be among the pioneers who will be first to find out just how quickly the CED disc and stylus wear out in the home. (Manufacturer reports claim 600 or more hours of life, but these are laboratory figures.)

But if you like the idea of using your TV as something more than a better boob tube, then you should consider the laser systems. With freeze-frame and slow-motion, random access to any frame on some models, no stylus to wear out and discs that are invulnerable to most home hazards, the lasers are appealing enough.

Simply throw in the whole new field of interactive video and you'll be getting more for your money than simply movie entertainment.

Only one definite

But it's still a guessing game. If the CED system becomes the standard, pity the poor laser owner a few disc-less years later. Much the same could be said about all these systems.

One thing is for sure, though. No matter which videodisc you buy, you'll be amazed at the fine quality of the TV image. Technology has never looked better.

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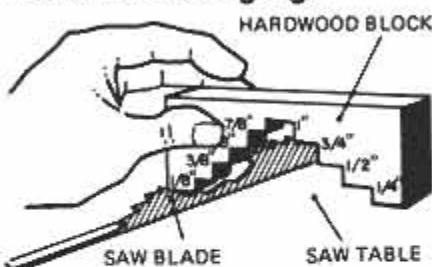
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HINTS FROM READERS

Table-saw blade gauge



This hardwood gauge saves time when you adjust your table-saw blade. Cut the notches accurately in $\frac{1}{8}$ -in. steps and position the gauge so the desired notch is over the blade. Raise the jig until it just touches the jig.—*H.E. Moody*

Handy index

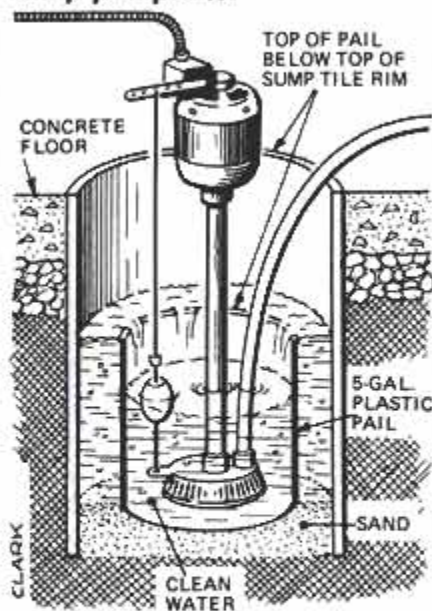
I keep the contents pages of my old issues of PM in a folder and refer to them whenever I want an article on a specific subject.

—*A.E. Heath*

Correction-paper shop aid

Typewriter correction paper transfers a drawing onto darkly stained stock more clearly than chalk. Bonus: There is no residue like that left by crayon or grease pencils.—*A.J. Zimmerman*

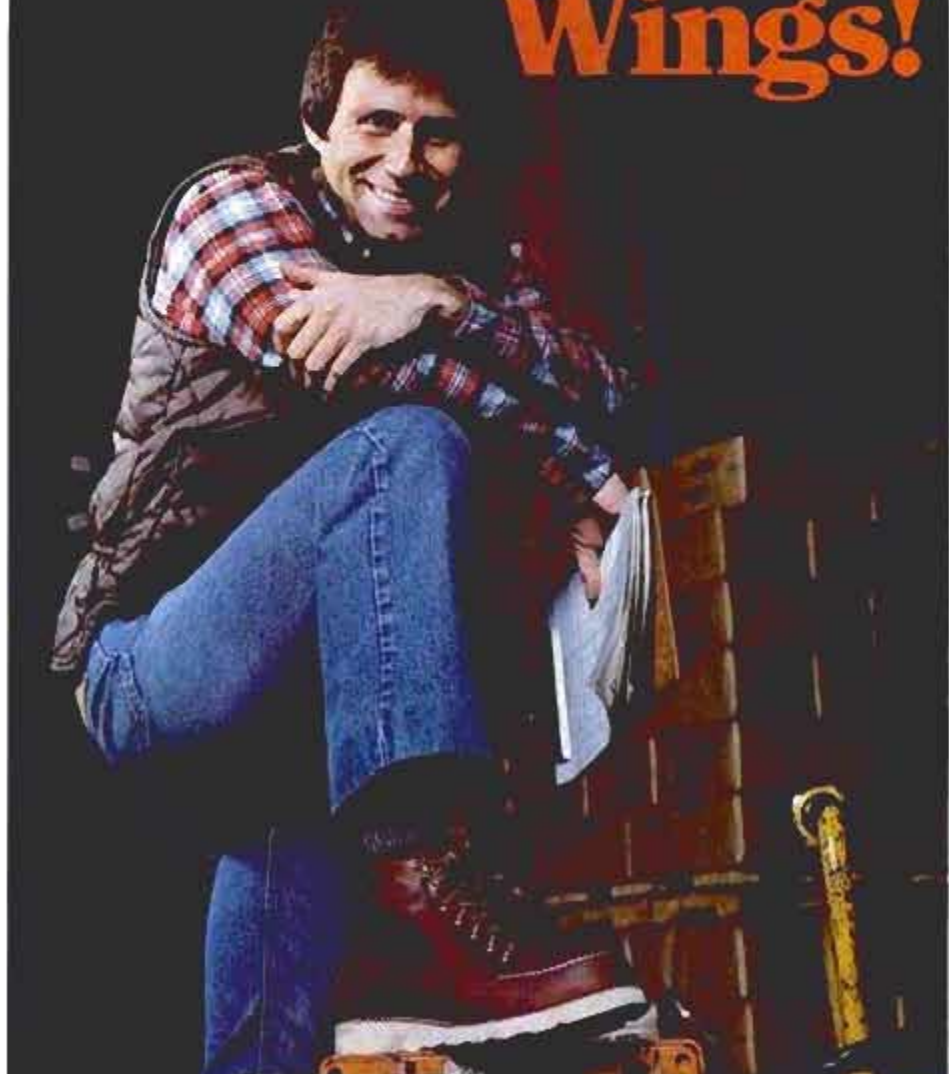
Sump-pump filter



If your sump pump draws sand along with water, you can place the sump pump in a 5-gallon plastic pail. Sand and sediment will settle outside the pail. A plastic pail will last indefinitely.

—*Gail Majewski*

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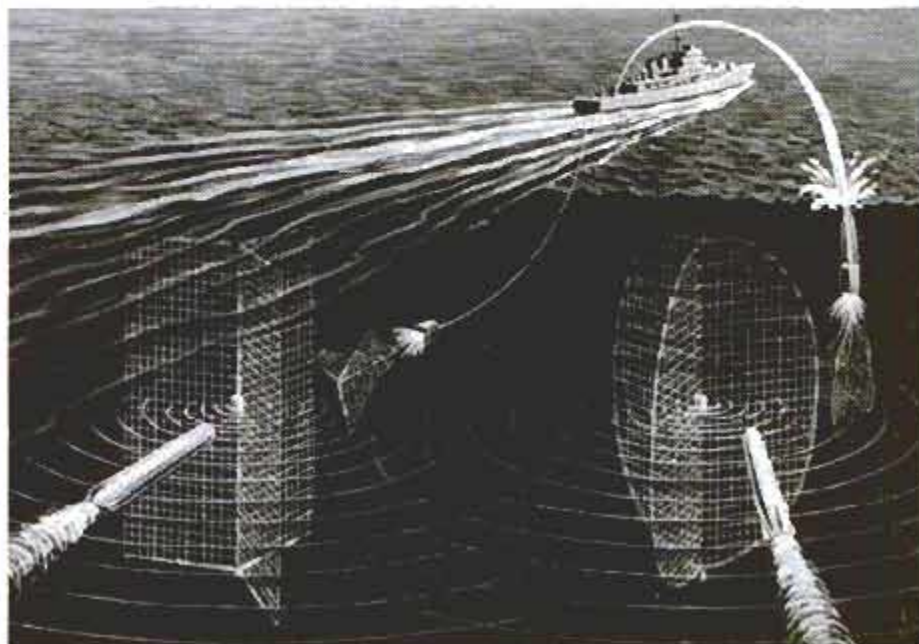
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TECH LINES

Explosive trap to lure enemy torpedoes



Decoy deploys screens under water, uses acoustic signals to attract homing torpedo. Device can be towed (left) to protect ships against wake-following torpedoes.

Inventions

As a homing torpedo closes in on a ship, crewmen fire a rocket which plunges beneath the surface and sprouts oval screens. Acoustic signals radiate from the center of the ovals, beckoning the torpedo off its course. When the torpedo's nose grazes a screen, the decoy blows up, saving the ship.

That's the scenario envisioned by inventor Ernest P. Longerich, an engineer at the Librascope Div. of the Singer Co., Burbank, Calif.

Other decoys depend on a sonar tracking system to trigger torpedo-killing explosives. But the acoustic signals used to entice torpedoes interfere with sonar tracking. Longerich's device, however, needs no sophisticated tracker: It blows up when it's touched.

Longerich won Patent 4,262,595 at about the same time a British company, Marconi, reportedly developed a "clever" torpedo with an on-board computer able to avoid decoys. A *New York Times* article suggested

the U.S. Navy might buy Marconi's Sting Ray torpedo. But a Navy spokesman tells us flatly that the Navy has no intention of purchasing the British torpedo.

Does that mean existing U.S. torpedoes—made by companies such as Honeywell, Gould, Northrop and Westinghouse—can evade decoys? No comment. Meanwhile, Librascope, which specializes in antisubmarine warfare, has submitted the antitorpedo device to the Navy for consideration.

Radio to foil rustlers

Drop that branding iron. An invention that tags livestock with tiny radios could end the need for searing identification into animals' hides.

A tiny radio transmitter, weighted to remain in an animal's "second stomach"—the reticulum—is shot into the mouth of a cow, sheep or goat.

To identify livestock, a rancher sends a signal to the stomach capsule, which responds with a unique string of pulses. Capsules can be recovered after slaughter for reuse. (Patent 4,262,632.)

Aerospace

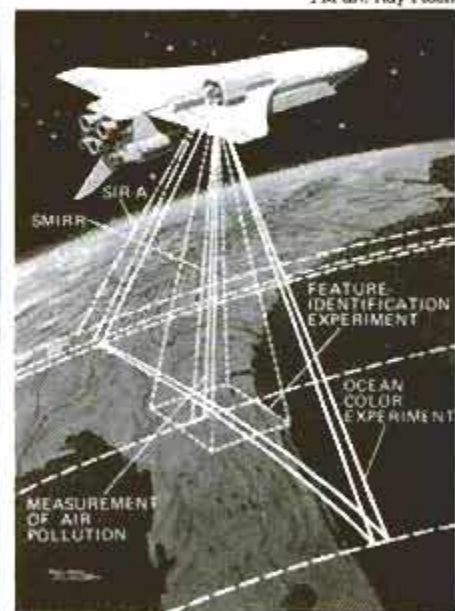
Columbia goes to work

When the second space shuttle flight thunders into the sky this fall, its bay will carry a research package that should deliver significant input to the search for oil, gas and mineral-bearing rock.

Space researchers used a similar system to find canals built by Mayans and buried under rain forests for more than 1,000 years. Now, the sensitive gear aboard Columbia will probe faults and other features in an 88-hour land survey.

Two systems may help the search for energy: the Shuttle Imaging Radar—Advanced (SIR-A), and the Shuttle Multispectral Infrared Radiometer (SMIRR). SIR-A's antenna—9.3 meters long—will pick up and record on film a land strip about 50 kilometers wide and 200,000 km. long to help map geological structures. SMIRR will measure solar reflectance of mineral-bearing rock. Coupled with existing data, SIR-A and SMIRR should speed exploration for fossil fuels and useful ores.

PM art: Ray Poch



Five devices in Columbia's open bay will probe a wide area of the Earth's surface.

Packaging

Would you drink to this?

How about a glass of fresh milk from a carton that's been stored for six months? Soon, you may be drinking it—and liking it. Corn flake fans say Ultra High Temperature (UHT) milk tastes better than day-old milk from the cow.

UHT milk has been in production for more than 30 years: The aseptic laminated-paper packaging for it was a 1951 patent of Real Fresh Inc., Visalia, Calif. But approval for sale in the United States wasn't granted by the Food and Drug Administration (FDA) until this year.

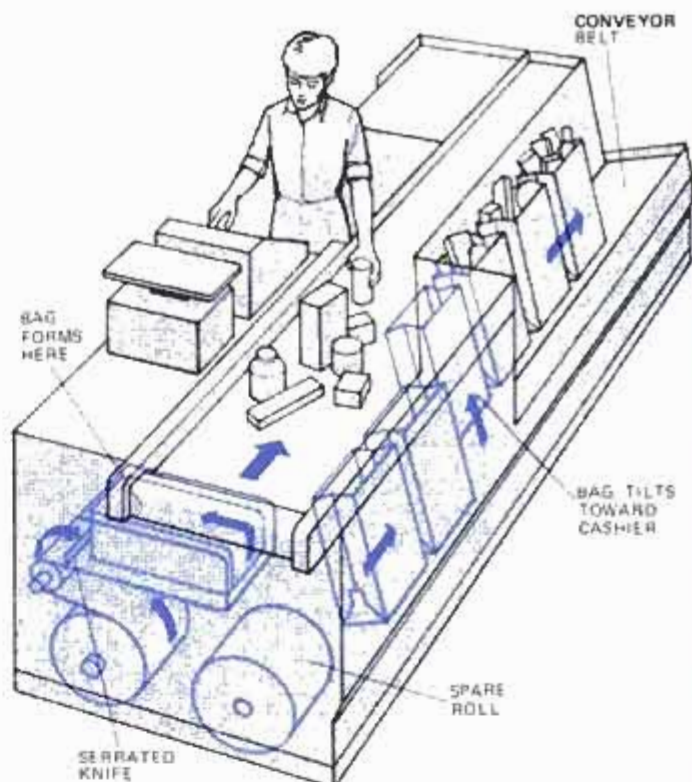
Real Fresh is marketing the UHT product in 10 western states. Prices are roughly 20 percent above the tag for conventional milk. Plans are afoot to distribute the product nationally.

During the UHT process, grade-A milk is pushed to 300° F., held for three seconds, then cooled. The resulting fluid stays drinkable for six months without refrigeration.

Food to go-go

A Canadian company is offering a new machine to speed up sluggish lines at supermarkets and help shoppers make a faster getaway. H. J. Langen & Sons, Mississauga, Ont., recently unveiled its \$7,000 Bag-O-Mat checkout counter, a sophisticated device that:

- Makes grocery bags automatically, in seconds, from roll stock.
- Sends empty bags zipping on a conveyor belt past the cashier, who rings up and packs merchandise with ease.
- Delivers filled bags to you on the same belt, thereby slashing the time a customer spends waiting in line by as much as 30 percent.



Bag-O-Mat cuts and glues bags from roll of paper, delivers them on demand to cashier and carries full bags to pickup area.

The system has rung up approval from cashiers. Bag-O-Mat cuts bending and lifting, they report.

And there's another bonus in the bags: Their softer edges cause fewer paper cuts.

Energy

Underground heat tap

Researchers at Oak Ridge National Laboratories in Tennessee are investigating a simple way to tap into geothermal heat in the ground under houses with crawl spaces.

They're snaking ductwork from the center of the crawl space to the intake of a heat pump. Ralph McGill at Oak Ridge reports that in preliminary tests last winter, when ambient air temperature was 5° F., air in the crawl space was 25°. The ground, at a constant 55° F., warmed the air. Result: less work for the pump and lower energy costs.

A hot issue

How do you light and maintain a fireplace fire? A debate roars.

Squared off are Lawrence Cranberg, a physicist and inventor of the Texas Fireframe, and the Consum-

er's Union (CU) which publishes *Consumer Reports*. Cranberg's double-decked grate holds logs in an arrangement that curves toward the room. In theory, the curve slings heat out of the fireplace better than random piles of logs. In its January 1981 issue, *Consumer Reports* aimed a barbed poker at the fireframe (and all grates), in favor of a grateless "standard fire." Cranberg says unequivocally: "CU's 'standard fire' won't work."

In a not-so-neutral corner is *PM* (*The Art of Burning Wood to Get More Heat*, page 122, Sept. '80) with its own entry—a two-log fire built over a bed of ashes. *PM*'s thesis: Hot embers, not fire, deliver maximum heat.

The power that will be

Electric utilities as you know them today are the mastodons of power—headed straight for extinction. That's the opinion of a brainy group at Massachusetts Institute of Technology, headed by Prof. Fred C. Schweppe,

an electrical engineer and specialist on power systems.

But Schweppe says there is a way to avoid the demise of the big power companies. The key to the plan is dialog between the utility's micro-processor and yours.

A major reason to establish communication is to allow quick sales of power to the utility from wind, water or photovoltaic generation. Another reason is to set prices. The MIT group believes the current rate structure ought to be scrapped. In its place "will be rates determined solely by basic supply and demand," Schweppe contends. For instance, during hot spells, when airconditioners demand more than generators can supply, prices would rise. "When it gets up to a dollar per kilowatt-hour, people are going to start to back off," Schweppe says.

During the dog days, such a system could leave customers howling. But there's a bright spot to the idea. It could end blackouts.

Automotive

Smart electric GT

Historically, electric vehicles have been squat and boxy, with a minimum of creature comforts. Recently, we got a chance to drive an electric that not only looks like a "real" car, but also is fitted with a first-class leather interior, a computer and all the comforts of a high-priced touring car.

It's called an Exar I and it's built by a Dallas firm, Amectran, which spent \$3 million to build the prototype. The body was designed and built by the famed Italian design studio, Frua, in Turin.

The company says that the car will achieve a range of 75 to 100 miles on a charge and can cruise easily at 60 mph. It has an on-board computer which senses road speed, load and electric-motor demand, and adjusts the flow of current to optimize mileage.

The car uses conventional lead-acid batteries and will retail for \$7,800 when it goes on sale sometime next year.



The Exar I departs from boxy electric-car look with exotic styling. The dash (left) features a cathode-ray-tube display.

The price sounds like a bargain, and some auto-industry and electric-vehicle industry people are highly skeptical. A GM spokesman says that even with GM's economy of scale, it would be hard to produce

such a vehicle for less than \$10,000.

Ed Ramirez, president of Amectran, says that the reason GM or any other auto company can't beat his stated price is that he's using advanced assembly and production technology, something the auto companies are unwilling or unable to do.

Since Amectran is starting from scratch, and not locked in to obsolescent tooling, it can buy the latest and most efficient production machinery, Ramirez argues. But it remains to be seen whether the Dallas company can beat Detroit in a battle of watts.

Aviation

Chopper simulator

A new helicopter simulator presses pilots back into their seats during acceleration, vibrates realistically as they change rotor angle, and displays a moving, tilting scene through five windows—all at just a fraction of the cost of a ride in the real thing.

A program developed by the American Airlines Training Corp. teaches corporate pilots to fly the Sikorsky S-76 twin-jet copter without leaving the ground. An hour's ride in the \$2.5-million simulator costs \$500—a third of the price of an hour in the helicopter itself.

Spidery legs

The heart of the new simulator is an actual cockpit, taken from Sikorsky's production line. It's mounted on a spidery set of six 2-inch-diameter legs, the working end of a hydraulic system under 3,000 pounds of pres-

sure. Movement of these rods, which is controlled by a computer, pivots, pitches, and rolls the cockpit. The rods can also raise and lower the white chamber by three feet, shift it forward, backward or side to side. For the pilot sitting inside, this bobbing and twisting duplicates forces felt during flight, up to one G over the background force of gravity.

The device is the first commercial helicopter simulator built by Reflectone, a Tampa, Fla., firm that has produced several military helicopter trainers over the past decade. The visual-display system, designed by Rediffusion Simulation Inc. of Arlington, Tex., flashes computer-generated scenes of night and dusk. It can fog visibility with scud clouds reflecting aircraft lights. It simulates lightning bolts. And it can even project the dark form of a truck straying out onto a landing area.

The training is so realistic that pilots require just 2½ hours in an actual S-76 before they are free to fly the \$1,676,000 craft home.



Cockpit, surrounded by a shell, permits visual effects, rides on six moving legs.

Electronics

Stereo on the road

Up to now, most battery-powered portable radio/cassette combos were nasty screamers that could turn Dolly Parton into a banshee—shrill with distortion if you cranked up the volume high enough to cope with the outdoors. And if you traveled more than half an hour away from the nearest FM station, the signal would get fuzzy and fade.

Now, the best portables are approaching sound quality usually associated with home components.

The fanciest portable sound gear ever produced has just been launched by Sony in their new Transound Series. The top model, the XF-5000, comes in two compact pieces. One package consists of two high-quality stereo speakers. But the real surprise is in the other box. Just 9 x 7 x 11 inches, it contains the only amplifier in any portable that works on advanced digital principles. Called a pulse-width modulation amplifier, it's nearly 100 percent efficient. This makes the built-in, rechargeable



This inch-thick TV set has a flat screen, the result of five years of research at Sinclair Research, Cambridge, England. The 4 x 8-inch "Microvision" set will enter pro-

duction in Scotland next year. Inventor Clive Sinclair says the screen will be brighter than similar sets, but will use less power. (About \$115.)

battery last for hours, even at 40 watts per channel. And total harmonic distortion is no more than two percent.

The sensitive FM tuner—tucked into the same unit—has 10 memory presets, automatic scan and manual tuning.

The built-in cassette player features Dolby and automatic tape reverse. The servo-controlled tape

drive (linked to an accurate frequency generator for speed reference) limits flutter and wow to 0.12 percent.

The \$1,495 price tag seems hefty for a portable, but figure it this way: The rig is good enough to double in brass as a home system.

Editor: Gurney Williams ***

Contributors: Tony Assenza, Hans Fantel, John H. Ingersoll, Stacy V. Jones, Harvey Shuman, Neil L. Shapiro

Medicine

Science builds a bone

Until recently, a vet whose jaw had been partially blown away by shrapnel had little chance of looking nor-

mal again. Bone grafts from his own body often triggered complications and corrective operations.

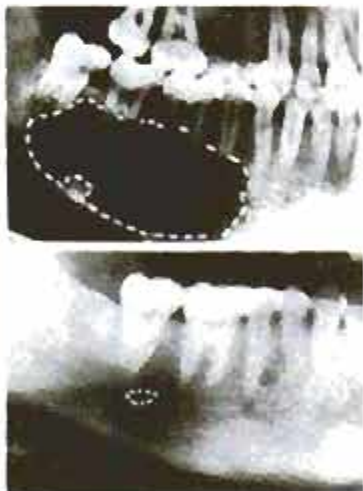
Today, there is hope for him. Harvard researchers have discovered that demineralized bone, removed from cadavers, can generate live bone growth. The lab-produced ma-

terial is shaped to match the natural facial contours. The implant induces cartilage growth, which spurs living bone growth.

Since Dec. 7, 1978, the team has treated 44 patients, repairing such defects as a cleft palate, missing nose and other facial deformities, cranial defects and missing portions of weight-bearing long bones.

Dr. John B. Mulliken, a surgeon and member of the research team, says it's too soon to know whether the treatment has been wholly successful. "But we are hopeful this approach may have application in selected orthopedic cases," he says. The research may solve dental and oral-surgical problems, as well.

To make the implants, researchers cut cadaver bone into pieces or sieve it into powder, and treat it with hydrochloric acid to remove minerals. The presence of minerals would cause the body to absorb transplanted bone. Acid is washed away before insertion in patients' bodies in the form of paste made from powder, chips or blocks.



Harvard researcher Julie Glowacki displays sample of bone material. X-rays at right show human jaw before (top) and after implantation to correct a bone deficiency.

HOW THEY BRING BAJA TO THE 50-YARD LINE

(Continued from page 81)

of dust—and then would wait half an hour for the next car to come by.

Mickey Thompson, a veteran of those early desert-racing days, is considered by many to be the father of modern off-road racing. He says, "I have competed in every form of four-wheel racing and I can tell you that off-road racing is, without a doubt, the most exciting. The only trouble is, no one ever gets to see it."

Baja comes to L.A.

In 1978, Mickey Thompson came up with the idea of building an off-road course for four-wheeled vehicles inside the Los Angeles Memorial Coliseum. This had been done before on a much smaller scale for motocross racing, but nothing on the scale that Thompson envisioned.

There were those who said it could never be done, that the motorcycle track was a joke and the four-wheel track would only be worse, that the amount of dirt needed for such a project could never be brought in for a reasonable amount of money.

Mickey Thompson set out to prove them all wrong. He employed Jim Kitchens, a Los Angeles contractor, to do the actual building of the track. The job seemed monumental, but Kitchens and his staff of 25 (which would peak to 50 people the days just before the race) were up to the challenge.

First, a small model of the Coliseum was built, then Thompson, along with other associates, spent many hours hunched over the plaster replica, with strips of paper substituting for layers of dirt, going this way and that until the track looked right to the promoter, and also to a number of journalists and the actual racers who served as consultants on the track design.

There were a number of problems with the mock-up. Many racers complained that the main straight was too narrow and didn't allow any passing. Thompson had

the track widened to 41 feet at this point, and during the race itself, more than once, four full-sized pickups ran full steam, door to door, down the track.

Other racers and fans complained that the tire barriers used were unsightly and didn't do a good job of protection. Thompson contacted the folks at the Long Beach Grand Prix and rented some of their two-ton cement barriers, which, used in conjunction with tire barriers, can safely stop a race car traveling at 190 mph.

Problem: Racers complained that only one entrance to the turn beneath the Coliseum Peristyle tended to make the competition more of a parade than a race. Solution: Thompson designed four lanes of entry to the turn, resulting in more action on the treacherous uphill portion of the racecourse.

Problem: The sharp curves on the course were too narrow, allowing for little competition. Solution: All the turns were widened, and each turn had a large dirt mound, or berm, in the middle. Choose the inside line and you have to maneuver around a series of tough bumps. Choose the smooth outside line and you'll probably wind up coming out of the turn slower. Result: more action and fast thinking needed on the part of the drivers. When you're whipping a two-ton pickup into a turn from an 80-mph straight, you'd better make the right decision!

Built in a week

With the design approved and ready for construction, the trucks for dirt hauling were lined up and the track builders went to work. Incredibly, it took only one week to build the track, and another week to tear it down, this with 12-hour work days. Still, the building of the track is nothing short of a modern-day construction miracle.

No less than 573 trucks and trailers
(Please turn to page 122)




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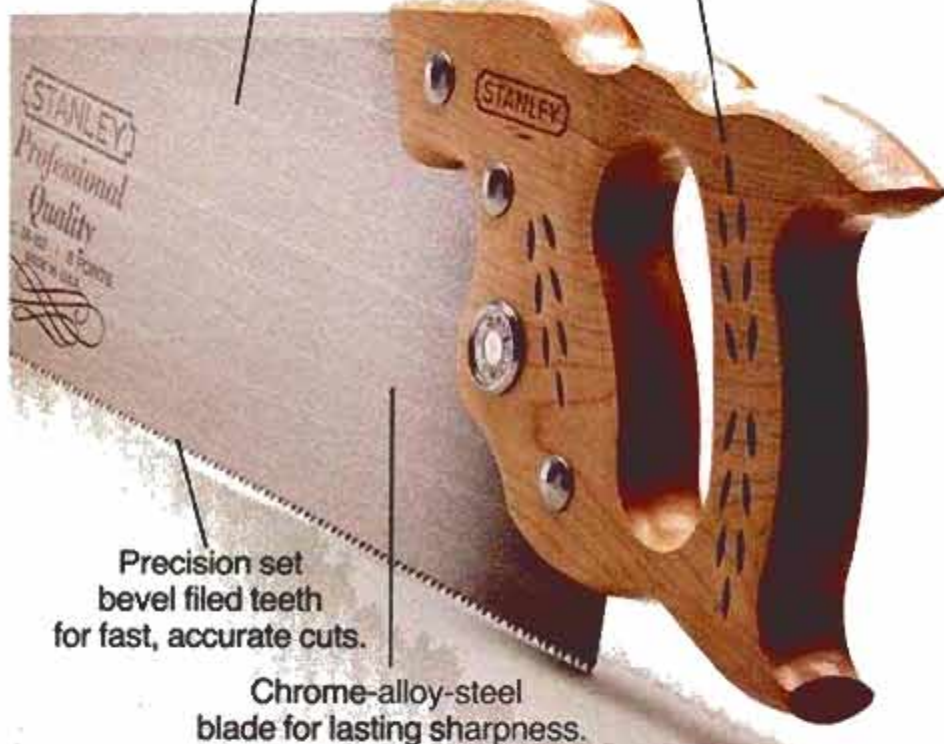
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BRINGING BAJA TO 50-YARD LINE

(Continued from page 121)

were used to haul dirt to the Coliseum from a pit 23 miles away. Why go so far for the dirt? "We needed a special blend of earth that contained a high degree of clay," says Thompson. High-clay content sticks together, and with the clay on top, water put on the track to hold everything together goes to the lower layers of dirt so they stay moist, keeping the track in one piece and preventing huge chunks of dirt from flying off the track. The dirt proved so successful that lots near the Coliseum have been rented, and the dirt is now stored there until next year.

The beautiful Coliseum sod is removed in squares and stored until the racetrack is removed, then the grass is replaced. Along the sides of the track itself, layers of heavy plastic are laid down to protect the nearby field grass. Under all sections of the track, before the dirt is put down, a layer of sawdust up to 6 inches thick is smoothed along the entire length of the course, further protecting the Coliseum turf and concrete from the heavy-weight racers.

In the 1979 opening event, an International Harvester Scout went out of control and crashed into the grandstands. No one was injured (including driver Sherman Balch) because the first 10 rows of the Coliseum were kept empty just for this eventuality. For 1980's event, however, Thompson installed a permanent and intricate set of fencing that runs around the entire Coliseum, a fence guaranteed to keep even the fastest race car or truck where it belongs—on the track, and not in the stands, where it could cause harm.

In fact, in the four-year history of the stadium event, not one spectator has ever been injured. There hasn't even been a close call. And each year, the safety measures get better.

Then they tear it down

Thompson spent an estimated \$600,000 on promotion of this single event. Total cost of the track and fencing for the two-day affair: \$175,000.

Bulldozers are called in for the cleanup job. This takes about a week, and all that sawdust has to be swept up by hand. It is a tedious job, building this track and dismantling it all when the racing is over, but a job that has a certain amount of beauty to it.

"With land for racing getting scarcer and scarcer, with transportation costs for racers going up and up, and with spectators demanding comfortable seating, cold beer and hot hot dogs, stadium racing is definitely the wave of the future," states Mickey Thompson. "What we have designed is a track that can be placed easily into any major sports arena large enough to accommodate it, and there are quite a few arenas of this size throughout the country."

volume available to driver and passengers. Finally, we used a shopping-bag index to measure how many full grocery bags we were able to cram into the cars, without blocking rear vision.

Obtaining all these figures required two full days of track testing. Only then did our "real people" road testers gather at the Tavern-on-the-Green in Central Park early one Saturday morning. We supplied them with clipboards and a rating sheet for each car. This rating sheet had categories for everything from exterior styling to ease of maintenance, including "performance categories" like handling, braking and engine driveability and "comfort and convenience" categories like driving position, interior fit and finish and position of controls.

Each tester had time to inspect a car before driving. Then the testers went off, at their own speeds, the way they normally drive, and covered a five-mile, 20-minute loop on Manhattan's west side.

By the end of the day, each tester had driven each car over the same loop, and filled out his rating sheets. After driving all 12 cars, we asked them to rank the cars in order of preference, from first to twelfth.

Sunday, they moved to the country and did the same routine all over again with fresh rating sheets. This time, the 20-minute loop covered 14 miles, and included four railroad crossings, a five-mile stretch of four-lane divided highway, an uphill start from a traffic light, a downhill 270° hairpin and a 1.5-mile winding road with more hills and corners than the Nurburgring.

The fuel-economy figures are an average of what our 12 drivers attained in approximately 170 miles of driving over all sorts of country roads and speeds.

Finally, when everyone was good and tired from driving for two full

days, we sat them down over dinner, turned on the tape recorder, and started a round-table discussion. The results of our test follow.

Honda Civic four-door

This wasn't a battle, it was a rout: The Honda Civic was ranked first by eight of our 12 testers, and garnered only one score less than third.

What makes the Civic so good? According to our testers, sharp handling, high quality of construction, clean styling and uncanny ergonomic interior design. At the track, the Civic was uniformly average in most areas; eleventh in noise level and fuel economy, eighth in braking and interior space, sixth in acceleration (fuel economy, noise level and acceleration would all have been significantly better if transmission had been five-speed). Where the Civic scored high was on the skidpad and slalom, where it was fastest of all.

Statistics don't tell the whole story. In the slalom, for example, which tests transient handling, the Lynx was second, a negligible tick behind the Honda. But the Honda was far and away the easiest car of the twelve to control. Our amateur testers felt this instinctively. Typical comments were "solid, feels like an expensive sports car"; "excellent road holding, safe and secure"; "nice, stable feel"; "a superb road car."

The Honda particularly impressed the group with its quality. Paint was even, body panels lined up, there were no squeaks and rattles.

The silver metallic Civic came with a matching silver velour interior that one color-conscious tester thought was "too much of a good thing." However, the rest of the group found it decorous and sophisticated.

"Intelligently thought out and planned," is the way one tester described the Honda. When you sit at

the wheel, all the controls fall logically to hand and foot, everything is labeled and nicely harmonized into a convenient cockpit. Honda's designers have brought off an almost impossible coup; making a small car "one size fits all."

The Honda's styling was universally praised by our testers, and after two days of driving, they had only two suggestions for Honda: Increase the rear seat legroom and reshape the front wheelwell to act as a foot rest for the driver's left foot. Lorraine Moscow said it best: "If I were in the market for a small car, this would be my only choice."

Subaru four-door GL

Ours wasn't just any Subaru, but the slickest Subaru you've ever seen. Painted black with polished alloy wheels, it was called "the best looking car in the test" by architect John Machinist. Said Gerard Morinigiello "Excellent styling . . . looks like something costing two times as much." The Subaru was upholstered with a leather-like gray vinyl, and this rich-looking interior was called "as classy as a 320i." Of course, at \$7,445, it was one of the three most expensive cars in the test.

Where the Subaru falls behind the Civic is in chassis engineering. The handling is safe and predictable, but there's too much understeer and body roll from the soft-riding suspension.

The testers who liked the Subaru responded to its elegant interior, "big-car" styling, fully instrumented dashboard, quiet cruising and excellent high-speed ride and handling. Those who didn't like it faulted "hard steering, vibration in the shift lever, sensitive clutch, lack of power, limp gearbox, sluggish acceleration and crummy handling."

Despite these serious complaints, the Subaru was picked as the best car overall by two testers, and was second or third on every other list but one. In other words, the car has some mechanical flaws, but not serious enough to detract from its obvious quality and style. Mary Polinsky had the last word about this elegantly dressed machine. "It's a banker's hot rod," she said.

Volkswagen Rabbit LS

The Rabbit has been the "standard of excellence" since VW hatched this class of car in 1975, but it got surprisingly mixed reviews. In city driving, it was picked as the best car by two testers, but had scores reaching down to fifth and sixth. In country driving, it had two firsts,

(Please turn to page 124)

CHART 2: PERFORMANCE TEST RESULTS

	1/4 Mile Acceleration (sec. @ mph)	Braking 60 mph to 0 (ft.)	Slalom (mph)	Skidpad (cw/ccw sec.)	Interior Sound Level	
					Full Throttle (30 to 60 mph)	Constant (60 mph)
Honda	19.200 @ 68.75	153	54.85	697/717	81	75
Subaru	19.350 @ 69.17	130	52.85	616/663	76	70
Rabbit	18.340 @ 72.81	136	52.27	673/736	76	72
Mazda	18.939 @ 71.25	145	51.87	655/696	80	72
Colt	19.279 @ 69.60	154	54.11	688/717	77	77
Toyota	18.808 @ 70.75	143	49.00	623/644	74	72
Fiat	18.679 @ 72.81	125	51.43	664/711	75	70
Renault	20.319 @ 65.82	156	52.50	642/670	78	73
Lynx	19.458 @ 69.44	137	54.83	673/702	74	72
Chevette	19.471 @ 68.91	183	52.51	681/715	76	74
Datsun	20.139 @ 66.91	155	52.79	660/669	78	76
Omni	18.690 @ 71.88	124	53.44	654/689	75	73

Slalom is speed in mph through seven cones spaced 100 feet apart with an entry speed of 60 mph. Skidpad is measured in G force, with a 105-foot-radius skidpad. Interior noise is measured in decibels.

*cw: clockwise; ccw: counterclockwise

but also a sixth and tenth. In the final balloting, it finished third overall. Only Louis Washington picked it as his favorite car.

The Rabbit did quite well at the track—runaway first in acceleration, second on the skidpad, third in the parking index, fourth in braking, sixth in interior noise, ninth in the slalom and fuel economy. At \$7,355, the LS-optioned, velour interior Rabbit was one of the most expensive cars we had, but only two testers singled out the Rabbit's lux-

urious interior for special mention.

Mixed reviews were the order of the day. Almost every tester mentioned the "spirited performance," "amazing get up and go," and "spritely feel," but almost everyone also complained about "noticeable floor vibration" and "a terrible shake at 55 mph." Handling was described as "like glue on the road," but the seats were criticized because "you sit on top of the seat rather than in the seat."

Nearly everyone criticized the

poor rear visibility caused by the Rabbit's thick C-pillars.

Summing up the Rabbit is tough. The car is a terrific performer, seemingly well constructed and fun to drive, but it's also a bit cramped, uncomfortable, fairly expensive and not very economical.

Mazda GLC

The much-publicized GLC was something of a disappointment. An obvious Civic clone, it shone in only two areas: interior passenger room and price. The stripped base-model GLC cost up to \$2,500 less than cars which ranked behind it. It was strictly average at the track—fourth in fuel economy, seventh in the skidpad and braking, tenth in the slalom, and fifth in acceleration. Our testers ranked it fourth overall, with a row of fourth-, fifth- and sixth-place votes.

The Mazda was consistently criticized for its ride and handling: "much sway and slide"; "torque steer on throttle liftoff in turns; needs stickier tires and rear shocks." Our testers also thought the shifter was "notchy," the transmission "very rough," the body "full of squeaks and rattles, front and rear," and that "there's more road noise than engine noise, but too much of both." They also criticized the seating position because "the pedals are too high, while the wheel is too low."

Some features of the Mazda were especially praised, however. Our testers thought the visibility excellent in all directions, styling clean and pretty, the steering light and precise, the seats comfortable, the instrument panel nicely laid out and the acceleration "snappy."

Dodge Colt

Not as perfectly turned out as the Civic or Subaru, not as snappy as the Rabbit, not as commodious as the GLC, the Colt ended up in the middle of the pack. Its unique Twin-Stick two-speed differential is the best feature, and helped give it the best fuel economy of any car in the test.

The Colt was rather noisy and the brakes comparatively poor, but it handled beautifully on the skidpad and slalom, placing third overall. Dodge's optional Rallye suspension would surely have moved the Colt even higher in the handling tests.

The Colt got mixed reviews from our group, with rankings that range from second behind the Honda to tenth behind almost everybody. Averaged together, though, the Colt ended up in fifth overall. "Aptly named Colt," said editor Bill Frech, "frisky, small and cute, but not com-



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Toyota Tercel

Toyota sells three different cars in this price range—the Corolla, Starlet and Tercel. We chose the Tercel because it's front-wheel drive (like every other car in this test except the Chevette) and more modern in conception.

Our group ranked it sixth overall, but they were seriously divided. The younger, performance enthusiasts dismissed it as "sluggish," but the older, more conservative drivers liked its "style, quickness, peppiness, attention to detail—nice car, suited to today's needs."

The Tercel's day at the track was equally inconclusive. It was shod with Bridgestone tires which howled during gentle cornering and slid during hard cornering. It finished dead last in both the slalom and skidpad. On the other hand, the Tercel was sixth in braking, fourth in acceleration and a surprising second in fuel economy. Providing performance and fuel economy from the same drive train is a trick that no other manufacturer has solved as nicely. Unfortunately, it has no personality—competently unremarkable transportation, neither very good nor very bad.

Fiat Strada

The Strada—now that has personality. Some people were seduced by it—Joshua Colwell picked it as his favorite car of all—and some people weren't. Rankings ranged from Josh's first to a twelfth, for an average of seventh overall. The Fiat does some things incredibly well. It was by far the quietest car, and second in both acceleration and braking. It finished fifth on the skidpad, sixth in fuel economy and was second in the amount of interior space and third in the amount of luggage room. It was also one of the least expensive cars, but had one of the most luxurious interiors. The one place it fell down in was the slalom, where the too-soft suspension wobbled its way to eleventh.

The Strada also has style. Indeed, from its odd circular door handles to its nearly incomprehensible dashboard, it has almost too much style. Once you get it rolling, the Strada is great fun to drive. It also exhibits that "big car" feel on the highway—soft ride, cushy seats, low noise level and a relaxed engine that's barely turning over at 55 mph, due to overdrive fifth.

Collectively, if our testers had some advice for Fiat, it would be to give the Strada a more conventional

dashboard layout, a straightforward driving position, a better shift linkage and a stiffer suspension. They thought the basic shell was both spacious and attractive, and the chassis excellent. The Strada is the most "different" car of the lot, with an overbearing personality that appealed to only a few. But the few who liked it, liked it a lot.

Renault LeCar GTL

The LeCar, like the Strada, has a strong personality. Nobody was lukewarm about it. Averaged together, the LeCar came out seventh

overall in city driving and tenth overall in the country. Some said, "It's great fun in clogged traffic, but out of breath at 65 mph."

The Renault suspension leans so much on corners it feels like it's going to turn turtle at any second, and the tires are so small and narrow, the LeCar has a tenuous grip on the road. It's not a machine to inspire confidence.

The testers who responded to the Renault's Gallic charm really liked the looks. "Inside and out, large sunroof is easy to operate." They also

(Please turn to page 129)

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expectations in the areas of quality and workmanship. Only 68.5 percent rated these aspects "good to excellent"—the lowest score we've recorded this year.

A Georgia claims adjuster: "Average workmanship. Windows aren't closely fitted and air noise seeps in. I have to slam the driver's door to close it."

A California secretary: "The rear seat of our diesel wagon has a large gap between the backrest and cushion, and small items get lost back there. The tailgate shows white spots on the blue interior—an obvious defect that should never have left the factory. Also, one rear door has a decal saying Cutlass LS. Our wagon is the Cutlass Cruiser, and the other three doors state this."

And a Wisconsin secretary sums it up this way: "I consider workmanship to be good, but I think they should check the car out before they deliver it. For instance, my directionals and wipers weren't working. Also, I complained to the dealer about the engine surging. He says it's the torque-converter clutch, but he hasn't fixed it and I'm not sure he can."

The majority of owners—66 percent—considered dealer service good to excellent. That's a relatively high score for both domestic and import dealers.

When we asked owners to suggest

changes they'd like to see, 19.7 percent recommended leaving the Cutlass just as it is.

Some 8.5 percent voted for better fuel mileage and improved workmanship. Others came up with these ideas:



Cavernous trunk is one of the many attributes of the car that Cutlass owners love.

"The trim under the windshield causes a glare at certain sun angles," noted a Georgia painter. "This wouldn't be hard to correct."

A retired Floridian: "Seatbelts get caught in the door because they don't retract properly. The coupe needs better retractors."

A California bridge-toll collector: "The rear windows in the sedan should roll down, even if it's only part way."

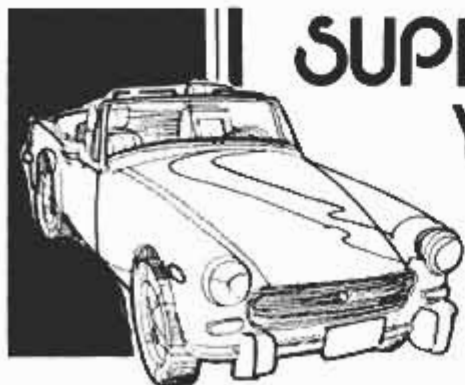
A New York salesman: "The rear seat of the coupe needs more legroom."

A Texas engineer: "The transmission should shift more smoothly."

On the whole, though, Cutlass owners are much more pleased than not. We'd like to offer these unsolicited testimonials in evidence of this.

A Florida naval officer told us, "The Cutlass rides smoothly, handles easily, and is very nice looking. I also appreciate having the name 'Oldsmobile' on an automobile."

An Alabama helicopter pilot: "Ventilation system is great! I like the driving and riding comfort and the fact that there's no engine or road noise. I refuse to buy a foreign car because I want to keep our dollars at home, so for me, this Cutlass represents the best deal for the money."



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A Michigan salesman: "This Supreme Calais rides better than my Cadillac!"

A New Mexico rancher: "My four-door Brougham with the 307 V8 is a great car—economical and comfortable."

A South Carolina mechanical engineer: "I paid a fair price, and the sales people bent over backwards to accommodate me. I bought the Cutlass diesel, and other than a minor oil leak, I've had no prob-

lems. I like this car's styling, mileage, high resale value, and Oldsmobile quality. All doors and trim fit perfectly. It's the best new car I've ever purchased."

A Tennessee salesman: "This is my fourth Cutlass. They've always been great cars—have lots of room, get good mileage and never give any trouble."

A New York bowling-alley owner: "I've always liked Oldsmobiles and one of the

reasons is that they're durable cars."

A Texas administrative assistant: "Best auto in its class for performance, roominess and resale value."

A New Mexico cowgirl: "Best buy for the buck!"

And finally a Wisconsin housewife: "America's number one car for me in every way. I don't know why everyone doesn't buy an Olds Cutlass." **PNB**

SUMMARY OF 1981 OLDSMOBILE CUTLASS OWNERS REPORTS*

Total miles driven	1,075,178	Why did you buy your Cutlass?		Workmanship opinion:		Dealer repairs satisfactory?	
Average miles per gallon		Styling	33.2%	Excellent	28.4%	Yes	55.8%
3.8-liter V6		Past experience	28.1	Good	40.1	No	44.2
In town	18.2	Economy of operation	20.3	Average	20.7	Dealer service opinion:	
Long trips	23.6	Size	13.4	Poor	10.8	Excellent	28.9%
4.3-liter V8		Olds reputation	10.1	Comfort opinion (front seats):		Good	37.1
In town	16.9	Specific likes:		Excellent	56.3%	Average	18.3
Long trips	22.5	Styling	61.6%	Good	35.1	Poor	15.7
5.0-liter V8		Comfort	41.9	Average	7.7	Number of vehicles owned:	
In town	16.3	Handling	31.0	Poor	0.9	Cutlass only	42.4%
Long trips	20.7	Economy	29.1	Comfort opinion (rear seats):		Two cars	41.5
5.7-liter diesel V8		Ride	26.1	Excellent	31.5%	Three cars	10.7
In town	23.0	Specific dislikes:		Good	44.0	Four or more cars	5.3
Long trips	29.5	No complaints	28.4%	Average	20.5	Makes of other cars owned:	
Engine choices:		Needs more horsepower	10.7	Poor	4.0	Oldsmobile	31.8%
3.8-liter V6	58.9%	Mpg lower than expected	10.2	Had any mechanical trouble?		Ford	20.9
4.3-liter V8	30.8	Poor workmanship	7.6	Yes	50.9%	Chevrolet	18.4
5.0-liter V8	3.7	Poor quality of materials	7.1	No	49.1	Pontiac	8.5
5.7-liter diesel V8	6.5	What changes would you like?		What type of trouble?		Cadillac	7.0
Body-style choices:		No changes	19.7%	Carburetor/fuel injection	38.4%	Age distribution of owners:	
Supreme coupes	56.2%	Better fuel mileage	8.5	Transmission	15.2	15-29 years	11.5%
Cutlass sedans	33.8	Improved workmanship	8.5	Brakes	9.8	30-49 years	39.9
Cruiser wagons	10.0	Better materials	7.4	Oil leaks	7.1	50-plus	48.5
		Less wind roar	5.9	Electrical	5.4	Would you buy another Olds Cutlass?	
						Yes	87.7%
						No	12.3

*Percentages might not equal 100% due to rounding or insufficient data.

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still called china around the world. The Chinese built water mills, crank-operated rotary fans to winnow wheat, and a chariot which measured distance and made a mechanical drum beat with each turn of the wheel. Sulfur matches first were used in China, and it was a Chinese who first darkened a room and experimented with a pinhole of light to discover the inverted image. A Chinese invention created a piston operated by a crank to open and close mechanical bellows for metalworking, and a system of toothed cogs and gears that later was put to use in Western steam-powered engines.

The ancient Chinese liked to be comfortable, and automatic fans operated by water power cooled the rooms of the well-to-do and the nobility. The Grand Censor Wong Hung (8th century) lived in the Lodge of Artificial Rain, where water was directed on the roof of his entertainment hall to keep away the heat of summer. Meanwhile, the emperor's "Cool Hall" depended upon rotary fans to stir the air, screens to keep out the sun, fountains in each corner to shoot sheets of water up the walls, ice under the benches and even an occasional rumble of thunder to make his imperial majesty think that it was a cool rainy day.

The Chinese also were clever at fashioning mechanical toys. In 200 B.C. the emperor possessed a mechanical orchestra, consisting of 12 bronze robots that played music on lutes and guitars. One inventor created an ingenious mechanical man who was put in the marketplace. There he held out his hand and cried, "Alms," and on one day alone, according to the ancient chronicles, over a thousand people handed him coins.

The great sea of the air also attracted the Chinese. In the 6th century Emperor Kao Yang had prisoners dragged to the Tower of the Golden Phoenix and "flew" them attached to paper kites. Most plummeted to their death, but later, one Yuan Huan-Thou flew on a kite for a distance of about a mile and a half. When Marco Polo visited China in the 13th century, he found that kites for lifting men were commonplace. One Chinese general flew his observers attached to kites over the enemy's fortresses to spy upon them.

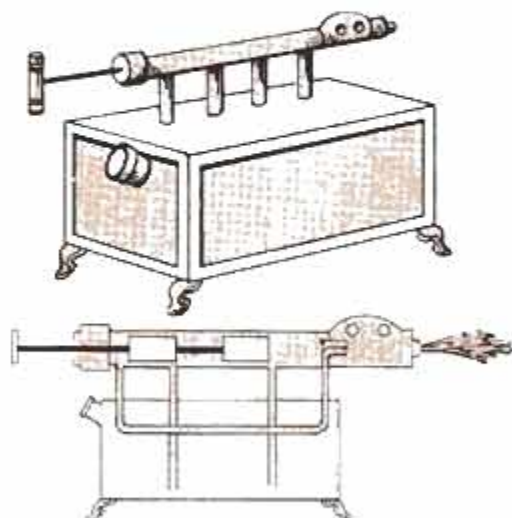
Early Helicopters?

As early as the 3rd century the so-called Chi-Kung people were reported to ride in aerial cars propelled by a wheel or rotary blade. Since these people were also said to be hermaphrodites and to possess three eyes, this report must be taken with considerable skepticism. However, writing in the 4th century, Ko Hung described in detail how to make a flying car with rotary blades, similar to those on today's helicopters. The Chinese never managed to create a source of power that was mobile enough to make the device work, but when Orville and Wilbur Wright flew at Kitty Hawk, N.C., they were employing adaptations of two very old Chinese inventions—the kite wing and rotary blades.

Given the diversity and ingenuity of Chinese invention through the ages, it would seem that once the dead hand of doctrinaire political theory is lifted from China, science and technology will flourish. Fang Yi, vice premier and current minister of science and technology, says his country expects to catch up with the United States by 1985 and surpass us by 2000. This is the claim,

but what is the reality beyond the bravado?

Today China is far behind the West in physical sciences and computer technology, but is not too far behind when it comes to the biological sciences. In the nation's middle schools, the natural sciences and mathematics are being given a new emphasis, and the best students aspire to become physicists. (Meanwhile, less than 50 percent of U.S.

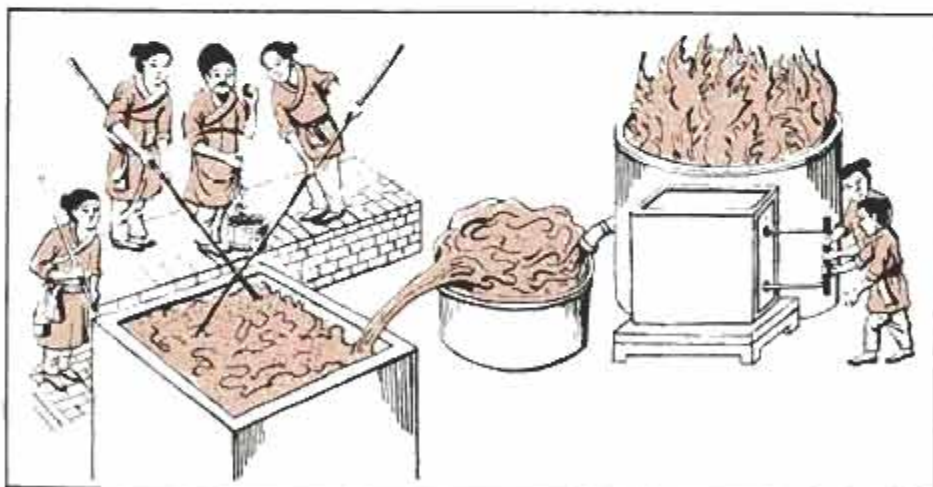


While stirrupless Saxons were losing the Battle of Hastings, Chinese armies went into battle with naphtha-fueled flamethrowers using double-acting pumps (by the 11th century, Chinese cavalry had been using foot stirrups for 1,000 years).

high schools now offer a physics course.) This may well alter the picture by the time a new generation takes over. The Institute of Biochemistry in Shanghai has done some important, internationally recognized work in molecular biology, and the Chinese study of cancer has impressed Western cancer researchers. On another front, the Chinese do not favor chemical overkill in dealing with agricultural pests. They have learned to employ mites, parasitic wasps and viruses to eliminate them.

In the field of chemistry, petrochemical studies and work on polymers have been impressive. In physics, the most significant Chinese work is on lasers and solid-state devices. The Chinese also have developed advanced high-temperature alloys, rare-earth metals and salts. Their technicians are making semiconductor materials, including silicon crystals, of excellent purity.

All of this is promising enough, but if China is to pull even with the West, the nation must steer clear of the political excesses of the last generation. As Science Minister Fang Yi remarked on his visit to the United States, "Virtually everything remains to be done." **PM**



"Puddling" method of producing wrought iron was used in China 2,000 years before its development in Britain. Note double-acting piston bellows charging the smelter.

PM'S REAL PEOPLE ROAD TEST

(Continued from page 125)

mentioned the "easy-shifting gearbox and comfortable seats" and said, "light, feels like a baby car." Those who didn't like the Renault, *really* didn't. To the question "what features do you particularly like" we got the answer "nothing at all." Another tester answered "features you particularly dislike" with "the car." Graphic designer Jean Constantine summed up the whole dilemma. "Fun, like a toy," she wrote, which depending on your interpretation, is either a compliment or an insult.

Mercury Lynx RS

Ford's \$3-billion World Car was a stunning letdown. At over \$8,000, it was the most expensive car in this test by \$600, and the most recently designed. And yet the highest score it received was a seventh overall, with a disappointing run of ninths and elevenths.

Our test Lynx had the full-tilt, RS, heavy-duty suspension with expensive Michelin XZX tires. It wallowed to sixth on the skidpad, almost solely on the strength of these sticky tires. A white-knuckle run at the ragged edge of good sense forced it into second in the slalom, but the under-shocked, softly sprung Lynx was more of a handful than any other car except the Renault.

Virtually every one of our testers remarked on the Lynx's suspension. Their comments included, "very mushy, seems front-heavy"; "poor cornering"; "soft suspension" and "I didn't like driving it."

Our testers complained that their knees hit the steering wheel, that the rear seat was quite cramped and that the shifter was wobbly. The engine came in for repeated complaints: "engine vibrates on acceleration," "rough and noisy idle," "lacks acceleration uphill," "low on power," and "no guts." But they also liked some features, especially the comfortable front bucket seats ("better than the ones in my Volvo," exclaimed one admirer), the generous headroom, the sporty exterior styling and the easily read dashboard.

Perhaps some Ford product planner would like to answer Malcolm Davies. "Why," he asked, "if this car looks so great, did it turn me off so completely?"

Chevrolet Chevette

Like the Tercel, the Chevette has very little personality. Like the Rabbit, it seems old-fashioned, with

(Please turn to page 130)

AQUA DRILL

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PM'S REAL PEOPLE ROAD TEST

(Continued from page 129)

small windows and a cramped interior. Like the Lynx, it is defiantly American, with color-coordinated plastic accessories given more emphasis than quick steering. Like the Renault, it's slow, noisy and comparatively uneconomical. Perhaps as a result, General Motors' first World Car ranked low in the eyes of our testers, eliciting neither love nor hate. They simply ignored it and voted it a lackluster tenth overall.

At the track, the Chevette was equally bland. The rough and noisy Chevette engine huffed and puffed to tenth at the dragstrip and slid to last overall in braking.

Our testers' reports are an unrelied string of complaints that make dreary reading. "The worst sort of American junk, all too tinny, cheap plastic and fake chrome" was a typical comment. "An extremely dated car by today's standards," said another, "a Caprice Classic, Jr." Louis Washington had the final word. "Frankly, I had the feeling I was in an unsafe vehicle."

Datsun 310 GX

The Datsun 310 is proof positive that even the Japanese can make a mistake, which ought to bring a glint of cheer to the otherwise gloomy halls of beleaguered Detroit. Like its rival, Toyota, Datsun offers three econoboxes: the 210, 310 and 510. We chose the 310 because it is front-wheel drive. Datsun optioned a five-door hatchback up to \$7,300 and it buzzed into eleventh place.

Our testers felt little mercy. "This bomb will do more to restrict Japanese imports than any legislation," said Louis Washington.

The 310 isn't hopeless. It scored an excellent third in fuel economy; it also has the fourth largest interior and the fifth largest luggage space.

Dodge Omni Miser

Our testers loved a few cars, were indifferent to others, and disliked a couple. But the Omni they truly *hated*. In a marvelous show of unanimity, the Omni received nine twelfths and three elevenths to nail down last place; it was no contest. Why? Why did the group universally detest this car?

It is moderately priced, only the sixth most expensive. It has average luggage and passenger room for this class, finishing eighth and seventh, respectively. It has terrific brakes, winning the brake test (though since the ones on this car weren't power assisted, they required a lot more leg muscle than the average driver is

used to—or capable—of providing).

The Omni is also relatively quiet, finishing fifth, and very fast, finishing a strong third at the drag strip. Alas, the misnamed Miser was last in fuel economy. In the handling tests, the Omni was eighth on the skidpad and fourth in the slalom. But mostly, this slalom performance was due to repeated efforts by a professional driver to trick the Omni's wallowing suspension into drifting around the pylons on the very edge of control.

Our testers had little good to say about the Omni Miser. A typical rating sheet lists "nothing at all" for "features you particularly like." Lorraine Moscow was one of the few who tried to find something nice to say. "The radio is really very good," she said. "Perhaps Chrysler could try the electronics field instead of building cars."

What we learned

Lesson One: The Japanese are the leaders in small cars—and with good reason. Their cars are generally better built, better engineered, better styled, more nicely appointed and lower priced than the competition. That's a combination that's hard to beat. Our test group uniformly preferred the cars from Japan.

Lesson Two: The idea that American drivers prefer cars with a soft ride and mushy handling is a myth. Our typical American testers uniformly preferred the cars which had the tautest, most "European" handling.

Lesson Three: Good tires can mask a multitude of suspension woes. The Toyota Tercel's basically good chassis was undermined by terrible tires; the Mercury Lynx's basically terrible suspension was made acceptable, if not perfect, by fitting high-performance Michelin XZX tires.

Lesson Four: For most people, the best of these small economy cars will perform every function that they require from an automobile, without compromise. These cars are completely competitive, even when compared with much larger machines that cost much more.

Lesson Five: The American car companies are in trouble not because of any outside forces, but through their own fault. Police chief Louis Washington put it best. "I'm an American," he said. "I'm a veteran and an old-fashioned patriot. I want to like American cars, but in good conscience, I can't bring myself to recommend them. They simply aren't as good." And that is the most important lesson of this road test. Let's hope that Detroit learns it before it's too late.

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GETTING AN EDGE

(Continued from page 83)

you must push the file forward against the sharp edge. Don't try to make a stroke using the full length of the file's cutting surface. That puts your hand too close to the edge of the knife or ax. Apply pressure during the forward stroke only, unlike sharpening a hook. Dragging the file back across the edge you're trying to sharpen will only dull it. Lift the file off the blade completely until you're ready to start the forward pressure stroke. Apply only enough pressure to feel the file cutting the metal evenly. Too much pressure may clog the file's teeth.



Versatile rectangular file, with short strokes to keep fingers away from blade, sharpens knife quickly. Oil against rust.

With a stone or file, count the number of strokes and use an equal number on each side of the blade. If possible, watch an expert like Al Buck, famous for his Buck knives, demonstrate sharpening at a sportsman's show. Note the thin angle he holds between blade and stone. It may appear that he uses a back-and-forth motion, but actually his pressure stroke will be as the blade cuts toward the stone; pressure is relieved and the blade floats back on the return stroke.

Only water is likely to damage a file seriously. If it's put away wet, rust is certain to appear in a few days; salt water can cause rust overnight. Some anglers make a simple leather sheath for their file, and keep this well oiled.

I do the same with the sheaths for my tiny ignition-point files, and have found I can usually get a full year's use out of each one this way.

In an emergency, you can sharpen a soft-steel knife or ax somewhat with a lot of things. Try a hand-sized flat rock, a brick or a chunk of concrete if nothing better is available. But for the sharpest—and safest—results, use a Carborundum or Arkansas stone for basics and pack away a file right now for knives and hooks afield.

PM

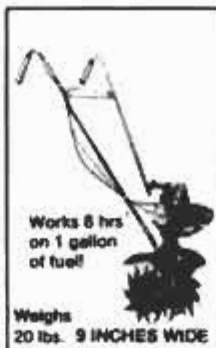
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5 energy-saving ideas from readers

Humid-climate control

My large refrigerator has a control for humid and dry climates. Since I live in Florida, I've always kept the setting on the humid-climate side. However, after carefully monitoring my daily watt usage, I found that using the dry-climate setting saved quite a bit of energy with little or no moisture buildup on the outside of the refrigerator.

I discovered that on the humid-climate setting, a small heating ele-

ment heats the cabinet to prevent moisture accumulation. Not only was I using energy to heat the external walls, but probably more energy was needed to keep the interior of the refrigerator at an appropriate temperature.

Incidentally, one week of daily meter reading and an electric-use diary helped me become more aware of places I could conserve energy.

—Gail Meadows, Brandon, Fla.

Extended swimming-pool season

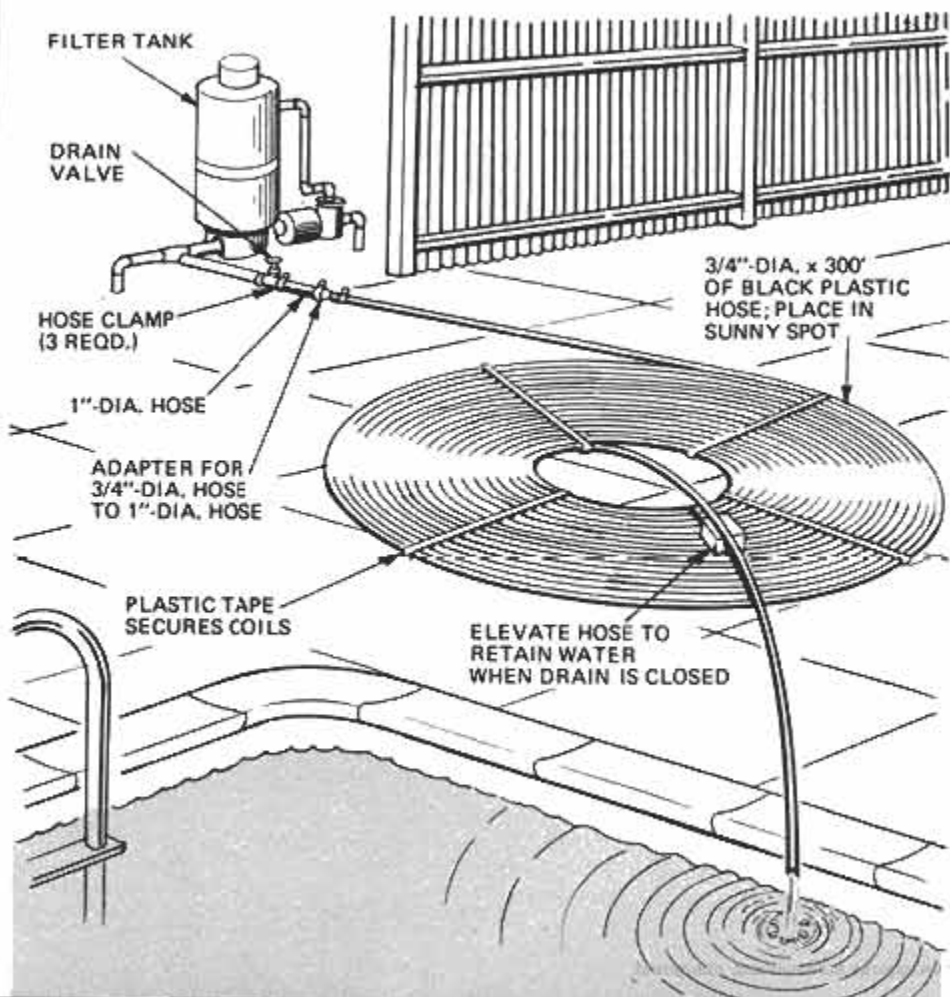
After noting how hot the water gets in a garden hose lying in the sun, I applied the same concept to heat my swimming-pool water. The homemade water heater allows an extra month of swimming in the fall and up to six weeks more in the spring.

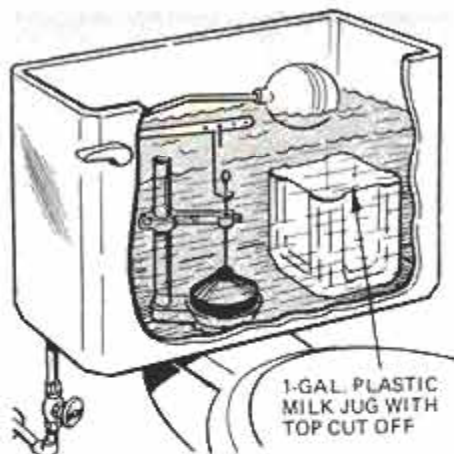
I use 300 ft. of 3/4-in. black plastic hose, commonly used for sprinkler systems. Wind the hose in a flat coil and place in on the pool decking to get maximum exposure to the sun. Connect the hose to the pool drain pipe with short lengths of larger

hose, adapters and clamps. (Total cost is about \$25.)

Leave the drain valve open when the pool pump is on, sending water through the hose where it is heated and returned to the pool. Elevate a portion of the hose near its end so that when the pump is off, water will remain in the hose and not vent air back into the system. On a sunny day, water running through the hose is warmed 4 to 6°F, and the pool temperature increases about 3°.

—Wes Kurtz, Fort Lauderdale, Fla.





1-GAL. PLASTIC MILK JUG WITH TOP CUT OFF

Toilet-tank water saver

Cut the top off a 1-gallon plastic milk jug and submerge it in a toilet tank as shown. Trim the jug's top to achieve the right displacement. This cuts down the amount of water used when the toilet is flushed.

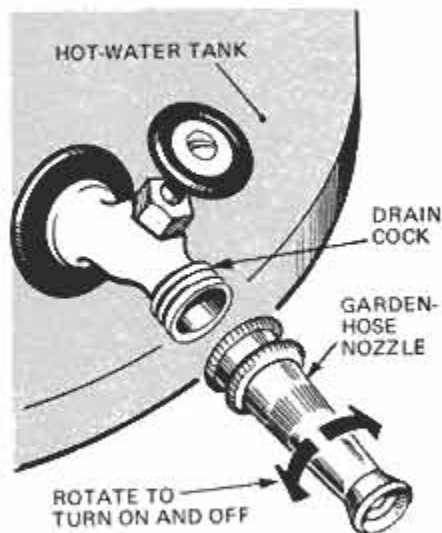
—Mary Heerema, Milford, Conn.

Less is more

Shades for our 72-in. windows are expensive. I've cut costs by buying only half as many shades as I have windows, plus two pairs of brackets per shade. I've put brackets on all windows. In winter, I put the shades on the north-side windows to seal out drafts. In summer, I move the shades to sunny windows.—Jane C. Scarborough, Titusville, Fla.

Nozzle stops drips

I liked the idea of plugging the drain cock of a hot-water tank to stop wasteful drips. (See *5 Energy-Saving Tricks That Work for Our Readers*, page 196, Nov. '80.) However, I stop these drips with a garden-hose nozzle that can be turned off. They're sold in hardware stores and garden centers.—Vince Musiorski, Mount Prospect, Ill.



Share your home energy-saving ideas. PM will pay \$25 for each published idea. Include sketch or photo, if necessary, and a stamped, self-addressed envelope if you want unused material returned. Send to Energy-Saving, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019

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Build this panoramic photo stand

Take snapshots as wide as the open sky, as encompassing as a full circle. Here's how to take real panoramic photographs.

by Fred Hartz

Spectacular panoramic pictures—even covering a sweep of 360°—are easy to take when you mount your camera on this pivoting platform. You can build a platform identical to the one here, or use it only as a guide to create your own design. The only critical measurement is locating the optical center of your own camera's lens. Details on that follow.

Overlapping sections

The platform lets you take a series of photographs that can be mounted side by side. As each photo is taken, the platform is rotated a few degrees for the next shot, and this is repeated until the entire scene has been captured.

Each photo in the series is made so it slightly overlaps the scene recorded on the previous photo. To show the entire scene, the photos in the series are overlapped so they form a composite image.

Once the photos are lined up and held lightly in place with masking tape, the overlapping areas are cut out so you don't get a double thickness of print paper when you mount the photos. The cuts should be made irregularly—sawtooth or wavy—so as to hold better and be less visible. After the trimming, the tape is removed and the pieces of the scene are butted together and cemented as a unit on a suitable backing.

The most important thing to remember when building the platform is that the camera should rotate around the *optical* center of the lens—not at the tripod socket or the

lens's physical center. Otherwise, your panoramas will be distorted.

Locating the optical center

Refer to our diagram and note that the aiming disc's center is the point your camera pivots above. The sliding camera platform allows you to position the camera lens precisely above this point, and adjusts for lenses that have different optical centers. (The optical center is determined by a lens's focal length.)

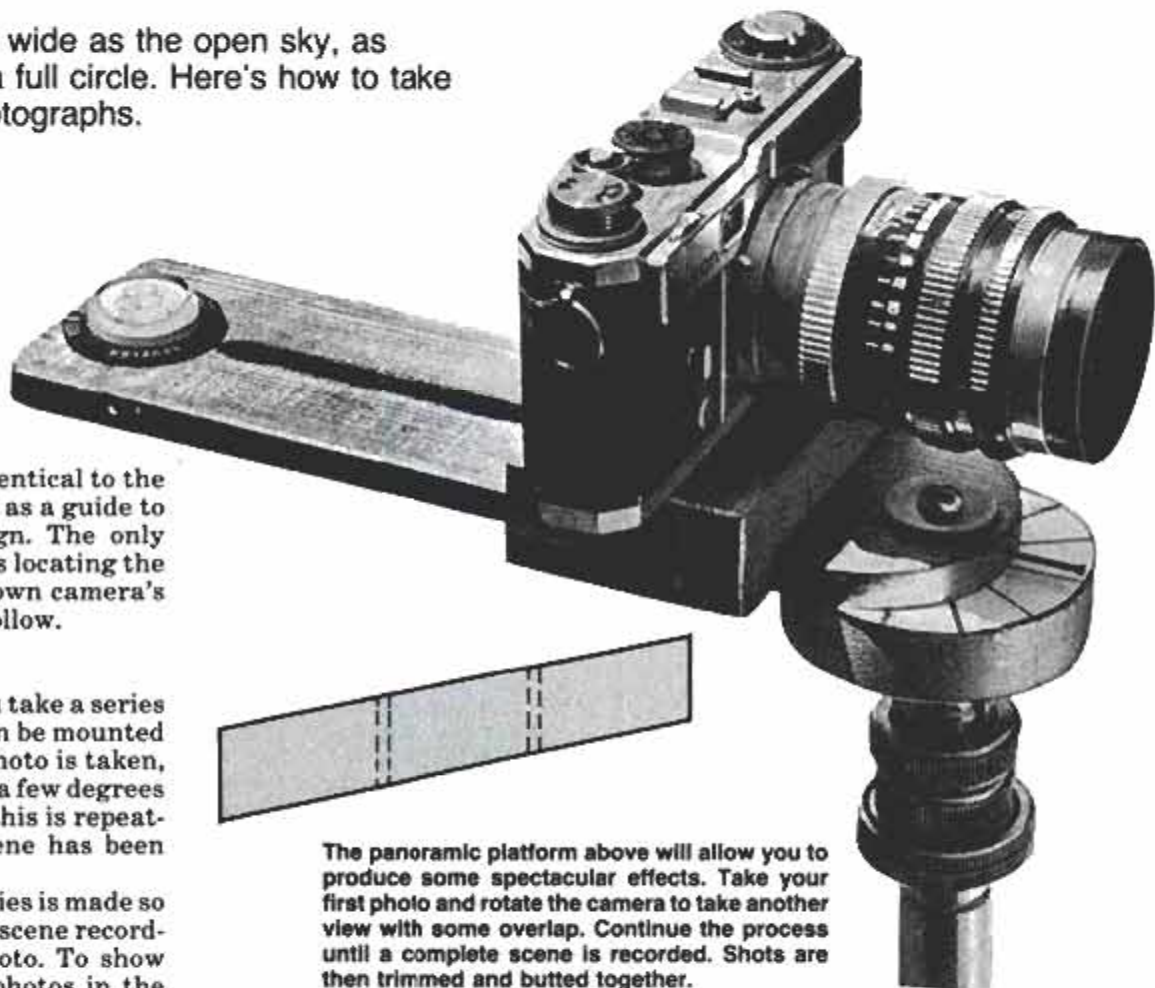
For each lens you will use, you must calculate its optical center. First, set the focus at infinity. Then find the film-plane mark on the camera body (a circle with a slash

through it is usually engraved at the film-plane point). Using a metric rule, measure from this mark to a point on the lens barrel that is the same number of millimeters from the film plane as the focal length. For a 55-mm lens, you'd measure 55 mm from the film plane and mark that spot on the lens barrel.

Once you have marked the lens's optical center, just position the camera atop the sliding platform. Move the camera back or forth until the mark on the lens is directly above the center of the aiming circle.

The platform need not be as long as we show if you will not be using

(Please turn to page 136)

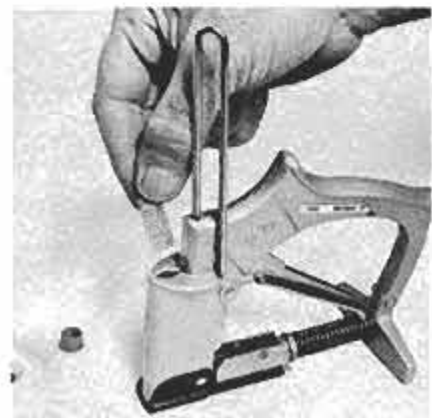


The panoramic platform above will allow you to produce some spectacular effects. Take your first photo and rotate the camera to take another view with some overlap. Continue the process until a complete scene is recorded. Shots are then trimmed and butted together.

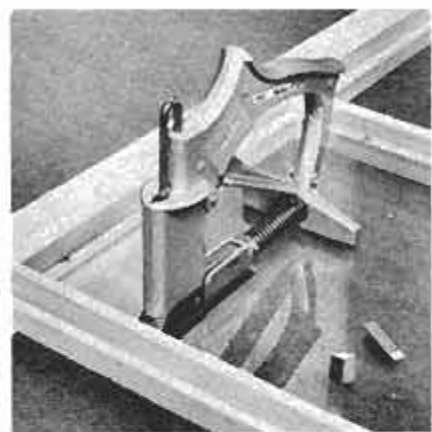
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A light squeeze on the handle is all it takes to drive glazier points with Red Devil's point driver. The 1/2-in., zinc-coated points are automatically inserted to the proper depth and hold fast if the window frame is in sound condition.

Although the point driver has been available for some time to professional glaziers and picture framers, it is now being offered to do-it-yourselfers. This move is based on the maker's claim that



To load the magazine with the points, lift the feeder rod and swing it to one side.



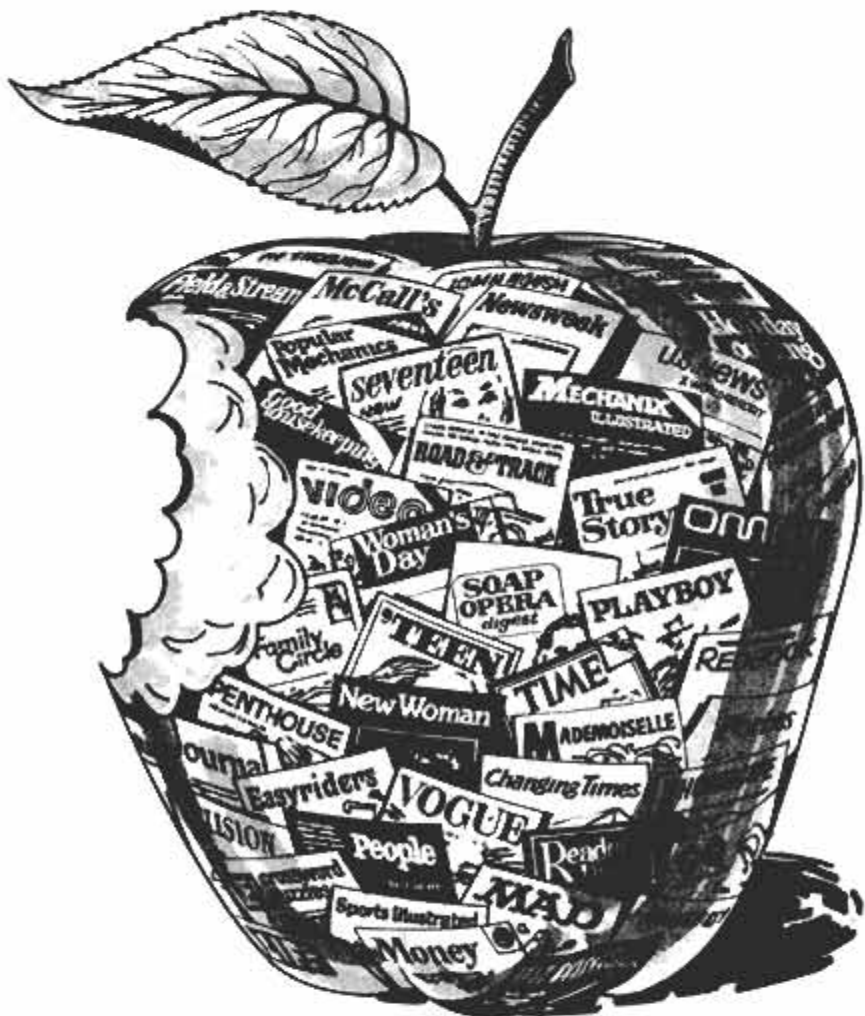
Point driver makes glazing lots easier.

window glazing and picture framing are simpler and safer projects when you use the point driver.

The Model No. 1602 point driver, priced at \$49, including a starter set of points and operating and loading instructions, is available at hardware, home-center and art-supply stores. Red Devil Inc., 2400 Vauxhall Rd., Union, N.J. 07083, makes it.

—Rosario Capotosto

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Car stereo: Three you can install

Here are the problems—and how we solved them.

Alpine 7308 in an Escort

Installing Alpine's 7308 AM/FM stereo tape deck in a 1981 Ford Escort was by no means an easy job. Many of the problems we encountered were caused by working in tight quarters—other problems are common to even the larger new cars.

The 7308 is one of the new auto-sound units that can make your car sound as sharp as a good set of living-room components. A limited-edition model, this unit gives you just about everything for its price tag of \$799.95. (Since it's a limited edition, the 7308 is not often discounted.)

One button lets you scan the radio dial, station by station. When you hear music you like, another push of the button stops the scanning. Or you can store six AM and six FM stations in memory. There is also a music-sensor button. When this is activated, the cassette tape can rewind or fast-forward automatically to the beginning of a song. The unit also includes features like Dolby noise reduction and an optional connection for an automatic power antenna.

We decided to boost the 7308's pre-amplifier power with an Alpine 7002 40-watts-per-channel afterburner amplifier. And we selected Epicure's LS-35 speakers for the front and its LS-70 speakers for the rear.

That's a lot of sound gear to fit into one tiny Escort. The first problem arose when it was time to cut the holes in the door panel, where the front speakers would be mounted. Usually, the panels are cardboard. The only problem we've ever had in installations on older cars was locating the hole so the speaker magnet wouldn't interfere with opening and closing the window.

We used a supplied template to mark the circle and tried to cut it out with a utility knife. Surprise—a thin sheet of tough metal shielded the entire door opening beneath the cardboard. Apparently, most '81



The Alpine 7308 offers such features as automatic scanning and a music-sensor switch.



When installing front speakers in car doors, check that the wiring is of correct polarity, and make sure that speakers do not interfere with the window-cranking mechanism.



EPI model LS-70 speakers in rear could mount flush or on top of trimwall. We used template supplied to mark out mounting hole for an on-top installation (inset).

Plastic trimwalls are difficult to cut with a knife. To make the job easy, we used a soldering gun (with a throwaway tip) to cut a circle in the plastic by melting it.

cars now have this metal obstacle. We were lucky enough to have access to a power nibbling tool, which saved us a few hours of manual nibbling.

Next step was to mount the rear

speakers on the left and right rear trimwalls. The trimwalls are made of a tough, resilient plastic—a knife here would make about as much sense as a fork. But some friends at

(Please turn to page 140)

NEXT MONTH IN PM

- **Aerodynamics shape the new car designs.**
- **Deep-dive simulations put human subjects under record pressure.**
- **Preview: Ford's lineup for '82.**
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CAR STEREO

(Continued from page 138)

Audio Breakthrough in Manhasset, N.Y., showed us a neat trick to cut this plastic.

Heat up a soldering gun (with a tip you can discard afterward). While it's heating, use a template to mark the size of the mounting hole. The soldering gun's tip will melt through the plastic like a hot knife through butter.

If you're installing speakers in nonplastic rear decks, you'll probably have to cut the cardboard that's over holes precut in the sheet metal. In an older car, you may have to cut holes in the sheet metal, too.

Installing the 7308 chassis would

have been simple in the Escort's roomy radio compartment, but Ford seems to have gone out of its way to create difficulties for the home installer. The radio must go in through the back of the dash—you can't pop a unit out of, or through, the front.

When we got the old radio out, we realized that the 7308 wasn't going to be a perfect fit. Ford uses a permanently mounted front plate with a number of interior protrusions. But careful work with pliers and knife cleared away the excess plastic and, at last, the new radio was seated in the compartment.

The power amplifier came next. We could have placed it on the fire wall, but the Escort has removable front seats. So we took out the pas-

senger seat and installed the amplifier on the floor, where it would be hidden once the seat was reinstalled. (The Escort is also roomy enough beneath the seat so that there is adequate airflow around the amplifier.)

Routing the wiring was the next stage. The main thing here was to be as neat as possible. We cabled and ran wires from the rear speakers under the rug in a wiring channel to the amplifier. We snaked the wires from the door speakers under the rug to the amplifier, making certain enough slack was left to permit the car doors to open and close. Finally, we ran the 7308 preamp's wires to the amplifier.

The only thing left was to install



Remote-control scanning of AM/FM stations with handheld switch is one feature of 3001. Saab saves you job of installing front speakers: They're built into top of the dash.

Blaupunkt 3001 in a Saab

Installing Blaupunkt's 3001 AM/FM stereo, autoreverse cassette player in the dash of a Saab 900 (1979 EMS model) is especially easy. The dash is already cut out for the radio chassis, and two good speakers are standard equipment with the car. They're mounted under the dash at the factory. Sound radiates upward and reflects off the windshield (right speaker grille is on top of dash in photo above).

First, position the 60-watt power amplifier close enough to connect to the radio. We chose a fire wall spot, as shown in the photo at right. From the amp, run speaker leads up to the dash speakers and snake two other wires back under the carpet to right and left rear speakers.

The 3001 is an electronic wonder, with automatic signal seeking, digital display of time and station frequency and memory presets for six AM and six FM stations. Discounted price (don't pay the \$630 list price) shouldn't be much over \$500.

Connections at the rear of the chassis—in addition to the usual 12-volt fused

lead, ground, antenna plug and output cable to the power amplifier—include an electric antenna connection (to raise and lower the antenna automatically when the radio is turned on and off), a plug for a wire-connected remote control for station selection and cassette reverse and a second 12-v. fused lead that must be connected *ahead* of your ignition switch. That way, power is always supplied to the digital clock and station preset memory circuits, so time and favorite stations aren't erased when you turn off your ignition.

If you're not using an electric antenna, tape the wire to the back of the chassis, where it will be out of the way. The Saab provides a 12-v. lead for the radio, situated at the right place behind the dash, that is connected *after* the ignition switch. Finding a 12-v. pickup spot *ahead* of the ignition, however, is time-consuming. If you've never explored behind your dash, allow several hours for the installation.

After you slide the 3001 chassis into the dash, you may have to shave the plastic



One B+ lead connects ahead of ignition, since clock and memory need a steady 12 v.



Connections on 60-watt power amplifier include outputs to four speakers (15 watts per channel). Best location for amp is on fire wall, high in passenger-side footwell.

faceplate for proper fit. Then, mount the remote-control switch holder in a convenient spot for the front passenger to use. From there, it's just a buttoning-up job before you get to use your high-tech sound system: Set hours and minutes on the clock, preset favorite stations, switch in Dolby and equalization and bask in 15 watts per channel of really super sound.—Bill Hartford

the capacitors, which would act as a crossover for the front speakers. Most of the power would go to the big rear speakers. The little ones in the doors were to be used just for mid-range fill. Attaching the capacitors took only a few minutes.

We placed all the speakers in their mounting holes and connected the speaker leads. To ensure polarity, we made sure that the positive and negative leads were in the same arrangement for each speaker. A mistake here would set the speakers out of phase. When speakers are out of phase, one speaker's cone may be pushing air out, while another's cone is moving in. Rather than reinforcing each other, out-of-phase speakers fight each other.

Since we didn't install a power antenna, we had to hook up the hot lead of the 7308 to an unused outlet

located on the Escort's fuse box. When we turned it all on, the sound washed over us in great, bassy thumps and sky-reaching highs—the likes of which you seldom hear in a car.

But, as loud as it was, we knew we were in no danger of blowing the speakers—EPIs are rated for even higher power. When you plan your own installation, use speakers that can stand the heat. Nothing is more annoying than ripping out an installation to replace a blown-out tweeter or shattered woofer.

At first, we felt that 80 watts of sound would be more than enough for four speakers. But now, we think we'll put the front speakers on their own amplifier, too.

After all, a car shouldn't stop shaking just because it's standing still.—Neil Shapiro

Panasonic in LeCar

Working in the tight confines of a Renault LeCar didn't overcomplicate this installation. Our Panasonic CQ5900 unit went into the car in a little over an hour.

This job went smoothly because the car's radio console is essentially a plastic tray which bolts to the bulkhead with two nuts. Once we removed the nuts, we took out the entire console and removed the original radio.

Panasonic's installation kit provided all the hardware necessary to complete the job. Unlike some other installations, it wasn't necessary to fabricate any pieces.

The new radio's bezel fit perfectly into the existing space. All we had to do was shift the volume knob $\frac{1}{8}$ inch. Both shafts can be shifted in $\frac{1}{8}$ -inch increments.

Wiring up the unit was also simple. This programmable radio with a built-in clock needs a permanently hot connection to keep the memory and clock working when the ignition is off. We simply routed the hot lead to the fuse box and wired it into the headlight circuit. We wired the switched power source into the ignition switch with a solderless connector and hooked the ground lead to the bolt which holds the console to the chassis.

We mounted two speakers in the removable panel in the rear (LeCar is so small, we didn't install the usual front and rear pairs). The rear panel is made of a stiff cardboard material which was cut easily with a utility knife to accommodate the speakers. Then we drilled four holes for the retaining bolts. We routed the



Panasonic CQ5900 AM/FM stereo cassette player fits into plastic console on center "tunnel" in LeCar. Rear speakers are mounted in panel with retaining nuts (below).



speaker wires under the front carpet, along the bottom of the rocker panel and into the rear bulkhead.

The 80-watt unit retails for \$449.95 with four speakers. Most mass merchandisers, though, will sell the CQ5900 for around \$350.—Tony Assenza

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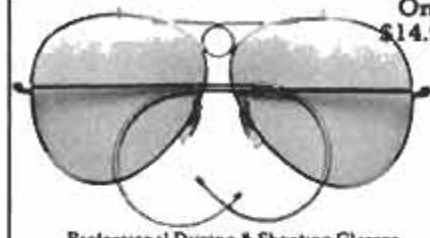
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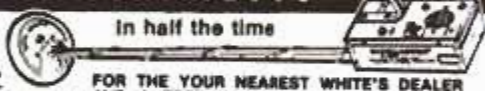
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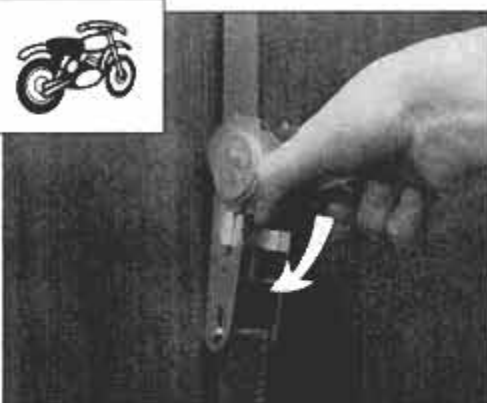
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THE BRAIN VS. THE BURGLAR

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, separating the two, the transmitter sends a signal to the console which sounds an alarm to scare away the burglar. Installation takes only a few moments & 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.

HERE'S HOW TO ORDER

To order simply send your check for \$199.95 plus \$4.50 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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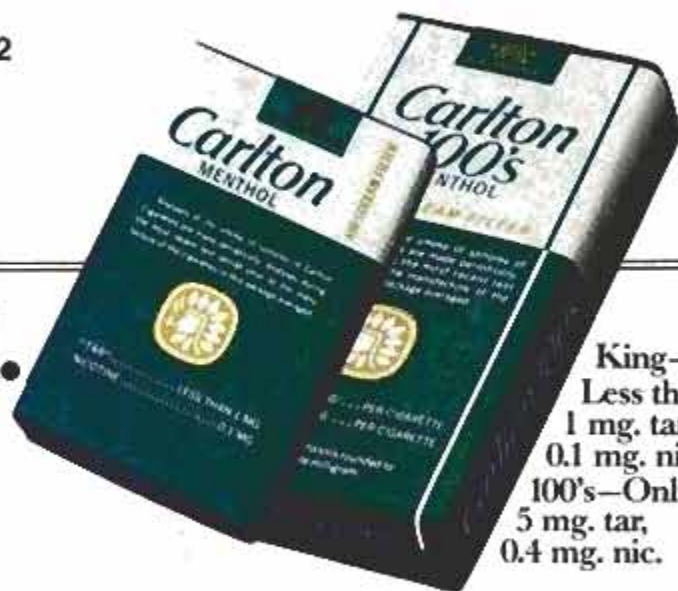
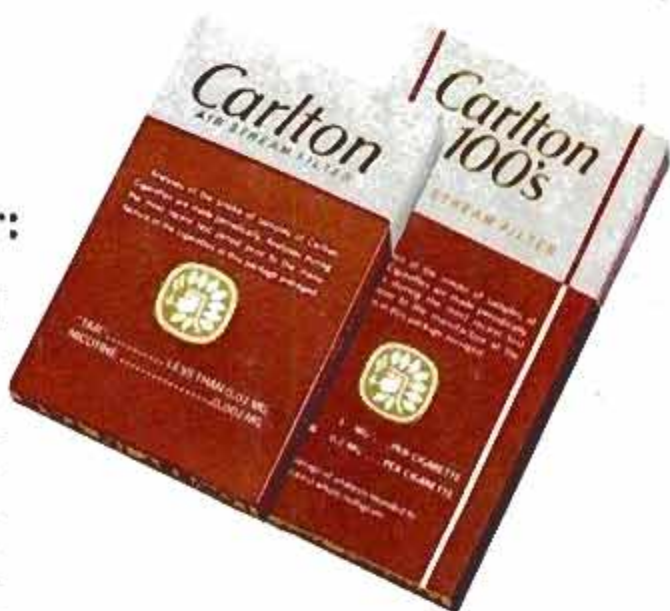
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