

JULY 1992 \$1.95

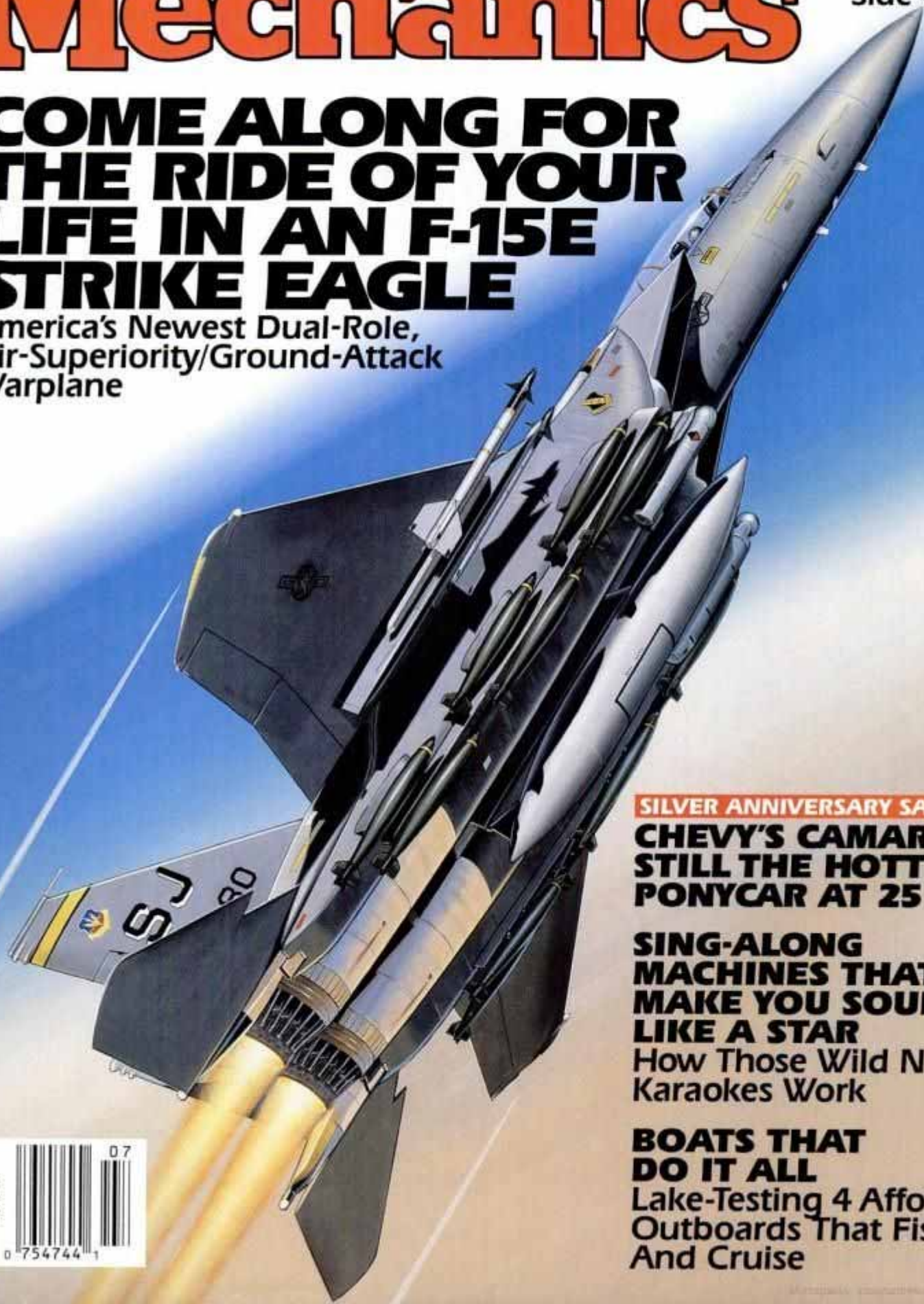


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# Popular Mechanics

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A FORD  
LATELY?



This One



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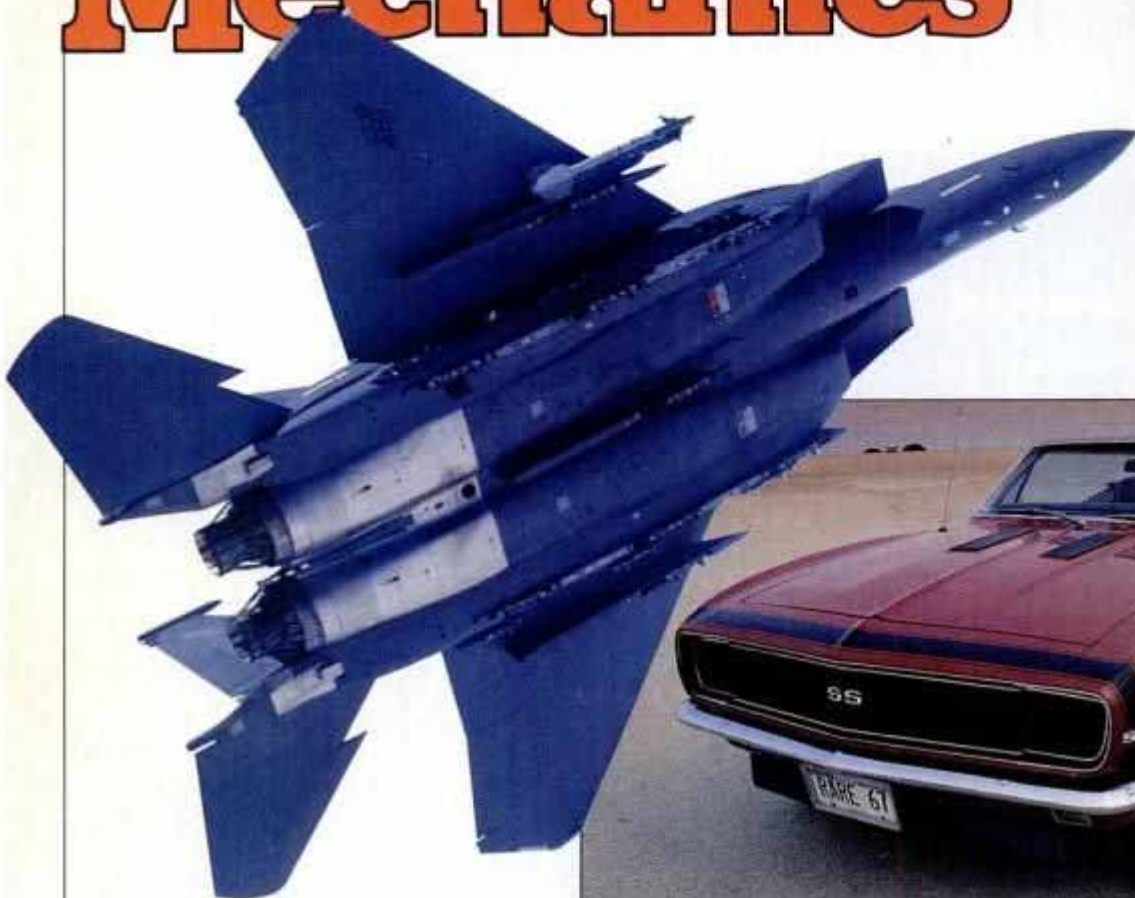
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# Popular<sup>®</sup> Mechanics

JULY 1992  
VOLUME 169  
NO. 7



55



75  
Special  
Section

## 29 COVER STORY

### AUTOMOBILES

#### 40 Long-Term Test Cars

We add supercharging and torture-testing to our fleet.

#### 75 Special Section: Chevy Camaro

America's hottest ponycar turns 25.

#### 76 Three generations of Camaro muscle

#### 80 Thriving on motorsports competition

#### 82 Road testing the '92 350 Z28

#### 84 Collecting special editions

#### 88 Spy shots of the '94

#### 92 New Cars

High-performance Buicks for '93, Infiniti J30, Mercury Villager, and much more.

#### 102 Motorsports

We go racing—again.

### BOATING

#### 36 Comparison Test: Family Boats

A 4-way showdown of boats that do it all—fishing, waterskiing, cruising.

#### 90 Boating

The next step in marine satellite nav.

### ELECTRONICS

#### 45 Singing Machines

The latest craze from Japan brings music technology to home entertainment.

#### 98 Electronics

Cellular telephones power it up.

### PM's 90th ANNIVERSARY

#### 34 Possible Dreams

Americans listen in on the world with the invention of the radio.

### HOME IMPROVEMENT

#### 49 Home And Shop Journal

- **Comparison Test:** Plate joiners
- **Shop Project:** Anniversary chair
- **New Products:** Outdoor living gear
- **Home Improvement:** Building a screen door, how to sharpen knives, and more

#### 62 Homeowners Clinic

Home maintenance Q&A.

#### 64 Appliance Clinic

Answers to fix-it questions.

### SCIENCE/TECHNOLOGY

#### 15 Tech Update

- NASA's Blackbird experiments
- Russian Mars rovers
- Probes that nail water polluters
- High-tech aquariums, and more

#### 29 COVER STORY: F-15E Strike Eagle

Come along for the ride of your life.

#### 96 Science

Man-made birds that fly.

### DEPARTMENTS

#### 4 Editor's Notes

#### 8 Letters

#### 12 Time Machine

#### 26 PM Awards Announcement

#### 108 Hotlines

#### 122 Coming Next Month

# EDITOR'S NOTES

● When I saw the first photos of the 1969 Chevy Camaro, I just had to have one. And I did. It was a Super Sport coupe that I ordered from the factory with the L-78 396-cu.-in. 375-hp engine. It was black on black with a Turbo 400 automatic and 4.10 gears. Incredibly, that wasn't enough for me back in 1969. So upon delivery at Baldwin Chevrolet, it was sent to Motion Performance where they yanked out the engine and installed an L-72 427. It was one of the now-legendary Baldwin-Motion Camaros, and if I still owned it today, I could probably sell it for \$100,000. I drove lots of Camaros after that. But I always yearned for the '69. In 1980, I found a 1969 Rally Sport convertible in Iowa City, Iowa, that I have now restored twice and still own. The first restoration was a D-I-Y job. The second, I farmed out to Roberts Motor Cars in Kingsport, Tennessee—the same company that helped us construct the kit car you saw on our February 1991 cover, and the same company that constructed the cars for the "Miami Vice" TV show. I had to include it in our 25th anniversary salute to Chevy's ponycar, which begins on page 75. . . . You'll find the second of our specially commissioned 90th anniversary commemorative furniture pieces in this issue—a curly maple side chair. Remember, I'd like to hear from anyone who builds the whole set. . . . Hey, we're going racing again. This year, we've stepped up in class—teaming with the



Old Camaros make me smile, especially if I own them.



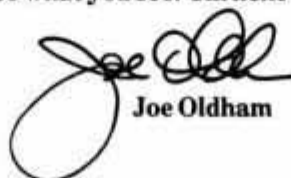
John Batchelor gets into his work.

super to work with, and thanks to their help, you see what you see. Till next time.



Auto Editor Tony Swan (center) with the Archers.

Archer Brothers, Tommy and Bobby, in a couple of Dodge Daytonas in Trans-Am. The cars are hotter, the racing faster, and we'll be telling you about it starting this issue in our regular Motorsports pages. . . . We've been fortunate to have John Batchelor's work often in our pages, and I still wonder how he gets so much detail into an illustration. To complete the artwork you see on page 32, Batchelor flew from his home in Wimborne, Dorset, England, to the McDonnell Douglas plant in St. Louis, Missouri, where the F-15E Strike Eagle is built. The McDonnell Douglas people were

  
Joe Oldham

# Popular Mechanics

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ONE THING REMAINS ROCK SOLID.**

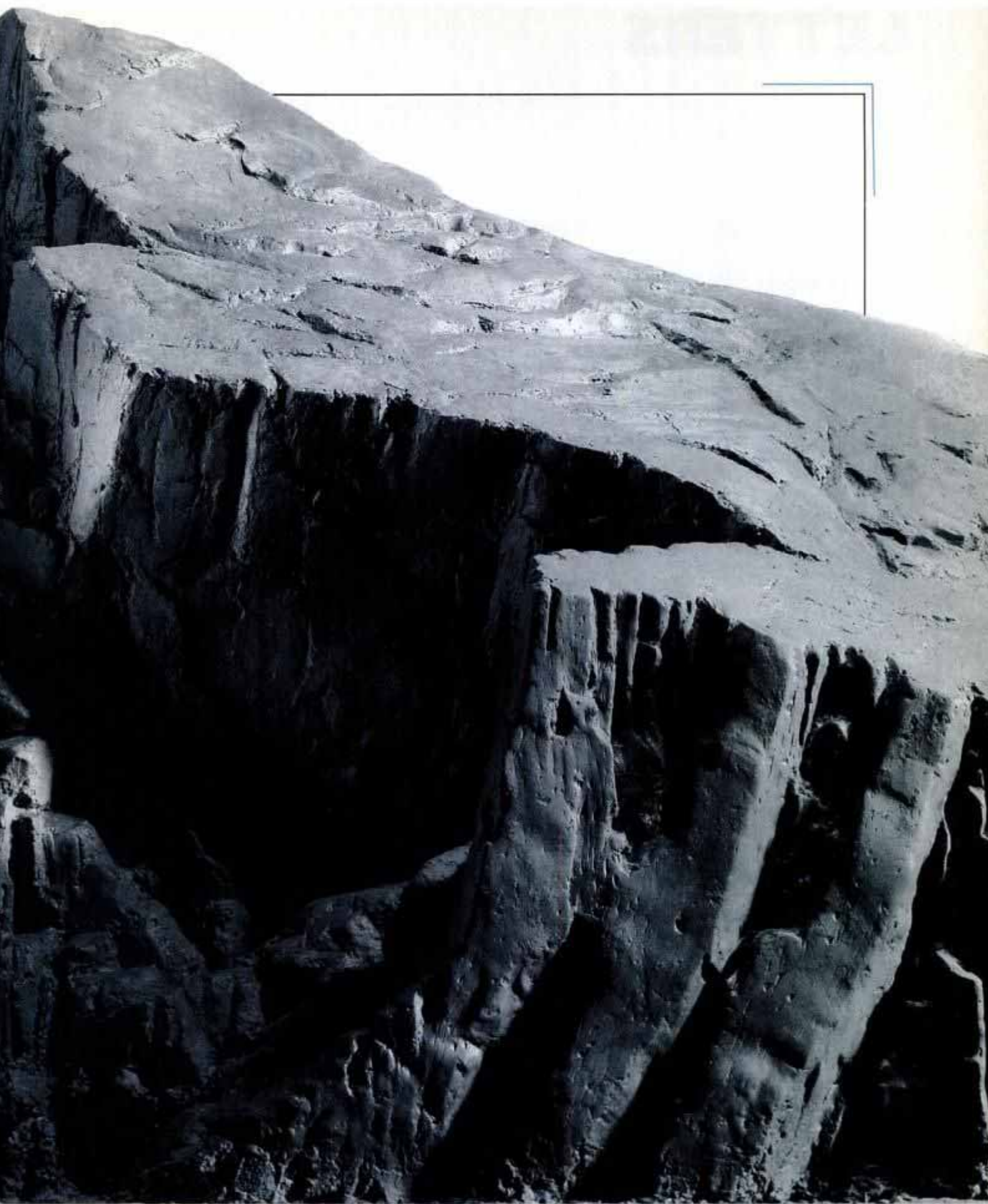
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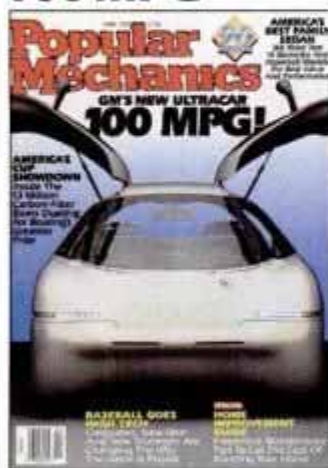
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# LETTERS

## 100 MPG



How typical of our automobile industry! GM creates a wonderful machine, with remarkable capabilities, only to announce that we—its customers—can't have it. There is no doubt in my mind why the American auto industry is in big trouble. Whatever happened to leadership and daring?

FRANK L. FOX SR.  
PEORIA, AZ

Time and again the Detroit automakers develop wonderful concept cars, but little if any of the advanced technology makes it to the showroom. The majority of American automobiles are still bulky gas guzzlers. Detroit has proven the technology is present. The 2-stroke engine has been cleaned up, and the carbon-fiber body is a featherweight with a heavyweight punch. They must get this new car, and others like it, out to the public now—really yesterday—or the Detroit decline will continue. No more concept, but reality. I want that car now.

STEVEN E. McDEARMONT  
ORMOND BEACH, FL

No such car exists. How can anyone be expected to

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

believe that the American car industry—which is pushing Mustang GTs, 10-cylinder Chryslers and full-size pickups—can build a vehicle that's more efficient than anything offered from Europe or Asia? Even though we are producing cars that use twice as much fuel as a Geo Metro, we have decided not to build a car that could compete.

BILL DETELICH  
TIJERAS, NM

Projects such as the Ultralite exercise American design, engineering and manufacturing skills. These projects are funded by sales of American cars. Every time you buy a foreign car, you give thousands of dollars to a country that cares nothing about the U.S.—its families, neighborhoods or industries—except maybe to buy them up. Simply assembling a vehicle in America is not enough. It must be designed, engineered and tooled for production here, in order to provide jobs in those fields and keep our technology at the cutting edge. As more new models come online from GM, Ford and Chrysler, with their attending high quality, there is little excuse for buying a foreign car. To the people who have abandoned American industry in these tough economic times, I say: Out of work? Hungry? Eat your foreign car!

LAWRENCE J. HOOKER  
AMHERST, NY

After reading about GM's Ultralite, it's easy to see why Detroit automakers are in trouble. Pay \$13,000 for a carbon-fiber body weighing in at 1400 pounds? Hey, back in 1971 Datsun 1200s only weighed a couple hundred more. I bought

one and got up to 43 mpg. With a little aerodynamics and today's engine technology, GM could build a car we could afford and also help the environment.

GEORGE COOK  
PARK RIVER, ND

I could barely get through the first three paragraphs of "Ultracar" without fuming. You people still try to put to rest the mere whisper of the 100-mpg carburetor. Produce a good, repairable, efficient car? Not before the outboard motor reaches 10 hp per cc.

T.L. NOLAN  
DESERT HOT SPRINGS, CA

While the head-on view of the Ultralite on the cover is most handsome, the side view of the car in the article has all the charm of a large bug with a severe gastric problem.

H.H. ISKE, V.P.  
AUTOMATION TECHNOLOGY  
SAN GABRIEL, CA

I just read your exciting article on GM's Ultralite. The way writer Cliff Gromer describes the various technologies is absolutely superb. I have dealt in technology for many decades

now, but seldom have been treated to such exquisite, eloquent writing of technical material.

AL WEVER  
BERGEN, NY

Why was an otherwise well-written article about a fascinating engineering exercise marred by an insulting sexist remark? ("But don't expect your wife to . . . pack in half the house like she does now for local trips.") Surely you realize that women read PM, too. But maybe we won't after more cracks like that.

SHERRI WHITE  
CONCORD, NC

## Show Boat

My 14-year-old son and I entered the canoe we built from PM plans in our county fair. It attracted lots of attention and won Best In Class, plus a gift certificate from a local lumberyard for the best use of wood. We veered from your instructions by lengthening the canoe to 16 ft. and simplifying the gunwales and stems. We also put in bulkheads to strengthen the ends and add additional flotation.

DICK & JASON POWELL  
CORVALLIS, OR



Prize-winning canoe built by readers Dick and Jason Powell.

4x4

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# TIME MACHINE

90 YEARS AGO: JULY 1902



## Coal Shoulders

While electric locomotion wasn't yet jolting the coal-fired steam engine, it was catching on quickly in the coal-mining business—much to the relief of the mules that traditionally hauled carriages through mine tunnels. In one Pennsylvania mine, 32 low-slung trolleys ran on a clockwork schedule, each transporting up to 500 tons of coal per trip behind a 13-ton motor. A motorman drove the trolley from gallery to gallery, accumulating a conga-line of carriages.

## Freeze Frame

Ice-making was a thriving industry. Efficient compressors and ammonia working fluid were now widespread, so manufacturers vied to outdo each other in the clarity and size of their output. The Frick Co. of Waynesboro, Pennsylvania, was the true ice giant. Its "Eclipse" system produced plates 16 ft. long, 9 ft. high and 16 in. deep. In Frick-

equipped plants, traveling cranes seized the plates as they rolled out of freezing cans and whisked them to the cutting tables, where they were split into blocks.



60 YEARS AGO: JULY 1932



## Light Year

Chicago would remember 1933 as the year the World's Fair lit up the skies. Instead of lavish decorations for buildings with a 6-month life span, planners opted for spare architecture and made up the difference with eye-popping illumination. Colored lights would play off richly hued paints on exhibition halls, beams often passing through artificial fog and water cascades. The highlight would be the huge flaming ladder arcs that leapt between two 30-ft. electrodes.

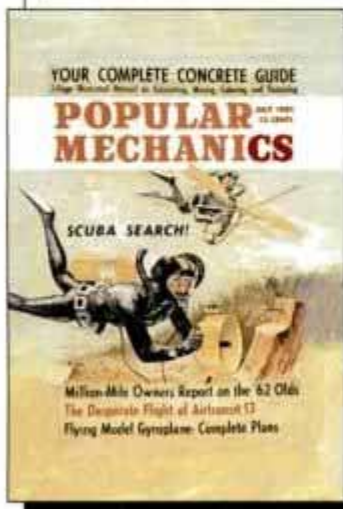


## Rubber Rail

Steamed by their losses to the automobile, railroads flirted with the idea of running custom-built motor coaches along the tracks. Forty passengers could ride in one of these rubber-

wheeled vehicles, invented by tire man J. Hauvette Michelin. The coach ran on a tiny 20-hp auto engine cooled by twin aviation-type radiators. Weighing less than a tenth of a standard Pullman, it got a stunning 10 mpg.

30 YEARS AGO: JULY 1962



## Wet Work

Scuba diving drew tremendous public interest in the early '60s, so we focused on an underwater search-and-salvage outfit in upstate New York. Equipment spelled the difference between successful dives and failures. Tools included electronic depth finders, handheld sonar, underwater camera gear and portable hydraulic dredges. Scuba diving opened up lakes, rivers and oceans to treasure hunters and archeologists—often at odds with each other.



## Super Fly

The world appeared ready for a supersonic airliner, and the French and British were zeroing in on a pact to pool their efforts. France's Sud-Aviation had revealed plans for its Super-Caravelle at the 1961 Paris Air Show, but the plane was a short-

haul intercity hopper. Meanwhile, British Aircraft's droop-nosed Bristol 223 was a transatlantic sprinter from the start. Blending features from both planes was supposed to save money, but instead ran the Concorde wildly over budget. **PM**



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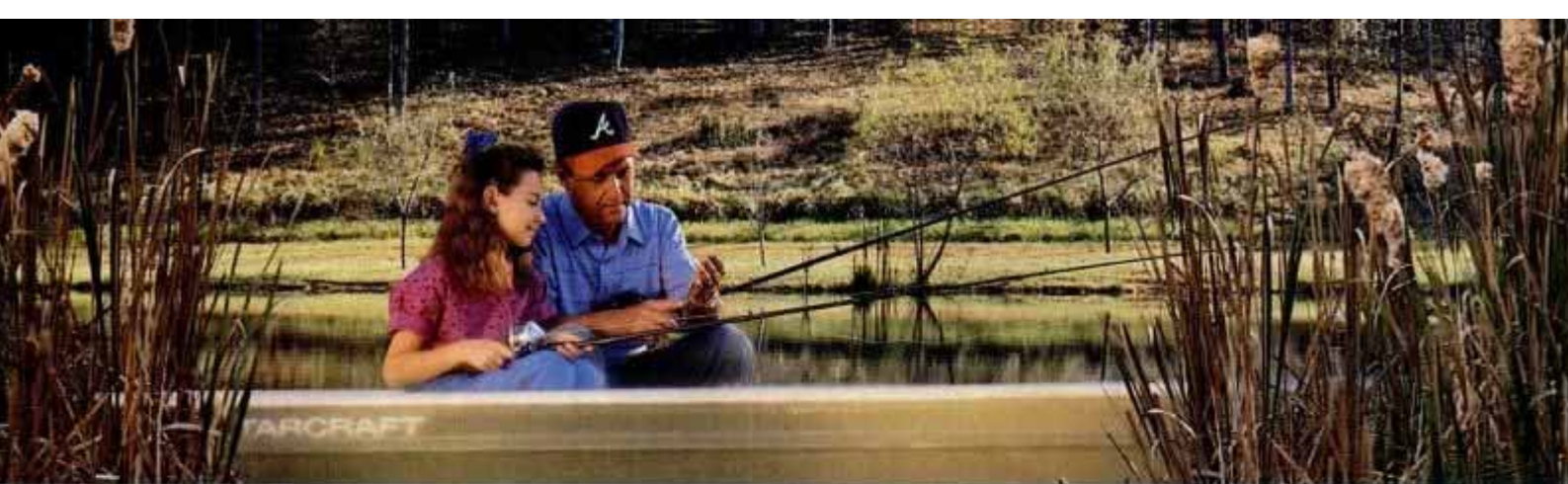
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# TECH UPDATE

News Of Tomorrow's Technology Today



FM ILLUSTRATION BY PAUL DIMARE

## Blackbird Begins Duty As X-30 Torchbearer

EDWARDS AFB, CA—The SR-71 Blackbird may be the world's fastest plane, but it won't hold a candle to the X-30, the proposed National Aero-Space Plane. The X-30 will streak to orbital speeds around Mach 25, whereas the Blackbird peaks out at about Mach 3.2. Ironically, the vintage speedster will demonstrate technology that will help the X-30 fly slowly.

Sculpted for meteoric velocity, the X-30 will lose efficiency at speeds under Mach 3, according to supercomputer predictions. The space plane's rear underbelly is shaped to act as a hypersonic exhaust nozzle. But at low speeds, air pressure on the nozzle isn't high enough to deliver thrust. In fact, low pressure back there will create drag.

The solution, say X-30 en-

gineers, is external burning, whereby hydrogen fuel is released and ignited behind the scramjet nozzles. Tests done with a Navy F/A-18 last year proved that the fuel will burn outside an engine in a Mach-1.26 airstream. Now, a more detailed study of the concept will begin.

At NASA's Ames-Dryden Flight Research Facility, an SR-71A will carry a half-scale model of an X-30's aft engine cowling and exhaust nozzle. The equipment bays along the old spyplane's fuselage will be plugged with hydrogen tanks.

During 10 flights at speeds up to Mach 3, hydrogen will vent and ignite from 19 apertures on the model. Sensors mounted nearby will record

Editor: Abe Danc  
Assistant Editor: Greg Pope  
Contributors: Philip Chien, Mike Fillon

air pressure and temperature. Engineers will also check whether the hydrogen exhaust plume triggers turbulence—and whether the fuel stays lit at three times the speed of sound.

NASA's Blackbirds may

SR-71A will carry half-scale X-30 aft engine cowling and exhaust nozzle for external-burning experiments.

also carry experiments on scramjet inlets and exotic materials in support of the X-30 project.

## Highlights This Month

- **Dishes To Go**—New space antennas ride huge tricycles.
- **Juking Jets**—Future fighters' uncanny nozzles.
- **Catfish Heaven**—Chattanooga's high-tech aquarium.
- **Airbags For Aircraft**—Army choppers get crash protection.
- **Water Monitor**—Sneaky probe to nail ocean polluters.
- **From Moscow To Mars**—Russia's rock-and-roll rover.

The 1992 Plymouth Acclaim is America's best-equipped six-passenger car for under \$12,700. Equipped with a standard driver's air bag, it costs \$2,900 less than Accord\*. Yet it has more interior space and more rear passenger room. Acclaim also offers greater available power than Accord. Plus our Owner's Choice Protection Plan: a 7 year/70,000 mile power-

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## Hauling Astronomy

CAMBRIDGE, MA—The Smithsonian Astrophysical Observatory is building a 6-telescope facility to probe the universe's submillimeter radiation, a little-explored slice of the spectrum between radio and infrared wavelengths.

The 18.6-ft. dishes of the Submillimeter Array will perch on Mauna Kea in Hawaii. The facility will combine signals from different dishes to get the sharpness of a telescope a quarter-mile in diameter. And for maximum flexibility, astronomers will rearrange the dishes using a gigantic custom-built 3-wheel transporter.

The vehicle will back up around a dish, and hydraulic hooks will raise the 14-ton structure.



Custom-built transporter will reposition dishes of the Smithsonian's Submillimeter Array.

A generator on the transporter will run the dish's cryogenic compressor during

travel to keep the superconducting receivers from overheating. The dish then plugs

back in to one of 24 foundations. The array should start operation in 1996.

## Rocket Galoshes

HUNTSVILLE, AL—NASA is getting tired of scrubbing salt out of its reusable rocket engines (like those on the Shuttle's solid-rocket boosters) after they splash down into the ocean. Now a simple device invented by Pratt & Whitney may obviate the expensive refurbishing.

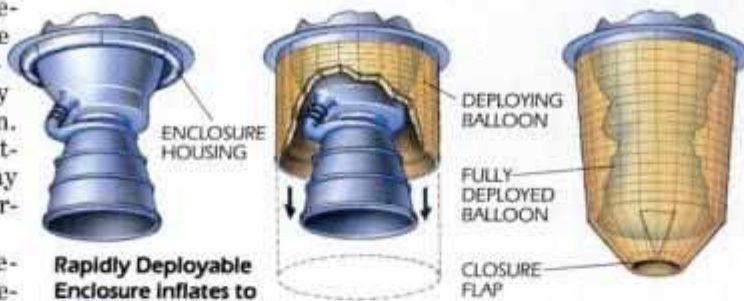
Called the Rapidly Deployable Enclosure, the device is a balloon-like sheath

that folds up in a circular housing around the engine's

powerhead. Inflation takes less than 4 seconds.

After engine shutdown, as the booster plunges through

the air, helium begins to fill rib-like sections of the balloon, forcing open doors on the housing. The balloon expands to form a tube that surrounds the rocket nozzle. Finally, a pull-cord motor cinches shut the open end of the tube through a bear-trap clamp to form a watertight seal.



Rapidly Deployable Enclosure inflates to keep rocket engine dry.

Under the aegis of Marshall Space Flight Center, several aerospace corporations are now refining the device.

## Super Turkey Feathers

WEST PALM BEACH, FL—No tail, no rudder, no stabilizer, no flaps—plus the speed and agility of a jet

fighter? That's the promise of axisymmetric thrust-vectoring engine nozzles, de-

veloped by General Electric and Pratt & Whitney.

The P&W nozzle can deflect thrust by as much as 20°

in any direction, the GE version by 17°.

As in a typical jet-fighter engine, convergent/divergent flaps—or "turkey feathers"—surround the exhaust orifice. Unlike those in previous vectoring nozzles, which just flicked up and down, each flap can pivot 360°.

Three large hydraulic actuators work to slew a sync ring that controls the flap positions through smaller linkages. In both makers' devices, the nozzle shifts angle as quickly as 45° per second.

Flight testing of the nozzles, as yet unscheduled, could occur under either Air Force or NASA research and development contracts.

Sync ring coordinates flap movements to produce vectored thrust at any angle.





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## World's Smartest Fishtank

CHATTANOOGA, TN—A new public aquarium shows off the varied environments touched by the waters of the Tennessee River.

The Tennessee Aquarium is the world's first major facility to focus on freshwater ecosystems—and the first to feature computerized environmental-control systems.

Microprocessors control fill level, temperature, flow rate, filtration backwash and other parameters in the 16 separate water systems that feed the tanks and pools. Much of the knowhow for the complex system derives from nuclear-reactor engineering.

In addition, two computer-controlled ozone generators



oxidize the water and zap unwelcome bacteria.

The aquarium features one of the largest freshwater tanks ever built: a 138,000-

gallon re-creation of the Nickajack Lake reservoir. A 10-ft.-dia. pipe connects the tank to its filter.

In addition to the aqueous environments, there are two indoor forests with live trees. The computer system adjusts soil temperature to trick the foliage into assuming its autumnal colors.

Should the aquarium's computer control system function as planned, engineers may add features such as seasonal lighting adjustments and pH and turbidity monitors.



The Tennessee Aquarium features a computer-managed water system for denizens such as huge paddlefish.



TENNESSEE AQUARIUM PHOTOS

## Mean Green Beam

SCHENECTADY, NY—General Electric researchers have doubled the brightness of solid-state green lasers, a development with implications for submariners.

Till now, only larger, more complex gas-based lasers have been able to put out a high-quality 52-watt green beam. By contrast, GE's smaller laser relies on the lat-

est solid-state optical tricks.

The researchers started with a commercial 16-watt infrared laser and fed its beam into a face-pumped laser amplifier. The 92-watt beam that shot from the amplifier passed through lithium triborate crystals that sliced the beam's wavelength in half, turning the light green but preserving the original tight beam quality.

The researchers are currently experimenting with the beam, which may be strong enough to drill plastics, composites and other materials. Since seawater is transparent to green light, the laser may also serve to detect or communicate with submarines.

GE's bright green laser fires from solid-state apparatus.



GENERAL ELECTRIC PHOTO

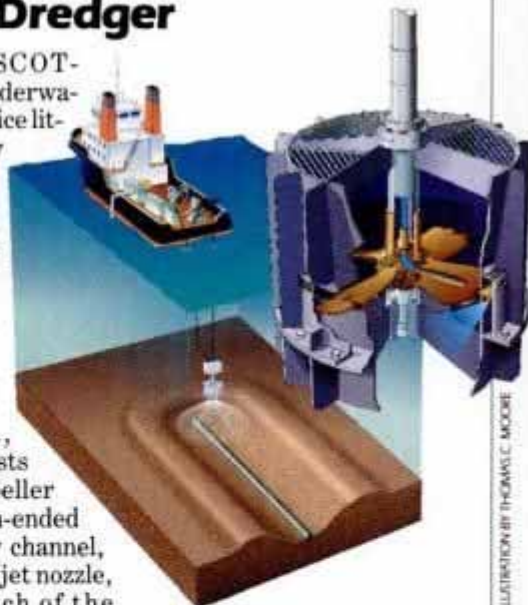
## Waterjet Dredger

ABERDEEN, SCOT-

LAND—A new underwater excavation device literally blows away sand, silt or offshore-oilwell drill cuttings. The Jet Prop can clear off up to 35,000 cu. ft. of seafloor material per hour.

Built by Consortium Resource Management Ltd., the machine consists of a 4-ft.-dia. propeller encased in an open-ended cylinder. A hollow channel, ending in a hooked jet nozzle, runs through each of the prop's four blades.

During operation, a pump forces high-pressure seawater down through a pipe and into the channels. As the water squirts out of the jet nozzles, the prop turns. This rotation draws a column of water down through the casing. Although the water stream moves slowly, its enormous volume flushes



Deployed from ship, Jet Prop unleashes column of water to uncover buried pipeline.

material off the seafloor in a radiating slurry.

The Jet Prop is simpler, lighter and more efficient than a submerged propeller powered by a motor, say the developers, who are currently building an even more powerful version.

PM ILLUSTRATION BY THOMAS C. MOORE

(More Tech Update on page 22)

**SURGEON GENERAL'S WARNING: Cigarette  
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Lights Kings: 12 mg. "tar", 0.9 mg. nicotine; Lights 100's: 12 mg. "tar", 1.0 mg. nicotine; Full Flavor Kings: 16 mg. "tar", 1.2 mg. nicotine; Full Flavor 100's: 17 mg. "tar", 1.3 mg. nicotine, av. per cigarette by FTC Method. © 1992 Eve Holdings Inc.

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## Airman's Airbags

SAN DIEGO, CA—Studies show that when helicopters crash-land, pilots and gunners survive with the lightest injuries if they're tightly restrained. With that in mind, TRW is adapting its automotive airbag technology for use in AH-1 Cobra attack choppers.

The Inflatable Body And Head Restraint System (IBAHRS) deploys a panel of airbags stored in the shoulder harness to limit motions of the head and torso.

The detector that activates the airbags is a derivative of TRW's auto crash sensor, modified to respond to deceleration in any direction of motion, not just forward

and backward. A diagnostics board monitors both the crash sensor and the firing unit that inflates the airbags.

TRW is subcontractor to Tempe, Arizona-based Simula, Inc., which is providing the airbags and managing the program. The Army has already agreed to buy 44 units, and as many as 1600 follow-on units may go into Army and Marine AH-1s starting next year.



In crash landings, AH-1 Cobra attack chopper drivers will benefit from airbag system that borrows automotive technology.

PH ILLUSTRATION BY ED VAUGHN

## Plane Speaking 2000

MELBOURNE, FL—New equipment will make life easier for the air traffic controllers who track planes once they leave the scopes of airport towers. The antiquated radio/telephone network used by these en-route con-



Touch-screen communications display (left) will fit into future controller consoles.

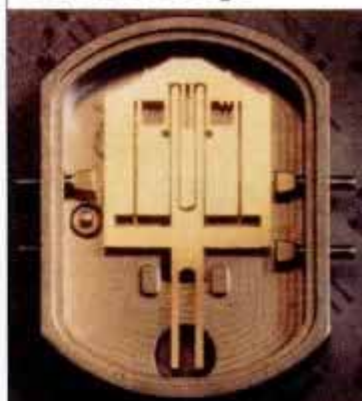
trollers is scheduled for a \$1.6-billion upgrade.

Instead of the old banks of toggle switches, they'll use a Harris Corp.'s Voice Switching and Control System which has two touch-screen monitors that display up to 24 UHF/VHF radio channels and 50 direct lines.

Behind the scenes, digital switches will connect calls in  $10^{15}/1000$ ths of a second. Outfitted with the new system, the facilities will be able to handle up to 2800 calls per minute.

All en-route control centers will have the new system by 1996.

## Gyroscope On A Chip



Cut from a single piece of crystalline quartz, rate sensor is tiny, power-thrifty and rugged.

CONCORD, CA—A solid-state rate sensor that takes up less space than a golfball threatens to throw conventional navigation gyros for a loop.

Developed by Systron Donner, the quartz device is micromachined into the shape of a double-headed tuning fork. One fork reacts to changes in angular velocity by oscillating its tines. The stress of this motion causes the quartz to give off a proportional electric signal.

Already aboard upgraded Maverick air-to-ground missiles, the quartz rate sensor may find other applications in cars and robots.

SYSTRON DONNER PHOTO

## Navy's New Chartbusters

BAY SAINT LOUIS, MS—The Navy now has two state-of-the-art hydrographic survey ships to chart the ocean floor around the world's coastlines.

The USNS *John McDonnell* and USNS *Littlehales* entered service last March, with a full complement of hull-mounted and towed sonar systems. Each 208-ft. ship also carries two 34-ft. sonar-equipped launches.

Both the launches and the mother ship use Global Positioning System-based navigation that integrates direct-

tioning System-based navigation that integrates direct-

ly with sonar readings.

Built by Halter Marine, the ships will survey 20,000 nautical miles a year.



HARRIS PHOTOS

HALTER MARINE PHOTO



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## Water-Pollution Spy

COLUMBUS, OH—Illegal dumpers will soon have to contend with a small probe that hides on the ocean floor until it senses pollution, then notifies authorities.

Battelle Memorial Institute, along with the Department of Energy and San Diego-based Ocean Sensor, Inc., developed the probe, called the Autonomous Expendable Conductivity/Temperature/Depth Profiler. Less than a yard long and 5 pounds, the device can drop

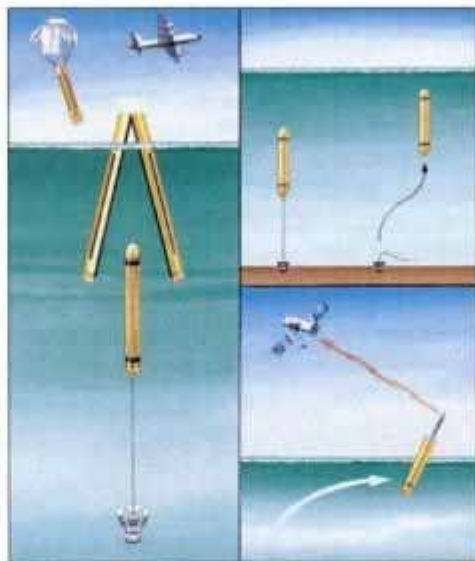
from a ship or via parachute from an aircraft.

Once in the water, the probe's clamshell carrier opens, and the device plunges to the bottom, where a small anchor roots it in place.

On-board detectors monitor sea temperature, conductivity and pressure. In addition, there's room for a sensor dedicated to a specific pollutant or change in water quality.

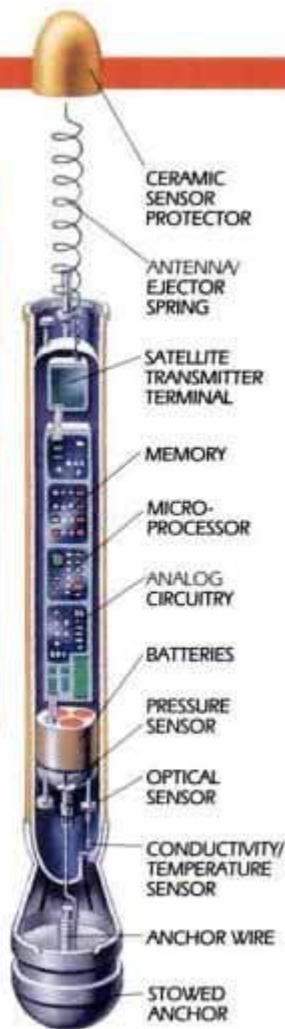
Once this sensor detects a problem, an electrical charge burns through the anchor wire. The device floats to the surface and transmits the information to a National Oceanic and Atmospheric Administration satellite.

The profiler could stand guard at sewer outfalls, nuclear-plant cooling towers



Expendable probe lurks in water until it detects pollution, then surfaces and radios satellite.

and other troublespots. Researchers could also use the probe instead of expensive ships for oceanographic modeling. Future versions will have longer-life batteries and deep-water housings.



BATTELLE PHOTO

PM ILLUSTRATIONS BY ADOLPHE BRITMANN

## Robot Chimney Sweep

STOCKHOLM, SWEDEN—A cat-size robot can prowl through ventilation ducts and give them the kind of cleaning that can't be done by hand without dismantling the vents, says its developer.

The Bandy II from Wintclean Air features an interchangeable set of spinning brushes, a vacuum pump and a video camera. The little

tracked vehicle crawls through ducts at the end of a 100-ft. cable and is controlled by a joystick.

The machine can even tackle grimy industrial-process vent ducts, says Wintclean Air. A Bandy variant will clean and re-coat ducts with internal acoustic lining, using the vacuum to remove loose fibers from the air.



Remote-control Bandy II sweeps away dust, fungi and microbes from ventilation ducts.

WINTCLEAN AIR PHOTO

## Russia's Ramblin' Rover

ST. PETERSBURG, RUSSIA—The latest Mars rover to undergo field trials in California's deserts carries the Russian flag.

The 5-ft.-long unmanned buggy comes from the All-Russia Scientific Research Institute for Transport Machinery. For its recent work-out in Death Valley, the Pasadena-based Planetary Society supplied some electronic equipment.

On the rover, a hinged, segmented backbone links three axles tipped with conical wheels. The backbone sections can lock into a rigid

spine, for crossing a ravine, say, or they can move independently on broken ground.

The segments can also expand and contract



in a "wheel-walking" motion. To climb a soft-soiled hill, for instance, two sections can anchor the vehicle while the third inches forward.

The machine that navigated around boulders in Death Valley is a prototype for a rover that's part of Russia's 1996 Mars mission. That vehicle will weigh about 150 pounds and carry about 30 pounds of scientific equipment. Powered by a radioisotope thermoelectric generator, the rover will explore Martian terrain at about 1/2 mph, 1 hour a day.

Russian rovers have run on volcanic terrain in Kamchatka and in Death Valley.

PLANETARY SOCIETY PHOTO

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# Popular Mechanics

# DESIGN & ENGINEERING AWARDS

● We are currently inviting nominations for our 1993 Design & Engineering Awards.

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POPULAR MECHANICS' stock in trade for 90 years. Our Design & Engineering Awards recognize the most significant developments and products in the areas we cover: science, technology, automobiles, home improvement, boating, outdoors, home electronics and photography. The winners that we select are really special in their fields. They stand out, representing the very best of the conceptualization and execution of concepts that are revolutionary, ingenious or just plain clever.

Anyone can make a nomination, and the rules are very simple. Submit a good, clear photograph or illustration of the product or project, and include a

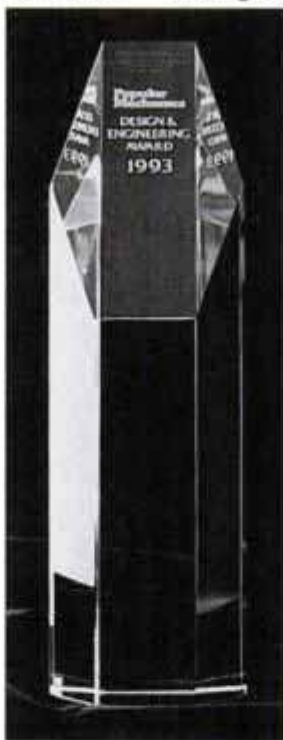
complete description with all the details of what it is, what it does and how it works. Companies may nominate their own new products and innovations.

Entries are judged by POPULAR MECHANICS editors. Winners receive a coveted PM Design & Engineering Award, and are featured in our January 1993 issue. Refer to previous January issues to check out past award-winning ideas and products. You'll find that simple products and ideas that have a unique and clever way of solving a problem or offer a better way of getting a job done have as much chance of winning as complex ones. So start

preparing your entry today.

Mail entries to: Design & Engineering Awards, POPULAR MECHANICS, 224 W. 57th St., New York, NY 10019. That's all there is to it.

Joe Oldham  
Editor-in-Chief



# *Kinder? Gentler? No Way.*



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# STRIKE EAGLE

Merging precision ground-attack technology with the world's deadliest fighter makes the F-15E lord of the skies. Strap in with PM for the ride of your life.

BY ABE DANE, Science/Technology Editor



● Video monitors cast a multihued bubble of reflections inside the jet's darkened canopy as Lt. Col. Steve Pingel and his back-seater, Lt. Col. John "Taco" Martinez, scan infrared images of the desert below. It's 9 pm over Triple-A Alley and the anti-aircraft artillery batteries for which this sector of western Iraq is named are quiet. Steve and Taco's F-15E Eagle has been sent to prowl the spot where two Scuds were just launched.

It looks like they've stumbled onto something. At the exact coordinates where the launches were detected, a convoy of heavy trucks, possibly missile transporters, has gathered. Their engines still glow warm on the infrared scopes.

With a hand gloved in fireproof Nomex, Taco works switches on one of his side controllers, placing the trucks in the crosshairs of the plane's targeting pod. He clicks a



# STRIKE EAGLE



Strapped into the nerve center of the jet, I'm ready. With canopy down (right), Slammer's face is weirdly distorted by the wide-field-of-view holographic HUD.

trigger to lock on and pops a little red button that marks the vehicles for destruction with an invisible dot of laser light. Then, just before breaking away from the target in a gentle 2.5-g turn, Steve lets a 2000-pound laser-guided bomb slip away into the night.

Watching gun camera footage of this in the 335th Fighter Squadron's briefing room at Seymour Johnson Air Force Base, North Carolina, I'm struck by a chilling sense of the power entrusted to Taco and the other young men around me. A digital timer on the TV screen ticks off the seconds to impact with cold precision as two truck drivers, alerted too late by the sound of the jets above, begin running for their lives. The timer clicks zero and a fireball engulfs them.

Tomorrow, I'll be flying one of these fearsome machines, my unpracticed hands on the same controls that unleashed such destruction in the desert a few months before. But we'll be over North Carolina rather than western Iraq. And it won't be Scuds we're chasing, but a story for **POPULAR MECHANICS**. A story about the newest and most formidable dual-role fighter in the world.

## Renaissance Jet

If one has to be in a war, then there is probably no better place to fight it from than the cockpit of an F-15E. Building on the athletic frame of the F-15, the Air Force's top air-superiority fighter, the E variant adds a second crew position, and equips it with a unique array of sensing, navigation and computerized weapons delivery systems. From this back seat, the weapons systems officer (WSO) picks out targets, plots intercepts, selects munitions and generally strives to



FM PHOTOS BY BRANK R. WOLFF

keep the pilot as undistracted as possible. Beefed up and modernized throughout, the E model can turn and burn with the best of them, but unlike its dogfighting predecessors, it can also unleash up to 24,500 pounds of air-to-ground ordnance with precision that rivals any purebred bomber.

The plane's military utility was borne out in the Gulf War. "The F-117 flew alone, and we flew alone. Everybody else went in packages," says Lt. Col. Mike DeCuir, commander of the 335th. Where other ground-attack planes had to operate in concert with a carefully prearranged cocoon of de-

fending aircraft, the F-15E and the Stealth Fighter could range over Iraqi airspace more or less at will. But unlike the Stealth Fighter, which depends on its invisibility to radar, the F-15E protects itself the old-fashioned way—with speed, agility and an ability to fight back when threatened.

DeCuir, better known around the squadron as "Slammer," is the pilot I'll fly with. A 3200-hour fighter veteran, his nickname befits a reputation for aggressive aerial maneuvering. On the ground, he's relentlessly energetic, an ebullient but demanding influence on the younger men. He'll



FM PHOTOS BY BRANK R. WOLFF



FM PHOTO BY FREDERICK SUTTER

In the simulator, Slammer shows me the scopes (top) and how to set them up in the plane (above). The F-15E's front office (left) has three more screens and a HUD.





take in his accustomed front seat for our flight, while I'll be in back playing WSO (pronounced "wizzo").

### Gee wizzo

In essence, the WSO's job is simple. As Slammer puts it, "I row the boat, and he shoots the ducks." But both boat and ducks are likely to be moving at better than 1000 mph, and there's a good chance the ducks will be shooting back. Therein lies the justification for much of the complex technology on which the WSO relies.

Dominating his instrument panel are four videoscreens—two 6-in. monochrome and two 5-in. color. Each screen is framed by 20 buttons and three wafer switches, with which he programs the displays before flight. Thereafter, he'll do most of his work by manipulating side controllers located on consoles flanking his seat. Studded with strangely shaped buttons, these ergonomically sculpted handgrips enable the WSO to continue with his often delicate tasks even as the pilot yanks and banks up front.

Feeding into the WSO's airborne control room are sensors that lend truly phenomenal powers of perception. The Hughes APG-70 radar in the jet's nose not only peers through clouds and darkness to pinpoint distant aircraft, but is the first in a fighter with a synthetic aperture mode to map the surface of the Earth. This creates sharp snapshots of landscapes more than 50 miles away, which the WSO can freeze on his screen, scrutinize for targets and then use to program a bombing run into the plane's computer long before getting within range. Slung beneath the aircraft is a pair of LANTIRN (Low Altitude Navigation and Targeting Infra-red

for Night) pods—one with radar and infrared sensors to guide the plane in all-weather terrain-hugging flight and another that locks onto targets and illuminates them with a laser designator.

To keep everything in geographic perspective, the WSO can also call up a full-color moving map with target and course information automatically superimposed. Other screens provide electronic renditions of flight instruments, aircraft diagnostic information and weapons loads.

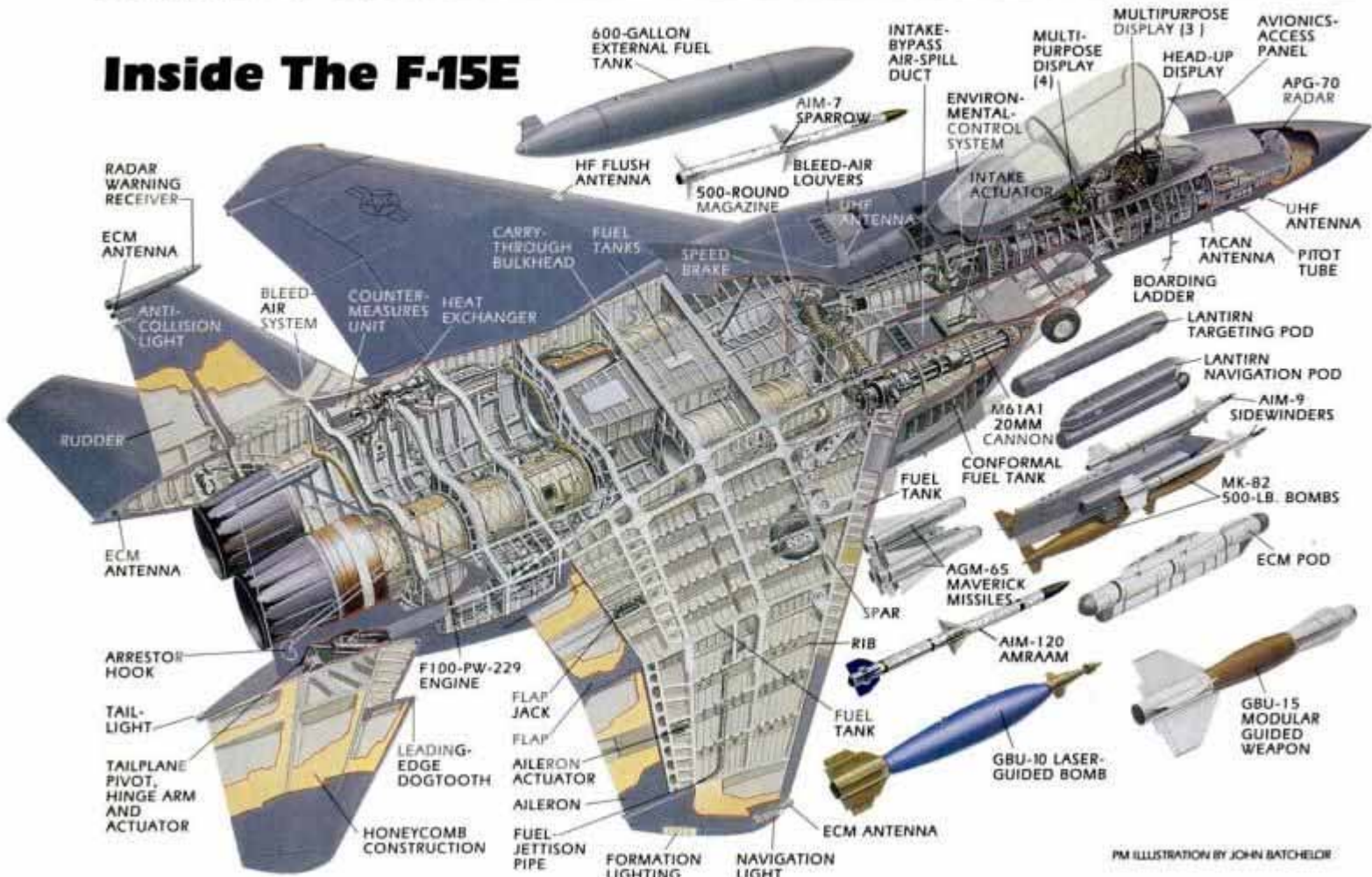
### Preflight

As flight time approaches, the relaxed banter of the squadron house gives way to more clipped conversation. The tempo of events is picking up, and adrenalin levels are rising palpably. I've already been over to



Pilot checks six while back-seater snaps a picture.

## Inside The F-15E



PM ILLUSTRATION BY JOHN BATCHELOR

life support to have my flight gear fitted, and been briefed on its use by Airman 1st Class David Swint. Over a Nomex flight suit, I have on a g-suit that looks like a combination of tight-fitting chaps and a cummerbund. Strapped around my upper body is a vest-like parachute harness, incorporating a lifejacket, and a backpack holding a length of nylon webbing with which I'm supposed to lower myself if my chute gets hung up in a tree.

Slammer conducts a rapid-fire preflight briefing. He and I will lead a 2-ship formation, with another F-15E flown by Capt. Ned Rudd at our wing. Capt. Brian Killough is his WSO. Call them "Neckless" and "Killer." We'll fly 90 miles south to Cape Fear, make a hairpin to the left, skim back up the coast of Onslow Bay at low altitude and then press inland toward the Echo Military Operations Area (MOA). There, we'll practice intercepts and basic fighter maneuvers (BFM).

After going over weather, communications frequencies, formation procedures and the like, Slammer takes me aside to review a few critical questions of safety. These focus primarily on the use of the ACES II ejection

seat. Once the seat is armed, placing 30 pounds of upward pressure on either of a pair of yellow and black handles just outside my thighs will cause the airplane and me to part company explosively. "Don't mess with those handles unless you intend to go for a ride," Slammer warns me. If and when the time comes to punch out,



F-15E's turkey feathers channel 46,000 pounds of thrust.

he'll give the order "bailout, bailout, bailout," during which I'm to flatten my spine firmly against the backrest. "The quicker you get into that position and get ready, the fewer back injuries you're going to have," he says.

### Meet the Eagle

On the flightline, our jet is prepped and ready. Slammer strides out and

greeted crew chief Staff Sgt. Bill Yarbrough and his backup man, Airman 1st Class Mike Harris. "This is their monster," Slammer tells me, gesturing toward the immaculate, slate-gray aircraft. "Don't break it, Abe."

The flightline is alive with sounds that could come from a menagerie of tortured animals. Strange wailings, howls and hard-edged whistles emanate from the planes around us as they start up and taxi. We pace through a brisk preflight inspection, and it's time to mount up.

The cockpit is a good 10 ft. off the ground. I step carefully off a ladder, onto the left air intake, duck under the canopy and drop into my seat. As Slammer settles in, I grapple with the various umbilicals that will join me with the jet. First, a seatbelt-like strap buckles across my waist, ensuring that a survival kit will trail behind me if I eject. Over that goes a lap-belt of heavy webbing. Then, two Kock fittings on the shoulders of my harness attach to the seat's inertia-reel shoulderbelts. The Kocks contain explosive charges that will automatically cut loose my parachute if I should land in the water. The air hose from my g-suit goes into a socket on



PM PHOTOS BY BRIAN R. WOLFF

the left side console. My oxygen mask and mike cord plug in on the right.

The jet-fuel starter hoots like an air wrench behind me as Slammer cranks up No. 1 engine. No. 2 starts, its generator comes on line and I begin to power up my scopes.

As instructed in a preflight simulator session, I put the moving map on the far left, a repeater of flight data from the pilot's head-up display (HUD) next to that, then radar output, and on the far right, a horizontal situation indicator (HSI) for course and heading information.

"Canopy clear," calls Slammer. The 270-pound acrylic bubble lowers smoothly, seats against the rails, then slides forward a few inches to latch. It's as if I've suddenly gone deaf. The world outside appears exactly as it had before, but the soundtrack is gone.

The ring laser gyro inertial navigator finishes aligning itself and all is ready. Slammer calls Yarbrough through the intercom, "Outstanding launch, Sergeant! See you in an hour and a half." The crew chief unplugs his headset from the jet's exterior, and we're rolling. On Slammer's signal, we both look left and salute Yarbrough in unison. It is a moment of inexplicable exhilaration. The jet is

*(Please turn to page 104)*



Complex LANTIRN navigation pod is diagnosed in an air-transportable clean room (middle). Targeting pod stares malevolently from under jet's left intake (above).

PM PHOTOS BY FREDERICK JUTTER

## EXHIBIT



# POSSIBLE DREAMS

Americans listen in on the world with the invention of the radio.

BY MARY SEELHORST

● "Radio will be as much a commonplace with the next generation as the telephone is with this, lifting civilization to new levels," predicted inventor Lee DeForest in a 1926 *POPULAR MECHANICS* feature, "Our Radio World Of Tomorrow." It was an era when growing legions of listeners charged batteries, adjusted aerials, tickled crystals and fiddled with tuners to pluck radio waves from the air.

Between 1919 and 1930, listening to radio broadcasts became a wildly popular pastime for millions of Ameri-

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

cans. The enthusiasm of a generation adopting the technology, language and habits of radio is recaptured in "The World Is Radio Mad!"—a section of Henry Ford Museum's "Possible Dreams" exhibit.

Several home-built radios are on exhibit, reminding visitors of the days before 1925, when having a radio more often than not meant building your own. The simple "cat's whisker" crystal set, with its 2-slide tuning coil, may remind some visitors of winding their own coils on round oatmeal or salt boxes.

PM presented numerous plans for simple, inexpensive crystal receiv-

ers, most often directed at boys. Although as one plan pointed out, "The grown-ups will also enjoy it."

Radio fans who wanted to listen without wearing the heavy, uncomfortable headphones of the day could build a simple horn speaker "with the odds and ends about the workshop," according to PM. On display is one such PM suggestion, making use of two "plumber's friend" plungers, an old phonograph horn and a set of headphones.

By the mid-'20s, dozens of radio companies were churning out thousands of receivers, speakers and amplifiers for home use. Some popular models are on display, including an early "all-electric" set that could be plugged into an AC socket, eliminating the messy, high-maintenance storage batteries.

PM began to run articles like "How

*(Please turn to page 100)*

# As Comfortable As Your Favorite Jeans And Just As Rugged.



**Ford Trucks.  
The Best Never Rest.™**

Is this really the interior of a pickup truck? You bet it is. But you'll only find it in the 1992 full-size Ford pickup. There's a redesigned instrument panel that's more functional and user friendly, a more efficient console and easy-to-reach available power controls.

And it's not only America's best-built full-size pickup,\* but it's been the best-selling pickup for fifteen straight years.

Isn't it time you tried a Ford on for size.

\*"Best-Built" claims based on an average of consumer-reported problems in surveys of all 1991 models designed and built in North America. Sales by Division. **Buckle up—**together we can save lives. Optional captain's chairs and rear bench seat shown.



THE BEST-BUILT, BEST-SELLING AMERICAN TRUCKS  
ARE BUILT FORD TOUGH.



The 1992 Full-Size Ford Pickup.

# CROWD PLEASERS

Multimission design and affordability converge in a 4-way showdown of do-it-all family boats.

BY JOHN WOOLDRIDGE, Contributing Editor  
PM Photos by Skip Gandy

● In recent years, dedicated niche boats have dominated the waterways. You could find either a family boat or a fishing boat or a waterskiing boat. It just wasn't easy to find one that did all three. But in the dual-income, multipurpose, value-conscious 1990s, boatbuilders are getting back to basics. They recognize that early risers might use the boat to flip crankbaits into the weedline at dawn, late risers might use it to shred water on a kneeboard at noon and others might want to cruise around all day long with friends.

There was a time when a simple open-bow runabout was billed as a boat that could fulfill this function. But with the rise of sport-specific boats in the '80s, expectations have risen and a new fish-and-ski boat born.

This new boat is hot out of the hole so it can pull skiers from deep-water starts and also pop easily on plane with a stern-heavy load of fishing gear. On the top end, it's fast enough to get fishermen to distant honey holes and keep barefooters comfortably on top of the water.

It has large livewells, dedicated rod storage and large casting platforms with pedestal seating for fishermen. Ski-tow pylons, lockers wide enough for kneeboards and ladders for climbing out of the water are for skiers. And, finally, it has twin consoles for weather protection, and fore and aft seating to carry a van load of passengers for just plain folks.

With these criteria in mind, PM brought four 19-ft. fish-and-ski boats to Orlando, Florida, for a thorough evaluation that included analysis by a Sea World pro waterskiier. Mercury and Force 150-horsepower outboards were the power of choice. Fishability and skiability rankings were added to our chart for this test. These are the result of comparing more than 10 criteria worth 10 points each. The criteria included dedicated features, user friendliness, casting platform size, trolling performance, wake characteristics, observer convenience and many others.

## Astro 18 FSX

Astro builds fishing machines sharp enough to ride with some of the biggest names in the megabucks world of tournament bass fishing. So it might be expected that the fast and flashy 18 FSX would dominate every fishability category. It did. But surprisingly, the 18 FSX came out on top in skiability, too. For all-around, multi-mission capability, the 18 FSX sets a new standard.

Powered by a 1.5-liter Mercury 150, the 18 FSX was a consistent second-place finisher in top-speed, hole-shot and performance course categories. Quiet operation at idle and (comparatively quiet) at wide-open throttle (WOT) netted the Astro two top scores.

Scoring 96 out of a possible 100 in skiability, the 18



### BAYLINER 1904 COBRA

FSX easily emerged as the fleet's top ski boat. Superior attributes were boarding ease, observer convenience and sufficient low-end power to pull skiers out of the hole. Wake and tracking were well suited to aggressive slalom runs. The soft double wake was ideal for kneeboarders and trick skiers. Turbulence on the table minimized barefoot potential.

Fit and finish was topnotch on the Astro, something you'd expect from a Brunswick boat. Features of note include recessed cleats, twin integrated swim platforms with flush-fit nonskid surfaces, quick-release trolling motor, an aft casting platform with a fold-forward extension, removable aft passenger seats and a ski locker wide enough to accept kneeboards.

For uncompromising versatility, the Astro 18 FSX is second to none.

### Crestliner V196 Phantom SST II

When you're talking about quality welded-aluminum boats, you're talking about rigs built by Crestliner, of

Little Falls, Minnesota. We've tested a number of Crestliners over the years, and they've always finished at or near the top of the chart. The V196 Phantom SST II is no exception. It features a baked-on hard enamel finish, very little aluminum exposed in the cockpit and few rivets. The overall effect is a pleasing, near-fiber-glass appearance.

By pinning turns in complete control, the V196 was a driver's favorite on the performance course. As you might expect from a wet-surface-riding, V-bottom hull, it was a bit sluggish out of the hole, but it made up for it in top end with a tie for second. It tied for first in low engine noise.

Although the V196 lacked a dedicated aft casting platform, it compensated by offering the fleet's largest cockpit. Lack of a dedicated ski locker diminished total stowage space. It damped the skiability ranking, too, which was also hurt by sluggish low-end pulling power and the necessity to board across the motor well. On the positive side, the Phantom earned raves for a soft wake,

# CROWD PLEASERS



**CRESTLINER  
V196 PHANTOM SST II**

exceptional tracking, ideal observer conditions and a superior pylon.

High marks in fishability were the result of immense cockpit area (aided by the SST II transom bracket), a bow-conversion feature that enables the seating area to become a casting platform and lockable rod storage. For family comfort, the stern has folding jump seats and a dinette.

## Gambler GT-206DL

Bass-tournament styling, blazing speed and numerous fishing features are Gambler GT-206DL strong suits. Built near our test site, this high-performance fishing machine has an air-trapping hull that lifted it to one of the fastest top-end speeds we've ever

recorded with a 150-horse single-engine boat—65 mph.

Part of the reason for the blistering top-end mark was the power supplied by a new Merc XR4 outboard, which has a slightly higher displacement than the fleet's other 150-hp outboards. To help the driver harness this speed, the Gambler replaced the typical side-mounted binnacle with a foot throttle. Trim switches are located on the wheel.

In addition to top-end performance, the Gambler edged out the fleet in hole shot, but not by much. Precious seconds on the performance course were lost due to slippery tracking and sliding around the markers.

As expected, the fishability criteria

played into the Gambler's strength and enabled it to finish at the top, tied with the Astro. The test team was impressed with the ample casting platforms, dedicated storage space for tackle and rods, belowdeck stowage of pedestal seats, 3-person bench seat and large fore and aft livewells.

The Gambler's wake was spray-free and flat, which is good for tricking and kneeboarding. Also, it has low turbulence for comfortable barefooting. But a hard, sharp crest presents a problem for slalom skiers, and the boat's slippery tracking makes the driver work hard to stay on course while pulling adult skiers on slalom runs. Lack of a swim ladder made boarding inconvenient, too.

## TEST PARAMETERS

Boats were propped and tuned by Mercury technicians. Top-end, acceleration and performance course data are averages of multiple runs with two riders and matched fuel. Fishability and skiability marks are a combination of 10 criteria worth 10 points each. A perfect score is 100. A professional waterskiier helped determine skiability. Bold numbers on each line indicate ranking in fleet.



MAKE/MODEL	1. ASTRO 18 FSX	2. CRESTLINER V196 PHANTOM SST II
LOA/Beam/Weight/Fuel Capacity	18'8"7'4"/2054 lb./28 gal.	19'2"7'3"/1882 lb./38 gal.
Top-End Speed	2. (tied) 51 mph, in the elite 50-mph club	2. (tied) 51 mph, fast for a V-hull
Acceleration 0-30 mph	2. 6.67 sec., quick to plane	4. 6.75 sec., half a second from the leader
Performance Course	2. 24.65 sec., a smooth operator	1. 23.46 sec., beats faster boats with better handling
Deck Area/Stowage Space	1. 71.48 sq. ft./2. 41 cu. ft.	2. 71.27 sq. ft./3. 23 cu. ft.
Noise Level	1. (tied) 72 dBA idle/1. (tied) 106 dBA WOT	1. (tied) 72 dBA idle/1. (tied) 106 dBA WOT
Fit And Finish	1. Flashy with sound fundamentals	3. Great hull work, interior due for upgrade
Fishability	1. (tied) 97, huge casting platforms	2. 90, immense, open cockpit, good lockers
Skiability	1. 96, good wake for all-around skiing	2. 95, great wake, but no dedicated ski stowage
Price	\$18,750 base/\$19,885 as tested	\$10,700 base/\$21,968 as tested
Address	Astro Boats, P.O. Box 720, Murfreesboro, TN 37130; (615) 890-1593	Crestliner, 609 13th Ave. N.E., Little Falls, MN 56345; (612) 632-6686

## What's A Fish-And-Ski Boat?

We define a fish-and-ski boat as one that has raised casting platforms, aerated livewells, twin consoles, a ski pylon, trolling motor and dedicated ski and rod stowage.

Dash layout has ideal sightlines. In-dash flasher a plus. Excellent nonglare finish.



Instruments and gauges crowded around the wheel. Room for fishfinder above dash.







THE GAMBLER GT-206DL

Our test boat came equipped with a range of options, including two fishfinders and a Pro Package comprised of dash instruments fitted with custom bezels, deluxe livewells and an extra bilge pump. Numerous options and a more powerful outboard made the Gambler our most expensive boat. But serious anglers expect to pay for this kind of performance and fishability. Skiing versatility is less a feature than a bonus.

### Bayliner 1904 Cobra

On the opposite end of the spectrum from the fishing-friendly Gambler is



ASTRO 18 FSX

the family-friendly Bayliner 1904 Cobra. Fit and finish on the sporty Cobra runabout is top drawer, with flaw-free gelcoat and fiberglass work. Abundant family-style seating is

found in the deep main cockpit. Despite Bayliner's penchant for enclosing design elements that limit usable deck and stowage space, there's still a comfortable feeling throughout the boat.

The 1904 Cobra is a complete package boat and comes with a 5-cylinder Force 150 outboard, which is renowned more for its affordable price than for its ability to set the water on fire. But surprisingly, the Cobra was a half a second from the leader in hole shot and turned in a respectable 48 mph at top speed. Handling course time lagged due to a wide turning radius.

Slalom skiers will find the Cobra's small, narrow wake easy to cut through. Barefooters won't appreciate turbulence in the table and the boat's sluggish speed. All will like the grab rail on the swim platform and the flip-down boarding ladder. A wider opening would make the well-drained and ventilated ski locker more useful for kneeboards.

Fishing features include fore and aft casting platforms, two pedestal seats that store beneath the consoles, trolling motor, fishfinder and aerated aft livewell. But, as mentioned, versatile family fun is basically what this boat is all about. Fishing features are a bonus. At just under \$16,000, the fully packaged Bayliner 1904 Cobra is the value leader of the fish-and-ski fleet.



#### 3. GAMBLER GT-206DL

20'6"/7'4"/1945 lb./50 gal.  
 1. 65 mph, a pin-back-your-ears rocket  
 1. 6.25 sec., head-snapping hole shot  
 3. 26.89 sec., a wide rider in corners  
 3. 60.61 sq. ft./1.45/86 cu. ft.  
 2. (tied) 84 dBA idle/3.112 dBA WOT  
 4. Interior a bit spare, but glasswork good  
 1. (tied) 97, practically tournament ready  
 4. 88, slippery tracking, no boarding ladder  
 \$20,000 base/\$24,000 as tested  
 Gambler, 5980 Lakehurst Dr., Orlando, FL 32819; (407) 352-6066

#### 4. BAYLINER 1904 COBRA

19'3"/7'3"/1882 lb./38 gal.  
 3. 48 mph, brisk enough for cruising  
 3. 6.72 sec., fast in a fast fleet  
 4. 27.42 sec., another wide rider  
 4. 55.16 sq. ft./4.21/66 cu. ft.  
 2. (tied) 84 dBA idle/2.108 dBA WOT  
 2. Nearly flawless, quibbles are minor  
 3. 86, confined casting areas, little stowage  
 3. 94, good features, fair wake  
 \$14,495 base/\$15,895 as tested  
 Bayliner Marine, P.O. Box 9029, Everett, WA 98206; (206) 435-5571

Foot throttle and in-dash flasher. Windscreen is a bit low. Grab rail is handy.



Superb high-mounted gauges. Windscreen cuts in unnecessarily close to driver.



PONTIAC  
BONNEVILLE SSEi



# LONG-TERM

We add supercharging and torture-testing to the long-term fleet.



CADILLAC SEVILLE

PAI PHOTO BY CLIFF GROMER



PM PHOTO BY CLIFF GRAMER

● Besides a flock of new faces, this long-term test car update features something new in the annals of vehicle testing—the only evaluation we can think of that's even tougher than a year in New York City.

### **Pontiac Bonneville SSEi**

For those who berated us for not waiting for the supercharged version of the 3800 V6 engine in our Buick Park Avenue Ultra test car last year, this one's for you. The same engine has been plugged into the all-new-for-'92 Pontiac Bonneville SSEi. And what an engine it is. Bolting a supercharger to the 3800 V6 engine ups the horsepower from 170 to 205 and ends all our complaints about GM's intermediates needing "a few more oats under the hood."

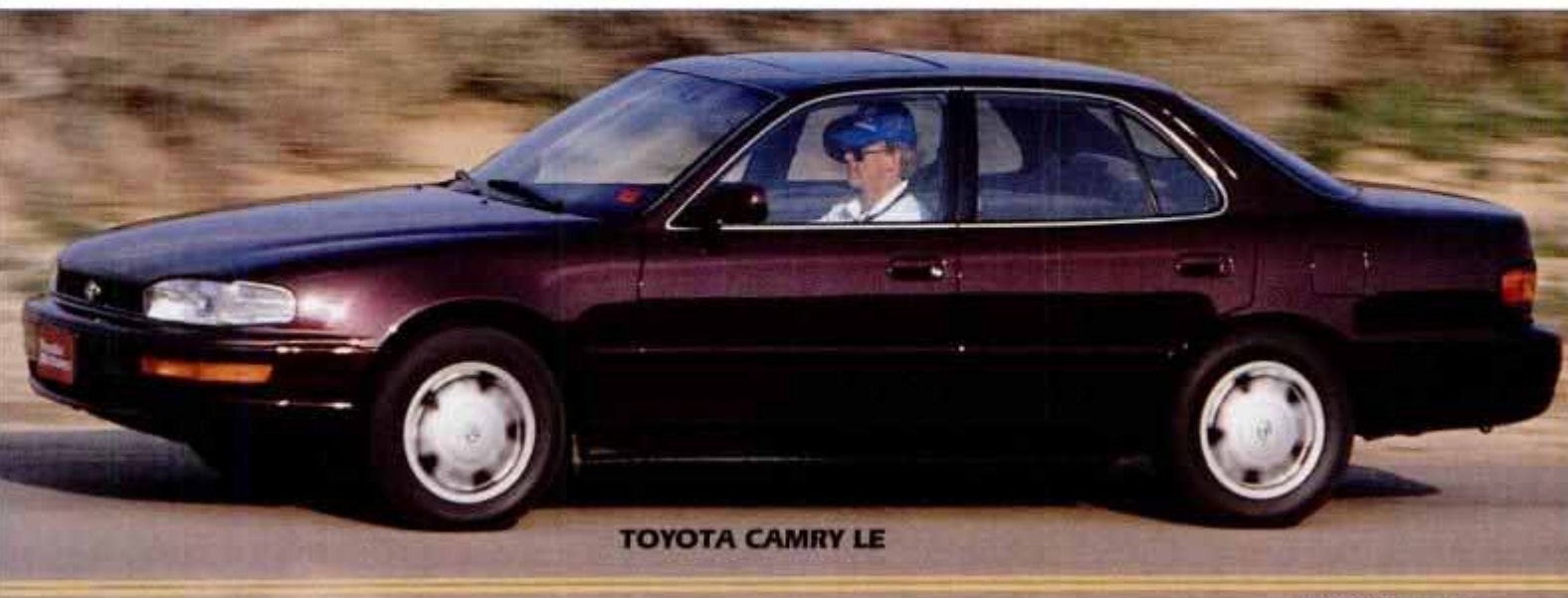
Unfortunately, you can get the supercharged engine only in the SSEi version of the Bonneville, which is the top-of-the-line, take-no-prisoners 4-door sports car from Pontiac.

It's power that is there only when you call on it for safer highway passing or for maneuvering in city traffic. When you don't need it, you'll think you're driving a conventional V6-powered intermediate sedan. Stomp on it and you're gone. It's a very versatile powerplant and we like it a lot.

We also like the body it's wrapped in. The Bonneville is built off the same basic platform as the Buick LeSabre and Oldsmobile Eighty Eight Royale (another member of our current fleet). But it's amazing how Pontiac designers have instilled a completely different personality in the Bonneville. While the Olds is a terrific road car in its own right, the Bonneville is light years ahead in transmitting a sporty feel to its driver. The interior is geared to the driver. The dash layout is just about perfect, and the head-up display is a feature we think will become common on autos in the future. The leather upholstery could come out of a Jaguar or Maserati, and the driving position is excellent. However, there are 9 buttons just to adjust the seats, a rather silly affectation on an otherwise serious high-performance luxury sedan.

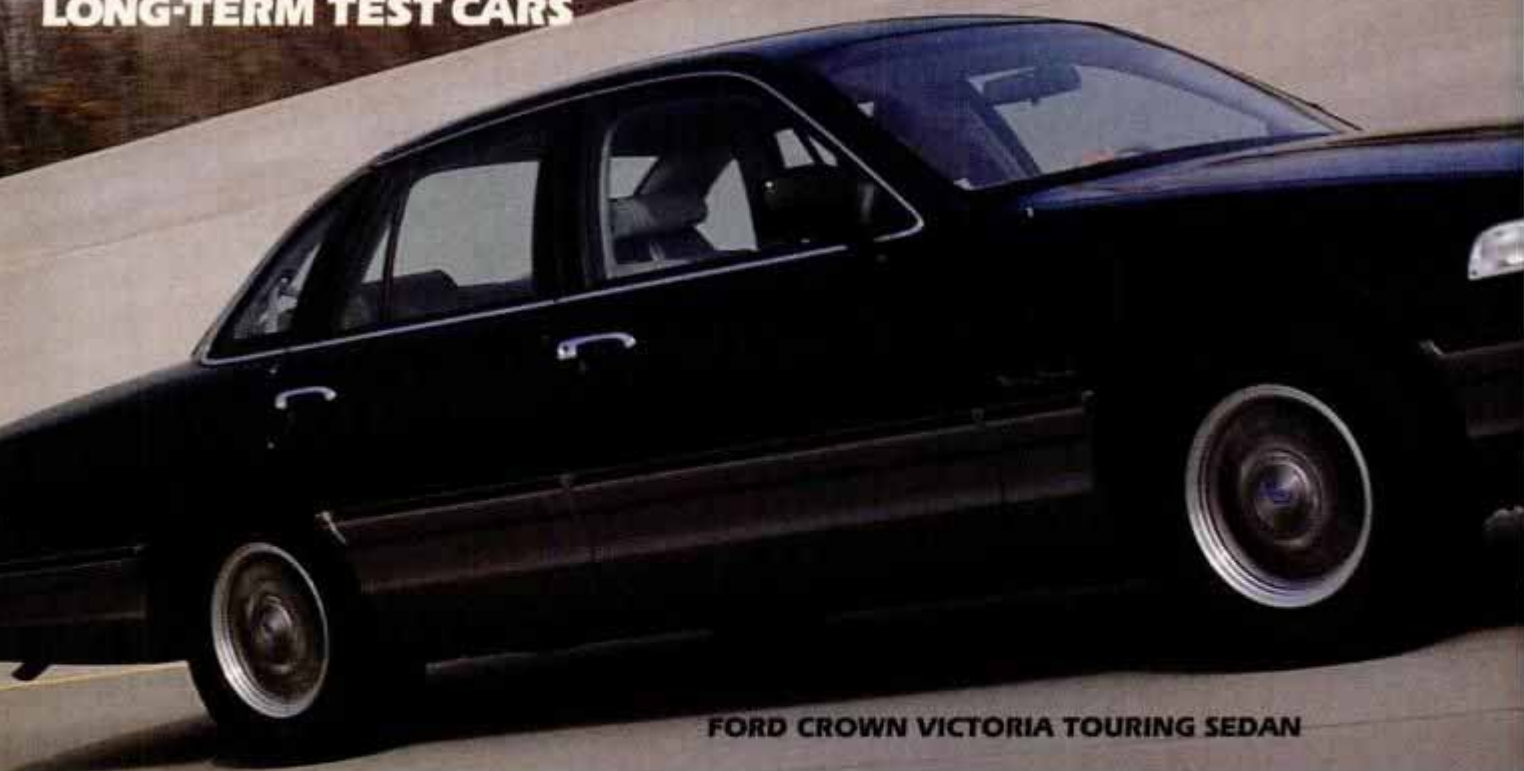
The sporty feel continues throughout the driving

# TEST CARS



**TOYOTA CAMRY LE**

PM PHOTO BY RON HUSSEY



FORD CROWN VICTORIA TOURING SEDAN

experience. We'd call the suspension taut, but never uncomfortable, even over New York's potholed streets.

Out on the road, the SSEi's suspension calibration makes you want to push the car hard. It'll take as much aggression as you can dish out. And when you've got it all out of your system, you can drive this car like a family wagon. A true dual-purpose sport sedan.

—Joe Oldham

### Cadillac Seville

Another new face in our fleet this month. It's a 1992 Cadillac Seville, a car that we've given a lot of attention to in the past six months. We liked it so much we gave the STS version one of our '92 Design & Engineering Awards in our January issue. Then the STS came up as our favorite in a comparison test (see "Fast And Fancy," page 38, Feb. '92) that included such competitors as the Lexus LS

400, Infiniti Q45 and BMW 525i.

So what else is there to know about this wonderful car? Well, how about how well it's built and how it holds up after the new wears off? That's what we intend to find out in this test.

We just took delivery of our test car—a standard Seville, rather than the STS—and have only driven it about 1500 miles as of this writing. Most of our previous attention has been on the STS, and we wanted to try a standard version for this test. Stay with us as we put this award-winning Cadillac through one of the hardest tests of all—surviving the PM staff.

—Joe Oldham

### Toyota Camry LE

The new Camry was a favorite in our recent sedan showdown (see "Family Affair," page 42, Apr. '92), and initial impressions of this new long-term test car strengthen our conviction

that Toyota is offering one of the best midsize sedans available today.

Equipped with a supersmooth 185-hp 3.0-liter dohc 24-valve V6, 4-speed automatic and independent strut suspension, this roomy newcomer is an able performer in any environment. But it really shines in extended freeway travel, with living-room comfort and amazingly quiet operation.

Our LE came with power windows, a power sunroof, a very good AM/FM/cassette sound system, power locks, cruise control, air conditioning, alloy wheels, a driver's airbag and antilock brakes—a list of amenities that helped bump the sticker price to over \$21,000. While we find the Camry supremely smooth and comfortable, we think that a price of this magnitude should include a little better grade of upholstery, as well as a little more in the way of instrumentation.

The LE came to us with 7 miles on

### OLDSMOBILE EIGHTY EIGHT ROYALE LSS



FM PHOTO BY CLIFF GROMER

old standard in the Ford lineup, but it's a thoroughly modern car.

While the new Crown Vic's construction is traditional rear-drive body-on-frame, it's been updated with high-tech touches like traction control, air springs at the rear, quick-defrost windshield and Ford's smooth new 4.6-liter sohc V8. It's also up-to-date in terms of safety, with antilock brakes and dual front airbags.

In our test car, the Touring Sedan

only flaw is a tiny dashboard squeak that shows up on rough roads.

At \$27,000-plus, this Ford is far from cheap. But it's loaded with comfort/convenience/safety features—a luxury car in everything but name.

—Jim Dunne

## Oldsmobile Eighty Eight Royale LSS

Our test car continues to delight with its excellent roadability and luxury accoutrements. This is, admittedly, one of the favorite cars in our fleet, and it's racking up impressive, trouble-free mileage.

A freak spring snowstorm



PM PHOTO BY G. PHOTO

PM PHOTO BY BOB HUSSEY



NISSAN NX 2000

the odometer. There are 1237 now, and we've averaged just under 21 mpg while running them up.

—Tony Swan

## Ford Crown Victoria

Although this is your first look at another long-term newcomer, we've already logged over 6000 miles with our '92 Crown Vic in all kinds of conditions, including the slush of early spring in Michigan. And from the first mile, we've been impressed. This is an

version, the 4.6 delivers 210 hp, which provides excellent performance in a car that weighs nearly 2 tons—as well as surprisingly good fuel economy. Our mpg average in all-around driving has improved to over 24 mpg as the miles roll by.

As you'd expect of a big car, the Crown Vic shines on the open road, where it's roomy, quiet and smooth. Build quality seems good so far—the seams are straight, the trim panels match, the paint is excellent and the

allowed us to experience the Eighty Eight Royale under the worst possible road conditions, and the car definitely showed us something. It's a compliment to Oldsmobile's suspension engineers that the car remained extremely driveable, stable and safe at all speeds and in all conditions.

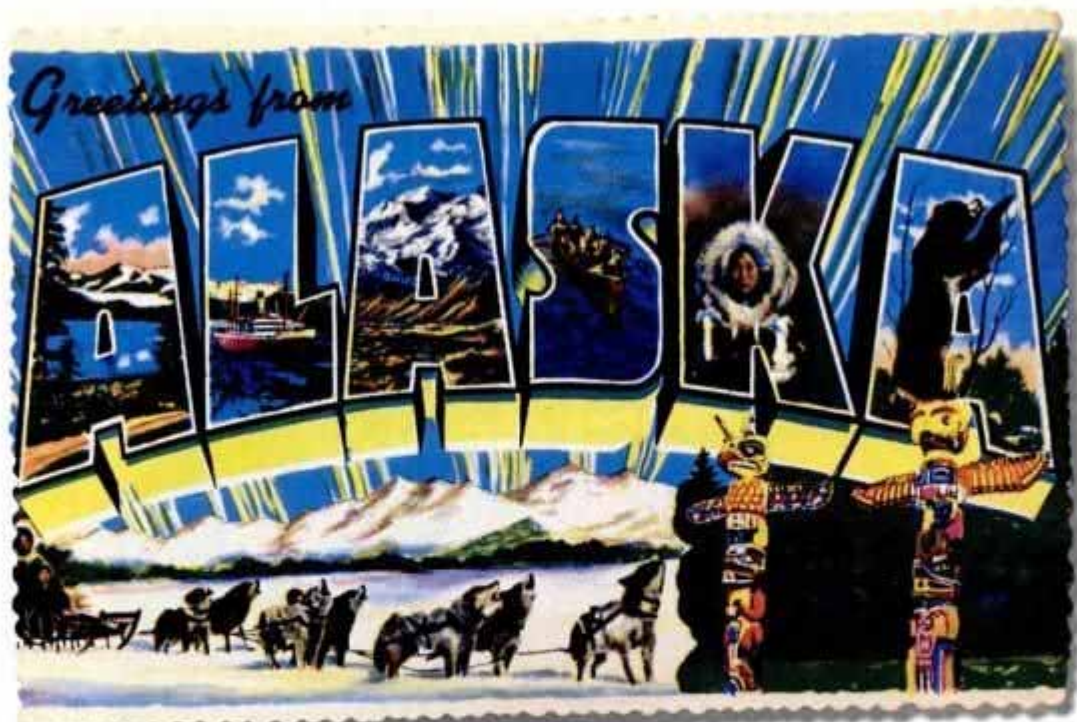
At 4900 miles, the Driver Information Center began flashing "Change Engine Oil" warnings even though the owner's manual calls for periodic

*(Please turn to page 95)*

## CHEVROLET CORVETTE CONVERTIBLE



PM PHOTO BY CLIFF GROVER



"My boss promises me a big raise and promotion.  
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# SINGING MACHINES

Take over the lead vocals with your favorite band.

BY RON GOLDBERG

● The adoring crowd clamors its appreciation as you step up to the microphone. After a moment, the intro swells in—that's your cue. Before you know it, you're belting out your favorite number, with a backup band of top musicians providing the accompaniment. It all sounds like one of those idle afternoon fantasies, but somehow, you're really doing it.

This illusion of grandeur comes courtesy of karaoke, a Japanese entertainment craze that's slowly making its way into the American mainstream. Loosely translated as "empty orchestra," karaoke is a technology that brings the music minus one instrument concept to its logical extreme. The performer sings behind

Sing along with the Beach Boys using Pioneer's CLK-V90 karaoke home entertainment system. List price is \$1900.



PHOTO BY BRIAN KOSOFF; MICHAEL ODYS ARCHIVES BACKGROUND PHOTO

## SINGING MACHINES

prerecorded instrumental tracks, often receiving a helping hand from some vocal enhancement circuitry. Remembering the lyrics is never a problem because they're displayed on a video monitor and highlighted in time to the music.

Karaoke made its U.S. debut in the late 1980s, first appearing in sushi bars and watering holes frequented by Japanese patrons. The concept was already a hit in its native country. But something about karaoke is obviously beginning to click on this side of the Pacific. Not only are karaoke bars springing up everywhere, but the technology is now being marketed directly to consumers.

In its early incarnations, consumer karaoke came in the form of portable tape-based systems packaged with an internal amplifier, a microphone and sometimes a second tape well for recording the sung performances. These consumer karaoke systems, however, have been largely superseded by optical media, with software provided on both laserdisc and CD+G (compact disc plus graphics) discs. The advantages of these digitally based systems are obvious: instant song access, high-fidelity and the addition of digital signal processing (DSP) for the instrumental tracks as well as the vocals.

The versatility of these DSP functions has helped many a nervous karaoke novice get more fun out of the experience by polishing up an otherwise raw performance. For example, a feature called key control digitally raises



JVC's portable CD+G machine, the KX-G1, lists for \$700 and holds six discs.

or lowers the key of the current song in musical half- or quarter-step increments. This can be applied to either the instrumental tracks or the vocals, and because the effect is done digitally, it works without slowing or speeding up the song's tempo. Reverberation, equalization and echo are also available on several of the current laserdisc and CD+G karaoke players. When used subtly, these can fill a thin vocal performance with a rich feeling of ambience. When used with a heavier hand, they can provide exaggerated, spacey effects. One of the more clever DSP functions to find its way

into the karaoke market is harmonizing, a technique often used in professional recording studios. By analyzing the fundamental key being sung, a harmonizer can synthesize 2- or 3-part harmony and layer them over the live vocal.

DSP also allows you to manipulate audio signals to perform various psychoacoustic tricks. One of the most common DSP effects is the re-creation of different room ambiances, ranging from a small jazz club to a full arena. This audio sleight of hand is achieved by playing with the signal's left/right phase information and adding various amounts of time delay.

Digital wizardry aside, karaoke is only as much fun as the software can provide. While most karaoke bars feature an extensive list of available songs, only recently have the software gates opened to the consumer market. Discs for combi-type laserdisc/karaoke machines are available in either 12- or 8-in. formats, with the former holding about 14 songs on each side of the disc and the latter offering a total of eight for both sides. List prices can be as much as \$150.

The CD+G-based machines provide 18 or 19 songs on one side of a disc, and like the standard audio CD that it resembles, only one side is the play side. By contrast, CD+G discs list for about \$40.

The songs available for karaoke include a wide range of standards, oldies and baby-boomer classics.

In case the users find the available software somewhat limited, several machines offer a unique feature called a vocal reducer. This removes most of the vocals (up to 85%) from an existing non-karaoke CD by using companding and notch filtering along the frequencies occupied by the human voice. Naturally, the effect isn't foolproof, since different vocalists sing in different registers. Likewise, not all recordings are mixed the same way, and the technique is most effective when the vocals stand out from the instrumental backing.

Predictably, most of the major players in consumer karaoke are already a presence in laserdisc and CD technology. Pioneer, for example, has been especially active in promoting laserdisc karaoke combi-players. The company offers three consumer-oriented models: the entry-level CLD-V510 (\$700); a step-up model called the CLD-V720 (\$850), which offers a wide range of DSP functions; and the CLD-V820 (\$1000), which is essen-



Pioneer's CLD-V820 karaoke player (top) features digital sound processing and will suppress the vocal tracks of most standard CDs. The company also makes a car player with voice cancellation (right).







A testament to karaoke's popularity in Japan are these two products from Sanyo. The portable MCD-S850 (left) lists for \$350 and features two microphone inputs. The Robo-K10 (below) for children lists for \$100. Both may soon be available in the United States.



tially the same machine as the V720 with the advantage of 2-sided play. Pioneer also makes a car cassette/receiver, the FH-M75, listing for \$1200. It features a voice cancellation circuit for highway karaoke.

Other manufacturers have begun to join Pioneer in promoting combi-karaoke technology. Nikkodo, for example, a major player in commercial karaoke equipment, now offers two units designed for the home market. The LV-2000 (\$999) features 2-sided play, digital echo and programmabili-

ty for up to 20 tracks, as well as multiplex playback capability. This is a technique where vocals and instrumentals are recorded on separate channels. By turning down the appropriate left or right channel of a multiplexed disc with the machine's balance control, a singer can eliminate the existing vocals completely. Sanyo takes the notion a step further in its \$799 LV-P500U player. The unit allows variable fadeouts of prerecorded vocals, as opposed to straight elimina-

tion. Denon may have the most versatile player of all in the LA-2150K, a \$999 combi-unit that will not only play all laserdisc-based software, but CD+G discs as well.

CD+G is a format that seems to have finally found a home through karaoke. Originally conceived to display song lyrics, chord charts and liner notes along with audio CD releases, the idea went nowhere until finding full expression in the sing-along market. Since the discs are smaller and more easily replicated than laserdisc software, CD+G karaoke discs tend to be less expensive than their competition, although sometimes harder to find. These advantages have led several manufacturers to place their bets on this format, as opposed to laserdisc/combi-machines. JVC, for example, offers several self-contained CD+G karaoke decks, as well as an integrated system consisting of a 6-disc CD+G changer, an integrated amplifier and combination speaker system/component rack. The company's KX-G1 (\$700) is a portable unit featuring a unique vocal replacement circuit. When singing along with a multiplexed disc, the prerecorded vocals are muted. But if (or more likely, when) the singer forgets a line, the original vocals return until the singer resumes singing. Nikkodo is also active in CD+G karaoke. The CDG-100 (\$999) offers an interesting twist by incorporating a video input—this allows a video to be superimposed on the monitor while the vocalist sings.

Is karaoke the 1990s' answer to the hula hoop? Perhaps, but there's a definite feeling of sociability and communal spirit involved, especially when someone turns out an unexpectedly moving performance. Of course, sitting through rancid renditions of *Stormy Weather* and *Heartbreak Hotel* might not be everyone's cup of tea, but there's little point in booing—after all, it'll soon be your turn. **PM**

## How Karaoke Makes Everyone A Good Singer

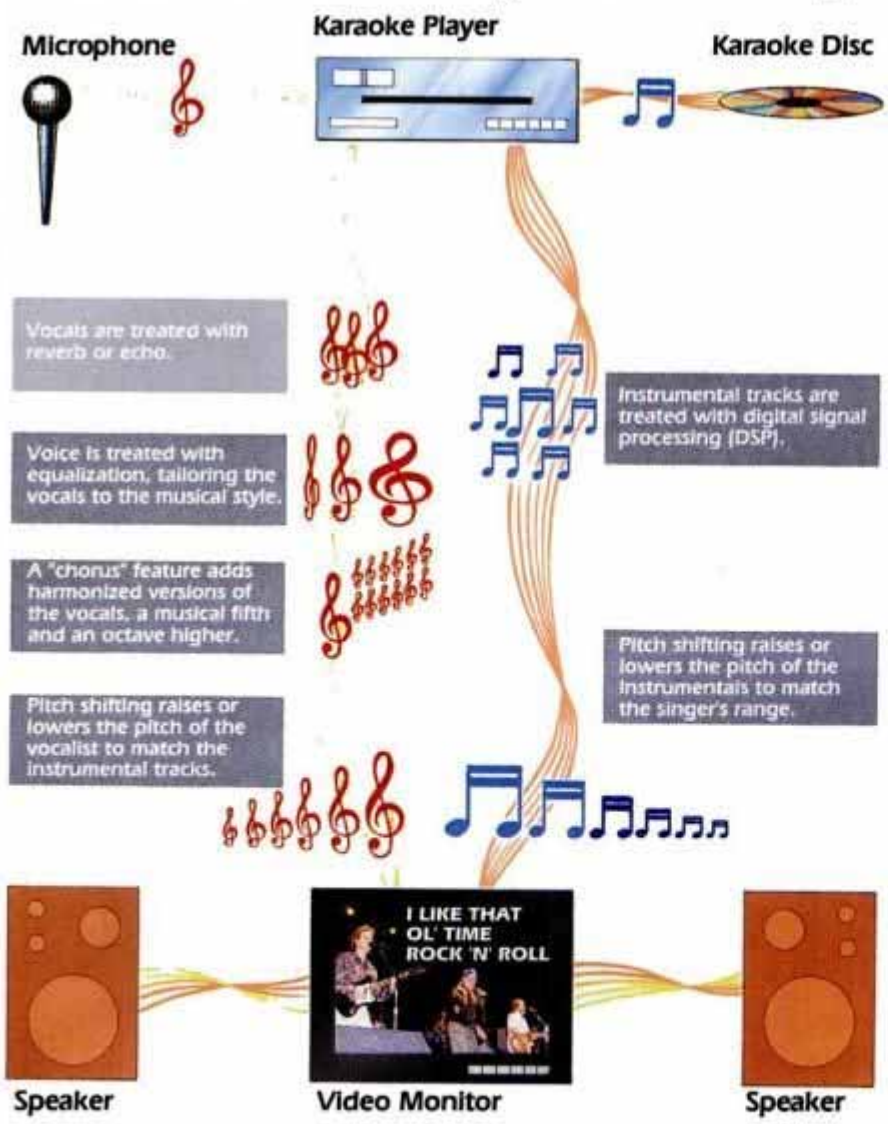
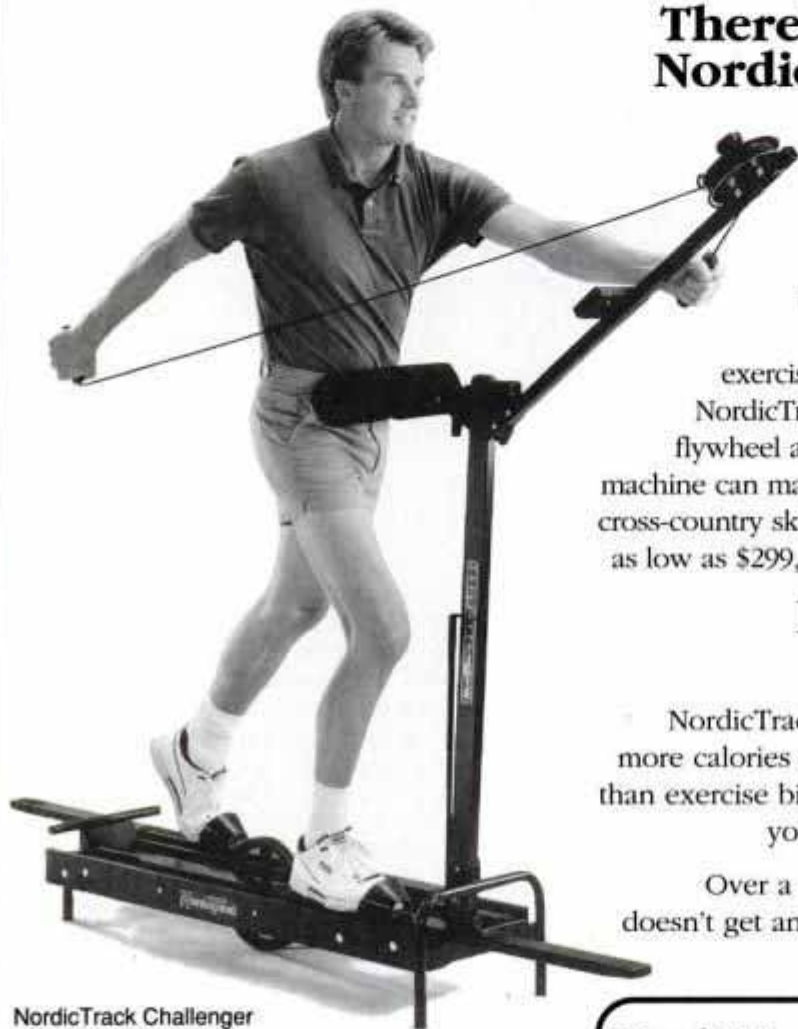


ILLUSTRATION BY HANK KEN

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NordicTrack Challenger model shown.

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**COMPARISON TEST**

**PLATE JOINERS**

With more manufacturers in the act, it's time to find out which one's right for you.

BY THOMAS KLENCK,  
Associate Home Improvement Editor

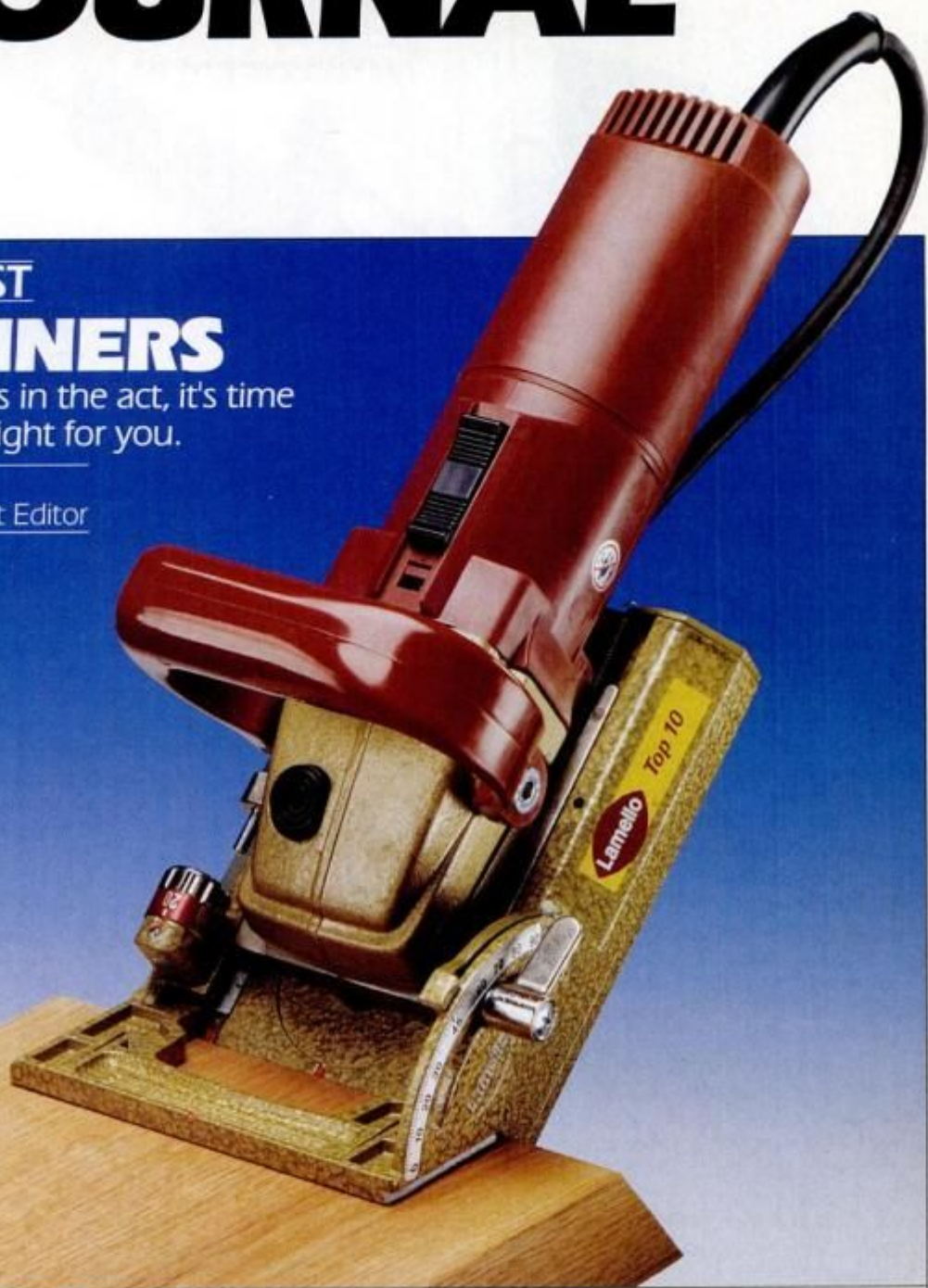


PHOTO BY STAN SILVER

● You've read about them, seen them advertised and perhaps even tried one out. They've been referred to as the most significant innovation in joinery since the wood screw. It's one tool that's generated such interest and demand that manufacturers are tripping over themselves to get on the bandwagon. And, there simply hasn't been a better time to bring your workshop into the 20th century—with a plate joiner.

Originally developed as a system for quickly assembling panels for case construction, plate joining has captured the imagination of woodworkers of all persuasions. In place of a traditional, full-length spline, plate

joinery uses one or more oval-shaped plates, or biscuits. The beauty of the system is that it's very fast, tolerant of minor alignment errors, relatively strong and only requires that components be prepared for simple butt joints. The plate joiner's job is to cut aligned slots in two mating surfaces that accept the plate. It does this with a small, carbide-tipped blade and a system of reference surfaces and fences that allow the slots to be positioned and registered accurately and consistently.

Most plate joiners have a cylindrical motor housing and a right-angle gear drive that powers the blade. In fact, manufacturers generally base

their plate joiners on an angle grinder in their product line. After a few modifications to handle the saw blade, all that's required is a blade housing and base design that allows the blade to cut into the wood and then retract safely inside the housing. All but one of our test tools, the Elu 3380, have a spring-loaded straight-line cutting action. The Elu uses a spring-loaded pivoting action.

The base of a typical joiner not only houses the blade, but acts as a referencing surface for making a cut. Its bottom surface is parallel to the plane of the blade. When both the workpiece and the base rest on a flat surface, such as your bench or table saw



**RYOBI JM-100**

top, repetitive cuts will be positioned uniformly. The side adjacent to the base—where the blade opening appears—is square to the base bottom and is held up against the work. Because many applications, such as shelf construction, require that the tool rest on this surface, this side of the plate joiner is extended to give better support.

In addition to using the base to register a slot, plate joiners have a fence that's mounted on the front baseplate extension. The fence holds the tool at the desired angle and distance from a reference surface on your workpiece. The simplest designs are reversible so the tool can be held securely against a miter cut, as well as handle ordinary square butt joints. Some models feature pivoting fences that can be set for any miter angle.

For handling 45° miters, plate joiner fences are designed to either reference against the inside of the joint, the 135° corner of the miter cut, or the outside of the joint, the 45° corner. Because miter joints in cabinet construction are seen primarily from the outside, referencing to this side of the joint ensures that the visible faces will be aligned even if the two pieces are of different thicknesses. Freud and Skil reference against the inside, and Elu and the standard Porter-Cable refer-



**ELU 3380**

ence to the outside. (P-C's 5556 pivoting fence accessory references to the inside.) Lamello and Ryobi both handle inside and outside miter referencing (see fence details on next page).

While the distance of the slot to the working face of the stock is set by referencing with the base or fence, positioning a slot along the joint is done by lining up an alignment mark on the tool with a slot location mark you make on the stock. To keep the tool from shifting as the cut is made, most joiners have spring-loaded steel points next to the blade opening. The Lamello has nonmarring rubber pads, and the entire surface around the blade opening on the Ryobi joiner is rubber covered.

With plate joiners, power isn't really an issue. Performance is more related to features, flexibility, ease of use and quality of construction.

### **Elu 3380**

The most unusual model in our selection is the Elu tool. Where the circular blade on all the other tools plunges straight into the wood, the Elu pivots much like an ordinary pivot-foot circular saw (Photo 1, page 54). The blade opening isn't directly in front of the cylindrical motor housing, but on one side. With this configuration, the Elu 3380 can be used as a trim saw or



**SKIL 1605**

grooving tool. Because the blade is so close to the blade housing, you can trim close to a wall or obstruction—places ordinary trim saws can't reach.

In keeping with its multipurpose nature, the Elu has a few unconventional features. It has two auxiliary handles, along with the motor housing, so it can be held in just about any position. The depth adjustment isn't the typical stop system that quickly locks in place for different plate sizes. Instead, Elu uses a simple screw adjuster with a depth scale that indicates appropriate cutting depths for the various plates. It may not be as fast as other joiners, but this system makes more sense for using the tool as a small saw and groover. To handle 45° miters, you attach a special 45° block to the base. Unlike a typical 45° fence that's held against the work, the Elu attachment rests on your bench and supports the tool at 45°. For other angles, you'll need to make special shims.

Also, unlike typical joiners, the position of the blade in relation to the base is adjustable. This means that the base of the tool can act as an adjustable reference for handling stock of different thicknesses. Other makes require a sliding fence—a slightly less accurate mechanism for consistent kerf location. The scale that gauges



**FREUD JS 100**



**LAMELLO TOP 10**



**PORTER-CABLE 555**

the blade/base spacing ranges from 1/2 to 1 1/2 in., and represents the stock thickness for an approximately centered kerf. Elu also supplies a fence that can be used for plate joint positioning, grooving or sawing. With the fence in place, the spacing range increases to a very impressive 4 in.

The sliding switch doesn't lock on—perhaps out of respect for this tool's role as a small circular saw. The Elu

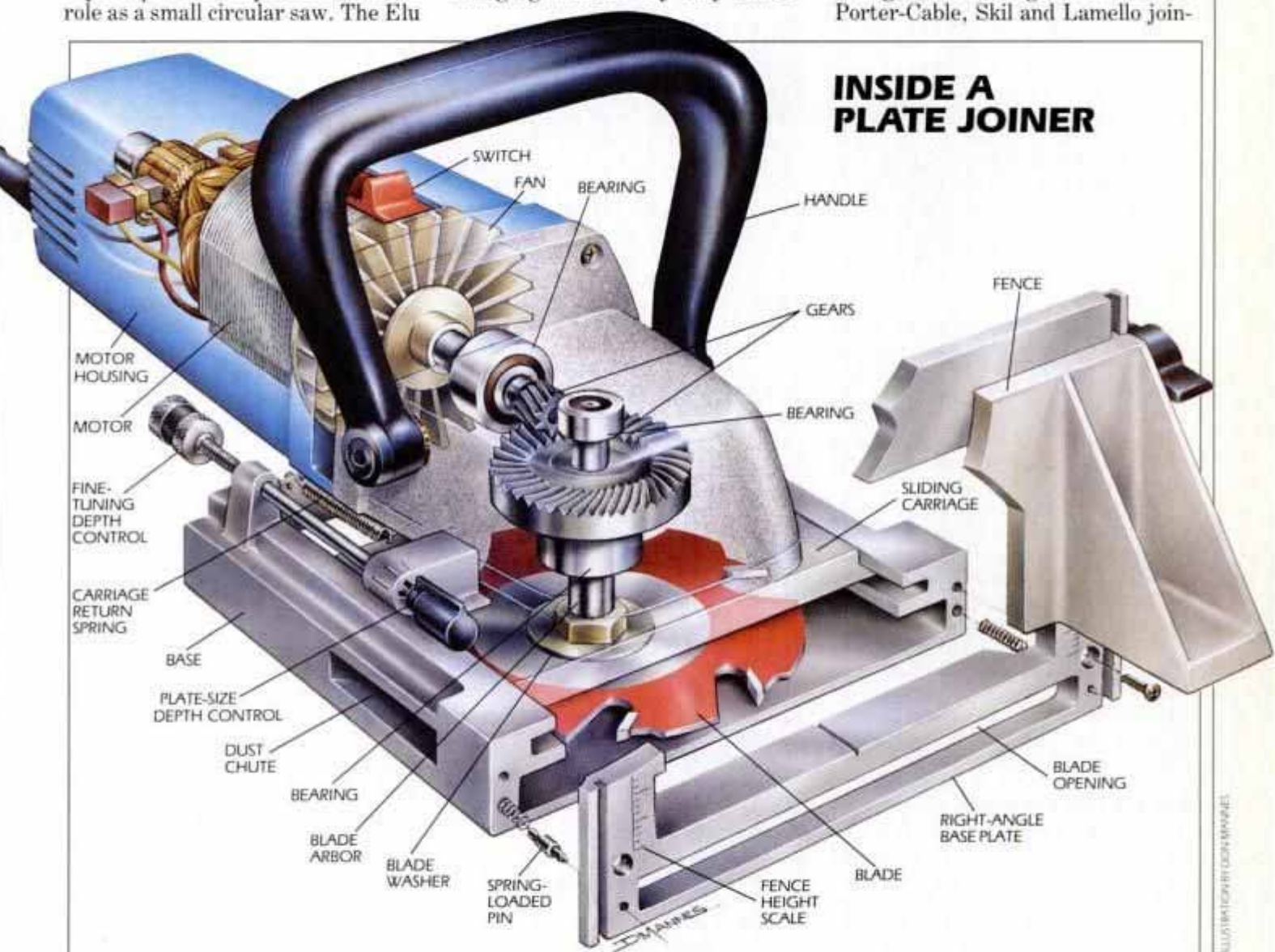
comes with an antisplintering insert to help protect veneered and laminated surfaces, and has spring-loaded locating pins that can be retracted for sawing or grooving.

The Elu 3380 is well made and works smoothly. However, it might seem a little awkward at first if you're used to the standard design. Blade changing is relatively easy and re-

quires two wrenches that are included with the machine.

## Freud JS 100

If you're looking for a basic, no-frills joiner, Freud has one for you. There's absolutely nothing fancy about this tool. Freud has chosen the standard angle grinder-modified design with a straight-line sliding base. Like the Porter-Cable, Skil and Lamello join-



## INSIDE A PLATE JOINER



### HEIGHT-ADJUSTABLE FENCE

This specific design, used by Freud and Skil, is reversible for handling 45° miters and can be removed.



### PIVOTING FENCE

Pivoting systems on Lamello, Ryobi and P-C 5556 can be set for any miter between 0° and 90°.



### INSIDE MITER REFERENCING

Reversed, the Freud and Skil fences match the 135° angle of a 45° miter—the inside surface of the joint.



### OUTSIDE MITER REFERENCING

P-C's standard reversible fence references slots to the outside surface of miter joint.

ers, this tool has a removable, sliding fence for positioning the blade relative to the worksurface. The range is about 2½ in. Also like P-C and Skil, the fence is reversible for handling 45° miters.

The Freud fence, with its pair of locking knobs, is far easier to remove and adjust than the P-C and Skil entries. However, the castings are rough and the fence doesn't slide smoothly. The scale for measuring blade/fence spacing is graduated in ⅛-in. increments on one side and millimeters on the other, and indicates the distance from the fence to the top of the blade. Freud uses metal, spring-loaded points to hold the tool in place during a cut. One of the points on our test tool didn't retract properly.

The switch is on the left side of the motor housing—lefties will have to adapt. It's a sliding type that can either be held for momentary operation or locked in place. Although the tool has a simple, 3-position depth gauge for accommodating the three standard plate sizes, it's not difficult to accidentally alter the fine-tuning knob when switching from one plate size to another.

The center-of-cut indicator mark is cast in the base, but not highly visible. To compound the problem, we found that plate location marks on the stock are invisible with the fence in the miter position at certain depths.

Failings aside, this joiner does do the job. The base is flat, and the tool is stable in use. However, try not to damage or dull the blade—changing it is by far the most complicated procedure in our test group.

## Lamello Top 10

When plate joinery took off a few years ago, Lamello was just about the only show in town. And, if you wanted to get involved, you paid the price. Now, with offerings from European, Japanese and American manufacturers that average out at a little over

half the cost of the Lamello, you may wonder what the fuss is all about.

Well, the fuss is about quality. Everything about the tool functions smoothly and effortlessly. The sliding base is flawless, and all the adjustments, levers and controls are well designed and thought out. The craftsmanship in construction alone might be enough to justify the price for those who demand the best.

While the fence configuration appears similar to many other models, there are some notable variations. The right-angle front baseplate isn't fixed, but pivots from 0° to 90° like the Ryobi and the Porter-Cable fence accessory (Photo 2). Unlike Ryobi and P-C, the Lamello pivoting faceplate can't be adjusted for height. It's positioned to handle most standard cabinet-thickness stock. A small plastic shim that attaches to the fence is provided for handling thinner work.

To make the system more versatile, Lamello includes a sliding fence that fits on the pivoting faceplate. The fence scale measures to the center of the plate joint slot and ranges from 0 to 1½ in. When the pivoting faceplate is used alone, miters are referenced against the inside surface of the joint. When the sliding fence is installed, miters are referenced against the outer surface. Lamello's alternative to the reversible fences of Freud, P-C and Skil is simple and elegant. The back edge of the reference surface on the Lamello fence is chamfered at 45°. This chamfered corner holds the tool against a 45° miter, while the front horizontal part of the fence handles 90° butt joints.

The faceplate and fence are each locked or unlocked with their own single lever. The depth-stop knob is separated from the fine-tuning depth adjustment so the fine setting won't be accidentally altered. And, the Top 10 handles five plate sizes—one smaller and one larger than the range available to other makes. The small plate

requires a special blade that produces a shorter kerf for small frames and similar work. To use the larger plate, set the depth of cut to MAX and place two kerfs about ⅜ in. apart.

When it comes to changing the blade, nothing could be easier. Loosen one screw by hand and the base slides away to expose the blade. A spindle lock holds the blade while the blade nut is unloosened (Photo 3). The Top 10 has a sliding switch that's mounted on the top of the motor housing, so it should work equally well for right- or lefthanded use. The switch simply locks on, freeing your hands to position and operate the tool. To help place the cut, alignment marks are both recessed and painted in red.

## Porter-Cable 555

With the exception of Elu, Porter-Cable is the only company that's gone back to the drawing board to question exactly how a plate joiner should be built. And, they've come up with a few interesting twists on the concept.

Most evident is the departure from the angle grinder-adaptation route. Instead of using a right-angle gear system to transfer power from the motor to the blade arbor, P-C has set the motor axis parallel to the blade arbor axis, and transmits power through a belt. P-C claims that this produces a quieter tool, although our sound-level checks have it coming in pretty close to many of the others. In addition, positioning the motor vertically necessitates a new approach to how the tool is held. And on the surface, it looks like this version might be easier to handle. Plate joiners, by their very nature, are often held in varying and awkward positions. While the standard design may not be the best, we're not so sure this variant is any better.

The D-handle configuration almost asks for a trigger switch—and this is what Porter-Cable has opted for. Unfortunately, it can't be locked on.

## PLATE JOINER SPECIFICATIONS

MANUFACTURER	MODEL	PRICE <sup>1</sup>	AMPS	CUTTING MOTION	MITERING CAPACITY	MAX. FENCE DEPTH <sup>2</sup>	CUT DEPTH SETTINGS	SWITCH <sup>3</sup>	DUST COLLECTION <sup>4</sup>	NOISE (dBA)	CASE
Elu	3380	\$516	5	Pivoting	45° <sup>5</sup>	4"	Variable	Int.	Opt. Access.	91	Metal
Freud	JS 100	\$333	5	Straight	45° <sup>6</sup>	2½"	3	Int./Lock	N/A	91	Plastic
Lamello	Top 10	\$699	6.4	Straight	Variable <sup>7</sup>	1½"	6	Lock	Opt. Access.	92	Wood
Porter-Cable	555	\$315	5	Straight	45° <sup>5</sup>	1"	3	Int.	N/A	91	Metal
Ryobi	JM-100	\$444	5.3	Straight	Variable <sup>7</sup>	2½"	3	Int./Lock	Dustbag	90	Metal
Skil	1605	\$119	6	Straight	45° <sup>6</sup>	1½"	3	Int./Lock	Dustbag	94	Plastic

1. Suggested retail price, joiners may be sold for less. 2. Distance of fence to blade as shown on scale, P-C and Elu as measured. 3. Intermittent switches must be held on. 4. Dust collection accessories enable vacuum attachment. 5. References to outside of joint. 6. References to inside of joint. 7. Inside and outside referencing.

Usually, after you've cut your stock and laid out the plate positions, you're ready to cut a number of slots at one sitting. In this situation, a way to lock the switch on would be handy so you're free to hold the tool conveniently for the job at hand.

Like Freud and Skil, this joiner has a fence that adjusts up and down for plate positioning, and is reversible to handle 45° miters. Unlike Freud and Skil, the fence registers against the outside face of a miter (Photo 4).

The most annoying thing about the fence is that it's held on with two Allen screws. This means adjusting it requires an Allen wrench—or several, if you're at all prone to misplacing them. And if you want to use the tool without the fence—many plate joining op-

erations don't require it—you're left with two small Allen screws to get lost in that pile of plate joiner shavings on the floor.

To give this tool added versatility, Porter-Cable offers an adjustable miter fence (model 5556, about \$67) that pivots from 0° to 90°. This fence is similar to the basic Lamello pivoting faceplate in that it references to the inside of the miter joint. However, P-C's version also adjusts up and down. To mount this accessory, you'll need to replace the standard right-angle faceplate, and the new faceplate won't accept the original fence with the outside miter referencing feature. The pivoting fence accessory is adjustable for height, but has no scale for gauging blade distance from the fence.

Blade changing is just about as difficult as it is on the Freud joiner—too many parts to remove. The tool is equipped with spring-loaded steel points to help keep it in place during a cut.

## Ryobi JM-100

Ryobi's recent entry is a conventional angle grinder adaptation coupled to a straight sliding base. While there are a few departures in the base assembly, Ryobi's attention has been clearly directed toward the fence and front faceplate system. The result is a fence that's capable of handling just about any joining situation you're likely to encounter—without resorting to removable components.

Basically, it's a pivoting fence sys-

## Still On Top

● For many woodworkers who have been practicing their craft for a while, the terms plate joiner and Lamello are almost synonymous. After all, this is where it started. Of course, it didn't take long for other manufacturers to give this Swiss company a run for its money. While for the dedicated pro and industrial user there may be no substitute, the revolution in plate joinery and the influx of models have moved Lamello to offer a variety of models and popularize a wide range of applications through specialized hardware.

Today, Lamello builds three different plate joiner models. The Standard 10 (about \$499) and Top 10 (about \$699) have replaced the original Lamello Top—the tool that started it all. These two new tools differ primarily in their fence configurations. Where the Top has a very flexible system that uses a pivoting front faceplate, the Standard has a nonpivoting faceplate and a sliding fence. The fence is similar to the Top 10, and it has a 45° chamfer for handling ordinary miters. For most typical cabinet work, the Standard is the only tool you need. And, like other

fixed-fence tools, you can always make shims to handle special mitering jobs. We chose the Top 10 for our tests because its pivoting faceplate makes it comparable to the best of the other manufacturers.

New to the Lamello line—so new that we weren't able to try out a unit until our comparison tests had been completed—is the Cobra plate joiner (about \$350). This compact joiner features a vertically oriented motor like the P-C 555. However, instead of using a belt to transmit power, the Cobra features direct drive. It has the same fence arrangement as the Standard, and the motor is controlled by a nonlocking trigger switch. If you can live without a pivoting faceplate, this tool ranks very well against the competition.

As well as making the actual tools, Lamello offers special plate joiner accessories and hardware. In addition to supplying five standard plate sizes—and a downsized blade to handle the smallest plate—special-application plates include a type for joining solid-surface material and a self-gripping plastic plate for use in situations that clamps can't handle. And, not content to view plate joiners as dedicated joining

tools, Lamello also makes knockdown fittings and hinges that fit in a standard plate joint slot. And since the slot size is standard, Lamello's specialty plates can be used regardless of the manufacturer of your tool. —T.K.



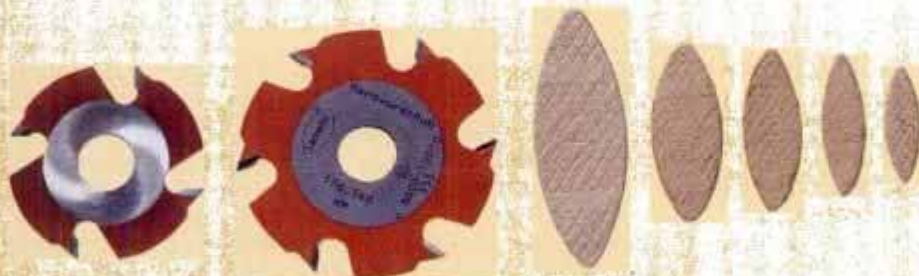
LAMELLO TOP 10



LAMELLO STANDARD 10



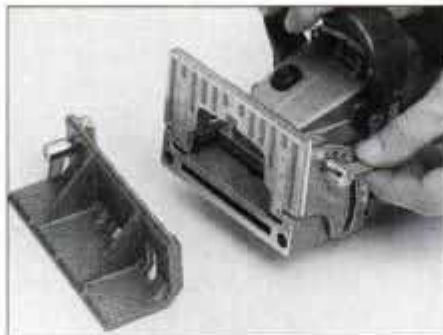
LAMELLO COBRA



To handle a wider range of plate sizes than most other joiners, Lamello offers a small plate joiner blade in addition to the standard size. Plate sizes range from the 1½-in. H9 plate (far right) to the large 3¼-in. version.



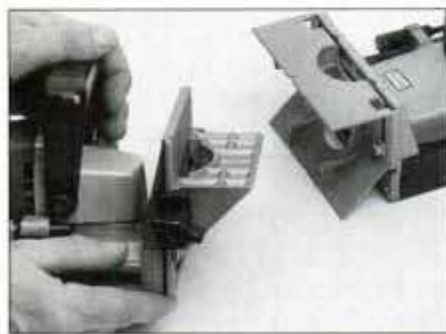
**1** Elu joiner is pivoted into stock when making a slot. This design allows the tool to serve as a trim saw and grooving tool.



**2** Pivoting faceplates adjust for any angle. Sliding fence mounts on faceplate to set slot location across stock thickness.



**3** Blade change on Lamello Top 10 is simplest of all plate joiners tested. Spindle lock, also found on Ryobi, speeds removal.



**4** Reversible fences of Freud (left) and Porter-Cable (right). Freud uses knobs to lock fence, P-C uses two Allen screws.

tem similar, in principle, to that found on the Lamello Top 10 and the P-C fence accessory. However, the Ryobi fence is not only adjustable in height, it pivots both forward and backward for referencing against either face of a miter joint. When you don't need the fence, it simply folds up. Fence capacity—the maximum distance from the fence to the blade—is an ample 2½ in. The fence scale is graduated in ⅛-in. increments and measures to the top of the blade (Photo 5).

The entire area around the blade opening is covered with rubber. This gives you an antislip surface that will handle any size stock you're joining. The depth adjuster is a dial on the base side, and fine-tuning is set with an independent setscrew. Blade removal is straightforward, but you do have to pry out a small plastic plate on the base.

Other notable features include a spindle lock for easy blade changing and a sliding switch that can be used intermittently or locked on. The switch is positioned for righthand use. And finally, there's an easily removable dustbag.

### Skil 1605

The most recent entry is the model 1605 from Skil. In comparison with the other tools, this model seems to be aimed at the home woodworker rather



**5** Ryobi fence is locked with side levers. It pivots forward and backward, and slides up and down through 2½-in. range.



**6** Allen screws on Skil must be removed to reverse fence or to shift fence from one of two fence-location ranges.

indexing mark on the base difficult to see in certain situations.

### Time To Choose

When you come right down to it, all six of these tools cut plate joints. With that in mind, the Skil, with the lowest price of the lot, looks pretty good. And, this tool is sure to bring plate joinery into workshops that otherwise would have gone without. But, if your notion extends to something a little more substantial—and the dustbag isn't a priority—our suggestion is the Freud JS 100. You get a heavier tool, metal base and fence, and knobs to adjust the fence instead of Allen screws. On par with the Freud joiner is Porter-Cable's unique entry. Although fit and finish put it ahead of the Freud model, and the fence accessory makes the joiner more versatile, P-C loses points on its Allen screw adjusted fence and nonlocking trigger switch.

Of course, we think the best tool is the Lamello Top 10. If you're going to use your plate joiner often—and your budget can stand it—it's not likely you'll be disappointed with this tool. The Elu is also a very attractive professional machine with incomparable versatility. However, with a price just above the group average, the Ryobi JM-100 has the most versatile fence system around. **PM**

PHOTOS BY THOMAS KLENCK





## SHOP PROJECT **ANNIVERSARY PRESENT**

A chair built to celebrate  
PM's 90th birthday.

BY NEAL BARRETT

● This side chair marks the second installment in our 4-part furniture project series. Built to celebrate PM's 90th anniversary, our curly maple chair is evocative of the Arts-and-Crafts furniture style that was popular when PM appeared on Chicago newsstands in 1902.

We especially liked building this

piece, because designing a chair is one of the greatest challenges in all of woodworking. Seen from all sides, a chair must look attractive. And, it has to be sturdy because people not only sit in chairs, they also stand on them and lean back in them—in short, subjecting them to all sorts of abuse that other kinds of furniture rarely see.

You also want a good chair to be able to function in a variety of situations. And we think this one fills the bill nicely. It can be used at a desk, a dining table or in a living room. The seat is generously proportioned and carefully upholstered so you can be comfortable if sitting for prolonged periods. Please keep in mind that we built this chair from curly maple, but other hardwoods, such as walnut and cherry would work just as well.

Color photo: John Griebisch  
Black-and-white photos: Neal Barrett  
Technical art: Eugene Thompson

## Making The Legs

Study the plans carefully. Note that the dimensions for all parts, except part C, show the size of the blank that the finished part is made from. Blank sizes are necessary here because the components are curved, and cannot be dimensioned the same as parts with straight lines.

The first step is to make templates of the front and side profiles of all legs from 1/4-in. plywood or hardboard.

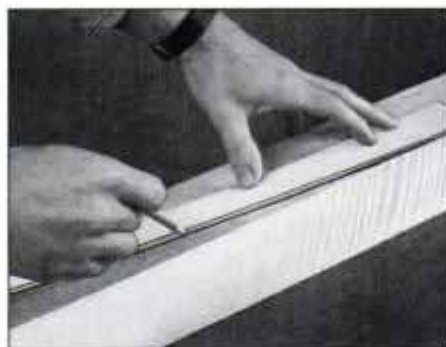
Rip and crosscut the blanks for the front and rear legs from solid stock or glue up the blanks from several pieces. Trace the side profile of the rear legs onto each blank and cut it out on the band saw (Photos 1 and 2).

Next, use a spot of hot glue to reattach the cutoff to the leg blank (Photo 3). Trace the front profile on the blank and finish cutting the leg to shape. Gently detach the cutoff by prying with a chisel. Save this and all other cutoffs for later use.

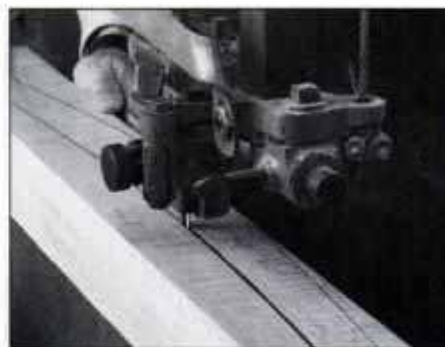
Use a sharp spokeshave, block plane and scraper to smooth each leg and refine its shape. Hold the work firmly in a bench vise, changing its position as required to shape surfaces.

Lay out the position of the mortises in the rear legs. Bore overlapping 3/8-in.-dia. holes on the drill press to remove the bulk of the mortise (Photo 4). Support the leg while you bore using the band-sawn cutoffs. Pare the ends of each mortise square and its sides flat using a sharp chisel.

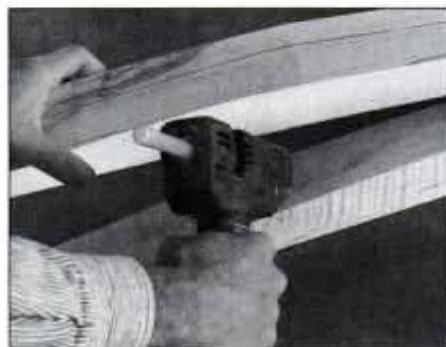
You can follow the same sequence to make the front legs, or you can cut the mortises in these legs with a plunge router before sawing the blank to shape (Photo 5). Square the ends of each mortise with a sharp chisel (Photo 6). Cut the legs to shape on the band saw, and refine their shape with a spokeshave, block plane and scraper.



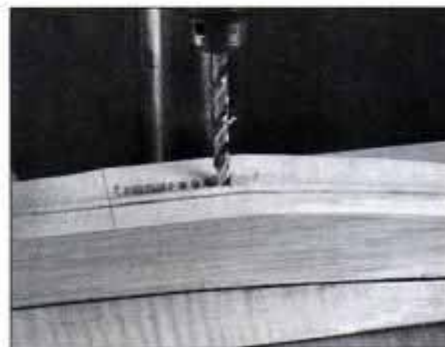
**1** Make templates of the front and side leg profiles using 1/4-in. plywood material. Trace the shape on the leg.



**2** Cut the leg to shape on the band saw. Stay just to the waste side of the line and use a slow rate of feed.



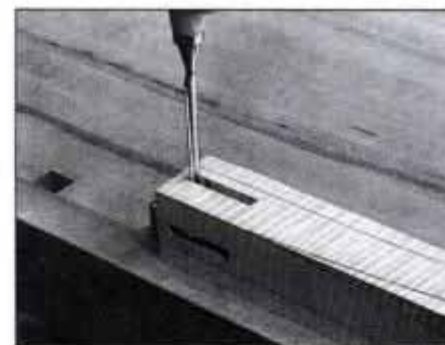
**3** Use a spot of hot glue to reattach the cutoff to the leg blank. This makes it easier to saw the remaining profile.



**4** Bore out the bulk of the mortises in the rear legs on the drill press. Support the legs using the band-sawn cutoffs.



**5** Lay out the mortise locations and the leg profiles on the front leg blanks. Cut the mortises with a plunge router.



**6** The plunge router will leave a mortise with radiused ends. Square the ends of the mortise with a sharp chisel.

## Rails And Splat

Rip and crosscut the stock for the front and back rails. Cut the tenons on these rails using dado blades in the table saw. Push the rail over the dado blade using the miter gauge. Attach a clamp to a miter gauge extension to act as a stop. This procedure will ensure that the tenons are consistently the same length (Photo 7). The dado blades leave a rough surface on the tenon's cheeks, so cut the tenons slightly oversize and pare them smooth with a sharp chisel.

Mark the mortise location for the splat in the top edge of the rear seat rail. We cut this mortise by clamping the rail in the bench vise and using the

plunge router (Photo 8). To do this, provide support for the router base by clamping a wide piece of scrap next to the workpiece, but make sure that you leave room for the router's fence. Square the ends of the mortise with a chisel. You can also bore out this mortise on the drill press and square it up with a chisel.

However, be aware that since the splat does not have a tenon but fits directly into the mortise, there are no shoulders to hide a sloppy fit.

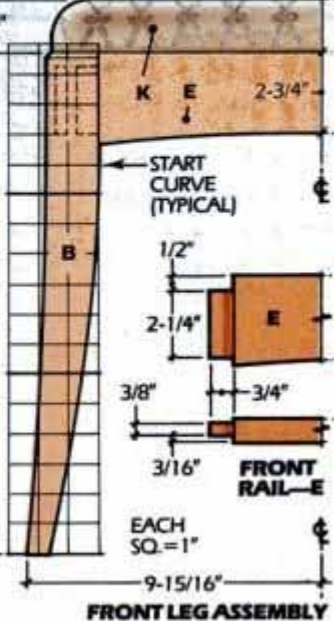
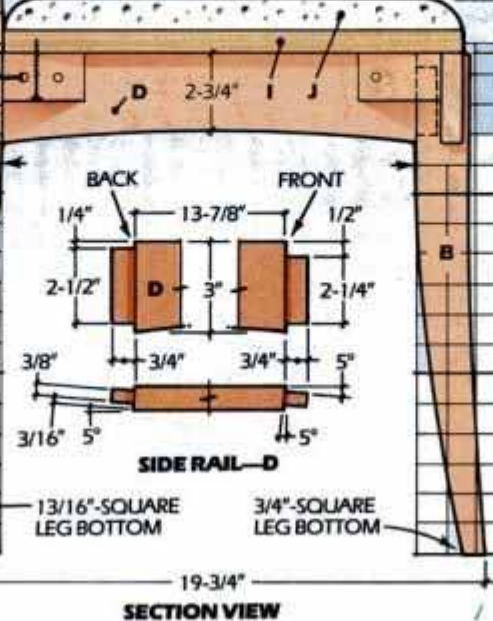
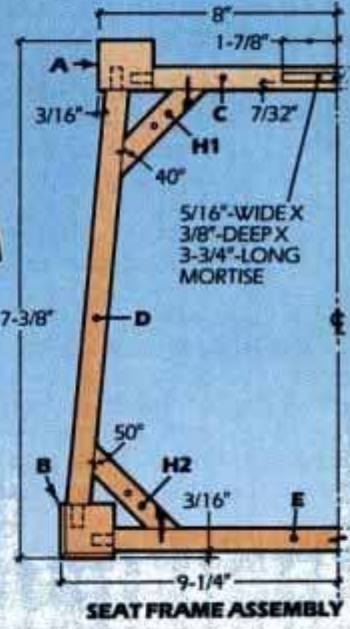
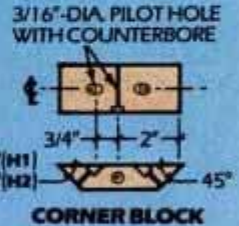
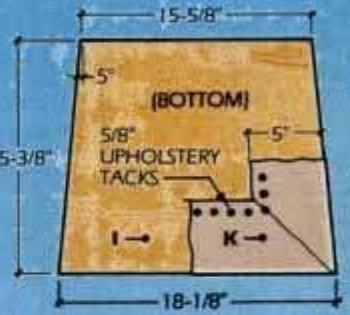
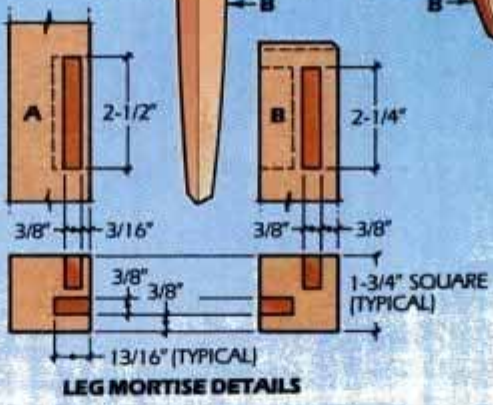
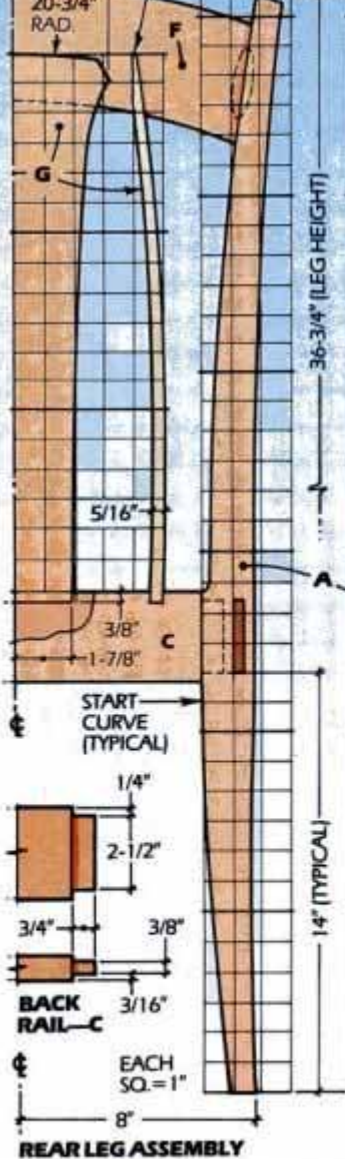
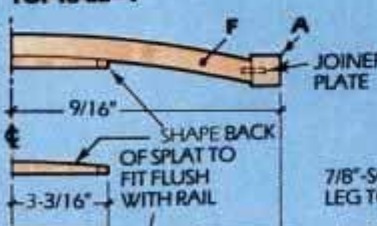
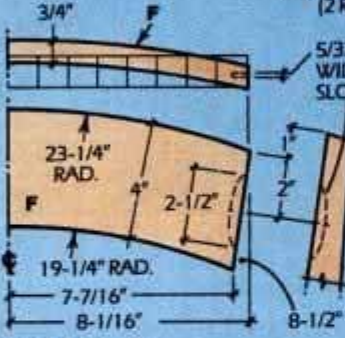
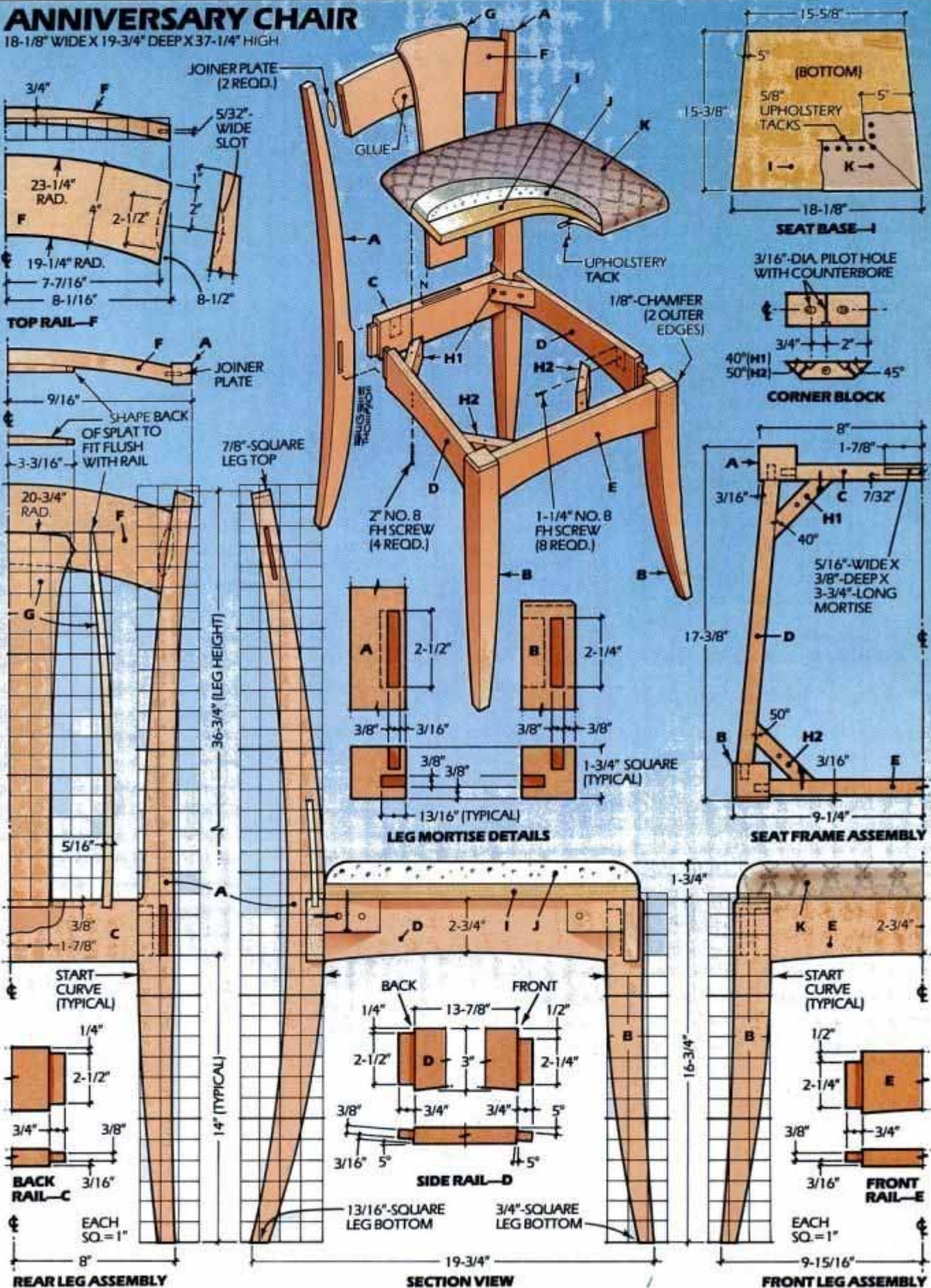
Rip and crosscut the blanks for the side rails. Lay out the angled tenons on these rails using a mortise marking gauge, a sliding bevel gauge and a square.

### MATERIALS LIST—ANNIVERSARY CHAIR

Key	No.	Size and description (use)		
A	2	2 1/4 x 3 1/2 x 38" maple (rear leg)	H2	2 3/4 x 1 1/2 x 4" maple (corner block)
B	2	2 1/4 x 2 1/4 x 16 3/4" maple (front leg)	I	1 3/4 x 15 1/2 x 18 1/2" plywood (seat base)
C	1	3/4 x 3 x 14" maple (back rail)	J	1 1 x 15 1/2 x 18 1/2" foam (seat pad)
D	2	3/4 x 3 x 15 1/2" maple (side rail)	K	1 As required fabric (seat cover)
E	1	3/4 x 3 x 16 1/2" maple (front rail)	Misc:	No. 20 Joining plates (biscuits); 5/8" upholstery tacks; four 2" No. 8 fh screws; eight 1 1/4" No. 8 fh screws, sandpaper, glue, steel wool, Waterlox Transparent Finish, hardboard or thin plywood for templates.
F	1	1 1/2 x 6 x 16" maple (top rail)		
G	1	1 1/2 x 6 1/2 x 20" maple (splat)		
H1	2	3/4 x 1 1/2 x 4" maple (corner block)		

# ANNIVERSARY CHAIR

18-1/8" WIDE X 19-3/4" DEEP X 37-1/4" HIGH



For maximum accuracy, mark the tenons with a sharp knife and run a pencil along the knife lines so you can see them better.

Clamp a rail to a bench hook on the workbench, and saw the angled tenon's shoulders using a dovetail saw or a back saw (Photo 9).

Next, clamp the rail upright in the bench vise and make the tenon cheek cuts (Photo 10). It's best to split the line on the waste side and then pare the tenon to fit with a sharp chisel. Next, cut the remaining shoulders at the top and bottom edges using the dovetail saw.

Lay out the curve on the bottom edge of the front and side rails, and cut the curve on the band saw. Smooth the cuts with a spokeshave.

Dry assemble the rails to the legs to test fit all joints. Pare the tenons if a joint is too tight. If a joint is too loose, glue a veneer shim to the tenon cheek and refit it.

Rip the top rail blank to dimension, but crosscut it slightly oversize. Use the miter gauge on the table saw to trim the piece to length with the  $8\frac{1}{2}^\circ$  angle at each end.

Lay out the curve on the top edge of the back top rail and cut it to shape on a band saw, staying to the waste side of the line (Photo 11).

Proceed slowly as you make the cut because the blade will wander in such a deep cut if you push the workpiece quickly. Also, to avoid having your fingers too near the blade at the end of the cut, push the workpiece through with a stick.

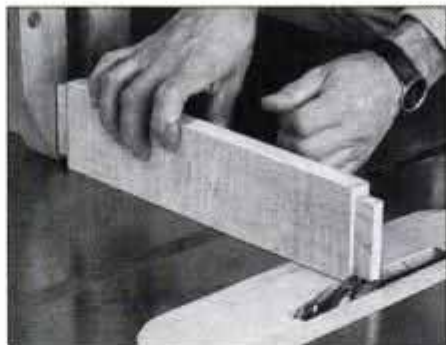
Clamp the rail to the workbench and smooth the curve using a block plane, spokeshave and a cabinet scraper.

Set a pencil compass to  $\frac{3}{4}$  in. wide and mark a line parallel to the curved rear surface along the blank's top edge (Photo 12). Using a pencil compass to copy the curve ensures that both sides will be even. Next, mark the location of the joining plate slot on both ends of the rail.

Turn the rail's flat face (its front) down on the bench, and cut the slot for the joining plate that holds the rail to the rear legs (Photo 13).

While you have the plate joiner set up, mark the corresponding location of the joining plate in each rear leg. Firmly clamp each leg to the workbench and cut these slots (Photo 14). Shim under the plate joiner to locate the slot at the correct angle. We used a piece of sheetmetal, but any thin material will work just as well.

Finish shaping the top rail by cut-



**7** Use dado blade on table saw to cut tenons on the front and rear rails. A clamp on miter gauge extension acts as a stop.



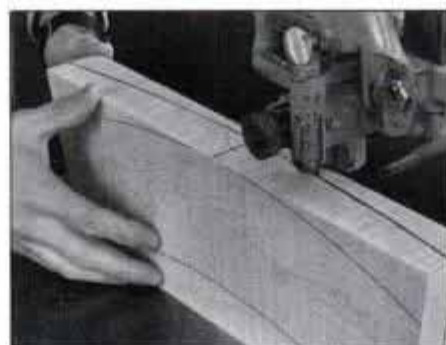
**8** Cut the mortise in the rear rail with a plunge router. To support the router's base, clamp a block next to the rail.



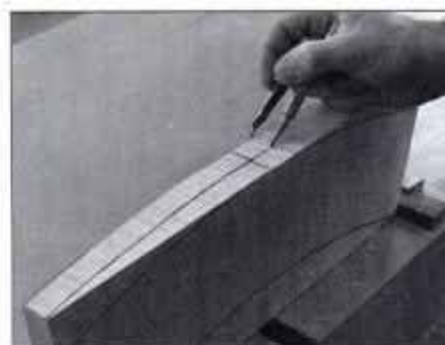
**9** Cut the angled tenons on the side rails with dovetail or back saw. To cut the shoulders, clamp the rail in a bench hook.



**10** To cut the tenon cheeks, hold the rail upright in a vise and saw just to the waste side of the line. Clean up with chisel.



**11** Lay out the profiles on the top rail blank. Saw the curve on the back surface, but leave the front surface flat.



**12** Copy the curve from the rail's back to the front edge using a pencil compass. This ensures an even curve.



**13** Lay the flat face (the front) of the top rail on the bench, and cut the slot for the joining plate that joins rail with legs.



**14** Cut the matching plate slots in the rear legs. Note that the plate joiner is shimmed with sheetmetal to the correct angle.

ting the front curve on the band saw and smoothing it to shape using a spokeshave and a scraper.

Rip and crosscut the blank for the

splat. Lay out and cut the front profile first, and then lay out the side profile on the splat's edge and cut it to shape. In both cases, cut to the waste side of

the line and use a plane, spokeshave and scraper to bring the workpiece to the finished dimension.

The top portion of the splat is shaped to fit against the top rail. Dry assemble the chair, insert the splat in its mortise and trace the outline of the rail on the splat's edge using a sharp pencil (Photo 15).

Shape the back of the splat using a sharp spokeshave (Photo 16). Be sure to test fit the splat against the rail as you go. Because the splat is face-glued to the rail, it's important to achieve a close fit.



**15** Saw the rail's front curve and smooth it. Dry assemble the chair and copy the curve on the back of the splat.



**16** Clamp the splat to the bench and shape the curve on its back using a spokeshave. Test fit the splat as you go.

## Assembly

Pre-sand all parts with 120-, followed by 220-, grit sandpaper. If you are careful during assembly, only a light sanding with 320-grit paper will be necessary after the chair is together.

Glue and clamp the front legs to the front rail. Prevent marring by using softwood scrap blocks under the clamp heads. Check the assembly for square by comparing diagonal measurements (Photo 17). If the diagonal measurements differ, angle the clamp and retighten it. Recheck the measurement. If the difference increases, angle the clamp the other way.

Glue and clamp the two rear legs to the lower back rail and the top back rail. Measure the cross diagonals for square. Adjust the clamps if needed.

When the glue on both subassemblies has dried, glue and clamp them together (Photo 18). It's important that this assembly be done on a flat surface, otherwise you risk imparting a twist to the chair. To check for twist, take two straight pieces of scrap that are the same width, and lay them across the side rails, then the front and back rails. The two sticks should be separated by as much distance as possible. If the assembly is twisted, it will become apparent sighting over the two sticks. Again, check cross measurements for squareness.

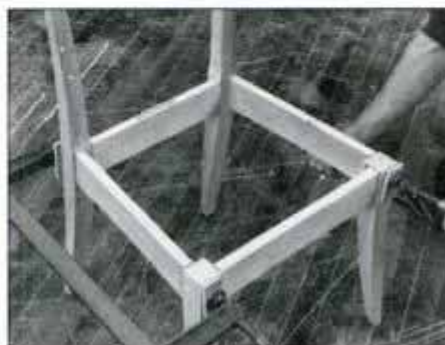
Rip and crosscut the four corner blocks to size and cut the angles on them. Note that the front and rear blocks have different angles (this is why two sets of corner blocks are in the Materials List on page 56).

Bore and counterbore the pocket holes in each corner block, then bore the hole through each block for mounting the seat. Screw the corner blocks to the rails (Photo 19).

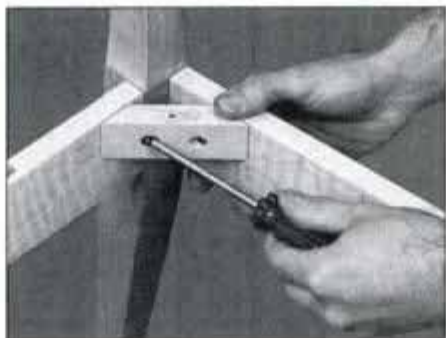
Slip the splat into its mortise without glue, then spread glue on the center 2 in. of the splat where it is clamped to the top rail. Clamp the center of the splat to the rail (Photo



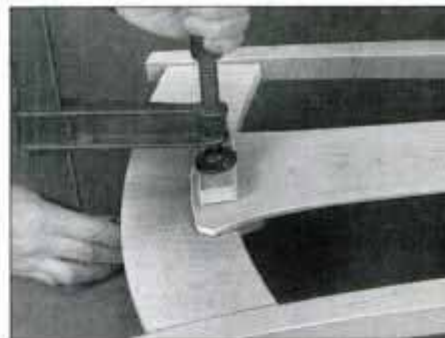
**17** Glue and clamp the front legs to the front rail. Measure the diagonals to check for square and adjust if necessary.



**18** Glue and clamp the rear legs and rail, then connect the two subassemblies that are spanned by the side rails.



**19** Screw the corner blocks to the rails. The front and rear blocks have different angles, so be sure not to mix them up.



**20** Insert the splat in its mortise, but do not glue it. Glue only the center of the splat's top and clamp it to the rail.

20). This ensures the splat and rail can move with changing humidity.

Finish sand the chair with 320-grit sandpaper, and remove dust with a tack cloth. We finished the chair with three coats of Waterlox Transparent Finish. Wipe on each coat with a rag, leaving only a damp surface, and let each coat dry overnight, then scuff sand it with 320-grit sandpaper. Remove all dust with a tack cloth and apply the next coat. Rub down the final coat when dry using 4/0 steel wool.

Rip and crosscut the base for the chair seat from 3/4-in.-thick plywood. Sand the plywood's edges to remove sharp corners and splinters. Trace the plywood's shape on the foam and cut the foam with a serrated knife or on the band saw.

Place a fabric of your choice upside down on a clean worktable, and place the foam and base over it. Trim the fabric to approximate size, leaving an extra 5 in. around the perimeter of the seat base.

Pull the fabric up and around the seat base, and use 5/8-in. upholstery tacks to fasten the fabric to the bottom of the plywood base. Work on two opposite sides at a time, keeping even tension on the fabric as you work. Frequently check the top of the seat to be sure that no wrinkles or unevenness results. When the fabric is fully tacked down, trim off the excess with a knife. Attach the seat to the chair by screwing through the corner blocks into the seat base with 2-in. No. 8 fh screws. **PM**

**NEW PRODUCTS**

**OUTDOOR LIVING GEAR**

BY ROY BERENDSOHN, Assistant Home Improvement Editor



**We Have Ignition**

Weber's new Touch-N-Go charcoal ignition system offers a unique benefit to those who like charcoal grilling—propane gas ignition. To light the barbecue, just touch the piezoelectric igniter. Switch off the igniter flame after about 5 minutes and, according to the manufacturer, the charcoal is ready to use in another 20 minutes. Other features that make the grill

worth examining include: a porcelain-on-steel kettle, a stainless-steel worksurface and a cart made from heavy-gauge steel coated with polyester urethane paint. The Performer grill shown, with Touch-N-Go ignition, costs about \$330 at Weber dealers. Contact Weber-Stephen Products Co., Consumer Service Center, 560 Hicks Rd., Palatine, IL 60067; (800) 999-3237.



**Made In The Shade**

Made of a woven polypropylene, Pro-Shade fabric delivers shade densities ranging from 50% to 85%, according to its manufacturer. The fabric is tough enough to be nailed, stapled or tied, and it resists fungus. It comes in green, black, brown and tan, and is sold in 72 in. widths at home centers. A swath 72 in. wide x 8 ft. long of 85% shade density fabric costs \$14. Write to Nicolon Corp., 3500 Parkway Ln., Suite 500, Norcross, GA 30092.



**The Force Is With You**

The Gasforce is a UL-listed combination safety valve and gas gauge. The heat-resistant device threads on to a standard propane tank valve, and the tank's regulator screws into the other side of it. According to its manufacturer, a major leak, such as that caused by a broken gas hose, will cause it to shut off the gas flow. It is machined from solid brass. It costs about \$63 postpaid from Wright Industries, 8819 Blankenship, Houston, TX 77080.



**Design And Build**

You can build patio and deck furnishings and planters with these interlocking timbers, or shoot for larger scale projects like an entire patio, a curved retaining wall or elevated flowerbed. The pressure-treated southern yellow pine timbers come in 4 x 4 and 6 x 6 sizes in 2, 4, 6 and 8 ft. lengths. They range in cost from \$3 for a 2-ft.-long 4 x 4 to \$20 for an 8-ft.-long 6 x 6. The 36-in.-long pins that join the timbers cost about \$1. A bag of four wood buttons, to cap the tops of the joints, costs about \$2. Design-Wood interlocking timbers are sold at home centers and garden centers. Write Thompson Industries, Inc., Rt. 1, Box 142, Russellville, AR 72801.

### Cooking With Gas

These steel plates replace the lava rocks in tabletop gas grills. The advantage of this, says its manufacturer, is twofold. First, it solves the problem of lava rocks that fall down inside the grill. Second, it prevents the mess associated with lava rocks spilling out of a portable grill and getting broken in the process. The manufacturer says the device saves fuel because the grill can be used on the low-flame setting. It costs about \$17 postpaid from Janco Products, Inc., 110 B Valley Oaks Dr., Visalia, CA 93291; (800) 582-6490.



### Plastic Paradise

We tried these products on our badly weathered plastic lawn furniture and found that they worked well enough to earn a mention here. The results we achieved, however, weren't as dramatic as those shown, except in one case where we rejuvenated the plastic interior trim in a pickup truck cab. FeronFinish (shown) is the new product in the company's 3-product lineup. It is a clear, wipe-on liquid

that restores the sheen to hard plastic, flexible plastic straps and metal. The company's other two products are Feronclean (a cleaner) and Ferongard (a cleaner/refinisher). All three come in 16-ounce sizes. FeronFinish costs about \$15, Feronclean and Ferongard cost about \$9. They are sold through home centers and home product catalogs. Contact Gordon Feron & Co., Newport Dr., Quail Valley, CA 92380; (800) 282-9722.



Deck shown protected with Wolman® RainCoat® with Cedar Natural Wood Toner.



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STEP 2: PROTECT & BEAUTIFY

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# HOMEOWNERS CLINIC

BY NORMAN BECKER, P.E., Contributing Editor

## Lightning Protection

My house, built on the shore of a man-made lake in Venice, Florida, was recently struck by lightning. I have been told that this is the lightning capital of the world, yet I can't seem to find lightning protection equipment or information. Can you tell me how to install this type of protection system?

MICHAEL POLINCHAK  
VENICE, FL

*I don't know about the world, but you do live in the lightning capital of the United States.*

*Although you may be handy, installing a lightning protection system is not considered a do-it-yourself project. A lightning strike can cause considerable injury and property damage if the protection system is installed improperly.*

*There are many details that you have to be familiar with to install a lightning protection system. Here's one example of how complicated this can be: Although copper air terminals are acceptable on most sections of a roof, a terminal within 2 ft. of a chimney top must be protected from corrosive flue gases by a covering of hot-dipped lead.*

*To ensure that a lightning protection system complies with nationally recognized codes and standards, the installation should be performed by a UL-listed installer.*

*For information on UL-listed in-*

*stallers, contact one of the following UL offices:*

- 333 Pfingsten Rd., Northbrook, IL 60066
- 1285 Walt Whitman Rd., Melville, NY 11747
- 1655 Scott Blvd., Santa Clara, CA 95050
- 12 Laboratory Dr., Research Triangle Park, NC 27709

## Discolored Roofing

I have light-colored shingles on the roof of my house to reflect the summer sun, and thereby reduce my air-conditioning costs. The problem is that the shingles are discolored by dirty streaks of what I believe is mold. Is this discoloring due to mold, and is there anything that can be done to eliminate it?

KARL FENRICH  
MOUNTAIN HOME, AR

*The discoloration is probably caused by mildew spores. According to the Asphalt Roofing Manufacturers Association, this is a common problem and is often mistaken for soot or dirt. Fortunately, the mildew spores do not cause the shingles to deteriorate.*

*The discoloration cannot be eliminated, but it can be lightened temporarily with bleach. Gently sponge a dilute solution of chlorine bleach on the shingles and then rinse it off with a hose. Don't scrub the shingles, or you will loosen their granules.*



Venice, Florida, and the surrounding area, is the lightning capital of the U.S., registering 100 lightning storms a year. Installing a lightning protection system, however, isn't a D-I-Y job.

## Buckled Floor

We have a moisture problem. Our 4-year-old, 2-story home is a few hundred feet away from a saltwater creek. By midsummer, condensation develops in the crawlspace under the house and drips down on the plastic vapor barrier that covers the crawlspace floor. By autumn, the dampness has caused the oak flooring in the room above it to buckle. When the heat comes on in the winter, the floor dries out and settles down, though not completely. Can you help us solve this problem?

SARAH ESCHENBURG  
BERLIN, MD

*Check that the vapor barrier on the crawlspace floor has no holes or open joints. Specifically, check the joints between the vapor barrier and the foundation walls. All open sections must be sealed with duct tape.*

*In addition, in the winter when humidity is low, install a vapor barrier (large 4-mil polyethylene sheets with taped overlapping joints) to the underside of the floor joists in the area below the room with oak flooring. Also, place a dehumidifier in the basement that can discharge condensation to the outside by means of a condensate lift pump. Disconnect the dehumidifier during the winter.*

*It's important to keep the crawlspace dry, not only for the oak flooring, but because excessive dampness promotes rot and creates conditions conducive to termite infestation.*

## Outdoor Lighting

The summer months are a perfect time to tackle an outdoor lighting project, and there's a 43-page booklet that can show you how. The pocket-size booklet is published by Intermatic, a low-voltage lighting manufacturer, but it's not simply a promotional vehicle for that company. Among the topics covered are how to lay out a low-voltage system and calculate its electrical requirements. Checklists for troubleshooting a system and maintaining it are included, as is a glossary. The book, *Light Up Your Life*, costs \$1.50 from Intermatic, Inc., Box PM, Intermatic Plaza, Spring Grove, IL 60081. **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.*



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<sup>1</sup>Dakota 4x2 Club Cab out-ran Ford & Chevy compact extended cabs 0-60, empty, w/960 lbs payload & w/5,850 lbs combined payload & trailer weight.

All trucks equipped with auto. trans. & max. avail. axle ratios. Graph not proportional to test data. <sup>2</sup>Overall total combined model scores.



# APPLIANCE CLINIC

BY STEVE TOTH,  
Contributing Editor

## Needs Timer Motor

I am having trouble finding a replacement timer motor for my Monarch electric range model No. K3GHC, serial No. 117311188. The timer motor is model No. WG-180-1 from International Register Co. I have been told that the company is no longer in existence. Is there any other source for Monarch appliance parts that might supply a new motor?

F. W. MARSO  
CUSTER, SD

After being in business for 90 years, the Malleable Iron Range Co.—also known as the Monarch Range Co.—was dissolved, and its stock and equipment liquidated through a series of auctions. Hometown Glass & Improvement, Inc., bought the national franchise for parts, and still stocks a lot of the old parts for Monarch ranges and appliances.

I suggest you contact Monarch Range Parts Division, Hometown Glass & Improvement, Inc., 1403 N. Spring St., Beaver Dam, WI 53916. There is a good chance the company has the motor.

To install the new timer motor, first disconnect power to the range. Then pull the range away from the wall and remove the sheetmetal panel that covers the top section of the range back. Next, remove the two mounting screws which hold the timer motor in place. Leave the old motor dangling by its electrical leads. Screw down the new motor and, one by one, swap the two electrical leads on the old timer motor with those on the new motor—this prevents mixing up the wires and accidentally connecting the 110-volt motor leads to nearby 220-volt terminals.

## Looking For Brown Stove Parts

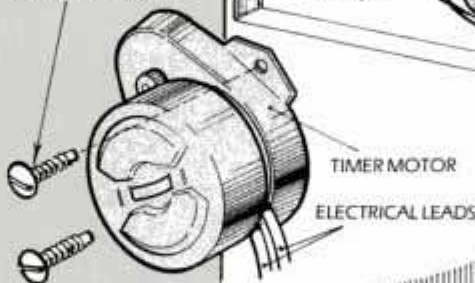
I am looking for the address of Brown Stove Co. and wondered if you could help. We have a gas stove with a double oven and may need parts sometime in the future to keep it operating right.

BARTON ALLEN  
NEW ALBANY, PA

To get parts for your stove, contact the company at Brown Stove Works,

## TIMER MOTOR REPLACEMENT

MOUNTING SCREWS



Replacing a timer motor in some old Monarch electric ranges is straightforward. The timer motor is held on with two screws and has two electrical leads.

1422 Carolina Ave., Cleveland, TN 37311; or call the company at (800) 251-7224 (Brown stove owners in Tennessee should call (800) 277-2490). When ordering parts, you will need to supply the company with the model number of the range and the type. The type is identified by the one- or 2-digit number on the model plate next to the model number.

## Old Range Needs A Gasket

I have an old Bradford electric range that needs a replacement gasket for the larger of its two ovens. It's model No. 8909 or 8907 (the last digit is partly worn), serial No. 801321. Can you furnish me with the name and address of a supplier?

ALBERT J. POGGI  
OXFORD, NY

Replacement parts for Bradford electric ranges, which were sold by the now defunct W.T. Grant Co., can be purchased from Jacoby Appliance Co., 266 State St., Hackensack, NJ 07611; (201) 489-6444.

Because the range that you own is about 30 years old, the original gasket has become obsolete and is no longer available. However, all is not lost. The company suggests you send it a small sample piece of your old gasket. Jacoby Appliance may be able to find an appropriate match for your gasket and supply a newer type that they have in stock.

## Unhinged

I have a Royal Chef gas oven model No. GDCZ3-ND, serial No. 49529. I need repair parts for the oven door hinges. I sent a letter to the manufacturer, Gray & Dudley Co. (2300 Clif-

ton Rd., Nashville, TN), but my letter was returned. ROBERT EAST  
HAWESVILLE, KY

Gray & Dudley Co. went out of business about four years ago. Napco Appliance Parts Co. (501 S. Second St., Nashville, TN 37213) bought the company's inventory of repair parts. The company has depleted much of its inventory, but still has some types of thermostats and gas valves. Unfortunately, body parts, such as door handles, panels and hinges, are unavailable. You can contact Napco by calling (800) 627-2666.

## Rusty Reflector

I have an electric Char-B-Que grill model ECB-3 that has a rusted bottom reflector/grate. I have written the company at Tinton Falls, New Jersey, but the envelope came back: "Forwarding Address Has Expired." Where can I get a replacement grate for this grill, or is there a substitute?

PHILIP J. LUNSFORD  
CARY, NC

Contempra Industries has moved to 651 New Hampshire Ave., Lakewood, NJ 08701; (908) 363-9400. The company discontinued manufacturing the electric outdoor grill about 10 years ago. No replacement parts are available.

To keep your grill in service, buy a cookie sheet about the same size as the reflector/grate, and cut it to shape with a pair of tin snips. **PM**

## 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.

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**HOME  
 IMPROVEMENT**  
**SHARPENING  
 KNIVES**

BY PAUL BARRETT  
 PM Illustrations by  
 George Retseck

● Like any cutting tool, a kitchen knife is safer and easier to use when it's sharp. That's because cutting with a dull knife requires extra force to compensate for the worn edge.

It's simple to put a good, sharp edge on a knife, though it does require a little practice, and if your knife is in bad shape, a bit of patience as well.

Perhaps the easiest knives to sharpen are those made of carbon steel. These knives hold an edge well, but they are hard to care for, since they stain quickly if they are not washed and dried immediately after each use.

Knives made of stainless steel are hardest to sharpen. It's the chromium in their steel that gives them stain resistance, but also makes them incredibly wear resistant. Hence, it is difficult to remove some of that steel in order to sharpen them. On the other hand, they are the simplest to care for because they resist rust and stains.

Knife manufacturers have come up with a steel alloy known as high-carbon stainless steel, which combines the sharpening properties of carbon steel with the stain-resistant properties of stainless steel.

Knives are ground differently, depending on their intended use. In general, a knife that will see rough service is ground so that there is more steel supporting the edge, whereas a knife used for slicing—cutting fillets, for example—may have a thinner edge with less metal behind it.



A "V" grind, commonly used on butcher knives, is relatively easy to sharpen, but offers only moderate resistance to abuse (Fig. 1).

A cannell or convex grind features a lot of metal behind the edge, so it's good for cleavers and rough service knives.

A hollow grind makes for an excellent slicing knife, because it slips easily through the material it cuts, as does a concave grind. Both the hollow and concave blades should be handled carefully because they are delicate.

**Whetstones**

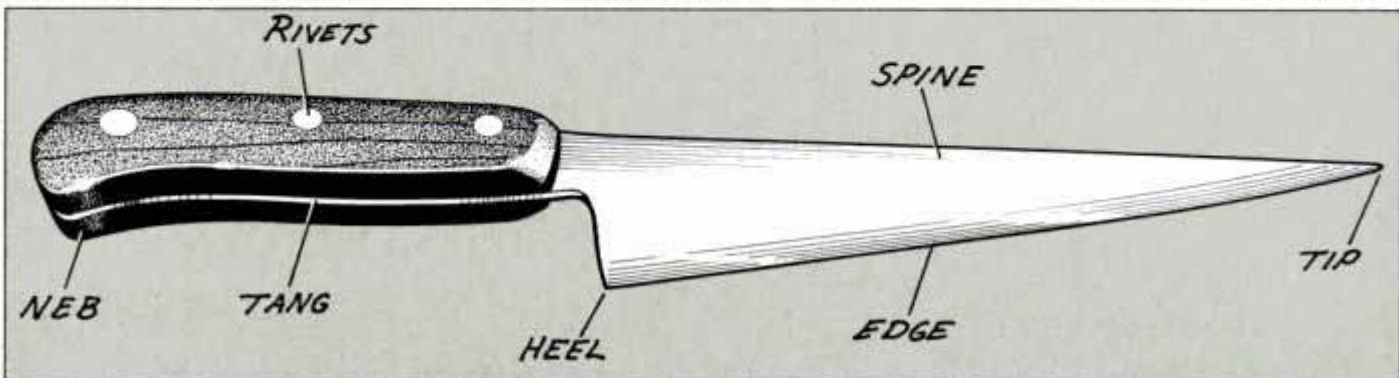
Although there is an abundance of sharpening gadgets on the market, you can easily learn to use one of the simplest, most effective sharpening tools—the whetstone. This is an abra-

sive block made from natural stone, such as Washita or Arkansas, or manufactured materials, such as ceramic, carborundum or aluminum oxide.

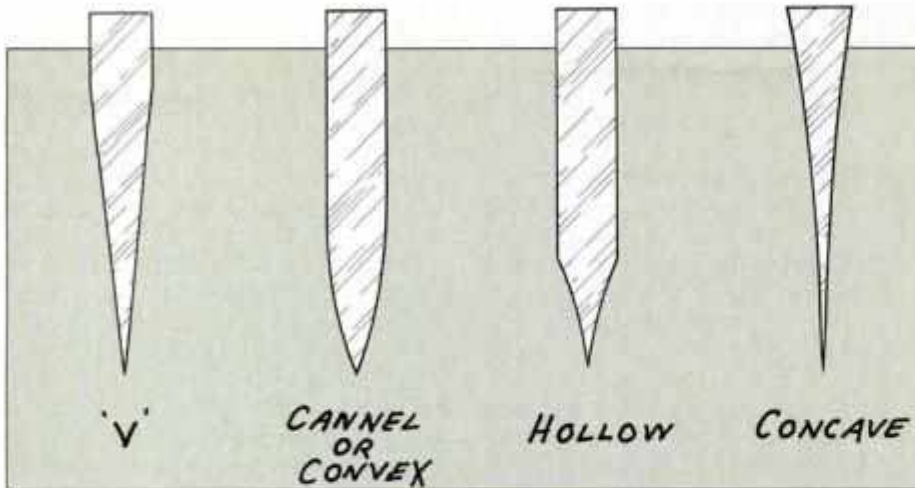
Like sandpaper, manufactured whetstones are available with abrasives of different size. The smaller the abrasive grains, the finer the stone.

Whetstones require lubrication. This carries away the particles as they are removed from the blade's surface. It also suspends the particles to keep them from getting ground into the stone's surface. Some stones work best when lubricated with oil, though they also work with water. Some stones perform properly only when lubricated with water. Use the correct lubricant, and use enough of it to keep the particles in suspension.

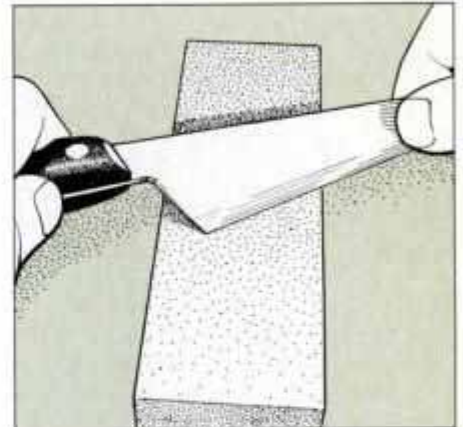
For this story, we used a Japanese



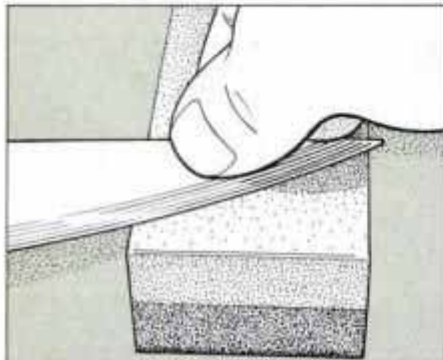
Most kitchen knives are assembled as shown. The blade and tang are one piece, and the handle is two pieces riveted to the blade.



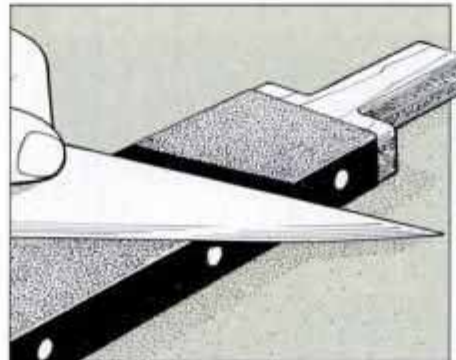
**1** There are four basic types of blade configurations. The most rugged are the two on the left, and the most delicate are the two on the right.



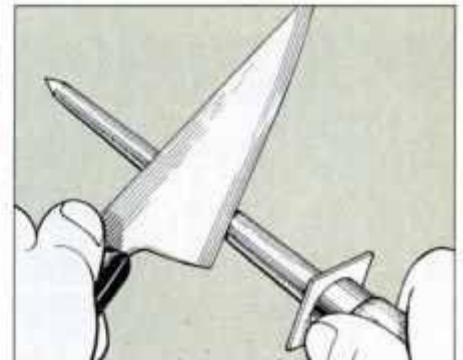
**2** Hold the knife at 15°, supporting the blade at the tip. Start on the stone's coarse side, then use the smooth side.



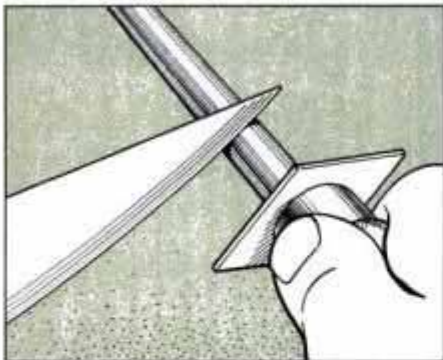
**3** Draw the blade toward you while moving the blade from heel to tip. Maintain a 15° angle during the length of the stroke.



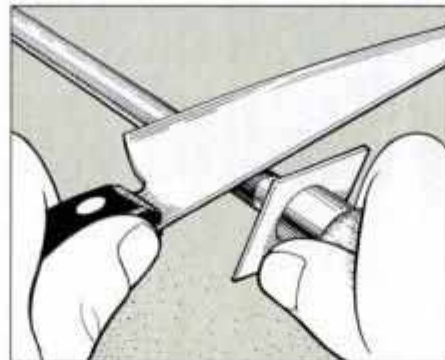
**4** You can make a "water stone" using a block of wood with wet/dry sandpaper stretched over it. Use water for lubrication.



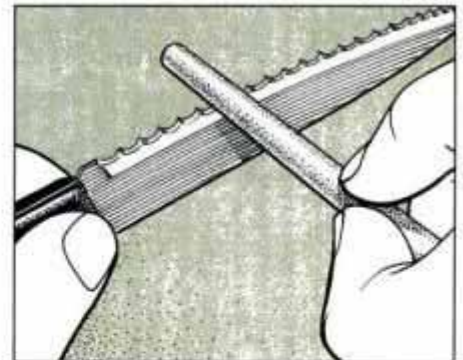
**5** Holding the blade at 15° to the steel or ceramic rod, draw it toward you. Choose a rod with a guard on the handle.



**6** Using a slicing motion, draw the blade from the heel to the tip. Apply gentle pressure—a few light strokes are all it takes.



**7** Finish the honing process by taking a few light strokes on the opposite side of the blade, stroking away from you.



**8**hone the flat side of a serrated knife on a whetstone. Next, gently hone the serrated side with a cylindrical stone.

water stone—a stone that is manufactured using very fine abrasives. These stones are convenient to use because they remove metal very quickly though they must be soaked thoroughly in water before use. Since you can lubricate them with water, they are not messy to use.

To get the knife as sharp as possible, use a stone with a coarse surface, and repeat the process on a stone with a fine surface. Generally, it's cheaper to buy a combination stone than two separate stones.

Make sure you start on the stone's

coarse side. It's easy to get the two sides confused, since they are both "smooth." Run your thumb over the two surfaces to be sure. Also, unless the blade is badly nicked, you don't want to remove a lot of metal—just enough to produce a sharp edge.

### Sharpening the blade

To begin, examine the blade under a strong light. Note any part of the blade that is nicked or badly worn. A bad nick may require too much work to remove in one sharpening. Instead, you may have to remove it over the

course of several sharpenings.

Place the stone on a firm surface, with its end facing you. Lubricate the stone with water or oil (add more lubricant as needed to cover the stone as you work).

Next, lay the heel of the blade flat on the stone, with the knife's edge toward you. Raise the spine slightly, so that the angle between the blade and the stone is about 15° (Fig. 2).

Take several passes, gently drawing the blade across the stone, moving it toward the tip as you go, so that the entire edge is sharpened (Fig. 3).

Switch the knife to the other hand, and do the other edge, again drawing the blade toward you. Wipe the blade periodically with a cloth or paper towel, and examine the edge under a light to check your progress.

It takes practice to maintain the correct angle on the stone while being able to sharpen the entire edge along the stone's length. After you do this several times, your movements will become more natural and you will be able to hone a blade in a fraction of the time needed when you first started.

If you prefer, you can make a "water stone" using a flat block of wood and a sheet of wet/dry sandpaper. Stretch the paper tightly over the board, holding it in place with thumb-

tacks (Fig. 4). Use water as your lubricant. This is also a good technique if you occasionally need a different grit than that of your stone.

#### Removing the wire edge

The waste metal from sharpening that is not ground off as particles forms a wire-like burr along the knife's edge. Barely visible to the eye, this is known, appropriately, as the wire edge. It must be removed to attain a truly sharp edge.

To do this, use a steel or ceramic honing rod, commonly available at department stores and through kitchen supply catalogs. Select a rod with a finger guard, to prevent cutting yourself during this step.

Maintain the 15° angle between the blade and the rod. Beginning at the blade's heel, draw the knife along the rod toward the handle (Figs. 5 and 6). Maintain a steady, gentle pressure as you work the blade across the rod. Flip over the blade and dress the other side (Fig. 7).

To sharpen a serrated knife, first sharpen the flat side on your stone. Then, using a ceramic rod, gently hone the hollows on the blade (Fig. 8).

Now that your knife is sharp, take extra care with it. When you are done using it, wash it by hand and store it so it won't bang against other kitchen utensils. Use your honing rod to put a fine edge on the blade before each use.

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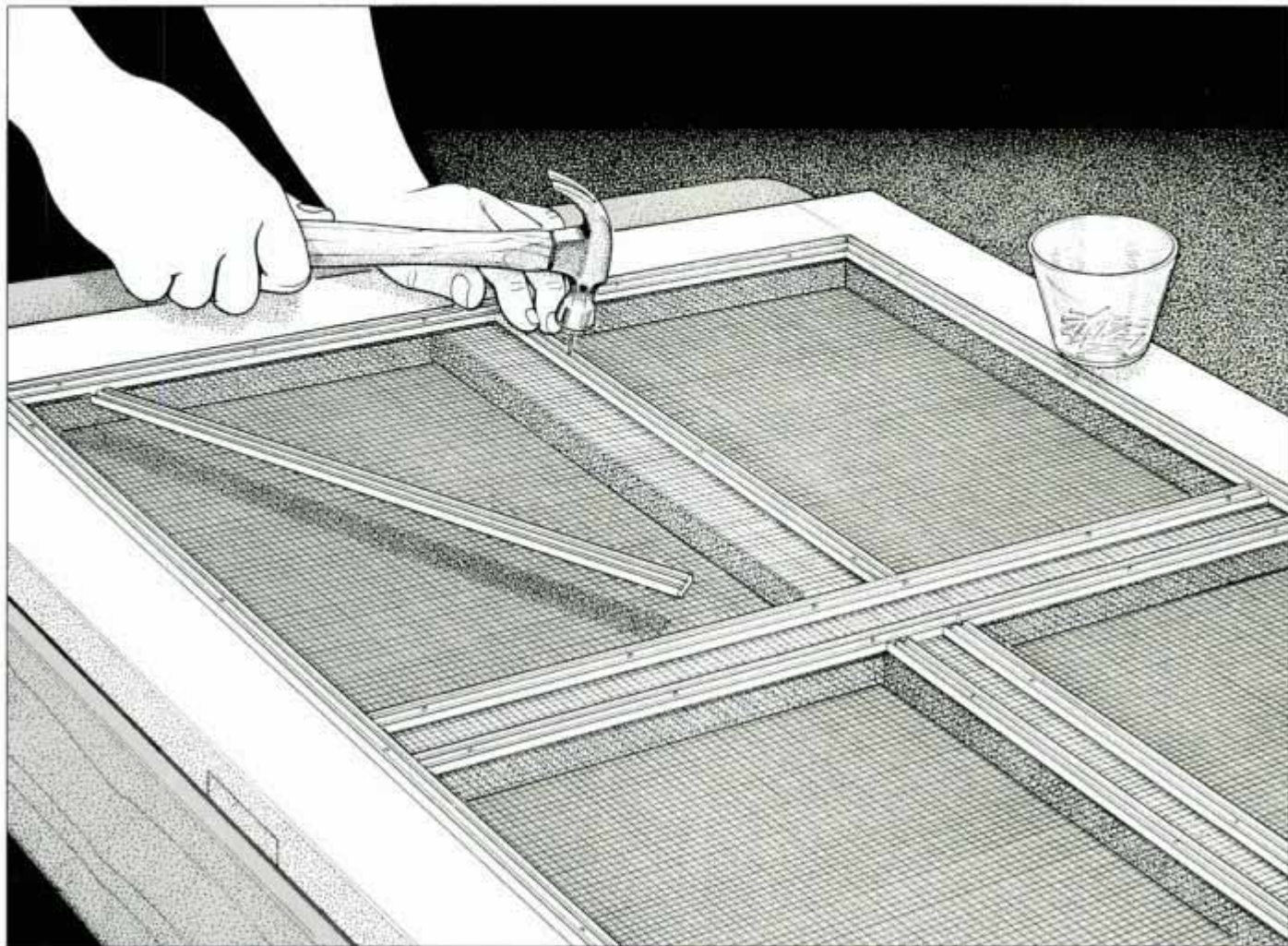
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## HOME IMPROVEMENT

# BUILDING A SCREEN DOOR

BY ROSARIO CAPOTOSTO, Contributing Editor  
 PM Illustrations by George Retseck

● The wood screen door, so popular in days gone by, has nearly been replaced by its aluminum counterpart. But the wood versions have some notable advantages over their metal brethren. Consider that you can make a wood screen door yourself, and out of relatively inexpensive materials. You can also paint a wood screen door to match your house's color scheme, and easily repaint it to keep it looking great.

Brushed aluminum doors, on the other hand, get badly oxidized with age. Only a thorough chemical cleaning can bring back their appearance. Anodized aluminum doors look good for a while, but once they become weathered, they too are difficult to rejuvenate. If you dent an aluminum door with a snow shovel, you might as

well replace the door because it's too difficult to repair it.

### Screen door construction

Our screen door is easy to build because it is designed with stock lumber. You won't have to rip any of its components out of wider material.

The materials required for this door are 5/4 pine (often used as bridging to stiffen floor joists) for the stiles and rails (usually 1 1/16 in. thick, but it can be slightly thicker or thinner) and 1 x 3 stock (3/4 in. thick) for the center rails and stile. Use square pine trim, 3/4 in. x 3/4 in., for the cleats to which the screen is stapled, and 1/8-in.-wide screen molding to trim around the screen. When shopping for wood, be sure and purchase 5/4 stock that is surfaced on all sides, not rough-sawn

stock. Also buy some water-resistant plastic resin glue, 1/4-in., 1-in. and 1 1/2-in. galvanized finish nails and metal or fiberglass screen. We'll discuss door-knobs and hinges later.

Begin by measuring the opening that the door will fit in. To arrive at the screen door's finished dimensions, subtract 3/8 in. from the opening's width and height.

The screen door's handle (or knob) should be centered on the stile across from the inner rail. Remember, when you position the door's center rail, allow enough room for the screen door's handle to clear the knob on the door behind it. Measure the exterior door first, then lay out the door components (Fig. 1).

Next, make a crosscut guide for your circular saw. This simple T-shaped guide is made by joining two pieces of 1/2-in. plywood scrap at 90°. Run the saw's shoe against the top of the T to cut off the guide's excess stock (Fig. 2).

Cut the stiles to the full height of the door, and the rails to the full width. You can tape several pieces together and crosscut them at one time (Fig.

3). After the pieces are cut out, code them to prevent confusion during assembly and while cutting the half lap joints (Fig. 4).

Mark the half lap joints accordingly. There are two different half lap thicknesses used in this door ( $1\frac{7}{32}$  in. on  $5/4$  stock and  $3/4$  in. on  $3/4$  stock). To adjust blade depth, mark a piece of scrap and hold the saw against it (Fig. 5). The scrap block should be large enough to span the cutout in the saw's shoe.

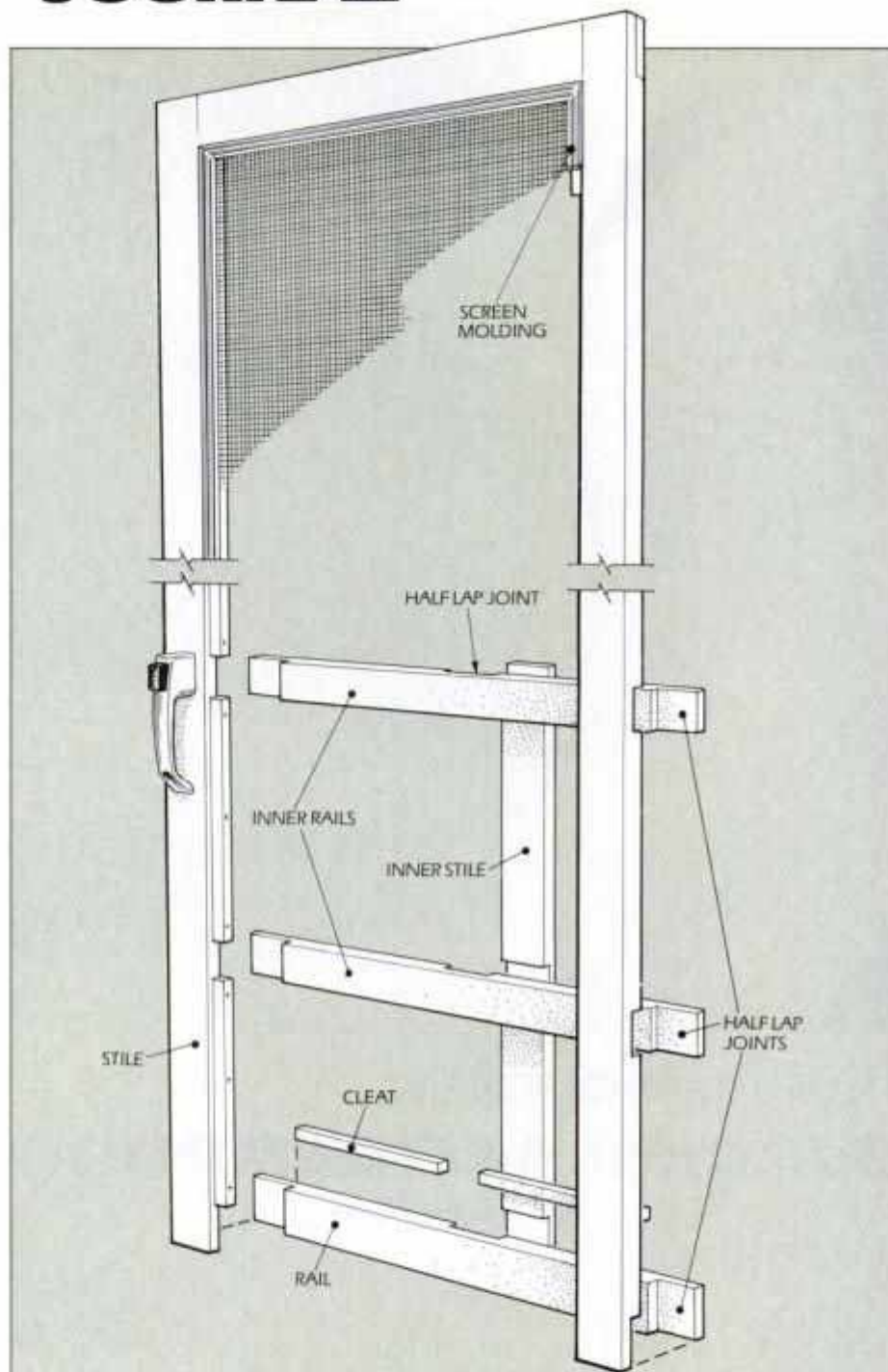
To provide a stable base for the saw while cutting these joints, screw two pieces of 8-in.-long stock along the top of the T (Fig. 6). The pieces should be separated by a distance slightly wider than the width of the stile or rail being cut.

Make some test joints out of scrap, and when you are satisfied with the fit of the pieces, make the half lap cuts on the stiles and rails. Make the shoulder cut (or cuts) first, then make a series of cuts spaced about  $1/8$  in. apart.

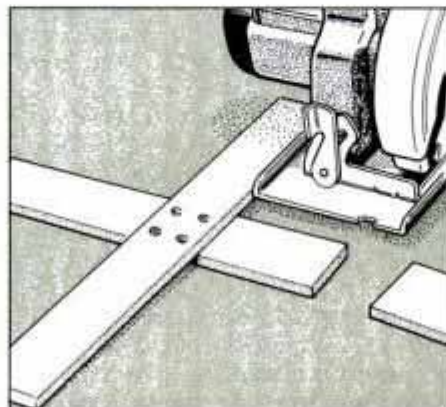
Use a sharp chisel to pare off the waste between the kerfs (Fig. 7). Finish paring the joints smooth with the chisel's bevel face up. Dry assemble the rails and stiles to check their fit, then mix up a cup of plastic resin glue to the proportions specified on the container.

## Assembly

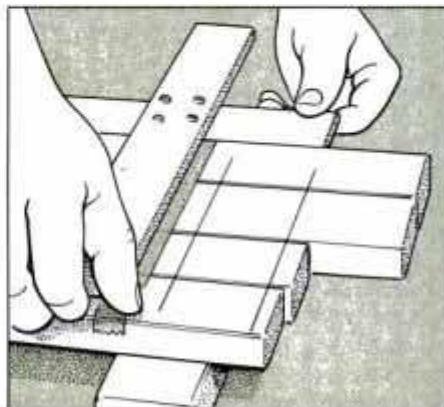
Spread some glue on each side of a half lap joint using a small paintbrush (Fig. 8). Drive two 1-in. brads into each corner joint to keep the parts in position while clamp pressure is applied. If you are fussy, drive the brads on the inside door face and set their heads. You can fill the dimples over the nailheads before you paint. The inner stile is clamped on last, and remember to use blocks of wood under the clamp heads to prevent marring (Fig. 9). Use a framing square to



**1** The screen doorknob must clear the knob on the entry door. Measure first, then lay out the screen door accordingly.



**2** Make a crosscut guide by screwing together some scrap at  $90^\circ$ . Leave the bottom leg overlong, then cut it to length.



**3** Tape together several pieces of stock for crosscutting. Hold the workpieces above the bench using a scrap block.



check the assembly for square (or measure the diagonals). If the rectangle is out of square, loosen the clamps and, with the aid of an assistant, apply diagonal pressure as required to square the frame.

When the glue has set, crosscut the cleats and fasten them with 1½-in. finish nails and glue (Fig. 10).

Scrape off any glue squeeze-out, lightly sand the door and spread on a coat of exterior alkyd primer. Paint both sides and all edges. When the

primer has dried, apply a coat or two of exterior satin or enamel. You can use either an oil-based exterior paint or a latex—the choice is yours.

Cut the screen about ½ in. narrower than the inside width from stile to stile, and 6 in. longer than the frame's interior length. If you use metal screen, cut it with a pair of tin snips (Fig. 11), but if you use fiberglass screen, you can use scissors.

Place a length of 2 × 3 scrap under the top and bottom rails, and clamp

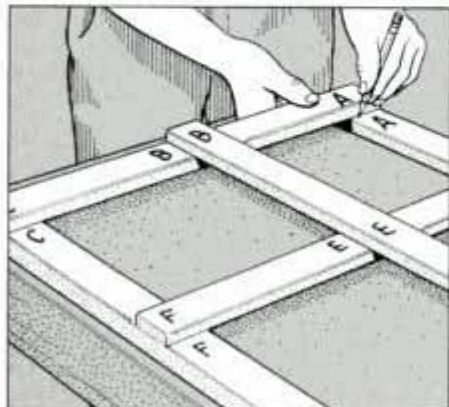
down the door's center. This bows the door to ensure the screen will be taut. Staple the screen to the cleats with 5/16-in. staples spaced about ½ in. apart (Fig. 12).

Next, with a sharp utility knife, trim off the excess screen (Fig. 13). Remove the clamps and blocks, and attach the screen along the sides.

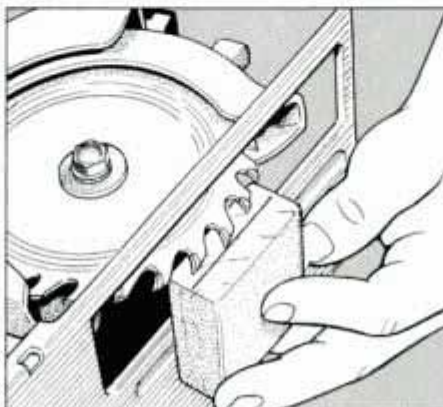
Crosscut the pieces of screen molding, and use a block plane to chamfer the bottom corner of each piece where it will meet the screen (Fig. 14). This permits you to snug an edge guard between the trim and screen while painting.

The molding is mitered at the four corners and butted at the center rails and stile. An easy way to miter the molding at the corners without using a miter box is as follows: Nail the molding in position with each end overlapping an inch or two. Insert a strip of cardboard to protect the screen and the door (Fig. 15). Then, use a fine-tooth dovetail saw to cut the miter through the strips (Fig. 16).

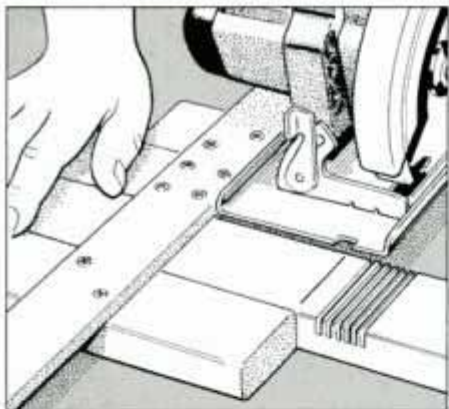
Use an edge guard when painting the screen molding. Hold the guard at about a 45° angle and apply the paint sparingly (Fig. 17). Wipe the edge



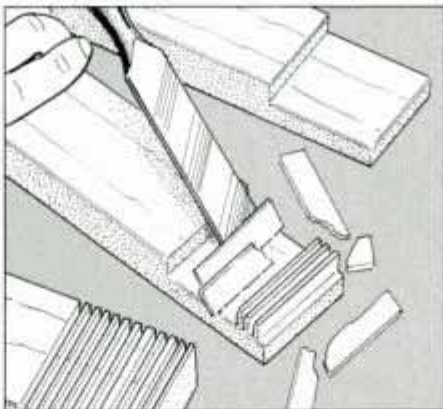
**4** Code the parts after they are cut to length. This prevents mixups while cutting joints and during assembly.



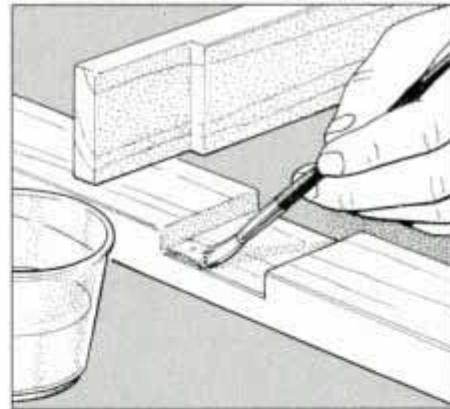
**5** Set the saw blade depth for cutting half lap joints. Mark the depth (half the stock thickness) on a scrap block.



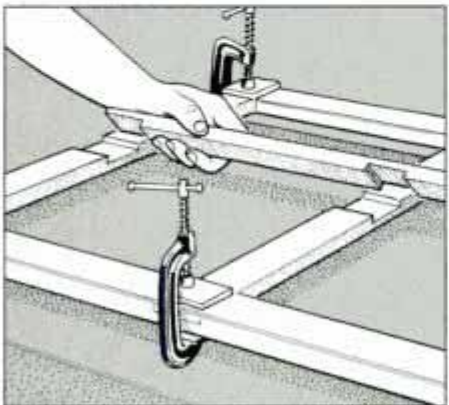
**6** Fasten two pieces of scrap to the crosscut guide. Scrap pieces support the circular saw while making multiple cuts.



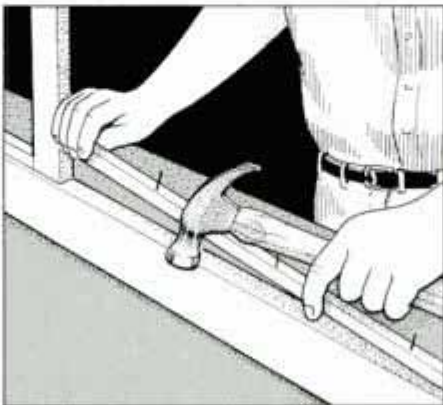
**7** Remove waste between the kerfs with a chisel. Pare the half laps smooth with the chisel's bevel facing up.



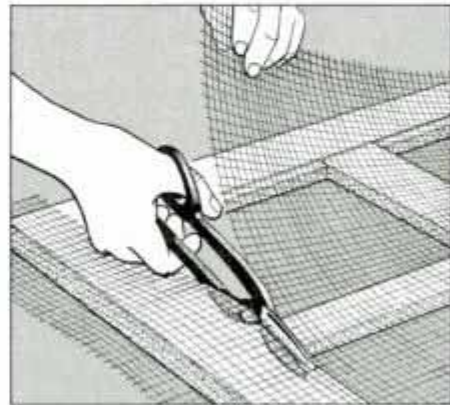
**8** Spread water-resistant plastic resin glue on both mating surfaces of a half lap joint using a small paintbrush.



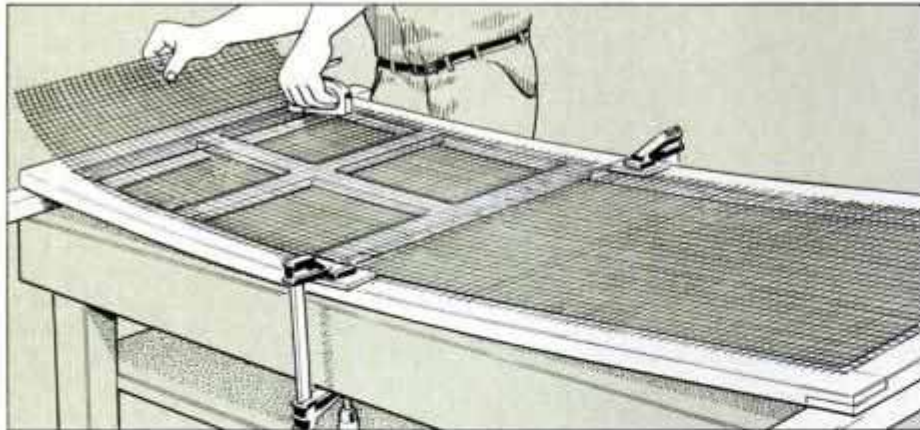
**9** Clamp the frame together with the center stile going on last. Use scrap blocks below the clamps to prevent marring.



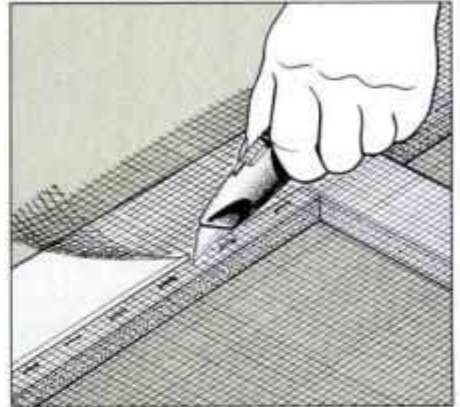
**10** Crosscut the ¾ × ¾-in. pine cleats. Glue and nail the cleats to the stiles and rails. The screen is stapled to the cleats.



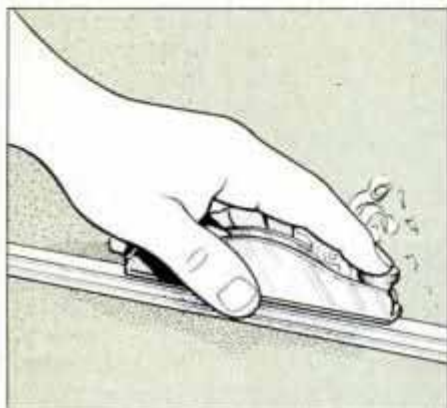
**11** Cut the metal screen to size with tin snips. If you use fiberglass screen, you can use scissors instead.



**12** To ensure a tightly fitting screen, clamp center of door to the bench, bend door ends up and support ends with scrap. Then, staple the screen to the cleats with  $\frac{5}{16}$ -in. staples.



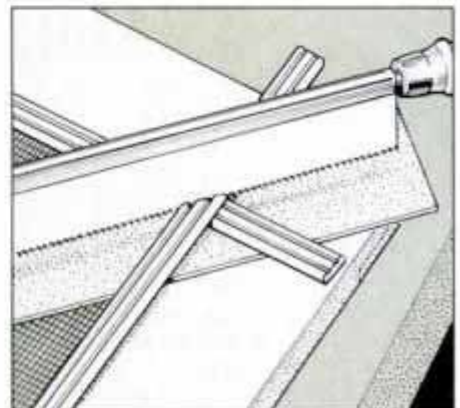
**13** Cut off excess screen at door ends using a utility knife. Note that the staples are spaced about  $\frac{1}{2}$  in. apart.



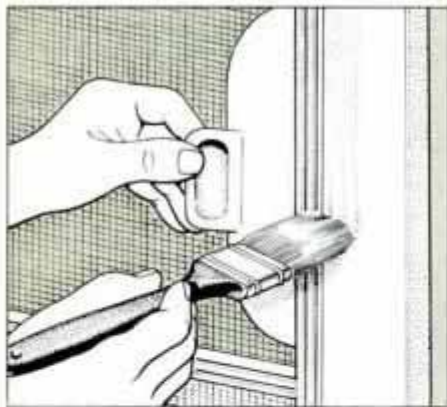
**14** Plane a small chamfer on the screen molding. Later, you can butt an edge guard to the chamfer while painting the molding.



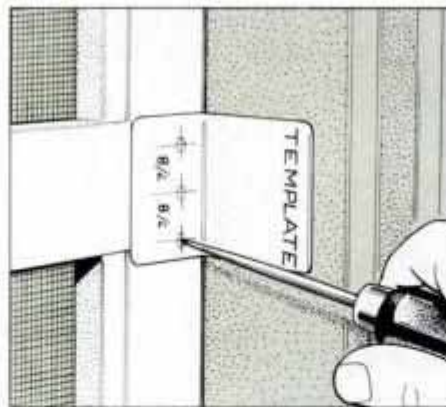
**15** Nail screen molding in place, but leave it overlong at the corners. Place cardboard under molding as shown.



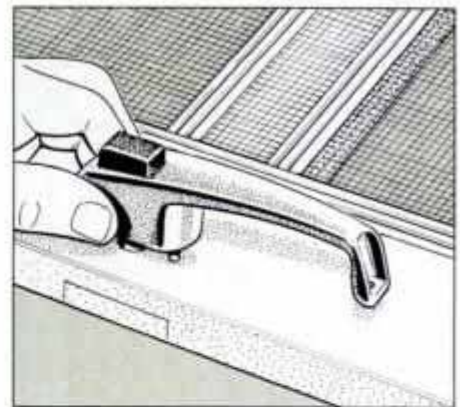
**16** Use a fine-tooth dovetail saw to cut the miter. Cardboard placed under molding protects the screen and the door.



**17** Butt the edge guard to the chamfer on the screen molding. As you paint, hold edge guard at an angle away from screen.



**18** Use a template to mark hole location for a pushbutton door handle. Template comes with handle hardware.



**19** Fasten handle to outside of door. The thumb-latch attaches to inside, and the bar catch fastens to the doorjamb.

guard clean after every section of molding is painted.

A variety of hardware is available for screen doors. We used a pushbutton door handle, because it is inexpensive and fast to install. To mark the position of the machine screws that hold the inner and outer parts together, you stand the door in the opening with a paper template in place between the edge of the door and the doorjamb. Next, you poke through the template with a sharp awl (Fig.

18). Bore on the marks with a  $\frac{1}{4}$ -in.-dia. drill bit.

Next, fit the pushbutton handle into the holes (Fig. 19). Attach the thumb-latch on the opposite side (to the pushbutton handle) with the machine screws provided. Mark the position of the bar catch on the doorjamb, bore holes for the screws that fasten it and screw it in place.

Mount the hinges of your choice. We used spring-loaded door closing hinges that are screwed to the outside

of the screen door and to the door casing that surrounds the exterior door. We paired these up with a simple chain doorstop. If you prefer a more finished look (if the screen door is at the house's front) you can also use butt hinges. These require more work, however, since you must cut hinge mortises on the edge of the door's stile and in the doorjamb. For the ultimate in luxury, you can install an adjustable door-closer mechanism with a hold-open feature. **PM**

SPECIAL SECTION

**25<sup>TH</sup>**  
**ANNIVERSARY**

# CAMARO

## AMERICA'S HOTTEST PONYCAR

- 25 Years And Three Generations Of Camaro Muscle
- Special Editions
- Camaros In Competition
- 1992 Z28 Heritage Edition Road Test
- Spy Shots Of The '94



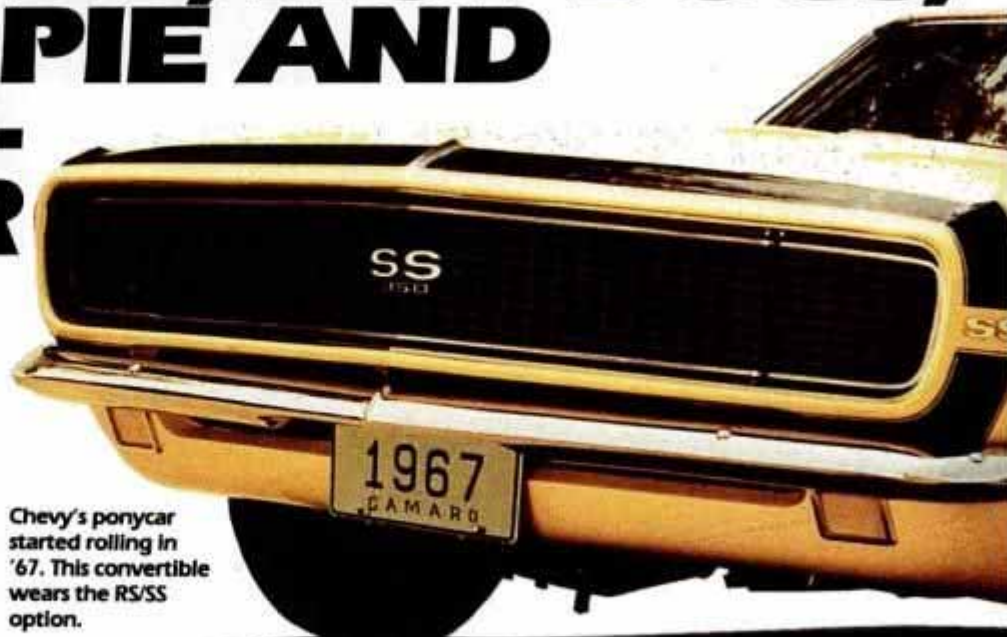
# BASEBALL, HOT DOGS, APPLE PIE AND HORSE-POWER

Celebrating 25 years of Chevrolet's Camaro.

BY CLIFF GROMER

● "Camaro? What's a Camaro?" That's what the press was asking when the new Chevrolet F-body car debuted in 1967. "Camaro" has since become a household word synonymous with sporty and performance.

But 25 years ago, the name sounded strange and unfamiliar. While the word Camaro was actually derived from the French word for comrade or pal, one Chevrolet executive could not resist having a little fun with the name at a press introduction. "Camaro?" he quipped. "It's a little ani-



Chevy's ponycar started rolling in '67. This convertible wears the RS/SS option.

front subframe arrangement, basic front and rear suspensions and axles. The base 6-cylinder Camaro played in the

econo-grocery-getter league, and netted players up to 19 mpg. But more serious versions of the Camaro could be brewed by checking off the right combination of the 81 factory options that were available. If that wasn't enough to build a Camaro to your liking, there were 41 more dealer-installed accessories just a checkmark away. The RPO designation (for regular production option) indicated a factory, as opposed to a dealer, option.

Chevrolet simplified—or confused—things a bit by packaging several options under one code. So the '67 RPO Z27 Super Sport option package included heavy-duty suspension, bumblebee hood stripe, D70-14 Firestone Wide Oval redline tires on 6-in. rims, raised



PHOTO BY CLIFF GROMER

Editor Joe Oldham's own '69 RS convertible is used on a regular basis.

mal that eats Mustangs."

It's no secret that if it weren't for the Ford Mustang, there would probably be no Chevy Camaro. Since 1964, General Motors had watched the Mustang carve out sales that reached 100,000 a year. The Chevy Corvair, with its rear-mounted, air-cooled engine, was more Volkswagen-like than a muscular Mustang and just was not up to the task.

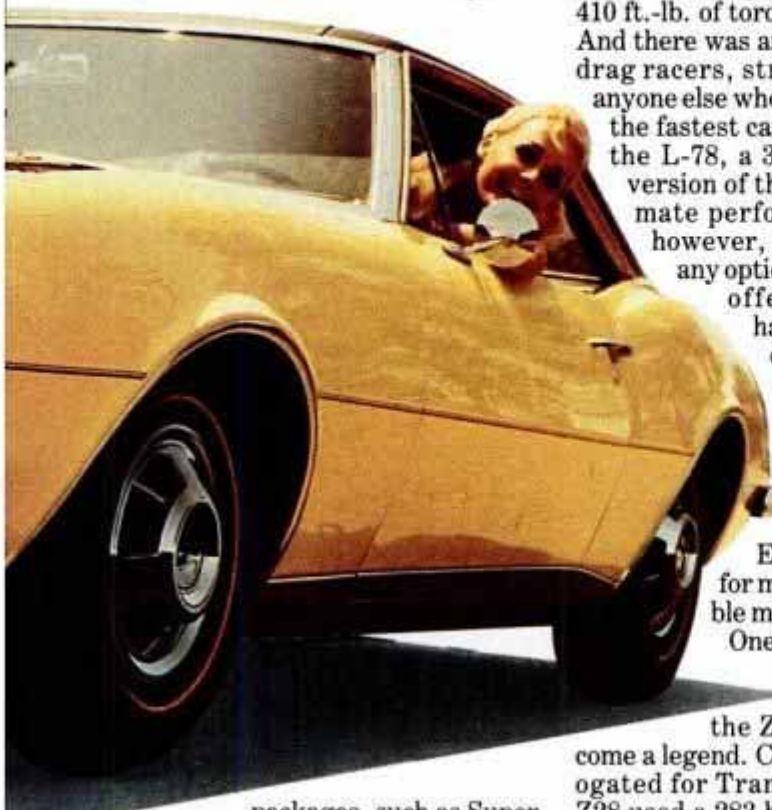
It would take a new car, with the engine up front, to give Ford's pony a gallop for its money.

The Camaro debuted as a totally new model, but it was developed along with the 1968 Chevy II economy sedan. So the two cars shared some of the same body and chassis components, including cowl, floor pan,



1972 was the last year for big blocks, and almost for the Camaro itself.

hood with finned inserts, underhood insulation, and special Super Sport badges and emblems. You could even combine various option



outdone by the blue oval boys, Chevy went to the parts bin and lifted out its L-35 396 big block rated at 325 hp at 4800 rpm and 410 ft.-lb. of torque at 3200 rpm. And there was an extra treat for drag racers, street racers and anyone else who wanted to have the fastest car on the block—the L-78, a 375-horsepower version of the 396. The ultimate performance setup, however, wasn't listed on any option sheet and was offered only by a handful of Chevy

dealers. They created a veritable rocketship by swapping a 427 Corvette engine in between the Camaro's frame rails. (See "Special Editions" on page 84 for more on these incredible machines.)

One special option package, released as a separate model—the Z28—went on to become a legend. Conceived and homologated for Trans-Am racing, the Z28 used a 283 block with the 327 crankshaft for a displacement of 302 cu. in. Goodies included big port heads, tuned runner aluminum intake manifold and 780-cfm Holley carburetor. The package was good for 290 horses on paper, but close to 390 in the real world. Only 602 Z28s were sold that first year.

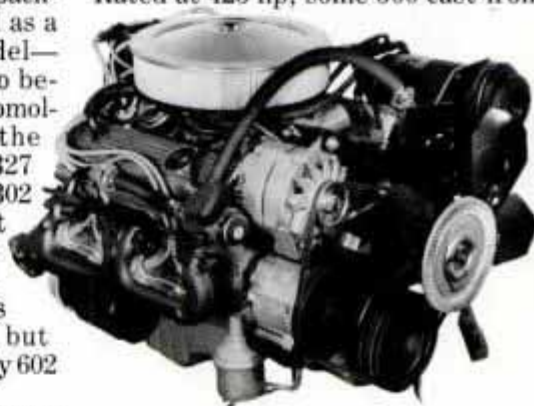
The last and most popular of the first-generation Camaros were the 1969 models. Buyers could choose from the largest engine lineup in the history of the marque, with no less than 13 different powerplants scrolled out on the order form. Two Sixes occupied the bottom of the heap, followed by the Z28's 302 V8. The previous base 210-hp 327 V8 was moved up one notch to make room for a new 200-horse 307. Two 350s follow-



1967 interiors came in base and custom levels of interior trim. The latter used molded door panels.

ed with 250 and 300 horsepower respectively, and then came the four big-block 396s, with outputs of 325, 350 and two with 375 ponies.

But there were two very special engines that made it into the Camaro in 1969 only, marking the peak of the Camaro's monster motor phase. These were the COPO (central office production order) 427-cu.-in. big blocks. Rated at 425 hp, some 500 cast-iron



The hottest engine in '74 was the 245-horsepower 350 that came in the Z28.

versions of this awesome combination were built, and there were only 69 of what are considered the rarest and most valuable Camaros ever sold—the all-aluminum ZL-1s. These big blocks, dropped mostly into base stripper models, boosted the Camaro's price tag to more than \$8500—a lot of crispy cash back in '69. In ret-

packages, such as Super Sport with Rally Sport—an option group that included headlights hidden in the grille.

Smooth, sleek styling with the classic long hood/short deck ponycar look was a strong feature for the first-generation (1967-'69) Camaro, but performance fans immediately checked out the engine offerings on Chevy's new fun machine, and they weren't disappointed. The base V8 listed was a 210-horse 327. More interesting was the new, Camaro-exclusive L48 350 cubic-incher that pumped out 295 ponies at 4800 rpm. This should have been enough oomph to satisfy any sane individual except for one thing—Mustang was prancing around with a 390 V8 engine that was good for as much as 335 horsepower. Not to be



The Berlinetta ('81 model year shown here) was an upscale Camaro that was derived from a Chevy show car.

respect, it was money well spent, as today's collectors are paying up to \$150,000 for good original and restored documented examples.

A couple of other interesting options offered in '69 were the ZL-2 factory fresh-air induction package, which used a special raised hood with rear-facing cold-air intake, and 4-wheel disc brakes, the latter being the binders of choice by Trans-Am racers.

The second-generation Camaros ('70½-'81) were marked by a radical restyling treatment. Basic proportions were the same, but the new models—available only as coupes—showed off a lower profile, fastback roofline, high front fenders and no rear quarter windows. A new Endura split bumper grille debuted on the RS model.

The engine lineup was reduced to seven. The hot Corvette 350 LT-1, conservatively rated at 360 hp, was



Most popular of the Camaro big blocks was the 325-horsepower version of the 396.

made available for the Z28, and you could still order a 300-hp version of the 396 big block, now punched out to 402 cubes. But big engines didn't mix well with fuel shortages and rising prices. Ponycars in general took a hit, and Camaro sank into a

## Firebird Is 25, Too

● Chevrolet's Camaro shares its silver anniversary with a close relative—its F-body sibling from the Pontiac Motor Division—the Firebird.

Saddled with 90% Camaro sheet-metal, Pontiac still managed to make the 'Bird distinctive. Different suspension tuning and 17 engine/transmission combinations frosted the cake.

The legendary Firebird flagship—the Trans-Am—charged into the lineup in '69 with an optional 345-horse 400-cube Ram Air engine and outstanding handling. But Pontiac really showed its mettle to performance fans in the mid-'70s—especially with its outrageous Super Duty and HO 455 Trans-Ams—when everyone else was cutting back on muscle cars. Pontiac's gamble paid off with strong sales.

In fact, Firebird sales was the factor that kept Chevy from pulling the plug on the



entire Camaro line. Starring with Burt Reynolds in the popular "Smokey And The Bandit" movies, third-generation hits like the 350 Formula and GTA and the turbocharged '89 Indy pace car have kept the Firebird a favorite with lead-foot drivers craving excitement.

—C.G.

sales slump in '72 that was so serious, GM considered killing the line entirely.

Camaro hung in there, but with some casualties. Federal safety, fuel and emissions regulations and poor sales caused the Z28 to be dropped for '75. Buyer demand and strong sales of the Pontiac Firebird Trans-Am forced Chevy to rethink the Z28 and bring it back as a '77½ model with special suspension and cosmetics. Engine options dried up so that by 1975, a low-water mark for performance, you had your choice of the base 105-hp Six and two 350

V8s—the "hot" one (LM-1) doling out a rather tepid 155 horsepower. The LM-1 picked up 10 ponies for '76, but the base V8 dropped 45 cubes to a 305 cu. in. with a 140-hp rating.

If Camaro fans could no longer buy mind-searing performance, they could at least couch their disappointment in more luxury. The Type LT joined the lineup in '73 with a 145-hp V8, power steering, complete instrument package, special upholstery and trim. In typical Camaro fashion, the LT could be combined with RS or Z28 option packages. The



1975 Rally Sport relied on color schemes and graphics to make up for what it lacked in power.

Super Sport option package, however, became history.

Berlinetta was another upscale badge to join the ranks in '79, although the "bumperless" soft front-end treatment of this original 1970 concept car made its appearance a year earlier.

Radical restyling and re-engineering top to bottom heralded the third- and current-generation Camaro. Debuting in 1982, the cars weighed in at some 500 pounds lighter than the '81



Radical restyling in '82 marks third- and current-generation Camaro.



The convertible returned in '87 after an 18-year absence.

version. On the top, the shorter body featured a glass hatch, the Z28 now sported a ground-effects package, and an all-new interior came with a fold-down rear seat. Underneath was an all-new unitized chassis, MacPherson strut front and coil rear suspension for better handling.

The new engine lineup started with a base Four, and included a Buick-built V6 for the Berlinetta and two 305 V8s—one carbureted (145 hp) and the other, the top option Cross-Fire with throttle-body fuel injection (165 hp), for the Z28.

The horsepower picture got rosier as Camaro, with the Z28 at the forefront, rolled



through the '80s and into the '90s. The L-69 305 HO engine for '83 claimed 190 horsepower. New 5-speed manual and 4-speed automatic transmissions were added. The IROC Z28 Camaro joined the

fleet in '85, and the small block was beefed up to 230 hp by 1989.

1987 marked the return of the convertible for the first time since '69. More importantly, the 225-horsepower Corvette 350 V8 (but with cast-iron heads and different exhaust manifolds) rejoined the lineup. It was available in IROC coupes only.

Chevy continued to shuffle the model mix, replacing the venerable Z28 with the IROC-Z in '88 and benching the Sport Coupe for a new V6-powered RS model. The RS offered IROC-Z show for a lot less dough.

A limited-edition Camaro, in the spirit of the old COPO cars (it had to be ordered by special written request), became available in 1989. This was the 1LE, a thinly veiled all-out race car that swept the

SCCA and International Motor Sports Association (IMSA) Showroom Stock series right out of the box. Special equipment included dual exhausts (each side with its own catalytic converter), 245/50ZR16 tires on 16-in. wheels, heavy-duty front and rear disc brakes, aluminum driveshaft, heavy-duty suspension, fuel tank baffles, special tank pickup and several delete options to reduce weight. Only 111 1LE models were sold in '89, and

another 62 were sold in '90.

Chevy's lease on the IROC name expired in '91, so they swapped it back for Z28. An interesting option, the G-92 performance axle package, gave you not only a 3.23 axle ratio with Positraction, but everything that had been included in the previously offered 1LE option package. This coupled with the L-98 350 Corvette engine option (available only in automatic Z28 coupes) gave you a romping, stomping 245-horsepower ready for action.

This year marks the end of the line for the current body style. The third generation of Camaros goes out in a blaze of glory with an optional Heritage Appearance Package to mark the car's 25th anniversary. The



Tuned-port fuel injection came on-stream in '85. The 350-cu.-in. Corvette engine became available two years later.

package includes hood and deck stripes reminiscent of the 1967-'69 Z28 pattern, body-color grille, black headlamp pockets and color-coordinated wheel treatment. The Heritage is available in red, white or black exterior colors.

Over the past 25 years, Camaro has left its indelible tire prints on the streets and racetracks of America. To its many fans, it's the heart of Chevy's heartbeat.

PM



PHOTO BY BILL STOWAN



PHOTO BY BOB MCCLUNG



# CAMAROS



PHOTO BY TAYLOR CONSTANTINE

Chevy's ponycar has thrived on motorsports competition.

● You stare at the photo of the Sunoco Blue Camaro with "Penske-Godsall" on the fender and you remember: Mark Donohue's Trans-Am Camaro. For a whole generation of enthusiasts, there was no car and driver who meant so much. If any race car is legendary, this is the one. Actually, the first Trans-Am race won by a Camaro had nothing to do with Penske or Donohue. At St. Jovite, Canada, in 1967, Dick Guldstrand won in a Camaro owned by Dana Chevrolet of Los Angeles. He

BY RICH TAYLOR, Contributing Editor

also won races at Riverside and Stardust, while Roger Penske's mechanic, Bill "Murph" Mayberry, sorted out Donohue's car. Finally, after months of trial and error, Mark Donohue won his first Trans-Am race in a Camaro at Marlboro, Maryland, then won the last two races of the 1967 season at Las Vegas, Nevada, and Kent, Washington. It was too late. Mustang had won the Championship.

In 1968, Penske's team was ready.

Its legendary Camaro won 10 of the 13 Trans-Am races, and Mark Donohue set records by winning eight in a row and starting from the pole nine times. Of course, Camaro won the Trans-Am Championship. In 1969, Penske won eight out of 12 races and the Championship again. Nobody ever won 18 out of 25 races in such a hotly contested series. No wonder we all remember those Sunoco Blue cars just like it was yesterday.

After Penske switched to AMC in 1970, Chaparral chief Jim Hall took





# ON TRACK

over the factory Camaro team using second-generation Camaros. He and teammate Ed Leslie were only marginally competitive. In 1970, Milt Minter won the Donnybrooke Trans-Am in a Camaro. Vic Elford won at Watkins Glen. Other than that, Camaros were basically shut out of Trans-Am racing for two decades.

In 1990, however, young Jack Baldwin won Rookie of the Year with his Camaro. Then in 1991, he finished second in the Championship to his teammate, Scott Sharp, who won six races and eight pole positions in his third-generation Camaro sponsored by Duracell and prepared by Buz



Camaros have done well in drag racing, just as they've dominated in road-race competition. Lee Shepherd, for example, piloted the Reher-Morrison Camaro into the top Pro Stock ranks from 1980-'84.

McCall's American Equipment team. After years of watching their favorites finish back in the pack, it was a great Trans-Am road-racing season for Camaro fans.

Trans-Am is not the only form of racing that Camaros have participated in—and excelled at. Over the years, Camaros have won nearly three dozen races in IMSA's GT classes. They also won in IMSA's Kelly American Challenge and even on the ovals in Late Model Stock series, run by ASA and other sanctioning groups.

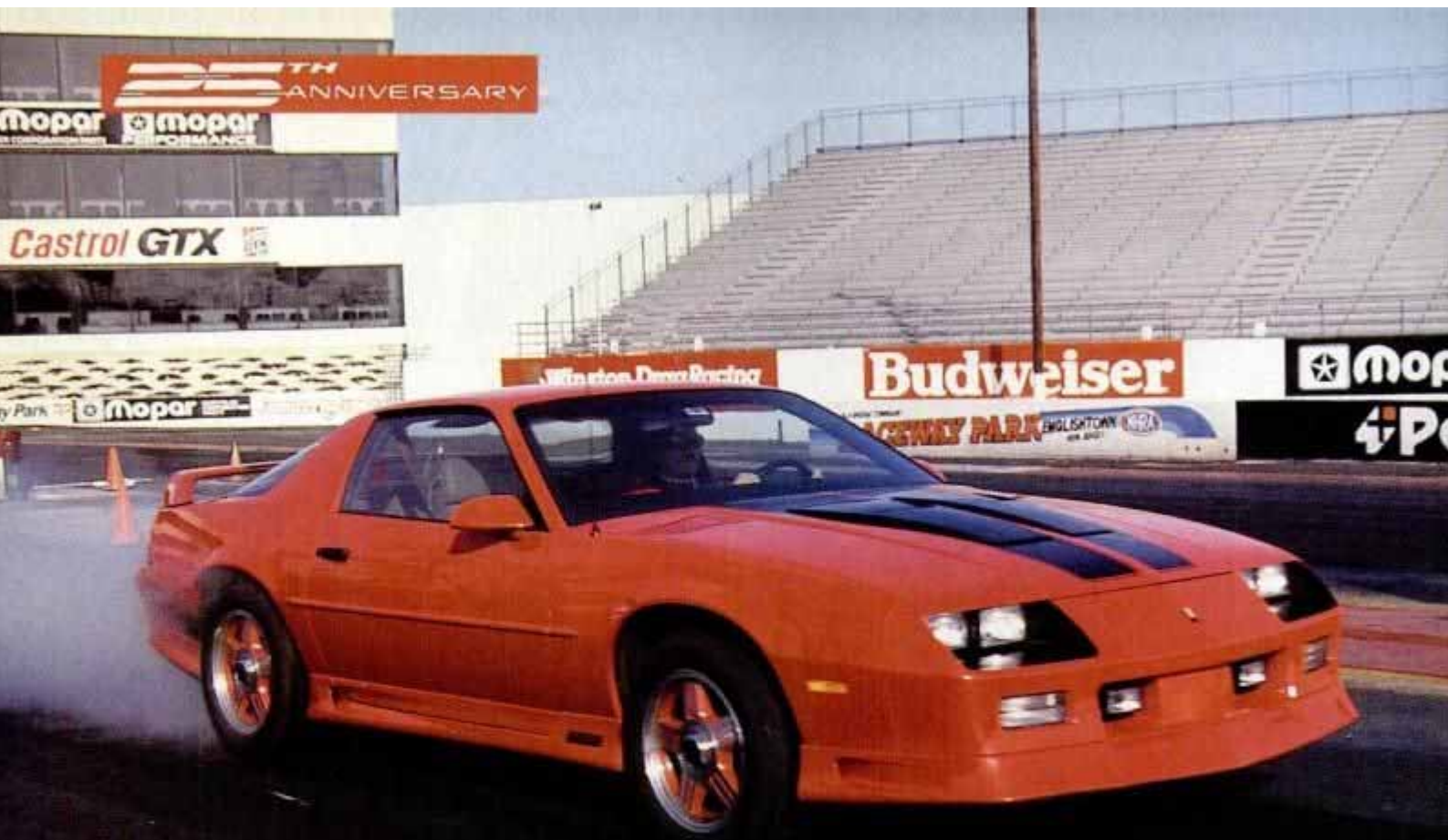
In the Firestone Firehawk series for Showroom Stock cars, Camaros won more races than any other. Eric Morrow/Nick Moore/Buddy Norton

*(Please turn to page 89)*



PHOTO BY BILLERMAN

PHOTO BY LESIE LOVETT/PHRA



# HERITAGE HURRICANE

Road testing the '92 350 Z28.

TEXT AND PHOTOS  
BY CLIFF GROMER

● Dinosaurs are very popular these days. New exhibits are opening almost daily at museums around the country, displaying the latest finds of paleontologists who are scouring every possible site for fossils and bones that tell the story of these ancient creatures, which are both terrifying and lovable.

In a way, Chevrolet's 25-year-old Camaro is a dinosaur. It's a front-engine, rear-wheel-drive car packing a big V8 engine with a cramped back seat and a tiny trunk. Compared to today's EPA mileage champs, it sucks down precious gasoline at an almost terrifying rate. In a time when the world is turning to more socially conscious 4-door sedans, the Camaro (and its sister F-car, Pontiac's Firebird) stands defiantly alone as a no-apologies muscle car—a sport coupe that can burn rubber at will, fly low on a winding mountain road and still get the attention of members of the opposite sex when you drive by.



350-cu.-in. tuned-port fuel-injected V8 engine delivers 245 horsepower and 345 ft.-lb. of torque. Cornering is flat. Instrumentation is very readable.



chassis that just flat out works. The result is a car that will amaze newcomers with its ultrahigh levels of performance.

At Raceway Park in Englishtown, New Jersey, our Camaro turned the quarter-mile in just 14.30 at 103.10 mph. There are only a few cars in the world that can run a quarter-mile quicker than that, and they all cost at least \$25,000 more than the Z28. Zero-to-60 times of less than 6 seconds adds to the mystique of a car that has earned the reputation of being the hottest ponycar you could buy throughout its history.

A dragstrip is a fun place to be when you're driving a Camaro. You can lock the front brakes and do massive smoky burnouts like a nitro-burning funny car, or you can simply punch the throttle to the floor when the light turns green and take the conservative way home. Either way, when you plant your right foot on the carpeting, your spine is compressed against the seat back, your eyelids peel back, and you're outta here.

Our test car, in its blatant red with black stripe splendor, also had a unique way of annoying everyone on the street, from Mustang owners to taxicab drivers. Just pulling up alongside seemed to trigger a silent challenge to dice to the death.

The Z28 has taken some flak over the years for its relatively old-fashioned live-axle rear suspension, but when it's time to hurry around corners, this setup still holds its own. The components have been fine-tuned

over the years, but the layout will look familiar to Camaro faithful: struts and coil springs up front, with coil springs, trailing arms, a track bar and torque arm keeping the limited-slip Salisbury axle anchored at the front, and a 21mm solid steel bar in back, with heavier bars and springs available as an option.

A 3.23:1 rear-axle ratio is part of the 350 package to make the most of the potent torque, and 245/50ZR16 tires on 16 x 8-in. alloy wheels put the power on the ground. Those sticky tires also do plenty for the Z28's ability to snake its way through tight turns. Although it's never been a lightweight, its 3319-pound curb weight has stayed about the same over the years, while many of its competitors have become even heavier.

As a result, the Z28 provides a level of adhesion and transient response that's as good as anything in its class and better than most, something the car proves annually at the Sports Car Club of America national championships. With its quick (2.14 turns lock-to-lock) and limited body roll, the Z28 attacks a slalom course with the light-hearted zeal of a Mazda Miata—provided the pavement is smooth. On chatter bumps, the Z28's aggressive spring and damping rates can't quite keep up, making it difficult to keep a selected line through the corner.

The stiff suspension also communicates small surface irregularities, like freeway expansion joints, directly to the cockpit. But if sports car handling is your priority, the Z28 delivers. **FM**

By all accounts, the Camaro should no longer exist. But it does, it's still going strong and we love it.

When we decided to put this special Camaro salute together, we knew we'd be writing a lot about older Camaros and the muscle-car versions that were hot in the '60s. As a counterpoint to that heritage, we decided to road and track test the hottest version of the Camaro that you can currently buy—sort of a state-of-the-union road test.

Chevrolet duly supplied us with a '92 350 Z28 sport coupe loaded with every performance and luxury option you can get, including the exclusive-'92 Heritage Appearance Package that commemorates the 25th anniversary of the car.

Some of you may not be aware of the fact that a Camaro 350 Z28 is absolutely one of the fastest cars you can buy—in the world. It's also one of the top-handling cars by any measure. Chevrolet engineers have had 10 years of road and race experience to develop a very sophisticated version of the small-block V8 engine and a



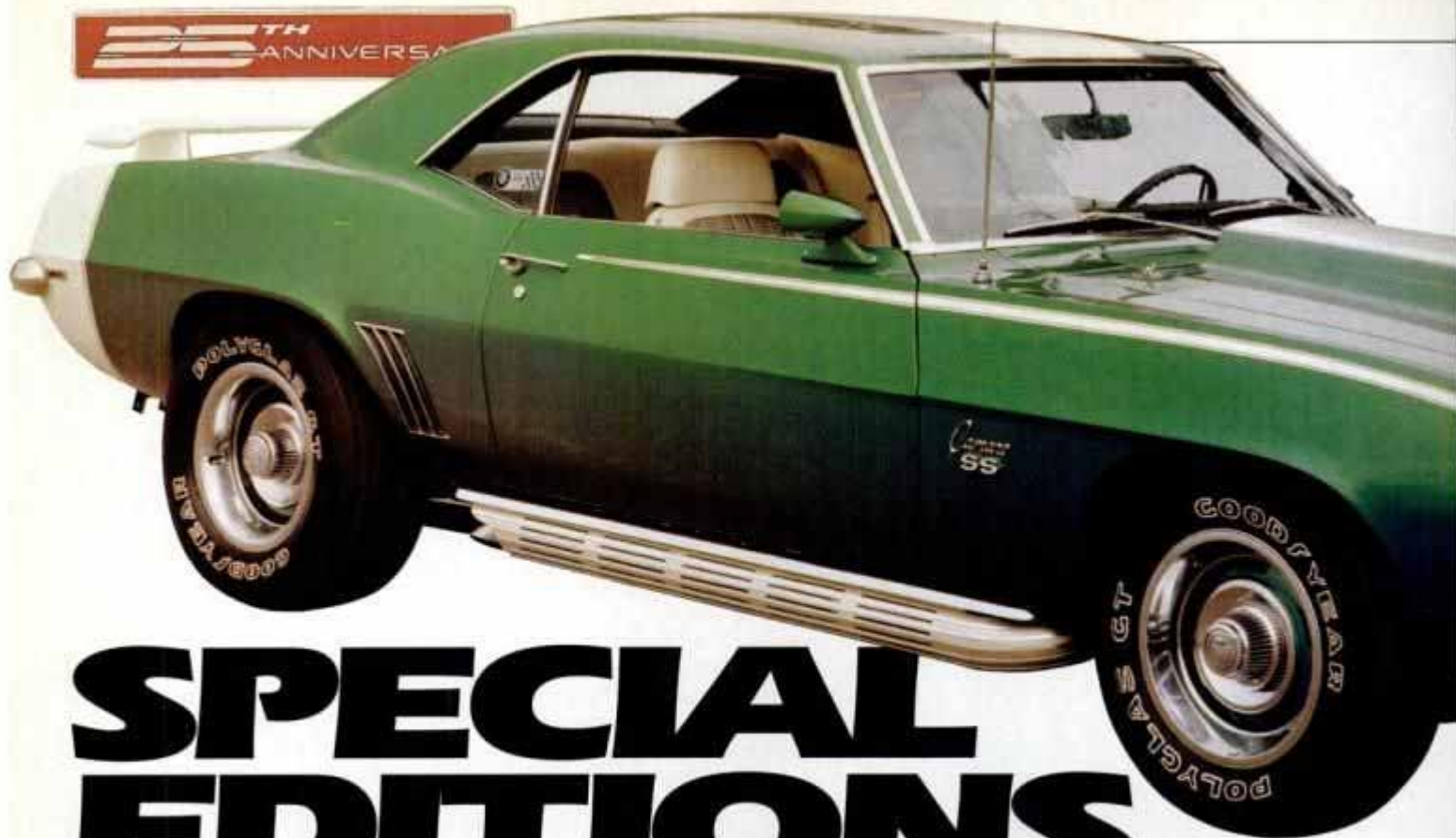
## Heritage Wannabe

● It was called the Collector Edition, and it would have been the best Camaro, by far, in recent years. To celebrate Camaro's 25th birthday, only 602 of the cars would be built—the exact number of Z28s built in '67. The goodies list was awesome: 270-horsepower Corvette 350 motor mated to a 6-speed manual transmission. Pack it all into a white with black

stripes paint job, just like the '67 Z28, and you have a 25th-anniversary edition worthy of its quarter-century heritage.

It certainly was too hot for the bean counters, as the car's projected \$28,000 price tag was too steep in a down sales market and too close to Corvette price/performance territory. Too bad.

—C.G.



# SPECIAL EDITIONS

Ultra-rare, commemorative and wild performance models—right from your Chevy dealer.

BY CLIFF GROMER

● Call them Camaros for fun and profit—fun then, very profitable now. They are the factory-brewed limited-production ultra-performance tire shredders, Indy 500 pace-car replicas and one-off specials. Companion to these were the dealer-brewed tire shredders, built by swapping 427 Corvette big blocks into factory 396 Camaros.

It was a heady time indeed, when you could walk into certain Chevy dealerships and drive out into traffic with a barely streetable 500-plus-horsepower Camaro that was a clone to the one holding a national record. For instance, Baldwin Chevrolet, in Long Island, New York, had contracted Motion Performance, a local speed emporium, to install 427 engines into 396/375 Camaros and then add to this *any* level of power, suspension and macho image a customer wanted using proven factory and aftermarket parts.

Custom hoods, badges, emblems and graphics let the world know you were not just driving a Camaro, you were in a Baldwin-Motion SS-427 Phase III Stage V Camaro, and you were a force to be reckoned with—on the street or strip. Joel Rosen, who ran Motion, tested his combinations on the strip and up and down Sunrise Highway.

It was a time when anything went, government regulation was unheard of, and no one except the stringed glove set gave a hoot about going around corners. And it was a time we'll never see again.



PM PHOTO BY CLIFF GROMER

## 1968 Z28 CONVERTIBLE

Owner: Milton Robson  
Oakwood, GA

Chevy didn't build Z28 convertibles until 1987. But when you're Chevrolet general manager Pete Estes, and you want a Z28 convertible in 1968, minor details really don't matter. Vince Piggins, head of the Z28 program at the time, suggested the project, and Estes gave the green light for this one-of-a-kind car. Since it was a special car anyway, GM styling made it extra special by adding the cowl induction hood and front and rear spoilers used on the '69 model. Estes used the Camaro from July to December '68. The Z28 was ultimately bought at auction by its present owner after being stored for 20 years.



ROY OLSEN/UNIONVILLE QUARTERS PHOTO



FM PHOTOS BY CLIFF GROMER

### 1969 BALDWIN-MOTION SS-427 PHASE III

Owner: Otis Chandler  
Oxnard, CA

"Last year it was something else. This year it's outrageous. Next year? Personally, we're afraid to think that far ahead!" Motion's ads (this one for 1969) were as outrageous as its cars. How else would you describe a 427 Camaro with 500-plus horses chomping at the bit?

### 1969 ZL-1 (COPO 9560)

Owner: Milton Robson  
Oakwood, GA  
Contemplate, if you will, the sheer ecstasy of a rated 430 (actually 560) horsepower in a 3200-pound car. Then realize that 69 buyers were able to live the experience with the 1969 all-aluminum 427 ZL-1 engine Camaro. Available right from the factory as COPO (central office production order) 9560, these Camaros came with selected options that included the fresh-air hood. Because there was no external 427 identification or anything else tacked onto these base coupes to give a clue as to what lurked under the hood,



dusting off the hot machines of the day was lots of fun. The aluminum block weighed 70 pounds less than the cast-iron 427. The ZL-1 option not only lightened the cars, but also buyers' wallets by \$8582.



### 1969 YENKO 427

Owner: Dan Bodnar  
West Mifflin, PA

In 1969, Yenko Chevrolet worked a deal with the factory to buy COPO 9561 Camaros with cast-iron L-72 427 engines rated 425 hp, which it then modified with special equipment (this included 5- instead of 4-leaf rear springs, 15-in. wheels) and graphics. The Yenko shown here is a fully documented original 13,000-mile car.

believed to be the lowest-mile original Yenko in the country. The original owner bought the car for \$4600, and raced it, turning 11.24 seconds at 124 mph. The owner parked and stored the Camaro in 1973, and answered an ad Dan Bodnar had run a couple of years ago wanting a "good Camaro body" for a restoration job he was doing. The owner wasn't aware of the car's worth and let it go for \$5000. Current value is about \$100,000.



FM PHOTOS BY CLIFF GROMER

50TH ANNIVERSARY



PHOTO BY CLIFF GUNN

427

**1967 YENKO 427**  
Owner: I.C.P. Crown Muscle Car Interiors  
Lewistown, PA

While the 1969 Yenko Camaros are well known amongst Camaro enthusiasts for their unmistakable graphics and emblems, the '67 version is not. Only a handful were built, and the only visual clue to the 425-hp 427 big block under the hood was the 427 emblem on the front fender. This documented example was originally ordered by a Chevy dealer for his young daughter. He wanted the fanciest Camaro he could get in '67. The Camaro from Yenko came loaded with options that included Corvette sidepipes. Most Yenkos were strippers for minimum weight. One ride around the block in this virtual race car convinced the dealer that this wasn't for his daughter, and he sold the car.



**1968 DANA 427**  
Owner: Milton Robson  
Oakwood, GA

Dana Chevrolet, in Southgate, California, was another dealer using the approved chain-and-hoist method to build its 427-powered stormers. In this case, the thunder and lightning come

from a Corvette L-71 435-hp solid-lifter tripower engine. Other Dana-added goodies on this original 325-hp big-block car include an L-88 cam, special Dana fiberglass hood, lightweight clutch and traction bars. All of these brought the total price of the package up to \$5592.



PHOTO BY CLIFF GUNN



PHOTO BY CLIFF GUNN



**1967 PACE-CAR REPLICA**  
Owner: David Roberts  
Columbus, OH

Chevrolet wasted no opportunity for exposure for its new Camaro. When the marquee was chosen to pace the pack at the Indy 500, Chevrolet built four vehicles for actual pace duty, and another hundred or so for various race officials and dignitaries. All the cars were Ermine white RS/SS convertibles, and sold to the public through Chevrolet dealers after the event.

**1969 Z11 INDY SPORT CONVERTIBLE**

Owners: Gary and Alta Nichol  
Saline, KS

Camaro came back in '69 to pace Indy again—this time in a Dover white with Hugger orange stripes convertible powered by a 375-horse 396 fat block and Turbo 400 transmission. Chevy produced some 3674 pace-car replicas for sale, but only 46 of these carried the 396 big blocks.

**1982 RPO Z50 INDY 500 COMMEMORATIVE EDITION**

Owner: Douglas Perry  
Columbus, OH

When the third-generation Camaro arrived on the scene, the big race in Indiana was again the venue of choice for promoting the model. As before, special Indy graphics graced the car's flanks. The 2-tone silver and blue package also included red-line accented rally wheels and "Z28" embossed on the driver's-side seat headrest. Chevrolet offered a car to each of its dealers, so a total of 6360 were sold, making the '82 edition the most common of the Camaro pace machines. **PM**

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# THE NEXT CAMARO

The '94 will go on sale spring '93. Here's what we know about it.

BY CLIFF GROMER

● According to our latest spy information, the next-series Camaro will ride on about the same 101-in. wheelbase as the current model, but Chevy will chop off a few hundred pounds from the car to get the weight down significantly from its present 3400 pounds. Helping the effort here will be plastic doors and fenders.

The chassis will not be a radical departure from the current practice of using unit-body construction and a solid rear axle at the driving end. The front suspension will remain basically unchanged. A metal "bird cage" attached to the unit body will serve as both a stiffening structure and a mounting framework for the plastic body components.

You won't need a computer when it comes to engine choices, as there will be only two on the order form. The base engine will be a 2-valve/cylinder 3.4-liter 180-horsepower V6. This is obviously not the hot 24-valve 200-hp LQ-1 V6 that you can now get in the Lumina Z34. The optional engine will come only in the Z28, and it will be a 285-hp version of the Corvette LT-1 engine. More restrictive intake and exhaust manifolds—necessary for packaging the engine in the Camaro—will account for the 15-horsepower reduction from the stock LT-1's 300-hp output. The code designation now being kicked around for this engine is LT-9. You'll be able to mate this mill to the Corvette's currently available 6-



General Motors' 1994 Chevy Camaro will be lighter and pack a 285-hp LT-9 V8 engine.

speed manual-shifting transmission.

The base V6 should do a good job of delivering acceptable performance with decent fuel economy. But the LT-9 should elevate the Camaro into the world-class performance league for 4-place sports cars.

It's almost certain that antilock brakes will be offered with the package, and even a possibility of traction control, as on the Corvette.

An all-new interior will complement the exterior re-skin job. Instrumentation will be the old familiar dial-and-needle analog type, as most carmakers have grown out of showing off their gee-whiz digital dash gimmicks (thank God), especially for sporty cars. Seating will remain in the 2+2 configuration, and dual airbags

will treat the front-seat passenger to the same puff job that drivers currently enjoy.

Initially, Camaros will hit the showrooms in sports coupe form only. Fresh-air fiends will have to wait about six to nine months after the initial introduction for a convertible. The droptop conversion probably will be farmed out to Cars And Concepts—the same folks who now peel off the metal roof on Mustangs for Ford's ponycar convertibles.

And speaking of Camaro's arch-rival Mustang, the blue oval boys won't be fielding their new pony until about a year after the new Camaro—as a '94½ model. So Chevy's pony should be in the homestretch before Ford's even leaves the gate. **PM**



The convertible edition is expected to be introduced about six months after the coupe model.



## CAMAROS ON TRACK

(Continued from page 81)

won the 1987 Championship. John Heinricy/Mitch Wright/Don Knowles won in 1989. Camaros also dominated the SCCA Escort Endurance Championship in the '80s, with many of the same drivers. Knowles/Heinricy won that Championship in '89, too.

Because they are so inexpensive and easy to work on, Camaros have been the perfect ready-to-roll race car for the little guys of racing for 25 years. They've won countless SCCA road races, oval track races and, most importantly, drag races. Go to your local dragstrip on any Friday night and you'll see dozens of Camaros of every age duking it out in bracket racing categories. Small blocks, big blocks, nitrous—you'll see it all. Along with the '32 Ford and the '57 Chevy, the Camaro is one of the classics of hot rodding.

There's a great tradition behind Camaros in drag racing. Remember the dark-green cars of the Detroit Rat Pack led by Dick Arons and Wally Booth? How about Mike Fons winning the Street Eliminator World Championship in 1969 with his 427 Camaro, or the various blue-and-white Camaros of Keener and Mercure?

Bill "Grumpy" Jenkins became a legend behind the wheel of a dozen different Camaros—all named "Grumpy's Toy." Among many other titles, he was NHRA Super Stock National Champion in 1967 and the first Pro Stock National Champion in 1970.


When he abandoned his Camaros in favor of a smaller Vega, Bruce Larson took Jenkins' 1971 second-series Camaro, repainted it USA-1 and drove it in Pro Stock. That same car was later raced by Richie Zul and Dennis Ferrara. Ferrara even won an NHRA World Championship in 1977 with that old, well-used Camaro.

In the late '70s and early '80s, Camaros also dominated NHRA Pro Stock. Frank Iaconio and Warren Johnson were the big names, then Lee Shepherd took over driving the Reher-Morrison car. Reher-Morrison won convincingly from 1980 through 1984, but then Camaros faded from the top of the Pro Stock ranks. Don't worry, they'll be back.

That's the thing about the Camaro. It's an almost perfect race car that keeps winning, year in and year out, no matter what the competition does. The Camaro has perfect balance. It can take anything from a 6-cylinder to an oversize aluminum big-block V8. It can be updated and backdated and made competitive no matter how the rules change. An amazing race car for 25 years and still counting—the Chevrolet Camaro, long may it reign. **PM**



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## BOATING

# DGPS: THE NEXT GENERATION

BY JOE SKORUPA, Boating/Outdoors Editor

● Operation Desert Storm was a trial by fire for some of America's most sophisticated technologies. Appearing in battle for the first time were the Patriot Missile, the airborne radar command center known as Joint STARS, the Tomahawk Cruise Missile and the Global Positioning System (GPS). All performed with distinction, including the Patriot Missile, although its effectiveness may have been less spectacular than originally reported.

But GPS, unlike the other pieces of cutting-edge hardware, has an important nonmilitary function. Its highly accurate positioning data is currently being used by surveyors, ocean-going ships and noncommercial boats. Rapidly developing technology will soon enable aircraft and land vehicles to begin tapping into GPS, too.

### Good news, bad news

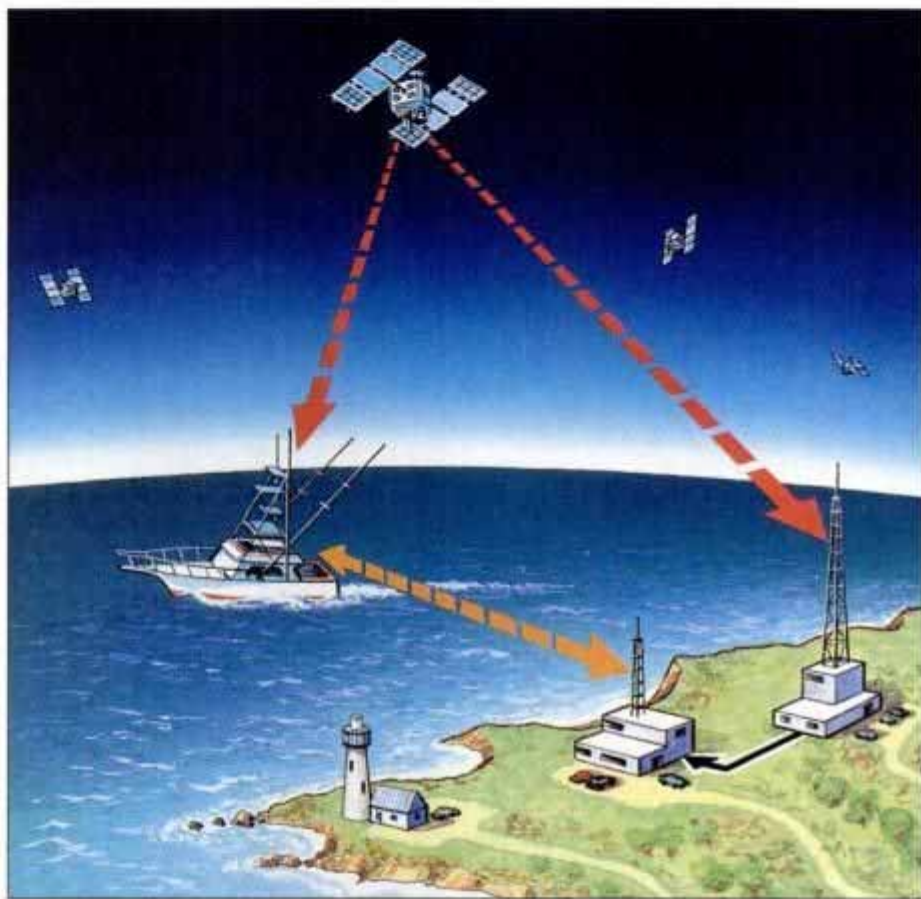
GPS receivers are currently hot items in marine navigation. Compact, powerful units are debuting at a remarkable rate, and prices are dropping. But, despite the boom, GPS continues to be a good-news/bad-news affair.

Full GPS operation is scheduled to go on line by the end of next year. This is good news. But the bad news is that it's six years later than originally scheduled.

Another piece of good news is that GPS performed sensationally during Operation Desert Storm. It provided positioning information accurate to within 10 meters. The bad news is that after Desert Storm, the military operators of GPS randomly degraded the data by a factor of 10. Why? To prevent GPS from being used by hostile nations for missile guidance.

Clearly, 100-meter accuracy isn't adequate for harbor and coastal navigation or surveying. What can be done? Fortunately, there's a solution. It's called Differential GPS (DGPS). Here's how it works.

Basic GPS navigation units receive signals from orbiting satellites. By processing signals from at least four satellites, the unit can determine a continuously updated 3-dimensional fix that's accurate to within 10 meters. But, as mentioned, the civilian signal has been degraded. To get around the error, the Coast Guard is



New DGPS improves accuracy of GPS data by using a land-based reference station.

working on a program to feed GPS units a correction variable that resolves the *difference* between a known location and a GPS fix, hence the name Differential GPS.

The key to DGPS is a series of reference stations installed at current Loran transmitter sites. These stations will be located at known spots and monitor GPS signals. By comparing the known position to the monitored GPS fix, these stations will calculate correction factors and then transmit the information via radio-frequency datalink.

Corrected DGPS information is spectacularly accurate. Marine vessels up to 300 miles away from reference stations can obtain position accuracy to within 2 meters.

For the past year, the Coast Guard has been conducting sea trials with a DGPS beacon at Montauk Point, New York. Operational DGPS beacons are now being installed in Michigan, Tex-

as and New Jersey. Plans call for coverage from Maine to North Carolina by this summer. The rest of the U.S. coast will be covered by 1996.

Without doubt, new DGPS navigation units will become as hot as current GPS units, and they will follow a predictable pattern. First, initial prices will be high. Second, DGPS modules will become available to upgrade current GPS units. And third, prices will fall as the market booms.

Then, by the end of the decade, boaters will have what the Pentagon sold to Congress in the late 1970s and spent \$10 billion making operational, "a navigator's dream come true."

### Mercury's 'Iron Fist'

If you've ever been to such Mercury Marine strongholds as Fond du Lac and Oshkosh, in Wisconsin, or Lake X, in Florida, then you know that the ghost of Elmer Carl (E.C.) Kiekhaefer still stalks the company he



## IRON FIST

The lives of **CARL KIEKHAEFER**,  
Industrial Caesar of a marine industry empire.  
By the best-selling author of *The Legend of Chris-Craft*.

**JEFFREY L. RODENGEN**

founded in 1939. Merc veterans still speak of E.C., who died in 1983, as if he roared past them only yesterday.

Colorful stories about the irascible engineer, inventor and businessman are legendary. His on-the-spot firings of employees. His work schedule that included weekends, vacations and Christmas. His penchant for hanging OMC outboards over bonfires and watching them melt. His 200 patents. His championships in boat, snowmobile and NASCAR racing.

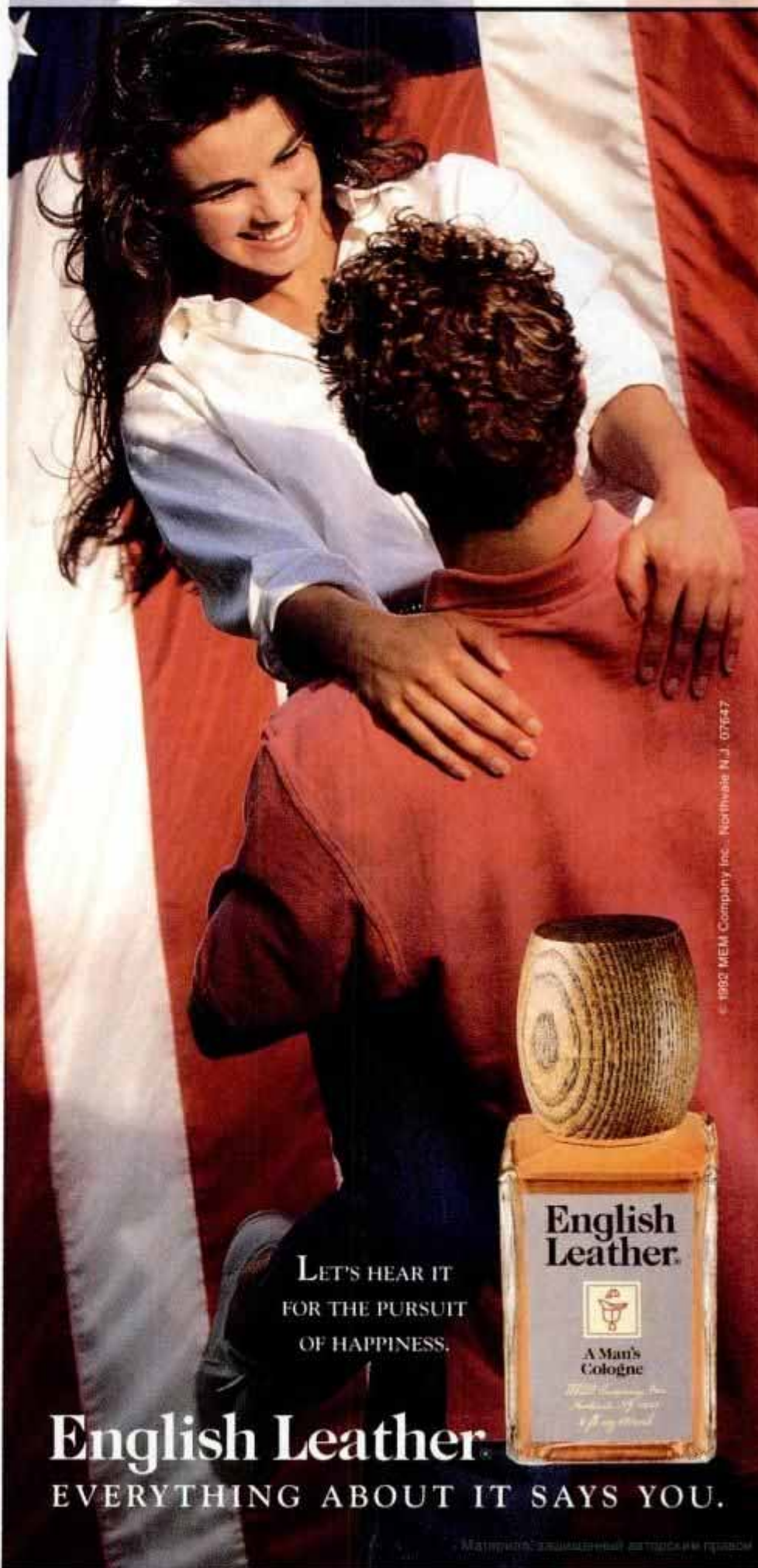
Which is why E.C. is a perfect subject for a biography. Stories about him have been circulating within the boating industry for years, and a book that simply brought these stories together would make a fascinating read. Jeffrey Rodengen's new book, *Iron Fist: The Lives Of Carl Kiekhaefer*, does this and much more.

Rodengen's bio not only brings to vivid life a complex and fascinating figure, but exclusively breaks one of the biggest technical and financial stories in boating. Rodengen's monumental research, which involved hundreds of interviews and thousands of hours of digging through archives, uncovers the juicy fact that the stern-drive engine wasn't invented by the much-heralded Jim Wynne, but by former E.C. righthand-man Charlie Strang, who was later to become head of OMC. The story is murky and complicated, and a stunner.

*Iron Fist: The Lives Of Carl Kiekhaefer* is available at bookstores or from the publisher: Write Stuff Syndicate, 1108 Citrus Isle, Fort Lauderdale, FL 33315; (305) 462-6657. If you're a fan of the modern era of boating, then *Iron Fist* is definitely a must-read for you. **PM**

POPULAR MECHANICS • JULY 1992

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## NEW CARS

**Bodacious Buicks**

● If you're one of those Buick buyers who'd like to have just a little more muscle next time around, here's a collection that'll whet your appetite. How about a supercharged/intercooled Regal, with 240 hp and 270 ft.-lb. of torque? Or a supercharged Skylark, with 183 hp and 215 ft.-lb.? Or, our favorite, a Corvette-powered Roadmaster—292 hp and 384 ft.-lb.?

We recently drove these and other Buick engineering specials in a one-day test session at Phoenix International Raceway. Though all these specials were presented on a concept-only basis, we expect a number of the concepts to show up on 1993 production cars.

In fact, the Roadmaster Limited Special is one hot package that stands a good chance of finding its way, intact, into showrooms next fall. This big 4-door is a lot livelier than current production Roadmasters—0-to-60 in 7.9 seconds. And for all its size (there's more than 4000 pounds worth of Buick here), it's also surprisingly easy to herd through corners, thanks to stiffer suspension components and a limited-slip differential.

The presence of two supercharged Regal Gran Sports in the concept car show suggests the strong likelihood of

more power in the Regal lineup next year. The question is how much. The milder version—205 hp, 260 ft.-lb. of torque—uses the same powertrain as the current Park Avenue Ultra: GM's 3800 V6 with an Eaton M60 supercharger making 8 psi of boost. With an intercooler, the output jumps to 240 hp and 270 ft.-lb. of torque.

Bolted to the Skylark's 3.1-liter V6, the Eaton supercharger boosts power to 183 hp and torque to 215 ft.-lb. However, the most impressive power came from a 3800 with high-flow aluminum cylinder heads, a lightweight, roller-rocker valvetrain, high-flow exhaust manifolds and revised camshaft. With 243 hp and 295 ft.-lb. of torque, this setup hustles a Park Avenue Ultra to 60 mph in 7.7 seconds.



Roadmaster Limited Special may be a 1993 special order. Corvette V8 torque provides sparkling acceleration, revised suspension lends agile handling.



With supercharged/intercooled 3800 V6 (above) pumping out 240 hp and 270 ft.-lb. of torque, Buick Regal engineering concept car dashes to 60 mph in 8.2 seconds.

Buick's bag of future tricks includes more than muscle, exemplified in the Park Avenue Customer's Choice concept car. Press the UNLOCK command on the keyless entry keyfob and the car automatically adjusts radio, climate control, mirrors and seat positions to customer-selected presets. More impressive, the car can also be preprogrammed by the dealer for suspension response, throttle response, steering effort and automatic-transmission shift characteristics.

As for the other Buick concepts, we expect to see at least some as early as this fall. Which ones? Stay tuned.

—Tony Swan

**Ad Infinit(i)um**

Refined, distinctive and powerful, the new J30 is designed to achieve two goals for Nissan's luxury car division. First, it gives the Infiniti lineup a truly all-new car to fit in between the athletic little G20 and the ultra-lux Q45. Second, it's aimed at eclipsing the successful Acura Legend sedan.

Based on our first hands-on experience, it looks like a success.

Designed specifically for the North American market, the leather-lined J30 supersedes the Infiniti M30, which will be dropped at the end of the





Distinctive styling of new Infiniti J30 is reminiscent of classic Jaguar sedans. Sumptuous interior layout (upper right) includes leather upholstery as part of a long list of standard features. Smooth 210-hp dohc 24-valve aluminum V6 drives rear wheels through 4-speed automatic. Antilock braking and dual airbags are standard.

year. Its shape, laid out at the Nissan Design International Studios in La Jolla, California, stands out from its many competitors at the lower end of the luxury car spectrum, while its cabin is as quiet as a Lexus LS 400.

Riding a 108.7-in. wheelbase, the J30 measures 191.3 in. long, 69.7 in. wide and 54.7 in. high. Track is 59.7 in. fore and aft, and curb weight is a hefty 3527 pounds. The suspension is independent all around, with struts at the front, a multilink rear system and antiroll bars at both ends.

There are two levels of suspension tuning—standard and Touring (the J30t, which includes forged alloy wheels, stiffer components, Z-rated tires and Nissan's Super HICAS 4-wheel steering). There are big vented brake rotors at all four corners, and a 3-channel ABS is standard.

The J30's 3.0-liter dohc 24-valve aluminum V6 is quiet but potent, with 210 hp and 193 ft.-lb. of torque—enough to produce 0-to-60 runs in the low 8-second range. Power gets to the rear wheels via a 4-speed automatic transmission and standard limited-slip differential.

Inside, the J30 says luxury with standard leather upholstery, wood dashboard paneling, multiadjustable power seats, power sunroof, standard CD player, automatic climate control, power windows, power mirrors and power locks. Dual front airbags are also standard, along with pretensioner front seatbelts.

Pricing says luxury too—\$33,000 for the standard J30, \$34,700 for the J30t. But the only option is a hands-free cellular phone—everything else is included. And as luxury packages go, the J30 may be one of the best in its class.

—Jim Dunne

### Mercury Villager

With more than a million Americans poised to buy a new minivan this year, it's no surprise that you'll be able to find one at your local Lincoln-Mercury dealer.

The 1993 Villager is Ford Motor Co.'s half of a cooperative venture with Nissan that also provides the virtually identical Quest minivan (see *New Cars*, page 112, May '92). Re-



gardless of brand name, the new minivan comes with a 151-hp Nissan 3.0-liter sohc V6 driving its front wheels through a 4-speed automatic. It's

(Please turn to page 94)



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## Big News At Cadillac

And we do mean big. The 1993 Brougham is longer than any other regular production sedan sold in the U.S. today—4 in. longer than the previous titleholder, the 1992 Brougham.

Key dimensions: 121.5-in. wheelbase, 225.3-in. overall length, 78.0-in. width, 57.2-in. height and 4367 pounds at the curb.

Cadillac has done a good job of building some of that additional length into the rear-seat area, as well as giving the exterior a more rounded, contemporary look. And Cadillac engineers claim that the refined shape and other noise-reduction measures give the new Brougham one of the quietest cabins on the road today.

While roominess and comfort have always been key, there are a number of technical updates that make it a better car: traction control, antilock braking, dual airbags and variable-assist power steering.



New V6-powered, front-drive Villager minivan will expand Mercury showroom offerings.

189.9 in. long, riding a 112.2-in. wheelbase. Translation: The Villager is just a bit shorter than the stretched-out Grand versions of the Dodge Caravan and Plymouth Voyager but longer than the standard models, which are still the prime competition for every minivan.

Available in two models, GS and LS, the Villager differentiates itself from the competition with some innovative interior packaging and with excellent ride and handling. In fact, when equipped with the optional suspension package, the Villager handles road irregularities and changes of direction with rare aplomb. The suspension upgrade includes stiffer springs, rear antiroll bar and 215/70R15 tires (versus the standard 205/75R15s).

All Villagers have the same drivetrain, which is smooth, quiet and peppy enough to make driving as enjoyable as it is in, say, a Taurus or Sable wagon. Antilock braking is standard equipment, and the Villager meets all passenger-car safety standards—the passive restraint system is a motorized seatbelt rather than an airbag.

Smooth as it is, though, the Villager's real strong suit is its versatility. The new minivan comes to the picnic with the standard issue sliding right-side door, rear hatch, three rows of seats and as much utility as any minivan. But unlike the Caravan, both front bucket seats are adjustable fore/aft, and there's still an access

aisle between the front seats. The center bench (or optional buckets) can be removed for more space, as with other minivans, but the rear seat is mounted on tracks so it can slide anywhere from the rear of the van all the way up to the backs of the front seats for a near-infinite combination of seating and/or cargo space. In addition,



Sunburst yellow finds its way onto Mazda Miata's palette for 1993.

like the Taurus/Sable wagon, the rear hatch is split so you can open just the glass section or the entire hatch.

Both the Villager and Nissan Quest will be assembled at Ford's Avon Lake, Ohio, plant, with Mercury slated to get slightly more than half the scheduled production—about 60,000 minivans per year.

—Don Chaikin

GM's 5.7-liter ohv V8 continues to provide propulsion. Peak output—180 hp—is ho-hum, but 300 ft.-lb. of torque at 2400 rpm provides enough thrust to keep up with traffic.

## Mellow Yellow

Although Mazda sees no need for major changes in its highly popular Miata sports car, special limited editions continue to emerge.

The screaming yellow Miata shown here is one of 1500 that will be offered, with the manufacturer's suggested retail price starting at \$15,050.

Mazda will also offer a metallic black variation on last year's British Racing Green edition, replete with leather upholstery and alloy wheels. The black Miata package starts at \$17,050, but Mazda expects a large number of buyers to order the \$1400 option package that includes, among other things, BBS alloy wheels and a wood shift knob by Nardi.

FM



New Cadillac Brougham has dual front airbags, antilock braking as standard equipment.

maintenance at 7500 miles—unless the car is subjected to “severe service.” Apparently, commuting into New York City is considered “severe service” by the car’s on-board computer. And who can argue? We’ve now put almost 6000 miles on the car, so, as we speak, the car is going to an Olds dealer for the 7500-mile by-the-book maintenance service.

—Joe Oldham

## Nissan NX 2000

Since sports cars are usually driven harder than family sedans, we decided to try something new for our long-term test of Nissan’s sassy little NX 2000. Besides driving it on the street, we plan to run it in Sports Car Club of America Showroom Stock racing through the ’92 season—a real torture test.

As the name implies, Showroom Stock racing is for box-stock cars, just the way they come from the showroom. The only modifications allowed are for safety—a bolt-in roll cage, 5-point seatbelts, a window net and a fire extinguisher. SS rules also require disconnecting the driver’s airbag, in cars so equipped, for obvious reasons.

We obtained the cage—a pre-fab unit of excellent design that saved hours of pipe-bending—from Autopower Industries, in San Diego, California. The belts and window net are from Simpson (Torrance, California). It took only a few hours to fit everything into place and voilà!—instant street-legal race car.

Since the car came into our hands just prior to our July issue deadline, there are just 856 miles on the clock.

However, we do have some strongly favorable impressions. Powered by a lively 2.0-liter dohc 16-valve Four, the NX 2000 will be a strong competitor. It makes 140 hp at 6400 rpm and 130 ft.-lb. of torque at 4800 rpm, with impressive midrange response. Mated to its standard 5-speed manual transaxle, it generates 0-to-60 mph

high operating temperatures.

Handling and braking are first-rate. Like most small front-drive coupes, it’s a bit nose-heavy, a trait that’s more than offset by its viscous limited-slip differential. And the all-disc brake system, with 10.2-in. vented front rotors, provides an edge against other cars in this class (e.g.,

Honda CRX Si, Acura Integra, Mitsubishi Mirage Turbo).

We’re barely into this unique long-term test, but our first impressions suggest the NX 2000 is more than equal to the challenge.

—Tony Swan



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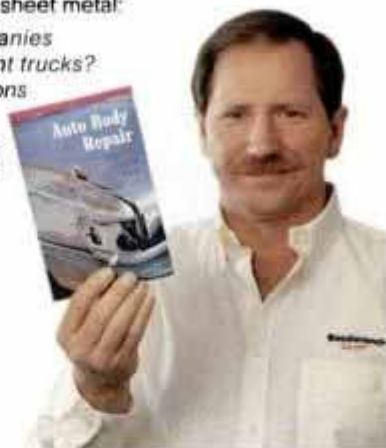
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runs in the low 8-second range.

Once the car has a few more miles, we plan to pour in a little extra grunt in the form of Valvoline’s new synthetic oil. Based on the experiences of racers like Al Unser Jr., we expect Valvoline’s ethylene-based synthetic to improve the NX 2000’s peak power, provide quicker heat dissipation and offer generally better performance at

was supposed to be fixed, too. But the radio/CD assembly is imprinted with the VIN, preventing the customary swap of a new unit for the bad one. This means that the system had to be sent off to a repair station. But after the car sat at the dealer for several weeks—with the radio untouched—we threw in the towel and retrieved it unrepaired. Next time. —Mike Allen

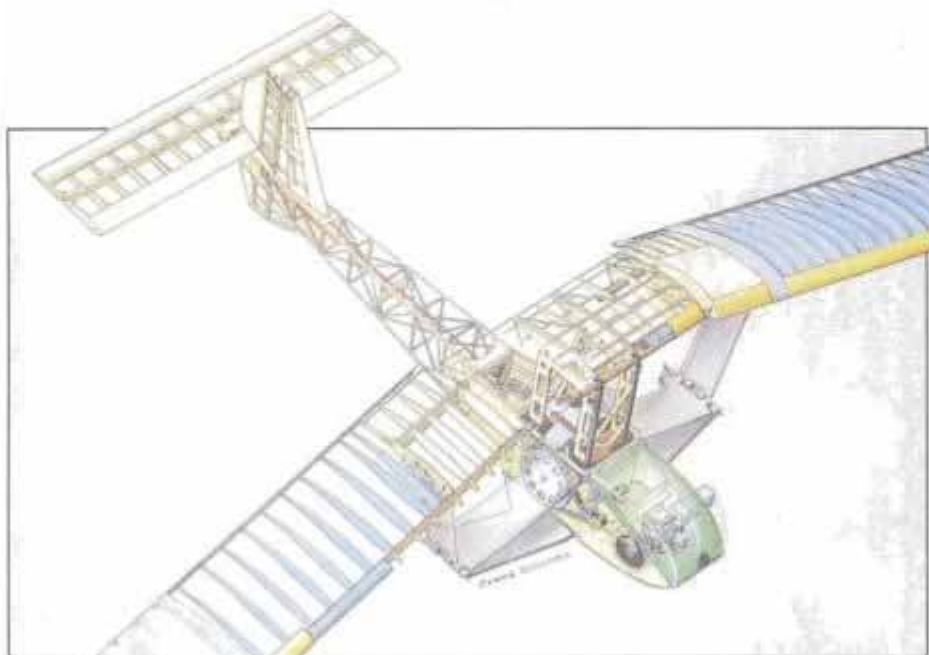
## Chevrolet Corvette Roadster

Immediately after the photography for our last installment, the Vette went to the dealer for service with just over 3000 miles on it. Service consisted of a new ignition system black box, an oil change and a general look-over. There had been some premature failures of these boxes in other Vettes, but we’ve had no trouble.

Several other problems were attended to as well, sort of. The alignment was touched up, and straight-line stability is much improved. The picky CD player, which wouldn’t play about half

# THE FIRST ORNITHOPTER

BY ABE DANE, Science/Technology Editor



● Like a high-powered rifle in an archery match, there has always been something just a tad unsporting about the way man has competed with birds for mastery of the skies. Yes, the aircraft we've built have been ingenious in their way, traveling at thousands of miles per hour and to the edge of the atmosphere. But none of them has taken as difficult an approach to the problem of flight as nature did. To be more specific, no one has ever built an engine-powered vehicle that flies by flapping its wings. As a result, human engineers have managed to sidestep a host of aerodynamic and mechanical challenges that our feathered friends overcame millions of years ago.

But that changed on September 4 of last year. On that date, Jim DeLaurier and Jerry Harris launched a piston-engined radio-controlled aircraft that flapped its wings so furiously it looked as if it was going to shake itself to pieces. Instead, its delicate-looking framework of high-strength composites held, and it climbed awkwardly but unmistakably into a clear-blue afternoon sky. The flight lasted 1 minute and 46 seconds, ending when the 8.8-pound craft

ran low on fuel, made a voluntary descent and skidded gently to a stop. After 20 years of collaborative effort, DeLaurier and Harris had built the world's first true ornithopter—a machine that flew like a bird.

Like many obsessions, it began with the naive optimism of youth. Harris, now a mechanical engineer at the Battelle Memorial Institute in Columbus, Ohio, first mused about the possibility of bird-like flight as he worked on a mechanical amplifier for his master's thesis in the '60s. He and University of Toronto aeronautical

engineer DeLaurier teamed up a few years later, pursuing the project in their spare time.

Harris focused on the drive mechanism, and DeLaurier handled the aerodynamics. They had no idea of the task's eventual proportions.

A logical first step was to study slow-motion footage of birds in flight. But according to Harris, this revealed surprisingly little. "There's a lot going on kinematically that may or may not be aerodynamically important," he says. That means it's hard to tell which of the many motions made by a bird's wings are actually needed to make it fly.

DeLaurier and Harris moved ahead on the assumption that a simple up-and-down motion, with the wing tilted forward on the downstroke and backward on the upstroke, could be tailored to produce the desired combination of lift and propulsion. Although birds also get some help from the fact that they fold, or crank, the outer halves of their wings downward to reduce surface area during the upstroke, this was thought to be unnecessarily complex.

In order to make it flap, the ornithopter's wing was hinged in two places, dividing it into three relatively rigid panels. The center panel is linked to a 1-hp model-helicopter engine by an arrangement of belts, pulleys and a large aluminum crank, which causes it to plunge up and down. Imparting this motion to the inboard ends of the outer panels causes them to rock like seesaws on pivot points supported by a pair of outriggers extending from the fuselage.

Thus, the mechanics of getting the wings to flap was relatively simple. What occupied the preponderance of the inventors' time was working out a design for the outer wing panels that combined two conflicting attributes. First, the panels had to be torsionally limber enough that they could twist backward and forward as they flapped. And second, they had to have an airfoil that



Ornithopter's first sustained flight was from an Ontario hillside.



would continue to produce lift at the varying angles of attack produced by the twisting. Unfortunately, the airfoils that did this best were thick, and thus difficult to twist.

DeLaurier and Harris used a computer program of their own design to analyze the aerodynamic and structural properties of a variety of wings. Eventually, they arrived at a way to make a thick, but twistable wing through the use of a principle they call shearflexing, which they are currently seeking to patent. The amount and timing of the twisting is controlled by the torsional stiffness of a leading-edge spar made of a combination of Kevlar and carbon-fiber composites over plywood. The rest of the wing's shape comes primarily from a series of structural foam ribs.

The fuselage of the aircraft is similar to that of a conventional model airplane, consisting of plywood, balsa, fiberglass and plastic film, strategically reinforced with carbon



**Expothopter's wing looks like a model airplane's, but incorporates modern composites and shearflexing design.**

fiber. Control is through three radio-controlled servos operating a rudder, elevator and throttle.

An important aspect of the program has been the degree to which DeLaurier and Harris built up a strong theoretical foundation as they went, rather than taking a trial-and-error approach. As a result, they expect to be able to take the lessons learned from their first successful model and apply them to bigger and more sophisticated ornithopters. They have already built a slightly larger bird for this year's World's Fair in Seville. This "Expothopter" is big enough that it will have to be winch launched, rather than thrown, and has a centrifugal clutch to make starting the engine easier. Eventually, DeLaurier and Harris hope to build a machine big enough to carry a person, creating a sport vehicle that would fulfill man's oldest fantasies of flight. But they also speculate that their technology may have more serious applications, stemming from the fact that flapping wings are potentially the quietest way to fly, as birds of prey demonstrate. This silence might be put to use in a variety of military and surveillance applications. **PM**

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# CELLULAR SOLUTIONS

BY FRANK VIZARD, Electronics Editor

● Cellular telephones have opened the door to mobile communications, but as the door opens wider, the number of choices to be made regarding cellular technology increases as well.

Nearly every manufacturer of cellular phones is trying to shrink them to about the size of a communicator like the one used by Captain Kirk on the old *Star Trek* television series. Panasonic's latest handheld cellular phone, the EB-H60, weighs 9.5 ounces, is  $\frac{3}{8}$  in. thick when closed and fits easily into a pocket. Other companies have models about the same size.

While extraordinarily portable, many of these handheld cellular phones have one limitation: power.

While car-installed cellular phones offer 3 watts of power, handhelds generally offer 0.6 watts of power. This is fine if you're using the cellular phone in what's called a Metropolitan Service Area (MSA) where cell sites are spaced closely together.

But if you're using a handheld in a Rural Service Area (RSA) where cells are larger, 0.6 watts may not be enough power to connect you with landline telephone service in certain circumstances.

If you're in an RSA but want the portability of a handheld, then consider a model like Blaupunkt's TC-132, listing for \$1079. The TC-132 offers more power—1.6 watts—if you need it, but can also operate at 0.6 watts to conserve battery life. The extra power adds about 5 ounces of weight (a total of 14.8 ounces), but the TC-132 is still pretty small, measuring  $6.9 \times 2.4 \times 1$  in. in size.

Battery life, of course, is a critical issue with cellular phones. If the battery is dead, all you're holding is an



Terk's Transceptor cellular antenna mounts on any glass or plastic surface.

expensive piece of plastic. Newer handheld cellular phones, like the Nokia 101 listing for \$799, allow you to use higher-capacity nickel metal hydride batteries that have the added benefit of not being a potential pollutant like nickel cadmium batteries.

With the nickel metal hydride battery in place, Nokia says you'll get 130 minutes of talktime and 30 hours standby. A high-capacity nickel cadmium battery for the same phone offers 95 minutes of talktime and 22 hours standby. And even with the high-capacity battery, this cellular phone weighs only 11.1 ounces.

The Nokia 101 is also a good bet for drivers, as it can be recharged using a cigarette lighter charger even while the phone is being used.

Drivers who are also owners of laptop computers may also be interested in a new product that provides an easy link to cellular phones. Developed by Command Communications, Inc., of Aurora, Colorado, Softcell allows you to easily connect a modem to a cellular phone. The package consists of two cables and a 3.5-in. floppy disk of instructions that is compatible with most communications software. Each element can be purchased separately. The complete package for a car-installed phone lists for \$399, while the package for handheld models is \$499.

Wireless data transfer, as this mode of communication is known, is a subject garnering a great deal of attention. IBM and nine of the largest cellular telephone operators are working together to develop new products in this area and to improve cellular transmission capabilities.

This consortium expects the market for this type of service to be 13 million people by the year 2000.

Cellular phones are also an increasingly favorite target of thieves. What they snatch is not your phone but your service. Electronically adept criminals can, and have, intercepted the ra-



Blaupunkt's TC-132 handheld cellular phone has extra power for use in rural service areas.

dio transmissions of cellular phones, stealing in the process the identifying codes of cellular phone users. Thieves then reprogram a cellular phone in their possession with the stolen codes. The reprogramming of the microchip in a cellular phone can be done using a personal computer.

Digital technology being developed for cellular phones and expected later this year should make theft harder. In the short term, however, perhaps one way to avoid theft of service is to make it less obvious that there is a cellular phone in the car. Cellular antennas on cars were easily identifiable up until now. Terk Technologies of Syosset, New York (800-942-TERK), has developed a cellular antenna shaped as a black, rectangular module that adheres to any glass or plastic surface. Terk claims its Transceptor antenna (\$80) also has better reception than standard coil antennas. The idea is to reduce the noise and number of dropped calls that occur as the car moves from one cell to another.

## More Cable TV

Cable TV operators are excited about a new compression technology that will allow them to offer many more channels for viewing. While electronics companies like Thomson, Philips, Zenith, Scientific-Atlanta and others are working with or against each other to develop a standard, it seems clear that some method of delivering a compressed video signal via satellite will be chosen and working next year.

In practice, this means a local cable operator could offer as many as 480 channels from one satellite. This added capacity will allow cable operators to essentially offer what's being called "video on demand." While a hit movie may now be shown every 2 hours, the added capacity generated by digital compression of the video signal allows the movie to be scheduled in 15-minute intervals, for example, over eight different channels.

Of course, all this added channel capacity means it will be a little harder to figure out what's on and when it starts. A number of companies are now working to develop sophisticated on-screen programming guides. One approach, scheduled to be used by Zenith in its products next year, is called InSight. The InSight system provides on-screen details about show titles, start times and descriptions of the story line. You're also able to tape a show on your VCR by pushing only one remote-control button.

Cable TV, however, has not always been the most cooperative medium for home video-tapers. Last year, a new product called VCR Plus made its debut on the market and, through the use of numerical codes printed in television guides, taping of TV shows was made much simpler.

This year, a second-generation VCR Plus technology being used by RCA in two of its new videocassette recorders promises to make your cable TV box a little more friendly. Called VCR Plus with cable channel control, this new system sends an infrared signal from the videocassette recorder to the cable box. This signal tells the cable box the time at which you want to change channels. Now, for the first time, you can easily program your VCR to record a program from cable channel 17, for example, then subsequently record shows on other channels at a later period. This new technology is a real breakthrough as far as unattended video recording is concerned. It's now available as a feature on RCA's VR667HF and VR536 VCRs. The VR667HF is a stereo hi-fi model listing for \$549. The VR536 features a center-mount design and is listed at \$419. **PM**

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**EXHIBIT** (Continued from page 34)

To Pick Your New Radio Set," offering advice still relevant for the electronics consumer of today. "Picking a new radio receiver, to build or to buy, involves other considerations than whether the cabinet matches the furniture and there are enough knobs to satisfy a longing for experimentation in wireless."

A few radio novelties are on display, recalling the height of the radio craze when PM reported, "A number of designers have built receiving sets in cigar boxes, safety-razor cases, matchboxes and what not, but now we have a really practical set built in a vanity case."

But the most unusual device is a receiver used by inventor C. Francis Jenkins to listen for radio messages from Mars. Guglielmo Marconi's detection of mysterious, unearthly radio signals in 1919 had touched off a rash of popular and scientific speculation about the possibility of intelligent life on Mars. In 1924, the Army and Navy participated in a period of radio silence to listen for any unusual transmissions. Jenkins did in fact detect some odd signals with the 1918 NESCO receiver on display, and recorded them on moving photographic strips. Although he took the strips to the Signal Corps's code section, nothing more was done about it.

But Jenkins was also known to PM readers as a promoter of "Radiovision Of The Future." Although electronic TV, and not Jenkins' mechanical system, eventually won the manufacturing dollar, visitors to the exhibit can see part of Jenkins' 1923 mechanical scanning television system and a 1928 "Radiovisor" television receiver built from a Jenkins kit.

By 1930, the radio receiver was a permanent fixture in most American homes. The novelty was wearing off. But here in "Possible Dreams: Popular Mechanics and America's Enthusiasm for Technology," the old radio dreams live again. **PM**

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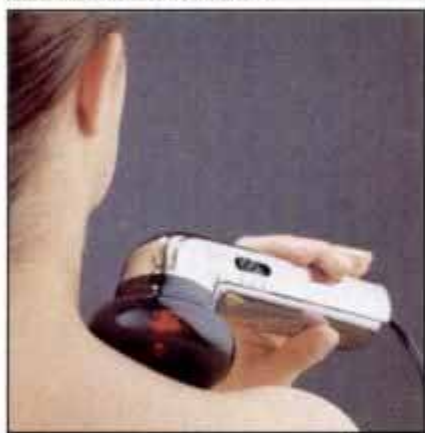
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# PM GOES RACING—AGAIN

BY TONY SWAN, Automotive Editor



● “Here we go again” is one way of looking at our 1992 motorsports activities. As in years past, we’ll be spending a heavy proportion of our summer at racetracks around the country.

But a more accurate way of looking at it is: “Here we go again, but much faster.” This summer PM will be on board with Dodge and the Archer Brothers as a sponsor in the Sports Car Club of America Tide Trans-Am Tour.

We’re excited about this for a number of reasons.

## Trans-Am tradition

Tops on this list is the series itself. The Trans-Am series has traditionally produced some very fierce racing, and after watching the recent opener at Long Beach, we’re looking for one of the most closely contested campaigns in years.

One of the reasons we expect the campaign to be a particularly close-run affair is because our team is in it. The ’92 season marks Chrysler’s first Trans-Am participation in 22 years.

We’re excited to be backing a team that knows how to win. Although they’re newcomers to this series, brothers Bobby and Tommy Archer have been consistent front-runners in every kind of racing they’ve tackled, from road courses to dirt tracks to circuits plowed out on frozen lakes.

However, the Archers are the first to admit that shifting to the Trans-Am is a big upshift indeed. It requires more preparation, more skilled help, more horsepower—lots more horse-

power—and, most of all, more money.

Moreover, the top teams they’ll be challenging have had considerably more experience at this game, and, as a result, a lot more development behind their cars. The Archer Brothers’ Dodge program got the green light last November, and with a target date of April 11 (Long Beach), they were already strapped for time.

But when Trans-Am followers suggested that the Archers’ compressed development schedule and lack of experience with this series might relegate them to the also-ran category, the boys from Duluth just smiled.

“They just don’t know about our work ethic,” said Bobby.



Brothers Bobby (top, left) and Tommy Archer (right) made their Trans-Am debut at Long Beach. POPULAR MECHANICS logo (above) will ride with the Archers throughout the ’92 season. In the season opener at Long Beach, Bobby (right) DNF thanks to a failed steering rack.



## The cars

There are two of them—one wearing No. 3, for Bobby Archer, the other, No. 32, for Tommy. Dodge calls them Daytonas, and if you look hard, you can see some vague family resemblance, although there’s also a lot of Viper in that nose.

But these Daytonas don’t have much in common with the ones you see in showrooms, something that’s true of the Camaros and Mustangs running against them. Like all the Trans-Am cars, the Archer Brothers’ Daytonas are purpose-built racing machines. If you really wanted to, you could duplicate any of the Trans-Am cars for about \$200,000 a pop.

## Dodge power

You’d have more trouble duplicating the engine. This is the only team running Dodge power, a 310-cu.-in. version of the 318-cu.-in. Magnum V8.

The engines are built by Joey Ar-



Trans-Am state-of-the-art hardware in Archer Brothers' Dodge Daytonas include Hewland 5-speed gearbox (right), no-nonsense array of instruments (left) and rugged tube-frame chassis by Riley and Scott. Chassis refinements include cockpit-adjustable antiroll bars. Massive 13-in. Alcon brake rotors are ventilated and cross-drilled for cooling. Calipers put a 4-piston squeeze on rotors with Brake Tech carbon pads.

ington, son of NASCAR engine man Buddy Arrington, which means there's a wealth of Southern super-speedway experience.

Horsepower? Well, defending champion Scott Sharp publicly admits to 570 hp in the Duracell Camaro Chevy V8, but anyone connected with the series will tell you that 600 hp is the absolute minimum for a competitive car. The Archers peg theirs at 605 hp, which makes for some pretty impressive go-power in a car that weighs about 2550 pounds.

From the flywheel back, the Daytonas reflect state-of-the-art, but generally available, Trans-Am technology: Power goes from the crankshaft to a 5½-in. Tilton multiplate clutch, through a Hewland 5-speed gearbox, down a Quartermaster aluminum driveshaft to a Salisbury locker diff.

### Championship chassis

All this powertrain hardware rides in a rectangular-tube steel chassis built by Riley and Scott, the same firm that supplies Sharp and his teammate Jack Baldwin, the '92 series runner-up.

Suspension is double A-arms, front and rear, with Eibach springs and ad-

justable Bilstein shocks with remote gas reservoirs.

There are also front and rear anti-roll bars. Both are cockpit adjustable.

The Alcon brakes, designed for merciless use in the hell-for-leather world of 100-mile sprint racing, are massive, with 13-in. rotors, ventilated and cross-drilled, 4-piston calipers and Brake Tech carbon pads.

### The race

Like many of the dates on this year's schedule, the Trans-Am cars ran as a supporting event for the IndyCar race at Long Beach. What this adds up to is limited track time, making chassis tuning extremely difficult for a new team with a new car.

The difficulties were compounded for Bobby Archer when engine problems limited his first practice session to four laps. But Tommy hustled his way into the Kenwood Fast Five qualifiers with the fifth-fastest time at an average of 89.958 mph, 0.8 seconds behind polesitter Robby Gordon.

Bobby's poor luck persisted in the race Saturday afternoon when a weld came apart in the steering rack with nine laps left.

Tommy, meanwhile, found himself in a long, fender-banging duel with the Camaro of veteran Les Lindley. Although he sank as far as seventh, Tommy came back to reclaim fifth.

While this may not seem a particularly auspicious debut, it was clear that veteran Trans-Am campaigners were looking at the Archer effort with new respect. It was also clear that the Archers were not at all discouraged.

"We're in this series to win," said Tommy. We'll keep you posted. **PM**

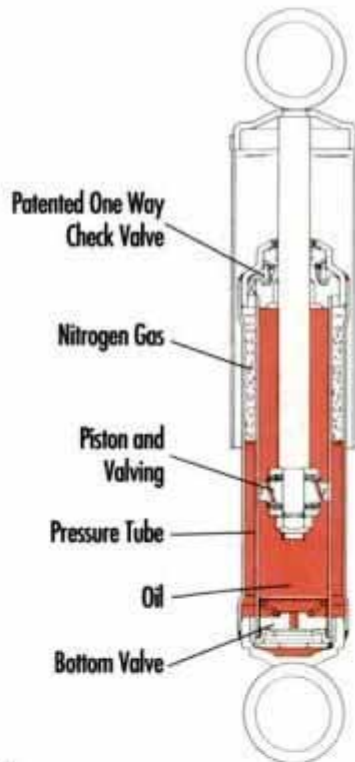


The 310-cu.-in. V8s are built by Arrington.



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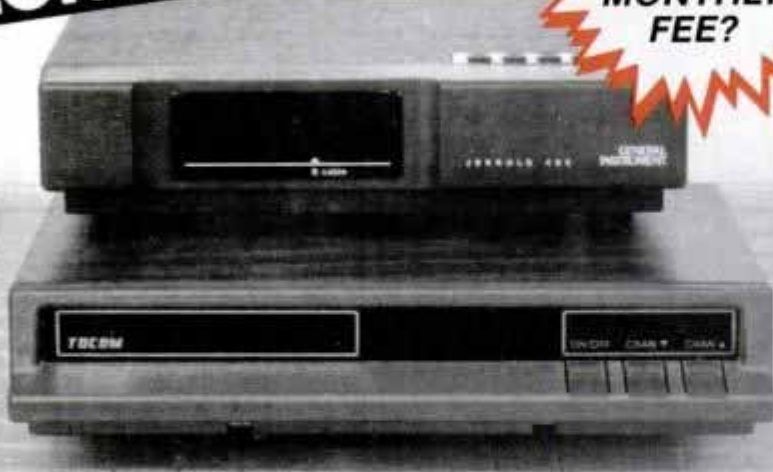
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The Alternative

## STRIKE EAGLE (Continued from page 33)

taxiing off toward the runway, Slammer is bustling through his litany of preflight checks, and I have nearly forgotten that in real life I am a magazine editor.

### Liftoff

Neckless's plane lines up to the right of and a little behind us on the runway for a formation takeoff. Mohawk 61 and Mohawk 62 have clearance from the tower. Slammer advances the throttles to full military power, the digital engine-management system meters in a healthy shot of fuel, and the acceleration comes on smooth and strong. "Two good engines, two good nozzles," I hear him say as speed builds, and at about 120 knots, we nose up and rise. The transition to flight is so seamless it feels like we've just rolled up a ramp into the sky.

Climbing steeply through a gray cloud deck at about 400 knots, the plane gives an incredible sense of solidity and tightly controlled power. The airframe is perfectly unyielding to turbulence, but the control surfaces twitch as if alive, responding to corrections from the computerized flight control system as we muscle our way fluidly through the air.

We level off at 16,000 ft. and slow down to let Neckless catch up after completing a systems check on his jet. He takes the lead while we make sure all is well with our aircraft, then we resume formation. As Mohawk 62 noses around behind us like a curious shark, I become aware of how utterly exposed we all are to the open sky. I can see Neckless and Killer plainly, their heads and shoulders poking up into the sunlight above the low-cut cockpit walls.

"Your jet," says Slammer, snapping me out of my reverie. My grip tightens on the stick and split throttles as I ponder my first control input. A tentative nudge of the stick to one side and 40,000 pounds of airplane tilts with exquisite precision. "Watch your wingman," says Slammer, reminding me that erratic flying could make life difficult for Neckless.

It takes only a couple of minutes to get a feel for the plane. The throttles seem a little sticky at first, making it hard to peg the airspeed I want, but the stick's action is wonderfully smooth, and the responses intuitively predictable. In fact, it's easier to fly an F-15E than the little Cessnas I'm accustomed to buzzing around in. No need to bother with trim wheels, carburetor heaters or an anemic engine's inability to climb straight up. And the only time you need to touch the E's rudder pedals is when you want to override the flight computer to do



something unorthodox. The plane seems ready to do anything you can think of, and to know instinctively what you want from it. "Carb heat on," I joke as I throttle back and descend toward the cloud deck below.

Slammer takes it, and we level off at about 1000 ft., racing out over the ocean past Cape Fear. He splits off from Neckless into a wide tactical formation, and begins to wring the jet out a bit. A couple of short, abrupt turns and then a longer, tighter one. The g-suit bladders pulsate to life, squeezing my legs and gut hard enough that my feet throb as if tourniquetted. Occasionally, I catch flashes of Mohawk 62 silhouetted alongside us between the gray clouds and the leaden sea, as we claw around turns like a pair of greyhounds.

Then Slammer levels out and shoves the throttles into afterburner. The engines respond with a muffled groan, and in an eyeblink, the air-speed readout on the HUD repeater goes from 540 knots to 680. We've just gone supersonic, but the only indication of it in the still-quiet cockpit is the machmeter ticking past one.

The jet can lose speed even faster, as Slammer demonstrates by snapping the throttles back to idle and flipping back the speedbrake switch. A panel of graphite composite pokes into the airstream behind me, and I'm thrown forward against my harness.

### BFM in the MOA

We press on into the practice area, and begin to mix it up with Neckless and Killer. Slammer swivels his head and cranes his neck wildly to keep our adversaries in view, and the maneuvers are growing steadily more violent. We clench our muscles against our g-suits and breathe in labored puffs to keep the blood from draining from our heads, while the horizon rocks crazily. Gradually, I'm coming to grips with some of the painful realities of this glamorous profession.

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What few people realize is the extent to which physical conditioning determines an aircrew's ability to cope with this environment and prevail in combat. A physiology briefer who prepared me for the flight referred to fighter pilots as professional aero-

*(Please turn to page 106)*

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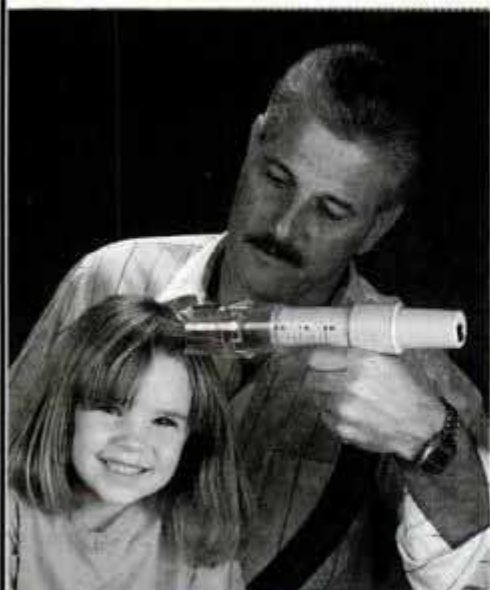
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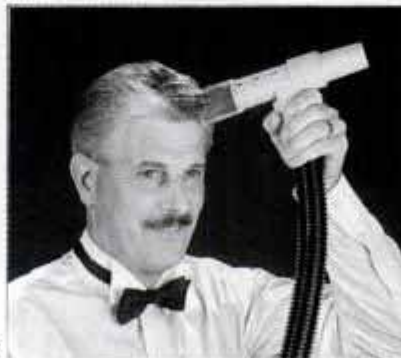


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## STRIKE EAGLE

(Continued from page 105)

space athletes. You can't just zip on a g-suit and expect to do what they do.

At one point, during a lull in the mock combat, Slammer lets me take the airplane again. "Pull on the pole all you want to," he says. I'm already pretty shaken up, but in the name of journalism, I push the stick to the right. The jet obediently rolls 90° onto its side, and continues to barrel ahead as easily as if it were upright. Then gradually I tug back. Our turning circle tightens, the g meter climbs and the steady hiss of air rushing past us becomes a gently shuddering groan. Close to my limit, I roll out and, misunderstanding the symbology on the HUD, climb several thousand ft. without even realizing it. Slammer brings the situation to my attention, and I shove the stick forward a little too briskly, the negative gs tossing my organs up toward my head. "Some neggies!" says Slammer gleefully.

My response is a little less enthusiastic. I shut off my mike, rip the oxygen mask from my face, and vomit neatly into a plastic bag kept handy for the purpose. I'd been told there was a good chance this would happen. People around the squadron said that even experienced aircrewmembers sometimes have the same problem when they haven't flown in awhile.

## Back to Earth

A little more BFM, and the computer-synthesized voice the pilots call Bitchin' Betty says, "Bingo fuel," signaling the time to head home.

On the way, Slammer demonstrates the mesmerizing powers of the F-15E's radar. With Seymour Johnson still 7 or 8 miles away, he switches from air-to-air to air-to-ground mode, and a fan-shaped image of the terrain ahead is painted across our screens. He boxes off part of the picture with his side controller, and snaps the trigger. A timer counts down the seconds as the radar gathers data, then a crisply etched bird's-eye view of the airfield appears. The buildings, runway, taxiways, even bulldozers working nearby are plainly visible. Just by moving a cursor, Slammer could now target any of them. Instead, he designates a runway intersection, providing a position fix to update the inertial navigator as we head for the field.

By the time we land, I'm thoroughly whipped, limp with fatigue and nausea. But with a breath of crisp evening air as the canopy rises, I feel better. I pull myself wearily from the cockpit, and I already have the overpowering impulse to ask, "When can I do this again?"

PM

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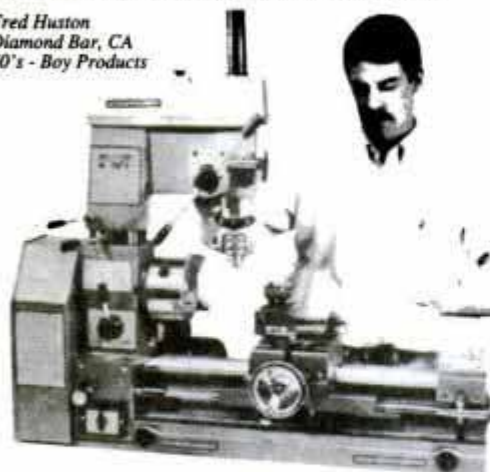
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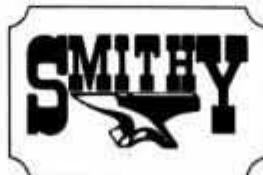
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### FAX MACHINE

You can fax written mail to us if you have access to a fax machine. Our fax number is (212) 586-5562, and is available 24 hours a day.

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You can call the PM computer any day between 6 pm and 8 am (only Eastern time. The number is (212) 582-8369. Once you're on line, you can leave messages for specific editors, or direct inquiries and comments to a specific department. The department bulletin board also allows you to share your thoughts with other readers who call in.

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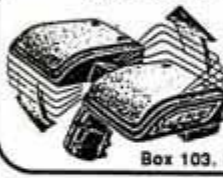
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