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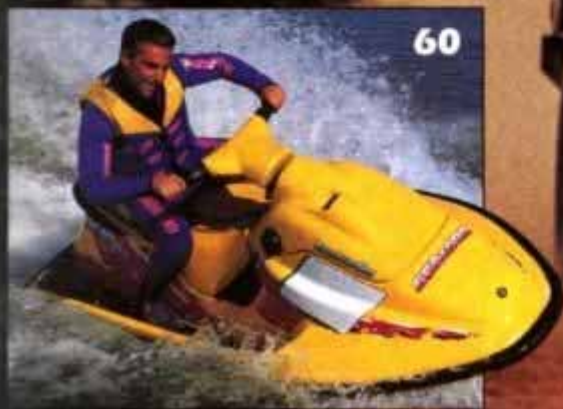
Sound too good to be true? That's just the kind of response we were looking for.

Popular Mechanics®

SEPTEMBER 1995
VOLUME 172
NO. 9



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EDITOR'S NOTES

● Somewhere in that mass of humanity in the photo below is West Coast Editor Scott Oldham. When he was 10, Scott dropped out of sleep-away summer camp after one day. He has never camped out and is deathly afraid of crawling insects—a perfect candidate to attend AM General's press event in the wilds of Baja California to show off the new gas-powered Hummer. By retracing the original route of the Baja 1000 rally in the newest Hummer, AM General came up with a unique way of demonstrating the attributes of the latest iteration of this vehicle. Obviously, the Hummer is a special—specialized—vehicle in many ways. After all, Arnold Schwarzenegger drives one. But even Arnie never drove one for a thousand miles over perhaps the roughest terrain in the world. But now, Scott Oldham has. "Compared to Baja, the sands of Kuwait were a Sunday drive to the beach," he says of the Hummers in the Gulf War. Of course, no one was firing AK-47s at him, either. For



the complete report on how the Hummer—and Scott—fared, see page 53. . . . Say the words "land-speed record" to a car guy and he'll respond with "Craig Breedlove." In the '60s, Breedlove pushed the land-speed envelope to the limits on the Bonneville Salt Flats in Utah, finally running 600.601 mph before hanging up his parachute. Now he's back, along with several other contenders, to not only set a new land-speed record, but actually exceed the speed of sound on land. POPULAR MECHANICS has signed on as a sponsor, and we'll be taking you along for the ride. So buckle up and turn to page 68. . . . Speaking of speed, if you have a computer and a modem, you're nowhere these days unless you're running at least 14,400 baud. But that's only the beginning of the superspeed modem story. For the rest of it, turn to our report, which begins on page 77. . . . Then there's speed on water, where jet thrust is making headlines as it replaces the unwieldy propeller we've become accustomed to. The newest jet-drives are more efficient than ever and much safer than props. The full report starts on page 60. . . . Imagine a surgeon in New York City operating on a patient in Dakar—or anywhere else on Earth—without leaving his office. From his workstation, the surgeon uses a television-like device to direct the motions of remote-control "hands" in the operating room thousands of miles away, hands that actually perform the surgical procedures. Incredible but not impossible with a system that combines electronics technology and mechanical engineering to create a new era in medical history. Turn to page 64 for the whole story. . . . If you're in the market for any new appliances, better check our roundup of all the latest stuff, which starts on page 93, before going to the store. Till next time.


Joe Oldham

Popular Mechanics

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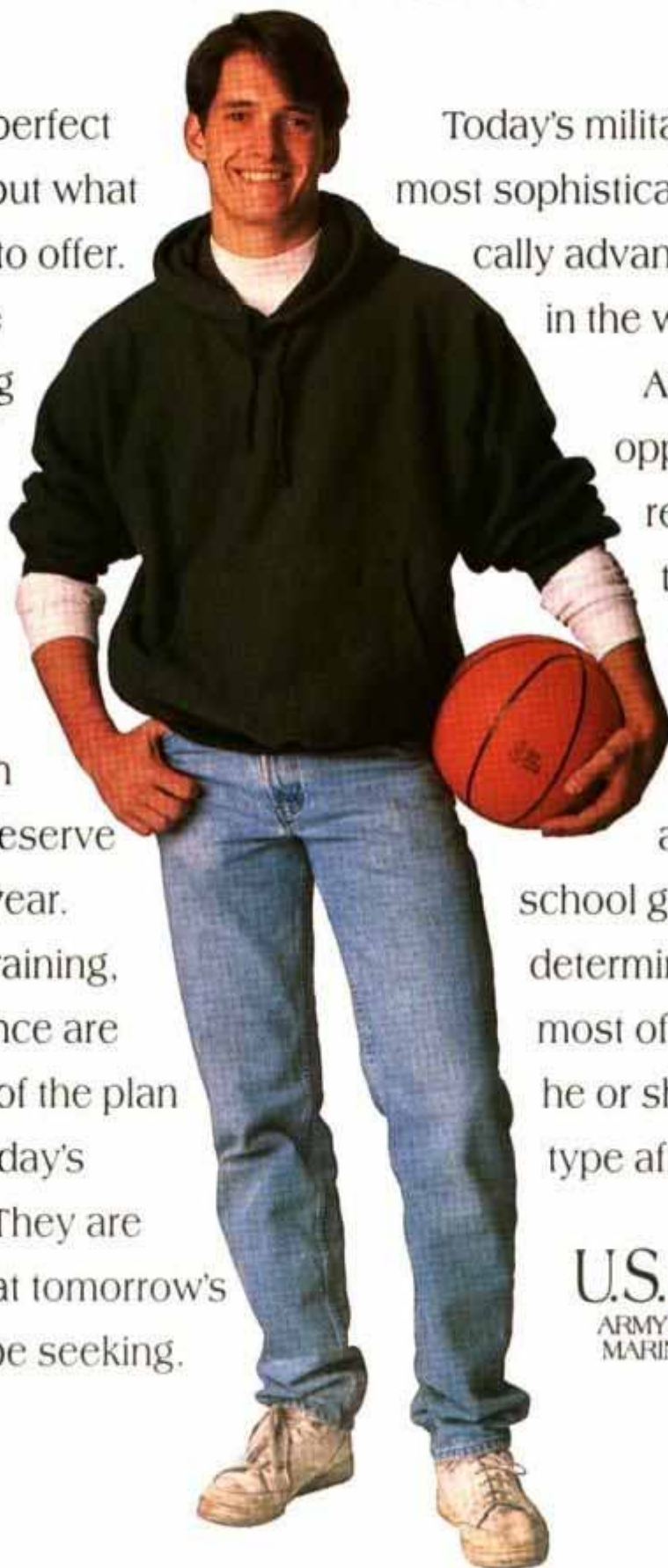
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90 YEARS AGO: SEPTEMBER 1905



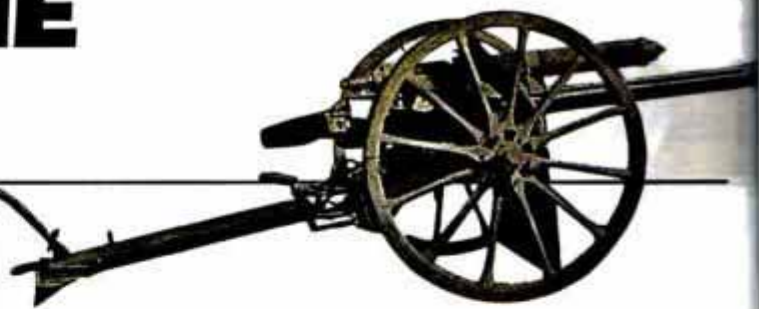
Flap Jacks

Birdlike flight obsessed inventors in the days before airplanes took over the sky. Two Englishmen got a 232-pound contraption off the ground. Driven by a 3.5-hp gasoline engine, the device flapped two 10-ft. wings 100 times per minute. Meanwhile, an Ohio experimenter created an unpowered 26-wing flying machine with thousands of real turkey feathers. It was supposed to get airborne by rolling down a ski jump. But it didn't.

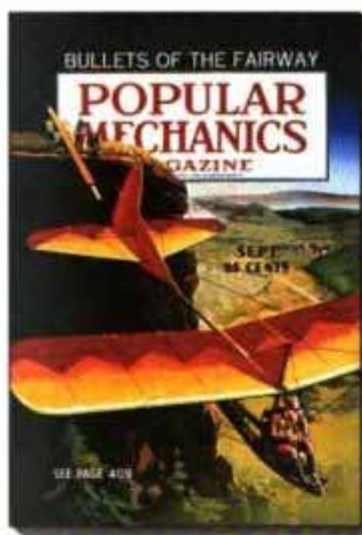
Big Guns

Although the great powers of Europe were years away from clashing, they were rapidly updating their field artillery. The new British 18-pounder had a modern recoil mechanism and, in theory, could deliver as many as 28 rounds per minute. After each discharge, springs returned the gun to position, with its sights aligned on the tar-

get. The French considered long-range accuracy essential and developed a compressed-air system to re-aim a gun after firing. Not to be outdone, the Germans also refined their long-range siege guns and howitzers, using strong Erhardt steel. Austria went with a bronze field howitzer. The new quick-firing weapons would wreak devastation in the coming war.



60 YEARS AGO: SEPTEMBER 1935



Glide Slope

Daredevils were already soaring toward the era of the hang glider and ultralight aircraft. Atop a mountain in the state of Washington, an open-frame glider took off from the brink of a 1000-ft. precipice. Its runway: a 20-ft. greased plank that slanted down from the roof of an automobile. The aircraft floated to a safe landing. Its flight leapt the gap between turn-of-the-century self-launched sailplanes and the modern Swift glider.

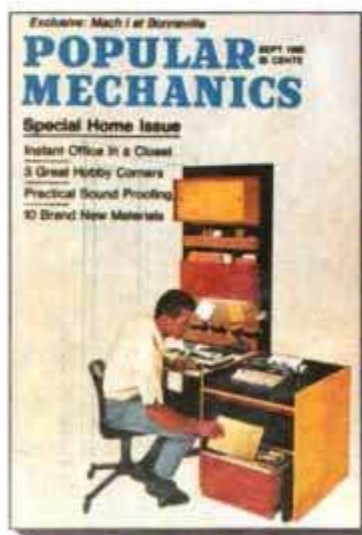
Bridge Work

Overshadowed by the Golden Gate Bridge, which was also under construction, the mighty San Francisco-Oakland Bay Bridge neared completion. Stringing cable 28 in. thick, workers braved death 450 ft. above the water. Engineers had already met monumental challenges. They sank the deepest bridge piers ever built into the bay.

And to complete the tandem suspension span, they would put in place the world's biggest bridge anchorage.



30 YEARS AGO: SEPTEMBER 1965



Inner Space

What to do with that wasted closet space? Our special home section overflowed with ideas. For closet authors, a foldout office featured a rolling desk and file drawer. Along similar lines, a home-movie projection center deployed from the back of a closet door. The sportsman's cabinet organized fishing and hunting paraphernalia. And a collector's corner packed plenty of shelves and a false-door front that flipped out to become a workbench.

Master Blaster

Who better than Craig Breedlove himself to detail the gremlins sure to plague his attempt to break the sound barrier? Breedlove told PM readers how shifting sonic flows over curved surfaces could play havoc with the stability of his car. At 750 miles per hour,

the ground-effect phenomenon was an unknown factor. Aerodynamic heating could thin intake air and upset the critical air/fuel ratio, causing engine flameout and loss of vehicle control. To muzzle all of these demons, Breedlove's Spirit Of America had a Coke-bottle silhouette and was festooned with all kinds of safety features. **PM**



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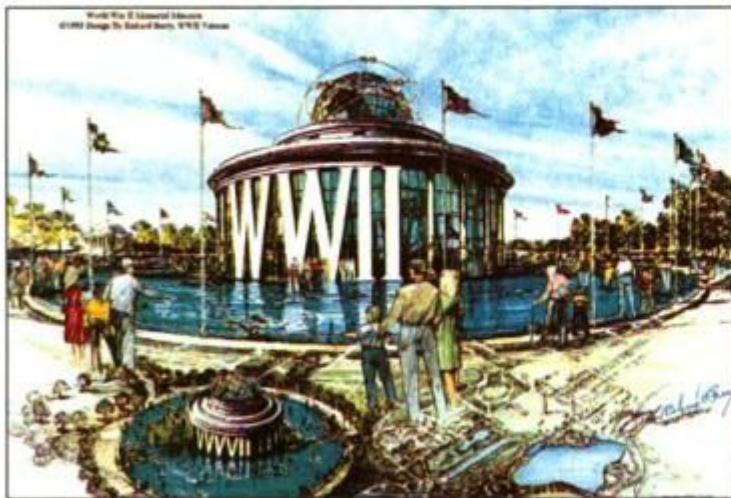
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WWII Memorial



Fifty years after the end of World War II, there still is no memorial in Washington, D.C., honoring the veterans of that war. For every American who died in the Korean and Vietnam wars, eight died in WWII—more than 400,000 gave their lives.

I understand that the American Battle Monuments Commission is pursuing the creation of a WWII memorial. I have enclosed my design, hoping that it will help stimulate support for this effort.

RICHARD BERRY
PERRYSBURG, OH

As we went to press, an official with the American Battle Monuments Commission told us that the agency has narrowed down potential sites for the World War II memorial to two, both on the mall in Washington, D.C. On November 4, President Clinton will announce which site has been chosen. The memorial will cost between \$50 and \$100 million to build, and will be aesthetically similar to the Lincoln and Jefferson memorials in Washington. Following the site selection announcement, the

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

commission will embark on a major 5-year fund-raising campaign, with the hope of breaking ground by the year 2000. Those who would like to donate to the effort should wait until the official fund drive begins. However, because Congress and the president must approve capital allocation and fund-raising activities, the commission says that right now people should voice their opinions on the memorial to their congressmen and to the president. —Ed.

Virus Protection

Your article on computer viruses, while informative, was in error by reporting that there is no virus policing on the Internet other than through commercial service providers, such as Prodigy and America Online. This is clearly not the case. In fact, most major FTP sites from which you can freely download software have strict uploading policies. They also scan all of the incoming files for viruses before allowing them to be publicly downloaded. Likewise, any self-respecting local bulletin board will check for viruses before passing on files.

Users should be wary of

FTP sites with open uploading policies and folks who send them files for seemingly no reason. Regular text files, such as recipes and baseball stats, cannot spread viruses on their own. However, an executable file—one that requires the user to activate or run the program from his or her own terminal—can spread viruses.

SPATCH
VIA INTERNET

Your article overemphasized a relatively small problem. I've been working on our student network for a year and have run into

only one virus. If you're prepared for them, viruses can usually be contained with the right programs. That preparation includes making backups of important files and keeping a clean boot disk nearby.

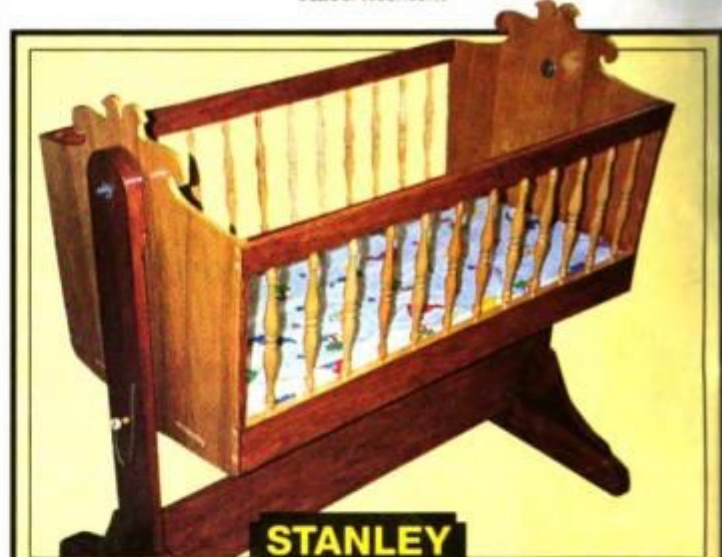
TODD HANSEN
VIA INTERNET

Uninstall All

The Uninstaller software you mentioned in your Electronics column is very good, but not for novices. I thought I was ready to execute the program and started zapping away. I cleaned up a lot of stuff, as adver-

(Please turn to page 14)

Advertisement



Reader Project Of The Month

Using your plans for a cradle from the October 1959 issue, I have constructed two similar models. I didn't follow your instructions to the letter, but they sure helped me get the job done. The body is constructed from 1/2-in. birch plywood, and the rails and the stand are pine. The 12-in. spindles, placed every 3 in. on each side, are also birch. The cradles are much appreciated by the mothers, who pull them around wherever they are working so their babies can watch them.

LOUIS EDWARDS
FLANAGAN, IL

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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attention to detail sets Stanley apart from other tool companies. It's what led us to design a garage door able to withstand a hurricane and a tape rule that's Mylar® coated for durability. And it's something we're quite confident you'll notice every time you pick up one of our products.

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tised, but later found that I had to re-install some of the software I did not intend to delete. This program must be used very carefully.

WALT
VIA INTERNET

Breaking Ground

Your illustration for "GFCI, Ground And Neutral" is in error. It shows the typical wiring for a non-GFCI circuit. GFCI protection can either be contained in the receptacle or the circuit breaker. Your illustration stated that the GFCI protection was the circuit breaker. In this case, the circuit's neutral should have been connected through the circuit breaker to the neutral bus. For the GFCI to be contained in the receptacle, you would have needed to show the receptacle with TEST and RESET buttons.

MARK R. AYDELOTTE
VICE PRESIDENT
HAYWARD ELECTRIC CO.
HAYWARD, CA

Easy Rider

I'm a 61-year-old biking enthusiast. Until a few weeks ago, I would huff and puff my way over the bridges of San Diego. However, after I read your article about assist motors adaptable to most bikes, I decided to look into getting one. After trying the unit firsthand, I purchased it.

The easily operated motor pushes me against strong winds and up hills with little effort on my part. And for \$6, I was able to license my motorized bike for street use. Thank you for printing the information about the power-bike kit in PM. It's a better-than-great magazine.

BRUCE BAINBRIDGE
SAN DIEGO, CA

Forefatherhood

Letters that have recently appeared in this column show just how much our education system has deteriorated, and how little Americans know

about our own Constitution. The Bill of Rights—the first 10 amendments to the Constitution—specifically delineate rights granted to the people. These are rights the government cannot infringe upon—rights that include the purchase of firearms and the formation of militias. Our founding fathers were suspicious of federal authority after their experiences with the British government. They knew what they were doing.

RICHARD KANE
ELLSWORTH, MA

D.W. Fans

Many thanks for the wonderful articles and photos of Darrell Waltrip. And welcome to NASCAR! D.W. is our No. 1 driver, and we are members of his fan club.

MR. AND MRS. DOUGLAS McINNIS
KINGWOOD, TX

We are too.

—Ed.

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Tax And Spend

I was surprised by your boating editor's statement that the 1989-93 downturn in boat sales was "cyclic" in nature. Surely, the most significant cause of the slump in boat sales must be laid at the doorstep of Congress, which levied a luxury tax on boats. Boat manufacturers were forced to sharply curtail production, and several had to close their doors forever, causing widespread unemployment within the industry. The luxury tax was a total mistake, one of many made by the last Congress.

DEAN P. TUININGA
EVERETT, WA

Padded Cells

I just finished reading one of your automobile articles, and it reminds me of a major flaw in all new cars. With the advent of airbags for crash protection, it seems as though most auto manufacturers are eliminating

padding on dashboards. The Ford Ranger I recently purchased is a perfect example. The dash is a big mass of hard surfaces. Soft padding should cover these areas as it once did. If you want to see some proper examples, take a look at our other family cars—a '63 Ford and a '54 Kaiser. If padded dashes were a good idea 40 years ago, how come they're no longer a good idea? Maybe people's heads are harder nowadays.

TOM ERICKSON
LAKE HUBERT, MN

Car Care Concerns

As an ASE-certified master technician, I and all of my co-workers were very disturbed by Mike Allen's comment in a recent Car Clinic column about the "veracity" of mechanics, implying that we are untrustworthy. Not only is the language in Allen's answer an insult to all mechanics, but it's his knowledge of the subject that

lacks veracity. In fact, it calls into question the professionalism of the whole magazine. Use a 2 x 4 prop to hold the engine forward to reach rear plugs? I think not. The safer method for holding the engine in the forward position takes advantage of another eyelet near the middle of the torque strut. The same torque strut retaining bolt can be used to hold the engine forward through the strut and mount.

MICHAEL DZIOB
NEW HARTFORD, CT

As an auto mechanic for more than 15 years, I find your recent article on resetting dash emission lights a little unsettling. Sure, readers will want to reset the lights themselves. But how many of them will actually do the required maintenance work to keep the emission system working properly? My guess is not many.

MICHAEL EGAN
VIA INTERNET



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Winston SELECT

BOX

The advertisement features a large, detailed illustration of a turtle carrying a pack of Winston Select cigarettes on its back. The pack is open, showing several cigarettes. The text "oth" is partially visible on the left, and "Winston SELECT Flavor." is written in large, bold, red letters across the middle. Below the turtle, the words "PERFECTLY AGED TOBACCO" are written in a circular logo. At the bottom right, the brand name "Winston SELECT" is displayed in a serif font. A small "BOX" label is visible on the side of the cigarette pack.

What good is a furnace with a lifetime warranty if it doesn't make your life more comfortable?

The real measure of comfort in a furnace is simply never feeling *uncomfortable*. With the Trane XV 90 Variable Speed Gas Furnace, you and your family won't have an uncomfortable moment. Variable speed means you get constant, even heat. No frequent start-and-stop cycles to cause uncomfortable cool drafts or too-warm spells. What's more, the even air flow also reduces annoying noise in the ducts.

Because the Trane XV 90 runs on clean-burning, economical natural gas, it delivers fast,



efficient heat, with an AFUE rating over 90%. In fact, the XV 90 has met the EPA's Energy Star guidelines for energy efficiency. And with a lifetime limited warranty on the heat exchangers, the XV 90 will be efficiently heating your home for a long, long time.



Surround yourself with the comfort of a Trane XV 90. Call your local dealer for more information — just look in the Yellow Pages under Heating Contractors.



Clean natural gas.
Think what you'll save.®

TECH UPDATE

News Of Tomorrow's Technology Today



Robot Crabs Clear Surf Mines In A Pinch

ANAHEIM, CA—The surf zone. If you're riding a boogie board, you love it. If you're poised for an amphibious assault on a hostile shore, you hate it. The surf zone is a prime locale to stumble into a minefield. Not only is the water perilously shallow, but wave noise and turbidity hamper mine detection. And because a major mine-sweeping operation is sure to attract unwelcome attention, you can quickly lose the advantage of surprise.

The solution? A horde of mechanical crustaceans that can sneak in under the waves, detect mines and neutralize them en masse. Rockwell International and IS Robotics are developing these little suicide robots, or mites, called Autonomous Legged Underwater Vehicles (ALUVs). The Advanced Research Projects Agency and the Office of Naval Research are funding the effort.

The ALUV pays tribute to a crea-

ture that thrives beneath the breakers. A crab scuttles through the surf zone on legs that can dig in when the waves get rough. The Rockwell mite can also weather severe surf, burying itself in the sand by vibrating its legs.

What's more, legs are great structures to load with sensors, because they touch whatever they walk on. When the ALUV chances upon a mine, it clings to its quarry and then awaits a command from an operations center aboard a landing craft offshore. Once the signal is given, each

While an invasion force assembles offshore, autonomous legged robots walk through the surf zone hunting mines.

mite blows itself—and the mine—up.

Rockwell's prototype ALUV runs about 22 in. long and weighs 23 pounds, including 7 pounds of ballast. The mite has already proven itself capable of walking through the surf zone and finding targets. The next step, say engineers, is to build a second mite and have it communicate with the first, to make ALUV mine-sweeping more efficient.

Highlights This Month

- **Sneak Peeker**—Stealth spy drone is unveiled.
- **Power Launches**—New rockets will double Delta's lift.
- **Out There**—The quest for extraterrestrial life resumes.
- **Sun Burners**—This year's solar-car showdown.
- **Air Cushion**—Next-generation hovercraft lose weight.
- **Genetic Ink**—Sign checks with your own DNA.
- **Fat Buster**—How the Russians clean out cholesterol.

Editor/Writer: Gregory T. Pope
Reporters: Philip Chien, Chris Chirrnock, Mike Fillon,
William Garvey, Scott Gourley, Barry Rosenberg

High Spy Uncloaked

PALMDALE, CA—DarkStar rolled out of the shadows last June. A cross between a flying saucer and a sailplane, the Tier III-minus reconnaissance drone (see Tech Update, page 13, Jan. '95) was built by Lockheed Martin and Boeing.

Stealth dictated the vehicle's unorthodox silhouette. DarkStar is designed to loiter over enemy territory, climbing above 45,000 ft., even if the skies are buzzing with hostile aircraft. The slim wings only return brief flashes if radar catches them at the right angle. Meanwhile, the circular fuselage is buffered with radar-absorbing material.

A Williams-Rolls FJ44 turbofan will propel DarkStar to a 130-knot cruise speed (which is 300 knots true airspeed at 45,000 ft.). The vehicle will carry either synthetic-aperture radar or a camera, as well as communications equipment. It's designed to operate within a 500-mile radius.

DarkStar should be ready to take to the air at Lockheed Martin's Skunk Works sometime this fall.



At 15 ft. long and 69 ft. across, DarkStar sports sat-com equipment on top of fuselage.

Talking Robot Hand

PALO ALTO, CA—To communicate with a deaf-blind person, you need to know fingerspelling, a hand-on-hand language in which words are spelled out as manual gestures, one letter at a time. But if you can't fingerspell, Ralph can give you a hand. An electromechanical fingerspeller, Ralph was built



Ralph fingerspells in response to computer input.

at the Department of Veterans Affairs Medical Center.

Press a letter on a computer keyboard, and software translates the input into commands for Ralph's servomotors. The motors drive rod linkages to flex and position the fingers. So far, the fourth-generation device is only a demonstrator.

How To Spot Bombers In A Flash

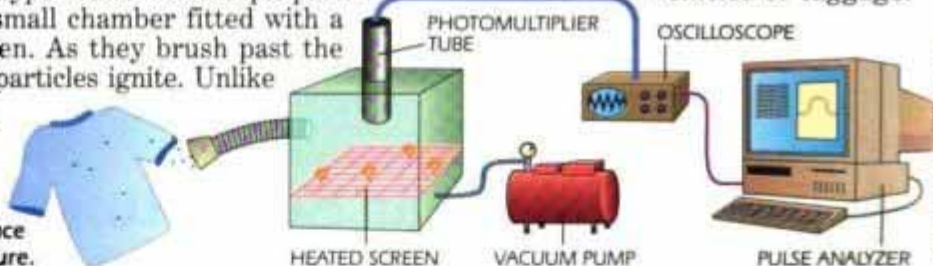
LOS ALAMOS, NM—Tiny specks of explosives residue can finger a terror-bombing suspect. But the evidence can elude detection, even with modern lab analysis. Now, two Los Alamos National Laboratory physicists have devised a simple method for identifying traces of explosives.

The prototype draws microscopic particles into a small chamber fitted with a heated screen. As they brush past the screen, the particles ignite. Unlike

dust, hair and other contaminants, explosives burn with a sharp flash, triggering a unique optical signature. A sensitive photomultiplier picks up the light, and a computer analyzes the signal.

The technique could be incorporated into a handheld device to check clothing, vehicles or luggage.

Whisked from clothing, explosives residue ignites to produce optical signature.



Navy Cutting A Big SWATH

MOSS POINT, MS—Pleased with the performance of its four new ocean-surveillance ships, the Navy is going to get at least one more. The USNS *Impeccable* will be the largest small-waterplane-area

twin-hull (SWATH) ship in the fleet, dwarfing its *Victorious*-class brethren.

Halter Marine Inc. will finish the 281-ft.-long vessel, known as T-AGOS 23, after Tampa Shipyards was unable to complete the original contract. Back in the 1980s, Halter also took over the con-

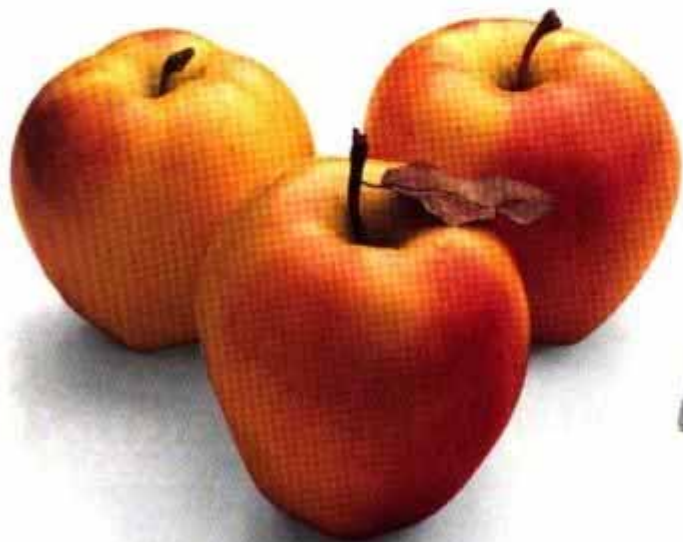
struction of the original ocean-surveillance ships, the mono-hull *Stalwart* class.

Designed for a 26-ft. draft, *Impeccable* will displace 5368 tons. A pair of 900-hp waterjets will supplement its 5000-hp diesel-electric propulsion. Like other ocean-surveillance ships, *Impeccable* isn't built for high speeds but for wallowing in high seas, towing sonar to hunt submarines.



Biggest SWATH yet will slice through rough waters in the North Atlantic.

Nature's Gold Series



Premium fruit you eat.

Tastes great.

Naturally refreshing.

Found in trees.

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Introducing Fruit of the Loom® Gold Series



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Fits great.

Naturally cool
and comfortable cotton.

Found in those big stores
where you buy everything.

Nope.



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. †Based on an average of consumer-reported problems at three months ownership in a survey of Ford and competitors.



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AND DISCOVERED ITS **HOT** NEW INSIDE.

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DOMESTIC COMPACT PICKUP†

100,000 MILES
BETWEEN TUNE-UPS**

NEW REMOTE KEYLESS ENTRY**

NEW SIX-WAY
POWER DRIVER'S SEAT**



**THE '95
FORD RANGER**



BUILT FORD TOUGH

New Rocket Will Double Delta II

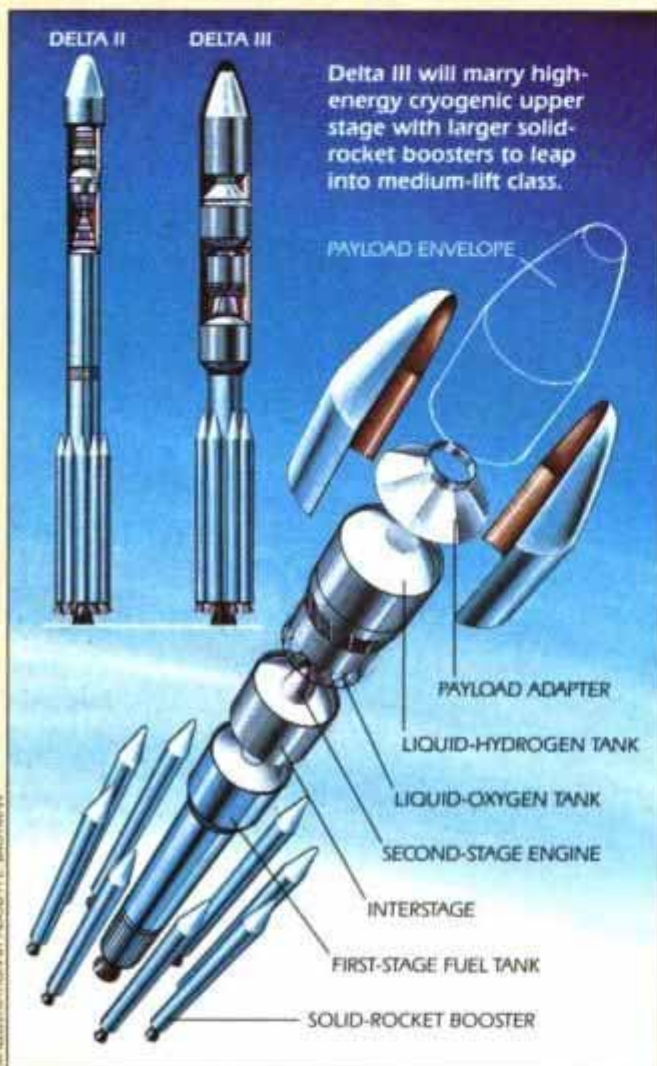
HUNTINGTON BEACH, CA—If you follow space matters, you know that the Delta II rocket reigns supreme in terms of reliability. So McDonnell Douglas is going to parlay its suc-

cess into a new vehicle called Delta III—the largest rocket ever developed without government funding.

The medium-lift rocket will double the Delta II's payload capacity, hoisting more than 8000 pounds into geosynchronous transfer orbit or 18,000 pounds into low Earth orbit. That puts the III into the same extremely competitive class as the Atlas II and Europe's Ariane IV, as well as the Russian Proton and Chinese Long March rockets.

A new cryogenic upper stage, burning liquid hydrogen, will provide the extra muscle. To power this stage, Pratt & Whitney will tweak its RL10 engine to blast out 24,000 pounds of thrust. For additional oomph, large solid-rocket boosters will ring the lower stage.

Hughes Space and Telecommunications has heard enough to book 10 launches for its 2-ton HS 601 communications satellites. Delta III's first flight will take place in 1998.



Heliwing leaps skyward during successful flight before crash ended its test program.

Heliwing Heads Up, Then Down

SEATTLE, WA—A one-of-a-kind unmanned air vehicle enjoyed two months of glory last spring—but, unfortunately, crashed on June 13 as it was completing a test sequence.

Built by Boeing Defense & Space, the Heliwing rose vertically on a pair of 7-ft. counterrotating prop-rotors. Rudder flaps then flipped the vehicle over into a horizontal attitude. The vehicle had just demonstrated this transition, and was flying normally, when its turboshaft suddenly conked out. Remote controllers restarted the engine, but not in time.

Boeing and Defense Department engineers are reviewing data to see if another Heliwing is worth building.

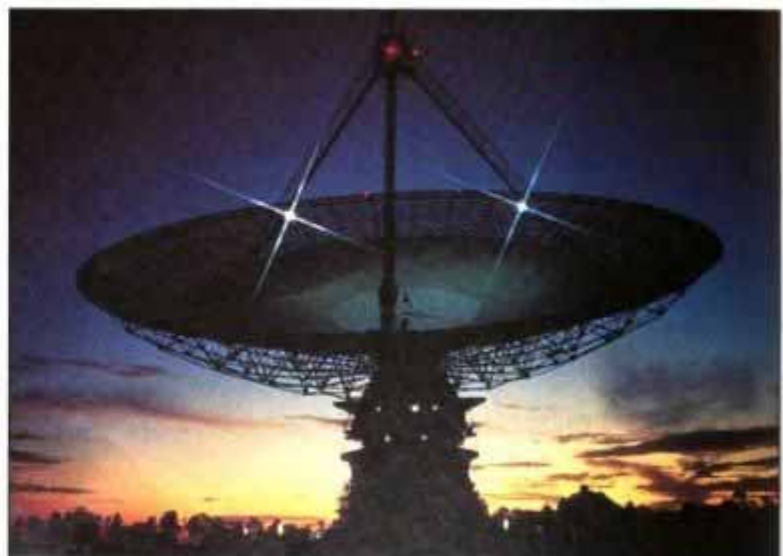
Aliens Stay Quiet

MOUNTAIN VIEW, CA—So far, ET hasn't called. Last February, the search for extraterrestrial intelligence known as Project Phoenix got under way with a 5-month stint at Australia's Parkes Observatory. But deep space didn't speak, so the search must continue.

Bankrolled privately, Project Phoenix rose from the ashes of a NASA program cancelled in 1993. The effort brings a high-speed multichannel scanner to radio telescopes worldwide. This receiver monitors millions of microwave frequencies at once, seeking unnatural signals that stand out against cosmic radio static.



During the experiment, the 210-ft. Parkes telescope targeted more than 200 Sun-like stars in the sky's southern hemisphere. The receiver spent half a day tracking each star, while a smaller



Parkes radiotelescope sought alien broadcasts for five months.

nearby antenna culled out any terrestrial interference.

Project Phoenix has roughly 800 more stars to scan. The effort will take the receiver to a northern radiotelescope, possibly the 140-ft. dish in Green Bank, West Virginia.

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RESERVE



Heavy-Hauling Single

LONG BEACH, CA—Imagine a C-130 Hercules with three engines out. It's a big airplane with a big problem, but it's also the essence of a big idea—and a big gamble. Freedom Aircraft Co. believes that a global market awaits a low-cost heavy hauler, and that simplicity is the key to such a machine.

The result: the DS-888, an 84-ft. airplane powered by a single Allison T-56 turboprop. The huge cargo hold can swallow something 9 ft. tall and 44 ft. long. Useload load: 34,000 pounds.

Because the aircraft is essentially a



Simple and inexpensive, single-engine flying truck would suit cargo operations in developing nations.

flying box, construction is basic. The identical wing ribs can be built with a single tool. So can fuselage panels.

All this means acquisition and operating costs dip surprisingly low. A new DS-888, fitted with a used T-56,

will sell for less than \$1.5 million and cost \$500 per hour to fly. Both figures are fractions of those associated with existing transporters. The company will market the plane in kit form, and anticipates first flight within a year.



Traveling At The Speed Of Sun

GOLDEN, CO—There's nothing like ending a solar-car race in a driving rainstorm. But when the checkered flag waved at Sunrayce '95, the Massachusetts Institute of Technology weathered this challenge to win. The MIT Manta

came in 18 minutes and 49 seconds ahead of the University of Minnesota's Aurora II—the tightest finish in Sunrayce's 5-year history.

The biennial competition pitted 38 universities against one another in a 1100-mile trek that began in Indianapolis. Manta pulled ahead early, but Aurora II took advantage of glorious weather on the race's seventh day to tighten the gap. Although rain slowed MIT on the final leg, the team had budgeted enough battery energy to hold off Minnesota's rally. Manta averaged 37.23 mph over the course, a Sunrayce record.

Finishing third, fourth and fifth were Cal Poly-Pomona, George Washington University and Stanford University. Midrace mechanical woes forced out 2-time defending champion University of Michigan.

MIT's Manta (top) breezes along during early going to secure its lead over second-place Minnesota's Aurora II (left).



Stealth Laptop

HYATTSVILLE, MD—Ever wish the guy sitting next to you on the airplane would keep his eyes off the confidential memo you're writing on your laptop computer? Well, now you can keep him guessing. For \$299, a liquid-crystal-display (LCD) repair shop called Man & Machine will tweak any lap-



Polarizing eyeglasses restore the image to a laptop display stripped of its front polarizer.

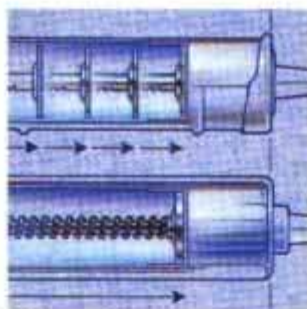
top to permit private viewing.

The secret? Polarized light. LCDs sandwich the liquid-crystal material with two polarizers. Man & Machine replaces the built-in front polarizer with a removable one. Left on the screen, the polarizer passes or blocks display light normally. But remove it, and the image vanishes. Users wear correctly oriented polarizing glasses to restore the image.



Better beads through thick and thin.

No matter what kind of project you're doing, now it'll come out better. Because with our new line of PowRCaulk™ cordless caulking guns, you'll be able to apply just about any



One squeeze is all it takes to get smooth, even pressure. (And less bumps, lumps, and jiggles.)

kind of caulk or sealant more smoothly and evenly.

The secret is smooth, even pressure. That's where manual caulking guns hit a snag. Our guns, on the other hand, use a screw-driven plunger, steadily advanced by a battery-powered

motor strong enough to apply even the thickest construction adhesive.

In fact, when you pull the trigger, you'll be eliminating most of the problems you've ever had

with caulking. There's less lumps, bumps, and hand and forearm fatigue.

What's more, the PowRCaulk stops as neatly as it works. Just release the trigger, and a unique drive system

instantly releases the pressure, effectively drawing the remaining caulk back up the tube. The result is the end of all those messy strings, blobs and drips.

So why let a bead of caulk come between you and a job well-done? Get a PowRCaulk cordless caulking gun. Just call 1-800-328-8251 for the retailer nearest you.



There is one advantage to a manual caulker. You'll get more exercise.

The New **PowRCaulk™** **WAGNER**

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PowRCaulk caulking guns start as low as \$44.99.

Son Of DC-X To Rise

HUNTINGTON BEACH, CA—Does the McDonnell Douglas/Boeing bid for the X-33 contract (see *Tech Update*, page 17, Feb. '95) look familiar? Yes, it's a conical rocket that takes off and lands vertically. In essence, it's a scaled-up version of the McDonnell Douglas-built DC-X, the experimental rocket now undergoing surgery to swap in composite materials.

Standing 100 ft. high, the X-33 candidate will weigh half a million pounds at liftoff, as compared to the 40-ft. DC-X's 41,600-pound takeoff weight.

Until last June, McDonnell Douglas and Boeing kept quiet about their X-33 efforts as they considered alternative configurations. But program engineers believe this design offers the best potential as an experimental vehicle. Not only can testers expand the flight envelope gradually, but the vertical lander can also cut short a flight safely and touch down at a variety of sites. The follow-on reusable launcher, for which the X-33 is to preview technologies, need look nothing like the testbed.

McDonnell Douglas/Boeing X-33 design will test propulsion system and materials.

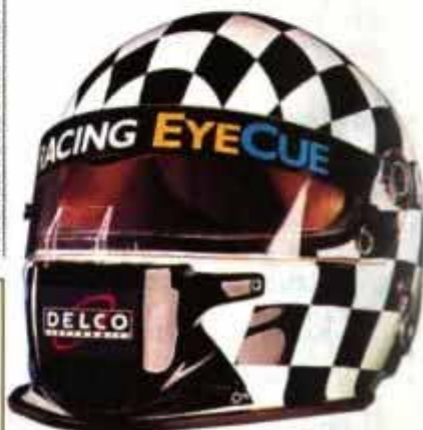


MCDONNELL DOUGLAS ILLUSTRATION

Heads Up For Racing

KOKOMO, IN—An occupation of breakneck speed and split-second decisions, in which you're bombarded with information. Fighter pilot? Try race-car driver. At 220 mph, a driver can cover the length of a football field during a single glance at the in-dash instrument panel.

So to keep drivers' eyes on the track, Team Penske and Delco Electronics are developing a safety helmet with a head-up display. Built into a Bell Sports helmet, the Racing EyeCue system projects images just below the driver's

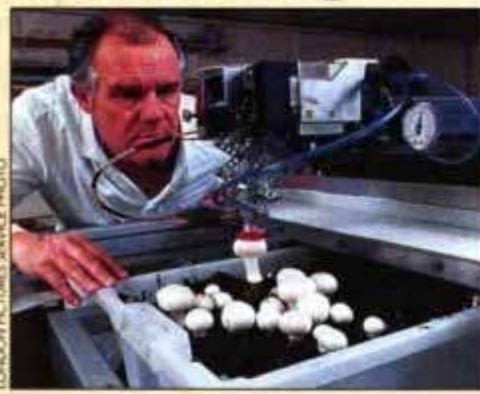


Delco's Racing EyeCue transfers head-up display from fighter jet to race-car safety helmet.

line of sight. Along with engine data, the information can include accident warnings or proprietary exchanges between driver and pit crew.

Not yet in use, the Racing EyeCue helmet draws from Delco displays on the windshields of certain Pontiacs.

Robot Tends To The Fungi



LOWERY PICTURES SERVICE PHOTO

SILSOE, ENGLAND—A sign that robots are more gentle-fingered than ever before: They're picking mushrooms. The Silsoe Research Institute, Britain's agricultural think tank, is developing the devices to fast-forward the country's mushroom industry.

Peering through a small TV camera, the machine must first identify ripe and unbruised specimens. The picking mechanism is straightforward—a suction cup on a scissored extender. With a slight twist and a lift, the mushroom is plucked from the soil, ready to be packed for shipment.

The robot is far enough along that it could go into service in two years.

Robot deploys suction-cup fingertip to bend and twist stalk without causing damage.

Hovercraft With Craft

FAREHAM, ENGLAND—The biggest hovercraft ever built from composite materials recently circumnavigated the Baltic Sea. The purpose: to demonstrate its ability to perform in extreme conditions.

Dubbed the M-10 by its designers at ABS Hovercraft, the 62-ft. vessel can reach 50-knot speeds and carry up to 77 passengers. At the stern, two 500-hp marine diesels power lift fans and turn controllable-pitch propellers that provide unusual low-speed maneuverability.

The M-10 hovercraft has piqued military interest as a coastal-patrol or mine-clearance boat, because it can operate from unprepared sites. Not only does its Kevlar-reinforced

plastic construction shrink the vessel's radar signature, it also lightens the craft enough to carry affordable but heavy diesel engines. On the civilian side, the M-10 could ferry passengers or run oil-spill response missions, shuttling equipment to otherwise inaccessible areas.



ABS HOVERCRAFT PHOTO

Now in sea trials, M-10 hovercraft features Kevlar construction for stealth and speed.

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Your computer features 8 meg RAM, 420 meg hard drive, and fax/modem to store, receive, and send huge amounts of data.

You'll also appreciate the brilliant display of your Super VGA color monitor, the drama of your CD-ROM drive and 16-bit sound card, as well as the cutting-edge technology of Windows 95.

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Studies show that jobs for computer service technicians will be up by 38% in the next 10 years. Even if you've never worked with



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R.A.C.E.R. plug-in card and QuickTech-PRO software help you detect problems on virtually all IBM-compatible machines, even if computer is 5% operational.

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Signing With Your Genes

LOS ANGELES, CA—You've shed blood, sweat and tears to produce your life's work, or buy your heart's desire. Now you can give a little more of yourself to protect it. To keep forgers at bay, a company called Art Guard will create ink containing your own DNA.

Extracted from blood, saliva or a hair follicle, the genetic material is first replicated in mass quantities. The DNA is then loaded into a pen cartridge good for thousands of signatures.

To verify a signature, Art Guard has devised a proprietary handheld scanner that reads biochemical markers added to the DNA.

Although chemists can readily



Ink infused with an individual's unique DNA foils would-be signature forgers.

synthesize DNA these days, forgers must know the exact start and end points of the fragment used in the ink. Of course, they could just steal your DNA-ink pen.

Diesel Rotary Engine To Fly

Diesel version of Rand-Cam engine would power unmanned aerial vehicle for 48-hour missions.

MORGANTOWN, WV—Having an unmanned air vehicle that flies on diesel fuel would suit Army logisticians just fine. To that end, Alliant TechSystems has joined forces with West Virginia University and British Columbia-based Reg Technologies. They are blueprinting a diesel version of Reg's high-power-to-weight Rand-Cam engine (see [Tech Update, page 16, Jan. '94](#)).



The Rand-Cam's only moving parts are six sliding vanes and a rotor—no gears or valves. That simplicity reduces noise and vibration during extended spy missions aloft. The diesel powerplant, designed to develop between 80 and 100 hp, would measure about 13 in. around.



OSI would use seven 1-ft.-wide telescopes to gain three times Hubble's resolving power.

Planet Hunter

PASADENA, CA—Do Earthlike planets revolve around other suns? Optical interferometry may provide our best shot at finding out. NASA is leafing through proposals to take this emerging technology into orbit.

Interferometry combines light from several small telescopes. The technique simulates a single telescope with a very broad mirror, and hence high resolving power.

The most ambitious plans would loft multiple telescopes into precise orbits. Alternatively, several small telescopes can perch aboard one spacecraft. NASA's Jet Propulsion Laboratory has already proposed one such arrangement, called the Orbiting Stellar Interferometer (OSI). Engineers are now studying a modification of this platform, specifically for spotting planets.

The Unflappable Mothra

AUBURN, AL—Flexing its tail like a living creature, Mothra has been gliding about the Auburn University campus. The little remote-control model airplane, named after a Japanese movie monster, is demonstrating flight control with no moving parts.

The secret is a piezoelectric ceramic material that expands and contracts in response to a voltage (see [Tech Update, page 13, Feb. '92](#)). Spliced into Mothra's vertical and horizontal tail pieces, the material eliminates the need for hinges and bearings normally required to move flaps. The tail simply reshapes itself to steer the 4-ft.-wingspan aircraft. A follow-on version, dubbed Rodan, will apply the same principle to ailerons.



Mothra proves that controlled flight without flaps is possible.

Wireless Supercomputer

MINNEAPOLIS, MN—What's inside a Cray supercomputer? For one thing, 36 miles of wire that link processor modules with memory. But Cray has replaced that mess with wireless connectors in its new top-of-the-line T90 series.

They're called electrically activated zero-insertion-force connectors, or eZIFs for short. Each houses 400 contacts that transmit impedance-controlled signals between modules. The connectors can disengage easily with a voltage-activated spring mechanism.

In addition, the T90's memory modules are also interconnected with similar technology. The only wires left are for external input and output.



Wireless connectors replace wire spaghetti in Cray supercomputer.

Discover the World's Most Creative and Satisfying Hobby... Build a Historic Wooden Ship Model!

Even if you've never built a model before, you can experience the pleasure and pride of accomplishment wooden ship modeling offers. You can build the two-masted schooner pictured here—a true-to-scale replica, decked out with gleaming brass fittings, delicate rigging—lifelike in every detail.

It's much easier than you think! Working with precise in-scale plans and fine materials, you'll sand the hull, paint and install deck furnishings. You'll add the helm and bowsprit, and apply the copper plating to the hull. Finally, you'll set the masts and rig the lines—just like a shipwright of a hundred years ago. The result? An authentically detailed, museum quality wooden ship model you'll display with pride... a valuable keepsake to be treasured for generations.



The Secret's In Our Kit

We designed our kit especially for the first time modeler. We include all the materials you need to build the model as shown. The solid basswood hull is pre-carved; all you do is a little shaping and light sanding. You'll get wood parts for the

cabin and companionways, ready-to-use wooden blocks and dead-eyes, solid brass and finely cast metal fittings and three diameters of rigging line. We even give you copper plating to cover the hull! Hardwood display base and launching ways complete the kit. Three sheets of plans and 16 page step-by-step instruction book show you the way to a magnificent model. (Expect to spend 50 to 75 pleasure-filled hours completing it.)

SPECIAL INTRODUCTORY OFFER WITH FREE BOOK AND CATALOG!

We want to introduce you to this fascinating hobby now! Our regular catalog price for the *Phantom* is \$44.99. But for a limited time only, it's yours for just \$34.99! And, if you order now, we'll also send you *The Neophyte Shipmodeler's Jackstay*, a richly illustrated 60 page beginner's guide to ship modeling. Selling for \$7.99, it's yours—absolutely free! You'll also receive a 92 page color catalog showing over 90 ship model kits, hundreds of miniature tools and reference books.



Save On A Tool Set!

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Model Finishing Set

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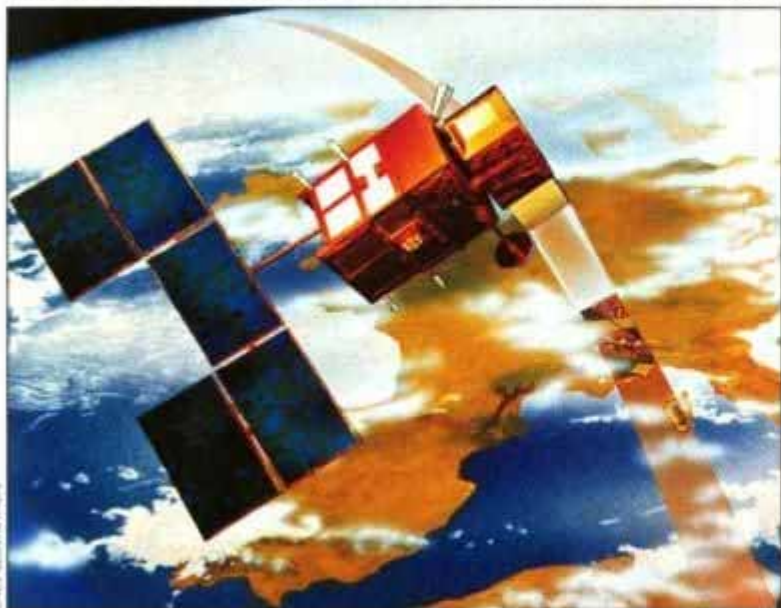
Offer valid through December 31, 1995

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Europe's Own Sky Spy

PARIS, FRANCE—The French have decided they don't want to rely on data from the United States—they want their own reconnaissance satellites. So they've embarked on a program to loft a series of "overhead technical assets."

The first of these—called Helios 1A—went up via Ariane rocket on July 7. At a glance, the spacecraft recalls France's



Helios 1A will ply a 530-mile Sun-synchronous orbit.

SPOT 4 commercial remote-sensing satellite. Small wonder: The two satellites were built simultaneously to save money. Helios is sharper, though, probably able to discern details as small as 3 ft. across. Spain and Italy helped fund its development.

The similar Helios 1B will launch in three years. The follow-on Helios 2—with even better resolution—is supposed to fly in 2001. Germany may chip in on Helios 2's development.



Compass Centre soaks up traffic-control radar.

The Stealth Building

HOUNSLOW, ENGLAND—A brand-new building at London's Heathrow Airport sports unique architecture that renders it virtually invisible to radar.

Airport authorities were worried that traffic-control radar would ricochet off the new British Airways nerve center and interfere with runway operation. To squelch the problem, architect Norman Grimshaw incorporated distinctive geometry.

The building's glass face looms outward as it rises, reaching an angle of 21° at the top. This curvature, combined with a series of external baffles and ribs, scatters radio energy down into an adjoining parking lot, which is paved with blocks rather than radar-reflecting asphalt. These features have shaved the building's radar signature by 99%.

Neutrons To Hit The Road

OXFORD, ENGLAND—Ever wanted your own source of neutrons, but couldn't afford a nuclear powerplant? This problem faces engineers who'd like to use neutron radiography to peer inside engines and other machinery.



Small cyclotron produces cheap neutrons.

Now Oxford Instruments is building a compact cyclotron that travels. Called Neu-Sight, the system slams protons into a beryllium strip to knock loose a stream of neutrons. The neutrons shower a screen behind the object that's being examined. The result? An X-ray-like image.

Russia's Cholesterol Buster

MOSCOW, RUSSIA—American physicians are looking into a swift means of unclogging leg arteries blocked by cholesterol buildup. The treatment, performed routinely in Russia but never in the United States, employs ultrasound.

Developed at Moscow State Technical University, the device combines an ultrasonic transducer with a long, thin surgical instrument fashioned from a titanium alloy. The working end of the tool, which emits vibrations, can be shaped like a ring, a ball or a blade.

The surgeon wields the device to make several intravascular incisions and remove cholesterol plaque—in pieces as long as 19 in. The vibrations do little damage to blood-vessel walls. And the operation

Russian cholesterol remover loosens plaque with 26.5-kHz ultrasonic vibrations.

takes no more than a few minutes.

Engineers are developing a second-generation model to be used on arteries in the heart and brain.





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New Cars

Oldsmobile Bravada

● After savoring the many delights of Jackson Hole, Wyoming, from the left seat of a '96 Oldsmobile Bravada, we can say we found only one thing wrong with this luxurious compact sport/utility—no one knows about it. Truth is, the Bravada has been around since 1992, but buyers—and even some Olds employees—have been ignorant of its existence. So deep was the Bravada sales void that the model ceased to be in 1995.

But like John Travolta, Bravada is back. And Olds is hoping that simplicity of purchase and a lower price than a similarly equipped Ford Explorer or Jeep Cherokee will sell about 20,000



with SmartTrak full-time 4-wheel-drive system. The only suspension available is tuned perfectly between cushy cruising and road-holding, making the Bravada ride and handle on paved roads like a sport sedan.

ever, in the age of the 2-year lease, we question the size of that advantage, especially when a mechanically identical GMC Jimmy or Chevrolet Blazer with leather seats costs a few grand less and a 4wd Cherokee is available with a V8 engine. —Scott Oldham



With those owl-like headlights leading, there's no mistaking the '96 E-Class.

Bravadas a year. In a market of about 1 million compact sport/utilities annually, Oldsmobile is niche-picking.

Every Bravada comes with 4-wheel ABS, all-wheel drive and everything you'd want inside—even a Homelink transmitter that can turn on any electrical device in your home from the driveway.

The only options on the 1996 Bravada are a 5000-pound towing package, white-letter tires, an engine-block heater, a CD player and, of course, a gold-trim package.

All Bravadas are powered by GM's torquy 190-hp 4.3-liter V6 and 4-speed automatic transmission

A loaded Olds Bravada costs about \$30,000, undercutting the bottom lines of the Eddie Bauer Ford Explorer and the Jeep Cherokee Limited. How-



The latest Chrysler convertible is the '96 Sebring.

Mercedes-Benz E-Class

Industrywide, redesigned vehicles generally supplant their earlier versions within three to five years. But Mercedes-Benz has soldiered along with its E-Class cars for a full 10. No longer. This fall will see the German automaker introduce a completely new version of the 6-cylinder E320 and E300D, followed in late winter by the E420.

The engines are essentially carry-overs, though the V8 gets a new 5-speed auto. As has been the case lately with Benzes, there will be no manual transmission available in the U.S.

The rest of the car, however, is completely new, starting with its distinctive owl-eyed headlamps and grille treatment. The bodywork is slightly larger than before in almost every dimension, with interior space increased to match.

The bigger story is the huge number of safety improvements, starting with airbags not only in the steering wheel and dashboard, but door-mounted side airbags for the driver and front passenger.

Seatbelts have pretensioners to take up excess slack in the event of a collision, and force-limiting torsion bars in the retraction mechanism feed a small amount of belt in a controlled deceleration. This is all designed to work in concert with the airbags for maximum safety. There's a shoulder belt and headrest



Audi's A4 is larger and lighter than the old 90, which it replaces in 1996.

for the center rear-seat passenger.

In addition to antilock brakes, the E420 comes standard with Mercedes' automatic slip control (optional on the E320). This computer-controlled system uses a steering-wheel sensor, a yaw sensor and the antilock-brake system to attempt to keep the car traveling in the direction the driver intended during the incipient stages of a skid or spinout caused by poor road conditions. —Mike Allen

Chrysler Sebring Convertible

Part of the legacy that Lee Iacocca left at Chrysler is a love for convertibles. Lido just knew that most people found driving pleasure increased exponentially with increased exposure to the sky. In that spirit, the next ragtop from Chrysler will be the Sebring. The open-top version will be here this spring, seating four and pulled around by either the 150-hp dohc 2.4-liter Four or the 164-hp sohc 2.5-liter V6 used in the coupe version. Start laying in your sunblock. —Don Chaikin

Audi A4

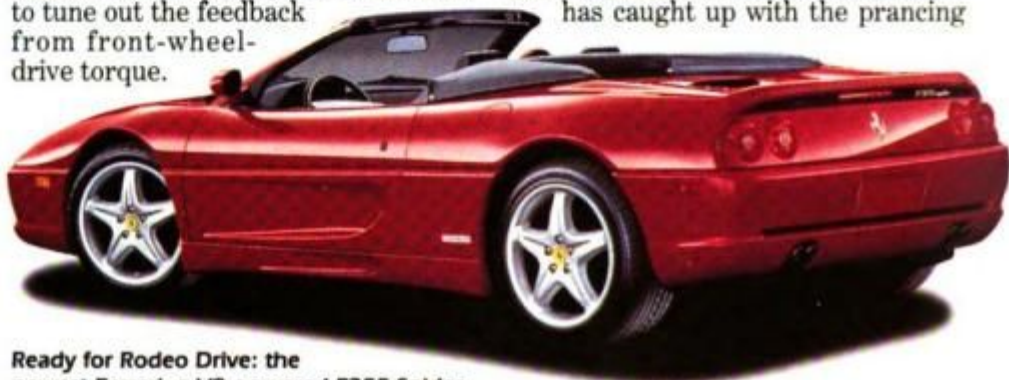
The new Audi A4 is the replacement for the carmaker's 90/80 series and is completely restyled for 1996. Underneath the fresh, rounded body surface are mechanical updates that make a real difference. Spending a week driving an A4 around Austria and Hungary quickly revealed improvements to the small sedan's ride, noise control and performance.

The A4 is available as a front-drive or an all-wheel drive. The engine is a high-revving 172-hp V6 that moves through a slick-shifting 5-speed automatic transmission, available for the first time in the awd Quattro. The whole system feels smoothly balanced, responsive and agile.

While the wheelbase is longer at 103 in. and the wheel track is wider at 58.9/58.2 in., the A4 is 75 pounds lighter than the 90 model. Those changes and more attention to the soft trim inside the car allowed Audi

to increase the cabin's head space by an inch and shoulder-room by even more. Inches were also added to interior width and length. With a new instrument panel, the slight increase in interior dimensions makes the cabin appear greatly expanded.

One of the most important changes in the A4 focuses on the front suspension, which uses a 4-point connection to tune out the feedback from front-wheel-drive torque.



Ready for Rodeo Drive: the newest Ferrari, a V8-powered F355 Spider.

On the road, the difference is noticeable. You can make turns during hard acceleration without the steering wheel pulling in the steered direction. Hard driving will produce a change

from neutral steer at controllable speeds to understeer as cornering increases. —Jim Dunne

Ferrari F355 Spider

What a miserable purgatory our world would be without a Ferrari ragtop. After all, in what else could Cindy Crawford cruise Rodeo Drive, her brunette tresses trailing in the breeze and leading the *paparazzi*? Well, let's thank our lucky stars that Ferrari has finished its latest model-line revamp with the F355 Spider. As a proper Ferrari should, the F355 has its engine mounted amidships in a Pinninfarina-designed body. The 40-valve dohc 3.5-liter V8 develops 375 hp—enough to move the 3000-pound 2-seater to 60 mph in 4.6 seconds and, if you have the room, the nerve and the bankroll, ultimately to 183 mph. And, since the F355 is a Ferrari, the transmission is a manual—a 6-speed—controlled via the expected tunnel-mounted, gated shifter. But despite the undying traditions, modern life has caught up with the prancing

horse. The folding soft-top is semi-automatic with electronic controls, the interior boasts dual airbags and the throbbing V8 meets the new OBD II requirements. —D.C.

Chevy Pace Truck



It takes power to hit the speeds required to pace Indy's Brickyard. Stock drivetrains almost always have needed the help of muscle-building aftermarket performance goodies to cut the mustard. Not so with Chevy's '96 C/K pickup in Brickyard 400 Pace Truck trim. With a new 5000 (306 cu. in.) V8 that features center-port fuel injection and dual exhausts driving a 4L60E 4-speed automatic, this small-block cranks out 220 hp and 285 ft.-lb. of torque. Additional Pace Truck particulars include lowering—2½ in. up front, 4 in. in the rear—an ASC T-top conversion, Boyds 17-in. alloy wheels carrying 275/40x17 GSC tires and special graphics. There are no plans to offer Pace Truck replicas for sale. Pity. —Cliff Gromer

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Saltwater Fish Battlers

BY JOE SKORUPA, Boating/Outdoors Editor



● On assignment not long ago, I found myself trolling for marlin aboard a posh 60-ft. sport-fishing yacht. It was a luxurious trip that featured a level of pampering far beyond my means. The next week I was on vacation and returned to the real world—fishing out of a rented 20-ft. center console.

Reflecting on these trips, I'm hard pressed to say which one I enjoyed more. Sure, the week aboard the \$1.8-million Bertram convertible was fantasy fishing at its finest—gourmet meals, expert crew, air conditioning, plush accommodations and an overall sense of gracious living. In many ways, it was as elegant as a scene out of a Merchant-Ivory film, except for some fish blood here and there.

However, I must admit that the modest, much-used rental boat didn't suffer too badly in comparison, in several fundamental ways. The rental (obtained from a franchise of the nationwide Club Nautico chain headquartered at 850 N.E. 3rd St., Dania, FL 33004) did everything asked of it during three days of heavy use, and did so with aplomb. Like the Bertram, it was a dedicated fish fight-

er equipped with all of the necessary components: bait well, fish locker, storage, depthsounder, VHF radio, sunshade, rod holders, windscreen, safety equipment, ice chest and much more. It ran reliably, provided an exhilarating sense of freedom and, perhaps most importantly, put me onto fish.

When looked at from this perspective, both the Bertram and the Club Nautico boat delivered quality fishing experiences. And let's face it, for serious fishermen that's the



Advancements have made center consoles masterpieces of versatility.

bottom line. Still, there's no denying that this is basically an apples-and-oranges comparison, and the differences between the boats are caused by more than just size and cost.

The boat I rented from Club Nauti-

co of Captiva Island (P.O. Box 445, Captiva, FL 33924) was a Quest center console fitted with a 125-hp Evinrude outboard. While the boat/motor package was of relatively recent vintage ('91), its basic design places it squarely in sync with one of the classic rigs of all time.

Center-console boats are presently one of saltwater fishing's most versatile rigs, but prior to the 1960s they were primarily used for inshore fishing or as tenders for larger vessels. Two innovations of the era changed this: unsinkable foam flotation and deep-V hulls.

While it's hard to pin down which builder first mated flotation foam to a center-console boat, it's easy to say which became famous for it: Boston Whaler. In the early 1960s, the company earned a national reputation for building unsinkable boats by staging publicity stunts showing its president sitting in a boat that had been cut into three pieces.

Soon, other builders began using foam-filled construction. And by the mid-1960s, several Miami-based manufacturers had improved the design of the center console by adding a wedge-shaped bottom characterized by a sharp angle—typically 19° or greater—of deadrise at the transom: the deep-V hull. In contrast, Whaler's bottoms at that time featured blunt tri-hull or cathedral-hull shapes, which delivered relatively hard, wet rides in windblown chop of just a foot or two. Aquasport was one of the first builders to popularize the offshore center console.

Mako and other companies soon followed. With the addition of softer, drier rides in rough conditions, center consoles ultimately became the go-anywhere, do-anything craft that they are today.

The deep-V hull, by the way, was championed by a naval architect, C. Raymond Hunt, who was based in Boston. This is somewhat ironic because Whaler wasn't among the first to take advantage of the

tram (as well as Trojan, Viking and a host of custom and semicustom builders) owe a great debt to the father of the sport-fishing convertible, John Rybovich. His celebrated boatyard in West Palm Beach, Florida, Rybovich and Sons, became known for building the mother superior of convertibles.

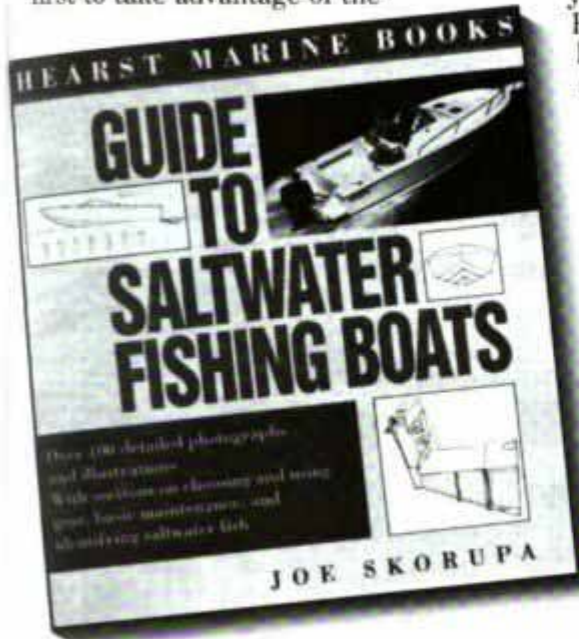
Beginning in 1947 with the first of his *Miss Chevy* series, Rybovich set the standard by which all future big-game sport-fishing boats were measured. His innovations included such now-familiar components as cockpit toe rails, rounded corners, hawse pipes, the flying bridge, the fighting chair, aluminum outriggers, tuna towers, the opening transom door, enclosed deck salons and many others. Taken together, these features virtually define the modern convertible sport-fishing boat.

My appreciation for convertibles and center consoles also extends to other well-built saltwater fishing boats: walk-around cabins (such as the Stamas model shown in the top photo on the opposite page), cuddy cabins, flats boats, bay boats, expresses, flybridge boats, dual consoles and what I call

hybrids—rigs that combine features from several different designs.

And while these boats are all very different from one another, they have one thing in common—they're purebred saltwater fishing machines. There's a lot to appreciate about rigs like these, and I'm a big fan. In fact, I sat down last year to record my thoughts on this interesting subject, and the result is a book that's currently available in bookstores: *Hearst Marine Books' Guide To Saltwater Fishing Boats* (William Morrow and Co., 1350 Avenue of the Americas, New York, NY 10019). The book covers the differences among saltwater fishing boats, the basics of outfitting, the fundamentals of construction and tips for money-saving maintenance.

Writing the book reminded me of my first offshore fishing trip 15 years ago out of Key West. I went offshore with some friends in a small walk-around cabin boat and caught little more than cero mackerel and triple-tail. Oh, I hooked a sailfish, but it threw the hook on the third jump. I brought a dolphin to boat, too, but the mate missed with the gaff and the line snapped. Some might say this was a trip of lost opportunities, but I wouldn't. A hook was set that day, and the invisible line has been pulling me back ever since. **FM**



The book on purebred saltwater fishing boats.

design. As noted above, the pioneers who initially capitalized on the deep-V hull were mostly based in Miami.

One of the first was an ocean racer and boatbuilder named Dick Bertram, founder of Miami-based Bertram Yacht. Bertram initially built fast ocean cruisers based on his famous *Moppie* series of deep-V high-performance boats. These speedsters revolutionized ocean racing.

Soon after becoming a production-boatbuilder in 1960, Bertram Yacht expanded its line and became the premier manufacturer of high-end, high-performance sport-fishing yachts. The 60-footer I fished on is an example of its current state-of-the-art output. Like the other boats in the Bertram line, it features a variant on the famed original deep-V hull.

Bertram's biggest boats, including the 60-footer, are technically called convertibles. This term was coined to refer to a boat with a dual personality. Convertibles are not only equipped to be wave-busting, fish-battling war wagons, but also to be comfortable, long-range cruising yachts. They are instantly recognizable with tall flying bridges, soaring tuna towers, skylines of antennas and outriggers, huge salons and cabins, and forests of rocket launchers loaded with gleaming heavy-duty tackle. They are considered the pride of saltwater marinas and the best offshore fishing boats money can buy.

Credit for popularizing the word convertible in the late '50s is generally given to Willis Slane of Hatteras Yachts. But both Hatteras and Ber-

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Detroit Spy Report

TEXT AND PHOTOS BY JIM DUNNE, Detroit Editor



1997 GM Minivan

● You won't be able to call them "plastic pachyderms" anymore. GM has joined the rest of the automotive world by designing its next-generation front-drive minivan with an all-steel body. It'll be available in the fall of 1996 as a 1997 model, replacing the current Chevy Lumina— with the new name Venture—Pontiac Trans Sport and Olds Silhouette. GM will also build a version for Opel for sale in Europe. Other than the departure from the composite-panel over steel-frame construction, the major difference in the new van is its styling. Gone is the long "Dustbuster" snout in favor of the more traditional "Roman-nose" profile. GM will offer an optional 4-door model, and will continue its exclusive remote-operation system for the sliding door. The new van will be built in two versions: short and long. Wheelbase and overall length of the longer van will be stretched almost 10 in. from the current size. The short version will be nearly identical in length and wheelbase to the current model. The prototypes shown hide the body's final styling. The camouflage includes a ridge across the top of the engine cover and a painted door on the rear hatch.

1996 Saturn

They're almost here. The first truly restyled Saturn sedans and wagons will soon be unveiled. Well, you get an early viewing, compliments of a couple of very thinly disguised prototypes. As you can see, exterior styling follows a traditional theme. However, there is more to the change than first meets the eye. Note the identical door



Almost at a Saturn dealer near you: the redesigned Saturn sedan and wagon.

shapes. Doors are interchangeable and the structure that frames the doors is the same on wagons and sedans. Don't look for similar styling changes on the Saturn coupe. That model is scheduled for a separate restyling next year.

4-Door Windstar

Ford plans to add a second sliding door to the Windstar body just as soon as new tooling can be put into production. You may remember that Ford poo-pooed the idea of a 4-door Wind-

star when the van was introduced last year. Now, with Chrysler's 4-door van on the market, and General Motors planning a 4-door in '97, Ford has changed its tune. At this stage of the Windstar's life, the conversion does not figure to be easy. Windstar was specially designed for one sliding door. To put the second one on the driver's side means a major redesign of the minivan's structure and body.

Keyless Driving

Buick is working on a super-sophisticated keyless system for "your" next car. The device features a small fob that you can keep in your pocket or purse. When you get near your car, the doors unlock. When you sit in the driver's seat, the ignition turns on. You press a button to start the engine. Press another button to shut it off. As you leave the car, the doors lock behind you. It's all done with an electronic pulse from the fob.

Cadillac DeVille

You must look closely to see it, but the front end of the 1996 DeVille is different from the current car's. The grille sticks out a little more and there's a greater separation between the grille and the headlights.

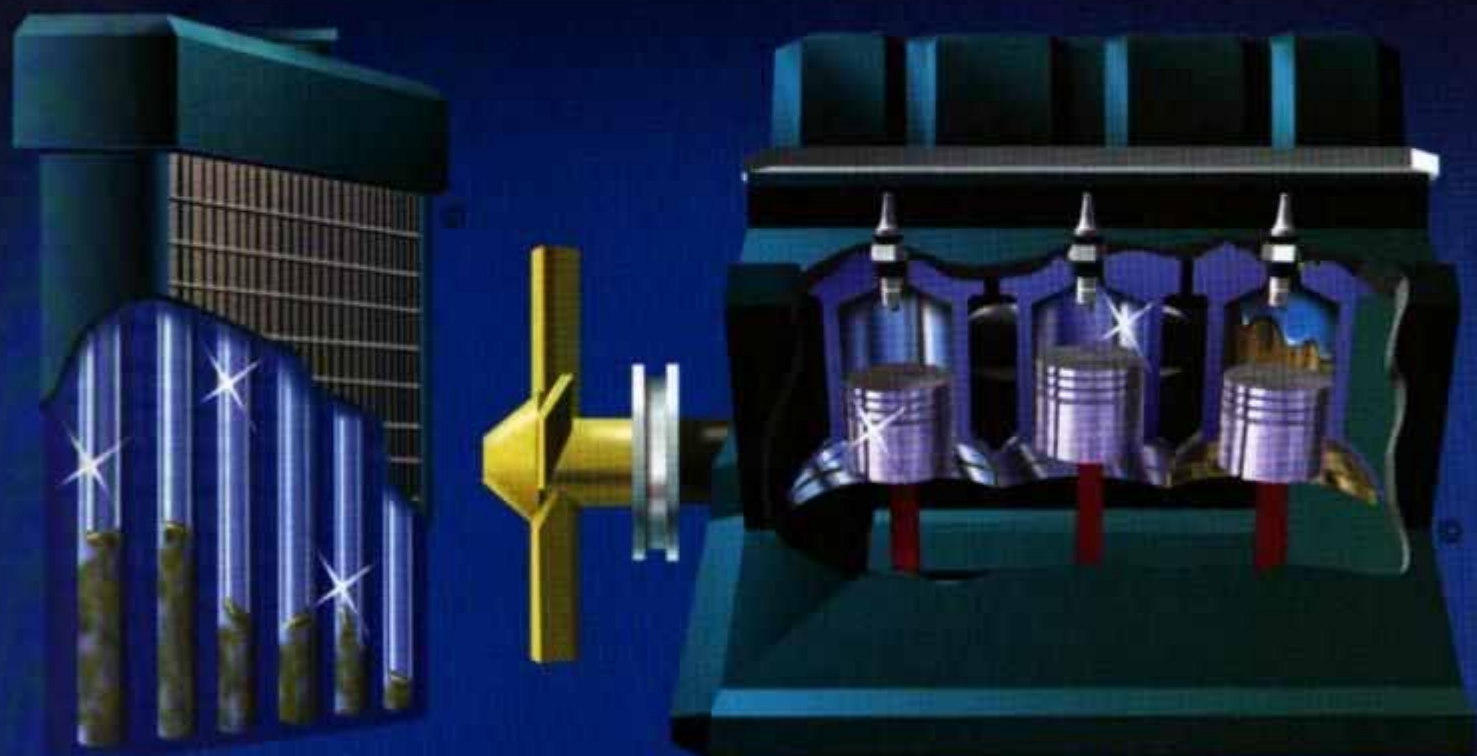


The bumper fascia is all new and the lower running lights are mounted in a new location. Overall dimensions, which make DeVille the largest production car in the world, remain unchanged. **PM**



The '96 DeVille sports a new, more prominent snout.

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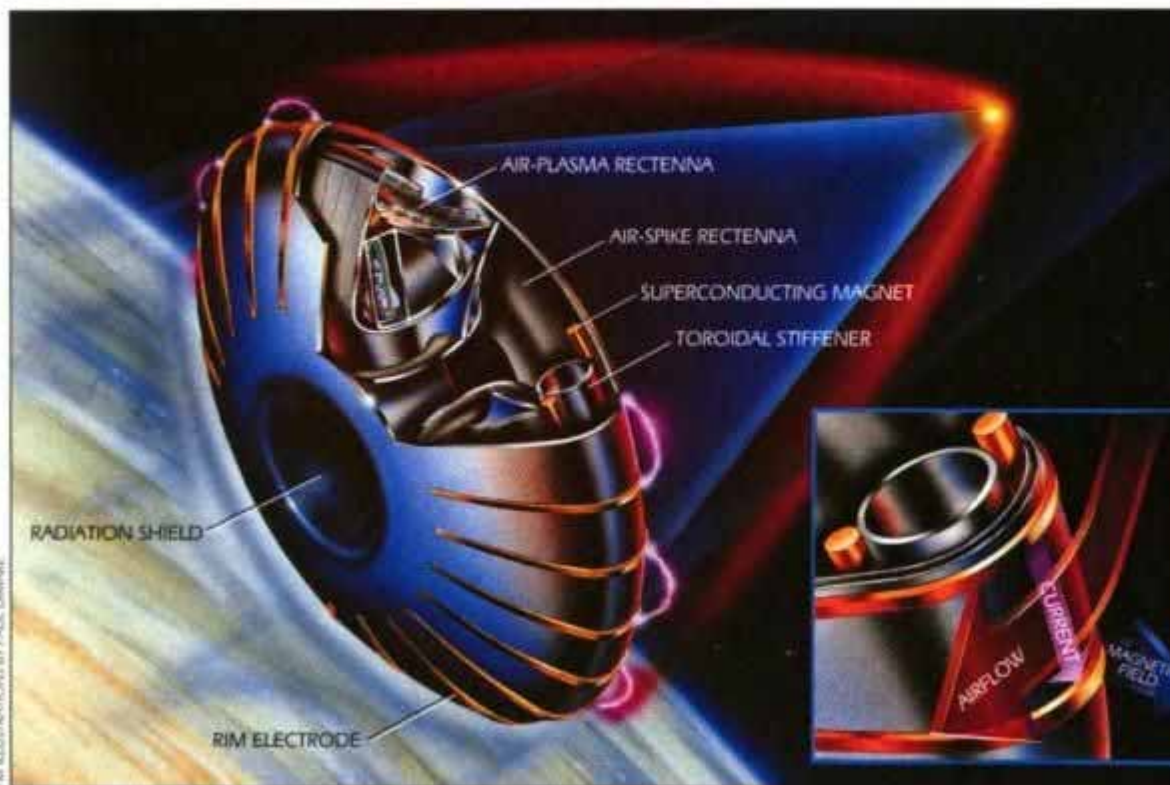
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Fly By Microwaves

BY GREGORY T. POPE, Science/Technology Editor



● Engineers come in two varieties. Some push the envelope from within, squeezing every last advantage out of existing technology. Their insights can turn a desktop computer into a notebook, or a Ford Fairlane into a Taurus. Without them, for sure, we'd be leading poorer lives.

But then there are engineers who perch outside the envelope and stir up trouble. Impatient with the pace of progress, they stretch for undeveloped technologies, mix and match nascent concepts and challenge the world to prove them wrong. They endure condescension while they're working out their ideas. But if their ideas do work out, they're lauded as visionaries.

Put Leik Myrabo into this second category. An associate professor of mechanical engineering at Rensselaer Polytechnic Institute, in Troy, New York, Myrabo is rewriting the laws of flight. But he's not tinkering with jet or rocket engines. Nor is he reformulating fuels or propellants. Instead, he's blueprinting a vehicle that does nothing less than streak into the sky on a beam of microwaves.

For more than a decade, Myrabo has pursued a vision he calls "Highways of Light." The concept began as a means of boosting a spacecraft without burdening it with fuel (see Tech Update, page 21, April '90). Shining up from the ground, a heavy-duty

laser would illuminate the spacecraft's lower surface. The barrage of energy would break air molecules into plasma—a blazing vapor of ions, or charged particles. The explosive expansion that accompanied this ionization would shove the vehicle skyward.

In experiments with scale models, the technique proved capable of imparting thrust. But the Strategic Defense Initiative Organization, which helped bankroll Myrabo's research, soon pulled the plug on 100-megawatt-laser development.

Unfazed, Myrabo joined forces with Yuri Raizer of the Russian Academy of Sciences. The Space Studies Institute, in Princeton, New Jersey, picked up the funding. Myrabo recalls the Institute's reasoning: "They said, 'We love your lasercraft, but we're still waiting for the high-powered lasers. High-powered microwave sources are here now—is it possible to design something around them?'"

The switch from laser to less energetic microwave power sent Myrabo and Raizer scurrying for ideas. As is often the case, the wealth of unexploited aerospace theory from the 1950s and 1960s proved a fertile hunting ground. Within weeks, the engineers concocted a fresh design, a disc-shaped vehicle called a microwave lightcraft. Myrabo has since refined the design into one that brims with

exciting, albeit untried, technologies.

Take the propulsion system, for example. Instead of simply riding a wave of expanding plasma, the lightcraft would wield electromagnetic forces to whisk the plasma past itself.

The driving force begins as a shaft of pulsed microwave energy. This beam showers the lightcraft from an overhead satellite that converts sunlight into microwaves. The energy hits two rectifying antennas, or rectennas, that lie beneath the vehicle's

microwave-transparent surface. These antennas, in turn, convert much of the microwave energy into electrical power. At the same time, they work like lenses to focus the rest to points outside the spacecraft.

Shaped like a shallow, curved lampshade, one of the rectennas drives the craft at subsonic speeds. It focuses the incoming microwaves into an ignition circle around the vehicle's periphery. There, the microwaves blast air into plasma.

As the plasma expands, it gets caught up in electromagnetic fields from two superconducting magnets that encircle the craft. Their relative strengths being adjustable, these fields can form a magnetic nozzle that propels the plasma downward, imparting lift to the spacecraft.

Futuristic enough? Yet at supersonic speeds, an even more radical propulsion method takes over. In this mode, the other rectenna—located on the lightcraft's upper face—joins in. It focuses part of the microwave beam back ahead of the vehicle, forming a conical reflection known as an air spike. Like the pointed nose of a fighter jet, this cone reduces aerodynamic drag, keeping a shock wave from hammering the vehicle's flat upper surface. Instead, the shock wave arches around the air spike. In

addition, the shock wave ushers the airflow to the outer edges of the spacecraft, where a unique air-breathing engine operates.

Here's how the engine works. Around the rim of the craft cling a series of electrodes, between which arcs of current leap. Meanwhile, the two superconducting rings continue to radiate their own fields. And the air-plasma rectenna continues to ionize peripheral air. The confluence of the electrical current and magnetic fields causes the ionized air to accelerate downward, lending thrust to the vehicle.

This engine concept, known as a magnetohydrodynamic (MHD) fanjet, is similar to the submarine-propulsion systems now under development in the United States, Russia and Japan (see "Jet Ships," page 60, Aug. '90). In Myrabo's calculation, an air-breathing MHD engine could deliver unheard-of performance, zipping from Mach 1 to Mach 25 in 10 seconds.

If you think all of this sounds far-fetched, you're not alone. NASA officials see promise in some of the component technologies, but envision no short-term payoff. Even Myrabo admits that microwave lightcraft won't fly for at least a generation.

On the other hand, Myrabo has already put elements of this system to the test. In 1991, at the Naval Research Laboratory, he added a magnetic field to his laser-induced propulsion apparatus to preview the MHD fanjet. It doubled the thrust. And just recently, in an experiment that won attention from NASA and the Air Force, he demonstrated the air-spike concept in a shock tunnel. The equipment consisted of a plasma torch, representing the air spike, mounted on a blunt body that resembled an Apollo-capsule heatshield. Placed in a Mach-10 air blast, the torch triggered an oblique shock wave well forward of the body's flat face.

These tests hint at eventual fruition for Myrabo's work. But they also invite speculation. Remember that the theory behind these technologies was first thrashed out more than 20 years ago. And remember that Myrabo represents the open side of the aerospace establishment. There is also a secret side, well funded and stocked with equally visionary engineers.

Glowing, highly energetic, disc-shaped aircraft with unearthly performance characteristics have long been associated with the secret side. Myrabo's concept may offer a terrestrial explanation for the night-sky sightings that rational people tend to dismiss or ignore. Perhaps. Or perhaps it's just a concept that looks good on paper, or is ahead of its time. You never know with visionaries. **PM**



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New Focus For Camcorders

BY FRANK VIZARD, Electronics Editor

● In an age when every leap forward in electronics seems to be defined by the use of digital technology, it's refreshing to learn of a technical advance that isn't chip-reliant. Better yet, the product—a new camcorder from Canon—is likely to set performance standards against which other video cameras will be measured.

The new upgrades to the Canon ES2000 camcorder are the result of improvements in optics that supersede the use of digital technology. One improvement is in its zoom lens. A camcorder with a 12X optical zoom lens creates a larger image electronically by magnifying a portion of the image captured by the charge-coupled device (CCD) inside of the camcorder. As magnification increases, however, image quality typically decreases.

The 8mm Canon ES2000 is the first camcorder to offer a 20X optical zoom lens that maintains image quality. The advance is a result of a new 5-group lens construction, the use of lightweight glass and smaller lens elements. The zoom is also pretty fast, traveling at seven different speeds across a 4- to 20-second range.

The ES2000, which lists for \$1599, also uses an optical, rather than an electronic, image-stabilization system



to reduce the image shake associated with handheld recording. Electronic systems usually apply a 10% compensation across the entire zoom lens. Canon's optical system provides compensation proportional to the lens' focal length, emphasizing the end of the telephoto range. This means that very magnified images are less inclined to appear to jump around even if you can't keep your shooting arm rock steady.

Another helpful new recording feature that's available throughout Canon's ES series of camcorders is called FlexiZone AF/AE. This recording option is particularly useful when tracking moving objects. With a subject in motion, you generally have to pan the camcorder to keep the subject in the middle of the frame since the autofocus system exposes for the entire shot. The FlexiZone AF/AE lets you lock onto a specific portion of the frame so that you can track a moving object and still be in focus. When activated, the FlexiZone AF/AE puts the subject inside a white box for easy tracking via a controller on the back of the camcorder.

Canon isn't the only company

making noise in the camcorder arena. Both RCA and Hitachi are addressing what is probably the most frustrating experience associated with camcorders. When the battery runs out, you're dead in the water until it's recharged. And as experienced camcorder users know, Murphy's Law says the juice will give out at the most inopportune times.

Eight new RCA and five new Hitachi camcorders are now sporting a dual-battery system. When the NiCd battery runs out, simply slip six alkaline AA batteries into the slot and you've got about an hour of extra recording time. Given the convenience and universal availability of AA batteries, it's a wonder that it took so long to implement this dual-battery approach.

Hitachi, meanwhile, is putting a new spin on video recording by making the lens on its VM-H100LA 8mm camcorder detachable and waterproof. When detached, the lens is connected to the camcorder via a 6-ft. cable. In a crowd, for example, you could hold the lens above everyone's head while still watching the action on the 4-in. LCD screen built into the camcorder.

Or, with the optional 15-ft. extension cable, you could dip the waterproof lens underwater to record divers or fish. Zoom and wide-angle shots can still be controlled from the camcorder. List price is \$2500, and it should appear in stores this October.

Not every technical advance is in the 8mm camp, though. Panasonic is now incorporating the DynAmorphous video heads available on its VCRs into its VHS-C camcorders. These video heads improve the signal-to-noise ratio, thereby significantly improving overall picture quality. This technology is available first in the PV-D705 model, which lists for \$1299. **PM**



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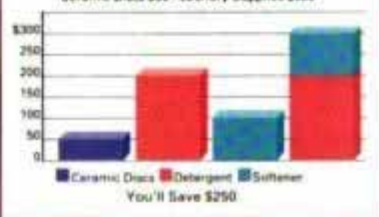
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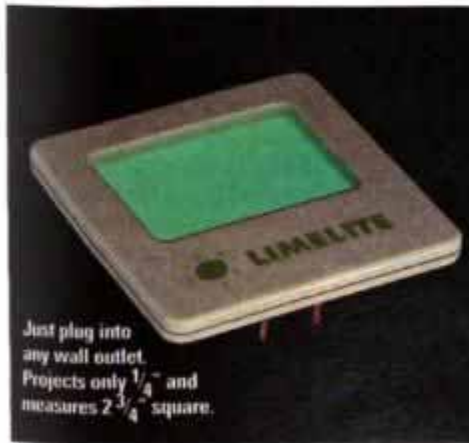
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Asia Spy Report

BY SCOTT OLDHAM, West Coast Editor



Hyundai dealers will get this Elantra-based coupe in early 1996 as a '97 model.

Hyundai's Hot

● They're cooking in Korea. Both Hyundai and Kia are stoking the flames under the stew as they keep adding to their mix. The bigger company of the two, Hyundai, has the most happening. First, there's an all-new, racy-looking coupe due here late next summer to replace the current Scoupe. We spied this heavily camouflaged prototype testing at Porsche's proving grounds. That sure leads an innocent mind to think that Hyundai is serious about this vehicle's performance—serious enough to enlist Porsche's input—and will give it the moves to back up its swoopy bodywork and aggressive 5-spoke aluminum wheels. Whether it will be called the Scoupe is not known, but it is clear that not everyone is enamored of that name, so it won't be a surprise if Hyundai decides to drop it.

Though the coupe is a 1997 model, it's based on the same platform as the new Elantra sedan and wagon due soon at a Hyundai dealer near you as '96 models. In fact, this fall, with the new Elantra, Hyundai dealers will have their first station wagon.

Rebadged in Korea as the Avante, the new Elantra has grown an inch, to 174 in., and rides on a wheelbase 2 in. longer, at 100 in., than its predecessor. Interior space has also been increased. Front and rear overhangs are shorter, and the sedan has an egg-shaped greenhouse, much like Nissan's Altima.

Power for all three of the models will be supplied by a new family of 4-cylinder dohc

engines, ranging from a 1.6-liter to a 2.3-liter, reportedly good for 150 hp. Sources say there are also 1.8-liter and 2.0-liter versions. You can expect that antilock brakes and dual air-



Kia continues to grow and will enter the midsize sedan market with its '97 Credo.

bags will be part of the package, with prices starting at about \$11,000.

As with the Scoupe moniker, it's unknown if the new car will still be called by the old name or if the Avante name will follow it to the

United States. For now, the station wagon is called the "Next One."

1997 Kia Credo

Not to be overshadowed by its giant countrymate, Kia has been busy as well. In fact, the carmaker unveiled its new Credo sedan at the Seoul Motor Show. This is Kia Motors' entry into the crowded midsize sedan market. About the size of a Mazda 626, the Credo will get a slight facelift and probably a name change before it arrives on the showroom floors of U.S. Kia dealers next fall.

The Credo rides on a 105-in. wheelbase, and will be powered by a Kia-developed 1.8-liter 16-valve

4-cylinder engine backed by a 5-speed manual or a 4-speed automatic transmission. No V6 will be available in the Credo. Look for it to be priced head to head with the Hyundai Sonata, which currently carries a window sticker showing a \$13,599 base price. You can be sure that the top of the Credo line will get antilock brakes and traction control.

1996 Nissan Quest

Slight exterior refinements mark the 1996 Nissan Quest minivan.

It boasts a smoother yet more aggressive look. Both the front- and rear-bumper fascias are new designs—the front parking lights have been relocated, and there are new sculpted air intakes under the front bumper. While the headlights may look the same as those on current models, they're

(Please turn to page 50)



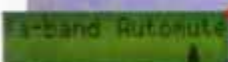
Nissan will update the look of its Quest minivan in 1996, giving the Ohio-built front-driver an overall smoother, yet more aggressive and masculine, look than it has now.



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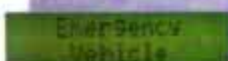
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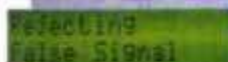
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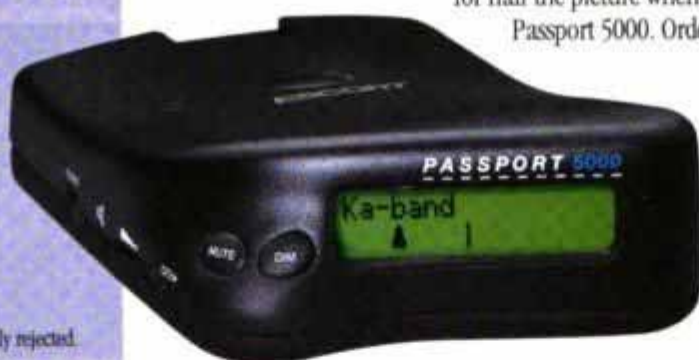
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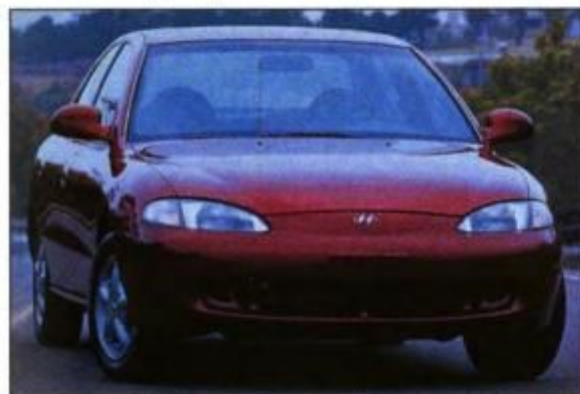


The new Japan-market Toyota Corolla may be coming here.

slightly restyled. They also project whiter, more focused light beams.

Japanese Minivan News

Toyota will build an all-new minivan in the United States in 1997 to sell alongside the Previa. Much like how Honda's Odyssey minivan is based on



Coming before the new Hyundai coupe are a sedan and, for the first time, a station wagon. The car replaces the Elantra and may carry that name on the decklid. The station wagon features a fold-down rear seat.

the Accord sedan, Toyota's new minivan will be built on the Camry front-engine fwd platform, and will be manufactured in Toyota's Georgetown, Kentucky, plant. Expect V6 power and two doors on each side, like the Odyssey and Chrysler's new minivans.

Honda is also looking to produce a minivan in the U.S. in 1998. This Ohio-built minivan would be larger than the Odyssey and offer V6 power.

Next Corolla

Toyota, Japan's largest car company, has just released a less expensive Corolla in its home market. Officially, Toyota has said this is a Japan-only model, but the U.S.-sold Corolla is due for a change in '97. Smart money is betting that our version of the car will take the direction of this Corolla. This means a car that weighs less and has a base price of under \$10,000—though a loaded model will

still top out in the neighborhood of 20 grand. This price structure, though attractive, is unlikely for the U.S.-spec car because such a low base price would eat into Terrel territory.

This Japan-market Corolla, which remains front-wheel drive and 4-cylinder powered, rides on the present car's 97.1-in. wheelbase and takes up the same amount

of parking space. Thanks to manufacturing advances, today it costs Toyota considerably less to build the new car. And from its pedestrian and rather Terrel-esque look, it would seem that Toyota has saved a bit on styling costs as well. A 4-door sedan, coupe and wagon should continue to be offered when a new Corolla bows in the United States. And the vehicles will continue to be built in Toyota's NUMMI plant in

uses existing 626 body panels from the windshield back, but sports an all-new front end. Peeking through the bra is a grille that looks like it was lifted right off the Millenia parts shelf. Flanking the chrome grille are large round headlights and turn signals. The redesigned 626 will continue to be built in Flat Rock, Michigan.

GangStar

Commonly known in China as the Beijing Jeep, the GangStar sport/utility may become the first Chinese-made vehicle to ever be sold in the American market. Manufactured by the Beijing United Automobile and Motorcycle Co., the GangStar, which



Mazda's 626 sedan heads toward the Millenia.

is about the size of a Jeep Cherokee, is a 4-door 5-passenger vehicle with a soft-top (optional hardtop) and rollbars. Prices will start at \$9999, and the top-of-the-line model will cost \$15,000.

Despite the allusion to gang violence from the sport/ute's name, with a weak 85-hp 4-cylinder engine and a slothlike top speed of 85 mph, we don't expect this truck to be a getaway vehicle of choice. A name

change is said to be in the works.

A dealer network is now being set up, and the importer hopes to bring in 10,000 trucks during its first year, beginning this fall. **PM**

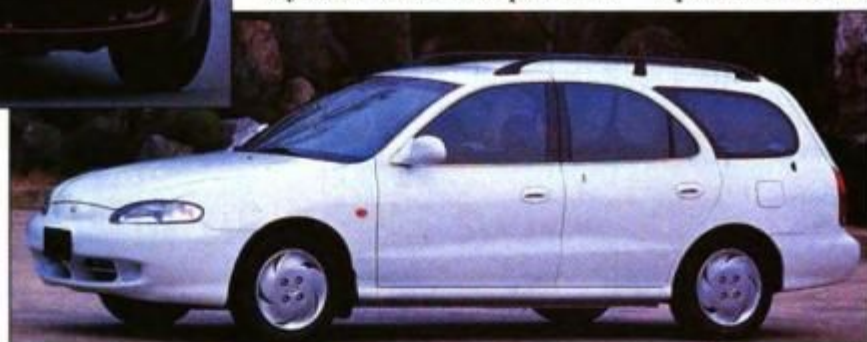
Fremont, California, and newly expanded facility in Cambridge, Ontario.

1997 Mazda 626

In the midst of a reevaluation that has Mazda's bean counters threatening to kill off the Japanese maker's entry-level 323, new MX-3 coupe and Navajo SUV, Mazda engineers are busy working on a Millenia-esque facelift for the 1996 626 sedan—and all-new sheetmetal and interior for the 1997 model.

While powertrains are expected to be carryovers from the present 626, the exterior will probably take on the shape of Mazda's larger and more expensive Millenia.

The prototype shown



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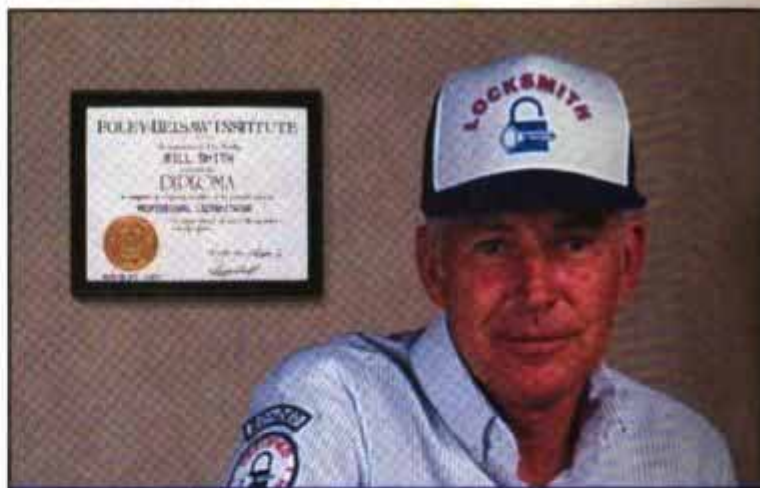
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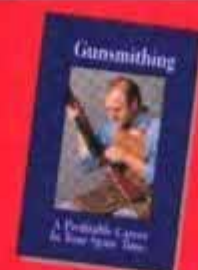
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HUMMERS CON MUCHO GUSTO

Blasting down Mexico's original Baja 1000 course in the new gas-powered Hummer.

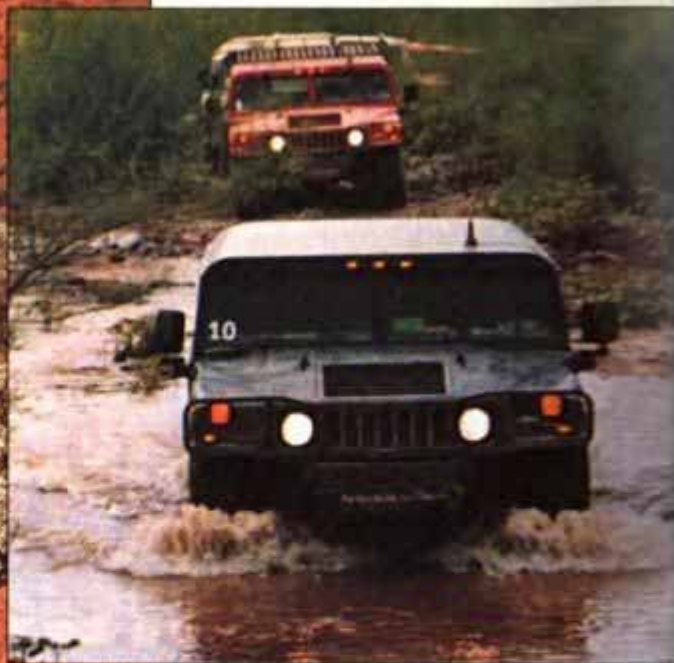
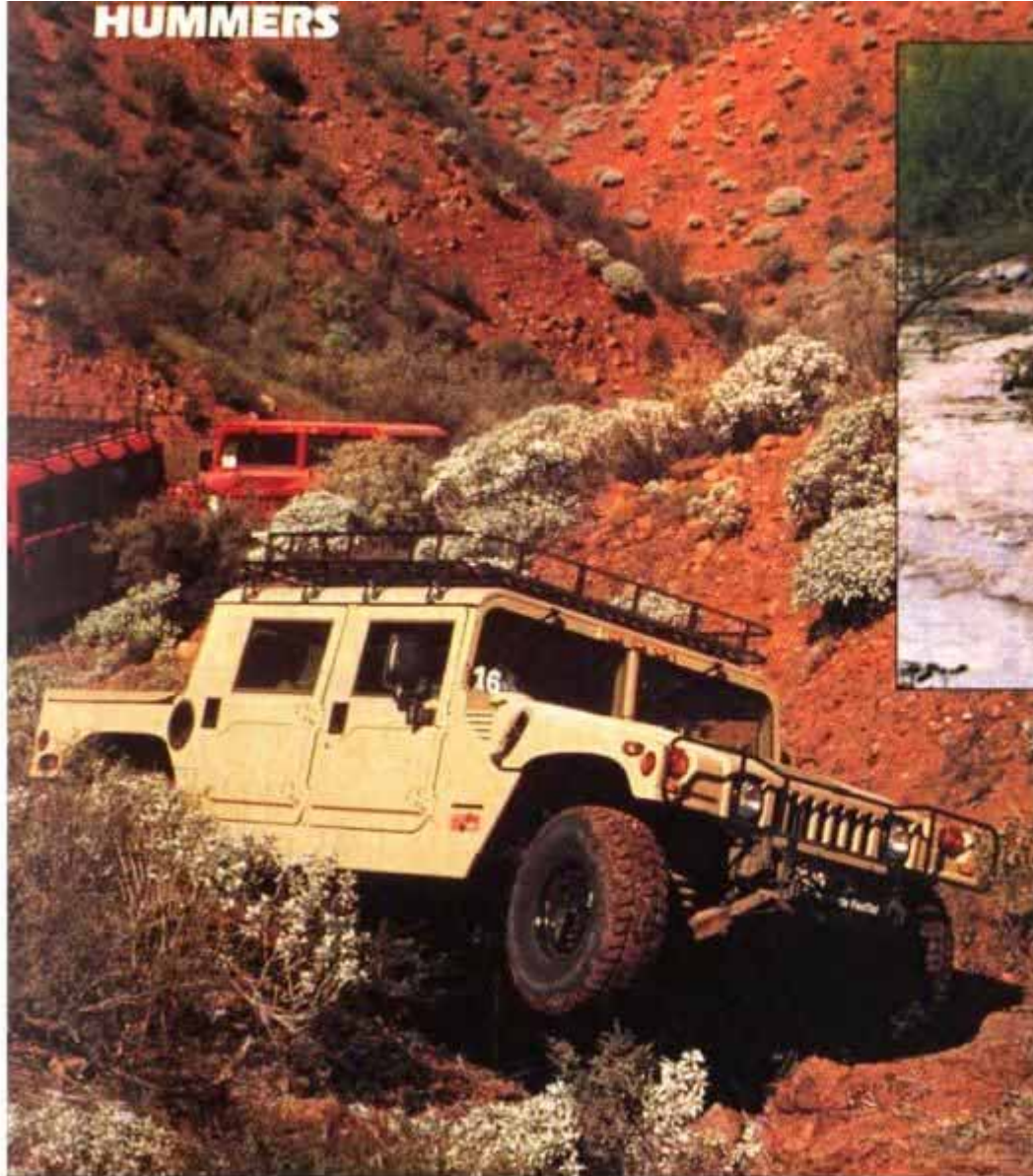
BY SCOTT OLDHAM, West Coast Editor



● As the incredibly huge, black scorpion slowly picks its way around my face, sweat pours from my body like the condensation on a warming Coke bottle. I lie perfectly still, staring at its ribbed underbelly, waiting for it to make its next move. At that precise moment, I make my decision. I am not a Baja kind of guy.

Hours pass.

As daybreak rapidly illuminates Mexico's blue sky, I'm yanked out of my twilight trance with a start when the silence of the desert is broken by the distinctive sound of a Chevy small-block V8 turning over. Thankfully, the scorpion was only a nightmare—one of several I've experienced since arriving south of the border, down Mexico way. I figure it's only a matter of time before the big, hairy spider shows up in one of them.



Nightmares like this have made sleep nearly impossible during this week-long, 1000-mile expedition to retrace the original route of the Baja 1000 off-road race.

I'd frankly be much happier gauging reaction to AM General's new gas-powered Hummer on the streets of Beverly Hills. Rodeo Drive, in particular, has sort of become Hummer Headquarters West as Hollywood's big shots fill them with shopping bags from Gucci and Ralph Lauren. But AM General wants to show us that civilian Hummers, which are slightly more luxurious versions of the truck made famous compliments of CNN during the Persian Gulf War, are not just showboats for Arnold Schwarzenegger and company. No, AM General wants to demonstrate that the Hummer is the most serious off-road vehicle ever sold to the public. They want to prove that, if necessary, even weighed down

with bags full of Armani's fall collection, a gas-powered Hummer can easily drive over Buffy's BMW convertible.

No, it really can. On the first day in Baja, we drove over rocks the size of Mercedes-Benz S-Class sedans.

Baja more or less begins at Tijuana, or "TJ," as Southern California surfer dudes have nicknamed it. Forty miles south of San Diego, California, Tijuana sits on the U.S./Mexico border between the Otay Mountains and the Pacific Ocean. After a chat with the Policía Federales, who drive 4-wheel-drive Dodge Ram pickups, we are in. I'm in over my head, considering that I don't speak Spanish beyond *gracias* and *uno*, I suffer from arachnophobia and I'm already running low on styling mousse.

The start

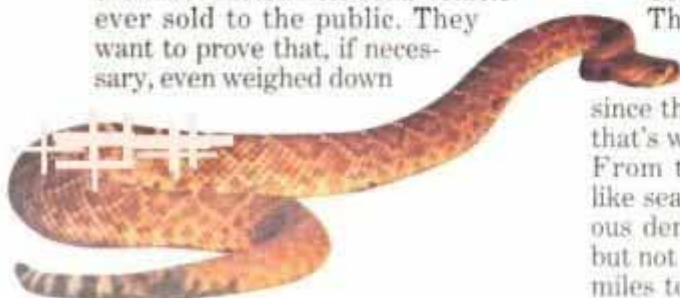
The Tijuana bullring has been the official starting line for the Baja 1000 off-road race since the trek's inception in 1967, and that's where we come off the line, too. From the Hummer's Sears Tower-like seating position, Tijuana's notorious dens of iniquity are within sight, but not on our itinerary. Roughly 1000 miles to the south is the coastal town

of La Paz, our ultimate destination.

As we set out, our pace is somewhat slower than that of the racers, who make the trip in less than 24 hours. We hope to finish by the end of the week.

Baja is breathtaking. The hilly landscape, which is covered with a rich green layer of vegetation, thanks to an abundance of recent rain, is sheltered by a deep, cloudless blue sky. Ed Pearlman, the creator of the Baja 1000 race and a man on his 100th trip over the Earth's fourth largest peninsula, tells me in the low dry voice you expect from a man who's just seen his first child born, "I've never seen it this green before, and you'll never see it like this again." The cactus gardens go on for hours. The fine silt of the desert floor, which roostertails off a Hummer's stern at speed, challenges the recirculating feature on the Hummer's air-conditioning system. But we drive with our windows down, and cough dust at every rest stop. It's more macho this way.

The Hummer under us is basically the same vehicle that left tracks all over Saudi Arabia's oil fields a few years ago. We've reported on this vehicle before—except for its new-to-





Terrain varied constantly from hilly brush to roads covered in powdery silt to muddy trails to rocky flatlands with boulders the size of Benzes. We even crossed a river or two. The only mechanical difficulties during the trip were two flat tires, a wasted battery and a sick crewman who ate something he shouldn't have. For weight distribution, the gas-powered 190-hp 5.7-liter Chevy V8 is set way back in the Hummer's chassis. Not much of it is visible under the truck's large clamshell hood.

Hummer powertrain. The truck's 6.5-liter V8 diesel engine has been replaced with a 190-hp 5.7-liter gasoline-drinking V8—the "corporate" version of Chevrolet's venerable small-block V8 engine. The diesel, which produces enough low-end torque to tow the space shuttle to its launch pad, is still available. But spewing diesel fumes in front of Tiffany's on Rodeo is uncouth and hearing your broker on the cell phone is difficult over the clatter of a diesel engine. The gas-powered 350-cu.-in. V8, which produces a significant 300 ft.-lb. of torque, is quieter, offers more refined power output, equals the diesel in over-the-road performance and saves you the trouble of tracking down sometimes-hard-to-find diesel fuel. The diesel-engine Hummer, however, does go farther without refueling. Way farther. Gas Hummers average about 8 to 10 mpg, depending on driver and conditions. A diesel will go about 15 miles on a gallon of fuel.

Both the diesel and gas V8s—along with the truck's 4-speed overdrive automatic transmission—have been plucked from General Motors' full-size pickups and sport/utilities. And while nobody sane would call those

vehicles fast, they do run strong. The 6700-pound Hummer, however, strains either motor. Okay, face it: on the road, a Hummer is a slug. The gas engine leisurely accelerates the vehicle to 60 mph in a yawn-inspiring 18 seconds, and can ultimately get a Hummer, which has aerodynamics a little worse than a 1947 Willys Jeep, up to a top speed of 83 mph. No wonder Arnold dropped a 300-hp LT1 version of the engine into his Hummer.

A Corvette it's not. But what Corvette can claw its way over a 22-in. vertical wall, drive through a raging river or get me to La Paz? And according to Rod Hall, 13-time Baja 1000 winner and our expedition's ring leader, no other sport/utility can either. The jury is still out on that one. But as slow, big and clumsy as the 86.5-in.-wide Hummer (10.5 in. wider than a Toyota Land Cruiser, itself no Slim Jim) feels on Santa Monica Boulevard, it's agile, swift and light on its feet out in the wild. Thanks to its power steering, quick steering ratio, power brakes and unique suspension design, layout and features, it's also extremely easy to drive over moon-scape terrain.

Drunken Sailor Hill, named after



The famous Baja 1000 off-road race route.

inebriated seamen tardy in returning to their ships and desperate enough to cut through the brush, gives us our first opportunity to Hummerize the terrain. The narrow pass is actually no more than a funnel for rain runoff and is as close to being a road as Sharon Stone is to being repulsive. Rocks the size of fireplugs and ruts large enough to swallow Danny DeVito make this route seemingly impossible to pass.

The Hummer's unique 4-wheel independent suspension, with beefy double A-arms and coil springs at all four corners, quickly demonstrates why, for good ground clearance, solid axles are obsolete on SUVs. Four-wheel disc brakes, each measuring 10.5 in., are mounted inboard to safeguard them from damage. The vehicle's drivetrain and exhaust system are also mounted high (above the lower section of the steel frame), keeping these vital pieces off the rocks and giving the Hummer an amazing 16 in. of ground clearance—nearly twice as much as a Jeep Wrangler.

And Drunken Sailor Hill uses up all of it, and then some. While clawing over the jagged boulders, the fact that I still haven't perfected my off-road driving technique is hammered home by the Hummer's box-section frame smashing into the rocks on several occasions. The impact is strong enough to chatter my teeth. The Hummer doesn't even flinch.

Such terrain also forces us to employ the Hummer's central tire-inflation system, which allows you to adjust the tire pressure on all four tires with a dash-mounted switch while you drive. There's even a pressure gauge. Eight psi is ideal for deep sand, 15 psi for general dirt trails and rocks, and 30 psi for asphalt. Pressure changes create a larger or smaller tire footprint, which varies the tire's traction characteristics. More pressure makes the footprint smaller, but it also strengthens the sidewall of the Goodyear GS-A tires, making them



more resistant to punctures. This system is unique to the Hummer.

It's dinnertime, and we're still out in the middle of nowhere. I estimate we're an hour behind schedule, which means we'll still be amongst the boojum trees and the saguaros well into the dark of nightfall. The beauty of the rock formations against the nuclear-orange glow of the sunset settles my nerves. Momentarily. Our destination is a beautiful bayside campsite. Our 7 pm arrival ends the first of five 14-hour days of off-roading. Hyme, the owner of the local cantina and our host for the evening, assures me that his point of land got its name because its shape resembles a scorpion's tail when viewed from the air, not because of an infestation. Even so, after a significant amount of *cerveza*, I refuse my canvas

accommodations and attempt to sleep in the back of a Hummer—with the doors locked.

I don't awaken with a big black scorpion on my face, but I do wake up in total darkness. It's so dark I can't read my watch. Four hours of constantly interrupted sleep keeps the human eye from focusing rapidly. I hear people rustling around outside. Breakfast is in the dark at 4:30 am. I'm told the coffee was made with bottled water. There are still four days to go. I go for it. I go for it the next four days. Four more days of sun, dust, rocks, washes, dry riverbeds, boulders, canyons, cacti and Hummers.

The finish

The sun shows itself at 6. As does a gray whale about 100 yards out. Today, mercifully, is the last day of our expedition. We roll into La Paz, which sits on the Sea of Cortez, in time for a shower before happy hour.

Between sips of the first of many margaritas I'll consume in the lobby bar of the Los Arcos Hotel in downtown La Paz, I ask Rod Hall why he comes back every year to battle Mother Nature and shake his shoes free of vermin each morning.

He first looks at me as if I have asked him why he eats. Then says, "If man was meant to race on pavement, God would have paved the Earth."

Such an Earth would not have use for a Hummer. And the inhabitants of such an Earth would never know the beauty of Baja.



The exhausted author revels at the finish line (left). Passing through San Ignacio and by the Misión San Ignacio Kadakaaman built in 1786 (top). Hall in the family (above)—our tour guides (left to right): Josh Hall, Chad Hall and Rod Hall.

GAMES FOR REAL

Faster processors and better graphics add up to more realistic action.

BY JAMES K. WILLCOX; PM Illustration by Bryan Canniff



- A wave of next-generation videogame systems, boasting banks of powerful processors and games stored on high-memory compact discs, is about to hit our shores, promising to radically change what we can expect from home videogame systems. Thanks to advances in silicon technology, these new systems are capable of delivering the same 3D graphics,



Initial games suggest Sony's PlayStation (left) has a graphic edge over Sega's Saturn system (right) even though PlayStation uses fewer processors.

Conspicuous by its absence this fall is Nintendo. It has decided to postpone the launch of its new videogame system, called Ultra 64, until next spring.

New microprocessors, in fact, are the brains and backbone behind each new system's advanced capabilities. Of particular importance is the use of Reduced Instruction Set Computing (RISC) chips, the same technology found in the new PowerPC home computers from Apple and IBM, as the central processors.

In every computer or game system, the main processor—called the central processing unit, or CPU—acts as the brain of the system, figuring calculations and directing the show. RISC processors are designed to perform narrower types of calculations, but do them more effectively. By reducing the number of instructions required for the CPU to perform tasks, RISC-based systems can process information faster and more efficiently than previous designs.

Another important design element in the new game systems is the move to a multiple-processor architecture. Out-of-the-box PCs tend to be great at crunching numbers, but not particularly adept at managing graphics-intensive action games. That's be-

Zap bad guys in virtual reality with Atari's Jaguar system.

near-photorealistic images and bone-jarring sound that was once possible only in sophisticated arcade machines.

The first of these new videogame systems, from Sega and Sony, are just now coming to market. The 32-bit Sega Saturn (\$399 to \$449) has been rolling out in limited quantities since early this summer, but should now be widely available. The 32-bit Sony PlayStation (\$299)—the consumer-electronics giant's first stab at a home game system—is just arriving.



cause personal computers generally rely on a single powerful CPU to handle all of the different processing functions. To get really great graphics or sound from a PC, you generally have to purchase add-on boards such as a graphics accelerator or a 16-bit sound card.

For that reason, the newest game systems take a multiple-processor approach, whereby various functions are offloaded from the main processor and assigned to separate chips engineered to handle specific tasks. This parallel-processing architecture is evident in both Sega Saturn, which uses eight microprocessors, and Sony PlayStation, which uses six.

In the coming months, both Sony and Sega will be making a big issue of their respective system's 32-bit architecture. What both companies are referring to is the number of individual bits of data that can be processed as a single entity.

In two systems where everything else is equal, a 32-bit system will outperform a 16-bit one. But just having more bits doesn't guarantee superiority, since processing speed and power, the amount of memory, additional graphics chips and the quality of the software that's available all help determine the level of play on any given system. So while Atari can brag that its \$159 Jaguar is a 64-bit system, for example, that in itself is not proof it's a better game system



than the 32-bit Saturn or PlayStation game consoles.

Atari, incidentally, is hoping to deflate some of the hoopla surrounding Sega's and Sony's new systems by offering a \$300 virtual-reality accessory for Jaguar. The VR system uses a "V-Trak" infrared tracking technology that reacts very quickly to head and hand movements, as a firsthand test of a prototype demonstrated. And while the experience was immersing, the graphics were not as detailed or as realistic as on other systems.

As previously mentioned, the Saturn uses eight separate microprocessors, including a pair of custom SH2 32-bit RISC chips developed by Hitachi, which act as the system's main processors. In addition, Saturn uses two other 32-bit chips—called video digital processors (VDPs)—that are specifically relegated to handling graphics. One VDP generates the sprites—the game's main objects and characters—and effects such as scaling, rotation and texture-mapping (a technique in which a computer-generated 3D wireframe model is "wrapped" with an image, creating a 3D character or object). It also supports Gouraud shading, a smoothing technique that reduces the geometric look of the polygonal objects.

The second VDP is responsible for creating multiple background objects and effects such as scrolling. In a game like "Daytona USA," an early car-racing title from Sega, the first VDP generates all of the vehicles and animation, while the other VDP creates the track and scenery. And, unlike the Genesis, which offers only 64 colors, the Saturn is capable of producing 16.8 million colors.

Saturn's other processors include:

- 32-bit RISC chip, which controls the double-speed CD-ROM drive.
- System control unit, which acts as the traffic cop in charge of synchronizing all of the processing activity.
- System manager and peripheral controller.
- Custom 32-voice sound processor developed by Yamaha, which includes an additional chip for creating effects such as 3D sound and reverberation.

While Sony's PlayStation also features a multiple-processor design, it relies more heavily on its main CPU than does Saturn. The reduced amount of silicon helps keep the PlayStation console physically smaller, as well as manufacturing costs down. Although the brain of PlayStation is a highly capable, custom 32-bit RISC processor developed by LSI Logic, it doesn't rely on the main CPU exclusively. Other key processors include:



The M2 Accelerator chip promises to turbocharge the 3DO game system.

rent standard for compressed digital video—PlayStation supports an older standard, JPEG. JPEG is capable of 35 minutes of full-screen, full-motion video from a CD-ROM, compared to 74 minutes for MPEG video.

Based on test drives of some of the early videogames available, however, Sony's forte appears to be slightly better graphic capabilities. We gave the edge to Sony's racing game, "Ridge Racer," and martial-arts title, "Toh Shin Den," in head-to-head comparisons with Sega's "Daytona USA" and "Virtua Fighter."

It's difficult to truly assess the merits of any game system in the first few months of availability, since it takes game developers as long as two years to optimize software for a system.

By then, there will be some new competition for the game player's dollars. In April, Nintendo says it will ship its 64-bit RISC-based Ultra 64 system, which it claims will run four to five times faster than both PlayStation and Saturn—and do so at a lower price of \$250.

And 3DO, which launched the first 32-bit system in the market, is readying a 64-bit upgrade for the 3DO Interactive Multiplayers sold under the Panasonic and GoldStar brands. The new system, called the M2 Accelerator, is based on a RISC-based PowerPC 602 chip and features 10 integrated processors as well as built-in MPEG video-playback capability. The M2, 3DO claims, is seven to 10 times more powerful than Saturn or PlayStation, and could be ready early next year.

- Geometry engine (GTE) and graphics processing unit (GPU) for creating the graphics.
- Data-decompression engine for video playback.
- CD-drive controller.
- Sound processor for the audio and reproduction of special sound effects.

The GTE and GPU work in conjunction to produce the PlayStation's exceptional graphics. The GPU is responsible for rendering character sprites, creating effects such as rotation and scaling, and producing the system's 16.8 million colors. The GTE handles texture-mapping, Gouraud shading and fog effects.

On paper, the Sega Saturn appears to have the edge. While both systems have separate CD-drive controllers to handle game data coming off of the CD, Sega's Saturn has roughly five times more buffer RAM (512K) than PlayStation. That's important because the more buffer RAM, the quicker information can be accessed.

PlayStation's data-compression engine is directly linked to the CPU, and provides full-screen, full-color video playback. While Saturn supports MPEG video—pretty much the cur-

JET AGE

If it seems like jet boats are taking over the waterways, they are. Here's why.

BY CHARLES PLUEDDEMAN



● Once a small niche player in boating, marine jets are suddenly everywhere. Sales of jet-propelled water-bikes are skyrocketing, and now account for an astounding 35% (about 140,000 units) of the domestic powerboat market. Minijets (open, jet-powered boats less than 15 ft. long) are another booming, high-profile segment. For the 1995 model year, retail sales of these craft have jumped by 32%.

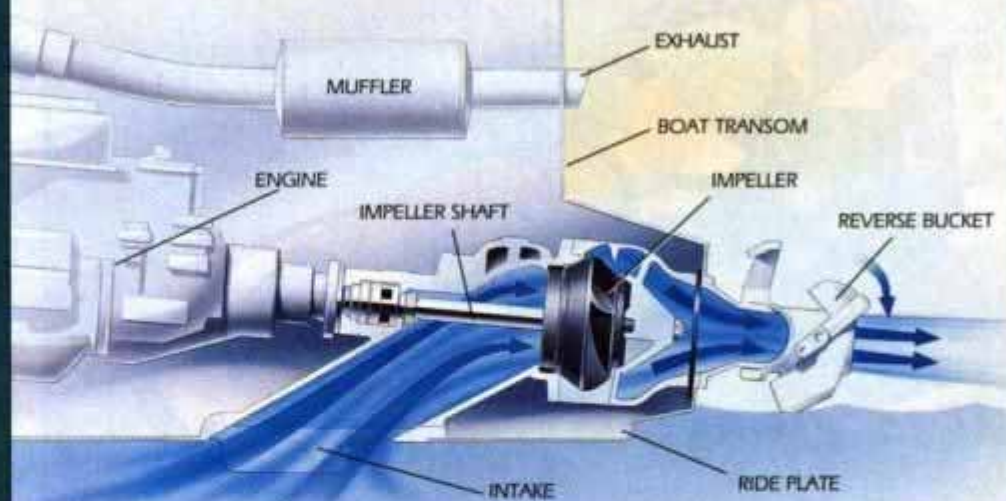
And in 1996, Four Winns, the innovative boatbuilder from Cadillac, Michigan, will complete a circle that was begun in the mid-1960s. It is bringing back a type of craft that disappeared from mainstream boating many years ago—the midsize bowrider runabout, powered by an inboard engine mated to a jetdrive. Clearly, something about jet propulsion is making everyone take a second look.

The first look occurred about 30 years ago when Californians began using Berkley irrigation pumps to

propel runabouts. Within a few years, jet boats became something of a rage, especially on the West Coast. They were usually powered by a hot-rod 455 Olds V8 mated to a Berkley jet. This system made a lot of sense to hot rodders, because the current drives on outboards and sterndrives couldn't handle the torque of big-block engines. A jet pump, on the other hand, could run almost unlimited horsepower, and many boaters did.

However, jet pumps at the time were fairly inefficient at transferring engine power into propulsion. They suffered a power loss of 25% to 30% in the process. Coupled with the voracious thirst of big-cube engines, the situation produced a fuel burn of roughly 35 gallons of gas per hour in many boats just to run.

Four Winns Horizon 190 Turbine



The American Turbine drive uses a mixed-flow pump that changes the direction of the water.

PHOTO ILLUSTRATION BY STUDIO C LUDWIG





Sea-Doo Formula Pump

This axial-flow design uses stator blades to straighten out the waterflow.



55 mph. More powerful and more efficient outboards and sterndrives (with props) eventually became available, which damped the popularity of jets. Then, the gas shortages of the 1970s arrived and jets became scarce.

Jets didn't disappear altogether, of course. Kawasaki introduced its first Jet Ski watercraft in the 1970s, and nurtured the sport to its current boom. Aluminum-hulled jet boats were also found running the shallow Pacific Northwest rivers.

But until Four Winns introduced its Horizon 190 Turbine—a 19-ft. bowrider powered by a V8 inboard—no large-scale, national builder had considered adding a midsize jet boat to its line since the late 1970s.

Four Winns started development of the Horizon Turbine in 1991, working with a new, more efficient pump design from American Turbine, a division of Red Line Marine of Lewiston, Idaho. The collaboration with American Turbine resulted in a new pump

model, the FW-309, which retains the same engine mounting position used by a sterndrive boat.

Like all jet pumps, the American Turbine (AT) pump generates thrust by compressing water and directing it behind the boat. Place your thumb over the end of a garden hose, and you've created a waterjet—the water is accelerated because its volume (which remains constant) is forced through a smaller opening.

Current jet pumps fall into two categories—mixed-flow pumps and axial-flow pumps. The AT pump is a mixed-flow design, which means it changes the direction of the water as it passes through the pump. The intake passage feeds water to a 9-in.-dia. aluminum impeller, which is driven by the driveshaft. The blades of the impeller bite into the water and discharge the flow radially to the stator—a series of passages cast into the pump housing, or bowl.

As the stator passages curve aft,

they get smaller, and the water is compressed before it's released into the nozzle area. The nozzle outlet has a diameter of just 3 in., so the volume of water that fills the 9-in. side of the pump has now been compressed by a factor of three. The resultant jet of water escapes out the pump nozzle, propelling the boat forward. A steering nozzle pivots right and left to control the boat's direction.

The mixed-flow pump works best when mated to a lower-speed/high-torque engine, such as the 190-hp 5.0-liter Ford block that's the base powerplant in the Horizon Turbine (a 215-hp 5.8-liter V8 will also be offered).

The AT jet is much more efficient than pumps of the 1970s, but it does give up some performance to a sterndrive with similar power (46.5 mph versus 43.7 mph during our test). The jet pump itself is less expensive than Four Winns' typical sterndrive unit (the Volvo Penta SX), but it requires a more elaborate, through-hull exhaust, which evens out the cost. The two boats have an identical retail price: \$18,303.

After driving both the jet-powered and the prop-powered Horizon 19-footers, I can note two major differences. First, there's no trim on the jet drive, so you have to settle for the -4° thrust angle built into the pump. This produces good acceleration (0 to 30 mph in 6.9 seconds versus 6.5 seconds for the sterndrive) and an acceptable ride in most conditions. Four Winns is developing a trimmable ride plate, controlled by a hydraulic ram, but it will never be as trimmable as a sterndrive.

The second difference with the Horizon Turbine is that engine speed is restricted to about 4200 rpm (43.7 mph) from choice of impeller pitch. This produces a fuel-efficient ride, which is nearly as comparable as a prop (3.2 mpg at 3500 rpm for jet versus 3.8 mpg). An impeller with less pitch would allow the engine to turn faster, pump more water and go faster, but fuel economy would suffer.

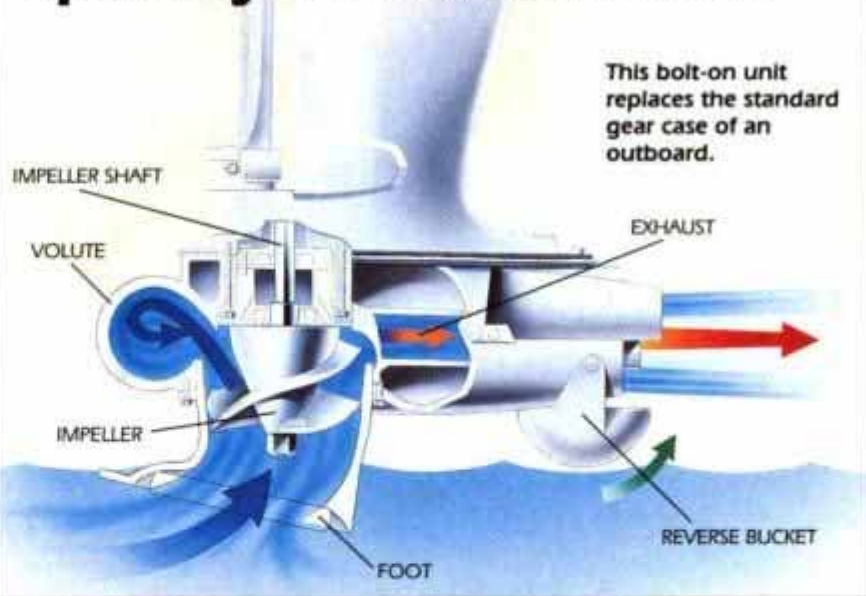
The Horizon Turbine handles like a prop-driven boat, and will not spin out like a minijet unless pushed to the absolute limit. Reverse thrust, accomplished by swinging a bucket over the steering nozzle, works well in docking maneuvers.

Clearly, the inspiration for the new wave of attention on jet technology comes from the huge success of personal watercraft in recent years. Watercraft rely on light, high-speed/low-torque 2-stroke-cycle engines. Powerplants like these respond best to an axial-flow jet pump, in which the flow of water stays essentially horizontal.

The Sea-Doo Formula Pump, used



Specialty Outboard Jetdrive



This bolt-on unit replaces the standard gear case of an outboard.

on Sea-Doo watercraft, features state-of-the-art axial-flow technology. Water is drawn into the pump housing through an intake in the hull bottom. A fan-shaped impeller accelerates the waterflow and forces it aft, where it's compressed by narrowing passageways. On this pump, impeller diameter is 5.5 in. and nozzle diameter is 3.5 in., so the ratio of compression is much less than that of the AT pump. However, at up to 7000 rpm, the speed of the impeller is greater.

The Sea-Doo pump has a stator between the impeller and the nozzle, but, unlike the AT pump, its function is to straighten the swirling flow of water off of the impeller blades and direct it aft. It doesn't compress the water.

The impeller tips mate to a sacrificial urethane wear ring inside the

pump housing, which can be replaced if damaged by sand or rocks. When new, there is an incredible 0.005-in. clearance between the impeller and the wear ring, and its service tolerance is 0.04 in., at which point the pump performance is diminished.

Compact jet boats present a challenge slightly different from other watercraft. Because these boats are larger and heavier than PWCs, the pump must turn a larger-diameter impeller that requires more bottom-end power for initial acceleration. Mercury Marine chose to power its Sport Jet drives with converted outboard-motor powerheads that offer more displacement and bottom-end power than a typical watercraft engine. A 3-cylinder 95-hp Sport Jet displaces 1231 cc, whereas a 2-cylinder 80-hp Rotax

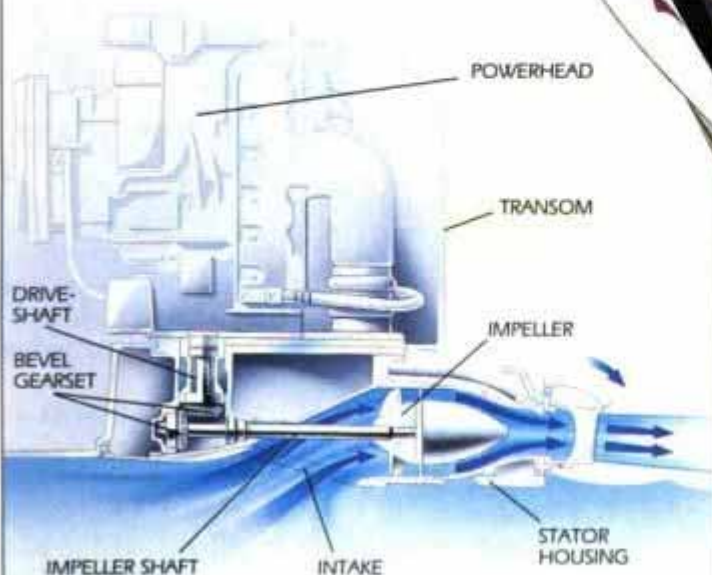
Sea-Doo engine displaces just 650 cc.

Another difference with the Merc Sport Jet engine is that it's mounted vertically and uses a bevel-gear drive to mate its driveshaft to the horizontal impeller shaft in the pump. Although there is a slight power loss through these gears (about 3%), this package is shorter horizontally than a direct-drive watercraft drivetrain and thus fits well in a small boat. The gears also make it possible to adjust the drive ratio between the impeller and the engine—to increase impeller speed while maintaining a lower, more efficient engine speed, or to gear down the engine to enable it to run an impeller with more pitch.

The Sport Jet pump is sort of a hybrid of mixed- and axial-flow designs.

(Please turn to page 123)

Mercury Sport Jet



Compactness is achieved by mounting the powerhead vertically in relation to the jet pump.





Inside front-line MEDFAST vehicle (right), teleoperated surgical instruments save soldier's life, while on-scene medic monitors his progress. At rear-echelon contingency hospital, surgeon (left) views 3D images and manipulates control devices. Signals are relayed through E-8C J-STARS surveillance aircraft. Stateside specialists (above left) offer real-time guidance via commercial satellite link.

LONG-DISTANCE OPERATORS

Robotics and telecommunications take the surgeon's skills anywhere in the world.

BY SCOTT GOURLEY, PM Illustration by Paul DiMare

• The year is 2005. A disintegrating political climate in Southwest Asia has once again put American soldiers in harm's way. Out ahead of an invasion force, Army Rangers are reconnoitering the desert landscape. But they've been spotted. And as a young sergeant lifts his scope to study the sands before him, an incoming rocket round showers his position with fragments of steel.

Twenty years ago, the attack would have left him miles from medical attention with life-threatening injuries. But today, medicine stretches out a long arm. From the moment the shards enter his chest cavity, the Ranger's personal status monitor—a wrist-worn

device that tracks his position and vital signs—begins transmitting information back to a battalion aid station. There, medics scan the data and opt to move directly to the wounded soldier.

Working quickly, they stabilize his most serious wounds and load him into a Life Support for Trauma And Transport (LSTAT) pod, a covered stretcher in which he is hooked up to a blood-infusion pump and a ventilator. During the short trip back to the aid station, the Northrop-built LSTAT hands off critical data. At the station, casualty-care workers transfer the soldier to a brand-new tracked vehicle. Called



LONG-DISTANCE OPERATORS

MEDFAST, for Medical Forward-Area Surgical Telepresence, this vehicle will save the soldier's life.

Meanwhile, the medic has contacted a thoracic surgical specialist about 100 miles from the combat area. The surgeon is having a busy night. He's just concluded an operation on a similar casualty 50 miles to the north. Now he must turn his attention to the wounded sergeant. But although he remains at the contingency hospital, his skills can fly to the battlefield.

That's because MEDFAST contains enough communications and robotic hardware to become the surgeon's eyes and hands, to mirror his training and instincts and duplicate his sense of touch. Controlling the needle and scalpel as if they were in his fingers, the specialist steers his robotic counterpart through the delicate procedure. In effect, he patches up the soldier over the radio waves.

MEDFAST is just one near-term result of the Pentagon's vigorous investigation into the field of remote medicine. The goal: telesurgery, the capability to conduct surgical procedures over long distances. The bottom line is that military operations will soon take on a whole new meaning. In the future, soldiers will bring their surgeons with them to the front lines. But the rest of us will also benefit. The same technology could soon put world-class surgeons right at the scene of highway

accidents, explosions, earthquakes and other civilian disasters.

Life on the line

The man who spearheads this effort is Army Col. Richard Satava. As well as managing an advanced biomedical technologies program at the Advanced Research Projects Agency (ARPA), Satava serves as special assistant to the Advanced Technology Program at the Army's Medical Research and Materiel Command.

"The main problem we have in the military," he notes, "is saving soldiers' lives once they have been wounded on the battlefield. About one-third of them bleed to death because they don't have a surgeon."

To remedy this shortcoming, ARPA is sponsoring fast-paced activity at universities and research centers. Among the most exciting developments is the Telepresence Surgery System from SRI International, in Menlo Park, California. As it turns out, SRI has been working on the hardware for several years.

The system places the surgeon in front of a large console at a remote location. He or she gazes at an "apparent workspace," viewing a 3-dimensional image that's relayed from stereo cameras at the operating site. Meanwhile, the surgeon's thumb and finger slip through control loops of two instruments hanging beneath the

console. Sensors measure and digitize the physician's subtle motions. This information is sent to two robotic manipulator arms that follow the movements, actually operating on the patient.

Researchers have already used the system to perform surgery on a live, anesthetized pig. This milestone took place last December at the University of California at San Francisco. According to John Hill, principal engineer for SRI's electronics technology laboratory, the procedure broke substantial new ground. "With live tissue," he explains, "the pig is breathing, and you have to follow the body movement with the manipulators."

Adds Satava, "They did surgical procedures to see if this equipment could stop bleeding. And it can. Until this time, we had proved the technical feasibility of the system. Now it's been proved functionally."

Air time

But both Hill and Satava acknowledge that steeper challenges lie ahead. In the telesurgery demonstration, wire cables connected the remote-control devices with the operating hardware. Last spring, SRI engineers began refurbishing the two sites for radio control, installing the surgical equipment in a modified M577 armored command post. The new configuration calls for data compression and the multiplexing of video, audio and control signals

Robotic manipulator can brandish several surgical tools such as graspers, needle drivers, scalpels and scissors. Stereo cameras provide video.



over a radio transmitter. This poses considerable difficulty because the necessary high-bandwidth technology is fresh out of the laboratory.

Once they have demonstrated the radiolink, engineers will upgrade both the robotic manipulators and the surgeon's control devices. Although they're impressively supple, today's manipulators feature only four degrees of freedom—motion up, down and sideways, along with the ability to roll. A fielded system must pitch and yaw as well. System designers also want to give the instruments more range—1 cu. ft. rather than the 4-in. cube that the current machines ply.

On the surgeon's end, refinements will focus on lending the operator a better sense of touch. The existing control devices provide force feedback on each axis. In essence, computer circuitry between surgeon and robot translates any resistance that the robot encounters, to make hard objects—such as bullets—feel hard, and soft objects—such as organs—feel soft.

But surgeons want better. So engineers are striving to pare down friction in the hardware, to let the remote surgeon feel as little as an ounce of pressure. A second program will place force sensors right on the surgical tools. These will feed back pressures as gentle as one-tenth of an ounce.

Hill hopes to demonstrate this next-generation hardware a year after demonstrating the radiolink. He adds that future enhancements will include better 3-dimensional imaging technology and a wider variety of trauma-surgery instruments.

Meanwhile, at ARPA, Satava suggests that it may be only 18 months before the Food and Drug Administration (FDA) begins to address the unique approval process for a telesurgery system. ARPA, after all, fosters dual-use technology, and the FDA must sign off on civilian applications.

Doctors on call

But although long-distance operations may be several years away, telemedicine is already laying the groundwork for the more technically challenging telesurgery. And while civilian scientists have made great research progress, the military has taken telemedicine to the front lines.

For the past year and a half, a program called Operation Primetime has been supporting the contingent of U.S. soldiers stationed in Macedonia, south of Bosnia. Based at Camp Able Sentry, Primetime covers a main aid station, two forward air stations and 10 to 12 observation posts scattered as far as 3 hours away.

At the heart of the system is a small arsenal of diagnostic instruments and

Surgeon's control devices feature loops for thumb and finger. For a finer sense of touch, computer provides force feedback, reflecting resistance that remote surgical instruments encounter.



a video-teleconferencing unit that permits consultation between doctors in Macedonia and medical specialists in Europe and the United States. The technique is known as telementoring. And it's already saved one life.

Last December, medics brought in a 26-year-old soldier from one of the outposts. Wheezing severely, the patient showed symptoms of respiratory failure. When initial oxygen and drug treatments failed, the medical officer at Able Sentry contacted the Army's Casualty Care Research Center in Bethesda, Maryland. Via the commercial Inmarsat satellite, doctors in Bethesda received digital color images of the patient, while pulse-oximeter data gave them real-time information on his blood-oxygen level.

Their satellite-relayed observations confirmed that the soldier was rapidly approaching respiratory failure. The specialists suggested an alternative drug therapy, which stabilized his condition. They also put together a contingency treatment protocol for the medic who accompanied the patient during his air evacuation to the Navy's 6th Fleet hospital in Zagreb, Croatia.

Wheels that heal

Just as ARPA's telesurgery effort centers on a vehicle, the Army is working to take its telemedicine system on the road—in a prototype Mobile Medical Mentoring, or M3, vehicle. "Its advantage is the ability to tap into many different forms of expertise,

without actually bringing those people to the scene," says Maj. James Ellis, clinical director of the telemedicine program at Fort Detrick, Maryland.

The M3 vehicle is evolving in a command post mounted on a Hummer. Although intended as both war machine and humanitarian-assistance vehicle, it will differ from civilian prototypes. It will be more rugged, air-transportable and compatible with military communications networks.

Inside, a Sun workstation will manage information and images from an electronic stethoscope, ultrasound, X-ray machine and other diagnostic scopes. To support these capabilities, communications links will work through Army tactical radios as well as civilian transmitters. Right now, designers are weighing their choices. Communications could flow at the data rate of a standard telephone call, a T1 leased line or a high-capacity T3 line. The tradeoff is that faster transmission would limit the M3's mobility, requiring the use of a large trailer.

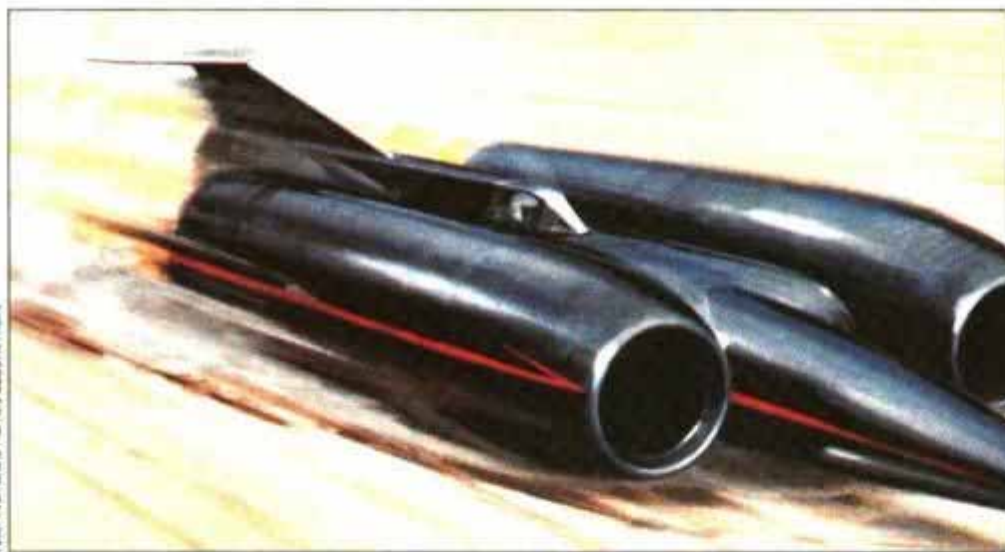
The communications challenge is common to telesurgery and mobile telementoring. But it's a challenge that's likely to be surmounted through rapid electronic evolution. As Satava says: "Medicine is no longer blood and guts—it's bits and bytes. This is the first representation of medicine moving out of the industrial age and into the information age. And telesurgery is just one more of these information technologies." **PM**

BREAKING THE —ON WHEELS!



These cars are designed to exceed Mach 1 and shatter existing land-speed records.

BY RICH TAYLOR, Contributing Editor



rett. Barrett's Budweiser Rocket reportedly went transonic in 1979 at Edwards Air Force Base. The rear wheels were literally blown clear off the ground and Barrett pulled out of the throttle before completing his run.

The new generation of land-speed record vehicles looks like a squadron of weird fighter planes. The design intention is to let shock waves dissipate beneath the tubular fuselage while using wing-mounted ailerons to keep the vehicle on terra firma.

Englishman Richard Noble blasted to 633.468 miles per hour in his jet-powered Thrust II back in 1983 to claim the world land-speed record (LSR). He still is the proud owner of the top mark. And, while nobody has traveled faster on the ground since, technology has continued to accelerate over the past decade. In fact, today's racers plan to not merely break Noble's record, they intend to demolish it—and burst right through the sound barrier in the process.

As if land-borne jet travel isn't potentially dangerous enough, the contenders to the speed crown are facing a great unknown. Any object that reaches 1088 ft. per second—741.8 mph at sea level and 32° F—sets up a series of shock waves as it surpasses the speed of sound. What will happen when these intense waves of uneven pressure bounce back from the ground beneath a speeding vehicle as it breaks through the sound barrier?

Only one man claims to know, and he is Stan Bar-

Here's a rundown of the current serious contenders that are out to set a new land-speed record.

Spirit Of America

Craig Breedlove was the first racer to break the barriers of 400, 500 and 600 mph. He held the LSR five separate times between 1963 and 1970, becoming a household name in the process. "Brave Speedlove" then retired to make his fortune in California real estate. Now 58, Breedlove is spending \$2.5 million to build a next-generation Spirit Of America vehicle.

Breedlove has eight employees working in a small shop in sleepy Rio Vista, California. The vehicle they're building is 47 ft. long, about 8½ ft. wide, and weighs 8500 pounds. It has a central fuselage with wings at the rear. The outboard wheels are covered by long aerodynamic fairings, and, of course, it's painted red, white and blue.

The vehicle's fuselage, wings and fairings use frames

SOUND BARRIER



welded from steel tubing, with special Alcoa aluminum alloy bulkheads and skin. There's a pointed nose in front of the cockpit, which in turn is sandwiched by the twin air intakes that are feeding a military surplus 48,000-hp jet engine originally used to power a Navy F-4 Phantom. About the only bits of truly unusual technology in evidence are 850-mph tires made with filament-wound Hercules-graphite.

Spirit Of America is close to completion. As we go to press, Breedlove expects to start testing at Black Rock Desert, Nevada.

If he succeeds, he will have set land-speed records some 32 years apart. That's got to be a record in itself.

Thrust SSC

Noble is building a new vehicle to defend his crown. Called Thrust Super-Sonic Car, it's powered by two Rolls-Royce Spey 205 jet engines, which produce a combined total of 100,000 hp. The driver sits between them behind a long pointed nose and ahead of an aircraft-style elevator/rudder tail section. Two forward wheels sit outboard of the side-mounted engines, and dual rear wheels—which are used for steering—are stagger-mounted inside the long-tailed Kevlar/carbon-fiber-bodied, monocoque-chassis vehicle.

Noble expects to make his first record attempt at Black Rock Desert right about now. Royal Air Force pilot Andrew Green will be at the controls. Noble, who retired from driving to become team coordinator, says the car is designed to go 800 mph.

Aussie Invader 2

Australian jet-car drag racer Rosco McGlashan hit 498.6 mph at Lake Gairdner, Australia, in March 1994.

Spirit Of America (above) and Thrust SSC (opposite page) are prime LSR contenders. Australian Challenge (below) is aiming for the wheel-driven record.



Theoretically, McGlashan's car has a potential top speed of 670 mph. That's enough to claim Noble's record, but nowhere near Mach 1.

Aussie Invader 2 was built in a small garage near Perth, Australia, by McGlashan and his friends. Invader 2 is designed around a single Atar 09C5 turbojet engine from a Mirage fighter plane built in the late 1950s. It produces about 15,000 pounds of thrust, roughly 30,000 hp. Invader 2 is just 27 ft. long, 4 ft. high and 7 ft. wide. The Atar engine is 22 ft. long and 3 ft. in diameter, so McGlashan's car is about as compact as it can be. The total weight of the craft is 11,000 pounds.

McGlashan's vehicle has a space frame of chromemoly tubing covered with a blunt fiberglass body. The driver sits in a cockpit set into the left side between the wheels.

The most high-tech components on Invader 2 are its four forged-aluminum wheels. These have ribbed rims and are designed to run without tires. Racing-style carbon-fiber disc brakes and two parachutes are used to stop the vehicle. McGlashan is sponsored by an Australian television network, so whatever happens to Invader 2 will be broadcast live for all the world to see.

Green Monster No. 27

Pioneer hot-rod Art Arfons, of Akron, Ohio, became famous with a series of aeroengined dragsters, all painted John Deere Green and called Green Monster. In 1965, he briefly held the land-speed record at 576.553 mph with a homebuilt car powered by a



For The Record

● There is an excellent chance that Craig Breedlove will make history, and his Spirit Of America could conceivably be enshrined at the Smithsonian Institution in Washington, D.C. The car will be a billboard for the names of a host of corporate sponsors. But there will be a place on the car where individuals who are sponsoring members of the team will have their names inscribed. Anyone can become a sponsor. For more information, write SOAWSRT, 200 N. Front St., Rio Vista, CA 94571, or call (510) 855-9902. The America Online e-mail address is SOAWSRT@AOL.COM.

GE J79 turbojet. In November 1966, Arfons survived the world's fastest accident—at 610 mph.

Two years ago, Arfons completed another LSR car, which, though still called Green Monster, is painted red, white and blue. It's a tiny missile just under 25 ft. long, 2 ft. wide and 3 ft. high (5 ft. to the top of the tail fin). It's built around a small biz-jet engine rated at only 9000 hp—but then, Arfons claims this Green Monster weighs an ultralight 1800 pounds.

The frame is 4130 chromemoly tubing, covered by a Kevlar-reinforced

fiberglass body. There are two front wheels set in tandem, each 26 in. in diameter and 3 in. wide. Forged by Alcoa, these aluminum wheels, like McGlashan's, carry no tires. Each rear wheel is carried on a rigid strut projecting from the side of the car and is only 16 in. in diameter and 2 in. wide.

Maverick

Much more costly than any of these other LSR programs, McLaren Advanced Vehicle's (MAV's) contender is still in the planning stages. To be called Maverick, it measures 42 ft.



long, 17 ft. wide and 11 ft. high. There's a wheel at the end of each wing, plus two wheels set side by side under the nose. A third of its 6600-pound weight is a Rolls-Royce RB199 Mk104 gas-turbine engine rated at 38,000 hp, which should push the Maverick from 0 to 850 mph in less than 40 seconds if a course that's long enough can be found.

The vehicle is made of Kevlar/carbon fiber. Like a fighter pilot, the driver will be strapped into an ejector seat programmed to blast him free if, as McLaren's Ron Dennis delicately puts it, "the angles experienced by the computer are inconsistent with the wheels being on the ground."

Unlike most other LSR machines, which use a fixed suspension, the Maverick has a computerized active suspension that's derived from McLaren's Formula One racers. The engineers hope this will allow the Maverick to smoothly traverse the Mach 1 "speed bump."

The team plans to make its LSR attempt by the summer of 1998.



BRITISH THRUST

Englishman Richard Noble and his Thrust II jet-powered car currently own the land-speed record at a shade over 633 mph. Noble intends to head a team to break his own record and Mach 1 with a twin-jet vehicle piloted by Andrew Green. The Thrust SSC has two Rolls-Royce jets for 100,000 hp, four wheels, a monocoque chassis and Kevlar/carbon-fiber body. SSC is designed for 800 mph.



While all of these jet-powered vehicles are chasing the speed of sound and the ultimate land-speed record, there's a whole 'nother show going on. That's the quest for the wheel-driven speed record. On November 13, 1965, California hot-rodder Bob Summers set that record at 409.277 mph in the Summers Brothers' homebuilt Goldenrod. Then, in August 1991, Al Teague posted a supercharged-single engine record for wheel-driven vehicles at 409.986. There are still

FUEL TANK
HOLDS 95 GALLONS
OF UNLEADED GAS

STEERING FIN
PIVOTS 2"

SPIRIT OF AMERICA

True American hero Craig Breedlove holds a model of the real thing, Spirit Of America. Former LSR record holder Breedlove intends to ride nearly 50,000 hp worth of an F-4 fighter jet engine across Black Rock Desert. The details of Spirit Of America show that it may not be unusual in design, but it is very purposeful.

SIDE-MOUNTED JET AIR INTAKES

CARVED-BILLET BULKHEAD

COCKPIT

STEERING-FIN
CONTROL
WHEEL

THROTTLE
CONTROL ROD

GAS PEDAL

THREE FRONT
WHEELS MOUNTED
ON SINGLE AXLE

BRAKE SHOE

folks who intend to better that feat, and they are as follows:

Australian Challenge

Australian hot-rodder Glen Davis hopes to break the Summers Brothers' and Teague's records by hitting 500 mph. His Challenge looks like a 41-ft. pencil, with small bulges around the tires. Davis will recline in a cockpit enclosed in the pointed nose ahead of the front wheels. Small tail fins flank the chisel-point tail. The chassis is a simple monocoque of sheet steel. The body is a Kevlar/carbon-fiber sandwich with balsa cores. Davis has designed an all-independent suspension with hydropneumatic load-leveling. He's also chosen two surplus Rolls-Royce Meteor Mk4B twin-turbocharged V12 tank engines for power, placed front to front in the center of the

chassis. Running on methanol, each 27-liter engine produces only 2500 hp at 3800 rpm—a very mild state of tune for a racing powerplant.

Team Natural Gas Streamliner

Indy driver Lyn St. James is putting together an attempt on the wheel-driven record. Built by Indianapolis-based chassis constructor Bob Riley, St. James's car is very conventional. Imagine a typical midengine Top Fuel dragster. Add awd for traction and a track less than 3 ft. for smaller frontal area. Cover its tubular space frame with a streamlined aluminum/composite body less than 3 ft. high, 3 ft.

wide and 28 ft. long. Even with the driver, the car should weigh only 2800 pounds ready to run.

Running on methane, St. James's car will produce only 2200 hp from a supercharged 570-cu.-in. V8. It should be more than enough to push her to 450 mph. If Davis has his way, that may not be fast enough.

At the very least, St. James should be able to grab the women's LSR, held since 1965 by Lee Breedlove, Craig's former wife, at 308.560 mph. **FM**



AUSTRALIAN CHALLENGE

The biggest threat to the Summers Brothers' and Al Teague's wheel-driven speed records is from the twin-V12-powered Australian Challenge. Built and driven by Aussie hot-rodder Glen Davis, the Australian Challenge is a 41-ft.-long all-wheel-drive pencil capable of going 500 mph. The methanol-powered turbocharged V12s each drive a set of wheels.



PHOTO BY BILL NATION



GROUND RULES

Ballpark field patterns are getting more and more complex. But creating them is surprisingly simple.

TEXT AND PHOTOS BY CLIFF GROMER, Contributing Editor

● "... And the Brewers' Dave Mellor lines one to third, while..."

Wait a minute. Mellor? This guy isn't in the Milwaukee lineup. Heck, he isn't even on the team. What gives?

Simple. Mellor doesn't hit line drives. He just lays down lines, or stripes, on Milwaukee County Stadium's field in his job as assistant director of grounds. Those stripes add up to some really eye-catching patterns. How does he do that?

The answer is surprisingly low tech—just by mowing with conven-

tional equipment. It's even easy enough for you to create a pattern in your front lawn and backyard, and have all your neighbors swarm over your lawn demanding to know how you did that.

Patterns aren't created by cutting the grass to different heights, as is commonly thought. The outfield grass is a uniform 1½ in. high, whereas the infield is higher—to slow down the ball—but also uniform at 1¾ in. The mowers used—a 22-in.-wide John Deere reel-type walk-behind and a

triplex (three reels in a row) riding mower that cuts a swath 72 in. wide—have rollers in front of and behind the cutting blades. The reel and rollers bend the grass blades in the direction of mow. Light reflecting off the grass creates the effect of light and dark areas. If a stripe of grass appears light from where you're standing, the mower was rolled *away* from you. A dark-looking stripe means the mower was rolled *toward* you.

Golf courses actually started striping their fairways long before ball fields picked up on the technique. But because golf greens are cut fairly



MILWAUKEE BREWERS PHOTO



Milwaukee Brewers' signature pattern (top). Conventional walk-behind reel mower with rollers that define stripes (left and above). Mowing in progress to create checkerboard pattern at Yankee Stadium (far left).

short—only about 1/4 in. high—the grass blades don't bend that much, making the stripes hard to distinguish. The big influence in baseball-field patterns has been television, to the point where groundskeepers tune in to other games to see the field rather than the action.

When Mellor creates a new pattern, he first sketches it out on paper. Symmetrical patterns take into account the mower's 22-in.-wide cut. It's not only the design that counts, but also how it will show up on TV. Stripes that go across the infield—from first to third—are almost invisible when

viewed from behind home plate. For important games, like those shown on ESPN or featured on the "Game Of The Week," the pattern is rolled two or three times for more definition.

To create the Brewers' signature pattern with its distinctive infield checkerboard-cross center surrounded by four quadrants of stripes, Mellor uses a tape measure and line string to lay out the sections. Then he rolls in the angle stripes of the checkerboard first. He cuts half the design in each of the four checkerboard quadrants, rolling parallel stripes in the same direction—toward the outfield—using the baselines as reference points to ensure parallel lines. He mows the home to first quadrant, and then the third base to second quadrant. Next, he cuts and rolls the contrasting cross stripes in the opposite direction—toward home plate—using the third/home and first/second baselines as reference points.

The four sections of straight stripes, from home to second, are last and help hide the turnaround areas necessary for making the checker-

board. To continue the straight line on the other side of the mound, Mellor uses a line string or mows by eye, focusing on a distant point that keeps him lined up.

When the team is away, Mellor cuts and rolls the grass—a blend of 90% Kentucky bluegrass and 10% perennial rye—in different directions to avoid letting the blades take set, creating a graininess that can cause a ball to snake instead of roll true. It also makes for stronger, healthier turf. A diet of micronutrients such as iron and manganese gives the grass a dark, lush color, increasing the contrast between the light and dark stripes. And

How did they do that?

towing a screen drag, which is sort of like a section of cyclone fence, over the field also helps the grass to stand up so it can be more easily rolled in different directions.

So much for how the pros do it. What about your home turf? You can create your own lawn art by hooking up a roller behind your walk-behind or riding rotary mower. All it takes is a homemade bracket, a length of PVC pipe filled with sand and some imagination.



PONTIAC BONNEVILLE

Meet GM's No. 1 Bimmer buster.

BY MICHAEL LAMM, Contributing Editor; PM Photos by Bill Delaney

● The current-generation Bonneville came on the scene in 1992 as Pontiac's sharp-looking, great-handling driver's car—a 5-passenger sedan that any young exec can park in front of his world headquarters with pride and confidence. In short, the Bonneville is a car that Pontiac positions as having everything a BMW buyer would want, for thousands less. Even back in 1992, the Bonneville SSE and SSEi offered dual airbags, ABS and optional traction control—all very important to buyers then and now.

Pontiac's success has traditionally been molded by body designers. That's because underneath any Pontiac you'll find some other GM car. Except for the

Fiero, there hasn't been a full-blooded Pontiac in years. So whether it's a Camaro derivative like the Firebird or an H-car like the Bonneville—with basics shared by the Buick LeSabre and Oldsmobile Eighty Eight—there's always one department in which every Pontiac shines, and that's styling.

In the opinion of our Owners Report respondents, the Bonneville does that in spades. Styling hit the mark so dead-on that 62.9% listed it as their main reason for buying. "Looks like an Infiniti on steroids," quipped a Tennessee photoengraver.

As we said, the Bonneville shares GM's H-platform with the Buick LeSabre and Olds Eighty Eight. It also



Interior comfort got good marks.



Both V6 engines put out lots of power.

shares engines and transaxles with the Buick Park Avenue, including the supercharged version of Buick's 3.8-liter V6. The standard engine in the Bonneville's 1994 series (the subject of this report), the SE and SSE, is the 170-hp 3.8-liter V6. But for \$1167 more, the SSEi option package included an Eaton supercharger, Z-rated 16-in. tires, 2.97:1 final-drive ratio and blower boost gauge. The supercharged V6 thinks it's a V8 and delivers 225 hp at 5000 rpm. "Performance with the supercharger," commented a Wisconsin manager, "is equal to a BMW 535i."

The SSEi's 275 ft.-lb. of torque comes on without lag and covers the middle of the rpm band, right where most drivers need it. All Bonnevilles come with an electronically controlled 4-speed automatic, but the SSEi's has two pushbuttons on the console, PERFORMANCE and NORMAL, that change the shift points. With the 2.97 axle, the pushrod V6 loafs along at 60 mph in overdrive Fourth gear, the engine

ticking over at 1650 rpm. This helps to explain the 17.4 city and 23.6 highway mpg our owners reported for the supercharged Bonneville.

How Pontiac cares

Pontiac vowed several years ago to give its customers the sort of dealer service Lexus and Saturn made famous. The Pontiac Cares program was set up to educate dealers that the customer was indeed king.

So how does the Pontiac Cares program rate with our surveyees? Not bad, actually. Dealer sales policies rated excellent in 60.1% of all cases and included lots of comments on followup phone calls from sales personnel. The service department garnered a rating of 56.1% excellent. Those are fine marks. "The dealer treats us like family," volunteered a Delaware civil servant. "He gives the impression that he's genuinely concerned with our wants and needs."

Pontiac offers a 3-year/36,000-mile,

SUMMARY OF PONTIAC BONNEVILLE OWNERS REPORTS*

Total miles driven	1,571,854	Handling	41.0	Average	0.7	What type of trouble?	
Average miles driven	5477	Comfort	34.1	Poor	0.0	Electrical	16.7%
Purchase price:		Performance	27.2	Control layout:		Transmission	8.3
Average	\$23,440	Ride quality	20.7	Excellent	57.7%	Windshield wipers	8.3
Range	\$17,892-\$32,000	Engine power	17.6	Good	38.9	Oil leaks	6.7
Why did you choose the Bonneville?		Interior styling	10.7	Average	2.0	Repair it yourself?	
Styling	62.9%	Specific dislikes:		Poor	1.4	No	94.9%
Owned Pontiacs before	23.7	No complaints	15.9%	Instrumentation:		Yes	5.1
Price/value	15.9	Wind, road, exhaust noise	13.2	Excellent	61.1%	Dealer repairs satisfactory?	
Performance	14.8	No lumbar or memory seats	10.0	Good	37.5	Yes	81.6%
Handling	13.4	Fuel mileage could be better	5.9	Average	1.0	No	18.4
Overall comfort	12.7	Rear, side vision	5.9	Poor	0.3	Dealer service opinion:	
Model choices:		Ride too firm	5.0	Driver sightlines:		Excellent	56.1%
Bonneville SE	63.0%	Needs more power	4.5	Excellent	52.9%	Good	34.2
Bonneville SSE	25.7	Suggested changes:		Good	39.6	Average	5.7
SSEi supercharger package	11.3	No changes, leave as is	12.0%	Average	6.5	Poor	3.9
Engine choices:		Make car quieter	12.0	Poor	1.0	Dealer sales policy:	
170-hp 3.8-liter V6	87.1%	More engine power	8.3	Overall convenience:		Excellent	60.1%
225-hp supercharged package	12.9	Lumbar, memory seats	6.3	Excellent	55.0%	Good	33.3
Options/Accessories:		Smoother ride	5.2	Good	43.0	Average	5.8
Cruise control	100.0%	Relocate cup holders	5.2	Average	1.4	Poor	0.7
Power driver's seat	97.0	Improve vision	4.7	Workmanship opinion:		Number of vehicles owned:	
Alloy wheels	93.0	Engine power:		Excellent	64.2%	This vehicle only	16.2%
Keyless entry	88.7	Excellent	65.5%	Good	33.7	Two vehicles	51.7
Premium sound system	77.1	Good	32.8	Average	1.7	Three vehicles	24.0
Performance/handling suspension	65.6	Average	1.4	Poor	0.3	Four or more	8.0
Leather seat trim	66.3	Poor	0.3	Comfort opinion, front seats:		Principal driver:	
Traction control	59.5	Handling:		Excellent	72.0%	Male	49.6%
Theft-deterrent alarm	35.4	Excellent	74.8%	Good	24.6	Female	46.7
Sunroof	26.9	Good	23.8	Average	2.7	Both equally	3.7
Computer Command Ride	21.5	Average	1.4	Poor	0.7	Age distribution of owners:	
Average mpg, city/hwy:		Poor	0.0	Comfort opinion, rear seats:		Under 29	5.6%
170-hp 3.8-liter V6	19.7/26.4	Braking:		Excellent	56.3%	30-49	50.0
225-hp supercharged V6	17.4/23.6	Excellent	70.5%	Good	39.1	50-plus	44.3
Specific likes:		Good	27.1	Average	4.6	Based on your experiences, would you buy a Pontiac Bonneville if you had it to do over again?	
Styling	69.7%	Average	1.7	Poor	0.0	Yes	70.7%
		Poor	0.7	Mechanical trouble?		No	29.3%
		Overall performance:		Excellent	79.9%	Maybe	26.6
		Excellent	69.5%	Good	20.1	No	2.8
		Good	29.8				

* Percentages might not equal 100% due to rounding up or insufficient data.

PONTIAC BONNEVILLE



Pontiac adds pizzazz to the style of all its cars for good reason—people love it. More than 60% of our owner respondents chose style as their favorite feature of the Bonneville.

EDITORS REPORT

Express Yourself

● Does Pontiac have a great idea or what? Imagine: Give buyers equal or better performance, luxury and handling than that of a BMW but for thousands less in price. It's a great marketing strategy—more for less—and the result is that the Bonneville is one of the best car values you can buy these days. What's more, Pontiac backs up the strategy with hardware that puts its money where its mouth is, and a dealer body that's really trying to satisfy customers. Like we said, is this a great idea or what?

It's great to hear about a dealer body getting rave reviews from customers. And that's the kind of feedback we're getting these days about Pontiac dealers. They really care. It was there in our survey results, too, with many respondents telling us about their dealers going overboard in trying to solve problems. Cheers to Pontiac and its dealers for recognizing that customers are going to keep you in business—or watch you go down for the third time.

Talk to Pontiac executives and they'll tell you that their customers are more "expressive" than other GM division customers and that they like more expressive cars. That's why the Bonneville has a lot more style and flair than its corporate cousins.

That's why Pontiac can hang plastic side cladding on its car, tune the suspension way stiffer, put gold badges all over it, bedeck the rear with a big spoiler and have the loudest exhaust of any of the three cars that share the same platform. Most

of its customers wanted it that way.

Much of the stuff we're talking about here is reserved for the SSEi option cars. In all fairness, the standard SE has one of the cleanest, best-looking profiles out of Detroit these days. And if only they'd let you get the supercharged engine without the gold badges and spoilers, they'd have a helluva package.

Last year, the standard Bonneville engine was fair to adequate but no match for the stylish looks of the car. Ditto for the handling with the standard base suspension. But this year, the power problem has ended with the new Generation II 3800 V6 rated at 205 horsepower. And there's still the supercharged 3800 available as part of the SSEi package.

Many of our survey respondents thought the Bonneville's suspension was too stiff. We agree. Today, there's no excuse for a stiff ride in the quest for better handling. Auto engineers long ago found out how to have both, and the Bonneville should definitely have both.

The interior design is busy but effective. The seats, especially with the leather option, are fantastic with excellent support and lots of comfort built in. The optional power seats still require 12 buttons to make all the possible adjustments—and that's ridiculous. But you do have a pretty good driving position after you've invested an hour adjusting your seat.

We guess that's part of that "expressiveness" expressing itself.

—Joe Oldham

no-deductible warranty. Only 20.1% of our owners reported any mechanical problems, and those were fixed properly in 81.6% of the cases. Electrical gremlins topped the list, with faulty batteries the most common major complaint. Among nonmechanical problems, the inch-long plastic hasp on the console lid tended to break off easily—a 5-minute fix in most cases.

We unearthed a few complaints about wind roar, tire noise and an extremely loud exhaust note. Seems the Bonneville's throaty tailpipe burble isn't universally appreciated. The traction-control system also lets out with something akin to braying.

In keeping with the Bonneville's image and purpose, handling was given a mark of excellent by nearly 75% of our owners. A Michigan engineer wrote, "Moderate understeer at the limit, but very predictable and fun to drive." Bonneville's come with all-independent suspension: MacPherson struts fore, Chapman struts aft. The SSE offers Computer Command Ride (CCR) when you order traction control. CCR uses another console button to select Touring or Performance damper settings. Performance firms up the suspension, while Touring automatically selects firm or soft damping, depending on road and driving conditions.

The Bonneville's cabin design was judged to be as good as the exterior's. Instruments appear to be straightforward and easy to read. Shorter drivers had trouble seeing out of the back window because of the center high-mounted brakelight and raised speaker pods on the parcel shelf.

Some drivers felt that their seats should have adjustable lumbar support and a memory feature. The optional leather 12-way buckets do, but they're available only in the SSE and cost about \$1200. Those who ordered the head-up display liked it, but, here again, it's expensive. You order it as part of a \$1440 option group that includes keyless entry, automatic transmission, a/c and several other items.

Owners gave the Bonneville high marks for quality and workmanship. A New York program manager said, "Forget the imports! The Bonneville's fit and finish are perfect!" And an Ohio retiree observed, "Quality is built into this car. I believe GM got the message and hope they continue to build such excellent automobiles." What it all boiled down to was value. With SE prices starting at \$20,424, or only \$1000 more than a Taurus LX, most of the owners we surveyed felt they'd gotten a good deal. And nearly 71% told us they'd have no qualms about buying the same car for the same money next time.

PM

THE NEED FOR SPEED

A new breed of faster modems makes data transfer less costly.

BY GEORGE MANNES; PM Photo by Michel Tcherevkoff



● Take it from any Internet surfer who's had to wait 2 minutes for the White House's home page on the World Wide Web to finish loading. Or from a CompuServe subscriber who's had time to read the sports section as a graphics file downloads. Just as you can never have a raise that's too big, you can never have a modem that's too fast.

Thanks to advances in modem technology and higher standards, speedier versions of these computer communications devices are growing in popularity. And along with hauling data at a breakneck pace, modems are taking on new, more complex functions. Indeed, modems are already becoming a key tool in

THE NEED FOR SPEED

helping repair personal computers.

But fast things first. The latest plateau in modem speed was reached last year, when an international standards-setting organization officially ratified modem specifications for transmitting data at a rate of 28.8 kilobits per second. This standard, known as V.34, doubled the speed of the V.32bis standard for 14.4-kbps modems set in 1991.

Probably the biggest single factor enabling this higher transfer speed is the evolution of the telephone network—not the modem—says Michael Ziehl, product marketing manager for Rockwell Telecommunications, a major supplier of integrated circuits used at the heart of all modems.

Starting with the early 1980s standard for 2400-bits-per-second (or 2.4-kbps) modems, on through the 1991 standard for 14.4 units, engineers were constrained to a sonic bandwidth of 2400 hertz in which to transmit information. (In comparison, the range of usable audio frequencies on a compact disc is about 20,000 hertz.) But now that nearly the entire long-distance telephone network has gone digital, thereby reducing potential interference, Ziehl says, modem engineers have 40% more elbowroom. The V.34 standard assumes a bandwidth of 3429 hertz.

A V.34 modem also can "learn" which parts of the spectrum are clearest for transmitting data, explains Ray Wright, director of marketing for Motorola's

modem products worldwide.

By using the data-compression technology that's part of the new V.34 standard, speeds of up to 115.2 kbps can be reached between computers.

tend to be less compressible than text files, Wright says.

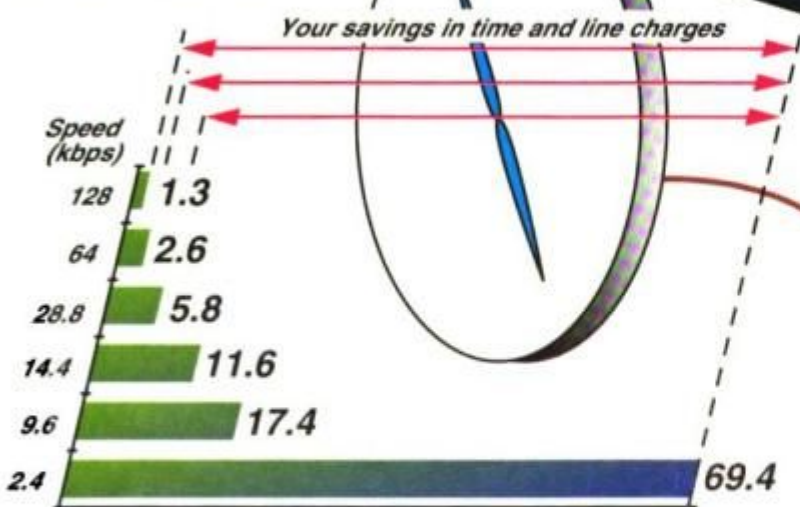
The uncompressed rate of 28.8 kbps is by no means an upper limit to modem speed. In fact, modem manufacturers such as AT&T Paradyne, based in Largo, Florida, and Penril Datability Networks, of Gaithersburg, Maryland, already manufacture modems that can transmit and receive at 33.6 kbps—as long as there's a compatible modem at the other end of the line. It's not a question of whether 33.6 kbps will become the norm, says Dick Stewart, vice president of technology for Penril and head of an international group that's setting modem standards. It's a question of when.

AT&T and Penril are only the latest in a long line of manufacturers marketing modems before an underlying international standard is set, satisfying the needs of impatient customers—though not guaranteeing that the modems they are selling will be compatible with



VoiceView transmits data and voice with one phone call.

But, as the saying goes, your mileage may vary. If the file is already compressed—for example, a .ZIP file found in an online service's library—you won't be able to get that much more compression. Also, graphics files



Minutes to transmit a 1-megabyte file

Source: Motorola

The rules of the road for modem transmissions are simple: The faster the transmitting speed, the lower the phone bill will be. This chart shows the time required to send a typical data file at various transmission speeds. If you intend to spend a lot of time online, the cost savings can be quite significant.

the eventual standard. Even before the 28.8 protocol was set, a number of manufacturers started selling not-quite-V.34 modems dubbed V.FC (or "Fast Class"). These operate at 28.8 kbps when communicating with other V.FC modems or with Rockwell-chipped V.34 modems, which are backward-compatible with V.FC. Otherwise—unless the manufacturer upgrades the modems—the speed drops down to 14.4 kbps. Since Rockwell's chips have at least a 50% share of the modem market, says Maribel Lopez Howard, an analyst for IDC, in Framingham, Massachusetts, V.FC users have a better-than-average chance that the modem on the other end of the line is V.FC-friendly.

Data plus voice

Beyond speed, the hottest development in the modem business are units that let people talk and transmit data



during a single phone call. This means they can play a computer game with a distant opponent and then yell at that person as easily as if they were sitting in the same room.

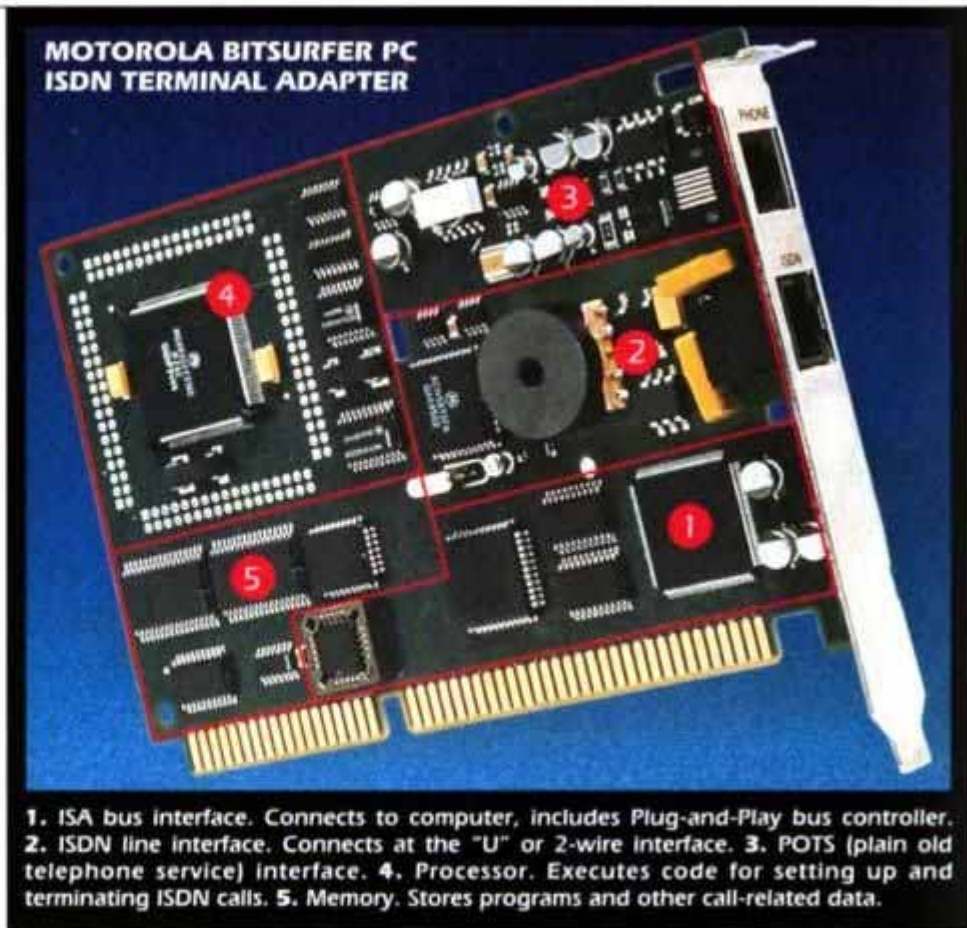
A simple approach that seems poised for quick acceptance is VoiceView technology developed by Radish Communications, of Boulder, Colorado. Costing very little to implement, VoiceView allows alternating voice and data to be transmitted during the same call. You talk, you send a file, you talk—and so on, as long as necessary.

The most compelling VoiceView application promises to be customer support of computer users, says Dick Davis, Radish's chairman and chief technical officer.

As any computer buyer might agree, one of the biggest hassles of computing is calling a computer or software company to get a problem solved. First you spend a half-hour on hold. Then you have a halting dialogue in which the person at the other end of the line says something like, "Call up your autoexec.bat file," and you ask, "What's that?"

Using the Radish technology, the same call for help could end up very different. Once you've given the technical service representative permission to delve into your computer, he or she can examine files on your computer alone while you just sit back. The tech rep can then make changes and re-save them to your computer.

VoiceView could be useful even be-



1. ISA bus interface. Connects to computer, includes Plug-and-Play bus controller. 2. ISDN line interface. Connects at the "U" or 2-wire interface. 3. POTS (plain old telephone service) interface. 4. Processor. Executes code for setting up and terminating ISDN calls. 5. Memory. Stores programs and other call-related data.

fore you get the technical service rep. While you're on hold waiting for help, Davis says, you could be presented with files to read on your computer screen instead of just music to listen to. A manufacturer might list, for example, the top-10 problems that users are complaining about that month. If your problem is among them, you

could download a text file that explains how to solve it.

This scenario isn't just wishful thinking. Computer manufacturer AST Research said earlier this year it would have VoiceView customer support starting this month for new buyers of its Advantage! line.

Visual phone calls

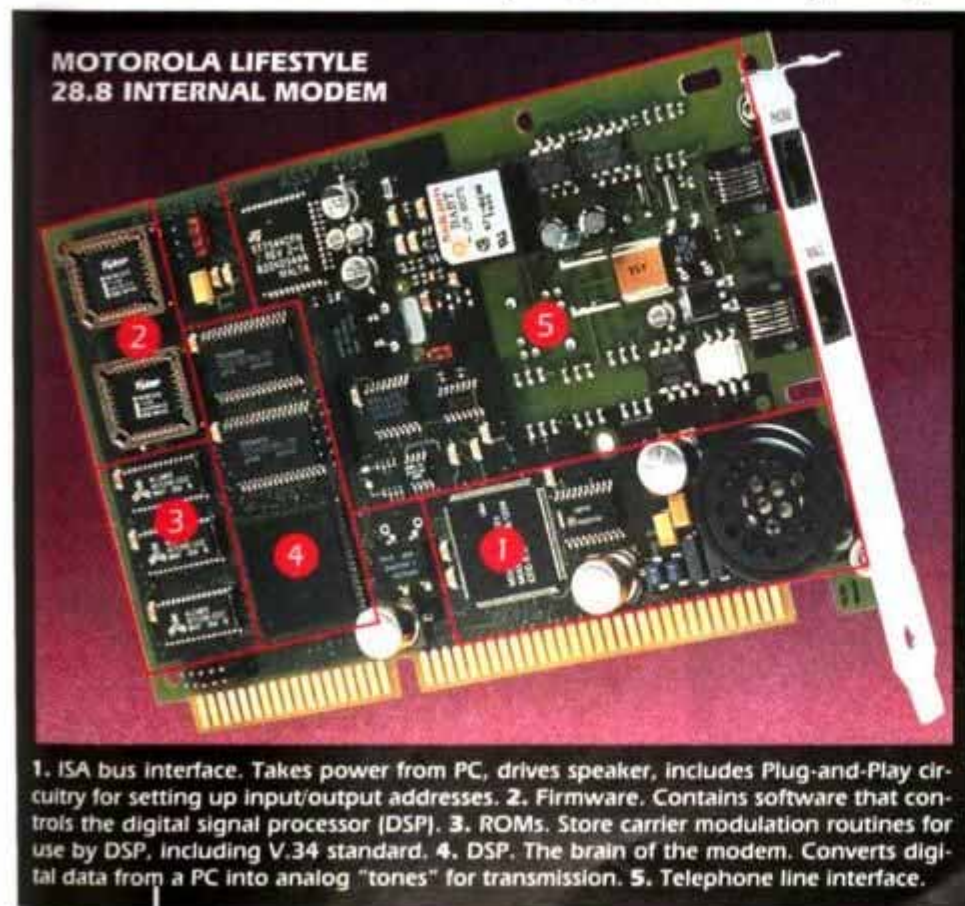
Another use for VoiceView is shopping. Blockbuster Music and 1-800-FLOWERS are two retailers that are scheduled to start VoiceView sales this summer.

In any event, VoiceView aims to be unimposing. It has "the look and feel of a telephone call augmented with visuals," Davis says. "It's not a data call augmented by voice."

Radish's technology looks as if it will take root quickly. The cost of VoiceView is negligible to the consumer. Rockwell, among other manufacturers, will be including the technology in its chip sets. "When you buy your next modem or PC, VoiceView will be there automatically through licensing agreements," Davis says.

Microsoft Windows '95, scheduled to ship this year, includes a simple application for transferring files with VoiceView modems. Microsoft is also supplying programming tools for companies to develop software using the technology. Boca Research started shipping 14.4-kbps VoiceView modems in late spring, and 28.8-kbps versions are expected from them and other

(Please turn to page 119)



1. ISA bus interface. Takes power from PC, drives speaker, includes Plug-and-Play circuitry for setting up input/output addresses. 2. Firmware. Contains software that controls the digital signal processor (DSP). 3. ROMs. Store carrier modulation routines for use by DSP, including V.34 standard. 4. DSP. The brain of the modem. Converts digital data from a PC into analog "tones" for transmission. 5. Telephone line interface.

HOME IMPROVEMENT

Installing A Fluorescent-Light Dimmer Switch

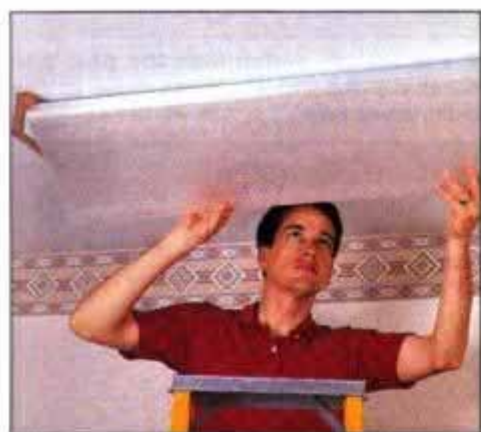
*How to add custom control to your
fluorescent fixtures.*

TEXT AND PHOTOS BY MERLE HENKENIUS

● You don't have to be an interior decorator to know that lighting plays a major role both in the utility and aesthetic appeal of any room. What you may not know is that dimmable fixtures aren't limited to incandescent bulbs. With the right hardware, you can control the intensity of fluorescent-light fixtures as well.

While variable-brightness fluorescent lights have been used at the commercial level for many years, few private homes have been fitted with dimmable fluorescent fixtures. In fact, few homeowners are aware that this option is available.

Before you run out to your nearest electrical supply outlet, however, bear in mind that dimmable fluorescent fixtures can be a bit pricey. Expect to



1 First, remove the fluorescent fixture diffuser. Lift one side and bend it out slightly to release it from the metal base.



2 Rotate the lamp tubes until the socket pins are visible from below. Then, pull down carefully to remove from fixture.



3 To access the fixture's ballast, squeeze the sides of the ballast cover to release it from the metal securing tabs.

pay about \$230 for a 2-tube fixture switch and ballast. To add to the expense, 3-wire cable will need to be installed between the new switch and the fixture in most cases.

Still, the advantages are clear. Dimmable fixtures offer more lighting options, both practically and aesthetically, and lights operated at less than full power save energy. A dimmable, overhead fluorescent fixture can be used for task lighting one moment and mood lighting the next. And while ours was a single-fixture conversion, it's possible to gang them together.

We opted to convert an existing 2-tube ceiling fixture using a Hi-Lume ballast and switch manufactured by Lutron Electronics Co. Inc., 7200 Suter Rd., Coopersburg, PA

18036. Switch/ballast compatibility is critical, so avoid the temptation to mix and match brands.

While there's nothing particularly difficult about converting a fluorescent fixture and adding a new switch, the job will become involved if you can't easily reach the existing cable. In our installation, the wiring ran through an accessible attic. If your attic is inaccessible, or your fixture is mounted on the first floor of a 2-story home, the job can still be done, although it will be more difficult and take more time. You may be able to pull the new cable with the old, presuming that the staples holding the old cable will come loose under pressure. You could also cut away the drywall or plaster where the wall

meets the ceiling. While this facilitates running cable from the fixture box to the switch, it will mean repair work when the wiring is done.

Removing The Old Switch And Ballast

Because the new dimmer switch requires a special ballast and new wire, the first step is to disconnect the existing wires from the fixture and the old switch.

Begin by shutting off power at the service panel. Determine which circuit supplies power to the fixture and switch off the circuit breaker or remove the fuse. This is not only a necessary safety precaution, it protects your hardware investment as well. In addition to posing a significant safety

hazard, wiring with the power on can result in component damage—voiding the warranty.

With the power off, lift the diffuser from the fixture (Photo 1) and remove the bulbs (Photo 2). This will reveal

a channel cover that conceals the fixture's ballast and socket wiring. To remove this sheetmetal cover, squeeze its sides until they clear the support tabs that are stamped into the fixture channel (Photo 3).

With the channel cover removed, pull the lead wires from the ceiling box and undo the wire connectors. You may also want to push the incoming wires through the top of the box to get them out of the way.

Pulling New Cable

With your fluorescent fixture ready to go, move to the wall switch that controls it. Remove the cover plate and unthread the screws that secure the switch to its box. Pull the switch away from the box and clip the wires close to the switch connections, or undo the terminal screws (Photo 4). Once the old switch is out of the way, it's time to tackle the problem of running new wire in place of the old.

As mentioned earlier, dimming ballasts require 3-wire cable between the fixture box and the wall switch. In our case, power originated at the switch and continued to the ceiling box via 14/2 with ground cable. We abandoned this cable and fished 14/3 with ground cable through the wall.

Because our wiring was routed through an accessible attic, it was a simple matter to fish the new 3-wire cable from the ceiling fixture box down to the switch. If your situation

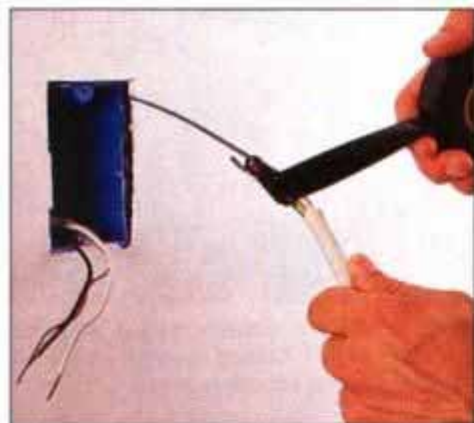
is similar, bore a 1½-in.-dia. hole in the top plate of the wall that contains the switch. Then, shine a flashlight through the hole and carefully feed the fish tape down through one of the switch-box openings.

Another method is to use two fish tapes—catching one with the other. One tape is fed up through the box, while the other is fed down through the top of the wall. Both methods will work just fine.

With the fish tape fed from above into the existing switch box, hook the wires from the 3-wire cable to the fish tape and secure the connection with plastic tape (Photo 5). Then, pull the end of the 3-wire cable into the attic (Photo 6).

Remove the cable from the fish tape and string it across the attic floor framing until it reaches the fluorescent ceiling fixture box. Allowing about 1 ft. of cable to extend through both the switch and the ceiling box,

cut the cable to length and strip about 10 in. of sheathing from each end. Finally, staple the new cable to the ceiling joists every 4 ft. and within 8 in. of the ceiling box. Insert the stripped cable into the fixture box (Photo 7), and then return to the switch box to install the new dimmer switch.



5 After feeding the fish tape to the switch box, hook the new 3-wire cable to the end and secure with plastic tape.



6 From the attic, carefully pull up the fish tape and the new cable through the wall and over to the ceiling fixture box.



7 Feed the new 3-wire cable into the ceiling box. Cut the cable to length and strip 10 in. of sheathing from the ends.

Installing The Dimmer Switch

Each manufacturer will have its own wiring configurations, so read the literature that comes with the switch carefully. Our switch provided one orange, one red, one black and one white (neutral) lead.

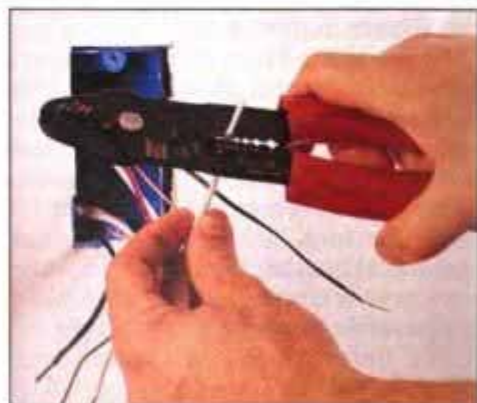
Begin by stripping about ⅝ in. of insulation from each of the switch-box wires (Photo 8). Then, join the white switch lead to the white circuit neutral wire and the white fixture wire.

Next, join the black switch lead to the black circuit hot wire. Make all connections with twist connectors.

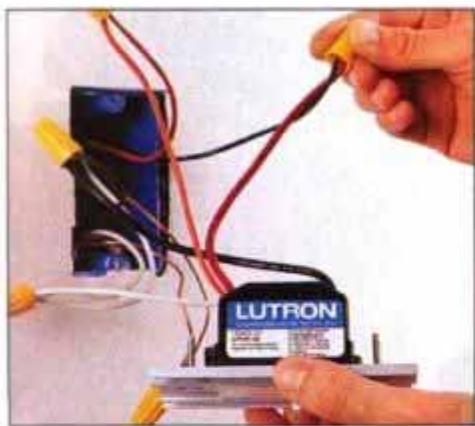
If the switch you bought doesn't have a grounding lead, simply join the circuit ground with the ground wire going to the fixture and tuck them both into the box.

To complete the wiring at the switch box, join the red switch lead to the black wire from the fixture and the orange lead to the red fixture wire (Photo 9).

After folding all wires to the back of the box, secure the new switch to the box with two screws (Photo 10). Then, press the cover plate over the switch (Photo 11) and move to the fluorescent fixture to complete the installation.



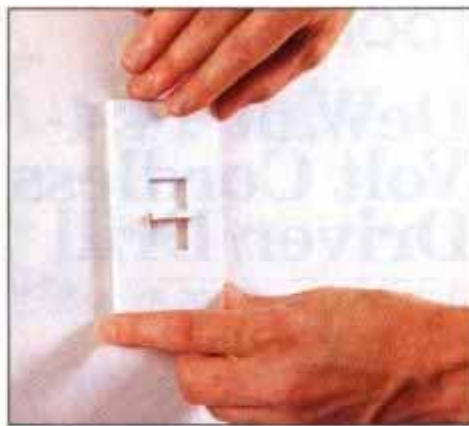
8 At the switch box, strip about ⅝ in. of insulation from the end of each wire, using an electrician's multitool.



9 Use twist connectors to join the circuit wires, switch-to-fixture wires and switch leads, according to instructions.



10 Tuck all the wires into the box and secure the dimmer switch. Tighten the two screws until the switch feels snug.



11 To complete the switch installation, snap the flexible-plastic cover plate over the sides of the metal switch yoke.

Replacing The Ballast

Start by sliding the lamp sockets inward to release them from their tabs (Photo 12). Then, loosen the nuts or screws holding the old ballast in place. With this done, remove the ballast and sockets and move them to a worktable so that the sockets can be connected to the new ballast (Photo 13).

You'll find spring-loaded, stab-in wire connections on the sockets. Carefully pull the old wires from their slots. Then, strip away 1/2 in. of insulation from the new wires and

press them into the slots (Photo 14).

Each ballast/socket wire is color-coded. It's easiest to simply duplicate the wiring of the old ballast, with red and blue wires serving the sockets on one end of the fixture and yellow and white wires serving the opposite end. To prevent cross-wiring the sockets, complete each 4-wire set before going on to the next.

With the sockets wired to the new ballast, lift the entire assembly to the fixture and slide the sockets back under their tabs. Then, screw the new

ballast to the fixture channel (Photo 15). In our case, because the new ballast was longer than the old, we drilled a pilot hole in the channel to accept one of the mounting screws.

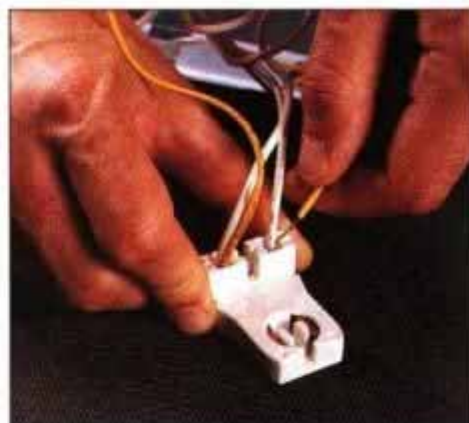
With the ballast in place, connect its wires to the 3-wire cable, according to manufacturer's instructions. We connected the circuit ground (bare) wire to the insulated green wire already bonded to the metal fixture (Photo 16), and then joined white-to-white, black-to-black and orange-to-red (Photo 17).



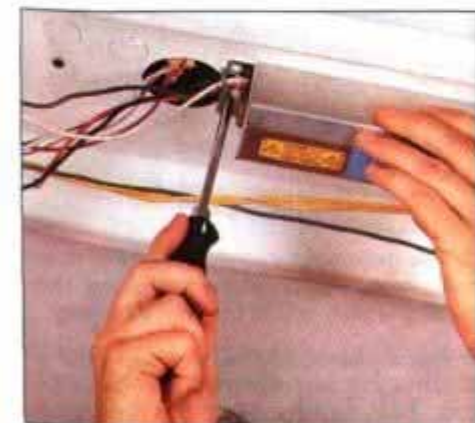
12 To remove the lamp sockets for wiring to the new ballast, simply pull inward until they clear their channel tabs.



13 Remove the old fluorescent ballast by loosening the screws or bolts that secure it to the metal fixture channel.



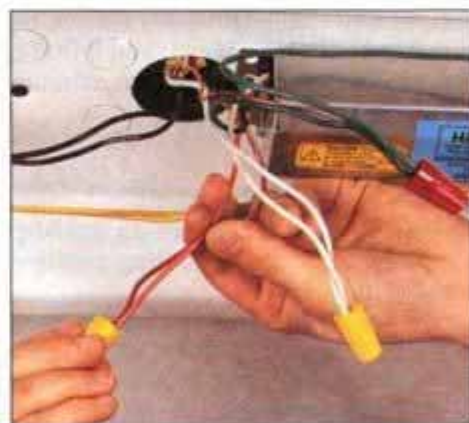
14 The sockets have stab-in connectors. Carefully pull out the old wires and push the new ballast wires into the sockets.



15 After installing the rewired tube sockets, secure the new ballast to the metal fixture channel with screws.



16 Use a twist connector to join the circuit ground wire to the insulated ground lead attached to the channel.



17 Complete the ballast wiring by joining white-to-white, black-to-black and orange-to-red with twist connectors.

TOOL TEST

DeWalt 14.4-Volt Cordless Driver/Drill

TEXT AND PHOTOS BY
 ROSARIO CAPOTOSTO,
 Contributing Editor

● When the cordless drill made its debut a few years back, there were few who didn't recognize the value of this important power-tool innovation. Finally, a truly portable drill with no strings attached.

Although the idea was an immediate success, its practicality remained a subject for debate. When it came to raw power, cordless drills simply couldn't compete with their corded cousins. Lately, though, the gap has been narrowing. And one of the newest and most powerful entries is the DeWalt model DW991K, a 14.4-volt 3/8-in. cordless driver/drill.

At this point, the DeWalt DW991K carries the highest voltage rating of any cordless drill available in the United States. And, although there are a few other factors involved, voltage generally translates into power. To keep the power on tap, this tool features DeWalt's XR Pack extended-run-time battery, which is touted to last 25% longer than standard batteries. Recharge time is 1 hour.

Driven by a 225-watt replaceable-brush motor, the drill's 3/8-in. chuck receives torque through a dual-range gear system. The low range (0 to 450 rpm) is for driving fasteners, and the high range (up to 1400 rpm) serves best for drilling. Gear shifting is handled by a sliding switch on the top of the housing (Photo 1). For driving screws and other threaded fasteners, directly behind the chuck you'll find a 5-position clutch for setting maximum torque (Photo 2).

Ergonomic features include conveniently located switches and easy-to-read settings. The balanced mid-handle grip, sheathed in an antislip rubber pad, makes handling positive and comfortable.

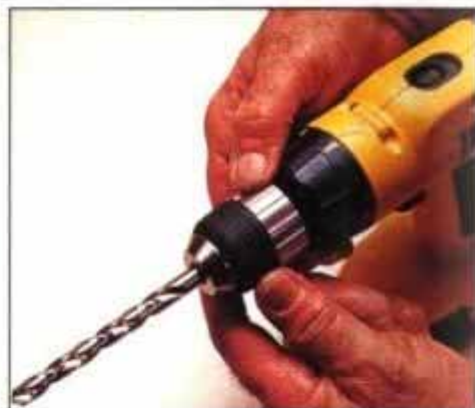
We tested the DeWalt DW991K in a variety of heavy-duty situations. Driving large screws into fir without pilot holes proved to be no problem for this tool (Photo 3). For a more difficult test, we installed a one-tooth holesaw in the chuck (Photo 4). But



DeWalt's 14.4-volt cordless driver/drill comes with an extended-run-time battery and a 1-hour charger. It features two gear ranges and a keyless chuck.



1 A sliding switch handles changing gears. The low range is for high-torque use, and the high range provides speed for drilling.



2 A keyless chuck makes bit changing fast and easy. Behind the chuck is a 5-position clutch that sets maximum torque.



3 Driving screws in tough fir is effortless in the low-gear range. Adjustable clutch ensures uniform depth of driven screw.

even when we forced it, the driver/drill refused to stall.

The DeWalt heavy-duty, adjustable-clutch cordless driver/drill comes with one battery, a battery charger and a steel case, and it costs about \$225. It's



4 The driver/drill's 14.4-volt power makes many heavy-duty operations practical. Hole-sawing is well within the tool's capacity.

available at home centers and through mail-order woodworking tool suppliers. For more information, write to DeWalt Industrial Tool Co., P.O. Box 158, 626 Hanover Pike, Hampstead, MD 21704. **PM**

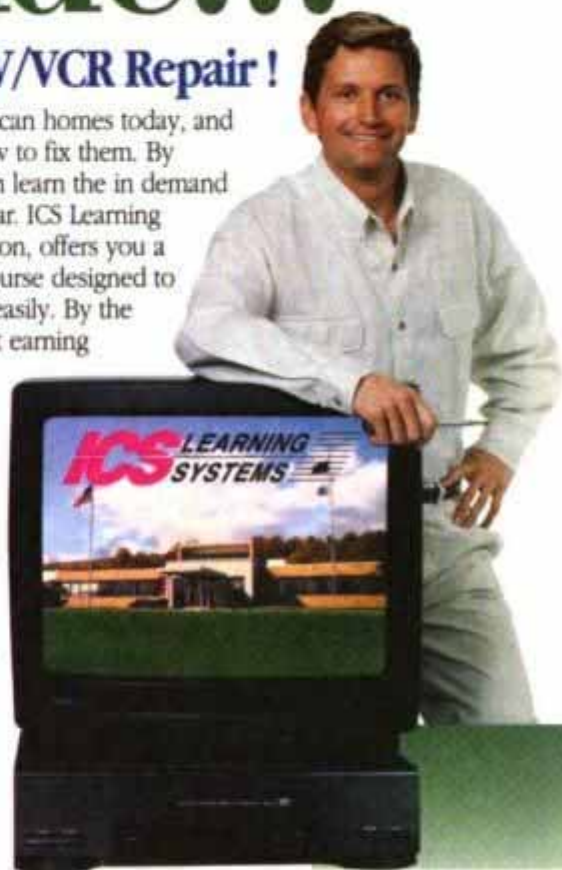
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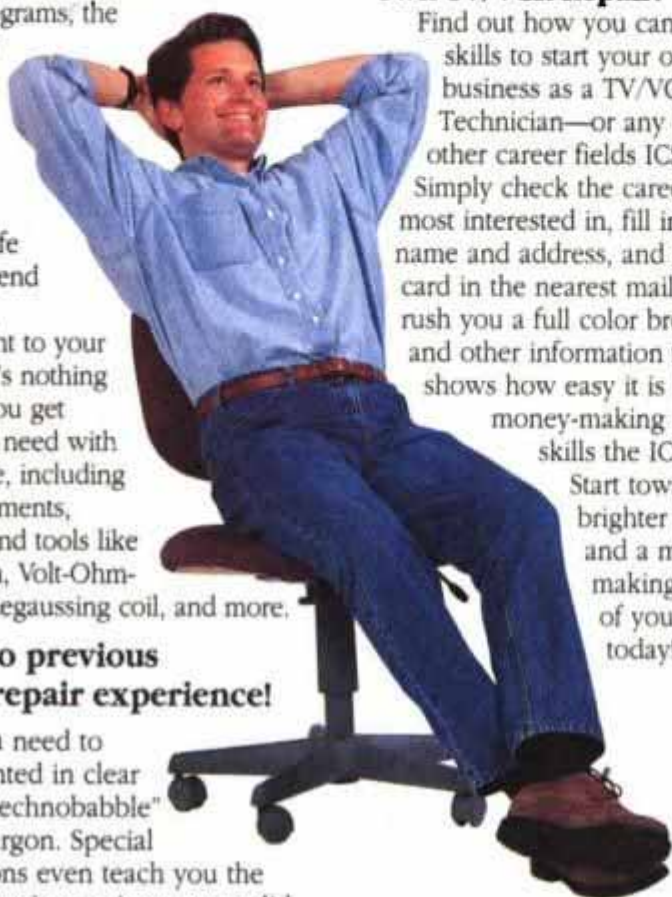
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TOOL TEST

Dremel Benchtop Band Saw

TEXT AND PHOTOS BY ROSARIO CAPOTOSTO,
Contributing Editor

● It's been said that if you can own only one stationary saw, it should be a band saw. No other woodcutting tool combines this machine's versatility, accuracy and speed. If you're worried about cash outlay and space requirements, however, the recent proliferation of benchtop versions provides little excuse for not hopping on the band-saw wagon. We tested Dremel's newest entry, model 1120, and found it a capable competitor.

The saw has a 10-in.-deep throat and can handle stock about 7 in. thick. Powered by a ½-hp induction motor, it features 2-speed operation—a low 900 sfpm (surface feet per minute) and a high 3000 sfpm. Speed changing is accomplished by shifting the drive-belt position on the easily accessible pulley (Photo 1).

The Dremel 1120 is well built and boasts a one-piece die-cast aluminum frame that's set on a sturdy cast-iron base. The tool weighs a hefty 69 pounds—a factor that contributes to relatively quiet and vibration-free performance. The 13½-in.-sq. table tilts from 6° left to 45° right, and a dust-collection port for a shop vacuum is built right into the frame. To keep the blade accurately positioned, Dremel provides standard tracking and tensioning knobs at the housing top, and a tire brush keeps sawdust from accumulating on the wheels.

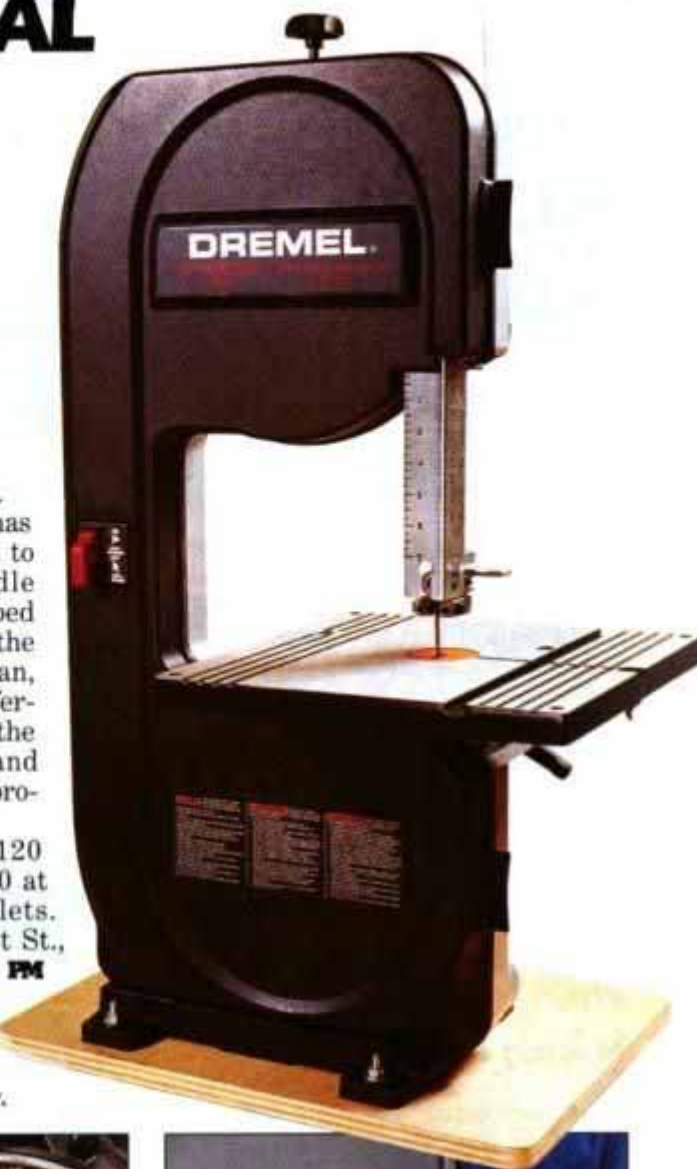
The blade guard features an easy-to-read height scale, and the blade guide blocks are made of a low-friction composition material instead of the traditional metal. While the guide blocks are adjustable, we found the lower guide block difficult to set properly with the short Allen wrench that comes with the saw.

Equipped with a ½-in.-wide blade, the Dremel band saw resaws tough 6½-in.-wide fir into clean and accurate slices (Photo 2). For intricate contour cutting, we replaced the ½-in. blade with a ¼-in. blade. The saw easily handles thick stock during square and bevel cutting (Photo 3). With a ⅛-in.-wide blade, the band saw is capable of tight curve cutting in rela-

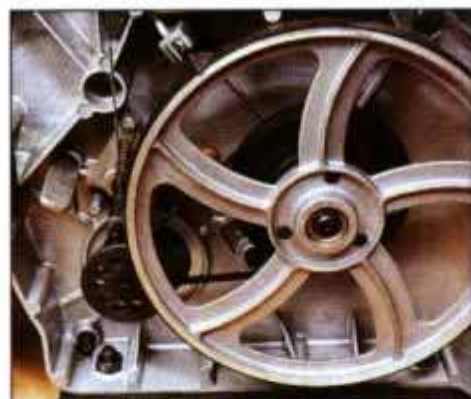
tively thick stock (Photo 4).

Because this band saw has two speeds, you can switch to the lower speed to handle modest metalwork. Equipped with a metal-cutting blade, the tool was able to make clean, fast cuts in ⅛-in.-thick nonferrous stock. In all our tests, the blade tracked smoothly and accurately and the motor provided ample power.

The Dremel model 1120 band saw costs about \$390 at woodworking supply outlets. Contact Dremel, 4915 21st St., Racine, WI 53406.



Dremel's new model 1120 benchtop band saw features two speeds, a 10-in.-deep throat and 7-in. resaw capacity.



1 Changing speeds requires removing the housing and shifting the drivebelt on the pulley. Note the solid frame construction.



2 Resawing 6½-in.-wide fir into ⅜-in.-thick slices is well within the tool's capabilities. A ½-in.-wide blade is used here.



3 Contour cutting is the forte of any band saw. With a ¼-in. blade, our test tool handled beveled contour in thick stock.



4 Tight contours with a ⅛-in.-wide blade are possible in thick stock. The blade tracks well and it produces true cuts.

SHOP PROJECT

Standing Tall

A colorful step stool for the kitchen.

BY ROSARIO CAPOTOSTO,
 Contributing Editor

● This Shaker-style step stool provides that extra reach so often needed around the home. And when at rest, it serves as a decorative accent or as a stand for potted plants.

The step stool is made of maple and assembled with wood dowels. It's designed with simplicity of construction and ease of finishing in mind. Take the sides, for example. You don't have to cut the two steps out of a large finished panel. You make the sides from three boards of identical width but different lengths. Glue and dowel them together, and you'll find that the steps are already formed.

Making the sides

Begin by using a smooth-cutting blade to rip two 4-ft.-long boards to 5¼ in. wide. Crosscut one board into two pieces 7¼ in. long and two 15¼ in. long. Then, crosscut the second board into two 23¼-in.-long pieces.

Align the cut pieces on the workbench, then lay out the dowel locations on the faces of the three members (Photo 1). The half-circle cutout should be marked at this time to avoid having a dowel in the path of the cutline. Code each set of pieces to ensure correct alignment later.

Use a doweling jig to bore the holes for the dowels in the boards' edges. Butt adjacent boards back to back with the edges facing up. Then use a square to carry the dowel centerlines from the faces across the edges.

If your doweling jig is not of the self-centering type, be sure to put the same side of the jig against the same face of each board. Doing so will make the edge-to-hole distances consistent even if the jig adjustment is off. Secure the doweling jig, and bore the holes (Photo 2).

Prepare two bar clamps, three C-clamps and four cauls to edge glue each side. The cauls are clamped



Lead photo: J. R. Rost.
 Step-by-step photos: Rosario Capotosto
 Technical art: Eugene Thompson
 Photo stylist: Gailie Hemick



1 First, rip and crosscut the pieces for the sides. Then, position them and mark the dowel locations, using a square.



2 Bore on the dowel-location marks using a doweling jig. The tape on the drill bit serves as a depth indicator.



3 Assemble the sides with glue and clamps. Wax the face of each caul to prevent glue from sticking to it.

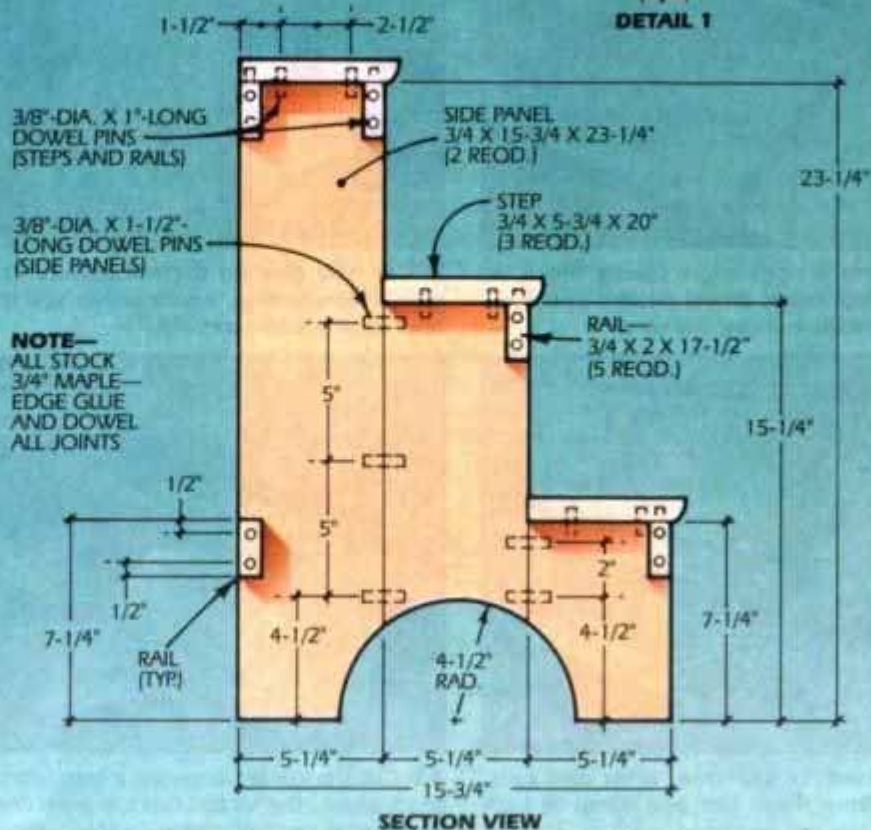
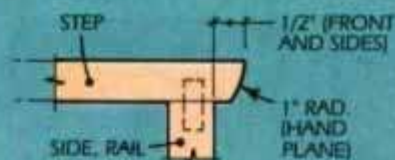
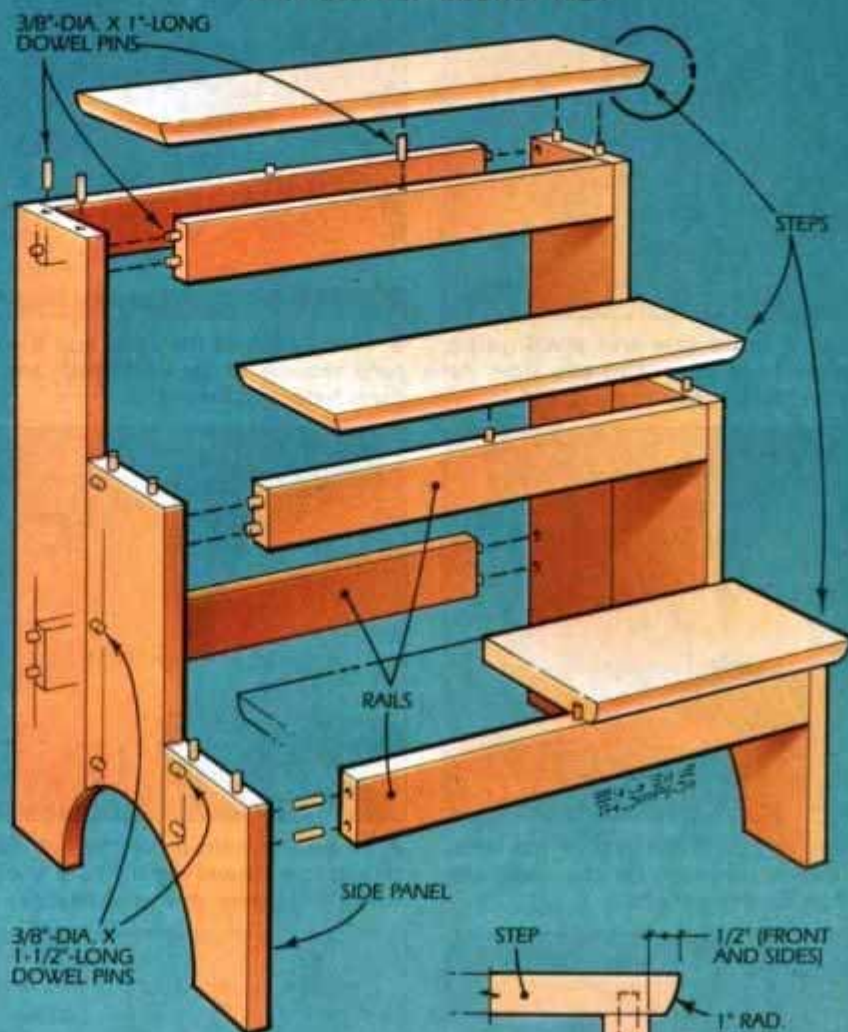
across the side to prevent it from buckling. Rub some paste wax on the face of each caul to keep it from sticking to the work. Any residual transfer of wax to the workpiece can be wiped off later with lacquer thinner.

To ensure good contact between edges, use a countersink to slightly chamfer the tops of each dowel hole. Clean out any wood chips, apply glue, insert the dowels and then join the pieces. Clamp the assembly until the glue is set (Photo 3).

After the glue has dried, use a scraper to remove glue beads on the joint lines. Use a sabre saw and pivot guide to make the circular cut in each

STEP STOOL

16-1/4" DEEP X 20" WIDE X 24" HIGH





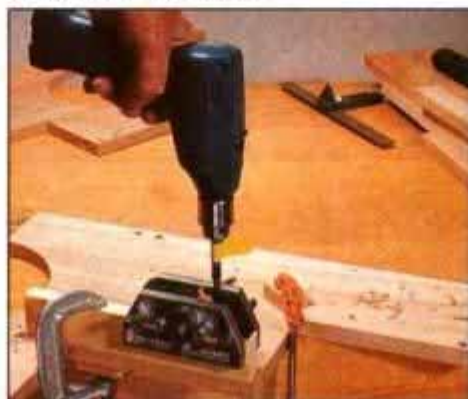
4 Using a sabre saw and pivot guide, make the base cutout in the side. An extension block supports the guide.



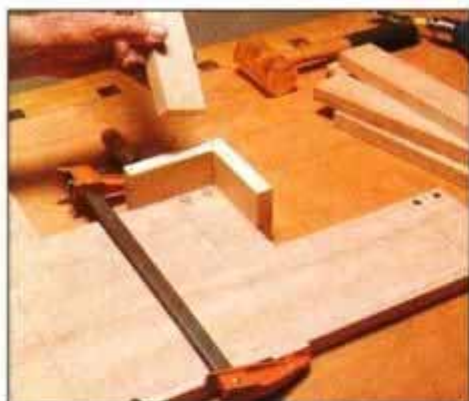
5 Clamp both of the sides and the other parts securely to the workbench and sand them before assembly.



6 Before attaching the rails to the sides, mark dowel locations on the steps and then bore on these marks.



7 To bore the holes for the rail dowels, attach the doweling jig to a block of wood and clamp this to each side.



8 Clamp a right-angle corner block on each step. Insert dowel centers in the rail dowel holes to mark the rails.



9 Use hide glue on the rail dowels. This glue is slow-setting, which allows you the time to proceed carefully.



10 Assemble the stool sides and rails, then clamp them. Use one clamp at each of the five rail locations.



11 Cut the curved edge on a step with a block plane. The scrap blocks at both ends of the step prevent endgrain tearout.

side (Photo 4). To cut as cleanly as possible, there are a few things you need to do. First, nail a small extension block centered on the bottom of the side to provide support for the pivot point. Make sure the point is precisely aligned with the blade's front. Also, use a set-tooth blade—not a hollow ground blade (with no set), because this kind of blade has a tendency to drift during the cut.

Sand the faces of each side with 120-grit sandpaper followed by 220-grit (Photo 5). Next, use the doweling jig to bore the dowel holes for the steps in the top ends of the sides (Photo 6). These holes must be bored before the rails are installed.

Lay out the hole center marks for the rail dowels on the inside face of each side. The doweling jig shown is not designed for use on broad surfaces, but we devised a method for using it in this application. First, secure the jig to a $\frac{3}{4}$ -in.-thick \times 2-in.-wide \times 12-in.-long cleat. Clamp the jig and cleat into position on the side so that the cleat's face is flush with the side's edge (Photo 7). Note that a drill-bit centerline is marked on the cleat, and this is aligned, one at a time, with the two centerlines marked on the side.

To mark the corresponding holes in the end of the rails, proceed as follows: Make a right-angle corner guide and clamp it to a side. Insert dowel centers in the holes bored into the sides. Position a rail against the corner guide, and press the rail onto the dowel centers so that they leave indents in the rail (Photo 8). Carry centerlines through the indents and down the face of each rail. Finally, bore the holes with the doweling jig.

Steps and assembly

Assembly is done in stages. Lay one of the sides on its back and apply hide glue in the rail dowel holes. Glue dowels into the rails and insert the rail dowels into the holes. Apply glue on the rail dowels at the opposite end (Photo 9). Place the second side on the dowels, and stand the assembly up. Using five clamps, apply pressure at each rail location (Photo 10).

Cut the steps to size and shape their curved edges and ends by hand planing and sanding. Use a block plane to cut the curved edge on the steps. When planing the endgrain, clamp sacrificial blocks at both ends of the step to prevent tearout (Photo 11). Install the steps with glue and dowels.

To finish, apply a coat of latex primer followed by a satin latex enamel. We used Dutch Boy Rye Fern. **PM**

Homeowners Clinic

BY NORMAN BECKER, P.E., Contributing Editor
PM Illustrations by George Retseck

Hard-To-Open Windows

I have double-pane, double-sash windows in my house. They have been hard to open and close since the house was built. The builder said to apply soap to the window channels, but this does not make them slide any easier.

I suspect the windows were improperly installed. Perhaps they are not set square in their openings or are twisted slightly. I would appreciate any suggestions that can help me free these stuck windows.

ED GIZINSKI
STEVENSVILLE, MD

There are several causes for stuck windows in relatively new houses. The most common is that an excess of fiberglass insulation has been packed between the window jamb and the window jack. This also can occur if too much foam insulation was squirted between the jamb and jack. Another likely cause is that the windows were racked slightly out of square when they were installed. Similarly, they may have been racked during shipment from the lumberyard and then not corrected when they were installed.

Occasionally, differential foundation-settling shifts the framing around the window. This settling is easy to recognize because it causes cracks in the foundation wall and in drywall around door and window openings.

Finally, when excessively wet or poor-quality framing lumber dries, it forces the window jamb out of square.

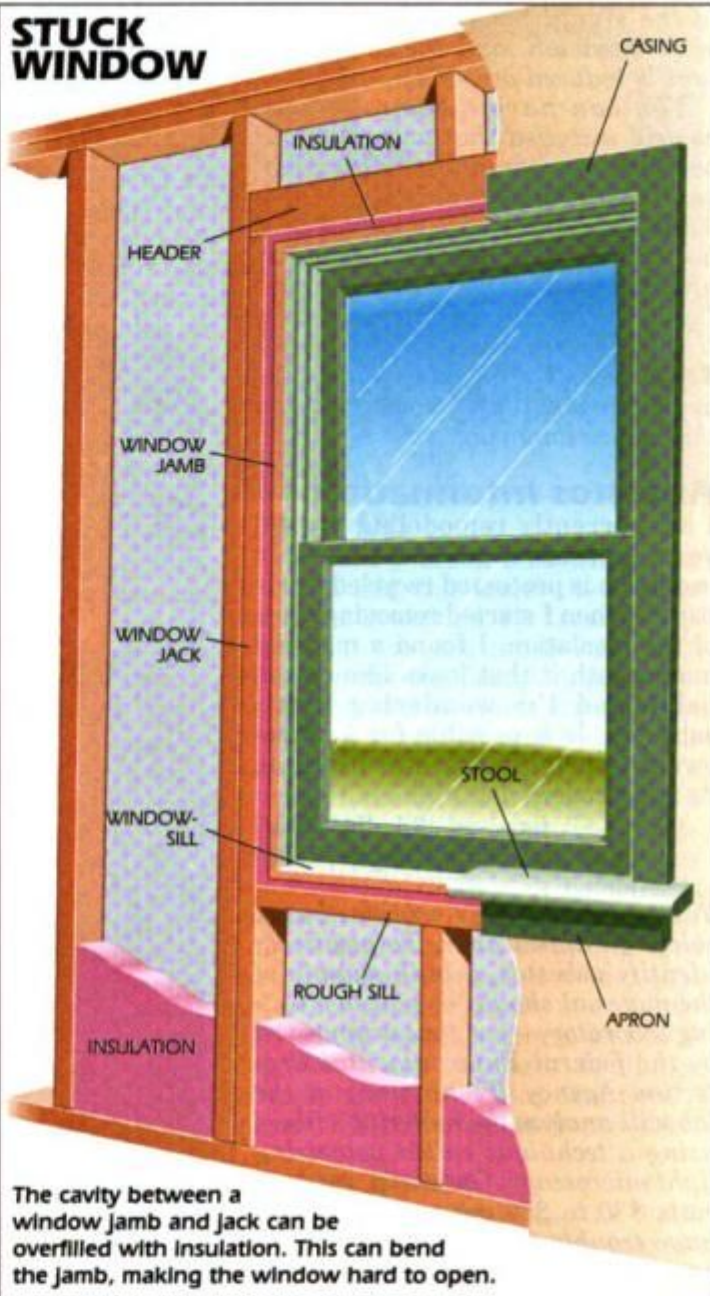
To find the problem, you'll have to remove the window trim to expose the jamb. If you discover that the space between the window jamb and the jack has been overfilled with insulation, dig out the excess insulation with a long and sturdy screwdriver—a major undertaking if it has to be done to every window.

An inward bowed window jamb can sometimes be pulled back slightly by driving a screw through the jamb and into the window jack.

Low Phone Volume

Why is it that our transmitting and receiving volume goes down in proportion to the number of phones that are in use? We have observed this in new houses in the United States and where we live now, in Korea. What can be done to remedy this?

DOUG BARKER
KOREA



The cavity between a window jamb and jack can be overfilled with insulation. This can bend the jamb, making the window hard to open.

In a typical residence, there is a fixed power input for the telephone signal. This signal has enough strength to activate the small speaker in the handset. However, when one or more telephone extensions are used to join in the conversation, resistance is added to the circuit. The signal to the initial phone is weakened because part

Water Heater Help

● Has your water heater been acting cranky? If it has, this *Troubleshooting Guide* can help. It's part of U.S. Craftmaster's efforts to make repairing and buying water heaters easier.

To begin, find a dealer by calling the company's toll-free number: (800) 999-9515. You can get the brochure at a dealer near you or by writing the company for one. If there isn't a U.S. Craftmaster dealer nearby, you can order replacement parts through the 800 number and even get technical help.

With the literature in hand, you're in business. One side shows replacement and installation parts. The company says the parts fit nearly all major brands. The other side has a thorough troubleshooting chart for both gas and electric water heaters.

Should you decide to replace the appliance, the company has information about that in its *Cold Hard Facts* brochure, which is also available at dealers or through the mail.

When making your request, specify the brochure you want. Send a business-size self-addressed envelope with a 32-cent stamp to: American Water Heater Group, Attn: T.S.G., P.O. Box 4056, Johnson City, TN 37602.

—Roy Berendsohr

CHECK CHARTS

CHECK CHART for Servicing U.S. Water Heaters

When an air vent or electric vent is blocked, it is important that the vent be cleaned or replaced. This is a good practice. When a vent is blocked, the water heater will not heat properly. This is a common problem. There are 11 other causes for the water heater not heating properly. Refer to the chart for more information. For more information, call (800) 999-9515.

CHECK CHART for ?

There is an air vent and electric vent. It is important that the vent be cleaned or replaced. This is a good practice. When a vent is blocked, the water heater will not heat properly. This is a common problem. There are 11 other causes for the water heater not heating properly. Refer to the chart for more information. For more information, call (800) 999-9515.

PROBLEM	CAUSE	SOLUTION
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent
Water heater not heating	Blocked vent	Clean or replace vent

of the signal power is diverted to each extension, and the sound volume is reduced proportionately.

You can have a computerized control installed that amplifies and balances the signal to provide equal sound volume on all extensions. This system can cost about \$1000, however. Another approach is to buy handsets with built-in amplifiers. Compared to a computerized control, these are inexpensive—about \$100 apiece. On the other hand, they amplify background noise too, and this can be annoying.

Asbestos Information

I am currently remodeling my 42-year-old house. Much of the blown-in insulation is processed recycled newspaper. When I started removing some of the insulation, I found a material underneath it that looks like cotton balls, and I'm wondering if it's asbestos. Is it possible for a homeowner to identify asbestos based on its appearance?

R.L. HARTMAN
REDONDO BEACH, CA

You cannot identify asbestos based solely on appearance. To positively identify asbestos, a bulk sample of the material should be sent to a testing laboratory—one that is approved by the federal Environmental Protection Agency. Technicians at the lab will analyze the material's fibers using a technique called polarizing light microscopy. Generally, this test costs \$30 to \$50 per sample. If you have trouble finding a laboratory, contact the National Institute of Standards and Technology and request a free directory of accredited laboratories. Write NIST/NULAP, Building 411, Room A162, Gaithersburg, MD 20899.

Most homes built or remodeled before 1978 contain some type of asbestos material (pipe insulation, for example). However, just because asbestos is present in construction material doesn't make it a health hazard. Asbestos is hazardous only when fibers are released into the air and inhaled. This happens when the material is damaged or in a condition known as friable—a point at which it can be pulverized by hand pressure.

Another source of information is *Asbestos In The Home*, an excellent free booklet available from the Asbestos Victims Trust Fund, 1500 Walnut St., Suite 1203, Philadelphia, PA 19102.

Replacing A Refrigerator Light Switch

● If your refrigerator is more like a cave than a well-lighted appliance, it's time you investigate the problem. There are two obvious causes for a refrigerator light to not turn on when you open the door: Either the switch is bad or the bulb is burned out. Your first step should be to check the bulb. If the bulb's filament appears to be intact or a new bulb doesn't light when installed in the socket, chances are good that the light switch has failed. There are basically two switch types: plunger and rocker—but they install in the same fashion, and it's an easy job.

Write down the refrigerator's make and model number, and locate an appliance store that has the replacement part. These switches cost about \$6 to \$8.

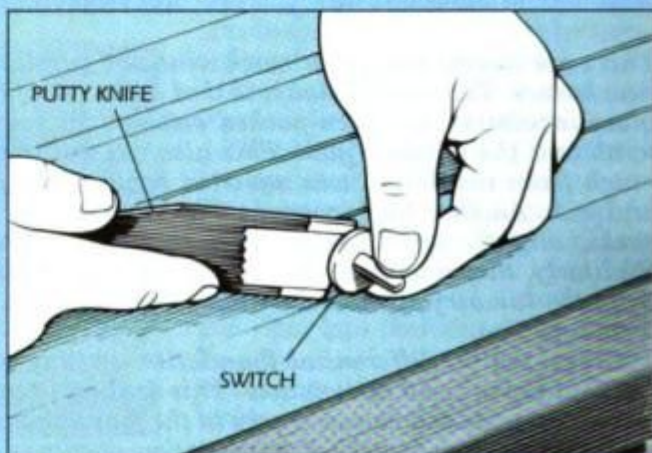
Begin the repair by unplugging the refrigerator and inserting a putty knife between the switch and the refrigerator breaker trim. Prevent marring the trim by wrapping the putty knife with masking tape.

Gently pry on one side then the other until the locking tabs on the switch release. Don't be concerned if the switch doesn't want to budge. Some release easily, while others require a good deal of coaxing. Once the switch is free, pull it out enough to disconnect the wires. Connect the wires to the new switch. Press the new switch down until its locking tabs snap into position. Then, plug in the refrigerator and test the switch. With the refrigerator door open, the light should come on when the appliance is plugged back in. Press the switch, and the light should go off.

—Steve Toth



APPLIANCE CARE TIP



More On Circulating Hot Water

The item titled "Instant Hot Water" (see *Homeowners Clinic*, page 91, Sept. '94) generated considerable interest. Quite a few people wrote to tell us how they installed a circulating hot-water system. Most of the respondents installed the system without a circulating pump. Whether or not a system without a pump is effective depends on the rise that the hot water travels. If the rise is small, these readers advise that the system be installed without a pump because it can be added later if needed.

One reader recommended the following refinements: an aquastat to control return water temperature, a

timer switch to turn off the pump during periods when no hot water is used and an ON/OFF switch to shut down the pump during vacations.

Another reader commented that after he installed a pump he found it caused a low-frequency hum that could be heard throughout the house. His solution was to mount the pump on a support beam. He connected flexible hoses between the pump and the copper pipe.

Thanks for writing, folks.

FM

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.

NEW PRODUCTS

Labor Savers

New appliances do more work in less time.

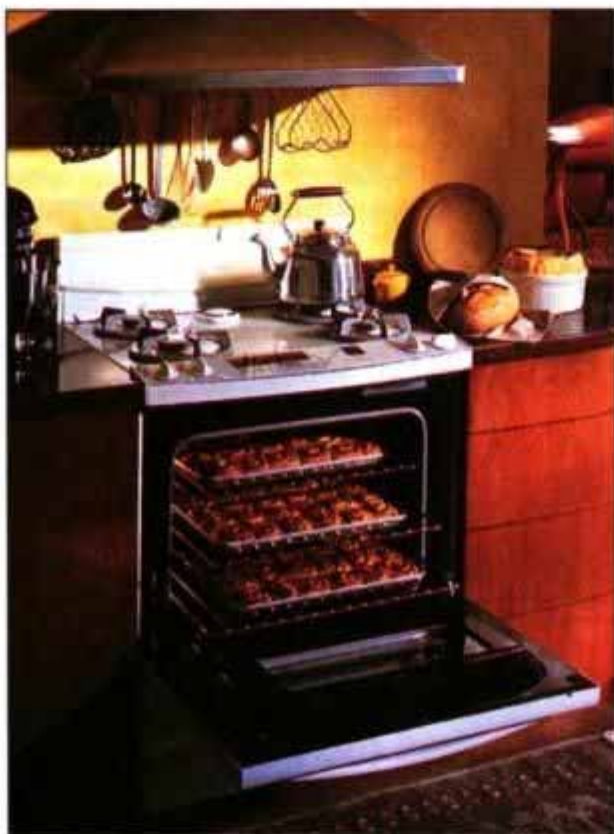
BY ROY BERENDSOHN, Associate Home Improvement Editor

Guess Not

KitchenAid says it has taken the guesswork out of convection cooking by designing a range that converts recipe times from radiant to convection cooking. You don't have to estimate by how much cooking time will be reduced. On the range's keypad, punch in the amount of time and



temperature that the recipe calls for and the convection function you want: bake, broil or roast. The digital readout tells you how long the meal will take to cook. Then just enter the time you want the cooking to start. The ranges also allow you to bypass the convection mode and cook conventionally. The gas and electric models cost about the same: from \$1500 to \$1580. The electric ranges are available with coil elements or with smooth-top radiant and halogen elements, or a combination of radiant and halogen elements. For more information, write the company at 2303 Pipestone Rd., Benton Harbor, MI 49022, or call (800) 422-1230.



Two For One

This combination clothes washer/dryer takes up about the same space as a dishwasher. The EZ1000 accepts a 10-pound load of clothes and uses a perforated stainless-steel drum to wash in a rocking motion. It spins water out of the load at 800 rpm, and begins drying automatically. The manufacturer says the machine is essentially vibration-free because the drum is mounted on springs and shock absorbers. It provides five wash cycles and five temperatures for the wash/rinse water. A fitting is included that allows the appliance to be hooked to a kitchen or utility-sink faucet. It costs \$895 at department and appliance stores, and can be shipped directly for about \$50. Contact Equator Corp., Arena Tower II, Suite 855, 7324 Southwest Fwy., Houston, TX 77074.



Open Up

If you find yourself struggling with twist-off lids, this under-the-counter appliance is worth a try. Insert a container into the cone and its rubberlike ribs grip the top firmly. A pressure-activated switch starts turning the cone and a geared transmission is supposed to multiply the motor's turning force by 1650. Once the lid is loose, remove it by hand. The manufacturer says the device accepts any top from 1/2 in. to 4 3/4 in. in diameter. It comes in two forms: a 120-volt model (about \$40) with a 3 1/2-ft.-long cord and a battery-powered model that uses four alkaline D cells (about \$30). It's sold in specialty stores and catalog showrooms. Contact Appliance Science Corp., P.O. Box 566, Southport, CT 06490, or call (800) 338-7304.

Makes Sense

This appliance filters the air while monitoring it for carbon monoxide (CO). By bringing air to the sensor, it avoids testing only surrounding air or that which wafts by. If it senses dangerous CO levels, it triggers an 85-dB alarm. The appliance pulls air through a prefilter, a pleated fiberglass filter and an activated charcoal filter to remove odors. An electronic ionizer takes out remaining particles. The air cleaner does not remove CO, however. Two sizes are available—a \$150 model for rooms up to 111 sq. ft. and a \$190 model for larger areas. Both versions change the air six times an hour. It's sold at hardware stores, home centers and department stores. For more information, write Customer Service, Holmes Products Corp., 233 Fortune Blvd., Milford, MA 01757.





Quiet In The House

General Electric says its Profile Maxus clothes washer is 50% quieter than any washer it has ever made, a helpful feature if the laundry is near a bedroom or family room. It has 3.2 cu. ft. of capacity and employs noise-reducing devices that include a fluid-filled balancing ring below the washbasket. This ring counters the tendency of small loads to spin out of balance, which creates the thumping noise so familiar to homeowners. Top-of-the-line washers range from \$550 to \$580, and they're complemented by large 7-cu.-ft. dryers with extra sound-absorbing insulation. The dryers cost from \$479 to \$509. Both are sold at appliance dealers.

For a quieter kitchen, consider the Profile dishwasher. It has plastic sound-deadening insulation in the door, an insulated cabinet and a motor that runs so cool it eliminates the need for under-cabinet air vents. And its door vents shut automatically during wash cycles to reduce noise.

Also, it employs an optical sensing device GE calls CleanSensor, which examines wash water clarity and automatically determines how much more washing the dishes need. The dishwasher costs \$500 to \$600 at appliance dealers. For more information, call (800) 626-2000, or write GE Appliances, Appliance Park, Louisville, KY 40225.



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Water Tight

Frigidaire says its horizontal-axis clothes washer uses just 19 gallons of water per load compared to 44 gallons for a typical vertical-axis washer. Its stainless-steel drum rocks clothes back and forth through the water



without an agitator. The company says that this is more gentle than agitator washing, and that it makes the washer easier to load while providing room for bulky items. To help in tight spots, the company makes a 2-

way tumble-action dryer that can be stacked on top of the washer, or can be placed next to it to form a continuous worksurface. The washer costs about \$750 at Frigidaire dealers. Contact the company at 6000 Perimeter Dr., Dublin, OH 43017.

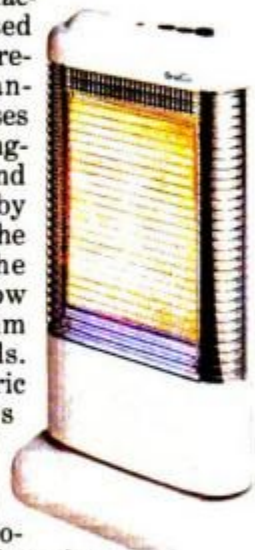


Blast From The Past

Consider this countertop appliance: It is compact yet offers convection cooking. It's UL-listed and roasts, bakes, broils and dehydrates. And it costs only \$175 to \$195. The appliance consists of a removable cook well that sits in an appliance body through which runs a heating coil. The design was introduced as an electric casserole in the 1930s. Through the years, it was refined and now features a lid-mounted removable fan for convection cooking with a temperature that's adjustable from 150° F to 450° F. It's built of porcelainized steel, and the cook well is nonstick. It's sold at hardware and discount stores, and on the QVC channel. Write MetalWare Corp., P.O. Box 237, Two Rivers, WI 54241.

Summer In Winter

The Silent Sunburst reaches its operating temperature three to five times faster than other electrical-resistance heaters, says its manufacturer. And it's supposed to warm you without creating a draft, like fan-forced heaters do. It uses halogen tubes with tungsten wires in them, and its heat is distributed by a parabolic reflector. The bright light from the tubes is focused below eye level by aluminum honeycomb-like panels. The result is an electric heater that produces the same amount of heat at its 600-watt setting that others need 1500 watts to produce. The heater can focus its heat or distribute it by pivoting on its base three times a minute. The UL-listed product costs \$100 to \$130 at department stores, through catalogs and at home centers. Contact Circulair Inc., 7400 Waukegan Rd., Miles, IL 60714, or call (800) 647-7749.



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DITTO.

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For more information, call anytime. 1-800-Y-STANLEY

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*Additional lubrication may be required based on an average of 2.5 open and close cycles per day.

Keep It Simple

Water-wick humidifiers are simple and effective, and the 7376 has several desirable features. It runs 28 hours on one filling, and has a 3-speed humidity control with a quiet setting and a light for night use. It costs about \$50 at hardware stores and home centers. Write Bemis Manufacturing Co., 300 Mill St., P.O. Box 901, Sheboygan Falls, WI 53085, or call (800) 558-7651.



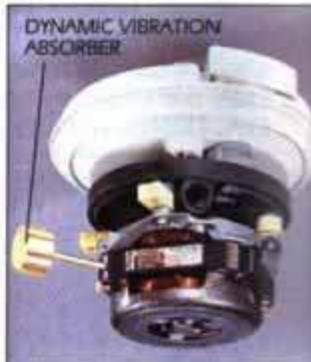
Getting To Know You

Maytag says its IntelliSense dishwasher not only monitors all aspects of the wash cycle, it also logs your dishwashing habits between loads. This includes how many times the door is opened and the length of time the dishes remain in the washer before they are cleaned. The result: Press the start button and the dishwasher will determine the best way to do the dishes. There are override buttons for a quick or heavy wash and a high-temperature wash. There's also a semiautomatic mode that reduces water velocity for delicate kitchen ware. It costs about \$850 at Maytag dealers. Contact Maytag, 1 Dependability Square, Newton, IA 50208.



Carwash Blues

If your dishwasher sounds like a carwash, then maybe you should consider Whirlpool's Quiet Partner and Quiet Wash Plus series. The appliances are equipped with a tuned dynamic vibration absorber (right), a device that cancels out the noise-inducing vibrations created by the motor. The appliance also deadens sound by adding more insulation and using flexible seals. Other features include 3-level washing and adjustable top racks. It costs about \$500 at Whirlpool dealers. For more information, write Whirlpool, Attn: CAC, Benton Harbor, MI 49022, or call (800) 253-1301.

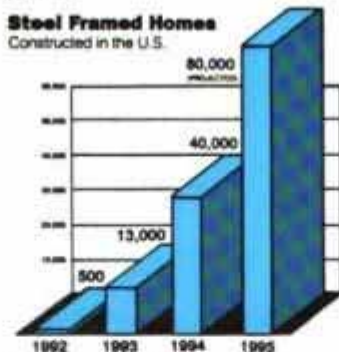


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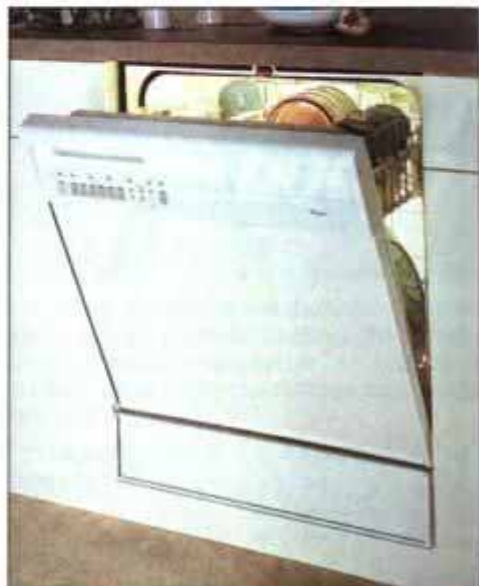
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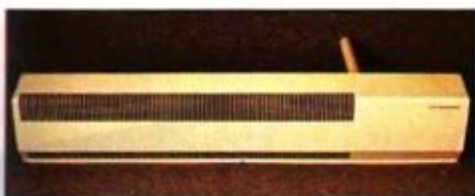
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Cool Heat

This gas heater is so compact, you might say it's cool. Designed to look like a conventional baseboard radiator, it's 5 in. wide x 9 in. tall x 48 in. long. It installs right on the floor and against the wall. It uses a small fan to vent exhaust gas out and to draw combustion air in, via a 2½-in.-dia. hole through an outside wall. Sold through plumbing and heating contractors, the heater is available in a natural gas or a propane model. Both cost about \$500 (installation is extra). To find a distributor, contact Hunter, P.O. Box 400, Orillia, Ontario, Canada L3V 6K1.

A Long Way

Window fans have come a long way from the simple boxlike devices that most of us are familiar with. This fan exhausts stale indoor air, brings in fresh outdoor air and even shuts itself off with a thermostat that you set to a comfortable temperature. It uses sliding side panels like an air conditioner to form a tight joint below the window, and this keeps out bugs and reduces heat gain. It has a 3-speed motor and a 10-year warranty. It costs from \$60 to \$70 at hardware stores and home centers. For information, contact Dura-craft Corp., 355 Main St., Whitinsville, MA 01588, or call (800) 554-4558. **FM**



Top To Bottom

The Dacor-RSD 30 range gives you a gas-burner top and an electric convection oven below. Two of the top burners are 9500 BTU, while the other two are 12,500 BTU. The burners are covered with continuous grates, so you can slide cookware over the entire top without lifting it. When used with the speed of the convection oven below, the range is designed to provide commercial-like capacity on a 30-in. home appliance that costs in the neighborhood of \$2200 to \$2400. Another nice feature: You can deselect the convection fan and do standard baking or broiling. The range is sold at appliance and kitchen dealers. Contact Dacor, 950 S. Raymond Ave., Pasadena, CA 91109.

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CAR CARE

CAR CLINIC

BY MIKE ALLEN,
Associate Automotive Editor

Clutching At Straws

I had to replace the clutch on my car after only about 40,000 miles because it was slipping badly. There was still plenty of friction material left, and no evidence of oil or glazed spots. I replaced the pressure plate as well, but didn't have the flywheel refaced.

Why was it slipping?

JOHN PERDUCCO
DES MOINES, IA

The clutch disc is gripped tightly between the flywheel and the spring-loaded pressure plate. When the three wear sufficiently, the springs aren't strong enough and the clutch slips. But even if the wear is minor, the clutch disc can be too thin—the paper facing of the disc is riveted to a series of wavy springs. If these springs collapse from fatigue or heat, the disc will be too thin to grip. This waviness is called "marcel." Check your old disc: You'll probably see the marcel squashed flat. Replace the disc, and, if it's worn, the pressure plate, and machine the flywheel. Replace the pilot bushing and the throwout bearing, regardless.

Remote Control

How difficult would it be to replace the fitting for the oil filter on my 1977 Buick LeSabre with the 301 engine? I have a very difficult time buying correct replacement filters.

R. MILETO
PISCATAWAY, NJ

It's not really a viable option to simply use a different filter on the side of the block—I'd order a half-dozen or so of the correct filter at a time.

But let me make another suggestion. Install a remote oil-filter adapter that allows you to put an oil-filter mounting block up on the firewall or fender well. This can be done for \$50 or so, and shouldn't take more than a couple of hours. Mount the block so the filter is threads up, for several reasons. One,



it's a lot neater when it's time to change the filter if all of the oil doesn't head immediately south as you unscrew it. Two, the filter will remain full of oil, reducing the time it takes to get the oil flowing at start-up. You can also use this opportunity to use a larger-capacity filter. Be sure to route the hoses far away from the exhaust manifold.

Mixing Gear Oil

I have a 1989 VW Jetta with 98,000 miles. I think there's ATF leaking

into the final drive because when I opened the final-drive filler plug, about a quart drained out of the opening. The transmission was low to match. Is this what's happening, and how big of a deal is it to have ATF mixed with the gear lube in the differential case? How long before ultimate failure occurs?

STEVE WHEELER
MINEOLA, NY

The VW front-drive auto trans does have separate sumps for 80W-90 gear lube and ATF. And you've got a

bad seal on the tranny output shaft between them. The good news is that ATF is not too far off the mark on providing marginally acceptable lubrication for the bevel-gear type of final drive used in front-drive cars. (Rear-drive cars use a hypoid-type gear that has a lot of sliding friction, and hypoid lube is the only correct lubricant.) The bad news is that it's still not perfect. The worse news is that gear lube will start contaminating the ATF as that seal deteriorates. That's not good either, but it won't fail catastrophically—the same as if you had, say, water in your engine oil.

How long will it last? How long is a piece of rope? I'd get it fixed. This means pulling the tranny out and disassembling it enough to get the seal replaced, and that's a job for a very sophisticated backyard mechanic or a transmission shop pro.

Squeak Up!

I have a 1992 Chevrolet S-10 pickup with squeaky springs. Two different dealers have gone so far as to remove the springs and replace the spacers. I've also lubricated the springs and the pins, but the noise always comes

Tipping The Glass

● Imagine explaining to your mother, or worse yet, the OSHA inspector, why you have a shot glass in your toolbox.

Wrong. It's not what you think. The oily scum stuck to the bottom of the glass isn't some exotic liqueur, used to toast the completion of some exotic car's resuscitation. It's much simpler.

Strut cartridges generate a fair amount of heat as the car bounces along at speed on bumpy roads. The energy of the damping they provide is translated directly into heat, internally. I've seen pro rally cars run with struts so hot that steam poured out of the wheel wells as I changed the tires—at subteen temperatures in Michigan's Upper Peninsula.

In order to provide a path for that heat to be conducted to the outside world, it's necessary to add an ounce or two—just a shot glass' worth—of ordinary motor oil to the strut when the cartridge is being replaced. Oh yeah, be sure to pour the old, smelly oil out first.

Bottoms up.



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* See can for details and restrictions on reimbursement.

CAR CARE

back in a week or two. I'd appreciate any suggestions you may have.

LARRY HALL
NO ADDRESS GIVEN

S-10 trucks of that vintage seem to represent a lot of the mail we see here in the squeak-and-rattle category, so don't feel all alone. I'd try a spring shop. They'll be able to fit Teflon spacers between the leaves. That chassis is inherently noisy, so don't expect it to sound like a Lexus.

Running On Empty

I have a 1974 Ford F-150 ½-ton pickup with only about 40,000 miles. It runs great, and it's in mint condition. Of course when I bought it, I used leaded gas, which is now unobtainable. Should I use a lead additive, and what octane gas should I use?

WES NICKLAS
CLEARFIELD, PA

Eventually, all the old, leaded-gas vehicles will be gone or uprated to run on leadfree fuel—and I'll stop getting these letters. In the meantime...

Your truck will run a long time—nearly as long as if it were running on leaded—on a steady diet of no-

lead, if it's driven in light-duty service. That means no racing, towing, snowplowing or midnight high-speed runs up the mountain.

The problem is a lack of lubrication for the valve seats. Lead in the gas kept the hot valve head from microwelding itself to the valve seat under extreme conditions. Modern vehicles have hardened seats and higher-quality valves, so it's no longer a problem.

The bottom line is if you're just driving around showing off your truck, no problem. But towing that 40-ft. trailer through Death Valley is going to make your valves recede rapidly. Big problem. Eventually, you'll burn a valve and lose compression. At that time, you can pull the heads for a valve job. Have the machinist install hardened valve seats and unleaded-gas-rated valves at that time. For now, use the lowest-octane gas that doesn't give you engine ping.

FM

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS

● If your Infiniti J30's a/c sometimes blows hot air when on AUTO, a dealer can install revised parts to keep things cool.

● If your mechanic wants to replace the engine computer in your 1991-93 Buick Park Avenue, LeSabre or Regal because the a/c won't engage, mention Code 66. The computer sets this code and keeps the a/c off if you're low on R-12.

● There's a revised brake booster check valve for 1990-91 Olds Silhouette minivans built before VIN MT305086 and 1988-92 Cutlass Supremes that give off a rattle or buzz from the instrument panel under braking.

● Does your 1993-94 Chrysler minivan moan at 1400 to 2000 rpm with the a/c on? Look into getting a new compressor clutch plate (PN 4773165) to reduce the noise.

● Ford has released a new power-steering gear input-shaft seal kit (PN E2TZ-3L526-A) that can withstand higher temperatures and eliminate leaks from just about all 1982-92 light trucks.

WE'LL MAKE THIS AD BRIEF AND TO THE POINT.

The TURBOMAX® drill bit, with the revolutionary JET POINT™ tip. In short, it stays sharp longer, to make even the most challenging jobs go smoothly. Independent tests have shown conclusively that TURBOMAX® bits drill twice as many holes as the leading drill bit.

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NEW PRODUCTS

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Diagnostic Scan Tool

You need help diagnosing problems with today's cars, help in the form of a scan tool. Unfortunately, most of these devices are pretty

darn costly. Now

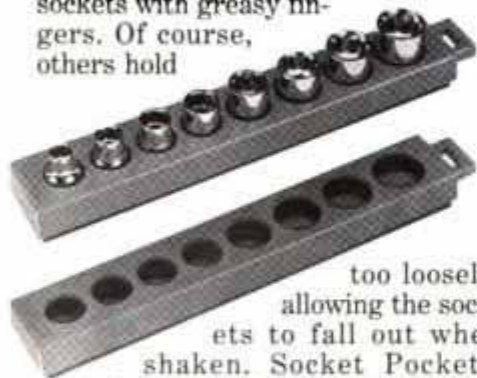
you can beat the high price that's normally associated with sophisticated diagnostic equipment.

The handheld AutoXray XP240 plugs into Ford, GM and Chrysler computers and displays all operational engine data and trouble codes in plain English. A capture mode helps solve hard-to-find driveability problems. Retailing

for less than \$300, the device is sold at tool and auto parts outlets. Contact AutoXray Inc., 2615 Pacific Coast Hwy., Suite 300, Hermosa Beach, CA 90254; (310) 379-0099.

Socket Tray

Ever have a tool do its job so well that it defeated its own purpose? For example, some socket holders grip so tightly you can't remove the sockets with greasy fingers. Of course, others hold



too loosely, allowing the sockets to fall out when shaken. Socket Pockets'

maker says this product grips just right. The holders use a high-density neoprene foam that's covered with a high-impact polypropylene plastic. A magnetic nitrile rubber base attaches to any metal surface. Socket Pockets sells for \$16.95 per tray, and is available from Sidewinder Products Corp., 850 Municipal Dr., Birmingham, AL 35216; (800) 999-3405.

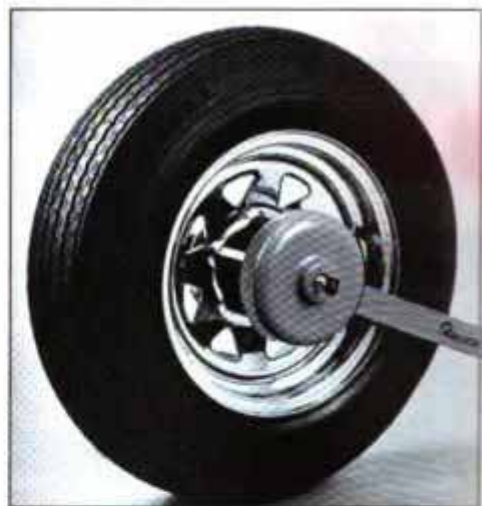


Vehicle Safe

Looking forward to that next hunting or fishing trip? Have you thought about the security of your guns or rods in your parked vehicle? Northland's vehicle safe helps keep your sporting equipment, tools and valuables away from sticky fingers. The safe bolts to the vehicle body behind the seat of pickup trucks, and inside sport/utilities and car trunks. Security features include a 12-ga. reinforced steel door, pushbutton combination lock, fully welded joints and pry-resistant construction. The safe costs \$395, and is available from PSI/Northland, 1720 Madison St. N.E., Minneapolis, MN 55413; (800) 245-3172.

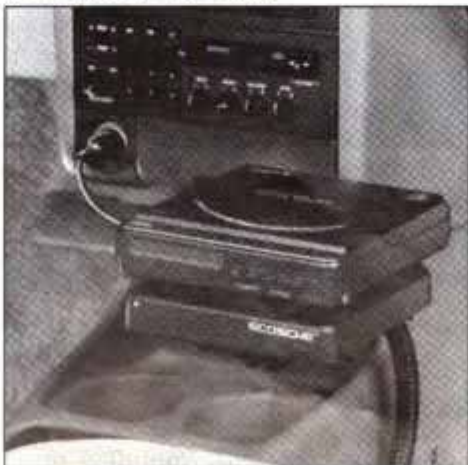
CD Player Mounts

You didn't get the factory-installed CD sound system because you have a portable player that can sit on the seat next to you. Trouble is, it slides all over the place and skips whenever you hit a bump. A solution is the CD Player Mount. It's available in several versions, including a standard mount, a model with a 15-in. extension that attaches to the side of a console and one with a universal cassette adapter. All versions can firmly position your player at any angle and dampen road vibrations. These mounts range in price from \$24.95 to \$74.95, and are available from Scosche Industries, 5160 Gabbert Rd., Moorpark, CA 93021; (800) 621-3695.



Trailer Lock

You've just spent a great day on the water, and you're all set to load your boat onto the trailer. Uh oh. The trailer isn't where you left it. You can deter trailer theft with a special lock such as this one from Trailock. The device locks the trailer wheel, preventing it from turning. Trailock fits any camper or trailer wheel with four or five lug nuts. It uses a steel backing plate, a cover plate and a 6½-pound solid-steel security bar that locks the system in place. Trailock also secures the lug nuts. It sells for \$129.50, and is available from Trailock Inc., 12461 S.W. 23rd Terrace, Miami, FL 33175; (800) 872-4562.



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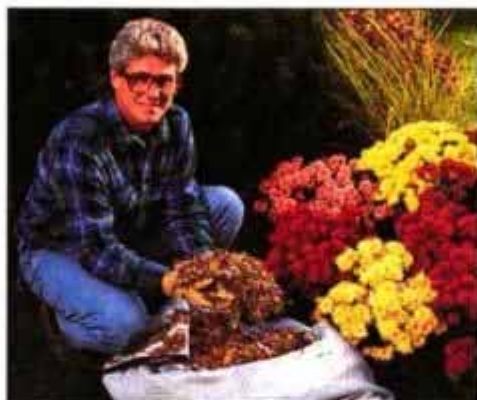
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SATURDAY MECHANIC

SERVICING YOUR A/C

BY PAUL WEISSLER

● It's hot, so hot your car's interior shimmers. Getting into the car is clearly out of the question, at least until the air conditioning hauls out a few million BTUs. You lean in and twist the key, being careful not to raise blisters by touching the steering wheel. The engine fires and idles smoothly, then you punch the MAX COLD button on the dash—nothing happens.

Great, you think, at least in the old days, ordinary folks used to be able to purchase R-12 refrigerant to punch up a tepid air conditioner. Not anymore. And it won't be too long before R-12 is off the market completely—

a victim of federal regulations that restrict the manufacture of ozone-depleting chlorofluorocarbons.

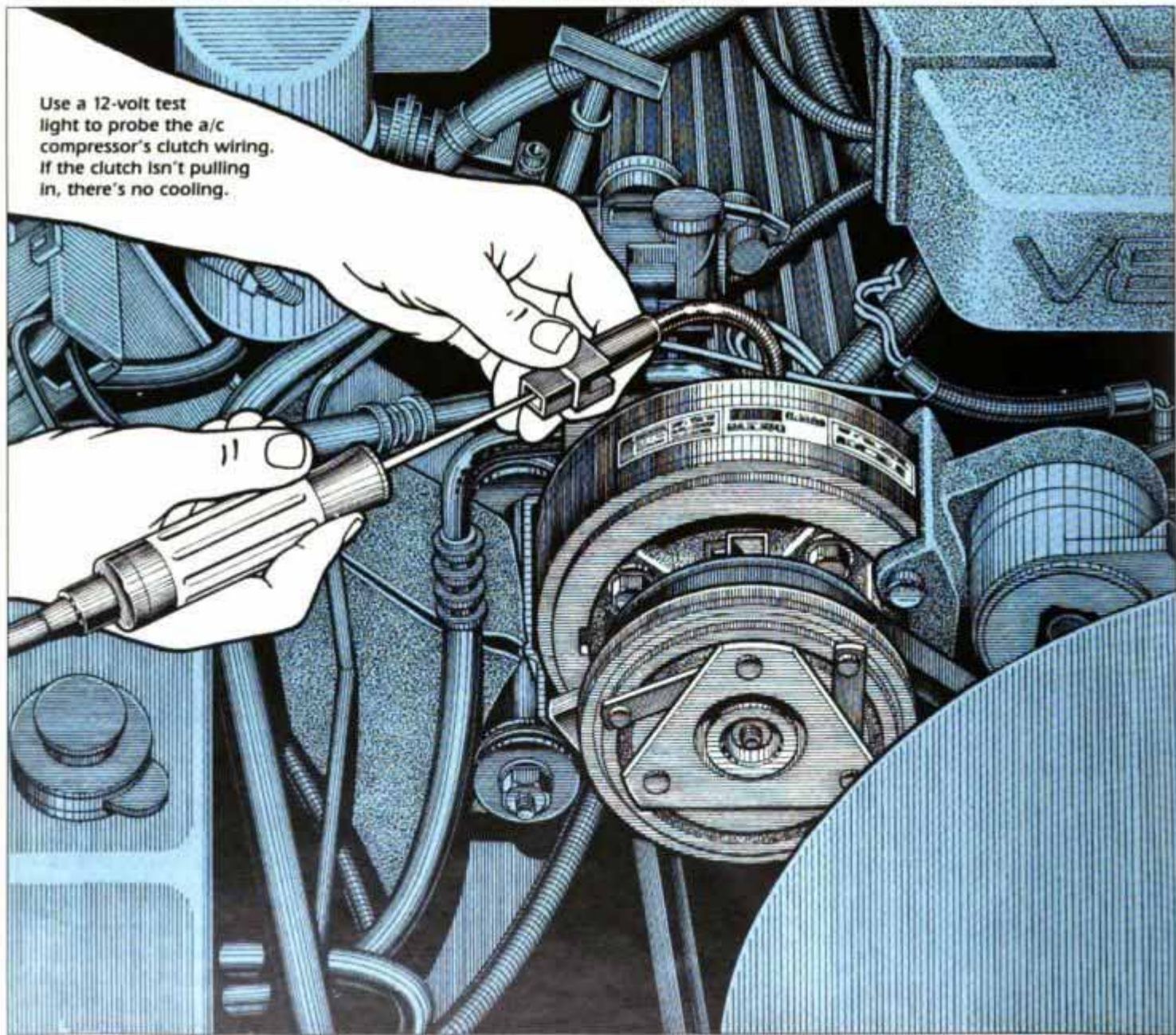
Fortunately, it's still possible for the average Saturday mechanic to fix most of what ails his air conditioner without having to open up the system. To keep you in the service picture, let's consider just a few of the common causes of poor—or zero—cooling that you can diagnose and cure. Start by acquiring the a/c service manual and electrical schematic for your vehicle. You'll also need a 12-volt test light. A volt-ohmmeter comes in handy as well.

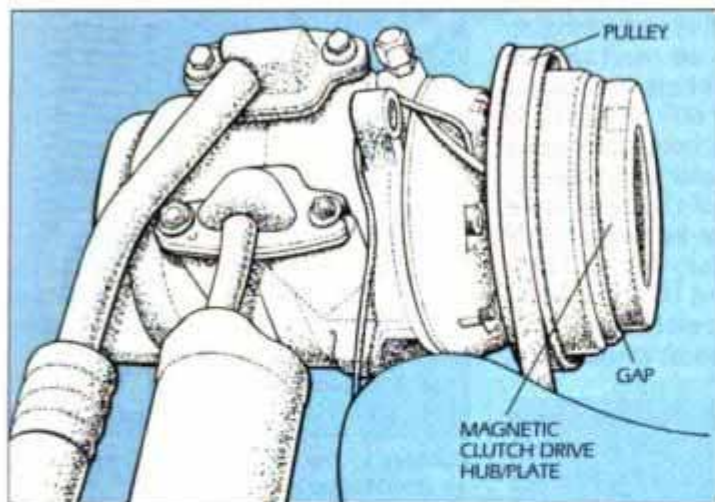
No Cooling

If the compressor doesn't engage, there will be zero cooling. An electromagnetic clutch should lock the drive hub/plate on the compressor, with the belt-driven pulley to spin the compressor shaft.

The clutch circuit is fused, so check the fuse. The fuse is good? With the engine and the a/c on, check to see if juice is getting to the clutch by probing its wiring connector with a 12-volt test light. If the light doesn't go on, there's a break in the circuit. If it does go on, attach a jumper wire to the ground side of the clutch circuit. If

Use a 12-volt test light to probe the a/c compressor's clutch wiring. If the clutch isn't pulling in, there's no cooling.





Gap between hub and pulley should close when a/c is turned on.

the clutch still won't engage, it's bad.

It takes special tools to change a compressor clutch. Unless you can rent them, leave this job to a pro.

If the clutch engages when you jump it, there's a problem with the ground circuit, which may be wired through to the engine computer. Both circuit problems require straight electrical diagnosis and a good wiring diagram.

However, the refrigeration system may also be involved. There's a low-pressure switch in the current-feed circuit that is designed to keep the compressor from engaging when pressure is low.

See if there's enough R-12 pressure to close that switch. When the system is running, one half operates at low pressure and the other at high. However, after the system has been shut off for a few minutes, pressures equalize, so you can check pressure at both of the Schrader valve ports (one low-pressure, one high-pressure). They should be the same—roughly equal to the ambient temperature.

If pressure is less than 35 psi, the refrigeration system is low on R-12, and that could account for the failure of the compressor to engage. Have a professional trace the leak and then recharge the system with R-12. Incidentally, if the Schrader valve caps are missing, they could be the cause of your loss, as they provide the real seal, not the valve itself.

Important: Use only R-12 in an R-12 system! Right now, there's enough R-12 around at moderate prices, so it pays to keep the system on R-12. However, if you ever have a compressor failure, the replacement will likely be compatible with R-134a, which would make changing over to the new refrigerant simpler.

The a/c pressure is normal? Apparently, the problem is purely electrical.

And in this case the first step is to check for a computer trouble code. The engine computer? You bet. On most American cars and some imports, turning on the air conditioning at the dashboard is just a request to the engine computer to provide the electrical ground to complete the compressor clutch circuit.

If the engine computer sees a reason not to, the a/c won't come on. Possible reasons, in addition to low refrigerant, include warning signals from certain engine sensors. The coolant-temperature sensor may be signaling a very high coolant temperature, and allowing the a/c to come on could cause overheating. Or a power-steering switch may be signaling high pressure (as in a parking maneuver), and allowing the a/c to come on could add to the engine load from the belt-driven accessories and stall the engine. Of course, some of these signals may be wrong, and you'll need to investigate the solution to these engine problems to get the a/c online again.

No computer trouble codes? Check for a bad a/c clutch relay. Also, note that some of the computer sensors are not covered by trouble codes—the power-steering switch is a common example.

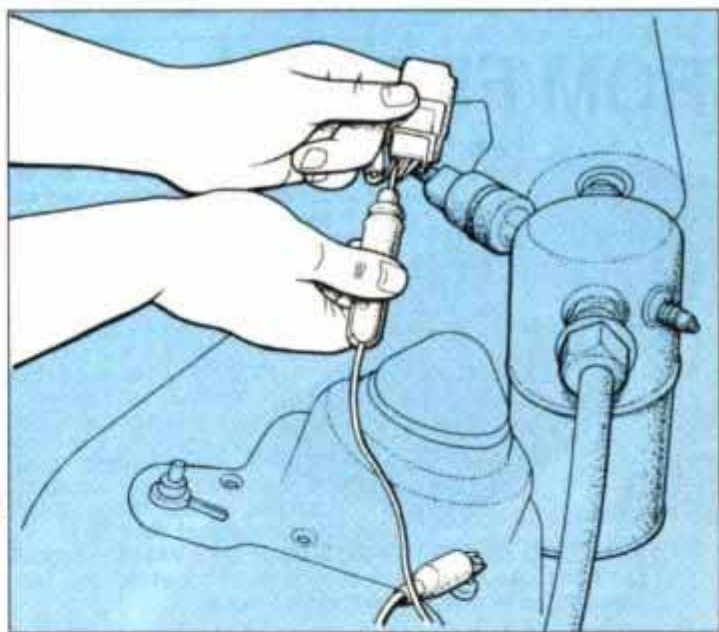
If your car has one, bypass it for testing. If the compressor now comes on, replace the switch.

No clues in the computer circuit? Refer to an a/c circuit diagram to see what additional switches or relays are in the compressor-clutch circuit. On most GM and Ford products, and some Chrysler vehicles, there's a switch that cycles the compressor clutch on and off to control performance. You can find out if the switch is bad by unplugging it and attaching a

jumper wire across its connector. If the compressor now comes on, the switch apparently isn't closing. Confirm this with an ohmmeter across the switch terminals. On GM and Ford vehicles, the switch usually is on a large cylindrical can called the accumulator. On Chrysler products, it's in a block at the firewall.

Bad switch? On late-models, the switch is mounted on a Schrader valve. As you unthread the switch, the valve closes so you won't lose any R-12. Grease the new O-ring with silicone lubricant, gently position it on the port and then thread the new switch into place. If the switch has a plastic body, a firm hand-tightening is enough. With metal, a gentle nudge with a wrench does it, because the O-ring makes the seal.

Note: Your circuit diagram may show other pressure switches. The variety is almost endless, depending on the type of vehicle, so without a diagram, you're in Guess City. Among the most common variety are a high-pressure cutout and a dedicated low-pressure cutout (often in addition to the cycling clutch switch). If the basic

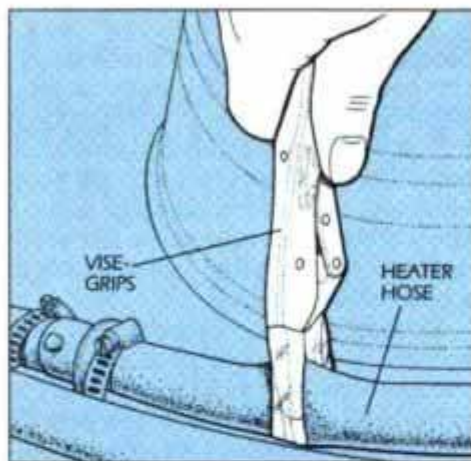


Use a test light to check for voltage at the low-pressure switch. Back up that reading by checking the switch with an ohmmeter.

pressure check showed nothing awry, unplug and bypass these switches for testing. In most cases, the bypass is achieved with a jumper wire across the wiring connector terminals—but read the wiring diagram details, as some switches are normally closed and open up as a signal. If so, simply unplug these to bypass. Double-check each switch with an ohmmeter.

Many cars—particularly Japanese models and most late-model Chrysler products—use a temperature sensor

CAR CARE



Clamp off the heater hose with padded Vise-Grip pliers to check for a leaky flap.

on the evaporator (the in-car heat exchanger that cools the interior air) in conjunction with an electronic module to cycle the clutch. The shop manual should provide specifications for a resistance check of the temperature sensor and where to connect a voltmeter to test for an output signal to operate the clutch. Make these checks under the dashboard.

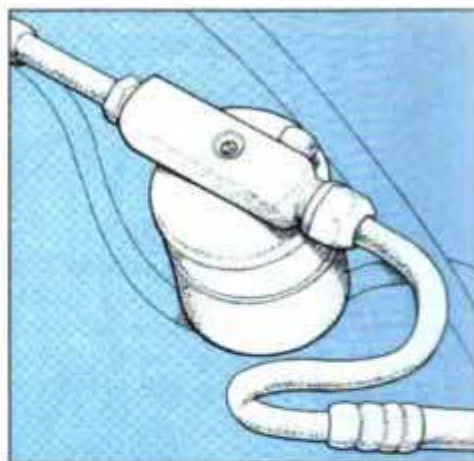
Poor Cooling

The temperature of the air coming out of the registers will not necessarily be

very low on a humid, hot day. The a/c may expend all its effort just wringing humidity out of the air, and the air blowing out of the registers easily could be as high as 60° to 65° F. If there is some cooling, but clearly not a normal amount, make this simple check: Is the front of the condenser (the heat exchanger in front of, or alongside, the radiator) free of bugs, leaves, road film and other debris? If it isn't, airflow is restricted. Clean the condenser with a soft brush and a detergent-and-water solution.

If you've got a car that has either no grille or a tiny one, you've got an "underbody breather." Inspect any underbody airdams and covers. If they're damaged or missing, they could be responsible for reduced airflow and poor cooling. And on almost all cars, when the air conditioning is turned on, a radiator/condenser electric fan should also come on. If it doesn't, that also reduces airflow and a/c performance, particularly in slow-driving conditions.

Of course, if the airflow is normal, you'll want to make sure a partial loss of R-12 is not responsible for a drop in performance. Japanese-made and some Chrysler systems have a sight



Bubbles in the sight glass may mean the air conditioner is undercharged.

glass—a tiny window into the refrigeration circuit. Check it to see if there are any bubbles when the clutch is engaged (bubbling when it's disengaged or in the first few seconds after engagement is normal). Bubbles with the clutch engaged may—repeat, may—indicate a low charge. Also, check operating pressures with a pressure gauge and compare them with factory specifications. You must use the specs because pressures vary widely with ambient temperatures.

You should be aware that a power-

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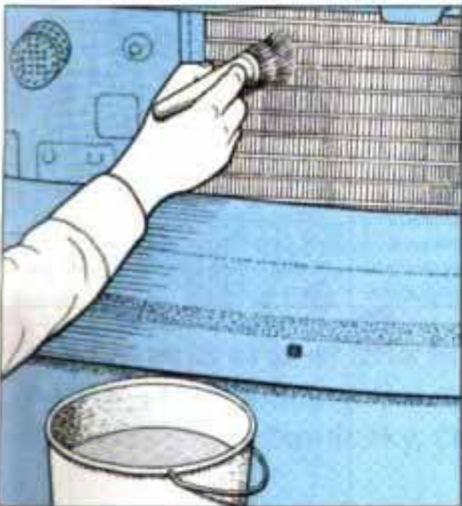
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steering switch may misbehave, signaling "high pressure" with just a slight rise in pressure, thus killing the a/c. If your system runs fine with the car parked, but stops as soon as you pull away, either a bad power-steering switch or a misbehaving throttle-position sensor (TPS) is possible. The TPS is supposed to signal "kill the a/c" on full throttle to provide improved passing performance, but the sensor may come in with this signal when you're just barely touching the gas pedal. Or if the air-conditioning system has an evaporator-temperature sensor, take a careful ohmmeter reading and convert it to degrees by consulting the table in the manual. You may find that the sensor *thinks* it's cold when it's really not.

If the air blowing in your face is cool, but there isn't enough air blowing, operate the blower switch and see if the airflow picks up. A nonrunning blower fan and a slow-running blower motor are purely electrical problems,



Use a soft brush and detergent to clean leaves and dead bugs from the condenser.

and are as likely to be responsible for poor system performance as anything. If the blower simply won't reach high speed, check the circuit diagram for a high-speed blower relay. You might be able to fix a bad connection by simply plugging in the wiring connector properly. Or you may find a broken wire by probing the wiring connector with a test light.

Another common cause of poor performance: the heater core's high temperature is bleeding into what should be purely chilled air from the evaporator. Some heat transfer is normal if you move the temperature lever or turn the knob from the MAX COLD position. However, at MAX COLD, there should be no hot-air bleed.

Clamp off a heater hose to block the hot-coolant flow. If a/c performance improves considerably, one of

the following could be occurring:

- A heater coolant-flow valve (used on many but not all vehicles) is stuck in the open position.
- The flap door that's supposed to regulate the airflow through the heater or evaporator isn't operating properly. If it's a manual, cable-controlled type with a lever, try slamming the lever against the MAX COLD stop. If you don't hear a flap door hit a stop inside the underdash case, the cable may need adjustment.

With an electric motor-driven design, check the case for a bad wiring connection at the motor.

And, of course, there may be cold air, but in the wrong place. If the cold air is going to your feet or out of the defrost ducts—but not to your face—that's an air-distribution problem. Air distribution is controlled by operating flap doors inside the heater/air-conditioning case, and it's done either by vacuum or electricity. If it's vacuum-operated, look for a leak. **FM**

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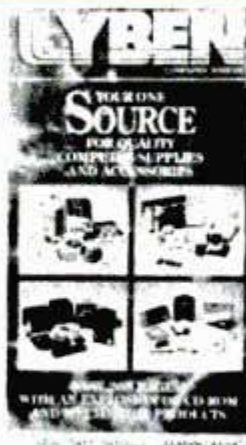
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FISHING THE BIT STREAM

Get ready for digital recording.

BY GEORGE MANNES

● How many hours of video can be squeezed onto a VHS tape? If you take a standard T-120 cassette and record at extended-play speed, you end up with 6 hours. Buy an ultrathin tape like JVC's Super VHS XZ-210 and you can squeeze in about 10½ hours worth of soap operas.

But now, JVC—the inventor of the VHS videocassette—is introducing a new technology that makes running times like these look like pocket change. Using digital-recording wizardry, machines that are built to JVC's latest format can record up to 49 hours of video onto a VHS tape.

This new recording format is one of two videocassette breakthroughs that JVC announced recently. The other is a movable version of a VCR mechanism that's usually motionless—a replacement that leads to a remarkable improvement in some kinds of pictures. Taken together, these innovations indicate that the home VCR, introduced nearly 20 years ago, is not at a technological standstill. As America enters the age

of digital videodiscs, interactive cable systems and new types of satellite television, JVC is trying to ensure that VHS isn't relegated to the Museum of Electronic Antiquities.

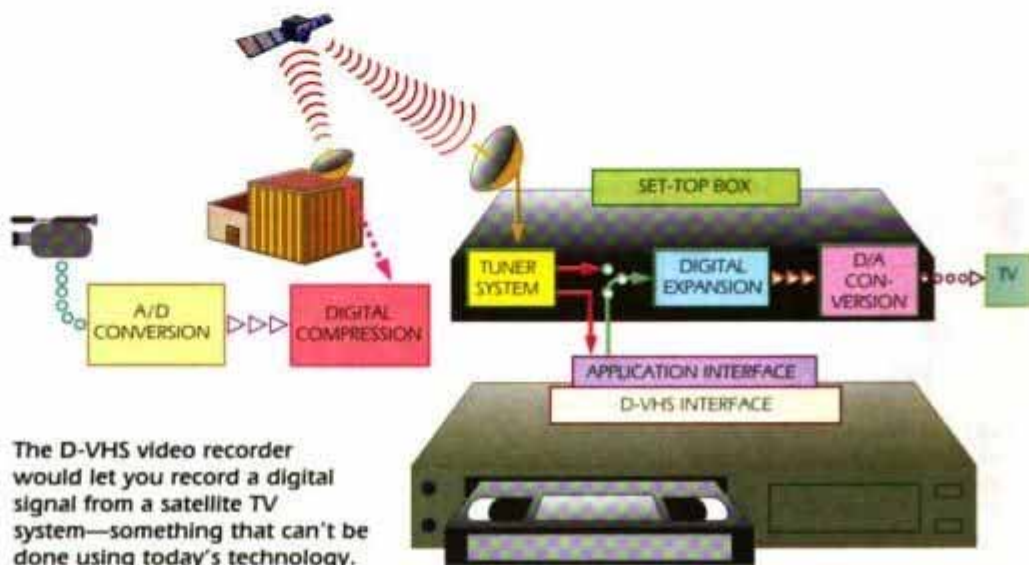
The 49-hour VHS recording is one possible payoff of a new VCR format that JVC calls D-VHS (for "data VHS" or "digital data VHS"). It's a variation on the VHS system that

brings the home-recording standard into the digital age—sort of.

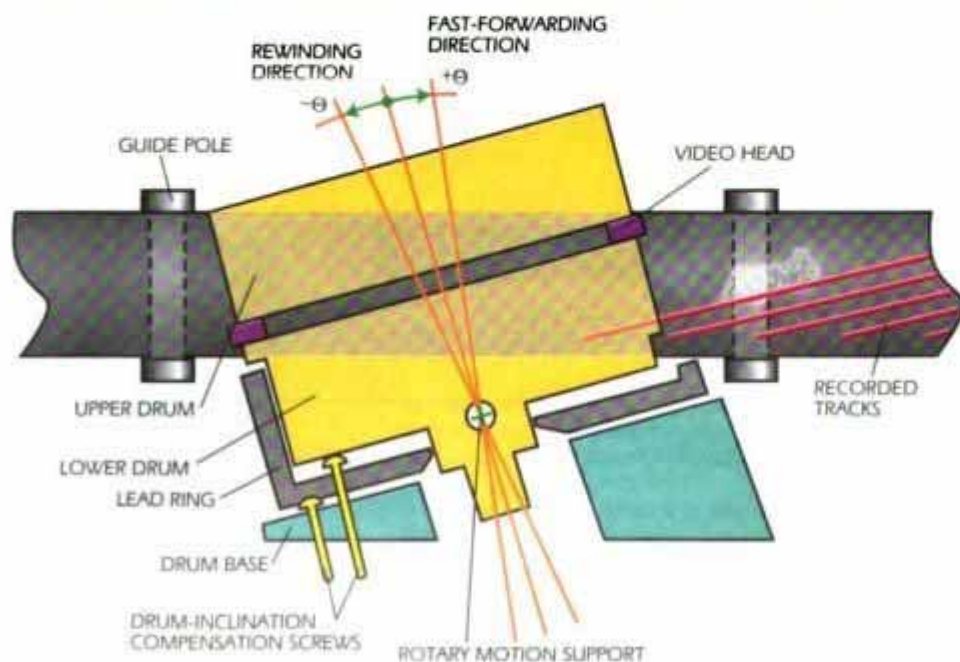
Instead of recording only analog sound and video signals onto a VHS tape—just as they've been recorded since the format was introduced in 1976—D-VHS machines will be able to record digital signals as well. Digital technology permits such applications as long-duration tapes, high-definition television recordings and copies of tapes that don't degrade (like analog recordings do) from the original master. D-VHS VCRs will also be able to record and play back today's standard VHS tapes, like any other VCR on the market.

But the new format has a catch: A digitally recording D-VHS VCR, in and of itself, is useless. Although it can record and play back a high-quality digital signal, it can't convert a conventional analog signal into a digital one for recording. And though it can read a digital signal from a tape, it can't transform it into a signal that's watchable on a television set.

So the digital part of a D-VHS VCR is useful only for people who own a machine that can translate the digital data to and from some sort of comprehensible analog information. One possible application would be for use by subscribers who have a new Digital



The D-VHS video recorder would let you record a digital signal from a satellite TV system—something that can't be done using today's technology.



JVC's moving Dynamic Drum yields a distortion-free picture even at high playback speeds.

Satellite System. Those with DSS get digitally encoded signals from the sky. Their home DSS receiver converts the digital signal into an analog one that can be viewed on their TV set. With a D-VHS VCR, people could record the digital signal of a movie received by the satellite dish. Then, to watch the recorded movie, they couldn't just connect the VCR to their television; they'd have to route the signal from the VCR back into the DSS terminal, where its proprietary electronics would convert it into an analog signal and then route it into the TV set. In fact, Thomson Consumer Electronics says it has been able to record satellite signals using a version of the RCA-brand DSS receiver. The only problem current DSS subscribers will encounter, Thomson says, is that such recording will require a special digital interface that isn't a feature of today's DSS receivers.

Because the new format records an incoming digital signal, it can record video that's encoded in a variety of ways. For high-definition television signals, it can accept 3 1/2 hours of data input at a rate of 28.2 megabits per second. To jam 49 hours of video onto a tape, it would use a lower-definition data rate of about 2 Mbps. And the format isn't limited to video; it could also be used

for storing computer data, says JVC. The first D-VHS VCRs won't be released until next year—at the earliest. It hasn't been determined how much money data recording will add to the cost of a VCR, but a retail price of around \$500 is the goal.

Another wrinkle on the VCR is JVC's new Dynamic Drum system, which will first appear in next year's models. The benefits of the Dynamic Drum would be obvious to anyone who has ever pushed a VCR's FAST FORWARD button while a movie is still playing. If you're watching a standard film and then begin to scan forward, you'll see one of two types of video distortion. If you have

a 2-head VCR, you'll observe large, snowy horizontal streaks that obscure much of the picture you're zipping through. If you have a 4-head VCR—including any machine with hi-fi audio—you'll see a more subtle problem. Instead of cloudy streaks, the fast-moving picture will have several horizontal seams running through it, almost as if the picture were constructed of strips of paper that weren't perfectly aligned.

These glitches—you also see them in fast-reverse—show up for a reason that becomes apparent once you examine videotape recording more closely. Unlike audiotape, in which the recording head is anchored at a fixed

faster than normal speed, the tape heads can't trace the same paths as they did upon recording. In fact, they run across several tracks.

Enter the Dynamic Drum. JVC's engineers in Japan have developed a VCR that, for the first time in VHS history, tilts the recording drum *together* with the lead that defines the path for the tape around the drum. Thus, it's able to compensate for the speed of tape running faster or slower than normal. Instead of the tape heads crossing diagonal tracks, the tape is realigned so the playback heads can trace tracks exactly as they were first laid down.

This innovation translates into several advantages. Most obviously, it creates distortion-free pictures—regardless of the speed at which the tape is moving. Viewers will see no seams and no noise. JVC says that the Dynamic Drum adds about \$125 to the cost of the machine.

JVC's Dynamic Drum also has benefits that go well beyond providing pleasant-looking scans. Today, slow-motion playback on home VCRs is rendered as a series of still frames. But by using the Dynamic Drum system, a VCR could play back low-speed action—not as a series of stills, but as fluid movements.

For security cameras, JVC engineers say that it

would be possible to build a VCR that could record endlessly on a single tape. Similar to an audiotape machine that records on both sides of a cassette without needing the tape to be flipped, a perpetual VCR would record in one direction until it hit the end of the tape, then reverse and record in the opposite direction. A staggering of the forward- and reverse-written recording tracks like zebra stripes would prevent the material on the last forward pass from being overwritten on the following reverse pass.

It's still unclear how many hours of recording such a tape could hold at a time. But if it were 49 hours, that would be quite a trick. **FM**

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spot, videotape uses moving magnetic heads that record at a diagonal to the path of the tape. When a VCR records, the tape feeds around a fixed metal drum inside the machine. In a slit in the drum, traveling around at high speeds, are recording heads that lay information down on the tape as it passes over the drum. Because the tape is wrapped around the drum in a slightly askew manner, the spinning heads trace a series of diagonally striped signals on the tape.

In normal playback, the tape runs past the drum at the same speed as when it was recorded, tracing the diagonal tracks at the same angle. But when the tape is scanning forward

THE VAGARIES OF FATE

A hurtin' Western Auto/PM team looks at the summer.

BY AL PEARCE



● Long-time NASCAR racers sometimes use a quaint Southern adage to explain away the fickle nature of their sport: Sometimes you eat the bear, and sometimes the bear eats you.

Well, during the end of May and all through June, that hungry ol' bear simply made a feast of Darrell Waltrip and his Western Auto/POPULAR MECHANICS Winston Cup team.

The team's fortunes sagged when Waltrip was diagnosed with three broken ribs and an intercostal muscle tear after he crashed with Dale Earnhardt in the Winston Select all-star race (see "Ridin' High, Ridin' Low," page 104, Aug. '95).

Coca-Cola 600

Waltrip endured the pain and qualified 21st for the Coca-Cola 600 at Charlotte, North Carolina, knowing

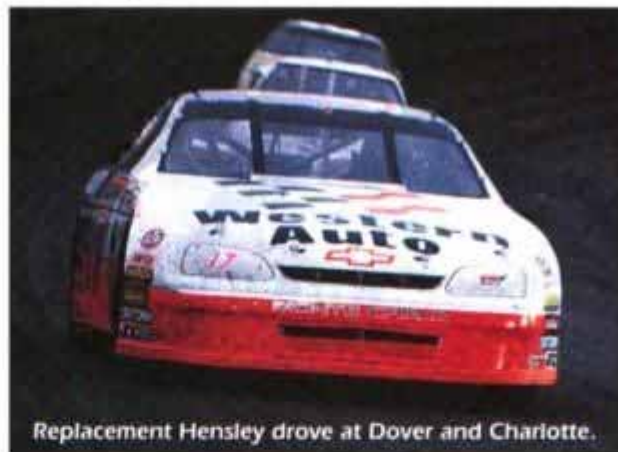
that he probably wouldn't be able to make the full 400-lap distance.

"I can get in the car and start the

because we've come a long way with our car and motor and team. The car is outstanding. Now if we can just get the driver healed up."

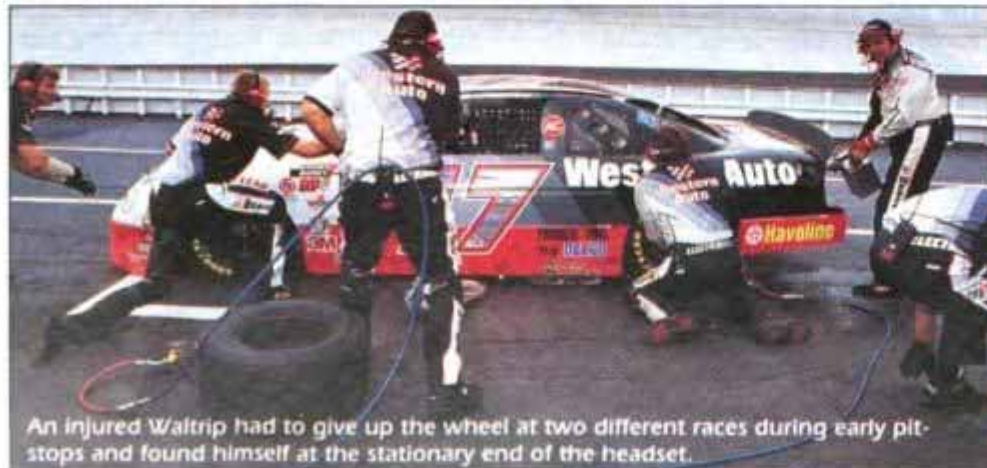
Waltrip and crew chief Pete Peterson recruited highly regarded journeyman driver Jimmy Hensley to stand by during the Coca-Cola 600. The plan was for Waltrip to start the race and run as long as he could. Later, when the opportunity presented itself, he'd turn over the wheel to Hensley.

Despite intense pain, Waltrip drove hard enough to stay on the lead lap in the early going. He yielded to Hensley during a caution period at lap 77, but the team lost a lap in the process.



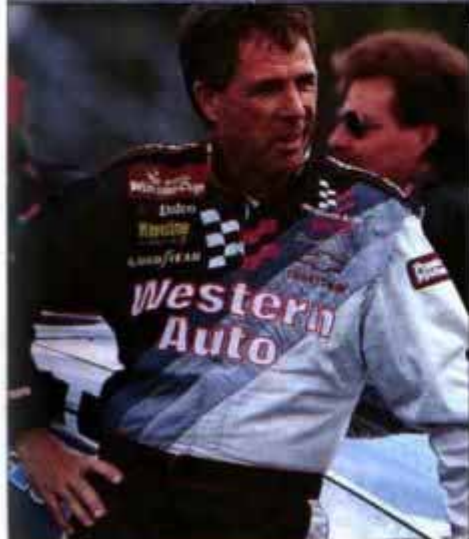
Replacement Hensley drove at Dover and Charlotte.

race," he said three days before the 600, "but I'm not going to be competitive unless I get a lot better. I hate it



An injured Waltrip had to give up the wheel at two different races during early pit-stops and found himself at the stationary end of the headset.





After one lap at Pocono, the PM Monte Carlo was alone in the pits with a broken rod. And Waltrip was watching the action.

sion. After qualifying seventh and feeling almost up to par, Waltrip was optimistic going into the 200-lap race—until the first lap, that is.

"We put in this engine [Saturday], but never got to run it because of the rain," he said. "If we'd run yesterday, we would have caught the problem. It's a shame because I felt good, and I think the car would have been real good. But we'll never know."

Waltrip was long gone by the time Jeff Gordon missed a late-race gearshift and threw away a cinch win. After dominating all afternoon, he fell from first to 16th, well behind winner Terry Labonte and top-5 finishers Ted Musgrave, Ken Schrader, Sterling Marlin and Hut Stricklin.

Miller Genuine Draft 400

Things were going relatively well in the Miller 400 at Brooklyn, Michigan, until fate again stepped in, near the end of the race. Waltrip had qualified 16th, led twice for three laps and seemed headed for a top-10 finish.

But at lap 176, after taking the caution flag entering Turn 1, the Western Auto/PM entry slid through the fluids dumped from Todd Bodine's blown engine. The car headed straight for the wall. "It just wouldn't turn," Waltrip said of his Chevy. "I didn't know if I had a tire going down or what happened. I tried to turn and it wouldn't."

Just as the car reached the wall, its rear end kicked out. When Waltrip corrected by steering into the spin, the wheels suddenly caught the asphalt and snapped him almost head-on into the wall. He was not injured, but the car was heavily damaged.

"That's the first time in a month I've been able to really run, and I was feeling fine," Waltrip said. "I have a new seat in the car, and I'd probably be suffering if I didn't. I survived a hard crash without further injury, so I'm pretty happy about that."

The bear was happy, too—at least for the time being. **PM**

Hensley briefly unlapped himself, but couldn't stay ahead of the leaders long enough to catch another caution. He remained one lap down until brushing the wall and losing three more laps.

The team finished 18th, four laps behind first-time Winston Cup winner Bobby Labonte.

Miller Genuine Draft 500

Waltrip spent even less time in his car the following weekend at the Miller 500, in Dover, Delaware. An 18-car accident on the second lap brought out an immediate caution, which allowed Hensley to quickly climb into the car that Waltrip had started from 39th on the 42-car grid. There were two other cautions within the first 44 laps, but only two more in the final 452. Hensley brought the Western Auto/PM car home in 20th place, six laps behind winner Kyle Petty. It was Petty's first victory since the summer of 1993 and Pontiac's first Winston Cup victory since the last race of the 1993 season.

UAW-GM Teamwork 500

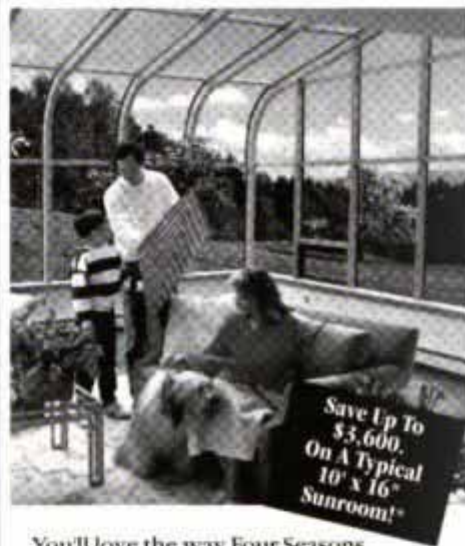
Perhaps the most disappointing race of the season was a week later at Pocono, Pennsylvania. The UAW-GM Teamwork 500 lasted just 5 miles for Waltrip after a connecting rod in his V8 engine snapped on the first lap.

As fate would have it, late-afternoon fog and rain on Saturday had forced NASCAR to cancel the weekend's final Winston Cup practice ses-

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IN-CAR INSTANT TRAFFIC REPORTS

Volvo's Dynaguide system alerts you to problems right now.

BY DON CHAIKIN, Automotive Editor

● If you've ever driven in a metropolitan area—especially at rush hour or on one of the popular visit-the-family holidays—you're all too familiar with the scenario. You've been listening to the radio, paying attention to all the traffic reports. You hear about accidents and construction and congestion on the other side of town—but not a word about your chosen route. Yet here you are, sitting stock still, surrounded by thousands of equally frustrated drivers, maybe a fraction of a mile from your exit—and mobility.

A little guidance

Nothing good comes of traffic jams. Time is wasted, tempers fray, accidents occur, fuel is wasted and air pollution escalates. Which is why Volvo has developed a full-time traffic warning system it calls Dynaguide.

This system consists of a dedicated radio monitor that receives information from a traffic-management center and displays the information, in the form of warning icons, on a dash-mounted video monitor. The monitor also shows the car's position on a displayed map, compliments of Global Positioning System technology.

But don't go running to your Volvo dealer to buy a Dynaguide. While it will be available in Sweden any day now, there are no current plans to bring it to the United States.

Reap what you sow

The Swedish carmaker did conduct a test of the Dynaguide here, however, and we—along with our Volvo 850 Turbo long-term test car—were part of it. But after commuting into our Manhattan offices for more than a month, we can tell you that we are not ready for Dynaguide—and it's not ready for us.

The biggest problem is that there isn't enough of an infrastructure to supply the system with up-to-date information. While Dynaguide in Sweden is supported with traffic and road



Remote control allows you to scroll around the maps on the high-resolution monitor.

conditions from a multitude of sources, including intelligent highways with electronic roadway sensors, the test here was supported by only one source: Metro Traffic Control. While Metro is one of the most extensive traffic-reporting networks in the country, it alone isn't enough to offer the level of information necessary for Dynaguide to be valuable. We often found ourselves sitting in traffic

for more than an hour—without any warning from Dynaguide. In fact, there were times when the *radio* had more accurate traffic information.

User not-so-friendly

With Dynaguide, you need to click through a menu of icons to pinpoint your particular trouble spot. And if you want detailed information, you have to keep clicking—but only when the car is stopped. Volvo feels that trying to read while driving could be dangerous. Actually, our experience was that operating the remote and scrolling through the menus was far more distracting while driving than reading a few lines of text. So, if Volvo intends to bring Dynaguide to North America—which it may not—the designers should consider using a touch-screen. And if a touch-screen isn't feasible, Volvo might opt for steering-wheel fingertip controls in place of the remote.

But for now, the hardware isn't the real problem. The system's biggest drawback is the unavailability of enough timely and accurate information. **FM**



Icons indicate location, direction and source of delays.

Natural Prostate Relief

It's a natural fact. If you are a male over 40 and don't already suffer from a prostate gland disorder, the odds are 2 to 1 that you will before you are 59. By the age of 65, most American men have enlarged prostates.

As the years pass, mild discomforts can become disabling. Today, prostate surgery is the second most commonly performed surgery in men over age 65! Surgical complications can include total loss of bladder control and sexual dysfunction.

Prescription drugs may halt the swelling, but rarely ends the suffering. Like many prescription drugs, they have side-effects, like weak erections and low sex drive.

Many doctors feel that prostate disorders can be treated or prevented by giving the prostate gland the nutrition it lacks.

Recent scientific research has shown how to remedy the underlying problems associated with prostate disorders--safely and effectively. These results have been published in the *British Journal of Clinical Pharmacology*, the *American Journal of Gerontology* and papers from the *National Cancer Institute*. They reveal that several vitamins, minerals and natural herbs can dramatically shrink the prostate and improve urinary performance in older men.



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"...and in the sex department, my wife thanks you."

-- Mr. G. Sawin
Lynwood, WA

TRIAL BY FIREFLY

We air out the Air Force's new T-3A, the plane that tests the mettle of would-be flyers.

BY WILLIAM GARVEY



● U.S. Air Force pilots operate some of the most exotic flying machines extant and do so under stressful conditions—such as when other people are trying to kill them. That these pilots perform so well is a tribute to their makeup and training. And now a key element in the making of these remarkable aviators is one of the newest and least complicated aircraft in the service's inventory.

In the past, the Air Force introduced pilot wannabes to the wild blue by lofting them in the T-41 Mescalero (known to the rest of us as the Cessna 172). If they displayed reasonable flying acumen, the candidates moved on to T-37 Tweet twinjets (in coming years to be supplanted by the Beech Mk. II), and the serious work began.

For decades, this worked well enough, but with the dollar squeeze at the Pentagon, training costs and efficiency came under scrutiny. The verdict: Do even better.

Enter the T-3A Firefly. Built in England by a little outfit called Slingsby Aviation Ltd., the Firefly is a 2-place, low-wing, aerobatic trainer with fixed gear and a 3-blade prop. The Air Force version sports a 260-hp fuel-injected 6-cylinder Lycoming engine.

In 1992, the Air Force signed a \$34-

million contract to buy 113 T-3As—that's \$300,000 per airplane—with 56 going to the Air Force Academy, in Colorado Springs, and 57 to another training group in Hondo, Texas. Deliveries were completed this summer. Meanwhile, the T-41s are being parceled out to various base aero clubs.

If spending \$34 million strikes you as a federally perverse way of saving money, take heart. Enough logic lies behind the buy to satisfy the most skeptical taxpayer.

First, the T-41s had chalked up thousands of hours of flight time. They had to be replaced eventually. More significantly, though, the T-3As can do much more than their predecessors. Unlike the T-41, the Firefly can execute loops, rolls, Immelmans, spins and steeply banked overhead patterns. In fact, the T-3A can perform every maneuver flown by students in the T-37. It just does them at slower speeds. By expanding the curriculum in the Firefly, the Air Force expects to eliminate marginal candidates sooner and to ensure that successful trainees are better prepared for the faster machines.

That's where money is saved. Hourly operating cost for a T-3A is \$58, plus 14 to 20 gallons of avgas—

a fraction of the expense of flying a T-37. The Air Force estimates that for every 1% cut in attrition during T-37 training, it saves \$1 million. Considering that the service moves hundreds of trainees through its system each year, \$34 million doesn't seem like a foolish investment, does it?

Curious about this new import upon which the Air Force is so dependent, I went to Colorado Springs for a hands-on evaluation. What hit me right off was the glistening white bird's composition: fiberglass-reinforced plastic. Excepting the engine, some pushrods, the cables and the landing gear, the Firefly is 100% nonmetal—the first all-composite aircraft operated by the Air Force.

The T-3A's cockpit setup also is unusual. The student sits to the right, where all the main instruments are grouped. This matches the T-37, thus aiding transition from one to the other. The instructor has his or her own controls and throttle. The radio package is standard Bendix/King, plus a UHF radio. The control sticks have electric trim, push-to-talk and mute

buttons. Rudder pedals are adjustable. Seatbelts are 5-point harness-type. The Air Force operates its Firefly without chutes.

Instructor pilot Capt. Steve Cooper, an '87 Academy grad, and I were assigned to N3100X (the T-3A is FAA-certified and bears a civilian registration number). We pushed the Firefly out of its hangar, climbed aboard, donned our Dave Clark headsets and awakened the big Lycoming. Taxing out, I was struck by the trainer's terrific, unobstructed visibility—and by the spectacular scene beyond the fighter-style canopy. As we rolled to Runway 16 Left, the panorama of the snow-topped Rockies spread from horizon to horizon.

Cleared for takeoff, we set 18° of flap and pushed everything forward. Despite the airfield's 6500-ft. elevation, the 2500-pound T-3A accelerated quickly. We were flying at 65 knots indicated. Air Force procedure sets the prop a hair below its 2700-rpm redline and leaves it there. Also, the fuel pump stays on all the time.

Maximum climb for the T-3A is 1650 ft. per minute, although the Academy's altitude steals about 30% of that. Still, the Firefly performs nimbly. En route to our training zone in the flats southeast of the field, cruise settled at 120 knots indicated.

THE NEED FOR SPEED

(Continued from page 79)

manufacturers by the end of the year.

A step beyond alternating voice and data is simultaneous voice and data (SVD)—enabling file transmission from one computer to another with no interruption in the conversation. One system with SVD, AT&T Paradyne's VoiceSpan, has been available since 1993. At press time, AT&T and Hewlett-Packard already sell 14.4-kbps VoiceSpan modems, with announcements of 28.8-kbps models due later in the year.

Digital blender

But threatening to overtake VoiceSpan's analog SVD technology is a digital SVD standard that's expected to be adopted next year. DSVD is already available in 14.4-kbps versions from AT&T and Hewlett-Packard. Unlike VoiceSpan, in which audio isn't compressed, DSVD digitizes voices and compresses them to a data rate of 8 kbps. Then the voice information is multiplexed with other data, such as a file or fax. Using a 28.8 modem, one could talk while still transmitting 20 kbps of data.

DSVD is more flexible than alternating voice and data—theoretically, you could be yelling at your opponent

All controls were sure and responsive.

Once in our assigned area, we began a series of maneuvers that pilot candidates are expected to master. In 60° banked turns, the Firefly was rock-solid and quick to respond when I corrected my sloppy handling. Then, wings level and nose down, we accelerated to 130 knots, pulled up 20° and did an aileron roll right, then left and right again. In rolling left, the stick mashed against my left leg, but otherwise the maneuver was ordinary.

Nose down again to 140 knots indicated, then a strong pull-back, and we went up into a loop. The all-clear canopy made it easy to maintain proper track. During our session, I tried cloverleaf turns, a split S, slow flight and even a delightful (albeit dreadfully executed) barrel roll around Pikes Peak. I'd liked to have stalled and spun the bird, but the Air Force nixed that before we took off.

As an aerobat, the Firefly balances responsiveness with forgiveness, adding plenty of power and unexcelled visibility. It's also rated +6/-3 g's, but we never came close.

Back at the Academy Field, we executed an Air Force-standard overhead entry and closed pattern—something that the T-41 couldn't do. The maneuver is important for several reasons. For one, it's faster than the

nonstop while you play a frantic "Doom" death match. On a more civilized note, DSVD is useful for what are called white-board applications: business software that lets a person sitting at one end of a phone call listen to the voice and see the on-screen scribbles of the person at the other end of the line. And DSVD could be used to send people voice mail with a file attached (or, alternatively, a file with voice annotation).

As is the fashion, manufacturers aren't waiting for a standard to sell DSVD modems. Scheduled to debut earlier this year, for example, was the Sportster Vi 28.8 Faxmodem from U.S. Robotics, of Skokie, Illinois, packaged with a white-board program and listing for \$399.

Reaching for video

Voice may be only the beginning for real, human contact over modems. "We see [DSVD] very much as a stepping stone into video telephony," says Mike Buckley, a business development manager within AT&T Bell Labs. He notes that a group is working to develop a standard for video telephony over the conventional telephone network. Building on advances in video compression, along with V.34 technology, the video-telephony system might be accepted

where proprietary video-telephone standards haven't been adopted.

Combining data, voice and video, conventional modems may soon raise the demand for ISDN, Buckley says. ISDN (for Integrated Services Digital Network) is a type of telephone service that can carry combinations of voice, video and data at speeds ranging, for basic users, from 56 to 128 kbps—no compression necessary. Requiring special equipment in the home, starting with a modem-like device known as a "terminal adapter," ISDN is being promoted heavily to home-office users by at least two major regional telephone companies—Pacific Bell and Ameritech. Prices start at \$24.50 per month for Pacific Bell customers, plus \$40 installation.

When the Air Force laid out specs for its new trainer aircraft, one stipulation was that the cockpit carry side-by-side, not tandem, seats. Why? "An instructor wants to see where the student is looking. He wants to see his eyes," one officer explained.

Often, I'm sure, what the instructor sees is intensity mixed with a touch of desperation. After all, if the student doesn't master the thing, he or she will be denied the dream of becoming an Air Force pilot. Indeed, the day I flew, 200 cadets got grounded forever.

I had nothing on the line that day. So I'm not sure what Capt. Cooper concluded when he glanced at me midway up on my second cloverleaf, nose pointed straight at the piercing blue, the Rockies filling the canopy top, the white wings of the Firefly ablaze with morning light. If my eyes didn't reveal my thoughts, the broad smile below them surely did. **FM**

Though ISDN users have to contend with hardware that's generally more expensive than modems (and not as likely to communicate with different brands of equipment), optimists like Buckley believe that various uses for ISDN will make the service quite popular. Addressing the skeptic, Buckley says, "I remember when we were talking about standardizing a 9.6 [kbps modem]. People said, 'What possible applications could there be for 9.6?'" For computer users, of course, it's just full speed ahead. **FM**

ALTERNATE FUEL REPORT HONDA'S 1998 ULEV

Cleaner living through applied technology.

BY HERB SHULDINER



The '98 version of this Honda Accord sedan may well turn out to be a ULEV.

● As Ed McMahon may have asked, "How low is it?" The level of exhaust emissions produced by Honda's test car is so low that only a laboratory equipped to measure the "immeasurable" can detect any of the car's emissions. In fact, the level is described as ultralow, hence the car's acronym: ULEV, for ultralow-emissions vehicle. And in late 1997, Honda intends to sell a ULEV as a 1998 model.

For those following the timetable, that introduction is two years before the next wave of California's strict standards goes into effect. Those regulations mandate that auto manufacturers sell ULEVs with emissions that are 90% lower than those produced by today's cars. Honda's ULEV is the first to be so certified by the California Air Resources Board (CARB).

As of this writing, Honda hasn't decided if the ULEV engine will be in an Accord or a Civic—or both. But the ULEV prototype Honda previewed at recent auto shows is based on an Accord EX model with a VTEC engine.

POPULAR MECHANICS tested a prototype over a 30-

mile route in Southern California. Driving the ULEV Accord back-to-back with a current Accord VTEC, we found the performance of the two cars virtually identical. But at cruising speeds, the ULEV felt a shade down on torque compared to the VTEC, translating into more frequent downshifting for passing in the ULEV.

VTEC before ULEV

Honda introduced its variable-valve timing VTEC engine technology in the 1991 Acura NSX. Since then, it has been used in Accords and in the

Civic VX, currently the most fuel-efficient car sold in the United States. The VTEC system is critical to the ULEV's success. In it, Honda engineers vary valve timing and lift by using computer-controlled hydraulics to actually switch cam profiles.

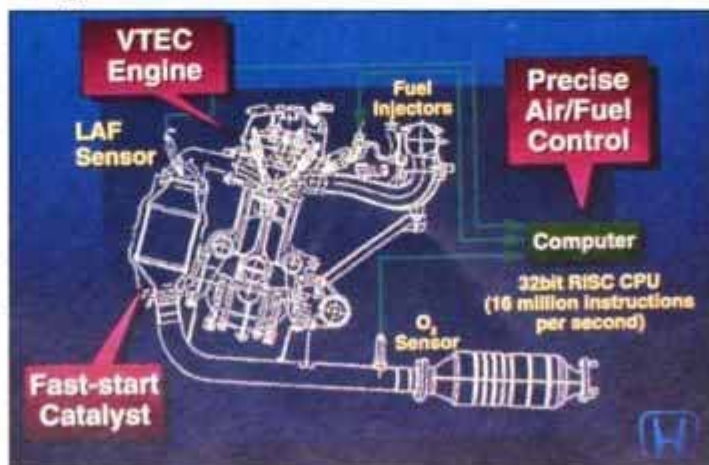
By extending the level of valve control, the engineers are able to further fine-tune the intake and combustion processes.

During engine startup—when engine speed is low—the VTEC system partially deactivates one of each cylinder's intake valves. This results in a swirl formation in the combustion chamber, which creates a stratified-charge effect. Thus, the engine runs fine on a very lean air/fuel mixture during cold startup. Conventional engines run more in the relatively rich neighborhood of 13.0 to 13.5:1 air/fuel mixture to maintain smooth idle. With VTEC, the ULEV can idle smoothly with a lean 15.5 to 16.0:1 mixture, and during startup, the engine cuts hydrocarbon emissions by some 45%.

Honda engineers have developed a single linear airflow (LAF) sensor system, and a new engine-control computer in order to maintain a precise air/fuel ratio. The 32-bit RISC computer, which can perform 16 million instructions per second, constantly compares the actual ratio with a target value. A self-tuning regulator then makes adjustments in real time to maintain this ratio.

Batting cleanup

Despite its tight mixture controls, the ULEV's exhaust still needs to be scrubbed. So Honda created a twin catalytic-converter system for faster activation and better efficiency. While other carmakers are experimenting with electrically preheated catalysts to convert emissions immediately after startup, Honda engi-



ULEV has its basis in current VTEC technology and advanced electronics, together with a much refined catalytic system.

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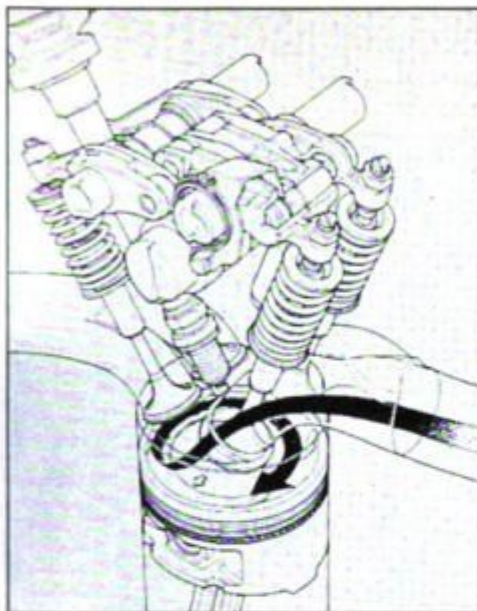
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All this adds only 15 pounds to the overall weight of the ULEV. Power is reduced by about 5%. ULEV horsepower is 137 hp at 5500 rpm versus 145 hp in the conventional Accord. ULEV torque is 138 ft.-lb. at 4500 rpm versus 147 ft.-lb. for the VTEC Accord EX. However, the ULEV has a 9.4:1 compression ratio compared to 8.8:1 for the Accord EX VTEC. While most drivers won't notice the difference in engine output, they *will* notice the ULEV's 2% better fuel economy.

Less for less

How much will this increase vehicle price? Some manufacturers have speculated that meeting the ULEV standard might cost buyers \$1000 or more. Hisao Suzuki, executive vice president of Honda R&D, claims that the ULEV system will add less than \$300 to the price of the vehicle.

Test results of the ULEV at Honda's R&D lab reveal that emissions are even lower than the CARB standard calls for—after the converter has been aged to 100,000 miles. Non-methane organic gases (which include hydrocarbons) are 0.035 grams per mile (gpm) compared to the standard of 0.055 gpm. Carbon-monoxide emissions for the ULEV are 0.527 gpm versus the standard's 2.1 gpm. Oxides of nitrogen (NO_x) emissions are 0.054 gpm versus 0.3 gpm standard. **PM**

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A cone on the forward side of the impeller hub begins the compression process, which is completed as the impeller forces water aft through a stator and into the narrowing volume of the nozzle. As on the Sea-Doo pump, the stator's function is to straighten the flow of water off of the impeller, not to compress it. The 95-hp Sport Jet turns a 6.43-in. 5-blade stainless-steel impeller, forcing water through a 3.5-in. nozzle. Mercury also offers a 120-hp 4-cylinder 1686-cc Sport Jet, and in 1996 will introduce a 175-hp 2.5-liter V6 model.

Jetdrive outboards complete the jet-technology picture. They bring the benefits of jet propulsion to smaller, lighter boats, and are especially useful for navigating extremely shallow rivers with a flat-bottom hull. Jetdrive outboards are offered by Yamaha, OMC, Suzuki and Mercury on models ranging from about 40 hp to 200 hp. All use the same pump, manufactured by Specialty Manufacturing of San Leandro, California. In production since 1962, the Specialty pump is also available through dealers, and can be mated to just about any outboard.

The pump in this technology replaces the gear case of an outboard, and its impeller shaft mates to the driveshaft. Water is drawn into the pump through a grated intake called the foot, which rides just 2 in. below the boat's bottom.

The impeller spins on a vertical shaft, so it must lift water through the intake and turn it 90° through a housing called a volute. This housing wraps around the front of the pump. Water is compressed as it travels through the tapered volute. The outboard's exhaust is routed through an inner tube in the nozzle, where the jet of water helps muffle its sound. This type of pump is less efficient than axial- or mixed-flow pumps, resulting in a 25% loss of performance over a prop-driven outboard.

A jetdrive adds significantly to the price of an outboard. For example, it will add about \$800 to \$1000 to the price of a Yamaha outboard. Through a dealer, a Specialty pump has a retail price of \$1100 to \$1500.

Despite the recent advances in jet-pump design, a propeller remains the more efficient method of propulsion. The American Turbine pump—perhaps the most efficient jet available today—suffers 5% loss compared to a prop. An outboard jet reduces efficiency up to 25%. However, that loss of efficiency has to be weighed against the benefits of jet power—shallow draft, simplicity of design and reduced maintenance—which should move jetdrives from the backwaters into the mainstream. **PM**

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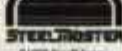
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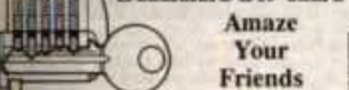
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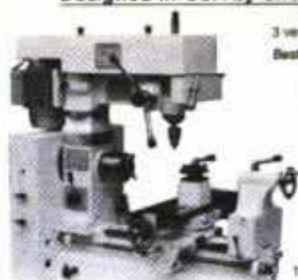
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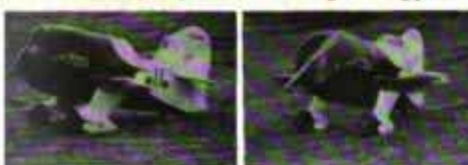
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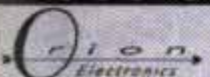
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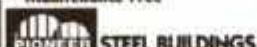
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**We Fly The B-2 Stealth Bomber**

What's it like to fly the world's most sophisticated warplane? Our cover story takes you for a ride you won't soon forget in this exclusive, first-ever civilian pilot report of the B-2 Stealth bomber. Better strap yourself in tight.

Battle Helmets

The crack of helmets echoes through the stadium as Emmitt Smith is stopped cold at the goal line. What keeps his brains from being scrambled? Our look at how football helmets protect includes the past, present and future.

Your Place In Cyberspace

Put yourself on the Web? Sure. You don't have to be a big corporation to have a home page on the Internet. Our story details the software, graphics and provider you'll need.

New Cars '96

Don't even look at the '96 models until you read this report, which covers features, specs and test drives of Detroit's latest. Included is a detailed look at the all-new Ford Taurus and engineering highlights on all the slick new models making their way to showrooms.

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Bonzai Pipeline

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[HAPPILY, WE OFFER A TAKE-HOME SIZE.]

Whether it's industrial size or a more personal version, you always get full strength in a GMC Truck. Indeed, you'll find the strength of the big TopKick is embodied in the Sierra. Its body panels are made of double-galvanized sheet metal. Even its frame has a similar C-channel design to the one used on our medium duty trucks. Of course, there's more to Sierra than steely functionality. We've added standard four-wheel antilock brakes, along with a driver's-side air bag* on Sierra models below 8600 lbs GVWR. And with Sierra's independent front suspension, you'll get a smooth, comfortable ride on most any road. Just slide back into the accommodating new interior, then pity the poor souls bouncing around in lesser pickups. All in all, Sierra is everything you'd expect from a company with over 90 years of truck experience. So if you're looking for strength, Sierra delivers. Big time. For more information, call 1-800-GMC-TRUCK.



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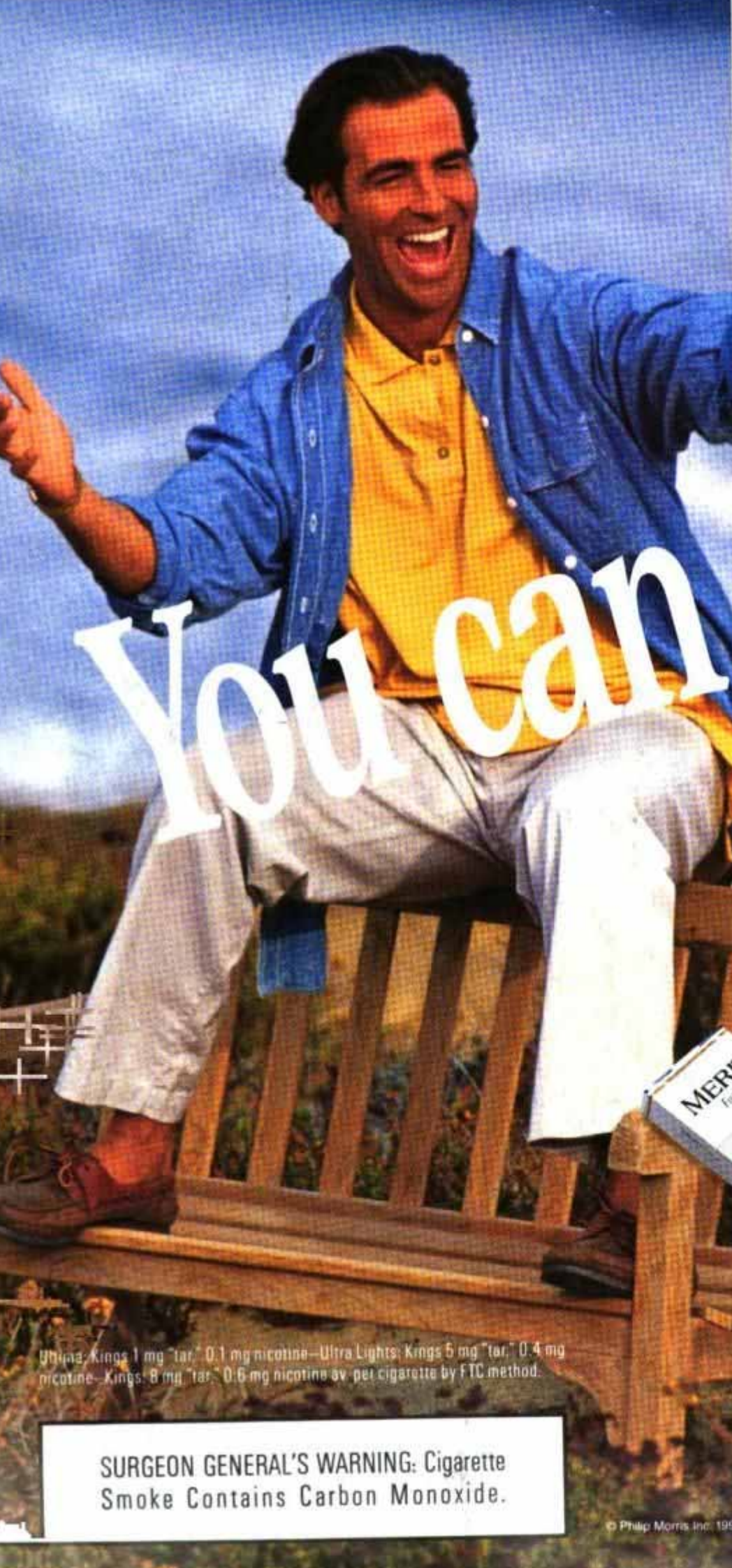
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May 1995

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