

MARCH 1992 \$1.95

# Popular Mechanics



**SNEAK PREVIEW  
OF A GREAT  
NEW EXHIBIT**  
"Possible Dreams:  
90 Years Of  
Popular Mechanics  
And America's  
Enthusiasm For  
Technology"

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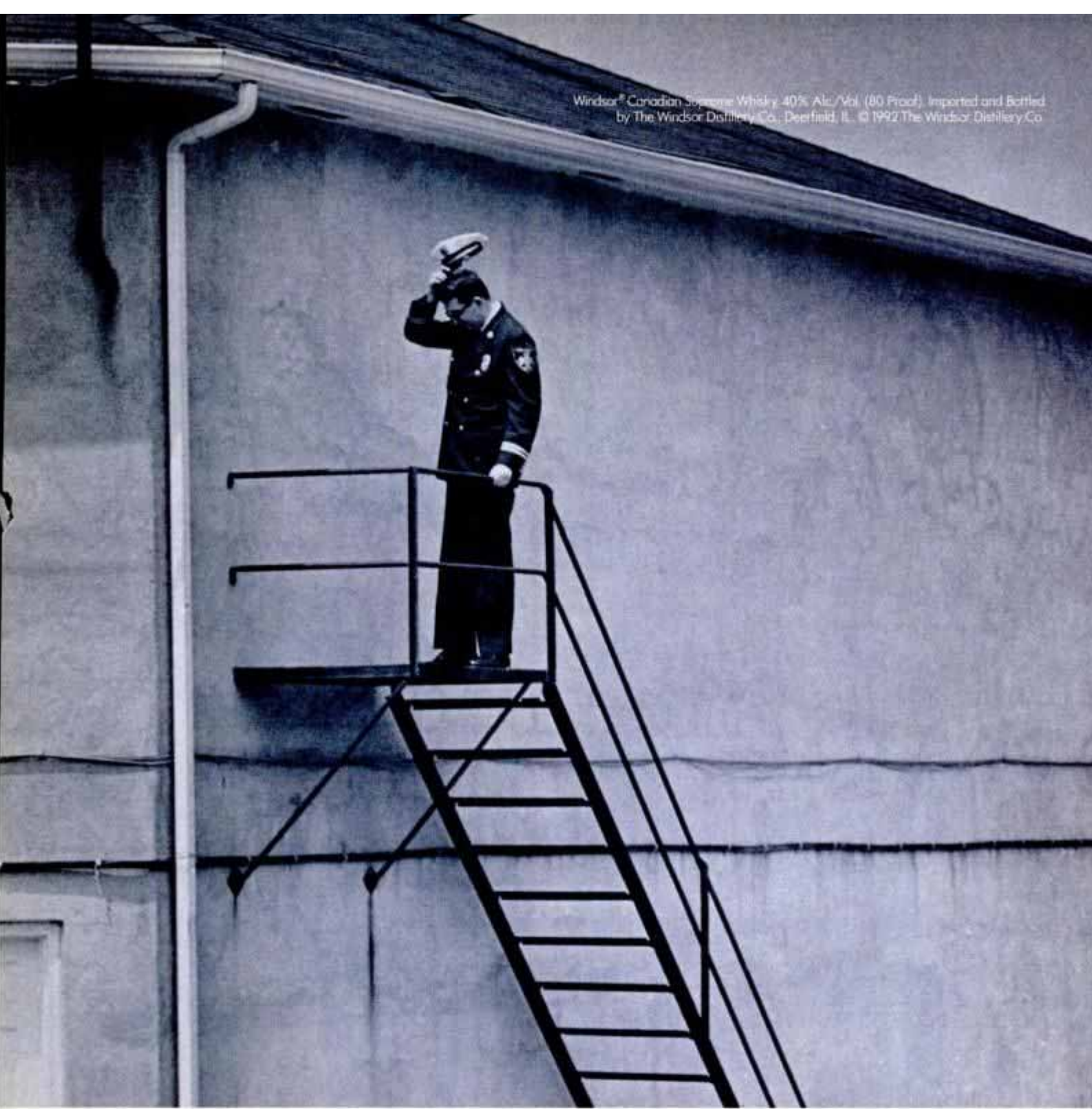


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March 1992

Dear Friends of **Popular Mechanics**:

Throughout the past nine decades, **Popular Mechanics** has covered the latest technological advancements and inventions, while giving our readers insight into the new technology coming our way. We have served our readers as both a mirror and a looking glass – covering both present-day innovations as well as futuristic concepts. As Henry Windsor, the founder of **Popular Mechanics**, began with his mission of explaining the complex world of technology in a way that those who benefit from it can comprehend, **Popular Mechanics** continues to be “Written so you can understand it.”

In honor of our 90 years of covering our ever-changing society, Henry Ford Museum & Greenfield Village in Dearborn, MI, a museum of history and technology featuring famous inventions and inventors, will bring our technological history, as it was told in the pages of **Popular Mechanics**, to life. The “*Possible Dreams: Popular Mechanics and America's Enthusiasm for Technology*,” exhibit will reflect the American dream of building a good life and better world through technology.

The exhibit will kick off with a black tie gala/preview on February 28th, and will open for display to the public on February 29th, through to December 31, 1993. You can catch a glimpse of the exhibit through photographs included in the in-depth article featured in this issue. We are delighted to welcome the Ford Motor Company as a sponsor of the program and appreciate their commitment to continuing the exhibit's editorial coverage throughout our 90th anniversary year's issues.

As we bring our editorial and our history to life, I sincerely hope that during the next two years, you have the opportunity to visit the Henry Ford Museum & Greenfield Village in Dearborn, MI. All of us here at **Popular Mechanics** are very excited about the exhibit. I'm sure you will find it most enjoyable.

Sincerely,

A handwritten signature in black ink that reads "Bob Dillingham". The signature is written in a cursive, flowing style.

Bob Dillingham  
Vice President & Publisher

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1902-1992

This One



9SRL-Z5J-S2BP

# Popular<sup>®</sup> Mechanics

MARCH 1992  
VOLUME 169  
NO. 3



28



## EXCLUSIVE PREVIEW

**28 90 Years Of PM Come Alive** Here's a firsthand look at the "Possible Dreams" exhibit at Henry Ford Museum & Greenfield Village. **PLUS**, pull out our free 90th Anniversary collector poster!

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# EDITOR'S NOTES

● As part of our 90th anniversary celebration, I'm very proud to tell you about a special exhibit which opens to the public on Saturday, February 29, at the Henry Ford Museum & Greenfield Village in Dearborn, Michigan. It's called "Possible Dreams: POPULAR MECHANICS And America's Enthusiasm For Technology." Even without "Possible Dreams," the Henry Ford Museum is a fascinating place to visit. I've played hookey there on many an afternoon. But now that the board of trustees of the museum has honored us by making POPULAR MECHANICS an integral part of one of the museum's exhibits, I urge you to visit many times over the next two years. The exhibit was designed by Staples & Charles Ltd., one of the most celebrated graphic design firms in the business. Barbara Fahs Charles and Robert L. Staples realized early on that capturing



Robert L. Staples and Barbara Fahs Charles.

the essence of a 2-dimensional medium (POPULAR MECHANICS) in 3-dimensional form (the exhibit) was a challenge not to be taken lightly. "In our search for visual ideas, we reviewed the massive 90-year selection of materials from the magazine assembled by the Henry Ford Museum project team," says Barbara Charles, "noting the nature of the articles and the character of their graphic presentation." The designers then translated that material into the exhibit that I hope you'll get to see at the museum. To whet your appetite, Mary Seelhorst, curator of the exhibit, gives you an exclusive preview in this issue of what you'll see when you walk through the portals in Dearborn. In addition, for those of you who can't get to the museum to see the exhibit in person, Ford Motor Co. will sponsor continuing coverage of the exhibit in the next 12 issues of PM. But I do hope you'll get to see the exhibit in person—and often. . . . Also bound into this issue is the same commemorative poster that will be given out at the museum as you leave the exhibit. The poster displays 66 covers from the 90 years that we have existed as a magazine. I hope you'll enjoy displaying your PM poster. . . . I told you in my January column that we had commissioned special furniture pieces to commemorate our 90th anniversary. The first piece, a curly maple dresser, can be built from the plans and instructions in this issue. You'll find three more pieces in future 1992 issues. If any readers build the whole set, I hope you'll write to tell me about your projects. . . . Is it a jet fighter on water? When you first look at the unusual craft on this month's cover, it's hard to tell. It's actually a hovercraft, part of a family of hovercraft that are possibly the most advanced designs of their type in existence. Boating/Outdoors Editor Joe Skorupa brings you the whole story beginning on page 17. Till next time.

  
Joe Oldham

# Popular Mechanics

Editor-In-Chief Joe Oldham

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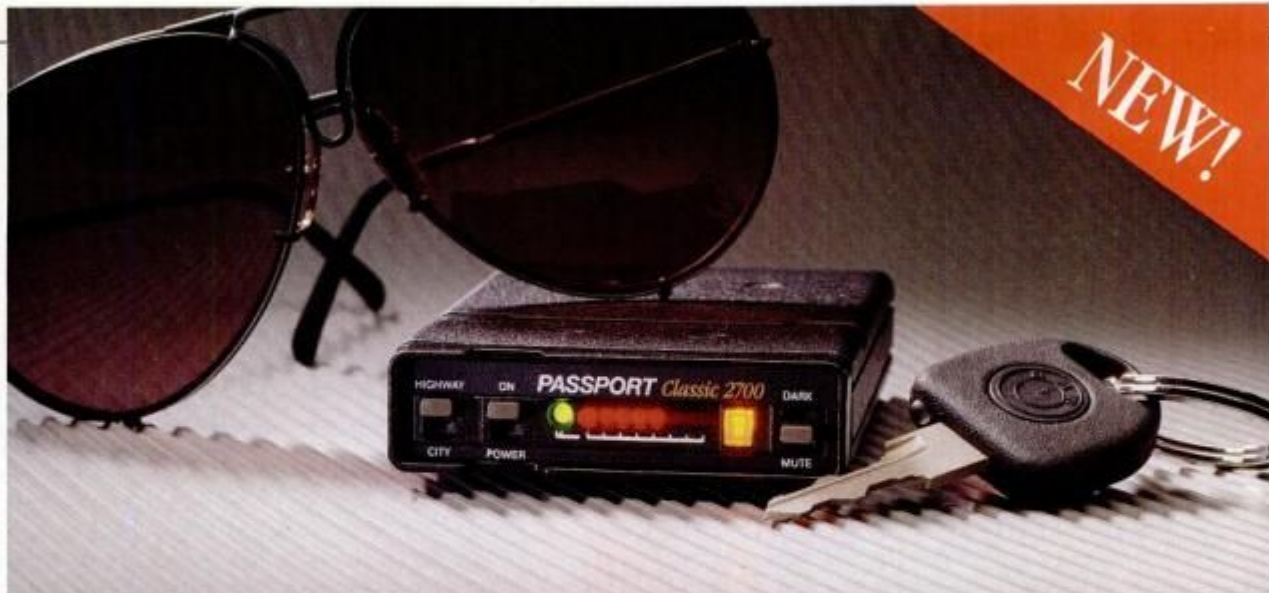
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# LETTERS

## Wings Of Man



Great article. I work for the government at Willow Grove Naval Air Base and see planes take off and land all the time. The story really explained what it takes to fly a plane—cost, time and so on. It's not cheap, and it's not easy.

WILLIAM P. BOWERS JR.  
CONSHOHOCKEN, PA

It's all very nice that one of your editors successfully underwent pilot training and got his license. However, let's not pretend that everything is peaches and cream when it comes to the state of general aviation in America. There is a definite insurance liability crisis. Manufacturers cannot get liability insurance and, therefore, cannot produce. Cessna, for example, developed a new piston-powered single-engine craft sometime in 1984, and has been flooded with product liability suits from trial lawyers ever since. Piper is in a similar mess, and is now very financially unstable. Beechcraft stopped producing the more basic lower-powered single-engine types all together. Overall, there's been about a 92% decrease

in such production since its peak in 1978.

General aviation in the United States today consists of million-dollar twin-engine turboprops and biz jets. With American production effectively closed down by lawsuits, our manufacturers cannot compete with the advanced technology coming out of Germany. German airframes are made almost entirely of lightweight composite materials, making them very fast and fuel efficient. We must get Congress to pass a general aviation liability reform bill, once and for all.

BRIAN P. DUMAS  
EASTON, CT

## Progressive Thinking

"The Problem With Dams" article was right on target. Raze the darn things. Who needs all the hydropower anyway? We could regain the rivers for canoeing and rafting on all the water now going to waste. Next, we



Reader George Knupp built PM's red oak racer with a twist, designing skis for sledding in the wintertime.

should restore our once-beautiful landscape by tearing up most of our ugly roads and relying on railroads instead.

BO THOTT  
CUTLER, ME

It's apparent that your information was from a single source. Western Area Power Administration, a federal agency responsible for marketing and distributing hydropower generated from federal facilities, cites the following points relative to the Colorado River and the Glen Canyon Dam.

Since 1981, research and studies have been ongoing to determine the effects of dam operations on ecologic, cultural and environmental resources. In 1989, the Bureau of Reclamation initiated the Environmental Impact Statement. There is no doubt that changes have occurred since the completion of the Glen Canyon Powerplant in 1964. However, long before the dam was constructed, the natural erosive forces of water, wind, heat and the cold began creating the Grand Canyon. Benefits that have resulted since the dam

closed include a blue-ribbon trout fishery, support of one of the best whitewater rafting experiences in the world, a bald eagle wintering area, a large breeding population of peregrine falcons and the continual attraction of waterfowl and the great blue heron.

LLOYD GREINER  
AREA MANAGER, DOE  
SALT LAKE CITY, UT

## Show Goes On

After reading the article on the Paris Air Show, it was interesting to note that despite the Soviet Union's political difficulties, they are still turning out advanced aircraft such as the A-40 and Mig A-31. When a pair of Mig-29s on tour throughout the U.S. recently stopped in Salinas, California, I got a chance to actually see a Soviet fighter aircraft in operation. A pilot took up one of the Migs and did a few snap roles, loops and other aerobatics. The Mig-29 may not be the Soviet Union's most exceptional aircraft, but it was still very impressive.

CRAIG JOHNSON  
SAN FRANCISCO, CA

As author David North found out when he "road-tested" a Mig-29 for our cover story. —Ed.

## 4-Season Wagon

I built your red oak wagon for my 27-month-old grandson. The only change I made was in the configuration of the stakes. I also made four skis by using  $\frac{3}{8}$ -in.-thick  $\times$  2-in.-wide hickory and  $\frac{1}{2}$ -in. copper tubing, bending them into the correct shape. Now the wagon can be used both in summer and winter.

GEORGE KNUPP  
EASLEY, SC

Letters are subject to editing for length, style and format.

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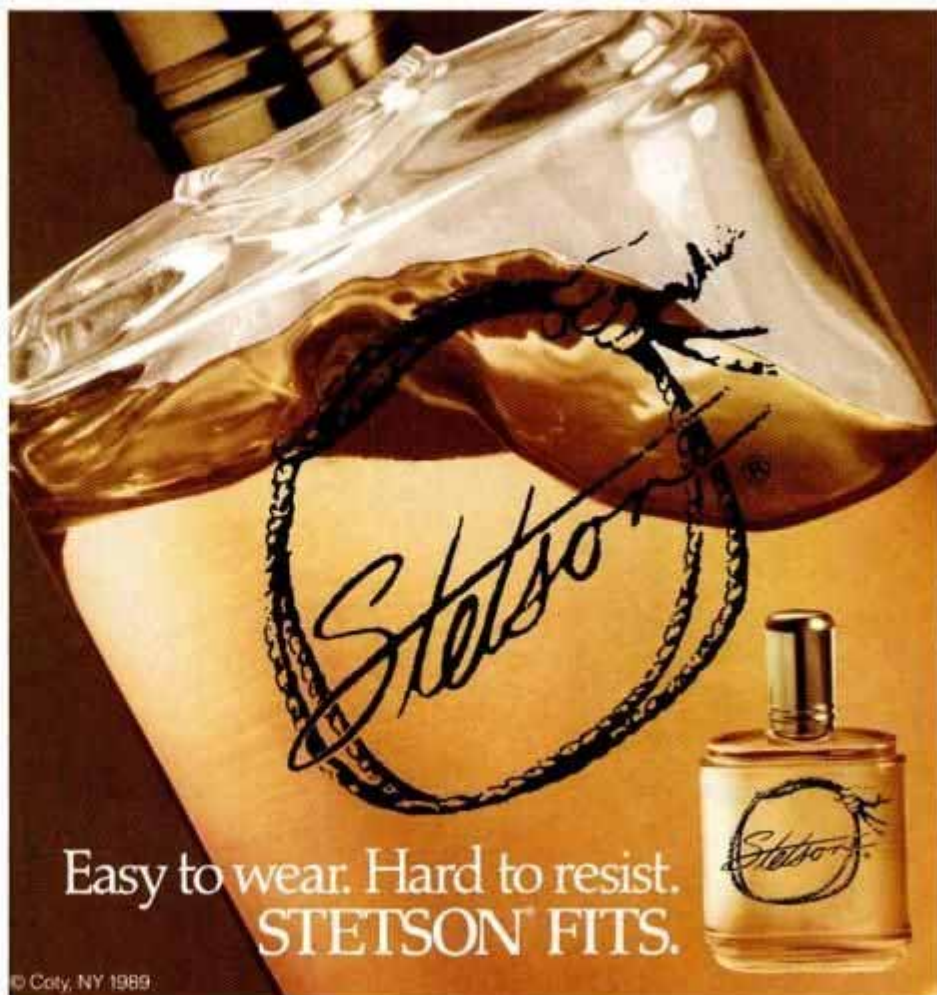
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# TIME MACHINE

90 YEARS AGO: MARCH 1902



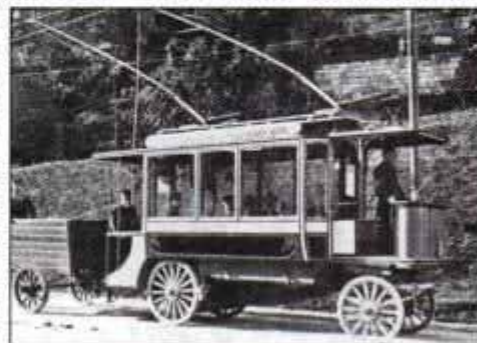
## Ship Of The Desert

Landsailing offered speedy trips across America's deserts, which at the turn of the century remained untamed. In California's Mojave Desert, a couple of prospectors spurred their "mechanical dromedary" to 80 mph on a dry lake bed that stretched between their gold mine and their home. The 14-ft. wheeled sailboat may have been the first of many oddball vehicles to traverse this lake bed—today experimental aircraft touch down there at Edwards AFB.

## Freewheeling

The streetcar had fast become an urban fixture, but cities paid dearly to install and maintain the rails. Now a new breed of tram was emerging on the battered streets of older European cities. The trackless trolleybus needed nowhere near the capital investment of a tram line, although they required more pow-

er. The cars could also weave through traffic. Yet trams and trolleys would soon be eclipsed by a contemporaneous invention—the motor bus.



60 YEARS AGO: MARCH 1932



## Catch A Plane

Retractable landing gear hadn't yet proliferated, and protruding wheels sapped speed and range from planes of the '30s. To one retired naval officer, the solution was obvious: jettison the wheels on takeoff, and touch down on a landing cradle. The device used sponge-rubber pads, springs and a sandbag to bring planes to a quick halt. The cradles would have opened up rooftop landing fields, although the inventor didn't address how to get planes airborne again.

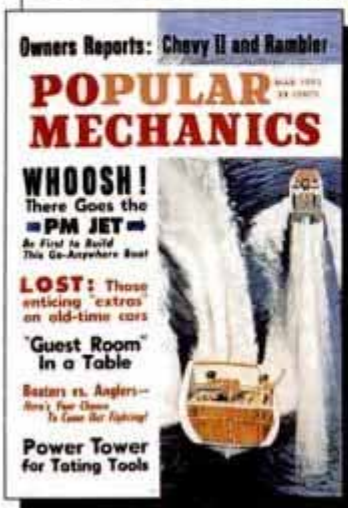


chine, often with bizarre results. One particularly fanciful effort was the "diridisc," a vehicle designed to fly on a rotating disc filled with hydrogen. The disc worked as a wing surface, as well as providing lighter-than-air lift. As if this weren't enough, a fixed elevator rose just above the front of the disc. Variable-pitch propellers delivered thrust. Needless to say, the aircraft was also amphibious.

## Dream Machine

During the 30's, airplanes, dirigibles and gyrocopters competed for air supremacy. Invariably, lift-happy inventors tried to combine them all into one flying ma-

30 YEARS AGO: MARCH 1962



## Squirt Gun

As Jet Age enthusiasm reached a peak, even boaters were catching on. For our 1962 project boat, we detailed a 15-ft. flat-bottomed runabout pushed along by a waterjet. Inboard, a marine version of the Comet-Falcon engine unleashed 100 horses, giving our prototype enough giddyup to hit 35 mph. We stressed practicality: the deck and windshield lifted off to open up bow space for fishing, and the jetdrive let the boat scoot through shallow, obstructed waterways.

## Turbo Test

Meanwhile, Detroit had a brief fling with the gas turbine engine. We flew around Southern California in Dodge's Turbo Fury and Turbo Dart. Both boasted a litany of advantages, includ-

ing low maintenance, clean, (if rather hot) exhaust and the ability to run on anything from kerosene to cognac. Acceleration was smooth, but the cars lacked snappy pickup. In addition, fuel efficiency was poor, even by 1960s standards.



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# TECH UPDATE

News Of Tomorrow's Technology Today



SUBSEA OFFSHORE PHOTOS

## Monster Robots Snuff Oilwell Fires

ABERDEEN, SCOTLAND — Crawling out of the surf, the tracked machine rumbles steadily toward a tornado of fire. From its nose rears a huge hydraulic manipulator jib, wielding a snuffer tube. Umbilical hoses baste the robot with water as it jams the snuffer over the blazing well-head. And the inferno dies with a gratifying hiss.

This scenario was played out on a North Sea beach last September, while an army of Texans battled the last of Kuwait's oil fires. Subsea's Automated Fire-Extinguishing Robot, or SAFER, may offer human firefighters some competition the next time all hell breaks loose.

SAFER weighs in at 30 tons,

and is driven by submersible electric motors housed in an internal water tank. Water deluges SAFER while it operates and circulates through the internal tank to keep the motors cool. In addition, stainless-steel heat shields swaddle the body of the vehicle and reflect heat from cameras mounted on the jib.

Tools available for the manipulator include the snuffer, a waterjet cutter, an excavating claw, wrenches and specialized oilwell equipment. At the other end, a control umbilical cord runs to an air-conditioned van, from which the robot is operated.

Editor: Abe Dane  
Assistant Editor: Gregory T. Pope  
Contributors: Philip Chien, Mike Fillon

SAFER's developers say it can be tailored for remote-control intervention in any hazardous environment.

Built by Subsea Offshore, SAFER demonstrates its imperviousness during tests on Scottish shores last fall.

## Highlights This Month

- **See How They Run**—Fuel-cell cars promise electric drive.
- **A Bridge So Far**—World's longest suspension span.
- **Thinking Man's Camshaft**—Variable-valve timing made simple.
- **King Crunch**—Huge machine destroys everything.
- **Dome Stretch**—Innovative roof holds itself up.
- **Off The Beaten Path**—Big trucks that go anywhere.

## Marathon Airbus Flies

TOULOUSE, FRANCE—The world's longest-range airliner is now undergoing flight tests, following its maiden voyage last October. A340s will be tested until the end of this year. That's when Airbus, aiming for nonstop connections between nearly every city on the globe, hopes to win certification from both American and European authorities.

First to fly was the A340-300, which can carry 295 pas-

sengers up to 7150 nautical miles. The shorter A340-200, which can take 262 passengers on a 7750-nautical-mile trip, is scheduled to take off this month.

The 4-engine jumbos feature the now-familiar Airbus fly-by-wire electronics and side-mounted joystick.

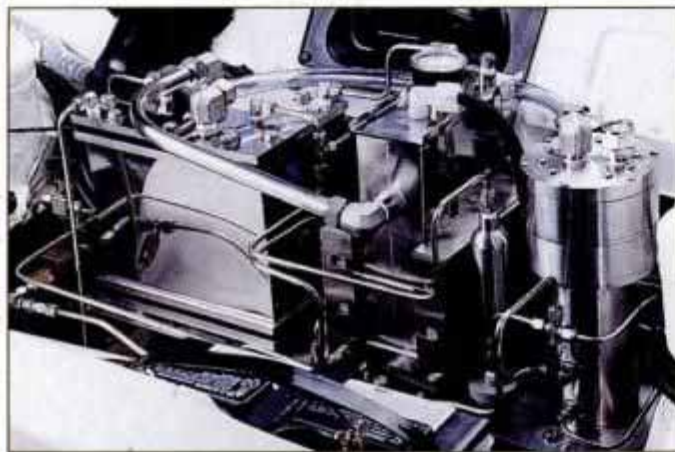
Lufthansa gets the first A340, in January 1993. Two months later, Northwest will become the first American carrier to fly the plane.



The ultimate nonstopper lifts off from Toulouse/Blagnac Airport.

AIRBUS PHOTO

## Is There A Fuel Cell In Your Future?



LaserCel takes a third of the space of comparable fuel cells.

NEW YORK, NY—To zip past the limitations of battery-powered electric cars, engineers are building zero-emissions vehicles that carry fuel cells as powerplants.

Fuel cells, best known as Space Shuttle electricity sources, generate current when fed oxygen and hydrogen in the presence of an electrolyte. They beat batteries in terms of recharge time and consistent power output. Problems that remain to be

licked are high cost, weight and low power density, but fuel-cell proponents say none of these is insurmountable.

Among more than a dozen fuel-cell car initiatives across the country is the Green Car, under development by Energy Partners in West Palm Beach, Florida. Engineers are converting a Consulier GTP to run on stored hydro-

gen with oxygen from the air. When paced through stop-and-go driving cycles, the vehicle's range should be 120 miles, about what is claimed for GM's Impact battery car.

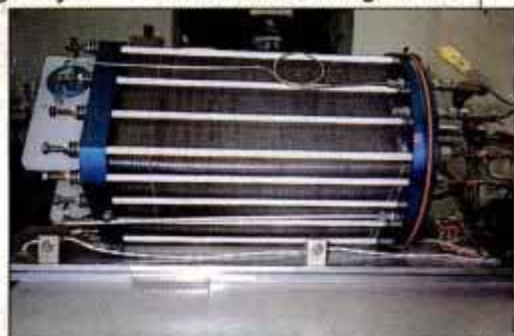
The fuel-cell apparatus is complex, involving two fuel-cell stacks, a battery for cold starts, a heat exchanger and a 15-in.-dia. hydrogen cylinder pressurized to 3000 psi. Still undecided is how to strip contaminants from the air that blows into the fuel cells.

Energy Partners will use the car as a testbed for fuel-cell-powered vans, which the company is hoping to produce commercially by 1995.

Meanwhile, Missouri engineer Roger Billings has already driven a converted Ford Fiesta that he asserts

can compete with gasoline-powered cars in terms of speed and economy. What's more, he says his vehicle has a range of 190 miles, and a new car designed around his technology could run more than 300 miles.

Behind these claims lie two major fuel-cell improvements. Inside Billings' com-

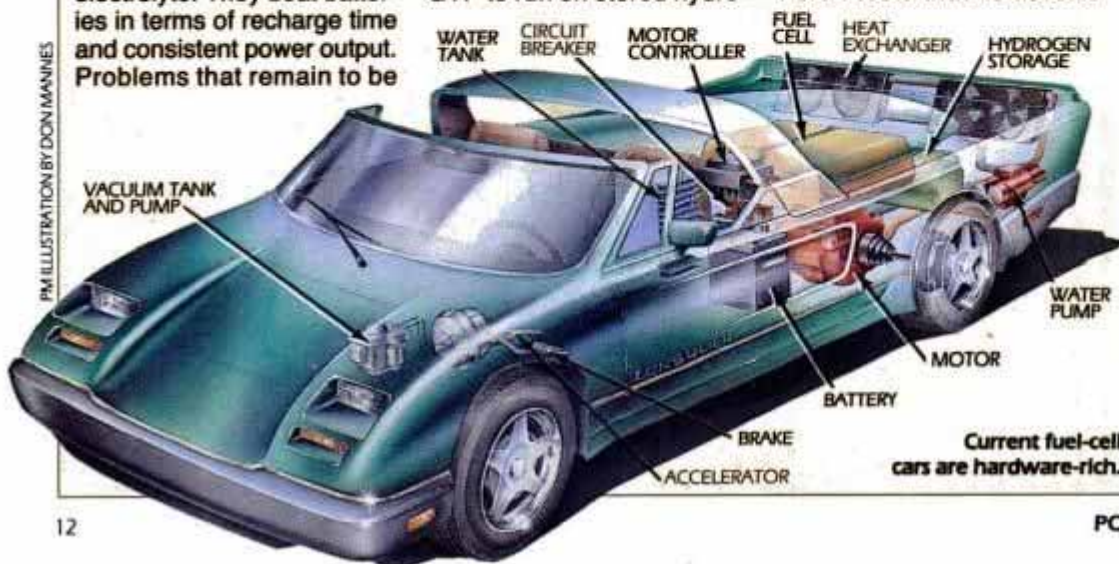


Green Car runs on hand-built fuel cell.

pact LaserCel, the membrane where the energy-releasing reaction takes place has been pocked with a laser to increase surface area and boost power output.

In addition, the cell is reversible, says Billings—just feed it electricity and water overnight to replenish the hydrogen stock. This recharging generates enough pressure to squeeze the hydrogen into a superdense metal hydride.

Faced with skepticism, Billings plans to make the hardware available to a government lab to verify his claims. If they hold up, they'll go a long way toward sparking automakers' interest in fuel cells.



Current fuel-cell cars are hardware-rich.

AMERICAN ACADEMY OF SCIENCES PHOTO

PM ILLUSTRATION BY DON MANNING

ENERGY PARTNERS PHOTO

## Driving Stick

TROLLHATTEN, SWEDEN—Dropping the direct mechanical connection between driver and wheels, Saab is experimenting with a drive-by-wire system similar to fly-by-wire aircraft control systems.

The test car, a Saab 9000, even has a side-mounted joystick instead of a steering wheel. The stick sends electrical signals to a control box on a hydraulic cylinder that moves the steering linkage. Since no steering column is needed, reasons SAAB, why

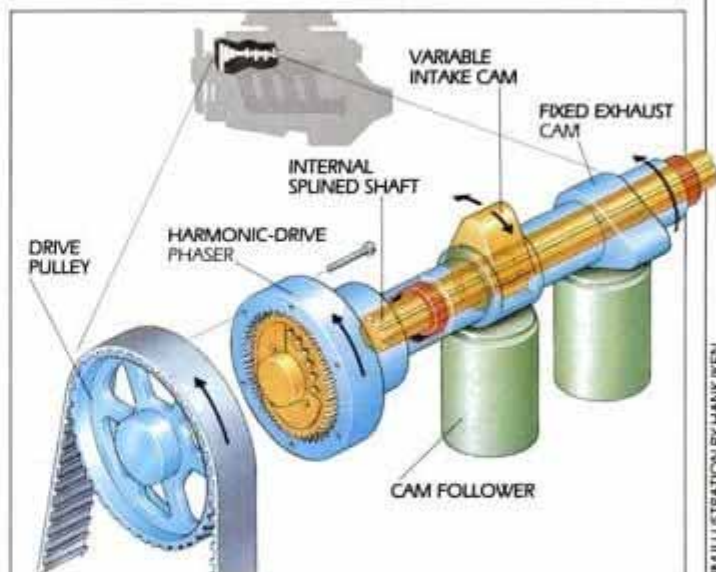
clutter up the instrument panel with the steering wheel, a prime safety hazard during a crash?

The system is fail-safed with reserve hydraulic pressure and electrical power.

SAAB's research ties into Europe's PROMETHEUS smart-highway program. The next step: adding force-feedback to the system to simulate the road condition and handling information that drivers can normally sense through a steering wheel.



Side-mounted joystick eliminates steering-wheel safety hazard.



Intake-valve lobes shift while exhaust lobes remain in place.

## Smart Camshaft

CLEMSON, SC—Automakers are parlaying research dollars into camshafts that permit variable-valve timing (VVT). Now Clemson University engineers have developed an elegant VVT system that, unlike its rivals, suits engines with a single camshaft for both intake and exhaust valves.

The Clemson camshaft phase-shifts intake camlobes independently of exhaust camlobes. The exhaust lobes are machined into the outside of the camshaft, while the in-

take lobes are mated to an internal splined shaft by means of toothed inserts.

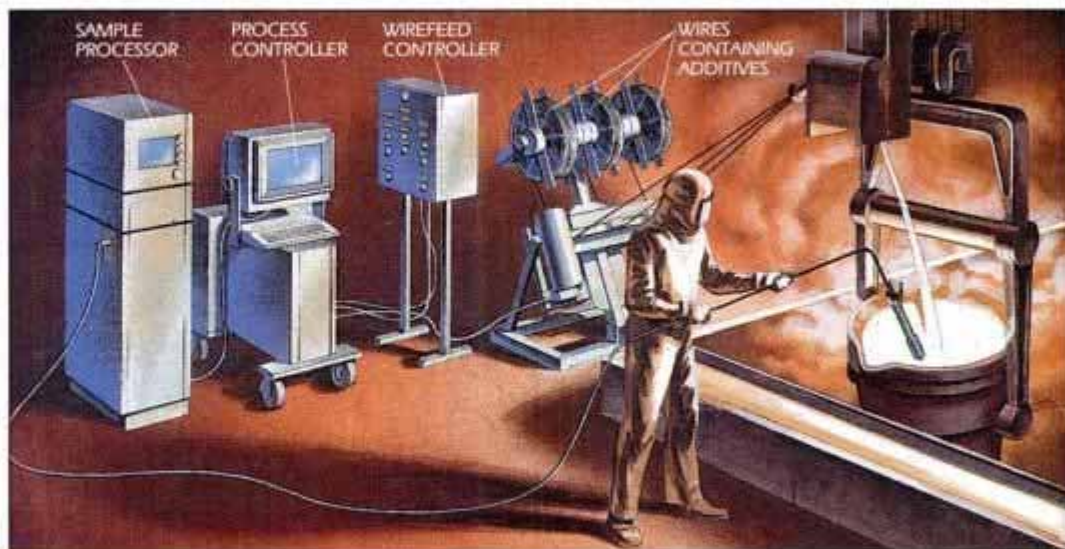
At the drive-pulley end of the camshaft, a phasing mechanism takes signals from the engine-management computer and shifts the lobes in accordance with rpm. The phaser can vary the lobes continuously through all driving conditions, boosting fuel efficiency as much as 20%, say the researchers.

Unnamed British and American automakers are now testing the device.

## Custom Cast Iron

AUBURN HILLS, MI—Technology has caught up with the cast-iron foundry, promising major weight cuts in auto components, like engine blocks and brakes. A new process developed by a Swedish chemist promises volume production of compacted graphite iron, which is twice as strong as conventional gray cast iron while much less expensive—and less dirty to produce—than aluminum. Designers can shave up to a third of the metal mass from components using the alloy.

SinterCast, Inc.'s Backerud process features a probe that samples the molten metal before it's poured



Sample probe analyzes cooling melt and signals controllers to adjust chemistry if needed.

into molds. The probe reads the microscopic structure that appears in the metal as it solidifies. That information is

routed to process controllers, which feed additives into the ladle to achieve the desired recipe.

The process is being installed at a German foundry that produces more than a million engine blocks a year.



## Space Rock Video

PASADENA, CA—The probe *Galileo* snapped the first-ever asteroid closeups—if 10,000 miles away can be considered close.

But the initial photos are just a tease. Scientists will have to hold still until more *Gaspra* data beams back from *Galileo*.

That's because while the

photographs were taken last October, Jet Propulsion Laboratory engineers were still trying to open the probe's jammed high-gain antenna by remote control.

*Galileo* will swing by Earth this fall. The probe will then slowly download the *Gaspra* data via its functional low-gain antennas.



*Gaspra*'s natural hues (left); color-enhanced version (right).

NASA PHOTO

## Digging And Thinking

LANCASTER, ENGLAND—An intelligent excavator may be the first of a new breed of robotic heavy-construction equipment, if research at the University of Lancaster pays off.

Engineers there used a 1/5-

scale model of an excavating arm to develop sensors, microprocessors and software. Now they've scaled up to a full-size excavator that can autonomously dig a trench the width of the bucket to any desired depth.

The machine can tailor its action to any terrain, even hard soil studded with boulders. Rotation sensors at the arm's joints allow the processors to keep track of the arm's motions and switch to a different digging style, if necessary.

Future efforts will focus on digging tasks that are more complex, like obstacle avoidance and laser-guided positioning of the vehicle.



Scale model helped guide development.

LONDON PICTURES SERVICE PHOTO

## Perseus Prototype Flies

EL MIRAGE, CA—A proof-of-concept vehicle for NASA's high-flying drones (see [Tech Update, page 20, Apr. '91](#)) lifted off last November.

The unmanned aircraft, from Aurora Flight Services, didn't reach the stratosphere, venturing no higher than 2000 ft. in flight tests. But the avionics, which will pilot the plane autonomously during some flights, and the slim-line aerodynamics proved themselves. The

heat-dissipation system and high-altitude engine, which recycles its exhaust, remain under development.

The follow-on vehicle, called *Perseus*, and possibly two more, will go to NASA next year to probe climate problems and environmental impact of supersonic transport. *Perseus* will have the same daddy-longlegs silhouette as the testbed, with a 58-ft. wingspan over a 24-ft. fuselage.



*Perseus* prototype tested aerodynamics and control system.

AURORA FLIGHT SCIENCES PHOTO

## Tough Trucks Ride Rough Roads

NEW YORK, NY—Big trucks engineered for off-road use have made recent debuts.

Last October, the Army awarded Houston-based Stewart & Stevenson Ser-

vices a contract to manufacture the next generation of tactical trucks. Known as the Family of Medium Tactical Vehicles, the 2½- and 5-ton trucks will come in 15 different varieties, including wreckers, cargo trucks, tankers, dump trucks

and troop carriers.

The all-wheel-drive machines will feature tire inflation systems that drivers can adjust while on the move.

Close to 11,000 will roll off

the assembly line in the next five years.

Meanwhile, Kenworth Truck Co. has introduced a 29,000-pound on/off-highway truck fitted with rear

steering. The T884, also an all-wheel-driver, features a steering rod that runs alongside the underframe to the rear axle. Rear steering shortens turning radius and prevents fishtailing on steep inclines.

The truck's air-suspension system provides twice the vertical articulation of comparable vehicles, states Kenworth. The company is pushing the vehicle for wilderness firefighting applications.



T884 provides rear-axle steering.



Army's new truck adjusts its tires' air.

## Bridge Will Span A Mile

FUNEN, DENMARK—The first suspension bridge to stretch more than a mile

from pylon to pylon will highlight a new European engineering extravaganza.



STOREBAELT PHOTO

Overall, Denmark's Storebaelt will cross an 11-mile gap, linking the island of Zealand and the peninsula of Jutland. A combined road/rail bridge will first march across the water to the island of Sprogø. Then the railroad will dive underwater through tunnels, while automotive traffic will cross the huge suspension span.

The bridge's box girder, which supports the road, will have no rigid connection to the pylons. Instead, bearings

The world's longest suspension bridge will connect Danes.



Storebaelt East span will set a record.

will suppress sideways sway, while hydraulic buffers at each end of the girder will limit horizontal motion. Inside the girder, dehumidifiers will fight rust.

New York-based Steinman Boynton and Italy's CMF Sud will build the bridge, scheduled to open for traffic in 1997.

PM ILLUSTRATION BY HANK KEN

## The Big Crunch

RISLEY, ENGLAND—A machine the size of a small house can plant more than 10,000 tons of pressure onto an object. The hulking rig, built by Schenck UK for Britain's Atomic Energy Administration (AEA), will be used to torture-test structural components of nuclear powerplants and offshore oil-production facilities.

The centerpiece of AEA's new Structural Features Test Facility, the 600-ton apparatus wields 20 servo-

controlled hydraulic rams, grouped in four banks of five. Two of the banks can rotate 90° to apply forces along two different axes. And each individual ram can deliver an independently measured load. While there are three other test rigs in the world that can generate 10,000-ton forces, none can vary how the load is applied the way this one can.

The machine, along with other specialized crunchers, began operation in May 1991.



AEA TECHNOLOGIES PHOTO

Test rig can stomp like 1000 elephants on small piece of steel.



HEERY/RFI/TVS PHOTOS

Finished stadium will be third largest dome in the United States.

## Georgia Dome Nearly Done

ATLANTA, GA—When the Falcons kick off their home opener this fall, they'll be playing in the biggest example yet of tensegrity, a Buckminster Fuller concept.

No vision-obstructing pillars will mar the 70,500-seat Georgia Dome, designed and engineered by the Atlanta firm of Heery/RFI/TVS. Instead, the primary structural component will be a concrete oval-shaped compression ring around the stadium's perimeter.

Inside this ring, three concentric ovals of steel posts will appear to hang from the ceiling. But in fact, in each ring, taut steel cables will link each post to the equivalent post in the next ring out,

transferring the load of the ceiling to the outermost compression ring. The steel posts act simply as struts to separate



Posts separate cables in tensegrity dome.

rate tensioned cables.

Upon this network, workers are now fastening the roof, 114 panels of fabric weighing 68 tons.

The Georgia Dome will house the Super Bowl in 1994 and some Olympic events in 1996.



# Quality is Job 1.<sup>SM</sup>

## Profile in Quality #33: Innovation

Craig Metros  
dreams cars.  
The kind of quality  
cars you'll be  
driving years  
from now.

Craig is one  
of over 366,000  
Ford people  
worldwide who  
are committed to  
making quality  
Job 1.

Our goal is to build  
the highest quality  
cars and trucks  
in the world.



"Today we're  
designing cars that  
are great looking  
and fit the  
environment."

Craig Metros, Designer  
Ford Employee for 5 years.

# Ford Motor Company

FORD, MERCURY, LINCOLN, FORD TRUCKS

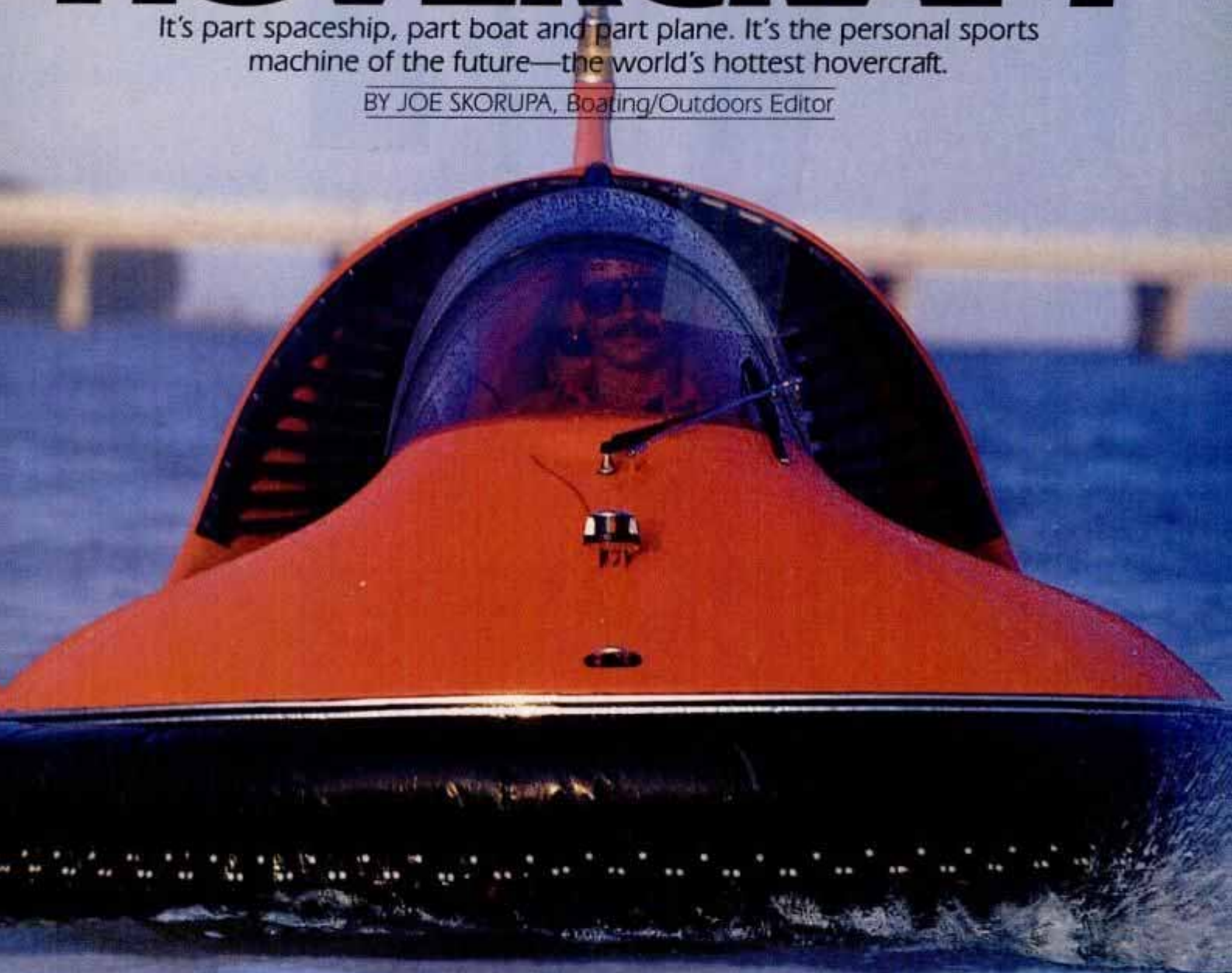
Buckle up — Together we can save lives.

Always insist on genuine Ford Motor Company collision repair parts.

# RED-HOT HOVERCRAFT

It's part spaceship, part boat and part plane. It's the personal sports machine of the future—the world's hottest hovercraft.

BY JOE SKORUPA, Boating/Outdoors Editor



● A crowd gathers as you glide the Ferrari-red hovercraft down the trailer ramp. It was a sleepy Florida marina a few seconds ago. Now it's buzzing with a swiftly gathering crowd. No one has ever seen anything like the futuristic Air Rider Hunter before. The sleek sports machine is so radically contoured that it looks like a cross between the Space Shuttle and a jet fighter.

You lift open the canopy hatch and your best girl climbs into the back. You hop into the front and pull the hatch down to seal the cockpit. Now, you turn the key, push the starter button, and the 54-horse, 2-cycle engine fires up. You move the throttle forward to 2500

rpm, and the 9-blade prop pushes air beneath the splitter plate to the plenum chamber, which is located beneath the fiberglass hull. A nylon-reinforced neoprene airbag fills up and distributes air to the outer skirts. When the Air Rider Hunter lifts 8 in. off the ground, you're ready to fly.

The crowd expects something special, so you jam the throttle forward and roar down the launch ramp. The Hunter smoothly accelerates. By the time you reach the water, you're up to 5800 rpm and 45 mph. You go from land to sea and don't feel the slightest change.

Biscayne Bay is a boater's paradise—pale-blue wa-

## RED-HOT HOVERCRAFT



ter, palm trees, powdery beaches and mangrove-covered keys. But boaters never witness the beauty you're headed for. You race out to deep water, and then duck beneath a low bridge. You turn into the shallows and keep flying until the water thins out to a glaze over white sand. You explore hidden places that few people ever see. You cross sand bars, beaches, reefs and coves. It's totally unrestricted freedom. It's an exhilarating assault on the senses. It's another perfect day in the world of sport hovercraft.

### **Riding on air**

If you know anything about hovercraft, you probably know about military landing craft or commercial ferries, which have been around for decades. Or you may know about build-it-yourself hovercraft kits that have been around for years.

More recently, you may have become familiar with several companies, primarily Scat and Neoteric, that have been producing turn-key sport craft for fun and racing. I tested these models several years ago and found them to be among the most exciting toys on the market. But if hovercraft are so much fun, why have they been so slow in catching on?

There are several reasons, and most of them have been addressed by Konig Maschinenbau GmbH, of Asslar, Germany, which makes the futuristic Air Rider hovercraft. Until the Air Rider, personal hovercraft were aimed at hardcore enthusiasts and racers. They were lean-and-mean machines built with little attention to comfort, amenities and operational ease.

The difference between the stripped-down, open-deck sleds I rode a few years ago and new Air Riders is dramatic. For one thing, you actually sit down in an Air



4-SEATER



2-SEATER



SINGLE-SEATER

## RED-HOT HOVERCRAFT

Rider. For my first flight in a hovercraft, I knelt on a fiberglass deck without pads.

Steering is a completely different animal, too. If you sat back and turned the yoke-type steering wheel in the hovercraft I flew, very little would happen. The rudders would turn, but the craft would simply crab sideways. Then, very slowly, it would begin to make an extremely wide arc. To make the turn tighter, you had to lean hard and use major body English. In an Air Rider, you turn the yoke and the craft turns. It's not a hard turn, naturally, but it's a turn nevertheless. This is because Air Riders are heavier than stripped-down sleds and more responsive, thanks to a bigger, more powerful engine.

Body English is also required in getting a sled-type craft over the hump, which is a term hovercrafters use to describe a wall of water that occurs during a water-borne start. Unfortunately for hovercraft, the flow of air that fills the skirts also displaces water beneath the hull. As the craft tries to go forward, it pushes against the displaced water. To go over the hump, the craft needs to have strong forward thrust—and the Air Rider does. On the sleds I learned to fly on, the driver must lean over the steering yoke to shift the center of balance.

Finally, perhaps the most annoying problem with open sleds is the wet ride. A fine mist works its way from beneath the skirts and sprays a constant shower onto the driver's face. Air Rider provides welcome relief with an enclosed-cockpit canopy.

### New-wave airpower

To date, the Air Rider fleet consists of three models—the Booster, the Hunter and the top-of-the-line Wildcat. We were able to test ride the



Booster and the Hunter, but the Wildcat is just now emerging from the prototype phase and is still at the Konig plant in Germany.

The lightweight Booster is Air Rider's one-person sport craft, but at \$21,000 it's hardly an entry-level machine. It's 12 ft. 2 in. long, 6 ft. 1 in. wide and weighs 418 pounds. Height to the top of the unique stabilizer fin, which helps the wind-sensitive craft maintain tracking, is 5 ft. 9 in. (same as the Hunter). Fuel capacity is 7 gallons for a range of 60 to 70 miles. Both the Booster and the Hunter use a 54-horse Goble-Hirth 2-cycle engine.

Next up in the Air Rider line is the sporty 2-person Hunter, which is 14 ft. 2 in. long, 6 ft. 1 in. wide and weighs 507 pounds. Fuel capacity is 9 gallons for a range of 70 to 80 miles. Instrumentation for both the Booster

and the Hunter includes a fuel gauge, tach and an engine hour meter. Also standard are a windshield wiper, nav. lights and an amber strobe light that serves as a warning to other craft that the hovercraft is subject to wind drift. Price is \$26,000.

The superdeluxe Wildcat is a big 4-seat luxury sedan, which is 21 ft. long, 8 ft. 2 in. wide and 6 ft. 11 in. high. It weighs a whopping 2420 pounds—most of which comes from its full complement of luxury features and a 150-horse 4-stroke, turbodiesel engine made by the German builder Steyr Motortechnik. This craft sports a 12-blade prop with blades that are 42 in. long. Fuel capacity is 30 gallons for a range of about 150 miles.

In addition to all the features found on the Booster and Hunter, the plush Wildcat has thrust reversers for air brakes, ailerons for adjusting the horizontal planing attitude, marine radio, radar, GPS, a Porsche-designed interior and much more. Each custom-built craft will run in the neighborhood of \$200,000.

Both the Booster and the Hunter are currently in production and available through Konig Hovercraft, 1801 Middle River Dr., Ft. Lauderdale, FL 33305; (305) 566-0526.

The Wildcat, according to Alex Sempf of Konig, should be ready for production soon. Keep this in mind if you happen to have an extra couple hundred grand around. While prices for Air Riders may seem high compared to other sport craft, the technology is definitely a step ahead of the others. And to the Ferrari set, the man with the most toys wins. **PM**



Sand bars don't stop a single-seat Booster (top right). The 2-cycle Goble-Hirth engine pumps out an impressive 54 hp (left). The 9-blade prop is made of Kevlar-reinforced composite (above).



# FORD CROWN VICTORIA

● Ford's Crown Victoria donned its new Taurus-style sheet-metal in March of last year and immediately became a much more modern-looking, aerodynamic automobile. The design team retained the basic rear-drive chassis, with substantial suspension revisions, and the coefficient of drag (Cd) promptly dropped from 0.42 to 0.34.

Ford also replaced the Crown Vic's old 5.0-liter pushrod V8 engine with its new sohc 4.6-liter V8. This added 40 peak hp (190 and bumped torque by 50 ft.-lb., to 260. With the dual-exhaust Touring Sedan version, peak hp jumps to 210, and peak torque to 270 ft.-lb.

So what emerges here is a full-size Ford with body-on-frame construction and excellent trailer-towing capabilities—a traditional American family car that no longer looks like a stack of boxes.

The person who buys a Crown Victoria—or its cousin the Mercury Grand Marquis—is usually mature and more safety conscious than most.

Positive reviews for the new shape of tradition.

BY MICHAEL LAMM, Contributing Editor  
PM Photos by Ron Hussey



The standard driver's airbag (a passenger airbag will soon be offered as an option), antilock brakes with traction control and even the body-on-frame construction swayed a goodly number of buyers.

Looks remain important, however, and in our survey styling led as the Crown Vic's prime purchase motivator. Just under half of the survey group cited the modernized exterior and interior as the best-liked feature of the car. But size, handling, comfort, quiet operation, ride quality, improved power and respectable fuel

economy were also important considerations.

Fully 60% of the Crown Vics in our survey were equipped with antilock brakes. The Crown Vic ABS system includes traction control, and is standard in the Touring Sedan. It's a \$695 option on the basic car or the midlevel LX model. Standard in all Crown Vics are Ford's 4-speed automatic transmission, speed-sensitive, variable-assist power steering, 4-wheel power disc brakes, front and rear antiroll bars, a reclining split-bench front seat, a driver's airbag and air conditioning.

The LX gets a 6-way power seat and a number of additional goodies, but it's the Touring Sedan that's accessorized to a fare-thee-well. The Touring Sedan stickers out at about \$4000 more than the \$20,108 base car, and its list of additional equipment includes more power, stiffer suspension, pneumatic load leveling at the rear, heavier antiroll bars, a 3.27:1 rear axle (versus 3.08 standard) and



# CROWN VICTORIA



Owners liked control layout, but said that wheel hub blocked instrument panel.



Interior space ranked as a plus, but cramped center front seat legroom drew criticism.

Smooth, quiet power of new sohc 4.6-liter V8 was best-liked performance feature.

cast-alloy wheels with 225/70R-15 Goodyear Eagle tires.

The performance and handling package is also available as a \$1612 option on lesser series. A towing pack-

age is also available for all models.

When we asked owners to specify their complaints, 22.1% told us they didn't have any—a level of satisfaction that ranks with the Lexus LS 400

and Infiniti Q45. The gripes we did hear had mostly to do with safety. For example, 7.9% felt that the rearview mirror is mounted too low, restricting both forward and rear vision.

## SUMMARY OF 1991 FORD CROWN VICTORIA OWNERS REPORTS\*

Total miles driven:	1,537,413	Overall performance:		Cramped center front seat	5.5	Brakes	7.0
Average miles driven:	4549	Excellent	74.8%	Air conditioner	4.7	Automatic transmission	7.0
Purchase price:		Good	24.3	Spacesaver spare tire	4.7	Did you repair it yourself?	
Average	\$20,799	Average	0.6	<b>Suggested changes:</b>		No	94.7%
Range	\$15,900-\$26,800	Control layout:	0.3	Passenger's airbag	9.2%	Yes	5.3
<b>Why did you choose the Crown Vic?</b>		Excellent	48.8%	No changes	7.6	<b>Dealer repairs satisfactory?</b>	
Styling	46.5%	Good	45.8	Reposition rearview mirror	6.5	Yes	78.8%
Previous ownership	28.3	Average	3.6	Better lumbar bladder	5.9	No	21.2
Size/interior space	18.5	Poor	1.8	Improved horn buttons	5.4	<b>Dealer service opinion:</b>	
Price/value	13.5	<b>Instrumentation:</b>		Eliminate center console	5.4	Excellent	53.7%
Comfort	11.4	Excellent	51.6%	Redesign instrument panel	5.4	Good	38.5
Ride quality	9.8	Good	42.4	<b>Workmanship opinion:</b>		Average	5.3
<b>Model choice:</b>		Average	4.2	Excellent	64.3%	Poor	2.5
Crown Victoria LX	91.1%	Poor	1.8	Good	33.3	<b>Number of vehicles owned:</b>	
Standard Crown Victoria	8.9	<b>Driver sightlines:</b>		Average	2.1	This vehicle only	28.6%
Crown Victoria		Excellent	44.3%	Poor	0.3	Two vehicles	41.9
Touring Sedan	0.0**	Good	42.2	<b>Comfort opinion, front seats:</b>		Three vehicles	17.3
Avg. mpg, city/hwy.:	19.1/24.9	Average	9.6	Excellent	70.6%	Four or more	12.3
<b>Engine power:</b>		Poor	3.9	Good	26.7	<b>Principal driver:</b>	
Excellent	78.5%	<b>Specific likes:</b>		Average	2.0	Male	54.4%
Good	19.8	Styling	47.8%	Poor	0.6	Female	37.1
Average	1.5	Handling	42.4	<b>Comfort opinion, rear seats:</b>		Equal	8.5
Poor	0.3	Ride quality	42.0	Excellent	61.4%	<b>Age distribution of owners:</b>	
<b>Handling:</b>		Comfort/interior space	35.2	Good	37.4	Under 29	2.1%
Excellent	74.9%	Engine power	32.2	Average	0.9	30-49 years	19.8
Good	23.0	Quiet operation	28.0	Poor	0.3	50-plus	78.2
Average	1.5	<b>Specific dislikes:</b>		<b>Mechanical trouble?</b>		<b>Based on your experience, would you buy a Crown Victoria if you had it to do over again?</b>	
Poor	0.6	No complaints	22.1%	No	83.4%	Yes	78.6%
<b>Braking:</b>		Rearview mirror too low	7.9	Yes	16.6	Maybe	20.5
Excellent	74.9%	Instruments blocked		<b>What type of trouble?</b>		No	0.9
Good	24.0	by wheel	5.9	Air conditioner	15.8%		
Average	0.9	Horn buttons	5.5	Electrical system	15.8		
Poor	0.3			Power seats	8.8		

\* Percentages might not equal 100% due to rounding up or insufficient data.  
\*\* Crown Victoria Touring Sedan production startup delayed.

A few drivers also complained that the adjustable steering wheel blocks some of the instruments, and that the two small horn buttons are impossible to find at night and difficult to use when the wheel is turned.

There were also scattered complaints that the Crown Vic's large transmission tunnel and instrument console conspired to virtually eliminate front center-seating.

No one had any argument with the way the new Crown Vic ran or performed, though. Many owners took the time to praise the new V8's quiet operation, its smoothness and the way it could hustle the 3770-pound sedan away from stoplights.

As we noted earlier, Ford made major revisions to the Crown Vic's suspension to go along with the new engine and body, and tweaked the standard car's coil and gas-shock set-up again for '92 to improve ride quality and reduce body roll during cornering. And the overall result impressed most of our owners.

### Quality quotient

Fit and finish were judged excellent by 64.3% of our owners, good by an additional 33.3%. The Crown Victoria's only trouble spots seemed to be the air-conditioning compressor and a few electrical aberrations, like false readings from the fuel gauge.

And service proved to be a painless experience at most dealerships. The majority of our owners (53.7%) gave their dealer shops a score of excellent. Not that there was much reason for most buyers to return for service. Only 16.6% needed after-purchase adjustments, and in those cases nearly 80% reported that the work was done right the first time.

So judging by our survey, Ford's new Crown Victoria proves to be totally satisfying to the vast majority of its owners. Most experienced no problems at all, and those who did were happy with their dealers.

### Value factor

What seemed to impress our owners most of all, though, was the fact that they were getting a lot of car for the money. Several owners noted that they would have had to pay roughly the same for a Volvo 240 or a top-of-the-line Honda Accord, ending up with less power and less space.

And it seems to be the value factor that prompted 78.6% to say yes to our bottom-line question: Based on your experience, would you buy a Crown Victoria if you had it to do over again? Another 20.5% said maybe, which adds up to an outstanding score for any car, at any price. **FM**



Although many full-size car buyers rate safety as a high buying priority, the new Crown Vic's styling easily topped the list of reasons for purchase in the survey group. Owners perceived body-on-frame construction as a safety feature, as well as a durability factor. Aerodynamic efficiency improved from the old car's 0.42 Cd to a respectable 0.34.

### EDITORS REPORT

## The Future Of Full-Size

● When it comes to cars, if you think American, chances are you're still inclined to think big. Full-size, as they're called—the kind of cars that American carmakers are known for building. Smooth riding, with plenty of engine power, they seem to offer an extra measure of safety in their weight and bulk.

Driving the new Ford Crown Victoria is a convincing demonstration of the viability of this peculiarly American style of automobile. The new sedans still ride big, but handle with a level of response that suggests something much smaller. The suspension is taut, letting the tires ripple over the pavement while keeping the body steady and level. The variable-assist steering is light to the touch at parking-lot speeds and gets firmer at freeway paces.

As with previous generations of the Crown Victoria, personal safety is something many owners associate with sheer mass. You find belt-and-suspender safety here—the 3700-pound curb weight that will win any head-to-head confrontation with the popular compacts, the driver's airbag, a truly user-friendly, manual 3-point belt system, and the option of antilock brakes and traction control.

Crown Vic buyers have every reason to be happy with the new 4.6-liter

sohc V8 engine. It's smoother, more fuel efficient and makes this big car much more peppy. Teamed with the 4-speed automatic overdrive, this powertrain approaches world class.

Big cars are all about interior space, and the Crown Vic is move-around spacious. While we agree with the owners concerning the 6-passenger rating—five is really closer to reality—those five will find plenty of extra inches for hips, hats and heavy winter clothing, front and back.

Consistent with this, the trunk is vast—wide, deep and capable of holding a family-size load of vacation luggage.

For all the driver seat space, Ford has managed to keep heater and radio controls within easy reach. A bonus is Ford's wheel-mounted cruise-control system, arranged around the edges of the airbag. We'd like it even better if the radio controls could be mounted there, too, and the passenger airbag option can't come too soon for the buyers this car will attract.

But there are few nits to pick here. In the steadily shrinking world of true full-size affordable cars, the new Crown Vic stands out as a leader. If this car is an indication of where the class is headed, we think the traditional American full-size sedan will be around for a long time. —Jim Dunne

## TECHNOLOGY



An international quintet of spaceplane concepts now vies to provide the first cheap, reliable way into orbit. From top: Japan's SSTO, France's Star-H, America's X-30, Germany's Sanger and Britain's HOTOL, boosted by the Russian An-225.



# SPACE RACE 2000

It's America versus the world in a high-stakes contest to launch an aircraft from runway to orbit and back.

BY GREGORY T. POPE; PM Illustration by Paul Dimare

● Fast-forward to the year 2000. The setting: Edwards Air Force Base, where a blue-and-white plane shaped like a blunt pencil point gathers momentum and takes off. The initial rocket blast gives way to the roar of ram-jets, soon drowned in a fusillade of sonic booms. Now out of eyeshot, the plane builds speed and noses for the stratosphere. An unearthly scream emerges, as ram-jets transition to supersonic combustion and propel the plane past Mach 8. Still the craft gains altitude and impossible velocity. Finally, the skimpy air can no longer satisfy the jets, and the rocket reignites to kick the vehicle into orbit.

This is the vision: routine American access to space from a runway, embodied in the X-30, the National Aero-Space Plane (NASP). But there can be no monop-

oly on such a dream. Flip the calendar ahead a few years and shift the scene to Germany. There, a black fang of a plane is slashing into the air from a refurbished Deutsche Aerospace runway in Manching, north of Munich. Accelerating headlong over Europe and the Atlantic, the plane climbs in a supersonic gallop until it reaches Mach 6.6. Then a smaller vehicle, carrying two astronauts, leaps from its back, fires a rocket engine and blasts into the heavens.

Jump ahead another decade, and aircraft are hopping from runway to space in Japan and France, perhaps even the former Soviet Union. That's because today, across the world, engineers are wrestling with the challenges of the aerospace plane, aiming to build vehicles that will blur the line between flight and orbit. Their en-

deavors are spurring international aerospace competition to a new and hypersonic tempo.

The boldest of the schemes is NASP, jointly under study by the Air Force and NASA. If construction gets the green light in September 1993, twin X-30 test aircraft would first fly in 1997 and take a shot at single-stage-to-orbit flight in 1999. Technology hurdles, still formidable, may slow down that aggressive timetable. But so far, progress in materials and propulsion for the Mach-25 vehicle has been on schedule.

Next on the runway is Sanger, Germany's 2-stage-to-orbit system. Technically less ambitious than NASP, Sanger could leapfrog the X-30s by executing real missions. The American aircraft, by contrast, will be strictly experimental, paving the way for mission-oriented "NASP-derived vehicles."

Behind these frontrunners are Japanese and French craft that will move from concept to reality in the 21st century, presumably after those nations have proven their proposed minishuttles, *Hope* and *Hermes*. Meanwhile, British and Russian engineers hold a wild card: a joint proposal to launch an unmanned spaceplane called HOTOL from the back of an Antonov An-225, the mammoth Russian cargo jet.

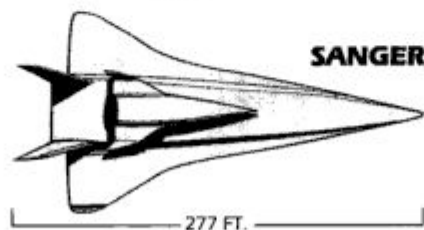
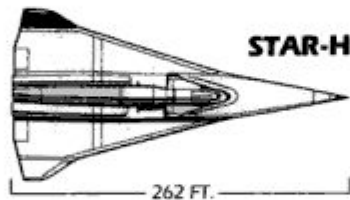
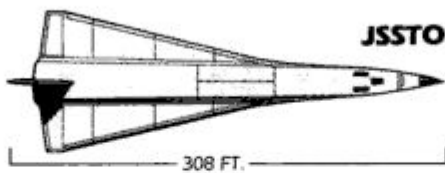
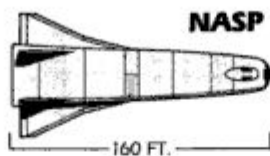
## NASP in the grasp

In the face of such competition, say NASP contractors, the brazen audacity of the X-30's performance goals will give the American aerospace industry a needed technological leg up—if those goals can be met. With that motivation, an unprecedented five prime contractors comprise the NASP National Program Office, based near Air Force Plant No. 42 in Palmdale, California.

Consider these demands: The X-30 will be as long as a Boeing 767, weighing dry only 100,000 pounds. Yet it must take off laden with 250,000 pounds of slush hydrogen to get into orbit. At the same time, its nose must withstand 5000° F temperatures, its leading edges 3000° F, while air temperatures inside the scramjet combustion chamber will reach 12,000° F. The question: What do you build the plane out of?

"That's where we've made such remarkable progress," says Dr. Robert Barthelemy, director of the Air Force/NASA joint-program office, which oversees the contractor work. The X-30 will be a crazy-quilt of composites and alloys that were impossible hybrids just five years ago.

Graphite-copper has emerged as a



likely candidate for combustion-chamber walls and leading edges, where hydrogen will circulate through built-in capillaries to cool things down. Titanium aluminide, laced with ceramic strands, will be used for fuselage panels and fuel tanks. Already, contractors are flattening and sculpting large sheets of this brittle material.

But Barthelemy admits that propulsion remains the biggest worry. Rocket combustion, probably oxidized with a built-in liquid-air compressor, will boost the plane from a standstill to Mach 3. NASP engineers are now convinced that, between Mach 1 and 3, external fuel combustion is necessary behind the rocket engine to keep the exhaust plume pushing against the base of the tail.

Above Mach 3, air compressed by the plane's forebelly will squirt through each of six ramjet/scramjets, reaching supersonic speeds. Injection

and ignition of hydrogen fuel must be timed perfectly to avoid triggering shock waves that would choke off airflow. Combustion mustn't fall short of peak expectations—95% efficiency—or else the plane will run out of fuel before reaching Mach 18, when the rocket takes over for orbital insertion.

The NASP scramjet, the "flying stovepipe" that must perform so flawlessly, can't be ground-tested throughout its grueling flight envelope. "When we push the envelope of the plane, we'll be pushing the envelope of the engine," says Barthelemy. "That's the difference between this X-plane and previous ones." So far, scaled-down engines have responded favorably in wind tunnels up to Mach 8. Ground tests at higher speeds must wait until a decision is made to complete RHYFL, a half-built shock-tunnel facility engineered by Rocketdyne. RHYFL would unleash Mach-24 blasts—but only for a fraction of a second.

## Doing the 2-step

Meanwhile, in Germany, researchers at Messerschmidt-Bolkow-Blohm (MBB) have it a little easier. The Mach-6.8 Sanger first-stage will fly on turbo-ramjets, fed kerosene jet fuel while the turbines are humming, then liquid hydrogen in ramjet mode. Although the engines must shift smoothly from turbojet to ramjet operation, the plane won't move fast enough to require scramjets.

Temperatures on the nose and leading edges will stay cool enough that the plane can be built of conventional titanium padded with carbon-carbon at the hot spots. "We won't need exotic materials," predicts Dietrich Koelle, director of advanced studies and scenarios at MBB in Munich.

One thing the Germans will need is some tricky engineering to manage second-stage separation. Perched on Sanger's back, the winged flyback orbiter will come in both manned and robotic versions. At 22 miles off the ground, Sanger will first nose heavenward at a 6° angle. Then the orbiter itself must rear up at an 18° angle to the first-stage carrier before disengaging and igniting its rocket. Already cruising at its top speed, Sanger must have extra thrust available to counter the increased drag from the maneuver, Koelle says.

The Germans, purse strings clenched by the costs of unification, have already roped in Sweden and Italy as research partners on Sanger. Construction of a demonstrator aircraft called Hytex has been put off for five years. As an alternative, the Germans are seeking to borrow a NASA



Sanger takes two steps to orbit.

SR-71 Blackbird to air-launch an unmanned testbed for their turbo-ramjet engine. (NASP engineers may get first dibs, however, to verify external combustion's effectiveness.) But still unanswered is how quickly the European Space Agency, already tied to its *Hermes* minishuttle and its mammoth booster *Ariane 5*, will assume funding of full-scale Sanger development.

"*Hermes* is a good step, but not the final answer to keeping launch costs down," argues Koelle. One advantage Sanger will have over *Hermes*, he says, is the ability to hop into space from any airport in Europe, which bars unmanned rocket launches from the Continent.

But researchers at France's Aerospatiale and Dassault Aviation, prime contractors on *Hermes*, are outlining their own hypersonic concepts. Under a research effort called STS 2000, Aerospatiale has tailored a Concorde-like single-stage spaceplane and a 2-stage system wedding a Mach-13 scramjet with a winged flyback rocket. Meanwhile, Dassault's STAR-H is closer to Sanger. The STAR-H scenario stars a Mach-7 plane that would piggyback an expendable *Ariane-5* second stage tipped with a *Hermes*-derived reusable orbiter.

By lifting technology from *Hermes* and *Ariane 5*, French engineers can concentrate on developing the air-breathing first stage, says Michel Rigault, technical director of space transportation systems studies at Dassault. The French government has targeted the scramjet for a major research push, with four aerospace firms planning to throw in together à la NASP.

### HOTOL recall

Two countries that have already thrown in together are the unlikely duo of Great Britain and Russia. In the mid-1980s, British Aerospace and Rolls-Royce developed a concept known as HOTOL (Horizontal Take-Off and Landing), an unmanned re-

usable single-stage-to-orbit vehicle driven by a combined airbreathing/rocket powerplant. The program stagnated, however, when the British government ceased funding.

But since 1990, British Aerospace and Russia's Antonov Design Bureau have mulled the feasibility of launching a simplified HOTOL at 29,000 ft. from the back of Antonov's An-225 heavy-lift cargo jet, the world's biggest plane.

The new HOTOL incarnation could get by on a conventional rocket engine of Russian pedigree. Meanwhile, the An-225, already designed to carry payloads on its back, would still require an extra pair of engines and some heat shielding. Allowing the



NASP does it in one step.

Russian jet to haul HOTOL through much of the atmosphere would free up several tons of extra payload capacity aboard the spacecraft.

Recent wind-tunnel tests indicate that separation would go off without a hitch. "My impression is that the Russians and British are getting serious," says Barthelemy. "They might try to pull off a launch in two years, and that would scoop everyone."

Meanwhile, Japan, nurturing its own fledgling aerospace industry, isn't about to be left out. Japanese engineers have recently aired a bewildering plethora of proposals, but their ultimate aim is to fly a plane into space in the 21st century. The Japanese Single-Stage-To-Orbit, or JSSTO, would couple four liquid-air-compression engines with six scramjets.

### And they're off

The flurry of research activity—and promises of generous government funding—suggest that Japan is jockeying hard for a place on the hypersonic racetrack. "The Japanese always talk an interesting story on what they might or could do," says Barthelemy, "but we all know they can move out when they want to. They're looking at this commercially, because they'd like to be in the high-speed people-moving business."

But the short-term challenge to American aerospace supremacy, Barthelemy believes, comes not from Japan but from Germany. "You bet we're in a race," he says. "The Germans are focused, and they have a strong commitment."

What spoils go to the winner? For Germany, it's a chance to play a leading role in Europe's emerging space program, providing a flexible counterpoint to *Ariane 5* and *Hermes*. For Japan, it's another opportunity to parlay high technology into a thriving business.

For the U.S., the stakes are higher. NASP research may give the Air Force a spyplane or a strategic bomber that can get to its target faster than a

ballistic missile. But for NASA, NASP represents the likely follow-on to a Shuttle system slipping into disfavor. Shuttles spend a minimum of 30 days on the ground between missions. Launch costs exceed \$2000 per pound of payload, and 15,000 federal employees must work to maintain and operate the spacecraft.

In contrast, a NASP-type vehicle could, according to Barthelemy, return to space 72 hours after touchdown, require between \$50 and \$400 per pound of payload, and tie up only 100 workers. In addition, he notes, the temperamental Shuttles will be over 25 years old by the time a NASP-derived craft gets off the ground.

Whatever the mission for a NASP-derived craft, it probably won't be the only flying machine to slip the bonds of gravity and venture into orbit. Space Race 2000 is on.

PM

# POSSIBLE DREAMS

Popular Mechanics and America's Enthusiasm for Technology



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Ninety years of Popular Mechanics come alive at the Henry Ford Museum & Greenfield Village.

BY MARY SEELHORST

● If Henry Windsor and Henry Ford had one thing in common—besides their first name—it was enthusiasm for the inventions and discoveries rapidly changing their world. They also shared a desire to help people understand those changes.

Henry Windsor established **POPULAR MECHANICS**, a magazine covering the latest developments in science and mechanics as well as things his readers could use and build. Henry Ford established Henry Ford Museum & Greenfield Village, a museum of history and technology featuring famous inventions and inventors, as well as the stuff of everyday life and ordinary people.

PM covered the dedication of the museum in Dearborn, Michigan, in 1929, and its reporters have returned many times since for information

*Mary Seelhorst is curator of the "Possible Dreams" exhibit at Henry Ford Museum & Greenfield Village, in Dearborn, Michigan.*

about the technologies of the times. This time, however, **POPULAR MECHANICS**—all 90 years of it—returns

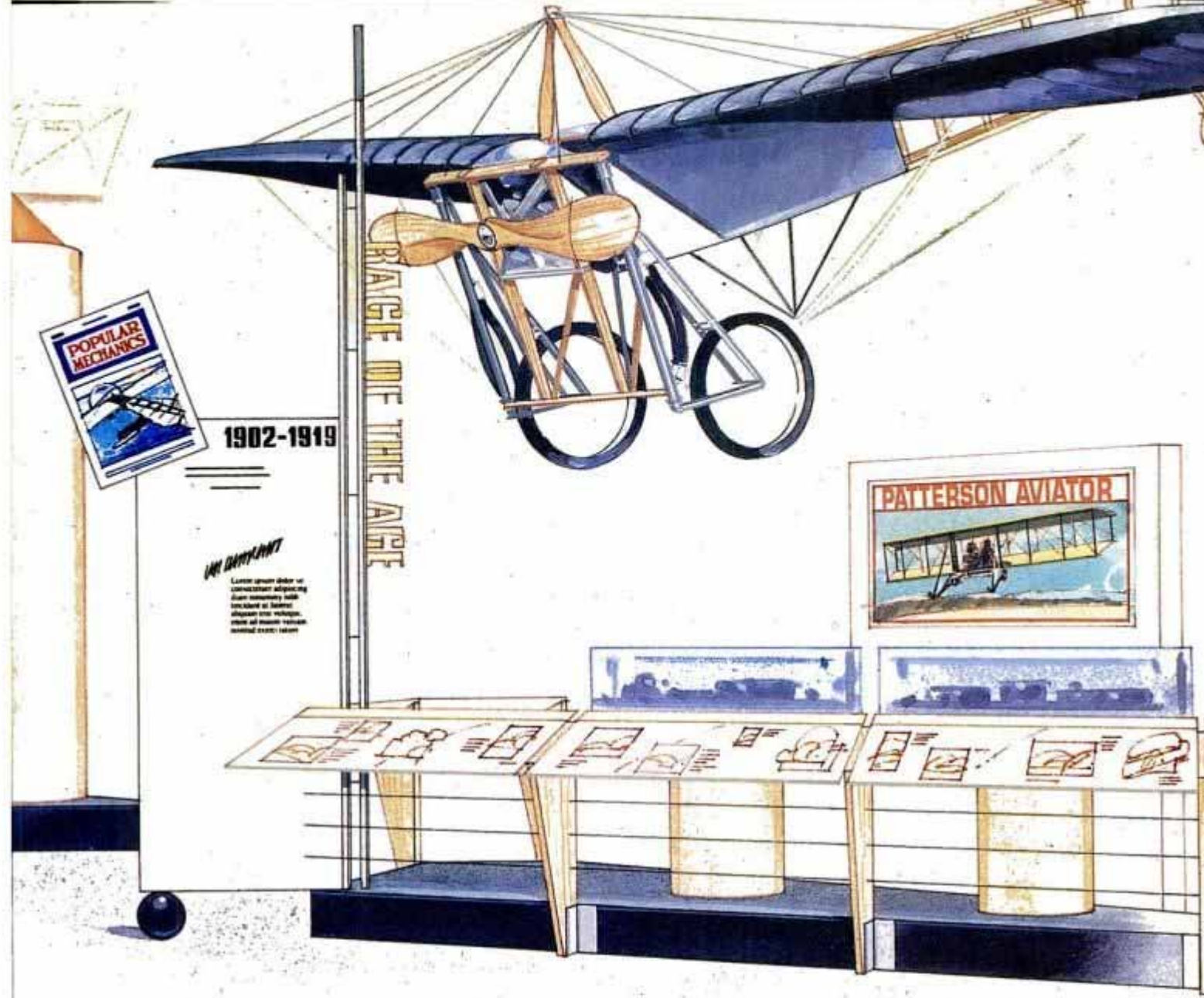


as part of a special exhibit put together by the museum on the occasion of the magazine's 90th anniversary.

On Saturday, February 29, Henry Ford Museum & Greenfield Village will open "Possible Dreams: **POPULAR MECHANICS** And America's Enthusiasm For Technology," a 6200-sq.-ft. exhibit that captures and explores America's technological dreams—dreams of the possible, the improbable and, as a true enthusiast would say, the not-yet-possible.

In this century, more than any other, many Americans have dreamed of building a good life and a better world through technology. Nearly all of our machines and inventions, our tools and trades, our projects and purchases are evidence of this single dream. Our passion for things mechanical has also supported dozens of technical, how-to and scientific magazines that help to explain and popularize new technologies.

**POPULAR MECHANICS** was the first



technical magazine for a general audience to include do-it-yourself projects, the first to be so heavily illustrated and the first to use full-page cover art. Because PM helped set the standard for an entire genre of magazines, and because PM has mirrored and reinforced America's enthusiasms for 90 years, the museum chose to use this influential magazine to help visitors examine American attitudes about technology.

It is a colorful and fun exhibit, the type you can linger in, or return to over and over and still find something new. Thanks to the sponsorship of Ford Motor Co., POPULAR MECHANICS will be bringing you continuing coverage of the exhibit in the next 12 issues. However, we hope you'll come in person to see the fascinating collection of objects that make up the exhibit. Let's take a look at some of them.

Once inside the museum, before you even get to the "Possible

Dreams" exhibit, you'll spot banners identifying objects that were featured in PM. The first stands next to the large cement block "autographed" by Thomas Edison at the museum's dedication in 1929. We are using these banners throughout the 12-acre museum to spotlight things, unusual and ordinary, that were covered in the



Thomas Edison signs the cement, 1929.

magazine over the past 90 years.

Upon entering the Great Hall of the museum and turning to your left, you will see four larger-than-life figures, "enthusiasts" beckoning you to come their way. There is the consumer enthusiast, who might not know what makes his microwave oven work, but nonetheless, enthusiastically compares brands and features. Next to him is our weekend enthusiast, who tinkers with her classic motorcycle just for the sheer enjoyment of it. Beyond stand two young, budding enthusiasts playing a hot, new videogame. And finally, our career enthusiast muses over a prototype mobile robot, perhaps thinking about his technical profession.

If you can relate at all to any one of these enthusiastic types, then there is something of interest for you in "Possible Dreams." Beyond them, in our Special Exhibits Gallery, more than 250 of the inventions, products and do-

*(Please turn to page 32)*





Buckle up — together we can save lives.

HAVE YOU  
EVER GIVEN  
YOURSELF A  
PROMOTION?

HAVE YOU  
DRIVEN  
A FORD  
LATELY?

Raising your status means raising your standards, so be prepared to accept some remarkable improvements on the new Crown Victoria: *A sleeker, more aerodynamic design. A quieter, roomier interior. A redesigned suspension for better handling.*

Next comes power, which you'll have on demand, courtesy of a new modular V-8, *the most advanced engine in its class.*

#### NEWS ABOUT SAFETY.

With power comes responsibility: An available anti-lock braking system with Traction Assist, speed-sensitive power steering and a standard driver-side air bag supplemental restraint system to be used with your safety belt. A passenger-side air bag is also available.

#### THE Nth DEGREE.

For an even more serious trip to the top, consider *the new Crown Victoria Touring Sedan*. It boasts added horsepower, an exclusive interior and standard anti-lock brakes with Traction Assist.

Whichever route you take, you'll be calling the shots. From a very impressive office.

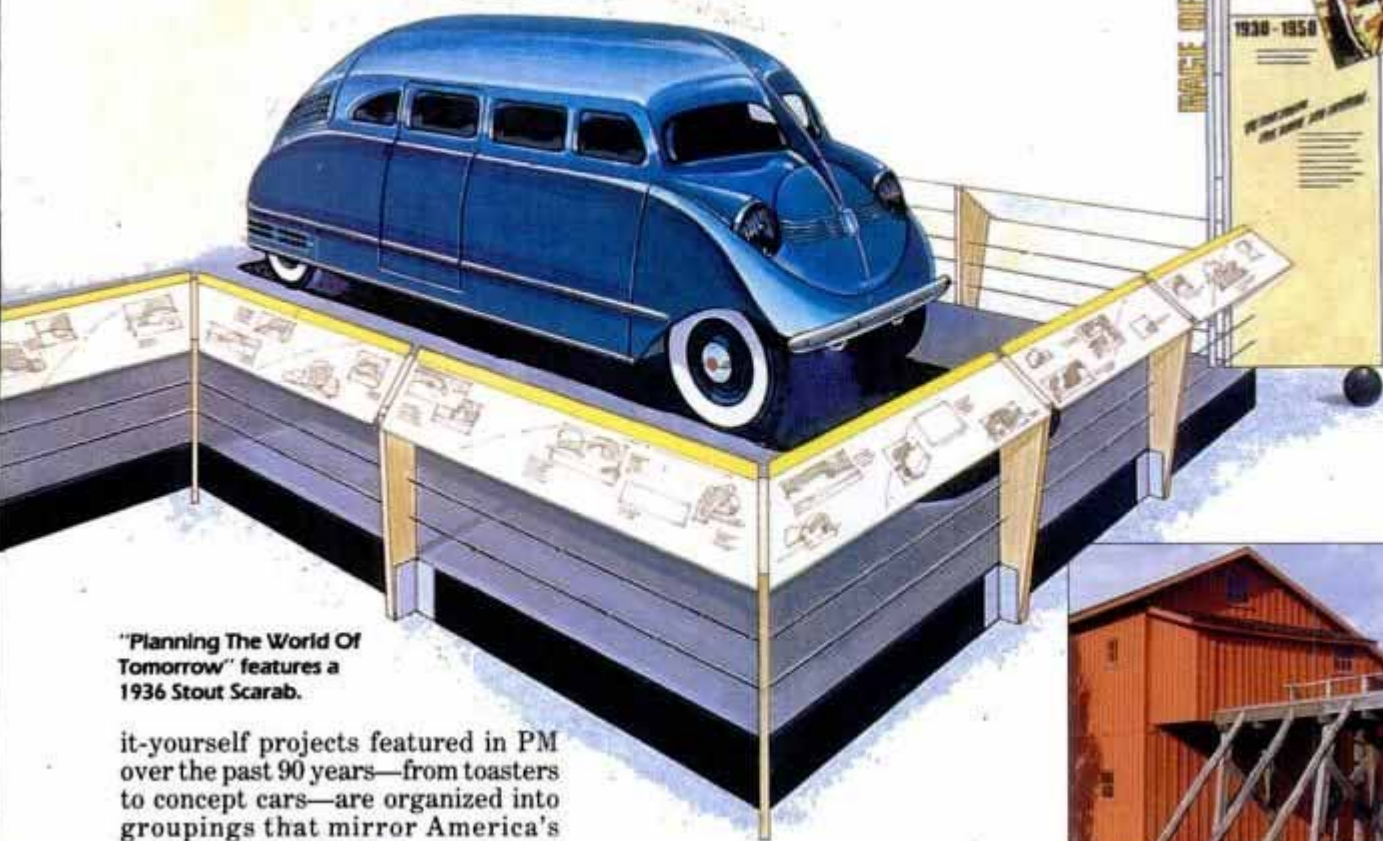
#### FORD. THE BEST-BUILT AMERICAN CARS ...ELEVEN YEARS RUNNING.

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NEW  
CROWN VICTORIA



## POSSIBLE DREAMS



"Planning The World Of Tomorrow" features a 1936 Stout Scarab.

it-yourself projects featured in PM over the past 90 years—from toasters to concept cars—are organized into groupings that mirror America's technological enthusiasms.

There are seven, chronological Rage Of The Age sections, each featuring a topic or technology covered with particular enthusiasm in PM in its day. Three more sections, titled "90 Years Of . . .," cover themes that have been of continual interest to PM readers. And throughout the exhibit, artifacts are matched up with PM illustrations and commentary that reveal how we have built, bought, used, altered, embraced, rejected or learned about them.

A Bleriot monoplane, like the one Louis Bleriot himself flew across the English Channel in 1909, swoops over

The Lotus that Jimmy Clark drove to victory in the 1965 Indy 500.

the entry. There, in a Rage Of The Age section called "Flying Fever," you can sense some of the excitement generated by aviation between 1902 and 1919. Under the Bleriot, this exuberant claim from 1909: "But above all, we can truly say that man is now completely master of the universe having under his control all the powers, yea, even the kingdom of the air." Nearby, a mascot doll taken on the first U.S. Air Mail flight in 1911 for good luck is a reminder of the dangers early aviators faced. Those interested in things mechanical can compare two early airplane engines, or wonder



Visitors can see Mr. Riker's 1901 electric racer.





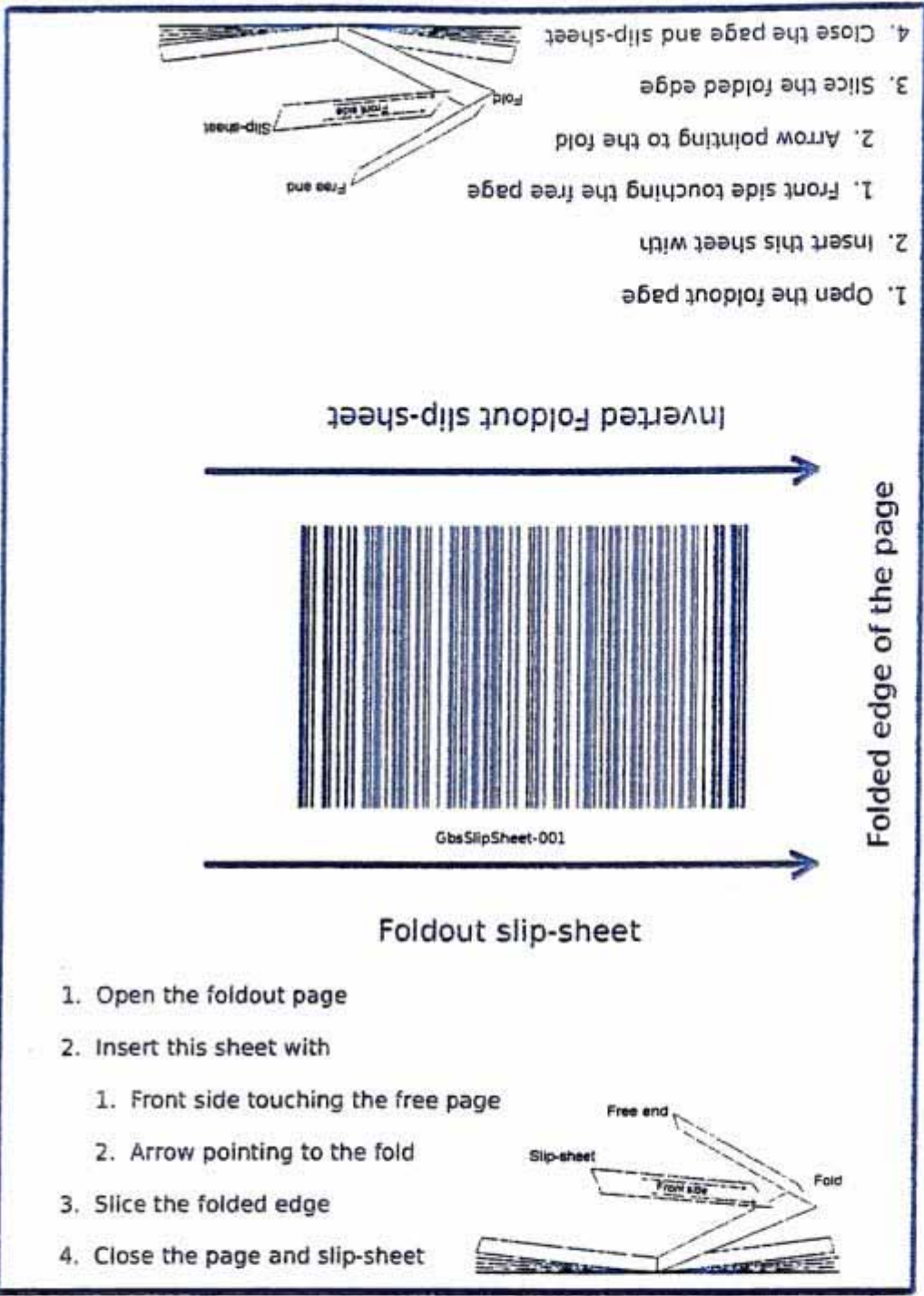
# THE DREAMS

car's Enthusiasm for Technology

and Museum  
Field Village

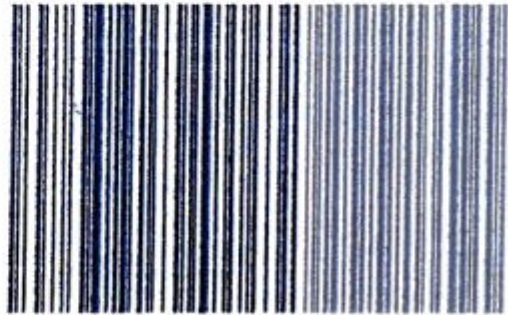
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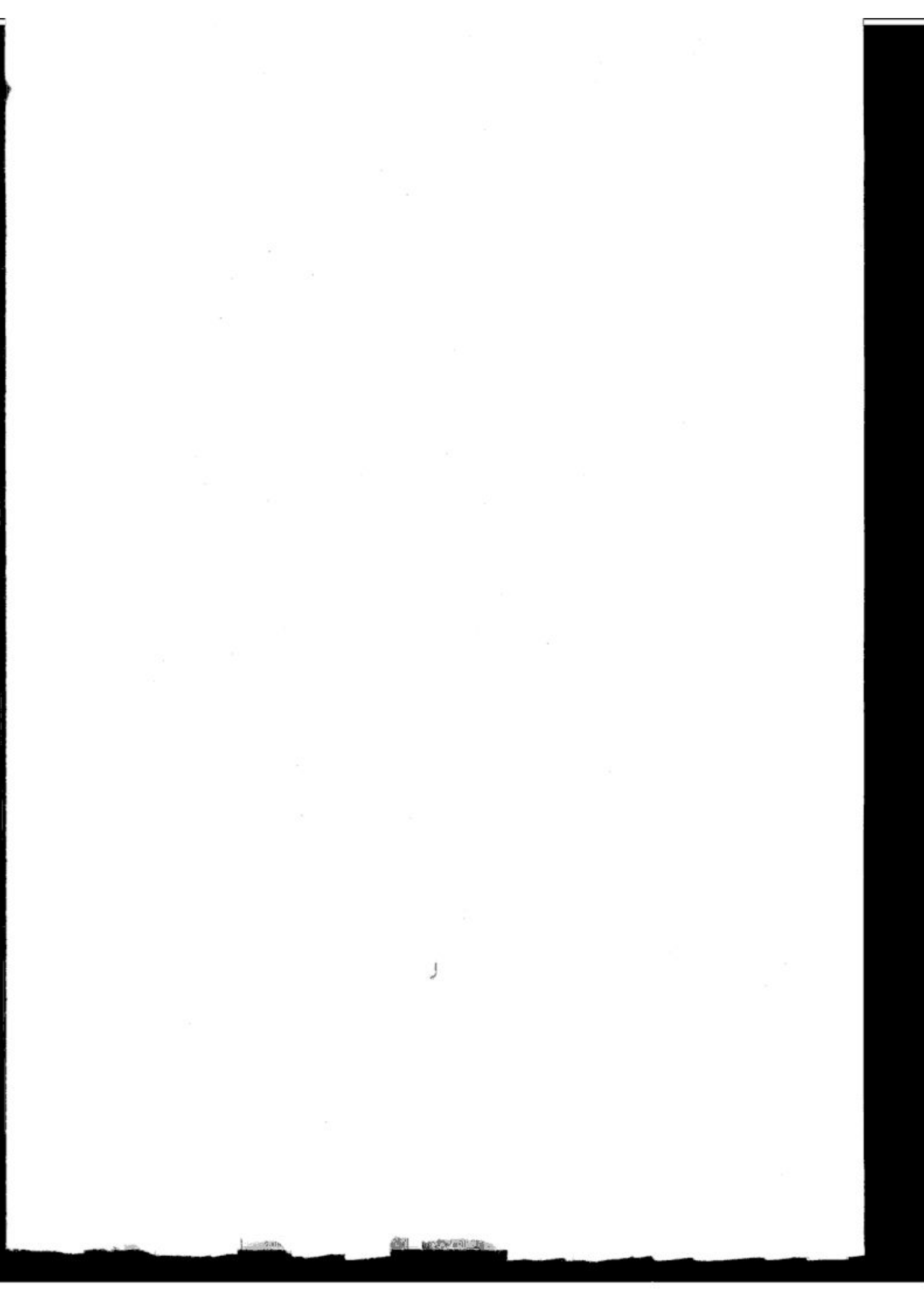
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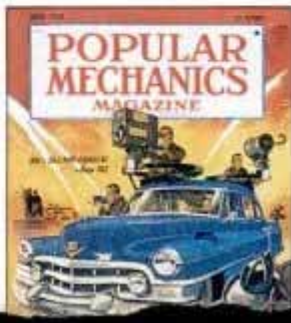
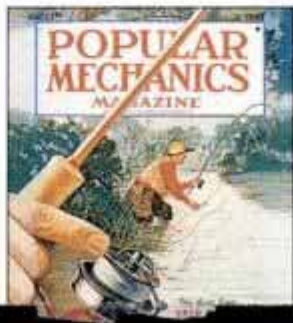
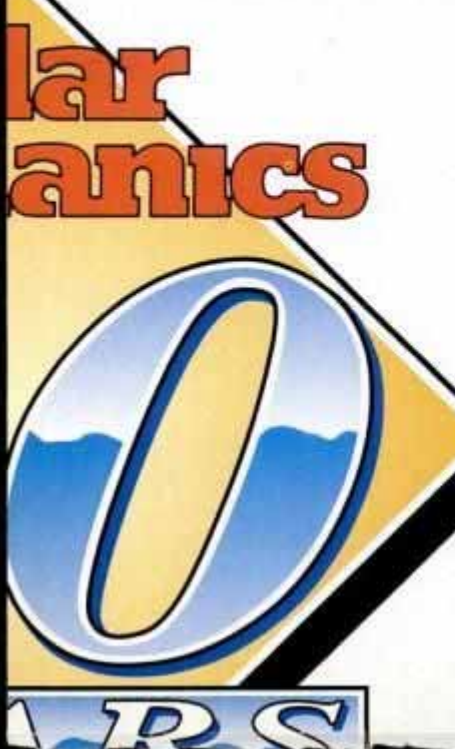
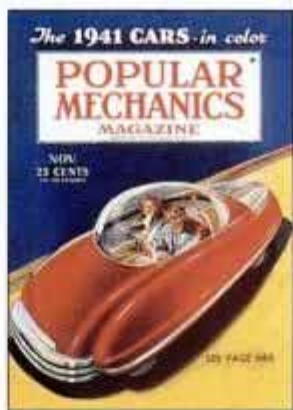
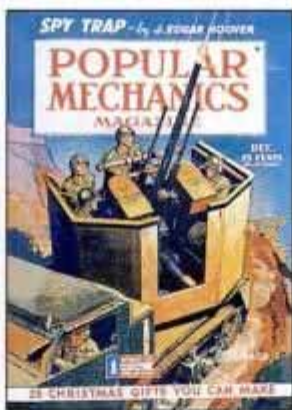
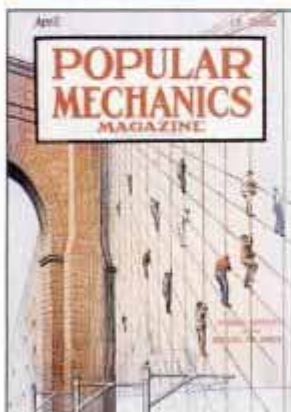
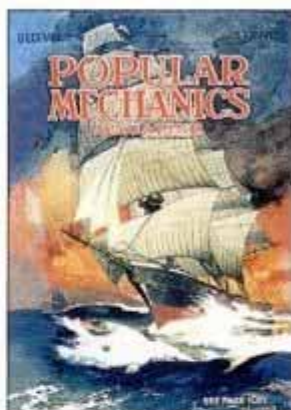
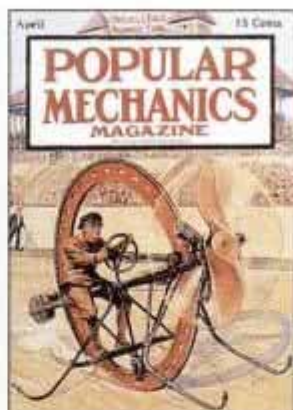
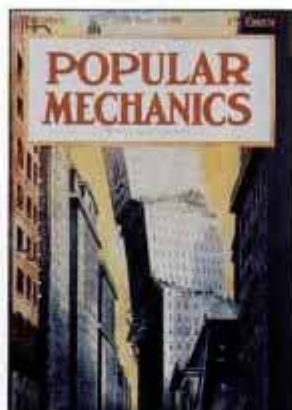
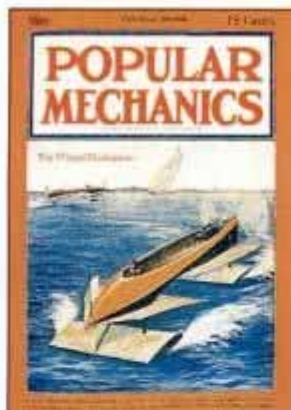
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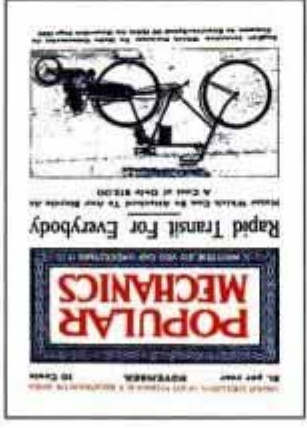
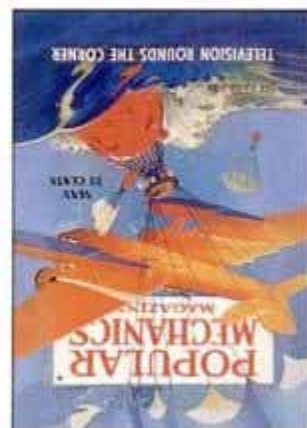
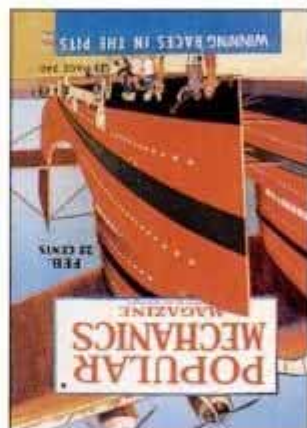








# Popu Mech





Objects once seen in PM are figured throughout the museum, like this '59 VW camper.

at the differences between a delicate 1905 dirigible propeller and a massive Olmstead prop of 1919. A 1914 PM article titled "Pictures Of Royal Yacht Made From Aeroplane" reveals that today's journalists are not all that different from their predecessors—although the c.1920 aerial camera close by is a far cry from today's machines.

But "Flying Fever" is just the beginning. The rage for electrifying cities, homes and farms from the late

"enough extra juice to run two lights."

Radio, a particularly popular rage of the 1920s, gets its own section titled "The World Is Radio Mad." PM

published dozens of tips and tricks showing its radio-crazed readers how to build, buy and use the newfangled devices that allowed ordinary people to listen in on the world. Some of those articles, illustrations and headlines are on display along with the latest receivers, speakers, headphones and D-I-Y radio tools of the 1920s. But our look at radio through POPULAR MECHANICS' lens would not be complete without a peek at "Radiovision." Here you can see some of the early, mechanical scanning television apparatus that was promoted so enthusiastically in PM between 1923 and 1929—despite its limitations. You will see that a 1928 PM article called the picture "about as clear and exciting as watching the fat gentleman across the street doing his setting-up exercises in a lighted room behind a drawn blind."



1910s to the mid-'30s is explored in "Electricity Wins!" Here you might be amused by a PM reader's 1922 suggestion for building an unusual-looking electric hair dryer from a vacuum cleaner and a toaster, amazed by a giant light bulb or entertained by seeing—and playing—a theremin, one of the world's earliest electronic musical instruments. If you were raised on a farm in the 1930s, you might recognize the wind-driven generator which could power a radio and still provide

Far more exciting were America's heady dreams for the future between 1930 and 1950. Despite the bleak realities of a present marred by the Great Depression and World War II—or perhaps because of it—many Americans had a penchant for planning, predicting and designing for the future. "Planning The World Of Tomorrow" takes a look at this trend as reflected in the pages of POPULAR MECHANICS. The activities of a new profession called industrial designer was a favorite PM topic. Some of the streamlined, modern products and design models created by "beauty engineers" Walter Dorwin Teague, George Walker and others can be found here. But the real star is the ultramodern 1936 Stout Scarab automobile, which might remind some visitors of today's minivans. A regular "living room on wheels" designed by aviation wizard William Stout, the Scarab was an idea ahead of its time.

Just beyond the turquoise Scarab arises the most dramatic feature of the exhibit—two full-size rooms from a PM do-it-yourself house. The cut-away house and its contents form a Rage Of The Age called "Building The Good Life," chronicling the postwar



Yes, motorized roller skates do exist. See them at the exhibit.

# POSSIBLE DREAMS



Walk into a dream—a 1947 PM dream house that looks like a diagram from the magazine.

boom in do-it-yourselfing. This 1947 dream house is constructed to look like a diagram from the magazine, revealing the various layers of construction, from studs and joists to shingles and siding. For visitors unfamiliar with house construction, many structural elements are labeled.

You will be able to walk through the living room and garage, which are fully furnished with items made from PM plans. In the living room, a beautiful train model built by a Massachusetts reader resides on the fireplace mantel, overlooking a matching sofa and hostess chair.

Next to the chair is a plywood sewing box built by a California reader, and on the floor, a model hovercraft that was built from

1965 plans and used as a science fair project by a young reader from the state of Washington. Out in the garage workshop is a PM Hydro Dynamic boat, built by a Michigan reader from 1963 plans.

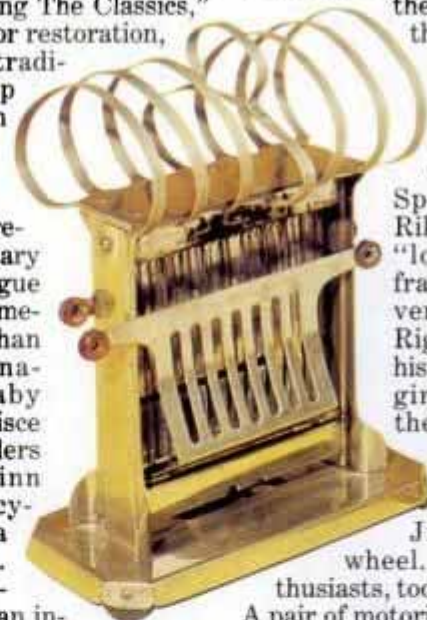
After leaving the house, you will encounter "Recycling The Classics," a look at the rage for restoration, preservation and traditional craftsmanship so prevalent in America and in POPULAR MECHANICS between 1975 and today. A restored 1905 stationary engine might intrigue those visitors with mechanical, rather than electronic, inclinations, while baby boomers can reminisce over the shiny fenders of a 1950 Schwinn Black Phantom bicycle, restored for a PM article in 1989. Woodworkers, indeed anyone with an interest in handicraft, are sure to admire a hickory chair built by former President Jimmy Carter using traditional hand tools. Quotations drawn from recent POPULAR MECHANICS articles reveal the reasons for our renewed interest in older, more familiar technologies of the past.

But a single chronological sweep through the 20th century still does not do justice to the wide-ranging technological enthusiasms of Americans. "90 Years Of In-

visible Rays" looks at our fascination with—and fear of—rays of all types from X-rays to lasers. If you've ever (or never) wiggled your toes under an X-ray shoe-fitting machine, stocked a bomb shelter or microwaved a meal, you're sure to have an opinion about the devices on display in this section.

One of the enthusiasms most characteristic of PM is captured in "90 Years Of Man's Quest For Speed." See the 1901 Riker racer, an electric "low-rigged racing frame" featured in the very first issue of PM. Right next to it sits the history-making rear-engined Lotus that won the 1965 Indy 500 with

See the latest plug-in toaster of 1918.



Jimmy Clark at the wheel. Amateur speed enthusiasts, too, have their day here. A pair of motorized roller skates, the world's first motor-scooter, a motorcycle and an electric slot-car racing set round out the story.

Of course, anyone who knows even a little bit about 20th-century technology is aware that much of its rapid advance has been driven by military research and development. Always in times of war, and often in times of peace, colorful PM covers have featured the latest in military technology. And while we cannot bring real aircraft carriers, jet fighters and



The 1920 Air-Way Sanitary System was all electric.

tanks into a 6200-sq.-ft. exhibit, the "90 Years Of Irresistible Force" section presents a selection of PM's military cover art, along with some of the commentary revealing common, and widely varying, opinions about war and its devices. In addition, we display some of the military toys that have been reviewed, along with other

with you a few of the many older versions of so-called new ideas.

And finally, just outside the gallery proper, we sneak a peek at a possible Rage Of The Future. There you can examine a hot, futuristic concept car, Ford's Probe V, embodying two of America's most characteristic enthusiasms—automobiles and the future. We also invite you to write a letter to Joe Oldham, the editor-in-chief of POPULAR MECHANICS. Write about the future, about the past, about anything that is on your mind. Joe

has promised to read them all, and some will be published in future issues of the magazine.

As a museum of history and technology, Henry Ford Museum & Greenfield Village is especially interested in helping our visitors understand how we as a nation have changed, and how things, attitudes and events have helped to shape our society. We believe that "Possible

Dreams" helps us do just that, allowing us to present a large, living scrapbook of American life in this most technological of centuries.

The exhibit runs from February 29, 1992, to January 2, 1994, so there's no excuse for missing it. So, point your favorite vehicle toward Dearborn, Michigan—be it jet pack, amphicar, steam motorcycle or motorized pogo stick—and come see "Possible Dreams." **FM**

PHOTO FROM HENRY FORD MUSEUM & GREENFIELD VILLAGE



The "Walkman" of 1921—the Radiola I.

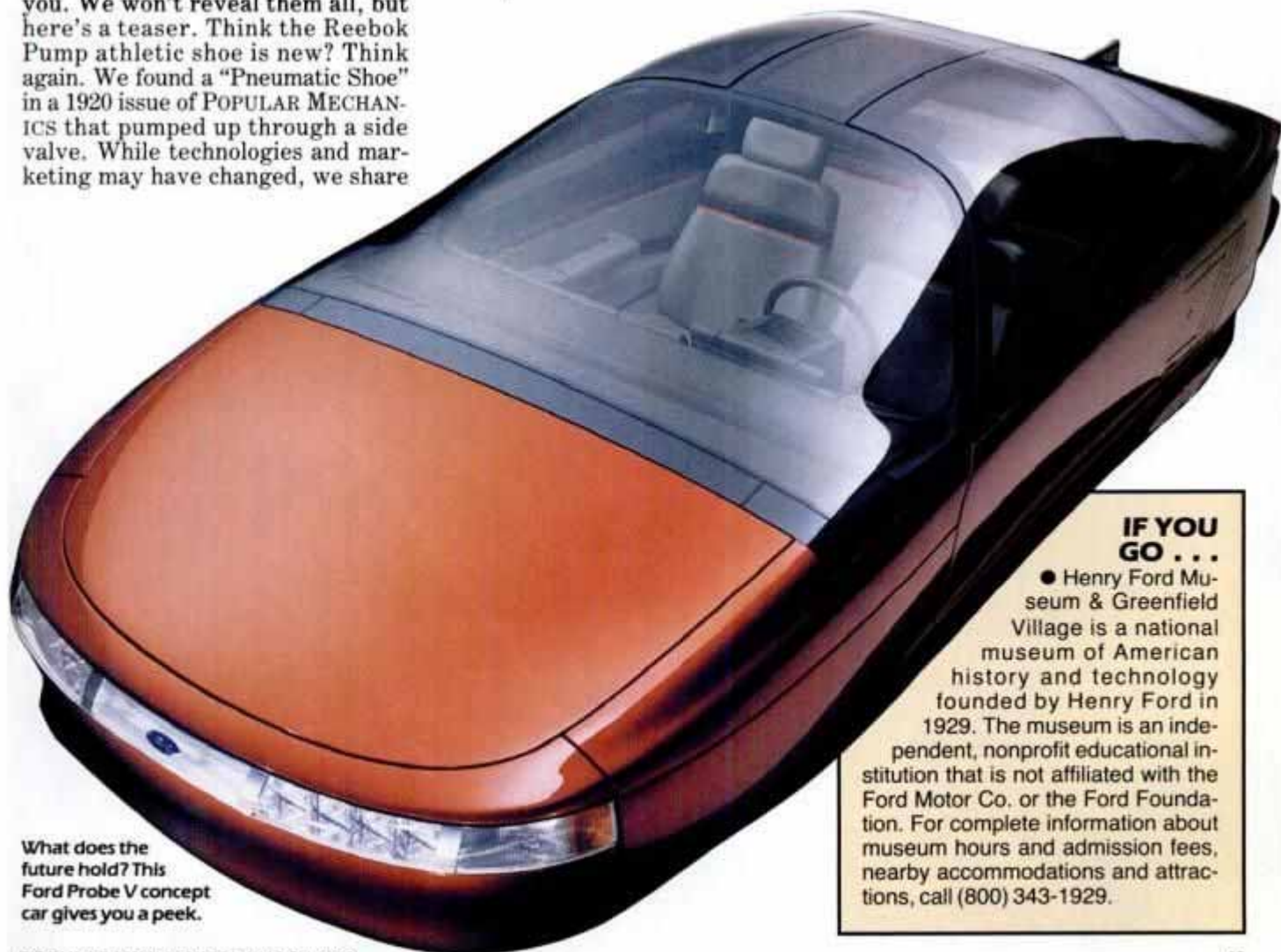
mechanical amusements, in such December articles as "Toys Make The Man" of 1929.

Among these larger sections, we have scattered a few surprises for you. We won't reveal them all, but here's a teaser. Think the Reebok Pump athletic shoe is new? Think again. We found a "Pneumatic Shoe" in a 1920 issue of POPULAR MECHANICS that pumped up through a side valve. While technologies and marketing may have changed, we share



PHOTO FROM HENRY FORD MUSEUM & GREENFIELD VILLAGE

"The World is Radio Mad" features the latest in radio, 1924.



What does the future hold? This Ford Probe V concept car gives you a peek.

**IF YOU GO . . .**

● Henry Ford Museum & Greenfield Village is a national museum of American history and technology founded by Henry Ford in 1929. The museum is an independent, nonprofit educational institution that is not affiliated with the Ford Motor Co. or the Ford Foundation. For complete information about museum hours and admission fees, nearby accommodations and attractions, call (800) 343-1929.



# BORN TO RIDE

Harley-Davidson—from motorcycle to American legend.

BY CARL CAIATI

*Motorcycles are like racehorses. You want to have the best bloodlines and that means to have a Harley, if you can. It's the most sought after motorcycle in the world, not just here, but in Japan, Europe, all around the globe.*

—Malcolm Forbes

● Malcolm Forbes knew motorcycles. His collection of 2-wheelers was extensive. He also knew the mystique of the Harley-Davidson nameplate. But acknowledging the Harley magic and defining it are two different matters. Japanese motorcycle manufacturers have been trying to nail down the Harley mystique for over a decade while pumping out their own versions of the American big V-twin. Their copies may have similar visual cues, but they still fall far short in that all-important intangible—Harley-Davidson.

Just what is it about Harley-Davidson that has embroidered it into the fabric of Americana? It's a look, a sound, a riding position, a certain style. One thing it's not is technically cutting-edge hardware. As a matter of fact, while some Japanese motorcycle engines are pushing new frontiers in performance-vehicle powerplant technology as a whole, Harley-Davidson is considered by some technoids as a dinosaur with its pushrod overhead-valve V2—the evolution of a basic design they've had since the mid-'20s. Paradoxically, Harley has done what no Japanese bikemaker is able to do—play up the current nostalgia craze by recreating the look of its 1940s and '50s machines in its Springer and Heritage editions. In fact, many Americans associate the Harley-Davidson name with the '50s look—massive size, flashy chrome, that distinctive “potato, potato” idle and raucous, straight-through exhaust note.

Visually, no other motorcycle captures the classic lines of a Harley hardtail—a design used by the Milwaukee-based firm up until the '50s. These bikes had the rear wheel attached solidly to the frame. In other words, no rear suspension at all. Spine-compressing would be a kind way to describe the ride. But there

around of social values, image-conscious Hollywood celebrities, who at one time wouldn't have been caught dead on a Harley, now consider it chic to tool around on the big, flashy machines. But the motor-mounted celluloid outlaws had their roots in real life. “Wild One” was based on an incident involving a motorcycle gang taking

over the town of Hollister, California. On the flip side of the ledger, Harley-Davidson has long been the motorcycle of choice for large numbers of police departments.

American pride runs strong in the Harley mystique. In the wake of the import motorcycle onslaught that started in the '60s, Harley devotees dug in their heels with a stubborn anti-import attitude. The more dominant the Japanese became in the marketplace, the stronger the Harley fans' resolve to buy American. Interestingly enough, Honda unwittingly

added to the Harley image with its '60s ad slogan: “You meet the nicest people on a Honda.” It was a veiled and underhanded swipe at the Harley rider, who was by implication somehow mad, bad and dangerous to know. Sure, it helped sell Hondas, but it also added to the macho Harley image.

Much of that image was of a rider who was highly individualistic. Harleys, more than any other motorcycle, are customized and personalized by their owners. It all started back in the '50s, when the thing to do was to bob



was an elegant simplicity to the motorcycle's profile, showing a frame that carried the top tube in a straight line from the neck clear back to the rear axle. Then there was the way the massive V-twin totally filled the engine space. Combine this with a heavy-looking front end carrying a deeply valanced fender and a wide, fat gas tank that housed the speedometer and warning lights, and the result was a motorcycle that achieved almost magical proportions.

Hollywood and Harley had a marriage that definitely wasn't made in heaven. But the silver screen unquestionably added to the marque's mystique, even though it was at the expense of its image. Film classics such as “Wild One,” with Marlon Brando, showed the good guy riding a British-made Triumph, while the bad guys went about their nasty deeds aboard Harleys. Interestingly, in a turn-





## BORN TO RIDE



1972 FLH custom done up in typical '60s chopper style.



1992 FXSTS Springer Softail carries a '48-style front end.

the rear fender. Then riders began removing the front fender, extending the front end, adding chrome, spraying on custom paint jobs with air-brushed murals on the tank and side covers, and even hand-fabricating various motorcycle components. These custom-modified bob-jobs or choppers were the breeding ground for a new aftermarket industry that produced lightweight, high-performance and dress-up parts for Harley-Davidsons—an industry that has grown to multimillion-dollar proportions. Magazines such as *Easyrider*s and *American Iron* cater to Harley builders and riders exclusively.

Harley customizers such as Dave Perewitz and Arlen Ness have styling clout to rival custom-car notables like George Barris and Roly Fernandez. Aftermarket parts are so extensive that it's even possible (though expensive) to build an entire motorcycle from non-factory catalogs.

The individualistic Harley attitude gradually developed into a lifestyle and a subculture that revolved around motorcycles. Outlaw groups, while achieving a high profile, really accounted for only a small minority of the Harley breed.

The extent of Harley rider bonding is evident today in the Harley Owners Group (HOG). Organized and run by the parent company with local chapters operated through its dealership network, HOG—with about 150,000 members—may well be the largest private club anywhere. The Harley mystique cuts across economic and social strata in a cult that has become a vast melting pot. Where else can outlaws, laborers, doctors and CEOs stand as equals—drawn together by one brand of motorcycle. And that's not just in the United States. Today, the Harley phenomenon spans the globe.

The loyalty among Harleyphiles extends not just to the hardware, but to the company itself. Harley-Davidson has accomplished what few American businesses have been able to do.

Beset by foreign competition, financial obstacles and internal problems, Harley-Davidson came perilously close to the edge. Then, Phoenix-like, it rose above its adversities, created a



Immaculately restored 1927 V-twin.

revitalized product and achieved a dominant niche in a fiercely competitive market.

Harley-Davidson, the motorcycle if not the mystique, had its beginnings

in 1903. Three Davidson brothers—Arthur, Walter Sr., William—and one William S. Harley founded the company. They worked out of a shed so small, it was once picked up and carried by hand. The famous twin-cylinder V-engine, with a displacement of 45 cu. in., was introduced in the mid-'20s.

The V-twin was enlarged to 61 cu. in. in 1936. Nicknamed the Knucklehead for the distinctive shape of its valve covers, the powerhouse featured a then-revolutionary combination: overhead valves and a fully recirculating oil system. A factory-built, streamlined, Knuckle-powered racer shattered the existing speed records. The "Big Twin" phrase found its way into Harley-Davidson advertising in 1941, when the engine went to 74 cu. in. The Knucklehead was superseded

### The Harley Heads

Harley-Davidson V-twin engines have long been identified by the unique shape of their heads and valve covers. Clockwise from top left: Flathead was offered in 45-, 74- and 80-in. displacements. Knucklehead was the first overhead valve design, and was available in 61- and 74-in. sizes. The engine developed a reputation for being bulletproof. Panhead featured aluminum head with bronze valve guides. It displaced 74 cu. in. Shovelhead design came in 74- and 80-in. displacements. It featured steel rockers mounted in the aluminum cover.





1992 FLSTC Heritage Softail Classic recalls the '49 Hydra-Glide.



1992 Sportster 883 Hugger is the lowest-sitting new Harley.

by the Panhead engine in 1948. The new 74-incher came with an all-aluminum cylinder head, plus extensive use of the light alloy for substantial weight savings and heat dissipation. Improved top-end lubrication, push-rod-type hydraulic lifters and redesigned rocker arms to minimize maintenance and engine noise were other benefits.

Harley's detail engineering improvements were in stark contrast to Detroit's preoccupation with annual cosmetic styling changes. In 1949, it pioneered the use of the hydraulically damped telescopic front suspension in its Hydra-Glide model—a concept that would become an industry standard. Nine years later, they added rear hydraulic shock suspension on a model dubbed the Duo-Glide.

Later on, much of the engineering

going on in Milwaukee would be in answer to the import-bike invasion. An optional foot gearchange similar to European motorcycles appeared in 1952. Standard Harleys were shifted



World War II WLA model in fighting trim.

automotive style with a foot clutch and gas-tank-mounted hand lever.

Bigger things began to happen in '52, as Harley went back to its roots to create a new, compact junior twin—

the K-model. It was a radically revamped version of the old 45-in. series that had started in 1929. Of particular note were a new crankcase that contained the transmission, primary drive in unit with the engine—a feature almost a decade ahead of the competition—and swing-arm frame. A race version—the KR—would win races for decades to come.

Harley fired a big salvo against the imports in 1957 with its potent and lean Sportster—an evolution of the K-model with 55 cu. in., overhead valves and magneto ignition on many models. The Sportster's spartan design was a significant departure from the Big Twin, which had oversized everything to benefit the touring rider. Performance was outstanding, and the bike quickly gained a reputation as an unbeatable street racer.

Meanwhile, Harley went on perfecting its tried-and-true big brother. A new Shovelhead design emerged along with electric starting in the mid-'60s Electra-Glide. Engine displacement was enlarged once again in 1978, this time to 80 cu. in. Refinements and improvements continued to flow from Milwaukee in the ensuing years—electronic ignition, five forward speeds and unique belt-drive systems that eliminated the problems of chains.

Today, approaching its 90th birthday, Harley-Davidson still has the vitality of a teenager. Its share of the U.S. heavyweight motorcycle market—more than 40%—is the envy of the industry. Harley still continues innovating with the industry's first application of electrostatic powder coating of parts in 1991 and O-ring sealed drive chains for '92. Rumor has it that the factory's next-year production is already completely sold out. Consortia of overseas buyers scour garages and shops nationwide for Harleys—in any condition. So well entrenched is Harley in American folklore and spirit that owning one is like owning a personal piece of the American dream.

Harley-Davidsons were known for their unique styling touches.

Clockwise from below: the bicycle pedal kick-starter, the tank-mounted hand shifter, hinged rear fender, beautiful tank-mounted speedometer and warning lights, and floorboards instead of footpegs.



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## SHOP PROJECT

## HAPPY ANNIVERSARY

A curly maple dresser built to celebrate PM's 90th anniversary.

BY NEAL BARRETT

● When asked to design a small collection of furniture for POPULAR MECHANICS' 90th anniversary, we thought it would be appropriate to have the first of the four pieces reflect

the dominant furniture style of 1902, namely Arts-and-Crafts or Mission furniture. With its roots in Great Britain, this movement found a strong following in the United States.

The movement's philosophy was to rediscover the values of craftsmanship and design that lay dormant since

the advent of the industrial revolution. It seems no less valuable today to re-examine these concepts.

We tried to capture the spirit of the movement, and set it in a contemporary context, by building our piece out of solid curly maple offset with walnut door and drawer pulls. The back of the dresser is also solid wood, allowing it to stand against the wall or function as a room divider.

Color photo: John Griebisch  
How-to photos: Neal Barrett  
Technical art: Eugene Thompson

## Making The Case Sides

Begin by selecting lumber for each part of the dresser. Reserve the most figured stock for sides and drawer fronts. Rip and crosscut stock to rough size for the side panels, top, shelves and partition. Joint the edges of each piece, and mark for joining plates spaced about 6 in. on center.

On a flat surface, cut the biscuit slots (Photo 1). Apply glue to stock edges and joining plate slots, insert panels and assemble the panel. Clamp until the glue has set, but scrape off glue squeeze-out after 20 minutes. Scrape the panels smooth, then rip and crosscut them to size (Photo 2).

Make the panels' false bottom rail out of 1 1/4-in.-thick stock with its grain running vertically. That way, the panel and false rail expand and contract in the same direction as humidity fluctuates.

To make this rail, glue up a short panel about 12 in. wide x 16 in. long and rout a 3/16-in.-wide chamfer along its top and bottom edges. Then, rip a 4-in.-wide strip off each edge for each rail. Attach the rails to each case side with biscuits (Photo 3). Glue and clamp the assembly.

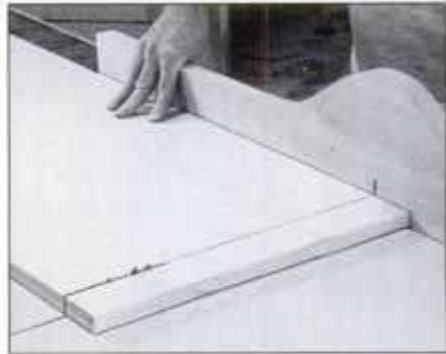
Rip and crosscut the legs from 10/4 stock (about 2 1/2 in. thick). Lay out and cut the curve on the two inside surfaces of each leg. Remove saw marks with a belt sander (Photo 4).

Lay out and cut biscuit slots in the legs and side panels for assembly of the case sides (Photo 5). Apply glue and clamp the legs to the panels.

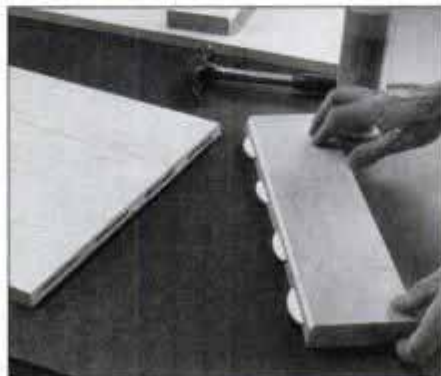
Use a plunge router with a 1/4-in.-dia. bit and edge guide to cut the groove in each case side to house the back panels (Photo 6). Make the cut in three shallow passes. Readjust the router's depth and cut the mortises at the ends of each groove. Readjust the edge guide to cut the mortises for the front bottom rail. Square the ends of each mortise with a sharp chisel.



**1** Mark the spacing for the biscuits on the stock for the case sides. Place the stock on a tabletop and cut the biscuit slots.



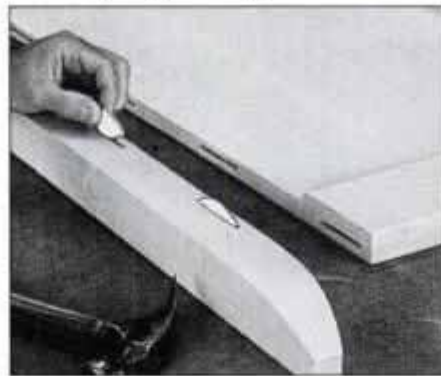
**2** Crosscut the glued-up panels for the case side on the table saw. It's most accurate if you use a sliding crosscut table.



**3** Cut biscuit slots in the ends of the case sides and the top edge of the siderail. Glue and clamp the pieces together.



**4** Clamp a case leg in a vise. Remove band saw marks and refine the leg's shape using a belt sander.



**5** Lay out and cut the biscuit slots in the legs and the edge of the side panels. Glue and clamp the assembly.



**6** Cut the back panel groove in the legs with a plunge router and edge guide. Reset the router's depth to cut rail mortises.

### MATERIALS LIST—ANNIVERSARY DRESSER

Key	No.	Size and description (use)
A1	2	3/4 x 16 x 61 1/4" maple (side)
A2	2	1 1/4 x 4 x 16" maple (siderail)
B1	2	2 x 2 x 71 1/4" maple (back leg)
B2	2	2 x 2 x 71 1/4" maple (front leg)
C	1	3/4 x 2 1/4 x 34" maple (back top rail)
D	1	3/4 x 4 x 34" maple (back bottom rail)
E	1	3/4 x 4 x 34" maple (front rail)
F	1	3/4 x 3 x 32" maple (cleat)
G	1	3/4 x 6 x 60 1/2" maple (back mullion)
H	2	1/2 x 13 3/4 x 59 3/4" maple (back panel)
I	5	3/4 x 3 x 32 1/4" maple (front drawer frame)
J	10	3/4 x 2 1/4 x 15" maple (side drawer frame)
K	3	3/4 x 17 1/2 x 32" maple (shelves)
L	1	3/4 x 13 3/4 x 17" maple (center partition)
M	1	1 1/2 x 22 x 40" maple (case top)
N1	2	1/2 x 5 x 16 1/2" maple (drawer sides)

N2	6	1/2 x 7 1/2 x 16 1/2" maple (drawer sides)
O1	2	3/4 x 5 x 32" maple (drawer front/back)
O2	6	3/4 x 7 1/2 x 32" maple (drawer front/back)
P	4	1/4 x 16 1/2 x 31 1/2" maple plywood (drawer bottom)
Q1*	4	1/2 x 9 15/16 x 16" maple (upper door veneer)
Q2*	4	1/2 x 11 15/16 x 16" maple (lower door veneer)
R1	2	3/4 x 9 15/16 x 15" veneer core plywood (upper door core)
R2	2	3/4 x 11 15/16 x 15" veneer core plywood (lower door core)
S1	4	1/2 x 3/4 x 9 15/16" maple (edge band)
S2	4	1/2 x 3/4 x 11 15/16" maple (edge band)
T	8	3/4 x 2 x 16" maple (door rail)
U1	4	1/2 x 3/4 x 8" walnut (door pull)

U2	4	1/2 x 3/4 x 20" walnut (drawer pull)
V	12	1/2 x 3/4 x 3" walnut (pull bracket)
W	4	1/2 x 3/4 x 1 1/2" walnut (glue block)
X		joining plates as required (wood biscuits)
Y	44	No. 8 x 1 1/2" fh wood screw
Z	12	No. 6 x 1" fh wood screw

**Misc.:** four pairs, Brusso L-knife hinges; four door catches; sandpaper; Waterlox Transparent Finish.

\* Combined dimensions of two pieces of book-matched veneer. Veneer available from Certainly Wood, 11753 Big Tree Rd., East Aurora, NY 14052.



## Case Assembly

Rip and crosscut stock to size for the front and back rails and the back center mullion. Use dado blades in a table saw to cut the tenons on each piece and pare the tenons smooth with a chisel (Photos 7 and 8).

Lay out and cut the curve on the front bottom rail, then smooth away saw marks with a spokeshave (Photo 9). Then glue and clamp the cleat to the front rail (Photo 10). When the glue sets, rout a  $\frac{3}{16}$ -in. chamfer across the rail's top edge.

Cut the grooves in the top and bottom back rails, and the center mullion, to house the back panels. Use a slotting cutter in a router or dado blades in a table saw.

Next, cut the mortises to house the mullion tenons in the rails. Bore the mortises with a  $\frac{1}{4}$ -in.-dia. bit in a drill press (Photo 11), and clean them up with a sharp chisel.

Because the case frame is a complex assembly, glue and clamp it together in subassemblies.

First, glue the bottom rail to the center mullion, using a long pipe clamp. Check assembly for square and let the glue set (Photo 12). Next, use a router with a straight bit, guided by two pieces of scrap lumber to cut the shelf dados across the mullion.

Glue-up  $\frac{1}{2}$ -in.-thick stock for the back panel. Rip and crosscut the panels to size. Cut the rabbet around the edges of the panel using a router and a  $\frac{1}{2}$ -in. straight bit and edge guide.

Lay out the location of shelves and drawer frames on each case side. Also lay out the joints between the partition and case top, and the case top, sides and back rail.

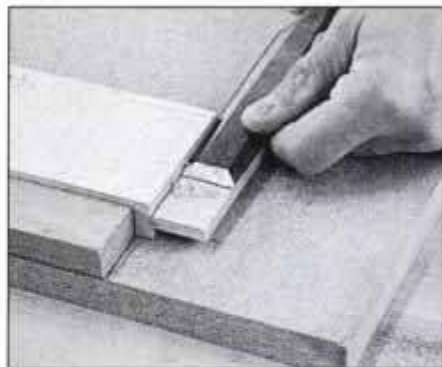
Cut the biscuit slots in the sides, shelves, partition and top and back rail as shown in the plans and Photo 13. Use a router and a straightedge guide to cut the stopped drawer frame dados in the case sides (Photo 14). Chisel the dados square.

Cut stock to size for the drawer frames. Lay out and cut the mortises in the front pieces with a router or on a drill press followed by a chisel. Cut the tenons on the sidepieces with dado blades in a table saw.

Use a jigsaw to make the curved cutout on the back end of each sidepiece, then use the drill press to bore the elongated pilot holes for attaching the frames to the case sides. These frames sit in a shallow dado in the case sides and are glued in place only at the front 4 in. The rear of each frame is fastened by a screw. The elongated pilot holes allow the case sides to ex-



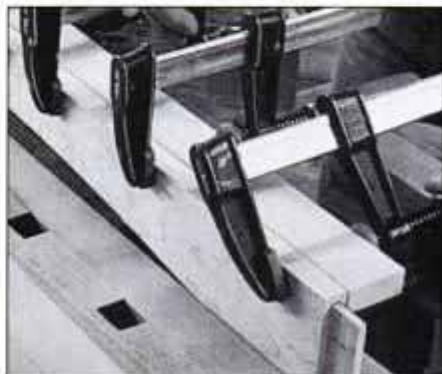
**7** Cut tenons on the front and back rails with dado blades in the table saw. Tip the piece on edge to cut the tenon to width.



**8** Clamp the rails to a bench hook and pare off the ridges on the tenon left by the dado blades. Use a sharp chisel.



**9** Saw the curve on the front rail, and remove the saw marks with a spokeshave. Edge should not need further smoothing.



**10** Glue and clamp the cleat to the front rail. When glue sets, remove the clamps and cut the chamfer on the rail's edge.



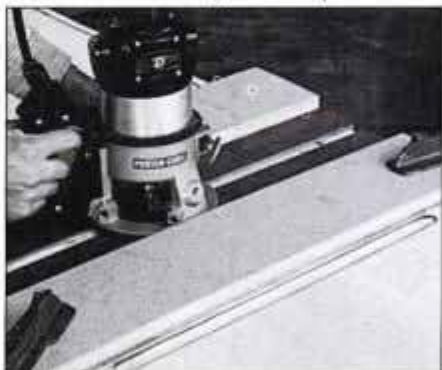
**11** Cut the mortises in the top and bottom back rail on the drill press. Square the mortises with a sharp chisel.



**12** Glue and clamp the mullion to the back bottom rail. Check that the assembly is square before leaving it to set up.



**13** Mark the biscuit locations for the shelves on the case sides. Use a straightedge to guide the plate joiner.



**14** Cut the shelf dados with a router and straight bit. Use a routing jig to accurately place and cut the dados.

pand and contract with humidity.

Bore three  $1\frac{1}{64}$ -in.-dia. holes side-by-side for slots, then use a chisel to connect them. Countersink the elongated holes for a No. 8 fh screw.

Glue and clamp each drawer frame, and check it for square (Photo 15). Use a table saw and miter gauge to cut the notch at the front ends of each drawer frame (Photo 16).

Prior to assembly, bore the pilot holes in the top shelf, partition and bottom rail cleat. Also, bore the clearance hole in the top drawer frame.

Begin assembly by laying one case side, inside face up, on a pair of sawhorses. Attach the top back rail to the center mullion without glue, then install the rails to the case side, gluing only the bottom rail joint. Pull the joint tight with clamps (Photo 17).

Install one shelf at a time to the case side, applying glue to the biscuit slots in the shelf and side as well as to the dado in the center mullion. Glue and clamp each shelf to the case side and center mullion. Use heavy cauls across the case side to distribute clamping pressure along the joints.

Glue and clamp the front bottom rail to the case side, and screw through its cleat into the shelf.

Apply glue to the front 4 in. of both the drawer frames and dadoes. Clamp the frame in place, and bore a pilot hole through the slot at the rear of the frame into the case side. Screw the frame to the case side (Photo 18).

After the glue has set on all parts, remove the clamps and the top back rail from the assembly. Install the remaining case side, using the same technique as for the first side. Have a helper position the side over the many parts. Glue, then clamp the side as required to bring all joints tight. Check the assembly for square by measuring diagonals. After the glue has dried, remove the clamps. Lay the case face-down and slide the back panels into position.

## Drawers And Doors

Cut the drawer parts to size. To make the dovetails, we used a router and Leigh Model 1258-24 dovetail jig, but any similar jig will work. However, your dovetail spacing may vary depending on the jig you use. Test your dovetail cutting setup on some scrap before working on the drawers.

To cut the tails on a drawer side, clamp the workpiece vertically in the jig and rout the joints. The pins are cut on the drawer fronts and backs with the workpiece held horizontally (Photos 20 and 21).

Next, use the dado blades in a table

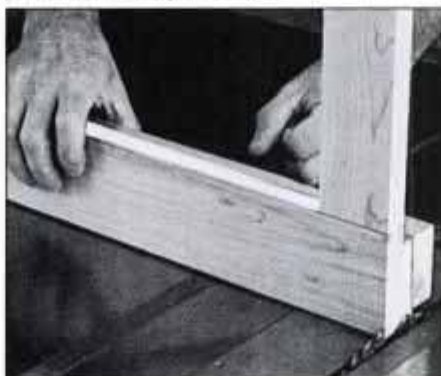
Finish the case construction by gluing and clamping on the back top rail. Don't get any glue on the panel surfaces, as this might restrict movement and cause the panel to crack.

Glue and clamp the center partition to the top of the case (using biscuits). Then after the glue sets, glue and clamp the top to the case (Photo 19). Use a caul with a thin piece of veneer wedged under its center to evenly distribute clamping pressure across the top.

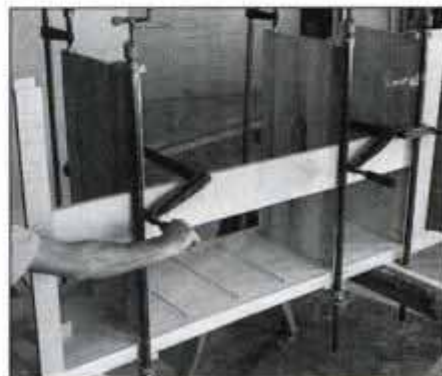
Use a ratchet wrench and a socket with a hex-shaft Phillips screwdriver bit in it to drive the screws into the bottom of the partition.



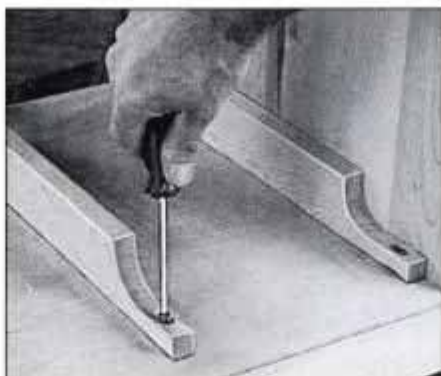
**15** Glue and clamp together the drawer frame parts. It's important that each assembly be square and free of twist.



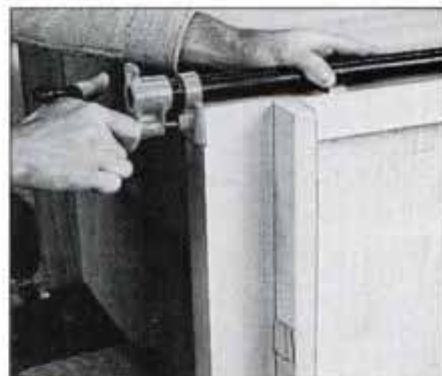
**16** Stand the drawer frame on edge, and using the miter gauge on the table saw, cut the notch on the front of each frame.



**17** Join the back rail assembly to a case side. Glue only the bottom rail joint, and clamp it. Top rail aids positioning.



**18** Glue the first 4 in. of the frame to the side. Then screw the frame to the case side. (Note the elongated screw hole.)



**19** Glue and clamp the top to the case. Use a caul with a thin wedge at its center to distribute clamping pressure.

saw to cut the groove for the plywood drawer bottoms. Sand interior drawer surfaces prior to assembly.

To assemble a drawer, spread glue on all dovetail joint surfaces with a small brush. Join a side to the front and back, slide in the bottom, then attach the opposite side. Use a mallet to bring the joints tight. If the dovetails fit properly, there is no need to clamp the joints. Check the drawer for square, adjust it if required and set it aside to dry.

The drawers are dimensioned the same size as the openings in the case. To make the drawers slide smoothly

in the case, sand or plane their outside surfaces to fit the opening.

Cut the plywood panels for the doors to width, but leave the height dimension slightly long. Note that the face grain of the plywood runs horizontally, while the veneer grain runs vertically. Glue the vertical edge banding to the plywood core, and when the glue has set, plane it flush to the plywood. Check your work with a straightedge frequently. An edge band that is too high or low will prevent proper adhesion of the veneer.

Cut the veneer sheets to rough length by scoring them with a utility



knife or veneer saw. Use a straight-edge and veneer saw to trim the stack of veneer to rough width (Photo 22). Then, clamp the stack between two straight boards and plane one edge of the stack straight. Match up two pieces of veneer per door, so they form a mirror image (bookmatch them).

Place the bookmatched veneer on a worktable, and use perforated veneer tape to assemble it. Wet the tape with a damp sponge, and apply it every 4 in. across the joint, followed by a length of tape down the entire joint (Photo 23).

To apply the veneer to the core, make two cauls to evenly distribute clamping pressure. Place the bottom caul between two sawhorses, and cover it with newspaper. Lay one of the veneer faces over the paper, taped side down. Use a foam roller to apply glue to the core surface and place the glued side over the veneer.

Next, roll glue on the remaining side of the core and place the other veneer face over the core, taped side up. Cover the assembly with more paper and the top caul. Clamp the panel starting at the center and working out toward the edges (Photo 24). If you don't have clamps deep enough to reach within 2 in. of the panel's center, you can use slightly crowned battens across the cauls to distribute the pressure.

Let the panel sit in the clamps at least 4 hours, then gently moisten the veneer tape and peel it off.

Trim the panels to dimension and cut the top and bottom rails to size. Glue the rails to the panels.

Lay out the hinge mortises in the doors and case frame. We used Brusso  $\frac{3}{8}$ -in.-wide L-knife hinges, available from Woodcraft, 210 Wood County Industrial Park, Box 1686, Parkersburg, WV 26102.

Chisel the  $\frac{1}{8}$ -in.-deep mortises in the door rails, and install the hinges in the case mortises. Be sure to install only the top hinge in the upper doors and the bottom hinges in the lower doors.

For the top doors, engage the hinge pins at the top of each door. Then, with the door held perpendicular to the case, slide the bottom of the door onto the fully assembled hinge at the bottom of the case and screw it in place. For the bottom doors, reverse the procedure, engaging the bottom hinge first (Photo 25). Trim the leading edges of the doors as necessary to achieve the desired margin around each door.

Next, cut the parts for the door and

drawer pulls from walnut. Cut the cove at the top and bottom of the vertical blocks and ends of the long bars, and smooth it with a drum sander in a drill press.

Cut the notch in each vertical block, then bore and countersink the pilot hole in each. Glue and screw the pulls together.

Bore pilot holes in all doors and drawer fronts for mounting the pulls. Hold the pulls in place and bore pilot holes in the pulls, then fasten them with  $1\frac{1}{4}$ -in.-long No. 8 fh screws. Mount the adjustable ball door

catches to the case and the inside of the doors (also available from Woodcraft). Next, remove all doors, drawers and hardware. Sand these parts and the case with 120-, 220- and 320-grit paper, brushing off between grits.

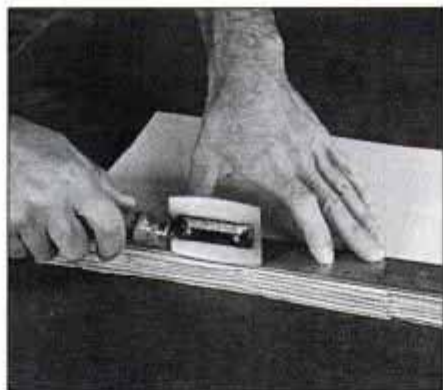
We used three coats of Waterlox Transparent Finish to complete the piece (Waterlox Chemical & Coatings Corp., Cleveland, OH; (216) 641-4877). Brush on each coat, and wipe it off, leaving only a thin coat each time. Let each coat dry overnight and sand it with 320-grit paper. Rub out the final coat with 4/0 steel wool. **PM**



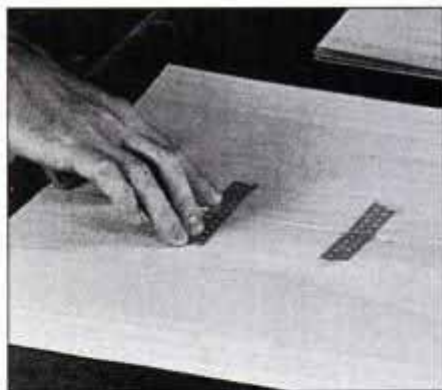
**20** Machine-cut dovetails are made with a router and jig. Hold a drawer side vertically in the jig to cut the tails.



**21** Pins are cut in the drawer fronts and backs with the workpiece at horizontal. A vertical board steadies the router.



**22** Cut the stack of veneer to rough length, then use a veneer saw and straight-edge to trim it to width.



**23** Join bookmatched veneer with perforated veneer tape. Wet the tape on a sponge and keep the joint tight as you go.



**24** Use heavy flakeboard or plywood as cauls to clamp the veneered panels. Place paper between the cauls and panels.



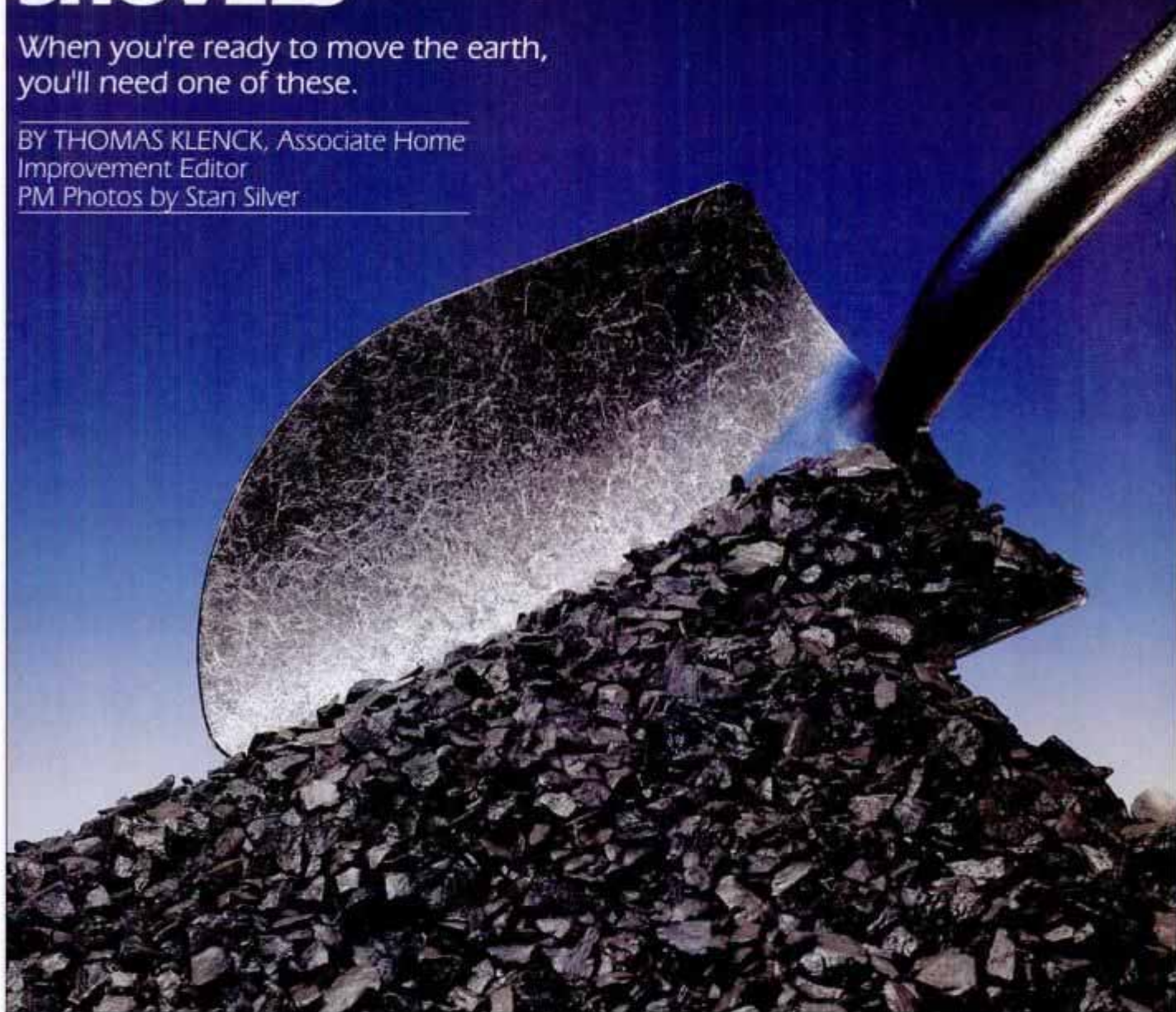
**25** The doors and hinges are installed in stages. Hinges are installed in the case, and the door is slid into them.

## TOOLS

# SHOVELS

When you're ready to move the earth, you'll need one of these.

BY THOMAS KLENCK, Associate Home Improvement Editor  
PM Photos by Stan Silver



● They're not the most glamorous tools in the world. Nor do they boast high-tech features, innovative design and flashy new models each season. Their forms and functions have been with us in one way or another for hundreds of years. Yet, the ordinary shovel is one tool that most of us consider basic survival equipment when it comes to dealing with Mother Earth.

Like all simple tools, it's easy to take shovels for granted. After all, they're little more than a long handle with a blade fixed to one end. However, for each situation that demands material be moved by muscle power, there's probably a shovel that is ex-

pressly designed for the purpose.

In fact, the word shovel is a term that represents only one subset of this large group of hand tools. Specifically, a shovel is used for carrying material from one place to another. To make this work easier, the handle and blade are angled so you don't have to bend over so far when loading the shovel. Depending on the blade design, a shovel may also be suitable for digging into compacted soil. When the material being handled is light, the blade can be made larger so the work goes faster. Large-blade shovels are generally called scoops, and have deep, flared blades for greater capacity. Spades, on the other hand, func-

tion more as digging tools than carrying tools. They have flatter, more rectangular blades that are almost in line with the handle.

Shovel handles come in two basic styles. The standard long handle is simply a cylindrical rod for levering, carrying and dumping the contents. For ease of use, the handle is slightly tapered, and thicker by the blade for strength. At the top, the handle diameter increases again, and is rounded over for comfort.

The second configuration is the shorter D-handle design. This handle is better for working in confined spaces, although leverage power and reach are sacrificed. The D handle

makes it easier to twist the shovel sideways to dump its contents, and serves as a grip to apply pressure.

Although today's shovels usually have a steel blade, some models use lightweight aluminum when the strength and durability of steel isn't required. Some steel-blade tools come in either open- or closed-back construction. In an open-back shovel, the blade and socket

are forged from a single piece of steel, and a recess remains at the back of the blade where the socket is formed. Closed-back shovels have a triangular plate welded over the recess to increase strength and reduce drag. And, while wood—usually ash—is the standard for shovel handles because it combines light weight, resiliency and strength, many types are now offered with fiberglass handles. These provide increased strength, durability and weather resistance.

Most shovels are available in several quality grades. The more expensive tools have sturdier blades and stronger joints. Fiberglass handles also demand a premium price. Paying more initially can be an economy in the long run, as the shovel will last longer and may even perform better.

**1. Telegraph spoon**—You probably won't find this shovel in your local

hardware store—and for good reason. This single-minded tool exists for the sole purpose of scooping out the earth at the bottom of deep narrow holes—just the kind you might dig to install utility poles. As such, this tool is a heavily built, professional model that's designed for the rigors of daily use. Its long ash handle is about 1¾ in. thick to withstand heavy levering and prying. At the bottom, the severely angled spoon-type steel blade is massively joined to the handle with long, riveted straps. The blade has a circular edge about 9 in. wide. The model shown is called an Eastern-pattern spoon. The Western pattern has a more acutely bent, flat bottom.

You might think twice about buying this shovel, though. At 8 ft. long and costing about \$134, it might be a little difficult to store in your utility shed, as well as fit in your budget. However, if you're still interested, it's the model 11-144, and it's made by Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102.

**2. Round-point shovel**—The slightly pointed blade makes this shovel the choice for digging into soil and com-



packed materials, and it's ideal for planting shrubs and trees. The moderate blade size of about 9 in. wide × 12 in. long makes it convenient for handling heavy materials.

Some models have turned-over top blade edges, or steps, to make it easier to drive the shovel in with your foot. The model shown has plain edges and a long, 50-in. ash handle for extra leverage and reach. The handle fits into a steel socket that's integral with the blade, and it's secured with rivets.

A short D handle is also available for working in tighter areas and utilizing more arm power. Premium models have fiberglass reinforced handles for weather resistance and durability. The model FLR round-point dirt shovel shown costs about \$16. Contact True Temper, Box 3500, Shiremanstown, PA 17011.

**3. Roofer's spade**—While the evolution of shovel design doesn't exactly keep pace with other areas of contemporary manufacturing, here's a fairly recent innovation that will expand your ideas about what shovels are for. This spade is specially designed to remove asphalt roofing shingles in prep-

aration for a new roof.

Roofers have long recognized that a straight-tipped spade is a handy tool for slipping under layers of shingles and then prying them up. However, it wasn't long before some ingenious roofer decided that a few modifications would make the ordinary spade an effective and specialized roofing tool. The roofer's spade has a serrated edge that helps pierce under the layers of roofing and catch the roofing nails. To improve leverage and prying power, it has a steel bracket secured to the back. This raises the pivot point away from the shovel back and closer to the edge so greater lifting force can be applied. The long ash handle extends your reach and makes the job just a little easier on your back.

The model 15-655 roofer's spade shown is made by Ames and costs about \$27. Write to Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102.

**4. Trenching shovel**—When it comes time to bury underground cable or piping, there's no reason to remove any more earth than need be. This shovel is designed expressly to

clean out narrow ditches. The model shown has a carbon-steel blade that measures only 4 in. wide by nearly 12 in. long. Its curved profile is ideal for scooping out dirt, and the blade is riveted to a 47-in.-long ash handle.

While this light-duty model is better suited for trench cleaning and removing loose soil, larger models have 5- or 6-in.-wide blades and turned-over steps for applying foot pressure. For narrow trenches, a 3-in.-wide model is also available.

Similar in design and function is the drain spade, intended for cleaning out drainage trenches and general garden work. Its blade is straight along its length with slightly tapered sides, and curved across a roughly 6-in. width. It has a rounded tip and usually features the shorter D handle. Another specialized variation is the post spade. It's similar to the drain spade but has a parallel-sided blade.

The model TS4 trenching shovel shown costs about \$18. For more information, write to True Temper, Box 3500, Shiremanstown, PA 17011.

**5. Dutch spade**—If you work in the garden, there's a good chance you already own a spade. This common tool features a shallow rectangular blade suited for ordinary digging and earth turning. On some, the blade tapers slightly, and others, like the Dutch spade shown, have parallel sides.

This particular model has several features that contrast it to the hardware store models you're likely to find. The edge of the forged-steel blade is slightly rounded and sharpened to help pierce tough garden soils. And the blade socket wraps completely around the handle for extra strength. What's immediately unique about this spade is its T-shaped grip that functions like a typical D handle. However, the shaft is longer than most D-handled tools so you can apply more leverage. The Dutch spade is available from De Van Koek, 3100 Industrial Terrace, Austin, TX 78759. It costs about \$55.

**6. Grain scoop**—When leverage isn't an issue, and you simply need to move a lot of relatively light material from one place to another, you'll probably choose a tool like this grain scoop.

Because this tool isn't generally used with heavy foot pressure, the top blade edges have only very small turned steps and the corners are rounded and flared to hold more material. However, the D handle allows you to provide extra forward force with your hand and stabilize a wide load so the scoop doesn't lean to one



side. It also makes it easier to dump the contents with a flick of the wrist.

Because blade strength isn't as important as with ordinary shovels and spades, this scoop has an aluminum blade to reduce weight. The blade also is ribbed to add extra stiffness. Some models are available with heavier steel blades for extra strength. The D grip that caps off the ash handle is made of plastic. The Ames model 16-812 grain scoop costs about \$36. Write to Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102.

**7. Coal and street shovel**—While the name of this shovel makes it seem like something of an anachronism, you'll still find it useful for the right job. Intended to shovel material like coal and sand, this 14-in.-wide × 15-in.-long steel-blade tool carries more to get the work done quicker. The blade has flared sides and a ribbed bottom to add stiffness.

In addition to the D-handled model shown, it is also offered mounted to a long straight handle. In this configuration, the tool takes on its street chores, and, along with a stiff bristle broom, will handle all cleanup jobs. The True Temper model CB2 coal and street shovel costs about \$38. Contact True Temper, Box 3500, Shiremanstown, PA 17011.

**8. Square-point shovel**—While round-point shovels excel at piercing tough compacted soils, the square-point version's job takes up the rest of your typical shoveling chores. It's best at moving loose material such as sand, gravel and topsoil. Sized about the same as a round-point model, the rectangular-shape tool is in many ways a scaled-down version of the coal and street shovel. The smaller blade size, however, makes it better at handling heavier material.

The Ames model 15-627 shown (\$27) has a ruggedly constructed metal-and-wood D handle. The 30-in. ash handle is actually split at the grip end, and then forced into the metal D-handle casing. Like many other shovels, this model is available with a long, plain-end handle as well. Contact Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102.

**9. Garden spade**—If you're looking for high-tech in shovels and spades, this is about as high as it gets. This traditional garden spade blade is affixed to a fiberglass handle for extra strength and weather resistance. The handle is hollow in the upper half to reduce weight, and filled with a solid fiberglass core at the socket for strength. In addition to wood and fiberglass, spades are also manufac-

ured with tubular steel handles.

The D handle is plastic with a textured grip and has a unique collar between the shaft and socket. The manufacturer claims this helps to keep the socket from spreading. The blade is slightly tapered with steps for applying foot pressure.

This True Temper model PFGSH garden spade costs about \$46. Write to True Temper, Box 3500, Shiremanstown, PA 17011.

**10. Rescue shovel**—Also called a fold-away or camper's shovel, this collapsible tool is the shovel to own if you're interested in combining compact size and utility. The round-point blade is shaped for handling compacted soil easily. It's mounted on a pivot so that it can fold back 180° for storage. In addition to locking in the open position as shown, the blade can also lock 90° to the handle so the tool can be used pick-axe fashion to break up tough soil. The blade size is about 6 × 8 in. and the overall length of the tool when open is 24¾ in. When the blade is folded up, the shovel is 18 in. long. The end of the handle has a contoured grip for comfort.

The model 15-930 rescue shovel shown costs about \$20, and is made by Ames Lawn and Garden Tools, Box 1774, Parkersburg, WV 26102. **FM**

## BOOK REVIEW

### FIX IT FAST, FIX IT RIGHT

● Most homeowners enjoy doing things themselves. However, if your enthusiasm for maintenance, improvement and renovation go a little beyond your practical experience, this may be the book for you. *Fix It Fast, Fix It Right*, by Gene and Katie Hamilton, is a compendium of projects, tips and useful information for making improvements and repairs around the house.

With experience gained from many years of working on their own homes, the Hamiltons present the topic from the point of view of the layperson rather than the professional. Their explanations are more conversational than technical, while providing all the basic jargon necessary for taking the anxiety out of talking to building supply dealers and contractors.

This well-illustrated, 300-page hardcover book includes topics ranging from painting and wallpapering to kitchen and bathroom improvement and repair. There's a chapter on storage ideas that describes how to install simple shelves as well as how to frame a new closet. The outdoors section includes topics such as outdoor lighting, driveway repair and basic deck building. There's even a chapter on home security.

*Fix It Fast, Fix It Right* is a book for those of us who simply want to get the job done with a minimum of fuss and a maximum of satisfaction. If you're the kind of person who

Fix it  
**FAST**

Fix it  
**RIGHT**

Hundreds of  
Quick &  
Easy Home  
Improvement  
Projects

Step-by-step directions for

Painting  
Wallpapering  
Plumbing  
Lighting  
Weatherproofing  
Cooling  
Shelving & Storage  
Flooring  
and more



By Gene & Katie Hamilton

would ask an experienced neighbor before calling in the pros, you'll enjoy having Gene and Katie Hamilton around on a permanent basis. The book costs about \$15, and is published by Rodale Press Books, 33 E. Minor St., Emmaus, PA 18098.  
—Thomas Klenck

## HOME IMPROVEMENT NEW PRODUCTS

15 ways to improve your home.

BY ROY BERENDSOHN, Assistant Home Improvement Editor



### Fresh Air

Enviraicare says its air cleaners remove 99.97% of the tobacco smoke, fumes, pollen, bacteria, animal dander, dust and dust-mite allergens from the air. They force air through a polyester activated-carbon filter, and then through a HEPA (high-efficiency particulate air) filter. Available in three sizes, all have a cfm (cubic feet per minute) rating paired to an air-recirculation rate of six times an hour per a given room size. The range includes a 150 cfm unit for 12-ft. x 14-ft. rooms, a 250 cfm for 16-ft. x 20-ft. rooms and a 350 cfm for 20-ft. x 22-ft. rooms. They cost \$200, \$250 and \$300, respectively, at department stores. Write Enviraicare, 747 Bowman Ave., Hagerstown, MD 21740.

### Put A Lid On It

This clear Lexan plastic cover installs over your outdoor outlets to keep them clean and dry. The hinged plastic cover mounts to the existing outlet or electrical box, and is sealed with a gasket. Its manufacturer says that the cover complies with the National Electrical Code, and fits single- and double-gang electrical boxes that are mounted vertically or horizontally. It comes in two sizes, with cover depths of 2 1/4 in. (about \$20) and 3 1/2 in. (\$24), at hardware stores and home centers. For more information, write Inter-matic, Intermatic Plaza, Spring Grove, IL 60081.

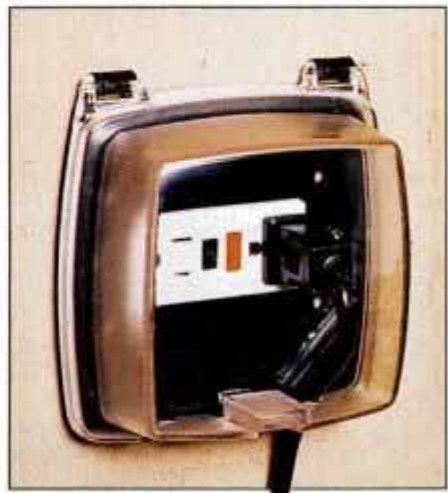


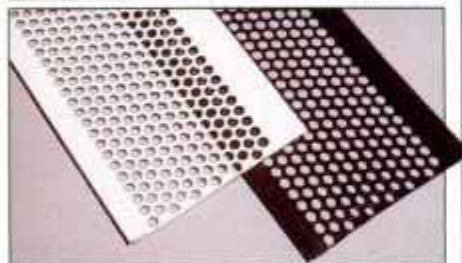
### Tighten Up

Screen Tight takes the carpentry out of screening a porch because its components just snap together. To do the job, you first cut the vinyl base with a pair of sheetmetal shears, and screw it to the porch's framing. Then, the fiberglass screen is attached to the vinyl base with a spline and roller. To finish the instal-

lation, simply slice off the excess screen with a utility knife, and snap the cover

cap over the base. To screen in a typical porch costs about \$250 (plus screen), according to the company. It's sold at hardware stores and home centers. For more information, write Screen Tight, 221 N. Fraser St., Georgetown, SC 29440.





PM PHOTO BY ROSARIO CAPOTOSTO

**Stay Clear**

Keep gutters unclogged by covering them with PVC vinyl screens. To install, tuck the 7-in.-wide × 3-ft.-long screen under the shingles and snap it over the edge of the gutter. Sold in white, brown and black, they cost about \$1.60 each at home centers and lumberyards. Write Sweers Roofing and Gutter Products, 4600 Park Rd., Suite 300, Charlotte, NC 28209.



PM PHOTO BY ROSARIO CAPOTOSTO

**Flat Out**

The Flat Plug has several noteworthy features for an extension cord. First, its head is flat, making it easier to install furniture and appliances near the plug. A folding ring on the back of the plug makes it easy to grip for removal. The plug's stem is angled so the cord clears the outlet below it. The receptacle has a plug-in plastic protector that allows either side of the receptacle to be used, but not both at the same time. The 13-amp Flat Plug cord costs about \$5 at hardware stores and home centers.

Write Paige Manufacturing, Inc., 15 Keele St. S., Unit No. 2, P.O. Box 520, King City, Ontario, Canada, LOG 1K0.



PM PHOTO BY ROSARIO CAPOTOSTO

**In Hot Water**

If you need hot water fast, and are tight on space, this product may fit the bill. This gas-fired instantaneous water heater is so compact, it doesn't require a utility closet. It measures 11 in. deep × 17 in. wide × 30 in. tall and weighs about 50 pounds. Installation is further simplified because it uses outside air for combustion and it vents directly outside without a flue. The company says it is the only instantaneous gas water heater that is approved by the American Gas Association for use in mobile homes. It costs about \$675 (plus installation) through plumbing and heating contractors. For more information, write Myson, Inc., P.O. Box 7789, Fredricksburg, VA 22404.



**Wire-Free**

This doorbell installs in minutes because it's wireless. Its chime is adjustable for one or two bell-tones, to help distinguish between the front and back door if you install a second button. You mount the doorbell's radio signal transmitter outside—it's weatherproof—with screws or the double-face tape included. The transmitter is powered by a 12-volt battery (included), while the chime takes three D-cell batteries (not included). It's about \$30 at hardware stores and home centers. Write Heath Zenith Reflex Brand Group, 455 Riverview Dr., Benton Harbor, MI 49022.



PM PHOTO BY ROSARIO CAPOTOSTO



**New For Painters**

This unique paintbrush earned a PM Design & Engineering Award for 1991. It's part of a slab—snap off a brush to use it. When you're done, throw it away. The brush's plastic bristles are frayed at their tips to spread paint evenly. The paintroller is made of reticulated foam with a synthetic web bonded to the outside. This design holds and spreads paint better, says 3M, and also allows the roller to be washed of latex paint in 1 minute. Both come in a range of sizes. A 9-in. roller costs about \$5.50, and a pack of five 2-in.-wide brushes costs about \$8.50. Both are sold at hardware or paint stores. Write Consumer Relations, 3M DIY Division, 3M Center, 515-3N-02, St. Paul, MN 55144.

PM PHOTO BY ROSARIO CAPOTOSTO

**Clean And Bright**

This polyurethane enamel gives you high gloss and a tough surface with an added bonus—you can clean it off your paintbrush with water. It dries in 30 minutes, and is available in 10 colors. You can also tint it to produce a range of pastel shades in gloss or satin finish. It's sold in ½-pint, 1-quart and 1-gallon sizes (about \$5, \$10 and \$30) at hardware and paint stores. Write to Parks Corp., P.O. Box 5, Somerset, MA 02726.



(More New Products on page 62)

# Get Relief From Back & Neck Pain

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**Conservative Therapy, Comprehensively Applied**

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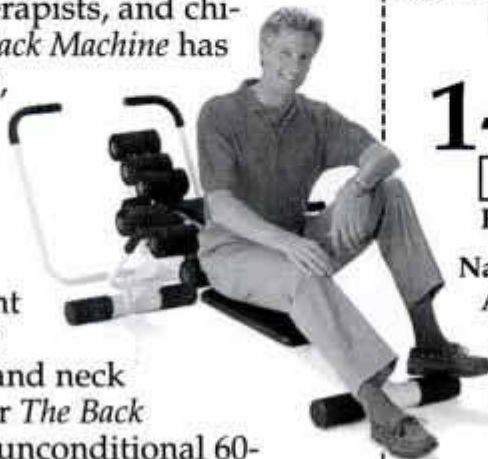
- *Massage* – Soft rollers massage muscles, increasing circulation, reducing muscle spasm, tension and stress.
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**Back Technologies**

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Dept 155





### Keep Track

The Easy Track storage system is designed to make installation easy. To install it, locate the wall studs and hang the horizontal 14-gauge steel track. The vertical panels are notched to hang on the track. The shelves are height adjustable, and the closet rods and drawers adjust so they can be relocated. Both panels and shelves are vinyl coated, and the steel parts are powder coated.

An 8-ft.-wide combination closet costs about \$175, and is available at home centers and hardware stores. Write Laminations, 3311 Laminations Dr., Holland, MI 49424.



### On A Roll

Markel's Versiwrap picks up where standard electrical tape leaves off. It's made of silicone rubber and resists high voltage (15,000 volts) and high temperatures (500° F). And, it's self-bonding. Wrap it around something, and it welds itself into a unified rubber mass. To remove it, slice it and peel it off. It doesn't leave a sticky residue. A 36-ft. roll costs about \$20 (plus shipping) from Revere Products, 6680 Parkland Blvd., Solon, OH 44139. Write Markel Corp., P.O. Box 752, Norristown, PA 19404.

### A Drink Of Water

The WaterBoss is designed to provide maximum water softening in as compact a space as possible. The \$650 appliance uses a built-in microprocessor to simplify operation. Set the water hardness on a control panel, and the microprocessor takes over. The company supplies you with water test strips to determine the hardness of your water. To install, hook up its inlet and outlet hoses, and plug in its 24-volt transformer. The company says the softener has a built-in water filter that is self-cleaning to remove sediment a conventional softener might miss. It's sold at hardware and plumbing supply stores. Write WaterBoss International, 1699 North Astor, Milwaukee, WI 53202.



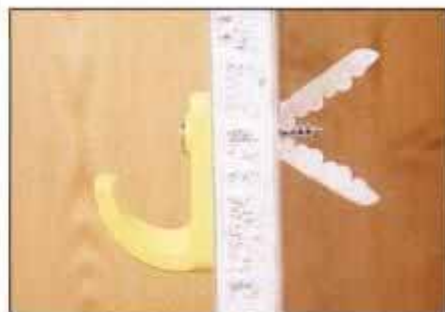
### Put On, Peel Off

Red Devil's sealant differs from others in that it's meant to be easily removed. After it's applied with a caulk gun, it dries into a rubber-like film that sticks to painted or unpainted wood, metal, glass and vinyl. Tug up on it, and you can peel it off in a strip, making it ideal for seasonal weather-stripping or caulking that's temporary. A 10-ounce tube costs about \$6 at hardware and paint stores. Write Red Devil, Inc., 2400 Vauxhall Rd., P.O. Box 194, Union, NJ 07083.



### Power-plant

Powered by natural or LP gas, this backup generator is installed outside the home. It's wired into the house's service panel, and an automatic switch activates it in a power failure. As a maintenance-reducing feature, a sensor starts and runs the generator for 15 minutes once a week. Models range from an 8-kw, air-cooled unit (\$4300) that supplies 100 amps of single-phase power to a 20-kw, liquid-cooled unit (\$9100) that provides 200 amps of 3-phase power. It's sold through the Sears catalog and Generac distributors. Write Generac Corp., P.O. Box 8, Waukesha, WI 53187.



### Anchors Away

You can hang objects on a hollow or solid wall with the plastic Alligator anchor. It starts out as a sleeve with a pair of interlocking jaws. Bore a hole, insert the anchor and screw into it. In a solid wall, the jaws expand around the screw; and in a hollow wall, the jaws spread apart, expanding behind the wall surface. The Alligator comes in  $\frac{3}{16}$ -in.,  $\frac{1}{4}$ -in. and  $\frac{5}{16}$ -in. sizes. A bag of six costs about \$2.50 at hardware stores and home centers. Write Mechanical Plastics Corp., P.O. Box 328, Pleasantville, NY 10570. **PM**



PM PHOTOS BY ROSARIO CAPOTOSTO

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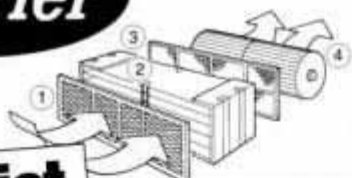
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# APPLIANCE CLINIC

BY STEVE TOTH,  
Contributing Editor

## Dishpan Hands

My 12-year-old Sears Kenmore dishwasher model No. 587.761403 still works, but the cleaning performance is lacking. We have to handwash the dishes before using it. Is there anything we can do that will improve its performance?

PAUL McMORRIS  
SOUTH POMFRET, VT

*Assuming the water temperature in the dishwasher is about 140° F or hotter, and you are using fresh detergent, I suspect that there's a problem with either the water volume or its distribution.*

Because of your washer's age, first check the water level. You need between 9½ to 10 quarts of water in the tub, or enough water to completely cover the heating element.

To check this, advance the timer to the FILL position, and turn on the machine. When the water stops filling, check the water height. The tub should be filled up with water to the bottom of the lower spray arm. If the level is low, the filter screen in the water inlet valve may be clogged.

Check the spray arms to see that all their holes are open and that they have no split seams. Spin each arm to be sure it turns freely.

If the lower arm binds, replace the pump housing, the spray arm or both. If both the water level and the spray arms test okay, the problem is likely the water pump. The pump impellers may have broken or eroded away.

## Busted Knobs

My parents have a Bradford electric range that they bought from a W.T. Grant department store, now long out of business. The range is still in good working order, but four of its six knobs are broken. Where can I get replacement knobs?

VICTOR LONG  
CAMBRIDGE, OH

*Kelvinator Co. built your range for W.T. Grant under the Bradford trade name. W.T. Grant went out of busi-*

*ness, and Jacoby Appliance Parts (266 State St., Hackensack, NJ 07601) bought its remaining inventory. The company can supply you with replacement knobs.*

## BBQ Quandary

I have a problem related to electric barbecues purchased in the United States. We have a portable and a larger stand-mounted model that have burned-out elements, and we are unable to locate the original manufacturers. They are Charmglow model No. 147100 and model No. 145300. Any information would help.

MRS. E. MALINOWSKI  
YORKTON, SASKATCHEWAN

*Contact Bristol Gas Grills, 8601 200th Ave., P.O. Box 215, Bristol, WI 53104; (414) 857-9433. It seems the*

We washed inside the refrigerator with hot, soapy water to no avail. Please help.

ANN KELLY  
UNION BRIDGE, MD

*Unplug the refrigerator and remove the food, shelves, ice-cube trays and icemaker bin. Discard the ice. Place the inside of the refrigerator and all interior parts with a solution of 2 tablespoons of baking soda per quart of warm water. Clean everything again with a mix of dishwashing detergent and warm water. Rinse and dry all surfaces.*

*Next, pour a solution of vinegar and warm water through the defrost drain system. Remove and clean the water-collection pan located underneath the refrigerator.*

*Reassemble the refrigerator. Leave an open box of baking soda in both the refrigerator and freezer. Add the food, but throw out anything that's stale.*

*Plug in the refrigerator, and check it after three or four days. If the odor persists, spread activated charcoal (available from pet stores) on a cookie sheet in the refrigerator and another in the freezer.*

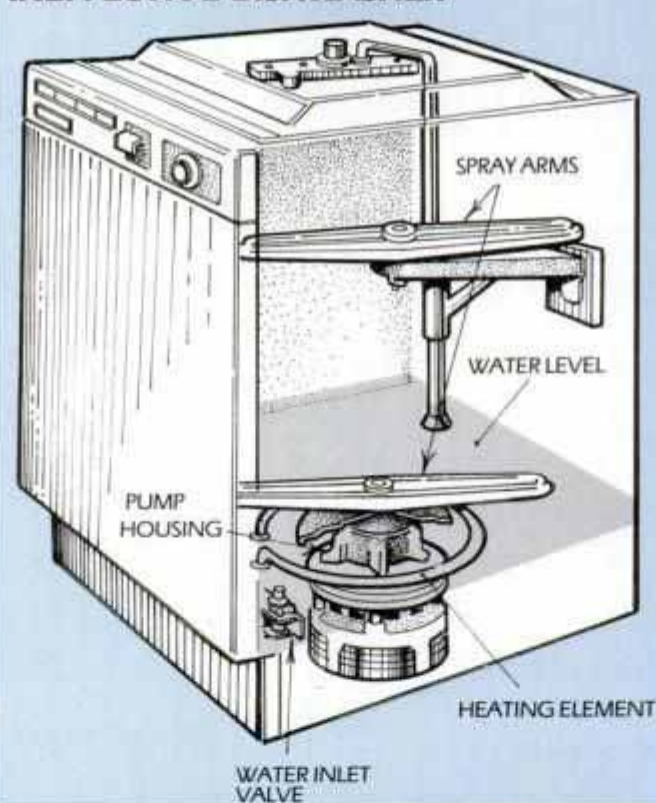
*If the odor is still there, this remedy is more involved. Remove the food again. Tightly stuff the refrigerator and freezer with balls of crumpled newspaper. Put 2 cups of water in the refrigerator door, and close it. Let the refrigerator run for three or four days, then clean out the compartments with soap and water. Repeat if necessary.*

*Eliminate any lingering odor by using Kleen-Air. According to its manufacturer, place the bottle of Kleen-Air, with the fliptop open, next to the refrigerator's intake air vent. The*

*product eliminates odors in the air, but not smells imbedded in the walls of the refrigerator. The product is nontoxic and will not harm foods. One bottle lasts a year. It's sold at appliance parts distributors.*

PM

## INEFFECTIVE DISHWASHER



**Clogged or broken spray arms or a malfunctioning water inlet valve may result in poor performance. Check that arms move freely.**

*company has had so many requests for Charmglow elements that it contracted with a Canadian company to make replacements.*

## Offensive Fridge

For more than a month, our refrigerator has produced a very offensive odor. We have checked the drain from the back and underneath, both are open. We have removed the freezer bottom and back, and found nothing.

## DO YOU HAVE AN APPLIANCE PROBLEM?

*Just ask Steve about it. Send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.*

**TOOL TEST**  
**PASLODE**  
**CORDLESS**  
**FINISH**  
**NAILER**

TEXT AND PHOTOS BY  
ROSARIO CAPOTOSTO,  
Contributing Editor

● For those of us who do occasional carpentry jobs around the home and shop, nailing with a hammer is simply the easiest way to get the job done. Not so, however, if you make your living driving nails all day long. To get the job done quicker and with less effort, house framers and production woodworkers use electric or pneumatic nailers. The latest innovation combines the cordless freedom of a handheld hammer with the effortless speed of power nailing. It's the Paslode IM250F Trimpulse Cordless Finish Nailer.

Paslode is no newcomer to the cordless-nailer market. We reviewed the original Paslode cordless nailer (see "Airless Power Nailer," Sept. '86, page 45) that handles standard framing chores. This new tool differs in that it's designed for finish carpentry and cabinetwork. It uses liquid hydrocarbon fuel to power an internal-combustion driving mechanism. The disposable fuel cell (about \$5) drives about 2500 finish nails. A rechargeable battery (about \$40) powers the ignition system, and handles about 8000 nails between charges. The battery also drives a fan that dissipates heat and exhaust. A battery voltage indicator lets you know when recharging is necessary.

The nailer weighs about 6 pounds, has a comfortable handle and is well balanced for one-handed operation. It drives 16-gauge chisel-point coated finish nails in sizes ranging from 3/4 to 2 1/2 in. They come in 50-nail strips and the nailer can be loaded with two strips at once.

We used the nailer to install door jambs, paneling, casing, chair rail and baseboard with satisfying results. The tool is capable of driving two to three nails per second with no kick-back and only a low, muffled pop as each nail is driven. You can switch from flush-driven nails to deep-set nails by changing the tip on the drive mechanism. This driver works well in



The Paslode Cordless Finish Nailer shown with replaceable fuel cell and nail strip. It drives finish nails from 3/4 to 2 1/2 in. into hardwoods and softwoods.



Fuel cell fits into rear of nailer. Cell has a valve at top to meter the precise amount of fuel required for each cycle.



The nail magazine holds two finish nail strips of 50 nails each. Holes in the side show the nails remaining in the magazine.



The nailer is suitable for all finish carpentry such as wall paneling. Tool doesn't function unless tip contacts work.



Plastic tip prevents marring work and controls nail depth. Tips are available for nailing flush or setting below surface.

hardwoods where normal nailing often requires a pilot hole to avoid splitting the wood.

The Paslode IM250F Finish Nailer comes with a carrying case, one battery pack, charger safety glasses and operating instructions. The case has room for two fuel cells (sold separate-

ly), an extra battery and two boxes of nails. Although the suggested retail price seems high—about \$890—Paslode claims that it's less than the cost of a comparable pneumatic nailer and compressor outfit. For information, contact: ITW Paslode, 2 Marriott Dr., Lincolnshire, IL 60069. **PM**

# HOMEOWNERS CLINIC

BY NORMAN BECKER, P.E., Contributing Editor

## Loop Vent

Recently, I had a plumber add a shower stall. The shower is located between the kitchen sink and the bathroom sink. The plumber put a few extra pieces of drainpipe around the shower stall, and told me it was a loop vent and that it's legal. Is it?

HANK HADRICK  
SOUTH BEND, IN

*Before discussing a loop vent, let's define the purpose of a vent system as part of the drainage/waste system in a house. A vent system consists of a pipe or a series of pipes that are tied into the drainage system. It provides a flow of air within the system, and this equalizes pressure in the drainage system to prevent water from being sucked out of traps (which would let sewer gas into the house).*

*According to the National Plumbing Code, a loop vent is a branch vent that serves two or more traps, and extends from in front of the last fixture connection of a horizontal branch to the stack vent. Just because a loop vent is defined in the code doesn't mean every municipality permits it.*

*If a loop vent was originally installed for venting the kitchen and bathroom sinks, all the plumber had to do was tie the shower drain into the*

*branch wasteline. Unless the plumber installed the plumbing originally, or all the pipes are exposed, he would not know the configuration of the venting system. In this case, the shower may not be properly vented.*

*You should check with your local Building Department. Most municipalities require permits for any plumbing installation. Final approval is granted if the installation complies with the local codes.*

## Cold Floor

The hardwood floor of my living room is unbearably cold in the winter. Below the living room is the garage, which has a ceiling with 6 in. of insulation between the joists, held in place with a nylon netting.

How could I better insulate the garage ceiling to solve my problem of "cold feet?"

SUSAN PETTIRARO  
BIRDSBORO, PA

*You should be more concerned with the potential fire hazard in the garage than with the cold floor. Nevertheless, minimizing the former will also help the latter.*

*An attached interior garage that is used for parking a car is considered a fire hazard because of the gasoline in*

*the car. Exposed floor joists should be covered with fire-rated gypsum drywall, such as Type X Sheetrock.*

*If a fire should develop in the garage, the exposed wood framing, such as the overhead living room floor joists, would quickly burn causing the living room floor to collapse. With Type X Sheetrock covering the exposed wood, it would take longer for a fire to burn through the floor. This provides more time to escape.*

*The exposed floor joists are responsible for the cold floor. Although wood joists are not good heat conductors, they will conduct heat away from the floor. To reduce this—and the fire hazard—cover the joists with rigid insulation boards, followed by fire-rated drywall.*

## Basement Moisture

We had a new church built two years ago, and we still don't have a concrete basement floor in it. The basement walls are always damp. Sometimes there are beads of water and mildew on them. There is also a real musty smell at all times. I don't think we have water coming in from the outside. I think we have a serious sweating problem. What do you think?

P.D. SCHULLER  
NEW CASTLE, PA

*It sounds like a lot of moisture is entering the basement from the dirt floor. If your church cannot afford to cover the dirt floor with a concrete slab, then it should at least cover the floor with a vapor barrier such as 4- or 6-mil. polyethylene sheets.*

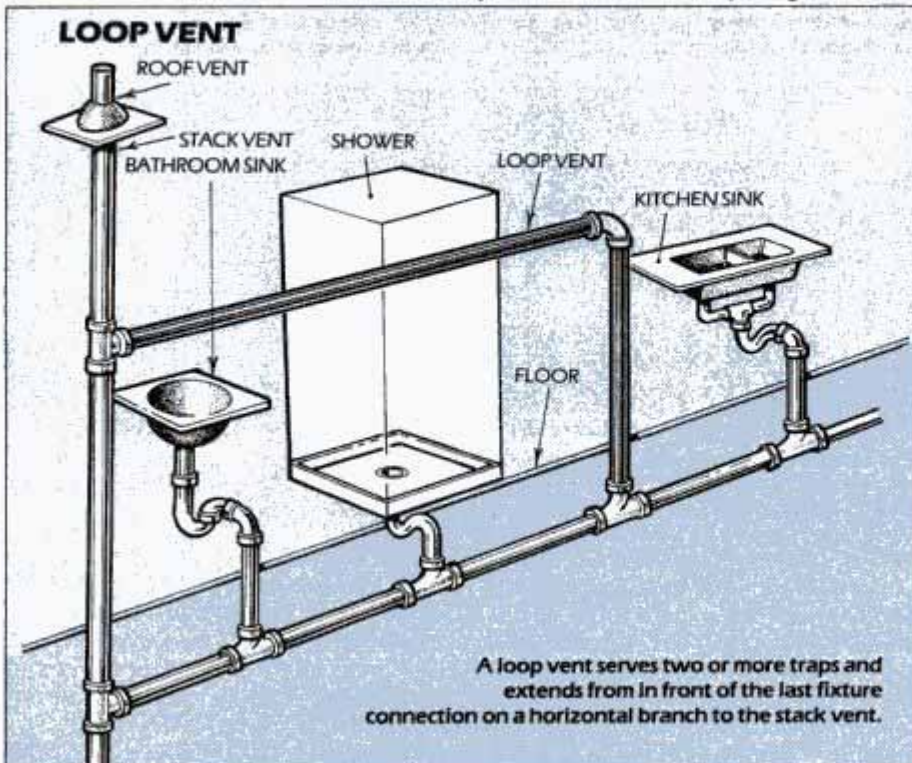
*Even when the dirt floor feels dry to the touch, a considerable amount of water still evaporates into the atmosphere of the basement because of capillary rise of ground moisture. According to the Small Homes Council at the University of Illinois, the soil under a 1000-sq.-ft. house can release as much as 18 gallons of water per day through evaporation.*

*Even with a concrete slab or a vapor barrier covering the floor area, it may be necessary to use a dehumidifier to help control the amount of moisture.*

PM

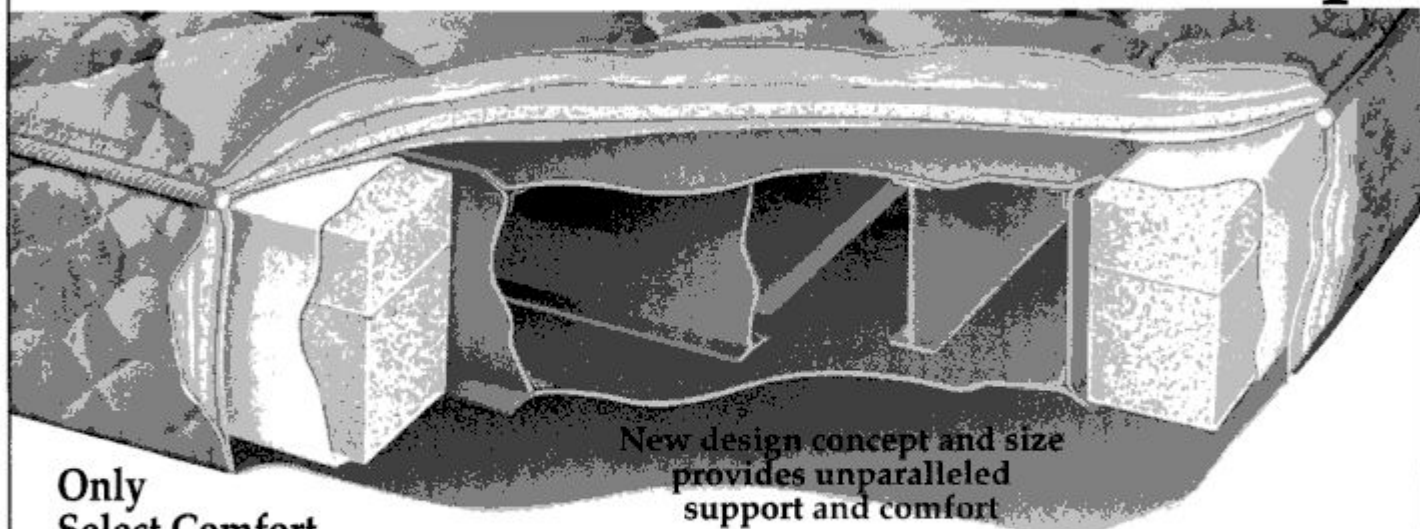
### DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

*Just ask Norman about it. Send your question to Homeowners Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$5.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.*



PM ILLUSTRATION BY ED LIPKINSKI

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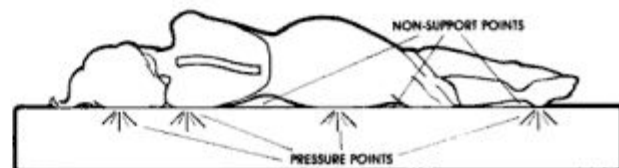
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Cindi & Bob Denton  
West Bloomfield, MI



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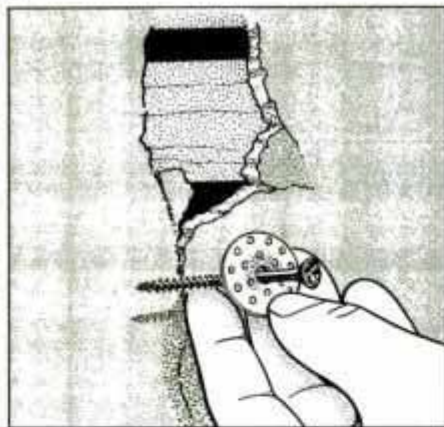
**HOME  
IMPROVEMENT  
PLASTER  
REPAIR**

BY GENE & KATIE HAMILTON  
PM Illustrations by  
George Retseck

● Old houses are appealing on any number of levels. Some of us cherish the period detailing, while others appreciate the refined proportions that older buildings can have. And, some people are simply charmed by the sense of history that seems to float from every old nook and cranny.

One of the most common characteristics shared by old houses is their pervasive use of plaster. It may not be in the best condition, but it certainly has more style than gypsum wall-board.

Fortunately, for those of us who own an old house, plaster is highly repairable. Cracks and holes can be



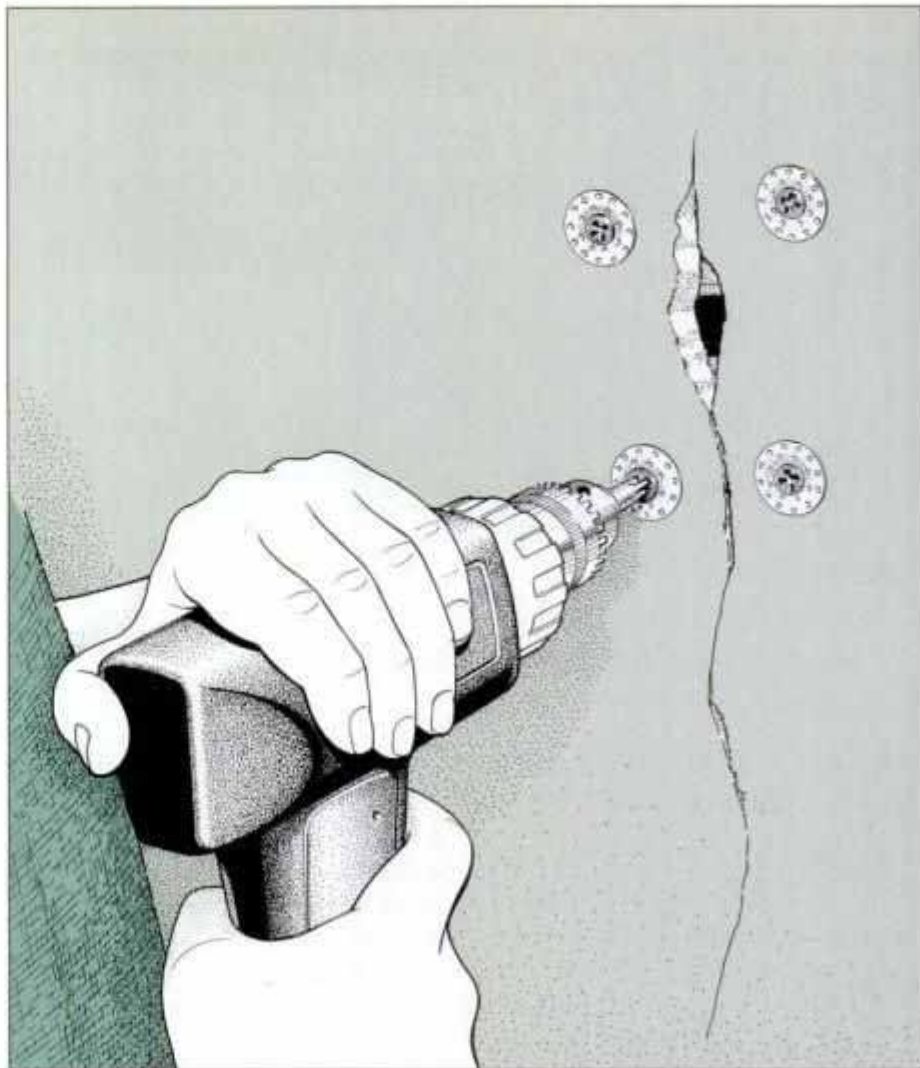
**1 Reinforce plaster with drywall screws and plaster washers. Washers are perforated to hold drywall compound.**

filled, and plaster that has pulled away from the lath can be re-attached.

Since refurbishing an old house is a messy and difficult business, repairing plaster instead of replacing it improves the efficiency of the process. Time and money that would have gone into replastering a wall or ceiling can be diverted to more pressing concerns, such as fixing a leaking roof or replacing aged kitchen cabinets.

Speaking of which, schedule your plaster repair so work that can affect the finished plaster is done first. You don't want to fix a plaster ceiling only to have a roof leak ruin it.

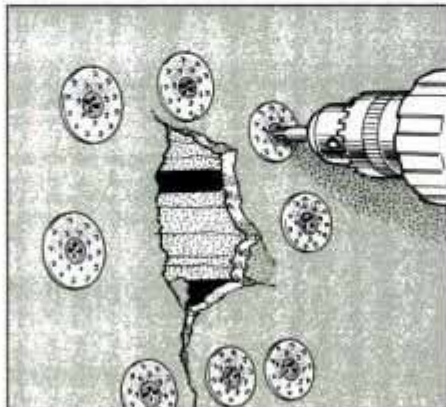
Once a plaster surface is cleaned,



repaired and painted, you'll notice a significant improvement in a room's appearance.

**Plastered walls and ceilings**

A plaster surface is composed of three or more coats of plaster secured to lath. In turn, the lath is fastened to the house's framing. The lath may be wood, metal, metal and paper, or strips of gypsum similar to drywall.



**2 Drive drywall screws with washers into the lath (or framing) around the hole. The washers should be nearly flat.**

As the first coat of plaster is troweled on, it's pushed through the small spaces between the lath and oozes behind it. The plaster dries and is locked to the lath. The portion of the plaster that has dried behind and around the lath is called a key.

Usually, two more coats of plaster follow the first coat. The three coats are quite heavy, and if the plaster keys behind the wall or ceiling surface break, the plaster sags away from the lath. Sagging plaster, especially on a ceiling, is cause for some alarm. Vibration from above can break the keys completely and let the plaster fall in chunks.

Damaged plaster can be reinforced using drywall screws and plaster washers. These saucer-shaped washers are punched from spring steel, and are perforated to hold patching plaster or drywall compound (Fig. 1).

Screws (with plaster washers) are driven into the lath and framing surrounding the damaged plaster. The saucer-shaped washers nearly flatten out as the screw is driven home. Like a washer and bolt, a plaster washer

(Please turn to page 72)

# Amazing New Product Gives Crisp, Clear TV Reception WITHOUT Cable!

AS SEEN ON TV

Until recently, the only convenient way to guarantee great TV reception was to get cable installed. But who wants to pay those irritating monthly cable fees? Now, thanks to years of micro-electronic research, a new device has been developed that's so advanced it actually makes all other antennas a thing of the past. It's called the SWEDA™ Power Antenna and is without a doubt "the single most important thing you should own if you have a TV!"

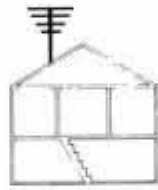
## A PICTURE OF ADVANCED TECHNOLOGY!

Just imagine watching TV and seeing a picture so brilliantly clear that you'd almost swear you were there live! Just plug this tiny 2" x 4" Power Antenna into any ordinary AC outlet, connect your TV and get ready for the best reception you've ever had. You'll watch in amazement as YOUR TV set suddenly displays a sharp, focused picture. You literally "won't believe your eyes!" Even older TV sets suddenly come to life. The Power Antenna is so easy to install, so convenient to use, and so incredibly effective that you'll wonder how you ever got by without it!

## A THOUSAND FOOT ANTENNA?

Power Antenna is a highly sophisticated electronic product (like a transistor radio) with a simple function. It takes ALL the electrical wiring in your house or apartment (hundreds or thousands of feet) and turns it into a

Just plug your Power Antenna™ into any ordinary outlet and watch in amazement as your entire house turns into a giant TV reception station!



BEFORE:



AFTER:

giant TV reception station! It's like having an antenna the size of your entire house! Imagine how effective that would be. But there's more, because Power Antenna takes that signal and electronically boosts it before it gets to your TV set. The results are amazing! Even the weakest, smallest signals come in super strong! You can finally enjoy your favorite prime time shows or sports events the way they were meant to be watched.

## WHAT ABOUT MY TV "DISH" ANTENNA?

Return it! Millions of these things have been sold in recent years because people were led to believe they would work like a satellite dish. The truth is that they're no more effective than rabbit-ears, a loop, or rod antenna — and people have been struggling with these things for years! The incredible SWEDA™ Power Antenna makes everything else seem obsolete. Just plug it in and watch it work. There's simply NOTHING ELSE better valued on the market today!

**LIMITED TIME OFFER!**  
Electronic antennas like this



one normally sell for \$50 or more! But now, for a limited time (if you respond before April 5, 1992), you can have the amazing SWEDA™ Power Antenna for just \$19.95. Experience the best reception you've ever had or simply return it within 30 days for a prompt and courteous refund. You absolutely must see it to believe it! ORDER TODAY.

**P.S.** Works just as good for radio reception too! Limit 3 per order.

### RESPOND BEFORE APRIL 5TH FOR THIS SPECIAL OFFER!

**YES!** Please rush me the following SWEDA™ Power Antenna(s)!

- One Power Antenna for just \$19.95 plus \$4 P&H.
- SAVE \$5!** Two for just \$34.95 plus \$5 P&H.
- SAVE MORE!** Three for just \$49.95 plus \$6 P&H.

Enclosed \$\_\_\_\_\_. VA residents add sales tax.

Payment method: (Check one)

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Apt. \_\_\_\_\_ City \_\_\_\_\_

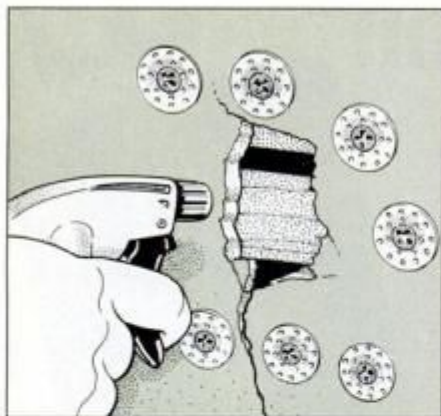
State \_\_\_\_\_

Zip \_\_\_\_\_

U.S. Buyers Network, Dept. AT4520  
One American Way, Roanoke, VA 24016

**UET Brands**™ 1991, (2624)  
Allow up to 60 days for shipment.





**3** Spray the lath and plaster with water. This prevents the patch from cracking due to drying too quickly.

pulls in on the surrounding surface as the screwhead bears down on it. The cupped nature of a plaster washer makes the screwhead easier to cover with a skim coat of drywall compound.

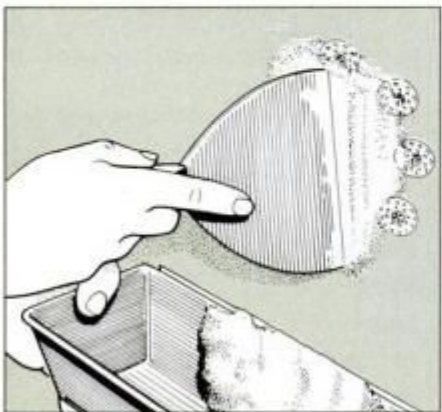
### Fixing cracks and holes

Begin repairing large holes and cracks by chiseling out loose or crumbling plaster using a cold chisel. Undercut the edges of cracks and holes so the edge of the crack or hole will better support the patch.

Next, drive 2-in. drywall screws, with a plaster washer on each screw, into the wall or ceiling framing around the crack or hole (Fig. 2). Drive 1½-in. drywall screws and washers into the lath. Drive in the screws until the washers flatten out.

Use a screw gun or a variable-speed drill and a Phillips screwdriver bit to install the screws. Tighten the screws just enough to pull the plaster snug against the lath.

If you use a drywall-screw gun, experiment with the screw-depth setting so the screw will come up tight and flatten the washer. The drywall-screw gun can break off the screwhead or strip the driver slot if it is



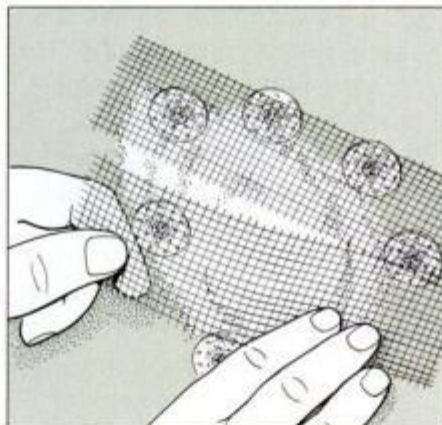
**4** Mix a small batch of patching plaster and spread it into the hole with a 6-in. tapping knife. Let it dry.

adjusted for a setting that's too deep.

If tightening the screw does not flatten the washer, you have missed the wall stud, floor joist or lath. Remove the screw and washer, move it about 1 in. in either direction, and try again. Hitting a web in metal lath will probably stop the screw dead in its tracks, as will hitting a nailhead in wood lath.

Next, using a spray bottle, thoroughly wet the plaster around the crack or hole (Fig. 3). Plaster soaks up water and if you don't wet it before making the repair, it will pull the water out of the patch, causing the material to shrink and crack.

Using a 6-in. tapping knife, fill the hole or crack with patching plaster (Fig. 4). Don't use plaster of Paris, it shrinks too much and hardens too quickly to be of use for these repairs. Also, work quickly with patching plaster—it dries quickly.



**5** Sand the patch level after it is dry. Cover the patch and screwheads with self-stick fiberglass mesh tape.

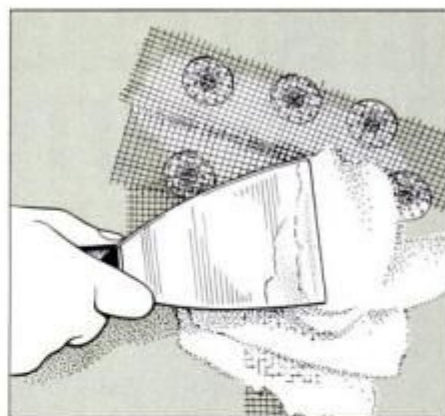
Let the patching plaster dry, and sand it fairly smooth. Next, apply short strips of fiberglass tape over the patch, and apply a coat of drywall compound (Figs. 5 and 6).

Let that coat dry, and sand it smooth (Fig. 7). Apply a second coat—or however many coats are necessary—to blend the patch into its surroundings. Use a ceiling sander on a pole to sand patches that are hard to reach. You can use drywall screen or sandpaper to sand patches.

Dust off the sanded area. If possible, use a shop vacuum to pull the dust off the surface. Assuming you'll paint the room with latex paint, prime the repaired surface with latex primer or use the same paint as used on the rest of the room.

### Sagging plaster ceilings

Sagging plaster that looks otherwise sound but flexes when you push on it



**6** Spread the first coat of drywall compound over the tape. Feather the compound out toward the edge of the patch.

can usually be shored up with screws and plaster washers.

First, determine how wide an area is loose. Push on the plaster and mark the boundaries of the loose area with chalk. Next, locate the ceiling joists. Drive 2-in. drywall screws, each with a plaster washer on it, into the framing where the chalklines cross the ceiling joists. Space the screws at 8- to 10-in. intervals.

Drive 1½-in.-long drywall screws with plaster washers into the lath so that you form a circle around the dropped plaster. Drive additional 2-in. screws and washers into the framing as required to pull the dip out of the plaster.

One ring of screws and plaster washers may be enough to pull the plaster against the lath, or you may have to drive another ring closer to the center of the dropped area to complete the repair.

Finish over the washer heads as before, using fiberglass mesh tape and patching material spread with a 6-in. tapping knife.

Sand the patch, and prime it before you start painting the rest of the room.



**7** Sand the patch level. Use a ceiling sander on a pole if the patch is hard to reach. Apply more compound as necessary.

# CAR CARE

## MAINTENANCE BASICS

### WINDSHIELD WASHERS

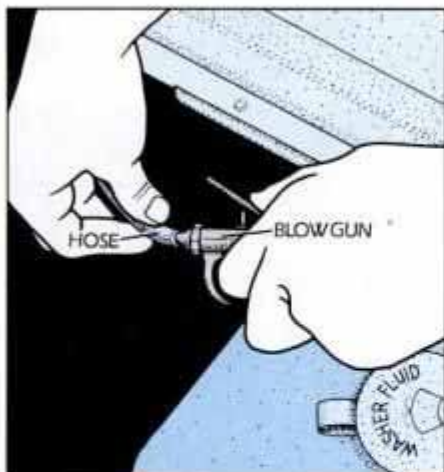
BY DON CHAIKIN

● To make sure you don't get caught dry the next time you need your windshield washer system, inspect the system once a week.

It's a simple job. The entire system consists of a reservoir, pump, tubes and the actual spray nozzles. You'll find all the components—with the exception of the nozzles—under the hood. If your car has a rear washer, you'll find that unit's components in a special compartment in the rear. Some things to keep in mind when you begin your inspection:

- The pump may be located in the reservoir or remotely, typically at the windshield wiper motor.
- The nozzles may protrude from the hood, be hidden beneath the air grille (cowling), be located at the base of the windshield or on the wiper arms.

Regardless of the specifics of your



Blocked washer fluid tubes can be cleared easily with compressed air.

car's system, maintenance and any necessary minor repairs are simple and straightforward.

● First, check the solvent in the reservoir bottle. Top it up if necessary. Use a solution that is both a cleaner and antifreeze.

If the fluid level drops precipitously between weekly fillups, suspect a



leak. Some likely sources are cracks in the reservoir—especially around the pump or tube connections—and pinholes where the container mounts or rubs against the fenderwell or firewall. If the reservoir is leaking, replace it.

● Next, check the tubes that run from the bottle to the nozzles. These tubes may go directly from the tank-mounted pump to the nozzles, or they may run from the reservoir bottle to the pump and then to the nozzles.

Inspect each tube end to verify that it is snugly attached. Make sure there's enough slack for you to trim cracked or hardened ends, and reconnect the tube. Also make certain that the tubes are clipped or routed out of harm's way.

Check that the tubes are clear by blowing air through them. If a hose is torn, chafed or hardened for most of its length, replace it.

● Next inspect the pump. Be sure that all wiring—including the ground connection—is snug, and clean any corrosion.

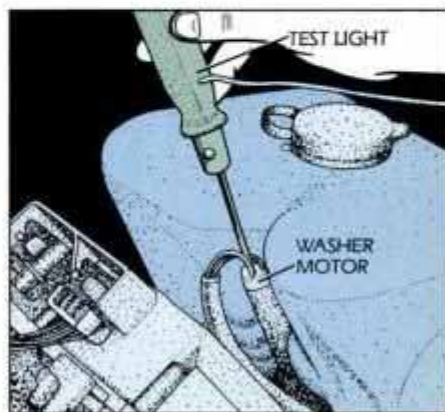
If the pump does not work but its wiring appears good, check its fuse. If the fuse is okay, use a test light to see that the pump's wiring and switch are good. If everything else checks out, replace the pump.

New pumps are readily available at

auto parts stores. The job involves removing a few bolts, and switching the hoses and wiring over from the old pump.

● Finally, check the nozzles. Partial or uneven spray indicates a clogged nozzle. If the nozzle is clogged, clean it with a straight pin. If the spray is not hitting the windshield about two-thirds of the way up the glass, re-aim the nozzles.

Loosen any mounting screw and gently move the nozzle, using needle-nose pliers, if necessary. If there is no screw, gently bend the nozzle tip using pliers. For ball-in-socket nozzles, adjust the ball, using a straight pin with its tip in the ball's hole. **FM**



If washer pump won't run, check wiring with test light before replacing pump.

FM ILLUSTRATION BY RON CARBONI

FM ILLUSTRATION BY DON MANNES

FM ILLUSTRATION BY RON CARBONI

## CAR CARE

### NEW PRODUCTS

## IMPROVE YOUR CAR

### Hi-Po Muffler

Thanks to tighter noise and air pollution laws, the days of improving performance by running your car through open exhaust pipes is long gone. But you can still keep exhaust noise within legal limits and gain power by using a low-pressure exhaust system, like the DynoMax Super Turbo from Walker Mfg. Each muffler in the line offers improved performance over stock—the Corvette Super Turbo, for example, has 50% less backpressure than the stock Corvette muffler. The Super Turbo pipes are specially made and bent to reduce backpressure as well, up to 35% over stock. Prices start at \$39. From Walker Mfg., 1201 Michigan Blvd., Racine, WI 53402; (800) 767-DYNO.



### Interior Security Light

Some of us feel a little anxious getting into a car in a dark, deserted lot. Kraco has an innovative and inexpensive relief for that anxiety in the form of a remote-operated interior light. The light gets its power from the cigarette lighter receptacle, and can be turned on from up to 50 ft. away via a small transmitter. The light also has a timer that shuts it off 60 seconds after you plug it in. There is a manual override so you can also use the light for reading. Suggested retail price is \$29.95. From Kraco Enterprises, 505 E. Euclid Ave., Compton, CA 90222; (800) 421-1910.



### Remote Radar Detector

A radar detector is a serious driver's good friend. It's also a thief's favorite target. One theft preventer is the remote radar detector—mounted behind your car's grille instead of sitting on your dash. Two new remote radar detectors from Whistler, the 3000 and

5000SE, feature compact receiver units—3.2 × 4.2 × 1.5 in.—designed to be installed in cramped quarters. The receivers, which detect X, K and Ka band radar, transmit a radio signal to a separate console inside the car. Since there's no wire between the two units, you can mount the console anywhere. While the console for the 3000 must be wired to the car's electrical system, the 5000SE unit takes a 9V battery. The 3000 costs \$249.95, the 5000SE, \$349.95. From Whistler, 5 Liberty Way, Westford, MA 01886; (800) 531-0004.

### Wheelless Trailer

Sometimes it's just not worth the trouble of hitching up a trailer to haul a little extra cargo. A nifty cargo-carrying solution is this Hitch Haul. Essentially, the Hitch Haul is a steel-mesh platform that slides into your car or truck's 1½- or 2-in. receiver hitch. The 20 × 60-in. platform is ideal for toting up to 500 pounds (or the hitch maker's tongue weight limit) worth of bulky items that won't fit in your car. Detachable siderails keep the cargo from sliding off the edge of the platform. Price is \$99.95. From Masterbuilt Mfg., Inc., 1645 2 Ave., Columbus, GA 31901; (800) 288-1581.



### Trailer Chock

After you've parked the trailer, how do you know the trailer will stay put? If your trailer has tandem axles, you lock it using the innovative Chock-Lock. Place the Chock-Lock between the trailer's wheels and turn the center turnbuckle handle to expand the

lock. Then you padlock the turnbuckle handle to keep anyone from loosening it. Available in two sizes: 4 to 8 in. at \$119.95 a pair, and 6 to 10 in. at \$129.95 a pair—both plus shipping. From R.L.O. Co., Inc., P.O. Box 4752, Diamond Bar, CA 91765; (714) 946-0973. **PM**

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Spread around flowers, landscape plantings, and your garden, this "slow-release" fertilizer will help your plants grow lusher and more beautiful than ever before!

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Also available in Canada. ©1992 Garden Way Inc.

## SATURDAY MECHANIC

# MAINTAINING DRUM BRAKES

BY PAUL WEISSLER

● Pushing down on your brake pedal seems to mirror the sinking feeling in your stomach, and the brake pedal hovers dangerously close to the carpet as you slow down. And lately, it's been accompanied by a grinding noise. The front brakes look good—at least from what you can see by looking through the front wheels. It's time to check your rear brakes.

Most cars nowadays use front disc brakes. And with the front discs doing most of the work, there's good reason

**Reinstalling brake return springs can be a handful—so use stout needle-nose pliers to pull while you push the spring's hooked end over the tab.**

to use lighter, less-expensive, low-rolling-friction rear drum brakes. But even so, there's still some occasional maintenance to be done.

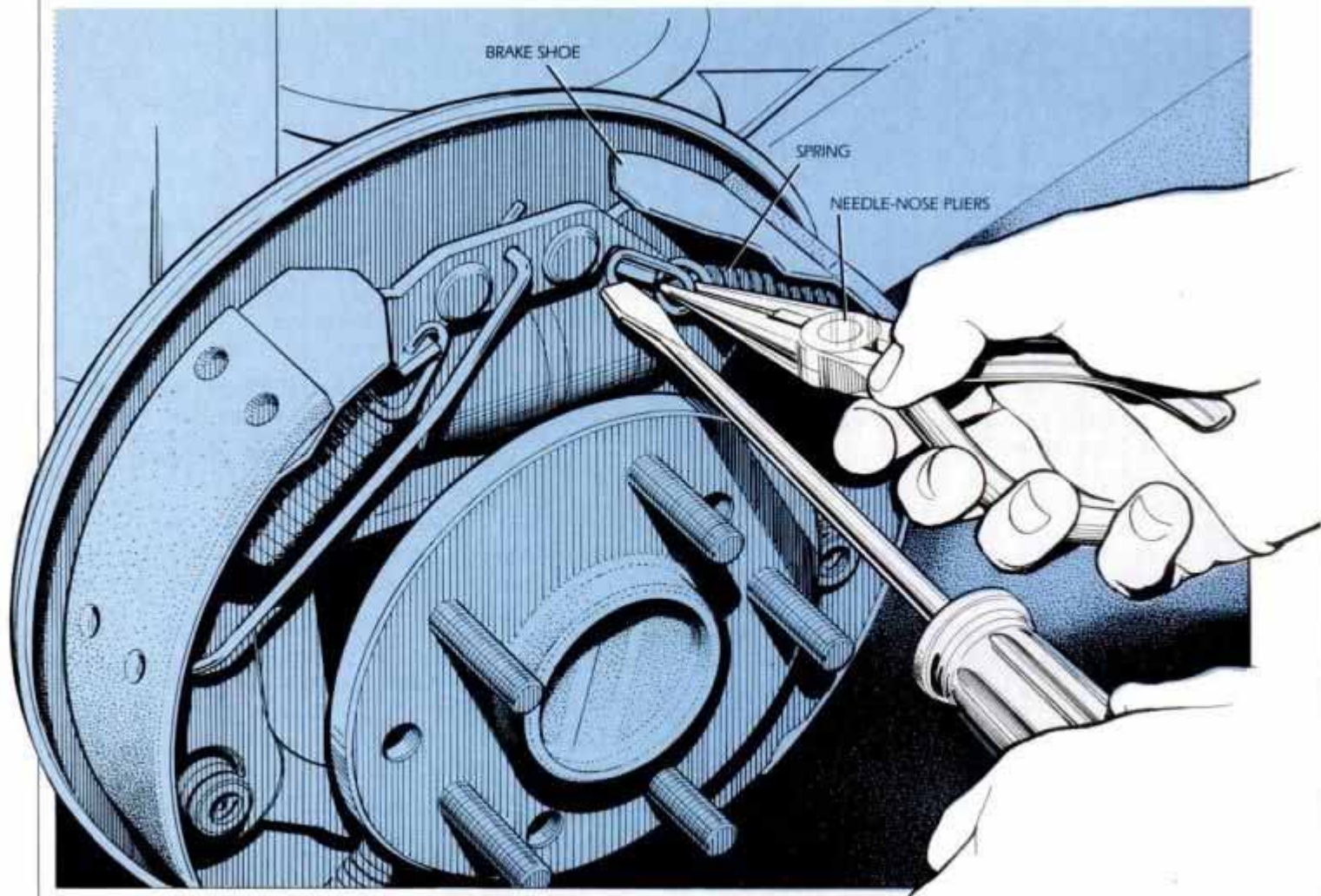
### Seeing the sights

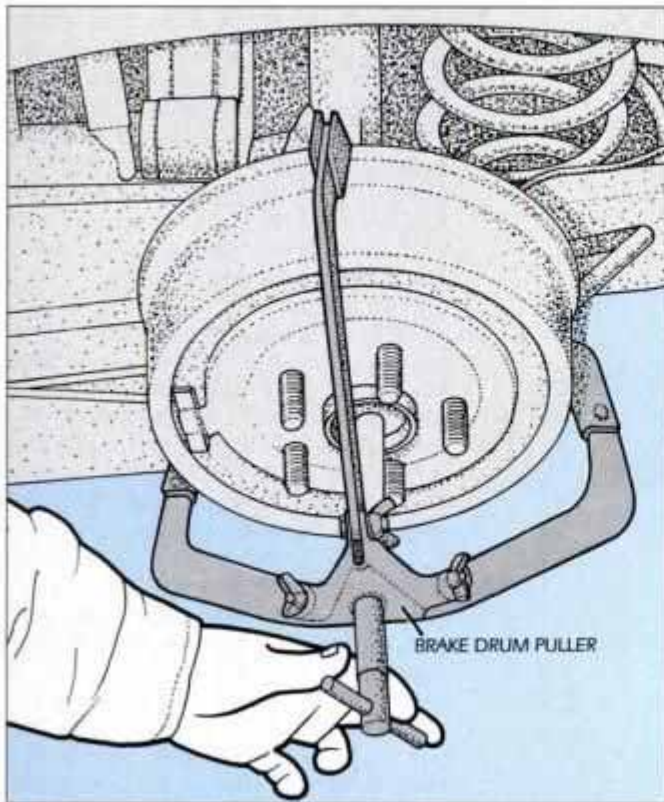
Only a few rear brakes have tiny lining inspection holes in the backing plates, so generally you've got to remove a drum to really see. It's absolutely worth doing.

Drum removal can be a minor pain on some cars, particularly if the drum is held by the wheel-bearing adjusting nut. Pick up a fresh cotter pin or tabbed nut, and a grease seal as well, and check a manual for the removal/

installation/adjustment procedure. Don't forget, you'll need some appropriate grease to repack the bearing if you remove the drum.

Most drums, however, are just on a hub, and with the wheel off, the drum slides off. There might be a metal clip or setscrew to keep the drum from falling off during wheel changes. If it doesn't pull right off, rotate the drum. If it's binding against the lining, that's usually because the device that moves the shoes to compensate for lining wear, called a star wheel adjuster, needs to be backed off to let the ridge inside the drum clear the shoes. Retract the brake shoes by releasing the





PM ILLUSTRATION BY RUSSELL VON SALES

You can rent a brake drum puller at rental agencies or auto parts stores. Don't try to hammer the drum off—it may bend or crack.

adjuster, accessible through a hole in the backing plate.

If the drum is stuck to the hub, apply penetrating solvent to the rim of the joint, and if there are stud holes in the drum, apply it to them. Next, try a drum puller. Hammering on the hub or even using a torch on the drum (if it's beefy cast iron) are techniques, but you shouldn't need them. On some late-model Nissans, look for two threaded holes in the drum. Insert a couple of bolts, turn them down evenly, and they will thread through and push the drum off the hub. Where the drum fits to an axle flange, always make alignment marks to refit the drum for proper rear wheel balance.

If the linings are less than 1/8 in. thick, replace the shoes. If they're thicker, they can stay.

Replacing the shoes, which should be done on both sides for balanced braking, is straightforward. Take off the drum on the other side, so you have a mirror image of how everything goes back together.

The star wheel adjuster may be automatically turned by a lever, or perhaps with a cable. There may be one coil spring, one U-shaped spring or a pair of coil springs to retract the shoes when you release the brakes. Most shoes are held to the backing plate by a spring, pin and retainer; others are held by a pin and spring clip

assembly.

Brake specialty tools are helpful in the removal and installation of springs, but a little patience and a good assortment of standard hand tools can get you through the work.

Begin by removing the shoe return spring(s), which you can usually disengage with needle-nose pliers. Don't waste your money on the old drum brake pliers, which just won't work on late-model cars. If you can't get the springs off with the needle-nose, you can use pliers with specially shaped tips for late-models or a tool, such as the one for GM cars,

disconnect the parking-brake cable from the parking-brake lever arm, which is pinned to one of the shoes.

Disconnect the lever from the shoe, typically by prying out an E- or C-shaped clip from a pivot pin in the shoe. That pin, and any others in the shoes, may not be included with the replacement shoes, so, if necessary, drive them out with a punch and insert them in the same holes in the new shoes. If any lever is supposed to pivot around a pin, be sure the pin is loose in the new part. Wire-brushing or light filing may be necessary to free corroded pins. Lubricate with a stingy dab of antiseize or grease.

## Line 'em up

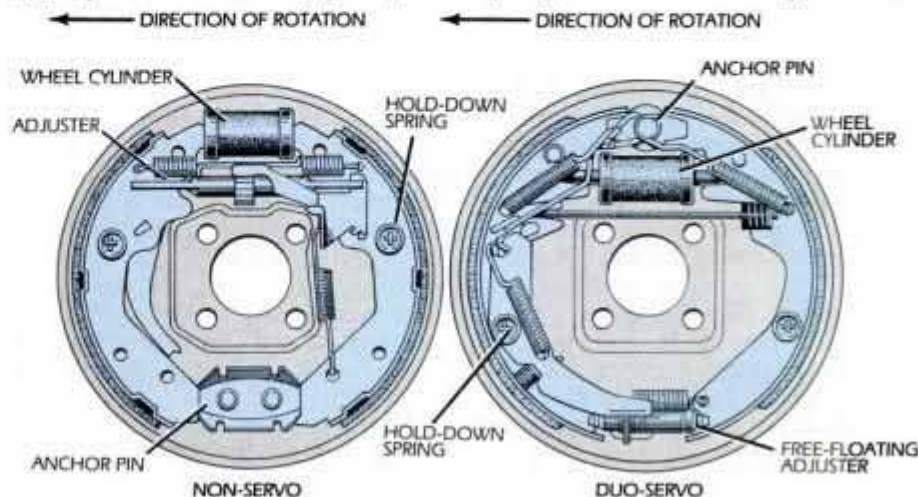
The new shoes should be as close to a duplicate of the old as you can get, or better. If the original shoes have semimetallic linings, get them as a replacement. If it's not semimetallic, don't "upgrade," as brakes are a balanced design of linings, drum materials and provisions for transfer of heat. Many cars have asbestos linings, and if you can't get a replacement in asbestos today (because of the health issue, asbestos linings are being phased out), you should find one in another nonmetallic material (there are many combinations using aramid and fiberglass, among others). Always pick a name brand—and only that brand's premium lining. There have always been a lot of cheap linings out there, and although they stop a car, they can't compare with the good stuff for fade resistance, lining life, wet performance and relatively low noise levels. A relined shoe may be fine, but a name-brand new shoe is best—and generally not a lot more money.

Always replace the springs. Weak springs allow shoes to drag, which af-

that pivots on the rivet heads of a duo-servo anchor.

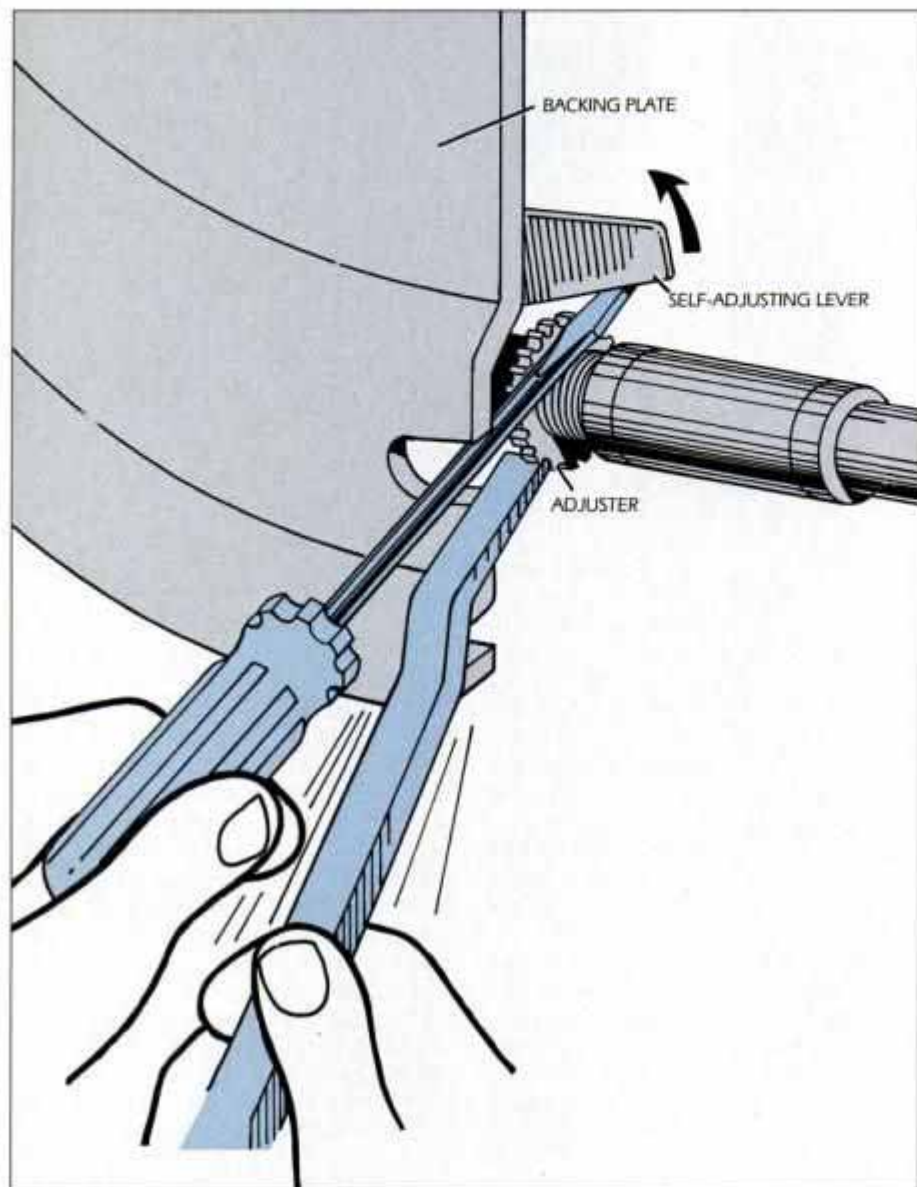
Next, take out the self-adjuster spring(s) if they are accessible at this point, and they usually are. Then, disengage the shoe hold-down springs. With needle-nose pliers (or a specialty tool), turn the pinhead 90° so it aligns with the slot in the retainer, and then the coil spring underneath will push the retainer up and out.

The shoes are now free of the backing plate, so spread them apart (they are connected together at the bottom in a servo design). Pull them away slightly from the backing plate, and



Some cars use non-servo-type brakes, especially with power boosters. Servo brakes use the wedging action of the shoes to lower pedal effort. Service is essentially similar.

PM ILLUSTRATION BY RON CARBON



PM ILLUSTRATION BY RUSSELL VON SAUERS

To remove or adjust many self-adjusting brakes, you'll need to use a thin screwdriver to lift the self-adjuster away from the adjuster's star wheel in order to rotate the star wheel.

ffects brake smoothness and lining life. You should think hard about replacing all of the automatic adjuster hardware and the hold-down springs if they look heavily corroded. An auto parts store that sells shoes probably has a complete kit. If the star wheel adjuster has even one slightly damaged tooth, or if any strut or lever is bent or badly rusted, replace it.

Before you reassemble, clean the area. Remember that on all but a few of the newest cars, the brake dust is high in carcinogenic asbestos. Vacuum up or wet down the dust, and dispose of it properly. Lubricate the rotating shaft and threads of the self-adjuster with wheel bearing or chassis grease, but if it's really frozen, replace it. Clean the backing plate with brake cleaner, a light solvent that leaves virtually no residue. Inspect the

brake shoe platforms, those raised sections along which the shoe slides. Wire-brush if necessary to remove rust, then apply a film of grease to them.

Pry back the wheel cylinder dust boots, and if there's any evidence of brake fluid inside them, replace the wheel cylinder. If you do have to replace a wheel cylinder, and the car's mileage is 50,000 or more, consider flushing the entire brake system with fresh fluid instead of just a simple bleeding. And as long as you have to loosen the bleeder valves anyway, unthread them and coat them with anti-seize compound, so they'll still be free the next time.

### Bang the drum slowly

Inspect the drum. If it's cracked, get a new one. If there are grooves deep enough to catch a fingernail, have the

drum resurfaced at a machine shop. Even if the drum looks good, unevenly worn linings may indicate warpage. You may have suspected this already if the brake pedal feels like it's doing the boogaloo under your foot. Have the drum measured for out-of-round (which should not exceed .002 in. on drums up to 7 in. in diameter, .004 in. on larger drums).

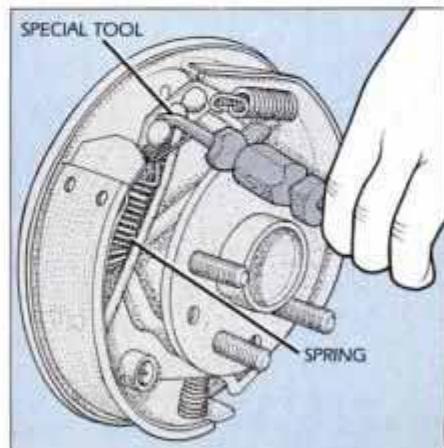
A tough part of reassembly is getting the hook eyes of springs into their holes or notches without specialty tools or losing all the skin on your knuckles. If you're using needle-nose pliers, grasp the spring close to the coil, pull it until the hook end reaches the slot, and then push the hook in with a flat-blade screwdriver.

### Gimme a break

After you've reassembled, give the brakes a break-in. First, operate the automatic adjuster. On most cars, it works while the car is moving in reverse, so slowly back up the car and firmly apply the brakes. On many cars, however, the rarely used parking brake operates the self-adjuster, so begin a new habit by applying it now.

If there's no self-adjusting function, you'll have to adjust the brakes manually. Turn the adjuster through the backing plate while rotating the wheel, until the wheel scrapes. Then spin the wheel rapidly, while a helper stabs the brakes sharply to seat the new brake shoes onto the arresting pins. Then readjust. You'll probably want to adjust within 100 miles or so as well, as the new shoes radius themselves to the larger diameter of the drum.

Then road-test the car, making several moderate stops from 30 to 40 mph, and the drums should be ready to make their contribution. **PM**



This special tool is a big help when reinstalling return springs on many GM cars.

PM ILLUSTRATION BY RON CARBONI

## CAR CLINIC

BY MIKE ALLEN,  
Associate Automotive Editor

### Stripped To Kill

The carb on my 1965 Mustang has one of those filters that sits right inside the carb inlet fitting. And I think it's plugged up because the float bowl is dry, even though there's fuel getting as far as the fitting. I've replaced the fuel pump and checked the pressure up to the carb, so I know that's not the problem.

I want to change the filter, but the fitting is stuck big time. What will give up first, the brass fitting or the aluminum carburetor top? Somehow I have to get this thing apart without trashing the carburetor—I'd like to avoid buying a new carb, and the auto parts store guy won't even take this one in exchange until the fitting is loose. Can I use a torch to loosen this thing up? If so, how do I keep from setting the rest of the carburetor on fire?

OSCAR WAINRIGHT  
TEHACHAPI, CA

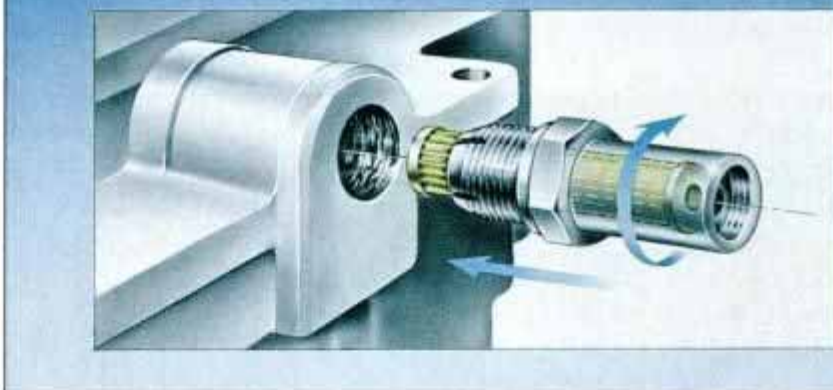
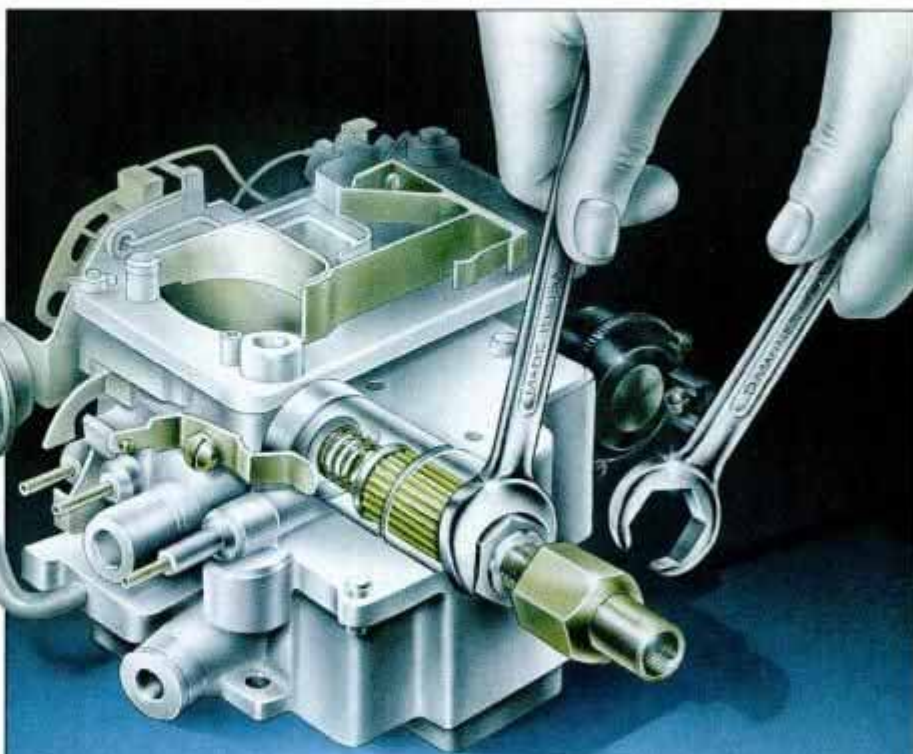
*Don't even think of using the torch. The aluminum carb top will simply warp, anyway. Leave the carb and carb top attached—you'll need a solid base to work on.*

*First, use a pair of tubing wrenches if you need to remove the outer half of the fitting from the inner. Tubing wrenches will often succeed when open-ends won't by virtue of the fact that they grip four corners of the fitting instead of two.*

*Use some penetrating oil, but don't expect it to work miracles. Hold the inner fitting steady with one wrench, while you break loose the outer. You'll be able to put plenty of muscle on the outer fitting because all the force is being transmitted directly to the wrench on the inner fitting—not into the carburetor's fragile top casting.*

*Now, take a 6-point socket and a T-handle breaker bar to the inner fitting. Use both hands to twist the fitting in a circle around its center, rather than pushing or pulling off-center. Just yanking on the end of a wrench is likely to bend or crack the carb top. You'll either unscrew the fitting or remove all the threads in the aluminum carb.*

*No problem, just clean all the sediment and, maybe, metal shavings out*



*of the bore where the filter sits.*

*Dorman and Thexton both make a nifty self-tapping fitting that should make your life a lot simpler. Just carefully thread the self-tapper into the hole until it seats. I'd remove the carb and rebuild it. Twenty-five-plus years of varnish and sediment, as well as a few shavings from the new fitting, won't do your driveability any good.*

### All Charged Up

I have a question about automobile batteries. Here in New England, the salesmen at the stores are always trying to sell me a battery that has a higher capacity, in terms of cold cranking amps, than the original equipment. The larger battery they try to sell me is more expensive of course, but is it necessary?

KEVIN BEGLEY  
TOPSFIELD, MA

*It's not necessary—but it isn't a bad idea to upgrade the capacity of your battery, especially in a severe climate. In their unending quest to meet federally mandated Corporate Average Fuel Economy (CAFE) requirements, car manufacturers have had to reduce the weight of vehicles any way they could.*

*One easy way to lose 3 to 4 pounds was to use a lighter battery. Three to 4 pounds doesn't sound like much, but when you're desperate to make the cut into the next—lower momentum—class to meet some arbitrary standard, it can put you over the hump.*

*Especially during the winter months when heavy electrical drains like lights, rear-window defrosters, heater motors and wipers are on a much greater portion of the time, a larger battery will have more headroom to supply sufficient current for cold cranking. The difference in the*



## CAR CARE

cost may be offset by extended battery life—not to mention the fact that your engine will be more likely to start on some subzero morning.

### Shock Treatment

When I slide off the seat of my Town Car on really dry days (especially during the winter), I can sometimes make a spark jump 2 to 3 in. Will dragging a chain on the ground help this?

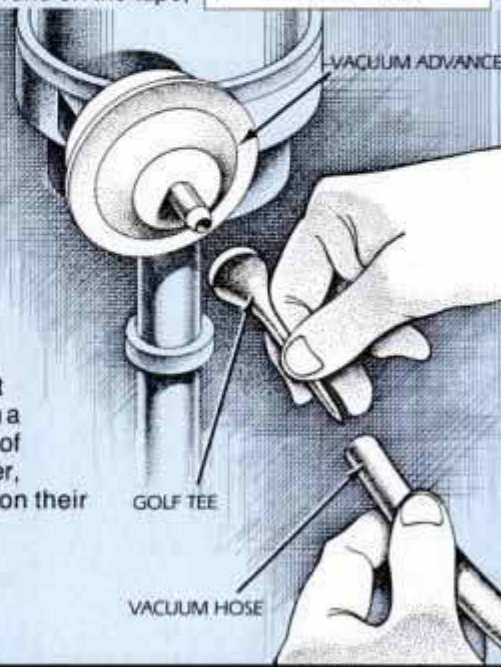
BOB BAKER  
MAPLE PARK, IL

*Dragging a chain will probably not help. You're generating a large amount of static by dragging your backside across the synthetic-pile velour seats. So the car is charged in one direction—which the chain would help—and you're charged in the opposite direction. You'd need to drag a chain from your ankle. Spraying the seat fabric and carpets with some of that antistatic spray intended for household carpeting will make a big difference. Radio Shack sells a similar spray, for twice the price. Or you might try some fabric softener, which is really the same thing.*

### TEED OFF

● For a long time, I've relied on the time-honored method of plugging loose vacuum hoses with masking tape. This has the added advantage of giving you a surface to write some identifying rune on the tape, in hope of increasing the chances of ultimately returning the hose to its intended fitting. Then I found some neat plastic thingamajigs in assorted sizes and colors at the auto parts store. They're intended for plugging vacuum lines, but they keep disappearing from my toolbox.

While browsing at a yard sale, I came across a box full of old golf tees. Not being a golfer (golf is boring!), I'd never looked at a golf tee closely—but they were perfect for plugging lines, and even came in a bunch of different colors. And none of the guys in the shop play golf either, so these probably won't walk off on their own as often.



## IF YOU JUST CREATED A COCKPIT LIKE THIS, WHERE WOULD YOU PUT IT?



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## CAR CARE

### Seat Installation

I own a 1966 Pontiac with a 326 engine. The heads do not have removable valve seats, so I can't have unleaded-gasoline-rated seats installed. And I can't buy leaded gas anymore. Do you have any suggestions?

GUY GRANATO  
BROOKLYN, NY

Not so. In spite of the fact that Pontiac didn't use a replaceable valve seat—they just ground a valve seat area into the cast iron of the head, which was good enough at the time—a sharp machinist should be able to countersink and shrink a set of modern, hardened valve seats into your original head castings.

But don't forget that the octane is a bunch lower than it used to be—you'll need to lower the compression ratio as well. This might mean new pistons or a thick, shim-type head gasket, or both.

### Changing Times

I have an '89 Nissan Sentra with 5-speed transmission. It shifts fine into every gear except 5th. The gearshift

will pop out of 5th and back into the Neutral position.

DARAN TALLARIDA  
NO ADDRESS GIVEN

*There are several possibilities: some minor interference in the shifter—that is, the shift boot or a foreign object is keeping the tranny from going completely into 5th. Or, the shift fork on the 4-5 shift rail has shifted, preventing the gear from sliding completely into mesh. The worse case would be that the teeth on fifth gear are damaged. These last two will necessitate the disassembly of the trans.*

*If it's a shifted shift fork, then fourth gear has probably been cooked by the friction of the fork, which normally isn't pressed up tight against the gear. Unless you can blame this problem on something like a petrified french fry parked in an inappropriate place in the shifter, be prepared to rebuild the tranny.*

PM

### DO YOU HAVE A CAR PROBLEM?

Just ask Mike about it. Mail your question to Car Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters, faxes or phone calls cannot be answered individually, problems of general interest will be discussed in the column.

### SERVICE TIPS

- If you've had to service the rear-axle drive pinion on your 1991 Chevy Caprice, TSB 91-66-4B says to be sure to replace the ABS sensor ring with a new one. Reinstalling the old press-fit ring may result in slippage and false speed signals to the ABS computer.
- Some 1989 Nissan Maximas built before September 3, 1989, may have Freon leaks from the low-pressure air-conditioner hose. Look for compressor oil near the crimped end, or for small pinholes or cuts under the rubber tube covering the hose. TSB NTB90-084
- 1991 Chrysler Ram Vans, Pickups or Dakotas whose fuel gauge reads less than full after filling the tank, should have the fuel-sending unit inside the gas tank replaced. TSB 08-11-91
- If your Suzuki Samurai acts like the exhaust system is plugged up, TSB ST-033-8 details a procedure for determining how plugged it might be by attaching a fuel pump pressure gauge to the EGR valve.
- If the sound from the headphone jack on your LeBaron Coupe is garbled, TSB 08-06-89 suggests adding a ground wire to a vacant cavity on the right rear speaker wiring-harness pigtail. Connect the other end of the wire to the package shelf.

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## DETROIT SPY REPORT

BY JIM DUNNE, Detroit Editor

**New Camaro Shapes Up**

● Like its cousin from GM's Pontiac division, Chevy's sporty Camaro is headed for a complete restyling, with introduction planned for next January as an early 1994 model.

As our spy shots show, however, the new Camaro's skin, much of it crafted in plastic, doesn't represent as radical a change as the next-generation Firebird. Although the front view is substantially revised and a full-width taillamp stretches across the rear, the new car will have a familiar look in profile.

The Camaro's vertical plastic body panels will bolt to a steel spaceframe, à la Saturn and the GM TransSport/Silhouette/Lumina APV minivans, but the chassis is expected to be essentially the same live-axle rear-wheel-drive setup that has carried Camaros since the current car came along in 1982.

While several of the V6 and V8 powertrains will also be familiar, one big change could be the availability of Chevy's new 5.7-liter LT-1 V8 engine. Peak power probably won't be equal to the Corvette version of this engine—300 hp—but it should be 30 or more hp above the most muscle available in the current car (245 hp).

**Riviera Revision**

The photo at right provides just a hint of what you'll see when the new Buick Riviera makes its late-'93 debut as a 1994 model. The prototype captured here has disguise panels covering the C-pillar, decklid and grille opening,

but the new body shape is evident in the belt-line, rear quarter panels and the windshield.

Buick plans to offer the new Riv in both coupe and convertible body styles, while its Oldsmobile cousin, the Toronado, will become a 4-door.

The big powertrain question is whether Buick will stick with the GM 3800 V6 or perhaps return to a V8. Smart money inside GM is on a modified version of Cadillac's new Northstar 4.6-liter V8 engine.

**GM 2-Cycle V6**

Insiders won't talk much beyond hints, but those hints strongly suggest that General Motors is working full time to develop a 2-cycle V6 engine for use in its full-size cars of the mid-1990s and beyond.

Still in the early stages of development, the powerplant will be as small as a typical V6, but pack the power of a V10 or V12. The program is not a definite go as yet. As with most 2-cycle engine projects, there are still fuel-injection and emissions problems to be solved.

Just as important in an era of GM austerity, the price of the new engine's tooling and production facilities has to survive management's scrutiny.

But the hint-

droppers look for the engine to be on the road three years after it gets the green light from the financial planners. Yes, it does take a long time to get innovation out of the automotive companies.

**Program Bargains**

Learn about "Program Cars" if you want to pay used-car money for your next new car.

Program Cars are low-mileage—usually between 3000 and 10,000 miles—sedans that were first purchased for fleet duty.

After a short stint as rentals with Hertz, Avis and others, the cars are sold back to new car dealers. You can buy these program models at thousands of dollars less than they cost new. Many are only a few months old. And they are warranted just like new models.

**Privacy, Please**

That's what you get with a new sunshield glass that Libbey-Owens-Ford



Disguised Buick Riviera prototype may have V8 power under hood.

has ready for use in vans and utility vehicles.

The gray-green glass is much more than a privacy feature, though. It blocks 90% of the Sun's energy, stops the Sun's infrared rays from passing through and shuts out 90% of the Sun's ultraviolet rays.

Unlike other tinted glass, the new glass reflects little light from the inside of the vehicle. That leads to better visibility during night driving. Look for this new glass—called "Privasee"—to show up first on side windows of the Dodge Dakota pickup and Chevy Blazer ST.

## Mustang Makeover

Ford insiders are quietly confident about the design of the next Mustang, due for the 1994 model year.

Besides a complete overhaul of styling, the car will get a version of Ford's world-class V8 engine, the 210-horsepower 4.6-liter modular design now used in the company's full-size cars. One of the options for this popular ponycar will probably be the dohc 32-valve version slated for introduction in the '93 Lincoln Mark VIII. Horsepower expectations for the 4-cam 4.6 range between 275 and 300.

The basic Mustang engine will continue to be a V6.

While extensive suspension revisions are planned, the basic chassis will be developed from the current rear-drive setup.

## Age Of Hybrids

Import or domestic? In an era of joint-venture vehicles, it's getting increasingly hard to tell.

The latest Ford/Nissan minivan project is a good example of this trend. The Mercury Villager/Nissan Quest van was designed and engineered by Nissan. Nissan will also supply the basic V6 powertrain and will handle stamping of body panels.

However, Ford will assemble the vans for both companies at its Avon Lake, Ohio, plant. Ford is also expected to offer powertrain options for the Villager from its own family of engines.

The Villager and Quest are all but identical in appearance except for grillwork, wheels, badging and minor exterior trim details.

## GM Slowdown

Financial cutbacks at General Motors have already pushed back planned introduction dates for several new vehicles, and will probably affect others if economic conditions don't improve sometime soon.

Tops on the list of delays are the Oldsmobile Cutlass Ciera and Buick

Century replacements. The new mid-size A-body cars were once scheduled to appear as 1993 models, but have been pushed back to 1996 and could disappear from the lineup entirely.

Meanwhile, General Motors plans to update the cars for 1993 with driver's-side airbags and interior trim revisions.

Also affected are the Chevy S-10 Blazer/GMC S-15 Jimmy sport/utility vehicles and the Chevy S-10/GMC Sonoma pickup trucks. Introduction of the pickups has been delayed from 1993 to 1994, and the sport/utility vehicles slide from '94 to '95.

## Power Play

By the time you read this, we will already have driven the new Jeep Grand Cherokee. At introduction, the new Jeep sport/utility will be powered by the familiar 190-hp straight-Six that also propels the regular Cherokee. However, Jeep insiders say the new vehicle will have a V8 engine option available by midyear. Chrysler plans to make its 230-hp Magnum V8 truck engine available to buyers who want more muscle.

Chrysler sources also hint that the new Grand Cherokee may be added to the Dodge truck lineup. **PM**

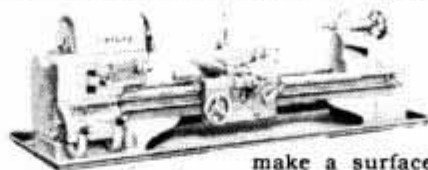


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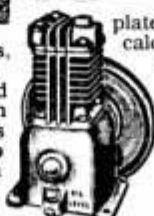
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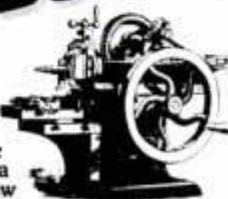
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# AMERICA'S CUP 1992

BY JOE SKORUPA, Boating/Outdoors Editor

PM PHOTO BY BOB GREISER



● Imagine yourself gripped by an obsession. Not just any obsession, but a magnificent one that leads to glory for yourself and your country. Years of single-minded preparation, immense sums of money, advanced technology, highly specialized skills—all of these and more are needed for you to succeed in your determined quest. What inspires such a consuming passion? Fame, wealth, influence? Yes, these, and a small silver mug commonly known as the America's Cup.

Few people today are totally in the dark about the America's Cup, the Holy Grail of competitive sailing, but to the vast legions of nonsailors—and I count myself in this category—an unavoidable question comes to mind: Why all the fuss?

## Understanding the Cup

The whole thing was started by the British 140 years ago. In possession of a proud seagoing heritage and the most powerful navy the world had ever known, Brit yachtsmen got tired of jousting with each other and issued an open challenge to a match race in 1851. The schooner *America* showed

up at Cowes, on the Isle of Wight, and to the surprise of the Brits, beat the sails off them.

An international match race was held every couple of years since that fateful day and, to growing British embarrassment, the United States successfully whipped all challengers. This went on for so long that the British-made mug and the race it stood for eventually became known as the America's Cup. (Incidentally, the only time the U.S. ever lost the America's Cup was in 1983 to the Aussie team, with their controversial winged keel.)

But enough history. By the time you read this, the series of round-robin

elimination races will be underway and the battle begun. Here's some information that you might find useful in understanding what's going on.

● To sound like a veteran, use the initials AC when referring to the America's Cup. Sailors will know what you mean. Others will think you're talking



PM at the helm of *Stars & Stripes* with Dennis Conner (left).



Dennis Conner's new AC boat, *Stars & Stripes* (right), jousts with an old 12-meter AC boat.

about alternating current.

● Since the last regular AC race, 1987 in Perth, Australia, an entirely new class of AC boat has been created. Without going into great detail here (see the AC story "War In The Wind" in next month's issue), the new boats are bigger and faster than the familiar 12-meter boats of yore. By the way, don't expect to see any wing-sail catamarans. The 1988 AC contest that produced the high-tech cat was an aberration that isn't likely to be repeated in our lifetime.

● Dennis Conner is the most recent AC champ, but that doesn't give him an automatic entry as AC defender. First, he must win the Defender Selection Series, a round-robin series of races among all U.S. entrants. A dozen teams were originally formed, but all dropped out because of money problems except for two—the Conner team and a team headed by Bill Koch (pronounced, "coke"). These teams will go head-to-head for a period of several months, but it won't be boring. There's a lot at stake.

● The challenging team for the AC must first beat all comers in a round-robin series of races that's known as the Louis Vuitton Cup, after its sponsor the French luggage maker. The competition consists of a series of 2-boat match races. In the first round, AC teams earn one point for each victory. In the second round, they earn four points per victory. The two teams with the most points after the first two rounds then meet for a best-of-7 match race. The lengthy process will allow teams to make design adjustments in midseries.

● One of two U.S. teams will defend the AC this year, and the men in charge couldn't be more different. Conner is the most experienced AC skipper in the world, and by all ac-

counts, the best all-around sailor. The 4-time AC winner is the son of a San Diego fisherman, and sailing is his life. Koch is an AC rookie with relatively limited experience in elite competitive sailing. In Koch's favor is his personal wealth, estimated at \$650 million, which is the basis for his team's bottomless funding.

● There are 10 AC challengers this year from nine countries, a new AC record. Of this group, the teams from

Yugoslavia and Russia are more symbolic than serious contenders. A second tier, consisting of teams from Australia (two), France, Spain and Sweden, are more serious and may make a surprise appearance in the finals. The big three, by all accounts, are from New Zealand, Italy and Japan.

● Money makes the world go round in AC competition. Boats cost \$2 to \$3 million, and the top teams campaign with more than one. For the first time, lack of money has forced Conner to mount a one-boat AC campaign, which puts him at a distinct disadvantage. The other top teams have at least three boats each. Here are projected team budgets (estimated) for the top-5 AC hopefuls: 1. New Zealand, \$40 million; 2. Italy, \$60 million; 3. Japan, \$50 million; 4. Koch's *America 3*, \$40 million; and 5. Conner's *Stars & Stripes*, \$15 million.

With so many better-financed challengers gunning for the old silver trophy, including one team from the U.S., will Conner's sailing skills and team management acumen be enough to maintain his hold on the Cup? Conner is clearly an underdog, but no one is counting him out. With so many unknowns—new boat design, new course, new venue—anything could happen, and this will make the 1992 AC fascinating to watch.

FM

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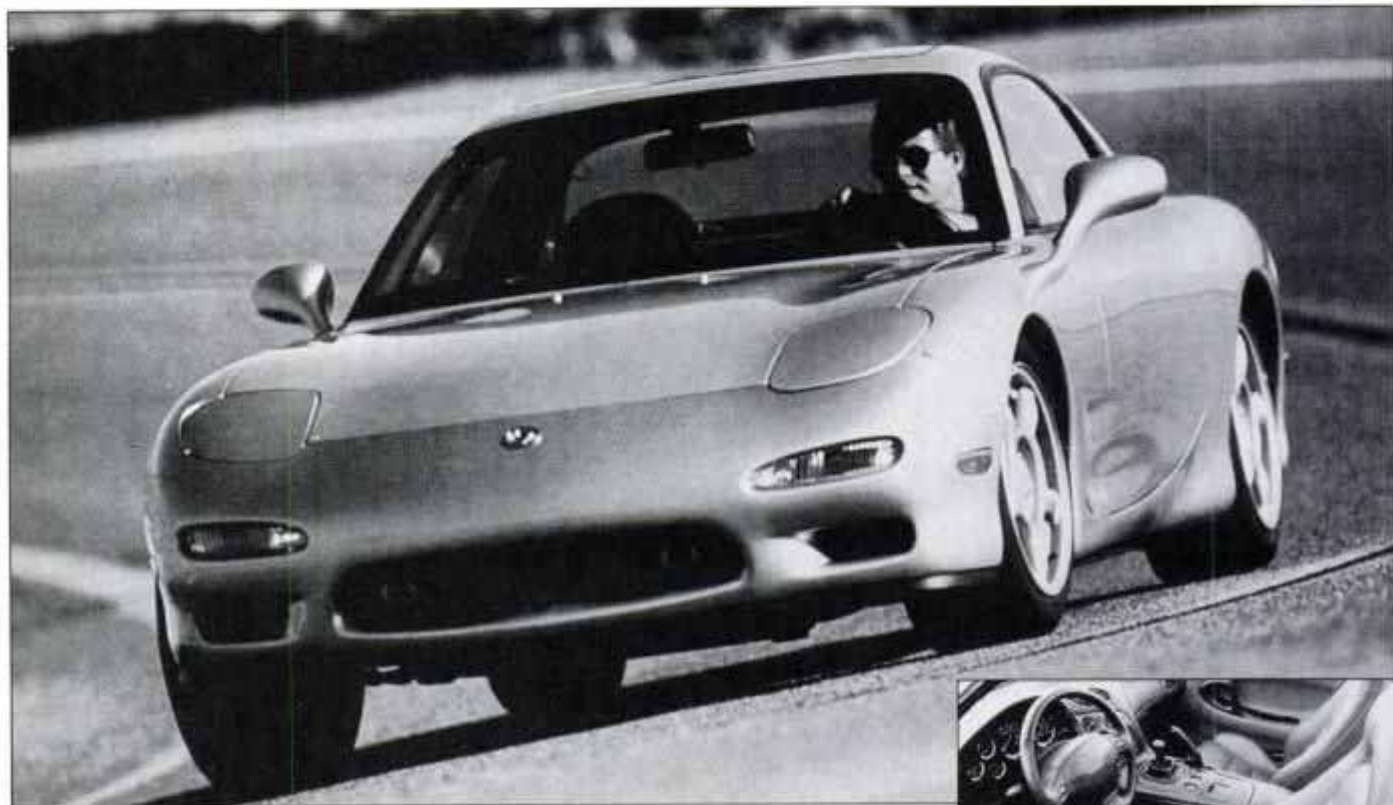
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# NEW CARS



## Mazda RX-7—The New Rotary Rocket

● Since 1978, Mazda's RX-7 has embodied a long list of sports car virtues: low weight, responsive handling, excellent brakes, good looks, reliability—in short, just about everything you could ask for. Unless, you happen to ask for supercar performance. Even in turbo tune, the previous RX-7 didn't have the suds to run with the likes of the Chevrolet Corvette, Nissan 300ZX Turbo, Dodge Stealth or Acura NSX.

But the new one does. The third-generation RX-7 adds true world-class hustle to its already extensive bag of tricks. Boosted by sequential twin turbochargers and a new Bosch D-Jetronic injection system, the 13B rotary engine now makes a robust 255 hp at 6500 rpm. The sequential action of the turbos—one turns virtually all the time, while the second comes on when rpm spikes upward—keeps turbo lag pretty much out of the performance picture, and low weight helps give the car serious performance numbers. How about 0 to 60 in less than 5 seconds and the quarter-mile in

the 13-second range? Top speed lies in the rare regions beyond 150 mph.

The car that surrounds all this potency is correspondingly better than its predecessors. Under the demanding leadership of Mazda sports car and racing boss Takaharu Kobayakawa, the RX-7 design team substantially improved the new car's platform rigidity while keeping weight to an impressively low 2800 pounds, a process that entailed endless refining of various subsystems.

Suspension components also show an unswerving commitment to performance. The new RX-7 sports



Twin sequential turbos and Bosch F.I. boost 2-rotor 13B Wankel to 255 hp.



Retro styling belies supercar performance of substantially reengineered platform.

forged aluminum double wishbones at the front and a sophisticated multi-link system at the rear with a Torsen limited-slip differential. The 8-in.-wide cast-alloy wheels wear 225/50R-16 tires and the brakes—vented 11.6-in. rotors with ABS—are nothing short of race-ready.

The chassis work pays off with handling that is as good as anything in this class, and better than most. Although the RX-7 is a front-engine car, its weight distribution is 50/50, giving it wonderful balance and certainty when the scenery goes into fast-forward. The feeling of car/driver solidarity is enhanced by the snugly supportive fighter-plane cockpit, and the power rack-and-pinion steering is as precise as everything else in this car.

The new RX-7 comes in three subtly different flavors—basic, deluxe



The Bugatti marque will soon rule the Autostrada again with the 210-mph EB 110.

and a slightly stiffened hard-edged super-performance edition. All are fast. All come with the twin-turbo motor only (no more normally aspirated RX-7s). All are thoroughly confident on the road, and all are a good deal more expensive than previous models. Pricing should start at \$30,000.

You could think of it as a lot of money for an RX-7. Or you could think of it as we do: a sports car that will match the superb Acura NSX stride for stride, at half the price.—Tony Swan

### Bugatti Redux

The revival of the legendary Bugatti name may bring joy to the hearts of most enthusiasts, but it's likely to

produce a sinking feeling in the hearts of those who own exotics like the Ferrari F40 or Lamborghini Diablo.

The Bugatti EB 110, first creation of the new Automobili Bugatti, is a one-upmanship collector's item of the first magnitude. It also promises to deliver first-magnitude performance.

There's a race-car carbon-fiber tub under that swoopy blue bodywork, and raceworthy horsepower to propel it. The EB 110's new 3.5-liter dohc 60-valve (five valves per cylinder) quad-turbo V12 is rated at 550 hp, with 434 ft.-lb. of torque. Bolt that to a 6-speed transmission in a car that weighs just over 3200 pounds, and you get 0-to-60 times in the 3.5-second region, with top-speed capability approaching 210 miles per hour.

Stopping power, which is supplied by enormous 13.1-in. Brembo brakes (look for carbon-

fiber discs on production models), is equal to the speed potential. Massive 245/40R-18 front and 325/30R-18 rear Michelin tires keep the Bugatti glued to the ground. The tech team, lead by ex-Ferrari production car chief Nicola Materazzi (the F40 is just one of his many credits) looked for skidpad numbers in excess of 1.1 g's and handling to go with it.

But don't look for this car to be anywhere close to the price range for mere mortals. The initial rush of collector/speculator types will keep EB 110 prices in the realm of a half-million.

### Isuzu Trooper

Isuzu's introduction of the all-new Trooper should be a shoo-in for 1992's



Isuzu has moved trusty, utilitarian Trooper considerably upscale.

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PHOTO BY MIKE GASTER



Integra GS-R has smaller, more efficient engine, with highest hp/displacement ratio available in production cars sold in the U.S.

"Exceptional Courage by a Manufacturer" award. Not on the merits of its new design, but for the fact that Isuzu has decided to move the Trooper from the low end of the sport/utility market, where it has been king of the segment in sales, to the high end, where the Trooper is likely to find the going a lot rougher. Rougher? Ford Explorer, Olds Bravada, Mazda Navajo, GMC Yukon and a half-dozen others make it a crowded niche indeed.

The Trooper was first introduced in 1984, and has been a significant product for the company in terms of both sales and brand recognition. In 1986, the Trooper grew to 4-doors and had the best price-to-equipment ratio of any vehicle in the segment. It sold like hot cakes in the now rapidly growing sport/utility/family-car market.

This fact proved somewhat surprising in view of the Trooper's station-wagon-on-steroids appearance. We're talking edges so square you could cut bread on them. In the looks-are-everything '80s, such sales success could only be attributed to buyers seeking value over cosmetics. And with an \$11,000 base price, the first Troopers were a solid value.

But seven years is a long time for any one design, and following the very successful 1990 introduction of the Rodeo, Isuzu chose to redesign and redirect the Trooper for 1992. The '92 Trooper is all new and very much upmarket. At the heart of the matter is the freshly developed 3.2-liter V6 engine. It will be available in either double-overhead-cam or single-overhead-cam configurations, which develop 190 or 175 hp, respectively. It's a smoother, quieter, substantially more powerful engine that puts the '92 Trooper on a performance level with its competition.

The new shape is decidedly more upscale and reflects the fine fit and finish Isuzu has become known for. With the largest passenger doors in the segment, the new Trooper's plush and nicely detailed interior is much easier to get in and out of. Interior road noise levels at highway speeds are on a par with most full-size sedans. This is very much a luxury sport/utility vehicle.

But, for as much fuss as will be made over the new engine, the new body and the new interior of the '92 Trooper, it is the new chassis that has

impressed us the most. Here is where the Trooper sets the market-segment standard. With sedan-like ride quality—yet, with the cornering balance and power not unlike some sport coupes—the '92 Trooper is the best-handling 4wd sport/utility we've ever driven. This is no small accomplishment given the compromises required in the design of a suspension system for a high-center, 4wd, on/off-road, family, service vehicle.

From an overall design, manufacturing and packaging standpoint, the 1992 Trooper is at the cutting edge of the sport/utility segment. As of press time, no pricing had been announced. Our best estimates would put it between \$21,000 and \$24,000.

—Rick Titus

### Acura Integra GS-R

When it comes to sporty cars, Honda has regularly demonstrated it's not one to be left behind. And here's yet another proof. With other manufacturers of small sport coupes steadily closing ground, Honda has taken the Acura Integra series an important step forward with the addition of the new GS-R coupe. Not only is the GS-R considerably quicker than the rest of the Integra lineup, it also helps provide a sharper definition of this entry-level offering from Honda's luxury/sport division.

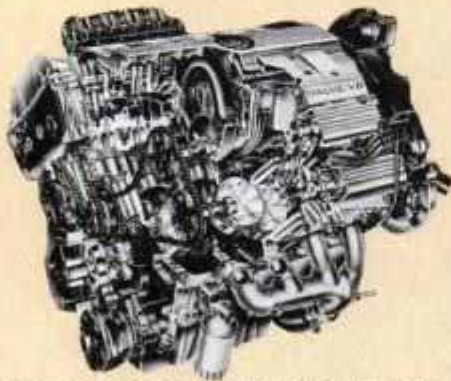
Remarkably, Honda has quickened this Integra's paces by *reducing* the displacement of its dohc 16-valve alloy 4-cylinder engine, from 1834 cc to 1678. Bore remains the same at 81mm (3.19 in.), but stroke is reduced from 89mm to 81.4 (3.2 in.). Compression is up from 9.2:1 to 9.7:1. The power secret lies in the GS-R's VTEC (Variable-Valve Timing and Lift Electronic Control) system. Adapted from the NSX sports car, this system raises both the engine's redline and power peak, from 140 hp at 6300 rpm for the standard Integra 1.8L to 160 hp at 7600 for the GS-R.

As the numbers suggest, this little screamer just loves to rev, and even though there's not much grunt at the low end (even the torque peak is 7000

## '93 Allanté Ups The Ante

● Who says you can't put some serious power through a front-wheel-drive chassis? Certainly no one at Cadillac. The 1993 Allanté is the first car to be pulled—very quickly—by GM's brand-new 290-hp (at 5600 rpm) Northstar V8.

The '93 Allanté also sports a strong, new electronically controlled 4-speed automatic to handle the Northstar's bodacious 290 ft.-lb. of torque at 4400 rpm, new independent rear suspension, speed-sensitive steering, second-generation traction control and computer-controlled shock damping.



But the brightest jewel in this stunning technological crown is the 4-cam, 32-valve, all-aluminum (with cast-iron cylinder liners) 4.6-liter Northstar V8. The engine bristles with more engineering developments than most new cars. Fact is, the '93 Cadillac Allanté is an all-new car despite the sheetmetal that has been only slightly tweaked. And with the changes that have been made,

you'd have to rank the Allanté as one of the most technologically sophisticated automobiles in the world.

—Don Chaikin

PH ILLUSTRATION BY DAVID KIMBLE

rpm), the special close-ratio 5-speed manual gearbox (only transmission available with the GS-R) makes the most of the power. While we have yet to harness our fifth-wheel test gear to the GS-R, we look for 0-to-60 test times to be markedly quicker than the standard Integra, probably well under the 8-second mark.

Elsewhere, the GS-R is indistinguishable from other Integras, offering the crisp road manners that go with Honda's double-wishbone independent suspension, speed-sensitive-assist power rack-and-pinion steering and 4-wheel ABS disc brakes.

One element that will distinguish the GS-R from other Integras, however, will be its window sticker. Al-

though pricing wasn't final at press time, look for the GS-R to be higher than even a leather-lined GS model, probably a bit more than \$18,000.

### Volvo 960

The look is familiar—pure Volvo 9-series boxiness. Slipping in behind the wheel won't dispel that familiarity, since you sit in the same supportive, leather thrones, facing the familiar Volvo dash. In fact, there is nothing visual about the 960 to let you know that this car is a major step up.

What separates this new \$36,000 flagship from the rest of Volvo's fleet is what sits

under its broad, square hood. Though never famous as road rockets, some Volvos have nodded toward sportiness. In the 960, the nod is more profound, thanks to its willing and but-tery-smooth new engine.

The all-aluminum 3.0L inline Six has 24 valves, dual overhead cams, distributorless direct ignition, and long, tuned intake runners. This is the most potent engine Volvo has ever bolted into a car, putting out 201 hp at 6000 rpm, and 197 ft.-lb. of torque—with nearly 160 of it available from 1000 rpm onward. The motor simply and sweetly pulls the car forward ever quicker as your right foot prods the pedal. Yes, torque is good, even in a Volvo.

Behind the engine is an electronically controlled 4-speed automatic, which features ECONOMY, SPORT and WINTER modes. In WINTER mode, first and second gears are locked out, reducing wheelspin on slippery roads. And since the 960 is a Volvo, it features the Swedish carmaker's latest safety innovation. Called SIPS, the new system entails a reengineering of the B-pillars, floor pan, doors and sills to divert side impact forces around the passenger compartment.

—Don Chaikin



Volvo 960 places highest-tech 3-liter Six into a 900-series body shell.



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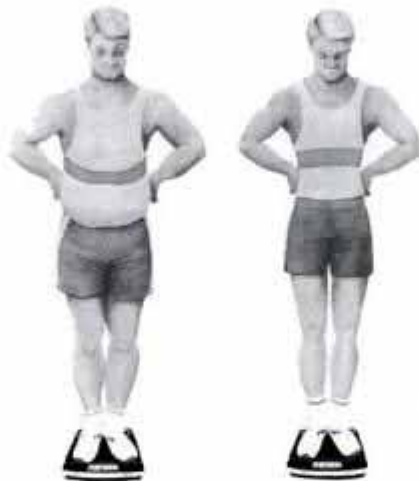
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## LITTLE PLEASURES

BY FRANK VIZARD, Electronics Editor

● Many people believe that for something to be good it has to be big. While that theory may have validity in some areas, in electronics you should never judge a product simply by its size.

Among the more recommendable small electronic devices now available is Cobra's new solar-powered radar detector. While a little more expensive than some radar detectors at a list price of \$320, the RD-6000 has one great feature going for it: no wires.

The RD-6000 is the first solar-powered radar detector, so you don't have to plug the unit into the car's cigarette lighter for power. Of course, the big question is: How well does it hold a charge? Very well, thank you. Out of the box, you need to give the RD-6000 a good charge by plugging it into the car's cigarette lighter for about 12 hours. The cigarette lighter adapter cord comes with the unit, but this should be the last time you use it.

Once the NiCd battery is fully charged, the solar panels keep recharging the radar detector. The RD-6000 also uses a pulse-powered supply system, which sends power to the unit once every  $1/50$  of a second, to reduce energy consumption.

In a trial run of 460 miles in a Suzuki 4-door Sidekick, the handsomely designed RD-6000 performed admirably. On three separate occasions, police swooped in from behind to irradiate our out-of-state vehicle with X- and K-band radar. In each instance, the RD-6000 provided adequate warning, thanks to built-in metallic deflectors that route the radar signals received from the rear into the unit's receiving horn. Two encounters with police radar occurred at night, so the



The first solar-powered radar detector from Cobra makes its debut.



The Technics SL-XPS900 portable CD player is less than 1 in. thick.

RD-6000 has adequate power reserves. Cobra says the unit will operate for 30 hours in non-daylight.

The RD-6000 also has one other feature that's very handy. Built into the unit is a piezoelectric motion detector that automatically shuts off the radar detector if the vehicle is motionless for 3 minutes. Vehicle movement turns the radar detector on again. Once installed, you'll never have to touch the RD-6000 again.

### Big Sound

If you're looking to put together a small stereo system with high-fidelity sound, you might consider using the Technics SL-XPS900 portable compact disc player as your anchor. This portable player, like its SL-XPS700 predecessor, is the slimmest of its kind. Both machines measure  $5\frac{1}{16}$  in. sq. and are only  $1\frac{1}{16}$  in. thick. The SL-XPS900 adds a remote control.

Neither machine is designed for jogging, as the mechanisms are sensitive to shock. But the performance is equal to that of many larger home players. These machines are most suitable for trips to vacation homes, offices or other locations where a small system might be desirable. List price for the SL-XPS700 is \$340. The SL-XPS900 should cost a little more.

If you want to use the portable CD player for more than just headphone listening, you will need a pair of powered speakers. The best small

powered speakers we've heard lately are the Persona system speakers from M Technology, a division of Monster Cable Products, Inc., in South San Francisco, California.

Standing at just under 9 in. tall, the Persona speakers reproduce sound much better than their small size would lead you to believe, particularly since the amplifier is rated at only 10 watts per channel. A big part of the Persona's success is the use of a proprietary ambience recovery system (ARS) that delivers a very accurate and natural sound. List price for the Persona speakers is \$230. **PM**



Even though they are less than 9 in. tall, the Persona speakers deliver big sound.

## HOME IMPROVEMENT

# PROBLEM SOLVERS OF THE MONTH

BY JEFF WILLIAMS, Contributing Editor



### Sandflex Abraser

● The flexible sanding block is not a new idea. Most sanding blocks on the market are made of foam with the abrasive bonded to the outside. They don't cost much, and they don't last very long. The Sandflex Abraser developed by Klingspor is a solid sanding block with abrasive embedded throughout. The rubberized composition of the block is mixed with the abrasive granules as a liquid, then

molded into shape and cut to size. As it wears, it reminds you of an eraser. The molded rubber is easily cut to match any shape you might be working with.

Uses for the product are as varied as your imagination. The Sandflex comes in coarse, medium and fine grit. You can use the fine grit as a polisher for stainless steel. When combined with water, it performs all the functions of wet/dry sandpaper.

In our tests, the occasionally difficult task of cleaning heat marks from stainless-steel cookware was made easy, as was removing rust stains from inside the toilet bowl, sink and tub. When the coarse grit was tested on wood crosscuts, it removed the sawtooth marks with ease.

Its  $\frac{3}{4} \times 2 \times 3$ -in. size makes for comfortable hand fit and easy storage in a toolbox or belt. After you've used a Sandflex Abraser for a while, you will begin to wonder if you'll ever need to use sandpaper again.

According to its manufacturer, Sandflex can be used to restore the nap to suede, and when combined with cleaning fluids and waxes, it can create high-polished surfaces. It will always produce an even abrasive at the working surface, and will not harden with age.

Klingspor's "no-home-should-be-without-one" tag is appropriate in this case. At \$3.95, the price won't bust your budget either. Klingspor products are sold through The Sanding Catalog. For more information, write to the catalog at Box 3737, Hickory, NC 28603; (800) 228-0000.

### AAA Stain Remover

Once upon a time, I spent about 20 hours and five trips to the store trying to find something to remove an annoying stain in a white wool rug. Nothing worked until I came across AAA Stain Remover. Within 20 minutes, the stain was gone. No scrubbing, no sweating.

Saying that a product is miraculous sounds like someone is peddling snake oil. But in this case, it's true. Even the manufacturers, Johnson and Johnson Chemists of Clearwater, Florida, are amazed by the stories coming in from users of the product. The manufacturer maintains that the product works equally well on wood, concrete, plaster and a wide variety of fabrics. It can also be used as a laundry additive to remove stains in clothing and to generally brighten and deodorize.

The chemical compounds contained in AAA are as old as the hills. Only recently did anyone discover their stain-removal and deodorizing properties.



There is nothing about the product that causes environmental concern and, according to the EPA, no label cautions are required.

The product is a white granular powder. It's odorless, and has a shelf life into the next century. Once mixed with warm water, the mixture has an effective life of about 5 hours. You need only be careful not to mix more than you can use in that period of time. Add to its stain-removal proper-

ties a deodorizing capacity second to none, and you have a one-two knockout punch around the house.

The product is sold in an inconspicuous 8-ounce wide-mouth jar. Mixed according to the directions, one jar will dilute in water to make up to 25 quarts of usable potion. All things considered, the \$14.99 sale price seems like a heck of a deal. I probably spent \$75 on the products to clean my white rug, and none of them worked.

AAA Stain Remover is only available through a catalog. For ordering, write to Johnson and Johnson Chemists, Inc., 5100 Ulmerton Rd., Suite 12, Clearwater, Florida 34620; (800) 358-1999. **PM**

*Jeff Williams is the host of "The POPULAR MECHANICS House Doctor," a satellite broadcast radio talk show about home improvement. Anyone interested in submitting problem-solving products for review in future issues of this column should send information to Jeff Williams, 4275 34th St. S., No. 340, St. Petersburg, FL 33711.*

## MOTORSPORTS

# GOOD OLDS DAYS

BY TONY SWAN, Automotive Editor



Though it lacked peak hp of SSA class rivals, Quad 4's response kept PM effort in the hunt throughout the '91 season and powered the car to two SCCA Regional wins at season's end.



● The net result of our 1991 racing season reminds me of comedian Jerry Colonna leading a posse to rescue Bob Hope and Bing Crosby in one of the old "Road" movies. Thundering up about 1 minute too late, Colonna reined in, looked around and said, "Well, we didn't make it. But it was exciting, wasn't it?"

That about sums up our run for the 1991 SCCA National Championship Runoffs. We missed the cut by exactly one point. But it was exciting.

What does this say about the Oldsmobile Quad 442's performance? In a class dominated by turbocharged cars, the Quad 442's H.O. (for High Output) Quad 4 engine gave a good account of itself.

Although it gives something away in rated horsepower to cars like the Mitsubishi Eclipse, its quick response and willingness to rev kept us in the hunt in most of the races we ran.

And in other racing venues, those allowing suspension modifications, the Quad 4 had enough muscle to make the Calais a winner. More on that in a moment.

### Tire edge

One other element that helped sustain our hopes was our choice of tires. The BF Goodrich R1, with its extra-stiff inner sidewall, performed beautifully throughout the season, providing exceptional adhesion and excellent wear, which is critical in front-wheel-drive race cars. At Road Atlanta, R1-shod cars claimed two of the four Showroom Stock titles up for grabs.

### Pro Olds

As we hinted earlier, Calais teams campaigning in various pro road racing series had a bang-up season. Paul and Karl Hacker, driving the W41 variant of the Quad 442, dominated the Sport class in the IMSA Firestone Firehawk endurance series, winning six of 10 races, the manufacturer's title and the Sport class driver's championship (Paul Hacker). Chuck Hemmingson took the IMSA Toyo Tire series, winning four of seven and another manufacturer's title. And Dave Jolly made an excellent showing in the SCCA Escort World Challenge series, despite a midseason start.

Oldsmobile's '91 racing achieve-

ments weren't limited to Quad-4-powered cars, of course. Harry Gant's remarkable record in the second half of the NASCAR Winston Cup season—including a string of four straight victories—is an inspiration to all over-40 racers, including yours truly.

Olds was particularly active at the dragstrip, scoring 108 Winston Cup Drag Racing Series wins and winning its eighth-straight National Hot Rod Association Manufacturer's Cup. Five different Oldsmobile drivers won NHRA titles—John Force (Funny Car), Blaine Johnson (Top Alcohol Dragster), Pat Austin (Top Alcohol Funny Car), David Nickens (Competition) and Jeff Taylor (Super Stock).

And just in case anyone thinks any of this was a matter of luck, Olds is planning to do it again this year, with the addition of campaigns in IMSA's GTS class (formerly GTO)—starring Darin Brassfield, Paul Gentilozzi and Irv Hoerr—and a GTU entry (GT Under 3.0 liters) for Scott Hare.

The Hacker brothers, Hemmingson and Jolly will be campaigning the new Achieva SCX in their respective series, and we look forward to bring-

ing you a firsthand report on these new Oldsmobiles from a couple of 24-hour races later this season.

### Acknowledgements

We want to thank everyone who helped out in our own campaign. Oldsmobile, for spare parts, advice and patience. BF Goodrich, for tire support. Matco Tools, for an excellent collection of beautifully crafted tools. U-Haul, for the loan of a car trailer that made child's play of towing. Competition Graphics (Farmington Hills, Michigan) for top-quality stick-ons. And Burne Oldsmobile (Scranton, Pennsylvania)—particularly Burne service technician Nick Percival—for between-race maintenance.

As for the '92 season—well, we're still determined to make that national championship appearance at Road Atlanta. But that's another story.

### No More Truckin'

Although it was initially popular with fans and racers alike, the 5-year-old Sports Car Club of America Sport Truck Challenge won't be around for another season.

Faced with thin starting grids and limited participation by factory-backed teams, SCCA decided to pull the plug on its pickup truck series at the end of the 1991 season.

In its first three seasons, this appealing idea produced extremely close racing and fierce competition between manufacturers. Nine different truck makers contended for the championship at one time or another, but shrinking racing budgets, diminishing sponsorship money and controversy over rules gradually eroded factory participation.

Steve Saleen, a series regular, won the final Challenge driver's title in a Ford Ranger.

### Rotary Racing

After years of distinguished effort in the International Motor Sports Association Camel GT Series—GTU, Camel Lites, GTO—Mazda is aiming a little higher for 1991 with a 2-car effort in the superfast GTP class.

The new Mazda P-cars will resemble rival streamliners from Nissan, Jaguar, Porsche, Toyota and Spice, with sleek bodywork riding on a midengined semi-monocoque chassis, but its propulsion will be unique. Like every Mazda that's ever run in any IMSA GT event, the Mazda GTP car will have a rotary engine. In this application, however, there will be more rotors—four in all.

Besides its unusual method of converting the fuel/air mix into horsepower, the 4-rotor engine has another intriguing technical feature. Instead

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of conventional fixed-length injector trumpets, Mazda will use computer-controlled tubes that slide up and down as a function of factors like throttle position and rpm. Varying the length of the tubes improves peak horsepower and, more important for a rotary engine, low-end torque.

This is essentially the same setup that powered a Mazda Group C car to a surprising victory in last summer's 24-hour classic at Le Mans.

No one in racing is ever forthcoming about how much horsepower he's got on tap, of course, and Mazda racing boss Dick St. Yves is consistent

with his contemporaries on this score. However, the current ballpark minimum for a competitive IMSA GTP effort is 650 hp.

St. Yves has named Pete Halsmer and Price Cobb as his principal drivers for the GTP campaign. Halsmer won the 1991 GTO (GT Over 3.0 liters) title for Mazda, and Cobb is a veteran of several IMSA GTP campaigns, primarily in Porsche 962s.

With the addition of Mazda to an already competitive IMSA GTP field, the 1992 season promises to provide some of the most stirring action on either side of the Atlantic.

PM

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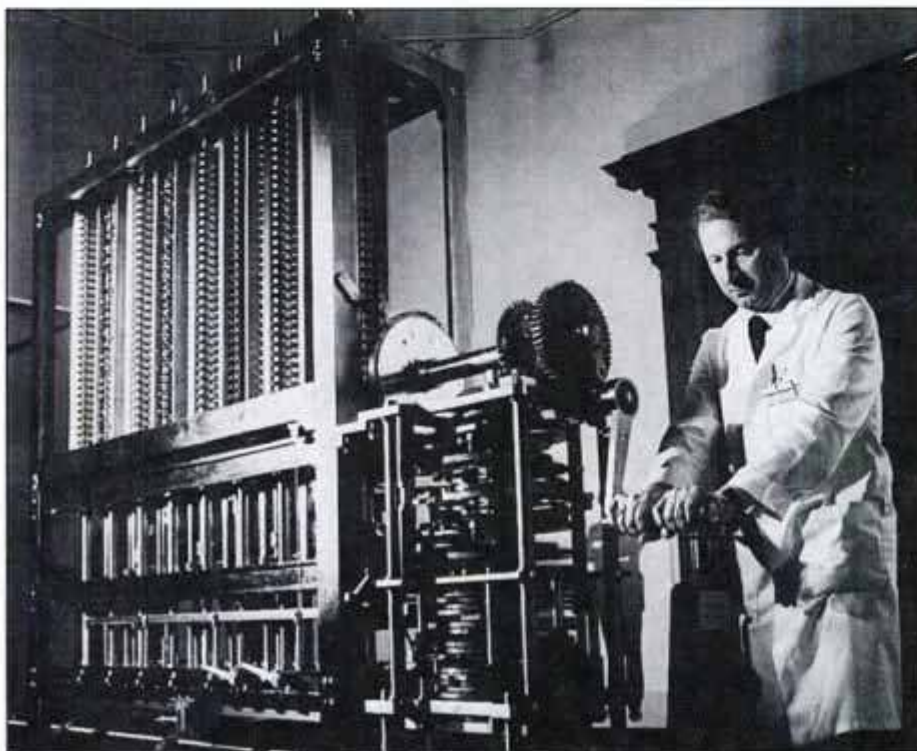
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## SCIENCE

# BIRTH OF AN OLD MACHINE

BY ABE DANE, Science/Technology Editor



LONDON PICTURES SERVICE PHOTO

● Back in Charles Babbage's day, the term "computer" referred to a person who did math for a living. Usually, it was repetitious sweatshop toil, grinding out tables to be sold for use in engineering, navigation, banking and similar occupations. Although tremendously expensive and tedious to prepare, these tables inevitably contained mistakes, occasionally with dire consequences.

Around 1820, Babbage decided to change all that. His exasperation with the inherently unreliable nature of man's arithmetical work reached the point where he once declared, "I wish to God that these calculations had been executed by steam." It was not long afterward that he embarked on a lifelong quest to build machines that would take man out of the loop, and end the reign of error. Remarkably, he very nearly succeeded. And it now appears that if things had gone just a little bit differently, Babbage would have ushered into being a fully mechanical computer more than a century before the advent of similarly capable electronic devices.

This contention was recently borne out by the successful testing of a fully operational version of Babbage's Dif-

ference Engine No. 2 at the National Science Museum in London, England. The engine, which forms the centerpiece of an exhibit commemorating the bicentennial of Babbage's birth, is the first and only of his designs ever brought to fruition.

As such, it lays to rest much of the controversy that has long swirled about Babbage's work. Although few ever doubted the ingenuity and theoretical soundness of his designs, many have questioned whether Victorian-era machine-tool technology was up to the task of executing them. Difference Engine No. 2, for example, comprises more than 4000 parts, many of which have complex shapes and must be machined to close tolerances. The toolmaker Babbage hired to build his first Difference Engine walked off the job after 10 years of work and a huge expenditure of money.

That failure haunted him for the rest of his career, and he was never able to get any more than a small part of any of his subsequent designs built. The museum concluded that the only way to see if Babbage's machines could have worked would be to build one. So they raised 295,000 pounds (about a half-million dollars) in fund-

ing and set loose a group led by senior curator Doron Swade on Difference Engine No. 2.

Since a machine built to standards any better than those of the 19th century would prove nothing, their first task was to determine exactly what the technology of that time was capable of. This was done with the help of a composition analysis performed on materials available to Babbage, and in consultation with the museum's in-house expert on 19th-century machine-tool technology. It turned out that tolerances no better than  $15/10,000$  to  $2/1,000$  of an inch were allowable. Parts were to be made of steel, bronze and cast iron.

With these limitations in mind, Swade's group then went about the task of converting the 20 drawings that made up Babbage's design into 50 drawings that a modern machine shop could work from.

Although Babbage had described the workings of all the parts, he had not specified materials, methods of manufacture and tolerances. It was also necessary to rectify a number of inconsistencies. "We found the kinds of things Babbage himself would have found—drafting errors, design errors," Swade told me.

Now complete after about a year of fabrication and assembly, the Difference Engine is an extraordinarily imposing piece of machinery. Standing 7 ft. high and weighing 3 tons, it renders the intangible complexity of

*(Please turn to page 100)*

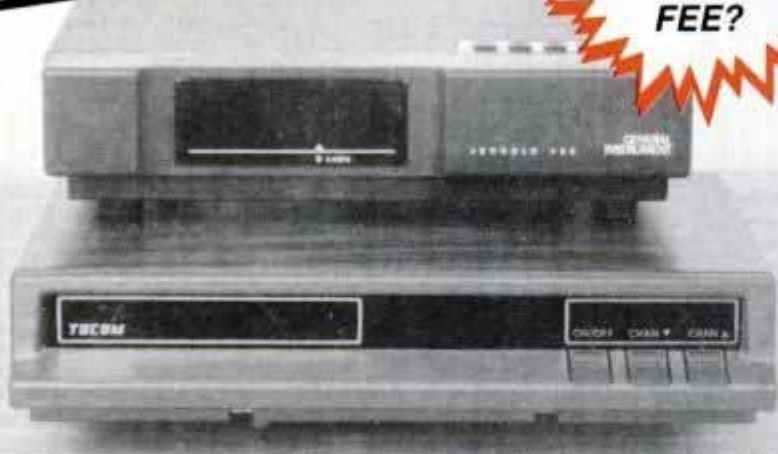


Charles Babbage, 1791-1871, designed a programmable computer a century too soon.



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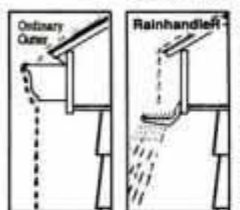
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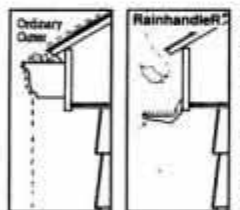
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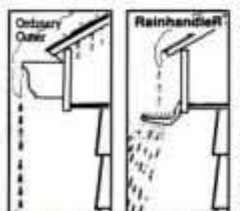
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## SCIENCE (Continued from page 99)

mathematical law into gleaming metal. After several months of testing, it has shown itself capable of calculating 7th order polynomials out to 15 digits (for example,  $1^7=1$ ,  $2^7=128$ ,  $3^7=2187$  and so on), and is expected to go out to 31 digits. "That's no slouch even by modern standards," says Swade.

Even more important, it shows that Babbage's ideas were indeed workable at the time he developed them. That means not only that the Difference Engine could have been built, but also that the even more ambitious Analytical Engine was also feasible. Bearing an uncanny resemblance to computers of the 20th century, the analytical engine could be programmed via paper punch cards, and its systems were divided into a separate "store," or memory, and "mill," or processor. Thus, if political, economic and other factors had only been a little more favorable, the dawn of the computer era might very well have come a century sooner than it did.

## Planet X

Ever since Clyde Tombaugh discovered Pluto in 1930, astronomers have suspected that there was another planet somewhere out there in the dark and distant reaches of the solar system. Many believed that this mysterious 10th planet, known as Planet X, was the only way to explain peculiar disturbances observed in the orbits of Uranus and Neptune.

Recently, however, hopes of finding Planet X began to wane sharply. At an international conference held by England's Royal Astronomical Society late last year, its existence came under attack from several directions. Now, a growing number of astronomers feel compelled to reconcile themselves to the idea of a 9-planet solar system.

Among the anti-X arguments was a new analysis of data from the Infrared Astronomy Satellite (IRAS). Two IRAS surveys covering three-quarters of the sky were compared to find objects with the movement patterns of a planet. Nothing turned up. Other scientists chipped away at the basic foundation of belief in Planet X—the disturbed orbits of Uranus and Neptune. Similar disturbances, it was argued, could have been caused by random observational errors. The sharpest criticism came from a scientist who contended that there is no way a planet could have formed so far from the Sun within the time that the solar system has been in existence.

Responses can be made to all of these arguments. But even the staunchest boosters of the Planet X idea now concede that there's a strong possibility that it doesn't exist. **PM**



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## LONG-TERM BOAT TEST

# WELLCRAFT GENESIS 20

BY JOE SKORUPA, Boating/Outdoors Editor



● Designing a new boat is fairly easy for most companies. A guy in charge walks through a boat show, looks over the competition and says to his staff, "See that boat with the metal-flake swim platform? The one with all the splashy decals? Let's build one just like it." You can demonstrate this yourself by taking a stroll through any marina. Imitation in boating, you'll quickly see, is the sincerest form of flattery.

This was reconfirmed in early 1990 after the midyear introduction of the trailblazing Genesis 20 day cruiser. To the amazement of other lock-step boatbuilders, Wellcraft proved that there can be something new under the sun. They did it by conducting market research before the Genesis was built to find out what a certain segment of boaters wanted most out of their boats. While this is a standard practice in other industries, it's rare in boating. Wellcraft then turned its design team loose on a cutting-edge computer system, and the designers came up with a boat that fit the highly specified data.

Thus, the innovative Genesis was born. Not surprisingly, it became the talk of the New York Boat Show when it debuted in 1990. In the two years since its introduction, the boat has continued to attract attention and, naturally, to inspire imitators.

My first test ride in the Genesis came at the Wellcraft dealer meeting

in the summer of 1990. Later that fall, I gave it a second test. These two hands-on impressions were enough to convince me that boating had never seen anything quite like the Genesis before, and I nominated it for a unique honor—to be a finalist for the first-ever POPULAR MECHANICS Design & Engineering Awards.

When the D&E awards were announced in January '91, only one boat



**View from the raised bridge: Excellent sightlines and generous console space.**

made the cut—the Wellcraft Genesis 20. In essence, it was PM's boat of the year. Other D&E winners in '91 were the Acura NSX sports car, the Ford Explorer sport/utility, the F-117A Stealth Fighter, the Canon Photura camera and the Bose Lifestyle Audio System. The Genesis had some impressive company.

Soon after the D&E awards were announced, it came time for me to look

for a long-term test boat. The Genesis 20 was an obvious choice.

Around the Fourth of July, I picked up the boat at Chic's Marina, in Bolton Landing, New York, which is located on the west shore of Lake George. I returned it to Chic's two months later. During this time, the Genesis 20 racked up about 100 hours of operation. It made marathon runs up the lake's 32-mile length. It pulled waterskiers and tubers. It hosted fishing expeditions and massive family gatherings. It served as a shuttle to restaurants, and in effect, was a waterborne base of operations for a summer's worth of fun in the sun.

### Clear the deck

If one element of the Genesis stands out among the many that make it unique, it is roominess. Anybody can build a big boat. The trick is to make a small, trailerable boat *feel* big. And the Genesis 20 does this better than any boat on the water. How? By opening up walkways, creating generous sitting/lounging areas and putting in a large raised bridge platform. Deck areas throughout the boat have been opened up so much that most family groups will feel like they're aboard the QE2. Not only is there a place for everyone to sit, but there's room to stretch, sunbathe and move about without the usual elbowing for space.

The Genesis 20 accomplishes this by expanding the hull's beam to 8½

ft., the maximum width allowable for a trailerable boat. A beam this wide is rare in a 20-footer. But the length of the Genesis 20 listed in the spec sheet—20 ft. 7 in.—is somewhat misleading. It only measures the distance from the bow to the transom. Overall length, which includes the dual-purpose bow pulpit and the integrated aft swim platform, is a substantial 24 ft. 10 in. This extended length and expanded beam are the primary reasons that the Genesis 20 has the feel of a big houseboat.

But there are other reasons, too. Chief among these is the raised bridge platform, which is the single most distinctive element on the Genesis. It's also the one that places it well beyond the realm of its competition. This inspired multilevel design not only gives the driver excellent sightlines, but provides an opportunity to install an enclosed changing cabin with standing headroom, which is located below the helm. It also gives the large aft deck a pleasantly separate character from the lower U-shaped lounge area in the bow.

### Minivan of the water

On the lake, the people-pleasing design of the Genesis served it especially well for passengers. For the driver, however, there were a few quirks to deal with. Before we get into these, remember, this is a big, beamy, multi-use boat that isn't built to score points on a handling course. It's made to cruise and treat its passengers with roomy comfort, and it does this with aplomb.

The wide, 3500-pound, mod-V hull was exceptionally stable in all conditions, and ran dry in windblown 3-ft. swells. This was especially true if you trimmed up the engine, and kept the boat on plane. The boat felt happiest at 3500 rpm and about 28 mph, where it could cruise all day on the fuel stowed in its 60-gallon tank.

Outfitted with a 200-hp Yamaha outboard and a 17-in.-pitch Quicksilver Mirage prop, the Genesis hit a top speed of 43 mph at 5200 rpm, but few boaters will ever push their rig this fast. Shakes and shudders start in the



Wide U-shaped bow lounge converts to dining area or sunpad with inserts.



Easy access to engine was put to the test during a mishap with the throttle linkage.

high 30s, and get increasingly stronger from this point on. Also, the ride hardens up at these speeds and the unusual sponson-assisted 14° bottom, which is reminiscent of an old cathedral hull, begins to thump over wind-whipped 3-footers.

Surprisingly, the Genesis ran a respectable hole shot—7.97 seconds from 0 to 30 mph. This accounts for its success in towing skiers and tubers. It also leads me to believe that the boat was slightly overpowered. My feeling is that either a 150-hp or 175-hp outboard would be a reasonable alternative. It might slow acceleration somewhat, but it would reduce purchase price, operating costs and the temptation to drive faster—beyond 35 mph—than the boat is happy going.

Of the two nits to pick I discovered during the summer-long test, one was with the boat and one with the engine. The fuel tank is huge, as mentioned, and unfortunately it took ages to fill. The problems are poor venting of the tank and a sharp angle in the fuel fill line. Backed-up fuel kept shutting off the pump and made it impossible to put the gas-dock system on automatic. Since the tank and line would only accept a slow trickle of fuel, filling up was a long and arduous process. The Genesis is far from alone in having this problem. In fact, it's one of boating's most common complaints. From a user's point of view, it's hard to see why any company would send out a fuel-burning product with a poorly designed fuel-fill system.

The engine problem was also hard to understand. Soon after accepting delivery of the boat, I was out in the middle of the lake and the throttle linkage fell off the Yamaha outboard.

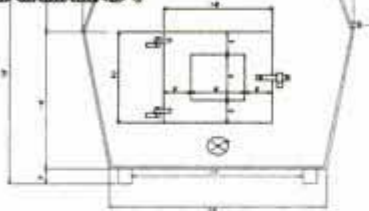
The main holding bolt backed out. To get back to the dock, a crew member manually opened and closed the throttle while I steered from the helm. It was fairly easy to fix, but it didn't seem like it should have happened to a brand-new engine.

These problems aside, the Genesis is notable for scrupulous attention to detail. Every feature of this fully loaded boat performs at least double duty. The portside swim platform has an integrated boarding ladder, while the starboard platform has a built-in ski locker. The wide bow pulpit not only has a unique retractable boarding ladder, but a hidden anchor. The forward seating area converts to a large sunpad with the addition of a cushion insert, and becomes an entertaining/dining area with the installation of a pedestal table.

Without doubt, the crowning achievement of the Genesis is the superbly designed raised bridge. Topside, it gives the helm console a huge area to mount instruments and controls, with plenty of room left over for stowage compartments and a dedicated slot for the radio/cassette player. Forward, it serves as a convenient location for a wet bar. Inside, there's a compartment with standing headroom that has space for a Porta Pottie, a mirror, a skylight and shelves. Few boats of this length have such belowdecks room.

Few boats of any length have half the built-in features of the Genesis (\$32,000 as tested), only a portion of which were touched on here. To get the whole story, I'd need twice the copy space and another summer's worth of testing. Hmmm, that's not a bad idea.

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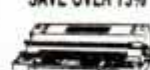
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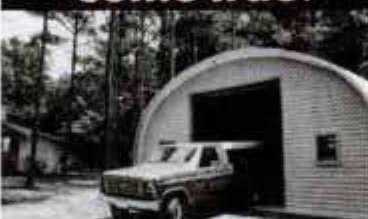
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(Continued on next page)

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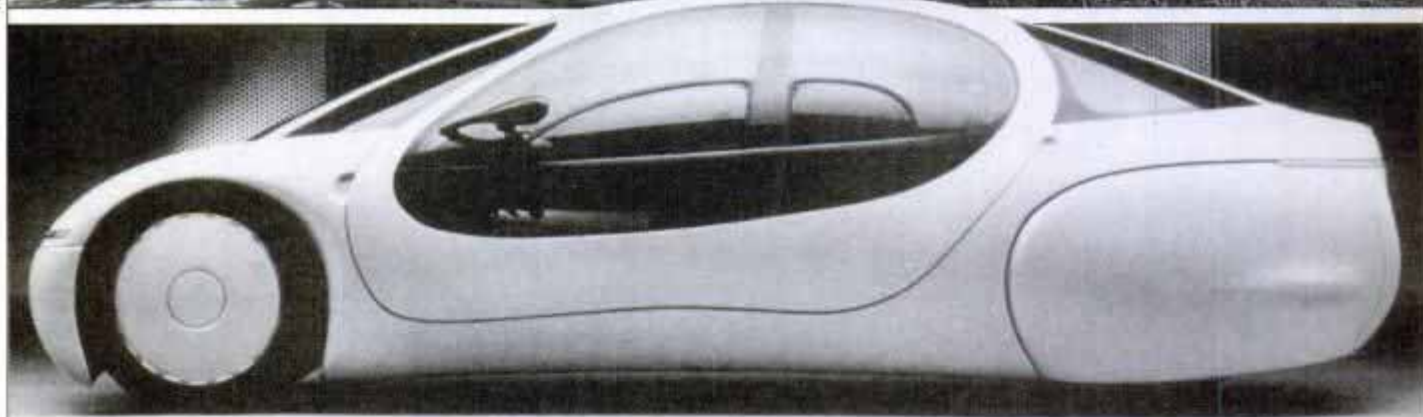
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