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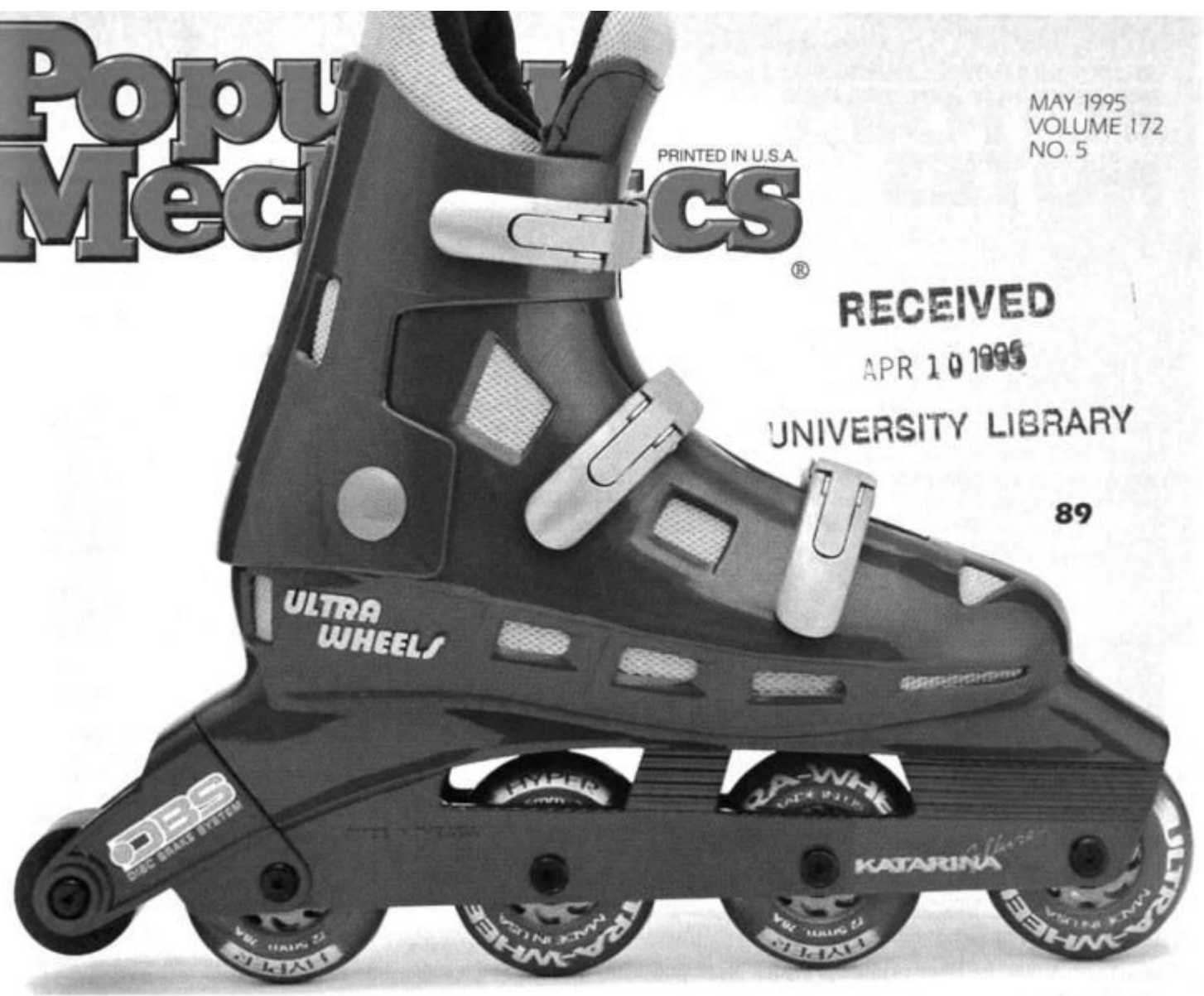
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NO. 5

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EDITOR'S NOTES

● Yes, admittedly, it's a fantasy. But what a fantasy. You go off to a barren location in the desert, discover a million bucks worth of gold buried 400 years ago by Spanish conquistadors and retire a happy man. The thing is, a few people are actually living the dream. Many more, though, are still just fantasizing. So our cover story this month by Science/Technology Editor Greg Pope is dedicated to all you dreamers out there. There are loads of documented lost treasure out there just waiting to be claimed. Let us help you get started with the nine most-likely sites where you might strike it rich. ... **A few short years ago**, artist extraordinaire Gene Thompson's tools of the trade included several



Thompson at his "drawing" board.

drawing tables, pencils, pens, brushes, paints and an airbrush. Today, he focuses his attention at one table only—the one holding his Macintosh Quadra computer. With mouse in hand, Gene now digitally produces virtually all of his work. Software tools replace the pencils, pens and airbrush, while acetate, vellum and illustration board have given way to 21- and 14-in. color monitors. A 600-dpi laser printer provides black-and-white proofs, and a scanner, Syquest drive and CD-ROM drive round out his equipment suite. An electronic art skeptic at first, Thompson has mastered the new equipment to the point where he creates electronically the type of technical art you see on page 99—a quality level once thought impossible by the critics, except with traditional media. ... **Hey, we're going racing again.** This time, we're joining Darrell Waltrip and his thundering Chevy Monte Carlo on the Winston Cup stock-car circuit. Whether on the superspeedways like Daytona and Talladega or on the short tracks like Richmond, Bristol and North Wilkesboro, Waltrip will be pushing his No. 17 Western Auto car to its limits. So come along for the ride. Begin by turning to page 56 for all the details. ... **If you want to slow things down**, check out the fantastic palaces on wheels beginning on page 76. Today, motorhomes let you travel in a luxurious style unheard of even a few years ago. If you want to take along the kitchen sink, now you actually can. ... **Last, from the wheels department**, how about brakes for your roller skates? No, really. The latest inline-skate technology incorporates brakes as part of the design. And in some cases, you hand-activate drum brakes similar to those found on motor vehicles. Would I kid you? Check page 89. Till next time.

Joe Oldham

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LETTERS

Air Disasters



During World War II, the Army Air Force learned very early that aircraft and thunderstorms don't mix. I've seen B-17s with holes punched in the wings from hail the size of oranges. I've seen planes crash after penetrating thunderstorms. Today's aircraft, even with their new technology, are just as vulnerable to weather as aircraft were 50 years ago.

RALPH L. MADDRIX
ELDERSBURG, MD

So you like to sensationalize airline tragedies. Your sensations and titillations of disaster from the skies are no more than a means of boosting sales. With more than 28 million fearful flyers in this country, the tabloid cover and photographs showing broken metal reinforce the false impression that flying is unsafe.

J.G. CRAFT
FORT WORTH, TX

Abe Dane's story was informative and well written. But your cover totally misrepresented its contents. Please don't resort to such shoddy tactics to pique reader interest.

RICHARD V.D. FIELD
ALGONQUIN, IL

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

My wife was one of the 132 people aboard the US-Air Flight 427 that crashed near Pittsburgh, killing everyone. So it was with great interest that I read your article. I don't really feel that you answered the question of whether the FAA was doing its job. Simply put, the FAA has a 2-fold assignment. As is commonly known, it is charged with ensuring the safety of air travel. But as is not commonly known, it is also charged with promoting air travel and the airline industry. Unfortunately, these two roles often directly conflict with each other. Improved safety invariably translates into increased costs—not a positive in the eyes of the airline industry. Therefore, the FAA does not do everything possible to make air travel as safe as is the general perception. As I write this, NTSB has strong indications that a faulty power control unit (PCU) malfunctioned on Flight 427, causing it to crash. Boeing and safety authorities have known about this rudder actuator problem since 1991. Finally, in March 1994, an FAA directive took effect, giving the airlines five years to replace the PCU in all 737s. Five years! The USAir 737 my wife was on did not have the upgraded PCU. The bottom line is: Who is the FAA protecting? The airline industry's profitability or the American people?

BRETT VAN BORTEL
LA JOLLA, CA

My heartfelt sympathies.

—Ed.

UFRs (Unidentified Flying Readers)

Is POPULAR MECHANICS turning into a tabloid maga-

zine? Your flying-saucer cover story implying new information about super-secret UFOs was a cheap rehash of tired old information.

DEAN CASE
NEVADA CITY, CA

Does that mean you didn't like the article? Personally, I found it fascinating.

—Ed.

How many camcorders and cameras are there in America? And we can't get one decent photo of a flying saucer? The other day on "Geraldo" I saw a woman who claims to be contacted eight to 10 times a year by aliens. But she doesn't have a camera! GEORGE SEMPLE
SIOUX CITY, IA

I would love an explanation of the UFO sighting I made in 1983 over New Rochelle, New York. In a clear sky, I spotted 10 oval-shaped white objects in a bowling-pin formation. They accelerated from an apparent hover to an extremely high top speed in a second or two, then disappeared.

RICHARD F. CAMPAGNA
MT. LAUREL, NJ

What, no camera? —Ed.

At 8:15 pm on April 22, 1983, on U.S. Route 8 in northern Wisconsin near Turtle Lake, was the last time I saw one. Unfortunately, no camera.

WILLIAM CEILKY
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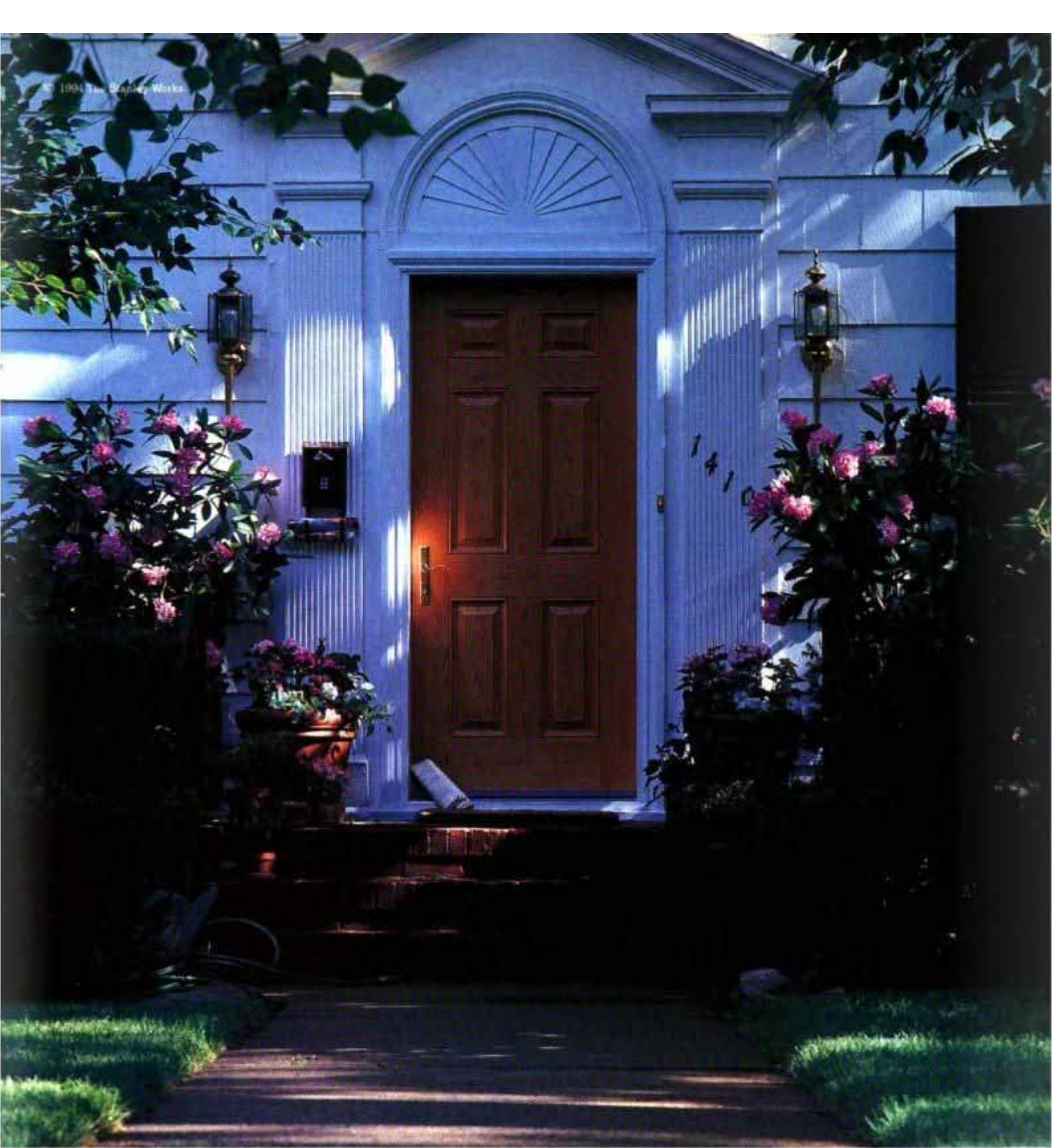
STANLEY

Reader Project Of The Month

This VW Woody project started with a '67 Beetle and wound up being a complete frame-off restoration as well as a Woody conversion. It was built from the ground up using a brand-new VW frame assembly and parts from two other Beetles and a Ghia, plus countless new parts. The body is '74, the engine and transaxle are '71, the front-axle assembly with disc brakes is Ghia, and a few parts—such as the front bucket seats, rear fenders and front turn lights—came from the '67 Beetle.

NICHOLAS ROTH
LEESBURG, FL

If your project is chosen as Reader Project Of The Month, you will 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 Street, New York, NY 10019.



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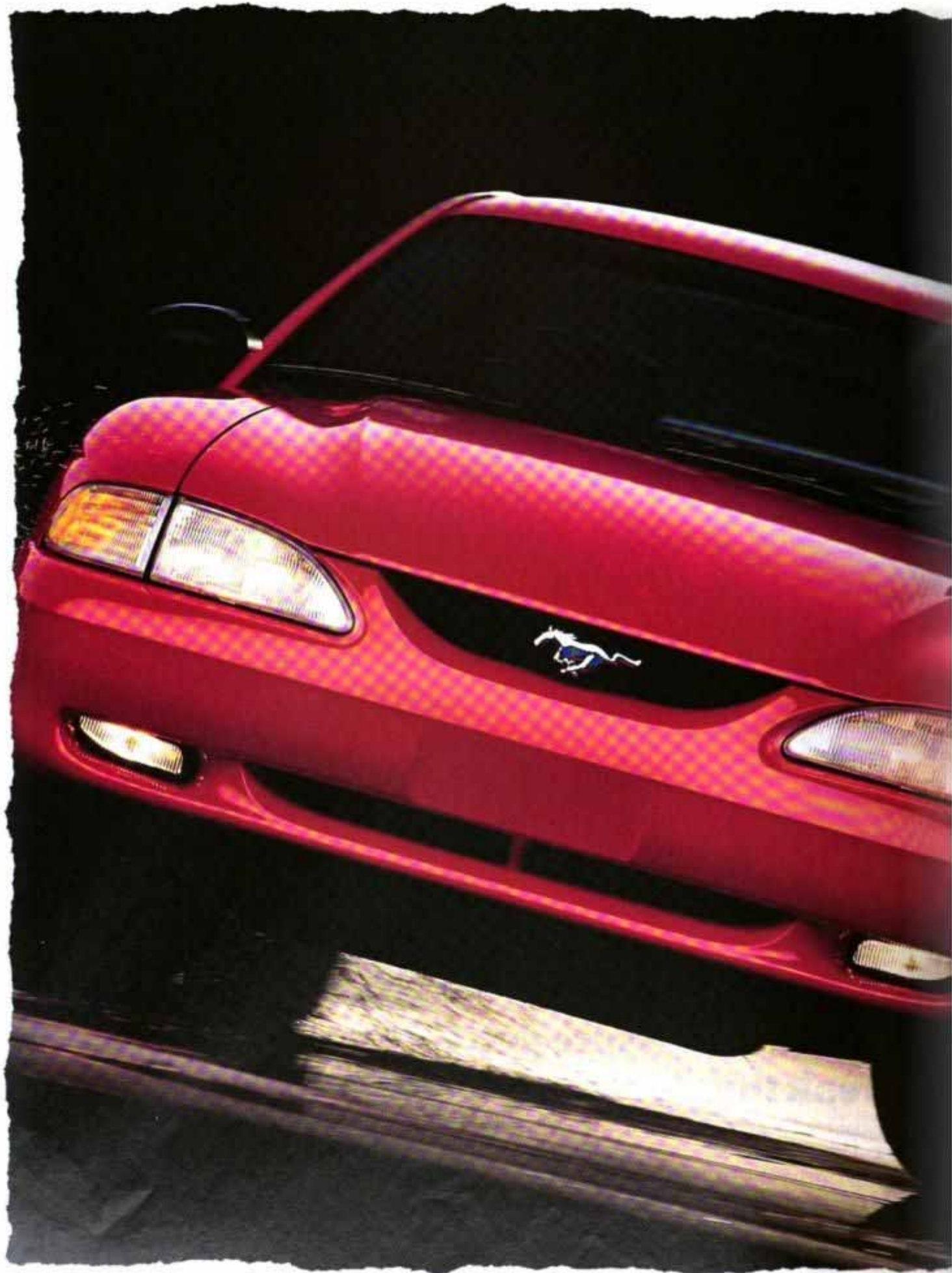
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TIME MACHINE

90 YEARS AGO: MAY 1905



Ice Screamer

Ice yachting across frozen lakes left winter sportsmen at the whims of winds. So a Toledo inventor harnessed a gasoline engine to take control of his 12-ft. craft. The motor spun a spring-mounted drivewheel edged with staggered spikes. A testbed for a 100-mph version, the iceboat gained 40 mph during tests across Lake Erie. There the boat's most critical component proved to be its steel windshield, which fended off flying chips of ice.

Coal Comfort

No pick-wielding coal miner could deliver several hundred blows per minute. But mechanization was chipping away at the back-breaking labor of coal mining. Pneumatic coal cutters now machine-gunned away at seams, opening channels in a fraction of the time. Twirling a hand crank, a miner could continuously reposition the drill head as it hammered

away. The cutter proved especially useful in undercutting seams—dangerous manual labor until this machine's introduction. Electricity would soon spark a second revolution in mining.



60 YEARS AGO: MAY 1935



Skim No-Vac

While Gar Wood's fire-breathing speedboats hit speeds of more than 2 miles a minute, pint-size outboard motorboats gained respect if they reached half that velocity. In particular, the radical "No-Vac" design proved that watercraft a few feet long could safely negotiate 60-mph speeds. The boat was streamlined to a fare-thee-well, with hull and planing surfaces flattened to pare down the vacuum behind the pilot.



Tube Walkman

Transistors were still a generation away, but radio enthusiasts of the 1930s could build their own portable belt receiver with our plans. Cramped into a wooden sewing-kit box, the device was a one-tube wonder, with a 5-ft. antenna lead rolled into a pocket or sewn into a coat lining. For long-distance listening, you could clip it onto a wire fence. Batteries back then came in flexible ribbons that you carried in a patch pocket.

30 YEARS AGO: MAY 1965



Wheel Meals

Remember those open-road family trips of the 1960s, when meals turned into mayhem at overcrowded rest stops? Our chuckwagon trailer project put an end to roadside squabbles. Built into the 2-wheeler were an icebox, drawers and storage cabinets for folding chairs. For cookouts without fuss, a flip-down plastic-coated countertop revealed a gas stove. Meanwhile, a hi-fi outdoor speaker hooked into the car radio to soothe frazzled nerves.

Mars First

Sweeping past Mars at 11,000 mph, *Mariner 4* would become the first probe to reach the Red Planet. An Atlas rocket had hurled the spacecraft on its 325-million-mile journey. At NASA's Jet Propulsion Laboratory, researchers were gearing up for the rendezvous, which promised 22 photographs at unprecedented closeness. Shot from

only 6000 miles away, the photos would reveal as much about Mars as Earthly telescopes did about the Moon. They'd also end speculation about Martian oceans and vegetation. **PM**



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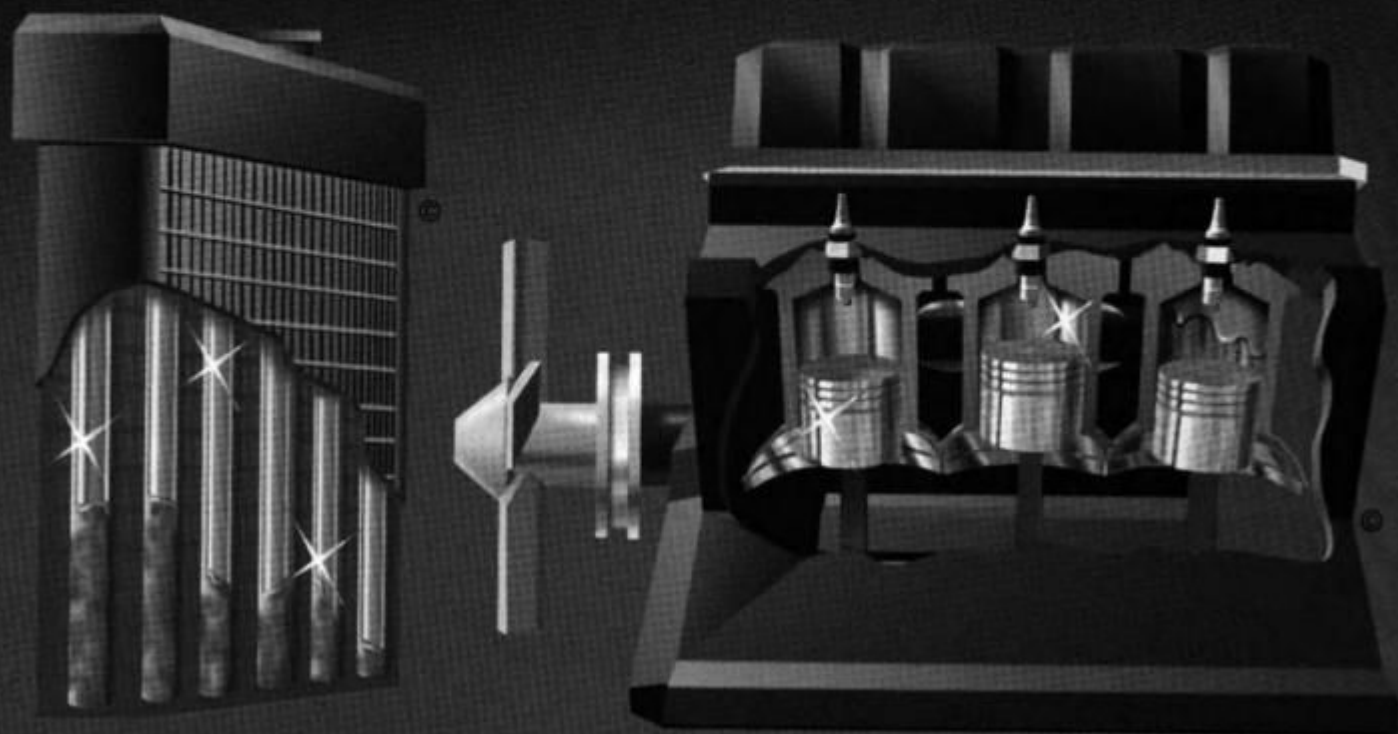
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TECH UPDATE

News Of Tomorrow's Technology Today



Pipeline Moves Passengers In Ground-Effect Machines

LAS VEGAS, NV—Cross a levitating train with a hovercraft, send it flying through a tube and what do you get? The unique vehicle that Levitated Transport Systems is proposing.

True, engineers have long raised hopes for pneumatically suspended transit vehicles. The attraction of such systems echoes the appeal of magnetic levitation: efficient transport without wheel friction.

But the Air Cushion Transport System (ACTS) boosts the concept to a new level. ACTS combines pneumatic suspension with lift from aerodynamic ground effect. Curved to match the lower arc of its enclosed tubular guideway, an ACTS vehicle starts out riding a pillow of air that's ingested by a fan in its nose. Meanwhile, a rear variable-pitch propeller gets the car moving.

Once it has gained sufficient speed, the car slips into ground effect. Mounted above the craft's main body, two large rings act as airfoils to suspend the vehicle. The rings, along with the semicylindrical body itself, create a circumferential air buffer between the car and the tube's inner walls, enhancing stability.

As the ACTS vehicle whistles through the tubeway, valves open and close to regulate air pressure, vent

out exhaust and supply breathing air. In one proposed application, air-cushion vehicles operate in ground effect as they whisk gamblers between casinos.

Although the technique is unproven, ACTS appears to offer a number of advantages, particularly speed. Running in ground effect within the controlled environment of a tube, the vehicles require little power to reach impressive velocities. The ACTS concept covers cargo transport, moderate-speed people movers and 300-mph intercity passenger service.

Highlights This Month

- **High Hand**—Spacewalking robot to aid astronauts.
- **Spy In The Sky**—Satellite monitors missiles, sees stars.
- **Special Operations**—Remote surgical microvehicles.
- **SEAL Machines**—New commando speedboats.
- **Shore Thing**—Flexible reef to fight beach erosion.
- **Plane By Train**—Shipping an entire airliner body.
- **Gear Splitting**—Stepless transmission comes of age.

Editor/Writer: Gregory T. Pope
Contributors: Philip Chien, Chris Chinnock,
Mike Fillon, Rick Schrader, Herb Shuldiner

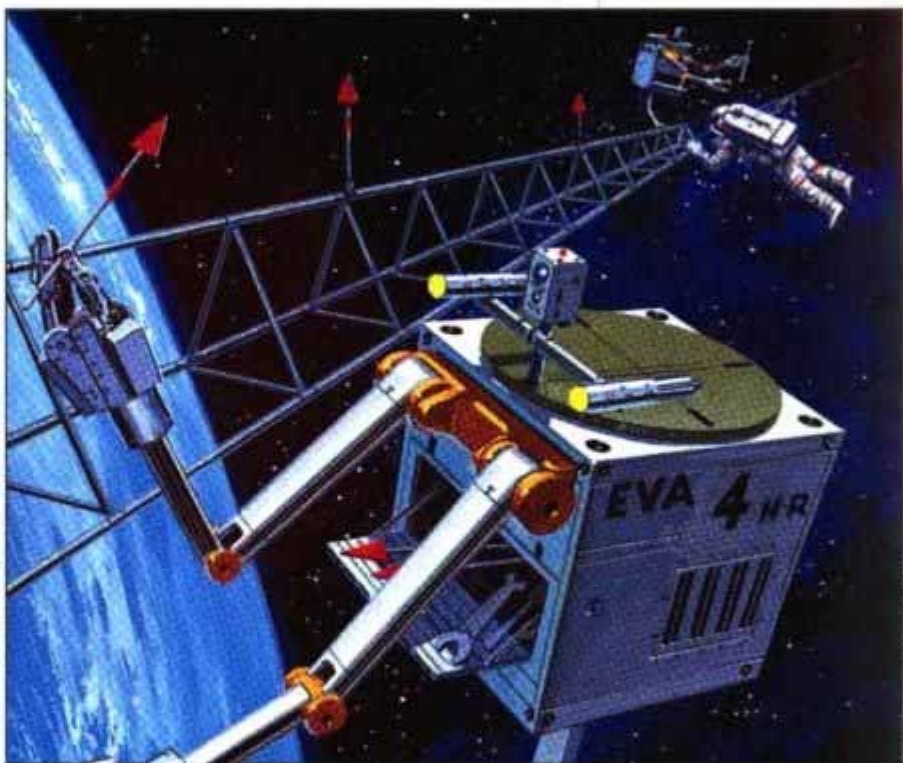
Helping Hands For Spacewalkers

HOUSTON, TX—Ever need a third hand while working on a project? For spacewalking astronauts, the problem crops up all the time. Extravehicular activities, or EVAs, will play a big role in future spaceflight—the International Space Station could take 888 EVA hours to assemble. And NASA doesn't want to send any more astronauts outside than it has to.

So to give spacewalkers a mechanical sidekick, Johnson Space Center roboticists are developing an EVA Helper/Retriever, not unlike R2-D2 from "Star Wars." The robot will have stereo camera eyes mounted on a pan-and-tilt unit. Its hands will be 3-fingered devices that can snatch objects as they float weightlessly. NASA has tested the hands' dexterity on recent flights aboard the gravity-defying KC-135 aircraft.

Most of the time the robot will cling to external spacecraft structures with a grasping foot mechanism. Another version could aid astronauts with tasks in the cabin. Engineers hope to put the robot into action by 1998.

Two-fisted EVA Helper/Retriever will assist spacewalking astronauts during extensive activities.



PH ILLUSTRATION BY BO VINCIGUARY

Big Bad THAAD

WHITE SANDS MISSILE RANGE, NM—Ballistic-missile protection returns to the front burner as the Army prepares to test its first Theater High-Altitude Area Defense (THAAD) system.

Built by Lockheed, THAAD is designed to defend an area 20 times bigger than that guarded by the Patriot missile. The idea is to intercept warheads far from military targets or civilian populations.

In operation, a ground-based radar will identify an approaching threat. Once a THAAD launches, the radar unit will send it periodic updates. Zeroing in for the kill, THAAD will switch to an infrared seeker. If it misses, the radar will notice and cue up another interceptor.



The Army simulates hot launch of THAAD in preparation for the real thing.



LOCKHEED PHOTO



News Production In Midair

SEOUL, SOUTH KOREA—TV-station helicopters are a familiar sight above the scene of breaking news. But the Korean Broadcasting Service now has one that lofts video-production capabilities that are usually packed in 18-wheelers sitting outside football games.

Heli-Dyne Systems outfitted the chopper, a Bell 230. The helicopter has two independent microwave receive-transmit systems that can simultaneously broadcast live aerial footage and relay signals from news teams on the ground. A 300mm Sony video camera peers from a stabilized, nose-mounted turret, while a handheld camera can collect video through the side door. Meanwhile, in the aft cabin, a third camera records commentary from on-air talent.

Sophisticated video-production console rides in news-gathering chopper.



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See other side for highlights of NRI hands-on computer training



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Star-Wars Sky Eye

VANDENBERG AFB, CA—Conceived during the heyday of the Strategic Defense Initiative, a \$325-million missile-watching satellite will fly into orbit before summer. But the Midcourse Space Experiment (MSX) will also see work from civilian researchers.

Built by the Applied Physics Laboratory of Johns Hopkins University, the spacecraft carries 11 sensors ranging from far-infrared to ultraviolet detectors.



The MSX will attempt to distinguish decoys from warheads during test missiles' midcourse trajectory.

MSX will track a missile after its booster burns out but before its warhead reenters the atmosphere.

After a series of missile experiments, MSX will train its instruments on Earth, seeking clues to global change. It will also probe the heavens, aiding research into astronomy and space debris. In addition, sensors will be able to spy on other spacecraft—including those built by foreign nations.

Long Arm Of The French

PARIS, FRANCE—The United States and Russia enjoy a long-range surgical-strike capability no other country can match. But France will soon catch up. The French air force has decided to upgrade its Apache runway-cratering weapon (see Tech Update, page 28, Nov. '92) into a 250-mile stealth cruise missile.

The original Apache, now undergoing tests, carries a submunition-scattering device. For the long-range version, manufacturer Matra is yanking out this apparatus and substituting extra fuel. As its warhead, the missile will pack 1000 pounds of explosives. The weapon will keep its low-profile silhouette.

An advanced navigation system, based on both radar and infrared imaging, will guide the long-range Apache. A cheaper variant will also rely



Apache, shown dropping from French Mirage 2000, will become long-range cruise missile.

on signals from Global Positioning System satellites.

The French, who normally offer their conventional weapons to the export market, insist that they're keeping this one for themselves.

Touring The Depths



Mobilis operates from floating drydock off the island of Martinique.

ST. PIERRE, MARTINIQUE—Now christened *Mobilis*, the tourist submarine Seamaid TS IV (see Tech Update, page 16, Dec. '93) has entered service.

Depth-rated to 450 ft., *Mobilis* carries 48 tourists to the remains of three sunken ships. Because the submarine ventures beyond the range of res-

cue divers, French authorities demanded stringent testing and extra safety features, such as long-endurance life-support stores and 20 tons of positive buoyancy in the ballast tanks.

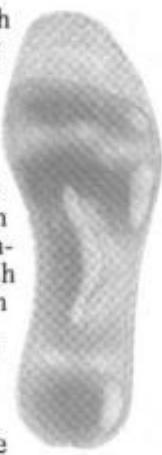
Another noteworthy tour-sub on the way is the transparent Comex *Seaview*, which will begin diving off Freeport, in the Bahamas, this summer.

Water On The Foot

EVANSTON, IL—While high-tech sneakers might hush your barking puppies, what about those hard-bottomed oxfords you wear around the office? A company called Liqua Care is marketing insoles that use a gel-like liquid to reduce

foot pain. Developed in Denmark, Viva-Step insoles are riddled with channels through which the gel oozes. Its motion provides shock absorption, arch support and a massaging action. The devices disperse weight across the entire foot, thus cushioning bones, and also improve circulation to relieve sore muscles.

Viva-Step active insoles feature channels through which gel circulates as you walk.



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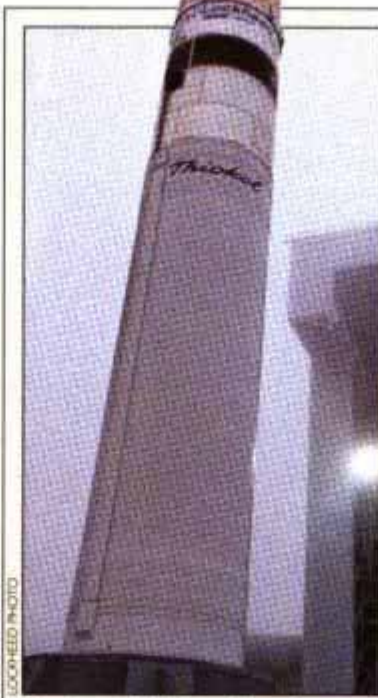
Copycat Robot

HOUSTON, TX—Since robots are likely to set foot on other planets before humans, NASA wants its mechanical explorers to be as capable as astronauts. Toward that end, Johnson Space Center engineers have created a Dextrous Anthropomorphic Robotic Testbed, or DART. The system allows unprecedented control of a complex human-like robot arm.

Instead of joysticks, DART uses a pair of gloves fitted with sensors that read arm, hand and wrist movements. The ambidextrous robot mimics these movements. A head-mounted display shows images from the stereo color cameras that serve as the robot's eyes.



DART robot mirrors the motion of its teleoperator.



Mockup of LLV-1 on launch mount at Vandenberg Air Force Base.

Lockheed's Liftoff Looms

VANDENBERG AFB, CA—The long-awaited maiden flight of the Lockheed Launch Vehicle, or LLV, may be under way even as you read this. The rocket is due to lift off from Vandy's Space Launch Complex-6, a never-used facility originally furnished to send the space shuttle into polar orbit.

The launch date slipped from last November because the vehicle had to meet the Air Force's stringent new safety requirements for emergency flight termination (blowing up the rocket in midair if something goes awry).

The LLV-1 is the smallest in a new line of Lockheed rockets (see Tech Update, page 16, Dec. '93). Its payload—a 300-pound GEM-Star communications satellite built by CTA Inc.—will ply a near-polar orbit to bring messaging capabilities to Earth's remotest regions. In addition, NASA's *Lewis* and *Clark* satellites (see Tech Update, page 24, Oct. '94) will now ride LLV-1s rather than Pegasus winged rockets.

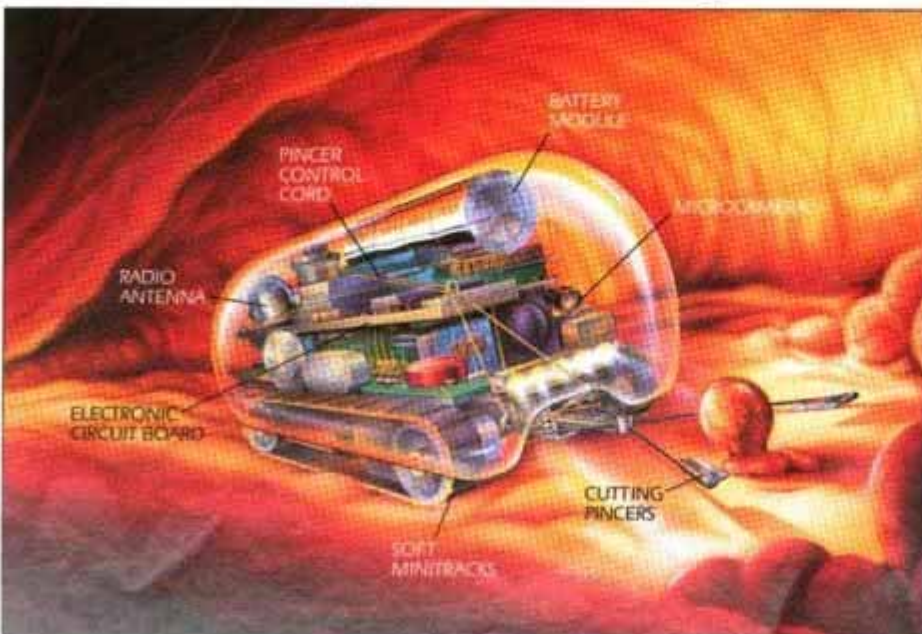
Surgery Without The Scalpel

CAMBRIDGE, MA—Crawling around inside your colon, an inch-long micro-robot could remove polyps or tumors without a surgeon laying a finger on you. At the Massachusetts Institute of Technology, researchers have built a midget vehicle, called Cleo, that's drawn interest from the medical community.

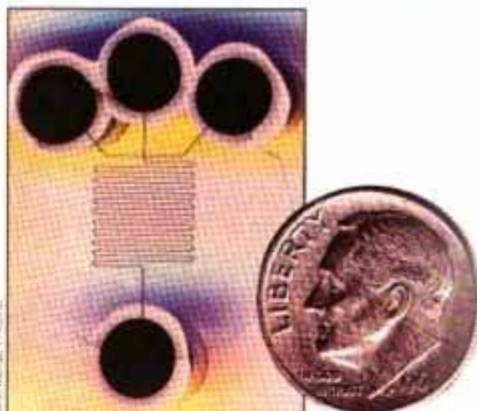
Engineer James McLurkin salvaged Cleo's tiny components from existing devices. Gogs and treads came from toy cars, while the motors were plucked

from vibrating beepers. But right now, Cleo is nowhere near ready to explore the human body—and the hostile yet fragile environments it contains.

Nevertheless, the technology intrigues surgeons because they'd be able to maneuver joystick-controlled robots better than their endoscopic instruments. Built small enough, a robot could venture into locales, such as the small intestine, that lie beyond the reach of an endoscope.



Miniature robo-surgeon, based on Cleo, could operate inside the colon.



Tiny chemistry lab would incorporate microchanneled glass plate.

Chemistry Set On A Chip

OAK RIDGE, TN—Don't throw out your beakers just yet, but the world's smallest chemistry lab is under development at Oak Ridge National Laboratory.

The lab's centerpiece: a glass plate etched with capillary microchannels. The channels serve as a venue for reactions or for the quick separation of chemical compounds in a drop of liquid.

No bigger than a postage stamp and as thin as a microscope slide, the plate could figure into microchip-based devices that diagnose illness, monitor chemical-process production or survey waste sites.

Materials, synthesized at Oak Ridge National Laboratory



If this is your skin,



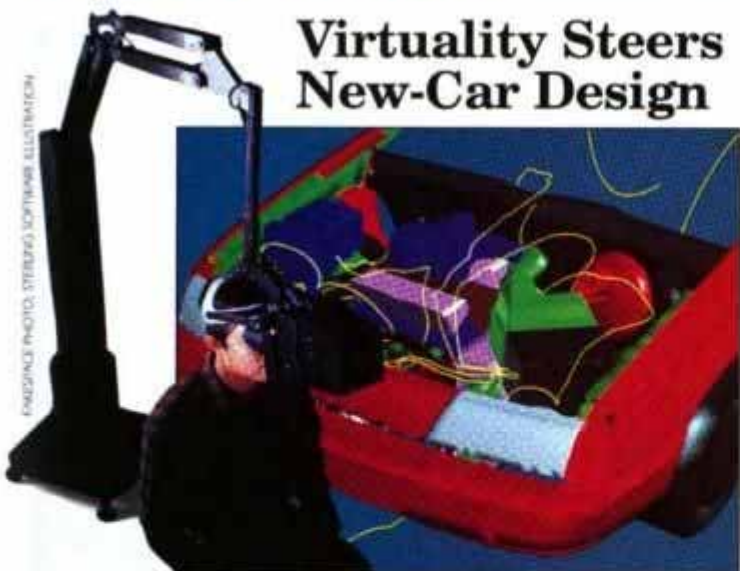
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Virtuality Steers New-Car Design



Fakespace's BOOM display lets designers go with the flow.

DEARBORN, MI—Ford spent only three years bringing the new Mustang from “concept to customer.” Still too slow, say time-driven auto executives. So engineers are hoping virtual reality will quicken the pace of car development.

Ford, for example, has wheeled in the same companies that helped create NASA's Virtual Wind Tunnel (see Tech Update, page 14, April '93): Fakespace Inc. and Sterling Software. Although Ford also harnesses the technology to study car aerodynamics, virtual reality is providing special insight into ergonomics—i.e., how smartly the dashboard is arranged, how easy the trunk is to load. The idea is to solve problems early, before factories cut their tooling.

Wide-Eyed Helmet

CARLSBAD, CA—Yes, virtual-reality videogames are fun, but the images on head-mounted displays remain grainy. That's because their liquid-crystal display (LCD) screens, borrowed from camcorders, pack only about 180,000 pixels.

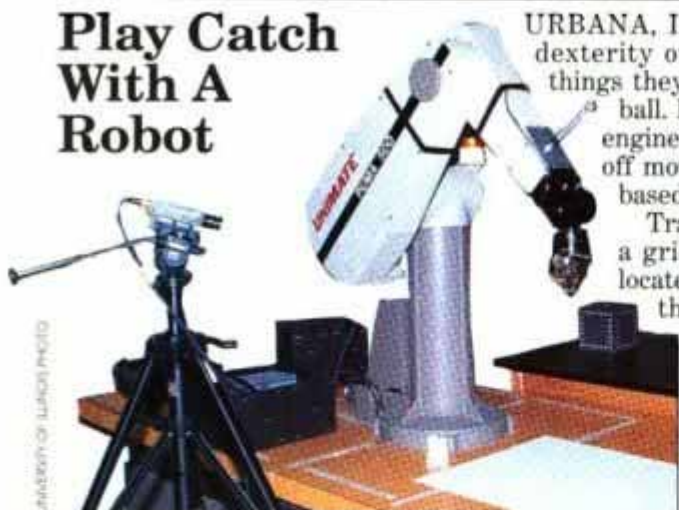


High-resolution wide-screen virtual-reality displays use three LCDs per eye.

Kaiser Electro-Optics plans to sharpen the picture with a wall-of-TV's tactic.

Kaiser is developing displays that arrange multiple LCDs in front of each eye. The result: a wide field of view with crisp images. Using advanced LCDs from Kopin Corp., Kaiser believes the technique may challenge the limits of human eyesight.

Play Catch With A Robot



URBANA, IL—While robots have gained dexterity over the years, there are still things they can't do—like catch a thrown ball. But at the University of Illinois, engineers are teaching robots to pick off moving objects with a new vision-based guidance system.

Traditionally, robots have relied on a grid-and-coordinate approach to locate objects. But the Illinois robot thinks in terms of perspective, calculating angles and distances from its video-camera eye. For a moving target, the robot can predict a trajectory, flex its joints and intercept.

Robot uses principles of perspective to play catch.

Special-Ops Speedboat

NEW ORLEANS, LA—Who won the SEAL speedboat competition (see Tech Update, page 28, March '94)? Halter Marine's Pegasus aluminum-hull design. Special Operations Command will get the first two Mark V craft this September. Equitable Shipyards, birthplace of many of World War II's PT boats, is building the vessels.

The 82-ft. Mark Vs will roar on two waterjets powered by 2253-hp diesels. They'll reach top speeds of well over 45 knots, making them the world's fastest

patrol boats of this size. They'll also deliver 16 fully armed special-forces personnel without sapping battle readiness.



Mark V Special Operations Craft combines stealth with lightning speed.

Deep-Disk Data Stack



Multilayer optical disks use partially transparent storage material to boost capacity.



SAN JOSE, CA—Just when you thought optical disks represented the ultimate in data storage, they're getting even more capacious. IBM's Almaden Research Center has created multilayer optical disks that could pack in not just books, but entire libraries of information.

Keys to this development are a more transparent storage medium and a moving lens for the disk drive's laser. The lens shifts up and down to select the layer on which the laser will either read or write data.

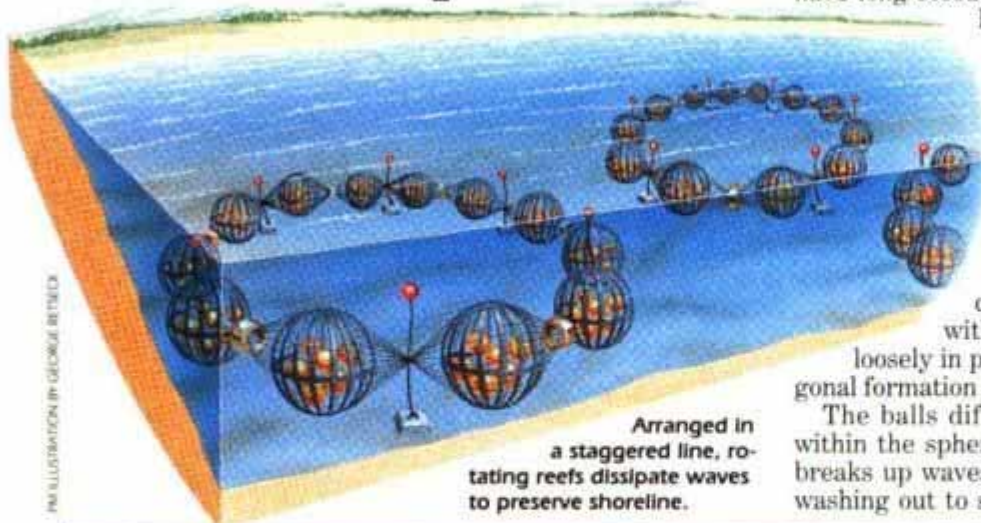
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Reef Shores Up The Shore

WEST CALDWELL, NJ—Seawalls, jetties and groins have long stood as hard barriers against beach erosion. But have they been effective? Hardly. Now Demi-Tek Inc. has proposed a more flexible solution, with the philosophy that peaceful coexistence wins out over confrontation.



Arranged in a staggered line, rotating reefs dissipate waves to preserve shoreline.

PH ILLUSTRATION BY GEORGE BETHED

Off the coast of New Jersey, Demi-Tek has been testing its so-called rotating reef, which lies 6 to 8 ft. underwater. It comprises a series of stainless-steel cage-like spheres, each containing a cluster of plastic balls filled with air. The larger spheres are enclosed loosely in plastic nets. The nets are linked in a polygonal formation and tied to pilings sunk into the seafloor. The balls diffuse waves' energy by rotating freely within the spheres, which also rotate. The netting, too, breaks up waves. In addition, the reef keeps sand from washing out to sea. Once it has replenished a shoreline, the reef can be unhooked and moved farther out to sea.

Navy's Virtual Landing Craft



The first-ever hovercraft simulator trains Navy's LCAC crews.

ARLINGTON, TX—Air-cushion landing craft (LCAC) move through such varied domains—from calm waters to crashing surf to cratered land—that they're not easy to simulate. But the Navy wants to expose LCAC crews to rough conditions without risking lives during peacetime. So Hughes has built a unique full-motion hovercraft trainer that harnesses far more data than an aircraft simulator.

The machine has to synchronize the visual depiction of different sea states with the dynamics of its motion base, which rocks on six computer-controlled actuators. The simulator also must model land conditions and obstacles that the 300,000-pound hovercraft would be called on to traverse.



ALPHABET PHOTOS

Volvo's Split Personality

GOTHENBURG, SWEDEN—Volvo is moving quickly toward production of a hybrid electric car based on its 850 model. The company recently revealed its initial step in that direction—an electrically powered 850 that tows an internal-combustion engine and alternator on a trailer. The vehicle is really just a test mule

for the hybrid Volvos, which will number between 200 and 500. The first will arrive on American shores in 1998. Engineers anticipate combining a small 3- or 4-cylinder engine with an undetermined number of nickel-cadmium batteries. The gas-turbine engine showcased in Volvo's ECC concept hybrid car is considered too far off for immediate production. But even a piston engine in a serial hybrid consumes 20 to 30% less fuel because it runs at peak efficiency.



The hybrid electric Volvo 850 testbed hauls its generator in a separate trailer.

Watching Your Waste

RICHLAND, WA—The burping radioactive-waste tank at the old Hanford Nuclear Reservation has calmed down, thanks to a mixing pump that's been running since last year (see Tech Update, page 16, Jan. '94). The flammable-gas buildup no longer threatens catastrophe. Now, en-



Engineers will install dual cameras in six Hanford nuclear-waste tanks.

gineers have installed a pair of color video cameras to keep an eye on the notorious hellhole.

Lowered through an access pipe, the two cameras cling to a 21-ft. retractable arm. One sports a wide-angle lens, while the other scans around on a pan-and-tilt mechanism. Remediation engineers can now see the crystalline face of the waste that lines the tank's bottom.

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| SUPERIORITIES | MORE POWER | MORE TOWING ³ | MORE CARGO ROOM | MORE HIP & SHOULDER ROOM |
| FORD RANGER 4x2 | 3.0L V-6 MPI/ 147 HP | 1,800 LBS | 37.4 CU FT | 52.8 IN/54.6 IN |
| CHEVY S-10 4x2 | 4.3L V-6 EFI/ 156 HP | 4,000 LBS | 39.4 CU FT | 52.0 IN/57.2 IN |

All data based on information available at time of printing. ¹Dakota Sport V-6 \$12,189 MSRP comparison vs. compacts. Tax extra. ²See limited warranty & restrictions at dealer. Excludes normal maintenance & wear items. ³Standard towing with manual transmission and engine shown. For still more information, call 1-800-4-A-DODGE. **TREAD LIGHTLY!** Always wear your seat belt. Only the driver should drink and drive.



compact delivers more.

At about \$12,200, including destination, Dakota Sport V-6 gives you more power for the money than any compact pickup.¹ Plus, you get more hip room, more shoulder room and more cargo room than with a comparable Ford Ranger or Chevy S-10.

That's just for starters. Dakota also has more standard towing than those compacts.

Want even more? With Dakota, you get

standard rear-wheel anti-lock brakes plus a standard driver's airbag. And Dakota provides the security of the new Customer One Care™ 3-year or 36,000-mile bumper-to-bumper warranty and 3/36 Roadside Assistance.²

So if you're looking to get more truck for your money, look here. Dakota Sport. It's a little bigger. A lot better.

America's Truck Stop



The New Dodge

A DIVISION OF THE CHRYSLER CORPORATION

Boeing Rides The Plane Train

SEATTLE, WA—Although the Burlington Northern has carried some unusual loads in its day, this one tops them all: an entire passenger-jet fuselage. Next year, Boeing will ship the airliner body aboard back-to-back railcars.

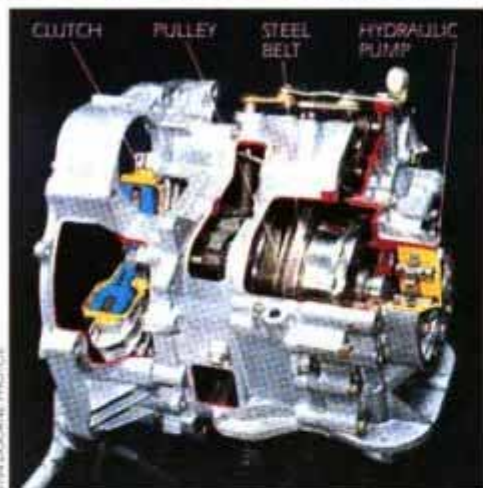
The stretch 737-700 fuselage will ride the rails from Wichita, Kansas, to Renton, Washington. Last summer, a weighted partial mockup made the trip on a single railcar. Jutting pegs studded the model to pinpoint any clearance problems. Meanwhile, accelerometers mounted on the railcar gauged how much the vehicle twisted and flexed along the route. The results satisfied the engineers.



Resting on special mounts, fuselage of 737-700 will travel by rail between Boeing factories.

Boeing currently uses two separate railcars to transport 737 fuselage halves from Wichita, where workers build the pieces, to Renton, where the

entire aircraft undergoes final assembly. By shipping the fuselage intact, the company expects to speed up production and trim transportation costs.



Steel belt, with elements linked by bands, enjoyed success in Canon-Williams Formula One racer.



Stepless Tranny Gears Up

TILBURG, THE NETHERLANDS—The continuously variable transmission (CVT), long-time rival of the gearbox, may soon have its day. Van Doorne's Transmissie BV is engineering its CVTs for bigger engines, hoping to shift them into the mainstream.

A CVT links two pulleys with a steel belt, which curls around a deep V groove cut into each pulley. To change transmission

ratio, hydraulics either push the sides of the pulleys together or pull them apart. This forces the belt to ride higher or lower in the groove, thus effectively shrinking or expanding the diameter of the pulleys.

Long seen in overseas economy cars, Van Doorne CVTs are being tested in two Chrysler Voyager minivans. A major Japanese carmaker will introduce a CVT sedan in 1996.

Swamp Walker

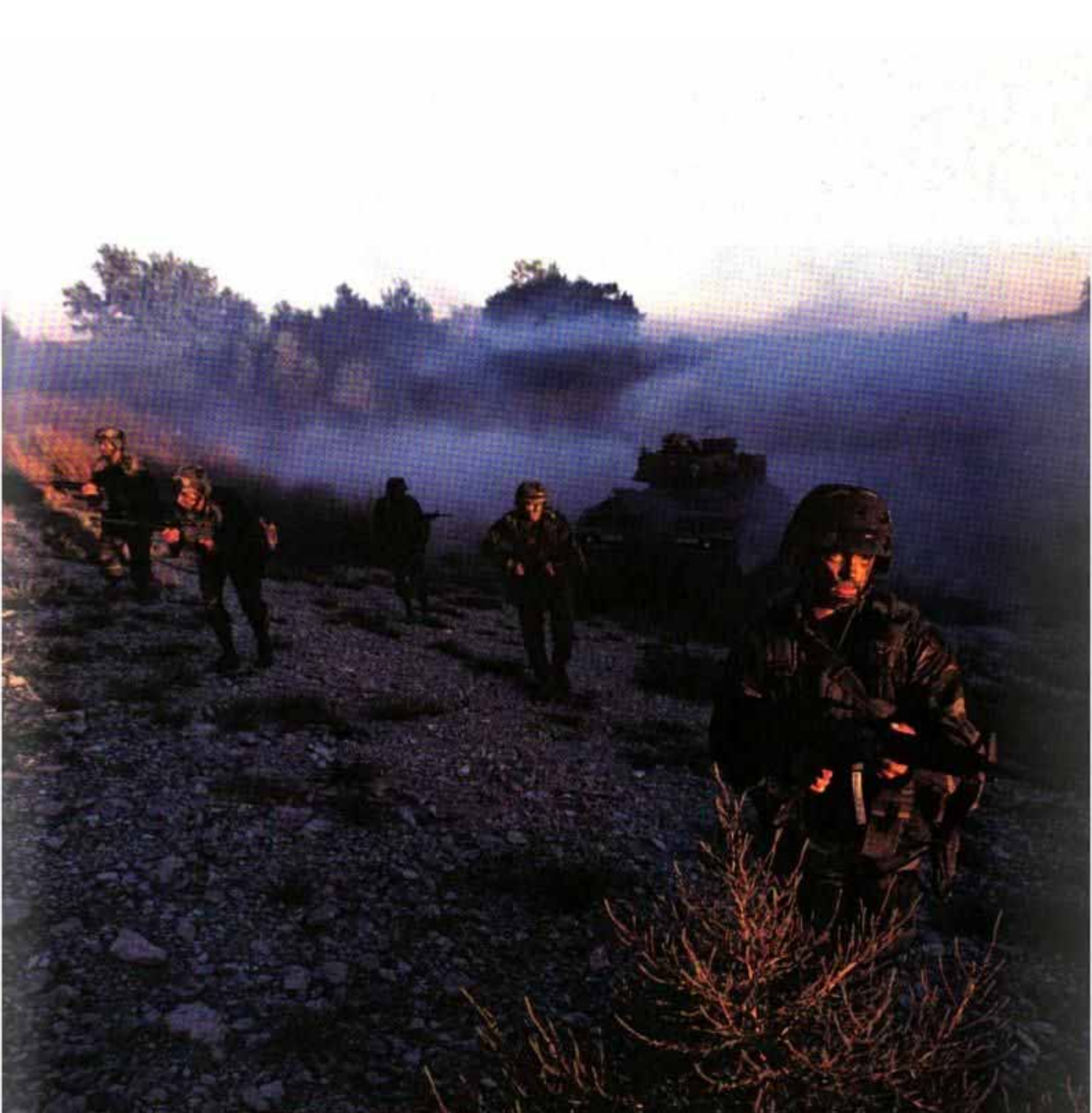
HONITON, ENGLAND—A little-known truck is bringing new meaning to the phrase all-terrain vehicle. Used by the British Army, the 6-wheeled Supacat can handle anything from deep mud to hard ice. It climbs 100% gradients and negotiates sideways slopes of 40°. It can even float.

Supacat's signature technology is a unique handlebar, which allows two types of steering. Conventional steering turns the front two axles. By pulling back on either side of the handlebar, the driver activates skid steering, which brakes the three wheels on one side of the vehicle to permit tight turns and extra traction. A turbocharged VW diesel engine supplies the pull, and wide low-pressure tires avoid tearing up the ground.

pressure tires avoid tearing up the ground.

Six-wheeling Supacat uses dual steering system to traverse inhospitable terrain.





The soldier on the right has it.

So does the soldier on the left. In fact, all the soldiers in this picture have the

**Can you find the \$30,000
in this picture?**

opportunity to earn \$20,000, \$25,000, or up to \$30,000 for college, for a two, three or four year enlistment respectively.

You can too. All you have to do is qualify. The Montgomery GI Bill plus the Army College Fund are great ways the Army helps you save for college. Along the way, you'll also learn things like confidence, teamwork, and self-discipline. The things that will make you better prepared for college. And for life.

See your Army Recruiter. Or call 1-800-USA-ARMY. **ARMY. BE ALL YOU CAN BE.**

Video's New Look

BY FRANK VIZARD, Electronics Editor



● Get ready for a new way to watch movies at home. Sometime in the first half of next year, you're going to see a stunning new video format called the Digital Video Disc (DVD). The disc is the same size as, but in many ways different from, current compact discs.

After seeing a sneak preview, it's clear that the picture quality offered by DVD is vastly superior to the familiar VHS videotapes, and is even demonstrably better than laserdiscs, the best prerecorded source that's currently available.

Here's a basic rundown on what DVD offers:

- 135 minutes of video on one side.
- Multiple-aspect ratio, meaning the disc can be played in a standard 4:3 aspect ratio, a letterbox mode or in a 16:9 aspect ratio.
- Parental lockout feature to censor objectionable material—not suited for young children, for example.
- A minimum of three language channels and four subtitle channels so that you can hear a foreign film in its dubbed or original-language version.
- CD-quality audio.

Pricing for the DVD player is expected to be around \$500. Each DVD disc would be priced under \$25.

Lest you think this new format won't stick or won't become very popular, consider the marketing muscle behind the project. Early on, two approaches to DVD were under consideration. One, developed by Philips and Sony, had a 3.5-gigabyte storage capacity per side, and is potentially upgradeable to 7.4 gigabytes.

A rival approach, though, developed by Toshiba and Time Warner, upped the ante and now appears to be the front-runner in the standards race. Already backing the Toshiba/Time Warner approach are companies like Matsushita (Panasonic), Thomson (RCA), Hitachi, Pioneer,

MCA and MGM/UA. This represents a meeting of the minds between Hollywood and electronics manufacturers—all of whom are eager to avoid a repeat of the VHS versus Beta battle that occurred when the videocassette recorder first appeared.

This DVD has 5 gigabytes of storage capacity per side. And, unlike the Philips/Sony version, data can be stored on both sides—10 gigabytes in all. Put another way, DVD has the storage capacity of 15 compact discs, 6900 floppy disks or a stack of paper twice as high as New York City's Empire State Building. This means that two movies can be recorded on one disc, or side B can be used to provide supplementary video, such as director interviews or material of a more interactive nature.

So just how did they squeeze so much more storage capacity into a compact disc? The Toshiba/Time

Warner DVD is actually two 0.6mm-thick discs bonded back-to-back. Thus, a laser in the DVD player can read data more precisely through a thinner disc. The laser used in the DVD player is also larger than the one in CD players, and it's able to focus better. Both of these factors allow more data to be encoded. The pitch—the distance between data bits—has actually been cut in half.

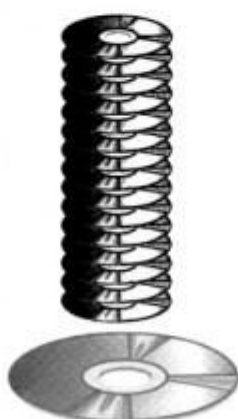
Additionally, DVD employs a digital image-compression technology called MPEG2. Rather than store all the information contained on a video frame, this technique stores only the data that changes from frame to frame.

One thing you won't be able to do is make digital or analog copies of DVD titles. A digital copy would be an exact duplicate, so it's an understandable restriction from a copyright standpoint. But an analog copy is, by nature, something less. It's like being told you can't make a cassette copy of an audio CD. Home recorders will take it on the chin with this format.

But don't worry: Videotape and VCRs aren't going to disappear anytime soon. Both formats will coexist for the foreseeable future. Unlike a videotape, you may not be able to rent a DVD, as it seems designed for retail sale only. Which probably means people will chip in and pass it around. **FM**

Packing It In

A single 10-gigabyte digital videodisc holds as much information as:



15 COMPACT DISCS



6900 3.5-IN. HIGH-DENSITY FLOPPY DISKS



A STACK OF PAPER TWICE AS TALL AS THE EMPIRE STATE BUILDING

FM ILLUSTRATION BY KURT NOVAK



YOUR BASIC® 3-PIECE SUIT



It Tastes Good.
It Costs Less.

SURGEON GENERAL'S WARNING: Smoking By Pregnant Women May Result in Fetal Injury, Premature Birth, And Low Birth Weight.

© Philip Morris Inc. 1995

Kings: 16 mg "tar," 1.1 mg nicotine av. per cigarette by FTC method.

New Cars



PHOTO BY SCOTT DANHOLM

Acura TL

● If Acura's Vigor sedan hasn't been on your shopping list, or even in your short-term memory, don't fret. Since its introduction in 1992, the Vigor has kept a low profile. Low enough that the car and the name are gone.

However, the 1996 Acura TL (for Touring Luxury) should not be overlooked when the new-car bug bites. There are two versions of the Acura: the 3.2-liter V6-powered 3.2 TL and the 2.5 TL, which uses a refined version of the Vigor's inline 5-cylinder engine. The 3.2 TL and the 2.5 TL offer buyers two distinct personalities in a price range of \$29,000 to \$35,000.

The 2.5 TL, although down on power from the V6 model (176 hp versus 200 hp), has a more aggressively

tuned suspension and more low-end torque, making it fun to toss around corners. The 3.2 TL is softer and offers less overall grip, but it is significantly quicker from a stop than the 5-cylinder model.

Acura's engineers developed different structures and engine-mounting systems for each car. To lessen vibration and front-seat noise, the 3.2 TL uses liquid-filled engine mounts, while the 5-cylinder is held in place by electronically controlled hydraulic engine mounts. Even at the 3.2 TL's 139-



Acura TL's interior is both spacious and quiet.

mph top speed, the interior remains quiet enough for Beethoven's Lenore Overture No. 3 to go from speakers to ears without rude interruption.

The TL, with either motor, is enjoyable to drive. But, like all Acuras, this car is ultimately a Honda, which means personality has taken a back-seat to the world-class engineering and dependability. —Scott Oldham

Kia Sportage

The Sportage compact sport/utility continues the Korean maker's formula: Emulate the leader of a market segment, and sell the Kia model at a lower price than the leader.

All 4-wheel-drive Sportages are powered by a dohc 16-valve 2.0-liter Four producing 139 hp and 133 ft.-lb. of torque. Two-wheel-drive models are powered by a 94-hp sohc Four.

We spent two days in a 4wd Sportage, the first covering hundreds of miles on paved roads and the second out in the Anza-Borrego Desert State Park, 250 miles east of San Diego, during a fierce rainstorm. The Sportage's long wheelbase all but eliminates the bone-jarring ride found in many small trucks. And forget the deep mud, the jagged rocks and even the flash flood—out in the desert, nothing but rest stops halted the Kia.

Prices for a 4wd Sportage—with standard power windows and mirrors and rear antilock brakes—start at \$15,295. That should help make this one popular truck. —S.O.



PHOTO BY DECK KELLEY



Solid value and performance set the Kia Sportage apart from the competition.



Race Into Spring Sale

69¢ Qt.
After Rebate

All Season
10W-40
motor oil

CARQUEST Motor Oil

| | |
|------------------|------------------|
| Sale Price | 11.88 Case |
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CARQUEST Cage Cam T-Shirt
Durable 100% cotton, pre-shrunk t-shirt.

SOLAR 40 Amp/12 Volt
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Ex. with Exchange
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CARQUEST 60-Month Battery
CARQUEST has a full line of replacement batteries all backed by the CARQUEST Coast-to-Coast Guarantee. Not available in Hawaii.

1.99 Each
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BRAVO
OIL FILTER
B-1A

Bravo Oil Filters
#B1A - Ford, Chrysler
#B111 - GM
#B241 - Many popular import/domestic applications. Not available in Hawaii.

WIN A TRIP TO THE BRICKYARD 400

August 5, 1995 at Indianapolis Motor Speedway

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AUTOMOBILES



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Heavy duty, professional quality with 6,000 lb. capacity.



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Dexron III/Mercon transmission fluid. 32-oz.



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Everyday Low Price!

CARQUEST carries a complete line of radiators all covered by the CARQUEST Coast-to-Coast Guarantee.

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For use in all cooling systems, including aluminum. 12-oz.



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REMLINE Tool Chest And Roller Cabinet Combo

\$949

Chest #11211-B (\$432 purchased separately)
• Central gas lift opens lid
• Full width bottom drawer with roller bearing slides
• All drawers automatically lock by closing lid

Cabinet #90114-B (\$622 purchased separately)
• 14 drawers
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• Extra deep socket drawer

Drawer liners also available. See store for details.

Buy the Combo and SAVE \$105



Mechanic's Creeper

Hardwood frame with metal reinforced corners. (Tools not included.)

31⁹⁹

CARQUEST Multi-Purpose Lubricant

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Stops squeaks. 9-oz.



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Fast Orange Hand Cleaner Smooth Or Pumice

Sale Price 9.99
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Cleans hands quickly and easily with a fresh citrus scent. 1-gal. Smooth #23-218
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Gallon Size!



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12 cloth towels. 15" x 15" each.



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Cleans carburetors and reduces exhaust emissions. Improves engine performance. 12-oz.



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Improves fuel economy, smoothes rough idle. 12-oz.



turtle wax Finish 2001

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12 month silicone resin/urethane car polish. For all car finishes. 16-oz.



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Synthetic chamois absorbs dirt and grime away from the surface of your car.

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Great for white-wall or black-wall tires. Spray on - wipe off. 20-oz.



Engine Brite Or Foamy Engine Brite

Your Choice **1.79** Each

Removes grease and grime for that "new engine" shine. 16-oz. #EB-1, 18-oz. #FEB-1 (Foamy)



CARQUEST Wiper Blades Or Refills

3.99 Each Blade or Pr. Refills

16", 18" or 19" blade or refills for most cars and light trucks. Made by Trico. Series #358, 451, 452, 453

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Kit includes bracket, mounting hardware

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MADE IN U.S.A.



Blackhawk. 30-Pc. Socket Set

29⁹⁹
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3/4" drive 30-pc. set includes 6 point deep and standard sockets (metric and fractional), a spark plug socket, reversible ratchet and a 3" extension.

2-Gal. Plastic Gas Can

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U.L. approved with vent. Mfr. may vary.



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Glare-free fluorescent light with 25 foot, 18 gauge cord. U.L. listed.

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Portable 11-Gal. Air Tank

Inflates, cleans and pressurizes. 125 P.S.I. capacity. Includes gauge, hose and tire chuck.

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Roller Timing Set

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Specially engineered to meet the demands of high performance applications. Fits Chevy V6 and Small Block V8. Not available in Hawaii.



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Cleans linings, pads, drums and rotors. 19-oz.



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Super heavy duty. DOT-3. 12-oz.



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CARQUEST Glass Cleaner

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BRAVO Spark Plug Wire Sets

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Set

Original equipment replacement. Meets or exceeds SAE specifications. #2949, 2970, 4680



AUTOMOBILES

Detroit Spy Report

BY JIM DUNNE, Detroit Editor



1998 Corvette

● A close look reveals that this is no mere speeding Corvette, not even a current one disguised with some masking and a large scoop on its side. No, friends, this is a prototype of the next-generation 'Vette, due here in 1997 as a '98 model. Despite the camouflage, you can see that though the new car resembles the current one, it's flatter and has smoother lines. Gone are the bulges and angles up front. Also gone is some of the front overhang, and the rear of

and shoulder belts, and flip-out side glass, are other features in this model. Ford is also tweaking its compact Ranger line. In fact, behind the mask of a prototype '96 Ranger is a newly designed front end. A larger grille opening extends above the headlight lines, while hints of fender bulges appear behind the lights. Look for new 4-cylinder and V6 engines in these models as Ford extends its "modular engine" family to light trucks. While the vehicle appears larger in size than



Ford pickups, small and large. New Ranger (left) gets a facelift. New F-Series (right) is really new.

the car is taller and more rounded than it is now. What stay are the big V8 engine and rear-wheel drive.

Ford's Future Trucks

You can expect pickup-truck sales to remain strong right through the end of the century. Ford certainly does. In fact, it's ready to take the wraps off the latest version of its—and the country's—best-selling vehicle, the F-Series full-size pickup. A look at a prototype of the 1996 Ford F-150 reveals one of its most innovative features, a 3-door cab setup. Note how the seams of the third door extend to the rear of the cab. Exterior handles for the door are covered by the front door so that the third door can be opened only after the front one has been opened. To be offered as an option on Club Cab models next year, the 3-door will give owners easier access to the rear compartment. Two rear seats with headrests

today's Ranger, there are no differences in major dimensions.

Concept To Production

Pontiac's and Oldsmobile's concept cars, the 300 GPX and Antares respectively, are close to production. Officials from both GM divi-

sions say the concept cars are actually built from prototype parts of the 1997 Pontiac Grand Prix and Olds Cutlass Supreme. Doors, hoods, rooflines and decks are identical to the future production cars. But some major styling parts are still kept secret. On the Oldsmobile Antares, the frameless glass in the doors will be framed on the '98 model production car. Pontiac's Grand Prix 300 GPX will have a different grille and side cladding when it goes into showrooms in late 1996.

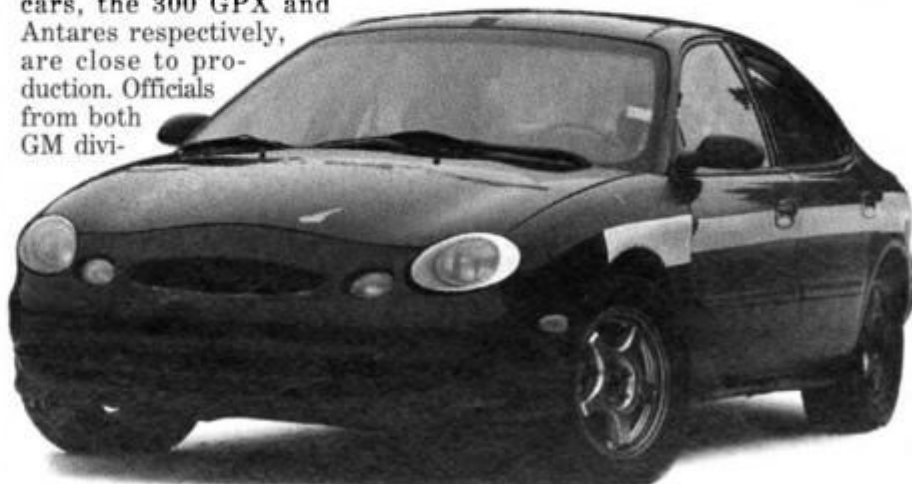
Bye, Bye, Big Guy

Plans to build a rear-wheel-drive Buick from an Opel chassis were canceled by GM brass. The proposed car, based on an Australian Opel chassis and styled like the sensational XP2000 show model, fell outside Buick's narrowing market focus. Look for Buick to concentrate on front-wheel drive in all its future models. And that, for now anyway, means the rear-wheel-drive Roadmaster is doomed.

SHO Taurus

Still under test is this prototype SHO Taurus, 1996 style. Close inspection of the exterior reveals unique wheels and front fascia. Tires are oversized 16-inchers, with a 55-series aspect ratio.

Under the hood is another surprise—a 3.4-liter 60° aluminum V8. The engine, rated at 250 hp, is Ford-built and replaces the Yamaha V6 of today's SHO Taurus. **FM**



Next-generation Taurus gets SHO version, powered by an aluminum V8 engine.

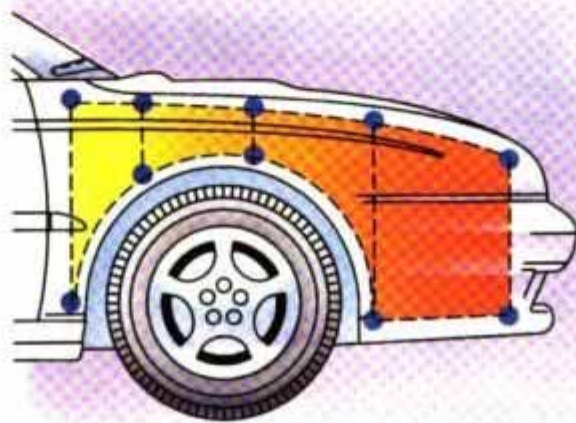
ONLY ONE OF THESE CAN HELP YOU AVOID

It seems every carmaker today is touting its safety features. The trouble is, you have to get into an accident in order to see how well they work.

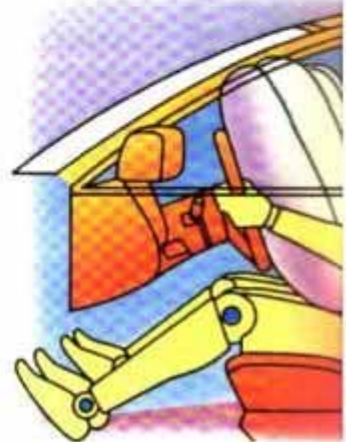
AVOIDING TROUBLE.

Embodied in the new Subaru Legacy is our firm belief that the best way to survive an accident is to avoid one altogether. Which is exactly why the all-new Legacy offers the active safety of Subaru All-Wheel Drive. This advanced system is designed to supplement the on-board passive safety features like dual air bags* and energy-absorbing crumple zones.

Under normal driving conditions, Subaru All-Wheel Drive delivers power to all four wheels. But should the system sense a loss of traction on a slippery surface, power is instantly redirected to whichever wheels have the best grip, usually making its adjustments before the driver even recognizes the problem. Altogether, it gives you the confidence of



Crumple Zones

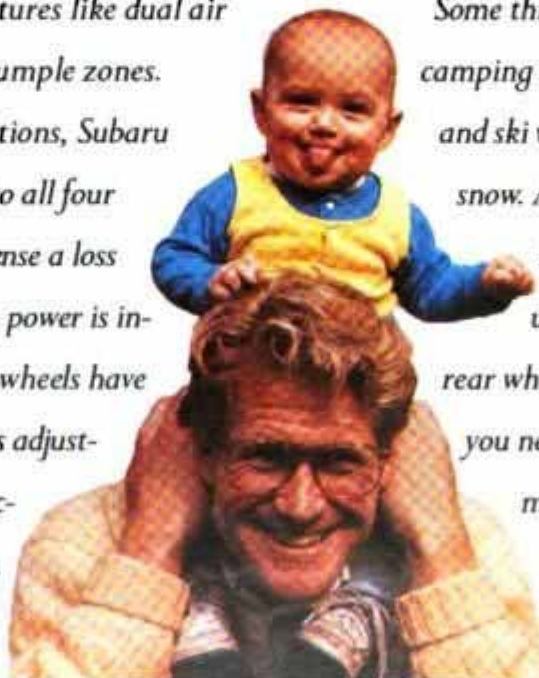


Air Bags

outstanding traction when and where you need it. Along with a better chance to avoid an accident. And that's the beauty of All-Wheel Drive.

AVOIDING NOTHING.

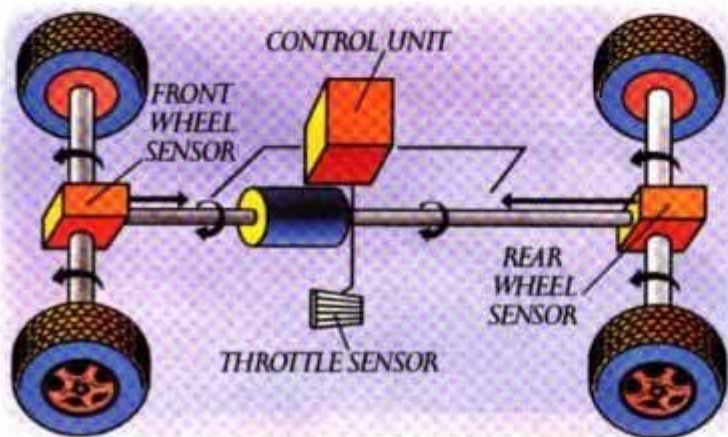
Some things you don't want to avoid. Like camping trips that invariably involve mud, and ski vacations that had better involve snow. As conditions change, the All-Wheel Drive system automatically distributes power between the front and rear wheels helping to provide the traction you need. One of the reasons Subaru sells more all-wheel drive cars in America than all other makes combined.**



*Always wear seat belts. **Based on R.L. Polk & Company Registration Statistics for year-end 1993.

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Subaru All-Wheel Drive

All-Wheel Drive Subaru Legacy is safely within your reach.

So call 1-800-WANT-AWD, or visit your local Subaru dealer to learn more about all the advanced safety features that are available on the new All-Wheel Drive Subaru Legacy. Including the ones you

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may never need.



Maintenance costs are surprisingly modest. Fuel mileage is better than a front-wheel drive Honda Accord Wagon. And starting at \$15,999,** even the price of an*

The New All-Wheel Drive Legacy, LS Station Wagon

SUBARU. 
The Beauty of All-Wheel Drive.

*Based on comparison of EPA city fuel economy estimates for 1995 Subaru Legacy and 1995 Accord Wagon. **Manufacturer's Suggested Retail Price of Legacy Brighton AWD M/T Wagon. Price does not include inland transportation, taxes, license and title fees. Dealer's actual price may vary. Pictured is Legacy AWD LS Station Wagon. MSRP is \$21,820. Certain items shown are optional equipment available at an additional charge.

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Return Of The Lifting Body

BY GREGORY T. POPE, Science/Technology Editor



● They were the “finned potatoes” that streaked from the underwings of B-52s. Yes, they were rockets—in fact, the last rocket-powered X-planes to fly—and they reached supersonic speeds and 90,000-ft. altitudes. But unlike the X-15, their sleek Mach-busting contemporary, they looked like fat, wingless bumblebees.

More than mere freaks of flight, though, the lifting bodies of the 1960s and 1970s pioneered space travel. Specifically, they showed that a space shuttle could land on a runway without needing jet engines. They did their job and then retired into history. But now an ambitious proposal may actually bring the lifting body back to life, in a bid to do what the shuttle really doesn't do—make access to space both routine and affordable.

Conceived in 1957, the lifting body is simply a vehicle sculpted to gain aerodynamic lift from its body contours, rather than from wings. Proponents argued that a lifting body could ride a rocket into orbit, then dive safely back through the atmosphere and land on a runway. Three full-scale experimental lifting bodies carried pilots between 1965 and 1975.

It was 30 years ago that the beer-bellied M2-F2 first rolled out of

Northrop's Hawthorne, California, plant. A year later, Northrop's HL-10, cambered like an upside-down airfoil, saw daylight. The two rival designs—hatched respectively by NASA's Ames and Langley Research Centers—hit trouble early on. The M2-F2 crashed in 1967 (and again and again during the title sequence of “The Six Million Dollar Man”). Meanwhile, the



HL-10 pioneered the lifting body. Lockheed's proposal (top) revives it.

HL-10 experienced control problems on its maiden glide flight and was grounded for 15 months. Not until November 1968—when the HL-10 ignited its XLR-11 rocket engines—did a lifting body fly on its own power.

The third and most sophisticated lifting body—Martin Marietta's X-24A—first dropped from its B-52 mothership in 1969. On November 26,

1975, the vehicle touched down for the last time. Piloted lifting bodies haven't flown since. And NASA picked the shuttle's winged-cylinder silhouette over a design, blueprinted by Lockheed, that featured lifting-body geometry.

Now, 20 years later, Lockheed is at it again. The company's Skunk Works has revived the lifting body in its proposal for the X-33, a spacecraft that NASA wants built to preview a shuttle replacement (see Tech Update, page 17, Feb. '95).

Can the lifting body make the leap from X-plane to space plane, which is fledged with huge thrusters and loaded with fuel tanks? Lockheed's David Urie, director of high-speed and space systems for the Skunk Works, certainly thinks so. He points to several lifting-body advantages.

For one, the design sidesteps tricky vertical touchdowns. “We were looking for a way to land horizontally,” Urie explains. “And both Martin and Northrop built lifting bodies that landed successfully.” After all, the original lifting bodies were designed to answer questions about landing. And they proved that wings were unnecessary.

Winglessness, in turn, brings up another advantage. "I'd prefer not to carry wings because they don't make good cryogenic fuel tanks," says Urie. In a single-stage-to-orbit vehicle, any weight that doesn't contribute to payload or fuel volume just drains spacecraft performance. Not only does a lifting body eliminate wings' parasitic weight, but its voluptuous shape can embrace more payload and fuel.

"One of the benefits of the lifting body is volumetric efficiency," agrees George Ware, who at NASA-Langley worked on the HL-10 and now analyzes space vehicles. "The most efficient is a ball, and a lifting body is just a ball mashed into an aerodynamic shape. The problem, though, is that it's a difficult volume to package."

Sculpting fuel tanks to fit the contours of a lifting body, he explains, makes them hard to manufacture. And irregular tanks would need thick—and thus heavy—skins to resist pressure. That was one of the reasons NASA picked the simpler winged-cylinder shape for the shuttle. "We were trying to solve the easier problem first, of getting to orbit," says Ware. "To do that, we had to get the weight of the vehicle down to a minimum." Urie contends, however, that in a lifting body, the payoff in volume would more than counter the added weight.

Meanwhile, the argument that rings loudest in favor of the lifting body is its ability to shake off heat during atmospheric reentry. Compared to a winged vehicle, a lifting body presents a greater bottom surface area to the air as it descends Earthward. The amount of air-friction heating it will encounter is proportional to its weight. Therefore, for a lifting body and a winged body of equal weight, the lifting body will distribute the heating load over a greater area. That means each point on its lower surface will stay cooler.

This principle could have major ramifications for cheaper spaceflight. "In turning the shuttle around, one of the biggest headaches is taking care of those thermal-protection tiles," notes Bob Baumgartner, chief engineer on the Lockheed X-33 project. "We're trying to find a system to eliminate that manpower-intensive task." In Lockheed's proposal, ceramic and metallic materials replace the tiles.

Lockheed has joined forces with corporate partner Martin Marietta on its X-33 bid. As this issue went to press, their proposal had just gone in. As you read this, NASA may have already granted a follow-on contract authorizing further study. But no matter the outcome of the X-33 competition, the lifting body's plump silhouette continues to allure engineers. **PM**

PM HOTLINES

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Asia Spy Report

BY SCOTT OLDHAM, West Coast Editor



PHOTO BY MICHAEL HANCOCK

1996 Nissan Pathfinder

● We caught this heavily disguised prototype of the next Nissan Terrano being tested in England. The Terrano, a sport/utility that Nissan sells in Europe, will come to North America as the 1996 Pathfinder. But perhaps even more important is the fact that Infiniti—Nissan's luxury-marketing arm here in the States—will also be getting a version of the vehicle, making it the first



This bigger, more powerful Mitsubishi Diamante will debut in July 1996.

Japanese luxury nameplate with a sport/utility on the showroom floor.

Both Nissan and Infiniti versions will be V6 powered. The truck is tall and narrow, in the style of Isuzu's Trooper and Mitsubishi's Montero. The all-new vehicle's styling is contemporary, yet conservative. Glass is flush and in abundance; the body lines are swooping, but subtle. There's a step for easy ingress and egress, and the beltline is low, giving the driver better forward vision. The new front end is expected to resemble Nissan's Maxima, with a rectangular grille and headlamps. The rear-end has taillights down in the bumper and an outside-mounted spare tire.

1997 Mitsubishi Diamante

Launched recently in Tokyo, the new Mitsubishi Diamante will be introduced to the United States in July 1996 as a 1997 model. Mitsu's Q-ship remains front-wheel drive and will be available with one of four V6 engines. The list begins with a lean-burn 2.5-liter engine that makes 175 hp, offers the economy of a 2.0 liter and produces substantially less NO_x. Next

up is a non-lean-burn, twin-cam version of this same engine, which makes 200 hp. Then there's a 230-hp dohc 3.0-liter and a 270-hp dohc 3.0-liter with variable-valve timing.



Turbocharged Impreza wagon sports 223 hp and race-car looks.

The Diamante's wheelbase remains 107.1 in., but a longer rear overhang and larger trunk increase overall length 2 in. Inside, there's slightly more room, and wood is used on the dash, console and door panels. Keeping with the current trend, the rear is held up by a new multilink suspension similar to the type found on Hondas and Nissan's new Maxima. Expect to pay somewhere in the high 30s for the new Diamante.



Acura CL-X showcar represents a true sneak peak at Acura's 1997 lineup.

Acura CL-X

The "Neoclassic" theme of Acura's CL-X showcar caused bug-eyed crowds at Detroit and L.A. auto shows. At the sight of those bulging eyes, Acura's brass breathed a sigh of relief



This Nissan Skyline GT-R may be the next 300ZX.

because this coupe will hit its showrooms as a 1997 model with most of its aggressive styling intact. The front-wheel-drive CL-X was created at

Honda's Los Angeles design studio, and will be built in the United States.

An Acura source says the showcar's radical rear-end styling will be on the production car, including the unusual triangular taillamps. The beltline that runs the length of the car will also

(Please turn to page 42)

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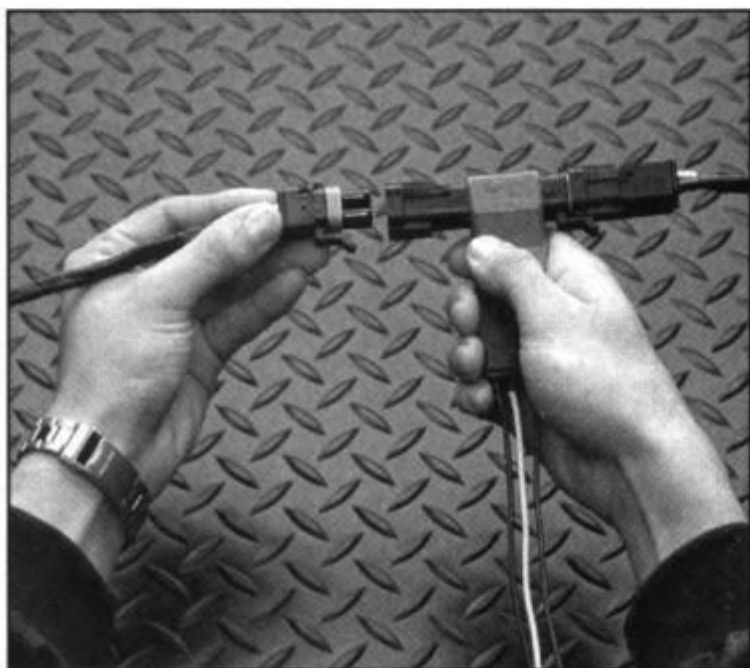
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remain, but the sculpted doors and the pointed beak won't make production.

The CL-X's 106.9-in. wheelbase, the same as the Accord, and wide 63.2-in. track will carry over to the production car. The eye-catching and road-grabbing 18-in. front and 19-in. rear wheels, however, will not make the cut.

Under Acura's new alphanumeric naming system, which will start with this year's Vigor sedan replacement called the TL, this coupe will wear the name 3.0 CL—the 3.0 being the all-new 3.0-liter dohc V6 now being developed. As with the Honda Accord, a 4-cylinder will be standard, with the new V6 as an option.

Nissan 300ZX

The rumors have been flying that the 1996 model year will be the last for Nissan's 300ZX. But knowledgeable sources at Nissan say the Z-car will live on. However, the car is due to change since it's expected that Nissan will Siamese the Japanese-market Skyline and the U.S.-market 300ZX. So while the Z will survive, it'll have to save Nissan some bucks in the process. However, Z-car fans need not despair. After all, the present Nissan Skyline, which was just introduced in Japan, is considered that country's hottest car. The Skyline GT-R is powered by a 280-hp 2.6-liter twin-turbocharged inline Six. The 4-passenger car sits on a 107.1-in. wheelbase, weighs 3373 pounds, sports awd and 4-wheel steering, and runs a standing quarter-mile in 13 seconds.

Unfortunately, there's a serious problem—as in virtually unsolvable—when it comes to adopting lefthand drive to the current car because of the unusual engineering that routes the steering column through the ceramic turbos. If the problem can't be solved, the fusion of the two cars will have to wait until the next-generation Skyline is ready, late in the decade.

Subaru Impreza WRX Sport Wagon

Turbocharged dohc 223-hp engine with a 7000-rpm redline, all-wheel drive, 4-wheel vented disc brakes, body-hugging seats and a bulging hood covered in racing stripes—it sure sounds like that sports car you'd be driving if Junior's tuition wasn't bleeding you dry. Fact is, it's a Subaru Impreza station wagon, albeit with some serious attitude. And, rumor is, it may be coming to North America in 1996. To light a fire of interest under the slow-to-sell Impreza, Subaru dealers may get some of these WRX wagons that are fashioned after Subaru's successful World Rally Championship race cars. Presently, this baby dragon wagon is sold only in Europe and Japan. **FM**

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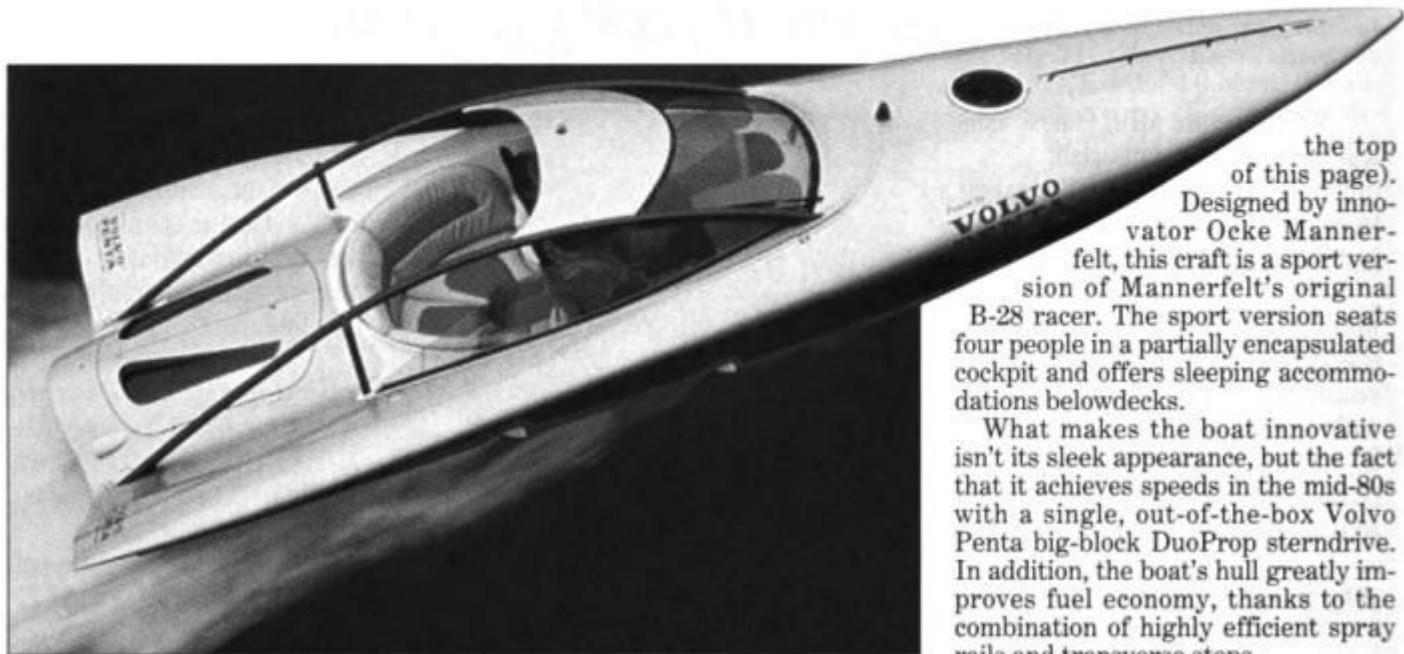
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BOATING

Boating Beyond 2000

BY JOE SKORUPA, Boating/Outdoors Editor



● The future's so bright that boaters will have to wear shades. That was the message delivered during a breakfast meeting at the recent New York boat show, where the National Marine Manufacturers Association assembled a panel to discuss Boating Beyond 2000. Being an occasional futurist, I was asked to serve on the panel and contribute predictions in the area of marine engines. My co-panelists were Norman Nudelman, an expert in boat design and construction from the Westlawn Institute of Marine Technology, in Stamford, Connecticut, and Gordon West, a noted authority in the field of marine electronics. The panel's vision of the future turned out to be quite interesting (no one threw bagels), so I jotted down the highlights for those who are interested in learning where boating is headed in the next century.

● Future boats will be designed, engineered and modeled by computer. No surprise here, except that today only about 50% are designed this way, and all—whether created on paper or computer—are currently modeled by hand out of clay or wood.

● Moving images of future boat designs will enable designers to use virtual-reality technology to take prospective builders and buyers aboard concept boats for both tours and sea trials.

● When a design is finished and ready to be constructed, builders will

send electronic data to machines that automatically make a mold by precisely routing out shapes from relatively inexpensive foam blocks.

● Expect to see more multihulls in both sailboats and powerboats. Multihull sailboats go faster and sail more upright than monohulls. Power catamarans develop greater speed per horsepower and burn less fuel.

● Fiberglass composites remain the material of choice for the foreseeable future, but the use of advanced composites will increase as prices come down. Polyester resins will shortly disappear due to restrictions on styrene emissions. Epoxy resins, now rarely used in construction, will become the resin of choice.

● In general, designers who are successful in the future will break free of conventional restraints. Powerboats will fly (using ground-effect techniques) and sailboats will operate sans sails (possibly using fixed wings or rotating cylinders to generate lift).

● One boat of the future, the Volvo Penta B-28, appeared last year. This delta-wing concept craft has a lifting fuselage for high-speed stability, a series of transverse hull steps (cutaways that run across the latitudinal axis of the running surface) and spray rails (sharply pointed reverse strakes) that run longitudinally on the aft two-thirds of the bottom.

This year, Volvo Penta unveiled the next-generation B-28 (shown at

the top of this page). Designed by innovator Ocke Mannerfelt, this craft is a sport version of Mannerfelt's original B-28 racer. The sport version seats four people in a partially encapsulated cockpit and offers sleeping accommodations belowdecks.

What makes the boat innovative isn't its sleek appearance, but the fact that it achieves speeds in the mid-80s with a single, out-of-the-box Volvo Penta big-block DuoProp sterndrive. In addition, the boat's hull greatly improves fuel economy, thanks to the combination of highly efficient spray rails and transverse steps.

● The traditional "Mayday" emergency signal will soon be replaced by a datastream from a marine VHF radio that not only sends out a call for help but identifies the boat requesting assistance, and gives the position of the call in longitude and latitude by linking with a GPS unit. This datastream is called digital-selective calling (DSC), and can be sent either manually or automatically.

● Ship-to-shore calls will feature automatic dialing, just like cellular phones. The present system of using a VHF radio to connect with a marine operator to make the link to land-based service will be abandoned in favor of a low-Earth-orbit satellite system. This arrangement will turn analog transmissions into binary codes and then reform the analog voice at the other end.

● The future of marine navigation is in GPS, and this future is already upon us. Personal GPS receivers will soon be the size of pagers and worn on belts. Larger units will come with built-in electronic charts so detailed and accurate (thanks to differential correction) that boaters will be able to set the autopilot and navigate within 10 ft. of their slip.

● This kind of capability means the present Loran system will be a memory by 2005. The Coast Guard is currently moving out of Loran-system maintenance. Private industry may take it over for a while, but the long-

term picture doesn't include Loran.

- Underwater sonar will incorporate phased-array transducer elements, not only to look down at the bottom and around the sides to see fish, but also forward to detect underwater hazards. These phased-array transducers will work without the help of moving mechanical parts.

- Radar will go from using a cathode-ray tube to flat panel displays. It will eliminate the current, slow sweep rate and yield a live picture without a mechanical unit rotating on the flying bridge or mast.

- Heavy wire bundles will soon be replaced by fiberoptic cables. Thousands of channels of information can be sent almost simultaneously on a fiberoptic cable, thus eliminating the need for massive corrosion-prone wire.

- With advanced satellite communications currently in development, we will ultimately be able to eliminate the "search" in search and rescue, and the "gone" in gone fishing. Position fixing will be ubiquitous and automatic.

- Starting this year, we're entering the most revolutionary period the marine engine industry has ever experienced. The dawn of environmental regulation by the EPA will force all engine manufacturers to accelerate the tempo of technological progress to a rate never before seen in the industry.

- Electronic fuel-injection (EFI) systems in marine engines have been developing since the late 1980s, but they'll be a juggernaut in coming years. Look for all marine engines—outboards, sterndrives and diesels—to be equipped with EFI at some point beyond 2000, and this includes most midsize and some small motors. Benefits of EFI are increased fuel efficiency, lower emissions levels, higher power and smoother operation.

EFI and other technologies will push the cost of the biggest V6 outboards and big-block gas inboards and sterndrives toward the pricey \$25,000 mark. On the upside, expect

longer warranties (from 3 to 5 years) to increase value.

- Four-stroke cycle outboards of the future are already starting to appear. But, contrary to earlier predictions, these motors are no heavier than current 2-strokes. Technology that was pioneered in motorcycles and cars solved the weight problem.

- Although the cost will be higher for 4-stroke cycle motors, boaters will get a break in dramatically improved fuel economy (up to 80% less fuel consumption at wide-open throttle). For those who remain loyal to proven 2-strokes, expect a dramatic drop in price to occur as the deadline of 2006 for EPA phaseout nears.



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- If the EPA eliminates the proposed reduction in NO_x (oxides of nitrogen), a scenario hoped for by the marine industry, look for the introduction of electronic carburetors on sterndrives and inboards. These low-cost, bolt-on units add electronic sensing and automatic adjustment to old-style carburetors. Ultimately, however, they'll be phased out in favor of EFI, at which point carburetors will become artifacts, except in specialty applications.

- Right now we hear about two different EFI technologies—throttle body and multiport injection. Soon, we'll hear about central-port injection and constant injection. Both of these cost less (from a production/develop-

ment point of view) than multiport injection, but multiport will be the ultimate winner of the technology race. Why? Because of its sophistication. Future multiport-injection EFI systems will be able to adjust the air and fuel mixture of each cylinder for each revolution of the crankshaft.

- Direct-injection 2-stroke engines, the most sophisticated marine technology, will begin appearing on the first OMC engine in 1996 and then phase in quickly. Direct fuel injection differs from EFI in the location of fuel delivery. Direct-injection systems deliver fuel into the combustion chamber of the cylinder. EFI systems deliver fuel to an outer passageway.

Mercury Marine has recently committed to developing direct-injection 2-strokes, and so will other builders, including manufacturers of personal watercraft.

- The advent of this new engine technology will make marine motors highly efficient. The engines of the future will show continued dramatic improvement in fuel economy, horsepower, torque delivery throughout the powerband, improved cold starts, noise reduction, fume elimination and reliability.

- All future boat engines will be equipped with microprocessor management/monitoring systems called electronic control mod-

ules (ECMs). Some engines have ECMs now, but from future units we'll be able to learn from past experiences and predict patterns and average parameters.

- With engines monitoring so much internal data through ECMs, builders will soon take advantage of the situation by visually displaying the information, first through simple lights and then through LCD computer screens. Maintenance cues and diagnostic data will appear on these screens as needed. At this point, today's instruments and gauges will be things of the past.

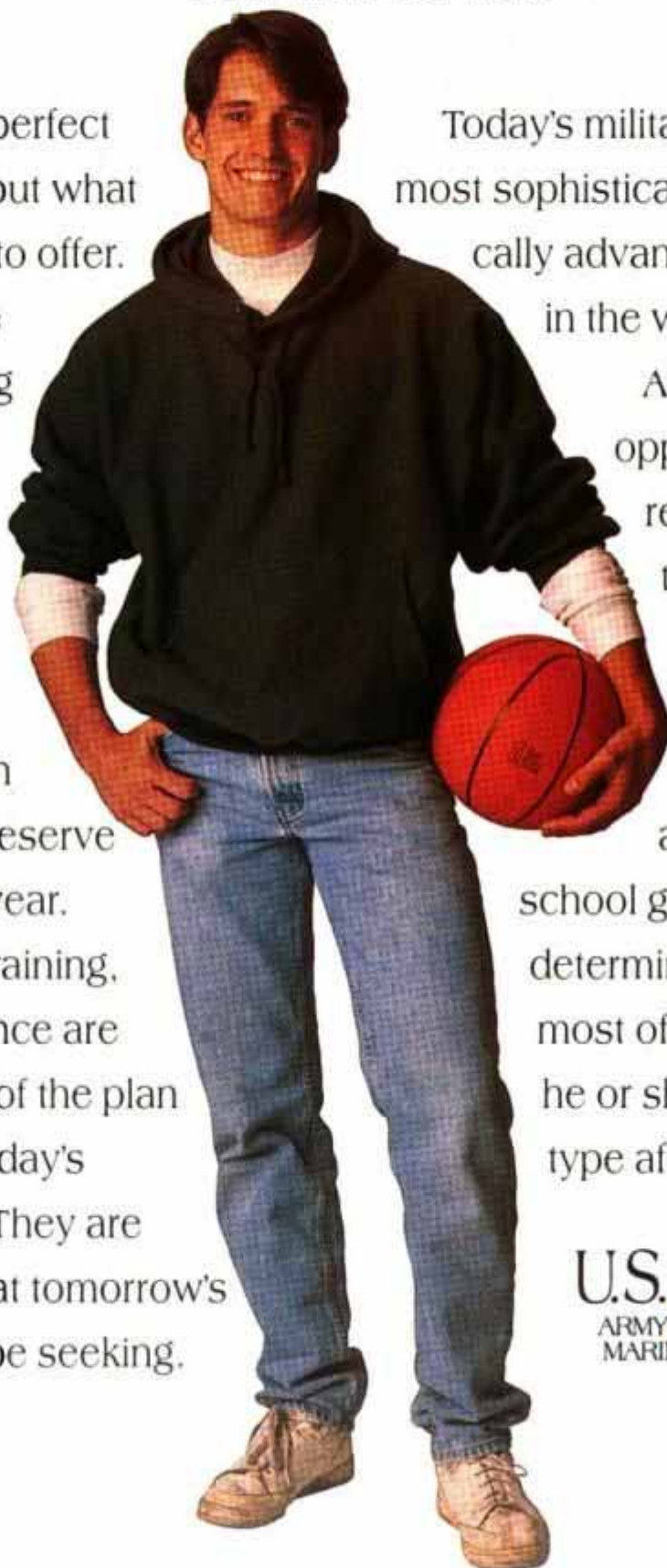
What else? Lots. The future's bright, so break out the shades. **PM**

IF YOU NEVER THOUGHT OF YOUR CHILD AS THE MILITARY TYPE, THINK AGAIN.

Now is the perfect time to think about what the military has to offer.

Although the military is getting smaller, the Armed Forces still need to recruit almost 400,000 young men and women for Active and Reserve positions each year.

Education, training, and job experience are important parts of the plan to restructure today's Armed Forces. They are also exactly what tomorrow's employers will be seeking.



Today's military is one of the most sophisticated and technologically advanced organizations in the world.

As in the past, the opportunities and rewards for joining the military will continue.

So, if you know a smart, ambitious high school graduate who's determined to make the most of the future, maybe he or she is the military type after all.

U.S. ARMED FORCES
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GET RICH QUICK!

Untold riches still lie within reach of the adventurous. Here's how and where to find them.

BY GREGORY T. POPE,
Science/Technology Editor

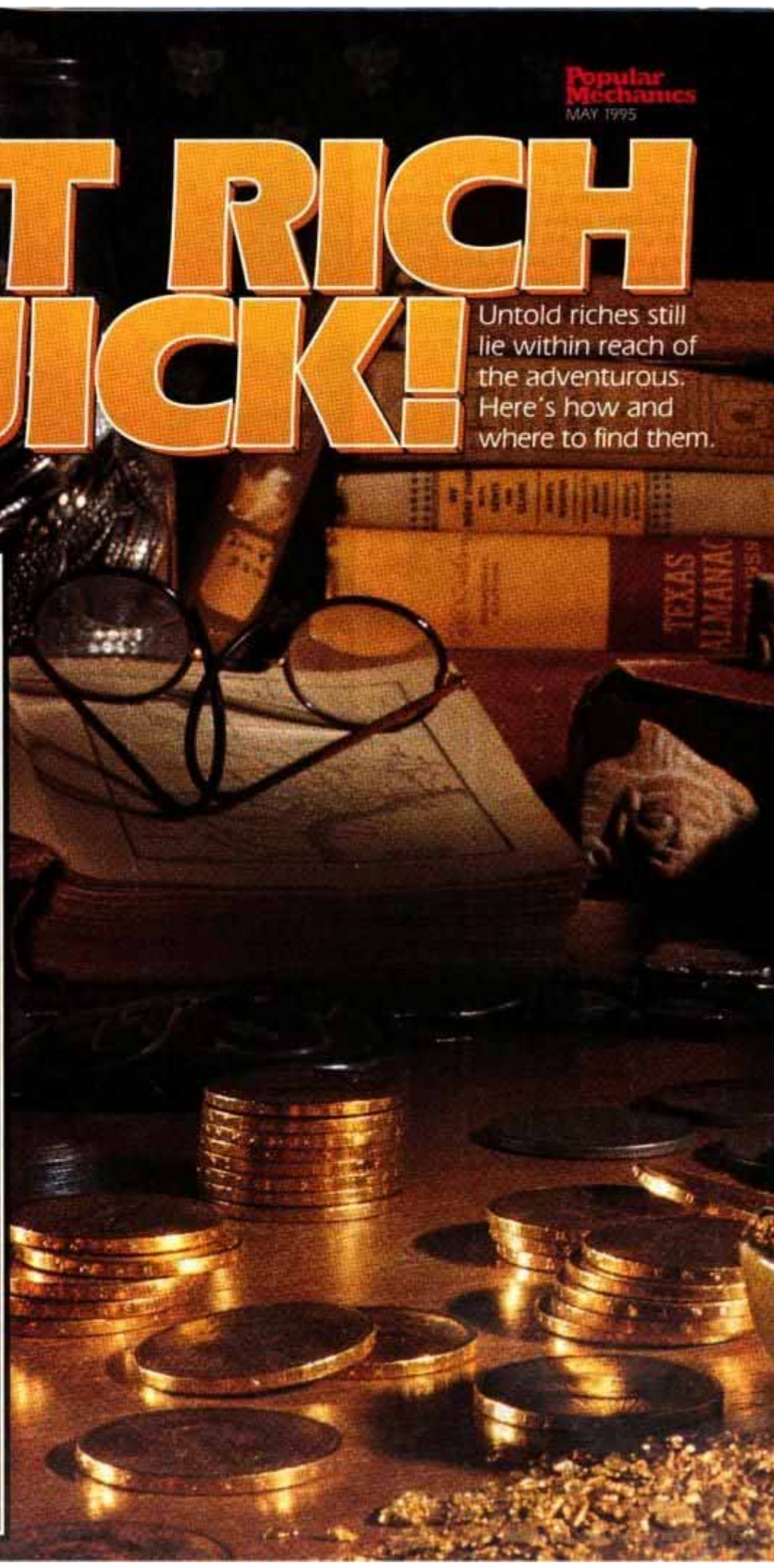
● Trapped in a canyon north of the Rio Grande, with Comanche Indians closing in, the band of prospectors had little choice but to bury \$250,000 in gold beneath a pile of rocks. One man escaped the ensuing massacre, and his son returned later to find the treasure. But weather had resculpted the canyon's topography and he left empty-handed.

In 1863, Confederate guerrillas captured some Union soldiers hauling \$350,000 in jewelry from plundered Virginia plantations. Before they marched their prisoners to Culpeper, the Southerners decided to bury the loot. But a flurry of troop movements then drove them from the area, and the treasure remains unrecovered, if not forgotten.

Outside Deadwood, South Dakota, three outlaws buried 47 stolen gold ingots in 1884. Captured later by Army troops, they died in prison without revealing the cache's location.

Pirates and pioneers, gold miners and gangsters, eccentrics and desperados—just as they enriched American history, they've also enriched the American landscape. No matter where you live, buried treasure lies nearby—whether it's bandit booty, an untapped vein of gold or simply a rusting Confederate belt buckle.

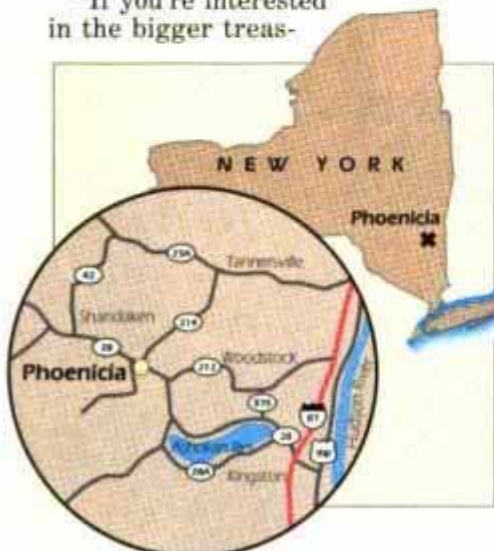
"It's been said for 25 years that there's more treasure lost, buried or hidden than there is in circulation today," notes Charles Garrett, president of Garrett Electronics and a long-time treasure hunter.



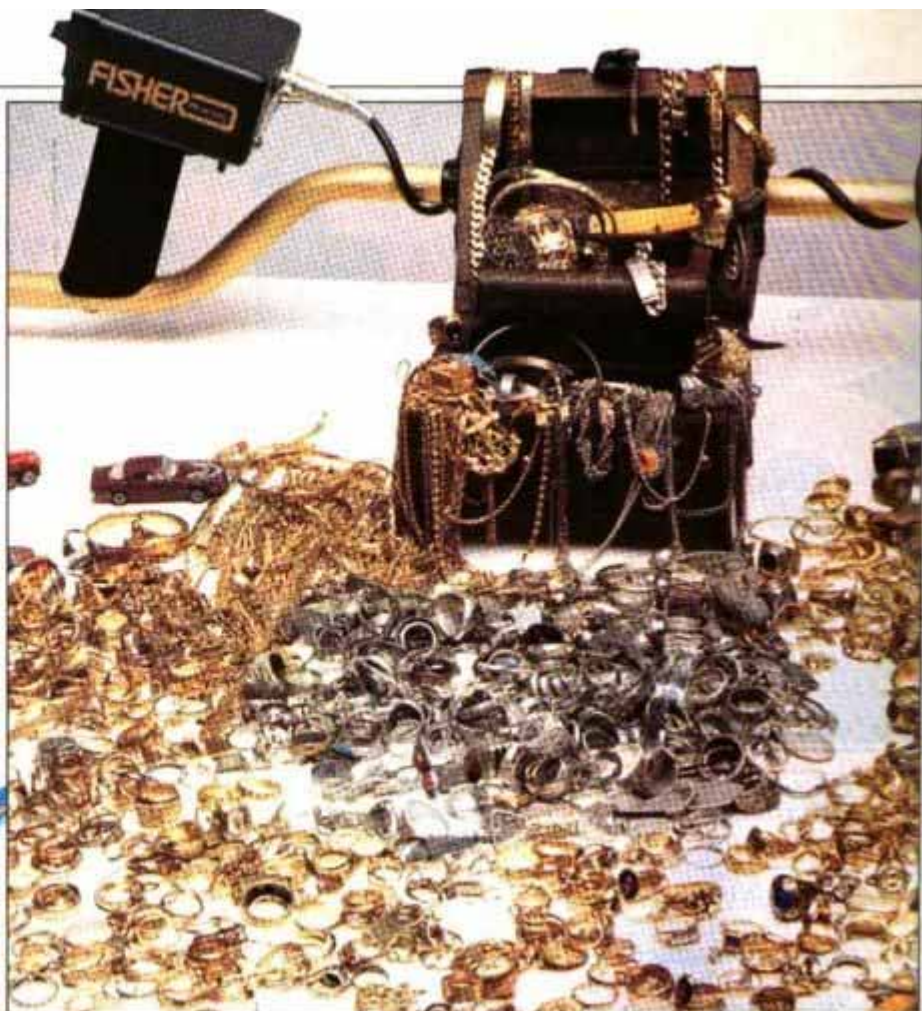
GET RICH QUICK!

To be sure, your chances of stumbling across a lost chest of Spanish doubloons rank up there with your odds of winning the state lottery. But stumbling won't get you far in your quest to strike it rich. There are two approaches to treasure hunting, and coin dealer John Parker of Middle Tennessee Coin and Jewelry, in Murfreesboro, likens them to fishing strategies: "Some cast their line in and come out with anything. Others fish for trophy bass with a large lure that a small fish isn't going to hit."

"If you're interested in the bigger treas-



1 In 1933, gangster Dutch Schultz tucked \$7 million in diamonds, gold pieces, \$1000 bills and liberty bonds into a steel chest. Its believed location: south of Phoenixia along Route 28.



Hunters can pile up treasure piecemeal or hit payday, such as a \$75,000 nugget (below left).

ures, they're within reach of anyone with enough patience and stamina," adds Milford Webster, a Salisbury, Maryland, computer consultant and part-time treasure hunter.

Maps and rumors

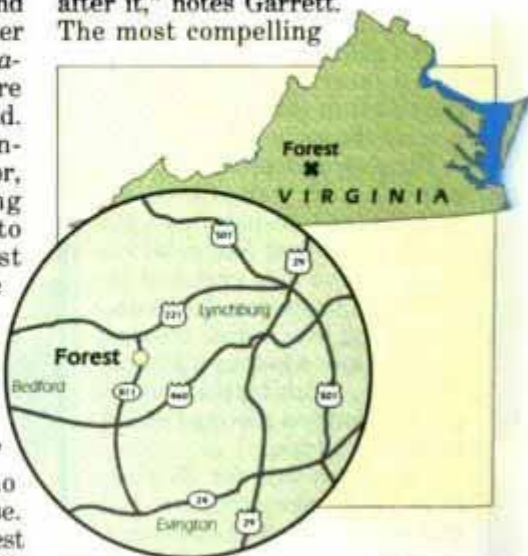
Where to begin? It depends where you want to look. One of the best guides to the geography of buried treasure is the 10-volume *United States Treasure Atlas*, put out by Specialty Publishing of La Crosse, Wisconsin, and sold in metal-detector shops. Another is the software *U.S. Treasure Database*, available through Treasure Garden in Salisbury, Maryland. The books roar comprehensively through fact and rumor, encompassing everything from relics and fossils to sunken ships and ghost towns. By contrast, the database zeroes in on 2500 sites and tags each with a reliability factor. "Most things fall into the legendary category," notes Webster, who compiled the database. "Those that have the best credibility have the most reliable documentation."

Check that documentation with a trip to the nearest library, treasure hunters urge. Valuable leads

can also spring from old maps that chart abandoned property and the courses of forgotten canals and railroads. Of course, documentation only goes so far. If words could pinpoint the exact location of buried treasure, someone would have already dug it up.

Accomplished treasure hunters develop a sixth sense about how a lead will pan out. "If we can come up with five reasons why it's there, but even a single reason why it's not, we won't go after it," notes Garrett.

The most compelling



2 As the Civil War drew to a close, a Confederate general concealed \$4 million in gold coins and bullion either in a well or a barn at the McIntosh farm, about a mile south of Forest.

Map courtesy of the Virginia Historical Society

POPULAR MECHANICS • MAY 1995



Metal detectors uncover gold nuggets as well as antique coins.



4 During Indian trouble in the 1790s, the Bridge family buried an iron cooking pot filled with gold coins. Their cabin stood 5 miles west-southwest of Eaton. The treasure was never recovered.

adds that quests for lost mines turn into wild-goose chases—an opinion echoed by other treasure hunters.

Just as important as research is getting permission from the landowner, whether it's your long-lost uncle or Uncle Sam. Get it in person. Get it in writing, along with a personal-liability waiver.

Tools of the trade

Once you've settled on a site, it's time to round up the necessary equipment. Bring digging tools—a folding shovel, a strong pick and a long, thin metal probe are good choices. But above all, bring a metal detector—the all-purpose divining rod of the modern-day treasure hunter.

Metal detectors have evolved dramatically over the decades. "I think I found a million beer cans using World War II metal detectors, which weren't very good," says Garrett, one



3 Before the rush of 1849, Rutherford County was America's gold source. It remains a magnet for amateur prospectors. Gold coins from an old mint also crop up around Rutherfordton.

reason to give up: the likelihood that someone has found the treasure and is keeping mum.

Places to go

A 50-year veteran of the quest for buried riches, Garrett also favors certain types of locales over others. Ghost towns, for example, virtually guarantee a successful expedition, even if you come home with just a few old silver coins. Ghost towns also hold out promise for small pockets of concentrated treasure.

Because they offer easy pickings, though, ghost towns will likely have lured and rewarded treasure hunters before you. The seashore, by contrast, renews its riches continually. "Go to any beach south of South Carolina,"

advises professional treasure hunter Jimmy "Sierra" Normandi. "After a storm, there are thousands of 1695 and 1715 gold coins still washing ashore from galleons that spilled in those two years."

Although tales of buried desperado loot offer tantalizing monetary values, they lie few and far between. "For every outlaw cache that was laid down," says Garrett, "you probably have a thousand farmers who might have put something in the ground. So the odds are in your favor to research these—the early-day settlers, the old hermits who didn't trust banks." He

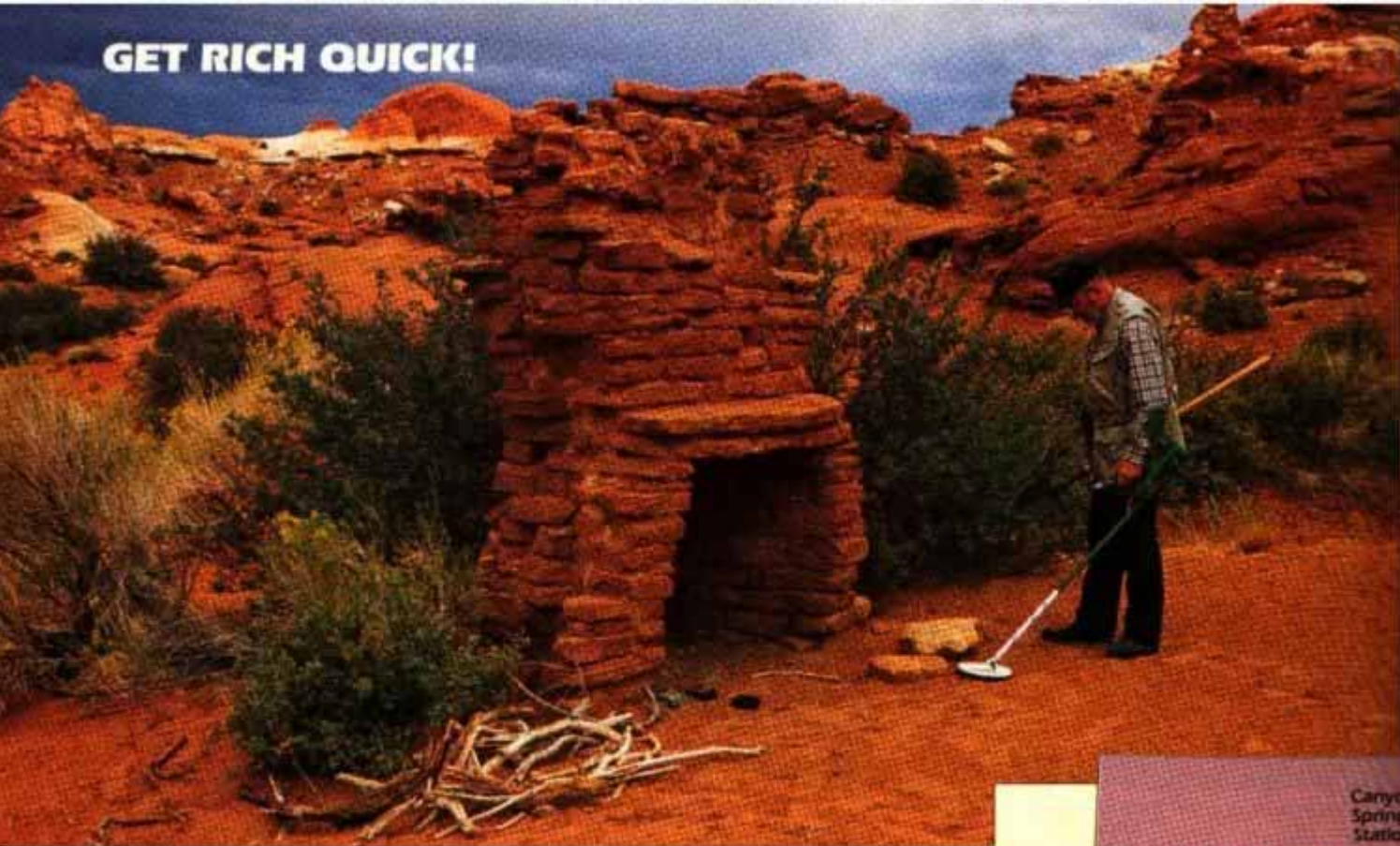


The surf zone is one of the best metal-detecting areas, particularly after a storm.



5 The Ashley gang of bank robbers buried \$110,000 in stolen gold and silver coins at their secret Everglades hideout near Canal Point. They were killed during a wild shootout in 1926.

GET RICH QUICK!



Charles Garrett explores the remains of a Utah settlement in search of coins and caches.

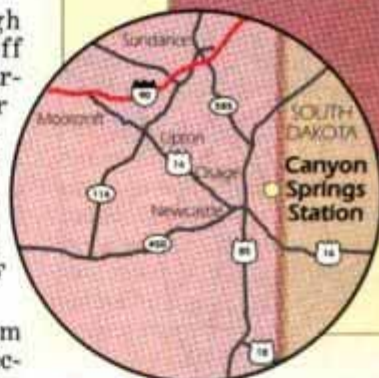
of several pivotal figures in the device's development.

Detectors sold today radiate an electromagnetic field through one or more search coils. Strong conductors, metallic objects reveal themselves when the field induces eddy currents on their surfaces. These show up as signals because the energy to generate the currents is drawn from the field, and electronic circuitry in the detector recognizes the power drain.

The circuits that process signals have become so refined over the past 20 years that manufacturers have been able to introduce very-low-frequency (VLF) units, which oper-

ate around 5 kilohertz. Although VLF metal detectors touch off fainter eddy currents on their targets, they also induce far weaker currents in conductive ground minerals and salts, background noise that for years plagued detectorists. The new circuitry can cancel ground signals while homing in on buried objects. In addition, VLF fields penetrate deeply.

Because conductivity varies from element to element, new metal detectors distinguish silver and gold from trash metals like iron. They discriminate against signals that suggest old nails or bottle caps. They can even give an approximation of the target's



7 Five outlaws ambushed the Cheyenne-Deadwood stagecoach in 1878, seizing about \$400,000 in currency, jewelry and gold ingots. Much of the loot remains buried nearby.



6 Four hoards of pirate gold and silver lie on Shell Ridge, near Sabine Pass. A local cattleman uncovered and re-secreted the treasure there, but he died suddenly without revealing his markers.



Ghost towns are perennial treasure sites, both for scattered relics and forgotten hoards.

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KEENE ENGINEERING PHOTO



The pan still works, but mechanized gold recovery calls for gear such as this dredge on pontoons.

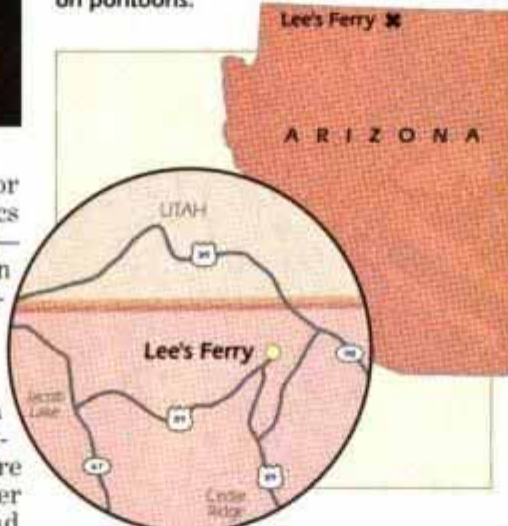
size and the depth at which it lies.

The three leading metal-detector houses—Garrett, White's Electronics and Fisher Research Laboratory—produce models that cost between \$200 and \$400 and suit general-purpose treasure hunting.

Golden retrievers

Metal detectors also play a role in hunting for gold, and there are machines that focus on gold's signature conductivity while ignoring all other signals. Old heaps of tailings and abandoned mines still divulge nuggets to electronic prospectors.

But to prospect in placer deposits—which attract thousands of fortune seekers—calls for specialized equip-



8 Prospectors camped at Lee's Ferry, burying and often losing their pokes. Meanwhile, a shipment of mercury disappeared just south of here in 1902.

ment. True, the pan remains the cheapest way to find gold. But just as the simple methods of the forty-niners gave way to hydraulic mining, modern-day prospectors have recourse to mechanized techniques.



FISHER RESEARCH LABORATORY PHOTO

Perhaps the most efficient way of gleaning gold is the portable dredge. As a suction hose passes over black sand in midstream, debris drifts up through a pump and flows through an open-ended sluice box. Riffles along the box's bottom snag heavier gold nuggets while the water washes lighter gravel away.

Where to find gold? Doing the research is much easier than for other types of buried treasure. The U.S. Mint and gold-rich states such as California and Alaska publish circulars that list active areas. Although California's Mother Lode area remains a big draw, the Appalachian regions of Georgia and the Carolinas—sites of America's first gold rushes—still yield enough treasures to attract the weekend prospector.

No matter how good your equipment and how thorough your research, dogged perseverance will play the biggest role in your quest for buried treasure. At the same time, it's never hard to forget how much lies out there. "Consider that the country is more than 200 years old, and consider how many coins have been minted in that time and how few are in collections," suggests Garrett. "Just go where the treasure is, and think like the person who buried it." And you may just strike it rich. **FM**

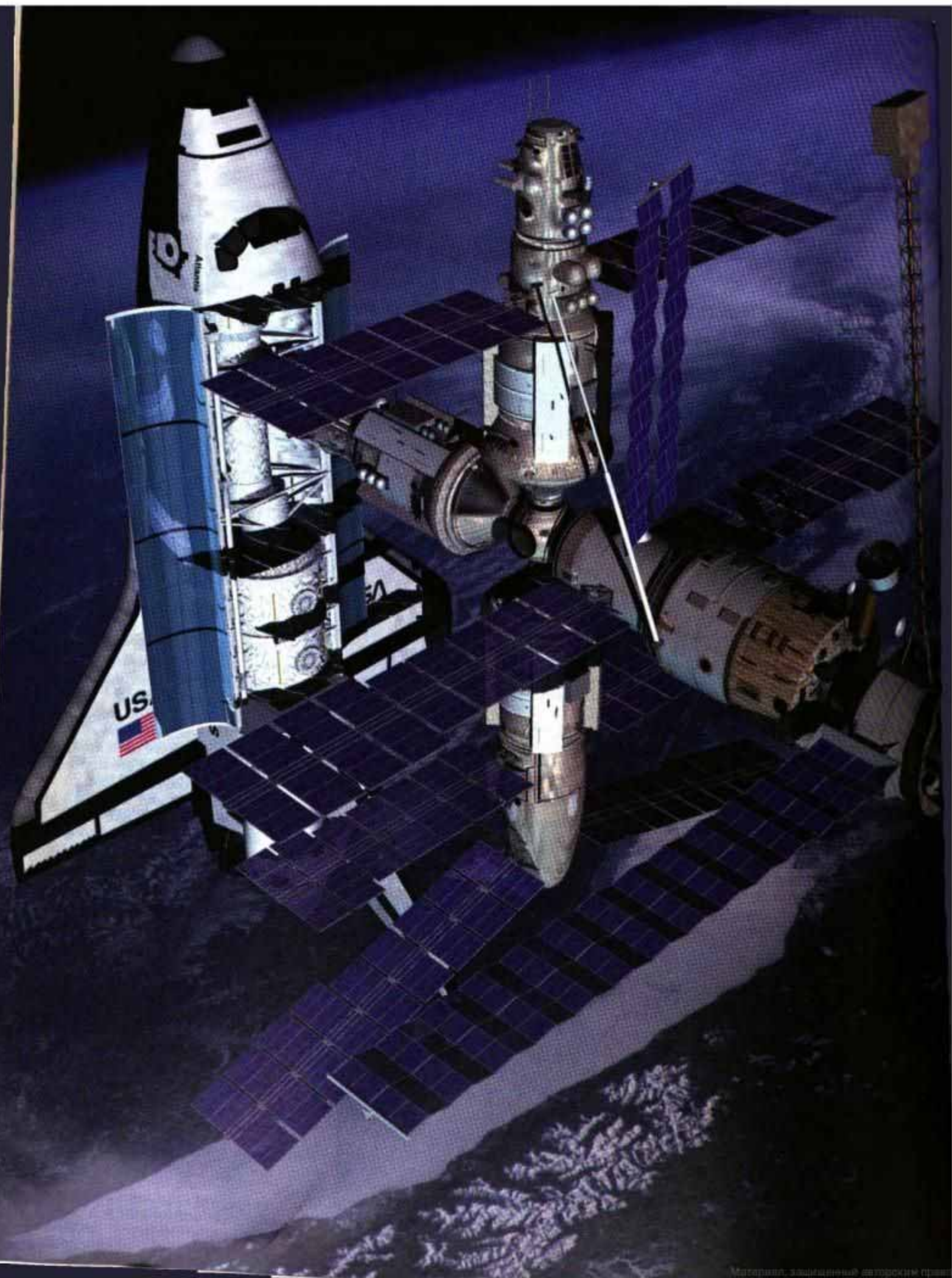


Magnetite deposits, or black sands, are dredged and passed through a sluice box.



9 Pork barrels filled with gold dust were seen at the trading post of Jim Savage, who was killed in 1852. His fortune never emerged after his death, and it's believed to be buried in several caches.

KEENE ENGINEERING PHOTO



TECHNOLOGY

MISSION TO MIR

As the shuttle begins docking at Russia's space station, we get a preview of 21st-century spaceflight.

BY PHILIP CHIEN

● In 1975, high above a simmering Cold War, an American spacecraft docked with a Soviet spacecraft. Beyond the symbolism, *Apollo-Soyuz* marked the first time that rival space travelers visited each other in orbit.

The world has changed drastically since then. The Soviet Union is no more, and Russia's space program is woefully underfunded. NASA isn't much better off, with a 16% reduction planned to thin out its workforce. So the two have agreed to pool their resources, with the ultimate goal being a joint space station.

The collaboration is already off the ground. Cosmonauts Sergei Kirkaley and Vladimir Titov have flown aboard shuttles. This past February, the shuttle *Discovery* skirted the Russian space station *Mir*, approaching within 37 ft. But that was simply dress rehearsal for the next, giant step—docking the shuttle *Atlantis* at *Mir*. The feat, scheduled at press time for this June, will distinguish America's 100th manned space mission.

"Shuttle-*Mir* has its own value as a research base," notes space engineer and historian James Oberg. "But more than that, it's a testing ground for the technology that will be crucial for the international space station."

Although NASA routinely docked small Gemini and Apollo spacecraft during the 1960s, this will be the first time the shuttle has docked with anything, and the first time two large spacecraft—neither intended to work with the other—have mated in space.

Atlantis will carry a docking adapter originally developed for the now-canceled space station *Freedom*. At the adapter's free end is a docking ring that Russia's RSC Energia built for the Soviet space shuttle *Buran*, which lies in mothballs. This fall, *Atlantis* will return to attach a new extension to *Mir*'s Kristall module. That will simplify future dockings.

Even more of a challenge than joining the shuttle to *Mir* is bridging the cultural differences between the two space programs. Hardware that's flown for years aboard *Mir* won't pass muster with NASA safety engineers. Medical standards clash. Even customs has proved a problem, delaying the delivery of American hardware to Star City, Russia's once-secret cosmonaut-training grounds.

At that facility, astronaut Norm Thagard underwent cosmonaut training for his trip to *Mir* aboard a Soyuz space ferry, scheduled for March 14. He'll be there for three months, breaking the American space-duration record of 84 days set during *Skylab*'s heyday.

Although the plan is to bring him home aboard the shuttle, Thagard isn't worried if the docking doesn't come off. "I did see something that the Russians agree they have an obligation to get me back if the shuttle doesn't," he deadpans. The mission will also swap two new cosmonauts into *Mir* and haul back results from joint scientific experiments, along with a failed Russian battery.

The ability to truck large masses in and out of orbit—the shuttle's forte—is what Russia gains from its collaboration with NASA (along with \$400 million). The Soyuz can't carry significant amounts of cargo, and the unmanned Progress freighter spacecraft don't make return trips.

But the Russians have much to offer as well. They know microgravity better than anyone: *Mir* has been continuously manned since 1989, and cosmonauts have spent more than a year in space at a stretch. What's more, with access to *Mir*, American researchers can now put their own equipment through long-duration missions. Together, the two programs complement each other, and the United States can pick up badly needed skills before the space-station era begins.



Forming the largest space structure ever, the first of seven shuttle-*Mir* missions will demonstrate techniques for future space-station operations. In *Atlantis* payload bay, the docking adapter juts from a pressurized tunnel between the cockpit and the aft Spacelab module. The adapter links with *Mir*'s Kristall materials-processing lab. A Soyuz ferry protrudes from *Mir*'s right end.



A T-bone steak in

We know. Driving a 4-door sedan is good for you. It's the right thing to do. But somehow it seems a little, well, bland. May we recommend you try the Chevy Impala SS? It has all the ingredients you've been missing in the standard 4-door fare: 260-horsepower V8, rear-wheel drive, de Carbon gas shocks, even meaty 17-inch tires mounted on custom 5-spoke aluminum wheels.

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I M P A L A S S  G E N U I N E C H E V R O L E T TM

PM RACING

We team up with Darrell Waltrip's Western Auto Racing Team to challenge NASCAR's Winston Cup circuit.

BY AL PEARCE; PM Photos by Don Hunter



• You're channel surfing on a Sunday afternoon but can't find anything worth watching. Baseball players are still on strike, the NBA is months away from games that really matter, you've never liked hockey and golf leaves you stone cold.

Suddenly, you stumble across a NASCAR Winston Cup race on ESPN. They're racing somewhere down south, running 500 miles for almost \$2 million. The grandstand is full of people, and the competition is fierce among the Ford, Chevrolet and Pontiac teams.

You watch for an hour or so and find that you're hooked. You're amazed at how close the cars get to one another and how fast they run. Finally, you realize that Ernest Hemingway was right: The only real sports are bullfighting, mountain climbing and auto racing. Everything else is just a game.

That's why POPULAR MECHANICS has teamed up with owner/driver Darrell Waltrip and the Western Auto Racing Team as associate sponsor of the No. 17

car for the 1995 NASCAR Winston Cup season. We'll have reporters and photographers at all 31 races, from Daytona to Atlanta, supplying monthly updates on the Western Auto/POPULAR MECHANICS Racing Team and on Winston Cup racing in general.

There is perhaps no stock-car driver more ready, willing and able to narrate this 31-race ride than Waltrip, a 48-year-old Kentucky native who has spent most of his 21-year career in Franklin, Tennessee. His résumé is among the sport's most impressive: 58 poles, 84 career victories, three Winston Cup titles, two NASCAR Most Popular Driver awards, victories in the Busch Clash and Winston All-Star race, and almost \$14 million in official earnings.

But Waltrip's success hasn't been limited to Winston Cup. He's done well in such diverse series as Grand National, All-Pro, All-American Challenge and Modified, and in the prestigious International Race Of Champions. He's also won in American Speed Associa-

'95



tion, Automobile Racing Club of America, United States Auto Club and ART-GO Challenge events.

None of this driving excellence has gone unnoticed by the men and women who report on NASCAR on a regular basis. Three times now they've selected Waltrip as their American Driver of the Year and National Motorsports Press Association Driver of the Year. Twice he's been the Auto Racing Digest's Driver of the Year, and he was honored in 1979 as Tennessee's Professional Athlete of the Year.

Waltrip drove his own cars early in his career before joining teams owned by Bud Moore, Bill Gardner, Junior Johnson and Rick Hendrick. He began forming his own racing team in 1990,



Three-time Winston Cup winner Waltrip is carrying the PM banner.

and it debuted at the Daytona 500 in February 1991. After working for other people for 18 years, Waltrip felt it was time that he take his career into his own hands. "When you own your team, you have to separate a driver's mentality from an owner's mentality," he says. "I didn't really understand that because I had always looked at things from a driver's perspective.

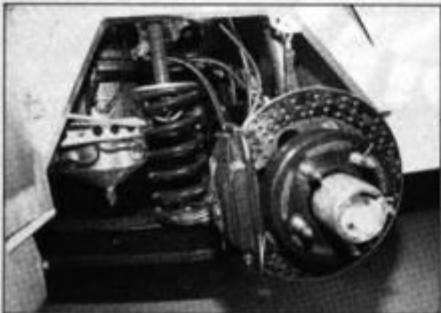
"When you're a driver, you want everyone on the crew to be your buddy. When you own the team, you've got to remember that those same people are your employees. Friendships develop, but you've got to look past them and remember that this is a business and your goal is to win races."

Speaking of which, Waltrip was

PM RACING '95

among NASCAR's most successful drivers in the '70s and '80s. Indeed, he's the winningest active Winston Cup driver, ranking behind only Richard Petty and David Pearson (and tied with Bobby Allison) on the sport's all-time victory list. But he hasn't won a race since September 1992. He entered this season only five for 119 as an owner/driver. Invariably, people ask how someone who once won races in 24 consecutive seasons could fall into such a slump.

"You've got to look at our sport as a piece of pie," Waltrip says. "Ten years ago [when he drove for Johnson], my piece of the pie was a lot bigger than anybody else's. There were only about four of us at that time who could even get a piece of it. As time has gone by, we have the same size pie but

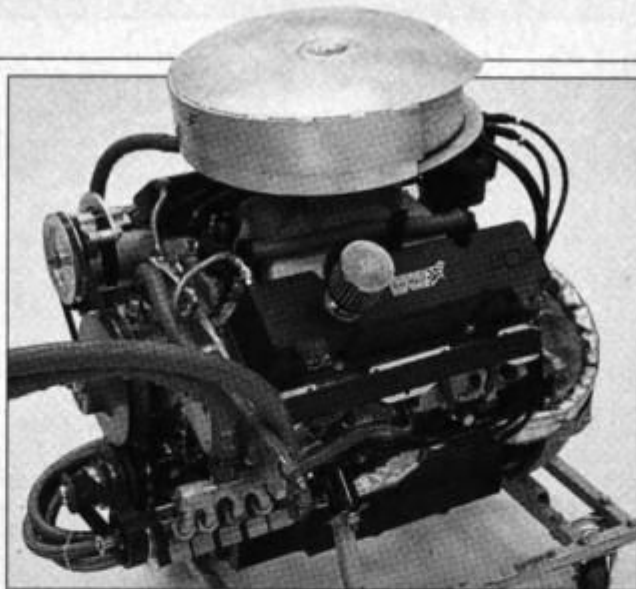


we've got more people taking bites out of it. I just don't have as big a piece as I used to."

But if Waltrip has thoughts of retiring, he's keeping them to himself. Clearly, he enjoys his status as NASCAR's "grand old man," one of only three active drivers (with Dave Marcis and Dale Earnhardt) to have won at least one race in each of the past three decades.

"I've heard whispers from people who think I'm too old and over the hill," he says with a mischievous twinkle in his eyes. "Nothing could be further from the truth. I work out regularly, and I'm probably in the best shape of my career. I have a goal to win 16 more races, to reach 100. Even though we've slipped some during the past few years, I still believe 100 wins is attainable. There'll eventually come a point when I put someone else in the car for the championship, but I'll still drive at tracks I really enjoy."

Waltrip was thoroughly delighted when Chevrolet designed the new '95

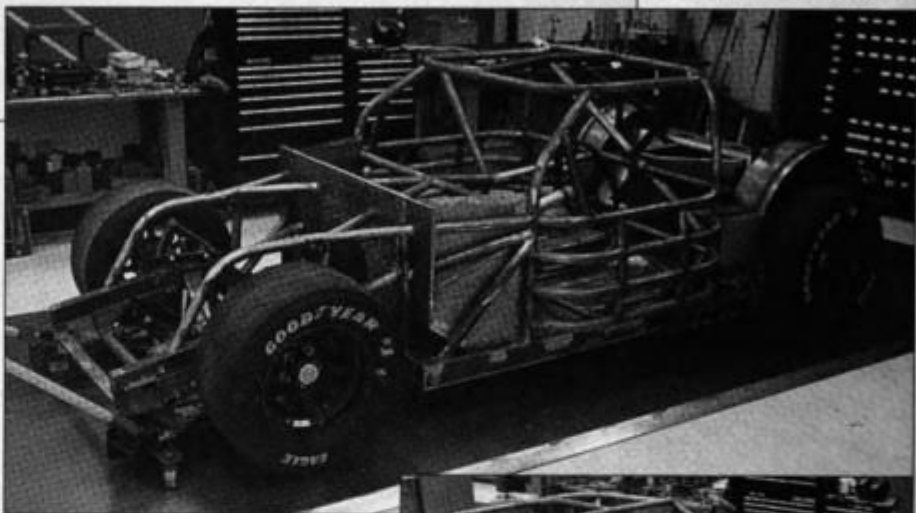


With pushrods and a carburetor, the Chevy V8 still screams.

Monte Carlo to be so racy. Its 358-cu.-in. cast-iron V8 engine hasn't changed since last year, but its sheetmetal is more aerodynamically efficient, especially important on NASCAR's fast and long tracks.

Chevy's old Monte Carlo SS captured 91 races in 175 starts from February 1983 until April 1989. Waltrip

A live rear axle and massive cross-drilled disc brakes get the Western Auto/PM Monte Carlo around the track.



The steel-tube frame incorporates the new safety features that should help protect the driver this year. Waltrip, like everyone else, will be running on Goodyears.

won 25 of them, including the model's farewell race at Martinsville, Virginia. The Lumina was 69 of 169 before retiring after last year's season finale at Atlanta Motor Speedway.

If truth be told, Waltrip is very glad to see Monte Carlo replace Lumina.

"I was never totally satisfied with the Lumina as far as balance is concerned," he says. "The car never seemed to sit on all four wheels the way I would have liked it to. Monte Carlo will be great for me because it's a very comfortable car. It feels like it could go 210 mph and really be stuck to the racetrack."

Also making Waltrip more comfortable is the fact that the NASCAR tire war between Hoosier and Goodyear is finally over. Hoosier has withdrawn from Winston Cup competition for '95, and all cars will now ride on Goodyears. Waltrip ran a portion of '94 on Hoosiers. "That was a mistake," he freely admits.

With Goodyear supplying what amounts to a harder, and therefore slower, spec tire for most of the 31 races, NASCAR will get its wish to slow down cars and make racing less dangerous. It will also likely be



Popular Mechanics

The Chevrolet Monte Carlo has been on America's racetracks since 1971, driven by such greats as Richard Petty, Bobby Allison, Dale Earnhardt and Benny Parsons. In 1979, Richard Petty drove a Monte Carlo to his record seventh Winston Cup championship. And between 1984 and the middle of the 1989 season, Monte Carlo dominated Winston Cup racing, winning Chevrolet the NASCAR Winston Cup Manufacturers Championship six years in a row. In total, Monte Carlos have won 91 of 175 Winston Cup races in which they've participated. That's more victories than any other car in NASCAR history. Darrell Waltrip, 3-time Winston Cup Champion and one of the winningest drivers in NASCAR history, is the owner/driver of the Western Auto/POPULAR MECHANICS Monte Carlo. Waltrip first drove a Monte Carlo in 1971, and for 1995, this winning combination is back together. POPULAR MECHANICS will be aboard with Waltrip as associate sponsor for the entire season, from Daytona to the Brickyard to Atlanta. And we're proud to be a part of such a strong racing heritage.



CAR MECHANICS RACING



content with rule changes already announced—although you never know with NASCAR. If it doesn't like the way something is going, it won't hesitate to make changes at any time.

The already-announced rules include using power-reducing restrictor plates at certain superspeedways, reducing the minimum weight of Winston Cup cars from 3500 to 3400 pounds, standardizing the location of all electrical switches within the cockpit, requiring roof flaps at all tracks not just those that are 1 mile or longer (see "What's New In NASCAR," page 44, June '94) and repositioning what is known as the "additional" cockpit rollbar.

The cars were lightened for two reasons: One, lighter cars mean a reduction in potential-impact forces; and two, weight that is removed from the left side of the vehicles means the cars become slightly looser and can't carry as much speed through the turns.

In the past, the additional cockpit rollbar could extend diagonally over the driver's head, but now it must run parallel to the centerline of the chassis. The change was made to improve safety, as was the case with standardization of electrical switchgear and mandatory use of roof flaps.

In an effort to improve not only safety but competitive balance, NASCAR will allow some modification to Winston Cup cars' sheetmetal, which basically is determined by passenger-car configurations. As Chevrolet switches from the Lumina to Monte Carlo body style, its cars will be lengthened to be nearly as long as the 193-in. Ford Thunderbird. The Pontiac Grand Prix started the '94 season some 5 in. shorter than the T-Birds, and Grand Prix teams were given a midseason break that allowed them to lengthen rear decklids in order to put more distance between the backlights and the spoilers. For '95, the Grand Prix will be allowed nearly 2 more in. of nose to further improve its aerodynamics. However, the Pontiacs will still be more than an inch shorter than either of their competitors.

As for the Chevy Monte Carlo, "Aerodynamically, it's better than anything we've ever had at Chevrolet, and it's equal to and, hopefully, sooner or later, will be a notch better than the hot-running Ford Thunderbirds," says Waltrip. "I think it's going to do for me what the old Monte Carlo did for me. It's going to put me back in the winner's circle."

And all 9 million PM readers will be right there to share the moment with you, Darrell.

PM



After the tube frame is done, the Monte Carlo's body goes on. The Monte is longer than the Lumina and will be better able to compete aerodynamically with its prime rival, the Thunderbird. Engine and cockpit are standard NASCAR. Western Auto/PM livery is unique to No. 17.



BICYCLES

AEROCYCLE

Innovative design made the 1955 Aerocycle the most advanced bike of its day. Unfortunately, it was 40 years too soon.

BY JOHN V. MOTTO. PM Illustration by Ian Liddell



● Following World War II, American manufacturers rushed to get back into the production of consumer products. After a few years of satisfying pent-up demand with essentially prewar designs, a race developed to produce new and improved versions of virtually every product.

Into this environment, the U.S. bicycle industry witnessed an influx of newly designed lightweight bikes from Europe. Not only were these lower in price than existing American models, but they offered appearance

and performance advantages over bulky, prewar domestic designs. As a result, American businesses scrambled to introduce bicycles to compete with the popular imports.

One of those manufacturers was the Evans Products Co. of Plymouth, Michigan, which had recently purchased the Colson line of bicycles. Evans' primary business was manufacturing car-hauling equipment for semitrailers and railroad cars. With no experience in bicycles, Evans boldly decided to develop a completely

new bike, and retained the firm Harley Earl Inc. (HEI), of Centerline, Michigan, to produce it.

HEI designers had wide latitude within the following parameters: 1. Create a fresh, exciting bike to establish Evans in the bicycle industry. 2. Make the bike weigh less than 40 pounds. 3. Reduce costs. 4. Develop unique features. The overriding goal was to produce a concept that would make obsolete all conventional models, including the imports. The name chosen was Aerocycle.



The way Aerocycle stress tests were conducted nearly 40 years ago.

During the research phase of the project, HEI discovered a German design of the late 1930s with an X-shaped frame. This feature led to many of the innovations found on the Aerocycle.

HEI strove to give Aerocycle a sleek, unibody look, so the chain was concealed in a lower frame arm and the gearshift cable was routed inside the frame casting. The shift lever was frame-mounted near the handlebars.

The lower-frame member contained cranks and the drive sprocket, and it was pivoted to accommodate

torque rods that were used in the rear suspension system. The V-shaped handlebars had a forward thrust to give the bike a rakish appearance. Other major features were a cantilevered seat mount, a horizontally sprung front-wheel suspension and a magnesium frame.

Prototypes weighing just 37 pounds were delivered to Evans in September 1955 and submitted for field testing and structural and production/assembly analysis. A second-generation prototype went to a De-

troit laboratory for stress analysis. The results of the testing encouraged Evans to proceed with marketplace and cost studies.

But the analyses took a year to complete, and by then Evans had shifted its sights to other areas. In early 1957, the Aerocycle project was shelved.

Like the Chrysler Airflow some 60 years ago, Aerocycle was probably too far ahead of its time. But its sleek styling and unique features seem current today—40 years after Aerocycle left the design studio. **PM**

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



*Always wear your safety belt. **Feature optional. †J.D. Power and Associates 1994 Light Truck Initial Quality Study. ‡Based on a total of 12,056 consumer responses.

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THE '95
FORD RANGER



BUILT FORD TOUGH

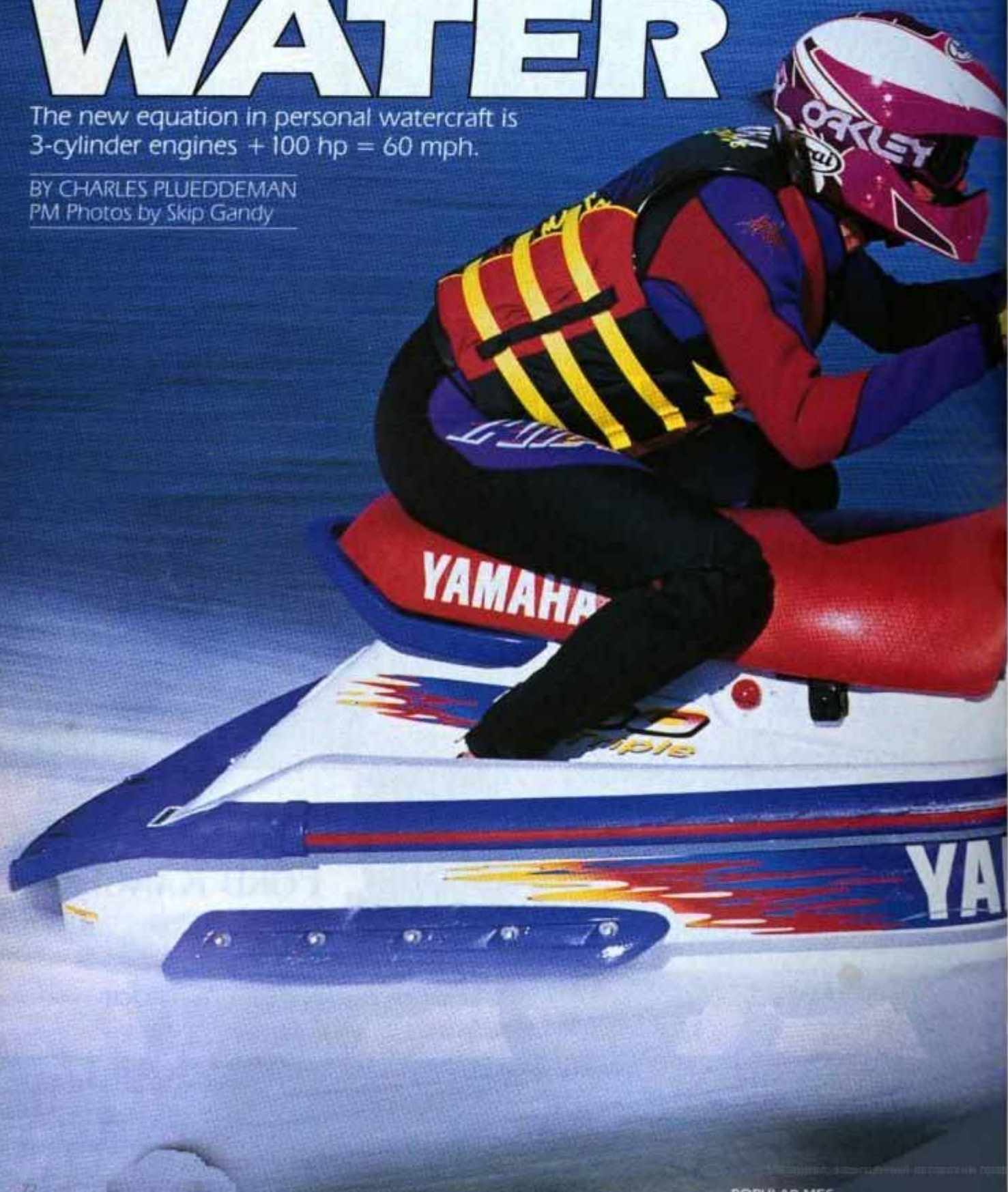
†indicating owner-reported problems during the first 90 days of ownership. **3.0L and 4.0L engines only.

COMPARISON TEST

BOILING WATER

The new equation in personal watercraft is
3-cylinder engines + 100 hp = 60 mph.

BY CHARLES PLUEDDEMAN
PM Photos by Skip Gandy



• Just a few seasons ago, watercraft riders were buzzing with the news that Sea-Doo had produced a runabout that would break the 40-mph mark. Since then, it has been a gloves-off battle for performance supremacy among Yamaha, Kawasaki, Polaris, Bombardier Sea-Doo and Artec Tigershark.

This season, both the performance and the rivalry reach a new level of intensity with the introduction of models that break several benchmarks—3-cylinder engines, 100 horsepower and 60 mph. A few years ago, watercraft like this seemed unthinkable.

Curious as to whether these new muscle-craft could live up to their performance claims, we gathered a fleet of 1995 models that met at least one of two powerful criteria—a 3-cylinder engine or a 100-hp rating. The contenders include the Yamaha WaveRaider 1100 and Kawasaki Jet Ski 900ZXi, both 100-hp big-bore triples; the Sea-Doo XP785, a high-compression 100-hp twin; and the 80-hp Polaris SL750, the original triple-cylinder watercraft. Notable by its absence is the new Tigershark 900, also a 100-hp triple. Shy of hard data collected by independent sources, Artec made an

11th-hour decision to cancel an appearance at our test.

We used the computer-linked Stalker radar gun to measure top speed and acceleration, and put each model through a short buoy course to gauge agility. All tests were conducted with the same 180-pound rider aboard.

Muscle-craft like these models demand respect—the days of pinning the throttle and hanging on are over. For each test, the PM rider wore an Arai watercraft helmet, goggles, wet suit and 70-mph personal flotation device for both comfort and protection.

Kawasaki Jet Ski 900ZXi

The big, brawny 900ZXi delivers the best all-around combination of sheer power and all-day riding comfort. The power comes from a new 100-hp 891cc Kawasaki triple mated to a 140mm-dia. jet pump with a 3-blade stainless-steel impeller. The pump is located as far aft in the hull as possible to reduce cavitation in choppy water. A new digital ignition is self-adjusting and limits rpm if the engine overheats.

At 108 in., the 900ZXi is long enough to provide a stable ride at high speed. It has a deep, 22.5" dead rise to cut through smaller waves and cushion reentry off of bigger ones. A set of spray ridges on the forward hull surface effectively deflect bow spray away from the rider's face, which is much appreciated when screaming at high speeds.



YAMAHA WAVE RAIDER 1100

BOILING WATER



SEA-DOO XP785



POLARIS SL750

A pair of rearview mirrors are standard, as are the analog tachometer, speedometer and trim and fuel gauges, plus a low-oil warning light. The delayed action of the trim gauge will be annoying to some, but a magnetic ignition lock device is an excellent theft deterrent. The 10.6-gallon fuel tank provides adequate range.

With an average top speed of 57.9 mph, the Kawasaki wasn't the fastest craft of this group, but it was the best at going fast, always composed, regardless of the water conditions. Its 550-pound dry weight no doubt helps in this regard, but it was a handicap in the 0-40 mph acceleration test, where the 900ZXi posted an average

of 4.4 seconds, which was last in this warp-speed group but still incredibly quick. In the buoy course, we couldn't find a technique to tame the Kawasaki's loose tail, which is prone to spin out in hard turns. So, if Kawasaki can tighten cornering, the 900ZXi will be close to perfect.

Polaris SL750

Polaris pioneered the big hull/big motor concept with its first model, the triple-cylinder SL650, introduced in 1992. But in '95, the 80-hp SL750 is actually low on power and displacement compared to the others in the test. By way of compensation, the SL750 is the most affordable big-bore

triple at a suggested retail of \$6099.

Stability, thanks to a wide beam (45 in.) and generous length (105 in.), is the chief virtue of the SL750. You can stand with both feet on one footwell and the Polaris won't tip over. Also, 2-up riding is a stress-free activity. At speed in choppy conditions, the Polaris is exceptionally unruffled, although it bangs the water hard on occasion.

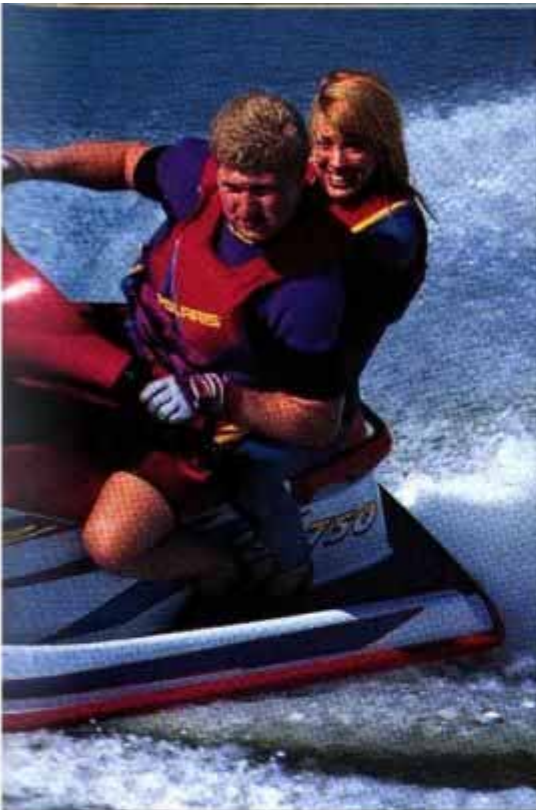
The 80-hp 744cc triple is built by Polaris engine-partner Fuji and boasts three 38mm Mikuni carbs and case-reed induction. A digital ignition is self-adjusting and includes sensors to detect low oil level and engine overheating. The Polaris pump has a 5.8-in.-dia. 4-blade stainless-steel

TEST PARAMETERS

All watercraft were tweaked and tuned by factory technicians. All models were showroom stock except for the Sea-Doo XP785, which was a preproduction model. Top-end speed, acceleration and performance course times (around a short, triangular, 3-buoy course) are averages of multiple runs. All models were operated by the same test driver wearing protective gear. Bold numbers in chart indicate ranking in the fleet.



| MAKE/MODEL | KAWASAKI JET SKI 900ZXI | POLARIS SL750 |
|-----------------------------------|--|--|
| Length/Width/Weight/Fuel Capacity | 108"/42"/550 lb./10.6 gal. | 105"/45"/499 lb./9.8 gal. |
| Engine/Displacement/Horsepower | Kawasaki triple/891cc/100 hp | Fuji triple/744cc/80 hp |
| Acceleration 0-40 mph | 4. 4.4 sec., takes a moment to build momentum | 3. 4.1 sec., quick, considering its power shortage |
| Top Speed | 2. 57.9 mph, rock-solid stability at the limit | 4. 50.2, smooth, steady, could handle bigger engine |
| Performance Course | 4. 18.3 sec., tail won't stick in hard turns | 1. 16.4 sec., lean outside for predictable turns |
| 2-Person Stability | 2. Comfortable with a light passenger | 1. Wide, flat hull is never tippy |
| Fun Factor | 1. Great mix of speed, comfort, rough-water ride | 2. Best for family use, where raw speed isn't a factor |
| Special Features | Magnetic theft deterrent, power trim | Digital, multifunction dash instrument, power trim |
| Price As Tested | \$7299 | \$6099 |
| Address | 9950 Jeronimo Rd., Irvine, CA 92718 | 11225 Hwy. 169 N., Minneapolis, MN 55441 |



KAWASAKI JET SKI 900ZXI

impeller, as well as power trim.

In its standard mode, the LCD instrument displays speed and rpm digitally, with bar graphs to indicate fuel level and trim position. A MODE button calls up such other data as engine hours, volts, time, distance traveled, peak speed and peak rpm. Lights warn of low fuel or low oil levels and engine overheat. The fuel capacity is 9.8 gallons.

No surprise that the Polaris, down 20 to 30 hp to the rest of the fleet, was the slowest craft with a top speed of 50.2 mph, but the SL750 shined on the buoy course with a time of 16.4 seconds, a tick quicker than the race-bred Sea-Doo. The Polaris

was easily the most predictable boat to drive and it carved clean, sharp turns in smooth or choppy water.

With more power, the Polaris SL750 would be a real contender in this class. It clearly has the hull to handle it, and a new 100-hp motor is rumored to be in the works. Because of outstanding stability and comfort, the SL750 is a good choice for family use and less-aggressive riding.

Sea-Doo XP785

Who needs three cylinders to make 100 hp? Not Rotax, the Bombardier engine division that came up with the all-new 782cc twin. Bred for racing, the Sea-Doo XP785 is a limited-

production model that will thrill even the most skilled riders.

The new engine has a crankcase tipped 30° to port, which helps lower the center of gravity, provides a more direct path for fuel to enter the cylinders and makes room for a huge tuned exhaust pipe. Twin 40mm Mikuni carbs are tucked low on the engine below the exhaust. Intake flow is controlled by a rotary valve between the carbs and the crankcase.

To fatten the powerband, both exhaust ports are fitted with a RAVE (Rotax Automatic Variable Exhaust) valve—a spring-loaded guillotine-shaped device that moves up as back-pressure in the exhaust increases. This raises the top of the exhaust port and changes the port timing. A digital ignition is self-adjusting and includes a rev limiter.

The jet pump has a composite housing and nozzle with a stainless-steel wear ring and 144mm stainless impeller. An extension on the housing moves the nozzle aft 4 in. from its position on other Sea-Doo runabouts to reduce cavitation and give the nozzle more leverage in turns.

Just 100 in. long and weighing only 433 pounds, the XP785 is the smallest, lightest craft in this class. The hull has a deep-V profile. A pair of 2 × 11½-in. removable aluminum plates may be used to fine-tune the aft edge of the hull. Our boat had plates that angled up about 1mm, but Sea-Doo will offer sets with different degrees of wedge to raise or lower the boat's nose.

The racing seat is designed to hold the rider in an optimal position on the boat, but taller drivers will wish they could move farther back. A

(Please turn to page 125)



SEA-DOO XP785

100"/42"/433 lb./9.0 gal.

Rotax twin/782cc/100 hp

1. 2.9 sec., blasts off like a rocket from the line

3. 57.6 mph, sensitive to trim and body position

2. 16.5 sec., turns hard, but can be very twitchy

4. Racing seat limits this competitor to one rider

3. Demanding for casual rider, built for racers

Tunable hull, digital theft deterrent, power trim

\$6999

6545 U.S. Hwy. 1,
Palm Bay, FL 32905

YAMAHA WAVERAIDER 1100

113"/44"/518 lb./13.2 gal.

Yamaha triple/1051cc/110 hp

2. 3.3 sec., roaring engine, powerful pump hookup

1. 59.9 mph, twitchy in chop

3. 17.4 sec., a difficult machine to master

3. Requires concentration at slow speed

4. Wonderful engine, quirky handling, bow spray

Digital, multifunction dash instrument, power trim

\$7799

6555 Katella Ave.,
Cypress, CA 90630

RECREATIONAL VEHICLES

PALACES ON

New from road to roof, big motorhomes pack more power, convenience and luxury for royal-class touring.

BY CLIFF GROMER, Contributing Editor



● The blackness slowly yields to a purplish blue outlined by a crimson orange tinge. An image starts to take shape through the windshield, a vista absolutely awesome in its magnitude. You can't buy a home with a view like this because they don't build houses on the edge of the Grand Canyon. Yet here you are, enjoying this amazing place amid all the comforts of home.

But this home is different. It specializes in scenes you can't buy. Or vistas that would tax the resources of a millionaire—if views like this were even for sale.

You take in this panorama pampered by luxury surroundings—plush leather furniture, plank kitchen floors, tiled bathrooms, cabinetry of rich wood that is skillfully crafted. The temperature is controlled by constant hot-water heat and central air conditioning. A big-screen TV complements a high-end home-

entertainment center. Open the big side-by-side freezer/refrigerator and the icemaker has a ready supply of cubes to chill your drink.

Push a button and 15 ft. of wall and floor extend out, instantly opening up 45 sq. ft. of additional living space. Call it life in the spoiled-rotten lane, if you will, but it's what the newest motorhomes have to offer.

Class A motorhomes start with an in-house-built or outsourced chassis that the manufacturer, or coach-builder, uses as a base for the body. Prices range from about \$30,000 to more than \$250,000. The ultimate Class A's are big touring buses that feature monocoque construction. The builder basically finishes off the bus' bare shell. The ante to step into one of these babies begins at more than a half-million bucks, and goes up to something on the order of the space shuttle. We don't cover

WHEELS



Holiday Rambler Navigator 400 rolls by the red rocks of Sedona, Arizona, where the cost of a building lot exceeds that of the motorhome. This luxury coach comes with full-leather seats and sofas and plenty of cabinet space. Features include on-board washer/dryer, central air and constant hot-water heat. Cockpit has excellent ergonomics. The electronically controlled 6-speed automatic transmission shifts via touch pad on left console.

PALACES ON WHEELS



COACHMEN DESTINY



ITASCA SUNCRUISER



Destiny comes with marble-tile flooring and hardwood cabinets.



Slide-out opens up additional living space at the push of a button.



Large freezer/fridge runs on LP or electric.

the buses here because unless you're a John Madden or Loretta Lynn, you probably won't be buying one.

The big news in Class A motorhomes can be summed up in a word—more. More power, room, comfort and safety. Entry models still come with gas engines up front, but the drawbacks are an extended front-end, heat, noise and reduced space if the engine is brought inside the coach under an access cover. The trend in the medium and large models up to 40 ft. long is the use of a diesel pusher. The rear-mounted engine minimizes noise and heat, and doesn't intrude on living space.

Until now, the problem with many diesels has been the lack of



Kitchen offers homelike convenience.

power. At the controls of a 30,000-pound motorhome, you had to bury the throttle and wait what seemed like years for your speed to pick up. But Cummins Engine Co.'s new



Bath features stall shower and dressing area.

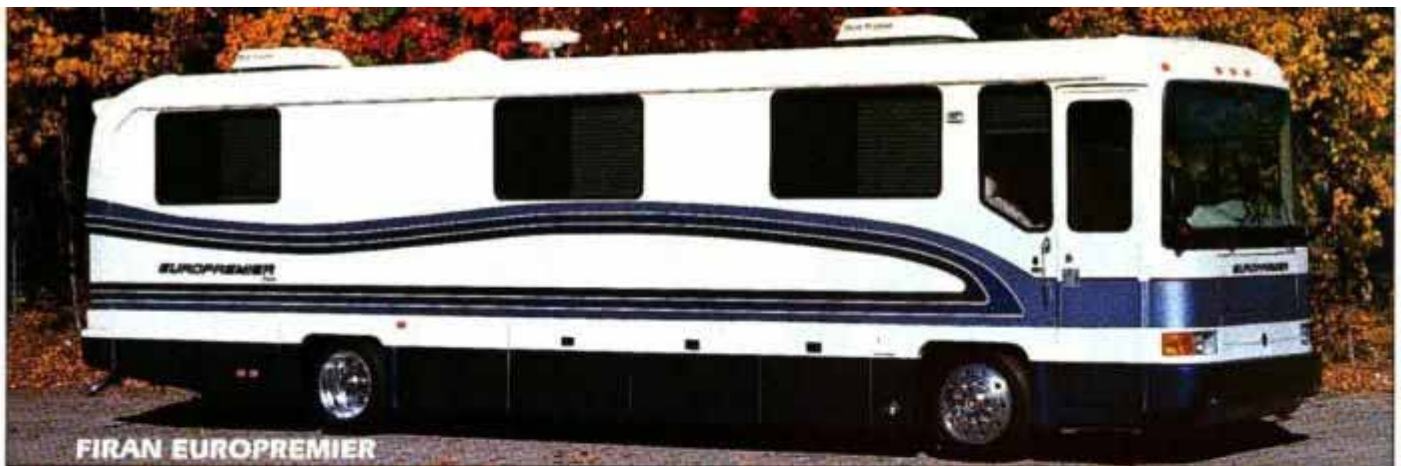
M11-440E, available on Holiday Rambler's top-of-the-line Navigator 400, changes all that. With 400 hp and 1350 ft.-lb. of torque, this 38- to 40-ft.-long coach takes off like the family car.

Tight maneuvers in a huge motorhome can be a challenge. So Oshkosh, a chassis supplier to several leading coachbuilders, is engineering a 4-wheel-steer chassis to make steering a little bit easier. The chassis will debut on Winnebago's flagship Luxor model this spring. Chassis makers also are incorporating big-truck features, such as air-ride suspension, antilock brakes and engine-braking systems.

Widebodies measuring 102 in. are supplementing the standard



Basement model stows luggage under the floor like a bus.



FIRAN EUROPREMIER



EuroPremier is available in eight different floor plans and offers a forward-facing couch, as well as a second television in the bedroom.



Cummins' 400-hp diesel has best-in-class power.

96-in.-wide coaches, but they're not yet legal in all areas. A slide-out—where about a 15-ft. section of the body is mounted on a sliding electric/hydraulic chassis member that extends from the coach when it's parked—is one way to increase living space. Multiple slide-out sections are also in the cards, but they'll depend on the GVWR of the chassis.

Basement-model motorhomes are becoming increasingly popular. They

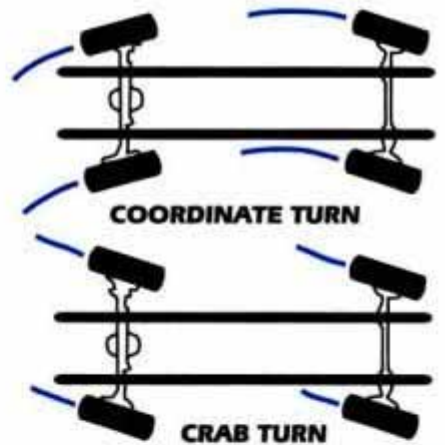
have raised floors with storage compartments underneath, like the luggage compartments on buses.

On the styling side, there's no doubt that the flat-faced bus look is in. A wedge front takes up to 3 ft. of livable space—and renders it unlivable. And the bus look makes even a low-line coach appear more expensive.

Inside, central air conditioning is replacing roof-mounted units that tended to blow down on you. The a/c air-unit mounts in one of the basement storage compartments, lowering the coach's center of gravity while giving it a cleaner roofline.

Appliances? Sure, you get the kitchen sink, but some motorhomes also have a washer/dryer unit and a central vacuum-cleaner system.

Behind the wheel, you get an entirely different perspective. Switches and controls have come under the scrutiny of the ergonomic engineers, and you sit so high up, the vehicles in front of you look like Matchbox cars. You can see ahead for miles. Big coaches, like the Navigator 400 we tested in Arizona, are surprisingly easy to drive. The ride is soft, but not

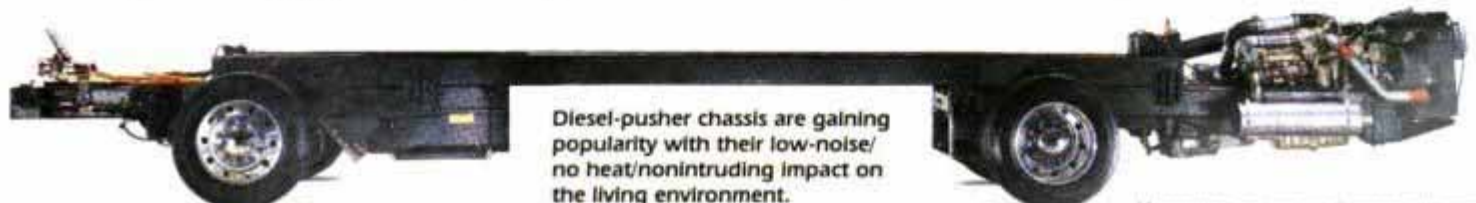


New 4-wheel-steer chassis by Oshkosh will ease tight maneuvering by large coaches.

overly mushy, and you can spend hours behind the wheel and feel no fatigue.

And when it's time to pull into an RV park or a scenic area to rest for the night, you know there will be no surprises awaiting you like in some no-tell motel. You simply walk back to your comfortable queen-size bed and spotless bathroom.

In fact, the new motorhomes make getting there so much fun, you may not want to come back. **PM**



Diesel-pusher chassis are gaining popularity with their low-noise/no heat/nonintruding impact on the living environment.

SHOW FINE

At the Consumer Electronics Show, the best new products point the way toward the future.

BY FRANK VIZARD, Electronics Editor

● Mixing business with pleasure seems to be the credo of the consumer electronics world. Hardware and software for both work and play were highlighted at this year's Consumer Electronics Show in Las Vegas.

While the show was a potpourri of gizmos, one trend was definitely clear. Whether it be a message center or a programming guide, the small space atop the television is being targeted for development.



Tommy, Can You Hear Me?

Here's the game that should appear in any remake of "Tommy," the rock opera by The Who. Strap on a pair of headphones and gaze into a 3-dimensional universe of red images against a deep, black background. Virtual Boy, made by Nintendo, is a RISC-based, 32-bit system that uses two mirror-scanning LED displays to give the player a feeling of total immersion. A double-grip controller handles spatial maneuvering. List price is \$200.



Video To PC Connection

Snappy, from Play Inc., is a pocket-size device that lets you transfer still images from any video source onto your PC. A proprietary chip renders these images in a high-quality, photorealistic manner. The \$199 product also comes with a painting, compositing and retouching program, as well as morphing software.



Band On The ROM

Jam with your favorite bands even if you're not a musician. It's possible, thanks to a new series of JamPak CD-ROMs from Ahead Inc. The instrument is your computer keyboard or a controller shaped like a guitar, called Virtual Guitar. All you do is follow the on-screen rhythm spikes. Characters on the PC screen respond to how well you're performing. Your skill level determines whether you become the star of a world tour or a lounge act. JamPaks are available for less than \$20. Music CDs can also be used once the JamPak software is installed.

SHOW FINE



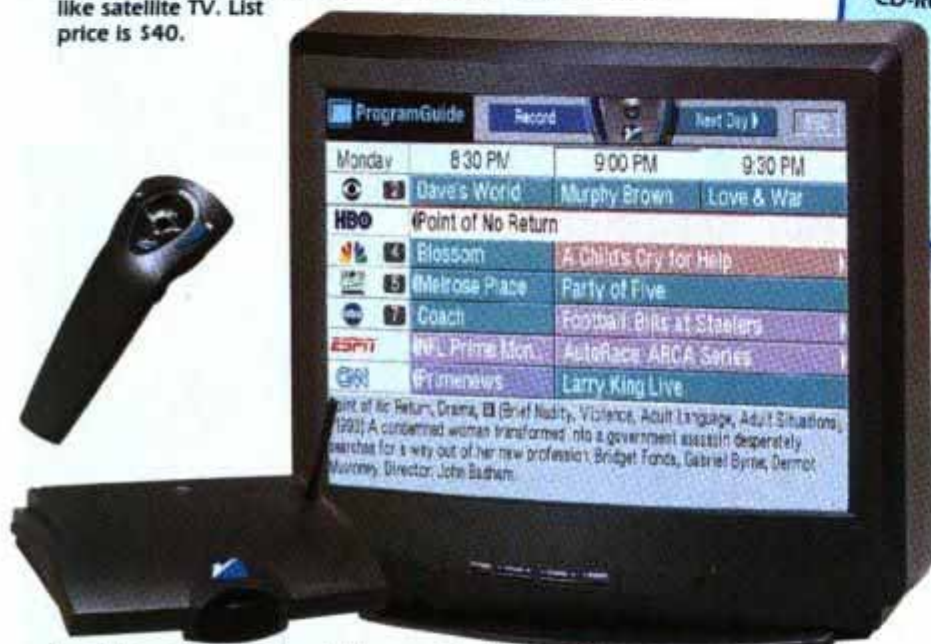
Stylish TV Reception

Terk Technologies says its TV15 indoor TV antenna has more going for it than just looks. The TV15 uses tuned circuits that electrically duplicate the varied-length array of an outdoor antenna. A 5-position switch helps you tune in a specific station. There's also an A/B switch so you can easily shift to alternate signal sources like satellite TV. List price is \$40.



Go Ahead, Make My Day

Developed by American Laser Games, *Crime Patrol* illustrates how electronic games, and particularly characters toward all-video productions. In *Crime Patrol* (\$60), you and your police partner apprehend suspects in a style that movie-icon Clint Eastwood made famous—just shoot them. While way short on police procedures, there's plenty of arcade-style action. A colored plastic gun is available for use with 3DO and Sega versions for between \$45 and \$55.



TV Listings Plus News And Sports

VideoGuide is an under-\$100 set-top receiver that offers subscribers a weekly programming guide, one-touch VCR recording, up-to-the-minute sports news and a news service that can be programmed to automatically prioritize the information you're interested in. The service, which is downloaded via BellSouth's Mobile Comm over-the-air wireless network, is available on a subscription basis. Basic service is \$4.99 per month, with another \$1.99 per month for both the news and sports feeds. Roll-out starts on the East Coast and goes national this fall.



Have It Both Ways

The Zaurus personal digital assistant from Sharp lets you input data with either a pen or a keyboard. Shown here with the modem attached, the pocket-size Zaurus permits the mobile professional to utilize E-mail, send faxes, create simple graphics and access online services. A PCMCIA slot allows you to add applications as well. List price is \$849.



Electronic Book

Another step further away from paper comes courtesy of Franklin Electronic Publishers. Called Bookman, this pocket-size device uses tiny, interchangeable cartridges

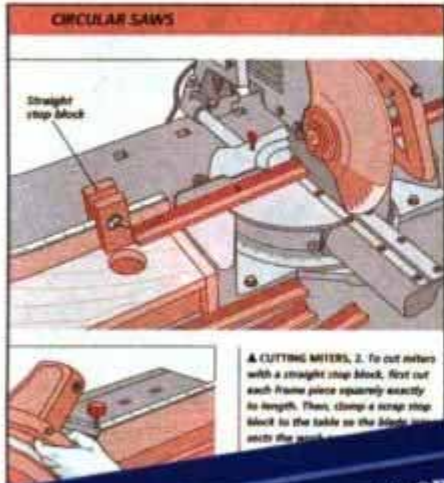
that hold lots of data. Just pop one into the slot on the back and you've got a whole new title—an entire dictionary, for example. Three Bookman devices range in price from \$60 to \$150, while titles, mostly reference works, range from \$10 to \$90.



The Biggest Picture

The biggest TV picture available is a new 80-in. projection ProScan model made by Thomson Consumer Electronics. The price tag is big too—\$8499. That's Executive Vice President Joe Clayton applying the ruler.

Ever wish you had all the answers



CUTTING MITERS, 2. To cut miters with a straight stop block, first cut each frame piece squarely exactly to length. Then, clamp a scrap stop block to the table on the blade's path onto the work.

TO DO-IT-YOURSELF QUESTIONS?

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TELECOMMUNICATIONS

FUTURE

Inside the first interactive TV network in the United States.

BY GEORGE MANNES

• For years, pundits have predicted that people would one day be able to sit down in their living rooms and order up a movie as easily as they might pop a tape into the VCR. Viewers would simply browse through a catalog of movies in an electronic library, pick the film they want and sit back as their local cable company retrieves that movie from an electronic database and starts the show. It was an enticing vision of the future, but this future seemed slow to arrive.

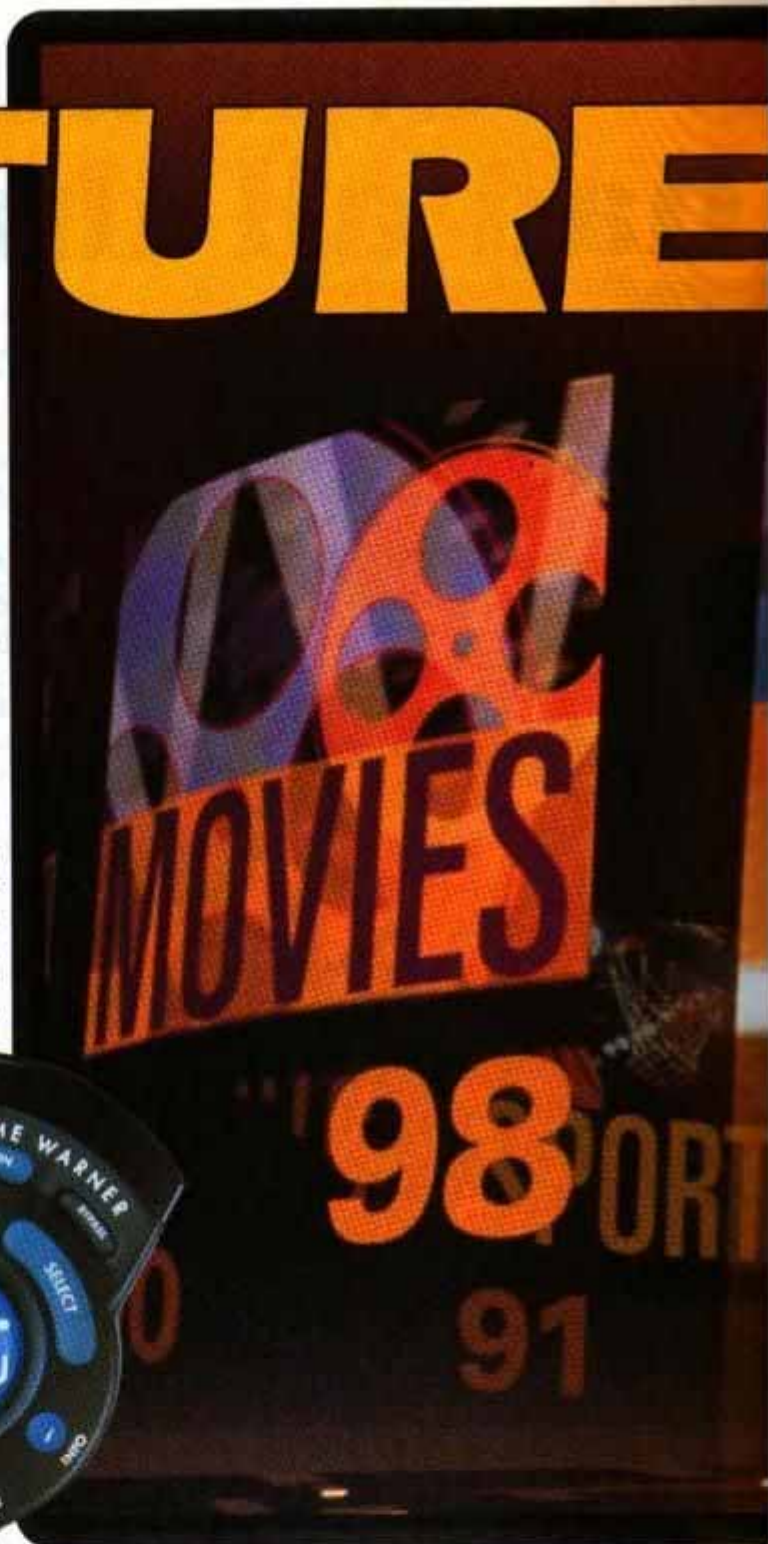
The future finally has arrived, albeit on a limited scale. Some lucky families in northern Orlando, Florida, are the first subscribers connected to a cable system that delivers on the perennial promise. Not only can they now order a movie whenever they want, but they can also control it just as they would a videotape. Viewers can replay the exciting parts, scan forward past the dull ones and pause the film while they microwave some popcorn. The movie may seem like it's coming from a VCR in the living room, but it's actually being retrieved from a computer across town.

This virtual VCR is only one of the features of an experimental cable network being developed by Time Warner, the world's largest media and entertainment company and the nation's second-largest operator of cable-television systems.

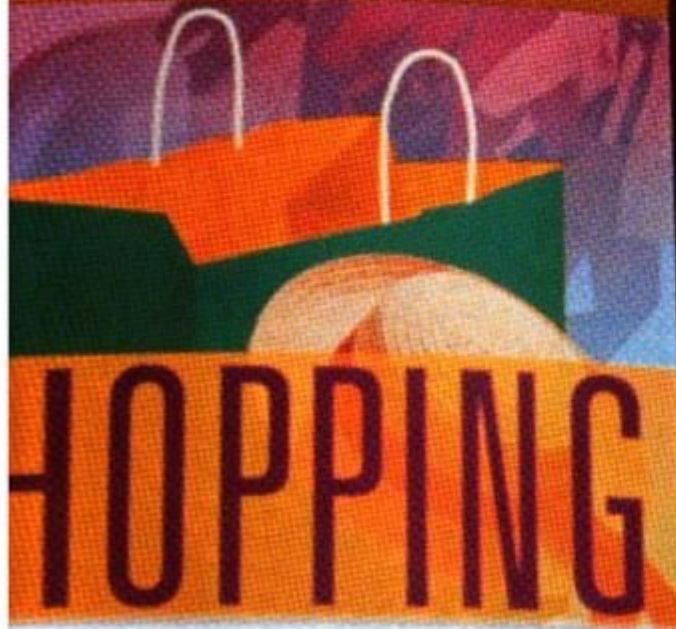
The Orlando operation is a laboratory where deep-pocketed Time Warner can test the technology of a fully interactive cable network and try to answer one of interactive television's nagging questions: When it comes time to pull out their wallets, what are Americans really willing to pay for? Time Warner wants to learn whether it



An on-screen carousel is your entry point for the many services offered on Time Warner's new interactive TV network. These on-demand services include movies, shopping and videogames.



WATCH



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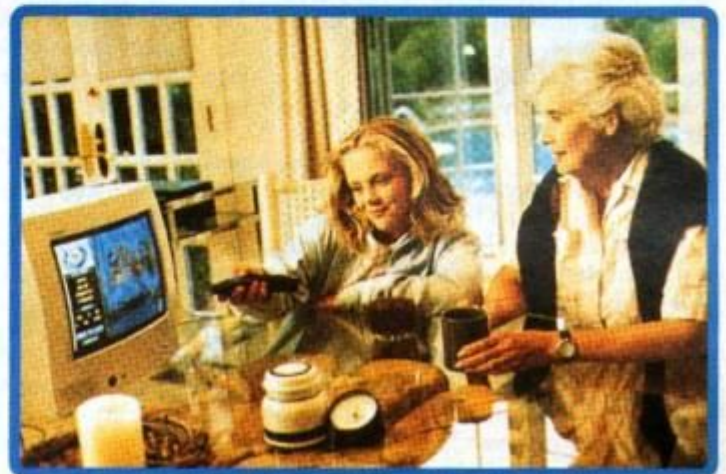
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FUTURE WATCH



About the size of a VCR, an FSN terminal lets you rotate a cereal box to check ingredients.

can make money offering—among other services—movies-on-demand, videogames and a telephone service that would compete with the local telephone company. Time Warner's successes and failures in Orlando will profoundly affect the development of American television.

Behind the innovative services offered by the Full Service Network (FSN), as Time Warner dubs its system, lies technology unlike any other cable system in current operation. FSN is the first to employ a transmission system known as Asynchronous Transfer Mode (ATM). Historically, cable services such as MTV and HBO are transmitted via wire to all homes in a local cable system in a continuous, uninterrupted flow. And that's how these traditional cable services are delivered on FSN. But interactive programming, such as pay-per-view movies and video clips of products in a video catalog, is transmitted via ATM. With video and audio already converted to digital bits and bytes, they're sent from FSN's Network Operations Center (NOC) in a series of distinct 48-byte packets of data, each having its own labeling information.

If a viewer orders "The Client," for example, the movie exits the NOC in a

sea of ATM packets, each containing data that's ultimately headed for different homes in the network. The packets for "The Client" travel down fiberoptic cables in the form of pulsating lightwaves until they reach the viewer's neighborhood. Then they're converted into a radio-frequency signal that travels over the familiar coaxial cable.

"The Client" packet is sent to all homes in the viewer's neighborhood, but it's ignored by the cable equipment in all houses except the one of the viewer who ordered the movie. In that home, an oversized cable box—FSN's custom-built home terminals are about the size of a VCR—converts the digital data back into an analog signal that can be viewed on a normal television set.

Only part of this technology was up and running when Time Warner debuted FSN last December. In the Network Operations Center, 16 different disk-drive "vaults," each the size of a large washing machine, will hold a total of 1.7 terabytes (that's trillions of bytes, or nearly 2 million megabytes) of digitized movies and other programming. Only six of the 16 were operational in December. Only three of the eight servers, or computers that will retrieve the information

from the drive vaults, were online. Time Warner says that FSN, when fully installed, will serve 4000 homes in northern Orlando, but only a handful were connected when the company invited the press to take a look at the system. In fact, the Willards, a local family that Time Warner presented as a typical subscriber household, had been connected to the network for only five days.

The programming on FSN is a work in progress as well. Planned for the network is a music-preview service that would let subscribers browse through a virtual record store, listen to snippets of each track on a CD and order the album simply by pushing a few buttons on their remote controls. A personalized sports-video clipping service would show highlights of recent games played by the professional and college teams that a viewer most wants to follow.

But these offerings, like so much of interactive television, remain a thing of the future. When POPULAR MECHANICS visited FSN, the only interactive features it offered were movies-on-demand, home shopping and videogames.

A hands-on test-drive of FSN, the most elegant interactive system in America, inspires a sense of both awe and indifference. At times, one can't help saying "Wow!" At other times, the response is "So what?"

The movies-on-demand feature was spectacular. Digitally transmitted films looked great, thanks to a higher-quality version of the video-compression system used to squeeze movies onto compact discs. And FSN lived up to its promise of making video-on-demand as simple to use as a VCR. It took only a few simple pushes of remote-control buttons to call up "Psycho" out of a menu of films. Searching for a particularly famous scene took only a few more button presses: skipping forward 10 minutes with a single push, then scanning backward after overshooting the sequence. And then, there it was: the opening moments of the movie's famous shower scene. The only drawback to the movies was selection. With less than 40 movies to choose from, FSN is starting with a rather small video store.

Home shopping on FSN, which lets you hunt for the products you need, seemed less of a time-waster than watching a home-shopping channel and waiting for something that looks interesting. Selecting the "shopping" option from FSN's main menu conjured

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Magazines, Inc. 1995

POPULAR MECHANICS MAY 1995



OUTDOORS

ROLLER BRAIKES

Putting a stop to downhill free fall, power brakes come to inline skates.

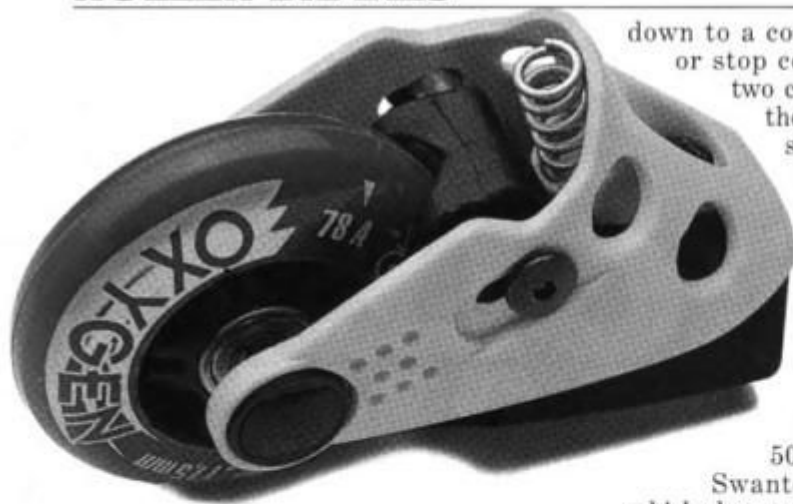
BY CHRISTOPHER McEVOY

• You're cruising along on a slick new pair of inline skates. You pull the water bottle from your fanny pack and replenish without missing a stride. Your speed is a comfortable 10 mph. Then you hit the crest of a hill. At first, you feel unfazed as your speed climbs to 15 mph and then 20 mph, but as you keep descending and picking up speed, your pulse begins to race.

At 25 mph, your eight wheels are spinning furiously and every bump in the road is magnified. You begin to wonder if your helmet can handle a spill at such speed, if your pads can protect your joints, if your exposed skin can escape the gnawing teeth of the pavement.

The handheld Grip works much like a bicycle brake.

ROLLER BRAKES



A V-pad contacts the rear wheel in the PBS.

As a feeling of panic begins to set in, you ask yourself, "How do I stop these things?" Until now, the only way to reduce speed on inline skates was to execute one of two tricky maneuvers: either engaging a rubber brake stop at the back of one of the skates by shifting your weight to the nonbrake skate and then lifting the toe of the brake skate while sharply leaning back; or you turned your skate sideways and simply dragged the wheels. Both methods have serious drawbacks, and neither delivers genuine stopping power.

To help inline skaters out of this

down to a comfortable rate or stop completely. The two cables run along the outside of the skater's legs and then tuck under the kneepads.

The Grip retrofit kit [just recently licensed by Bauer (Canstar Sports U.S.A., Inc., P.O. Box 716, 50 Jonergin Dr., Swanton, VT 05488),

which also uses the Force Multiplier heel brake], costs \$69 and features a brake caliper cassette in each skate. The calipers are installed by removing the second and third wheels from the rear of the skates. The cassettes align on a special braking-drum side of twin Griptonite wheels, which are included in the Grip kit. Axle spacers of 6mm, 8mm and 1/4-in. widths are provided in order to allow for installation on a wide range of skate styles. The Grip kit fits about 90% of existing skates.

When first activating the Grip, it's best to practice on flat ground before attempting inclines. Work up to downhill situations slowly, learning to feather the controls as opposed to

grip and a hydraulic tubing system to engage two drum-brake assemblies, one in each skate. While the Grip is inspired by brakes on bicycles, Roll Control takes its cue from cars.

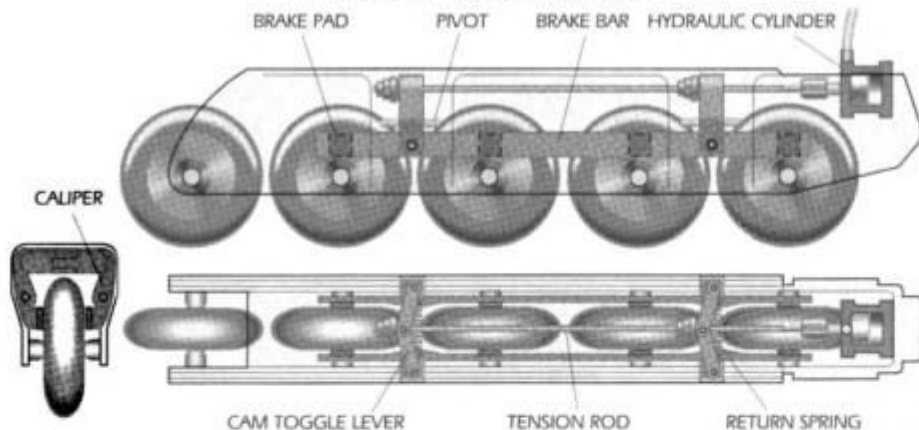
The Roll Control kit (\$69 to \$125 depending on the skates) uses tubing made of pliable Kevlar-reinforced urethane that attaches to a thumb-controlled actuator built into a wrist glove. The 1/8-in. tubing runs down the body to a Y fitting at the waist. Here, two lines emerge and head down the skater's legs to hydraulic cylinders at the back of each skate. By pressing the thumb control, a skater activates both hydraulic cylinders to achieve synchronized stopping.

The cylinder in the Roll Control system works by activating a tension rod that moves forward in the frame of the skates and closes (tightens) a hinge, which squeezes a caliper-style brake bar. This brake bar is fitted with brake pads that contact the wheel hubs. The result is a smooth stopping action.

For those who don't want cables running down their bodies, several manufacturers have developed systems that increase the stopping power of conventional heel-stop brakes. Rollerblade's (Rollerblade Inc., 5101 Shady Oak Rd., Minnetonka, MN 55343) Advanced Braking Technology (ABT) system is activated by moving one foot forward in a semi-lunging, semi-squatting manner. When you assume this foot-forward position, your calf naturally applies rear pressure on the cuff of the skate. ABT uses this pressure to cause the braking device to automatically lower and make contact with the ground. This is done by running a brake arm between the cuff of the brake skate and the rubber stop.

As the cuff places downward pressure on the arm, it forces the brake pad to strike the pavement. The brake arm is adjustable so you can fine-tune clearance of the rubber pad.

Roll Control



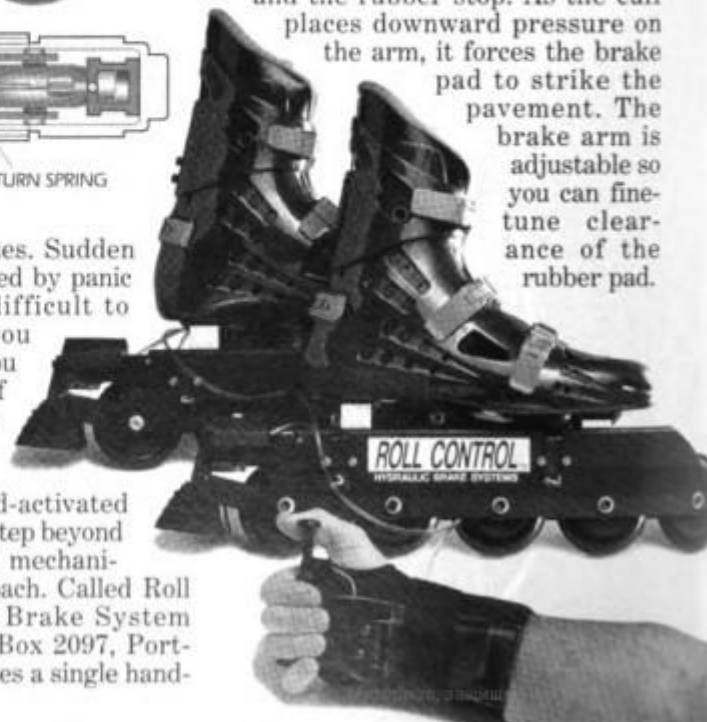
Inline skating's version of hydraulic brakes from Roll Control.

predicament, skate manufacturers have come up with a number of new brake systems that range from merely improving the current approach to mechanical systems that deliver true power braking.

One recently introduced system is the handheld power brake called the Grip (Grip Inc., 5375 Western Ave., Boulder, CO 80301), which works much like a bicycle brake. The Grip employs two lever devices linked by cable to caliper-style brakes within the frame of each skate. By squeezing one or both levers during high-speed descents, you can feather your speed

making hard squeezes. Sudden shifts in weight caused by panic squeezes may be difficult to control, but once you get the hang of it, you have the option of skating hands free by clipping the handles onto hip clips.

Another new hand-activated brake system goes a step beyond the Grip's 2-handed, mechanically activated approach. Called Roll Control Hydraulic Brake System (Roll Control, P.O. Box 2097, Portland, OR 97208), it uses a single hand-

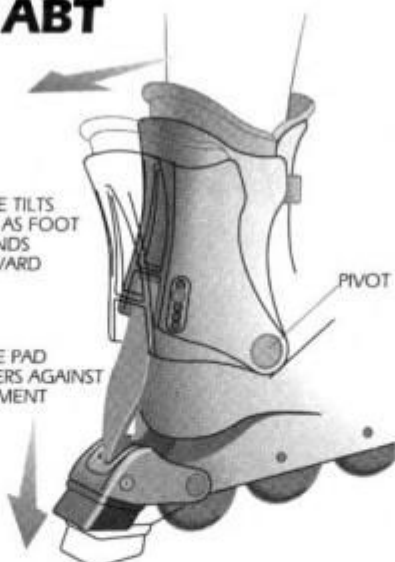


Rollerblade ABT



ANKLE TILTS
BACK AS FOOT
EXTENDS
FORWARD

PIVOT
BRAKE PAD
LOWERS AGAINST
PAVEMENT



ABT uses a cuff-activated brake arm to force the heel pad down to the pavement as the skater's foot extends forward.

and are interested in affordable, cuff-activated braking, you needn't purchase new skates. Out of Line Sports (3140 S. Williams St., Englewood, CO 80110) offers a Ground Engaging Moveable (GEM) retrofit kit (\$34.95) that's similar in action to the ABT system. It retrofits pre-ABT Rollerblades and many other models with only minor modifications.

In addition to hand-activated and cuff-activated systems, several companies have taken a completely different approach to braking. Oxygen (Atomic Ski USA, 9 Columbia Dr., Amherst, NH 03031), for example, offers a Power Braking System (PBS) on all its current skate models, which range in price from \$129 to \$299. At first glance, PBS

Cuff-activated GEM retrofits most skates.

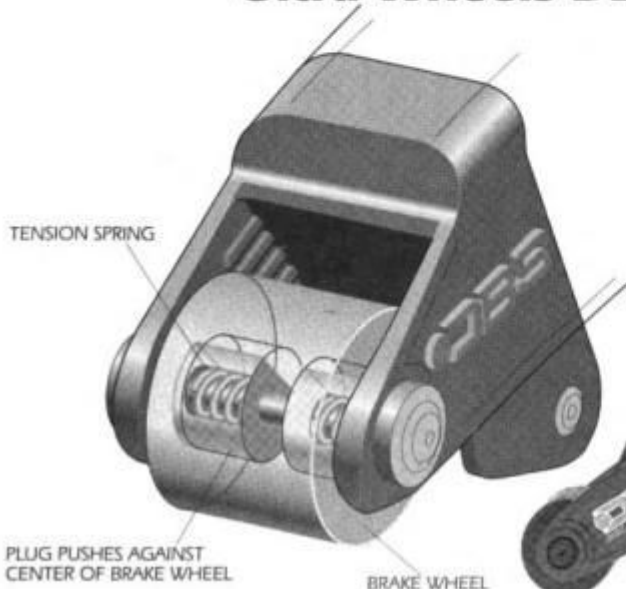
looks no different from other heel brakes on the market, but internally, a spring forces a V-shaped pad to come into frictional contact with the rear wheel when the brake hits the pavement. This dual-action braking system shortens stopping distance by about 40%. The brake is removable with a 4mm hex wrench, allowing skaters to transfer the unit between the left and right skates. Replacement internal brake pads are available in marking or nonmarking versions.

Ultra Wheels (First Team Sports, 2274 Woodale Dr., Mounds View, MN 55112) has come up with its own heel-brake device called Disc Brake System (DBS), a 3-in-1 approach that employs friction, disc and drum braking. Skaters operate the unit like any heel brake, but instead of having a brake pad at the heel, DBS features a slowly rotating rubber wheel that gradually helps skaters reduce speed. The benefit of using a wheel instead of a rubber stop for frictional braking is that a wheel maintains more consistent contact with the ground and reduces bouncing.

As the wheel brake strikes the ground, internal disc- and drum-brake systems go into action and apply pressure to the wheel brake's vertical and horizontal rotating surfaces. In effect, the disc and drum brakes internally slow the rotation of the brake wheel. DBS is available on three Ultra Wheels models: the Ultra-Air (\$229), the Great One (\$199) and the Katarina Allure (\$189).

Last year there were some 37,000 emergency-room visits resulting from inline skate accidents. Improved stopping power could have reduced this figure significantly. **FM**

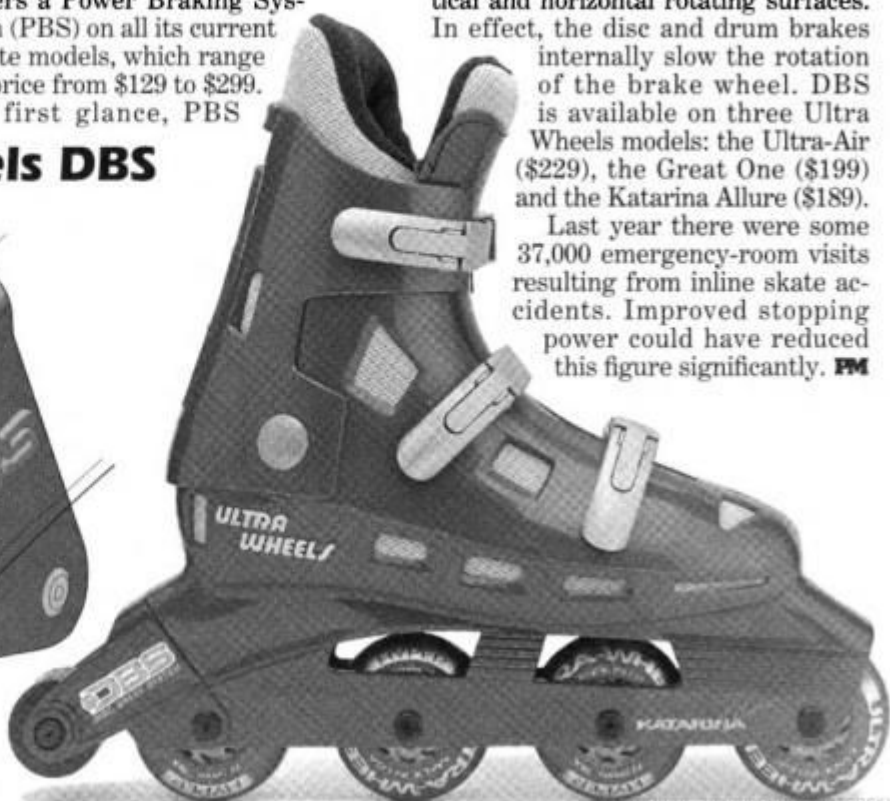
Ultra Wheels DBS



TENSION SPRING

PLUG PUSHES AGAINST
CENTER OF BRAKE WHEEL

BRAKE WHEEL



DBS uses a wheel brake instead of a pad.



● Hold a model in your hand these days and you might think you're in a scene from the movie "Honey, I Shrunk The Kids." The contours, details and finish appear to be identical to the model's larger namesake.

The reason is that both the makers of the real McCoy and the tinier replica are increasingly using the same manufacturing tool. The so-

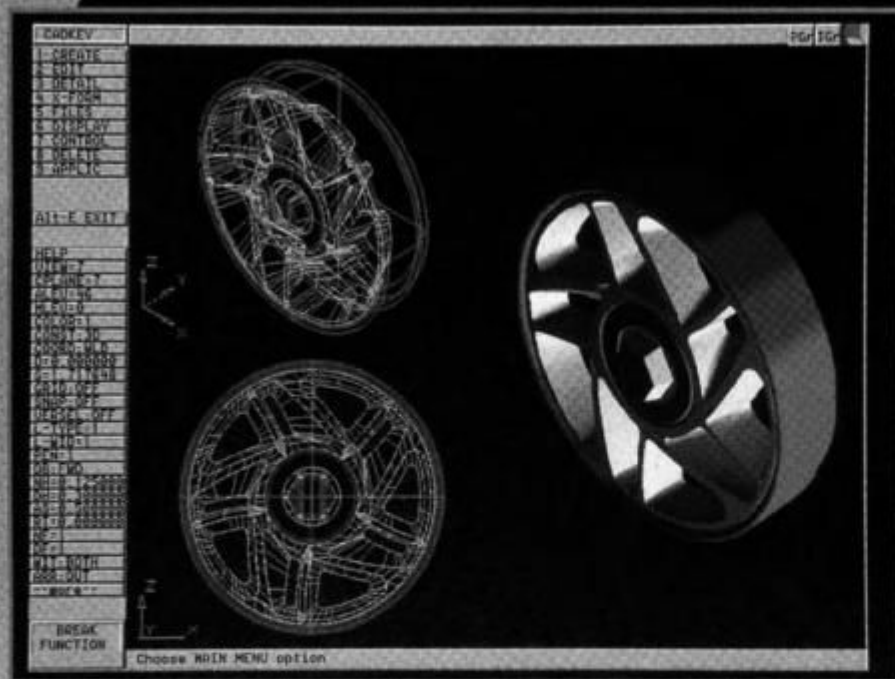
puter-aided design. CAD is the combination of computer and software that enables a skilled designer to create objects in three dimensions (width, height *and* depth) and rotate and view them from any perspective, while maintaining scale among the various components. If a revision is needed (say, widening the wheelbase or extending the drivetrain), the CAD program harnesses the computer's muscle to recalculate the proportions and make a new draft on-screen.

A basic CAD drawing looks like a blueprint on TV and is called the "wireframe." The latest frill adds a "skin"—the surface is rendered on-screen to show contours (fenders, for example) in 3D-like fashion. Despite the photorealistic shadowing, the on-screen model is flat. But within the CAD program are all the solid-geometry formulas needed to produce that given part on machines capable of tooling-by-numbers.

CAD is relatively new to the hobby-kit field. But within the past five years, virtually every U.S. model-maker (and Japan's Tamiya) has explored CAD to some extent, either in-house or through subcontractors.

For instance, modelmaker AMT/Ertl employs CAD in-house for the die-cast collectibles in its Ertl line, but for the plastic hobby kits of its AMT/Ertl brand, CAD is performed by an outside firm called InScale Design Engineering.

Industry insiders consider InScale the pioneer in CAD for scale-replica modeling. The Traverse City, Michigan-based company opened in



phisticated computer-aided design (CAD) techniques used to create real fuel-burning vehicles are now being applied to generate scale-model replicas—the plastic hobby kits you build yourself as well as display-ready metal collectibles.

Greater accuracy and tighter tolerances are the fringe benefits of com-



SUPERMODELS

1992 as a partnership of hobby-kit veterans Ed Dietz and Bud Alford. Some of their work provides an example of the degree to which CAD may be applied. Take the Chevy Camaro pictured on the previous page, for example.

General Motors supplied its original 3-dimensional CAD data to InScale. Dietz tells POPULAR MECHANICS that this input was modified and scaled to create CAD renderings suitable for the plastic model. To produce the final replica, InScale's CAD renderings were fed to tooling machines capable of interpreting the computer's numerical data to cut the steel molds for the plastic parts.

This process, though simplified here, pretty much remained CAD from input to output. "The B-52 bomber replica wasn't so easy," says Dietz. Though the steel molds were "cut" directly from InScale's CAD data, those computer renderings had to be done the old-fashioned way—replotted onto the PC from a combination of Boeing's 2-dimensional blueprints and hundreds of carefully composed photos.

The CAD program of choice at InScale, Testors and just about every modelmaker is CADKEY 7, from Windsor, Connecticut-based Cadkey, Inc.

CADKEY 7 is popular because it's optimized for mechanical design as opposed to, say, architectural rendering.

"There aren't a lot of straight lines in modeling," says Ken Stark, mechanical designer at Testors.

Equally important, the \$795 CADKEY 7 is designed to work on regular IBM-compatible personal computers. The PCs at InScale and Testors are not that different from what you might have at home—basically, 486DX2 microprocessors running at 66 MHz, though with many megabytes of random-access memory added. "We're using 20 MB of RAM," notes Stark. "It really helps out a lot with the surfacing."

At the moment, any cost savings in the manufacturing process are limited to those situations in which 3D-CAD data runs tool-cutting machinery directly, thereby cutting out one lengthy and costly stage of creation—the so-called pattern-making. Patternmakers fashion forms for the various parts, in wood or synthetic wood.

"Pattern-making accounts for about 30% of the cost of developing a hobby kit," says Dietz. "This is the stage that will be skipped, eventually, as CAD renderings go directly to the toolmaking stage."

Though it runs contrary to expectations, model designers say that



Franklin Mint's die-cast 1964 1/2 Mustang model has more than 100 parts.

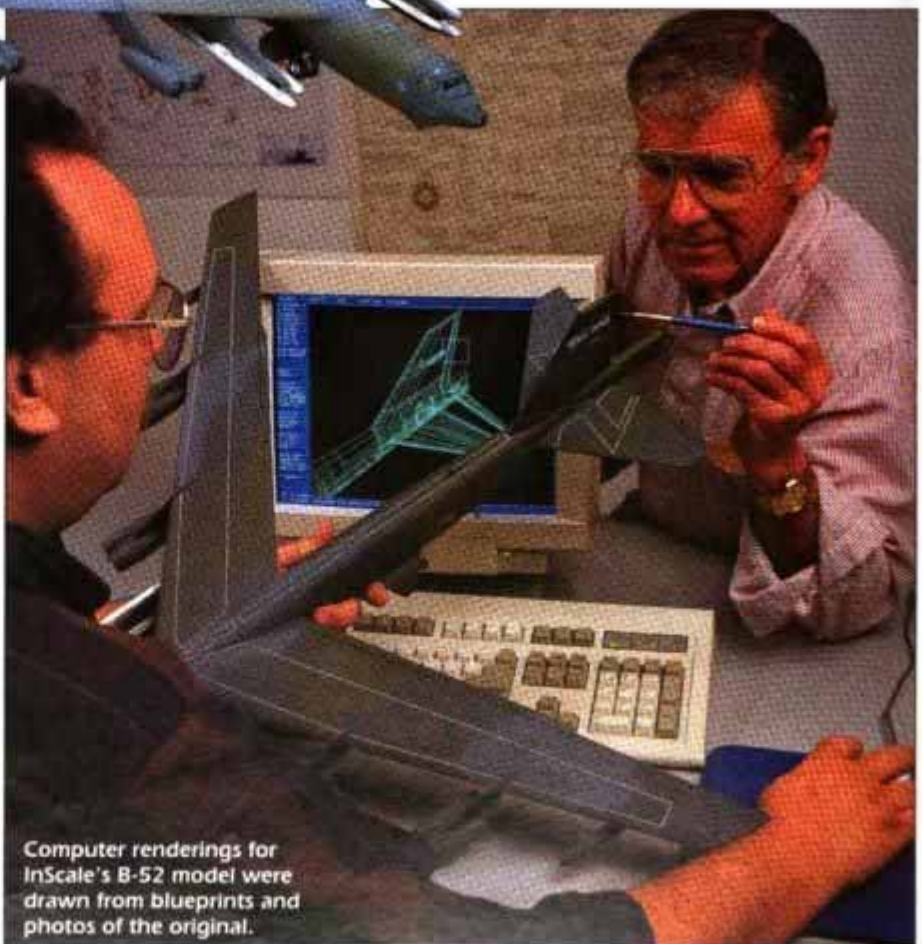
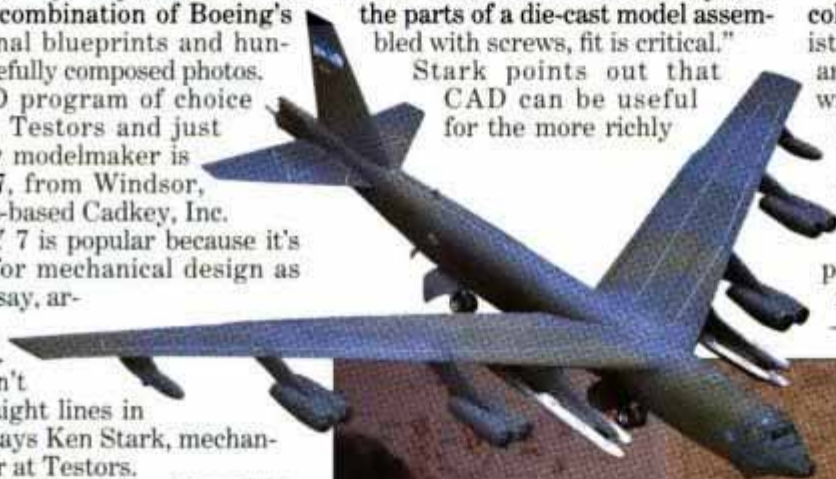
CAD is more useful for the multiple-part plastic kits than for the pre-assembled, often costly, metal collectibles, such as those sold by the Franklin Mint and others.

However, CAD can make a good die-cast collectible better. "You can design for tighter tolerances in the metal," notes Stark. "For example, in the parts of a die-cast model assembled with screws, fit is critical."

Stark points out that CAD can be useful for the more richly

appointed metal collectibles, such as those with leather or fabric interiors. "With plastic kits, everything's polystyrene with the same shrinkage factor," he says. "With collectibles, you might have a variety of materials—zinc, plastic, fabric—and all have different shrinkage factors."

CAD work for craft modeling isn't coldly abstract. Rather, there's artistry involved at several levels. One area, for instance, is creative leeway with proportions. It's virtually impossible to reduce the sheetmetal thickness of a full-size car proportionately for a 1:24 scale replica. Here, the CAD engineer must know how to "cheat" as cleverly as his pen-and-ink forebear did. A replica may not be proportionately precise—but it does have to appear so. **PM**



Computer renderings for InScale's B-52 model were drawn from blueprints and photos of the original.

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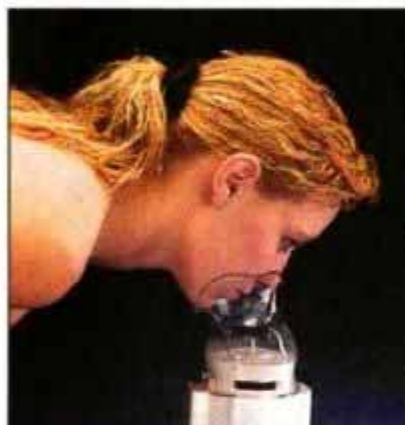
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HOME&SHOP JOURNAL

COMPARISON TEST

Self-Propelled Mulching Mowers

We rate 11 of the best grass-cutting machines.

BY ROY BERENDSOHN, Assistant Home Improvement Editor
PM Photos by Stan Silver

- Maybe you've decided it's time to get a new lawnmower because your old one just doesn't cut it anymore. You want your new mower to be more versatile than the old one, self-propelled, bigger and more powerful. It's a tough choice—picking the right mower—because there are lots of capable machines out there. Since these mowers cost from \$400 to \$850, it's important that you rank the features most important to you and then determine what you're willing to pay for them.

Mower Profile

The biggest news these days as far as mowers are concerned is their ability to do away with large grass clippings—a matter of no small importance, since nearly everyone loves a nice lawn, but hates the way the stringy clippings stick to shoes and get tracked into the house. More important, some towns charge a fee to dispose of clippings or forbid their public disposal.

In keeping with the times, we tested 11 convertible mulching mowers. These machines shred clippings into particles so fine that, in most situations, you'll never again have to rake or even bag them. Better yet, the shredded clippings can improve the health of your lawn. If you're meticulous about lawn care, you can convert these mowers so that they collect the clippings in a grass bag or, if you're cutting shin-deep grass, you can discharge them out the side.

It takes power to cut grass efficiently and to operate a drive system, so we tested mowers with big engines, 5 and 5.5 hp, and large decks, 21 and 22 in. wide.





TROY-BILT

SNAPPER

HONDA

TORO

Finally, 10 of the machines have recoil start, featuring a traditional pull rope. Just one (Craftsman, the Sears' model) has an electric start. Many of the other machines can be equipped with an electric start at an extra expense.

Uncle Sam And The American Lawnmower

Back in 1982, the federal Consumer Products Safety Commission told mower manufacturers that they had to find a way to prevent people from being accidentally cut by the mower blade. This resulted in the now-familiar—and often irritating—safety lever on mowers. In case you don't own a walk-behind mower, here's how it works: You hold the lever down and either pull the rope to start the mower or press the start button. When the engine starts, the blade turns, and when you let go of the lever, the engine and blade stop.

The mower industry refers to this safety feature as "zone start" or "extended rope start," since you must stand in a zone behind the mower to start it. Most of the mowers we tested

had this feature (see chart below).

Some manufacturers have produced a better system, one that employs a blade-brake-clutch (BBC). This feature allows you to start the mower engine and operate the blade separately. Once it's running, you press a lever to get the blade turning. This enables you to stop the blade and leave the engine running if, for instance, you want to remove an obstacle from in front of the mower. The zone-start models, on the other hand, shut off, and you must restart them every time you release the handle.

BBC operation does add \$75 to \$100 to the machine's cost. But take heart. If you find a mower you like and it doesn't have the BBC system you want, consider getting electric start to at least make restarting easier.

Another aspect of these safety levers is that they increase the complexity of operating a self-propelled mower. You must press one lever to run the engine or the engine and blade and another to operate the drive system. When combined with controls for throttle speed and ground speed, it can get a little intimidating.

There's one more thing that might surprise you about these high-end mowers. Many have OHV visible on the engine and perhaps mentioned on their shipping box. These letters, of course, stand for overhead valve. This valve configuration has a nice high-performance ring to it, and it does make engine exhaust cleaner while also improving fuel efficiency. Ohv engines are becoming the industry standard because the federal government is requiring outdoor power equipment to have cleaner emissions. Although traditional side-valve engines appear to be on the way out, mowers with this configuration still perform well (see chart). Now for the test results.

Ariens

The Ariens mower is a capable, basic machine that's rugged. In its construction it has more bolts than other mowers, which makes it easy to service, if not eye-catching. Even the side-discharge chute and mulching cover are bolted to the deck.

Ariens simplifies operation by eliminating the throttle lever. Push the engine's primer bulb, start the mower

MOWER SPECIFICATIONS

| MANUFACTURER | MODEL | PRICE | HORSEPOWER | CUT DIA. (in.) | TOP SPEED (mph) | NOISE LEVEL (decibels) ¹ | HEIGHT ADJ. | START CONFIGURATION ² | VALVE CONFIGURATION |
|------------------|-------------|-------|------------|----------------|-----------------|-------------------------------------|-------------|----------------------------------|---------------------|
| Ariens | LM 214 SP | \$660 | 5.5 | 21 | 3.7 | 89 | 4 levers | Recoil/Zone | Side Valve |
| Deere | 14ST | \$635 | 5.0 | 21 | 2.7 | 91 | 4 levers | Recoil/Zone | OHV |
| Honda | HRM215 | \$720 | 4.5 | 21 | 2.7 | 84 | 4 levers | Recoil/BBC | OHV |
| Kubota | W5021SC | \$850 | 5.0 | 21 | 2.6 | 85 | 4 levers | Recoil/BBC | OHV |
| Lawn-Boy | 10516 | \$530 | 5.0 | 21 | 2.6 | 91 | 4 levers | Recoil/Zone | Side Valve |
| Murray | 22855x6 | \$380 | 5.5 | 22 | 3.2 | 90 | 1 lever | Recoil/Zone | Side Valve |
| Sears | 917.373841 | \$400 | 5.5 | 22 | 1.9 | 91 | 4 levers | Electric/Zone | OHV |
| Snapper | RP21500 | \$695 | 5.5 | 21 | 3.7 | 93 | 4 levers | Recoil/Zone | Side Valve |
| Toro | 20464 | \$650 | 5.5 | 21 | 3.8 | 91 | 4 levers | Recoil/Zone | OHV |
| Troy-Bilt | 34311 | \$750 | 5.5 | 21 | 2.6 | 84 | 1 handle | Recoil/BBC | OHV |
| Yard-Man | 125-149A401 | \$400 | 5.5 | 21 | 2.6 | 91 | 2 levers | Recoil/Zone | OHV |

1. Peak decibel rating measured on A scale. 2. Zone and BBC start refers to safety features (see text).



ARIENS

KUBOTA

DEERE

LAWN-BOY

and set ground speed by pulling or pushing a round knob that's connected to a rod. However, the knob was quite awkward to use.

Deere

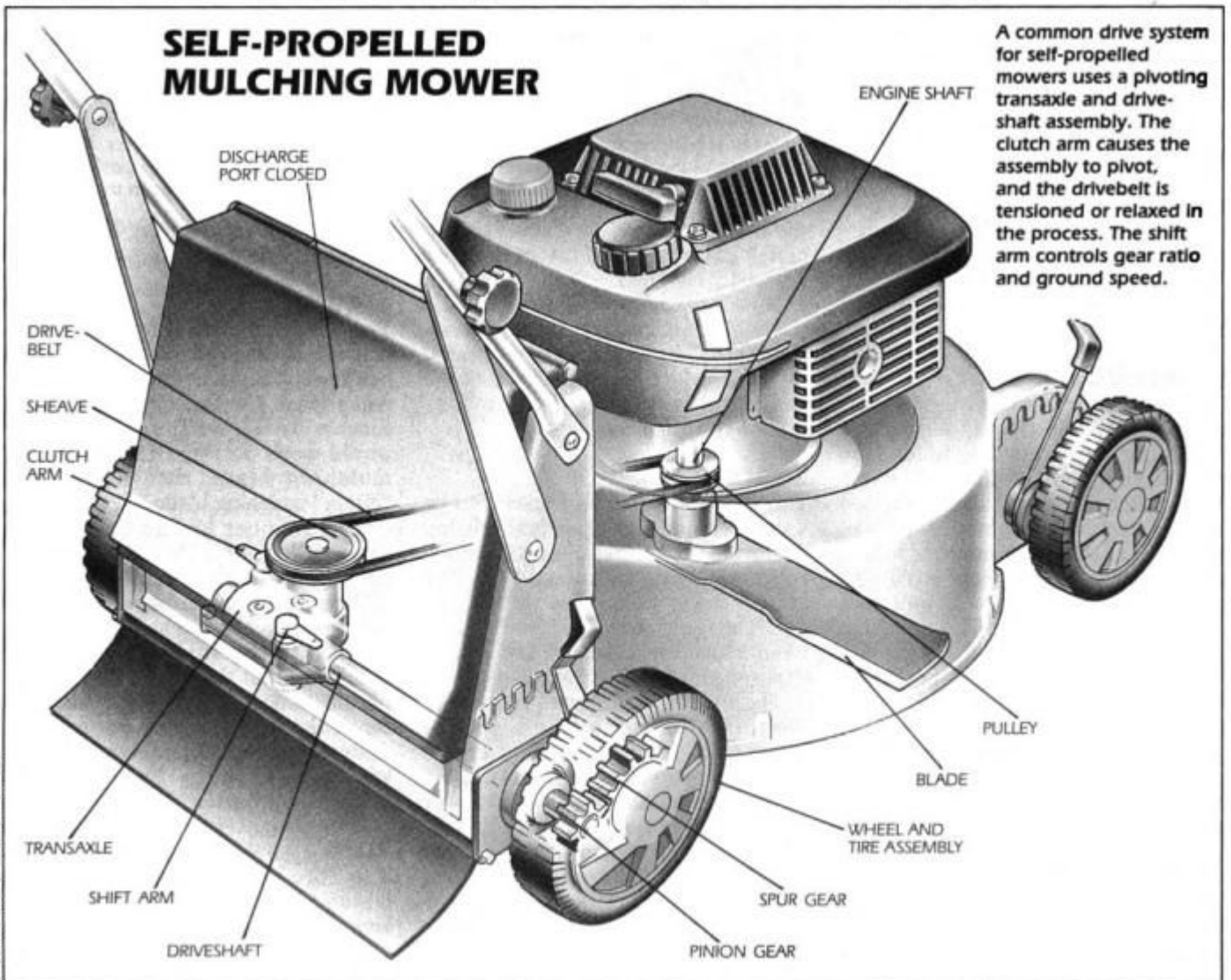
We found the Deere to be a sturdy and well-designed mower, and it was among our favorites with zone start.

It has a number of small features that we like, such as a translucent fuel-level view port on the gas tank and grease fittings for the rear wheels.

More important, the Deere is equipped with a well-engineered oil-change fitting above the deck. Attach a clear plastic hose (supplied) to the fitting. Loosen the fitting, drain the

oil into a container, tighten the fitting and refill with fresh oil.

The Deere has an ohv Kawasaki engine that provides plenty of power for cutting and propelling the 2-speed drive system. The mower also has easily installed mulching or side-discharge plugs and a well-balanced rear grass bag.



A common drive system for self-propelled mowers uses a pivoting transaxle and drive-shaft assembly. The clutch arm causes the assembly to pivot, and the drivebelt is tensioned or relaxed in the process. The shift arm controls gear ratio and ground speed.

Honda

The Honda is quiet, and easy to start and use. It also produces the nicest quality of cut, thanks to a sophisticated blade design that keeps grass particles suspended for a longer period of time as they're cut into fine pieces.

Also contributing to the mower's quality is a dome-shaped plastic deck that tilts to the rear, so the blade cuts in a slight shearing action. The deck resists accumulation of clippings, and when we pushed this well-mannered machine through ridiculously tall and damp grass, it refused to stall.

The model we tested is a BBC type. Engaging the blade involves a deliberate and slightly awkward step: You must press a yellow button while simultaneously engaging the blade lever. Otherwise, the 2-speed mower is simple to use, with a side-discharge chute and a grass bag that's easily installed on the rear of the mower.

Kubota

The Kubota was the most expensive and commercial-like machine we tested. For instance, it has a solid-steel driveshaft, not a V-belt. Another example of the commercial-level quality is the heavy metal deflector hinged to the back of the mower deck. Other mowers simply use a rubber flap.

Not one to take chances with cable failure, Kubota puts the 2-position ground-speed lever just above the rear wheel, but this makes it impossible to move the lever while mowing. Otherwise, the Kubota is easy to start and runs smoothly.

Lawn-Boy

The Lawn-Boy proved easy to start and easy to use. Equipped with a mulching fan below the blade, the mower chugged through tall, damp grass without stalling, and it mulched lawn-height grass very well.

Because the mower mulches so well and is so powerful, we doubt you'll even need its bag, which is just as well since it's difficult to mount. The mulching plate, however, easily slid into place.

In terms of durability, the Lawn-Boy should be a good buy. It is the only mower at the lower end of the price spectrum with an aluminum mower deck. Also, its muffler is well shielded, and it's equipped with grease fittings for the rear wheels.

Murray

The Murray is a good, competent mower. It's easy to use and, like the Troy-Bilt, it has single-point height adjustment—move one lever to adjust



The Murray's single-lever height adjustment was the easiest to use of any of the 11 mowers that we put to the test.



Troy-Bilt's handle turned out to be the most adjustable. It uses a rotating, geared knob assembly that's simple to change.

the mower deck up or down. Its bag, mulch plate and side-discharge port are easily installed.

However, the mower proved relatively difficult to start. Its righthanded drive lever was awkward compared to a full-length lever that spans the width of the handlebar—standard fare on the other mowers.

Sears

The Sears' Craftsman appears to be a good buy, if not an overwhelming performer. Even with electric start, the mower costs only about \$400. The starter never failed, but we feel the delicate ignition wires should have been housed in a jacket, not simply exposed and thus inviting snags.

The mower was simple to operate due to its having a single ground speed, but this machine was unanimously received as too slow. The Craftsman cut as well as any mower in dry grass of typical height. However, its deck plugged on deep and damp grass. And its front-wheel drive lost traction on wet surfaces as well.

Converting the mower from mulching to side-discharge cutting in thick grass was easy. All we had to do



Yard-Man's air-filter cover is well located and easily removed. These design attributes make it easy to clean or replace the filter.



Sears' Craftsman mower has a spring-loaded chute that is quickly positioned for mulching or side discharge in thick grass.

was flip open the spring-loaded deflector on the side of the mower deck.

Snapper

This machine proved to be fast cutting on ordinary grass of average height, but it bogged down in tall or damp grass. Contrary to the manufacturer's claims, we think the mower would work better with a standard mulching blade rather than its "Ninja" mulching blade.

The Snapper has an easy-to-use drive system with shift-as-you-go capability. And with an automotive-style differential, you can swoop through turns without one wheel spinning a mark into the turf. However, we didn't like that the driven disc assembly sits almost completely exposed on top of the mower deck. We think this design is an invitation to easy fouling with grass clippings, leading to premature malfunction.

Toro

The Toro is a substantial mower. It has an aluminum deck, iron transmission gears, grease fittings at the rear wheels—and a 5-year guarantee. The machine also shows signs of product

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Bill Smith

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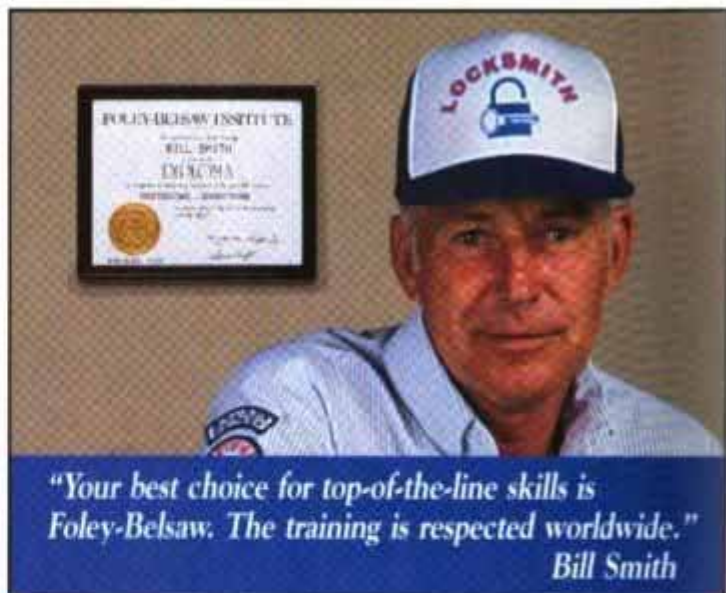
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"Your best choice for top-of-the-line skills is Foley-Belsaw. The training is respected worldwide."
Bill Smith

had to be a 'wiz' in electronics to succeed in VCR repair. Now I know nothing is further from the truth."

5 Computer Repair, Maintenance, Upgrade - Most businesses are "on-line." And so are a growing number of homes — personal computers are practically household appliances! The need for skilled computer installation, maintenance, upgrades and repair is tremendous. Foley-Belsaw offers the training you need to cash in on this growth.

6 TV/Satellite Dish Service and Repair - You see them popping up in yards all over town. The market for satellite dishes will continue to grow to satisfy the demand for variety in entertainment. Get the skills you'll need to profit.

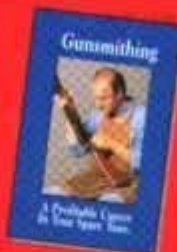
7 Professional Gunsmithing - Skilled gunsmiths - when you can find one - charge up to \$50 per hour for simple repairs. That's money you can put in your pocket with the training you'll get from Foley-Belsaw.

8 Professional Woodworking - You'll start your course with the simplest of projects, but soon will be crafting mortise and tenon joints, creating heirloom-quality pieces worth thousands of net-profit dollars. The course is also ideal for the do-it-yourselfer. As J. B. of Shawnee Mission, Kansas, writes, "I saved well over \$2,000 in kitchen remodeling and \$1,000 on a deck."

9 Upholstery - Furniture prices have increased yet quality has noticeably decreased. So many individuals and businesses now turn to skilled upholsterers to restyle furniture instead of discarding it. With the Foley-Belsaw course, you'll become an upholstery professional, using your knowledge for a full-time business, part-time career, or a satisfying, money-saving hobby.

10 Computer Programming - It's a fact: Computers are more widespread than ever before. And programmers with the right skills command top dollar for their work. Learn the languages most in demand — Q Basic, C, C+ and C++ — and watch your income soar.

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Lawn-Boy's discharge chute and mulching plate slide into place with very little effort. Parts are accessible on the mower deck.



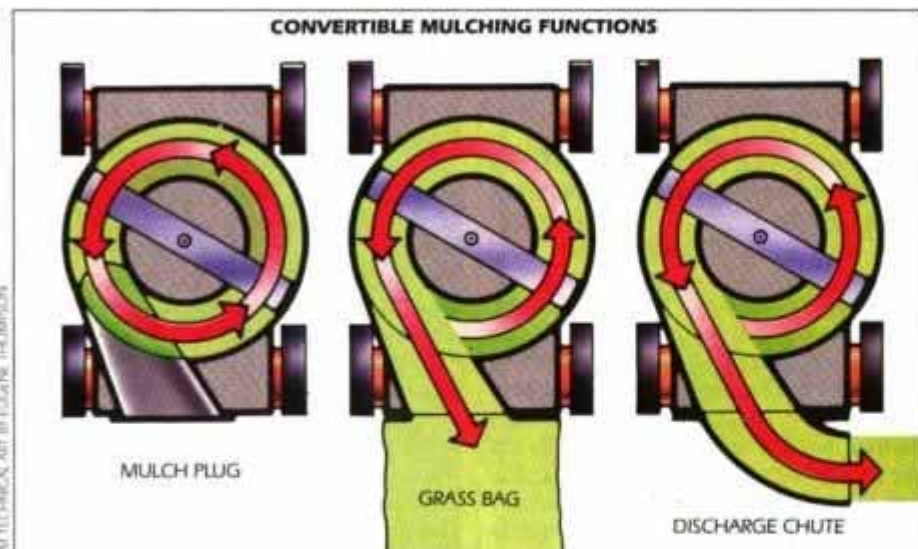
Deere's top-handled grass bag is easy to use. The bag hangs off the mower's back, right under the spring-loaded hatch.



The Ariens was one of several mowers that converts to mulching by simply sliding a plug underneath the back hatch.



To convert the Kubota to side discharge, all you have to do is lift the back hatch and then slide in a curved discharge port.



Convertible mulching mowers recirculate clippings to turn them into mulch (left), send clippings into a rear grass bag (center) or discharge clippings out the side (right).

development. The blade is curved and slightly twisted along its length. When combined with deflectors built into the deck, this is supposed to provide increased mulching action in tall grass. Unfortunately, we saw no improvement in its mulching or cutting capability beyond that of the less expensive machines.

The Toro was also very hard to start. And to change ground speed, you must release the drive lever to the halfway position and then move another awkwardly positioned lever.

Troy-Bilt

The Troy-Bilt is a powerful, smooth-running and quiet mower that starts

easily and is capable of mowing formidably tall grass. Its handle was the most adjustable of any mower tested, and it has an easy height adjustment. To raise or lower the mower deck, all you do is twist a well-positioned handle.

The mower's reasonably complex speed control employs a lever with a geared knob. This was not well received, nor was the machine's front-wheel drive, which made it lose traction on slopes and damp surfaces.

Also, the mower uses safety-interlock switches that require all deck components be installed properly so the mower will start. We thought it a poor design that the switch wires are exposed and prone to snagging. Another design shortcoming: There's no side discharge, a feature found on less-expensive mowers.

This mower needed substantial tinkering to start properly. And the mower was difficult to transport because when the engine is off, the front wheels lock and the mower can be pushed only on its rear wheels.

Yard-Man

The Yard-Man had an inauspicious beginning: We removed it from the carton and found it had a bent deck. We snapped it back into shape and pushed it hard during the test, and in the end it emerged as our favorite low-cost machine.

There's a lot to like about this easy-starting mower. Its spring-loaded discharge port lets you convert quickly from mulching to side discharge or bagging, and it's powerful enough to handle any kind of cutting. During the tall-grass test—in a cow pasture—it mowed down a rhubarb patch without stalling. An inspection afterward revealed a clean deck.

The mower has a righthand lever-operated drive system that received mixed reviews. But its ohv engine, 2-lever height adjustment, lubricated chain drive and ball-bearing wheels were all applauded.

Conclusion

The Honda emerged as our overall favorite because it was quiet, simple, smooth-running and capable. A thoroughly well-designed product, it was followed closely by the Deere in terms of capability and ease of use.

Further comparison yields a collective third-place ranking of Ariens, Kubota and Lawn-Boy, with Yard-Man showing up a very respectable fourth. The remaining mowers were less successful.

Homeowners Clinic

BY NORMAN BECKER, P.E.,
 Contributing Editor

Loose Siding Repair

A section of the horizontal-lap aluminum siding has loosened around the waist of our 2-story 10-year-old home. I've been told that the siding will have to be taken down and reinstalled. I can't believe there isn't some way to remedy this without going through that kind of work and expense.

JOHN STONER
 ELGIN, IL

I checked with the technical department of the trade association of aluminum-siding manufacturers, the American Architectural Manufacturer's Association (AAMA). The Association recommended the following repair procedure:

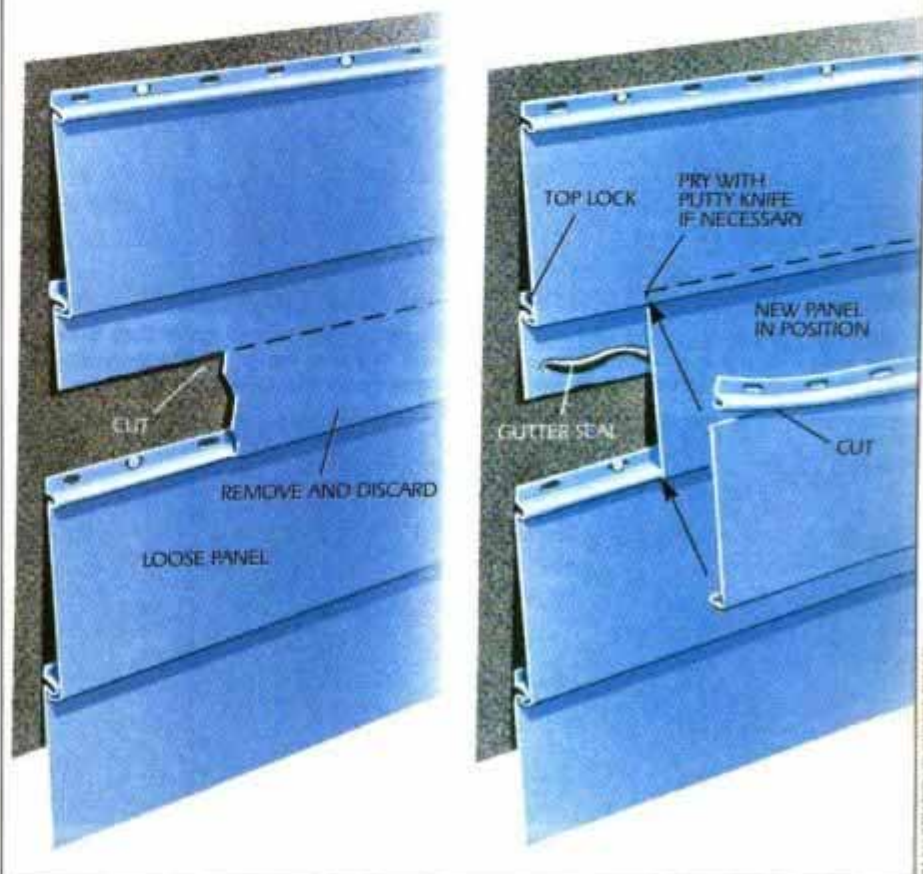
1. Cut the panel that's above and adjacent to the loose panel along its entire length at a point just above its center. This can be done using a utility knife and tin snips. Then, remove and discard the lower section.
2. The nailed portion of the loose panel will now be exposed. Remove the loose, bent panel and replace it with a new panel. Make sure to nail it properly at the top and then to snap the bottom section into the top lock of the siding panel below.
3. Remove the top lock of a new panel by deeply scoring it with a utility knife. Bend the piece and snap it off.
4. Apply a heavy coat of gutter seal along the full length of the cut panel, as shown in the drawing.
5. Install the new panel over the gutter seal. Tuck the top of the panel under the lock and snap the bottom lock in place. Be sure the gutter seal makes contact with the new panel. Apply pressure with your palm, but be careful not to bend the panel.

If you have further questions regarding aluminum siding, write to: Technical Information Center, AAMA, 1540 E. Dundee Rd., Suite 310, Palatine, IL 60067.

Basement Water Seepage

We have a paneled, finished and furnished basement that's being destroyed by water seepage, and I'd like to know which kind of contractor to call to fix the problem. I've spoken to a landscape contractor who said that

LOOSE SIDING REPAIR



Loose aluminum siding can be repaired. Just cut away the panel above to gain access. Then replace the loose piece and finish up by installing a new piece over the cut section.

dry wells will direct water away from the house. Will this correct the problem? Or should I call a general contractor for foundation work?

I recently had the wall treated by a waterproofing company, but it didn't do any good.

M. WYSOCKI
 JERSEY CITY, NJ

The contractor you should consider hiring to correct your problem is one who specializes in waterproofing basements. You don't need a general contractor, because that person would hire a subcontractor to do the job—and you'll be paying for the services of a middleman. But before hiring a contractor, there are a few important things you should know about water seepage into a basement.

Water can seep into a basement through the foundation walls, through the floor and through the joint between the floor and the walls. In order to correct the problem, it's important for the homeowner to determine the location of the water entry. For example, if water is seeping in through the floor or floor joints, then waterproofing the walls won't

correct the problem. Similarly, if water is seeping in through the walls, then installing a waterproofing system in the floor won't help.

Installing dry wells won't correct your problem unless they're tied to drain tiles. Also, if your house is in an area that has a high water table, the dry wells may not be effective during those parts of the year when the water table rises.

Based on your description of the problem, you'll probably need either an exterior or an interior drainage system. An exterior system should have a free-flowing outlet for the drainage piping. An interior system would require a sump pit and pump.

Secondary Heat

The high-efficiency oil furnace in my home is vented to a flue in the chimney. When the furnace is operating, the vent pipe gets hot and heat is lost up the flue. I've seen flue fans that are temperature regulated and mounted to a wood-stove chimney exhaust pipe. The fan turns on at a preset temperature, blowing across smaller pipes in the unit and sending a large amount of heat

into the room. Would such a unit work on the exhaust flue of my oil furnace?

DAVID EVANS
WEST PLAINS, MO

A heat-recovery system using a fan to blow air across the flue pipe could work, but it's generally not recommended. Such a system could extract too much heat from the flue gases, which contain water vapor, sulfur dioxide and nitric oxide (and other nitrogen compounds). If the gases get cool enough, the water vapor will condense out of the flue gas and combine with the sulfur and nitrogen compounds. This condensate can cause corrosion in the flue pipe or in the furnace. Also, a low exhaust-gas temperature could affect the draft over the firebox and decrease the efficiency of the oil furnace.

Computerized Home Improvement

Over the years, Gene and Katie Hamilton have written about a variety of home-improvement topics for *POPULAR MECHANICS*, so we can recommend them with confidence in their latest endeavor. They are

Handy Handbook

• We're not sure when people became labeled consumers, but the term is so widely used today it doesn't seem worth disputing. Aside from that small complaint, we think the *Consumer's Resource Handbook* is about as handy a

guide as you can get. The 123-page book serves both as a customer-protection guide and as a general directory to your federal government. Using it, you should be able to find just about any

niche in the federal bureaucracy with a few phone calls. And because it has 27 pages of corporate addresses, you can contact companies to praise or criticize their products and services. Best of all, because your taxes funded this book, there is no additional charge for it. Write to: Handbook, Pueblo, CO 81009. —R.B.

system operators for HouseNet, an international computer bulletin board devoted to home-improvement topics. Funded by Owens-Corning, the bulletin board is connected to the Internet, the telecommunications network.

To access the bulletin board, all you need is a computer, a modem and communications software. If you subscribe to an online service that provides an Internet and Telnet connection, you can reach HouseNet at

its Internet address: housenet.com.

If you don't subscribe to an online service, but have the equipment mentioned above, you can dial HouseNet directly at: (410) 745-2037. The bulletin board is accessible 24 hours a day, seven days a week.

DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

Just ask Norman about it. Send your question to Homeowners Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.



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TOOL TEST

Ryobi 4-Cycle Trimmer

TEXT AND PHOTOS BY THOMAS KLENCK,
Associate Home Improvement Editor

● It wasn't so long ago that trimming around fences, trees and other backyard obstacles was a hands-and-knees operation that utilized a technology on a par with ordinary household scissors. Nowadays, the string trimmer reigns supreme. However, if Ryobi is on the right track, even the dedicated string trimmer may be a thing of the past. We recently tested Ryobi's model 990r—part of the Ryobi Trimmer-Plus lawn-and-garden system—and found that there can be more to a string trimmer than whacking weeds.

The tool is powered by Ryobi's new Pro4Mor 26.2cc 4-cycle gas engine—an industry departure from typical 2-stroke machines. The 4-stroke engine not only eliminates the oil and gas mix from the fuel-up process, it reduces emissions as well. Ryobi claims that the Pro4Mor engine meets all proposed emissions standards for garden equipment (Photo 1).

Ryobi's 990r comes with a string-trimming head that can be easily replaced with the included brush-cutter blade. We tested the 990r in a variety of typical yard-maintenance situations and found it easy to start and well balanced. The throttle is controlled by a spring-loaded sliding switch, and a centrifugal clutch engages the cutting head. The heavy-gauge trimming line (.095 in.) plus 18-in.-dia. cutting path enable the tool to handle just about anything in its path. To adjust trimming-string length, simply bump the

trimmer head on the ground to release more line. This new section of line is automatically cut to length. For heavier cutting chores, unthread a few screws to free the trimmer shroud, and replace the trimmer head with the 6-in.-dia. brush-cutting blade (Photo 2).

The real adventure arrives when you snap on one of the optional Trimmer-Plus accessories. The trimmer

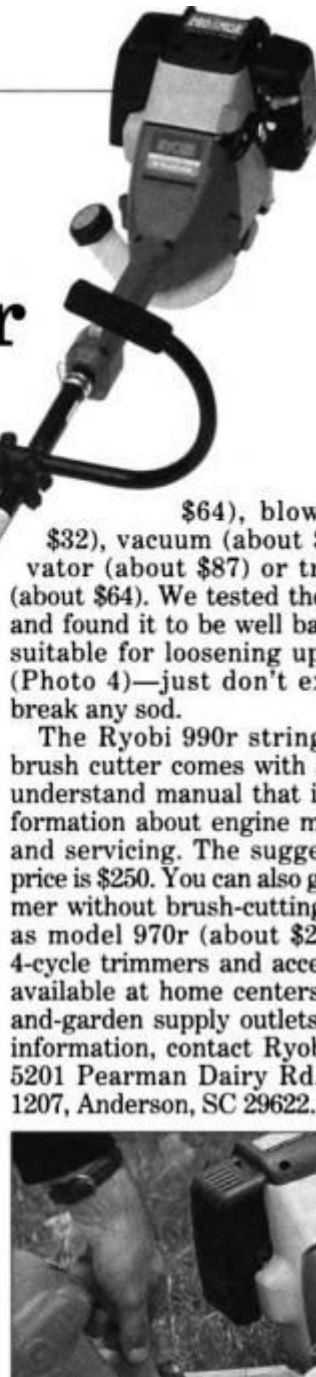
features a split boom—the shaft that connects the powerhead with the trimming head separates at its midpoint. Replacing the trimming head with an accessory requires loosening a couple of wing-nuts and depressing a release button (Photo 3).

Once disconnected, you can install one of Ryobi's accessories—either an edger (about

\$64), blower (about \$32), vacuum (about \$52), cultivator (about \$87) or tree pruner (about \$64). We tested the cultivator and found it to be well balanced and suitable for loosening up tilled soil (Photo 4)—just don't expect it to break any sod.

The Ryobi 990r string trimmer/brush cutter comes with an easy-to-understand manual that includes information about engine maintenance and servicing. The suggested retail price is \$250. You can also get the trimmer without brush-cutting capability as model 970r (about \$222). Ryobi 4-cycle trimmers and accessories are available at home centers and lawn-and-garden supply outlets. For more information, contact Ryobi America, 5201 Pearman Dairy Rd., P.O. Box 1207, Anderson, SC 29622. **FM**

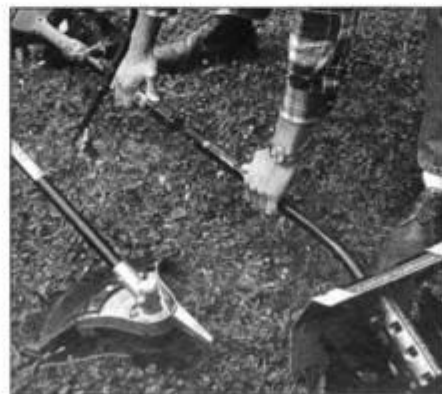
The Ryobi model 990r is a well-balanced, versatile string trimmer that comes with a brush-cutting blade accessory. The new 4-cycle gas engine also powers an assortment of optional Ryobi lawn-and-garden accessories.



1 The 4-cycle engine takes straight gas for simplified fuelling. Fill spout is easy to access with trimmer resting on ground.



2 To switch from trimming to brush cutting, simply remove the shroud and replace the trimmer head with the brush blade.



3 The split-boom system enables powering various accessories with a single engine. Here, the cultivator is being attached.



4 The cultivator is ideal for light tilling in loose soil. It's also well balanced, and the unit is quite easy to maneuver.

**HOME
IMPROVEMENT**

**How To
Rebuild
Wooden
Porch Steps**

Safe, sturdy and good-looking porch steps are easier to make than you think.

BY NEAL BARRETT
PM Illustrations by
George Retseck

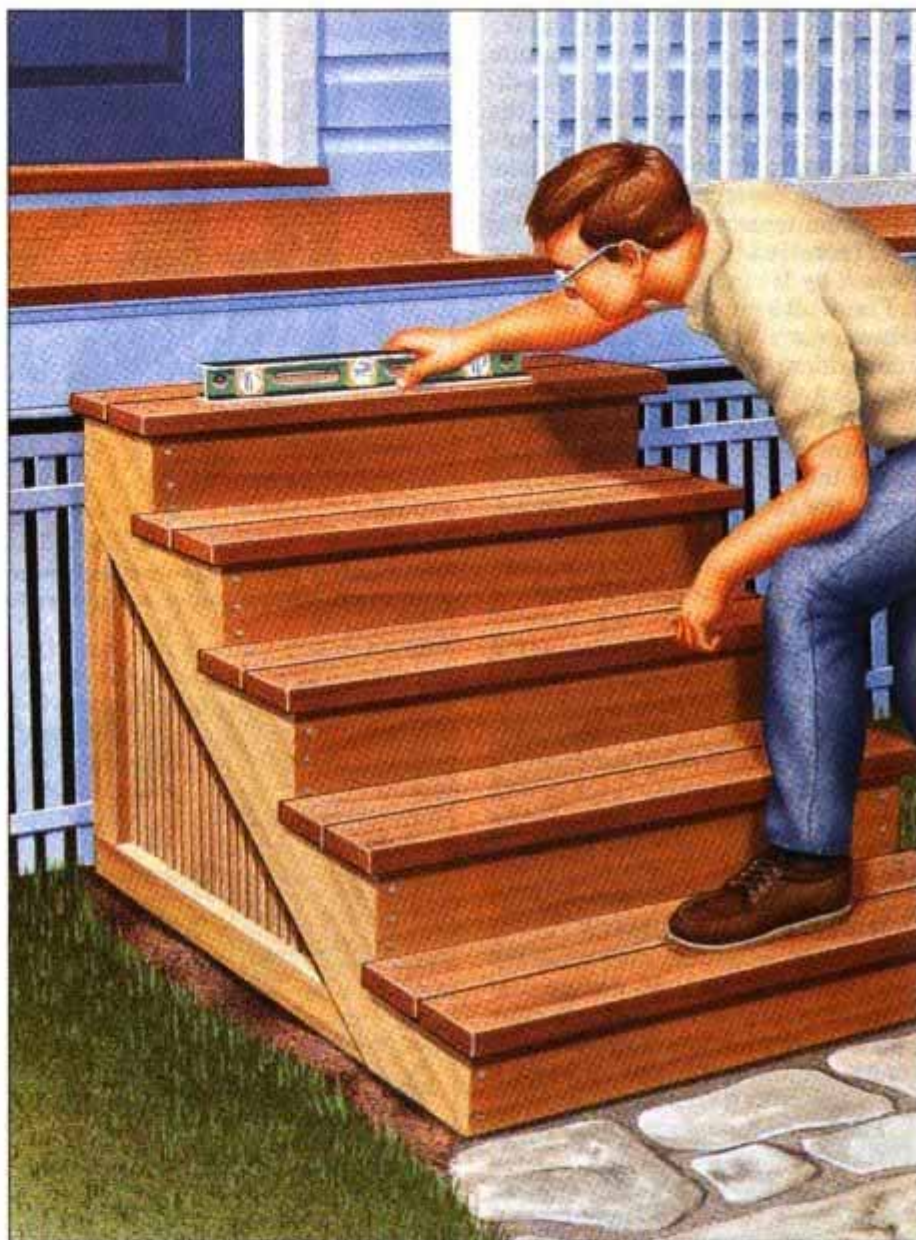
● If you're intimidated by stair construction, and your back porch steps have seen better days, consider yourself lucky. You have a golden opportunity not only to fix up the homestead, but to conquer the mysteries of riser height, tread width and stringer layout—all in one weekend.

The traditional style that we built features neat, mitered risers and beaded tongue-and-groove side panels, and is suitable for use either up to an entry or as an access to a porch or raised deck (see drawing at top of page 108). Except for the beaded side paneling, the structure is made from pressure-treated nominal 2-in. stock for long life out in the weather.

This free-standing design simply sits on a concrete or stone pad. If you don't have a pad, you can either pour one or set flat paving stones into the earth. Since the stair is constructed of pressure-treated material, you could even set it directly on the ground—just make sure that whatever foundation you choose is flat and level.

Stair Layout

A safe stair demands a uniform riser height (the distance between the treads) of between $6\frac{1}{2}$ and $7\frac{1}{4}$ in.—or as close to that as you can get. To calculate the height of your risers, measure the distance from your stair footing to your deck or porch surface. Divide that dimension by 7 to get an approximate number of risers. Round the resultant number to the next highest whole number and divide that figure into the deck height. If the resultant height is in the proper range, you've found your riser dimension. If

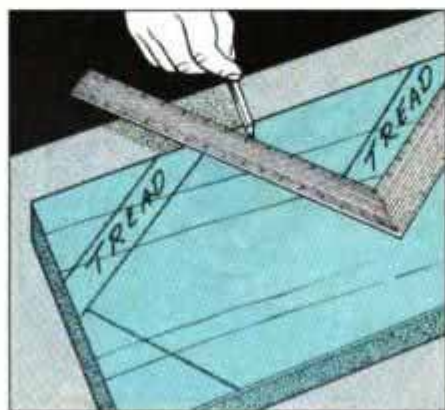


it's too small, divide by the next smallest whole number.

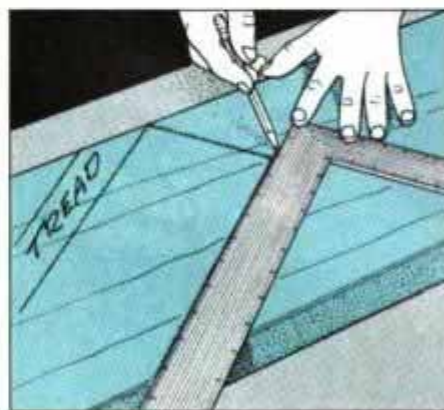
In most cases, this type of stair is built so that the top tread is one step down from the porch surface. To do

this, simply subtract one riser height from your overall layout. If you wish, however, your top tread could be left flush with the porch surface.

The width of your stair treads



1 Use a framing square to lay out the stringer notches. Align riser and tread lengths on square with edge of stock.



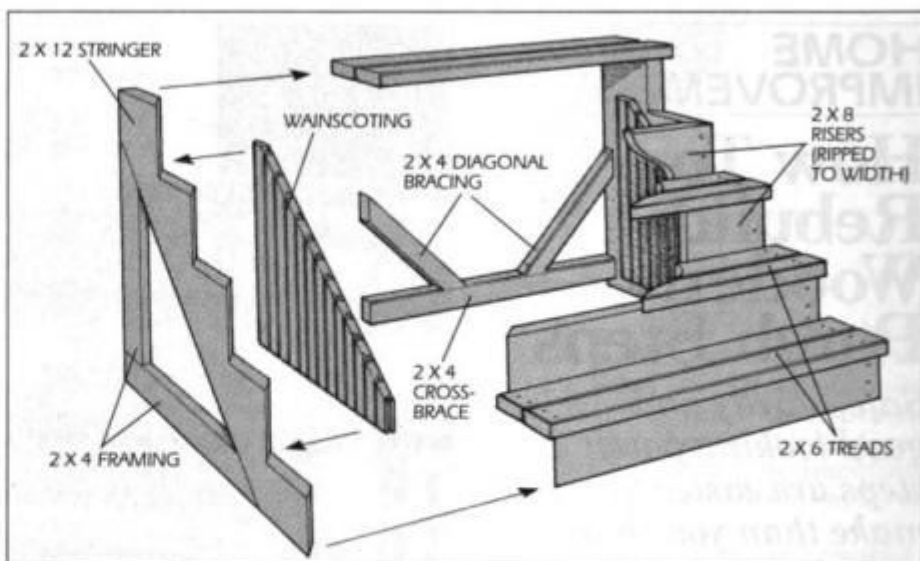
2 After laying out the last tread, mark the bottom cutline. Subtract one tread thickness ($1\frac{1}{2}$ in.) from the bottom riser.

should fall between 10½ and 12 in. We used two 2 × 6s, spaced ¼ in. apart, to yield an 11½-in.-wide tread (this dimension may vary depending on the actual dimensions of your lumber). When laying out the stringer, make the cuts for the treads 1½ in. less than the actual tread measurement. This way, each tread overhangs the riser below it by 1½ in.

The width of your stair will, of course, vary with its location. For stairs wider than 48 in., plan on one or more center-support stringers.

Use a framing square to lay out the stringers. Place the square near one end of the 2 × 12 stringer stock and locate the tread cut length (overall tread minus 1½ in.) on the blade (the long arm of the square) and the riser height on the tongue (the short arm of the square).

Adjust the angle of the framing square so that these two points are aligned with the edge of the board. Then, trace along the square's blades to lay out the top tread. Next, mark a perpendicular line at the back end of the top-tread layout line to yield the top plumb cut that defines the back edge of the stair.



Free-standing stair components include stringers with tread and riser cutouts, double 2 × 6 treads, beaded tongue-and-groove side panels and 2 × 4 bracing to add rigidity.

For the remaining steps, hold the framing square so that the riser height on the tongue of the square intersects the point where the last tread cutline crosses the stringer edge. Adjust the square so that the tread dimension on the blade also crosses the stringer edge (Fig. 1).

Trace along the square to lay out

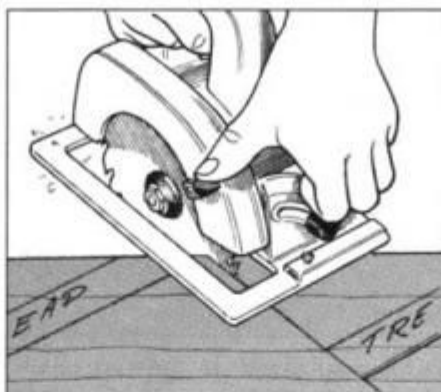
each step shape. Lay out the bottom-riser cut one tread thickness (1½ in.) less than the other riser cuts, and draw a line parallel to the tread lines from the bottom of this mark to indicate the bottom-level cut of the stringer (Fig. 2). This cut indicates the edge of the stringer that will sit on the concrete or stone footing.

Construction Basics

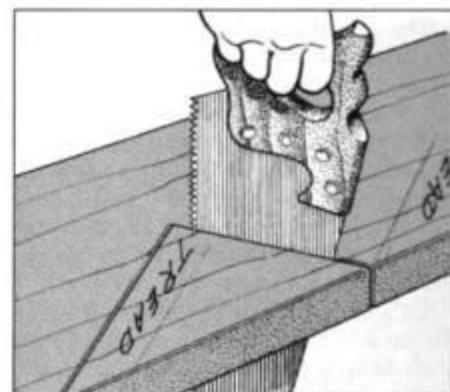
Use a circular saw to make the top and bottom cuts that define the stringer ends. Clamp each stringer between sawhorses to make the cutouts for the steps. Cut up to each layout line with the circular saw (Fig. 3). Then, use a handsaw, held vertically, to finish each cut (Fig. 4).

Once the first stringer is cut to shape, use it as a pattern to lay out the opposite stringer. Then cut the second stringer.

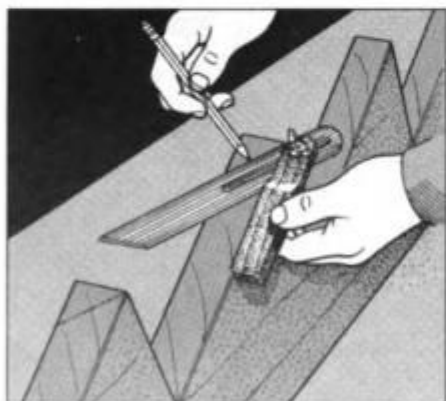
Clearly mark the inner and outer surfaces of the stringers. Support each stringer on its bottom edge, and use a bevel gauge set to 45° to mark the



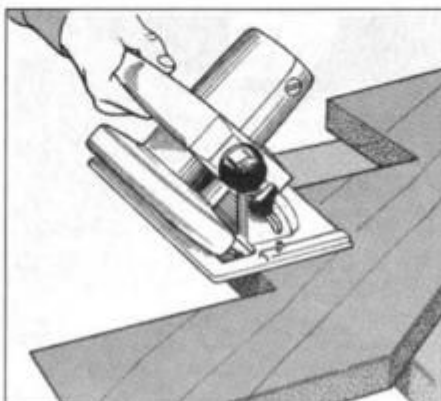
3 Begin the step cutouts with a circular saw set for a square cut. Follow layout lines and cut just up to intersecting lines.



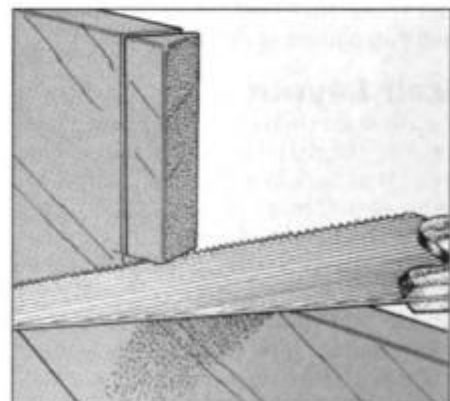
4 Finish cutouts with a handsaw. Hold saw vertically and cut into step corner. Use first stringer as a pattern for second one.



5 After marking inner and outer surfaces on both stringers, use a bevel gauge set to 45° for marking the mitered riser cuts.



6 Use a circular saw set to 45° to begin the riser cuts on the right stringer. Use a handsaw to cut the miters on the other stringer.



7 Remove the waste on both stringers with a handsaw. Hold the saw flat against the tread and cut into mitered corner.

miter cuts for the risers (Fig. 5). Note that the risers are cut back toward the inside surface of each stringer.

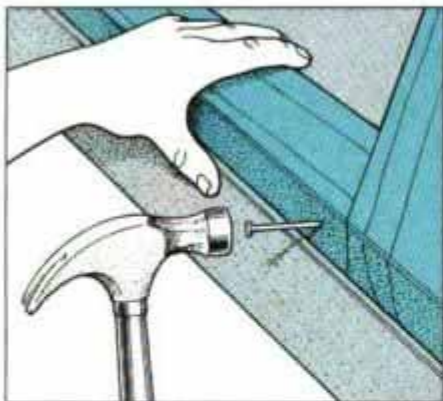
Since a circular-saw blade can be angled in only one direction, you'll be able to use it to cut miters only on the right stringer, as you face the bottom

Side Framing

A great technique for completing the layout of the stair side is to use a large worktable or sheet of plywood as a template for the side. It's much easier to visualize the stair, and ensure square assembly, if the stringer is aligned with the square edges of the table or plywood. To use this method, make two marks on adjacent edges of the work surface—one on the bottom edge equal to the sum of the tread cuts and one on the vertical edge equal to the sum of the riser cuts. Align the stringer on these marks and clamp it in place.

Cut the bottom 2 × 4 support at an angle to meet the back edge of the stringer. This angle is the same as the angle of the tread cuts on the stringer. Use the framing square to mark the 2 × 4 (Fig. 8), then make the cut with the circular saw. Next, hold the piece in place against the stringer and mark its length at the end of the table or plywood.

The angle at the top end of the vertical 2 × 4 support is the same angle that yielded the riser cuts on the stringer. Lay out and cut the angle,



10 Use 10d or 12d galvanized nails to secure 2 × 4s to stringer. Prebore pilot holes to prevent splitting the wood.

Assembling The Stairs

If necessary, use a circular saw and ripping fence to rip the riser stock to width. Our risers were 7 in. wide, which required ripping 2 × 8s to the proper size. Remember that the bottom riser will be 1½ in. less in width than the other risers.

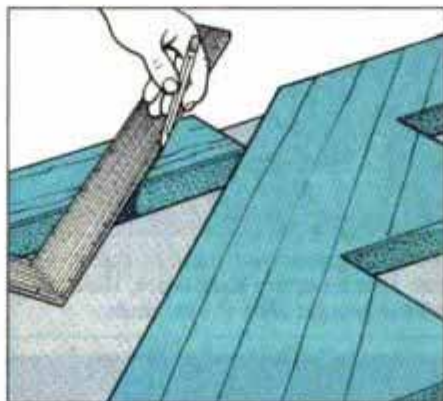
While the ends of the risers must be mitered to meet the stringers, it's easiest to first cut the risers squarely

of the stairs. Make the miter cuts just up to the tread line (Fig. 6), and use a handsaw to complete the cuts.

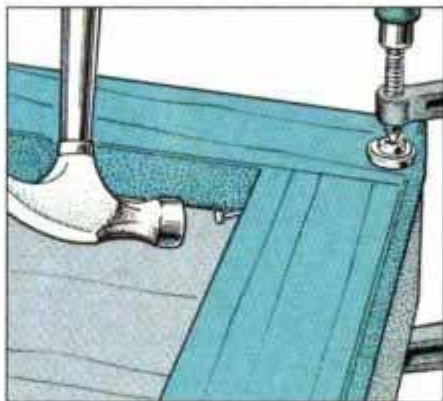
Cut the miters on the left stringer with a handsaw. Support the stringer in a vise, or clamp it to a workbench, to make the cuts. It's easier to make

then hold the piece in place against the stringer and mark its length against the bottom support (Fig. 9).

Position the two supports against the stringer and clamp them in place to maintain their position during fastening. It's a good idea to prebore holes for the nails in pressure-treated wood to reduce the chance of splitting. Use galvanized nails to fasten the bottom and vertical support to the stringer



8 Use a square to lay out the angled cuts on the bottom 2 × 4 support. The angle of the cut is the same as the stringer angle.

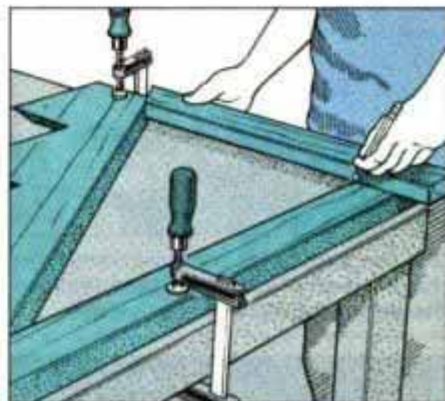


11 After boring the pilot holes, use 8d galvanized nails to toenail the bottom and vertical side 2 × 4 supports together.

these cuts accurately if you clamp the stringer so that the risers are oriented vertically. With the layout lines clearly marked on the stringer sides, slowly cut down to the tread line. Finish the cut by extending the tread to the bottom of the miter (Fig. 7).

and to each other (Figs. 10 and 11).

Turn the assembly over so that the inside surface is exposed. Then, cut and nail strips of 5/8-in.-thick beaded fir over the opening. This material is usually sold as porch ceiling or wainscoting, but is ideal for this application as well. Let the strips overlap the stringers and supports by approximately 1½ in., and use 4d galvanized nails to fasten the strips (Fig. 12).



9 Clamp the side components to a square table or piece of plywood. Mark and cut the vertical support and clamp into place.

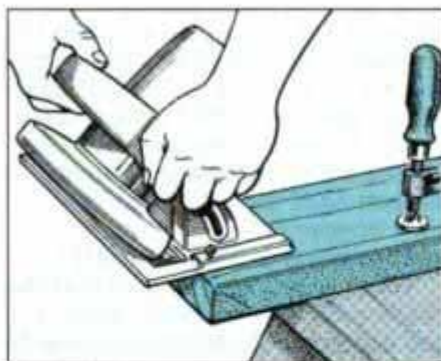


12 Install 5/8-in.-thick beaded fir to the inside surface of the stringer assemblies. Nail in place with 4d galvanized nails.

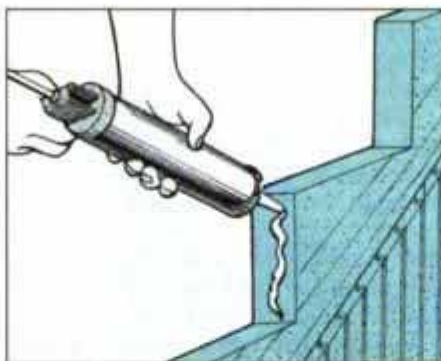
to length. Then, go back and use the circular saw to miter each end. Clamp the stock to the sawhorses before mitering (Fig. 13). By firmly clamping the stock, you free up both hands to control the saw cut.

Next, join the bottom riser to the two stringer assemblies. If you don't have a helper to support the stringers, temporarily clamp them to the side of a table or door while you at-

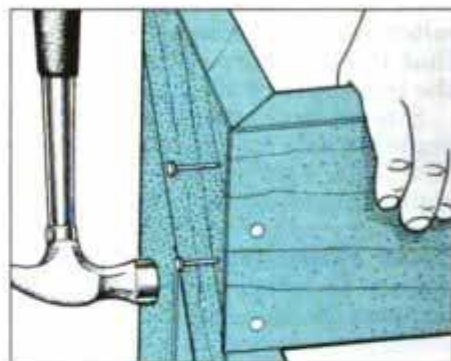
tach the first riser. After this is attached to both stringers, the assembly will be self-supporting. Apply construction adhesive, preferably one designed for pressure-treated lumber, to the miter joints (Fig. 14). Use 8d galvanized nails to fasten the risers to the stringers (Fig. 15). After nailing, use a chisel to slightly chamfer the corner of each miter joint so it doesn't have such a sharp edge (Fig. 16).



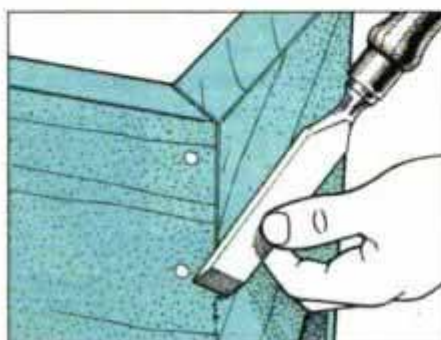
13 After cutting the risers squarely to exact length, use a circular saw to make the 45° miter cuts on each end.



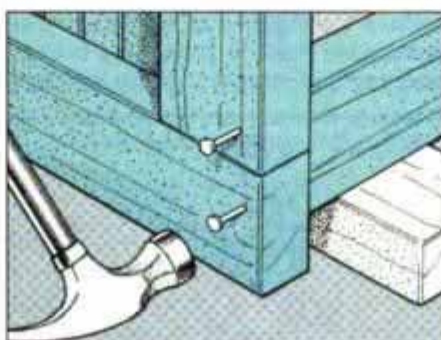
14 Apply pressure-treated lumber adhesive to the riser miter joints before nailing. Use 8d galvanized nails to fasten the joints.



15 Drive nails from both directions when fastening the mitered risers to the stringers. Prebore to avoid splitting the lumber.



16 Use a chisel to slightly chamfer the sharp corners of each miter joint. Pressure-treated lumber should not be sanded.



17 Use galvanized nails to fasten each side to the bottom back brace. Hold brace off the ground with 1½-in. stock.

Cut two horizontal 2 × 4 cross-braces for the open back of the stair. Shim the bottom brace 1½ in. off the ground when you fasten it in place (Fig. 17). This provides clearance for any irregularities along the back edge of the footing that might cause the stair to sit unevenly. Nail the top brace even with the top edge of the stringer assembly (Fig. 18).

Next, cut two diagonal 2 × 4 braces 18 to 24 in. long with 45° miter cuts at each end. Install these between the bottom crossbrace and the stringer's vertical supports (Fig. 19).



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FROM FRONT...



CAMRY MAT SHOWN

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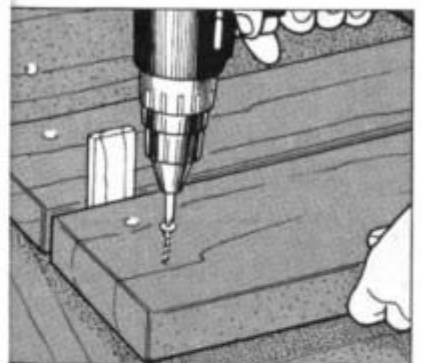
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P

TRICO
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Bore pilot holes and install the treads with 2 1/2-in. galvanized deck screws. Use a shim to space the boards.

Apply two or three coats of alkyd deck enamel, allowing each layer to dry before applying the next. Take the time to cover all inside and bottom surfaces of the stair because all of the stair's parts will be exposed to moisture and, therefore, should be sealed.

Finally, slide your stair into place against the porch or deck. Use a level to check its position and, if necessary, trim the assembly with a cedar shim to guarantee a firm base and a stair that doesn't rock.

PM

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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.

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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



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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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NEW PRODUCTS

Green Machines

The best new power equipment for outdoor work.

BY ROY BERENDSOHN, Assistant Home Improvement Editor



In Complete Harmony

Honda has introduced a lawn tractor to its Harmony walk-behind and riding mower line. The machine is powered by a 13-hp overhead-valve engine and is equipped with a 38-in. twin-blade deck that can mulch or side discharge. Two transmissions are available—one is a 5-speed shift-on-the-go type and the other is hydrostatic. The following are accessories for the tractor: a headlight kit, rear twin-bag grass catcher, a 2-stage snowblower, a front guard and rear hitch plate. The mowers cost about \$2000 at Honda outdoor power equipment dealers. Write American Honda Motor Co. Inc., 4475 River Green Pkwy., Duluth, GA 30136.



Keep It Light

If you're interested in lightweight grass trimmers, Poulan Weed Eater's double-barreled selection is worth considering. One is a 2-cycle gas-engine trimmer that costs about \$75, and the other is powered by a 12-volt battery and costs about \$80. Weighing 7½ pounds, the 2-cycle gas trimmer is appropriately called the Featherlite. The company says it's 30% lighter and 60% quieter than comparable units, and it takes half the pulling effort to start the engine. The device employs a tap-and-go line head that cuts a 15-in. swath. The spool can be removed without tools. The electric model weighs 9.4 pounds and is called the HandyStick. Its battery is built into the handle. The trimmer cuts a 9-in.-wide swath and runs 25 minutes on an overnight charge, the company states.

Both products are sold at hardware stores and home centers. For more information, write Poulan Weed Eater Marketing Dept., c/o Featherlite, P.O. Box 91329, Shreveport, LA 71149, or call (800) 554-6723.

Cut Back

Black & Decker says the Hedge Hog is the right tool for tough hedge cutting. It's designed to cut branches up to ¾ in. in diameter because its 18-in. cutter bar works in a combination sawing and shearing action. Its blade is driven by a 2.6-amp motor, and the tool has a cord retainer that prevents your extension cord from being accidentally disconnected. The tool costs \$63 at hardware stores and home centers. Write Black & Decker, Consumer Services, P.O. Box 618, Hampstead, MD 21074, or call (800) 762-6672.



Cover Up

Rain, rust and rays don't bother this light-duty lawn cart. Its polyethylene plastic has a UV inhibitor so it will stand up to the sun's rays. And you can leave it outside without it being filled with rain, since it has a dome-shaped cover held in place with pivoting clasps. To dump it, flip back the clasps, remove the lid and then turn the trailer over. The cart rides on a solid-steel axle, and it attaches to the tractor with a bolted-steel tongue. The trailer costs about \$140 at hardware stores and home centers. For more information, write Step 2 Corp., 1010 Aurora-Hudson Rd., P.O. Box 2412, Streetsboro, OH 44241, or call (800) 347-8372.

Double Deere

If you own a 12- or 12.5-hp lawn tractor and are interested in more power to handle mulching, consider the 14-hp Deere STX46. In creating this machine, Deere added 1.5 hp to the STX38, the nearest product in the line, and increased the deck size by 8 in. The STX46 accepts an optional 6½-bushel, 2-hopper material collector. And when you add cut-and-bag capability to its 15-in. turning radius, you have a tractor that can cut a complex landscape quickly. The tractor is available with a 5-



speed gear transmission (about \$2500) or with hydrostatic drive (\$2900).

If you want to do more with a lawn tractor than cut grass, the GT275 might be your machine. It's a 17-hp hydrostatic tractor that can accept a small disc harrow, cultivator or tiller. Equipped with a 48-in. mower, the tractor costs about \$5000. The machine has several features that contribute to durability, such as an overhead-valve engine and a welded-steel frame. Its hydrostatic-drive components are enclosed

in the housing with the differential and axle to reduce the number of seals. Both machines are sold at John Deere dealers. Write John Deere, 4905 77th Ave., Milan, IL 61264.

One Good Turn...

If you have to make lots of tight turns when you cut, and need a high ratio of power to weight, you might consider one of Simplicity's two 12.5-hp Coronet riding mowers. Both machines have a 12-in.-dia. turning radius and a mower-leveling mechanism that, the company says, keeps the deck level with the ground and prevents it from scuffing the turf on turns. The Coronet 13H has an overhead-valve Kohler Command engine with full-pressure lubrication and a spin-on oil filter. It has a 34-in.-dia. deck and costs about \$2600. The Coronet 12H has an overhead-valve Tecumseh engine and a 30-in.-dia. deck, and costs about \$2400. The machines are sold at Simplicity dealers. Write to Simplicity, 500 N. Spring St., P.O. Box 997, Port Washington, WI 53074.



Running Sweep

It looks weird, but maybe the Shindaiwa PowerBroom is the answer to your landscape-maintenance problems. The company says the 12-pound machine will remove just about any material from any surface—that includes light snow, leaves and grass clippings. Its 1.5-hp engine turns a main shaft that turns a gear case. The gear case supplies the torque for the nylon-drum and rubber-fin assembly. Hold the machine upright to sweep debris ahead of you. To pull debris out of corners, turn the PowerBroom upside down (its all-position carburetor allows this). The PowerBroom costs about \$700 at Shindaiwa dealers. Write Shindaiwa Inc., P.O. Box 1090, Tualatin, OR 97062.



Big Doings

Want power and capacity in a chipper/vac? Consider the Sears Craftsman model No. 79964. It's powered by a 9-hp engine with cast-iron cylinder sleeves. The self-propelled machine has six forward and two reverse speeds employing a substantial chain drive and pulley system. However, the impeller and rotor assembly doesn't take power off of the driveshaft for the rear wheels—a separate driveshaft provides torque directly to the 6-fan blade impeller. Sears says the machine moves 1200 cu. ft. of air per minute at 144 mph, which is supposed to provide enough suction to pick up anything—from hedge clippings to light trash. To ensure complete pulverization of whatever it picks up, the machine has nine rotating cast-steel flail knives and two hardened-steel knives on the rotor. Material also must pass through a hardened-steel screen. It costs \$1000. Write Sears Craftsman, 3333 Beverly Rd., D2-160A, Hoffman Estates, IL 60179.





Pioneer Products

If you're interested in cutting turf or busting sod, check out these products at a hardware store or home center. The tractor is a 4-wheel-steer model with a 42-in. cutting width. Four-wheel steering gives the machine an extremely tight 12-in. turning radius. It's powered by a 15-hp overhead-valve engine and a 7-speed gear transmission. The tractor costs about \$1800.

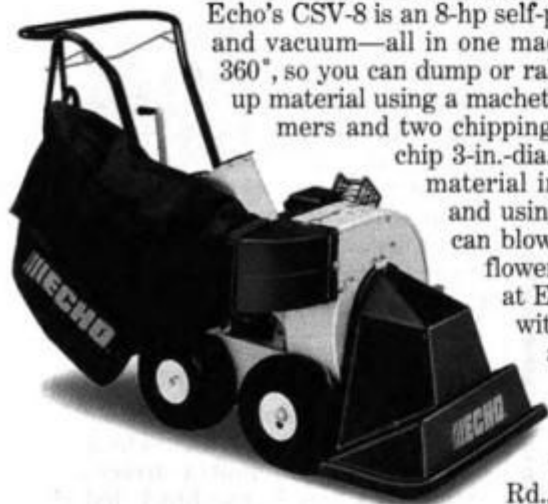
The 5-hp 18-in.-wide rear tine tiller can operate either as a counterrotating tine tiller or as a forward-rotating tine tiller. When set for counterrotating, the tines spin in reverse while the tiller travels forward. Use the tiller in this mode for sod busting, says the manufacturer, then switch to forward-rotating tines with a pull of a lever. With forward rotation, the tines further break up freshly tilled soil and leave a surface ready for planting. The tiller costs about \$800. For more information, write MTD Products Inc., P.O. Box 360900, Cleveland, OH 44136.



Do What You Want

Echo's CSV-8 is an 8-hp self-propelled chipper, shredder, blower and vacuum—all in one machine. Its hopper rotates through 360°, so you can dump or rake into it. The machine's rotor cuts up material using a machete-like blade, 12 free-swinging hammers and two chipping knives. The company says it will chip 3-in.-dia. branches. It blows the pulverized material into a 2.8-cu.-bushel zippered bag, and using a blower/broadcaster option, you can blow material onto the compost pile or flowerbeds. The CSV-8 costs about \$1500 at Echo dealers. Two 5-hp chipper vacs with otherwise identical features are also available from the company.

One is a push type (about \$900), and the other is self-propelled (about \$1200). For more information, write Echo Inc., 400 Oakwood Rd., Lake Zurich, IL 60047.



Work Comfortably

Husqvarna's 232R is a heavy-duty trimmer designed to be hard on grass and brush without being hard on your back. For example, its handlebar is mounted at 97° to the shaft, rather than perpendicular to it. This positions the trimmer head directly in front of the operator to allow for a comfortable posture. Also, this feature permits a larger sweep area and is supposed to reduce back fatigue. To further reduce operator fatigue, the handlebar's angle is completely adjustable, and it can be folded flat to the shaft for storage. Similarly thoughtful features are the rubber damping pads that isolate the handlebar from engine vibrations. The 232R is powered by a 31cc engine and, when it's equipped with a 2-line string head and brush blade, it costs about \$390 at Husqvarna dealers. Write Husqvarna, 9006-J Perimeter Woods Dr., Charlotte, NC 28216.

Getting Fancy

In the past, if you wanted a fancy lawn tractor that came complete with hydrostatic transmission, you had to go to a power-equipment dealer—your local home center didn't have it. Now, Murray offers a 15-hp tractor with hydrostatic transmission and a 42-in. deck to be sold at home centers. It costs about \$1200 and, like more expensive tractors, it has a foot-pedal-controlled transmission, step-through operator area, full-floating mower deck with a 6-position height adjustment, grease fittings on the front axle and a translucent gas tank.

For other landscape work, consider the company's minitiller.

Murray says it redesigned the gear ratio on the 2-cycle 1.6-hp machine, improving its performance and durability. It uses a lubricated vertical-worm-gear drive mechanism in a sealed die-cast housing. It has 8-in.-dia. heat-treated steel tines that are adjustable, so they can till a swath from 7 to 10 in. wide. The tiller costs about \$200 at home centers and hardware stores. Write Murray, 219 Franklin Rd., Brentwood, TN 37027.



Hits The Spot

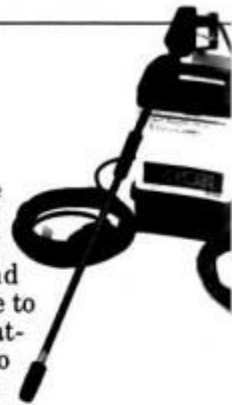
Toro says its 15-44HXL tractor is designed for homeowners who want a powerful lawn tractor but don't want to step up to a lawn-and-garden tractor. The \$2400 machine has a 15.5-hp overhead-valve engine with cast-iron cylinder sleeves and a spin-on automotive-type filter. The tractor moves via a foot-pedal hydrostatic transmission and 20-in.-dia. rear turf tires. It comes standard with a 3-blade mulching deck equipped with antiscalp rollers. To make the tractor comfortable and convenient, Toro outfitted it with a step-through operator area and a tilt steering wheel. If you want to clear clippings off your walks and patio after cutting, the company has developed a 6.7-amp electric blower/vac that, it says, is the most powerful on the market. We sampled one and agree that it's quite powerful. The 6-pound tool costs \$60-\$65 and produces a 190-mph airstream. It converts from blower to vacuum without tools. The blower/vac's other features include a safety-interlock switch that prevents it from running while it's being switched between functions, and a 2-speed air control. The tractor is sold at Toro dealers and the blower/vac is sold at hardware stores and home centers. For more information, contact the Toro News Center, 1401 W. 76th St., Suite 420, Minneapolis, MN 55423.



Clean Cut

The Ryobi pressure washer (about \$325) doles out 1450 psi of cleaning pressure and has an adjustable nozzle to deliver either a fan pattern or a jet stream. To help you get the machine next to what you're cleaning, the pressure washer has a 16-ft. cord and a 25-ft. hose.

Having tried Ryobi's self-propelled cordless mulching mower at a recent trade show, we think it's worth considering if you have a small yard. The mower cuts an 18-in.-wide swath and is designed to run for an hour on an overnight charge. Its drive mechanism can be set for any speed up to 3½ mph, and it costs about \$450. It's also available in a push convertible-bagging configuration for about \$370. The products are sold at hardware stores and home centers. Write Customer Service, Ryobi, 5201 Pearman Dairy Rd., P.O. Box 1207, Anderson, SC 29622.



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Long Arm Of The Saw

This electric pole pruner starts out at 6 ft. but extends to 15 ft. The machine's 1.6-amp motor drives a counter-balanced gear head that in turn moves the reciprocating saw blade at a fast 3500 strokes a minute. The manufacturer says it will cut limbs up to 3 in. in diameter. It's equipped with a 6-ft. extension cord, and it costs about \$60 at hardware stores and home centers nationwide. Write WEN Power Tools, 5810 Northwest Hwy., Chicago, IL 60631.



Safety Bar

Cutting wood can be a satisfying job, but it can also be dangerous. Sandvik steps in to help homeowners handle the job more safely with a new guide bar that reduces the chance of kickback. Kickback occurs when the nose of the chain saw hits a log and the torque from the chain flips the bar back toward the operator. Sandvik's Lo-Kick guide bar has a smaller nose radius than other bars to reduce the likelihood of kickback, and the bar is thicker than conventional types, which reduces vibration and lessens the chance of pinching. And, the chain has a more streamlined tooth configuration that further reduces kickback, the company says. The bars fit most major brands of chain saws and are sold at chain-saw dealers. They're sold in 12-, 14-, 16- and 18-in. lengths (\$16, \$19, \$21 and \$23, respectively). Write Sandvik Windsor Corp., P.O. Box 2036, Scranton, PA 18501.



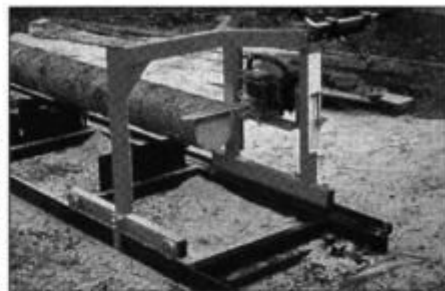
Good Fit

Suppose a garden tractor is too big and a riding mower is too small for your needs. What do you do? One solution is to examine Troy-Bilt's 13-hp 5-speed gear-transmission tractor. It has a 12-in.-dia. turning radius, a step-through operator area, a large 6-gallon gas tank and a welded-steel frame. Equipped with a 38-in.-dia. side-discharge deck, it costs about \$2200. If you opt for a hydrostatic transmission and 38-in.-dia. mulching deck, that tractor costs about \$2700. Both are sold at Sears and Troy-Bilt dealers. For information, write Garden Way Inc., 102nd St. & Ninth Ave., Troy, NY 12180, or call (800) 833-6990.



Saw It Your Way

If you want to try sawing lumber, this portable Swedish sawmill may be what you're looking for (about \$2700). At the mill's heart is a 7-hp 20-in.-bar chain saw attached to a saw carriage. The carriage has ball-bearing wheels and rides on a 10-ft. rail assembly that can be lengthened with 10-ft. extensions. To adjust the cut thickness, turn a hand crank at the top of the carriage. The saw can produce pieces from about 1/8 in. to 20 in. thick, its manufacturer says. To locate a dealer, contact Tilton Equipment Co., Dept. RPM, P.O. Box 68, Rye, NH 03870, or call (800) 447-1152. **FM**



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Fuel Injector Cleaner in your tank quickly starts cleaning your entire fuel delivery and intake system. So use STP to help your engine deliver dependable power and performance.

DRIVE A BETTER CAR



CAR CARE

CAR CLINIC

BY MIKE ALLEN,
Associate Automotive Editor

Rollin'

I went to tune up my wife's car, for the first time, last week. It was with a certain amount of concern, because these new cars aren't supposed to be worked on by us ordinary guys anymore, what with computers and all. But I figured I could handle an oil change and some fresh spark plugs.

I was wrong. The oil and filter were no problem, but I couldn't change half of the spark plugs because there was no way to access them. The firewall is too close to the rear cylinder head, and I couldn't get a wrench anywhere near the plugs. I even tried putting the car on ramps and coming in from underneath.

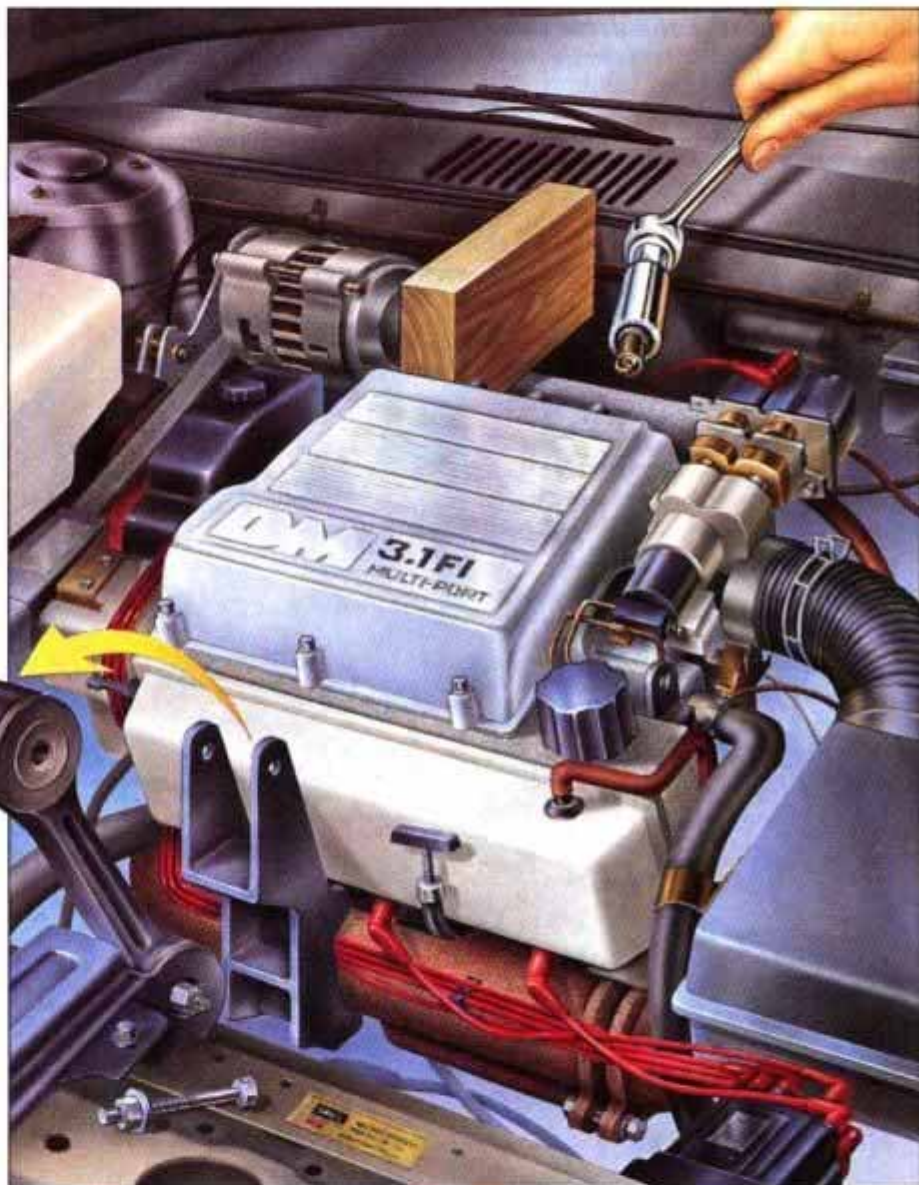
How do the dealership mechanics do this? JOHN PIERCE
FORT LEE, NJ

Some of them don't—they just change the ones they can reach and hope for the best—but the veracity of mechanics is another column.

Many fwd cars use an upper engine mount that goes forward from the top of the head to the radiator core support. This short connecting link is through-bolted at both ends. Remove the bolt on the inner end, and swing the link up and out of the way. Now you can rock the engine forward, away from the firewall. Prop a short length of solid 2 × 4 between the head and firewall to hold your position, and you'll have plenty of room to change the plugs.

This works because there's a flexible joint in the exhaust system to prevent binding and breakage as the engine rocks during rapid starts and wide-open throttle shifting.

I've also seen a tool used by professional mechanics that attaches to the strut's bolt holes. It has a big jackscrew that lets you adjust the engine's position precisely. But I've been able to use the 2 × 4 method just as successfully. Be careful, though, not to bend the firewall or pinch any wires, hoses or fingers.



Don't Look Back

The GMC dealer has replaced the outside driver's-side mirror on my Jimmy twice. It still vibrates so badly that you can't see anything. GMC had the dealer actually drill a hole in the mirror and use a setscrew to stop the shaking. It's still unusable. The passenger-side mirror is fine.

DIANE LOCKWOOD
ALMOND, NY

Your mirror isn't just vibrating—it's resonating at a particular frequency. Strapping it down might help a little, but the real cure is to change the resonant frequency

enough to take it out of the range that the mirror might encounter.

Stick some self-adhesive lead wheel-balance weights to the back of the mirror. Put them near the edges, top and bottom. (Clean the area where they stick with alcohol, or they'll fall off the next hot day.) You may need to disassemble the mirror to access the back of the glass.

Starting Over

A friend of mine bought a VW beetle that hasn't been started in 15 years or so. What should we do before we fire it up again?

HOWARD FOLTZ
HAGERSTOWN, MD

CAR CARE

Your VW may not be economical to salvage, but if your labor is essentially free, you may be able to rescue it.

The tires are probably dry-rotted, so you'll need to replace those.

With the humid climate on the East Coast, the brake shoes are probably corroded to the brake drums. You'll need to back off the manual adjusters, remove the drums and have them turned to remove the rust. Replace the shoes, and you may well have to replace the brake system's

wheel cylinders, rubber lines and master cylinder. At the very least, flush the system with lots of fresh brake fluid. I suspect you'll have plenty of trouble loosening the bleeder screws in the wheel cylinders. Use penetrating oil, some light raps with a hammer and a little patience. Let the oil work for a few days.

Now you've got a vehicle that can roll. Drain the gas tank. I'd take the tank to a radiator shop and have it cleaned internally, as it's undoubtedly

ly full of corrosion. Blow out the fuel line and replace the rubber sections, as they're probably rotted out, too.

You might just be able to get the car restarted without replacing the fuel pump or rebuilding the carburetor. I wouldn't, though, since the rubber parts inside them are probably history.

Remove the spark plugs and squirt some penetrating oil into the holes. Turn the engine over by hand a dozen times or so. Install new plugs, points and a condenser. If you're fortunate, the wires, cap and rotor might still be in decent shape.

Change the oil. Remove and clean the strainer plate. Inspect the fan and the fan shroud for mouse nests and other debris.

You'll probably need a new battery. Dribble some gas into the carb, then crank 'er over. Expect the old fan belt to fail soon, but leave it on for 100 miles or so to polish the rust off the pulleys before installing a new one. Change the oil after 50 miles or so, and again after 1000.

And expect a lot of minor electrical annoyances caused by corrosion in the fuse box and wiring harness.

Mixmaster

My beloved '83 Cadillac Sedan DeVille has picked up a lot of stone chips on the hood. I can't find any of those little bottles of touchup paint, as nobody stocks them for a car that's more than 10 years old.

This leaves me with the option of getting some paint mixed at a body shop, which may or may not match. Can you put me in touch with a source for the correct paint?

THOMAS B. JOHNSTON
MCALESTER, OK

Any factory-mixed paint is probably not going to match your sun-faded paint at this point anyway, Thomas. Paint pigments fade over time, especially older paints without clearcoat over them, as on today's cars.

Your best bet is to have a body shop wheel out your finish with an abrasive polish to remove the top layer of faded paint. You can try this yourself by hand, but it'll require a lot of elbow grease. Take the car to someplace that offers custom paint-matching, and have them mix up a couple of quarts. Be sure to have them pack it into several small cans, since paint doesn't keep well after it has been opened. That way, you'll have some left over to touch up with in a year or two.

Check last month's Car Clinic,

Материал, защищенный авторским правом

Is Your Water Safe?

FACT: 43% of all public water systems violate federal health standards. (Natural Resources Defense Council)

FACT: 560,000 American children suffer learning disabilities due to lead in drinking water. (U.S. E.P.A.)

FACT: 680,000 adult males have high blood pressure due to excessive levels of lead in drinking water. (U.S. E.P.A.)

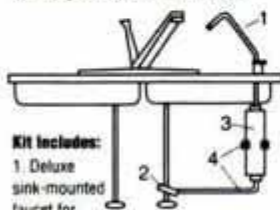
FACT: Drinking chlorinated water may as much as double the risk of certain cancers. (National Cancer Institute)

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CAR CARE

page 121, for instructions on how to apply your new paint.

Running On Empty

I'm in the construction business, and I see a lot of people come on and off the job site every day. These people invariably leave the engine idling, whether it's for 2 minutes or an hour. As a taxpayer and an environmental worrier, I feel that this practice is wasteful and polluting. Is this indeed the case?

T.K. LIECHTY
NORTH LAS VEGAS, NV

You're right, T.K. It takes essentially zero gasoline to restart an engine, especially a modern fuel-injected motor. The gasoline used to keep an engine idling is wasted. Not to mention that idling isn't good for an engine, as camshaft wear is accelerated by the low rpm.

How can this be? Wouldn't the wear be more at higher speeds? Nope. The lifter rides against the cam, held

there tightly by the pressure of the valve spring. At idle, the entire force of the spring pushes against the cam. Obviously, the highest pressure is at maximum valve lift. Not so obvious is that the inertia of the valve, which is opening, tends to reduce the pressure of the lifter against the cam nose as the engine speeds up. At maximum engine speed, just before valve float, there's almost no pressure against the cam nose.

The only good reason I can see

to idle an engine for more than a few moments is if there's a heavy electrical load—like a police car's flashing lights and radios. Another reason might be to run the air conditioning if you've got a baby or a pet on board. **PM**

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS

- When the a/c is engaged on some 1994 GM models with the 2.2- and 2.3-liter (Quad 4) 4-cylinders, the compressor may make a "brap" noise after a hard acceleration. This sound is considered normal.
- On some 1993 3.0-liter Dodge Shadows and Caravans—and Plymouth Sundance and Voyager models—a bad coolant-temperature sensor connector may be the cause of hard starting or no-starts. A new connector is available under PN 4414901.
- Ford says a revised power-steering reservoir and cap assembly (PN F3AZ-3E764-A) and a fresh fill of Type F fluid should quiet down the pump on noisy 1991-93 Town Cars and 1992-93 Crown Victoria/Grand Marquis models.
- Volvo wants the timing belt-tensioner lever bushing, bolt and sleeve on 1992-93 740s and 900-series cars lubed during belt replacement with a special non-petroleum-based grease, available under PN 1161246-2.
- Hyundai suggests replacing the distributor hold-down stud on Sonatas with an 8mm bolt and the existing washer to gain extra clearance for valve-cover reinstallation.
- Isuzu offers individual plastic relay covers for protection from extremely cold, wet conditions in the engine bay. Order the covers under PN 8-94140-446-0.



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MAINTENANCE BASICS

POLISHING YOUR CAR

BY DON CHAIKIN,
Automotive Editor

● In most parts of the country, the winter brings with it some road salt or sand and all types of precipitation. All of the above are less than good for your car's or truck's finish. So a spring cleaning not only makes your vehicle look sharper, it helps restore and preserve the quality of its finish. Your car will be worth more at trade-in or resale time if it looks good.

● You can help ensure that it looks good by regularly shining it up after you've washed it. Before you shine, though, be sure to match the type of polish or wax you use with your car's or truck's paint finish.

Polishing your clean car entails more than simply laying down a thin layer of wax or polish over the paint. The process also involves removing the very fine layer of dull, oxidized and weathered finish on the surface. This dull layer can either be removed chemically or with a fine polishing abrasive. With the oxidized layer removed, the fresh finish beneath it will shine. The wax or silicone in the polish then adds luster and protection to that clean paint.

● If your car or truck has a clearcoat/basecoat finish, you must use a wax or polish that's specially designed for it. The wrong product may actually dull rather than shine the finish.

● If you use a nonabrasive product made for a clearcoat finish on an acrylic nonclearcoat finish, the results will be disappointing at best. Be sure to use a product designed for a non-clearcoat paint.

● If you opt to shine your car with a wax, use a quality one that lists carnuba wax among its active ingredients. Or use a synthetic that contains silicone resins or amino-active silicones. (Most products have silicone fluids or oils that will make them easier to apply.)

Regardless of the type of finish your vehicle has and the finish-care product you use, the actual task of shining up the car is pretty much the same.

● Work in the shade, but not beneath the birds' favorite sap-bearing tree.

● Begin polishing early enough to



avoid having to work in the heat of the day, and finish the job early enough to let the wax cure before the dew begins to settle.

● Start on the roof and work your way down. Apply the wax or polish to a small section no larger than about one-quarter the area of the roof.

● Use a soft, damp applicator to put down a layer of wax. Small household sponges make excellent, disposable wax applicators.

● Don't be alarmed if your applicator removes some paint along with the polish on a nonclearcoat finish. This is the dull, oxidized layer coming up.

● Avoid getting wax or polish on any matte black plastic parts, rubber trim or molding, or on a vinyl roof.

● Allow the wax to dry to a haze according to the product's instructions.

● To get a show-car shine, buff the wax or polish off in a linear rather than a circular motion. This takes more time, but it leaves the car's

finish with a uniform-looking luster.


If you're using a totally nonabrasive wax or polish and don't mind swirl marks, you can finish the job using a power buffer.

● Make sure that the power buffer's lamb's-wool bonnet is clean. Change or rinse the bonnet frequently to avoid scratching the finish.

● Use the bonnet as a mitten to buff in the crevices and other areas that the power buffer can't reach.

● To help maintain the shine on your car after you've restored it, try to keep your parked car covered—in the garage or carport or beneath a cover. Also, periodically hose grit and dust off the finish, but avoid the temptation to wipe down the car after a rain—there's all manner of grit in those standing raindrops.

● When the finish no longer beads water the way it did after you polished, it's time to wax again—even if it still looks good.



*I appreciate your meeting me here.
The office can get so crazy
with the phones and everything.*

(Polite smile)

Would you like a glass of wine?

*No thank you.
I'll just have a club soda.*

*Allison, here's to you.
You're really doing a terrific job.
You sure you don't want a drink,
I hate to drink alone.*

*No, uh, thanks.
I'm fine.*

*Ah yes you're probably
wondering why I asked you here.
Well, uh, that blouse really looks good
on you. Oh, anyway I was saying,
how about a half a glass, just a little.
Here take some of mine.*

If someone at work is forcing you to mix business with pleasure, don't be afraid to speak up, even if it is your boss. Because unlike other situations at work, sexual harassment is one situation where you're not required to be a team player. For more information, visit your local library and read the *Stop Sexual Harassment* booklet.

 Women In Communications, Inc.

Created by Bozell Worldwide, Inc. Photograph by Sheila Metzner.

Sexual Harassment

It violates you and it violates the law.

CAR CARE

NEW PRODUCTS

IMPROVE YOUR CAR

Metal Polish

Chrome and stainless-steel trim may be more typical of cars made in the '40s and '50s than those of the '90s. Even so, if you want the massive bright metal on your older car—or the delicate amount of the shiny trim

on your new car—to really gleam, try Concours Quick Shine Metal Polish. It

cleans, shines and protects all metals quickly and easily. Environmentally friendly, the water-based, nontoxic polish contains no ammonia, acids or petroleum-based products. Its maker claims that a special anti-oxidation protective ingredient helps the polish maintain its luster longer than other polishes on the market. The polish is available by mail order. For \$9 you get a 16-ounce bottle, and \$6 buys the 8-ounce size (prices include shipping). From Concours

West Inc., 5915 Seaside Walk, Long Beach, CA 90803; (310) 433-2121.



Roof-Rack Ladder

Roof racks are a great way to carry all kinds of gear, but unless you're built like Michael Jordan, you probably have to drag out a chair or stepladder to stow your stuff on the roof—and then do the same to take it down. Wouldn't it be nice to have a lightweight ladder that folds down to a small compact size for easy storage in your vehicle? Sportstep is just that. The folding ladder hooks around the roof-rack rails while the base of the ladder is secured to the vehicle itself, making a large and stable platform. The 4¼-ft. unit folds down to 4 x 12 x 15 in. so the ladder can be stored under a seat. Sportstep sells for \$50 to \$60 and is available from Sportstep, P.O. Box 140, Aspen, CO 81612; (800) 283-1800.

Multilube

If it squeaks, rusts, corrodes or needs to be protected, give it a shot of CRC's Power Lube. The new multipurpose lubricant uses a precision spray and an environmentally friendly CO₂ propellant. The lube is odor-free, nonstaining and it won't damage plastic. Power Lube is available at auto-parts and hardware outlets. For more information, contact CRC Industries at (215) 674-4300.



Truck Tire

With all the new passenger-car tires coming out, light-truck tires seem to be playing second fiddle. Well, Hoosier gets a solo spotlight with its new HT—a light-truck tire for all reasons. The HT is made for on- and off-road all-season use, and features an aggressive 5-row tread pattern, full-depth lateral grooves, siping and wrap-around shoulder blocks. The design makes for good traction, while providing long tread life, good handling and a quiet, comfortable ride. The raised white-letter sidewall-style tire comes in five popular sizes and is available wherever General Tires are sold. **FM**

Garage Door Opener Transmitter

You know the tune, so hum along. "Oh where, oh where did the garage door opener go? Oh where, oh where can it be?" Forget about it. With Stanley's AutoTrans transmitter mounted under your hood and wired into the headlight circuitry, you need only flash your high beams to activate your garage door

opener. The transmitter measures 2½ x 1½ x 3½ in. and mounts with two sheet-metal screws. Instructions are included. AutoTrans units that operate Stanley door openers sell for about \$50. A kit

that adapts the unit to other brands of openers adds about \$20. AutoTrans is available at home centers, hardware stores and other home-service outlets. Contact Stanley Door Systems, 1225 E. Maple Ave., Troy, MI 48084; (800) 521-5262.



gauge on the cowl reads fuel level in LCD bars and has warning lamps. A trim gauge, placed low on the cowl, is standard, but a speedometer and tach are optional. The low-profile trim control on the left handgrip is hard to feel when under way. To deter theft, the kill-switch tether contains a microchip so that the ignition is disabled when it's removed. Fuel capacity is 9 gallons.

On a closed course, acceleration is often more important than top speed, and the XP785 was designed with that in mind. It blitzed from 0 to 40 mph in just 2.9 seconds, and then screamed to a top speed of 57.6 mph. The Sea-Doo, however, was the trickiest craft to ride at high speed. The short hull lacks stability in even light chop, and it's very sensitive to trim and rider position.

On the buoy course, the XP785 was as quick as the Polaris but was more work to drive. Wakes and waves may cause the hull to hook up suddenly, and it takes a lot of muscle to hang on through a hard turn.

The XP785 has tremendous performance potential, but getting there requires a lot of driver skill. This is not a boat for the faint of heart.

Yamaha WaveRaider 1100

Yamaha took the no-substitute-for-cubic-inches approach to performance, stuffing a 1051cc triple rated at 110 hp into its WaveRaider hull to create what is the fastest production watercraft on the market. In our test, the Raider 1100 posted an average top speed of 59.9 mph, 2 mph faster than the Kawasaki 900ZXi.

With all that displacement, the Yamaha engine can produce a lot of power with very little stress. Power is abundant, and the engine feels and sounds marvelous. The Yamaha triple uses three 38mm Mikuni carbs. A new 155mm jet pump has a 3-blade stainless-steel impeller. The pump nozzle is connected to a 3-position collar on the left handgrip that pulls a cable and moves the nozzle 5° up or 5° down from center.

The Raider hull measures 113 in. in length, almost as long as some touring watercraft. Its beam is 44 in. The hull has a deep-V profile and a beveled stern to aid turning. The running surface is stepped in the aft area to reduce water resistance at speed.

From the seat, the Raider feels long and low. A pair of rearview mirrors are mounted on the cowl sides, and an LCD digital instrument is placed on top of the cowl, displaying boat speed in large easy-to-read numbers. Bars show oil and fuel levels, and lights indicate low oil and fuel,

and overheat. The fuel tank holds 13.2 gallons, which sounds generous until you realize that this motor will burn 12.7 gph at wide-open throttle!

Of course, at the Raider's top speed, you'll cover a lot of distance in a short period of time—if the water is smooth. In chop, the Raider hull has a tendency to develop a mind of its own and wander off course, especially in a quartering sea. You can't use all of the Raider's speed in anything except calm conditions.

On the handling course, the WaveRaider proved difficult to master, mostly because it felt inconsistent

from run to run. We found that moving aft helped tracking around a turn, but waves and wakes still caused the nose to hunt.

Ultimately, many riders may find the WaveRaider a one-trick pony. You have to be devoted to straight-ahead speed to appreciate the WaveRaider, but if raw speed is your thing, this muscle-craft is for you.

Muscle-craft like these demand a safe riding technique that includes consideration of water conditions, other boat traffic and maximum concentration. But a real thrill awaits those who can handle the horsepower. **FM**

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DAYTONA 500: THE OPENING BELL

NASCAR's Super Bowl begins the season with a bang.

BY AL PEARCE



●In the overall scheme of things, which is, of course, the Winston Cup and its attendant \$1.3-million bonus, the Daytona 500 is just another race. It pays the same championship points as every other race, and it's carried live on radio and television like every other race. In the bottom line of NASCAR, though, the 500 is the single most important event of the 31-race season.

"Anybody who says that this is just another race doesn't know what he's talking about," says Darrell Waltrip, the driver of the Western Auto/POPULAR MECHANICS No. 17 Chevrolet Monte Carlo. "To every stock-car driver I know, this is the one race that everyone wants to win more than any other."

That's because, at 37, the Daytona 500 is stock-car racing's second-oldest major event, behind only the 46-year-old Southern 500 at Darlington, South

Carolina. The Daytona International Speedway is a well-struck 9-iron from the NASCAR headquarters, which

\$1 million if anyone wins three of the Big Four: the Daytona 500, Winston 500 at Talladega, Alabama, Coca-Cola 600 near Charlotte, North Carolina, and Darlington's Southern 500. It's been done only once so far, and that was by Bill Elliott way back in 1985.

But the 500 is important mostly because teams spend three months getting ready for it. They leave Atlanta after each November's final race and turn their attention to Daytona, their next event. They spend the ensuing 100 days building cars and engines, doing on-track and

wind-tunnel testing, and sitting around plotting strategy for the 500.

"You can't work that hard for one race and not consider it the most important of the season," Waltrip says.

(Please turn to page 129)



After a good start, the Western Auto/PM Monte Carlo lost its transmission.

means that anybody who's anybody in the organization is here during Speed Week. As they say, it's the Super Bowl of stock-car racing.

Daytona is also the first leg of the "Winston Million" program that pays

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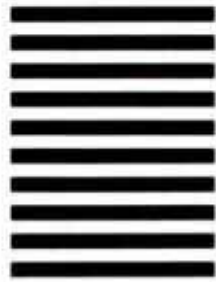
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PHOTO BY GUY HUNTER

Qualifying ninth fastest and finishing second in the qualifier, Waltrip's team was optimistic.

"It's important for me and the team, for our fans and especially for our sponsors. A win in the 500 generates enormous publicity that stays with you all year. It's true that it doesn't make or break a season, but it sure sets the tone."

The DarWal team went into this year's race more optimistic than it has been in a long time. Its new Monte Carlo was quick and stable in winter testing, and it proved even better in three prequalifying practice sessions: Waltrip qualified ninth-fastest at 191.041 mph.

"I feel like an old bear that's waking up after hibernation," he says. "I'm hungry, so don't mess with me. Don't go poking at me because I might just jump up and bite you. I feel as good about our chances this year as I have in years."

Such optimism is well-founded. Waltrip ran second in his 125-mile qualifying heat, finishing close behind eventual Daytona 500 winner Sterling Marlin. It was Waltrip's best 125-mile showing since winning the second qualifying race in 1988.

In the 500, as Sterling Marlin, Dale Earnhardt and Jeff Gordon ran near the front, Waltrip's No. 17 Monte Carlo lurked just behind them. With legendary guile and patience, he knew the field eventually would back up—like it always does—as the race wore on. "We'd work our way forward, then we'd slip back a little bit," he said later. "We weren't trying to do a whole lot until the end. We had a good car on old tires and would have been there when it counted. The only thing that might have helped was if the track had been hotter and more slick."

Waltrip was in contention until his Monte Carlo suffered gearbox failure as he left the pits following routine service at lap 161. "They dropped the

jack, and the gearbox shattered as I left the pits," he says. "We had to replace it, and that ruined our dream weekend. My heart almost quit beating when I popped the clutch. I was so sad I wanted to cry."

Meanwhile, Sterling Marlin, in the Kodak Film/Morgan-McClure No. 4 car, was making the rest of the field cry. In what appeared to be a flawless machine with a clear 15- to 20-hp advantage over the field, Marlin could break drafts at will, drive around people and, in general, dominate the opposition. Dale Earnhardt, last year's Winston Cup champion, and a driver who has won everything you can win in NASCAR competition—except the Daytona 500—made a gallant charge toward the end of this one. But Marlin was too much even for Earnhardt, The Intimidator in the black Mr. Goodwrench No. 3 Monte Carlo.

People were saying that this year's Daytona 500 might have been different had Earnhardt gotten some drafting help at the end. Trying to correct his car's pushing, he took tires and some front-end tape under the yellow when Bobby Labonte crashed. Marlin stayed out, remaining in first place. Though track position was crucial, Earnhardt's team thought that fresh tires and nose tape would put him in a position to charge and overtake Marlin, who was running on worn tires.

When the green finally came on, Earnhardt was 13th. With two laps to go, he had blasted his way to second place—where he would stay.

"This is the Daytona 500," Earnhardt said later. "I don't reckon I'm supposed to win the damned thing."

As for the Western Auto/POPULAR MECHANICS Monte Carlo, it's now on to Rockingham, North Carolina, and the rest of the 1995 season. We'll keep you posted.

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THE DANCING BEAR

We take Russia's aerobatic gold medalist through a high-flying ballet.

BY WILLIAM GARVEY

● Imagine the chairman of Lockheed getting this directive from Washington: "Proceed at once to design and build a small gasoline-powered aircraft that equals or surpasses the performance capabilities of all other aerobatic aircraft, extant or

it went bankrupt and exploded. The outfit that got the job was the vaunted Sukhoi Design Bureau, maker of supersonic Red warriors.

Sukhoi answered the challenge with the Su-26. A single-place monoplane

family. But the Su-26 comes from the same gene pool as the Su-27 Flanker. Forget everything you've heard about Russian caveman craftsmanship—



Sukhois are cut diamonds. And when the Su-26 entered world competition in the mid-1980s, the little diamond began attracting gold—medals, that is.

Brian Becker recalls the little Sukhoi's grand entrance at the World Aerobatic Championships in England in 1986. All the attendees were intensely curious about this new Red menace. Becker's interest was even more pointed. His Pompano Air Center in Pompano Beach, Florida, had become a mecca for aerobatics. Moreover, Becker was a board member of the U.S. Aerobatic Team.

After a series of Pitts, Lasers and Extras performed their routines, the Sukhoi got its chance. The preceding aircraft had entered the competition box from 3000 ft. or so, descended 1000 ft. in initial maneuvers and then struggled back up to continue. Not the Sukhoi. The Su-26 began from high above, maybe 5000 ft., and was virtually invisible. But from the

planned. Assign best talent and equipment to task. Profit guaranteed by Congress. Good luck."

Given today's political realities, such a program would be pure lunacy. The idea that competition aerobatics should become a national priority is preposterous. Still, it might be kind of fun to see what the boys who brought us the F-16, F-117A and F-22 could come up with.

And if the plane turned out nearly as good as the competition's, it would make your head buzz and short out most of your internal circuitry. I know. I've flown the competition's.

As improbable as the build-us-an-aerobat-and-make-us-proud assignment seems, that is precisely what the Soviet Union ordered before



No-nonsense cockpit and oversized stick distinguish the nimble Sukhoi Su-29.

with steel-frame construction and composite airfoils, the Su-26 flies on a supercharged 360-hp geared radial and lands on fixed, conventional gear. With an all-up weight of 1837 pounds, it's surely the runt of the Sukhoi

ground, everyone could hear the riveting scream of its 9-cylinder Vedenyev. Then the airplane appeared, descending at a 60° angle, its speed well over 300 mph. The trim Russian launched a series of radial, knife-edge wing rocks all the way to the bottom and, once there, transferred to the vertical and went right back up. Instantly. And then began its routine of maneuvers. It was mesmerizing. Breathtaking.

Becker turned to a companion and announced, simply, "We're screwed."

"It was almost unfair," he recalls today. "Vertical penetration, rate of roll and engine sound are not bases for judging." And yet there it was, an instant favorite. The Sukhoi "was like a beautiful woman coming into a room. Everything just stops."

The attraction was mutual, it seems, because shortly thereafter the Soviets contacted Becker to see if he had any interest in marketing their aerobat in the West. After three years of negotiations, a mammoth An-124 thundered into the Experimental Aircraft Association's Fly-In at Oshkosh, Wisconsin, and disgorged Pompano's first two Su-26s. In 1992, deliveries of the 2-seat Su-29 began. That's the plane I flew during a recent visit to the Pompano Air Center.

Its length and span exceed those of the Su-26 by 17 and 16 in., respectively. But the Su-29's 1900-pound aerobic gross weight—and hence its performance—is nearly the same as its predecessor. Sukhoi engineers shaved the 29's weight with judicious material substitution and structural redesign. For example, whereas the 26 has heavy, solid titanium main gear, the 29's titanium gear are hollow. The 26's stainless-steel tube structure stretches to the tail cone, but on the 29 the steel cage ends at the pilot's seat and the empennage is a monocoque structure made of carbon fiber and Kevlar. Special materials are a hallmark of the Sukhoi, from the wood-composite-metal prop to the composite wings and titanium tail spring.

Inside the spartan cockpit, the pilots sit in slightly supine seats, with knees high. This position permits greater g-tolerance, an important consideration in a machine capable of inflicting plus-11 or minus-9 g's. Prop and throttle controls lie on the left, and a control stick, overlong to give the pilot more leverage, stands in the center.

The two instrument panels on our 29 were outfitted strictly for visual-flight rules. Apart from the altimeter, most of the gauges spoke metric. Although all the placarded information read in English, the lettering was hand drawn and noticeably uneven, further underscoring that this was no

(Please turn to page 132)

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AVIATION (Continued from page 131)

Kansas cookie-cutter. Because Sukhoi is a design bureau and not a production facility, it virtually custom-built each of the 45 aerobats delivered to Pompano so far. But a former rocket- and missile-manufacturing plant north of Moscow will soon assume production. That should help correct any manufacturing anomalies.

Once the 29's M-14P engine blatted to life, Pompano instructor Marc Ludtke and I made our way to the active runway. Cleared for takeoff, we did so after a minimum ground run and from a 3-point squat. Immediately upon liftoff, I grasped the significance of a 2600-rpm engine mated to an 1800-rpm 3-bladed prop of 100-in. diameter. The Sukhoi's legendary vertical penetration results from this high-thrust engine-prop combination.

Most airplanes want to return to straight and level flight. Not the Sukhoi. Rather, it is designed with neutral stability and thus will do as you instruct it until you instruct it to do something else. This characteristic was apparent from my very first aileron roll. The maneuver began crisply, with minimal control-stick deflection, and ended 1 second and 375° later, when I centered the stick again. We were in a bank, and the 29 was perfectly content. A quick jab right and we started to go around again, until I jabbed the other way. The Sukhoi has no default to "normal."

After some cloud chasing, we got serious. Barrel rolls. Horizontal snaps. Loops. Vertical rolls. Half Cubans. Descending at 220 mph, we pulled 7 g's to the vertical, did rolls right and left and pushed over, having gained 2000 ft.—and had plenty of energy left. Then came another vertical pull with a roll left and a snap right, and we finished with a hammerhead.

The 29 has a max climb of 3150 ft. per minute and a roll rate of 360° per second. Consequently, each maneuver was unbelievably quick in entry, execution and finish. It's easy to understand why the Sukhois have collected more than 90 gold medals so far. And that figure will only increase. Recently, the Su-26 was succeeded by the even more agile single, the Su-31.

The Sukhois are not for just anyone. Although the 29 can carry two people plus shaving kits 700 miles at 155 knots, and even though it can be outfitted for full-instrument flight rules, this is not a cross-country everyplane. For that, look elsewhere. However, if you've got a yearning to excel in aeronautical artistry and have \$190,000 to spend in the pursuit, give Brian Becker a call. He's got the means to make your dreams come true—straight from the folks who once gave us nightmares.

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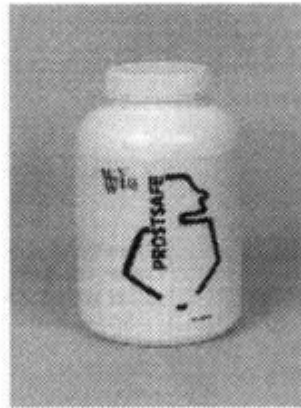
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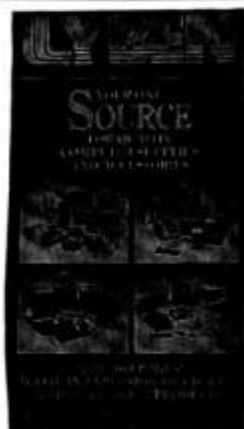
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up a pleasant computer-animated walk through a sunny outdoor mall, past storefronts of such merchants as Spiegel, The Nature Company and The Sharper Image. Once you register your credit card number with FSN, you can order products via your TV and have them delivered a few days later.

But, just like the movies, shopping suffered from a shortage of choices. The eight retailers with virtual stores on FSN—including the U.S. Postal Service—were offering a total of about 300 products. If you think about it, 40 products per store isn't much of a selection. A paper catalog would probably be more useful.

Videogames, the third category in FSN's initial selection of interactive services, were at once impressive and disappointing. In December, an FSN subscriber could play a game called "Gin" with a fellow subscriber in another home. But the way FSN is set up, players had no sure way of selecting the opponent they wanted to play. When a person signed on, the computer matched him or her up with the previous person who signed on—if that person was still waiting around for a game. Otherwise, players had to wait for the next person to sign on. (By contrast, The ImagiNation Network computer service, which lets players across the country compete against one another, allows you to pick your opponent.)

The 13 Atari Jaguar games available on FSN—none of which could be played home-to-home like "Gin"—looked a lot more interesting to play, but they didn't represent a leap forward in technology. Users picked a game title from a menu screen and then had to wait nearly 2 minutes as the software for the game was transmitted over the network and loaded via a special adapter plugged into a Jaguar machine, itself connected to the home FSN box.

At least the price was right for the Willards and the other families on the experimental network. After a free trial period, charges for movies and games are expected to be comparable to videocassette rentals.

As for how much it's costing to build FSN, Time Warner isn't saying. But subscriber equipment alone could run into several thousand dollars per household—far more than a traditional cable set-top box, which costs operators anywhere between \$100 and \$200. (As is the custom with all U.S. cable systems, FSN customers don't purchase their home equipment. Time Warner lends it to them as part of the cable service.)

Call it calculated overspending. While Time Warner admits the net-

work isn't self-sustaining yet, the point isn't to reap a profit from the system now. The company wants to learn how it can make money over the long haul, once systems as sophisticated as the one in Orlando blanket the country.

At FSN's debut, Time Warner chairman Gerald Levin called the system "an irreversible step across the threshold of change." So it's instructive to look back at another moment in the history of communications. When Samuel Morse demonstrated his telegraph in 1844, ushering in a new age of communication, the message that

he sent from Washington to Baltimore was pure poetry: "What hath God wrought?" One hundred fifty years later, the Willards ushered in a new age of communication by sitting down and watching a movie together. And what was the first movie they received over the network—the modern-day equivalent of Morse's fateful message? It was "Ace Ventura, Pet Detective."

Not that there's anything wrong with the movie, but it does make one wonder. As innovative as the Full Service Network is, like "Ace Ventura," it has plenty of room for improvement. **FM**

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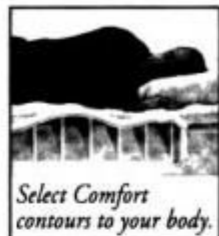
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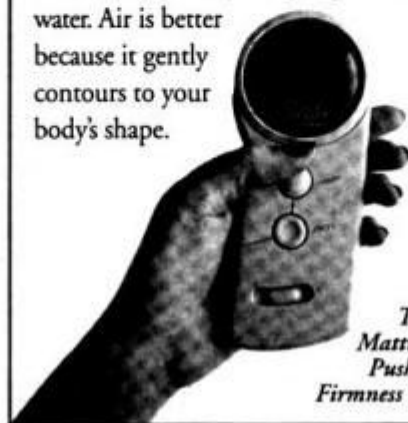
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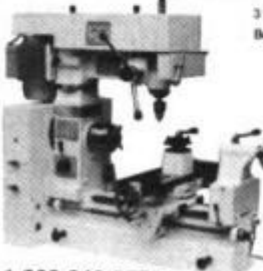
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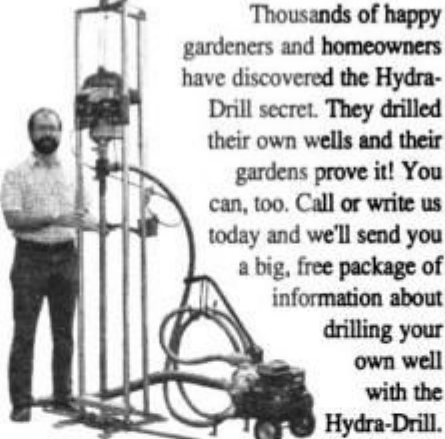
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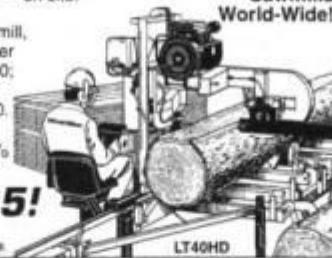
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