

Popular Mechanics

APRIL 1995

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FIRST DRIVE!
'96 CHRYSLER
MINIVAN

EVERYONE'S
GUIDE TO
THE

INTERNET

- What It Is
- How It Works
- How To Use It
- How To Start Now

COOL STUFF YOU
CAN BUY
Great Gifts From
the CIA And KGB

DON'T BUY A
6 CYLINDER SEDAN
until You Read Our
Head-to-Head Shootout

HOME IMPROVEMENT GUIDE
STATE LANDSCAPING
FOR ANY HOME
Plant A Garden • Build A Deck
Lay A Walkway • Install A Pool



T
HERE ONCE WAS A GUY NAMED CLYDE,



WHO WAS SEARCHING FOR A COOL

ONE DAY HIS HOPES SOARED,

WHEN HE DROVE THE RANGER FROM FORD



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Popular Mechanics



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EDITOR'S NOTES

● The Internet? What the heck is the Internet? I had heard the term often enough. But no one seemed to be able to really explain it to me. "Well, it's kind of like all the big computers in the world hooked together by telephone" is about the closest I got to an understandable answer. But if that was the case, why were people telling me that I needed to know how to get on the Internet? Why did I have to be able to get onto NASA's computer network, or the one at the University of Kuala Lumpur? And if it was just big computers, why were people telling me that *Time* magazine was on the Internet, so POPULAR MECHANICS should be "up there" too? I asked Senior Correspondent Abe Dane to look into it for us—and for you, since I suspected you might be having some of the same insecurities that I was. Dane, fresh back from a Knight Fellowship at the Massachusetts Institute of Technology, was game for the task. While at MIT, he had used the Internet extensively as an information source and as a communications medium. The result of his efforts these past few months is not only his cover story this month but also our own POPULAR MECHANICS site on the Internet, which he, and his brother, Mike, developed for us. Check page 66 for the whole story.... In January, we tested all the big family sedans for you. But many of you said you just didn't want that much car—or that much cost. You asked what we had in a size small or medium. So here we are again with another of our exclusive comparison tests. This time, Automotive Editor Don Chaikin and his staff gathered up 10 of the most popular cars in



The Danes, Abe and Michael, surf the Net.

America—small and midsize V6-powered sedans—and ran them through their paces to help you make an intelligent buying decision. The results beginning on page 54 may surprise you. . . . The trouble with publishing a magazine like POPULAR MECHANICS is that I'm writing this three months before you're reading it. And everything in the magazine was put there three months ago. So by the time you read this, the America³ team might already be out of the America's Cup competition in San Diego—or it might be in the thick of the finals. I hope it's the latter because the all-female team is unique and so is the boat design. Our Boating Editor, Joe Skorupa, spent a week with both the boat and crew to bring you the report that begins on page 60. Happily, we don't all have to consult the computers before we hit the water. . . . It's time to start the selection process for our 1996 Design & Engineering Awards. All the information you need is on page 73. You'll find the process very simple. Anyone can nominate anything. There really are no rules. If you're interested, check our call for entries. You have until the end of August to participate. . . . It's spring and our thoughts naturally turn to the outdoors. And so does our annual Home Improvement Guide, one of the most popular of all the special sections we publish each year. This year, Home Improvement Editor Steve Willson and his team look at outdoor beautification, from deck building to herb planting, and it all starts on page 91. It's a great way to get your green thumb going for the summer. Till next time.



Joe Oldham

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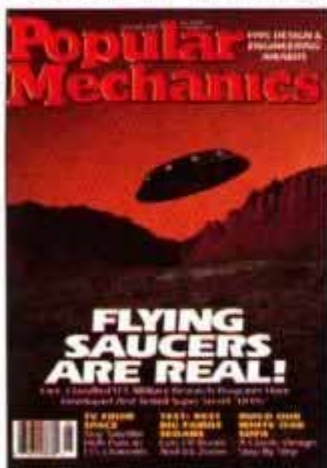
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LETTERS

Look To The Skies



Your January cover story about UFOs is not accurate. None of the craft pictured in the article became airborne for any period of time. These were, as the article correctly states, experimental craft. These craft have had nothing to do with the UFO/flying saucer phenomenon of the past or present. The experimental craft of yesteryear and the present have not made an influence on the classic sighting cases that are still listed as unknown. The experimental craft depicted in the article, and more current ones that were not, are known to us at Project Blue Book, a civilian continuation of the original U.S. Air Force project. We receive and evaluate reports of UFO sightings, and none of the experimental craft has created any reports that we investigate.

WILLIAM PITTS, DIRECTOR
PROJECT BLUE BOOK
FORT SMITH, AR

I'm afraid you missed the point of the article. What we wanted to show was that these types of aircraft have been explored on an ongoing basis, and this is only what we know about. There is no telling what

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

has been built and flown under the aegis of a Pentagon black program. It's not too much of a stretch to think that flying saucers have been built and have been flying for many years. I use the F-117A Stealth fighter as a good example. The plane was built and was operational for 10 years before anyone knew about it. —Ed.

No Juice

Give me a break! The O.J. Simpson debacle has been run into the ground and through the dirt by every other known form of media in their headlong rush to join the tabloids. Why did you have to accompany them? ROBERT I. EDGAR
MONMOUTH, OR

Please, if you want to show us what is new in the courtroom, okay, but could you spare us from this circus?

JACK GHISELLINI
ARTESIA, CA

Come on, get back to science and technology like the great story you did on the SP diesel locomotive.

TOM KING
APTOS, CA

Ye gads, what's next?

TOM E. MOORE
CLARKSVILLE, VA

How about an article on the Heidi Fleiss trial?

—Ed.

The article about the high-tech courtroom was not necessary. I hope this wasn't an attempt to increase sales, while allowing the reputation of POPULAR MECHANICS to suffer. PM is on top of a pedestal compared to tabloids and I hope it will stay that way.

TEDDY WONG
WESTMINSTER, CA

Gun Patrol

In this era of the gun-bashing media, your unbiased articles on new and different firearms are refreshing. Keep it up.

JOHN D. OLFIER
GRASS LAKE, MI

POPULAR MECHANICS is always enjoyed by our family, but I am extremely disappointed in your decision to include an ad for a handgun. In my many years, I've never seen an advertise-

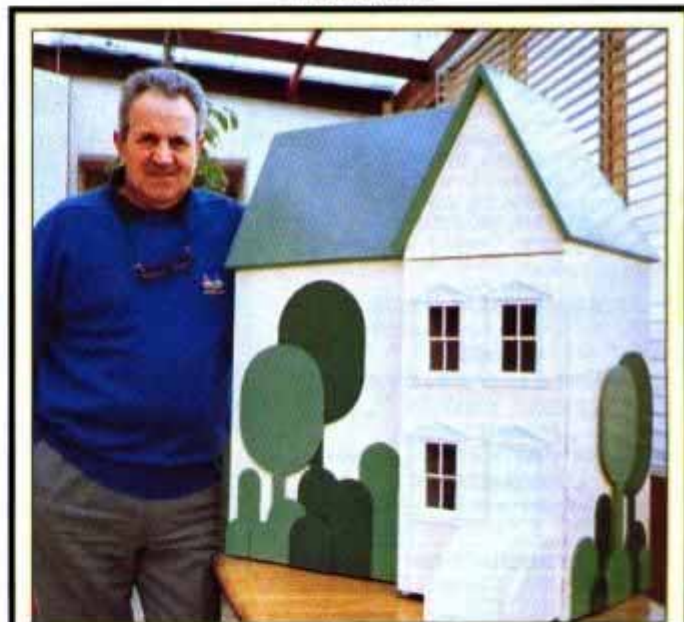
ment for anything other than a hunting rifle in any magazine or newspaper that might be on a coffee table—rather than under a mattress. The young and older folks of today's society don't need to be tempted to own firearms.

J.M. MANSEN
AUSTIN, TX

So much for the First and Second Amendments to the U.S. Constitution.

—Ed.

Advertisement



STANLEY

Reader Project Of The Month

For many years now I have been a regular subscriber to POPULAR MECHANICS and look forward to each monthly issue. When there is an article that is within my interest, I take it out and file it for future reference. I built this dollhouse/storage unit from plans featured in your June 1981 issue. It was my granddaughter's Christmas present. Long may your magazine prosper.

JOHN McDUGALL
BISHOP BRIGGS
GLASGOW, SCOTLAND

If your project is chosen as Reader Project of the Month, you'll receive a Stanley Home Improvement Kit, complete with hand and decorating tools, and an electric stapler/nailer, valued at more than \$200. For your project to be considered, please send a clear, color photo and brief description to: Reader Project of the Month, Popular Mechanics, 224 W. 57th St., New York, NY 10019.



If a 5,000 ton train can stay on its track, how come your closet door can't?

Right now, hundreds of trains are speeding across the country. Wheels holding firmly to their tracks. While at the same time, simple closet doors are falling off their tracks. Ridiculous.

Enter the Stanley Accent Mirror Door. Designed with an anti-jump track to prevent slipping. Plus wheels that actually roll without jamming (What a concept). In short, this closet door actually stays put. And when you consider it's been opened and closed over 100,000 times in our testing facility (equivalent to 28 years of use), you can bet it's going to be around to see quite a number of fashion crises in your home.

Because at Stanley, our approach to building products has always been rather simple. We're not going to make something unless we make it better than anyone else. Now if that makes us sound demanding, so be it.

Because that's exactly what we are.

Here at Stanley, research always comes before design. Engineering always comes before aesthetics. Testing always comes before sales.

In our humble opinion, that's the only way there is to create the kind of products we strive for. Like our screwdrivers with ergonomically

molded grips for increased torque. And exterior doors that can stand up to hundreds of pounds of pressure.

At Stanley, our goal has always been perfection. You can see that determination in everything we do. After all, why settle for inferiority when you can settle for superiority?

STANLEY
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The Accent Mirror Door from Stanley.
Designed with a special anti-jump track.

TIME MACHINE

90 YEARS AGO: APRIL 1905



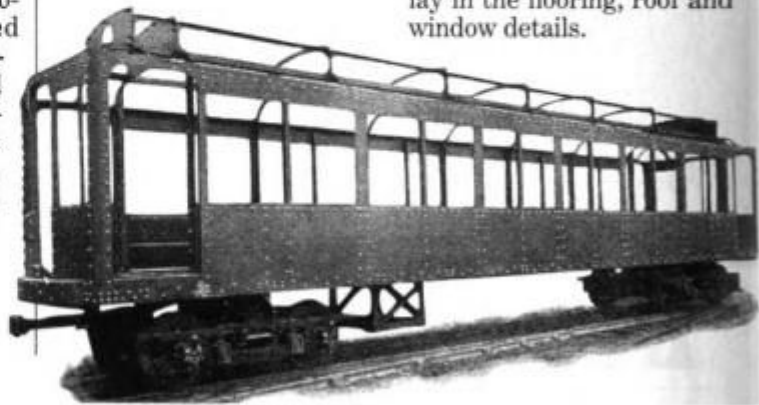
Pyro Drama

Welding was one of the hottest technologies of the early 20th century—not just for steel, but for the stage as well. The aluminothermic process riveted audiences in London theaters. Performers tossed thermite and barium superoxide into a crucible and ignited the powder. Temperatures burned past 5000° F, and a lump of molten iron formed. As a flourish, the entertainers then beat the iron into a horseshoe.

Metal Box

Meanwhile, ironworkers banged out the first all-steel cars for Chicago's elevated railroad. Engineers

managed to whittle down the frame design to match the 48,000-pound weight of the old wooden cars. The only wood in the vehicles lay in the flooring, roof and window details.



60 YEARS AGO: APRIL 1935



Globe Trotters

Around the world in 10 days? That was the prospect as great flying boats entered service. Glenn Martin's clippers would soon conquer the Pacific for Pan Am. Meanwhile, the French were rushing to complete 80-passenger flying boats for Africa-to-Brazil routes. But the sea-crossing aircraft that everyone awaited would dwarf all these, its dimensions equal to an oceanliner. This was the zeppelin LZ 129, later christened *Hindenburg*.



Harmony." The driver perched in a streamlined crow's nest, while the main cabin sported an aircraft rudder.

Air Bus

Aerodynamic design blew into Hollywood prop shops. Case in point: the snazzy touring bus for the orchestra in Paramount's "Stolen



30 YEARS AGO: APRIL 1965



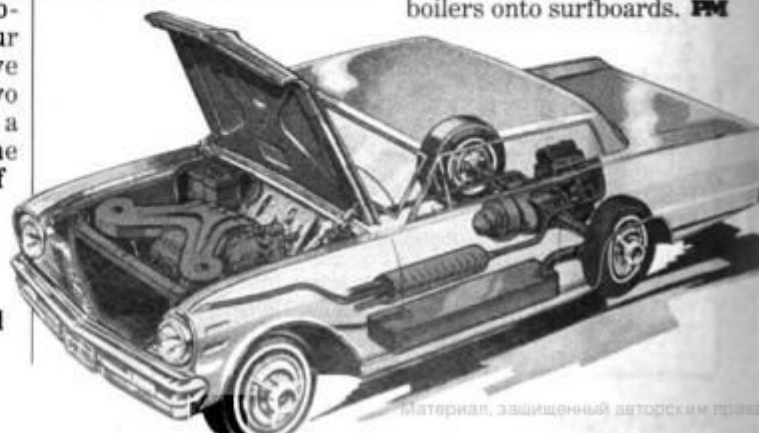
Shed Turning

While the patio emerged as a focus of family entertaining during the 1960s, the garage remained detached and locked into its auto-storing function. With our fondness for garages, we decided to merge the two into a cookout center as a 4-part reader project. The garage's overhanging roof sheltered a sink and cabinets for culinary gear and patio furniture. A deluxe version, tailored for bricklayers, featured a hooded barbecue.

Steam Rollers

While steam-driven cars had puffed around turn-of-the-century streets, they staged a last-gasp comeback

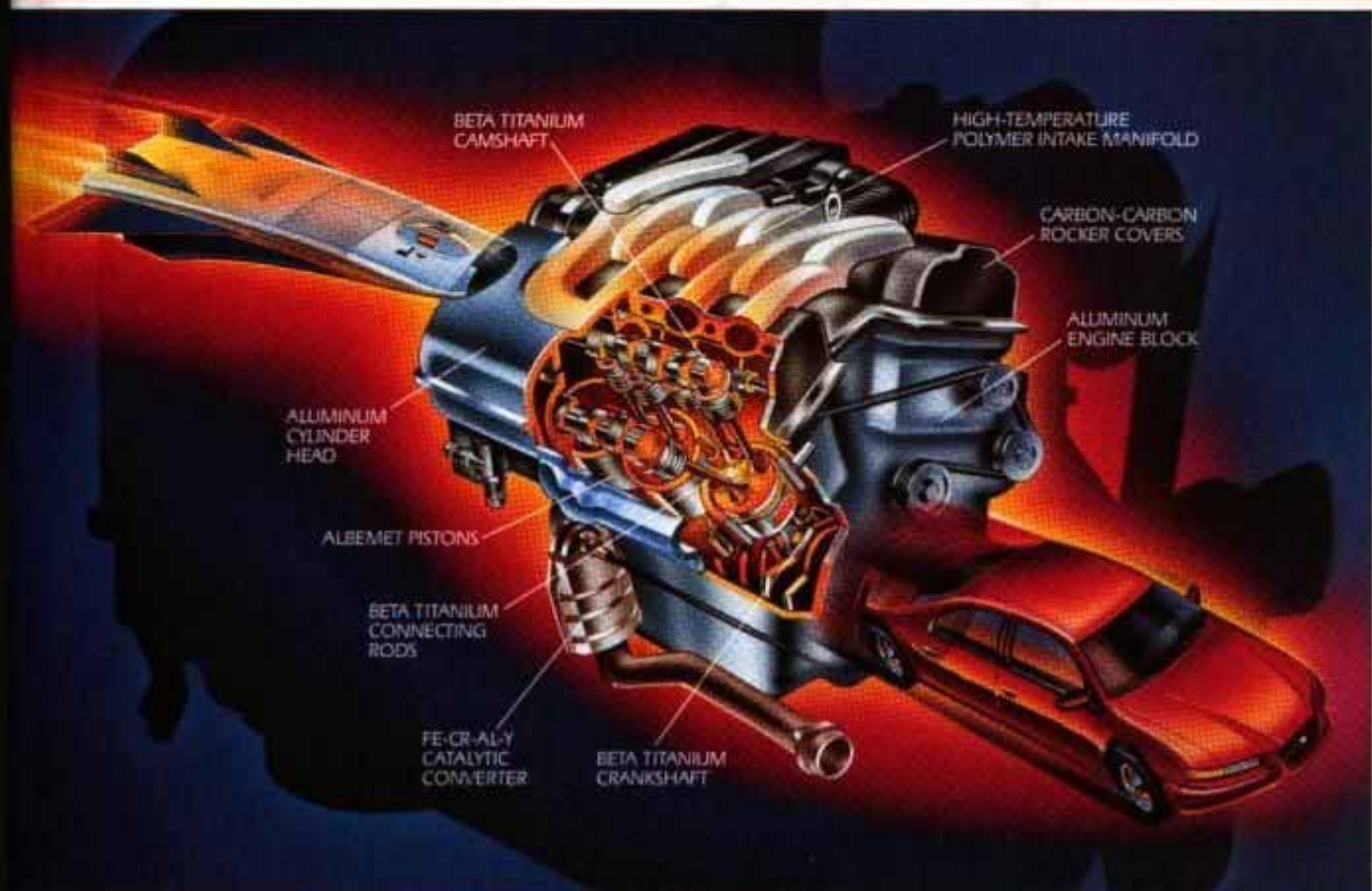
in the mid-1960s. Engineers drew up plans for steam-driven Bonneville racers and Buicks. But tinkerers took the idea too far, grafting boilers onto surfboards. **PM**



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TECH UPDATE

News Of Tomorrow's Technology Today



Space-Plane Makers Building Flyweight V8

BATTLEBORO, MA—A 200-hp V8 engine light enough for a person to hold? It's not what engineers foresaw when they laid plans for the National Aero-Space Plane (NASP). But now that budget cuts have grounded the NASP program, the engine may be the best they can come up with.

Led by Texas Instruments, a consortium of materials companies will bring the powerplant to life under a NASA technology-transfer contract. Callaway Advanced Technology of Old Lyme, Connecticut, is building the engine. It will measure only 16 in. long and 15 in. across the V. By contrast, a small-block Chevrolet V8 runs 24 x 28 in. According to Texas Instruments, the target weight for the engine is 100 pounds—half the weight of an equivalent conventional powerplant.

Key to the engine's trimness is the use of exotic materials concocted for NASP. These include advanced com-

posites, polymers and alloys of aluminum, titanium and rare-earth metals. With them the engine could attain a 20% improvement in efficiency. Not only will the materials lighten moving parts, they'll also allow the engine to run hotter and burn fuel more thoroughly.

By operating at higher temperatures, however, the engine will spew more oxides of nitrogen. So the consortium is also developing a new catalytic converter to handle the extra emissions. The device will feature a metallic (rather than ceramic)

Space-plane materials will dramatically reduce the size of a V8 automotive engine and cut its weight in half.

substrate for the platinum-group metals that do the actual conversion. Iron, chromium, aluminum and yttrium will alloy into the substrate's composition. More resistant to thermal shock, the metallic converter can nestle closer to the engine and reach optimum temperature faster. This will cut nitrogen-oxide emissions by 40%, developers claim.

The consortium aims to finish the advanced engine by 1997.

Highlights This Month

- **Wind Bells**—Tornado sensors sound the alarms.
- **Rotor Raider**—Special forces get the V-22 Osprey.
- **Best Of Lock**—Computer chip foils safecrackers.
- **Flight Plant**—Airport doubles as factory.
- **Braves' New World**—Olympic stadium conversion.
- **Car Crazy**—Toyota's flights of automotive fancy.
- **Blimping Home**—Backyard airship from Down Under.

Writer/Editor: Gregory T. Pope
Reporters: Phillip Chien, Mike Fillon, Barry Rosenberg, Bob Scheier, Herb Shuldiner

Finally the phrase "a lot of" means something.

Anyone can make an expensive car. The hard part is to make a car with the quality and features you want, the safety you need, at a price that almost anyone can afford. That's the all new Chevy Lumina.

It comes with just about everything you'd ever want, standard. Its exceptionally quiet and spacious interior features room for six, cloth seats, air conditioning, power door locks, Tilt-Wheel,TM



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160-horsepower sequential-port fuel-injected V6.

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Listening For Twisters

UNIVERSITY, MS—Tornado season has again whirled into the Midwest, bringing the threat of injury and death. And while the best way to avoid being killed by a tornado is to stay out of its path, the windstorms behave erratically and move with alarming speed.

A new device should give a 30- to 90-second warning that a twister is approaching. The Tornado Alert System, invented by University of Mississippi physicist Henry Bass, features an acoustic monitor bolted onto a building's southwest side—almost always the direction from which tornadoes strike.



Tornado alert recognizes trait frequencies of approaching storm and triggers high-decibel alarm.

The sensor picks up the unique sound signature of a tornado and feeds the data to an internal unit. A

microprocessor determines whether the data falls within tornado parameters. If so, an alarm goes off.

Return Of The Hiller Copters



HILLER AIRCRAFT PHOTO

Five-seat UH-12E5 will revitalize the Hiller name.

Flying Platform and the X-18 tilt-wing, founded the company in 1942. During its heyday in the early 1960s, Hiller ranked as the third biggest helicopter maker in the world. The company fell on hard times, though, and was sold several times before Hiller's son, backed by Thai investors, bought the outfit last year. Nearly 1000 UH-12Es still fly, mostly for industry and agriculture.

NEWARK, CA—One of the first nameplates in swash-plate history is back. Hiller Aircraft plans to crank out its UH-12E from a plant in the San Francisco Bay area and to introduce a new 5-seat version.

Stanley Hiller, who pioneered vertical flight with such oddities as the

Powerplant Powerhouse



LONDON/PICTURES SERVICE PHOTO

Engineers put monster Trent 800 through its paces at Rolls-Royce Test Bed 57.

DERBY, ENGLAND—The first engine certified airworthy at a 90,000-pound thrust rating will fly this May aboard a Boeing 777 (see *Tech Update*, page 30, June '94). The Rolls-Royce Trent 800 officially enters in service next year.

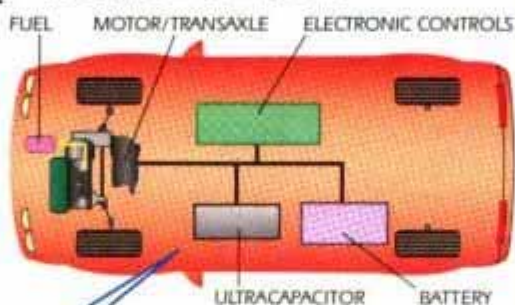
The engine rates 6000 pounds higher than the Pratt & Whitney PW4084 and General Electric's GE90, although all three engines will likely evolve to higher thrust ratings. Rolls says its powerplant, as is, can probably generate 95,000 pounds of thrust with little more than an extra push on the throttle.

Available ahead of schedule, the Trent 800 can thank its smaller cousin—the Trent 700—for its troublefree gestation. The 700 recently entered service aboard Airbus A330.

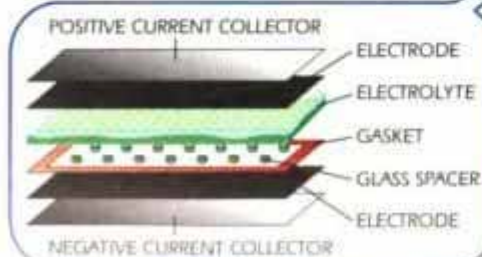
Electric Pickup With Punch

LOS GATOS, CA—To help you merge your electric car into freeway traffic, the ultracapacitor is charging out of the defense world into automotive labs.

Instead of separating charged plates with insulating material, ultracapacitors (see *Tech Update*, page 21, July '93) store electricity along the surface between a composite electrode



PH ILLUSTRATION BY KURT NOVAK



Ultracapacitor will stack cells like this one that share current collectors to save weight.

and an electrolytic fluid. Microscopic pores and folds in the electrode add up to a deceptively spacious surface area.

Working with Ford, Pinnacle Research Institute has designed ultracapacitor cells that could stack up in series to store 300 volts. Each would have bipolar current collectors that would attract negative charges in one cell and positive charges in the next.



The end justifies the means.

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seagram

Special Forces To Ride The Osprey

WASHINGTON, DC—The Marines are looking for a few good Ospreys, and they're going to get them. But they aren't the only ones: Among the first 40 V-22 Ospreys, seven long-range versions will wind up with Special Operations Command.

Having shaved the tilt-rotor's weight to less than 16 tons, engineers have frozen the Osprey's final design, and Bell Boeing is now building four pre-production aircraft. Right now only one V-22 is flying. Since a full-scale-development model suffered a fatal crash in 1992, the swiveling engine nacelles have undergone modifications. Investigators concluded that the tilt-rotor concept wasn't at fault.

The special-forces Osprey—the CV-22—will carry a bounty of commando features, including a nose-mounted .50-caliber gun, terrain-following radar, self-sealing fuel tanks and extra radio gear. The aircraft will replace both C-130 transport planes and MH-53 helicopters.



CV-22 will carry out long-range missions for Special Operations Command.

World's Smartest Lock

LEXINGTON, KY—Safecrackers will have to field a whole new arsenal of lock-picking tools to defeat the latest generation of computer-controlled combination locks. Take the X-07, built by Mas-Hamilton. It provides up to 500 billion possible combinations.

Instead of mechanical tumblers, the X-07 contains a generator that powers an Intel chip with nonvolatile memory. The electricity comes



X-07 lock is built around an Intel microprocessor powered by an internal generator.

from four twists of the dial. After the right combination is entered, a capacitor powers a stepper motor, which turns a gear to allow the user to retract the bolt.

The X-07 is so finely tuned that it can sense the difference between a dialing hand and a robotic dialer. It also resists 125,000-volt shocks and magnetic attacks. And the lock records the number of unsuccessful attempts to open it.

Space-Station Fabrication

HUNTSVILLE, AL—The International Space Station is taking shape quickly now that political support has firmed up.

At NASA's Marshall Space Flight Center, Boeing's variable-polarity plasma welders are fashioning the first of three habitation modules. The first docking port—a node that connects the modules—is nearing completion.

By this September, Boeing figures to have made about 23 tons of space-station hardware. The Russians are also building some key modules, such as the large central laboratory. Under the current schedule, a Proton rocket will launch the first flight component—a Russian-made power and propulsion block—in November 1997.

Crane hoists cylinder of radial docking port prior to mating with aft bulkhead at right.



Kids Unleashed



BeeperKid separates into two wireless modems that operate at non-radio frequency.

LONG BEACH, CA—Every parent's nightmare is losing a child in a crowd. But a device called BeeperKid should ease this fear.

The proximity sensor separates into two clips. The parent's unit beeps if the child wanders beyond a 15-ft. radius. A+H International Products won't reveal the frequency at which BeeperKid sends and receives its digital signals. But the device works through walls and metal objects—and isn't fooled by inadvertent reflections. The company licensed the technology from defense contractor Harris Corp.

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Airport Meets Industrial Park

RALEIGH, NC—The Tar Heel State calls it the industrial facility of the future—a 15,300-acre mix of manufacturing centers and transport terminals known as Global TransPark, or GTP. The idea is to allow cargo aircraft and freight trains to load up right at the factory door.

The GTP master plan calls for a state-of-the-art cargo-handling facility, three runways—one 13,000 ft. long—and links to the national rail network via CSX and Norfolk Southern.

An electronic data interchange will provide paperless communication of orders and invoices and tracking of shipments. GTP will



Global TransPark will combine manufacturing and distribution into a one-stop industrial facility.

also serve as a waypoint in North Carolina's new information superhighway. On site will be an education and training system linked with nearby colleges—GTP is located 80 miles southeast of the Research Triangle area. Within five years, authorities believe the facility will handle nearly 100,000 tons of cargo.



GLOBAL TRANSPARK AUTHORITY ILLUSTRATIONS

World's Fastest Powerplant

ALBUQUERQUE, NM—Run your car's engine at 500,000 rpm, and you'll melt a hole into the ground. But a micromachine carved from polycrystalline silicon can reach such speeds in a fraction of a second. Sandia National Laboratories made the micromachine.



Linkages move up and down and left and right to spin minute gear at 500,000 rpm.

A hair's width dwarfs the engine. It converts linear to rotary motion through a connecting rod that drives a toothed gear. A second linkage pulls and pushes the connecting rod to turn the gear. Both connecting rod and linkage are jerked back and forth by tiny electrostatic actuators.

The gear provides a simple, unencumbered means to supply power to other miniature devices.

SANDIA NATIONAL LABORATORIES PHOTO

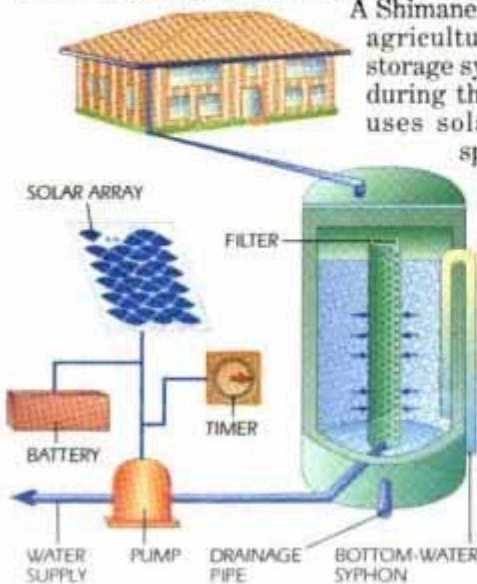
Rainwater With Sunshine

SHIMANE, JAPAN—If Japan's recent earthquake wasn't bad enough, the country suffered through a searing drought last year. As usual, the driest areas tended to be the farthest from sources of electricity to keep irrigation pumps going.

A Shimane University professor of agriculture has a solution. His storage system collects rainwater during the wet season and then uses solar power during dry spells to pump the water where it's needed.

To the traditional rain barrel, he's added new wrinkles. Solar cells and a battery collect and store energy. Filters and a syphon remove impurities. Although the water still isn't fit to drink, it's fine for watering small farm plots.

Two Japanese companies are making larger systems that can hold more than 750 gallons.



Solar-powered system collects rainwater and then pumps it when the Sun shines.

PH ILLUSTRATION BY TOM KANE

Drunk-Proofing Cars



Alcohol-monitoring steering wheel sets off car alarm if driver is drunk.

ATLANTA, GA—Cars that don't let owners drive under the influence could become reality. Biological Interaction Transportation Systems (BITS) has developed two steering wheels that monitor drivers' blood alcohol levels and react accordingly.

Both wheels measure alcohol content through sensors that soak up palm perspiration. In each case, the driver must grip the steering wheel for 10 seconds, and gloves aren't allowed. The sensors check for unusual levels of acidity that signal the presence of toxins. They then double check specifically for alcohol.

If the driver is beyond the legal limit, the systems respond. One version shuts down the engine and triggers an alarm. The other also sets off an alarm, and, if the subject attempts to drive, blinks headlights and sounds the horn every few seconds. This second system also monitors blood cholesterol and sugar levels.

BITS ILLUSTRATION

KOOL

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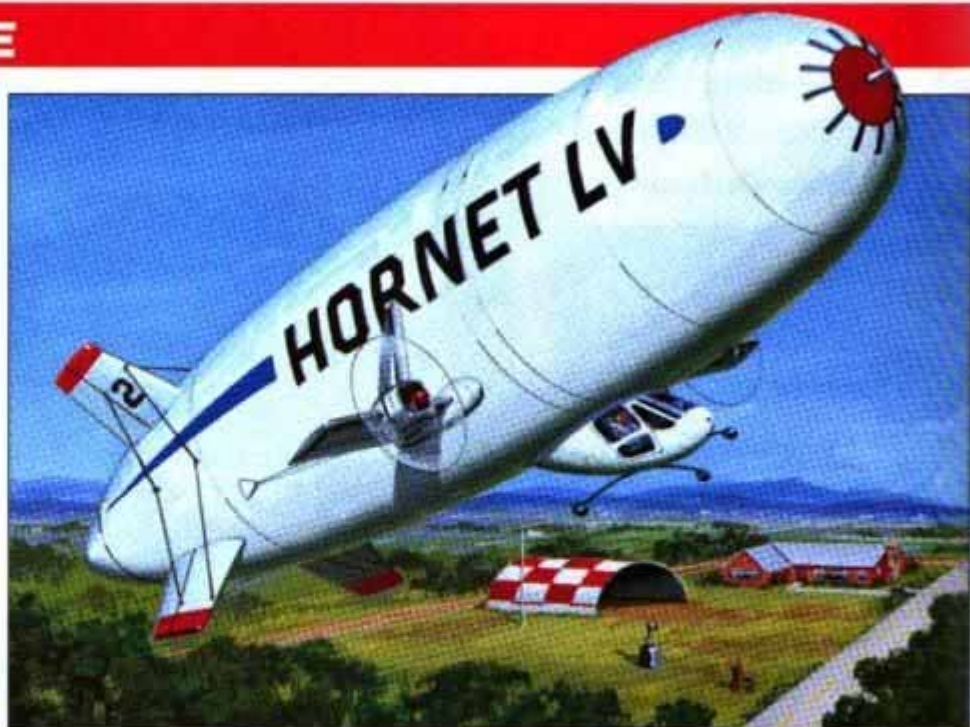
Midget Blimp For Backyard

KENSINGTON, AUSTRALIA—Always wanted to tether the Goodyear blimp to your chimney? If Advanced Hybrid Aircraft's plans take off, you soon can have the next best thing: a personal airship available in kit form.

The Hornet LV may come across as a dwarf blimp, but its roots lie in the microlight world. For one thing, it weighs only 336 pounds empty. Its tricycle-wheeled gondola looks like nothing if not a people pod from a microlight aircraft.

Vectoring stub-wings that carry the engines are the keys to its performance. With these winglets cocked 30°, the Hornet can climb at 2000 ft. per minute. The airship can reach 51-knot speeds behind a pair of 24-hp König engines.

Conceived for easy operation, the 50-ft. Hornet will remain on the ground while the pilot alights. One person can



Hornet LV combines airship grandeur with microlight convenience.

moor it to a mast or taxi it around. The Hornet is aimed at the American sport-flying market, although 726 sq. ft. of advertising space can sprawl across the airship's envelope.

The NOSE Knows All

BISHOP'S STORTFORD, ENGLAND—If you can't smell the difference between vinegar and chardonnay, you better call in the Neutronics Olfactory Sensing Equipment—a synthetic snout better known as the NOSE.

Made by Neutronics Ltd., the apparatus comprises 12 sensors, each made of an electrically conductive polymer.



Artificial nose creates olfactory fingerprints from the components in aromas.

The devices react to airborne chemicals in aromas. Different combinations of these vaporous ingredients bind to each sensor and either strengthen or subdue its electrical signal. The result: a kind of olfactory fingerprint that a computer can display visually and compare against a standard.

Perfume, cosmetics and food makers can run quality-control checks with the NOSE. The machine was originally developed for the British brewing industry.

Early Warning, Part Two

FALCON AFB, CO—The Air Force has begun tending its latest Defense Support Program early-warning satellite, launched last December. Meanwhile, the Pentagon has once again revamped its plans to replace these spacecraft (see [Tech Update, page 32, March '94](#)).

As now envisioned, the Space-Based Infrared program would loft four satellites into geosynchronous orbit and two more into a highly elliptical orbit. Extra spacecraft would join the constellation later, plying low Earth orbits to track missiles in mid-trajectory.

Russia has proposed an alternative international system—18 satellites in orbits inclined 51° off the equator. Flying 4500 miles up, the spacecraft would triangulate to predict missile trajectories.



Defense Support Program (above) will see multi-orbit replacements.

Zinc-Air Batteries Made Easy



JERUSALEM, ISRAEL—Although zinc-air batteries could triple the range of electric vehicles, they don't respond well to speedy recharging. Electric Fuel Ltd. plans to sidestep the problem with an off-line refueling/regeneration infrastructure. Electric Fuel's zinc-air batteries consist of 66 cassettes.

Each cassette houses a zinc anode and two cathodes that extract oxygen from air to fuel the electrochemical reaction.

Refueling-station machinery extracts spent cassettes and inserts fresh ones. The used modules go to a regeneration plant where electrowinning turns zinc oxide back into zinc.

The German Post Office is running a pilot program with 50 vehicles.



German mail vans will test Electric Fuel's zinc-air battery recharging system.

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Japan's Annual Car Freak Show



Super Egg on a roll.

TOYOTA CITY, JAPAN—Those wacky, devil-may-care engineers who brought you the Corolla and Camry are at it again. Toyota staged its 19th annual Idea Olympics last November—with the usual freewheeling results.

Consider vehicles named Aladdin's Crawling Carpet or Space Escargot, and



S.S. Twin moves any which way.

you get the idea behind the Idea Olympics. It's a chance for Toyota's engineering society to embrace creativity instead of practicality.



Radical Runner down the stretch.

Motor Skiing swiveled off with the coveted President's Award. The vehicle plowed along on a 50cc engine while the driver lurched forward to accelerate, leaned back to brake and turned his hips to hang a left or right. Engineer Kohshi

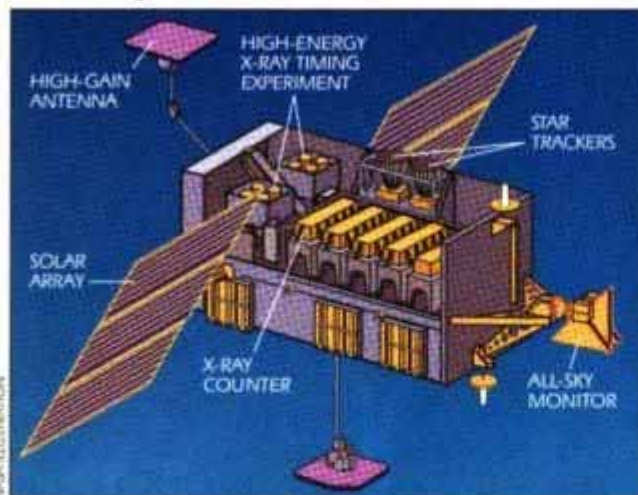
Kato believes the vehicle could aid ski instructors without putting novices out on the slopes.

Other notables? The omnidirectional S.S. Twin rolled at will on two rotating drums coated with 320 wheels. Meanwhile, the Radical Runner tiptoed on electrohydraulic lifts that raised its body over obstacles. Yellow Ceros, an amputated Toyota Soarer, reared up and roared like a lion. Finally, the wobbly Waving Vehicle Super Egg scrambled across the parking lot on oversized wheels. And, yes, a car that folds into a suitcase made an appearance.



Motor Skiing was the hippest entry.

X-Rays On A Timer



X-Ray Timing Explorer gets its own up-to-date spacecraft.

GREENBELT, MD—Remember the Extreme Ultraviolet Explorer (see Tech Update, page 15, Jan. '92)? Neither does anyone else. The satellite has performed so well it has received scant attention outside the astronomical community. Originally, shuttle astronauts were going to retrieve the spacecraft and swap new instruments into it. But why kill off a good thing? NASA decided it would be smarter just to send up a whole new spacecraft called the X-Ray Timing Explorer (XTE).

Scheduled for launch on a Delta rocket this summer, XTE will clock the arrival of X-rays from deep-space monsters like black holes and neutron stars. On-board instruments will study the radiation on time scales from microseconds to months.

Bone-Crushing Simulators

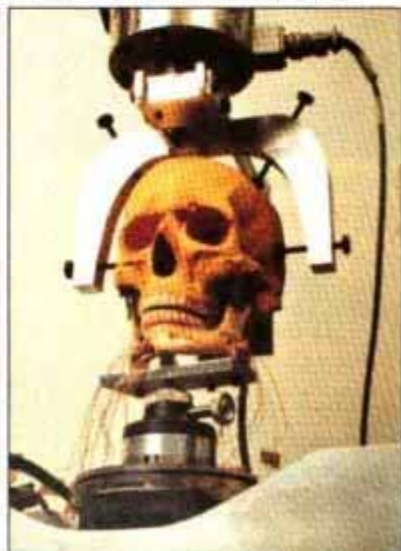
EDEN PRAIRIE, MN—How much strain can your surgically reconstructed knee take? How about your lower jaw? No need to find out the hard way—medical researchers now have machines that can simulate the wear and tear of day-to-day life.

MTS Systems, which makes stress-testing equipment for car manufacturers, has developed apparatus to duplicate body motions. In its kinematic knee-joint simulator, for example, a knee taken from a cadaver is run through squats, walking and leg-lifting exercises. Attached load cells and transducers measure the forces involved. The same equipment can test implantable joints to gauge the materials' durability.

The company makes similar apparatus to test artificial hips, surgically repaired jaws and other stress-laden body parts.



Knee simulator (above) and lower-jaw loader (right) measure durability.





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What types of vehicles are you considering?

1. Minivans only 2. Minivans & other types of vehicles

What is your primary reason for considering a minivan?

3. Family size 6. Hobbies/activities
4. Cargo space 7. Other: _____
5. Small business usage

What is the most important feature you're looking for in a minivan?

8. Built-in child seats 13. Styling
9. Cargo space 14. Vehicle with a proven track record
10. Flexible seating arrangement
11. Price/value 15. Other: _____
12. Safety features

How soon do you plan to buy or lease a new vehicle?

16. Within 3 months 18. 7 to 12 months

WHAT YOU CURRENTLY DRIVE:

Which of the following do you currently own or lease?

20. Dodge Caravan 22. Don't currently own or lease a minivan
21. Another brand of minivan

Please tell us about all your current vehicles.

Make	Model	Year	Own	Lease	Expiration Date(Mo/Yr)
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>	____/____
_____	_____	_____	<input type="checkbox"/>	<input type="checkbox"/>	____/____

ABOUT YOUR HOUSEHOLD:

What are the ages of the people in your household? Record the number of people in each of the following age groups.

Adults	Youth
_____ 19 - 29 yrs	_____ 2 yrs and under
_____ 30 - 34 yrs	_____ 3 - 5 yrs
_____ 35 - 39 yrs	_____ 6 - 12 yrs
_____ 40 - 49 yrs	_____ 13 - 18 yrs
_____ 50 - 59 yrs	
_____ 60 + yrs	23. <input type="checkbox"/> Currently expecting a baby

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24. VCR 26. Macintosh computer
25. DOS/Windows computer 27. CD-ROM computer capabilities

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Oval Converts Into Diamond

ATLANTA, GA—What do you do with an 85,000-seat Olympic stadium when the Olympics are over? Tear it down? Force-feed football into it?

Design and construction firm Heery International has conjured up a unique solution for Atlanta Stadium, now being built for the 1996 Summer Games. Crews will pull half of it down and re-



Atlanta Stadium will convert into home of the Braves.

align the remaining seats so that the Braves can play in a brand-new facility that holds 49,800.

Some of the foundations for the baseball configuration already lie in place. They're buried below the track and field, and will be excavated during the conversion.

During the partial demolition, workers will unwind and relocate the precast beams, columns and planks of the Olympic structure. Then the seats will be painstakingly shifted to face the baseball diamond.

The cauldron that held the eternal flame will remain as an Olympic legacy, as will the curved perimeter fence.

Air-Bomb Spotter



CTX 5000 CAT-scans bag and identifies explosives, highlighted in red. Technique can also spot detonators.

FOSTER CITY, CA—Ever since Pan Am Flight 103 blew up over Scotland, the Federal Aviation Administration has been scrambling to find a foolproof explosives detector. Now the FAA has certified one—the CTX 5000—to screen checked baggage.

The machine operates by computerized tomography, the same technology found in hospital CAT scanners. A bag's contents undergo analysis to determine objects' densities. The technique facilitates detection of all types of explosives, including sheets and plastics, even when cleverly concealed.

Hand Signals For Robots

ROCHESTER, NY—There's a new way to talk to robots: manual gestures. Roboticians at the University of Rochester are training their machines with a handy new technique called teleassistance.

The concept resembles teleoperation, by which joystick-wielding technicians plot out a robot's every step. In teleassistance, a sensor-laden virtual-reality glove sends information about hand motions to the robot's computer brain. It's a much easier way to show a robot how to grasp a novel object, for example, than



Rochester robot gets a hand during a training session with graduate student Polly Pook.

reprogramming it from scratch.

Combined with predefined programs that work like reflexes, teleassistance can allow a robot more autonomy than teleoperation. Operators can ultimately point to objects and let the robot take care of the details.

Singular Sensation


ST. LOUIS, MO—Is one engine shutdown every 125,000 hours a sufficient safety margin when the boss has the back seat? In the BJ-1 Vantage—a radical single-engine business jet—it better be.

Burt Rutan's Scaled Composites may build the proof-of-concept prototype for VisionAire. The 6-place all-



Vantage would need only half the maintenance of twin bizjet.

composite aircraft would fly on a Pratt & Whitney JT15D turbofan, 20 years in operation. The JT15D's shutdown rate means one failure every 250 years, assuming the aircraft flies 500 hours annually.

Vantage advantages? Fully loaded, it could take off weighing only 6500 pounds for an 830-mile flight. The plane could operate from 3000-ft. runways, permitting jet travel to airports usually open only to prop-driven aircraft. 

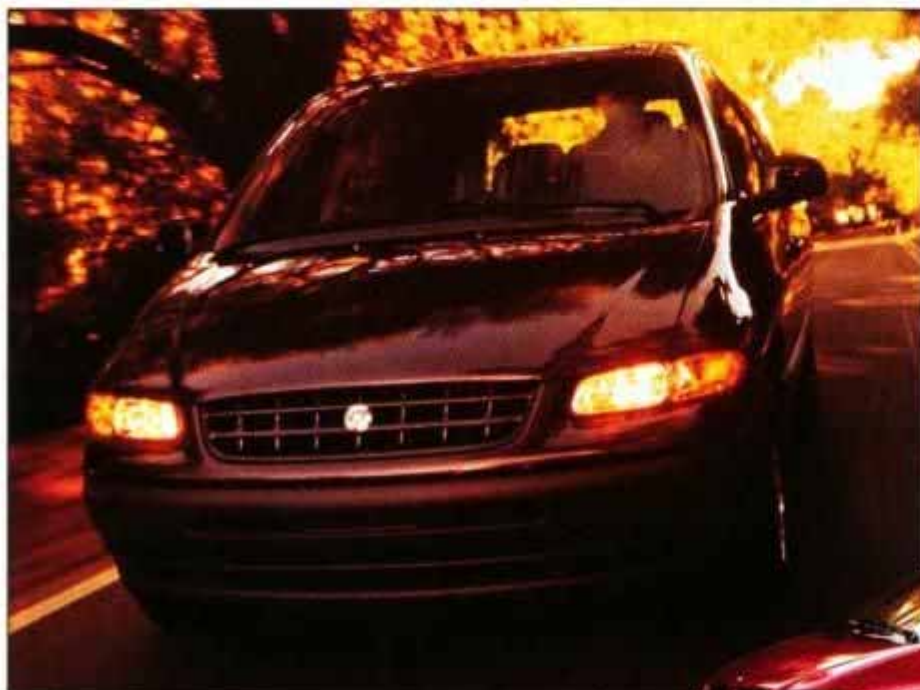
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New Cars



1996 Chrysler Minivans

• Two-peat? Three-peat? What do you call a champion that holds first place for 10 straight seasons? In a minivan contest you call it Chrysler.

Since 1984, Chrysler has sold almost as many minivans each year as all the others combined.

Now, with all-new 1996 Caravan, Voyager and Town & Country models, Chrysler is ready to further tighten its grip on first place.

The 1996 vans are larger than the current models and they offer an increase in both passenger and cargo space (10% and 25%, respectively). In addition to greater room, there's a greater level of comfort and convenience. And, not to be minimized, the

body and chassis structural strength on these new minivans have been increased markedly.

A 50-mile drive in one of Chrysler's first production prototype vans was long enough to convince me that the improvements are real. Ride quietness is much improved, thanks to the stronger chassis, better isolation of the suspension and improved window seals that reduce wind noise. The new interior offers sedan-level quiet.

City driving and parking-lot maneuvering are equally important in a do-everything minivan. Chrysler makes it all easier with a turning circle that's at least 3 ft. tighter than

was the former model's turning circle.

Just as important are the added conveniences. You don't have to step up quite as high to get into the new minivan. Its step-up height is 1.4 in. lower, which is convenient. But seats are at the same height above the road as they were in the old model.

The steering wheel and pedals are centered directly in front of the driver's seat, while the steering-column angle is lowered 6.5° for a more car-like feel. A lower instrument panel—by 4.7 in.—dramatically increases the view forward. The side windows are set almost an inch lower than before and extended up 2 in. at the top for lots more glass and airiness.



Other improvements include a second sliding door that allows for easy loading from the driver's side of the vehicle and wheels on the rear seats that make them easier to remove.

Chrysler has embedded heating wires in the lower edge of the windshield, right where snow and ice tend to collect, below where the defroster works best. And there's ½ in. more walk-through room between the front seats and 5 in. more shoulder-room and 4 in. more hiproom in the front seats.

—Jim Dunne

Acura NSX-T

An Acura NSX and your ego attacking your favorite road. Heather Locklear riding shotgun, 8000-rpm shifts, Formula One soundtrack, the wind tossing your hair, the sun tanning your ears and the acrid odors of burning rubber and brake pads.

Well, Heather aside, this is no longer fantasy, at least not for guys with \$80,000 under their mattresses. Starting in April, that cash affords you an NSX with an easily removable roof, allowing the wind, the sun and the bouquet of hard driving to finally

(Please turn to page 30)



NSX-T is as superb a performer as the original, and it lets the sunshine in.

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Don't Miss These Special Moments on Upcoming Episodes of Invention and NextStep

March 29 From passport photos to police crime scenes, Edwin Land's invention of instant photography has become an integral part of our lives.

April 5 Master glassblower Dale Chihuly takes the 5,000-year-old craft to extraordinary new dimensions, turning sand and air into art.

April 12 What can spiders teach weapons designers? How about sticky nets that immobilize troops! See the future of the defense industry with non-lethal weapons.

April 19 Computer simulation now allows for the development, deployment and testing of new armament without ever building them.

April 26 Virtual reality advances take cops and robbers out of the arcades. Now police can train for high-speed chases without deadly consequences.



Wednesdays **9-10PM** ET/PT



Infiniti's new I30 bears a striking resemblance to its larger Q45 sibling.

enter the cockpit of this NSX-T.

Powered by the same strong 270-hp 24-valve dohc 3.0-liter V6 that has powered the NSX, the NSX-T has more than 50 structural reinforcements that create a tight coupe-like structure. Still, an NSX-T only weighs 88 pounds more than an NSX (and costs \$4000 more), so there's no performance penalty for smelling the roses.

Also new is the Sportshift 4-speed automatic. You can let the transmission shift itself conventionally, or select each gear manually with a fingertip control shift lever, just like the Formula One guys. —Scott Oldham

Infiniti I30

After only its fifth year in business, Nissan's Infiniti Division is ready to introduce its fourth car line, the I30. The new model is a luxury 4-door front-drive sedan that carries a price tag starting at \$30,000. The I30's features borrow heavily from Infiniti's flagship Q45 sedan. In styling, the I30 captures the essence of the Q45 chrome grille in a slightly different shape.

Interior roominess is second only to the Q45 in the Infiniti lineup. Rear-seat roominess, especially legroom, is emphasized.

A new V6 engine is teamed with a smooth-shifting 4-speed automatic transmission to produce one of the quietest powertrains available at any price level. The engine, an aluminum dohc design, turns out 190 hp that moves this 3100-pound chassis to 60 mph in the 7-second range. A 5-speed manual is the alternate transmission. —J.D.

Volvo T-5R

If you had to pick a car to drive off the roof of a 2-story building, a Volvo probably would be close to or at the top of your list. If you had to pick a car

that was fast and sexy, well, maybe Volvo would be closer to the bottom.

Volvo's solution is a limited-edition (1000 total, sedans and wagons) model based on the front-wheel-drive 850 Turbo platform called the T-5R. It's



Not your uncle's or aunt's Volvo, the T-5R is a serious front-wheel-drive hot rod.

only available in yellow or black.

The T-5R boasts 240 hp, 18 more than the standard-issue 850 Turbo, itself a gentleman's (and lady's) express. The only available transmission is a 4-speed automatic. And the T-5R hits 60 mph in 7.7 seconds.

Huge 4-wheel disc antilock brakes stop you, while tenacious road-grip comes from the sport suspension with large swaybars, firm shocks and 17-in. alloy wheels shod with 205/45ZR17

ft.-lb. of torque at only 3500 rpm.

The rest of the Vulcan 800 is equally traditional: a 5-speed gearbox, chain-drive, single-disc front brake and rear drum and wide-spoke wheels (21 in. front, 16 in. rear). The Uni-Trak rear suspension hides the spring/shock under the seat, so the Vulcan looks like a genuine oldtime "hardtail."

On our test ride from Orlando to Key West, Florida, the Vulcan 800 turned out to be surprisingly comfortable, thanks to rubberized engine mounts, a thick saddle, front-mounted pegs and high-rise handlebars that encourage you to lean back and enjoy the ride.

At the track, the Vulcan accelerated quickly to 110 mph and was still pulling strongly when we shut down for the first corner. When you toss 485 pounds of Vulcan into a high-speed corner with a bump in the middle, it understandably pogo sticks in protest because of its soft suspension. But a long 64-in. wheelbase and 34° fork rake combine for reassuring road stability.

—Rich Taylor



Kawasaki's Vulcan 800 just wants to cruise and cruise some more.

Pirelli P-Zero tires. Volvo also offers a softer-riding, less aggressive 16-in. wheel/tire package. Inside, you'll find all the comfort and accouterments befitting a luxury automobile.

—Cliff Gromer

Kawasaki Vulcan 800

Kawasaki's new \$6699 Vulcan 800 is one of the best Japanese cruisers yet. It's powered by a 55° V-twin with a single carburetor set between the cylinders, single overhead cams to operate four valves per cylinder, 9.5:1 compression ratio and a Harley-style single-pin crankshaft to create that distinctive V-twin vibration and burbling exhaust note cruising riders love. This easy-to-service engine is rated at 60 horsepower at 7500 rpm and 47.7

PHOTO BY CLIFF GROMER



The Official 40th Anniversary Corvette® Collection



40th Anniversary Corvette shown approximately actual size of 6 7/8" (17.46 cm) L. Scale 1:24.

The twelve important milestones in Corvette history. Presented by Franklin Mint Precision Models in association with Chevrolet Motor Division.



1953



1958



1963



1978

Corvette, a great American sports car legacy. And now, on the 40th Anniversary of the introduction of the first Corvette, history is captured in an extraordinary collection of twelve precision-engineered replicas—each modeled after an original Corvette in mint condition.

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Each Corvette model has doors and hood that open and close, and a steering wheel that actually turns the road wheels.

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Detroit Spy Report

BY JIM DUNNE, Detroit Editor



Ford's Luxury Import Fighter

● Ford planners want to build a luxury Sable that will compete with imports in the \$30,000 class. Just add \$5000 onto Sable's cost for luxury items like leather interior, a quieter cabin and a more powerful engine. Then the Sable chassis could compete with 5- and 6-place imports at a much lower price. One plan is to build a luxury version of the new V8-powered Ford SHO Taurus, seen here in moderate disguise during winter testing. The new SHO gets a 3.4-liter aluminum V8 engine in place of the Yamaha-built V6. The V8 develops 225 horsepower and, mated to a 4-speed automatic transmission, pulls the 3800-pound SHO to 60 mph in 8.5 seconds. The Mercury version would focus on luxury, not performance. As of now, Ford Motor Co. insiders say the decision on this is still pending.



Park Avenue for '97 gets a cleaner, Riviera-inspired look.

1997 Buick Park Avenue

Caught during a towing test in Arizona, Buick's large front-drive sedan

ness and fuel economy" on certain '96 models. The engineers stated that the on-board computer that will run the new OBD II system is an order of magnitude more powerful than the computer that was on board the Apollo XI Moon-landing mission.

reveals some interesting styling cues, despite the camouflage. Residing beneath the large fake rear panel is a Riviera-style taillamp assembly. Other Riv tidbits include the door handles and the rub strips on the corners of the front bumpers. And while this Park Avenue shows no front vent windows, it is sporting dual exhaust pipes.

Moderately Grand Am

Pontiac's hot-selling Grand Am gets a minor facelift for '96. A close examination of this prototype shows a revised



'96 Grand Am gets a new going-away view.

tail treatment: rounded corners, a new fascia, reshaped spoiler and new exhaust-pipe tips.

Stainless Over Alloy

Using a process similar to the one used for making those shiny, bright bumpers on long-haul trucks, Texas Instruments intends to produce stainless-steel-clad wheels, which may be preferred over cast-alloy wheels. The new wheels will be cast of aluminum, then covered with an outside layer of cast-in stainless. The wheels will offer the light weight of aluminum, with the appeal of highly polished stainless. **TM**

GM's Underhood Supercomputer

Engineers from GM's Powertrain Division announced that General Motors will introduce a new V6 engine, a new inline 4-cylinder, a new supercharger package and an enhanced OBD II emissions control system—all on various 1996 models. The engineers also said that they would be showing a "major new technology with dramatic increases in smooth-

End Of The Road For The Corvette ZR-1



● The king is dead.

The 405-hp ZR-1 Corvette, the car called the King of the Hill since its introduction in 1990, will soon be put to rest. The last 448 ZR-1s will

be built during the 1995 model year. Whether the model will return on the all-new 1997 Corvette is unknown at this point.

—Scott Oldham



The first and only toothbrush that fights plaque... **ULTRASONICALLY!**

Now remove plaque and fight gingivitis and gum disease the same way your dentist does — ultrasonically! Through an exclusive arrangement, *The Magellan Group* is pleased to bring you *UltraSonex*,[®] the first and only toothbrush that uses the advanced ultrasonic technology previously available only to your dentist.



Clinical studies show that using UltraSonex can reduce bacterial plaque by 97%, bleeding gums by 60% and gingivitis by 28% - in just 4 weeks - and UltraSonex can reverse the progression of gingivitis, which can lead to periodontal disease.

Accepted by the ADA and recommended by dentists, the *UltraSonex* is not an electric toothbrush. It has no moving parts, does not vibrate and is absolutely silent. It works by emitting 1.6 million cycles per second of incredibly effective ultrasonic waves that penetrate the gum tissue to disrupt bacterial growth, which helps reduce gingivitis. No other product available for home use does this. The *UltraSonex* can also reverse the progression of gingivitis and gum disease. It is extremely gentle, yet you'll quickly notice dramatic results. Just brush normally. Shuts off automatically after 3 minutes. Recharges in its own base. Try *UltraSonex*. Then check with your dentist. You'll both be amazed at the results. **\$99.95** (\$10.95) #3100. *UltraSonex* and 6 Replacement Heads (Year's Supply) **\$129.95** (\$11.95) #3300.



Ultrasound penetrates deep into gum tissue.

To the thief, this is rather alarming!



The parking lot is dark. You can't find the car. You're all alone —with the baby. But in an instant, you're able to light up the inside of your car and safely find your way with the help of the *Safe Entry Alarm System*. Not only does it provide excellent personal and property protection, but complete peace of mind, as well. Mounted prominently on the dash board, it has a flashing LED that alerts criminals to the fact that your auto is alarmed. If challenged by motion or vibration, it emits a deafening 110dB. alarm. You

can even arm and disarm via remote control from up to 25 yards away. It's completely portable and can be used in any car by simply plugging it into the cigarette lighter. A 9-volt battery back-up with low-power indicator ensures it will work even if unplugged. What's more, *Safe Entry Alarm System* is manufactured by the makers of *The Club*, so you know it's a high quality and dependable piece of security equipment. It's your family's best defense against car thieves and muggers. FCC approved. **\$69.95** (\$7.95) #4020.

Get relief from the misery!

Steam inhalation therapy has long been recommended by doctors for the relief of congestion from sinus infections, allergies, colds, asthma, bronchitis and throat irritation. Prepare yourself for the onslaught of the cold and flu season with the new *Steam Inhaler*. Unlike old fashioned vaporizers, this *Steam Inhaler* won't injure delicate membranes adding to your discomfort. Its unique design creates a controlled, gentle stream of steam. And the scientifically designed soft hood allows air to mix with the steam allowing comfortable, natural breathing. The patented grille design lets you control the flow of steam precisely, making it safe for both adults and children. Compact and lightweight, it's easy to use at home, the office or when traveling. Fill it with only 1.5 oz. of tap water and get up to 30 minutes of steam therapy. Add your favorite over-the-counter medications if you like. Automatic dual-voltage capability for use in the U.S.A. or abroad. Comes with soft travel case. **\$49.95** (\$7.95) #4040.



Don't be fooled by its size — This is one powerful vacuum!



You'll be amazed with the performance of this machine. At how effortlessly the *Oreck Power Broom* picks up anything and everything in its path. Dust, crumbs, broken glass, bugs — you name it. *In fact, it's got more power than any other electric broom you can buy.* The *Power Broom* features a two-speed motor for customized cleaning control, a large capacity dust cup with a washable, reusable filter and an extra-long 25-foot cord to make easy work of even the largest spaces. With a self-adjusting floor tool that quickly and easily glides from floors to carpets, the *Power Broom* goes places most regular vacuums can't, like under beds, up and down stairs, against walls and other hard to reach spots. It makes quick pick-ups a breeze. And when you're done, it hangs flat and out-of-the-way in a minimal amount of space. What's more, the *Power Broom* is so well-built and reliable, it's backed by a Mfr.'s 2-yr. ltd warranty. That's twice as long as most warranties. You'll find so many uses for the *Oreck Power Broom*, it just might make your regular vacuum obsolete. **\$69.95** (\$9.95) #3900.



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Navy Dolphins On Leave

BY GREGORY T. POPE, Science/Technology Editor



ANIMAL ANIMALS/EARTH SCENES/PHOTO

● Every dolphin has its day, or so the saying goes. Now dolphin researchers will have their day, thanks to the Pentagon's shrinking finances. Bowing to the budget ax, the Navy is paring back its squadron of 100 bottlenose dolphins. The flippers fleet is based in San Diego, at the Naval Command, Control and Ocean Surveillance Center's RDT&E Division.

So far, 16 surplus animals have secured honorable discharges to marine aquariums, such as Sea World. But two more are now on loan to the Uni-

versity of California at Santa Cruz. There, at the university's Long Marine Laboratory, they are providing marine biologists with a rare opportunity to investigate the physiology of dolphins.

True, these graceful, intelligent creatures have long attracted attention from scientists. But oddly, little is known about the mechanics of being a dolphin. A particular mystery is metabolism, or how dolphin bodies burn food to fuel swimming, diving and frolicking. "We understand their social structure and behavior," says Terrie

Williams, assistant professor of biology at Santa Cruz, "but we don't know what makes them tick."

This dearth of knowledge stands in contrast to the well-documented physiology of the other main branch of marine mammals—the pinnipeds, which include seals and sea lions. "The

reason we know about seals is that there is technology to glue small dive recorders and instruments to their fur," notes Williams. "We haven't had that with dolphins because there's nothing to stick to. They constantly slough their outer layer of skin." Dolphins also defy intimate study simply because they live full-time in the sea—an environment that's, at best, inconvenient to human researchers.

The Navy mammals will change all that. Last October, the two male dolphins—Primo, age 14, and Puka, age 9—arrived via C-130 airlift. Attended by trainers and veterinarians, they rested quietly in fiberglass tanks. After the plane touched down at nearby Moffett Field, the dolphins rode a flatbed truck to the laboratory.

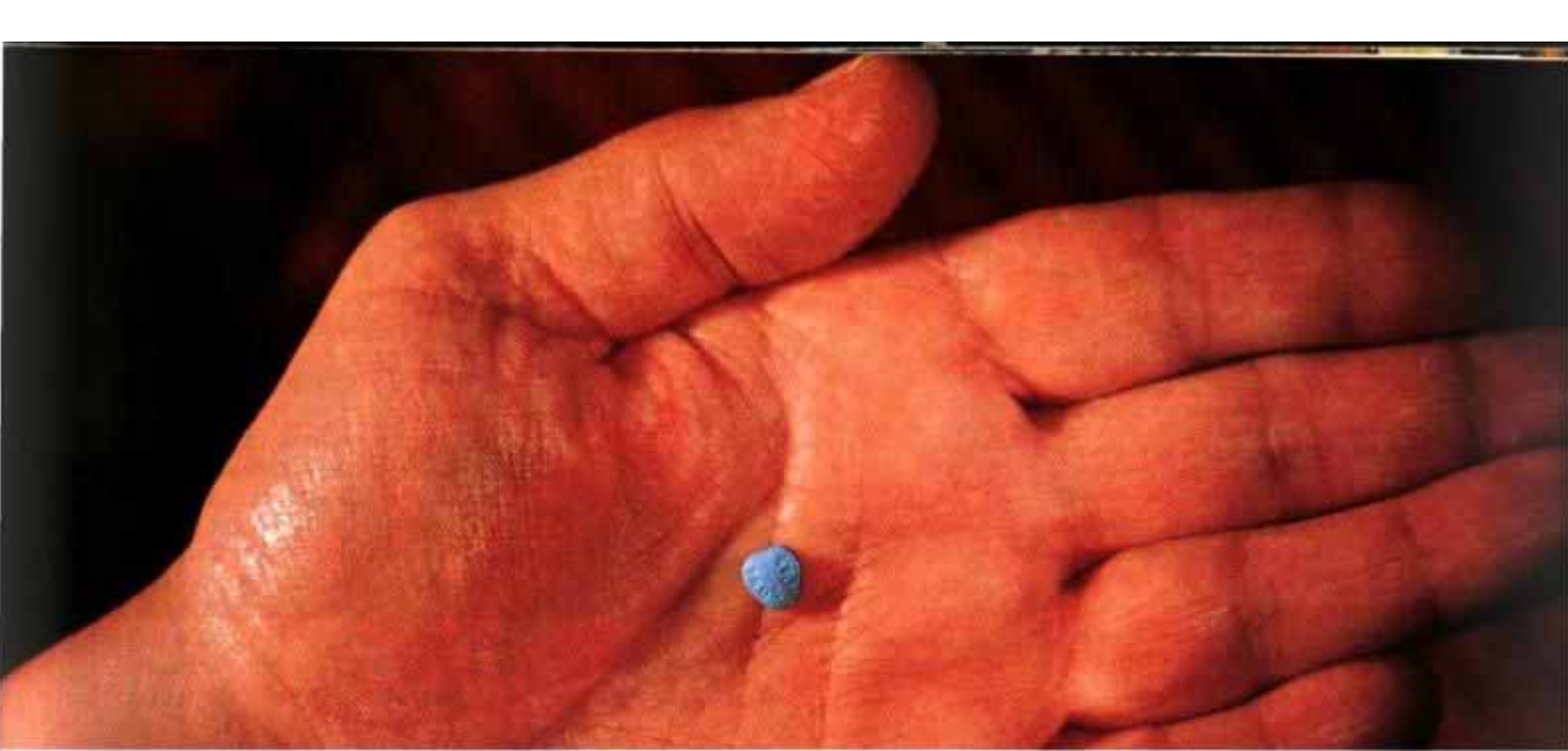
Like all Navy dolphins, these animals are uniquely trained. In Hawaii, the dolphins learned to spot, mark and retrieve objects in the ocean. The purpose: to prepare for operational duty as mine-hunters, a role in which Primo and Puka were never active.

Navy discipline makes these dolphins especially suited for science, says Williams. Not only are they re-

(Please turn to page 38)



Navy dolphin Puka high-fives trainer Jenifer Hurley.



If your doctor says you've got symptomatic benign prostate enlargement, help can be in the palm of your hand.

Many men mistakenly believe that an enlarged prostate is treated the same way for all men. But today there are more options than ever. By speaking frankly about your symptoms, you and your doctor can decide what is appropriate for you.

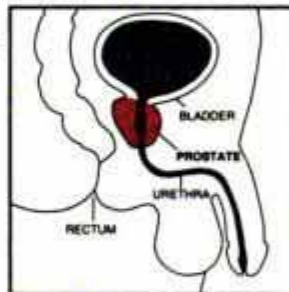
Is this you?	Yes	No
Do you get up more than once or twice a night to urinate?	<input type="checkbox"/>	<input type="checkbox"/>
Do you often have sudden, uncontrollable urges to urinate?	<input type="checkbox"/>	<input type="checkbox"/>
Do you have a hesitant or slow urine stream?	<input type="checkbox"/>	<input type="checkbox"/>
Do you have a frequent need to urinate?	<input type="checkbox"/>	<input type="checkbox"/>

If you answered yes to even one question, tell your doctor. Your symptoms may be caused by a condition called benign prostate enlargement (BPH). But remember, only a doctor can evaluate your symptoms and their possible causes. *While BPH is not cancer and does not lead to cancer, the two conditions can exist at the same time.*

Symptomatic BPH can be treated in several ways. In addition to surgery and monitoring the condition with regular checkups, now your doctor has oral prescription medicines. One oral medicine is PROSCAR, the only medicine for the treatment of symptomatic BPH that can shrink the prostate.

PROSCAR works by blocking a hormone that can cause the prostate to enlarge. *But it is important to know: PROSCAR doesn't work for everyone. Although the prostate may shrink, there may not be an improvement in urinary symptoms. However, in clinical studies with PROSCAR, some men have seen an improvement in their urinary symptoms after 2 weeks. Others have found that PROSCAR took up to several months to help them.* Because all men are different, you and your doctor will need to determine how PROSCAR is working for you.

Today you don't have to live with the discomfort of symptomatic BPH. Ask your family doctor or a urologist if PROSCAR is right for you. **For free information that will help you discuss your symptoms with your doctor, call 1-800-770-6149.**



The prostate surrounds part of the urethra, the tube that carries urine from the bladder. As the prostate enlarges, it can squeeze the urethra and cause urinary problems.

For the treatment of symptomatic BPH

PROSCAR[®] 5mg
(FINASTERIDE)

The only medicine that can shrink the prostate.



Please see the patient information on the next page.

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PATIENT INFORMATION ABOUT**PROSCAR® (Prah-s-car)**

Generic name: finasteride (fin-AS-tur-eyed)

PROSCAR is for the treatment of symptomatic benign prostatic hyperplasia and for use by men only.

Your doctor may prescribe PROSCAR if you have a medical condition called benign prostatic hyperplasia or BPH. This occurs only in men.

Please read this information, as well as the leaflet which accompanies your medication, before you start taking PROSCAR. Also, read the leaflet each time you renew your prescription, just in case anything has changed. Remember, this leaflet does not take the place of careful discussions with your doctor. You and your doctor should discuss PROSCAR when you start taking your medication and at regular checkups.

What is BPH?

BPH is an enlargement of the prostate gland. After age 50, most men develop enlarged prostates. The prostate is located below the bladder. As the prostate enlarges, it may slowly restrict the flow of urine. This can lead to symptoms such as:

- a weak or interrupted urinary stream
- a feeling that you cannot empty your bladder completely
- a feeling of delay or hesitation when you start to urinate
- a need to urinate often, especially at night
- a feeling that you must urinate right away.

Treatment options for BPH

There are three main treatment options for BPH:

- **Program of monitoring or "Watchful Waiting".** If a man has an enlarged prostate gland and no symptoms or if his symptoms do not bother him, he and his doctor may decide on a program of monitoring which would include regular checkups, instead of medication or surgery.
- **Medication.** Your doctor may prescribe PROSCAR for BPH. See "What PROSCAR does" below.
- **Surgery.** Some patients may need surgery. Your doctor can describe several different surgical procedures for BPH. Which procedure is best depends on your symptoms and medical condition.

What PROSCAR does

PROSCAR lowers levels of a key hormone called DHT (dihydrotestosterone), which is a major cause of prostate growth. Lowering DHT leads to shrinkage of the enlarged prostate gland in most men. This can lead to gradual improvement in urine flow and symptoms over the next several months. However, since each case of BPH is different, you should know that:

- Even though the prostate shrinks, you may NOT see an improvement in urine flow or symptoms.
- You may need to take PROSCAR for six (6) months or more to see whether it helps you.
- Even though you take PROSCAR and it may help you, it is not known whether PROSCAR reduces the need for surgery.

What you need to know while taking PROSCAR

- **You must see your doctor regularly.** While taking PROSCAR, you must have regular checkups. Follow your doctor's advice about when to have these checkups.
- **About side effects.** Like all prescription drugs, PROSCAR may cause side effects. Side effects due to PROSCAR may include impotence (or inability to have an erection) and less desire for sex. Each of these side effects occurred in less than 4% of patients in clinical studies. In some cases side effects went away while the patient continued to take PROSCAR.

Some men taking PROSCAR® (Finasteride) may have a decrease in the amount of semen released during sex. This decrease does not appear to interfere with normal sexual function. Rarely, some men have reported breast swelling and/or tenderness or allergic reactions such as lip swelling and rash.

You should discuss side effects with your doctor before taking PROSCAR and anytime you think you are having a side effect.

• **Checking for prostate cancer.** Your doctor has prescribed PROSCAR for symptomatic BPH and not for cancer—but a man can have BPH and prostate cancer at the same time. Doctors usually recommend that men be checked for prostate cancer once a year when they turn 50 (or 40 if a family member has had prostate cancer). These checks should continue while you take PROSCAR. PROSCAR is not a treatment for prostate cancer.

• **About prostate specific antigen (PSA).** Your doctor may have done a blood test called PSA. PROSCAR can alter PSA values. For more information, talk to your doctor.

• **A warning about PROSCAR and pregnancy.**

PROSCAR is for use by MEN only.

PROSCAR is generally well tolerated in men. However, women who are pregnant, or women who could become pregnant, should avoid the active ingredient in PROSCAR.

If the active ingredient is absorbed by a woman who is pregnant with a male baby, it may cause the male baby to be born with abnormalities of the sex organs. Therefore, any woman who is pregnant or who could become pregnant must not come into direct contact with the active ingredient in PROSCAR.

Two of the ways in which a woman might absorb the active ingredient in PROSCAR are:

Sexual contact. Your semen may contain a small amount of the active ingredient of the drug. If your partner is pregnant, or if you and your partner decide to have a baby, you must stop taking PROSCAR and talk to your doctor. If your partner could become pregnant, proper use of a condom can reduce the risk of exposing her to your semen (discuss this further with your doctor).

Handling broken tablets. Women who are pregnant or who could become pregnant must not handle broken tablets of PROSCAR. PROSCAR tablets are coated to prevent contact with the active ingredient during normal handling. If this coating is broken, the tablets should not be handled by women who are pregnant or who could become pregnant.

If a woman who is pregnant comes into contact with the active ingredient in PROSCAR, a doctor should be consulted.

Remember, these warnings apply only if the woman exposed to PROSCAR is pregnant or could become pregnant.

How to take PROSCAR

Follow your doctor's advice about how to take PROSCAR. You must take it every day. You may take it with or between meals. To avoid forgetting to take PROSCAR, it may be helpful to take it the same time every day.

Do not share PROSCAR with anyone else; it was prescribed only for you.

Keep PROSCAR and all medicines out of the reach of children.

FOR MORE INFORMATION ABOUT 'PROSCAR' AND BPH, TALK WITH YOUR DOCTOR. IN ADDITION, TALK TO YOUR PHARMACIST OR OTHER HEALTH CARE PROVIDER.



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West Point, PA 19486
J4PO47R(302)-MKP4085

sponsive and accustomed to handling, but they're game for anything. "To give these animals something novel to do is not that big of a deal. They received a lot of different types of stimulation with the Navy."

Although Primo and Puka are used to open-water exercises, they're now acclimating to life in Long Marine Lab's interconnected pools. They must then learn research procedures.

In one experiment, Williams will feed the dolphins fish at different temperatures. She'll then gauge how their bodies react by measuring oxygen consumption, heart rate and other metabolic yardsticks. "We're looking at parameters you'd monitor in any athlete," explains Williams.

Other investigations will target dolphins' remarkably efficient swimming. During open-ocean studies with the dolphins in Hawaii, Williams noticed that the animals' expenditure of energy didn't jibe with the speed at which they traveled. "They were moving a lot faster than they should have been," she recalls. "We sent a diver down there, and it turned out that instead of constant propulsion there were long periods without a lot of tail movement. They're so hydrodynamic, and they're smart—they know how to glide through life."

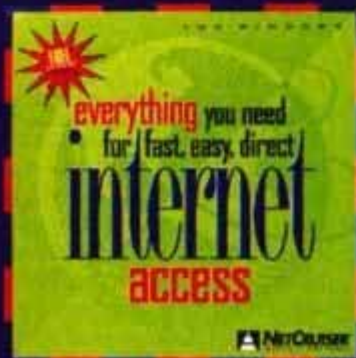
At Long Marine Lab, researchers will monitor the strength of the dolphins' tail flicks by having the animals push against load sensors. Meanwhile, biologists will watch two other Navy dolphins off the coast of San Diego, trying to quantify the time they spend swimming versus coasting.

Not only will these studies show biologists how dolphins budget their energy, but they have implications for naval architects as well. Seeking alternative propulsion systems for submersible machines, some engineers have become hooked on the mechanical fishtail (see [Tech Update, page 23, Jan. '95](#)). To drive such a device with only intermittent propulsion could stretch the battery life of an underwater vehicle. The Navy also stands to benefit from the physiological studies, just as a basketball team gains from research into athletic prowess.

Meanwhile, civilian researchers will reap insight into the conservation of these animals. Special questions: What ocean temperatures can dolphins tolerate? How much fish does it take to support a population of dolphins? The answers will enable wildlife managers to judge the effects of climate change and human activity on the mammals' well-being.

Although the Navy has scheduled the dolphins' civilian tour to last a year, the effort may be extended if research continues to go swimmingly. **PM**

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Europe Spy Report

BY MIKE ALLEN, Associate Automotive Editor

Son Of Boxster

● Porsche electrified the auto-show circuit a couple of seasons ago with the Boxster show car, a very refined but definitely retro-styled midengine no-compromise sports car. And the reaction to the show car galvanized the Swabian automaker to promise that the car would find its way into production as an affordable entry-level Porsche, one that would be within the means of all people— young, as well as old, enough to really be able to own and drive one.



Ford's World Car, Take Two

Ford's world car, the Mondeo/Contour/Mystique, was introduced what seems like only a few months ago here in the United States, but has been on sale in Europe for several years. (The Mondeo is the Euro version.) Consequently, here's a spy shot of the first revision to the Mondeo's appearance. This freshening of the front end will probably filter

down to the U.S.-made-and-sold Ford Contour and Mercury Mystique in a couple of years.

GM's European Minivan

Opel, the European division of General Motors, is developing a 7-seater minivan jointly with its GM counterparts in North America. We're betting the replacement for the GM-200 minivans (the Chevrolet Lumina,



Opel's minivan, to be built in U.S., may replace GM minivans.



Ford Mondeo gets facelift next year.

Shown at the top, testing in Italy, is a vehicle that is apparently very close to the one that will be in production. Though no one is likely to confuse this car with the show car, it seems likely that the nameplate will indeed say Boxster. This vehicle seems more reminiscent, styling-wise, of a slightly underinflated 911, in spite of its longer midengine wheelbase.

European buyers may see this vehicle with a 16-valve 4-cylinder engine, but North America, apparently, is slated for delivery of only a 6-cylinder version with an engine derived (or stolen outright) from the Carrera. This means two different engine layouts—the traditional flat Six will have to mount fore and aft, while the Four will need to go transversely. And we're betting the price, promised at under 40 grand, is more in the vicinity of 50 large.

Pontiac Trans Sport and the Olds Silhouette) will be on this platform, as Opel is building the vans here in the States. GM is abandoning the plastic body panels on the current crop of minivans for a more traditional steel-chassis construction.

There Will Always Be An England

Here's a second look—a better one—of the MG sports car we've shown before. This shot was taken during testing in the U.S. Built by Rover, look for this soft-top to carry an MGD badge and be sold at—take a deep breath—BMW dealerships, thanks to BMW's recent merger with the British carmaker. Propelled by powerplants varying from a 100-hp 1.4-liter 4-cylinder to a supercharged 1.8-liter, the small roadster is aimed at the Miata segment of the market, and may be available as a hardtop after a while.



Miata's competition from MG/BMW.

Grocery-Getters With Style

Look for a variety of new shapes in the showroom at your corner Mercedes-Benz dealer. Coming within a year is an all-new E-Class—Benz's middle-range model—followed by an estate wagon (what we call a station wagon on this side of the pond) version of the E-Class car. Right on the heels of that will be an estate wagon C-Class, sometime in 1996. And they're already testing a coupe based on the C-Class chassis, which should be available sometime in 1997. Right next door you may want to cross-shop for a BMW 3-series Touring model—which is also what we call a station wagon—but only if BMW decides to send the new car to our shores. **PM**

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1994
SCCA Trans-Am
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souvenirs. One weekend, it may be an idea on steering components from a hairpin curve in Monaco. Another weekend, a lesson in durability from off-road shock treatments in the Baja desert. Of course, the end result is simple: More winning technology for the Ford car or truck you can drive. Looks like we have everything covered.

Software Machines

BY FRANK VIZARD, Electronics Editor

● Sometime next year you can expect Intel to begin selling an upgrade chip for the current crop of Pentium-based personal computers now available from a variety of manufacturers. This new chip will make a Pentium computer run faster and perform better. Think 90 MHz is fast? Think again. This new Overdrive chip will boost your computer's processing speed to a very fast 150 MHz.

Surprised? Don't be. Overdrive chips are an accepted part of the computer business. The Overdrive Pentium chip that upgrades a 486 is already available (\$449), so it's not unreasonable to assume that current Pentium computers can be upgraded as well. The upgrade socket is built into the motherboard.

Is all this necessary? Can't I buy a computer that won't need an upgrade next year? The answer: not really.

If you need to blame somebody for this state of affairs, then pick on the software makers and not the computer manufacturers. While we tend to think of computer hardware as a cold machine and the software as something a little more warm and fuzzy, the truth is that software is a voracious machine that eats processing power as fast as it can.

Software gets hungrier as its makers add more and more features to the package. But, in what might seem a paradox, the more "feature creep" a piece of software exhibits, the slower it runs, assuming the processing power remains the same. Users of Word 6.0 for the Macintosh, for example, complain the program runs much slower than its 5.1 predecessor. One big difference between the two programs is that 6.0 requires 25 million bytes of disk space while 5.1 only uses 6 million bytes. To make the newer program run as fast and smooth as the old one, you have to upgrade the processing power, not to mention the memory and disk storage space.

While new features of all types demand more power, perhaps the single biggest new user of processing power is video. Just how to incorporate video onto a software title without using up incredible amounts of memory and disk space is the job of video compression technologies. The idea is to minimize the bandwidth needed for audio



and video signals so they can travel faster and more efficiently from a disk drive to a monitor, for example. Without some type of compression algorithm, you have to wait seconds or minutes for scenes to change and the audio would be racing to catch up to the video.

Even still, most video tends to run at a herky-jerky 15 frames per second (fps) and fills only a portion of the screen. Fans of the interactive best-selling CD-ROM game *The 7th Guest* will be pleased to learn that Trilobyte's sequel, *The 11th Hour*, uses a proprietary compression technique called Groovie that yields a more realistic 30-fps picture and fills the entire screen. *The 11th Hour* is currently perhaps closest to having a television experience on a computer.



The 11th Hour: full-screen, 30-fps video.

The good news is that more powerful computer hardware allows software to become more powerful as well. Clearly, some very high-level math is already being used, and nowhere is this more evident than on products developed by HSC Software of Carpinteria, California. The company's *KPT Bryce* title (\$199) for the Macintosh platform allows you to create landscapes that are breathtakingly surreal and reminiscent of *Omni* magazine covers (see picture above). The user interface is remarkably simple. Even more remarkable, though, is the fact that these images are not derived from manipulated, scanned-in pictures. All these images are mathematically generated. The more powerful the computer, the faster the images are calculated.

Another HSC product, *KPT Convolver* (\$199), allows you to enhance unclear pictures in a fashion that might have been available only to the CIA until now. The image of a barely visible mist-enshrouded car, for example, can be manipulated so all the mist is filtered away to reveal the car's license plate number.

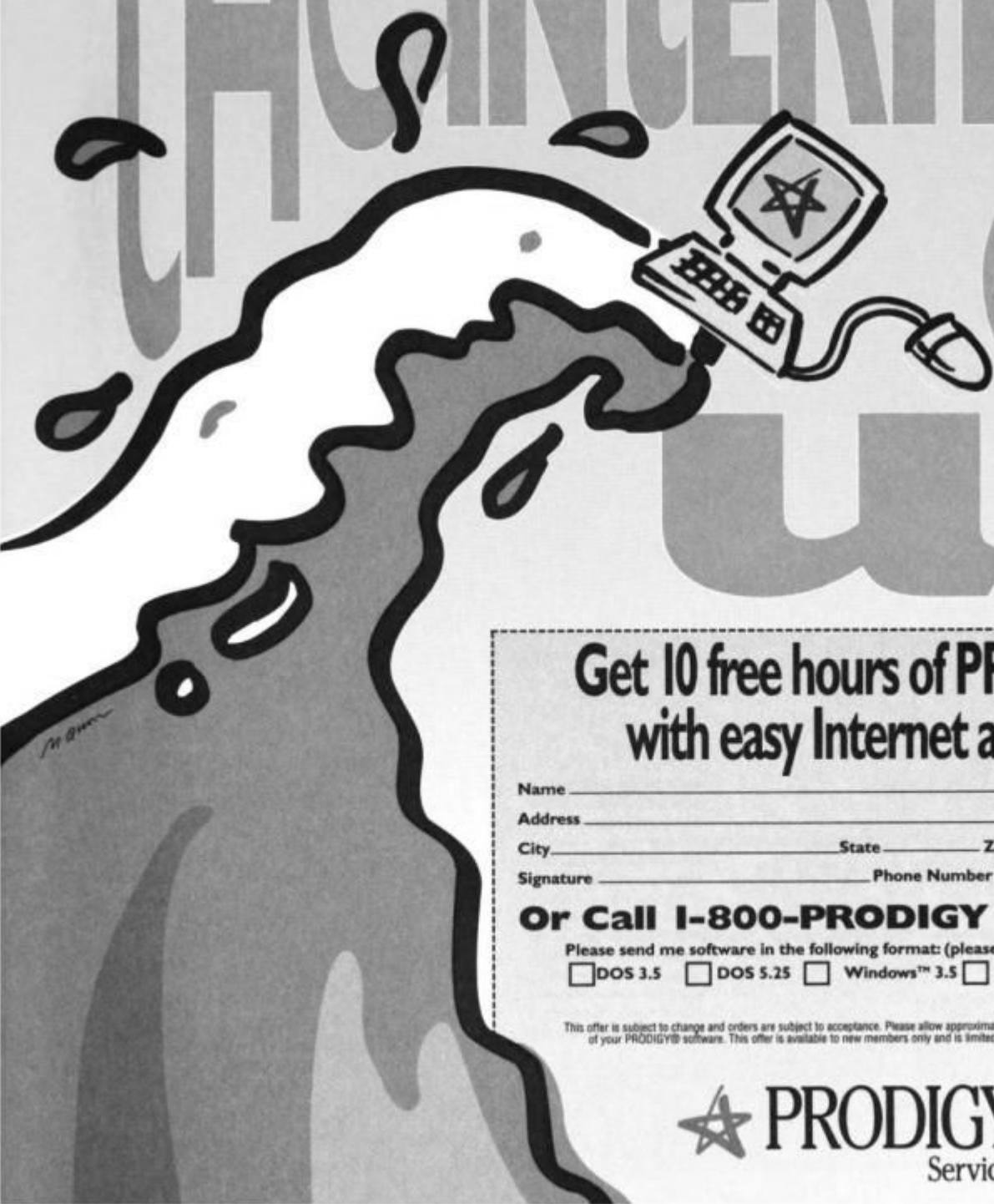
With this kind of capability, the software becomes an amazing piece of hardware in its own right. **FM**

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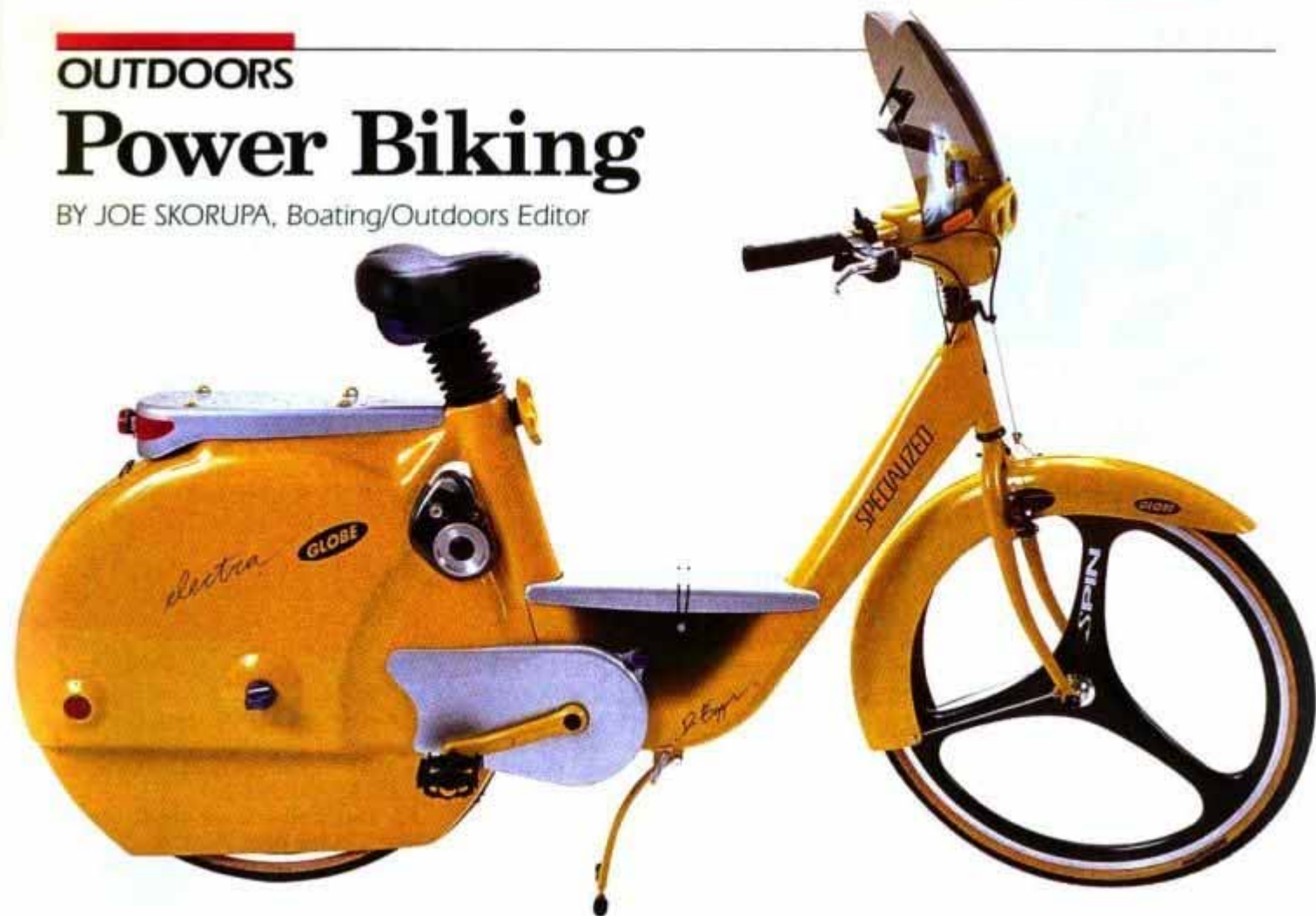
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OUTDOORS

Power Biking

BY JOE SKORUPA, Boating/Outdoors Editor



● Power-bike fans, this one's for you. This column is dedicated to a subject you've been clamoring for since the story "Whiz-Bang Bikes" appeared in the June '93 issue (page 116). I never realized how many power-bike fans there were until I received an avalanche of calls and letters following the publication of that story.

"Whiz-Bang Bikes," for those who missed it, was about the celebrated Whizzer, a popular gas-motor kit and motorbike of the 1940s and '50s. Hundreds of thousands of these snazzy bikes and motor kits were sold, and they continue to inspire fond memories. As a result, original Whizzers are now sought-after collectibles. The point of the story was that those who missed Whizzers the first time around now have a second chance. A company in Southern California is reproducing the classic Whizzer bike and adapter kit with updated technology. Cost for a new Whizzer is \$1495, and you can get more information by contacting Whizzer Motorbike Co., 15671 Commerce Ln., Huntington Beach, CA 92649; (714) 893-7674.

In researching this story I spoke with the people at Whizzer Motorbike, and they reported receiving requests for 4000 catalogs as a result of the previous story. In fact, they still get orders.

I suspected this to be the case, be-

cause I still get calls and letters about the story, too. My phone started ringing immediately after the story appeared, and then gradually tapered off. However, it never died, and that's why I'm writing this column.

As is frequently the case with letters to the editor, most are in the nature of complaints. You hardly ever hear from readers who want to say "Attaboy."

The problem with "Whiz-Bang Bikes" had nothing to do with the Whizzer or with the Whizzer Motor-

bike Co. It had to do with three paragraphs at the end of the story that mentioned an inexpensive bolt-on motor kit. The last paragraph noted the importer's name, address and phone number—and this was the source of the problems.

It turns out that after the research for the story was done, the importer bailed out of the motorbike business, and by the time the story hit the newsstands, the company stopped answering phones. This turn of events

(Please turn to page 48)

Vintage-Bike Guide

● Classic-bicycle aficionados, especially those interested in ornate balloon-tire bikes from 1934 to 1960, are a dedicated lot. They have to be. It's not easy to find and restore classic bikes when there are no authoritative books or magazines on the subject (only newsletters). That's changed now with the introduction of the annual *North American Directory Of Classic Bicycle Collectors & Dealers* (\$11.95). This directory, soon to be updated for 1995, lists dozens of hard-to-find businesses that specialize in new, used and new/old stock parts for classic bikes. The directory also includes a list of 1500 collectors and a calendar of classic-bike shows. For more information, contact Arjay Communications, 325 W. Hornbeam Dr., Longwood, FL 32779; (407) 862-0031. —J.S.





The compact Chronos Hammer delivers electric power to bikes.

didn't sit well with the power-bike aficionados who contacted me. Surely I could do something about it, couldn't I? Well, no, I couldn't. However, to satisfy loyal PM readers, I pledged to write a followup story about power-assisted bikes in a future issue. My followup is as follows:

• **Electra Globe** (photo appears on the top of page 47) is a power-assisted electric motorbike made by industry giant Specialized. What I like about the Electra Globe is that the entire bike—frame, wheels, spokes, chain, brakes and so forth—is designed with auxiliary power in mind.

The sleek, aero-style Electra Globe has a rechargeable electric motor, capable of helping riders reach speeds up to 18 mph. To maximize user-friendliness, the motor, battery, chain

and 7-speed drivetrain are all maintenance-free components and housed within lightweight body panels.

Specialized's motto is "Innovate or die," and the Electra Globe is a good example of the company's forward thinking. But how forward? Well, the first production models are scheduled to appear in 1997. Preview models might appear in late '96. The company considers the current version of the Electra Globe to be nothing more than a concept bike. So, don't be surprised if you contact the company and the representative can't give you much help. However, if you want to find out about other Specialized models, here's where to call or write: Specialized Bicycle Components, 15130 Concord Circle, Morgan Hill, CA 95037; (408) 779-6229.

• **TSI Powerbike Kit**, unlike the Electra Globe, is a product you can order and install right now. Auxiliary power is supplied by a 21cc 2-stroke gas engine that's equipped with a centrifugal clutch and a lever-type throttle routed to the handlebars. The unit (\$329) provides direct-wheel power to the rear wheel and adds 19 pounds to the bike. For more information, contact TSI, P.O. Box 4121, San Luis Obispo, CA 93405; (800) 833-7112.

• **Chronos Hammer**, like the TSI Powerbike Kit, is another power-

assist kit that you can order now. But unlike the internal-combustion Powerbike, the direct-wheel Hammer features a rechargeable electric motor. While the Powerbike pretty much turns a bicycle into a motorbike, the Hammer (\$659) simply boosts pedal power to help get the rider over hills. It weighs only 2 pounds and delivers 0.2 horsepower, which is equivalent to adding the power of four more pedaling legs. For more information, contact Chronos, 2936 Avenida Theresa, Carlsbad, CA 92009; (800) 364-8894.

• **Honda Racoon**, like the Electra Globe, is an electric motor-assist bike that you can't buy—unless you live in Japan. The model consists of an aerodynamically integrated 220-watt, DC brush-type motor that provides low-speed torque to the drivetrain. Above 15 mph the motor automatically shuts off. Power is provided by a rechargeable nickel-cadmium battery. Honda has no timetable for introduction of the Racoon to the U.S. market, but that could change. For more information, contact American Honda Motor Co., 1919 Torrance Blvd., Torrance, CA 90501; (310) 783-2000.

So, that's all I know about power biking. Let me point out that all these companies were in business when I wrote this. If we show enough interest, maybe they'll stay that way. **PM**

FROM FRONT...



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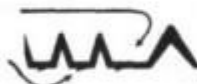
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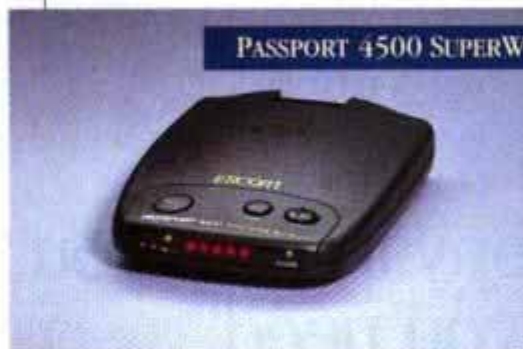


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Q's
EQUIPMENT LAB

BY REBECCA DAY
PM Photos by Bill Ashe

● A Mercedes rolls up to the Plaza Hotel in New York just before sunset. A well-dressed man steps out of the car into a slight drizzle, umbrella and briefcase in hand. Raising his umbrella, he comes around to the passenger side of the car and opens the door for his elegant wife, who, in diamonds and heels, commands the attention of anyone within 30 ft. They enter the hotel seemingly oblivious to everyone.

Things are not quite the way they seem to be, however. Our Ms. Bond, behind sunglasses with built-in rearview mirrors, watches their back as she ascends the steps. To the casual observer she appears to be fumbling through her purse as she walks. In actual fact, she is fingering the dial on her lipstick canister to expose a 1-in. blade and then

I SPY

places it next to the comb knife in her purse. Also in her purse is an electronic lock pick just in case they need to get through a locked door quickly.

Our Mr. Bond moves a little stiffly as he climbs the stairs—4 pounds heavier in his bulletproof vest. The umbrella is also bulletproof, the better to shield Ms. Bond in an emergency. Once inside the hotel lobby, he sets down his briefcase to collapse the umbrella.

An overzealous bellman picks up the briefcase to move it out of the way. Without waiting for an explanation, Mr. Bond calmly reaches into his pocket for a remote transmitter. At the push of a button, the bellman's hair becomes live wire, courtesy of a 50,000-volt jolt from Bond's shocking briefcase. The briefcase is dropped instantly.

The moment passes. Briefcase safely in custody, our couple seat themselves at a table facing the door. Our Mr. Bond discreetly takes out his dual-purpose ballpoint pen, extends the antenna and makes a quick sweep of the dining room to detect any radio-frequency bugs. Ms. Bond activates the audio recorder in her cigarette box, places it on the table, and they wait for the scheduled rendezvous to begin.

The scenario may scream Hollywood, but you'd be amazed at what goes on these days as everyday people turn spy in games of adult hide-

WRISTWATCH CAMERA

PEN BUG ALERT

and-see. Business people documenting meetings, journalists traveling overseas, parents protecting their children from kidnappers, office workers wanting to document claims of sexual harassment and law-enforcement personnel trying to outwit the bad guys—all are clients of stores like Quark Research Group and The Counter Spy Shop. Aptly named, these New York City one-stop spy centers sell everything from book safes for hiding jewels to camera-equipped dolls that monitor the babysitter.

We did a little sleuthing of our own at these stores, sniffing out the more popular novelty items as well as the hardcore, double-agent-type products. Visiting these stores is like going to Q's spy lab in a James Bond film.

For instance, what headwear collection is complete without a pair of night-vision goggles? Quark's Star Scope and the NightViewer pocket-scope (\$1500 and up) give you night sight. Quark claims light intensification of 20,000 times

for Star Scope, which is easily mounted onto most SLR and video cameras to provide a lux capability camcorder makers dream about. NightViewer's monocular lens uses an infrared-emitting diode to send out IR energy that can only be picked up by the night-vision goggles.

Although vests are the most common article of clothing for bulletproofing, there's really no limit to what you can have done. Most bulletproofing is done with Kevlar, a rel-

CIGARETTE BOX RECORDER

atively lightweight material that can withstand bullets from handguns and fragments from exploding bombs, Quark says. If you need more protection, The Counter Spy Shop's steel-reinforced vest will reject fire from an AK-47, according to store operations manager Elan Jamil. The metal backing may add 15 pounds to the scale, but "it's lighter than a coffin," he says.

Surveillance gear is big at spy stores, and you'd be amazed where cameras are showing up. See that guy in the sunglasses? Look closely at the bridge of the glasses and you can see he has three eyes, not two, with his video sunglasses (\$6000 and up). All you see is a 1/32-in. opening in the glasses, but inside is a 1/8-in. CCD video camera. Tiny

DIGITAL CELLULAR PHONE SCRAMBLER

cables in the glasses' sports strap connect to a belt-worn power supply and from there to an 8mm recorder in a belly bag.

You can monitor your bedroom in the same way with the clock-radio surveillance kit. A tiny 1/8-in. CCD video camera picks up images over a 78° field of view and can deliver them in color or black and white to a time-lapse recorder or to a monitor. A sensitive, omnidirectional microphone and preamplifier are also housed in the radio (\$450 and up) for audio monitoring.

For times when video surveillance is overkill, the wrist-watch camera (\$275 and up) might do the trick. Known as a document camera, the camera watch takes color or black-and-white photos using Minox film. Press what looks like a typical

BODY ARMOR (VEST) AND EAR TRANSCEIVER

VIDEO GLASSES

knob on the side of the watch, and you have a picture of important evidence. The Quark watch comes with its own developing kit and instructions.

Phantom ear mikes (\$600 and up) are popular with Secret Service wannabes who need 2-way communication capability without

MONOCULAR NIGHT VISION (CAMERA ADAPTABLE)

the obvious look of walkie-talkies. Wired sets give you an authoritative look, while wireless versions are for concealed communications. The ear mike communicates with a transceiver that's hooked onto your belt or stowed in a pocket to give you 2-way hands-free communication.

Scramble your cellular phone calls to protect your number and conversations from eavesdroppers.

Hide a knife in a

KNIFE IN COMB

pen, a letter opener or a watch. Record conversations from up to 50 ft. away with a tape machine in your pocket. There's a lot of it going around. Surveillance and protection is a \$500-million-a-year business, according to Gregg Graison, vice president of Quark Research Group. However, the people buying it are responsible for assessing the ethical and legal implications. Anyone getting into the spy game is well advised to learn the do's and don'ts first. Failure to do so can result in stiff penalties. **PM**

LIPSTICK KNIFE

ELECTRONIC LOCK PICK



COMPARISON TEST

SMALL V6 SEDANS

Yesterday's econobox is today's potent family car.

BY DON CHAIKIN, Automotive Editor
PM Photos by Rich Cox



CHRYSLER CIRRUS LX

● Once upon a time, the only "small" sedans to be found on our roads were oddly shaped, strangely named things from faraway lands.

My, my, but our world sure has changed. The once oddball-cum-econobox is now the family transportation of choice. In fact, there are dozens of quality, stylish and extremely competent models available.


However, with fuel supplies and prices comfortably stable, an ever-growing percentage of formerly fuel-frugal buyers are rallying around the cry of "More power!" Heeding that cry, we tested head-to-head those 10 "small" sedans that can be equipped with a V6 engine, including the newest models on the market—Ford Motor Co.'s Contour and Mystique, and Chrysler's Cirrus—as well as the best sellers in the segment—the Honda Accord and Toyota Camry. Here are the results in alphabetical order.

Chrysler Cirrus LX

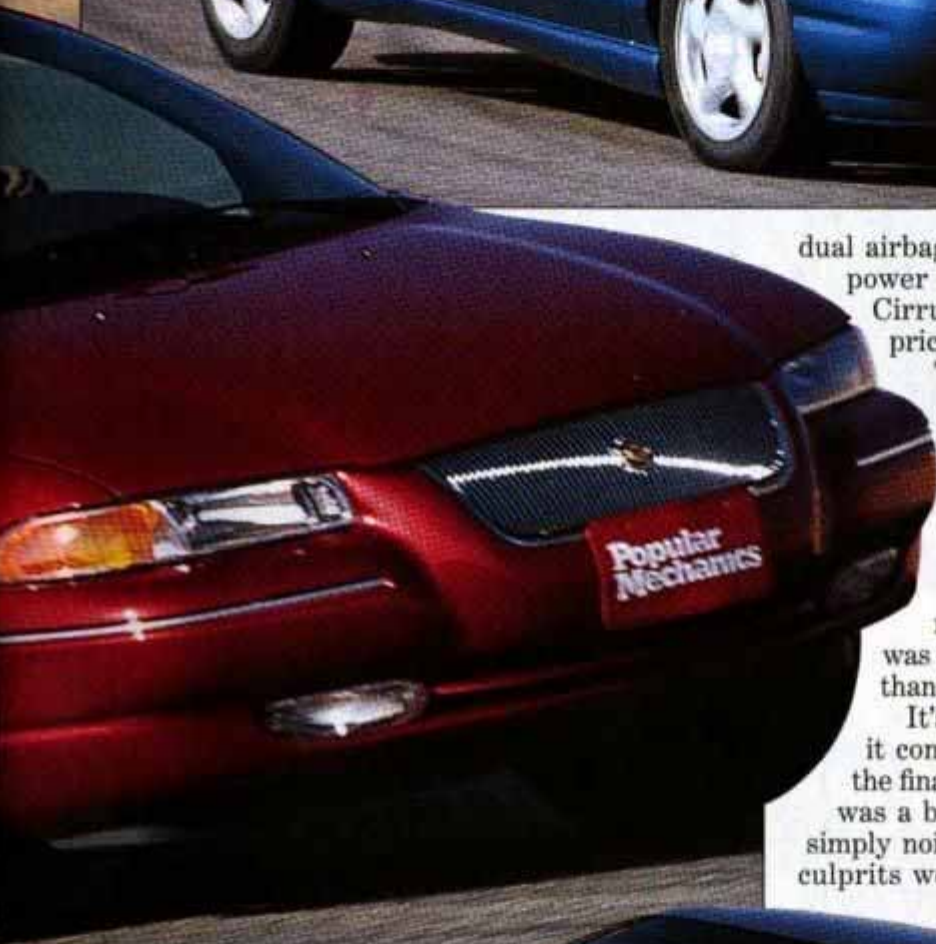
Talk about being born to high expectations. The Chrysler Cirrus (and its younger sibling, the Dodge Stratus, which it leads to market by a few months) finds itself riding the crest of Chrysler's wave of success, popularity and critical acclaim. Luckily for the Cirrus, it has no trouble staying atop the water.

True to Chrysler's cab-forward trend, the Cirrus is sleek and eye-catching on the outside and cavernous on the inside. While externally it is not the largest of the test group, it sits on the longest wheelbase. All of that distance between front and rear axles contributes to the Cirrus's large-car feel and its large-car road manners.

As important as representing the latest iteration of Chrysler's engineering and design philosophy and practice, the Cirrus adheres to the company's pricing policies. With its laundry list of standard equipment—




FORD CONTOUR SE



dual airbags, ABS, remote keyless entry, foglights, power windows, power mirrors and more—the Cirrus in LX trim, like our tester, has a base price of less than \$18,000.

The sophisticated 4-wheel double-wishbone suspension and speed-dependent variable-assist rack-and-pinion steering do a creditable job of keeping the Cirrus tracking where you want it. Since the Cirrus is sold at Chrysler stores, it is ultimately designed more for comfort and cruising than hard driving. But a quick look at the test results shows that the Cirrus's handling was middle of the pack, its acceleration better than average and deceleration top drawer.

It's certainly much better than average when it comes to providing interior space. However, the final fit and finish of the interior of our test car was a bit disappointing. Further, the Cirrus was simply noisier than it should have been. The major culprits were the engine (the Mitsubishi-supplied 24-valve sohc 2.5-liter is intrusively noisy and somewhat buzzy, especially under acceleration) and wind noise.



HONDA ACCORD LX V6

SMALL V6 SEDANS



HYUNDAI SONATA GLS

For such a svelte-looking package, the roar of the wind rushing by the A-pillars and permeating in through the doors was surprising.

However, aside from these complaints, as well as the observation that some of the interior trim could look and feel a bit classier for a car wearing the new Chrysler badge, this car is destined to be the next winner in Chrysler's string.

Ford Contour SE

If the Cirrus came to market bearing the large burden of following the Neon, the Ford Contour may have the Herculean task of justifying the billions of dollars Ford invested in creating it.

Good news, folks. When the dust settled, the Ford Contour was everyone's favorite.

Despite its slit-like headlights and grille opening, the Contour is in many ways a less daring design than the Cirrus. The Contour is a shade smaller than the Cirrus, and sits on a shorter wheelbase. The interior is neither as spacious nor as airy as the Cirrus's. But the Contour is quite comfortable for four, a bit tight for five.

The Contour also rides on struts at all four wheels, as opposed to the Cirrus's double-wishbone setup. Yet with the sporty tuning of our SE test car's suspension, the car was unflappable. The ride is nice and taut without being at all jarring, yet the handling is crisp, responsive and very predictable. On both the skidpad and through the slalom, the Contour was second quickest. It was second to none during the subjective testing of driving the canyon roads of Southern California.

The 170-hp V6 pulled the Contour around very smartly. Since the Contour SE in our test group was the only car equipped with a 5-speed manual transmission, its acceleration numbers are meaningless in terms of comparison to the group. However, the Contour's near-twin Mercury Mystique, with the same engine and an automatic transmission, found its way to the middle of the pack.

The lightweight, compact 24-valve

value. The Contour boasts such standard equipment as an air filter to keep the air coming through the ventilation system pure. Our SE test car was equipped with Ford's traction-control system (which comes in tandem with ABS), a remote keyless-entry system as well as a power driver's seat to complement the power windows and mirrors. And the sticker in the window read less than \$19,000.

Honda Accord LX V6

Take the second best-selling passenger car in the country and cure what many perceive as its only real problem.



MAZDA 626 ES



PONTIAC GRAND AM SE

dohc 2.5-liter V6 is one of the reasons that Ford spent so much money on the Contour's development. The money also produced the base-engine dohc 4-cylinder as well as both the new 5-speed manual and 4-speed automatic gearboxes. Money well spent. The V6 is tractable, smooth and responsive. Its light weight and small size contribute to the Contour's balance and nimble attitude. It doesn't hurt the ownership experience that the V6 needs to have its spark plugs replaced only once every 100,000 miles.

Nor does it hurt the ownership experience that Ford understands

Look out world, here's the Accord V6.

The Honda Accord has a hard-earned reputation as a refined, comfortable, well-made sedan. But with only four cylinders under its hood—four very efficient cylinders, it must be noted—the Accord was giving up something in performance.

Not any more, thanks to a 170-hp 24-valve sohc 2.7-liter V6 inspired by the engine in the Acura Legend.

Honda is offering this strong engine in Accord LX and EX sedans. Our LX-trimmed test car was among the quickest to 60 mph and through the quarter mile. But more than that,

the V6 under the Accord's hood adds a level of driveability and smoothness that your standard 4-cylinder Accord simply cannot match. For one thing, there's the matter of torque. The V6 offers nearly 20 ft.-lb. more of it than even the mighty VTEC Four. For another, there's the silkiness of the Six, which just makes cruising delightful.

Add to the engine all of the qualities that have made the Accord a success—superb handling and ride, unsurpassed fit and finish, quietness and quality—and you'd be hard pressed to find fault with the Accord V6. However, it has to be noted that though our Accord LX tester was equipped quite similarly to the Cirrus and Contour, it costs a few thousand dollars more than either.

Hyundai Sonata GLS

If you want stuff—lots and lots of neat stuff—and are not hypercritical about the finer points of all of that stuff, test drive a Hyundai Sonata. Our GLS test car boasted dual airbags, antilock brakes, a dual-mode electronically controlled 4-speed automatic, an AM/FM/cassette/CD stereo sound system with redundant steering-wheel controls, power windows, mirrors and door locks, and defrosting outside mirrors—and the sticker still said less than \$20,000. Such a deal.

A glance at the test results, however, shows that the Sonata lagged behind all the others in acceleration. And that sort of helps us get back to those finer points.

Yes, the Sonata has a V6, an sohc 3.0-liter—but with 12 rather than 24 valves. And breathing makes a difference. The Sonata has less power than all the others in this group. Likewise, the interior of the Sonata is a bit less polished than most of the others.

The Sonata's a real tradeoff: lots of room, better-than-acceptable ride and comfort, as well as clever touches and gadgets lacking elsewhere for absolute topnotch execution.

Mazda 626 ES

Handsome styling, comfortable interior, better-than-average performance and handling, and high-quality fit and finish all give the Mazda what it needs to compete in these shark-riddled waters.



TOYOTA CAMRY LE



MERCURY MYSTIQUE LS

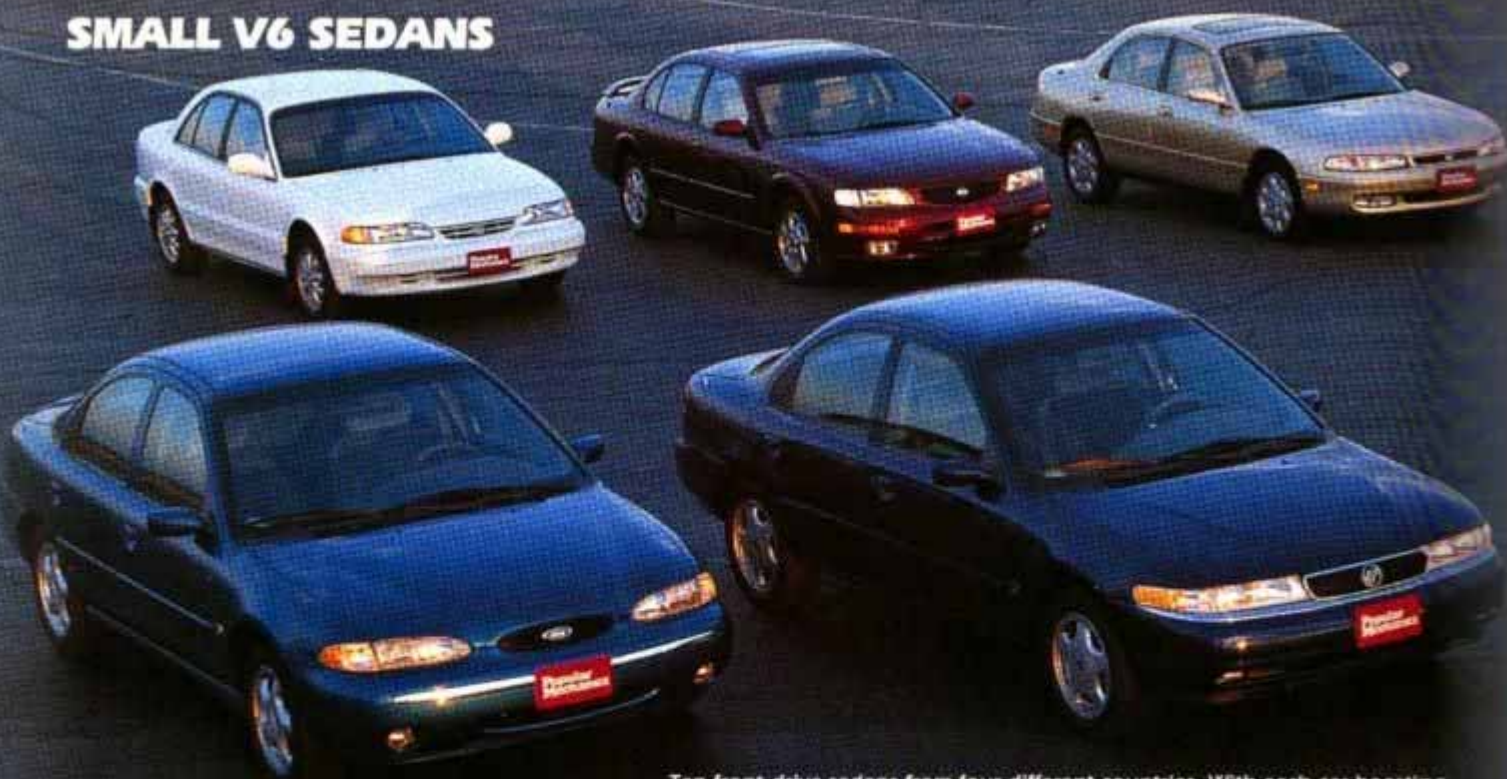


VOLKSWAGEN PASSAT GLX



NISSAN MAXIMA SE

SMALL V6 SEDANS



Ten front-drive sedans from four different countries. With each car boasting a V6 engine, ABS and room for five, there's not a loser in the group.

SPECIFICATIONS AND DIMENSIONS

MANUFACTURER/ MODEL	BASE PRICE/ PRICE AS TESTED	ENGINE DISPLACEMENT (liter/ci)	ENGINE HP, NET/ TORQUE (ft.-lb.)	DRIVE LAYOUT	ENGINE/ TRANSMISSION TYPE	WHEELBASE/ LENGTH (in.)	TRACK FRONT/REAR (in.)	WIDTH/ HEIGHT (in.)	HEAD-, LEG-, HIPROOM, F/R (in.)	EPA INTERIOR/ TRUNK VOLUME	CURB WEIGHT (lb.)/ WEIGHT/HP RATIO (lb./hp)
Chrysler Cirrus LX	\$17,435/ \$18,563	2.5/ 152.3	164 @ 5900 rpm/ 163 @ 4350 rpm	front/ front	sohc 24V V6/ 4A	108.0/ 186.0	60.2/ 60.2	71.0/ 54.1	F: 38.1/42.3/52.8 R: 36.8/37.8/52.7	95.9/ 15.7	3145/ 19.2
Ford Contour SE	\$15,695/ \$18,965	2.5/ 155.0	170 @ 6250 rpm/ 165 @ 4250 rpm	front/ front	dohc 24V V6/ 5M	106.5/ 183.9	59.2/ 58.5	69.1/ 54.5	F: 39.0/42.4/50.7 R: 36.7/34.3/45.5	103.0/ 14.1	3073/ 18.1
Honda Accord LX V6	\$22,300/ \$22,767	2.7/ 163.2	170 @ 5600 rpm/ 165 @ 4500 rpm	front/ front	sohc 24V V6/ 4A	106.9/ 186.8	59.6/ 59.1	70.1/ 55.3	F: 39.4/42.7/52.6 R: 37.6/34.3/51.4	94.7/ 13.0	3219/ 18.9
Hyundai Sonata GLS	\$17,199/ \$19,130	3.0/ 181.3	142 @ 5000 rpm/ 168 @ 2500 rpm	front/ front	sohc 12V V6/ 4A	106.3/ 185.0	59.6/ 59.1	69.7/ 55.3	F: 38.5/43.3/57.9 R: 37.7/36.6/57.1	101.3/ 13.2	3018/ 21.2
Mazda 626 ES	\$21,545/ \$22,790	2.5/ 152.3	160 @ 5500 rpm/ 156 @ 5000 rpm	front/ front	dohc 24V V6/ 4A	102.8/ 184.4	59.1/ 59.1	68.9/ 55.1	F: 38.2/43.5/NA R: 37.2/36.8/NA	97.0/ 14.0	2985/ 18.6
Mercury Mystique LS	\$15,230/ \$19,690	2.5/ 155.0	170 @ 6250 rpm/ 165 @ 4250 rpm	front/ front	dohc 24V V6/ 4A	106.5/ 183.9	59.2/ 58.5	69.1/ 54.5	F: 39.0/42.4/50.7 R: 36.7/34.3/45.5	103/ 14.1	3223/ 19.0
Nissan Maxima SE	\$22,599/ \$27,634	3.0/ 182.4	190 @ 5600 rpm/ 205 @ 4000 rpm	front/ front	dohc 24V V6/ 4A	106.3/ 187.7	59.8/ 59.1	69.7/ 56.0	F: 40.1/43.9/54.3 R: 37.4/34.3/55.9	99.6/ 14.5	3072/ 16.2
Pontiac Grand Am SE	\$13,004/ \$17,247	3.1/ 191.4	155 @ 5200 rpm/ 185 @ 4000 rpm	front/ front	ohv V6/ 4A	103.4/ 187.3	55.8/ 55.3	68.7/ 53.5	F: 37.8/43.1/49.1 R: 37.0/34.9/50.2	104/ 13.3	2881/ 18.6
Toyota Camry LE	\$21,878/ \$24,936	3.0/ 182.7	188 @ 5200 rpm/ 203 @ 4400 rpm	front/ front	dohc 24V V6/ 4A	103.1/ 187.8	61.0/ 59.1	69.7/ 55.1	F: 37.0/43.4/55.9 R: 36.1/35.0/55.4	112.1/ 14.8	3241/ 17.2
Volkswagen Passat GLX	\$20,890/ \$22,930	2.8/ 170.3	172 @ 5800 rpm/ 177 @ 4200 rpm	front/ front	dohc 24V V6/ 4A	103.3/ 181.5	58.4/ 56.2	67.5/ 56.4	F: 39.3/45.1/NA R: 36.6/37.0/NA	98.7/ 14.4	3197/ 18.6

1. Times from a steady-state 40 to 70 mph. 2. Best speed achieved while weaving through eight cones 100 ft. apart. Speeds provide index of transient response.

The current 626 has been rolling around for two years now with a profile that looks like a subdued version of the new Ford models. All that while beneath its skin the Mazda has had a 4-wheel strut suspension with lateral links in the rear, similar to what's holding the wheels of the new Fords on the road. And beneath the Mazda's hood—in LX and ES trim—there can be an all-aluminum 24-valve dohc 2.5-liter V6 that puts out slightly less horsepower and torque than Ford's new V6.

The comfort of our luxuriously ap-

pointed top-of-the-line ES with leather upholstery, a power sunroof, power windows, door locks and mirrors was exquisite for a car in this class. Given its spot in the 626 lineup, however, our test car also had a window sticker of close to \$23,000.

Mercury Mystique LS

Ford division's distaff side usually gets a version of what the big guy gets. So it's small wonder that the Mystique has arrived along with the Contour. As has been the way for decades, the Mercury version of the

car is a bit more conservative inside and out than the Ford. But the cars are nearly identical beneath their slightly different skins.

Our Mystique LS was equipped quite like our Contour SE, with the notable difference of having the new electronically controlled 4-speed automatic instead of the 5-speed manual. The difference in gearboxes is worth about 2 seconds to 60 mph. It's also worth about \$800 on the bottom line.

Otherwise, the difference in suspension tuning was worth a couple of hundredths of a g on the skidpad and



TEST RESULTS

STEERING TYPE/RATIO (overall)	TURNING CIRCLE (ft.)	WHEELS/TIRES	BRAKE SYSTEM FRONT/REAR (in.)	FUEL ECONOMY (MPG EPA city/hwy.) PM test	ACCELERATION 0-60 MPH (sec.) 1/4-MILE (sec./mph)	PASSING ¹ ACCELERATION 40-70 MPH (sec.)	BRAKING 60-0 MPH (ft.)	700-FT. ² SLALOM MPH	200-FT. ³ SKIDPAD (lateral g)	PM ⁴ SERVICEABILITY INDEX
power rack & pinion/17.5:1	37.0	15 x 6-in. steel 195/65R15	disc/drum ABS 11.0-in. vented/7.88-in.	20/29 18.3	10.6 17.62/77.9	8.4	142	57.4	.72	7
power rack & pinion/14.5:1	37.3	15 x 6-in. alloy 205/60R15	4-wheel disc ABS 10.24-in. vented/9.88-in. vented	21/29 23.4	9.1 16.67/82.9	7.0	143	59.6	.78	7.5
power rack & pinion/16.3:1	36.7	15 x 6-in. steel 205/60VR15	4-wheel disc ABS 11.1-in. vented/10.2-in.	19/25 20.9	9.9 17.44/80.3	7.9	155	58.6	.75	8
power rack & pinion/15.5:1	34.6	15 x 6-in. alloy 205/60HR15	4-wheel disc ABS 10.11-in. vented/10.11-in.	18/24 19.9	11.4 18.16/75.2	9.8	151	57.8	.74	9.5
power rack & pinion/17.8:1	34.8	15 x 6-in. alloy 205/55VR15	4-wheel disc ABS 10.2-in. vented/10.3-in.	20/26 20.4	10.6 17.80/77.2	9.7	154	57.9	.77	7.5
power rack & pinion/14.5:1	38.4	15 x 6-in. alloy 205/60R15	4-wheel disc ABS 10.24-in. vented/9.88-in. vented	22/30 21.0	10.9 17.75/78.1	8.6	158	57.9	.75	7
power rack & pinion/16.7:1	34.8	15 x 6.5-in. alloy 215/60R15	4-wheel disc ABS 11.2-in. vented/11.12-in.	21/28 18.7	9.2 16.66/82.8	7.1	148	57.5	.74	6.5
power rack & pinion/13.4:1	35.3	16 x 6-in. alloy 205/55R16	disc/drum ABS 10.38-in. vented/8.0-in.	20/29 19.8	11.0 17.76/77.5	9.3	152	58.0	.70	8.5
power rack & pinion/17.4:1	35.4	15 x 6-in. alloy 205/65HR15	4-wheel disc ABS 10.8-in. vented/11.3-in.	20/28 18.9	9.2 16.64/83.3	8.6	142	56.4	.75	11
power rack & pinion/17.5:1	38.4	15 x 6-in. alloy 215/50HR15	4-wheel disc ABS 11.0-in. vented/8.9-in.	18/25 21.0	11.0 17.79/79.3	8.4	150	59.9	.79	5

3. G-force generated during steady-state travel around a 200-ft.-dia. circle. Number is an average of best cw and ccw. 4. Based on 12 basic maintenance functions.

a mile an hour through the slalom course. However, over the road and through the hills, the Mystique was nearly as much fun as the Contour.

Like the Contour, the Mystique offers a truly together feel—everything about the car is working right and working together. The quality is good, even if fit and finish are not quite up to the Toyota's or Honda's standards.

And like the Ford version, the Mystique is priced to sell. There's a mountain of value in this car with a window sticker that doesn't break \$20,000.

Nissan Maxima SE

The second biggest car in this group happens to be the most powerful. It's also the most expensive.

Nissan redesigned the Maxima for '95, and the current car is larger outside and in than the old. It's also powered by a more efficient all-aluminum engine. The redesign also brought about a new rear suspension, with a beam axle replacing the struts.

And one of the comments we have about this car is how the rear end tends to wiggle just a mite and just for an instant when it gets unloaded,

as when going over a bump. In fact, the Maxima's handling was just a tad less responsive than most in this group. The car just didn't seem to like being driven as hard as, say, the Contour or the Accord, and our seat-of-the-pants evaluations were reinforced at the track, where the Maxima's body roll took its toll on the skidpad and through the slalom.

However, the drivetrain is a whole 'nother matter. The potent 24-valve dohc 3.0-liter engine driving through the electronically controlled 4-speed

(Please turn to page 142)

Материал, защищенный авторским правом

BOATING



BLOWN AWAY

Sophisticated electronics and databases give the defending champion, America³, a winning edge in this year's America's Cup competition.

BY JOE SKORUPA, Boating/Outdoors Editor. PM Photos by Daniel Forster

- America's Cup races kick off with a cutthroat game of cat-and-mouse that begins before the firing of the starter's gun. What's at stake is a key advantage that can be ridden all the way to the finish line 18.5 miles away. Because the stakes are so high, the boats take extraordinary risks, often maneuvering within inches of each other.

To make sure they don't bump hulls, someone from each crew stands on the rocking-and-rolling point of the bow to signal thumbs up for clearance and thumbs down for collision. Then, after the race starts and the boat rounds the leeward mark, someone crawls to the outboard end of the spinnaker pole (6 ft. beyond the bow) to blow away a shackle that secures a sail the size of a dirigible. And when the spinnaker chute unexpectedly snags in the rigging, someone climbs aloft carrying a knife to hack away the entangling sail fragments atop a wildly swinging 110-ft. mast.

That someone is traditionally called the bowman. But in this year's America's Cup competition, tradition has been thrown to the wind. Bill Koch, the quixotic head of the America³ syndicate and winner of the 1992 Cup, stunned the sporting world last spring by announcing his intention to field an all-female crew. In the entire 144-year history of the Cup, only three women have ever sailed in competition—the last in 1937. This year, which climaxes with a best-of-nine series in early May, 16 women will sail each race on the America³ boat.

And that raises an important question: What do you call the daredevil who flies on America³'s



BLOWN AWAY

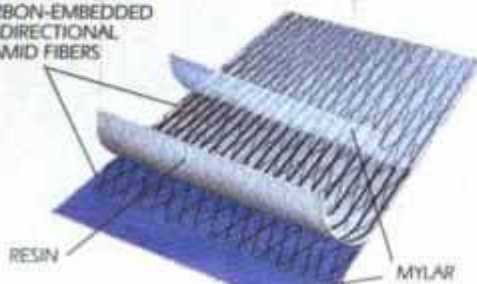
1. SPINNAKER—Cuben Fiber
2. FORESTAY—aramid fiber line
3. TOPPING LIFT—aramid fiber line
4. AFTERGUY—aramid fiber line
5. FOREGUY—aramid fiber line
6. HULL—carbon fiber with foam core
7. MAST—carbon fiber
8. SPREADER—carbon fiber
9. SPINNAKER POLE—carbon fiber and Kevlar
10. SIDESTAYS—aramid fiber line
11. DECK HATCH—sail stowage
12. MAINSAIL—Cuben Fiber
13. BATTEN—carbon fiber
14. DIGITAL DISPLAYS—navigation instruments
15. BOOM VANG—carbon fiber
16. BOOM—carbon fiber
17. PRIMARY WINCH GRINDERS
18. PRIMARY WINCHES
19. MAINSHEET GRINDER
20. WINCHES FOR HALYARDS, LIFTS AND HOISTS
21. KEEL—steel



22. TRIM TAB—carbon fiber, possibly movable
23. BALLAST BULB—lead
24. BEAVER TAIL—probable look of secret appendage
25. KELP CUTTERS—mechanical blades, manually operated
26. RUDDER—carbon fiber
27. STEERING WHEELS—rudder controls
28. RUNNING BACKSTAY GRINDER

Cuben Fiber Sailcloth

CARBON-EMBEDDED UNIDIRECTIONAL ARAMID FIBERS



halyards like Tarzan swings on vines? Bowman isn't right. How about Bow Chick? That isn't exactly right either, but it works for the all-female crew. And since the sailor's name is Susanne Leech Nairn, why not Susie Bow Chick? Hey, I'm not making this up, I just went along for a ride.

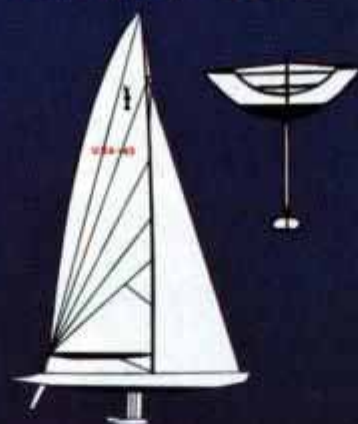
On the day I sailed with the America³ team, an all-day session of full-contact

rabbit-start scrimmages, Susie Bow Chick performed an impressive high-wire act in lumpy 8-ft. seas. In addition to scampering on the point of the bow and muscling out to the end of the spinnaker pole (without being hoisted), Susie twice buckled up her harness and went aloft. On the second trip, she was near the top of the mast when the pitching boat threw her helplessly into the rigging for several hair-raising minutes.

Later, despite nursing a deep bruise on her upper arm caused by



America³ 1995



Overall length: 75 ft.
 Waterline length: 57 ft.
 Beam: 18 ft.
 Displacement: 50,000 lb.
 Draft: 13 ft.
 Mast height: 110 ft.

- 29. MAINSHEET PEDESTAL—winch, manual hydraulics and digital displays
- 30. AFT HATCH—17th man position, access to kelp cutter
- 31. RUNNING BACKSTAY WINCHES
- 32. MAINSHEET TRAVELER
- 33. RUDDER BEARING
- 34. ANTENNAS FOR DATA TELEMETRY AND GPS
- 35. MAINSHEET—aramid fiber line
- 36. SCOOPED AFT DECK—reduces weight above waterline

slamming into a spreader, Leech Nairn admitted she loves her job, especially its athletic, daredevil side. "Some roles in sailing are mechanical and physical, while others are intellectual and artistic," she said. "I enjoy the mechanical/physical parts, especially on the bow, which puts you out on the extremes. You're challenged to perform tasks and solve problems. You're getting wet. You're under the time gun. It's exhilarating, and scary, too. I guess that's why I like it."

In addition to being a Bow Chick,

Leech Nairn is an aerospace/data systems engineer and for this reason, perhaps more than other crew members, she understands the large role played by science and technology in America's Cup racing. Prior to joining the America³ team, Leech Nairn worked in the Microgravity Division at NASA, where she helped develop video data and digital imagery for the space station and space shuttle. Interestingly, these same technologies are used extensively by the brain trust at America³.



Crew translates wind force into speed.

While superior sailing skill is crucial to victory in the America's Cup, the truth is that the key to victory boils down to this: The fastest boat wins. And the key to designing and building the fastest boat is technology.

Part of my day with the America³ team consisted of spending time on the tender *Chubasco*—a SWATH (small-waterplane-area twin-hull) boat that serves as a mother ship for the team's racing boats and support vessels, and as a command center for data gathering. *Chubasco* is loaded with XP60 computers provided by Hewlett-Packard (a major sponsor of the team) that are linked by a secure radio-frequency network to the test boats. Like the handheld walkie-talkies used by the crew, this telemetry link is encrypted to prevent eavesdropping.

With a vast amount of telemetered data flowing into *Chubasco*, the flying bridge tends to resemble a war room during equipment testing and training sessions, as well as during the actual race. The data flow varies depending on the day's agenda, but it encompasses both digital and video readouts—all of which are recorded in extensive databases.

A case can be made that America³'s databases—covering boat speed, hull design, sail design, composites and underwater appendages (such as keel fins, bulbs, wings and trim tabs)—are

(Please turn to page 120)



Laser/GPS gun gives speed/position data.

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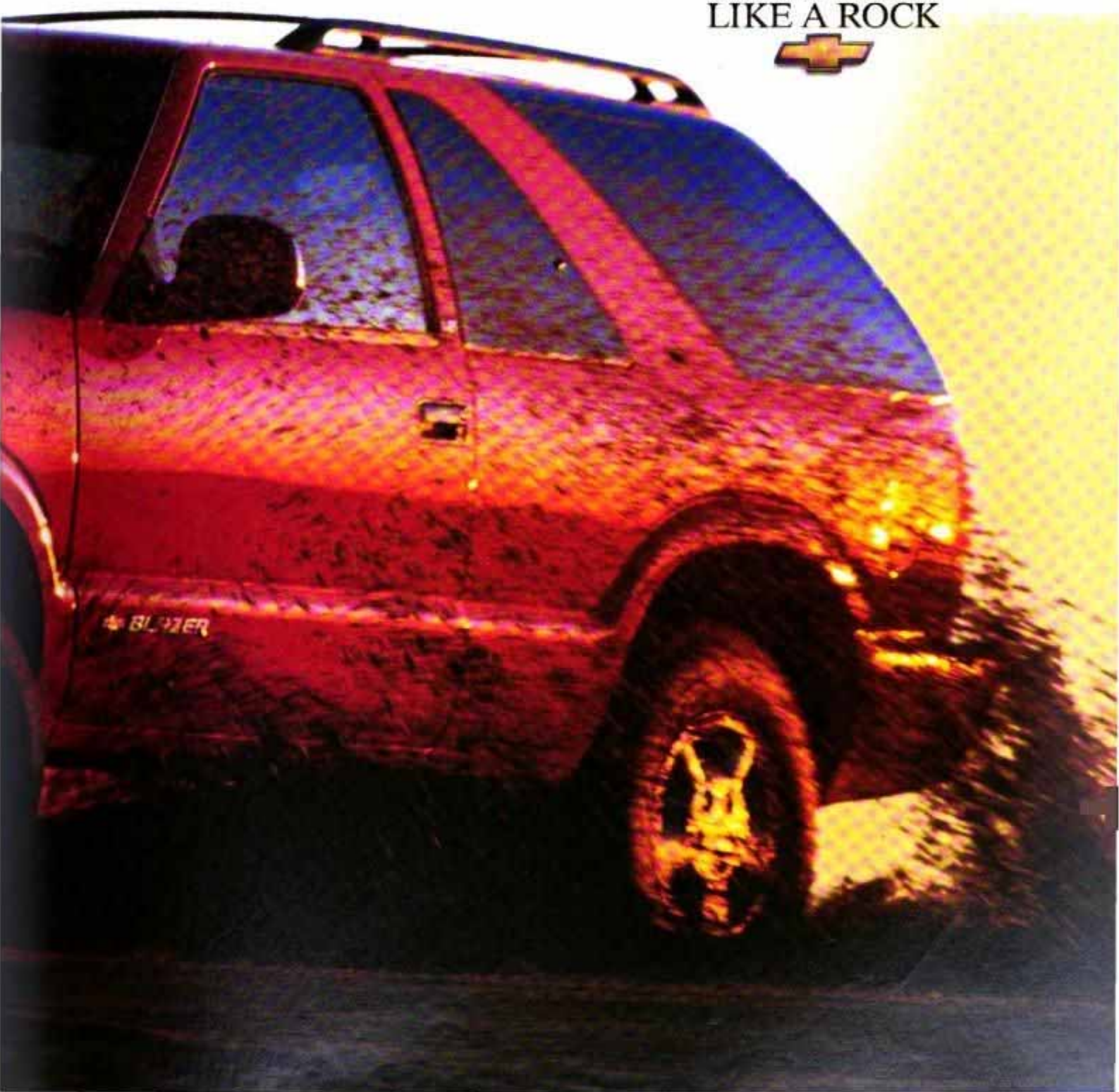


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COVER STORY

UNDERSTANDING AND EXPLORING THE INTERNET

A home computer is your link to a worldwide web of information and services. Here's our guided tour to cyberspace's new frontier.

BY ABE DANE, Senior Correspondent; PM Illustration by Michel Tcherevkoff

• The bridge between Penang Island and the Malaysian mainland is the longest in Asia and, the locals believe, the third longest in the world. It spans 13.5 km, 8.5 of them over water. A toll is charged. Visitors are discouraged from stopping on their way across.

I know this because a computer at the Universiti Sains Malaysia, Penang, tells me so. As page after page of neatly formatted text and pictures about the place scroll by on my World Wide Web browser, I can

also infer that Penang's communications infrastructure is on the rickety side. The picture I requested with a mouse-click is taking more than a minute to make its way around the world. But somehow the delay, along with the grainy quality of the image, only heightens my sense of being in touch with an exotic place.

It's time to move on. I search my hotlist of Web addresses and double-click on Internet Underground

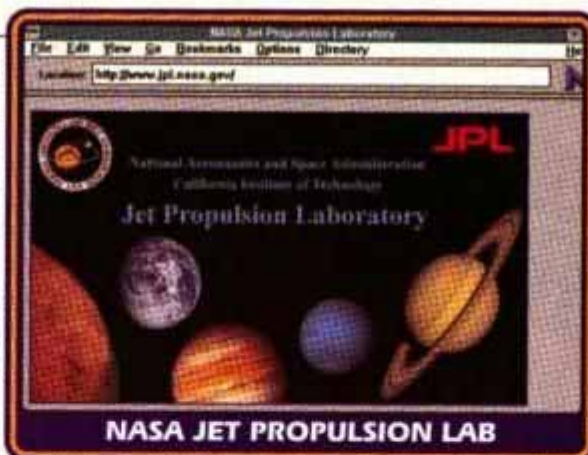


INTERNET

Music Archive. A few clicks more and a song by The Barking Spiders is streaming onto my hard disk in digital stereo. It's a 5-megabyte file, and even with my 28.8-kilobits-per-second (kbps) modem, it'll be awhile before that download is finished.

To pass the time, I open a Telnet window that teleports me into the computer system at MIT, 200 miles away. By chance, a former classmate has logged on from his home in Germany. I page him, and we pass a few minutes typing away at each other, with my words appearing on one-half of a split screen and his appearing on the other. We would hardly ever talk if we had to pay for phone calls across the Atlantic.

When we log off, The Barking Spiders are still downloading, so I browse around at CDNow!, an online CD store, and test the depth of its in-



NASA JET PROPULSION LAB

The Barking Spiders are still downloading, so I open the Web browser again, and wander over to NASA's Jet Propulsion Lab for a look around its archives of digital movies and images sent back by its planetary probes. Finally, The Barking Spiders download completes, automatically launching software that plays the song through my stereo. Hmmm. Not bad.

It's been like this since early this morning, when, with a warbling shriek from the modem, my computer took over my home phone line and became a full-fledged part of the Internet. From then on, me and my little 486

have been moving in some pretty fast company, traveling along the same great worldwide data corridors as multimillion-dollar NASA mainframes and high-end university workstations.

Thanks to dizzying progress on several fronts at once, the Internet—once the sheltered preserve of Department of Defense (DOD) scientists—is now fully accessible to anyone with a reasonably up-to-date PC, a fast modem, a few pieces of software and an account with an access provider. And when I say accessible, I don't mean

in the sense of having an E-mail address and access to all-text online forums. I mean your home computer can now do what the big boys do. It can become a full-fledged participant in a teeming electronic mind made up of millions of computers and users all over the world.

And because of new software and data standards, you can now navigate this ocean of information as easily

as you can read this article. In fact, starting March 10, you will be able to read this article at PM's new World Wide Web site, The PM Zone (The POPULAR MECHANICS Zone—<http://popularmechanics.com>). What's more, you experience material on the World Wide Web not simply as words and numbers, but as pictures, sounds and video clips.

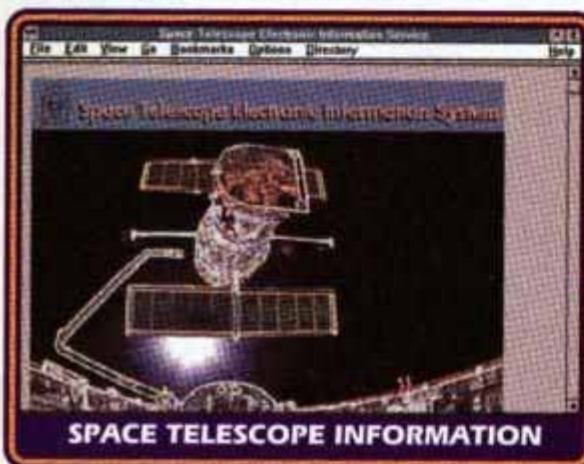
The Internet began in 1966, when a researcher at the Defense Department's Advanced Research Projects Agency (ARPA) set in motion the first serious effort to teach computers to talk to one another. The task was so complex by the standards of the day that a separate dedicated minicomputer had to be installed at each location to mediate between the site's main host computer and the others on the network.

Known as Interface Message Processors, these smaller computers managed the newly developed process of packet switching. To this day, packet switching fundamentally characterizes the Internet.

From the Defense Department's point of view, the key advantage of a packet-switched network was that it would keep working even if parts

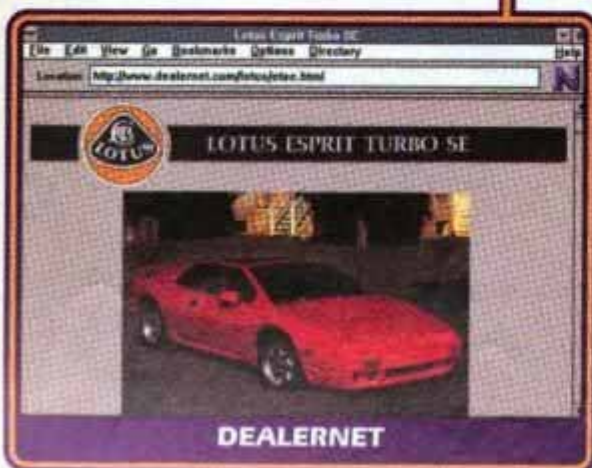
of it were destroyed in an attack. By nature, packet networks are flexible, resilient and able to keep data flowing around areas that are knocked out.

The principle is simple: Unlike the phone system, in which an uninter-



SPACE TELESCOPE INFORMATION

ventory with searches for a few of my favorite obscure bands. The Barking Spiders aren't listed, but The Blood Oranges are. I type my address into the blanks on my screen, then encrypt my credit card number, to keep hackers from stealing it, and E-mail my order in. Postal delivery, they say, should be within three to six days. While I'm shopping, I hop over to the Hearst Multimedia Newsstand and renew Mom's subscription to PM to make sure she sees this article.



DEALERNET

INTERNET CODEBOOK

World Wide Web (WWW)—Lets you jump around the Internet with hypertext while using a multimedia browser.

Uniform Resource Locator (URL)—The address used to access a Web site.

File Transfer Protocol (FTP)—Software and standards used to send and receive files between computers.

Archie—Helps you locate files available by FTP.

Gopher—Organizes information into a hierarchy of menus so it's easier to find.

Veronica and Jughead—Help you find Gopher menus containing the information you want.

Telnet—Lets you log into a distant computer to execute programs and look at files.

Transmission Control Protocol/Internet Protocol (TCP/IP)—A common language that holds the Internet together.

rupted circuit—essentially a length of wire—has to be continuously kept open between the two parties in a conversation, a packet network divides everything that's sent along it into small chunks or packets. Each packet



UNDERGROUND MUSIC ARCHIVE

is encoded with the address of its destination. A packet can take any number of routes because the routing computers all along its path know how to interpret its address and send it off in the right general direction. The data eventually gets where it was meant to go, and is reassembled into the original message.

Borrowing the ARPAnet's concept, nonmilitary organizations spawned their own networks, and these were eventually merged, or internetworked, with the ARPAnet to form the Internet. In 1982, the Transmission Control Protocol/Internet Protocol (TCP/IP), which remains in force today, was introduced as the common language.

The Internet Protocol is the addressing scheme used to designate destination computers, while the Transmission Control Protocol handles the tasks of breaking the data down into packets and then re-assembling it.

Four years after TCP/IP went into effect, there were 5000 computers on the Internet.

Three years after that, there were 100,000. By the middle of last year, there were more than 2.2 million. And that merely sets the stage for a surge of growth unlike any the Internet has seen before.

As the Internet has grown, and the amount of information on it has grown more and more unmanageably huge, a variety of tools have evolved to help people find what they want, go get it and use it. Conversations among Internet enthusiasts are invariably



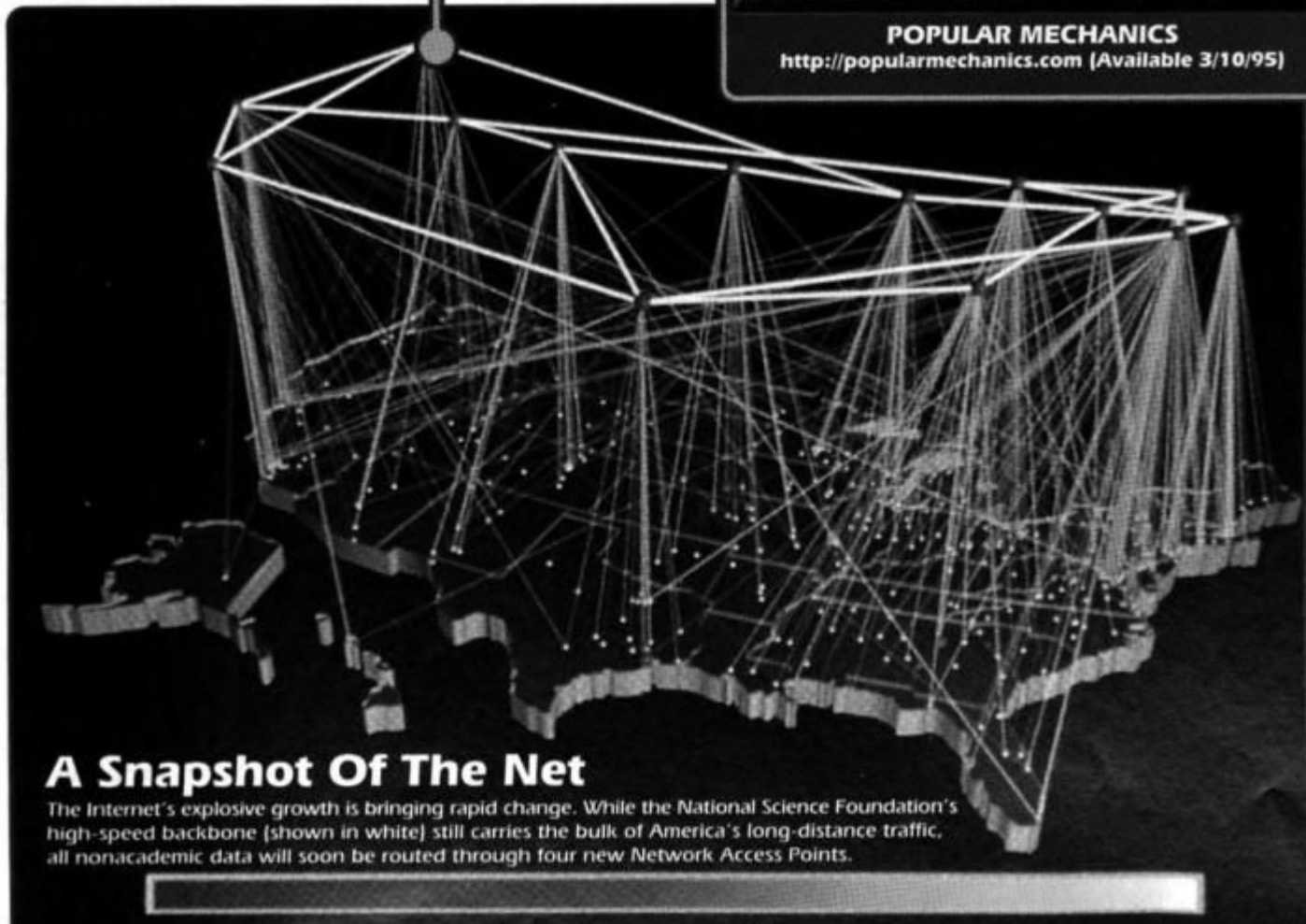
WEATHER MAP

laced with terms like Telnet, FTP, Gopher and Archie. The problem is that ingenious as these tools are, they were designed largely by



POPULAR MECHANICS

<http://popularmechanics.com> (Available 3/10/95)



A Snapshot Of The Net

The Internet's explosive growth is bringing rapid change. While the National Science Foundation's high-speed backbone (shown in white) still carries the bulk of America's long-distance traffic, all nonacademic data will soon be routed through four new Network Access Points.

INTERNET

and for the scientists and other academics who have dominated the Internet. And these tools were not easy to use. Fortunately, two major innovations are already at work making Internet use easier.

The first of these is called the World Wide Web. Invented at the European Particle Physics Laboratory (CERN) in Geneva, Switzerland, the Web's prominent feature is that it organizes information on the Internet as hypertext. That means that words or pictures in a document act as links that jump you directly to related words or pictures in other documents.

For example, say you were reading this article on the Web at the new POPULAR MECHANICS World Wide Web site, The PM Zone. The word "ARPA" would be highlighted in blue, designating it as a hyperlink. Click on it and you'd go directly to one of ARPA's computers, and there

of programs called World Wide Web browsers.

A Web browser runs on your computer and acts as a graphical interface between you and the Web. When you click on a link, it issues the necessary commands to request data from other computers, then interprets whatever comes back. Documents written in the standard Hypertext Markup Language (HTML) contain codes that tell the browser what typeface to use and how to format it. Most browsers can also display digitized pic-

tures, so that a well-written HTML document appears as an illustrated page.

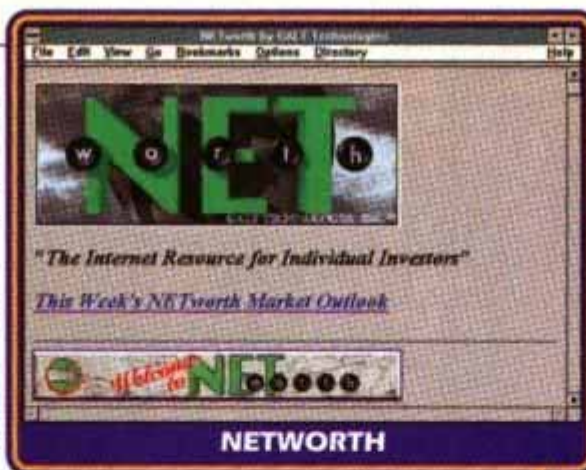
In the first year that Mosaic was introduced, the traffic along the World Wide Web exploded by more than 400,000%. This despite the fact that running a Web browser generally required a full Internet connection, which was nearly impossible for the average home PC user to get.

The final piece of the puzzle fell into place last year. Internet access providers began offering what are called Serial Line Internet Protocol (SLIP) and Point-to-Point Protocol (PPP) connections to consumers.

access its documents, pictures and other files.

Hypertext has long been a basic part of all sorts of interactive computer programs. The difference with the Web, however, is that the links tie in to data outside your own computer. With a mouse-click or a keystroke, you can jump between documents on any of thousands of computers all over the world, following your whims through a vast web of information. And all the while, you're blissfully unbothered by the technicalities of what disk drive the information is on, what directory it's under or what format it's in.

The second key advance was the development of a piece of software called Mosaic at the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign. Introduced in 1993, Mosaic was the first of a now rapidly proliferating category

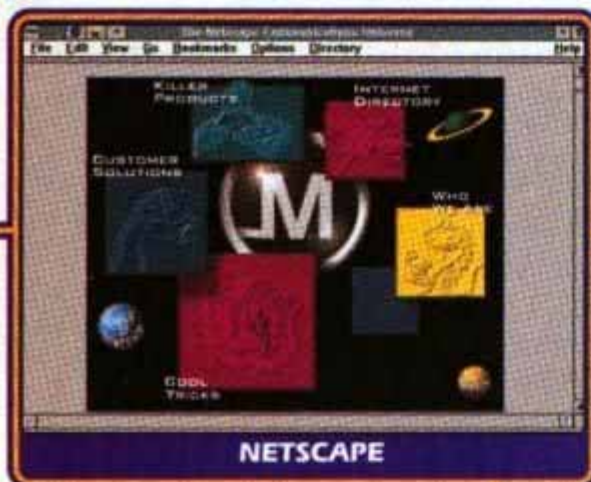


These allow anyone with a phone line, a fast (14.4 kbps or better) modem and a piece of software called a TCP/IP stack to make their computer truly one with the Internet.

At first, these connections were tricky and expensive. But these problems are quickly being ironed out.

Several companies have begun offering complete software packages preconfigured to work with certain providers. All you do is install the software, and an automated setup program walks you through the process.

Even this may become unnecessary, since new PC operating systems, such as IBM's OS/2 Warp and Microsoft's soon-to-be-released Win-



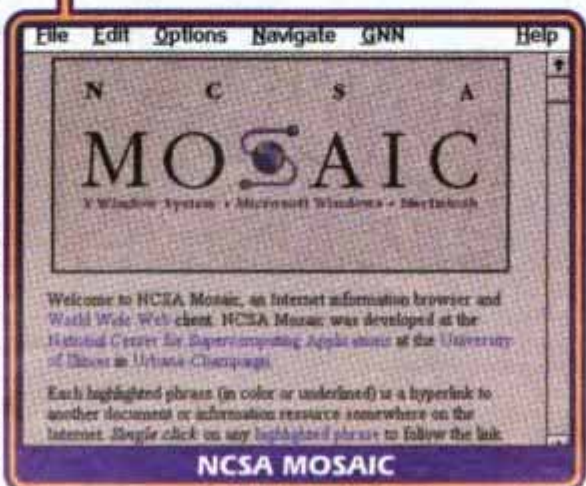
dows '95 have TCP/IP built in.

Meanwhile, the Web seems primed for explosive growth thanks to the major online services. Prodigy recently became the first of the major online service providers to make full Web access available to all of its 2 million subscribers. America Online (AOL) and CompuServe won't be far behind in bringing their millions to the Web.

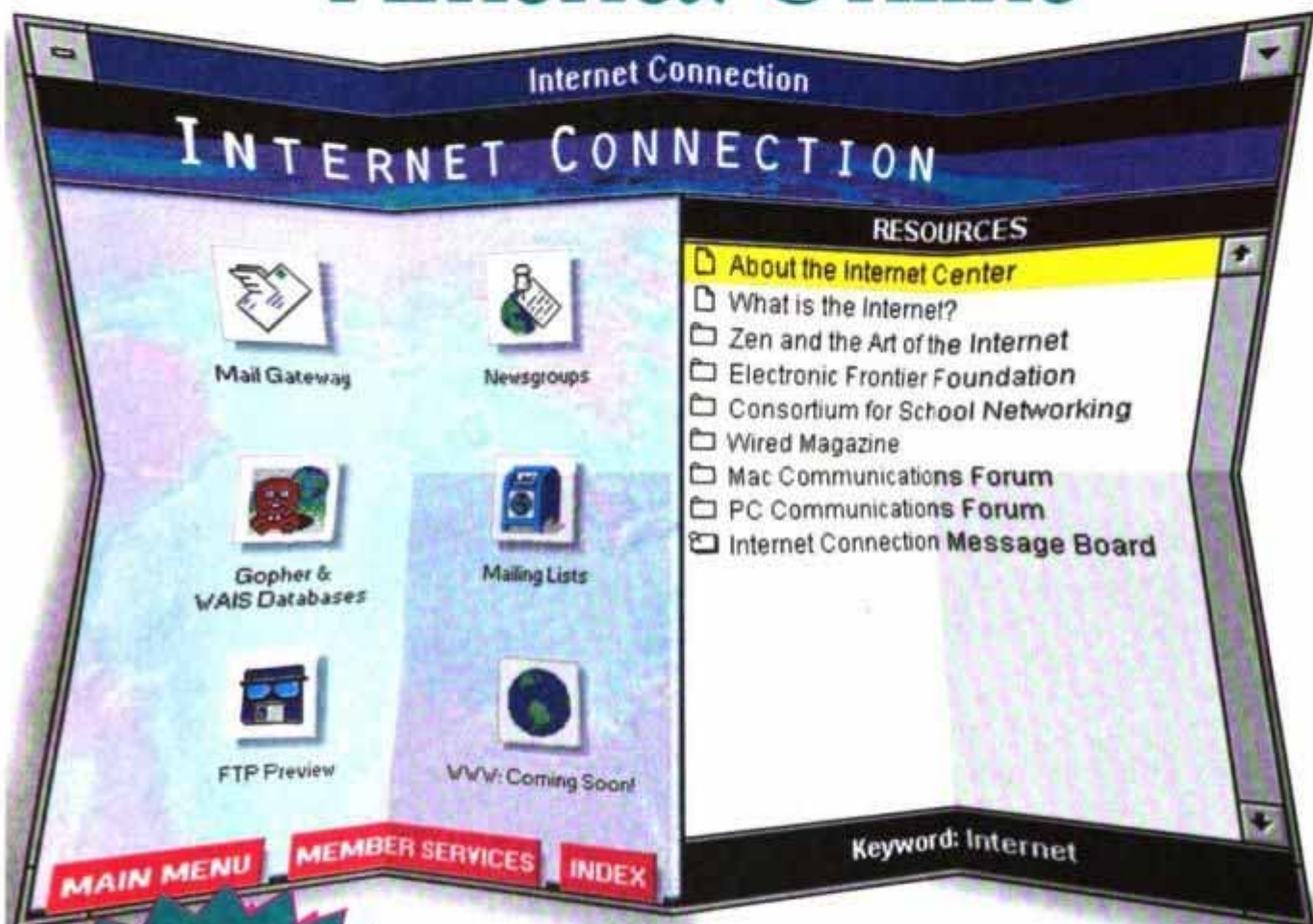
There are two basic ways to get yourself on the Web—the easy way and the hard way. The easy way is, well, easy, but the hard way offers more flexibility and understanding because it forces you to wrestle with some of the basic Internet mechanics.

The easy way is to buy a product such as Spry's Internet In A Box (\$149 list), which comes with all the software you need, and has a utility to automatically set you up with a provider. I tried it on my 486 PC, and it worked as advertised. After filling in a few blanks in a setup screen, it automatically dialed my modem, asked me to select a PPP provider and took my credit card number, then

(Please turn to page 140)



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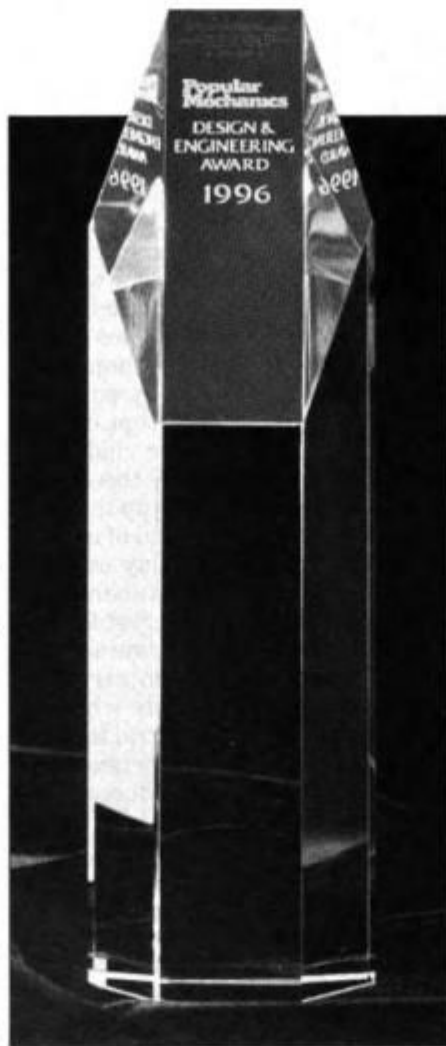
Popular Mechanics

DESIGN & ENGINEERING AWARDS 1996

• In the years since its inception, the POPULAR MECHANICS annual Design & Engineering Awards has become one of the most prestigious forms of recognition for achievement in design innovation. The tradition continues as we invite your nominations for our 1996 Design & Engineering Awards.

Anyone—company or individual—can nominate anything for an award. If you believe that you have a really good innovation, invention or even just a great idea, you are welcome to enter. All it takes to submit a nomination is a good, clear photo or illustration of the product, project or whatever it is you are nominating. Include a complete description with all the details of what it is, what it does, why it's innovative and why you think it deserves an award.

There are no specific categories or set number of awards or written rules or guidelines. We'll give as many awards as



we think are appropriate. What kinds of entries have won awards in past years? They run the complete range of human imagination—from a solar-powered robotic lawnmower, to the world's largest telescope mirror blank, to the F-117A Stealth fighter. To get a better idea of past winners, check our January issues of the past few years. Selections are made by the POPULAR MECHANICS editors, each an expert in his field—automotive, home improvement, shop tools, boating, outdoors, electronics, telecommunications, photography, science, technology.

You have to get your nomination in to us by Aug. 31, 1995. The decisions of the judges—the PM editors—are final.

Mail your entries to Design & Engineering Awards, POPULAR MECHANICS, 224 W. 57th St., New York, NY 10019. Good luck.

Joe Oldham
Editor-In-Chief

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THE HOLE TRUTH

Ten years after the discovery of the ozone hole, new evidence nails human industry as the culprit.

BY GREGORY T. POPE, *Science/Technology Editor*

• April ushers a lingering twilight over the South Pole. May cloaks the ice in darkness—and brings even grimmer changes to the sky. About 15 miles up, a gas called ozone starts vanishing from the stratosphere. By October, when spring dawns across Antarctica, only a fraction of the normal ozone concentration remains. Then, as summer brightens the polar region, ozone levels rebound.

This seasonal depletion—quickly dubbed the “ozone hole” after its discovery in 1985—would interest only atmospheric scientists were it not for ozone’s critical role in shielding the planet from ultraviolet radiation. And were it not the most dramatic example of the ozone depletion occurring across the globe.

Debate still smolders over what’s been blowing holes in the ozone layer. But NASA scientists now believe they’ve found the smoking gun.

Hydrogen fluoride, a gas that has no business being in the stratosphere, is the telltale clue. Spied by a huge NASA spacecraft called the Upper Atmospheric Research Satellite (UARS), this molecule is a marker for a family of manmade chemicals. These are the chlorofluorocarbons, or CFCs, used for refrigeration, electronics manufacturing and other industrial processes.

Hydrogen fluoride itself doesn’t destroy ozone. Nor, in fact, do CFCs, which are inert long-lived molecules. But once CFCs drift into the stratosphere, they lose their stability. Exposed to ultraviolet rays, they crumble. Hydrogen fluoride is one byproduct of this disintegration. An-

other is raw chlorine. And it’s the chlorine that savages ozone, by hounding in on the very process through which ozone shelters us from radiation.

A molecule of three oxygen atoms loosely bound, ozone breaks apart as it absorbs radiation. Fortunately, ozone readily re-forms from double-atom oxygen molecules and free oxygen atoms. A chlorine atom will also break up ozone, but then wanders off with one of the oxygen atoms. These chlorine-oxygen combos themselves pair up. Then, tickled by sunlight, they spit out double-atom oxygen molecules. That frees the chlorine to wreak more havoc, while the oxygen in the stratosphere locks up into double-atom molecules instead of ozone.

All these reactions play out with special vigor when winter grips Antarctica. Ice clouds crystallize in the stratosphere and provide surfaces to accelerate the chemistry that releases chlorine. Winds wheeling around the South Pole corral the chlorine, keeping it from dispersing. The result: concentrated chlorine, and severe ozone depletion. When the ice clouds dissipate in the summer, the ozone returns.

Chlorine’s destructive behavior isn’t questioned. Nor is its presence in the stratosphere. But some claim that CFCs have acquired a bad rap as the chlorine’s source. Volcanoes, they say—or even sea spray—are natural sources of the gas.

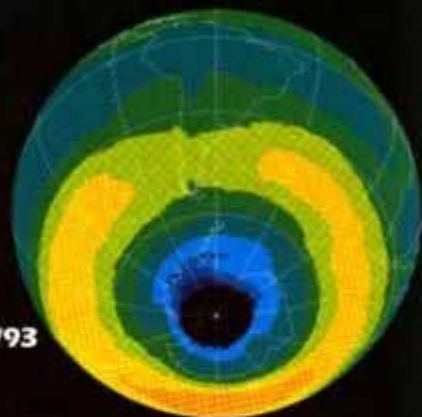
The UARS data, particularly the hydrogen fluoride readings, poke holes in that assertion, says Mark Schoeberl, the satellite’s project scientist. Simply too much hydrogen

fluoride floats in the stratosphere to blame nature. Tellingly, Schoeberl adds, the higher you look, the more hydrogen fluoride there is. At loftier altitudes, he argues, there’s more ultraviolet radiation to trigger the cracking of CFCs and the release of hydrogen fluoride. True, natural hydrogen fluoride does waft from volcanoes, but rain would wash this gas into the sea before it could reach such rarefied heights. “It’s a big red herring, this volcano business,” Schoeberl concludes.

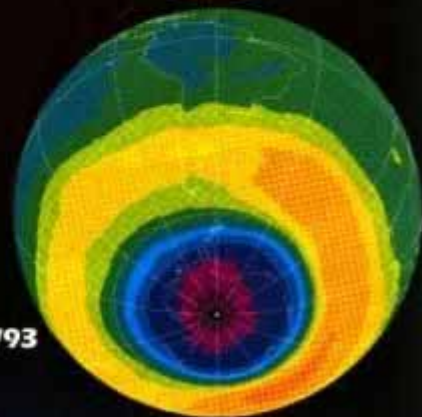




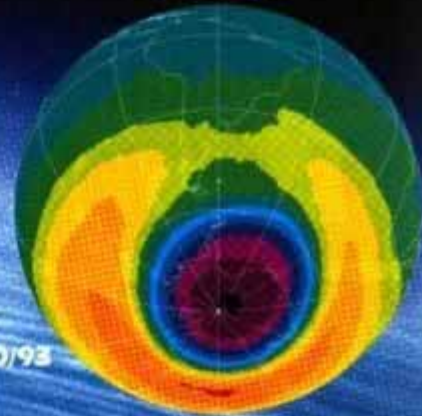
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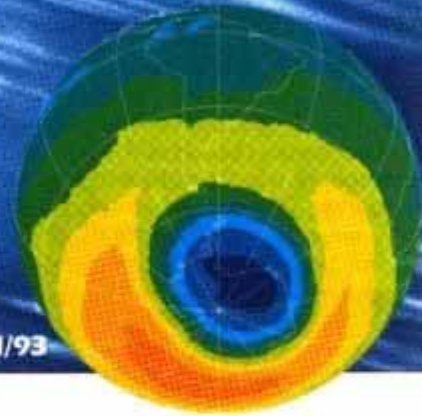
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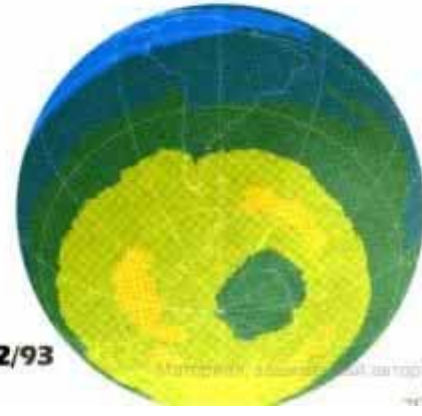
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12/93



UARS has confirmed something else—a steady increase in stratospheric hydrogen fluoride over the years. NASA researchers believe this buildup comes from a reservoir of CFCs lurking in the lower atmosphere. Should the agreement among developed nations to ban CFCs hold up, this CFC backlog should begin to dwindle after the turn of the century. Still, notes Schoeberl, the annual ozone hole could recur until 2040 or 2050—a stark reminder of our atmosphere's fragility.

PM

In 1993, the worst-yet ozone hole opened over Antarctica and was measured by the Total Ozone Mapping Spectrometer aboard a Russian Meteor-3 satellite. In graphics at right, purple and blue represent abnormally low ozone levels, while green and yellow represent normal concentrations. In October's purple patch, the ozone, if flattened into a layer, would have been only 1/25th of an inch thick. That's less than a third of the worldwide average. The Upper Atmospheric Research Satellite (above) has charted the presence of hydrogen fluoride molecules—the chemical fingerprints of CFCs, which trigger ozone depletion.



LEXUS LS 400

LONG-TERM TEST CARS

We welcome a couple of D&E winners to the fleet.

Lexus LS 400

● From a twinkle in Toyota's corporate eye to luxury-car benchmark in half a decade, the LS 400 is a dazzling example of what's right with the auto industry. The second-generation LS 400, recently introduced as a '95 model, impressed us from the get-go—so

much so that we bestowed a POPULAR MECHANICS Design & Engineering Award upon it. But to prove to ourselves that we were not beguiled by an impressive but ultimately brief (couple of days and a few hundred miles) tenure inside the eerily serene passenger compartment, we decided

TEST SUMMARY

Report number: 1
 Base price: \$51,200
 As-tested price: \$56,553
 Extra-cost options: traction control, power-adjustable steering wheel, memory system, in-dash compact-disc changer, carpeted floor mats and trunk mats
 Drivetrain: 4.0-liter dohc 32-valve V8, 4-speed overdrive automatic, rear-wheel drive
 Engine performance: 260 hp/270 ft.-lb.
 EPA fuel economy: 19 city/25 hwy.



CHEVROLET BLAZER LT

to see how well this marvel of engineering and manufacturing would fare over the long haul. So we ordered one for the long-term fleet.

There's really precious little to add to the "base" car, but given the vagaries of the weather here in the Northeast, we did specify that our LS 400 be equipped with traction control. And given the long hours one may spend stuck in Manhattan traffic, we also opted for the unique in-dash 6-disc CD changer.

The car has just recently arrived at



NISSAN MAXIMA SE

PHOTO BY BILL DELANEY

our offices and we're busily putting some necessary break-in miles on it. In the next update report we'll see how this potent luxury cruiser is doing in the brutal world of everyday commuting.

—Don Chaikin

Chevrolet Blazer LT

More than a decade ago, the S-10 Blazer first appeared at Chevrolet dealers. And the compact sport/utility market was born. The latest version of this trendsetter is simply called the Blazer and it is still a trendsetter. With its strong combination of carlike qualities and rugged all-weather, all-terrain capabilities, it remains one of the primary setters of trends in this explosively hot market. In fact, the 1995 Blazer—and its near-twin, the GMC Jimmy—is such a leap forward it was winner of a POPULAR MECHANICS Design & Engineering Award.

As worthy of the award as the Blazer is, we know that the ultimate test of any vehicle is the nonrelenting trials of being a seven-days-a-week driver. So when we awarded the Blazer its deserved D&E honors, we also ordered one from Chevrolet.

TEST SUMMARY

Report number: 1
 Base price: \$21,953
 As-tested price: \$26,845
 Extra-cost options: locking rear differential, LT decor package with power windows, door locks and mirrors, remote keyless entry, power driver's seat, AM/FM/cassette stereo, tilt steering wheel and cruise control
 Drivetrain: 4.3-liter ohv V6 engine, 4-speed overdrive automatic, 4-wheel drive
 Engine performance: 195 hp/260 ft.-lb.
 EPA fuel economy: 16 city/21 hwy.

We've just recently had our red 4-door, 4wd Blazer LT arrive at our offices, and have already thrown it into the fray.

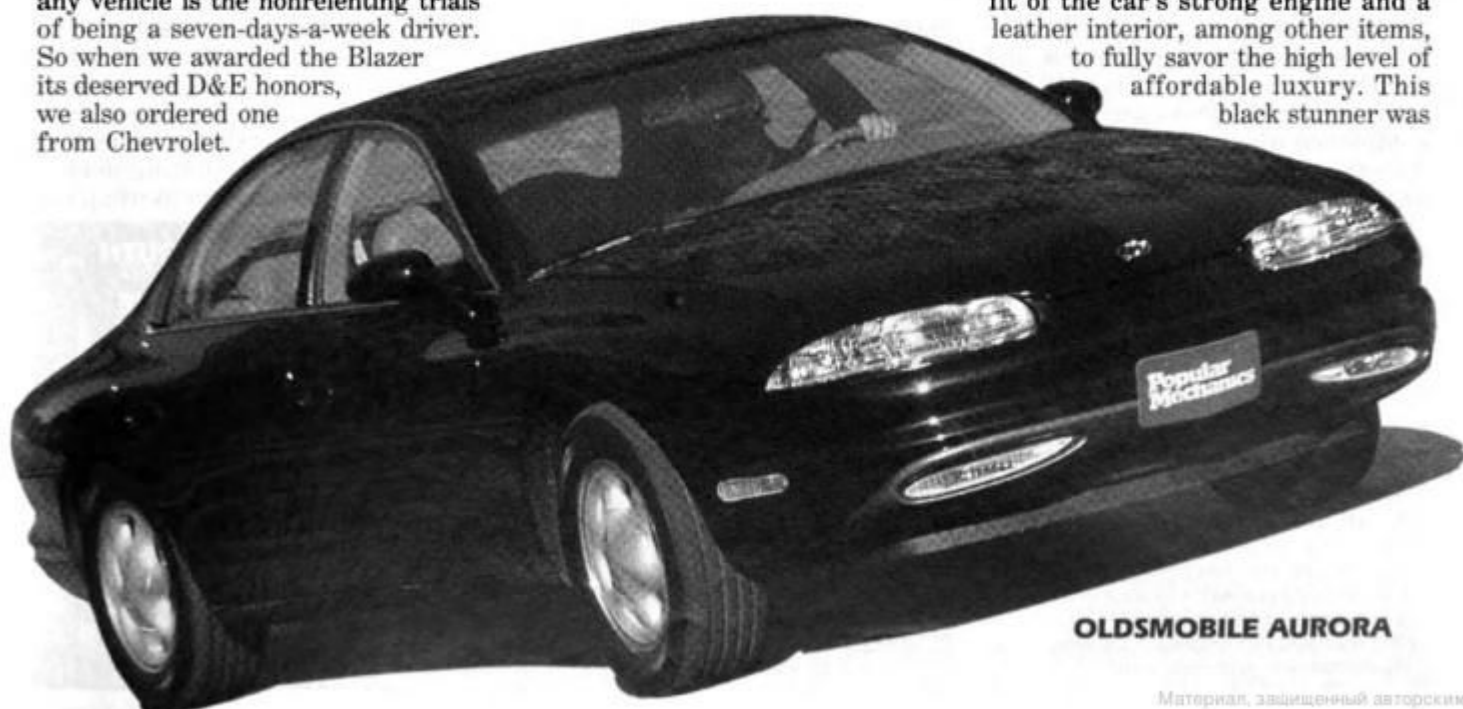
Now the Blazer is getting settled into the always varying daily routine that defines the winter months here in the New York area. We'll let you know how this nicely trimmed, eager-to-please American original fares as the miles and tribulations accumulate.

—D.C.

Nissan Maxima SE

Before there was an Acura, before there was a Lexus, indeed, before there was an Infiniti, there was a Maxima. This top of Nissan's sedan lineup had been the Japanese auto industry's rolling example of a sport sedan for all those years before the Japanese carmakers launched their second channels. And now, despite the many fine examples of the luxury sport-sedan genre that the Japanese—and the European and the American—carmakers are building, the Maxima continues to be one of the best. So when Nissan totally revamped this already highly regarded sedan, we wanted to take a deeper, longer and more extensive look. So we decided to order one and headquarter it at our Southern California offices.

To ensure that we had the full taste of sports and luxury, we specified a Maxima in SE trim with a 5-speed manual transmission to get full benefit of the car's strong engine and a leather interior, among other items, to fully savor the high level of affordable luxury. This black stunner was



OLDSMOBILE AURORA

LONG-TERM TEST CARS

TEST SUMMARY

Base price: \$21,599
As-tested price: \$26,634
Extra-cost options: ABS, power glass sunroof, leather upholstery, SE security and convenience package with power driver's seat, remote keyless entry, antitheft system, power trunk release and variable intermittent wipers
Drivetrain: 3.0-liter dohc 24-valve V6, 5-speed manual transmission, front-wheel drive
Engine performance: 190 hp/205 ft.-lb.
EPA fuel economy: 22 city/27 hwy.

delivered to our offices just in time for us to get some photos of it and to begin to limber up the car's muscular drivetrain and chassis. We'll let you know how well this sedan fits into the freeway life of California as well as the demanding 2-lane roads that crisscross the less-populated sections of the state. —D.C.

Oldsmobile Aurora

This is a real driver's machine. Yes, it coddles you with leather-lined luxury and every amenity known. But this is a car that begs to be driven—



GMC SONOMA SLS

driven hard. The very rigid platform makes the car feel tight and squeak-free. There's absolutely no wind noise, and the taut suspension gives you a feeling of complete supremacy—like you can encounter any obstacle and smash it flat and keep rolling. All of it together breeds almost arrogant self-confidence when you're driving the Aurora and you think you can put it anywhere on the road and do anything you want once you get there. Obviously, you can't and so the Aurora's brakes are well up to the task of bringing you back to reality when necessary. It's not unusual to find yourself cruising the interstate at 80, totally safe, secure and stable. And I don't care what anybody says about high-tech Fours and V6s, nothing

TEST SUMMARY

Report number: 2
Total miles driven: 6996
Miles driven since last report: 5996
Average fuel economy: 16.6 mpg
Worst observed fuel economy: 13 mpg
Best observed fuel economy: 21.3 mpg
Maintenance/repair costs: none



CHEVROLET
LUMINA LS

beats a V8 when you tromp on the accelerator pedal. I found myself doing that quite a lot just to hear the delicious sound of the 32 valves producing 250 horsepower. On the other hand, there were times when I was crawling in New York City traffic and all the horsepower was quite transparent because I had the CD player cranking out some Dizzy Gillespie big-band stuff.

Our Aurora is about to go in for service at just over 6900 miles on the clock. At 5780, the dash message center said

been over 20 mpg in pure highway driving and around 16 in mixed highway/city commuting.

There is one dumb thing in the car I'd like to report. Whoever designed the cup holder should be shot at dawn. It keeps popping open with the slightest brush against it. And it makes you wonder who would be poking along drinking coffee in an Oldsmobile Aurora instead of enjoying this superb car to the fullest. —Joe Oldham

GMC Sonoma SLS

Driving a pickup truck solo from midtown Manhattan to Santa Monica, California, sounded worse than a house call from Dr. Kervorkian. But driving our long-term GMC Sonoma 3000 miles in three days wasn't much different than covering the distance in a good sedan—the trip left me without back pain, without loose fillings and with one horrific speeding ticket. The truck ate up highway at an average rate of 81 miles each hour, and still managed to average 18.3 mpg.

Since that early November trip, the Sonoma has been in sunny Southern California, racking up more than 12,000 zero-trouble miles by Super Bowl week. But some minor idiosyncrasies have shown themselves. For instance, at over 60 mph, the side mirrors shake in their pods, making them useless. Then there's the squeak in the back seat that's getting louder. And the tires that seem to wimp out

CHANGE OIL SOON. At 6207, it changed to CHANGE OIL NOW, even though the book calls for a servicing at 7500 under normal conditions. Once again, being a PM test car has proven to be "severe usage." While the car is in for service, we'll ask the dealer to get the right rear electric window working again, which is the only mechanical problem we've had. Fuel mileage has



PLYMOUTH
NEON
HIGHLINE

TEST SUMMARY

Report number: 2
 Total miles driven: 12,633
 Miles driven since last report: 10,043
 Average fuel economy: 18.5 mpg
 Worst observed fuel economy: 15.6 mpg
 Best observed fuel economy: 21.9 mpg
 Maintenance/repair costs: add 1 quart motor oil, \$1.19
 6000-mile maintenance, \$90
 brake check and cleaning, \$59.95

when the road turns sharply and have to be rotated every 6000 to 7000 miles. (However, the Uniroyal Tiger Paws on our truck do work very well on rain-soaked roads.)

This truck has found its niche in active L.A.—it's perfect for hauling mountain bikes and surfboards. We've also found the fold-out rear seats to be very useful, as long as the trip's short and your friend isn't Gorilla Monsoon. Soon the racing season will start and we'll see how the GMC tows a race car. —*Scott Oldham*



**DODGE RAM
1500 LARAMIE SLT**

Chevrolet Lumina LS

Our sister publication, CARSMART, recently picked the '95 Lumina as a Buy Of The Month. It's easy to see why. You get a lot of car for the base price of about \$15,000. Our car, an LS model, is a few thousand more but the price-value relationship is still there in spades. If you enjoy a family car that can double as a sport sedan, the LS option is the way to go. With a 3.4-liter 4-valves-per-cylinder V6 pumping out 210 horsepower, a suspension tuned for crisp handling and fat Goodyear Eagle RS-A tires mounted on 16-in. wheels, our Lumina LS has embarrassed quite a few "sports" cars on the Exit 11 off-ramp of the New Jersey Turnpike. This is a true dual-purpose sedan, equally adept at hauling five adults in total comfort or sucking the doors off European sport sedans costing tens of thousands more.

Now the negatives. The people who design Chevy's seats need to talk to the people who design Buick's

**HYUNDAI
SONATA
GLS**

seats. Hey, they're right down the hall in GM's Design Center, yet they're miles apart in their approach to seat design. And I'm not talking about upholstery here. I'm talking about seat

a dealer. Lastly, the brake pedal travel was long to begin with, and it's gotten worse from there. The brakes have no feel at all and do not give one a feeling of confidence. We used this same vehicle in our comparison test of big sedans in the January issue, and it recorded the longest stopping distances of any car in the group. Probably something was amiss even

TEST SUMMARY

Report number: 2
 Total miles driven: 6101
 Miles driven since last report: 4227
 Average fuel economy: 21.5 mpg
 Worst observed fuel economy: 15.7 mpg
 Best observed fuel economy: 24 mpg
 Maintenance/repair costs: none

back then. This, too, is being checked.

This sounds like a mixed report, and it is. But generally, we like the Lumina a lot and hope our dealership repair experience matches our enthusiasm for the car. We'll let you know next time. —*J.O.*

Hyundai Sonata GLS

Maybe it has something to do with the rubber—we really can't explain it. But just about from day one—and a few times each week—we'd find one or another of the Hyundai's tires low, very low. We had the tires checked, but no reason for the seepage was discovered. So one particularly raw morning when we found one corner of the Sonata closer to the driveway than the other three corners, we

(Please turn to page 129)



MAZDA MILLENIA S

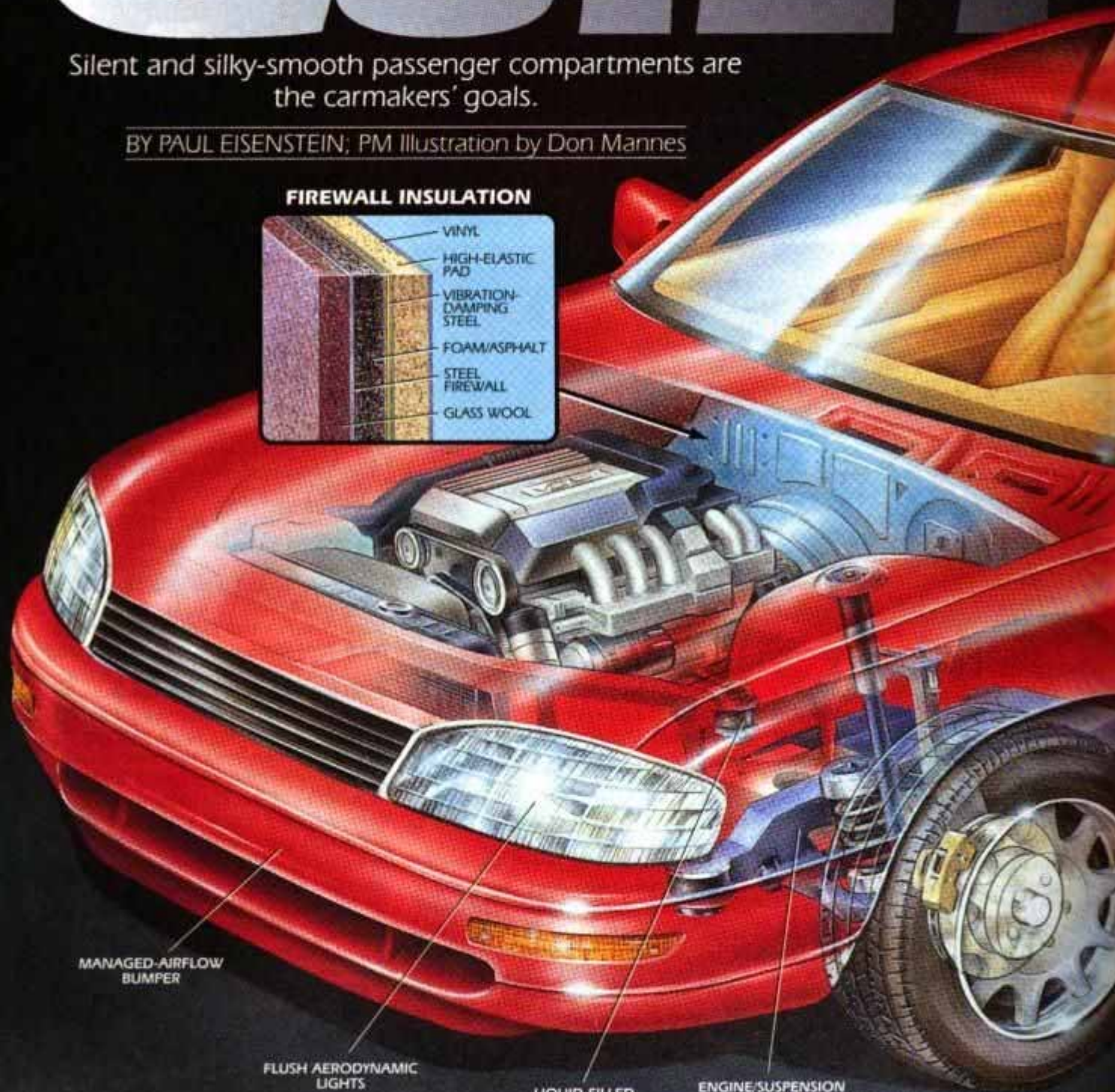
AUTOMOBILES

MAKING CARS QUIET

Silent and silky-smooth passenger compartments are the carmakers' goals.

BY PAUL EISENSTEIN; PM Illustration by Don Mannes

FIREWALL INSULATION



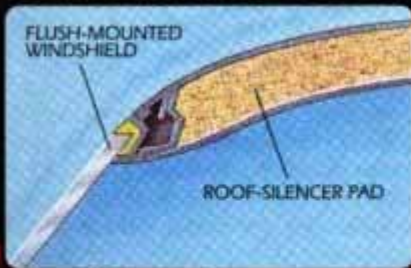
MANAGED-AIRFLOW BUMPER

FLUSH AERODYNAMIC LIGHTS

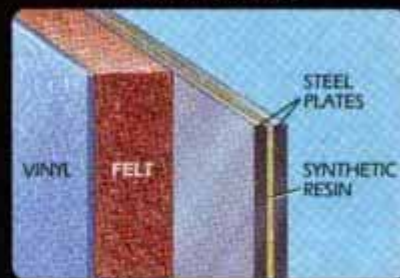
LIQUID-FILLED ENGINE MOUNTS

ENGINE/SUSPENSION SUBFRAME

FLUSH WINDSHIELD & ROOF



REAR PANEL



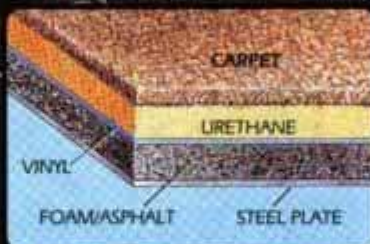
FLUSH SIDE GLASS

FLUSH AND SMOOTH DOOR HANDLES

QUIET-ROLLING TIRES

SUSPENSION SUBFRAME

FLOORBOARD



AERODYNAMIC MIRRORS

• A beam of blue laser dances off the door of the Ford Taurus, forming an improbable crosshatch pattern, seemingly suspended in midair. "I'm going to turn up the volume," an engineer announces, "something we can see, rather than hear," as he cranks the control knob. The light show is created by a transducer, which shakes the Taurus's door as though we were driving on a country road. The laser's light translates the vibration into something we can see.

We've gone deep into the bowels of the Ford Motor Co.'s new Advanced Engineering Center, or AEC. The \$75-million complex houses some of the most sophisticated research gear an auto engineer could hope

for, from crash-simulation computers to stereo lithography. But a disproportionate share of the AEC is devoted to NVH. That's auto-engineer-speak for noise, vibration and harshness, for you newcomers.

The treasured trio

As you probably remember from Physics 101, noise is created by vibration. And vibration is often caused by a sudden—harsh—impact upon an object. So these three—noise, vibration and harshness—are often considered as one by auto engineers, as they often have the same root cause. And even though we all know the differences between a noise, a vibration and the bone-

MAKING CARS QUIET



The generally accepted current benchmark for a smooth and quiet automotive environment is the passenger compartment of the '95 Lexus LS 400.

jarring shock of harshness, it's often difficult to pinpoint which of the three is creating the most discomfort at a given instance. Hence the elaborate research followed by methodical search-and-destroy of each of the reasons behind NVH conducted by all carmakers.

Quality you can't hear

Other than the alluring exhaust note of a high-performance sports car, most people associate silence in a car with quality. Back at Ford's AEC, David A. Velliky, manager of NVH operations, notes that, "NVH is a battleground that, to the customer, demonstrates product quality."

If NVH is the auto industry's new battleground, Toyota should get credit for firing the first shot back in 1989 when the automaker introduced its Lexus line. The LS 400 sedan was almost eerily quiet.

Lexus introduced a variety of new concepts in its aggressive approach to NVH control. Parts of the firewall and floor pan, for example, were made of a unique "sandwich metal," actually two thin sheets of steel glued to a layer of sound- and vibration-absorbing asphalt.

Meanwhile, other automakers are racing to play the game of NVH leapfrog. Chrysler Corp., which has taken some criticism in years past over the NVH of some of its products, has been watching what competitors

like Toyota are doing. So, beginning in the middle of next year, Chrysler will sandwich together two pieces of metal in the rear wheel wells and fill the space between the pieces of metal with blow-in insulation.

We've come a long way

For years, engineers tried controlling NVH by simply isolating the passenger compartment. They damped out the steering wheel, isolated the pedals and stuffed insulation into the pillars and firewall.

These days, the NVH engineer's first rule is to cancel noise, vibration and harshness at the source.

Harshness can be tamed with thicker bushings, more compliant shocks and changes in suspension geometry. Changes as simple as a new timing chain or a 2-piece oil pan can help bring a raucous engine under control. Even tire and wheel size matter. Lower profiles and higher inflation may improve handling, but they usually increase harshness. And a stiffer chassis

goes a long way toward decreasing NVH when you're trying to control noise and vibration that are created by or passed through the vehicle's body.

The platform used in the latest version of the Honda Accord has a resonant frequency of 23.5 Hz, significantly higher than the chassis of the model it replaced. That helped Honda reduce interior noise levels by 4 decibels. (In the mathematics of the acoustic engineer, a 3-dB drop cuts sound energy in half.)

High-tech weaponry

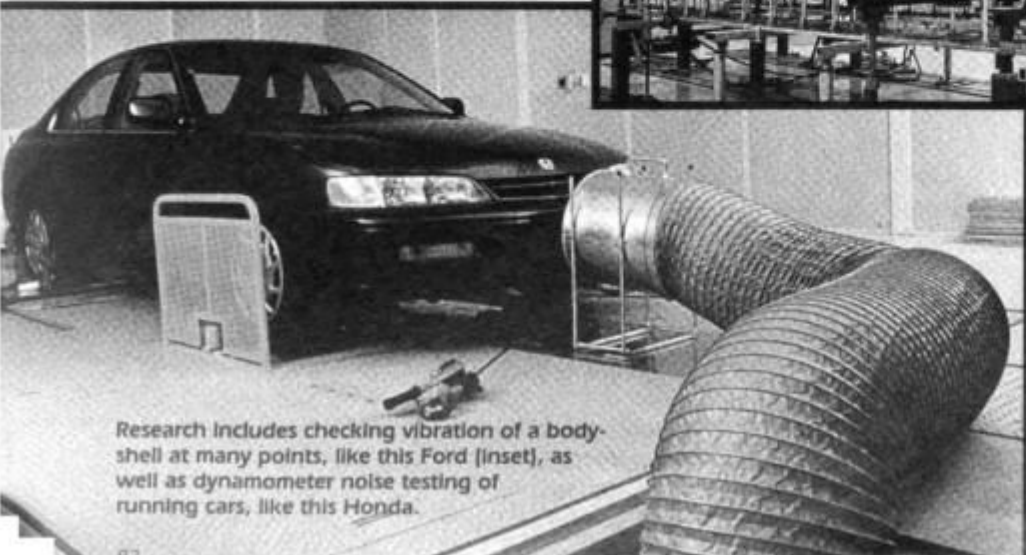
In a small cell in the basement of Chrysler's massive Technical Center in Auburn Hills, Michigan, an engine is whirring away on a dynamometer. "We've got some catching up to do," acknowledges Walter Esser, the man in charge of Chrysler's NVH operations. Right now, Esser is trying to tweak the engine—no easy task when you consider the myriad mechanical actions taking place simultaneously. But he's got some sophisticated help. Inside the test chamber, technicians carefully sweep the engine with a pair of binaural microphones. Spaced a head's width apart, they hear things much as our own human ears do.

After recording several minutes on digital tape, the signal is processed by a program that breaks the noise into individual frequency components. A technician can isolate individual sound spikes and use them to track down the source of particularly irksome noises, like the resonant frequencies created by valve slap. It even allows the technician to simulate what the car would sound like if the spikes were muffled or eliminated.

Group Lotus, the British sports carmaker and research firm, has spent years developing a concept called "Active Noise Cancellation." At its most essential, a prototype system constantly analyzes the noises echoing through the passenger compartment. A microprocessor

responds by generating out-of-phase audio signals, which are played through the car's speaker system, canceling out the unwanted noises.

Engineers also hope to be able to minimize engine vibration, shake and wobble with a curious substance known as rheological fluid. The viscosity of this fluid changes as electrical current passes through it. That could make it ideal for use in engine mounts. Mechanical mounts must solve two very different problems. They need to be soft in order to damp out powertrain



Research includes checking vibration of a body shell at many points, like this Ford [inset], as well as dynamometer noise testing of running cars, like this Honda.



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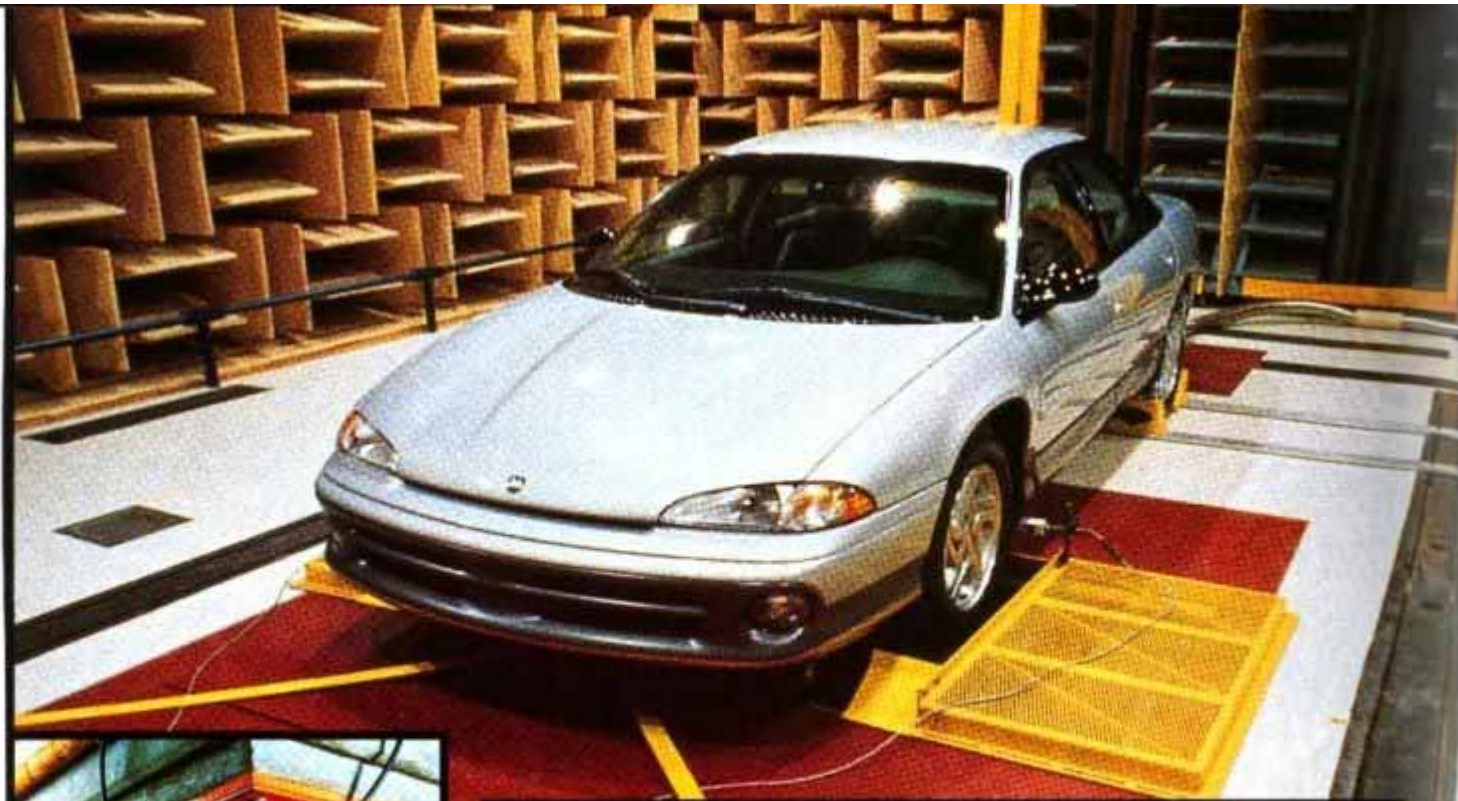


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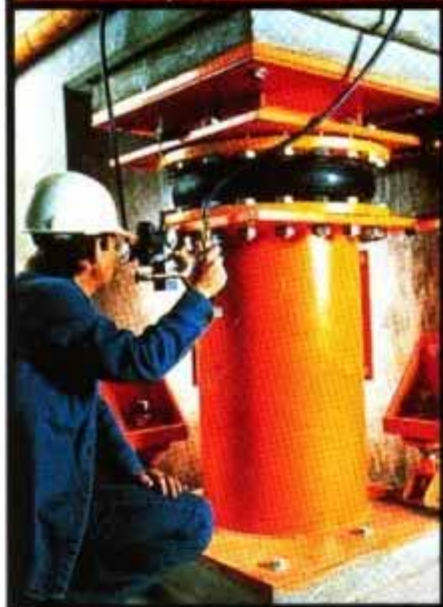


SIERRA
THE STRENGTH OF EXPERIENCE

Материал, использованный в этой рекламе, является товарным знаком.



Sophisticated testing technology includes the use of sound chambers like this one at Chrysler's Tech Center. The chamber is suspended on an isolating air chamber (left).



vibration, but they must also be stiff to counteract shake and wobble passed to the powertrain by the tires as they bounce along the road. A computerized engine mount filled with rheological fluid might be able to switch from soft to firm on command.

How loud is it?

As engineers have gotten better at understanding and reducing noise, they've discovered the "drained-swamp syndrome." As the overall noise level drops, odd noises start to

show—much like the tree stumps in a drained swamp. "When we were developing the LS 400, we heard a whistling noise we never noticed before," says Lexus' Mike Michaels. "It turned out to be the cellular-phone antenna. We had to go back and develop a more aerodynamic antenna."

The coming of the electric car further complicates the NVH picture for carmakers. "All of those engine sounds that used to mask other noises will be gone," notes Mike Wischhusen, product engineering manager for Michelin America Research and Development.

"There's a lot of research being done to quiet down tires," says Wischhusen. Tires generate two types of noise. One is "tire slap," which is the sound of the tread actually hitting the pavement as the tire rolls. The other is "structure born" noise, which includes such things as the vibrations created by the tire interacting with various road surfaces. We all have driven over certain sections of con-

crete road surface that seem to make the tires actually sing. To resolve tire noise, engineers are making heavy use of computer simulation to alter tread shapes and sizes in order to randomize the noise. As Wischhusen explains, "The idea is to avoid creating a specific-frequency component."

In the effort to control NVH, there is no Holy Grail. Trying to find out what consumers really want isn't easy. The mind has a short audio memory and finds it hard to compare sounds. Using new computer and audio technology, however, acoustic alchemists are learning to spin straw into gold.

"One of the key pieces of the puzzle was missing: human perception, and how to connect it to the engineering process," says Norm Otto, a researcher at Ford's Sound Perception and Quality Lab. "The key is to allow people to express what they're hearing in a simple, easy way."

While many like a silently serene car, others like a roar and a squeal when they stomp on the gas. **FM**

Still required are people's perceptions of various sounds, registered at places like this Ford lab.



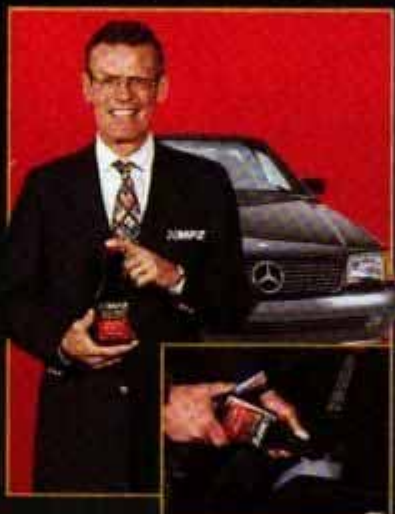
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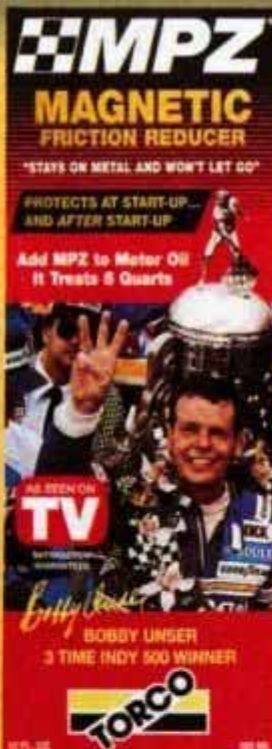
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ELECTRONICS



VIRTUAL THRILLS & CHILLS



The new amusement park in the neighborhood puts you in a computer-generated adventure.

BY MURRAY SLOVICK

● It's a jungle out there. It's a Martian colony, too. Or an underwater cavern. Or even a distant galaxy. And they are all in your local shopping mall, movie theater multiplex or video arcade. Watch out Disney, Six Flags and Universal Studios—fun-loving America is embracing virtual-reality games and motion-simulation rides, available at a new breed of neighborhood cyberspace centers spreading rapidly across the country.

These electronic playpens are being developed by some new companies, with such next-century monikers as Virtual World, Virtual Adventure and Showscan, and some familiar names, including Blockbuster and Sega. Their ultimate goal is to create a theme park that is as accessible as a movie. Indeed, Showscan and United Artists Theatre Circuit, for example, expect to put 20 motion-simulation attractions in 10 United Artist complexes in the next five years. The first ride will be built in Dallas.

Two types of computer-supported attractions are being developed:

1. Interactive virtual-reality (VR) games that let the players inside the game move

VIRTUAL THRILLS AND CHILLS



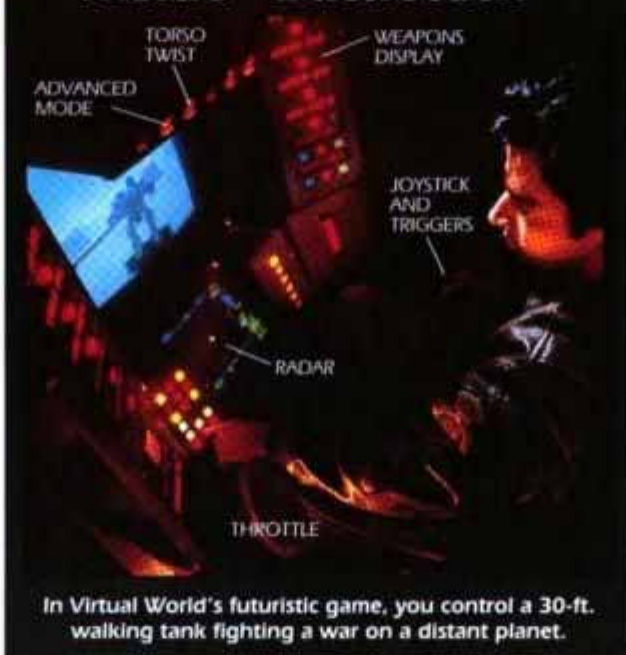
through 3-dimensional computer-generated settings. Players manipulate a joystick, steering wheel or electronic glove to navigate through adventure scenes and compete against other people, reacting in real time to other players' movements and strategies.

2. Software-driven thrill rides that depend more on sensory appeal than player input. Here, the visitors' surroundings and the ride itself combine to simulate motion. You are surrounded by the movie and become a player in it while a motion platform is programmed to move and lurch in synchronization with the film. Not only do these attractions create the honest-to-goodness 85-mph feeling of roller-coaster acceleration and freefalls, but unlike traditional gravity-driven amusement rides, software-based rides are reprogrammable. A new ride can be put in place as easily as changing a feature-film reel—the special film also carries the motion track that moves the seats.

VR games

You can get a taste of virtual-reality games and rides in entertainment centers such as Virtual World, currently operating in numerous U.S. cities. The 30-minute experience (of which 10 minutes is the VR game) costs from \$7 to \$9, and begins in the ready-room as each virtual-reality pilot waits for the number on his or her boarding pass to be called. They are then led, eight at a time (there are three groups of eight pods), into the containment bay where they compete against other players in individual-travel-simulation capsules resembling—but more sophisticated than—race-car arcade games. When the cockpit canopy slides shut over your

Inside "Battletech"



seat you are thrown into the fictional experience of "Red Planet," which has a story line centering on futuristic slave mines on Mars. The 10-minute electronic role-playing game begins with transportation to the drop zone. You see the world of "Red Planet" out the windshield. One inset screen shows the path to be negotiated—including closing doors, ramps and steel girders—and a smaller inset screen provides information on the names and location of the opposition. Your joystick controller is on the right, throttle on the left. The system is networked so all of the vehicles you see and interact with are piloted by the other people in your group.

In "Red Planet" and Virtual World's other current role-playing cyber-game, "Battletech," in which pilots control 30-ft. walking tanks on the surface of a desert planet, you are free to move, interact, explore and fight back. Players can team up with any of the other seven people tied into

the game. Verbal stratagems are relayed via microphones.

Virtual World expects to add one new "universe" for exploration each year. The original Virtual World site is on Chicago's North Pier. Virtual World also operates in San Francisco, San Diego, Houston, Dallas, Atlanta, Las Vegas, Tokyo and Yokohama, Japan. Sites scheduled to open this year include Boston, Costa Mesa, California, London and Sydney, Australia.

Iwerks Entertainment (Burbank, California), responsible for many of the special-format movie theaters in theme parks, has developed its own urban virtual-reality entertainment centers called Virtual Adventures.

The first Virtual Adventures ride, in the Nauticus Museum at the National Maritime Center in Norfolk, Virginia, has (naturally) an underwater exploration theme. "The Loch Ness Expedition" creates an interactive computer-animated environment with groups of players trying to save the Loch Ness Monster's eggs from evil bounty hunters. To play, four teams of six people sit facing a large video screen in rooms designed to resemble an underwater exploration craft. The virtual movements of each vehicle directed by the players (the vehicles do not actually move) determine what the other teams will see.

All participants wear polarized glasses to view high-resolution computer-generated images in 3D. Each team player has a role and operates different controls. A captain pilots the vehicle and a navigator, who sits in the back row, determines where the vehicle will go and sees all of the other vehicles. Real-time feedback, analysis and interaction by the four teams is the attraction of Virtual Adventures.

Albuquerque, New Mexico, and Indianapolis, Indiana, are the first two locations for Block Party indoor entertainment complexes. Developed by movie-rental giant Blockbuster Entertainment, Block Party offers eight areas and attractions including Virtua Alley, with interactive virtual-reality games; Go Motion Pictures, a motion-based simulator thrill ride; Soup'er Bloopers, described as a quirky parody of a sports cafe showing blooper clips and offering food; and Flippers, with pinball-type gaming.

Virtuality Entertainment Ltd. of England provides games for Block Party's Virtua Alley. Virtuality's games immerse the player in a computer-generated environment using

(Please turn to page 139)

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Building A Redwood Deck
Improving Your Landscaping
Planting A Culinary Herb Garden
Installing A Stone Walkway
**And, Shopping For New
Swimming Pools**

Basic Redwood

A well-tailored backyard deck will be the center of all your outdoor activities.

TEXT AND PHOTOS BY MERLE HENKENIUS

If the fronts of houses are more public and formal, the backs are decidedly private and informal, which explains why backyard decks are so popular in an age of instant access and crowded commutes. A wooden deck can be a kind of sanctuary, hosting only the invited. It can be both a party center and a quiet retreat—a place to repair, to relax or to conjure empires.

If your home and lifestyle are still waiting for that backdoor retreat, we have good news and bad news. The bad news is that lumber prices have spiraled out of sight in the past three years. The good news is that you can zero out these increases by building your own deck. The material costs for this simple, treated-lumber and redwood deck exceeded \$2000, but when finished, the deck is at least a \$4000 improvement. That moves the price back nearly a



decade. While there are dozens of deck styles and configurations you might choose, ours would fit a great many of the homes being built today.

We decided to build our superstructure out of pressure-treated pine because of its strength and high resistance to moisture and insects. But, we also wanted the rich look and feel of redwood—to say nothing of its weather resistance—in the finished product, so we came up with this box-like construction. The concealed pressure-treated lumber does most of the work, while the construction heart-grade redwood does most of the showing-off. When stepped in and out to echo the lines of the house, and when capped with a simple redwood bench, the deck manages an attractive complement of scale, with a look that is both satisfying and modest.

Getting started

The first order of business is to lay out the perimeter. Measure out from the house, at each end of your future deck, 13 ft. 10½ in. Then, drive in wooden stakes and stretch a string line between them. This line will give you the exact outer edge of the double rim joist and the posts that will support it. A redwood 2 × 12 trim board will eventually bring the dimension to 14 ft.

Using this line as a guide, dig posthole footings to frost level, usually 24 to 48 in., depending on climate. Place one footing at each of the outside corners of the deck layout and equally space two more posts between these. Then, to accommodate the step and offset, dig two additional footing holes—one at the outside corner and one at the inside corner of the offset.



Redwood lumber: California Redwood Assn.
Technical art: Eugene Thompson

Pour these holes to approximately 1 in. above grade with concrete, and while the mix is still wet, insert metal 4 × 4 brackets into the concrete, so that the outer edge of the bracket is aligned with the string line (Photo 1). Then, level each bracket in both directions with a torpedo level (Photo 2). Finally, allow the footings to cure a day or two before building on them.

Because this deck is built at ground level, there will be no getting under it once it's finished. For this reason, it pays to strip the sod and cover the area with landscape fabric. The fabric will keep weeds from growing under the deck. Just roll out the fabric and pin it in place with galvanized nails (Photo 3). Shovel a little sand over the fabric to hold it in place.

The next step is to mount the ledger plate on the house. In our case, the first row of hardboard siding was not shimmed out at the bottom. If yours is, you'll need to either remove the shim or shim the top of the ledger plate. The point is, the ledger plate should be vertical, not canted inward.

To mount the 2 × 10 ledger, block under it or have a helper hold it up, then nail it to the siding-clad rim joist

of the house with a few 16d galvanized nails. If your ledger will wrap around a trimmed corner, as ours did, use a circular saw to mortise out the depth of the vertical trim on the back side of the ledger. This need not be a perfect cut, as its only purpose is to allow the ledger to fit flush against the siding. In our case, we also continued the ledger partway around the cantilevered wall, stopping 1½ in. short of the adjoining 45° trimpieces.

With the ledger tacked in place, bore a series of pilot holes every 24 to 32 in. along its length and lag the ledger into the rim of the house. Galvanized lagbolts, ½ × 5 in. long, will reach through all three layers of material. Back up each with a washer.

Installing hangers and posts

Start by laying out and marking all the joists along the ledger. A 14-ft. span requires joists set on 16-in. centers. With the layout complete, install a joist hanger at each marked location. To keep from getting a few of them too high or too low, use a short piece of 2 × 10 as a guide, aligning its top with the top of the ledger (Photo 4). When positioned correctly, nail the

hangers in place, using proper joist-hanger nails.

With the house side of the deck laid out and fitted with hangers, it's time to determine the height of the 4 × 4-in. posts that will support the double rim joists. Begin by cutting short lengths of 4 × 4 and setting them in their footing brackets. Then, set a precut joist (13 ft. 6 in.) into one of the ledger hangers opposite a footing and place a 4-ft. level atop the joist. When the joist is level, mark the post and cut it to length, then set the joist on the post and check for level again (Photo 5). When two such posts are marked and trimmed, use their elevations to snap a string line across the remaining posts.

With all posts cut to length, nail two sets of 2 × 10s together with 16d galvanized nails to create the double rim joist. Alternate the nails, high and low, at 16-in. intervals. Make the outer 2 × 10 of the double rim 3 in. short of the overall length of the deck, to accommodate the redwood trim joist. Then, cut the inner joist 1½ in. short of the outer joist at each end. These stepped ends will allow you to nail the intersecting side joists from both directions.



1 After pouring each footing hole, set a 4 × 4 bracket into the wet concrete. Align the brackets with the string line.



2 Level the 4 × 4 brackets in both directions using a torpedo level, and let the concrete set a day before building on it.



3 Remove the sod, then cover the soil beneath the deck with landscape fabric. This keeps the weeds from growing.



4 Lay out the joist positions, then use a scrap of 2 × 10 joist to align each joist hanger. Use proper nails to install brackets.

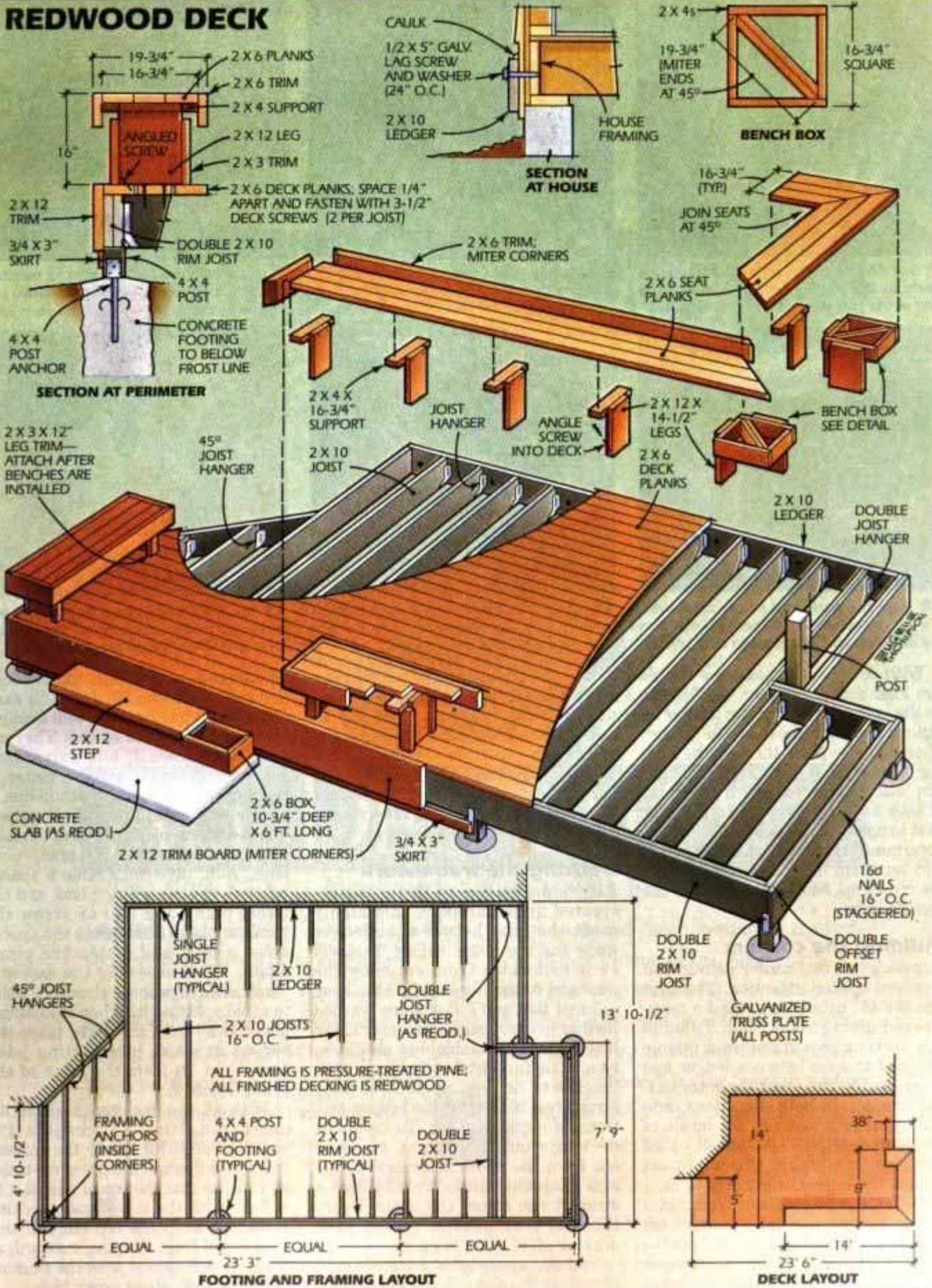


5 Use a straight joist to level between the ledger and the support posts. Mark and cut the posts, then check the level again.



6 Anchor the footing bracket to the post with nails and the post to the double rim joist with 2 × 5 galvanized truss plates.

REDWOOD DECK





7 Use 45° joist hangers to attach the joists to the angled ledger. Nail the top half of the joist directly into the ledger.



8 Double joists require double-wide hangers. Install these hangers on the rim joist, then slide the two joists into place.



9 Use a 1/4-in. plywood spacer to maintain consistent gaps between planks. Drive two screws through each board into each joist.



10 Trim the perimeter of the deck with 2 × 12 redwood. Screw these boards into the rim joists and also into the deck planks.



11 Build the square corner boxes, then install two mitered crosspieces in each to support the mitered seat planks.



12 Set the corner boxes in position and measure for the seat planks. Prebore the ends and screw the planks to the boxes.

With the posts cut and the double rim joist nailed together, set the rim on the posts and lay out the hanger locations to match those on the ledger. Then, nail the posts through the footing brackets and join the posts to the rim joist with galvanized truss plates (Photo 6). Nail the remaining floor joist hangers. Then check each joist to determine which side has the crown and set them into the brackets with the crown up. Nail all the joists to the joist hangers.

Building the corners

Our deck has two corner details that required special attention. The first was the 45° extension around a cantilevered dining room wall. To build this section, just frame-in a double rim joist to span between ledger and outer double rim. Nail the intersecting corners, in both directions, and add a corner bracket to the inside of the double offset. Then, use 45° joist hangers to support the joists set against the angled ledger (Photo 7).

As for the step offset, frame in a double joist on one side—in our case this was alongside our porch post—using a double-width joist hanger (Photo 8). Then, frame the outer edge

of the offset conventionally, wrapping it back to the double joist. A second double-width hanger makes this an easy connection. Then, bridge between the return of the double rim joist and the ledger plate on the house with a second double rim. Finally, cut shorter joists to fill in the open spaces and hang them, 16 in. on center.

Decking the framework

Before decking over the pressure-treated undercarriage, thoroughly caulk the joint between the ledger plate and the house siding. This will keep rainwater from entering the joint and rotting the siding. Also, keep in mind that you'll find some warped lumber in every stack you buy. These boards are still usable, but should be reserved for cutting into shorter lengths to fit tight spots. Use your straightest boards for the longest sections of exposed deck. To keep the decking running straight, measure out from the house at several points and snap chalklines to establish a straight run across the joists. Every three or four boards, re-key your decking off of these lines.

Starting against the house, lay your first length of 2 × 6 redwood tight

against the siding. Then, nail or screw it down, with two fasteners in each joist. Though nails work well enough, we used 3½-in. deck screws. They are harder to install, but galvanized screws hold longer and are better at coaxing warped lumber back in line.

For quick gapping of all subsequent decking planks, it pays to make two ¼-in. spacers. (We made ours from ¼-in. plywood.) Slide a spacer between the preceding plank and the latest plank and nail or screw the plank in place. Then, slide the spacer down a joist and fasten the plank again. When screwing the end of a plank, always prebore clearance holes to avoid splitting it. When fastening a plank away from the ends, place two screws at every intersecting joist, each ¾ in. in from the edge of the plank (Photo 9).

With all the decking in place, it's time to install the 2 × 12 rim-joist trim boards (Photo 10). Miter the corners and screw them to the pressure-treated rims, so that the top of each 2 × 12 is flush with the top of each decking plank. To keep the top edge of this trim board from warping outward, as it surely will, screw it to the decking planks as well, about every 18 in.



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13 To make the bench legs, cut 14½-in.-long pieces from 2 × 12 stock and center them on the crossmembers. Screw in place.



14 Bring the mitered bench sections together at the corners and screw them in place on top of the box supports.



15 Bore the clearance holes diagonally through the bench legs and into the decking. Then drive screws into the holes.



16 Finish the legs with 2 × 3 vertical trimpieces. These pieces hide the leg screws and give a more substantial feel.



17 To conceal the exposed truss plates on the posts, install a skirt of 1 × 3 redwood. Rip it from 1 × 8 stock.



18 Build a step box from 2 × 6 material and screw it to the deck face. Bore oversized screwholes to allow for movement.

Building the benches

The benches we built here are about as simple as they come. To construct the continuous J-shaped bench, start by building two redwood boxes, 16¾ in. square, using standard 2 × 4 lumber. Next, miter-cut two sets of 19¾-in. crosspieces for each box. Join them back-to-back with galvanized nails. Finally, screw them into the boxes (Photo 11).

Set each box in its corner, just inside the 2 × 12 trim board, and measure for the seat planks. Miter each plank at 45°, using the positions of the boxes to establish the length of the planks. Finally, screw these planks to the tops of the boxes, preboring clearance holes in the ends (Photo 12). To build the long runs of the bench, boxes won't be necessary. Just lay out 2 × 4 braces (also 16¾ in. long) about 32 in. apart, and screw three deck planks over them. With all three planks assembled, cut one end at a 45° angle.

To build the bench legs, cut 14½-in.-long pieces of 2 × 12 planks and screw one to each 2 × 4 seat support (Photo 13). Do the same with the boxes, placing one leg under the inside edge of each box, and one spaced between the boxes. Turn the assemblies

upright and set them in position. Then, join the two mitered corners and screw the seat planks in place (Photo 14). Assemble the short end of the J in like fashion, and build the remaining bench without corner boxes. To anchor the bench to the deck, drill the face of each leg and drive 3½-in. screws at an angle into the deck planks (Photo 15).

To trim out the bench, screw mitered 2 × 6 redwood planks to the sides of the seat, anchoring them at



19 If you'd like to design your own deck and could use some help, you should consider the Redwood Design-A-Deck Plans Kit. It includes deck modules of various shapes for plotting on a design grid, plus information on railings, stairs, benches and more. It costs \$19.50 ppd. from the California Redwood Assn., Dept. DDK-94, 405 Enfrente Dr., Suite 200, Novato, CA 94949.

each crossmember location and at each mitered corner. Finish the bench by nailing 3-in. uprights to the faces of each 2 × 12 leg (Photo 16). These vertical trimpieces not only bring the legs into a more satisfactory scale, but also hide the anchoring screws.

Finishing up

All that remains is to conceal the truss plates nailed to the posts with a redwood skirt and to build two box steps. To install the skirt, simply rip a redwood 1 × 8 into two 3-in. strips and nail them to the fronts of the posts (Photo 17).

Because our deck is built so near the ground, we opted for a simple box step, set on concrete. If you prefer, you can rest your steps on concrete cap blocks, set in a bed of gravel. To make the steps, build two rectangular boxes as shown on the plans. Set these boxes on their supports and drill the back of each several times with a ¼-in. bit (Photo 18). Then, screw through these holes, into the face of the deck. The oversized screwholes will allow the step to float a bit with the seasons. Finally, screw a 2 × 12-in. tread to the top of each box.

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Green Issues

A guide to improving the landscape around your home.

BY MERLE HENKENIUS

The landscaping you do outdoors can be as important in making a house a home as the decorating you do indoors. It may be even more important in terms of building equity. But while most of us know the look we're after in the family room, fewer of us can conceptualize a well-styled and self-sustaining menagerie of outdoor plants that will add real comfort and street appeal. There's design to consider, of course, but plants are living things, with specific and sometimes limiting soil and sunlight requirements. And at today's prices, it pays to get it right the first time.

So how to proceed? As we found out, you really have three options. You can do the job yourself. You can hire a nursery/garden center to draw up a plan—as we did—and either do the plantings yourself, according to the blueprint, or contract the nursery to do it all. In this case, the planner is usually a certified landscape designer (CLD), with a background in horticulture. And, finally, you can hire a design specialist—a registered landscape architect.

While these approaches can differ significantly, there is also some overlap. A do-it-yourselfer, for example, will certainly seek out the extensive free information to be found at every garden center. Moreover, while garden centers and nurseries usually employ horticulturists with design training, some also employ, or contract with, registered landscape architects. And though landscape architects are usually not associated with nurseries, a developing trend in the business is the "design/build" concept. In these cases, architects work with preferred subcontractors to provide turnkey services—plans, plants, plantings and all.

Designers versus architects

What's the difference? Certified landscape designers are often horticulturists with secondary training in landscape design. Though not always the case, they tend to know more about plants and plant diseases than architects. In some areas, CLDs are tested and certified by the state, while in others, it's an industry certification. Either way, the test is no walk-through. By all accounts, it's a difficult exam. Of course, some designers are not as well trained, and in some cases, not certified either. It pays to ask.

A registered landscape architect masters most of the same things, but comes to the task from a different angle. He or she is a designer by training and temperament, but must also be versed, and state certified, in hardscape principles, including grading and drainage, property laws, irrigation and erosion control. From the consumer's point of view, there's also a significant difference in the professional relationship. A landscape designer usually works for a nursery and creates an inexpensive plan, about \$50 to \$200. This fee is typically credited to your account after you purchase a certain level of merchandise, say \$500 to \$1000. It's understood that the nursery profits from the materials you buy. The plan is a big help to the consumer, but it's also an effective sales tool, and everybody knows it. In contrast, a landscape architect—except for the design/build variety—does not profit from materials or installa-

tions. On a practical level, this means that an architect has to charge more for his plan, but is more willing to accommodate exhaustive revisions. In addition to superior design training, his or her willingness to work your thoughts and afterthoughts into the mix is likely to yield a more striking and satisfying plan. Which is the better choice? For most of us, a garden-center design will do just fine. Simple yards, simple plans. But if you're shooting for something beyond a proportional pleasantness, or if your property is large, with multiple elevations and complicated drainage requirements, then a registered landscape architect is worth the investment.

Guidelines

Every landscape plan should be different, even when side-by-side houses are nearly identical, because the tastes and lifestyle preferences of the owners do affect the decision-making process. Still, there are a few goal-specific rules and guidelines that should be applied to each site.

The first thing to consider is that the front of a home is different from the back, both physically and socially. For better or worse, the front yard is part of the larger community, while the backyard usually requires a private invitation. Metaphorically, the front door opens inward, while the back door spills outward. The front is more formal, the back, less so. In addition, front yards are often lopsided, with the house, garage, driveway or entry door uncomfortably weighted to one side. And finally, the fronts of houses are usually dominated by hard lines, as viewed from the street. The line separating the yard from the foundation, the door from the walk and the vertical corners from the horizontal lawn all produce abrupt, severe edges.

A front-yard landscaping plan, therefore, has several jobs to do. To begin, it must complement its surroundings—its neighborhood. Any striking departure from the norm should begin modestly near the street and then develop its full effect as it nears the house. Above all, the front yard should be inviting, especially as you approach the front door. The plantings here should be chosen and placed so as to lead the visitor to the door and to focus attention there. In addition to setting an inviting tone, these plantings should also break up the hard lines near the door. In practical terms, if the door waits at the end of a long walk, or driveway, the area near the door should be softened, to diminish that end-of-the-runway feel.

How are hard edges softened? By variety—specifically,

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by plants that vary in height, texture and color. The plantings near the door can be placed symmetrically, as when the sidewalk is centered on the property, or asymmetrically, as when the entry is off-center, right or left. The same applies to a lopsided yard. If your house, garage or driveway hugs the left side, a prominent right-side grouping of plants can pull things back into balance. Similarly, the hard outside corners of a house can be obliterated by ornamental trees or shrubs, while the foundation line can be broken by shrubs, flowers and low-growing ground cover.

Sides and back

Side yards are transitional, both physically and visually. They either graft together the separate sensibilities of front yard and backyard or they deliberately separate them. When a side yard is wide and spacious, shade trees and evergreens make good punctuation points and function as good dividers. When side yards are narrow, shrubs and flowers can lead the eye toward the backyard. While front-yard sidewalks are usually made of concrete, side-yard and backyard walkways can make good use of alternative materials.

Backyards are more casual. They can be cozy or structured. They can harbor Japanese gardens or sandboxes and tire swings. It all depends. If houses are like their owners, backyards are most like them. The plant selection should be less formal, with greater emphasis on variety and experimentation, and plant placement can be more relaxed—less orderly. This is the place for wild clumps of tall grass, shade trees, vegetable gardens, fruited bushes, bird feeders, stepping stones, vine-covered arbors, a pool, horseshoe pits—it's your call.

Seasonal interest

Whether you live in a semitropical climate or smack in the middle of the Rust Belt, try to include plants and trees that offer year-round interest. Though the options are limited in the northern reaches of the country, textures and colors, however muted, can make a difference. Trees and bushes that hold their fruit well into winter are good choices as are tall grasses and trees that have interesting bark patterns, such as the river birch used in our sample design. Because trees can be functional as well as ornamental, tree selection and placement is important. You'll thank yourself if you avoid the messy "self-pruning" varieties, such as cottonwoods and sycamores. And because shade trees are as good as air conditioners in summer, a few well-placed trees now can save you big bucks later. The west side of a house has seven times the heat gain of the remaining sides, so west and southwest sections of yards are ideal shade-tree locations.

Don't forget the grass

Turf grasses are the foundation of every landscape plan, even when part of the plan is to reduce the percentage of grass in your yard. The only worthwhile suggestion here is to avoid traditional, short-root bluegrass varieties. These traditional turf grasses are notorious for their susceptibility to diseases and their reliance on huge quantities of water.

Today, turf-grade fescues are much less trouble, and even some new bluegrass varieties have deeper root systems and improved hardiness. If you prefer the low maintenance of zoysia grass, take heart. You no longer have to live with a brown lawn most of the year. Improved varieties, such as Meyer Z-52, are less cold-sensitive, so they green-up sooner and stay green longer. If you don't care to tear up your yard, overseeding with improved varieties several years in a row will replace much of your existing grass. **PM**

One Plan In Action

● Plans made by garden-center/nurseries are very popular these days. The reasons are apparent. Garden centers are near and familiar, and the process is low-key and manageable, allowing you to spread the work and expense over several years. To get a better handle on just how a garden-center plan works, we paid to have a design drawn up for a typical new home in a typical new development.

Every landscape plan should start with you—with your ideas, likes and dislikes. For this reason, most garden centers start with a questionnaire dealing with likes, dislikes and basic family habits. Once this was filled out, our designer had a better sense of our tastes and lifestyle. He learned, for example, that we don't care to spend our weekends begging life from suicidal rose bushes. He learned that we do plan to widen our drive (though not for a year or two), that we have a lot-width drainage swale just in front of a rear terrace, and that the drainage is slow, at best.

And from a careful survey of our lot—we walked and measured it together—he learned that our rear yard is shallow, private and fenced, with a large deck, and that our front yard is large, featureless, divided by a drive and weighted heavily to the left.

We agreed that our general goal was to shade the southwest corner of the house with trees and to accent the high side of the terrace with low bushes, tall grasses and other low-maintenance plants. We also hoped to break up the front yard with bushes, ornamental trees and colorful flowers—anything to diminish the 65-ft. run of open turf.

The plan we received does exactly what we hoped it would. Starting in the front yard, our designer suggested a kidney-shaped area midway between the street and house, on the right side. This blocked-out area curls left, which serves to tie the two sides of the yard together. Within this area, we will plant three Indian summer crab-

apple trees that will grow to roughly 15 ft. and spread about as much. Beneath these ornamental trees, we'll plant various perennials and annuals to further define the area. A second planting bed will skirt the front and right sides of the house, concealing part of the front foundation and the right-side utilities.

To balance the right-side plantings, the left side of the house, extending back from the future location of the widened drive, is anchored with a *lentago viburnum*, a bush that we'll trim into an ornamental tree. As for the backyard and left side (south) yard, our modest drainage flow dictated trees tolerant of wet conditions. We opted for two river birches, which not only thrive in wet soil but are resistant to birch blight. This area also holds moonbeam coreopsis, which are small plants with fern-like foliage and yellow flowers. These are among the longest-blooming perennials available.

At the far northern corner of the backyard, and on the high side of the terrace, we'll plant an autumn purple ash, which is a relatively fast-growing hardwood tree that turns a deep purple in the fall. We expect it to reach and spread 30 ft. Beneath this tree, and against a small garden shed, we'll plant variegated porcelain ampelopsis, a vine with green leaves that have white variegation and red and purple berries. To complete the plantings along the back of the house, we opted for another *viburnum*, but this time we won't be shaping it into a tree. The *alfredo viburnum* flowers white, gets only 4 ft. tall and is noted for its brilliant red/orange fall colors.

The backyard plantings were chosen to conceal part of a not-so-handsome stockade fence, running the length of the property. Dominating the left corner will be an autumn brilliance *amelanchier*, an ornamental tree that will be the first to bloom in spring. Also in this area, we'll have a mint julep juniper, another 4-ft. evergreen, a variety of *viburnum* bushes and several gro-low sumacs. —M.H.

Backyard Basil

How to plant a basic culinary herb garden.

BY NEAL BARRETT; PM Illustrations by George Retseck

Herbs have been collected and cultivated in all parts of the world for thousands of years. Ancient civilizations ascribed medicinal, culinary and even spiritual values to many plants—and many of these qualities have been substantiated by recent scientific research. Even today, many of our medications have their origins in plant material. But to the Western mind,

too. If you have had the chance to use any of these herbs in your cooking, then you have, no doubt, become aware of their attraction. While dried herbs are often more concentrated in their flavor, fresh herbs make a lively and savory addition to any dish. The pungency of these herbs is even more intense when the herbs are freshly picked from your own garden.

The pleasures of growing your own herbs are not limited to the warm months. At the end of the growing season, you can dry or freeze them for use throughout the winter—or, with many herbs, you can dig them up and place them in pots for growing on a sunny window ledge during the cold months.

A garden that includes culinary herbs can be structured in many ways. If space is limited, herbs can be grown in pots distributed around the yard or patio, or in window boxes on the sunny side of your house. Herbs can also be mixed in with ornamental or vegetable plantings.

If you do have space to dedicate to growing herbs, you will be amply compensated for your time and effort by a beautiful garden and useful harvest. To accommodate the growth of nine of the most commonly used herbs, a space of approximately 35 sq. ft. is all that's needed. We have provided a simple layout (page 107) for a garden that measures 5 x 7 ft. and includes parsley, basil, chives, sage, oregano, mint, thyme, dill and rosemary. This selection provides a mix of annual and perennial plants that are all extremely easy to grow.

The plants generally require little



CHIVES

care once they are established—merely cutting off selected stems for cooking use is sufficient to keep the plants healthy and looking attractive.

The bulk of the work in having an herb garden comes in preparing the soil and initially planting the herbs. Give some thought to the location of your garden. The best spot for herbs

is one that gets at least 6 hours of full sunlight each day, is sheltered from strong winds and has moderately good soil. If you have a location that fulfills the first two requirements, the soil can be conditioned to provide a suitable medium.

The primary requirement for the soil is good drainage. Based on our sample 35-sq.-ft. layout, if your soil has a high clay content, add one or two wheelbarrowfuls of sand to the bed to help promote



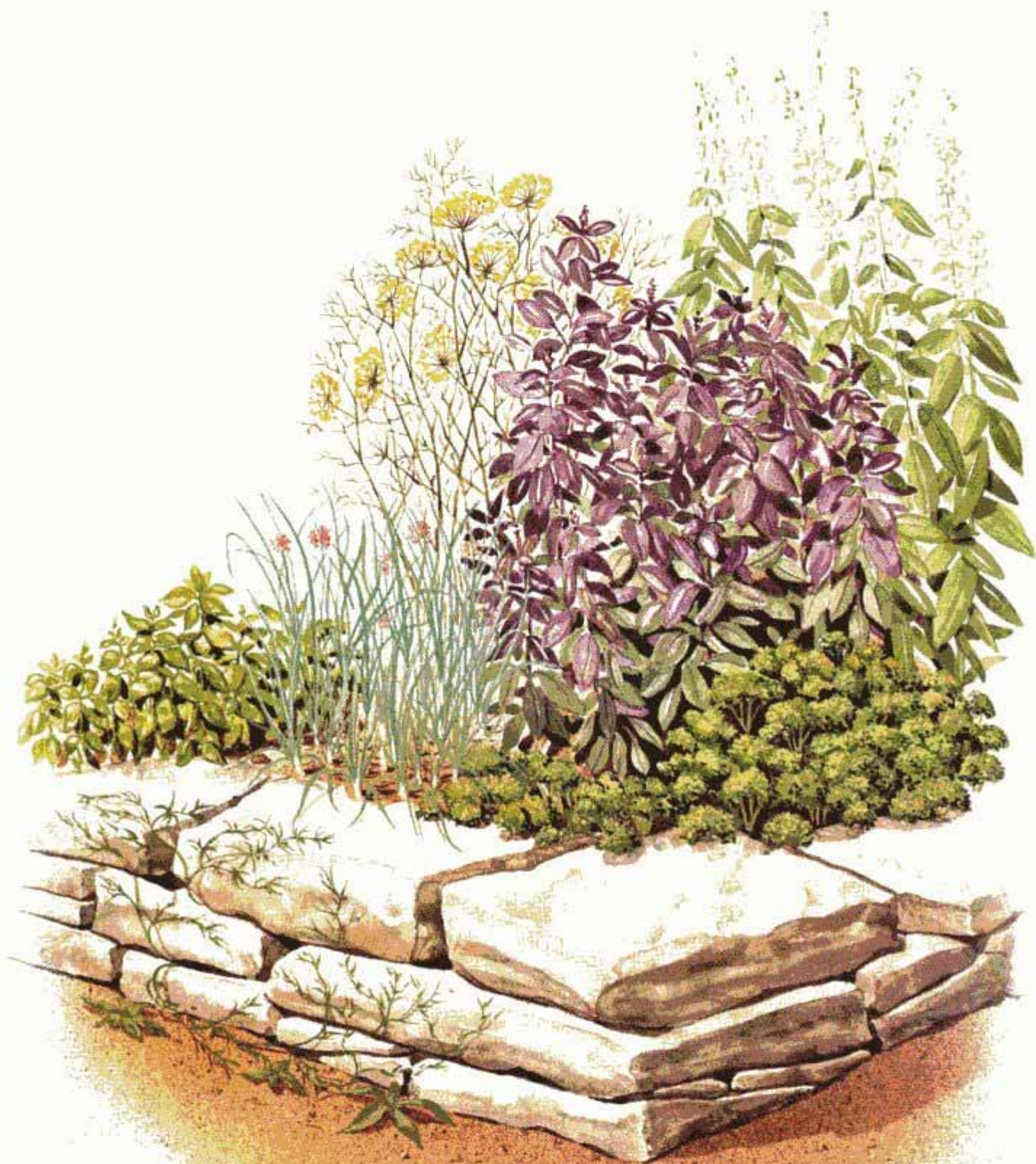
Dill



BASIL

the most obvious examples of herb use still crop up in the kitchen, where fresh herbs can easily transform a plain dish into something delectable.

For the homeowner who is developing an interest in herbs, the most satisfying and direct route to learning about these plants is to start a culinary herb garden. Most people are familiar with culinary herbs in dried form that are available in supermarkets. In many areas of the country, fresh herbs are now available,



drainage. Herbs generally do not require extremely rich soil, but a moderate amount (a wheelbarrowful) of organic matter—either compost, humus or composted manure—dug into the soil will supply all the required nutrients for the plants.

The best approach to starting a garden plot is to begin preparing the bed in autumn. If your garden is to be located where a lawn presently grows, the sod should be removed and the soil dug up with either a shovel or a pitchfork. Even if the area is already a garden, it's a good idea to remove

any weeds and turn the soil. This is also a good time to add any sand and organic matter (especially manure) to the soil, so that in the spring you can start tender plants without fear of the manure burning their roots.

In the spring, wait until after the last frost to begin planting your herbs. For the beginning gardener, it is easiest to purchase seedlings at a garden supply store, rather than to start the plants from seed. Look for healthy plant stock—strong plants have rich, green foliage with no yellowing leaves. And, as a general rule, it's bet-

ter to use plants that have already been successfully transplanted into pots, rather than to use plants that are still in starter flats. No matter what you choose, just make sure the plants appear full and strong, not wilted.

Before planting, test the soil for proper drainage by spraying the bed with water. If the water pools and does not appear to drain well, add sand and compost, then turn the soil over, loosening the soil to a depth of 10 to 12 in. Rake out the garden bed, removing any rocks or roots that come to the surface.

Position the pots in their planned locations in the garden. Space the plants with the mature size of each plant in mind. While you want to achieve a full, lush appearance in your garden, planting too close will inhibit the growth of each plant and leave them competing for moisture, sunlight and nutrients. When you are satisfied with the arrangement of your herbs, place the plants into the garden so that they are at the same depth as they were in their pots. Water the garden thoroughly.

With some herbs it is useful to sink a large pot into the garden and plant the herbs in the pot, rather than directly in the bed. Rosemary, for example, is a tender perennial that needs to come inside during the harsh winter months. To reduce transplant shock, you can merely dig up the pot and bring it inside. Mint is another herb that works well with this treatment. Members of the mint family are



MINT

rather aggressive plants and will spread underground, taking over a garden if not controlled. By planting the herb in a sunken pot, the roots are limited and will not spread.

Once the plants are well established, you can judiciously begin to use the leaves for cooking. Picking a leaf here and there will not damage even a young plant—just don't be too aggressive. When the plants begin to reach their mature size, you can harvest select branches for kitchen use, leaving the rest



OREGANO

of the plant to continue growing.

At the end of the growing season, annual plants can be pulled up by their roots and hung upside down to dry for winter use. Perennial herbs can be cut back, almost to the ground, and their leaves dried in the same manner. You will be surprised at how early in the spring the perennial herbs begin to show signs of life, providing the earliest garden delights of the season.

To help get you started in your selection of herbs, here are brief descriptions of nine of the most common culinary plants.

Basil—Basil is a tender annual plant, best known for its use in tomato sauces, dressings and pesto, but with innumerable applications in cooking.

The plant grows to a height of approximately 24 in. with a diameter of about 18 in. To encourage bushy growth, pinch off the flower buds as they appear—forcing the plant to continue leafing out.

Oregano—Oregano is a rather hardy perennial plant with origins in the eastern Mediterranean countries.

The plant will grow to more than 24 in. in height, and, over several seasons, will spread to a diameter of 24 in. or more. The roots can be divided at the end of the growing season to limit the size of the plant, or to start another plant elsewhere. Individual stems can be cut, or leaves and flowers picked off, for culinary use. This herb is renowned for its use as a seasoning for pizza and Greek and Mexican dishes.

Sage—Sage is a beautiful plant of softly colored leaves. Given enough time and space, this perennial will grow to a diameter of 36 in. Sage is often used as a seasoning in egg and cheese



PARSLEY

dishes and in stuffings. Many herb books state that sage plants will only last five to seven years, but in our experience a well-maintained plant can last more than 12 years before it starts to look unsightly.

Mint—The most well-known types of mint are spearmint and peppermint, but this family includes over 20 varieties. Mints are extremely hardy perennials, and, as previously mentioned, they need to be controlled, lest they take over a garden entirely. Mints are used both as garnishes and flavorings in drinks, soups, sauces, salads and desserts. Choose a variety that appeals to your taste.

Parsley—Parsley is technically a biennial plant—one that lasts two years—however, for practical purposes it should be planted every year. It is usually seen in either curly leafed or flat-leafed varieties, both being suitable for kitchen use. The plants will grow to a height of about 12 in. and a diameter of 12 to 16 in. Parsley plants tend to grow slowly at the beginning of the growing season, so they should be weeded carefully to remove competing plants while they become established. Parsley is used as both a garnish and a flavoring for sauces, stews and soups.



ROSEMARY

Rosemary—Rosemary is actually an evergreen shrub that

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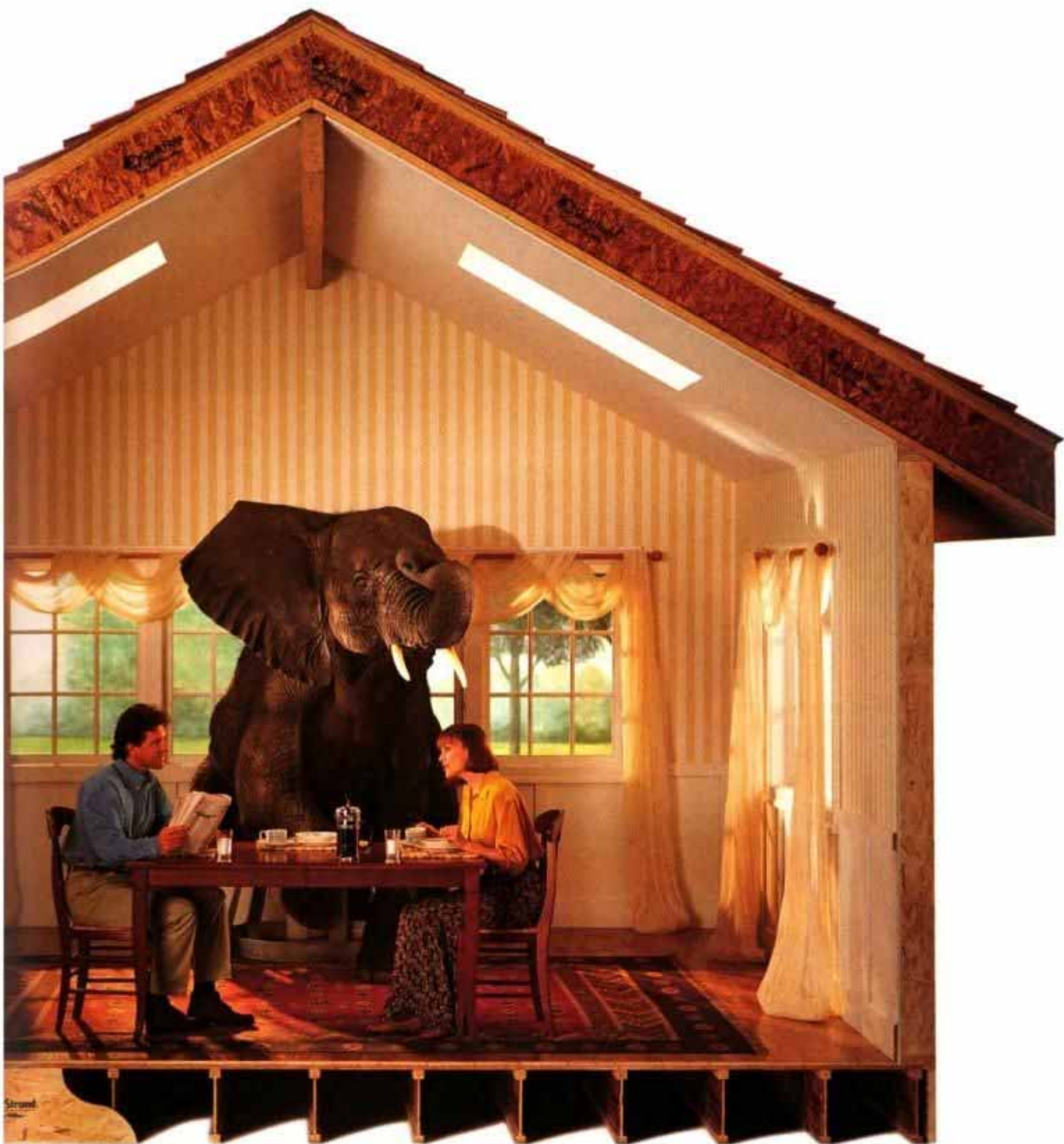
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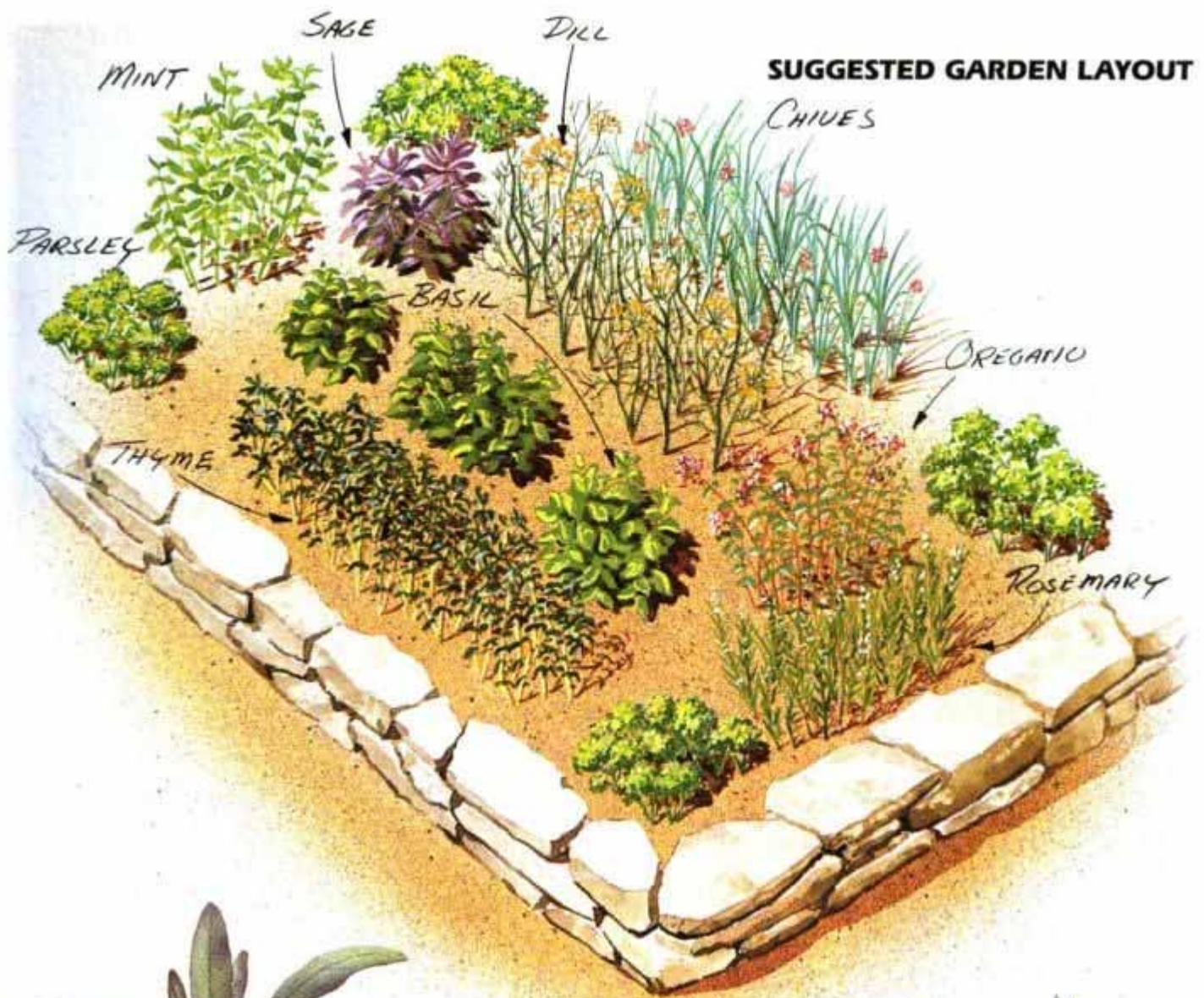


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SUGGESTED GARDEN LAYOUT



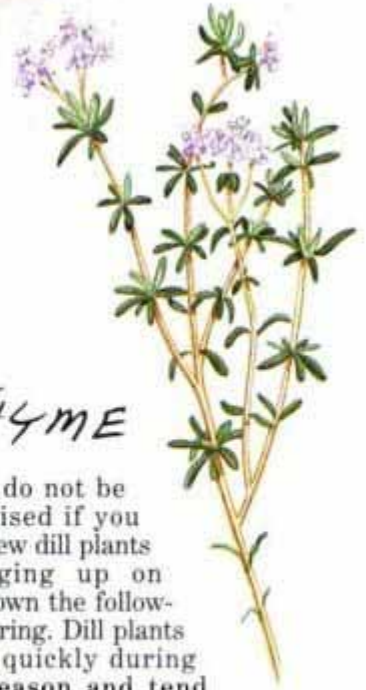
SAGE

can, in some varieties, grow to 60 in. It is rare to see a plant of such size in a home herb garden, but it can become quite beautiful, taking on a twisted, gnarled appearance. Rosemary is used as a seasoning in both meat and vegetable dishes—but it is quite pungent, so use it in small quantities. This plant is considered a tender perennial, so in cold areas it should be brought inside in a pot until early spring.

Chives—Chives are members of the same family as onion plants, and have many similar characteristics. Their gentle onion flavor is most valuable in soups, sauces and salads. The plants are extremely attractive, with long, thin stemlike leaves that support round lavender flower heads. Chive plants are hardy perennials that also do extremely well when grown in pots indoors. The plants grow in clumps and are well suited to use as border plantings. They grow to a height of about 18 in. Every three or four years, divide the root clumps to promote healthy growth.

Thyme—Thyme is a perennial plant that stays close to the ground. The plants reach a height of only 2 to 8 in. but tend to spread laterally and cover any adjacent bare ground. The growth can easily be limited, however, by cutting back the runners. The leaves of the thyme plant are extremely tiny, but are highly aromatic. Thyme is used in soups and sauces, and is excellent when featured in fish dishes.

Dill—Dill is an annual plant that can reach a height of 3 to 4 ft. If you let dill grow to the point where it goes to



THYME

seed, do not be surprised if you find new dill plants springing up on their own the following spring. Dill plants grow quickly during the season and tend not to last very long, so successive plantings, every two or three weeks, throughout the spring and summer will yield a continuous supply. Dill is best known for its use in making pickled cucumbers, but it can be used in many sauces, soups and salads.



Rock Solid

How to cut and lay a traditional stone walkway.

BY NEAL BARRETT

When landscape designers are faced with the task of creating an interesting environment, some of the most powerful tools they can use are the varied paving materials available today. The choice of material for a walkway, for instance, can dramatically alter the feeling of an outdoor area—whether it is a short passage from a driveway to the front door, or a meandering footpath through a large country garden.

The options available are limited only by one's imagination. The most commonly seen materials are poured or precast concrete, and while these walks are quite serviceable, they're also rather uninteresting. Other choices are more eye-catching. A brick or cut-slate walk, for example, suggests a formal elegance and makes reference to Colonial American design. A walk fashioned of wooden decking or blocks or rounds cut from a log has a casual feeling, and may be most appropriate for a retreat or summer home. A walk of randomly shaped flagstones falls somewhere between the previous alternatives in the feeling it conveys. The variety of sizes and shapes of the stones creates an interesting texture, while maintaining a feeling of solidity and permanence. Flagstone is an excellent option in many situations, and is the material we chose to construct our garden walk.

A stone walk can be installed three different ways. The first method involves setting the stones directly on

the soil and letting grass or a ground cover grow around each stone—a series of stepping stones. Another system is to set the stones in concrete. The third procedure, and the one which we used, is to set the flagstones on a base of crushed stone, and to fill the joints with the same crushed stone. This method yields a permanent and stable walk that still has a rustic feel and fits well in a garden location.

Flagstone is generally available as either slate or sandstone. In our area, most of the irregularly shaped stones are sandstone, while slate is sold in square-edged rectangular sizes.

When flagstone is taken from the quarry, it is split from the bedrock, rather than cut. This technique results in stones of varying thicknesses. Our stone varied from 1¼ in. to 2 in. thick. This irregularity presents a special challenge to the installer, but one that is easily accommodated by our installation technique.

Flagstone is generally sold by the square foot. And, there can be some waste, particularly if you want a look that's primarily large stones. To be sure that you have enough material to complete your project, measure the area to be paved and add about 15% to allow for breakage and fitting.

To form the base for your walk, you will need a quantity of crushed stone. This material is sold under several names, but is most widely known to stone suppliers as dolomite dust or "1-Bs." This is a combination of very small stone chips and dust. It forms a

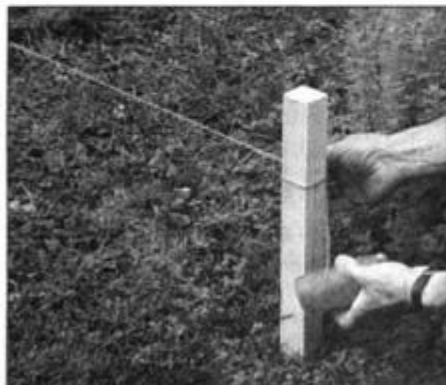
stable base and provides good drainage. In addition, when used as a filler between the stones, it compacts well to lock the stones in place and provides a poor medium for weed growth.

In areas of the country where severe winters are a factor, a base of 4 in. of crushed stone is recommended. To determine how much stone to buy, take the square footage of your path and divide by three to give the amount of crushed stone in cubic feet. Divide that figure by 27—there are 27 cubic feet per cubic yard—to give the amount in cubic yards. Most stone suppliers sell either by the cubic yard or by the ton. For crushed stone, you can figure 1½ tons per cubic yard. Again, add an additional 10% to 15% for filling joints and building up thinner stones.

Most homeowners will already have many of the tools required for this type of installation. A good shovel, pickax, steel rake, wheelbarrow and level are all necessary. In addition, a mason's brick chisel and hammer, layout string and hand tamper are also required. You will need some stakes for layout of the walk and a short length of 2 × 4 to act as a screed for the crushed stone.

Since this type of walk is intended to have a rustic feel, we did not install any type of edging at the borders. It seemed much more appropriate to have the stones abut the grass and garden directly, providing a natural transition between the two.

Lead photo: John Griebisch
Step-by-step photos: Neal Barrett



1 Stretch a mason's string tightly between the layout stakes. The line should fall just above the outside edge of the walk.



2 Using a pick and shovel, remove all the sod, stones and other obstructions to a depth of about 4 in. Rake the bottom flat.



3 Tamp the soil in the work area and then cover the excavation with landscape fabric. The fabric inhibits weed growth.



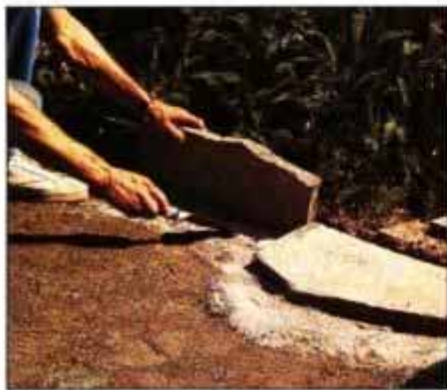
4 Spread crushed stone over the fabric to a depth of about 4 in. Make sure all the corners are filled, then rake the surface flat.



5 Use a 2 × 4 screed to even out the crushed stone. A uniform base at this point provides a useful reference for later work.



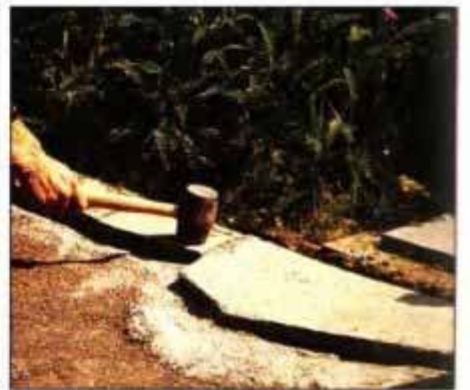
6 Once the bed is basically flat, use a hand tamper to compact the crushed stone. Compact the area uniformly.



7 Begin laying stone in a corner. First spread a thin layer of crushed stone onto the bed. Then lower a flagstone into place.



8 Level each ensuing stone in place. Because the surfaces are rough, the level is bound to rock. Shoot for approximate level.



9 Use a rubber mallet to make small adjustments. The stones are heavy and the less you move them the better.

Layout

Begin your walk by staking out the perimeter. Drive 2 × 2 stakes at the outside of each corner for a rectangular walk, and every 1 to 4 ft. along the edge of a curved side, depending on the severity of the curve. Tie a nylon mason's string between the stakes, stretching the string tightly, to outline the walk (Photo 1). Study the size and shape of the outline. It is a simple matter to make changes at this point, and much more involved once the installation has begun.

Before beginning to excavate the site, examine the flagstones you have purchased. Measure the thicknesses of the stones to determine the required depth of your excavation. The simplest method is to find the thickest stone that you plan to use and add 4 in. to that dimension. When setting the thinner stones, you simply place additional fill underneath to yield an even top surface.

Excavation

Start digging at the perimeter of the walk. Use a sharp shovel to dig down just inside the line created by the mason's string. The sides of the hole should be as vertical as possible to

provide a stable base for the walk along its edges.

Once the entire outline of the walk has been excavated to the required depth, you can dig out the body of the walk. You will need a pickaxe to remove any sod, stones and roots that you encounter (Photo 2). It is important that the base for the walk be firm and free of obstructions. Stones and roots must be removed, even if they require additional digging. To check the depth of your hole, use a 2 × 4 to span the width of the walk and measure to the board's bottom edge from the bottom of the hole.

Check the bottom of your excavation when the digging is complete. The base should be reasonably flat and well packed. Use a hand tamper to compact the soil. This will prevent uneven settling of the stones after installation. Next, cover the bottom with landscape cloth (Photo 3). This material will discourage any weed or plant growth under the walk.

Spread a base of crushed stone approximately 4 in. deep over the landscape cloth. Use the back edge of a steel rake to distribute the stone around the hole (Photo 4). Then use a piece of 2 × 4 that is about 4 in.

shorter than the width of the walk to even the surface of the stone (Photo 5). This 2 × 4 screed eliminates any high and low spots in the stone base, providing a smooth, flat surface. Use the hand tamper to compact the stone base (Photo 6). To further promote settling of the base, thoroughly soak the stone with water.

Laying the stone

At this point, you are ready to begin laying the flagstone. You will notice that not only do the stones vary in thickness from one to another, but also within an individual stone. This variation must be accommodated by adjusting the base layer—either building it up or carving it away—to provide a stable foundation for each stone.

Begin laying the first stone at one corner of the walk. Spread some loose crushed stone over the base, then position the first stone over it. Wiggle the stone into position, then check that it is at the proper height—that is, even with the surrounding sod or garden. Add or subtract crushed stone to adjust the level of the flagstone and to provide a base that keeps the flagstone from rocking (Photo 7).

Select the next stone for a reason-

TECHNOLOGY UPDATE

New device turns any electrical outlet into a phone jack

Engineering breakthrough gives you unlimited phone extensions without wires or expensive installation fees



By Charles Anton

You don't have to have a teenager to appreciate having extra phone jacks. Almost everyone wishes they had more phone jacks around the house.

When I decided to put an office in my home, I called the phone company to find out how much it would cost to add extra phone jacks. Would you believe it was \$158?

No more excuses.

Today, there are a thousand reasons to get an extra phone jack and a thousand excuses not to get one. Now an engineering breakthrough allows you to add a jack anywhere you have an electrical outlet. Without the hassle. Without the expense. And without the miles of wires.

Like plugging in an appliance.

Now you can add extensions with a remarkable new device called the Wireless Phone Jack. It allows you to convert your phone signal into an FM signal and then broadcast it over your home's existing electrical wiring.

Just plug the transmitter into a phone jack and an electrical outlet. You can then insert a receiver into any outlet anywhere in your house. You'll be

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Clear reception at any distance. The Wireless Phone Jack uses your home's existing electrical wiring to transmit signals. This gives you sound quality that far exceeds cordless phones. It even exceeds the quality of previous devices. In fact, the Wireless Phone Jack has ten times the power of its predecessor.

Your range extends as far as you have electrical outlets: five feet or five hundred feet. If you have an outlet, you can turn it into a phone jack—no matter how far away it is. The Wireless Phone Jack's advanced companding noise reduction features guarantee you crystal-clear reception throughout even the largest home.

Privacy guarantee.

You can use The Wireless Phone Jack in any electrical outlet in or around your home, even if it's on a different circuit than the transmitter. Each Wireless Phone Jack uses one of 65,000 different security codes. You can be assured that only your receiver will be able to pick up transmissions from your transmitter.

Is the Wireless Phone Jack right for you?

The Wireless Phone Jack works with any single-line phone device. Almost anyone could use it, especially if...

- **Few jacks.** You want more phone extensions without the hassle and expense of calling the phone company.
- **Bad location.** You have jacks, but not where you need them most, like in the kitchen, garage, home office or outside on the deck.
- **Renting.** You want to add extensions, but you don't want to pay each time you move.
- **Other phone devices.** You have an answering machine, modem or fax machine you want to move to a more convenient place.

The Wireless Phone Jack System

consists of a transmitter (right) and a receiver (left). One transmitter will operate an unlimited number of receivers.



Unlimited extensions—no monthly charge. Most phone lines can only handle up to five extensions with regular phone jacks. Not with the Wireless Phone Jack. All you need is one transmitter, and you can add as many receivers as you want. Six, ten, there's no limit. And with the Wireless Phone Jack, you'll never get a monthly charge for the extra receivers.

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The Wireless Phone Jack lets you add a phone, modem, fax machine or answering machine almost anywhere.



10 To cut a stone, position it on a flat piece of ground and score the cutline with a mason's chisel. Score the bottom, too.



11 Once scored, place the stone over a 2 x 4 block, with the waste area unsupported. Then strike it with a hammer.



12 Lay all the large stones in place first, then fill in the gaps with smaller stones. Gaps should be 1 in. wide or less.



13 When you're finished laying the flagstone, spread crushed stone over the surface and into the cracks with a broom.



14 To keep the large stones from shifting, use a wide-blade mason's chisel to pack the joints as tightly as possible.



15 Finish up by giving the walk a thorough rinsing. This will remove the stone dust and further compact the joints.

ably close fit along one side of the first stone. Since flagstones are irregular in shape, you will have to sort through your stones to find appropriate shapes. Keep in mind, however, that this material is not meant to fit together too tightly. Variation in joint size is natural and even desirable in this type of installation. Aim for joints of $\frac{3}{8}$ in. to 1 in. in width.

Again, adjust the thickness of the base for the stone, providing an even transition between stones. You can use a 2-ft. level to check the surface of adjacent stones, but the uneven surface of the stones makes this an imprecise job (Photo 8). It is best to rely on a combination of factors in positioning each stone: the reading from your level, the height of both the adjacent stone edges and the surrounding lawn or garden and, most important, your eye. Use a rubber mallet to make minor adjustments in the position of a stone (Photo 9). You may be surprised at how quickly you develop a sense of what is a proper placement of a stone. A slight pitch is desirable to promote drainage, but should not exceed $\frac{1}{4}$ in. in 4 ft. This pitch can be created in one direction, or by crowning the walk in the center.

Cutting the stone

Given a limited number of flagstones to work with, it is inevitable that you will run into situations where you need a stone of a particular size or shape that you don't have. When this occurs, it is a simple matter to cut a stone to shape. Begin by tracing the desired contour onto the stone. It is sometimes helpful to place the stone into approximate position to better envision the shape. Mark both the top and bottom of the stone.

With the stone resting firmly on the ground, use a mason's brick chisel and small sledgehammer to score the stone along the line. Turn the stone over to score the bottom side as well (Photo 10). Next, rest the stone on a 2 x 4 block, with the scored line directly over the edge of the block and the waste portion hanging freely. Use the hammer to tap the waste portion of the stone to break it along the line (Photo 11). Cutting these stones is generally not too difficult, but there are times when the grain of a stone or a pre-existing crack will yield an unpredictable result. It's generally possible to make use of these stones somewhere in the walk, so try to keep your frustration in check. It is also

important to keep track of the waste pieces when cutting stones. These small pieces are used to fill shapes that cannot be accommodated with large stones. Used either singly or in combination, these small stones add interesting texture and contrast to the mass of the larger stones (Photo 12).

It is important to note that the large flagstones can be very heavy. Plan to have a helper available to assist in moving these pieces to minimize the risk of serious back injury.

When the flagstones have been placed, all that remains is to fill the joints between the stones. Place one or two shovelfuls of crushed stone on the walk. Then use a broom to sweep the material into the joints (Photo 13). It is important that the joints are packed full of the crushed stone to keep the flagstones from shifting. Use a brick chisel to tamp down the stone in the joints, encouraging the material to settle (Photo 14). Apply more crushed stone as required to fill the joints, then spray thoroughly with water to encourage further settling (Photo 15).

Finally, sweep the walk one more time to clean up the joints and remove any excess crushed stone. **PM**

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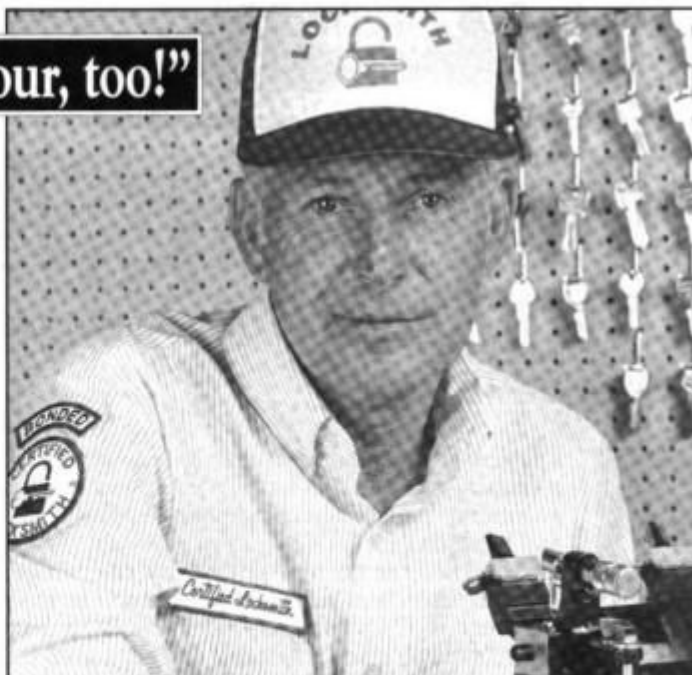
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Making A Splash

What's happening in the aboveground pool market.

BY MERLE HENKENIUS

If you're like most homeowners, you've given at least a passing thought to having your own backyard swimming pool. Swimming pools can be both fun and healthful, for all ages. Even so, you've probably let the thought go by—put off by the images of extravagant expense and tricky, time-consuming maintenance. Still, many of us would consider installing a backyard pool if it could be made affordable and easy to maintain. As it happens, both are possible, within obvious limits.

What are the options?

The first option is an in-ground pool, usually made of concrete and tiled at the water line. Given a choice, most would-be pool owners would rather have an in-ground pool. They appear—and are—more substantial, but they are also more expensive. A base price of about \$20,000 is common for a medium-size pool. These prices sort of slam the door on many families.

At the opposite end of the spectrum are the small, aboveground models sold by discount stores. These shallow, steel-walled pools (usually round and measuring about 3 x 15 ft.) can be purchased for less than \$200. Naturally, at these prices, quality is an issue. In fact, we found few in the industry willing to speak favorably of these "weak sis-

ters." But we may have polled the wrong age group. Thousands of soaking-wet first-graders might beg to differ. Still, these are, at best, starter pools, meant mostly for splashing and wading. The broad middle ground of the pool market is claimed by larger, more elaborate aboveground pools. While still viewed askance from some circles, these pools can offer the best of two worlds. They can be large enough to accommodate real swimming, while remaining quite affordable, especially when installed by the homeowner. It is possible to buy an oval or rectangular steel-walled pool, in the 15 x 30-ft. range, for about \$2000—pump, ladder and filter included. If you'd rather have a professional do the installation, add \$500 to \$1000 to the deal.

Most medium-size, aboveground pools center in the \$1200 to \$2500 range, though some pool packages, with installation and specialty equipment, can reach \$8000 to \$14,000. On the other hand, if a quality smaller pool will work for you, the material costs can dip as low as \$600 to \$800. Keep in mind, however, that the lower figures are for the pool and basic equipment costs. City codes and insurance companies may well require fencing, and possibly some additional safety equipment. You may also wish to upgrade the water-treatment system to one that requires less maintenance. And because aboveground pools can



appear a bit stark, many homeowners build decks around them, which naturally adds to the total cost.

The aboveground advantage

In addition to modest initial costs, aboveground pools may offer some less obvious long-term savings. Because they are considered portable, or at least removable, they do not usually raise property taxes. In contrast, an in-ground pool is considered a permanent capital improvement, and its contribution to the value of the property will be taxed accordingly. Site limitations may also come to bear. Narrow side yards, mature landscaping, rocky soils and climates that leave the ground frozen for much of the year all favor aboveground pools. And finally, because abovegrounds are portable, they can be removed when you move, or when the kids are grown and leave home.



K-D POOLS PHOTO

K-D's portable pool is easy to assemble and has adjustable sides. In its shallow form, it's only 24 in. deep, which is safer for young children. When the sides are raised, it measures 45 in. deep.



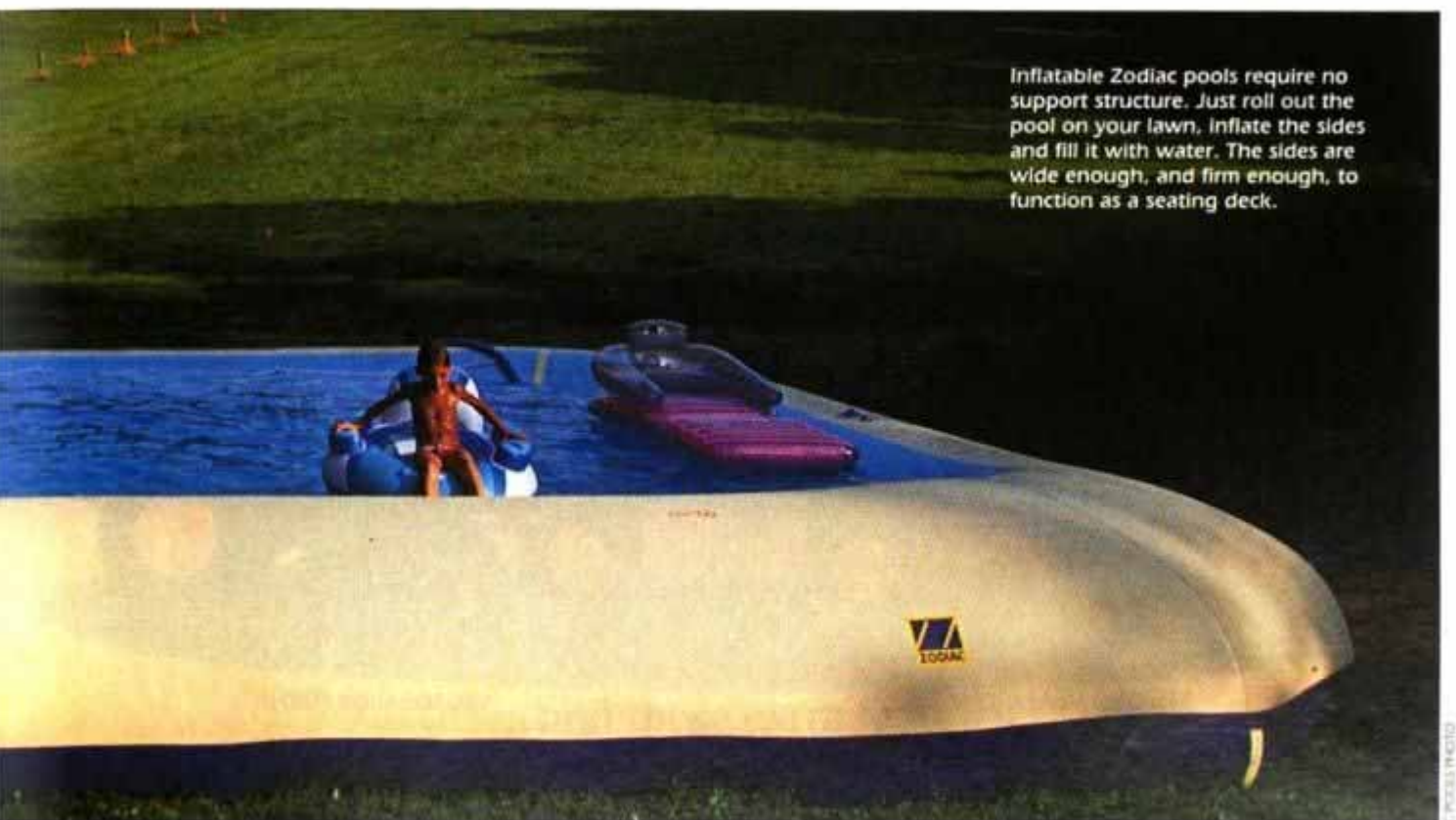
DOUGHBOY POOLS PHOTO

This Doughboy pool showcases the traditional design with support posts and metal sides. These pools come in a wide range of styles and sizes from small, round pools to oblong designs like this.

On the downside, aboveground pools are not diving pools. While some are available with one deep end, abovegrounds are primarily swimming and wading pools. Moreover, every pool can be dangerous, no matter how diligent you are. For that reason, it's a good idea to raise the liability limit on your homeowner's insurance. While the premium increase is usually modest, it is an increase. And no matter which cleaning system you choose, you'll need to budget some money for upkeep. This should include the electricity needed to run the filtering-system pump 8 to 12 hours a day, plus chemical costs ranging between \$20 and \$50 per month.

Three sample pools

There are a great many pool manufacturers in business these days, and most offer quality products. Here are three that represent the wide variety of pools that are



Inflatable Zodiac pools require no support structure. Just roll out the pool on your lawn, inflate the sides and fill it with water. The sides are wide enough, and firm enough, to function as a seating deck.

K-D POOLS PHOTO

available. The abovegrounds made by Hoffinger Industries (10959 Jersey Blvd., Rancho Cucamonga, CA 91730), and marketed under the Doughboy label, are fairly typical. These steel-walled pools come in a variety of sizes, including round models ranging from 12 to 28 ft. and ovals as large as 21 x 41 ft. Water depths are in the 3½-ft. range, but the heavier liners are flexible enough to accommodate some center excavation. One end of the pool can be as deep as 7 ft.

Round pools are the simplest to design and build because the water pushes against the sidewalls in all directions equally. All that is needed is a secure band of steel and modest vertical supports. Oval pools require a bit more strength in the elongated sections of the walls, but the ends are nearly identical to round pools.

While steel-walled pools can be taken down and set up elsewhere, it's not something you'd want to do very often. Moreover, each installation would require a new liner.

These pools are portable in only the most limited sense—only when compared to in-ground pools. With this fact firmly in mind, several manufacturers have designed pools that are truly portable and that take only an hour to set up.

One version is made by Zodiac Pools (401 E. Thomas St., Wilkes-Barre, PA 18705; 800-767-7634). These are a little like the tiny, inflat-

able wading pools we've all seen. The difference, of course, is that they're larger and stronger. They gain their strength from a fiber mesh that is heat-bonded between layers of tough, rubberized plastic. Projected problem-free use is about 10 years, and each pool comes with a patch kit that works underwater, which extends its life.

Pool shapes include rounds, ovals and rectangles. Round pools range in size from 24 to 16 ft., and rectangular pools can be as large as 37 x 24 ft. Prices go from \$800 to \$6500, and include sand-type filters and pump.

One of the Zodiac advantages is that the inflated sides make a built-in deck. The concept is appealingly simple. To inflate one of these pools, you can use a foot pump (included), or a shop vac with the motor reversed. The inner pool sides have disc-like plugs that are closed when you pump in the air. When the sides are inflated, you add about 18 in. of water to the pool and remove the discs. Water from the pool then



The height of an aboveground pool can be visually unappealing. But good site selection and beautiful landscaping, as shown here, can completely hide the sides.

Q: What's the difference between the John Deere® and the Yard-Man™?



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rushes into the inflated walls and compresses the air, creating a sturdy deck. Then fill the pool, connect the pump and filter and you're set.

Taking the concept of portability one step further, K-D Products (1015 Calle Amanecer, San Clemente, CA 92673; 800-777-3553) has come up with a design that focuses on child safety. The unique aspect of this pool is that it converts easily from a shallow, 24-in.-deep pool for small children, to a deeper, 45-in.-deep pool for older children and adults. As your kids grow, you simply add another vertical section to the framework and lift up the pool liner to full height. The skimmer/filter works at both levels. And come winter, the entire pool can be folded and stored.

A K-D Konvertible pool can be assembled by two people in about an hour, and entirely without tools. It consists of an anodized, aluminum-tubing frame and a heavy-vinyl liner, sleeved to accept the framework. The

pool can rest on any kind of surface. These round pools are available in 12-, 16- and 20-ft. sizes, with suggested retail prices between \$1200 and \$2900.

Support equipment

Every pool must have a pump and filter system. The pump piping is attached to a skimmer box, usually located in the side of the pool and partially submerged. The box is equipped

with a vacuum fitting and a basket. Floating debris, such as leaves and twigs, are caught in the basket, while smaller impurities, such as dirt and oils, are drawn through the skimmer and pump, into the filter.

Three types of filter media are commonly used. One of the most popular is the sand filter. In these, water is drawn across layers of sand, which trap impurities. Next are cartridge filters that contain a fibrous fabric that screens impurities. And finally, some filters contain a white, powdery substance known as diatomaceous earth.

Maintenance

If you suspect that water-quality maintenance is a perpetual nuisance, you're at least partly right. If you start with water that may be high in dissolved minerals and metals, or that is too acidic or basic, and then add airborne and swimmer-borne bacteria, suntan lotion, body oils and virtually any substance that could fall from the sky, you have a mix that can grow



Another way to hide the pool sides is with an elaborate deck. This one provides easy access to the pool from all sides and still yields plenty of space for entertaining.

NATIONAL SPA & POOL INSTITUTE PHOTO

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algae, damage equipment and make swimmers sick. Though there are a broad range of chemical treatments available, chlorine compounds are the most common.

While you don't have to be a chemist to treat your pool water, some people would rather not bother. These homeowners turn the job over to professionals, who test and treat on a weekly basis. This adds to the cost

of operation, of course, and may not be right for you.

Another approach is to have the dealer test the first water in the pool—or of the season—treat it for minerals, metals and pH balance, and then set up a purification regimen for you to follow. And finally, you can choose a line of chemicals from any dealer, buy the testing kit that goes with it, do some reading and handle



ELECTRONIC SYSTEMS PHOTO

Traditional water treatment requires adding lots of chlorine. But newer alternatives like this chlorine generator, which converts common sodium chloride into chlorine, are gaining ground.

the job yourself. The National Spa & Pool Institute (2111 Eisenhower Ave., Alexandria, VA 22314) also offers easy-to-follow information on pool care and chemical safety.

PH balance

The key to effective chemical use is the relative pH balance of the water. On the pH scale, which ranges between 0 and 14, the ideal balance is 7.4 to 7.6. If the balance is tipped too far toward the alkaline side, the bacteria-killing capacity of the chlorine is reduced, water may appear cloudy and scale will begin to form on pool walls and filtration equipment. If the water is too acidic, equipment will begin to corrode, chlorine residual (chlorine left after the initial killing shock) will drop and the water will irritate eyes and skin. Manufacturers package products formulated to raise pH (soda ash, sodium carbonate) or lower pH (muriatic acid, sodium bisulfate), but the trick is in knowing when to use one or the other.

How can you know what the pH balance of your water is at any given time? The usual choice is a chemical



CAREFREE CLEARWATER PHOTO

Another form of water treatment is by ionization. This unit introduces a low concentration of ions into pool water that neutralizes any disease-causing microorganisms.

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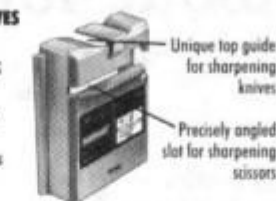
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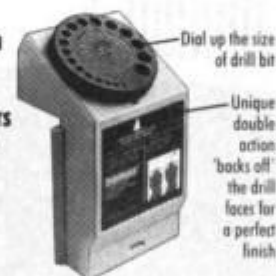
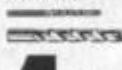


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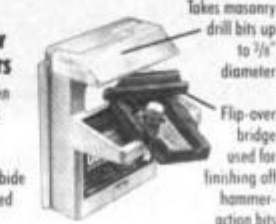
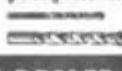


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Ozone treatment can clean water, revert to oxygen, and in the process reduce the amount of chlorine needed by nearly 90%.

reagent test. In this case, you'd take a sample of water in a test tube, add a few drops of reagent, shake it up and compare the color change to a graduated color chart. Chlorine content can be tested in a similar manner.

While this method is still the most popular, electronic probes are now on the market that do all the work for you, without the mess. One such product is the Electro-Tester, which retails for about \$40, and is made by World Industries International (17955 Aranth Ave., City of Industry, CA 91748; 800-535-POOL). You do, however, have some alternatives to chlorine treatment. Here are three.

Alternate treatments

Ozone has long been used in purifying drinking water, so it stands to reason that it might work in swimming pools as well. Because ozone has little residual—it reverts to oxygen—some chlorine is still needed, but the reduction in chlorine is said to approach 90%, which is quite a savings. Ozone does require a balanced pH, however. The equipment, a small, electrified cartridge spliced into the piping, is easily installed on new pools and just as easily retrofitted to existing pools, and prices start at about \$350. The version we show here is made by Prozone International (1019-A Old Monrovia Rd., No. 233, Huntsville, AL 35806).

Another reduced-chemical approach uses electrolytic ion exchanges to strip microorganisms of their sustaining atomic structures. Keep in mind that ionization, like the ozone treatment method, does require management of the water's pH balance, plus enough chlorine to sustain a 0.4-parts-per-million residual. Electrolytic ionizers for pools start at about \$900. The model we show here is made by Carefree Clearwater (2307-A Browns Bridge Rd., Suite 148, Gainesville, GA 30501; 800-364-5710).

A final category of purification

equipment is able to convert common table salt (sodium chloride) into chlorine and do so in a way that allows the chlorine to revert back to salt when its work is done. Chlorine production is a simple process—usually consisting of passing electricity through an inline chamber containing sodium and water. The electrical charge causes the chemical components to separate and realign. One of the resulting byproducts is chlorine, which is the basis of most pool chemistry products. Unlike regular chlorine additives, however,

this treatment is said to be strong enough to eliminate the need for heavy, chlorine shock treatments. And because the spent chlorine reverts to salt, and does not linger as chloramine leftovers ready to assault eyes, skin and hair, this process should be welcomed by many. A chlorine generator for a backyard pool should start at about \$350. The example we show here is called the AutoPilot, and it's made by Olectranator Systems (5755 Powerline Rd., Fort Lauderdale, FL 33309; 800-922-6246). **FM**



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its primary edge in this year's competition and a major reason the team won the Cup in '92. This point is driven home when you learn that the 200-strong America³ syndicate is composed of a crew of only about 40 sailors but a technology team of more than 50 scientists/designers/engineers.

The technology team uses a wide range of hardware and software tools, most of which it created itself. These include a sailing dynamometer that measures sail shape and rig effectiveness, a video monitoring system that measures mast twist and keel flexing, a sail-shape digitizing system and a

boat-performance software system that's linked to Differential GPS.

An interesting point about the America³ technology team is that for the '92 Cup it had an operational life of only 20 months, and much of its work was completed too late to use. All of this research will be fully utilized in this year's effort.

One project that bore fruit late in the '92 effort was a high-tech sail material called Cuben Fiber, which is 50% lighter than the lightest Kevlar sails. Equally important, the material doesn't stretch. This high-tech sailcloth is a polymer composite made with

fibers of carbon, extended-chain polyethylene (aramid) and liquid crystals. Several Cuben Fiber sails were used by the '92 America³ team, but this year's crew will get a full supply.

As expected, the cost of building and outfitting an America's Cup boat is expensive, about \$5 million. And since research and design provides the America³ team with its most significant edge, you can imagine that a fair amount of screening surrounds the release of technological information to the public. The details presented in this story are the result of cooperation with the America³ team (as far as it went) and independent research. In the end, some educated guesswork was involved, especially regarding the look of the team's final race boat, which is scheduled for delivery about the time this issue hits the newsstands.

But the secrecy all comes to an end by mid-March. For the first time in America's Cup competition, the teams must pare their multiboat inventories down to a single boat and then take the wraps off the hidden underwater appendages. This show-and-tell is the result of a change in the spirit of America's Cup rules, which also eliminates espionage. Starting with this year's competition, no more underwater spy cameras nor dirty tricks will be allowed. Despite the spirit of openness, teams still make every effort to play it close to the vest.

To win the '95 America's Cup, America³ will first have to earn the right to defend it. To become the official defender, America³ must beat two American-based syndicates, Team Dennis Conner and PACT (Partnership for America's Cup Technology) '95. The schedule calls for a 2-month, 4-round series of head-to-head races followed by a month of semifinals and finals. The team that accrues the most points during this process earns the right to defend the America's Cup against a challenger that emerges after undergoing a similar process. The two finalists meet in a best-of-nine series that begins on May 6 in San Diego.

Wind and muscle are the sources of power on a sailboat. Sailing skill and teamwork are the keys to strategy. But technology is the foundation for success. America³ was built on such a foundation, and its sights are clearly set on building the fastest boat and racing it first across the finish line. And when it does, you might wish to celebrate the victory with Susanne Leech Nairn and her female crew mates. But after she's devoted a year of 12-hour shifts and 6-day weeks to a single goal, you might wish to avoid reminding her of it by calling her Susie Bow Chick and inviting her out to sail. At least for a week or two. **FM**



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Associate Automotive Editor

Blemish Medicine

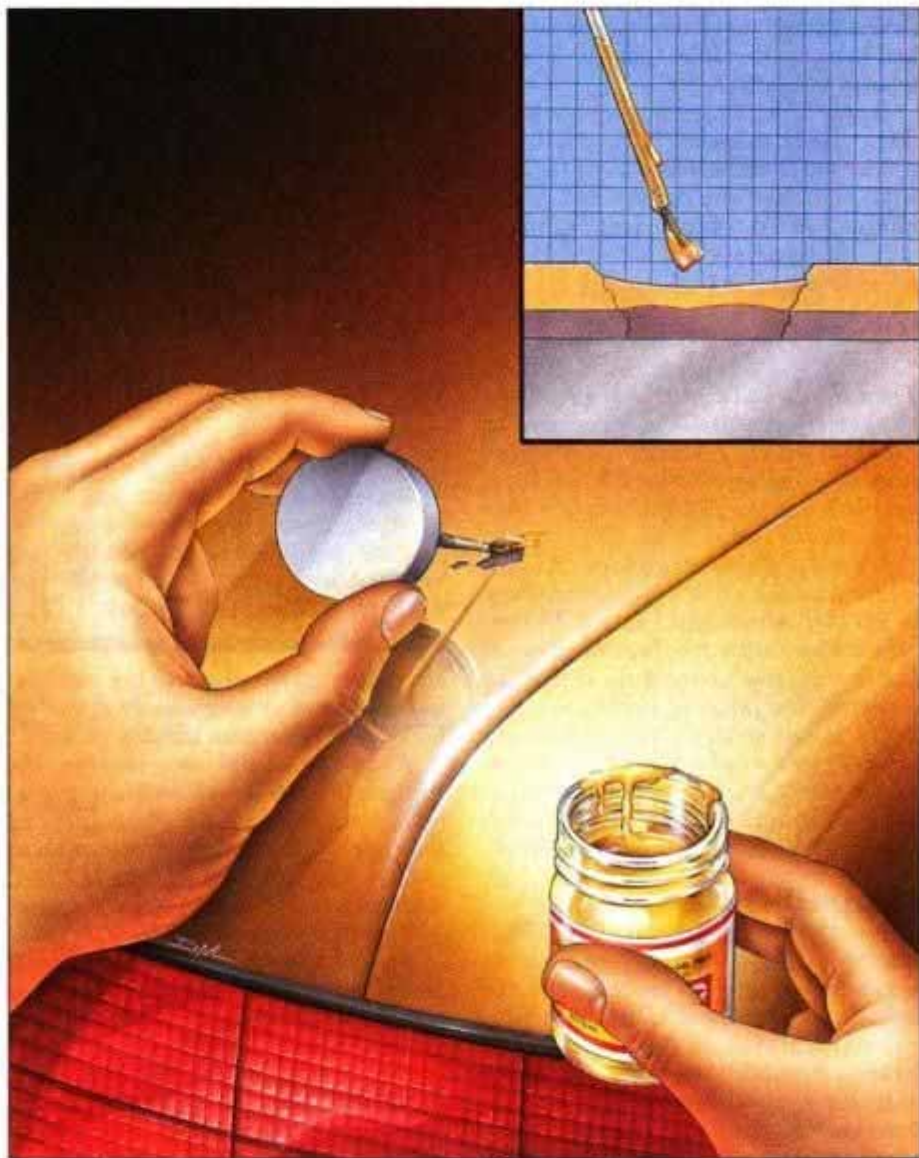
I've got several stone chips on the front of my new truck. The body shop guy wants almost \$200 to repaint the hood, and he won't even guarantee the paint will match. Help!

JOHN WEST
AMARILLO, TX

If the chips are small, and you have some patience, it's possible to do a nearly invisible repair with a bottle of touchup paint. Start by removing all rust from the chip with a scratch awl or a sharp pocketknife. Remove all of the loose paint, too—even if it makes the chip larger. Then dab on some rust-conversion jelly, which will convert the red rust to the more stable black iron oxide.

With a small artist's brush, prime the metal. Use a lacquer-based primer intended for auto finishes. Don't use the oil-based antirust primer intended for lawn furniture, as the lacquer-based finish coat you're going to put on next will make it bubble up. You may need to buy a spray can of lacquer primer and spray some into the cap to get the right kind of paint, unless you can talk your pal at the body shop out of an ounce or two from his gallon can. Apply this paint in several thin layers to fill the chip to about half of the original paint's thickness. Let it dry, at temperatures above 60°F, for 24 hours between coats. It may take four or more coats. Don't let any primer get on the good paint. Let this dry for several days, as the lacquer does tend to shrink.

Now, carefully, apply some touchup paint. Brush-on paint is best. While you can use the brush in the bottle's cap, an artist's brush is better. Shake the bottle thoroughly, and don't work in the sun. You want the paint to flow into the chip rather than be brushed in. It will take several coats, 24 hours apart, to fill the chip above the level of the surrounding paint. Let this dry for at least a week.



Get some 800-grit wet-or-dry sandpaper, and back it up with a hard plastic sanding block. Wet it thoroughly, and carefully sand the raised touchup paint until it's level with the surrounding paint. Do not disturb the surrounding paint. Follow the 800-grit with some rubbing compound on a rag to polish out the sandpaper's dull finish to a shine.

If your paint is a clearcoat-type finish, you could overspray this repair with a clearcoat bull's-eye a couple of inches in diameter, and use the 800-grit and polish to feather-edge in the repair. This is not easy to do, and you may want to leave this for the body shop.

Nutty Guy

The lug nuts on my Mazda seem to be seizing on the rims. I start them on by hand before using my impact wrench so as not to cross-thread them, but the wheel studs keep breaking off when I remove them.

V. BROWN
FARMINGTON, UT

Put away your impact wrench. Buy a can of Never-Seez or some other antiseize compound and coat the studs with it. Your studs are breaking because they are way, way, way too tight. Never use an impact wrench on a lug nut or bolt. Coat the threads and chamfer of the lug with anti-seize compound, and use a torque

CAR CARE

wrench to tighten them in a criss-cross pattern. Check your owner's manual for the torque specs.

Coast Guard

A group of us were traveling through the Blue Ridge Mountains when someone suggested that putting the car into a lower gear while coasting downhill on long grades would be better, because it would keep the brakes from overheating.

In general I agree, but we were doing 65 or more on I-75, and I was concerned that these prolonged speeds would damage the engine and transmission. We'd often travel for many miles at these speeds with the transmission in SECOND gear.

MARIO AMBROS
CORAL GABLES, FL

They don't have much of anything steeper than a freeway overpass in Florida, do they Mario? Your reaction is a common one I hear from people from the flatlands when they travel to the mountains.

It's not possible to damage an automatic transmission by downshifting to SECOND at any legal speed. The engine will not over rev, because it never turns over any faster than it does in a high-speed passing maneuver.

On some really steep mountain grades, you might have to resort to using FIRST gear on some downhills (at a commensurately lower speed) to keep from boiling the brake fluid.

Flipped Out

I recently blew the engine in my Toyota 4wd truck, I think as a result of an accident but several mechanics have said it was unrelated. Can you help?

In the accident, the truck rolled over into a ditch, where it sat on its side for several hours. A tow-truck operator righted the vehicle, which was then immediately started and run for about 5 seconds before it started to make expensive noises. The engine was immediately shut off, and a subsequent teardown revealed two broken rods and oil in the corresponding cylinders. Is there any definitive way to find the cause of the failure?

CRAIG DINELY
FORD CITY, PA

No definitive way, Craig, but here's my educated guess.

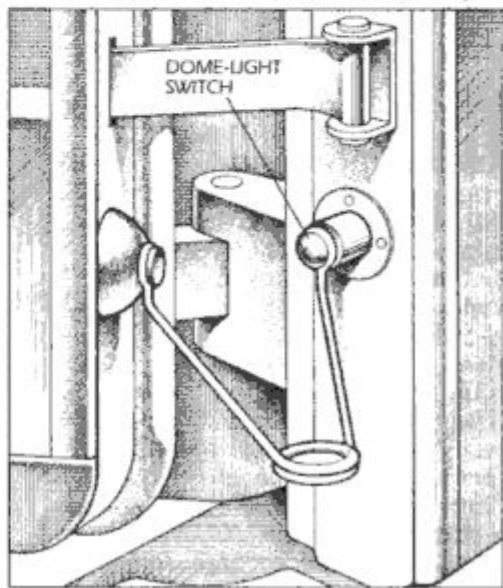
Engine oil, thinned to a water-like viscosity by the engine's heat, seeped past the rings into the cylinders after the vehicle overturned. The vehicle sat for several hours, and the oil thickened as it cooled. The vehi-

Beep, Beep

● I, like many people, spend a lot of time in and around cars. One modern convenience item, the "beep, beep" noise that's made by most cars when one of the doors is open and the key is in the ignition, is one feature that I have never cared for—in fact, I've disconnected it on all of my own vehicles.

But here at PM we're around a lot of vehicles, often doing photography or just mucking around inside. And we spend a lot of time listening to that most annoying beeping noise. It's gotten to the point where I can't listen to a Road Runner cartoon anymore.

A simple solution is at hand. I made one of these gadgets myself years ago, and I just ran across a commercially manufactured one in an auto parts store last week. It's simply some wire bent into a spring, complete with a couple of suction cups, to go between the door frame and the dome-light switch. There's no "beep, beep" with the switch depressed. I put a nice red "Remove before flying" banner on mine to remind me not to slam the door on it.



cle was uprighted—but the cold oil only had a few minutes to make its way back down into the crankcase.

When the engine was started, the volume of oil—which is incompressible—was larger than the volume of the combustion chamber at top dead center. The weak point was the rod, which failed. I might have suggested that the rods failed as the result of an over-rev during the accident, but the presence of oil in the two failed cylinders, and not the others, was the tipoff.

Too Much, Too Soon?

I recently bought a new Buick Park Avenue. I had some warranty work done, and the mechanic also changed the oil. I thought the oil was supposed to stay in until the first scheduled interval, at more than 2000 miles. It's supposed to have some effect on the cylinder walls so oil will stay on them. Will I have any problems because he changed the oil?

T.C.
WATERLOO, IA

No. I heartily recommend changing the factory-fill oil (and filter) within

DO YOU HAVE A CAR PROBLEM?

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



the first 500 miles or so to remove any dirt or contaminants from engine assembly, as well as all of the initial metal particles from break-in.

SERVICE TIPS

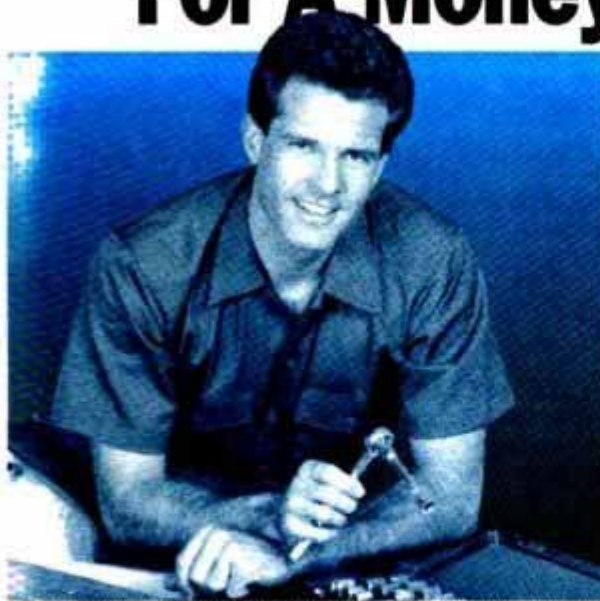
● If your 1991-94 GM car with a 4T60E transmission has erratic upshifts or is missing gears, there's a TSB that points to an intermittent short to ground on the A or B shifting solenoid.

● If your Mazda Protegé has a squeal or whine from the front of the engine after a cold start, it may be the timing-belt tensioner. There's a thicker tensioner and a new tensioner bolt to cure this.

● 1990-94 Mitsubishi Eclipse owners with drivetrain vibrations between 45 and 55 mph should ask their mechanics to look at the radiator mounts. The radiator on these cars serves to quell the engine vibration, and misaligned mounts may cause a perceptible vibration. Center the mounting posts in the brackets, and check the lower mounts for at least 1mm of clearance.

● Does your Isuzu Trooper have an outside mirror that vibrates excessively? There's a TSB that shows how to add more tension to the springs inside the mirror housing to correct this.

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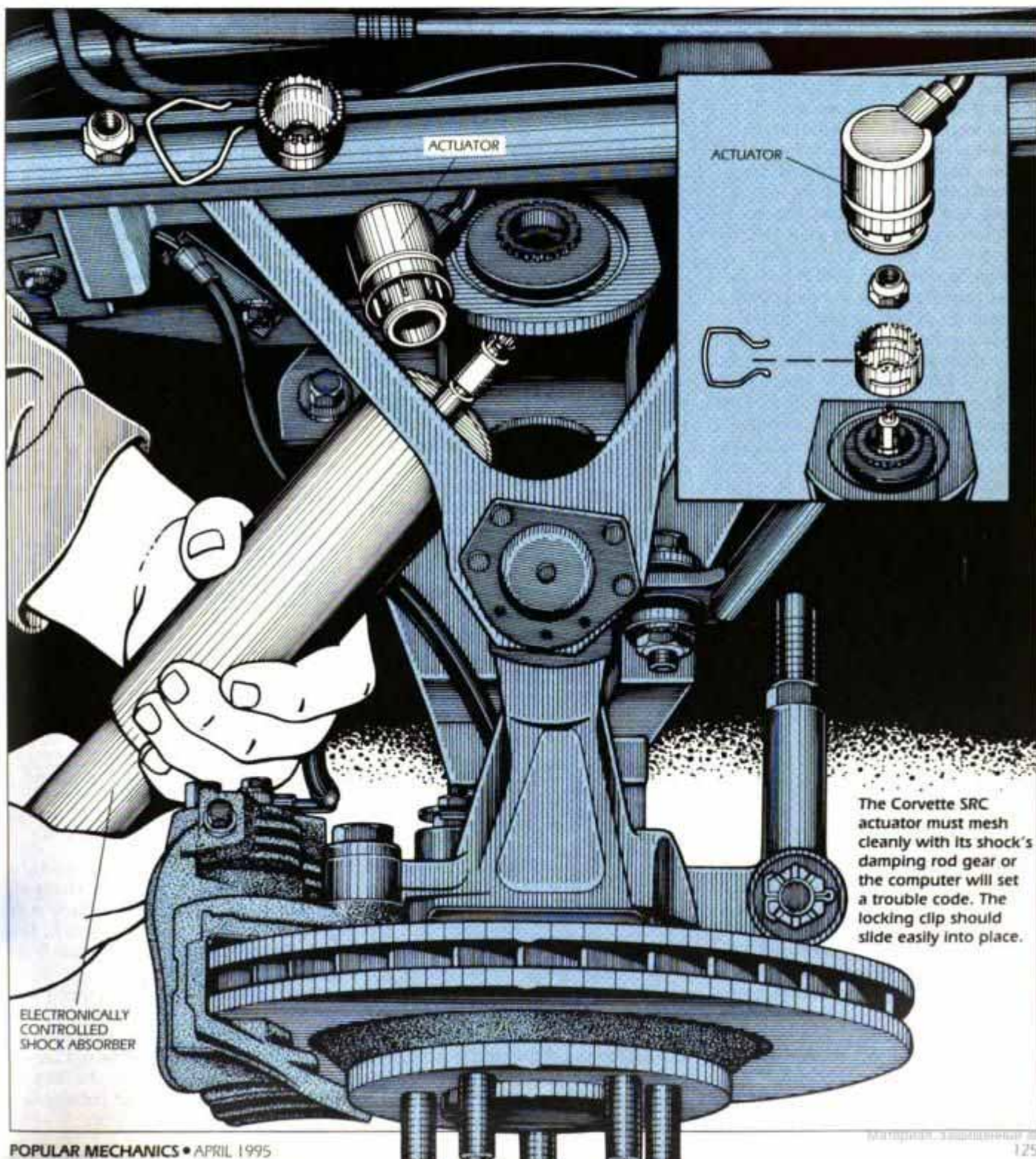
BY KEN JURAN

● You and your Corvette have been terrorizing the same back road on the way home for months. A warning lamp that says SERVICE RIDE CONTROL winks at you from the dash. No problem, you say—I'll take it to

the dealer for service next week.

That sensuous, sweeping switch-back turn is disappearing—rapidly, very rapidly—under your front tires. You've been through this turn a hundred times before, but this time some-

thing is different. A small pothole suddenly makes your outside front tire start to skitter across the asphalt and you mow down a solid hundred feet of weeds between the verge and the ditch before regaining control.



The Corvette SRC actuator must mesh cleanly with its shock's damping rod gear or the computer will set a trouble code. The locking clip should slide easily into place.

ELECTRONICALLY CONTROLLED SHOCK ABSORBER

Suddenly the need to see the dealer has become much more urgent. Then the dealer says it may cost as much as (ulp!) two grand to fix. Time for the Saturday mechanic to get busy.

Finding the problem

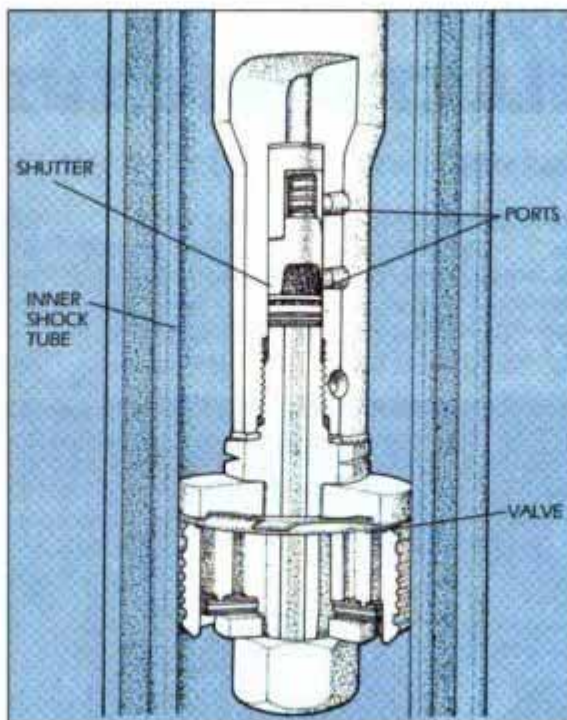
Consider the fact that the warning light mysteriously came on after the car was jostled around on some broken pavement. That means there's a good chance you're dealing with just a bad electrical connection. Or maybe one of the Bilstein shock absorbers was severely worn and just needed that last pounding to jam the adjustment mechanism. In retrospect, the right front corner has felt a bit mushy lately, hasn't it? Luckily, the Selective Ride Control (SRC) system in the Corvette is one of the simplest setups, if not *the* simplest, of its kind. OE replacement parts aren't cheap (the shocks cost about \$300 apiece), but at least you don't have to pay labor when doing the job yourself.

Pity the guy who has problems with an air-strut setup, such as those found in Lexus LS 400s, some Mitsubishi and the Lincoln Continental. Except for Infiniti's Q45 active suspension, these are the most complicated systems on the road. The Lexuses and Mitsus adjust damping rate, ride height and spring rate automatically through a computer. The Continental changes just damping and ride height. Unlike the Corvette and some other ride-control systems, the Continental's air struts can't be converted to a conventional suspension. Tough luck.

Check the basics first

Roughly half of all the mainstream carmakers offer some type of electronic suspension system on some models. In general, they all make computer-controlled adjustments in response to one or more of the following inputs: road conditions, vehicle speed and weight/load, brake application, steering-wheel angle, power-steering pressure, throttle position, lateral/longitudinal acceleration and the position of a dash- or console-mounted driver-selectable switch.

But don't let this list overwhelm you. The key to any modern automotive system is to keep it simple and check the basics first, then move on. One prerequisite for working on almost any modern car is adequate documentation. Beg, borrow or steal the manual for your car, which may in-



Lincoln Continental's air-strut damper shutter varies oil flow through ports. Other systems are similar.

volve ordering it from the dealer. Without some sort of manual, you'll be guessing, and probably not only won't be able to make the repair but you might inadvertently damage some pretty expensive parts.

In the case of your Corvette, there should be at least one trouble code stored in the computer. So you would jump right to "Corvette diagnostics" on page 127, because it would probably lead you to the problem a lot faster.

If the computer hadn't turned on the warning message but you felt something wrong with the suspension (or you don't have the self-diagnostic information for the system you're dealing with), you would start by taking a close look at the adjustable shocks for signs of oil leakage as if dealing with plain ol' shocks. If you see any stains or drips, the first piece of business is to replace the bad unit and hope the system is fixed. The same logic applies to all electronic suspensions, be they air, hydraulic or both. No matter how complex the system is, the damping portion of the shock/strut is still filled with hydraulic oil and needs to be sealed.

Next, do a visual inspection for any air/fluid lines that have burst and for damaged or misadjusted height sensors on those setups that use them. Look around for any obvious harness connector trouble and check the shock/strut actuators and their connectors. If you hear the air compres-

sor running constantly, it usually means a height sensor is out of whack, there's a small air leak or a relay is stuck in the ON position. If the compressor never turns on, you can suspect a bum height sensor, a stuck-open relay, a clogged air bleed-off valve, a blown fuse or even the compressor itself.

Ford has issued a technical service bulletin on this exact subject. It seems that on 1990-93 Crown Victoria/Grand Marquis and Town Car models, the rear air suspension may not pump up when loaded because the air-supply line at the Y connector near the No. 4 crossmember tends to rub on the underside of the car body. The constant rubbing eventually wears through the line and creates a leak. An improved air line with a protective shield has been issued to remedy the problem. The OE part numbers are F2AZ-5A897-B (Crown Vic/Grand Marquis) and F2VY-5A897-A (Town Car).

Corvette nitty-gritty

Understanding how the SRC system works will help to diagnose and fix it, and will make other setups easier to comprehend. SRC consists of four adjustable gas-charged shocks, an actuator motor on top of each shock and a computer to drive the actuators.



Air suspension must be off before jacking up Lincoln Town Cars or Mark VII/VIIIs.

SRC can adjust the damping rate only—the ride height never changes. Inputs to the computer include a 3-position driver-selectable switch, the vehicle speed sensor and signals from each actuator's Hall-effect position sensor. Based on the car's speed and where the driver has the switch, the computer powers the actuator motors so that they rotate a certain number of degrees. Every time the key is turned on, the computer rotates the actuators back to the 0° stop.

Inside the conventional-looking shock shaft is a thin rod, called the damping rod. It extends from the top of the shaft down to the piston. On top of the damping rod is a gear. When the actuator is mounted, its gear fits over the gear on the rod, which enables the actuator to rotate the rod up to 160° inside the larger shaft. Because the bottom of the rod is beveled, as it turns clockwise it gradually closes off the bypass orifice machined in the side of the larger shaft. The smaller the orifice gets, the stiffer the shock gets. Mechanically it's simple. As long as the electronics don't screw up, only normal wear should affect the system.

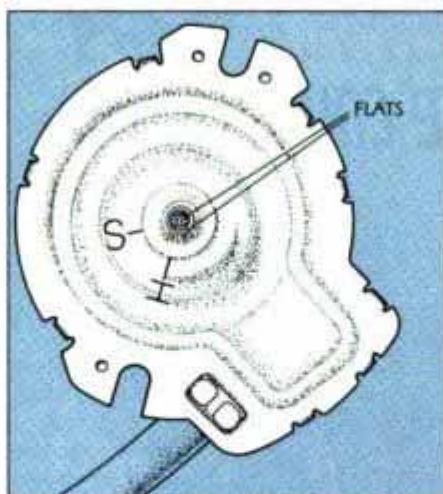
Other electronic dampers work in basically the same way but they vary in design. For instance, the Continental's air struts use a shutter-type mechanism with different size orifices to vary the oil flow.

Replacing the shocks

If you find a leaker or one shock that's clearly worn out, replacing it is about as straightforward as any conventional shock. Start by loosening the lug nuts of the wheel that has to come off and jack up the appropriate end. Remove the wheel. (On some air systems, such as the Lincoln Town Car and Mark series cars, you must flip off the air suspension switch in the trunk before jacking up the vehicle—don't say we didn't warn you.)

Next, pull the actuator's locking clip and pull the actuator straight up off the shock to expose the damping rod's little gear. Lay the actuator gently on a frame rail, if possible. Don't let it hang on the harness. If there's no place to set the actuator down, either tie it out of the way or pull its connector from the main wiring harness and remove the actuator and its harness completely.

Now, you just need to remove the upper and lower mounting bolts and pull the shock. You may need to pump up like Arnold Schwarzenegger for a few seconds to compress the stiff gas shock enough to slip it out between the control arms. The same goes for slipping the new unit through the arms into place. Be careful not to damage the new damping rod gear. The actuator must remesh smoothly with the new gear. Anything that prevents the actuator from doing its job will set a trouble code in the computer.



Actuator must align with top of damping rod to maintain proper soft/hard positions.

Actuator precautions

Don't hit the Corvette's actuator with anything during installation—press it on gently by hand. Never wail on the upper retaining nut with an impact gun or you'll jam the damping rod. The nut must be torqued to 33 ft.-lb. Hold things steady with a wrench on the flats of the retainer insulator while tightening the nut. Make sure there's a good mesh between the damping rod gear and actuator gear, and a good fit for the locking clip.

Once mounted, make sure the actuator harness pigtail points directly rearward for a front shock and directly forward for a rear shock. This prevents the harnesses from rubbing against the fender splash shields and frame rails.

The actuators on other electronic shocks/struts are usually held in place by two screws, so they can be installed in only one position. This means the computer doesn't need to take a zero reading with each key cycle. On the Dodge Daytona and Stealth/Mitsubishi 3000GT and GM's Computer Command Ride found on

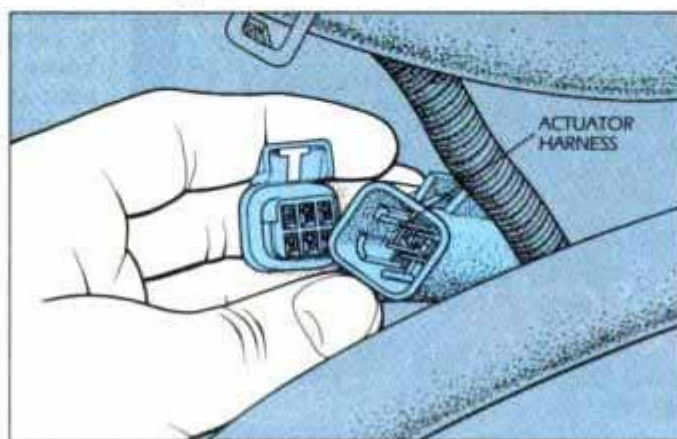
Cadillacs and the Olds Ninety Eight Regency Elite, the actuators are mounted in the dampers.

There's no way to install an SRC shock backward because the actuator position sensor keeps tabs on the damping-rod angle. However, this doesn't necessarily apply to all electronic suspensions. The height sensor for the Chrysler Imperial's air suspension is mounted inside the right rear shock. The sensor is made up of two permanent magnets. If the harness pigtail and the paint mark on the bottom of the shock aren't lined up when the shock is installed, the magnets sit 180° out of phase and the switch doesn't work. With no rear height input signal, the computer turns off the system.

Corvette diagnostics

Remember that SERVICE RIDE CONTROL warning? When it's on, it means the system is in a fail-safe mode and the computer has locked all the actuators at the 60° position until the problem is fixed. With the car stopped and the ignition on, jump terminals A and B (1989 only) or A and C (later models) of the ALDL (assembly line diagnostic link) located under the knee bolster with a paper clip or a piece of jumper wire to make the SERVICE RIDE CONTROL warning message flash out 2-digit codes. There are 13 possible codes that can be spit out, but you'll need a service manual to decipher them and to do the proper tests.

Four things can prevent the warning light from flashing codes or from coming on with the key for a bulb check: a burned-out bulb, a blown fuse, a bad harness connection at the computer or a bad computer. The electronic brain for this system is found in the bin behind the driver's seat in the Corvette. In other cars, it's usually mounted behind the rear seat in the trunk area. One exception is the original Ford Probe/Mazda MX-6, whose computer is under the passenger's seat. On Chryslers, the suspension system is tied into the body's computer. Only two problems won't set codes in the SRC system: a leaking or worn shock and system voltage out of the 10- to 16-volt range. To clear codes after the repair has been completed, jump ALDL terminals A and B (1989) or A and C (later models) three times, 2 seconds each. **FM**



With no trouble codes stored in a ride-control system's computer, begin the diagnosis by visual inspection of the parts and wiring.

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Cargo racks may be the greatest invention since sliced bread, but they're more like soggy toast when they're difficult to install, block your tailgate or rear doors, or you have to



be as tall as Patrick Ewing to load and unload the roof variety. The Eagle Tire Carrier is a swing-away rack that inserts into a Class 3 trailer-hitch receiver. The carrier, which allows full receiver-hitch function, can be fitted with a variety of accessories including racks for bikes and skis, as well as a rotating cargo rack. The cost is \$399, from Tote-Um Systems Inc., 880 Calle Plano, Unit H, Camarillo, CA 93010; (800) 486-8386.

Clearcoat Remover

Shiny alloy wheels look cool—as long as they stay shiny. So many manufacturers of these wheels and other polished alloy accessories use a clearcoat protective finish to keep their products looking great. But when the clearcoat discolors or chips, it sometimes takes hours of buffing with steel wool to remove it to get the wheel looking good. Busch's Clear Coat Remover simply brushes on to chemically break down the clearcoat so it can be hosed off. The 16-ounce bottle can do six to eight wheels, and it costs \$16.95. It's at tire and auto parts stores. Busch Enterprises Inc., P.O. Box 7407, Charlotte, NC 28241; (800) 213-2067. **PM**



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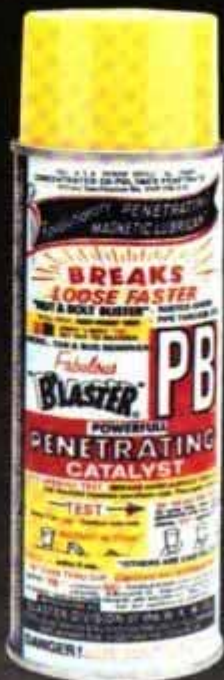
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drove to our local Goodyear dealer and had him install a set of Eagle GT+4 all-seasons in place of the original rubber. Problem cured. The other rubber idiosyncrasy we gave up fighting was with the car's windshield wipers. Again, nearly from new, the wipers smeared, streaked and generally did everything but remove the water from the glass. A stop at our local NAPA dealer finally cured that.

Now we admit that if we had more patience, we would have gone to our local Hyundai dealer to see what the warranty would have covered, but we simply reached our limit before we made it to the dealership.

Now, you know what? All said and done, we love our Sonata GLS. Honest.

TEST SUMMARY	
Report number:	2
Total miles driven:	8259
Miles driven since last report:	8039
Average fuel economy:	21.9 mpg
Worst observed fuel economy:	16.1 mpg
Best observed fuel economy:	32.1 mpg
Maintenance/repair costs:	add 1 quart of motor oil, \$1.25
	replace windshield wiper blades, \$18
	replace four tires, \$779.10

Day in and day out, the car's combination of size, comfort, luxurious appointments—the in-dash CD player with its steering-wheel controls is tough to beat—and performance gets us and our passengers through 100 miles of daily commuting with a minimum of grief, anger and pain. In fact, we've racked up more miles than we should have before bringing the car in for its routine maintenance. But the reality is, since it's become a favorite, reliable ride, we're not anxious to make that commute in something else while the Sonata is being serviced.

Other than its rubber-related ills, the only complaint we have is a recently developed leak in the windshield washer reservoir, which we expect will be taken care of when we do make it to our dealership. —D.C.

Dodge Ram 1500 Laramie SLT

The combination of staff-wide heavy travel schedules and massive family visits during the holiday season was enough to force our Ram pickup into the position of being odd vehicle out. In fact, during the few months since our last report our big blue bruiser was relegated to not a whole lot more than some Christmas-tree hauling and furniture-fetching duties. All this through no fault of the truck's—except for the fact that when we were in town, most of us found ourselves in need of transportation for five or six or more people at a time.

With the bulk of that travel and holiday madness behind us, the truck is

getting back into the busy groove that it fills so ably. Still running essentially troublefree, the truck is due for its regular maintenance as this is being written. In fact, once out of the dealership's service bay, the Ram has been accounted for by several staff

TEST SUMMARY	
Report number:	3
Total miles driven:	8702
Miles driven since last report:	1857
Average fuel economy:	18.1 mpg
Worst observed fuel economy:	13.3 mpg
Best observed fuel economy:	18.8 mpg
Maintenance/repair costs:	add 1 quart of motor oil, \$1.25

members who want to get an early jump on spring gardening chores.

And, as in our last report, all we can say about this truck is that it continues to be a comfortable and still surprisingly practical blast to drive, both around town and on that long haul down the turnpike. —D.C.

Plymouth Neon Highline

Since joining our fleet, this endearing and cheerfully red Neon has run the gamut. Used for everything from daily round trips between our Manhattan offices and home, to weekend ski trips to the barely snow-covered New England slopes, to making those all-important grocery runs, the Neon has not stopped working. Nor has it stopped working anything but right on cue, all the time, each mile.

Over the course of the thousands of accumulated miles, several facets of the Neon's personality and performance have made themselves known, shining through the car's winningly cute demeanor. For one thing, the stability of this small car is simply no less than astounding. We particularly appreciated the car's stability during one truly nasty Northeaster. And we really came to appreciate the car's handling and the simple beauty of its antilock brakes on some slick, twisting ski-country roads.

On the other side of the ledger, however, the car's nimble handling is still no excuse for the car's harsh ride.

TEST SUMMARY	
Report number:	2
Total miles driven:	8447
Miles driven since last report:	7860
Average fuel economy:	27.1 mpg
Worst observed fuel economy:	22.2 mpg
Best observed fuel economy:	33 mpg
Maintenance/repair costs:	scheduled maintenance, \$240.16

And the commodious rear seat is not enough of a compensation for a trunk that holds only two suitcases.

Though the truly accommodating interior has an incredible amount of headroom and entry/exit is easy, the driving position is awkward for some

drivers. We had trouble with the A-pillars blocking some of the sightlines and with the tilt steering wheel, which doesn't adjust to a low enough position. And though the center console has convenient coin slots and cup holders, they're a pain to get at when driving because the reach is too far.

But all the nit-picking aside, the Neon is still a favorite and a winner with the staff, thanks in no small part to the car's stout chassis and excellent overall design. —Deborah Frank

Mazda Millenia S

We've used the Millenia primarily for perhaps the most grueling kind of driving we can imagine—ninja-ing through Lincoln Tunnel traffic 10 times a week. There's no quarter given or taken, and a car that blends with the cement walls of the bridge's approach is an advantage. More of an advantage is the handling and acceleration—especially the acceleration—to cash the checks the driver's ego has written. Oh yeah, good brakes are kind of important, too.

Happily, the Millenia has all of these qualities. Its understated good looks blend in in traffic, leading unsuspecting cab drivers to forget all about protecting that precious 12 ft. of turf in front of their bumpers. We appreciate the Millenia's excellent balance of power and handling.

During these daily duels, the only refuge is the passenger compartment. Also happily, the Millenia's interior is well done indeed, with the exception of the quirky stereo and climate controls. We also feel the automatic temperature control isn't up to standard, as there seems to be a lot more

TEST SUMMARY	
Report number:	3
Total miles driven:	13,751
Miles driven since last report:	4066
Average fuel economy:	22.5 mpg
Worst observed fuel economy:	19.8 mpg
Best observed fuel economy:	24.3 mpg
Repair/maintenance costs:	none

tweaking of knobs required than with most other cars.

As long as we're exposing quirks, another one we'll report on is the power steering. Several violent maneuvers in a row—something that happens in the real world about as often as free beer—will outstrip the power-steering pump's ability to supply hydraulic pressure to the steering, resulting in unexpectedly high steering effort. It's not dangerous, but potentially disconcerting. Steering effort returns to normal within a second, but the Millenia S isn't a car we'd recommend if parking-lot autocrossing is your intended purpose. But for daily transportation, we recommend it mightily. —Mike Allen

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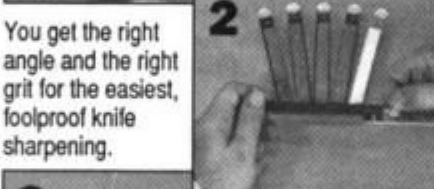
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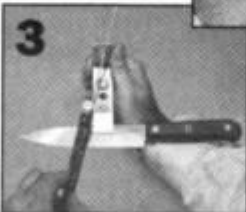
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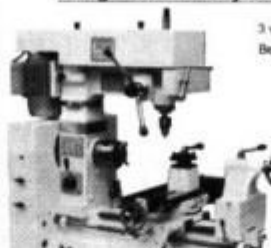
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SECRET WEAPON

Exclusive first look at one of the best-kept secrets in boating.

BY CHARLES PLUEDDEMAN

● Under the cover of pre-dawn darkness, a team of technicians trundles down to the waterfront with large cases of electronic gear. At the end of the dock waits an unusual-looking boat with a tall boom on its bow. The

propeller in action, a mission to gather "intelligence" that may be unmatched in the marine industry.

The security surrounding the session is evidence of the value Mercury places on its underwater-photo capa-

portable generator, banks of batteries and a control panel. On the bow, there is a boom made of welded-aluminum tubing that holds a waterproof camera housing, which places the lens and a light source just 3 ft. from the underwater subject.

Video and film cameras are loaded into the welded-aluminum camera housing through a double-gasketed hatch opposite a glass-paned viewing port. Two sealed high-intensity light pods flank the camera at a precise angle. A thick umbilical of cables snakes out of the water as the boom is lowered below the surface.

The test boat today is a Nitro 2000TF bass boat powered by a Mercury 200XRi outboard, a high-performance rig capable of speeds in excess of 70 mph. The photo subjects are a handful of prototype Quicksilver Tempest and Trophy props. Interestingly, the props and the outboard gear case are painted with flat-red primer, a color that absorbs light and contrasts with the dark background and white air bubbles.

The test boat driver must guide the



end of the boom is covered with a canvas shroud. The gear is quickly loaded aboard, and the boat edges out onto the still waters, chase boats at its flanks.

Is this a clandestine intelligence operation? Or the Navy testing a secret weapon? Close on both counts, if you work at Mercury Marine and its parts/props division, Quicksilver. The secret weapon is Mercury's high-tech underwater photo/video imaging system. This system cost the company hundreds of thousands of dollars to develop and places it a decade or more ahead of the data-analysis capabilities of its competition. With detailed data on every aspect of the prop's performance already in hand, the engineers want one last look, literally, at how the prop works.

So, a Mercury test team is heading out this cold morning on an isolated lake in northern Wisconsin to take high-speed underwater photos of the

abilities. We were allowed to accompany the Mercury team during the session, but only after we promised not to reveal the precise location of the test site and some details of the test itself.

Since the 1950s, Mercury has been using underwater photography to observe the performance of its propeller and gear-case designs. Early efforts included hiring the snorkel-equipped crew from the television show "Flipper" to shoot still photos of boats passing overhead.

The current setup, the result of years of experimenting, involves using an underwater photo system supported by a 26-ft. pontoon boat. The helm of the boat is located in a small pilothouse aft. Amidships are two long cabinets containing monitors, a



Nitro between a pair of yellow buoys that are 8 ft. apart, and the nearest one just 5 ft. off the camera boat's bow. The slot between the buoys is just 4 in. wider than the boat's beam. The gunwale of the boat will actually pass over the camera.

Because the lens focus is fixed and light falls off quickly in water, the position of the subject boat is critical. Photo

(Please turn to page 135)

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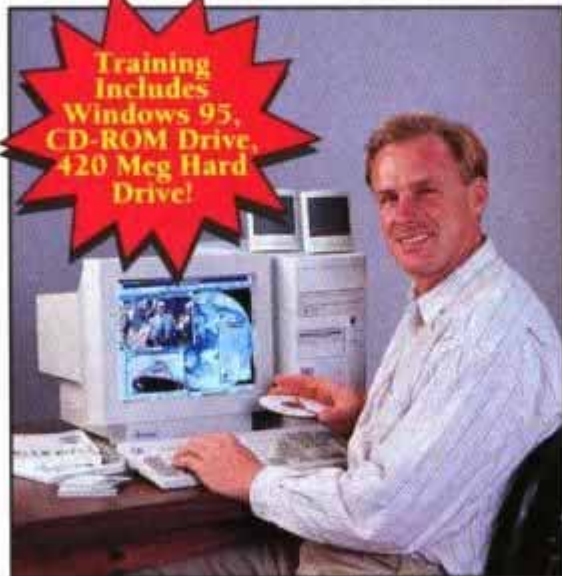
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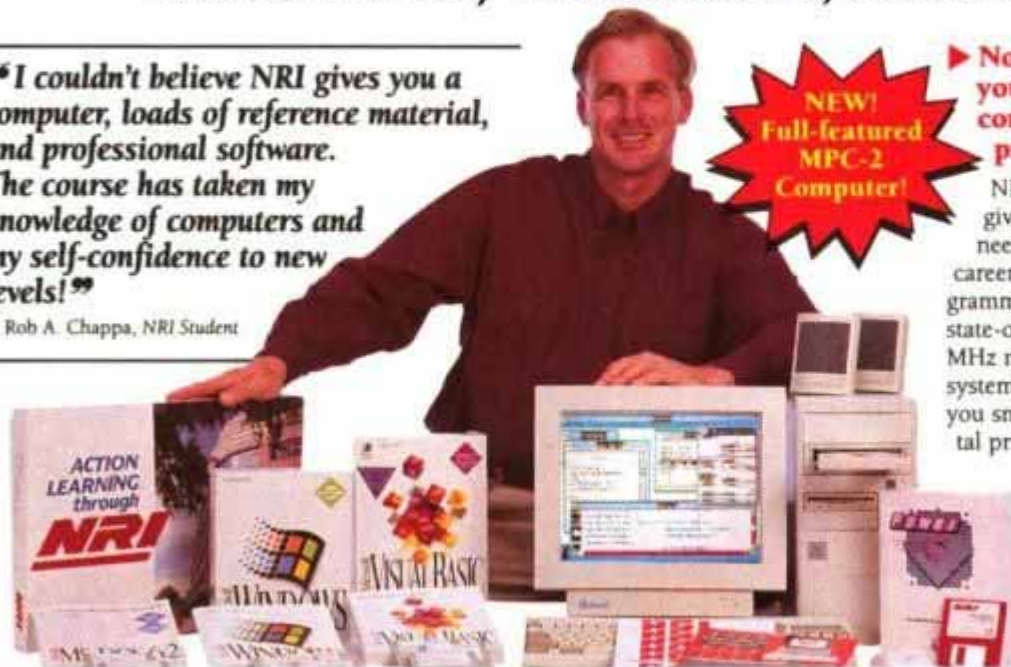
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At the control center of the photo boat.

technician Jack Litjens starts with video images, which he replays instantly to check camera angle and focus.

After a final radio check, test driver Ken Butts powers up the boat and bears down on the buoys at about 60 mph. As he passes a marker about 20 yards from the camera, Litjens hits the power button and the lights glow brightly beneath the surface. The boat smacks the outboard buoy and passes the camera position in an instant.

The Panasonic 5100 video camera runs at 30 frames per second (fps), just fast enough to capture one full image of the prop at this boat speed. A replay reveals that the boat was about 6 in. too far

from the lens, and that the camera angle needs adjusting. On the next pass, Butts hits the inboard buoy, and we get a crisp image of the prop and gear case on the video screen.

Subsequent passes are captured with a 500-fps Redlake 16mm film camera. Mercury is experimenting with an \$80,000 NAC HSV1000 high-speed video camera that runs at 1000 fps. However, with the limited light available under water, its resolution is limited compared to film. The crew shoots four passes of each prop.

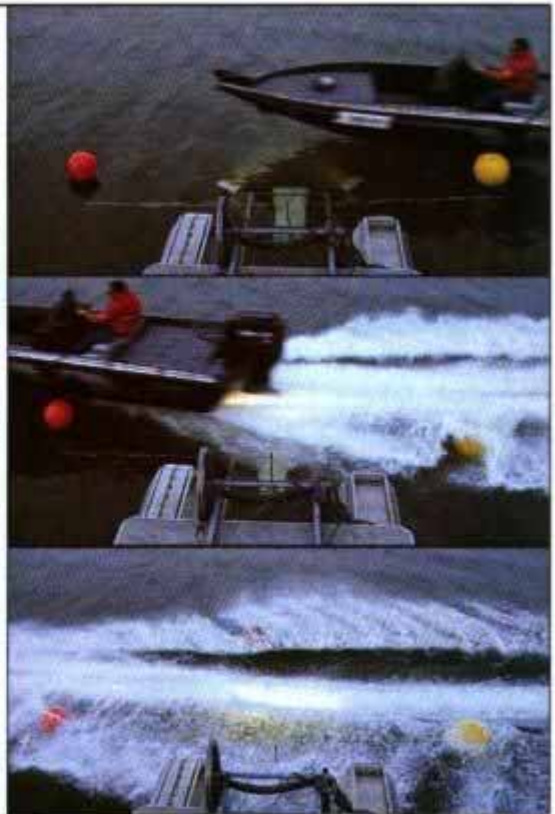
The resulting images can be viewed in super-slow-motion sequence or in stills lifted from the movie film or video. Propeller engineer Roger Koepsel explains that the underwater photos are important problem-solving tools.

"We have written our own software for propeller design," says Koepsel, "and that, combined with years of experience, usually results in a good prop with little tinkering. However, when we have a problem, especially with cavitation, the photos are invaluable."

Cavitation occurs when pressure on or near the blade face gets so low that water turns to a vapor. At some point, cavitation breaks down and the water vapor returns to a liquid state, a violent event that creates a sound wave which can eat away at the metal surface of the prop, eventually pitting and weakening the blades. This corrosion can be seen on painted props as a "burn" mark on the paint. In the underwater photos, cavitation appears as a cloud of white vapor on the blade.

"We generally see some cavitation on the suction face of the blades," says Koepsel, "but that's not a problem as the breakdown of cavitation usually occurs away from the blade. Cavitation on the pressure (working) face of the blade is a problem that could be caused by a number of factors, including too low an angle of attack or too much blade area, blade diameter or camber. If the blade has too much cup, we may see cavitation on the leading edge of the blade."

The two props photographed during our session were the 3-blade Tempest and the small-tube Trophy, a 4-blade prop. When mated to the 4.75-in.-dia. gear case, exhaust flows over the outside of the hub and allows the blades to ventilate on takeoff, which lets the motor rev up to peak power range before the blades bite in the water, enhancing acceleration. Once up to speed, however, the ex-



Submerged lights flick on as boat enters the target zone (top). Strobe flashes when prop is inches from camera (middle). At run's end (above), a single photo is captured on film.

haust is supposed to stay off the prop blades, and the photos confirmed that was the case.

Looking at a print, we could clearly see the exhaust streaming over the hub and staying in a tight tube well behind the boat, trapped in the low-pressure zone created by the gear case pushing through the water. The blades looked clean, except for a small cloud of "sheet cavitation" on the low-pressure blade face, a normal occurrence.

Above the prop, we can see air bubbles on the low-pressure side of the cooling-water inlets on the gear case, filling space vacated by water entering the gear case. There's even a slight white shadow just behind the drain screw for the gear-case lube.

While used primarily to study new prop and gear-case designs, Mercury has utilized its underwater photo capabilities to solve other problems. By shooting from below the hull, Mercury has been able to help boat companies choose the optimal location for the water intake of the Mercury SportJet jetdrive. Underwater photos also accelerated the development of the twin-prop MerCruiser Bravo III and Blackhawk drives, two of the most complex designs ever attempted at Mercury Marine.

Mercury's secret weapon turns the guesswork of prop design into hard-data certainty, and the proof is in the pictures.



Flat-red paint produces underwater contrast.

NEON AS RACE CAR

This friendly little sedan makes a mean racer.

BY SCOTT OLDHAM, West Coast Editor

● "Hi."

This most casual of greetings has become advertising brilliance. "Hi" has sold Neons like Super Bowl Sunday sells beer. Like daybreak sells coffee. Like Tex-Mex sells antacid. You get the idea: Neon is a hit. It's a hit in a very crowded and competitive subcompact market

guisher and some shaved racing tires.

What's more amazing is that the Chrysler engineers planned it that way, coming up with a competition package so racers can order a practically track-ready ride (short of the extra safety equipment).

motorsports, to enhance Neon's fun-to-drive image," says Mike Mihelich, Chrysler's motorsports public relations manager. Proving Chrysler is serious, the Neon racing program is backed by the largest manufacturer's contingency program ever offered for a single vehicle model—totaling a more-than-cool \$220,000.



The proof is in the winning

To see if a subcompact car can really make a good race car, we talked Dodge into coughing up an ACR for a few SCCA Southern Pacific regional races last year.

Of course, we must confess that before putting it on the racetrack, we opted to make one important modification to the ACR specs. We decided to go for slightly larger tires than the Goodyears that are part of the ACR package. So we scrapped the stock tires for larger 195/65R14 shaved BFGoodrich R1 racing rubber. Then we won three of four races, set two track records (at Las Vegas and Willow Springs, California), and, in the process, gave the region's SSC champion and fellow Neon racer Bryan Farnsworth from Huntington Beach, California, a good case of the sweats.

In 1995, \$12,880 buys you a Neon ACR coupe with a dohc 150-hp 2.0-liter Four that Dodge claims will rule the SSB class this year. And to back its boast, Chrysler is even increasing its support by upping the contingency money total.

Make no mistake about it, while Neon the car says "Hi," as a racer it says "Bye" to the competition. **FM**

that includes the Honda Civic, Toyota Corolla, Saturn, Ford Escort and Chevy Cavalier.

For \$10,000, Neon gives first-time buyers dual airbags, 38 mpg and room for three friends in a cutesy package that most find irresistible. Therefore, it's no surprise that college campuses and Generation-X neighborhoods such as Manhattan Beach, California, are full of them. It is a surprise, however, that Neons have found a second home rubbing fenders on America's racetracks.

Double Identity

Truth is, turning a cute-faced Dodge or Plymouth Neon into a winning race car is amazingly easy. All it takes is some safety equipment and a set of sticky tires. Equipped thusly, these endearing little Neons have been breaking track records and dominating the Sports Car Club of America's Showroom Stock C (SSC) class all over the country. All this with no modifications other than a rollbar, safety net, 5-point seatbelt, fire extin-

Neon's in the club

The Neon ACR (American Club Racing) comes with a performance-tuned suspension with front and rear anti-roll bars, 4-wheel disc brakes, a 5-speed performance manual transmission that has a shorter final-drive ratio, a faster-ratio steering box, 14 x 6 aluminum 5-spoke wheels wrapped in Goodyear 175/65R14 tires, sport front and rear fascias, a tachometer, right-side remote mirror and improved cooling capacity.

These ACR enhancements, combined with Neon's 4-wheel independent suspension, sohc 132-hp 2.0-liter motor and lean 2340-pound curb weight, create a winner whether the car is competing in the SCCA's SSC class, ProSolo class Stock 5 or Solo II class E Stock. And at \$11,575, the Neon ACR is the club racer's buy of the decade. But it's not a secret. In fact, 200 racers walked into Dodge dealerships in 1994 and purchased Neons with the American Club Racing competition package.

"Dodge is back in grass-roots



Cage, 5-point belt, extinguisher add safety.

Natural Prostate Relief

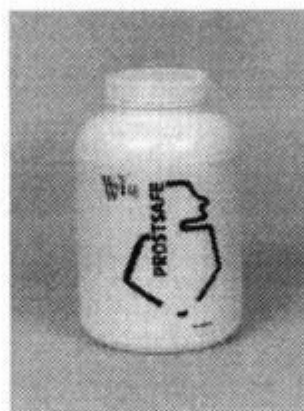
It's a natural fact. If you are a male over 40 and don't already suffer from a prostate gland disorder, the odds are 2 to 1 that you will before you are 59. By the age of 65, most American men have enlarged prostates.

As the years pass, mild discomforts can become disabling. Today, prostate surgery is the second most commonly performed surgery in men over age 65! Surgical complications can include total loss of bladder control and sexual dysfunction.

Prescription drugs may halt the swelling, but rarely ends the suffering. Like many prescription drugs, they have side-effects, like weak erections and low sex drive.

Many doctors feel that prostate disorders can be treated or prevented by giving the prostate gland the nutrition it lacks.

Recent scientific research has shown how to remedy the underlying problems associated with prostate disorders--safely and effectively. These results have been published in the *British Journal of Clinical Pharmacology*, the *American Journal of Gerontology* and papers from the *National Cancer Institute*. They reveal that several vitamins, minerals and natural herbs can dramatically shrink the prostate and improve urinary performance in older men.



The most modern application of these healthy ingredients is found in **ProstsafE** from Whitewing Labs. **ProstsafE** is the nutritional "tool kit" for men with prostate problems, and those who wish to prevent them. It is a mixture of zinc, serenoa serrulata, ginseng, certain amino acids, bee pollen and vitamins A, B-6 and E. Working as a team, these ingredients have been scientifically proven to shrink a swollen prostate.

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Stop that burning sensation during or after urination!

Prevent uncontrollable wetting!

Improve bladder control!

Empty bladder completely!

Sustain erections and enhance virility!

Please a concerned wife!



Dr. Michael Rosenbaum, M.D. says "ProstsafE supplies essential vitamins, minerals and herbs needed to nourish and maintain a healthy prostate."

For as little as a dollar a day, that seems like inexpensive insurance against deadly prostate disorders. If for some reason you are not satisfied, just return the unused portion within 30 days for a full refund.

The reasons why men over 40 use **ProstsafE** are clear. If you are looking for relief, order **ProstsafE** today.

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Cleburne, TX

"ProstsafE has stopped the burning after urination."

-- Mr. C.E. Black
Barboursville, WV

"I empty my bladder and have a good stream of urine with no strain."

-- Mr. S.J. Hymel
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"I previously encountered discomforts such as bladder urgency. These problems are now completely absent."

-- Mr. B. Doser
Holland, MI

"This is a little personal but, how can I say, I am more virile."

-- Mr. G. Howard
Cleveland, OH

"...and in the sex department, my wife thanks you."

-- Mr. G. Sawin
Lynwood, WA

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A TV FOR THE PC

This all-in-one monitor lets you switch between watching TV and using a computer.

BY STEPHEN A. BOOTH, Contributing Editor

● Given all the electronic devices that now take up space on your desktop, some days it's hard to find a spot to place a cup of coffee. So it was with some sense of relief that we greeted the arrival of TIMM, a combination TV and PC monitor.

TIMM stands for Toshiba Integrated Multimedia Monitor—a 20-in. video display that performs double duty as both a TV and a PC monitor.

Conventional TVs do not perform well as computer monitors—even if you find a way to connect the television to the personal computer. Television receivers just aren't made for computing chores—they're too bright yet not sharp enough for up-close use. Meanwhile, although TV tuner boards are readily available for computers, the small screen size and lack of brightness just don't cut it for prolonged television viewing, when you're likely to be relaxing and viewing from a distance rather than from 18 in. away in a desk chair.

Best of both worlds

TIMM (\$999) addresses both issues and comes out with a compromise that will make sense for some people. It's a very fine TV, though four times as expensive as a typical 20-in. set. On the other hand, it's pretty cheap for a computer monitor this size—17-in. PC monitors cost as much. Yet TIMM isn't the most sophisticated monitor you could buy.

Its resolution is VGA-level, meaning 640 × 480 pixels. Super-VGA monitors put more pixels on the screen, and noninterlaced monitors do away with the horizontal scanning lines. But these refinements are necessary because it's expected you'll be working closer to these smaller monitors (14 to 15 in.) for lengthy periods—doing word processing, for example.

The company's argument for TIMM as a computer monitor is that you'd probably use it at a distance for multimedia entertainment from a CD-ROM or game, group presentations, desktop video conferencing, even

video editing using your PC, a camcorder and a VCR. In fact, using a 20-in. monitor for writing memos is a bit overwhelming, though it's a fine size for doing graphics work or design. When you are doing word work, you can adjust the size of TIMM's display to a scale that's comfortable from keyboard distance. You'll do this with the same remote control that handles all the television functions.

ness and color purity even into the extreme corners of the picture.

TV-wise, TIMM's sharpness is 500 lines of horizontal resolution, which is more than adequate for live broadcasts (330 lines), laserdiscs (425 lines) and anything that comes off a CD-ROM or videotape (240 to 400 lines). A glare-resistant high-contrast screen enhances all of these viewing situations.



At 0.58mm dot-pitch (the distance between pixels or each dot of red-green-blue phosphors), TIMM has a much finer pattern than most 20-in. TVs—about 36% finer according to Toshiba. It also has an Invar shadow mask, something usually found in larger TVs. While an Invar shadow mask makes TV shows like "NYPD Blue" more enjoyable, it is of even greater benefit for computer uses. This alloy doesn't deform under the high voltages needed for brightness, and thereby maintains sharp-

TIMM has all the necessary connectors for video gear and IBM-compatible PCs (you'll need an adapter for Apple's Macintosh computers). And since it's meant for multimedia, it has an ample 10-watt audio amp and a bass-enhancement circuit for its built-in speakers. The sound package will do justice to CD-ROMs or stereo telecasts through the 181-channel tuner.

Now, if we only had a stand-alone CD-ROM player that could connect to TIMM. . . .

FM

VIRTUAL THRILLS AND CHILLS

(Continued from page 88)

a 1-pound 7-ounce headset. Once plugged into the fantasy game world, the players can see representations of each other, talk to each other, work alone, compete with each other or play as a networked team. The player uses a joystick to box in "Virtuality Boxing," battle 21st-century urban warriors in "Zone Hunter" or fly an intergalactic fighter in "X-treme Strike."

Thrill rides

Motion-simulation rides allow you to experience the action of the movie because of the speed at which the film is shot and the way the cinema seats move in sequence with the plot.

Among those placing sizable bets on virtual roller coasters are NY Skyride, set to open in New York City's Empire State Building. The ride launches from the 102nd floor of King Kong's favorite building. Passengers "ride" through the Manhattan skyline, "play" in traffic in Times Square, "zoom" past the Statue of Liberty's torch, "crash" on Wall Street (pun intended) and, in the ultimate irony, "dive" down the stomach-crunching first hill of Coney Island's Cyclone roller coaster. Two-story-high motion-picture screens with surround-sound digital audio are housed inside the skycopter set. You'll be able to experience the virtual-reality NY Skyride and see the real observation deck of the Empire State Building for about \$10.

Showscan's (Culver City, California) Dynamic Motion Simulator combines film images and hydraulically interactive seating to produce a sensory experience that the brain translates as real—people can and do develop vertigo watching the company's Roller Coaster, Devil's Mine Ride and Olympic Bobsled simulation rides in such diverse places as Universal's CityWalk in Los Angeles, the Lotte World department store in Seoul, Korea, and the Excalibur Hotel in Las Vegas.

Showscan's film process uses 70mm film (four times the size of the traditional 35mm motion-picture format) and runs it at 60 frames per second, or 2½ times the speed of a standard movie. In 35mm film, each frame is photographed at 1/60th of a second and then projected twice, so in just under 1/30 second, about 3½ frames are photographed. By contrast, the Showscan process photographs nearly 11 frames in the same time period, providing greater visual depth and less blur and strobe. This is 10 times more visual information for the human eye to process than that of conventional films. Curving the screen captures much of the viewer's peripheral vision, and motion information on the



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film synchronizes movements of the hydraulic motion platform.

Taken together, the effects trick the viewer's brain into believing that he or she is on a thrill ride.

How much actual movement is experienced by the motion-simulation rider? Much less than it seems. Intamin AG, itself one of the world's largest builders of amusement rides (including steel roller coasters), manufactures 10-person Dynamic Motion benches and 2-passenger Maxi Motion seats. To replicate the dynamic action portrayed in the ride films, the 2-person module features up to six degrees of freedom—that is, it can move in six different ways: up to 6.3 in. forward or backward, 3 in. up or down, 6 in. side to side, and plus or minus 21°, 15° and 27° in pitch, roll and yaw movements, respectively. Maxi Motion is said to be capable of generating as much as 1 g in straight-line acceleration and has a top velocity of plus or minus 9.8 in. per second.

Quadra simulation ride modules, built by McFadden Systems—a builder of simulator modules used in the aerospace industry—are a bit quicker but offer a slightly smaller pitch, roll and yaw motion envelope. The 4-passenger fiberglass pods are propelled along six axes and can move 9 in. forward or backward, 7 in. up or down and 7 in.

side to side. Pitch, roll and yaw movements are 18°, 19° and 21°, respectively. The Quadra motion base steps along at a jaunty velocity of plus or minus 20 in. per second, generates straight-line acceleration of 20 in. per second per second and rotational (or centrifugal-force) acceleration of plus or minus 100° per second per second.

For shopping centers, malls and other pedestrian sites that have size restrictions, Showscan's High-Definition Simulation Theaters can seat 24, including pre-show audience staging, ticket office and merchandise sales, in 75 ft. × 30 ft. of space with a 12-ft. ceiling, which is about the size of an average shoe store. The Showscan HD theaters utilize Sony's 16:9 format high-definition HDIH-3000 video projector and Sony's HDL-2000 high-definition videodisc player. "Passengers" can be seated in either 2-passenger or 4-passenger modules. Maximum screen size is 20 in. × 12 in., and the ride operator has a touch-screen master control to vary the intensity of the ride experience, from "mild" to "wild," as the company puts it. Changing the story line requires only that the laserdisc be changed.

So keep in mind that the next time you head down to the mall to see a movie, you just might be in it, thanks to virtual-reality technology. **FM**

I was up and running. The package has a number of nice features, including a fat, well-written book called The Whole Internet User's Guide, a Web browser and Telnet, Mail, Gopher and Usenet news utilities.

Other Web access products that combine software and a service provider include Netcom's Netercruiser, The Pipeline, PSI's Interramp and the new Prodigy service.

Some people, however, may want to shop for their software and service provider separately. I tried this approach by configuring Netmanage's Internet Chameleon TCP/IP package

to work with two service providers I already had accounts with.

As it turned out, Chameleon came with a connection profile preconfigured to work with one of them, PSI, so setup was just a matter of entering a phone number, a log-in and a password. After that, PSI gave me admirably reliable service, and access numbers all over the world.

The other provider, a New York outfit called Panix, got me deeper into the nitty-gritty. Panix gave me my own IP number (basically an address for your machine), which is kind of a status symbol in the Internet commu-

nity. I plugged this into my software and set up a script to automate the log-in process.

With the connection established, I used Chameleon's FTP client program to download a copy of an excellent Web browser, Netscape Communications' Netscape, which is free on the Internet for anyone who wants to evaluate it. I then downloaded a number of other free programs to work alongside it, including a movie viewer, a stereo sound player and an E-mail client. One of the neat things about a TCP/IP hookup is that a bunch of client programs can send and receive information packets through the same phone line at once.

This ability to see and interact with data from several points around the globe simultaneously is one of the great joys of the World Wide Web. As you learn to find your way around, you're constantly adding the addresses of new data sources to your browser's hotlist, and scarfing up new pieces of free software as you stumble across them, making your computer a steadily more powerful Web-surfing machine.

With time, you gain an almost omniscient sense of having the world by the wires, of transcending the limitations imposed by time, space and the cost of intercontinental phone calls. The Internet's growth from four DOD computers 25 years ago to millions today is compelling proof of how powerful information becomes when the barriers to sharing it disappear. And with the coming of widespread access to the Web, the last of those barriers now seems to be falling away. **FM**

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Mind Power Breakthrough!

Plug Your Mind into the Amazing Learning Machine™ To Boost Mental Powers, Program Your Mind for Success & Launch Virtual Reality-Like Fantasies. Plus Get \$600 of Free Learning CDs!

By Dane Spotts



Absolutely mind blowing!!! I popped a French Learning CD into the Learning Machine™. Immediately I was sucked into a deep, dream-like trance. Weird colors and patterns were created on the insides of my closed eyelids. While in this super-relaxed but hyper-aware state, the special Learning CD began unfolding its magic programming.

A Vacation in 22 Minutes

It was as if a movie were playing inside my head. I could see myself in France having lunch at the Eiffel Tower. The music, the sounds, even the fragrance of summer in Paris. A beautiful woman spoke to me. "Bonjour, mon ami," she said. In an almost unconscious way I began following the dialogue. The mental imagery was so intense I not only understood what was going on, it was like I was there.

Learning at Light Speed

The Learning Machine is more than virtual reality. More than just a cool way to relax after a hard day at work. According to one college professor, "It may be the most powerful learning tool since the invention of the book."

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dream you've ever had. Then while in this highly euphoric mental space, the Learning CD opens your learning centers to peak receptivity and pours in new knowledge and skills. It's the ultimate mind trip. But it's not just for fun.

Let's say you want to learn a foreign language, improve your reading and comprehension, or increase your math skills. Or just give your kids a powerful edge in school, learning many times faster than their peers. It's simple.

You select a specially programmed Learning CD in the area you want to study. Plug it into any ordinary CD player. Then attach your Learning Machine digital headset into the headphone jack. Push play and a few moments later your mind is launched into a pre-programmed learning session. In a fun, almost effortless way, the Learning CD unfolds its program and literally forces you to learn. It's the most amazing thing you've ever experienced.

Speak French, Spanish, German & Italian

Learning foreign languages, or anything for that matter, at rocket speed can be very empowering. And I'm going to include a ton of valuable Learning CD software with your Learning Machine so you can get immediate results from this new technology.

You'll receive 4 basic language courses — French, Spanish, German, and Italian. Plus a Super Vocabulary course, a Super Memory course, and a Super Speed Reading course. And for your kids, a SuperPhonics™ reading program. Over \$200 worth of Learning CDs make this the deal of the century. But I also



Beyond virtual reality, the light-sound matrix stimulates your mind and opens your learning centers. Like magic it pours in new information, skills, mental programming, and launches your imagination.

want to show off its other incredible mind expanding powers.

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So I'll include the 3-D Mind Sync™ Library, with 10 mind launching programs on 3 CDs. Turn your Learning Machine into a meditation, self-hypnosis, and virtual fantasy computer. You'll get the following titles: *Creativity Booster, Quick Energy, Stress Zapper, Mental Tune-Up, Virtual Visualization, Imagination Stimulator, Learning Accelerator, Super Intuition, Lucid Dreaming, and Super Zen States.*

A \$150 value, this extensive collection is a super added bonus. But even more exciting is how it can be used for habit control, success conditioning, and eliminating self-sabotaging behavior.

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Let's say you want to transform a loser mind-set into a winning one. Or you'd like to quit smoking or lose weight. Pop in an InnerMind™ Programming Disc. The sensory stimulation matrix opens a window into your unconscious mind. Then by infusing your "inner mind" with positive programming, you can rescript negative, self-defeating attitudes. I'm including an awesome 18-title InnerMind Programming Library. From success conditioning to weight control this is another \$150 value.

30-Day Risk Free Trial

Plus in addition to the Language Learning Library, the SuperPhonics, Super Speed Reading, Super Memory, and Super Vocabulary programs, the 3-D Mind Sync Library, and the InnerMind Programming Library (a \$600 combined value), I'm including coupons worth a thousand dollars. These coupons are for hundreds of future Learning CD applications, including software that links your mind directly to a multi-media computer. It's something you absolutely must experience.

Try the Learning Machine for 30 days risk free. Take your mind on an incredible journey. If for any reason you're not totally blown away by the experience, send your kit back to me for a full refund.

To order, credit card holders call toll free. Or send your check or money order for \$299.95 plus \$12 shipping & handling to the address below. (Item #4501). Please allow 4-6 weeks for delivery.

\$600 Super CD Bonus Pak

Hundreds of dollars worth of valuable Learning Disc Libraries are bundled with your Learning Machine™ to make this an incredible deal. Here is just a sample of the mind-boggling benefits of your Learning Discs that will be bundled FREE as part of this special introductory offer.

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InnerMind™ Programming Library (\$150 Value) 18 programs on 3 Learning Discs program success behaviors into your subconscious. Titles: *Building Self-Esteem, Eliminate Fear & Anxiety, Projecting a Winner's Image, Attracting Love Relationships, Health & Healing, Expanding Psychic Powers, Attracting Prosperity & Wealth, Time*



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THAT WAY YOU COULD
JOG ALONGSIDE INSTEAD.



S I M P L E . R E A L L Y S I M P L E .

able and predictable, if not particularly exciting, fashion. In fact, the ride-tuned suspension of the Toyota gives up something in handling to many in this group—the Camry is the slowest through the slalom. But it ties for first when stopping and it accelerates to 60 mph as quickly as the pack-leading Maxima.

Inside, there's *beaucoup* room and then some. And the amenities inside the car are extensive. Among the nicest of those amenities is one that comes as standard equipment—the quiet, solid, high-quality and serene interior. The Camry LE's base price also brings dual airbags, power windows, mirrors and door locks, the potent 3.0-liter V6, the electronically controlled 4-speed automatic and more.

Volkswagen Passat GLX

The sleeper in this group has to be this superb performer from Germany. The Passat GLX boasts a unique-to-VW powerplant, with its 24-valve dohc 2.8-liter V6. The angle of the engine's V is only 15°, so both cylinder banks are covered by a single cylinder head. Besides light weight and compactness, this engine pumps out 172 hp, giving the Passat the third most power in this group. Unfortunately, the engine's characteristics seem more suited to the 5-speed manual transmission than the optional 4-speed automatic that was in our test car.

However, the tried-and-true VW strut front and twist-beam rear suspension and the Passat's hefty 215/50HR15 tires—the lowest-profile tires in the group—result in some very spirited handling. The Passat posted the best numbers on both skidpad and through the slalom. Driven hard through the hills and dales, the Passat seemed to swallow and straighten the road no matter how curvaceous the route. In fact, only the Contour SE in this group begged to be driven harder than the Passat did.

Couple the Passat's handling prowess to a taut, well-controlled ride and a cavernous, well-appointed interior and you have a terrific family sedan.

All Passats come in GLX trim, which means power windows with a one-touch down for driver and front passenger, power mirrors, dual airbags, antilock brakes and the 2.8-liter V6—all for less than \$21,000.

In sum

This group of 10 proves undoubtedly that it is increasingly more difficult for the average person to buy anything but a good car these days. But given the blend of performance, comfort and value, the newcomers—especially from Ford Motor Co. and Chrysler Corp.—are tough to beat.

SMALL V6 SEDANS

(Continued from page 59)

gearbox was able to pull the Maxima to 60 mph almost as quickly as the manual-equipped Contour.

It's no spartan ride, either. Our SE was trimmed to the gills with a power driver's seat, power windows, sunroof, mirrors and door locks, leather upholstery and a killer Bose stereo system with cassette and compact disc. Factor in the ABS along with the other options, and the base price mushrooms to nearly three long ones more than anything else in our group.

Pontiac Grand Am SE

GM's lone spear-carrier in this test is the strong-selling compact from Pontiac. And with a base price of less than \$14,000 (including the V6 engine), it has to be considered a contender.

Some of the reasons for the low cost of the Grand Am are good ones: the advantage of GM's size and the fact that the Grand Am has been around now for several years so its costs have been amortized. Unfortunately, others are not so good: This car has the largest engine—but the only pushrod engine—in the group, but it puts out less power than any save the Hyundai's slightly smaller motor. It's also the only one of the 10 cars that does not offer a passenger's airbag.

These factors are all noticeable when you drive the Grand Am SE. Its acceleration was among the poorest in this group, and it offered the least grip of any going around the skidpad. Over the road and through the slalom, the Grand Am is fun and predictable.

The car's age is also noticeable inside. The interior is cramped compared to the others—especially in the back seat—and the hard plastic simply looks and feels less than elegant.

Of course, on the exterior, Pontiac's designers have done their usual masterful job of making this car look really good. And since it's sold by your ubiquitous Pontiac dealer for a very reasonable amount of money, you may opt to overlook some of its more outdated aspects.

Toyota Camry LE

The second most expensive and second most powerful car in the group is also the largest.

Roomy, comfortable and as reliable as mom, the Camry continues to offer solid, competent transportation. Perhaps one of the Camry's greatest strengths is that there's nothing cosmically esoteric about it. It's just solidly designed and engineered.

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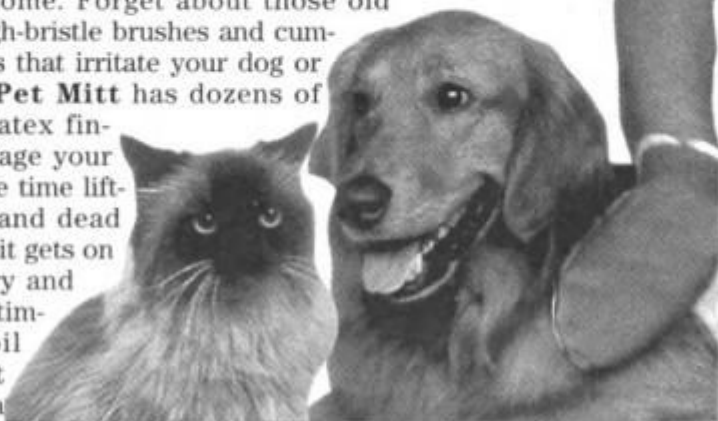
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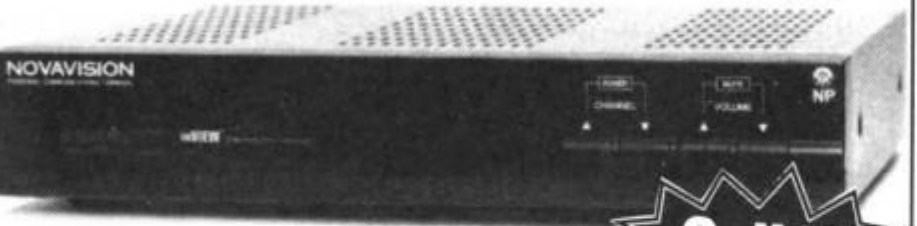
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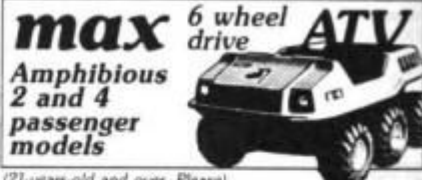
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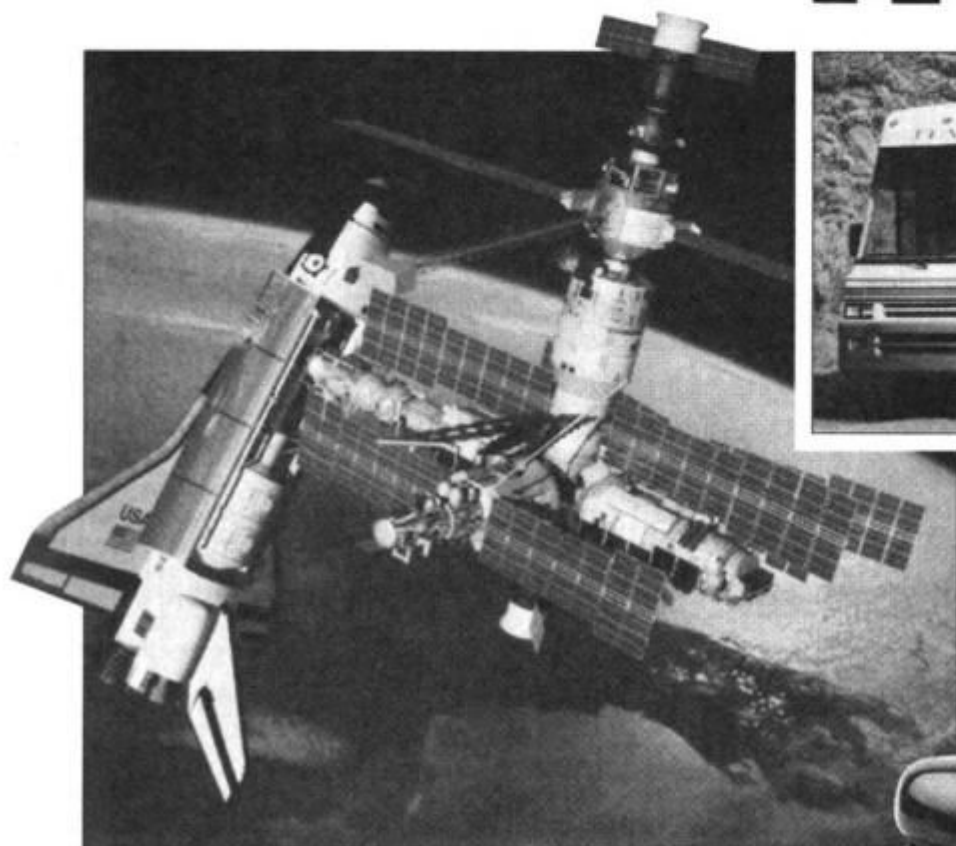
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