

# Popular Mechanics

SEPTEMBER 1994

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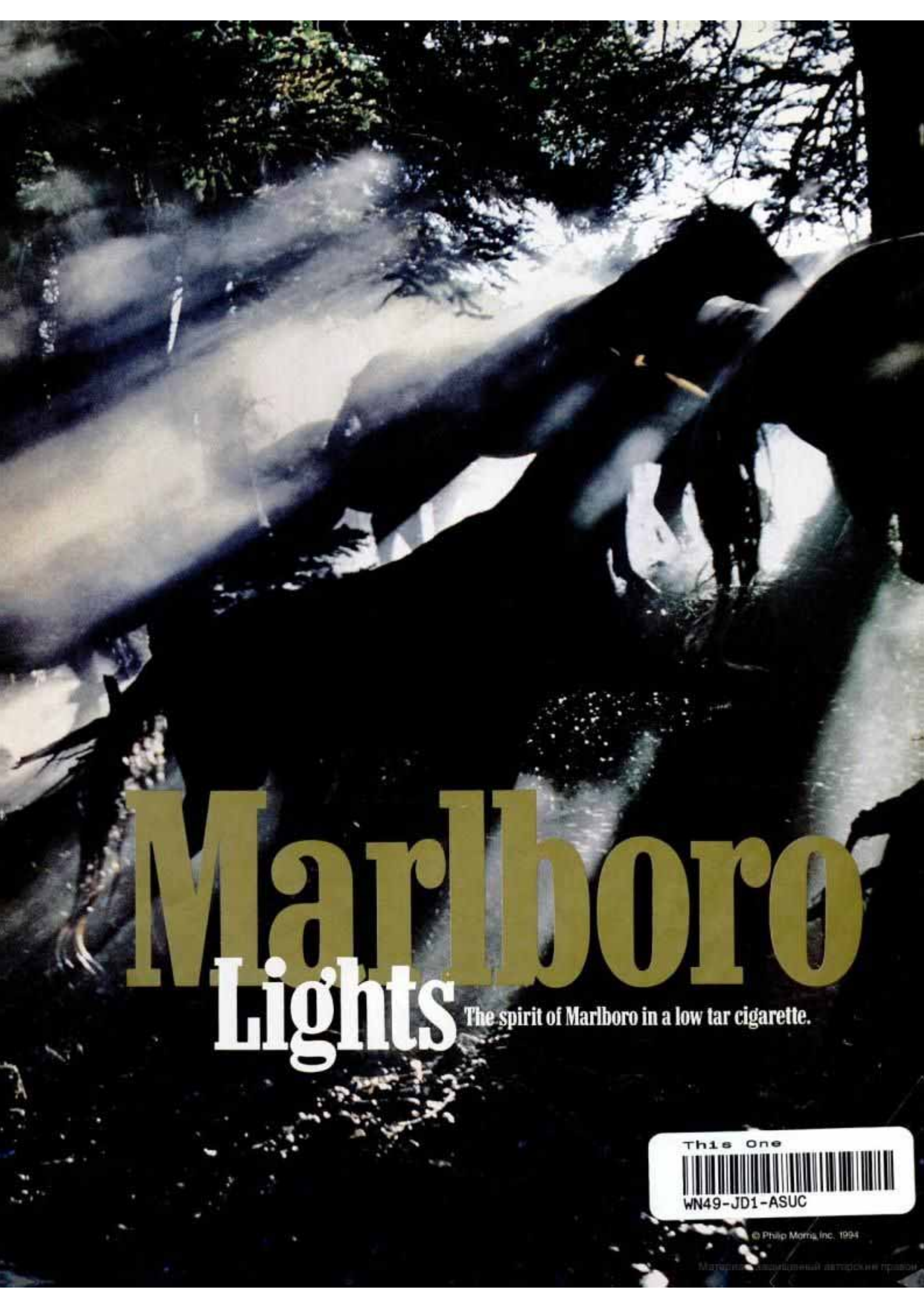
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Kings & 100's Box: 10 mg "tar," 0.8 mg nicotine; 100's Soft: 11 mg "tar," 0.8 mg nicotine av. per cigarette by FTC method.

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# Marlboro

## Lights

The spirit of Marlboro in a low tar cigarette.

This One



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# Popular Mechanics®

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NO. 9



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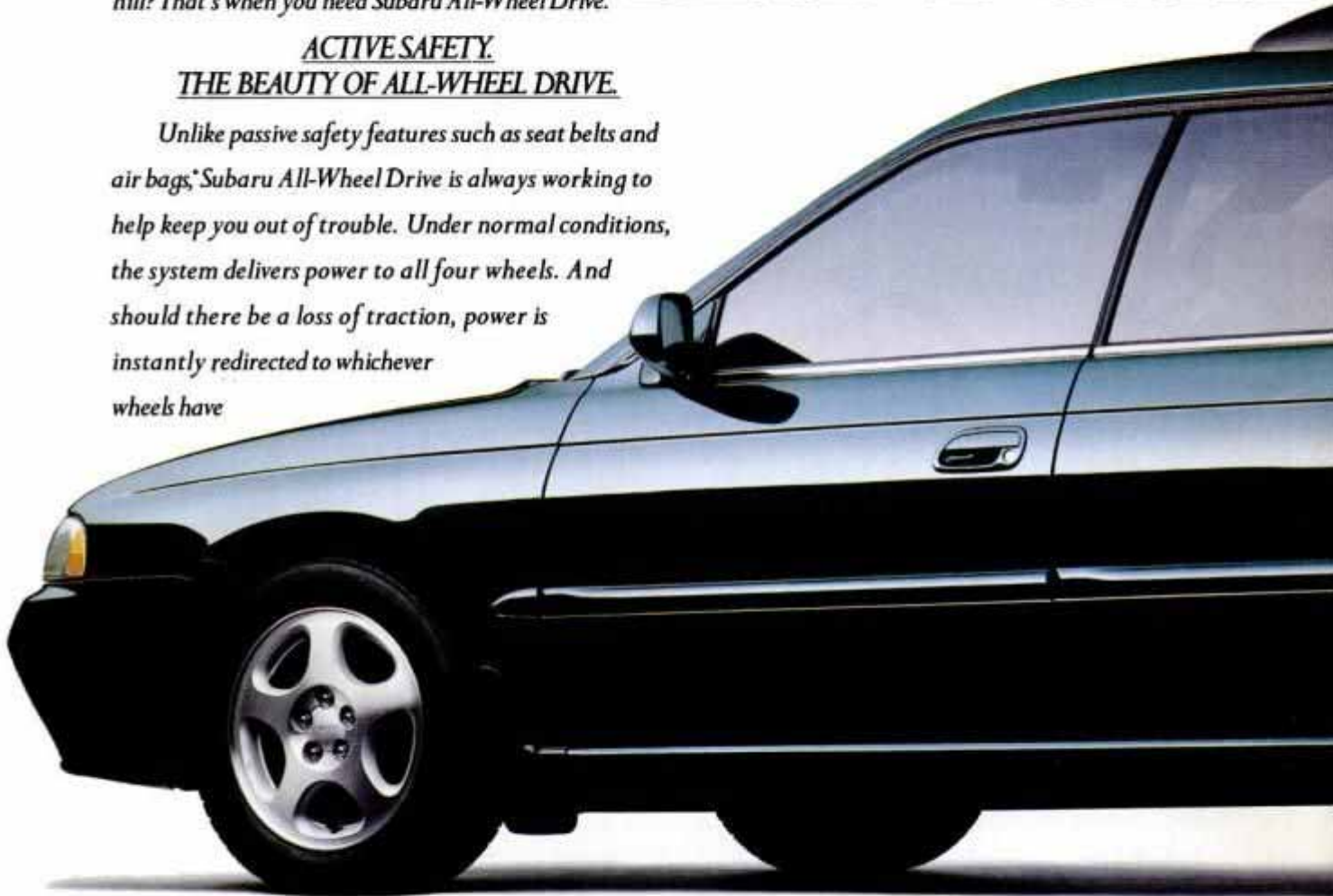
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# WHY BUY A CAR WITH AND DUMB

Buying a car with anti-lock brakes is a smart move. But what about when you're not braking? When you're just driving? Cornering? Or tackling a slippery hill? That's when you need Subaru All-Wheel Drive.

## ACTIVE SAFETY. THE BEAUTY OF ALL-WHEEL DRIVE.

Unlike passive safety features such as seat belts and air bags,\* Subaru All-Wheel Drive is always working to help keep you out of trouble. Under normal conditions, the system delivers power to all four wheels. And should there be a loss of traction, power is instantly redirected to whichever wheels have



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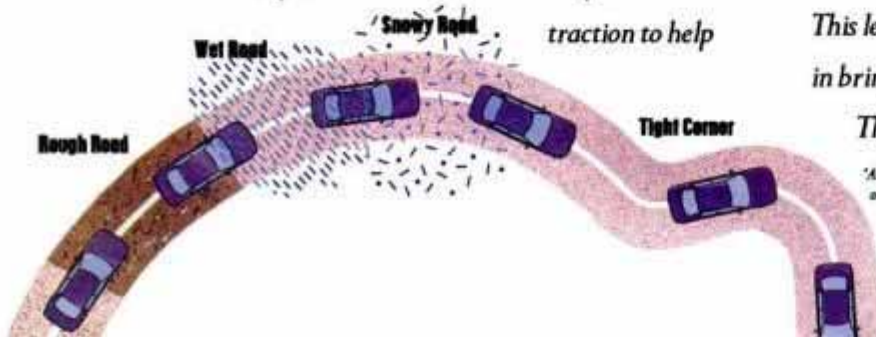
## AWD MEETS ABS.

There's no question that All-Wheel Drive provides extra traction to help

get you moving. But Subaru All-Wheel Drive also helps you stop. During heavy braking, the All-Wheel Drive system steps in to assist the Anti-lock Braking System. By having power available to all four wheels all the time, All-Wheel Drive uses the engine to help control wheel speed. This lets the Anti-lock Braking System be more effective in bringing you to a safe, controlled stop.

This ingenious cooperation between All-Wheel Drive

\*Always wear seat belts. †Based on R.L. Polk & Company Registration Statistics for year-end 1993. ‡Based on a comparison of 1995 Legacy and 1994 Toyota Camry. ††Suggested retail price of Legacy Brighton AWD



# TH SMART BRAKES WHEELS?

A SMALL PRICE TO PAY FOR A SMART VALUE.

*Subaru All-Wheel Drive doesn't have the drawbacks of standard four-wheel drive. It's fully automatic and requires little maintenance. Plus, it gets*

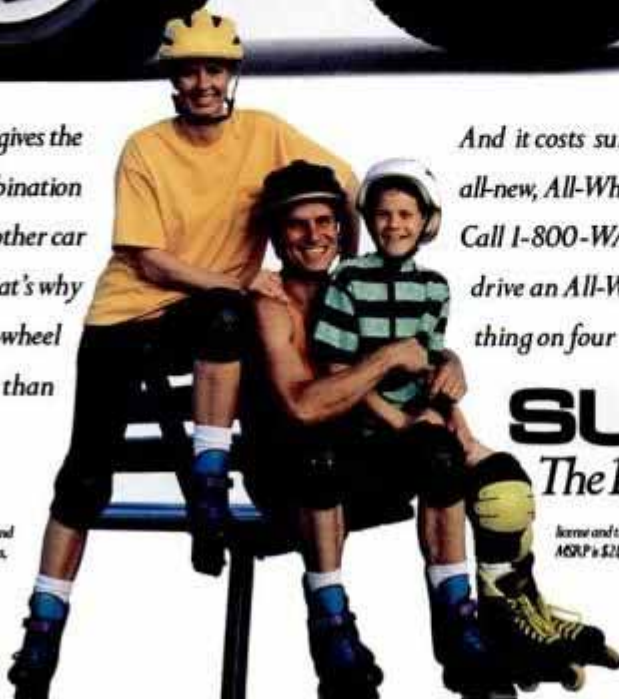
*better mileage than a front-wheel drive Toyota Camry.†*



*The New All-Wheel Drive Legacy.  
STARTING AT \$15,999††*

*and anti-lock brakes gives the Legacy, a safety combination you can't get on any other car in its class. Perhaps that's why Subaru sells more all-wheel drive cars in America than all other carmakers combined.\*\**

Wagon not including dealer prep and inland transportation. Price does not include taxes.



*And it costs surprisingly little. In fact, you can get an all-new, All-Wheel Drive Legacy for as little as \$15,999†† Call 1-800-WANT-AWD or visit your dealer to test-drive an All-Wheel Drive Subaru. It's the smartest thing on four wheels.*

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*The Beauty of All-Wheel Drive™*

license and title fees. Dealer's actual price may vary. Pictured is AWD Legacy LS Wagon MSRP is \$21,455. Certain items shown are optional equipment available at an add-on.

# EDITOR'S NOTES

● It's a sickening sight to Americans. A downed plane. North Vietnamese regulars or Viet Cong picking over the wreckage. The fate of the crew unknown. Unfortunately, it's a scenario that took place more than once in the '60s and early '70s in Vietnam. In some cases, the fate of the crew—and the fate of over a thousand other U.S. armed forces personnel—has never been determined. Now, with the lessening of tensions between our country and Vietnam, finally some measure of cooperation has begun to determine the fate of those still unaccounted for. It's an all-out effort by teams of specialists bringing the latest technology to bear on the situation. Contributing Editor Cliff Gromer followed one military team to a potential aircraft crash site in a remote area of north Vietnam early this year, then followed the trail of information as it led,



Gromer in Hanoi at the Ho Chi Minh Memorial.

literally, around the world. His gripping account begins on page 41. And we wish those involved every success. . . . While we sit here pondering what the future might be like, telecommunications engineers are already designing it. How about a world where you can instantly communicate with anyone, any time, from anywhere? If either the Teledesic or Globalstar low Earth orbit satellite systems gets built, that's what we'll have. The chances are pretty good. Check out the story on page 67. . . . And while it's nice to know we'll all have a high-tech future, it's also comforting to know that some things never change—like classic furniture design. The 4-posted bed is one of those designs and if you've ever coveted one, here's your chance to build it yourself. Our Home Improvement Department editors tell you all you need to know beginning on page 80. . . . There's nothing hotter on the water this year than jet boats, those feisty little screamers that scoot around acting like high-performance speedboats but sell for prices more like low-performance rowboats. Well, not that cheap, but you get the idea. If you're thinking of buying a jet boat "for your kid," check our comparison test of 10 of the most popular models out there. It begins on page 46. . . . Ever wonder how those Winston Cup stock car teams change four tires, dump in a full tank of gas, adjust the suspension, clean the windshield and give the driver a cold drink all in one 15-second pitstop? Having the right custom-made special tools is part of it, as Contributing Editor Rich Taylor found out after spending a weekend with the Darrell Waltrip/Western Auto Chevrolet team. His fascinating report begins on page 53. Till next time.

  
Joe Oldham

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Editor-In-Chief Joe Oldham

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Associate Editor Thomas Klenck  
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Contributing Editors Norman Becker  
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## Editorial Administration

Administrative Asst. Josephine Caronia  
Asst. to the Editor Barbara A. Novak

## Reader Service Department

Manager Norah I. Golad

## Editorial Offices

224 W. 57th St., New York, NY 10019  
(212) 649-2000

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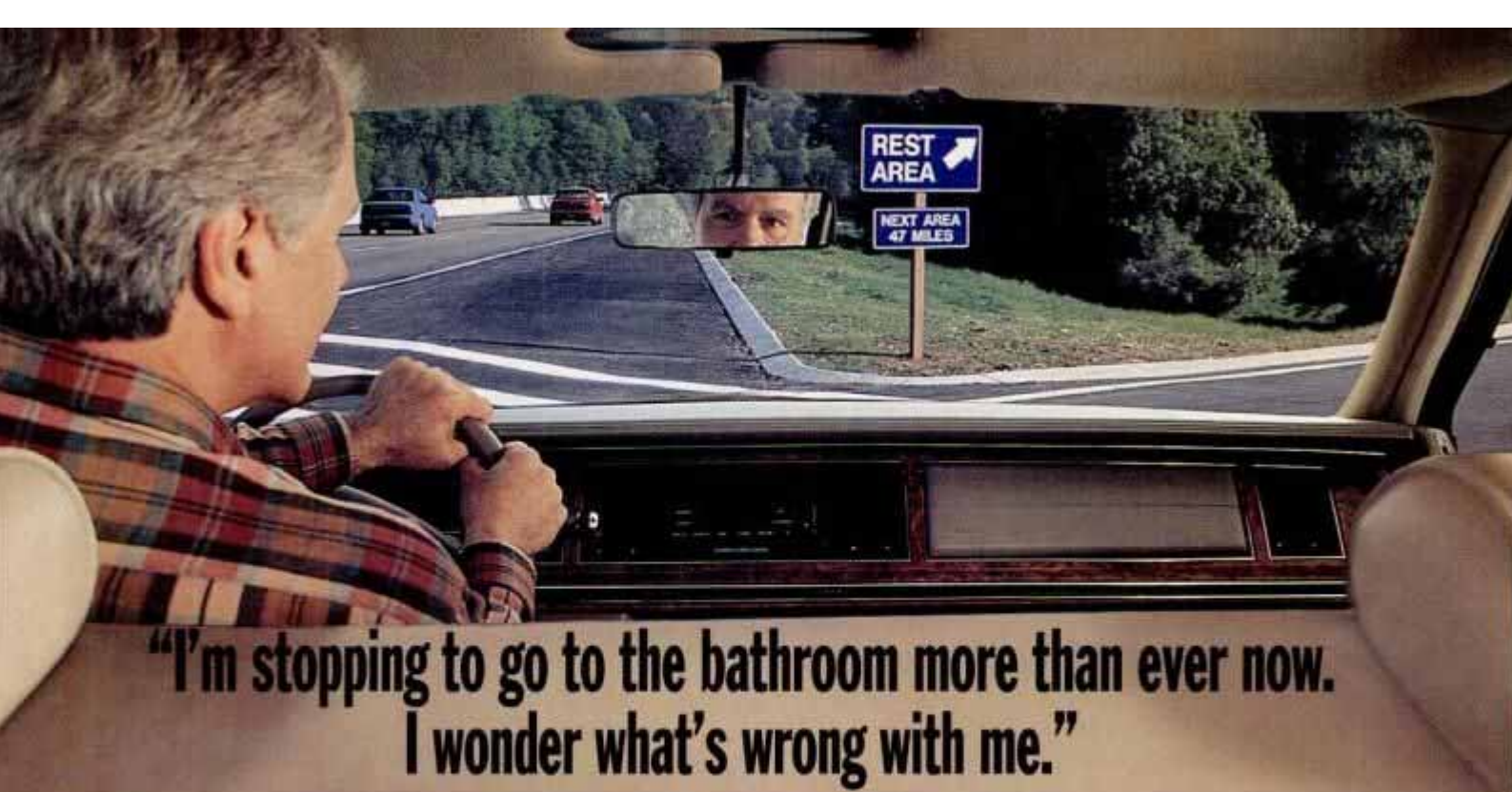
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**"I'm stopping to go to the bathroom more than ever now. I wonder what's wrong with me."**

Your urinary symptoms may be caused by a condition called benign prostate enlargement or BPH. BPH is not cancer and does not lead to cancer, although the two conditions can exist at the same time. Remember, only a doctor can

evaluate your symptoms and their possible causes.

**Is this you?**

Yes No

Do you get up more than once or twice a night to urinate?

Do you often have sudden, uncontrollable urges to urinate?

Do you have a hesitant or slow urine stream?

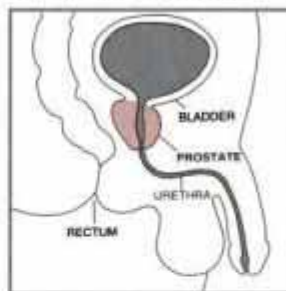
Do you have a frequent need to urinate?

If you answered yes to even one question, tell your doctor.

**Today, symptomatic BPH can be treated by your doctor in several ways.** The options are monitoring the condition with regular checkups, surgery, or oral medicines. One oral medicine is

PROSCAR, the only prescription medicine for the treatment of symptomatic BPH that can shrink the prostate.

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



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

If you have any urinary symptoms, see your family doctor or a urologist soon, and ask about PROSCAR. For free information to help you discuss your symptoms with your doctor, call 1-800-635-4452.

*For the treatment of symptomatic BPH*

**PROSCAR<sup>®</sup> 5mg**  
**(FINASTERIDE)**

**The only medicine that can shrink the prostate.**

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224 West 57 St., New York, NY 10019

Philip A. DeCarlo

(212) 649-3141

Paul M. Jowdy

(212) 649-3142

Thomas D. Schreckinger

(212) 649-3143

### Chicago

1 South Wacker Dr., Chicago, IL 60606

(312) 984-5190

Manager Richard T. Weithas

Spencer J. Huffman

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Hearst Magazines Sales, Inc.

2301 West Big Beaver Rd., Troy, MI 48084

(810) 649-2981

Manager D. Craig Rebold

### Los Angeles

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## PROMOTION

Manager Erin M. Overend

(212) 649-3085

## PRODUCTION

Manager Carole L. Hartman

Adv. Prod. Mgr. Patricia A. Woods

(212) 649-3164

Published by The Hearst Corporation

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

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

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

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

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

### What is BPH?

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

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

### Treatment options for BPH

There are three main treatment options for BPH:

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

### What PROSCAR does

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

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

### What you need to know while taking PROSCAR

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

ing sex. This decrease does not appear to interfere with normal sexual function. Rarely, some men have reported breast swelling and/or tenderness or allergic reactions such as lip swelling and rash.

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

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

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

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

PROSCAR is for use by MEN only.

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

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

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

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

**Handling broken tablets.** Women who are pregnant or who could become pregnant must not handle broken tablets of PROSCAR.

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

If a woman who is pregnant comes into contact with the active ingredient in PROSCAR, a doctor should be consulted. Remember, these warnings apply only if the woman exposed to PROSCAR is pregnant or could become pregnant.

### How to take PROSCAR

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

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

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

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



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## PASSPORT 5000 TRAFFIC ADVISOR

**NEW!**



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*Introducing Passport 5000:  
The first detector with an LCD monitor for  
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### **NEW!** The first detector with an LCD monitor

*An innovative LCD monitor (patent pending) lets Passport 5000 display more information than any conventional LED-style detector. More information means you can drive with complete assurance.*

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K-band



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Our patented DPR™ anti-falsing system automatically detects and rejects false Ka readings. You'll receive audible alerts for true Ka readings only.

Emergency Vehicle Alert

Each Passport 5000 incorporates the Emergency Vehicle Warning System, should the proposed system be introduced in your driving area.

**P**assport 5000 is the ultimate driving instrument. An innovative, angled LCD monitor (patent pending) displays far more traffic information than conventional LED detectors – information required for total driving confidence.

Incoming signals are quickly analyzed and then displayed on Passport 5000's monitor, eliminating the guesswork typical of conventional LED models. And no guesswork means you can devote your full attention to driving.

At a glance, Passport 5000 provides the information needed for quick decision-making, such as the type of radar/laser used and the signal strength. It even displays when false signals are rejected. Best of all, it comes with the quality, features and performance you expect from an Escort detector.

The Passport 5000 Traffic Advisor: Improve your ability to react with the most advanced detector ever invented. Only from the detector professionals at Escort.

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# LETTERS

## Foiling The Bad Guys



I am bothered by the comment in your Editor's Notes that you favor the simple: "I have nailed shut all the bottom-floor windows." Fire codes in all 50 states prohibit any person from recommending such a procedure, but a homeowner can do what he pleases. It is amazing that you made this statement.

THOMAS J. CHUDA  
SANDWICH, MA

While casing the house photo in the Crimebuster's Checklist from "Safe At Home" (June '94), I found a good, simple theft deterrent that was missed. Simply spray paint the inside glass of the garage door windows gloss black. The windows look the same from the outside, but a potential burglar cannot look inside to see if there is a vehicle.

DWAINE T. GORDON  
WYNDMOOR, PA

## Dirty Harriet

I get my first subscription issue, and there's this error. Not a little error, but a huge zit-on-your-face-at-the-prom kind of error. "Dirty Harry's .357 Magnum?" I took a reality check and asked my wife what kind of gun Harry

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

used. "Forty-four Magnum," was the immediate reply. Joe Skorupa, hang your head in shame. Next time you want a correspondent to cover the SHOT Show, give me a call. I'll even take my wife.

RICHARD M. FINK  
DULUTH, GA

Thanks for the coverage of the guns at the SHOT Show. It's a welcome change from your competitor, whose publisher's anti-gun bias even extends to the point of censoring out interesting news about firearms.

JOEL ANDERSON  
VENICE, CA

It's good to know that PM is committed to advancements in technology and hasn't bought into the "guns are evil" state of mind. Most publications would shy away from gun advertisements. The anti-gun attitude of *Popular Science* and its contributions to Handgun Control Inc. resulted in my subscription move to PM.

JAY HEMING  
HARRINGTON, DE

Popular Science? Are those guys still around?

—Ed.

I understand you're taking a lot of heat for reviewing the Beretta 92FS. Well, you're defending the Second Amendment, and you're also defending the First. Thanks for sticking up for freedoms!

CRISTINA YU  
NEWARK, CA

Your intelligent and honest coverage of gun-related issues is refreshing. The great mass of the print media has chosen to adopt a policy of smears, lies, half-

truths and ad hominem viciousness on these matters. Your work is a beacon of honesty in a growing filthy cloud of spiked stories and outright lies.

JOEL ANDERS  
LOS ANGELES, CA

Thank you for not jumping on the antigun bandwagon. I appreciate and enjoy your firearms articles. People who wouldn't be caught dead buying a "gun" magazine might even learn something!

MIKE TRUETT  
RIVERSIDE, CA

## Revenge Of The Titans

The Tech Update section of the May issue erred with the report that "the Titan that ferried Milstar was the first to carry a Centaur upper stage." Strictly speaking, the launch vehicle in question may have been the first Titan IV to have a Centaur upper stage, but this stage has

been used on Titan launch vehicles for 20 years.

MICHAEL J. GALLAGHER  
ORONO, ME

## Mustang Blues

In reference to the Ford Mustang, you say it has been "consistently setting styling trends and performance standards for 30 years." How can you say this lie? The '94 Mustang is an '80s design with a '70s engine—butt ugly.

GIL SAMUDIO  
ST. CHARLES, MO

*Looks are subjective. There were thousands of people who at one time liked the AMC Pacer and Subaru 360 enough to buy one. As for the engines, the Mustang's V6 is a thoroughly modern, if conventional, design. And a GT with the 1970s-era 5.0-liter V8 can still blow 95% of all other cars on the road directly into the weeds.*

—Ed.

## Reader Project Of The Month

In 1970, I built a grandfather clock following plans from the June 1969 issue of *POPULAR MECHANICS*. Now, 23 years later, I decided to build another clock as a wedding gift to my daughter and her husband. After reviewing plans from other sources, I again chose your plans from that 1969 issue. These plans were far superior in detail and clarity to others that I paid for. The clock I built in 1970 is the larger of the two and stands 86 in. high. The smaller one (shown here) is a grandmother clock and is 76 in. high.

GRAHAM HOFFMAN  
PLYMOUTH, WI



Oct + Nov issues

**At least the fuel injectors are clean.**



It's fun to play in the mud, but not so fun to get stuck in it. Or anywhere else for that matter. That's why we developed STP® Super Concentrated Fuel Injector Cleaner.

One bottle quickly helps unclog dirty fuel injectors that can rob your engine of depend-

able power and performance. Plus it cleans up your entire fuel delivery and intake systems for up to 2500 miles.

So the next time you clean your car, why not add a bottle of STP Super Concentrated Fuel Injector Cleaner. Make it beautiful on the inside, too.



**DRIVE A BETTER C**

# TIME MACHINE

90 YEARS AGO: SEPTEMBER 1904



## Bottom Feeder

Railroads were picking up steam in their drive to run man-made canals out of the business of transporting heavy goods. To solidify their monopoly, the railroads even appropriated the machinery of waterway engineering. In England, for example, a massive dredger worked for the railroads, raising and discharging as much as 1000 tons per hour. It was one of a new breed of industrial goliaths that would change the landscape of the 20th century.



## Log Rolling

To blow its own horn at the St. Louis World's Fair, the state of Washington sent an extraordinary railcar carved from the trunk of a gigantic spruce tree. Measuring 40 ft. long x 9 ft. wide, the log was hollowed out and mounted on rail trucks.

Inside, compartments held an office, a register and a reception hall, which was said to have accommodated 30 people and a piano. Meanwhile, behind all this, a wild-animal den housed the car's star attractions: a bear and a "man-attacking cougar."

60 YEARS AGO: SEPTEMBER 1934



## Marathon Motor

French automotive engineers were toying with the idea of building a car for a nonstop race across the United States. What sparked their thinking was a Hotchkiss motor on the test block. The powerplant showed it could have driven a car 5000 miles—from New York to San Francisco and back to Pittsburgh—in 52 hours. As a racer, though, such a vehicle would have carried one drawback: a 300-gallon fuel tank, adding a ton of extra weight.

## Cinq Chevaux

Meanwhile, the French were convinced that the day of the war horse had

not yet passed—as witnessed in the popularity of the military riding school at Saumur.



30 YEARS AGO: SEPTEMBER 1964



## Channel Surfing

In the jump-jetting '60s, everyone had an idea about short-takeoff aircraft. One that had been hovering around for years was the channel-wing, the brainchild of Gen. George Custer's great-grand-nephew. The principle was simple: A propeller sucked air through a semicircular channel sunk into the wing, lowering pressure to supply lift. Although he built two working proof-of-concept planes, the latter-day Custer never saw his idea take off.

## Bullet Fever

Japan was about to fast-forward its railroad system with the "Dream Superspecial." The world's first bullet train

had clocked 152 mph in test runs along its trademark straightaway track. **PM**



# Park Avenue Ultra. A car so thoughtful, even its mirrors remember how you look.

With a touch of a button, the available outside memory mirrors recall your favorite viewing position. They are also heated for better vision in nasty weather. Even the electrochromic rearview mirror automatically adjusts to reduce headlamp glare.

These and other features, like Ultra's supercharged engine, dual air bags, and anti-lock brakes, are further reflections of Buick quality. To learn more, call 1-800-4A-BUICK.



**BUICK**

The New Symbol For Quality  
In America.



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Park Avenue is a registered trademark of GM Corp.  
Buckle up, America!

900 MHz breakthrough!

# New technology launches wireless speaker revolution...

Recoton develops breakthrough technology which transmits stereo sound through walls, ceilings and floors up to 150 feet.

By Charles Anton

If you had to name just one new product "the most innovative of the year," what would you choose? Well, at the recent *International Consumer Electronics Show*, critics gave Recoton's new wireless stereo speaker system the *Design and Engineering Award* for being the "most innovative and outstanding new product."

Recoton was able to introduce this whole new generation of powerful wireless speakers due to the advent of 900 MHz technology. This newly approved breakthrough enables Recoton's wireless speakers to rival the sound of expensive wired speakers.

**Recently approved technology.** In June of 1989, the *Federal Communications Commission* allocated a band of radio frequencies stretching from 902 to 928 MHz for wireless, in-home product applications. Recoton, one of the world's leading wireless speaker manufacturers, took advantage of the FCC ruling by creating and introducing a new speaker system that utilizes the recently approved frequency band to transmit clearer, stronger stereo signals throughout your home.



**Crisp sound throughout your home.** Just imagine being able to listen to your stereo, TV, VCR or CD player in any room of your home without having to run miles of speaker wire.

Plus, you'll never have to worry about range because the new 900 MHz technology allows stereo signals to travel over distances of 150 feet or more through walls, ceilings and floors without losing sound quality.

### 150 foot range through walls!

Recoton gives you the freedom to listen to music wherever you want. Your music is no longer limited to the room your stereo is in. With the wireless headphones you can listen to your TV, stereo or CD player while you move freely between rooms, exercise or do other activities. And unlike infrared headphones, you don't have to be in a line-of-sight with the transmitter, giving you a full 150 foot range.

The headphones and speakers have their own built-in receiver, so no wires are needed between you and your stereo. One transmitter operates an unlimited number of speakers and headphones.



Recoton's transmitter sends music through walls to wireless speakers over a 75,000 square foot area.

**One transmitter, unlimited receivers.** The powerful transmitter plugs into a headphone, audio-out or tape-out jack on your stereo or TV component, transmitting music wirelessly to your speakers or headphones. The speakers plug into an outlet. The one transmitter can broadcast to an unlimited number of stereo speakers and headphones. And since each speaker contains its own built in receiver/amplifier, there are no wires running from the stereo to the speakers.

### Full dynamic range.

The speaker, mounted in a bookshelf-sized acoustically constructed cabinet, provides a two-way bass reflex design for individual bass boost control. Full dynamic range is achieved by the use of a 2" tweeter and 4" woofer. Plus, automatic digital lock-in

tuning guarantees optimum reception and eliminates drift. The new technology provides static-free, interference-free sound in virtually any environment. These speakers are also self-amplified; they can't be blown out no matter what your stereo's wattage.

**Stereo or hi-fi, you decide.** These speakers have the option of either stereo or hi-fi sound. You can use two speakers, one set on right channel and the other on left, for full stereo separation. Or, if you just want an extra speaker in another room, set it on mono and listen to both channels on one speaker.

Mono combines both left and right channels for hi-fi sound. This option lets you put a pair of speakers in the den and get full stereo separation or put one speaker in the kitchen and get complete hi-fi sound.



These wireless stereo headphones have a built-in receiver.

**Factory direct savings.** Our commitment to quality and factory direct pricing allows us to sell more wireless speakers than anyone! For this reason, you can get these speakers far below retail with our 90 day "Dare to Compare" money-back guarantee and full one year manufacturer's warranty. For a limited time, the Recoton transmitter is only \$69. It will operate an unlimited number of wireless speakers priced at \$89 and wireless headphones at \$59 each. Your order will be processed in 72 hours and shipped UPS.

**Recoton Transmitter** (you must have a transmitter to operate speakers and headphones).....\$69 \$4 S&H  
 Wireless products compatible with the Recoton transmitter:  
**Recoton Wireless Speaker**.....\$89 \$6 S&H  
**Recoton Wireless Headphones**.....\$59 \$4 S&H  
 Please mention promotional code 161-PO1104.

For fastest service call toll-free 24 hours a day

**800-992-2966**



To order by mail send check or money order for the total amount including S&H (VA residents add 4.5% sales tax). Or charge it to your credit card by enclosing your account number and expiration date. Send to:

**COMTRAD INDUSTRIES**

2820 Waterford Lake Drive Suite 106  
 Midlothian, Virginia 23113

## AWARD WINNING WIRELESS SPEAKER

Built-in receiver and amplifier:

The wireless speaker and headphones both contain a built-in receiver and amplifier. Signals are picked up and transmitted as far as 150 feet away through walls without the use of wires.



**Don't take our word for it.** Try it yourself. We're so sure you'll love the new award-winning Recoton wireless speaker system that we offer you the **Dare to Compare Speaker Challenge**. Compare Recoton's rich sound quality to that of any \$200 wired speaker. If you're not completely convinced that these wireless speakers offer the same outstanding sound quality as wired speakers, simply return them within 90 days for a full "No Questions Asked" refund.

Recoton's Design and Engineering Award





# TECH UPDATE

News Of Tomorrow's Technology Today



PM ILLUSTRATION BY PAUL DIMARIE

## Commandos Spring From The Wings Of Jump Jets

ST. LOUIS, MO—Suppose you're the commander of a 12-man special operations A-team, and you've been forced to scrub your mission deep inside enemy territory. No helicopter has the speed to arrive in time to extract you, and a fixed-wing aircraft won't find a landing strip within miles of your location. What options are left?

McDonnell Douglas believes it has one. Using its own money, the company has spent a year designing and building a people pod to hang from the wing of an AV-8B Harrier jump jet.

Although the pod idea has been around since World War II, it may have a shot at becoming reality because the United States uses its special forces now more often than ever—they carried out missions in 118 countries last year. The pod's designers hope to generate enough interest

from the U.S. Special Operations Command that they can complete and test a full-scale model.

Although the final design would not lock in until the Green and Black Berets sign off on it, the ultimate idea is to accommodate three people per pod. At the same time, the pod must have the same "footprint" as a Harrier external fuel tank to avert a lengthy aircraft recertification.

To keep the single-engine jet stable, one pod would bolt under each

Harrier might carry Ground Rescue, Infiltrate, Exfiltrate and Resupply (GRIER) pods to insert and extract special forces.

wing, mounted on stations that supply air and power. Because the Harrier can take off heavy, the plane could still carry a gun and fuel tanks.

If three people can fit in a pod, then a mere pair of Harriers could extract an unlucky A-team. Ironically, Marine pilots would rescue Army special forces—the Corps is the only branch of the U.S. military to fly Harriers.

### Highlights This Month

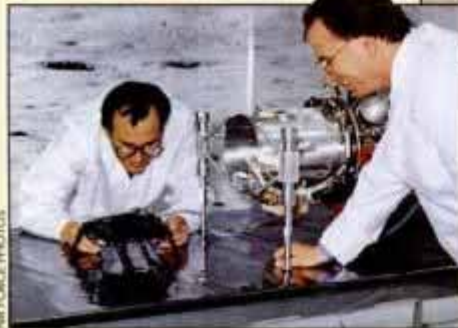
- **Giant Leap**—Air Force rockets for Moon probe.
- **Liquid Sky**—Telescope's mirror is pool of mercury.
- **Super Tanker**—Shuttle's new featherweight fuel tank.
- **Laser Blazer**—Megawatt Scud-buster to ride 747.
- **The Big Tow**—Athletic new tugboats to escort tankers.
- **Ice Houses**—Habitats for Antarctica's high plateau.
- **Olympic Park**—Atlanta's high-tech extravaganza.

Editor/Writer: Gregory T. Pope  
Reporters: John Boatman, Philip Chien,  
Mike Fillon, Scott Gourley, Jerry Heasley,  
Barry Rosenberg

## Air Force Takes A Moonwalk

EDWARDS AFB, CA—Small, lightweight, highly maneuverable rockets are just the ticket to land robotic explorers on the Moon or other planets. It turns out that military rocketeers have been fine-tuning such propulsion systems over the past decade—but for high-speed missile interceptors. Now, in an effort that parallels the recent *Clementine* Moon-mapping expedition (see *Science*, page 96, July '94), Air Force engineers have shown how these nifty little rockets could aid space exploration.

At Phillips Laboratories, a 45-pound rocket vehicle hopped 18 ft. into the air and hovered



Microrover spiders its way out of landing vehicle outfitted with rockets from kinetic-energy missile interceptors.

briefly. Then it sidled through the air, restabilized itself and touched down on a 4-point landing mechanism. As a kicker, a door then sprang open to release a 4-pound payload—a mechanical cocoon from which an insectlike micro-rover unfolded and scuttled away.

Called the Advanced Concept Architecture Test, the demonstration featured a punchy new liquid rocket fuel developed by Aerojet.

## Big Trouble For Little Sats

VANDENBERG AFB, CA—The Air Force and TRW have high hopes for their Space Test Experimental Platform (STEP) series of miniature satellites. But STEP has stumbled of late. And it looks as if the air-launched Pegasus booster is to blame.

The first STEP went off without a hitch (see *Tech Update*, page 18, June '94). But last May, the second STEP, lofted by a Pegasus, fell short of its intended 450-mile orbit. The spacecraft will still be able to test methods of pulling weak radio signals out of a noisy background.



The third STEP, an ionospheric probe, never made it off the launch range. Safety officials destroyed its booster—a beefed-up Pegasus called the XL—when the rocket seemed to lose power.

One STEP (left) got parked too low, but still functions. Not so lucky was next STEP (above), destroyed during launch.

## Swimming Pool For Gamma Rays

COLLEGE PARK, MD—Bursting out of the heavens, high-energy gamma rays pound air molecules high in our atmosphere. From these collisions, showers of photons rain down on Earth. To intercept these particles—and trace gamma-ray activity across the sky—a unique new detector will gaze from Fenton Hill in New Mexico.

Called Milagro, the facility isn't a telescope but a pool of water the size of a football field, filled with more than 700 photomultiplier tubes. A huge pool cover will screen out daylight but permit energetic photons to penetrate.

The University of Maryland, Los Alamos National Laboratories and other institutions are building Milagro.



Wide-angle Milagro will detect gamma rays carrying the highest energy levels.

## Mirror Of Mercury

VANCOUVER, BRITISH COLUMBIA—A shimmering pool of liquid can give a glass mirror a run for its money, telescope builders are finding. At the University of British Columbia, for example, a telescope with an 8½-ft.-dia. mirror—the world's biggest liquid reflector—is now staring at the Northern sky.

A containment dish rotates to throw a parabolic silhouette across the liquid's surface. Although the liquid mirror can't tilt, it can still gaze at stars wheeling overhead. Electronics can then compensate for Earth's rotation. NASA is building a bigger version to track space junk.



Liquid mirror, made of highly reflective mercury, provides quality images at a tenth the cost of glass equivalent.



SOME FLOORS WILL SQUEAK NO  
MATTER WHAT WALKS ACROSS THEM.

# THE SILENT FLOOR IS



# AS QUIET AS A MOUSE.

You can tell a lot about how a home was built by listening to it. A squeaky floor will keep reminding you that something isn't quite right. A quality floor doesn't make a sound.

No matter how big an entertainer you are, your floor doesn't have to squeak. Use the Silent Floor® system and it won't. We guarantee it.



Instead of ordinary 2 X 10 lumber standing on edge, the Silent Floor® system consists of wooden I-beams. These Silent Floor® I-beams are made by rearranging wood fiber into a material that is uniform, strong and guaranteed to be free from warping and defects. (Considering the herd you'll probably have running through your house, it better be.)

The Silent Floor® system creates a stronger joist, yet does it while using substantially less wood. Our revolutionary "I" shape lets us put the wood only where it will deliver the strength you need. That means we can use up to two or three times less than a traditional, lower quality floor.



No two ordinary 2 X 10s are alike. Their strength varies from one joist to the next. Plus, they warp and shrink differently, leaving gaps around the nails. Then as the flooring rubs on these nails—you hear the dreaded squeak.

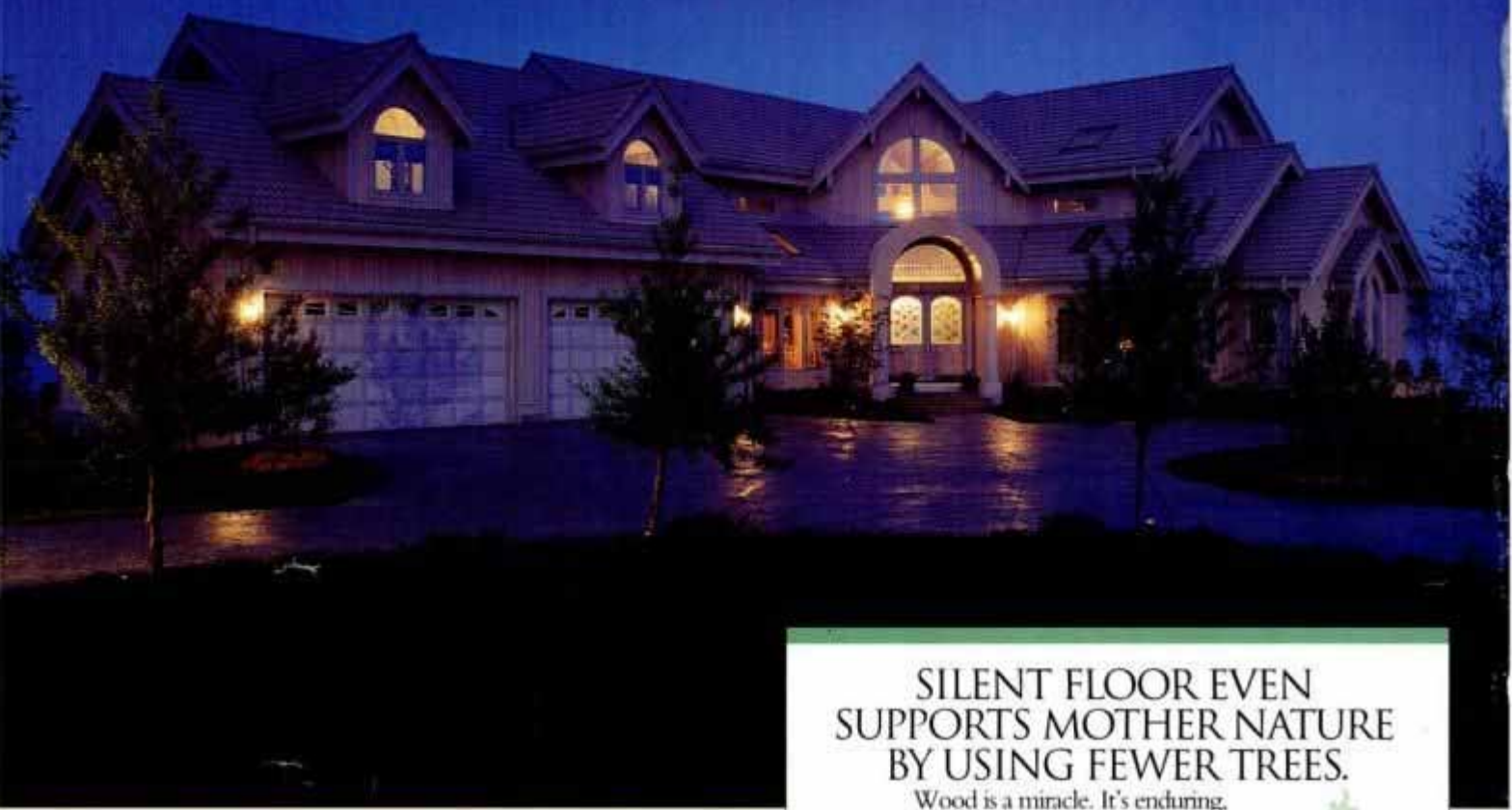
You may never have heard of the Silent Floor® system. (It is quiet after all.) Truth is, you've probably been in a home built with it. Since we invented it in 1970, it's been installed in more than 1,000,000 homes, condominiums and apartments.

Talk to your builder about the system. He's probably already building with it. For more information, the name of a TJM technical representative or a dealer near you, call 1-800-338-0515.

 **Silent Floor**  
*Tim Joist MacMillan*

Part of the **FrameWorks™** building system.

# BUILDERS ARE SOME OF OUR STRONGEST SUPPORTERS.



A builder's business rests on his reputation. And the only way to get a good reputation is to have happy customers like you. He knows that to keep from hearing a squeak from you, you better not hear a squeak from your floor. That's why so many builders and architects are using the Silent Floor® system.

But the Silent Floor® system does more than stop squeaks. The consistency of the materials makes for a trouble-free installation, with no surprises at the site. The incredible strength and integrity of the System also give builders design flexibility and the ability to create spans that would be impossible using ordinary methods.

And since the Silent Floor® system comes with a guarantee, good for the life of your home, both you and your builder will be able to sleep a little better at night.

Builders are also using more of the other products developed by Trus Joist MacMillan, inventors of the Silent Floor® system. Products such as MICRO=LAM® LVL headers and beams, Parallam® PSL posts and beams, and TimberStrand™ LSL rim board are all engineered wood products that make even more out of every wood fiber.

## SILENT FLOOR EVEN SUPPORTS MOTHER NATURE BY USING FEWER TREES.

Wood is a miracle. It's enduring, economical, beautiful and extremely more energy-efficient than any other common building material. But wood is also in demand for the vital role it plays in the forest ecosystem.

The Silent Floor® system uses two to three times less wood than old-fashioned building methods. This System and all the products produced by Trus Joist MacMillan are designed to make the most of each wood fiber. This is one important reason more and more home buyers, builders and architects are demanding these innovative materials.

The good news is that you don't have to give up a thing to do the right thing. No compromises. The Silent Floor® system is stronger, quieter and uses far less wood—which is pretty cool even if you're not a forest. To find out more about how these technologies from Trus Joist MacMillan use our forest resources more efficiently, call 1-800-338-0515.



 **Trus Joist MacMillan**  
A LIMITED PARTNERSHIP

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2135

## Japan's Jump Into Space



H-2 launches Japan's increasingly sophisticated experimental communications satellites.



TANEGASHIMA, JAPAN—With the space-launch capability afforded by their new H-2 rocket, the Japanese can now pursue an ambitious communications-satellite program. And they are. The 2.2-ton Engineering Test Satellite 6, scheduled to be launched in August, leaps ahead of anything NASA has on the drawing boards.

The satellite will experiment with high-capacity Ka and O frequencies, transmitting to small handheld receivers. More exotic is ETS-6's laser transceiver for future satellite-to-satellite communications. Other on-board packages will also preview intersatellite relays, a concept for which Japan has big plans.

## Shuttle's Supertank

NEW ORLEANS, LA —If the space station ever gets built, it will fly in a Russian-style orbit tilted 51.6° off the equator. NASA is now concerned that the shuttle will have to work harder to reach this orbit.

One way to tune up the shuttle is to trim away some weight. To



MARTIN MARIETTA PHOTO

Super-lightweight external tank will carry shuttle's liquid fuel and permit spacecraft to reach orbit for space station assembly.



NASA PHOTO

that end, Martin Marietta and Reynolds Metals are fashioning a next-generation external fuel tank.

The incorporation of lithium—the lightest metal—into the tank's alloy should add up to a 5000-pound weight savings. A reformulated spray-on insulation, which gives the tank its orange hue, should help cut another 3000 pounds.

Although the tooling rigged to manufacture the current tank can be adopted for the new version, use of the alloy has posed some technical challenges. Nevertheless, NASA hopes to send the new tank aloft in 1997.

## Electric Ice Buster

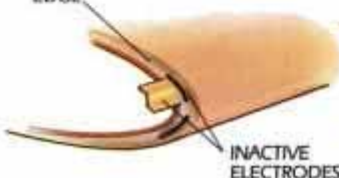
CLEVELAND, OH—A plane's engine inlets and wing leading edges could flex artificial muscles to free themselves of dangerous ice glazes. NASA's Lewis Research Center has been testing electro-expulsive de-icing.

The system features thin ribbon electrodes, folded back and forth and embedded in an elastic polymer. In operation, an electric pulse races through the electrodes. As the current doubles back on itself, it touches off a strong electromagnetic repulsion. This force separates the electrodes and swells the polymer to burst ice off its surface.

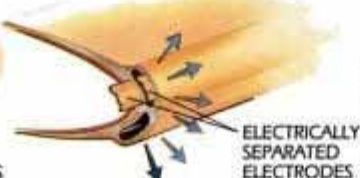
Electric de-icer pops ice glaze off vulnerable surfaces. System has been tested at NASA and military facilities.



ELASTOMER ON WING'S LEADING EDGE



INACTIVE ELECTRODES



ELECTRICALLY SEPARATED ELECTRODES

NASA ILLUSTRATIONS

## NASA's New Flying Lab



NASA PHOTO

HAMPTON, VA—For two decades, Boeing's prototype 737—modified with a hidden interior flight deck—served as NASA's airborne aeronautics laboratory. The original "Fat Albert" flight-tested technology from glass cockpits to windshear sensors. But now its day is done.

A Boeing 757-200, rescued from the fleet of bankrupt Eastern Airlines, recently touched down at Langley Research Center and has begun its transformation to replace the 737. The new jet already has digital cockpit controls and displays compatible with planned experiments. The plane will demonstrate technology for NASA's Advanced Subsonic Transport program as well as the agency's supersonic-airliner efforts.

Former Eastern Airlines workhorse will replace 737 in support of NASA's aeronautical research.

## High-Flying Laser To Zap Scuds

KIRTLAND AFB, NM—Lasers have joined the arsenal of weapons being marshalled to counter the ballistic-missile threat. The Air Force's Phillips Laboratory has tapped two rival industry teams, captained by Rockwell and Boeing, to design airborne laser systems that would shoot from the snout of a 747.

Modified for in-flight refueling, the big jet would prowl airspace above 40,000 ft., where the air is relatively calm and clouds lie few and far between. Sensors would react to launches of Scud-type missiles and slue the laser around to fire at multiple targets.



BOEING ILLUSTRATION

Ambitious airborne laser system would down rising Scuds before they left their country of origin.

The laser's mission will be to pick off missiles before they are out of the atmosphere. To hit bull's-eye after bull's-eye, its control system will have to operate at unprecedented speed.

The weapon itself will be a megawatt-caliber oxygen-iodine laser.

If plans hold out, the program will produce a winner in 1997—and a lethality demonstration in the year 2000.



Artlight uses laser to loosen grime without abrading surface. The technique preserves weakened and polychromatic stone.

## Light Fights Grime

RUEIL-MALMAISON, FRANCE—The French have come up with a way to clean centuries of soot off historical monuments without scouring away their rich architectural heritage.

Known as Artlight, the device is a solid-state infrared laser that fires through an articulating delivery arm. The grime layer under attack absorbs each brief laser blast and resonates, loosening itself mechanically from the stone surface. Extensive analysis with X-ray diffraction and other techniques show that the stone undergoes no damage from the shock wave induced by the process. In fact, the method can even restore multicolored facades because it leaves the surface intact.

The cathedral at Amiens and Notre Dame of Paris are among the monuments that Artlight has freshened.

## Infobahn's Fast Lane

OAK RIDGE, TN—Despite recent ballyhoo, Hollywood's hits won't be pouring through your phone lines without a few technical breakthroughs first. For one, something will have to machine-gun out hundreds of times the number of light pulses that now carry data through fiberoptic lines.

Developed at Oak Ridge National Laboratories and elsewhere, a transparent ceramic may hold the answer. The material would figure into switches that cut laser beams on and off to produce digital pulses. Fiberoptic networks currently use lithium-niobate crystals, which degenerate after repeated use. But, the new material lasts much longer. The thin-film ceramic material can handle much faster on/off switching as well.

Physicists test thin film of optically clear barium titanate for electro-optical switch.



OAK RIDGE NATIONAL LABORATORIES PHOTO

## Laser Hits The Spot

MURRAY HILL, NJ—AT&T Bell Labs has constructed a semiconductor laser that focuses its light output without a lens. Called a zone laser, the device could allow data to travel through free space—between chips or circuit boards—without a fiberoptic link.

The zone laser, which delivers light from its top rather than its side, acts like a miniature Fresnel lens. On its surface, a series of concentric trenches, separating light-emitting zones, converge the beam to a minuscule dot. The device also puts out a healthy 200 milliwatts—not bad for something smaller than a flea's eye.



AT&T BELL LABS PHOTO

Molecular-beam epitaxy machine, which lays down one atomic layer at a time, makes zone laser.

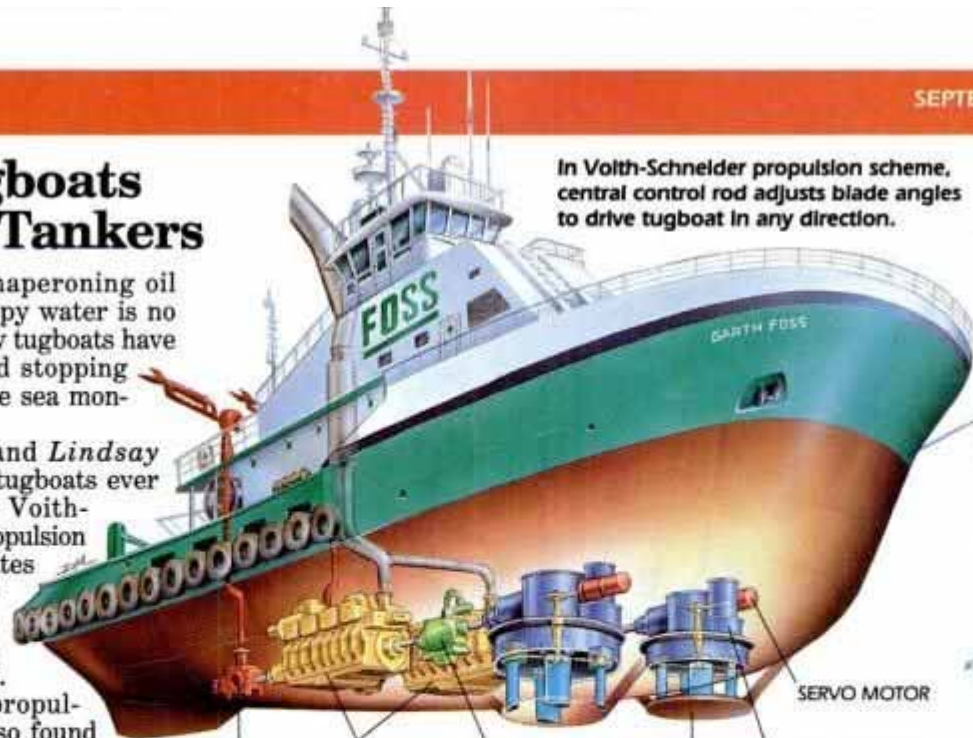


# Super Tugboats To Escort Tankers

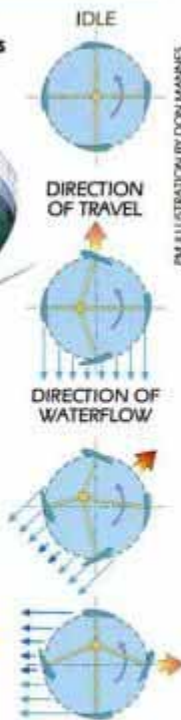
SEATTLE, WA—Chaperoning oil tankers through choppy water is no easy task. But two new tugboats have the speed, agility and stopping power to wrestle those sea monsters into submission.

The *Garth Foss* and *Lindsay Foss* are the biggest tugboats ever fitted with so-called Voith-Schneider cycloidal-propulsion units. Glostin Associates and Foss Maritime designed the vessels, built by Halter Marine in Lockport, Louisiana.

The "eggbeater" propulsion arrangement—also found



In Voith-Schneider propulsion scheme, central control rod adjusts blade angles to drive tugboat in any direction.



FM ILLUSTRATION BY DON MANNES

FIRE PUMP MAIN ENGINES TURBO COUPLING PROPELLER GUARD VOITH-SCHNEIDER PROPULSION UNIT SERVO MOTOR

on New York's Staten Island ferries—consists of two sets of vertical blades. A central control rod, tilted by a servo motor, manipulates the angles at which the spinning blades attack the water. The result: unprecedented 360° steering ability. Meanwhile, two Gen-

eral Motors diesels develop 4000 hp each, good for 15 knots.

Either of the new Foss tugs can corral a drifting tanker twice as quickly as a conventional open-wheeled tug with equal power.



HALTER MARINE PHOTO

# Air-Breathing Sea Robot

ANAHEIM, CA—Put a snorkel on an unmanned remote-control submersible, and you've got a synthetic cetacean known as the Dolphin. Canada's International Submarine Engineering developed the 24-ft. diesel-powered vehicle, which Rockwell's Autonetics division now makes in the United States.

The Dolphin's chief advantage is that it breathes air, so it can run for 24 hours on a single tank



ROCKWELL ILLUSTRATION

of gas, prowling 500 miles at a stretch. But the vehicle's body stays deep enough to duck under rough waves. A constant-tension winch trails an umbilical line to a sensor package, which could house anything from mine-detecting equipment to hydrographic-survey sonar.

Beyond covert military operations, the Dolphin could also assess seafood stock, chart navigational hazards or conduct oceanographic research.

**Dolphin breathes through snorkel, avoiding ocean surface effects, to hunt mines or count fish.**

# France's Stealth Ship

PARIS, FRANCE—Who owns the planet's stealthiest operational warship? Not the United States—the *Sea Shadow* (see "America's 'Invisible' Warship," page 28, July '93) is merely a testbed. The French have snuck up on the world with the frigate *La Fayette*.

The 410-ft. vessel is a tour de force for "signature reduction." The superstructure leans inward 10° to reduce radar echoes. It's constructed largely of fiberglass, coated with radar-absorbing material. Capstans and other deck gear lie concealed. Below-decks, the four diesel engines hang suspended and fitted with noise-reducing equipment.

Notwithstanding this squeaky-clean profile, the *La Fayette* can deliver a nasty punch. Standard equipment includes a 100mm gun, eight sea-skimming Exocet mis-

**Stealthy *La Fayette* is now completing sea trials and is destined for the Indian Ocean.**

siles and a Crotale surface-to-air missile launcher. Displacing 3500 tons, the vessel can steam at 25 knots.

France has plans for six *La Fayette*-class frigates.



AGENCE FRANCE PRESSE/STAN MARRI - CHOUQUERIE PHOTO



Performance.  
Protection.  
Quality.®

AND



Solutions to Engine Problems.®

PRESENT

# THE NATIONAL AUTO QUIZ

1. What car line offered a model with these stripes and decal on the rear fender?



A) Pontiac. B) Dodge. C) Chevrolet. D) Mercury.

2. Which of the following models is built in the U.S.?

A) Mazda MX-6. B) Chevrolet Camaro. C) Ford Crown Victoria. D) Both B and C.

3. Which NASCAR driver is the all-time Winston cup money winner?

A) Richard Petty. B) Rusty Wallace. C) A. J. Foyt. D) Dale Earnhardt.

4. What Japanese car manufacturer will be building their own Indy car engine for 1995?

A) Mazda. B) Mitsubishi. C) Toyota. D) Subaru.

## WIN A FREE VIDEO

Send us your auto-related questions. If we use one of them in a future quiz, we'll send you a free car care video. In case of duplicate questions, the one with the earliest postmark will win.

Send your entries to:  
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224 W. 57th St.  
New York, NY 10019

5. The car featured in the film, "Back To The Future," was a:

A) Ferrari. B) Bricklin. C) DeLorean. D) Lamborghini.

6. Which of the following pairs of car families are not related?

A) BMW-Range Rover. B) Volvo-Renault. C) Nissan-Infinity. D) Honda-Acura.

7. A burned valve can be caused by:

A) Carbon under the valve seat. B) Excessive valve guide clearance. C) Abnormal combustion. D) All of the above.

8. GM's first 4-cylinder engine since 1928, debuted in 1961. In which car model was it offered?

A) Chevrolet Corvair. B) Chevrolet Citation. C) Pontiac Tempest. D) Buick Special.

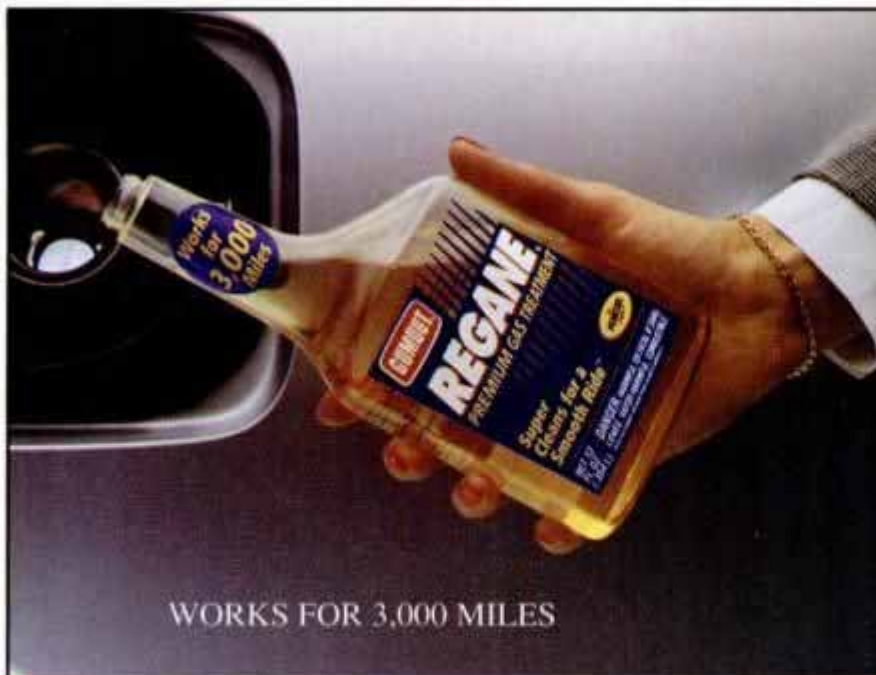
9. The first car to offer a steering wheel (instead of a tiller handle) as standard equipment was the:

A) Packard. B) Cadillac. C) Durant. D) Oldsmobile.

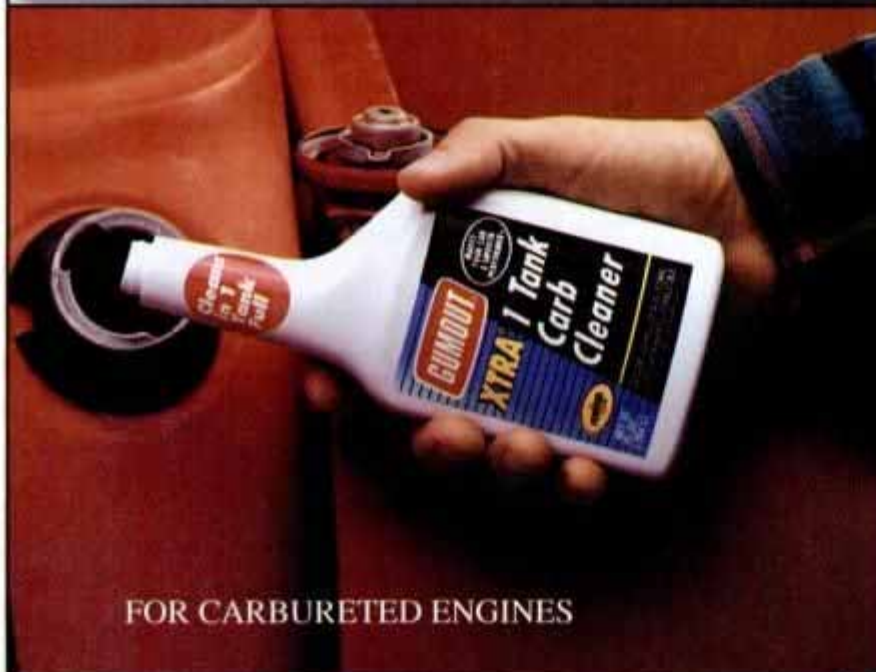
10. As engine oil is used in an engine, it becomes:

A) Thinner with age due to chemical breakdown. B) Thicker due to oxidation, wear metals, and combustion by-products. C) Thicker due to temperature changes. D) Thinner due to oxidation, wear metals and combustion by-products.

ANSWERS  
1. B 2. A (Camaro and Crown Vic are made in Canada) 3. D 4. C 5. C 6. B 7. D 8. C 9. A 10. B.



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## Home On The High Plateau

WASHINGTON, DC—Where might Earthlings get their most authentic taste of life on a remote planet? The South Pole is close, but even more extreme is the eastern Antarctic high plateau—at 13,000 ft., the highest point on the ice sheet. Cold, dry and forbiddingly dark for five months, the spot cries out for a scientific research station, similar to the South Pole facility run by the National Science Foundation (NSF).



The NSF recently sponsored a design competition for just such a station through the American Institute of Architectural Students. Two imaginative schemes shared first prize.

The foam iceberg, conceived by Paul Geldbach, begins with a huge double-membraned balloon. A construction crew fills the space between the membranes with foam. Over months, the foam slowly freezes, while wind and shifting ice sculpt the building. The crew returns and hollows a cave out of the foam. An occupiable wall then closes off the space.

Meanwhile, Kurt Micheels took the space-station route, designing a modular facility whose pieces could be shuttled in by ski-footed LC-130 planes. Micheels envisions a Y-shaped configuration, with fold-out inflatable habitats abutting a "crew assured survival module."

Winning designs for Antarctic high plateau stations are the hollowed-out foam iceberg (above) and the modular space station (left).



AN ILLUSTRATION BY TED UNDELBERGER

## Flaps Muffle Chopper Thwaps

HAMPTON, VA—A helicopter's trademark "thwap-thwap" sound arises as each whirling rotor blade bites into turbulence—swirling air that tumbles off the blade in front of it. Quell the turbulence, engineers believe, and you will quell the noise.

With that in mind, McDonnell Douglas recently tested a flap system at NASA's Langley Research Center. Attached to a blade's trailing edge, the flap flicks up and down to moderate the vortex behind the blade's tip.

In the test rig the flaps are actuated mechanically, but McDonnell Douglas is already looking into flap systems based on "smart" materials, such as shape-memory alloys or ceramics that change shape when zapped with an electric current. The Advanced Research Projects Agency wants to test such a system on the rotor blades of an MD Explorer helicopter.

Active flap system tested in wind tunnel muffles the "thwap-thwap" of helicopter blades by reducing blade-tip vortices.



NASA PHOTO



KAMAN AEROSPACE PHOTOS



Seen on Sea Dragon (left), Magic Lantern debuted aboard USS Vreeland (above).

## Minesweeper's Flashlight

WASHINGTON, DC—During the Persian Gulf War, mines blew far more holes in Navy ships than did missiles or torpedoes. So mine countermeasures have replaced antisubmarine warfare as an urgent priority in naval technology.

One revolutionary mine-detection system was drafted right out of the laboratory during Desert Storm. Code-named Magic Lantern, the device hangs in a pod on a helicopter, probing the water with laser pulses. The pod then picks up reflections and processes them into crisp images.

Developer Kaman Aerospace is now producing two advanced models, as well as a high-speed variant with which the Marines' F/A-18 jets can scan beach landing zones. Meanwhile, the Navy is opening up production of an Airborne Laser Mine Detection System to industry competition.

## Atlanta's Tech Park

ATLANTA, GA—The Olympics are now just two years away, and the city is gearing up with new attractions for waves of visitors. Not far from the Olympic venues, for example, a huge complex called GeoNova will house high-tech exhibits.

According to its creator, Visioneer International, GeoNova will showcase a new 3D virtual-reality display system that won't require special goggles. A simulator ride using this technology will incorporate seats that buck and turn as viewers seemingly



GeoNova will include GeoSphere exhibit (above), based on satellite composite image of Earth, and simulator ride featuring visorless virtual reality (left).

ride the rapids of a northern Georgia river. Nearby, fiberoptic and video projections will light up an oversize globe to illustrate Earth's changing conditions, such as climate, geology and ocean currents.

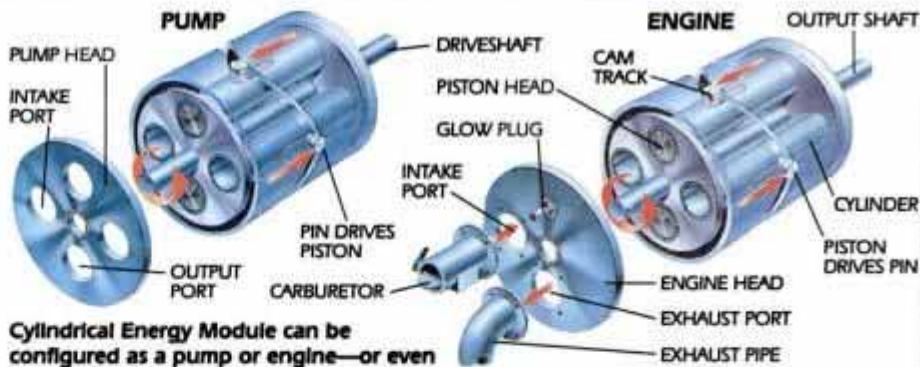
Meanwhile, interactive-video booths will allow visitors, through real-time image processing, to join in great sports moments—pitching to Babe Ruth in Yankee Stadium, for example. Participants will be able to take home copies of their videotapes.

## Peewee Pump With Power

EL SEGUNDO, CA—A versatile little device with only five moving parts could serve as a remarkably powerful pump or an engine.

Invented by Eddie Paul of E.P. Industries, the Cylindrical Energy Module consists of four double-ended pistons in a rotating body. These components move within a split shell, the two halves of which meet at a sinusoidal cam track.

As a motor turns the body, pins attached to the pistons travel along the cam track. The pins' sinusoidal path drives the pistons up and down.



Cylindrical Energy Module can be configured as a pump or engine—or even a double-ended self-powered compressor.

Meanwhile, the rotation aligns the pistons' cylinder openings with intake and output ports in the end cap.

Alternatively, the device could work in reverse, as a powerplant. The pis-

tons would compress and exhaust a fuel just like in a conventional internal-combustion engine. Their linear motions would translate into rotary movement as the pins are forced to follow the S-curve of the cam track.

## Laser-Guided Mining

PITTSBURGH, PA—Putting coal-mining vehicles under computer control could pay dividends in safety and efficiency. But the concept depends on the computer knowing where the machines are at all times. For that purpose, the U.S. Bureau of Mines recently tested a laser-based guidance system on a continuous miner. The experiments showed promise.

To track the tunneling vehicles, four laser-scanning sensors, fixed in explosion-proof housings, flank a mine gallery's entrance. The lasers

Equipped with reflective targets for laser tracking, miner could run under computer control.



# Import Spy Report

BY MIKE ALLEN, Associate Automotive Editor

## Son Of Lexus

● Start looking for this replacement for the nearly 5-year-old LS 400 at your Lexus dealer later this fall. Five years is a long time for a Japanese auto manufacturer to leave any model untouched (although this car did receive a minor facelift a couple of years ago), but the LS 400—and the Lexus franchise in general—has been so successful there was little need to hasten a newer car along. Styling changes will make the new midsize luxury flagship bear more of a family resemblance to the rest of the Lexus product lineup. There's increased slope to the hood-



Volvo 540 shares Mitsubishi platform.

line and a more rounded rear with less overhang, making the car appear less bulky.



Most recent version of the Jaguar saloon seen testing in Detroit.

## The Sun Never Sets On The British Empire

Spotted tooling around on a freeway in Detroit is what could be nothing less than a Jaguar saloon car. Latest view of the 1995 Jaguar shows the car in one of its final test stages before engineering sign-off. While the front-end changes are obvious—round headlights, nacelles in the hood and more brightwork—the rear redo is subtle. The trunklid has a lip curl to the side

and rear, while the taillights are extended from side to side. It seems a contradiction, but Jaguar, owned by Ford, will offer an improved GM automatic transmission in the new models. Later, in the 1996 model, Jaguar will get its long-awaited Ford-based V8 engine to go with the GM transmission.

## Volvo 540

This heavily disguised prototype, captured in southern Italy, is the new Volvo 540. Scheduled for a 1996 introduction, the 540 shares its platform with the Mitsubishi Lancer, and will be manufactured in Holland by NedCar—a joint venture between Mitsubishi, Volvo and the Dutch government. Powerplants are from Renault, including 1.8- and 2.0-liter engines. Available in Europe—and perhaps in the United States—will be a 2.1-liter turbodiesel.

## Audi Lite

Audi's new lightweight alumi-

num-bodied luxu sedan, the 300, has completed testing, although the introduction date is still officially vague. Powered by, variously, a 180-hp 2.8-liter V6, a 250-hp engine of unspecified type (maybe an inline Five) and a 300-

hp V8, the flagship will have 4-wheel drive and perhaps even 4-wheel steering. Also on the menu are a 5-speed automatic transmission and a 6-speed manual.



MG midengine sports car boasts strut suspension.

## MG Forever

We talked about it a couple of months ago, and here's a photo of the new midengine sports car code-named PR 3. We're expecting it to be called the MGD. It uses one of several MG engines and a Honda transaxle. Appointments will be sports-car-like—minimal—in the British stiff-upper-lip tradition, but we're betting on roll-up windows instead of vinyl side curtains.

## Hyundai Accent

It will be at the dealers within a month or two of our publication date, but we thought you might appreciate a shot of the new Hyundai Accent, which replaces the Excel. It was captured during final testing. **PM**



Hyundai Excel gets a fresh skin and a new name next year.

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# Detroit Spy Report

BY JIM DUNNE, Detroit Editor

## Très Cavalier

● The hottest-looking coupe is not quite as sizzling as that same model with a droptop. Knowing that, Chevrolet is out to gain extra styling points with this convertible version of the 1995 Cavalier. The convertible will be officially unveiled later this year, after the introduction of the coupe and the sedan. Unlike many other convertible efforts, the Cavalier will be totally home-grown—Chevy will do the convertible



to itself. In addition to the sharper looks, GM has revised the instrument panel and added dual airbags to the 1995 Astro/Safari minivan twins.

## The Next Big Cat

You probably cannot see a single straight line on this test model of the 1996 Mercury Cougar. The curvy front end displays a new grille, new headlights, new bumper/fascia and a



Ford's '96 Taurus wagon (above) shows some curvaceous lines as do the next Taurus sedan (right) and Mercury Sable (above right).

at its own assembly plant, not farm the job out to a customizer.

## GMC Safari

In case you were wondering why Ford intends to keep the Aerostar for another couple of years, consider



Sharp new looks, dual airbags and refined interior should help boost Safari sales.

the smartly styled GMC Safari and its near-twin Chevy Astro minivans that will be ready this fall. The GM siblings, along with the Aerostar, are the biggest-selling rear-wheel-drive minivans. Ford had second thoughts about canceling the Aerostar when it saw the possibility of GM having the rear-drive minivan market all

## Ford's Future Best Sellers

Whether in sedan form or station wagon, the '96 Ford Taurus and Mercury Sable are destined to be styling leaders—at least based on the glimpses of the cars we've been getting. Take the teaser view of a partly stripped Taurus sedan that, despite the car cover, reveals a Porsche-like front end with round headlights in oval frames. You also notice the oval radiator opening that Ford started with the Contour. Combine the exposed Taurus front end with the uncovered rear and profile of a Sable prototype to get a close-to-whole picture. You can tell that this car is a Sable by the small triangular window just aft of the rear door—Sable gets this exclusive 6-window design as well as a unique nose and taillamp treatment. The cars are built on the same platform, and share drivetrains. They also share the same low hoodline, obvious in the shot of the Taurus wagon.



new hood, which shows a major dip at its leading edge. This may be the last styling change for the rear-drive V8 Cougar. Reports say that the next-generation of the Mercury coupe will change to front-wheel drive and a much smaller chassis—perhaps picked up from the Mazda 929—due to be introduced in the 1998 model year. **FM**



In all likelihood, this '96 Cougar will be the last rear-wheel-drive version of Mercury's sport coupe.



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# The Information Waterway

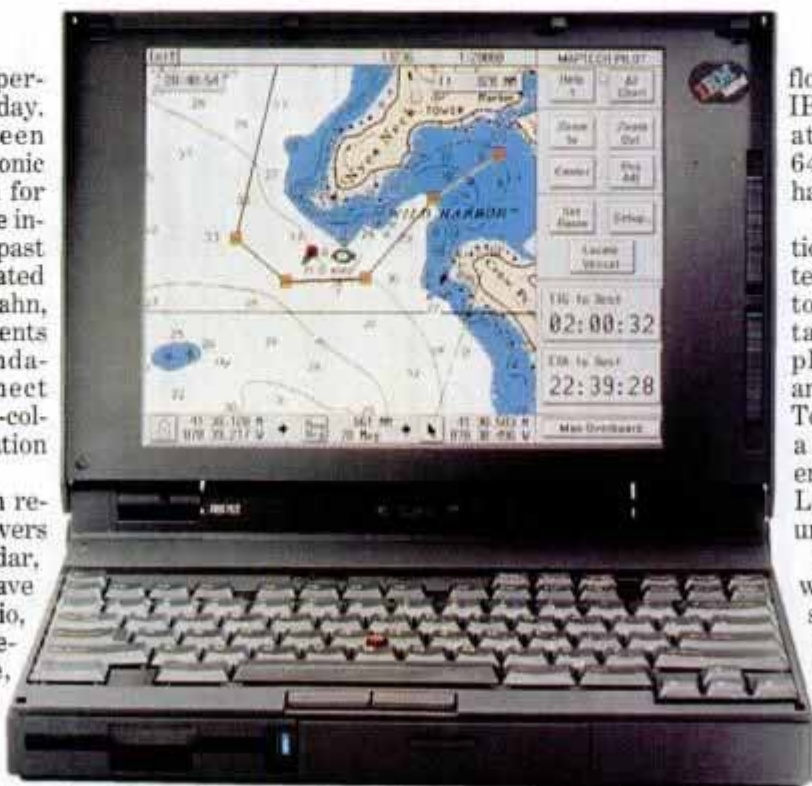
BY JOE SKORUPA, Boating/Outdoors Editor

● The information superhighway is big news today. But boaters have been cruising down an electronic waterway of their own for years. True, many of the instruments used in the past are not normally associated with the present Infobahn, but these early instruments fulfilled the same fundamental goal: To connect remote stations to data-collection and communication services.

The marine units I'm referring to include receivers and transmitters for radar, sonar, Loran C, shortwave radio, citizens band radio, VHF radio, single-side-band radiotelephone, satellite navigation (Sat/Nav) and satellite weather transmission. When first introduced, most of these items were big-ticket units that could only be afforded by upscale yachtsmen and sport fishermen. But by the early 1980s, average boaters were buying them and quickly becoming familiar with microprocessors, software and flat-screen displays, especially on sonar and Loran receivers, which were able to interface with each other and with radar, compass and autopilot units.

Sat/Nav technology was available to boaters by the mid-1970s, but in truth very few boaters took advantage of the system. Initially, the receivers were prohibitively expensive. By the early 1980s, when prices started to fall, the system's replacement was already on the horizon—the Global Positioning System. The 24th and final satellite in the GPS network was launched in June 1993, yet by this time boaters had already been using the system for five years despite incomplete satellite coverage and spotty service.

So where is the information waterway leading



boaters today? The current hot products are interactive software and hardware chart navigators, many of which can be used with a home computer.

Although introduced in the mid-1980s, the Resolution Mapping Maptech chart and navigation system didn't catch on until home computers became as common as microwave ovens. Unlike previous marine electronic gear, the Maptech system is strictly software and comes on 3.5-in.

floppy disks. It requires an IBM or compatible PC with at least a 286 processor, 640K RAM and a 20MB hard drive.

In its latest configuration, called *Pilot*, the Maptech system enables boaters to zoom in and out of detailed navigation charts, plan 20-waypoint routes and calculate transit times. To enable boaters to follow a real-time course, *Pilot* enables a PC to connect to Loran, GPS and compass units on the bridge.

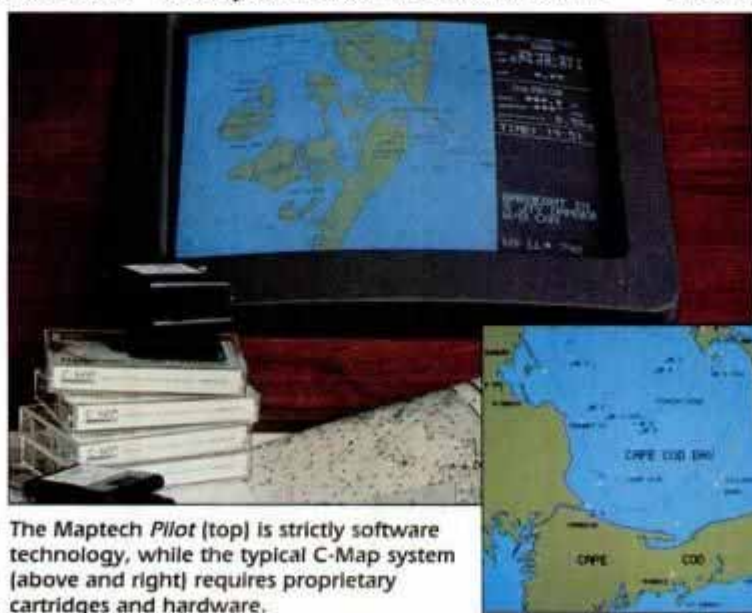
The Maptech *Pilot* comes with an interface cable, a systems disk and one free chart disk for \$290. Chart disks (\$35 each) feature exact reproductions of NOAA (National Oceanic and Atmospheric Administration) charts. The charts are also available on CD-ROM disks (\$400 per disk, containing 30 charts). A more powerful Maptech *Professional* package is available from \$1300 to \$1600.

Another electronic charting system available to boaters is C-Map, a combination of software and stand-alone hardware. Instead of using computer disks, the C-Map system uses cartridges driven by a plotter.

Like Maptech, C-Map isn't new.

It was developed in Italy in the mid-1980s and established in the United States in 1988. To date, C-Map has licensed its chart-navigation technology to such familiar companies as Datamarine, Apelco, Lowrance, Magellan, Si-Tex and Sony. These companies market

video chart plotters to run the C-Map cartridges, which display NOAA charts and navigate in real time by linking with Loran and GPS. Among C-Map's many software fea-



The Maptech *Pilot* (top) is strictly software technology, while the typical C-Map system (above and right) requires proprietary cartridges and hardware.



Global Map 1000 displays C-Map and freshwater charts.

tures are storing waypoints and routes, displaying distance and bearing, and calculating transit time.

Each C-Map cartridge measures  $2\frac{1}{4} \times 2 \times \frac{1}{2}$  in. and weighs 2 ounces. The average number of charts contained on a cartridge is 15. The cost is about \$150 per cartridge.

One of the newest C-Map capable plotters is the Lowrance Global Map 1000 (\$650 plus the cost of a Map-Link Cartridge Reader). What makes the Global Map 1000 unique is the availability of freshwater charts, featured on Lowrance's exclusive Inland Chart Modules. Each module covers a 3- to 4-state region and costs about \$125.

Other Global Map 1000 features are: a high-resolution LCD screen, and the ability to zoom in/out, store waypoints and routes, display distance and bearing, calculate transit time, and connect with Loran and GPS.

The beauty of a stand-alone unit like the Global Map 1000 is that it is built specifically for its rugged purpose. Still, one has to wonder what the future has in store for information-waterway mariners. Will it be stand-alone units, which may ultimately become obsolete, or software that runs on home and portable computers?

One company betting on the latter is Fair Tide Technologies. Its software product, called *Navigate!*, comes in both Apple (introduced in 1988) and IBM (introduced in 1992) formats. The basic IBM-compatible package (\$295) comes with a program disk, a GPS/Loran interface and one

coastal chart file. To add a regional set of 14 to 19 charts costs \$4.95.

Like the Maptech navigation software, *Navigate!* can zoom in/out, store waypoints and routes, display distance and bearing, calculate transit time, and interface with GPS or Loran. In the IBM version, *Navigate!* requires a PC-compatible computer with at least a 286 processor, VGA graphics, 600K of RAM and a serial port.

Not willing to risk being left out of the home-computer market, C-Map has recently signed a licensing agreement with Advanced Marine Technology to produce the SeaPlot Professional system, which runs C-Map software and interfaces with IBM or compatible PCs. Among the familiar navigation features are compatibility with Microsoft Windows and capability to interface with radar, sonar, GPS, Loran, gyro and autopilot.

Clearly, these products represent the tip of

the iceberg in marine software. For a comprehensive look at this expanding market, Wavetop Technology publishes a source book for marine PC and Apple software and related products. It's called *Marine Computing Directory* (\$30), and it is required reading for those wishing to navigate the information waterway. **FM**



New Fair Tide *Navigate!* is PC compatible. Mac, too.

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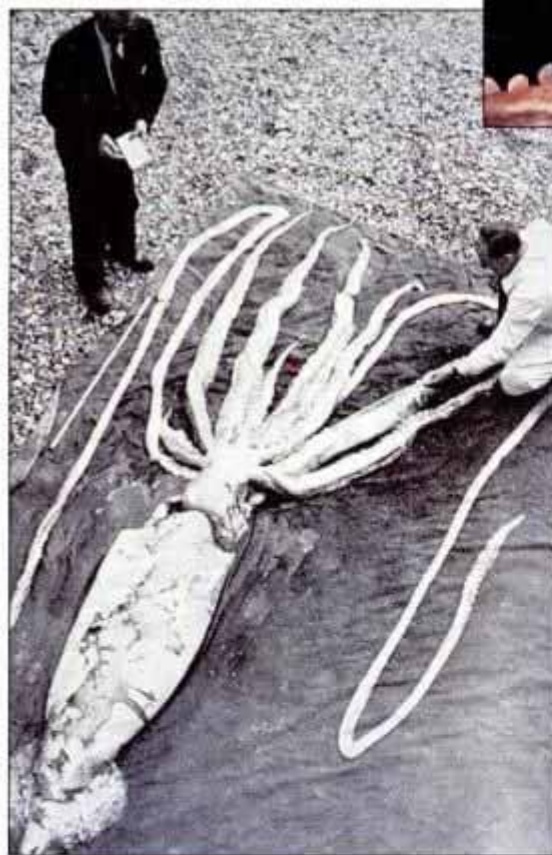
# Stalking The Giant Squid

BY GREGORY T. POPE, Science/Technology Editor

● "Give me a submersible, and give me 30 days—no, make that 60 days—and I'll find one." So says Clyde Roper, marine biologist, calamari gourmand and a man with a mission.

With his New Hampshire accent and trim Captain Ahab beard, Roper looks as though he'd be right at home brandishing a harpoon on the *Pequod*. Indeed, this former commercial lobsterman turned invertebrate zoologist harbors a desire as consuming as Ahab's quest for Moby Dick. Roper wants to see something no scientist has ever glimpsed: a giant squid, alive, in its natural habitat.

No other creature its size is as little known as the giant squid, notes Roper, who curates a new exhibit on the subject at the Smithsonian Institu-



Stranded specimens are all that separates fact...

tion's National Museum of Natural History in Washington, D.C.

The planet's largest animals without backbones, giant squid are hardly scarce. But they seldom cross paths with mankind. And when they do—snared in trawlers' nets or stranded on beaches—they're in no shape

to reveal much about their hidden lives.

That's unfortunate, says Roper, because much public perception of the giant squid is an ocean of fallacy, drawn from old mariners' engravings that show outsize tentacles pulling ships to watery graves. In reality, giant squid haven't been documented longer than 60 ft., half of which is tentacle. Even so, a giant squid leaves a giant impression, with eyes as big as basketballs, a surprisingly complex brain that rings the animal's esophagus and a sinewy body capable of jetting through water at 45 miles per hour.

The 440-pound female specimen on display at the Smithsonian washed ashore on Plum Island, Massachusetts, in 1980. Only 9 ft. long, it floats in alcohol like a long dumpling. Tentacles and arms missing, the specimen scarcely conjures up the menace these creatures must exude on their fellow sea dwellers.

The giant squid hunts relentlessly, chasing down tuna, sharks and other big fish. It reels in prey with two long feeding tentacles, then wraps its eight sucker-lined arms around the victim

and administers the kiss of death with a horny, birdlike beak. It fears only sperm whales, whose heads bear great sucker scars from battles with giant squid. "These tend to be one-sided encounters," says Roper. "The whale almost always wins." In fact, giant squid may be a critical food resource for imperiled sperm whales,



...from giant-squid fantasy.

making the dearth of knowledge about them all the more frustrating for marine biologists.

Their social lives, hunting tactics, reproduction and development remain mysteries. Even where they dwell is a nagging question mark. Only in the past few years have zoologists established that giant squid don't prowl the ocean's deepest recesses, but more likely lurk just off the continental shelf, between 300 and 1000 ft. down. Still, that leaves a lot of uncharted territory. "The whales know where they live," says Roper, "but we don't." Roper, in fact, has more of a clue as to the squid's favorite feeding grounds than most. But he isn't telling, for fear of tipping off trophy hunters and rival scientists.

Even armed with this knowledge, Roper admits he would be hard pressed to mount an expedition just to spy giant squid. Instead of netting and pickling specimens, he prefers capturing live animals on videotape, a technique that preserves their distinguishing characteristics.

Roper does this with cameras mounted on research submersibles, such as the *Johnson Sea-Links*, a pair of bubble-faced vehicles operated by the Harbor Branch Oceanographic Institution out of Fort Pierce, Florida. But scientists clamor for access to such assets, and few would look kindly on his monopolizing a valuable sub just to stalk a single species of squid.

So instead, Roper and colleagues have been using their time aboard subs to build a resource for squid identification. Their video footage highlights features unique to each species. The clips are now being transferred onto a multimedia database. Roper, who can cook calamari more ways than you'd care to hear, hopes his efforts will raise consciousness about squid as valuable food for humans.

Beyond the giants, other squids constantly surprise and preoccupy Roper. The Smithsonian's exhibit, for example, includes a rare species called *teuingia danae*. This 7-footer comes with a spectacular trademark. Two of its arms sport light-emitting organs that flash like Kelly-green strobes, apparently to blind potential predators. Only 12 of these deep-sea denizens have ever been spotted. The Smithsonian specimen happened to show up in a fisherman's net off the coast of Massachusetts in 1990.

Random encounters such as this remain Roper's best hope of running into live giant squid. In his words, "You can't just go out fishing for them." Until Roper's cameras capture these sea monsters, to him they'll remain elusive symbols of the unfathomable ocean. **PM**



It may not look like it, but this photograph was taken just last year, on Hurricane Creek Road.

THINGS MOVE SLOWLY in Jack Daniel's country. Occasionally, they stop altogether.

In Lynchburg, Tennessee, you can park in the middle of the road to talk with a neighbor about taxes or the weather. You can pick enough wild blackberries to fill a tin bucket. And you can see a distillery where Jack Daniel made whiskey way back in 1866. We still make it in a slow, deliberate fashion, much as he did. One sip, and you'll be glad to know we don't ever plan to stop.

## SMOOTH SIPPIN' TENNESSEE WHISKEY

Tennessee Whiskey • 40-43% alcohol by volume (80-86 proof) • Distilled and Bottled by Jack Daniel Distillery, Lem Motlow, Proprietor, Route 1, Lynchburg (Pop 3611), Tennessee 37352  
Placed in the National Register of Historic Places by the United States Government.



# Wired For The Highway

BY FRANK VIZARD, Electronics Editor



cessible by all three. The wall socket shown here is made by USTec Products of Canandaigua, New York, and is aimed at new home construction projects. USTec wants its TecPlate, as the wall socket is known, to be built into new homes. And while the TecPlate is far from universal at the moment, and a little pricey, it does provide for an interesting model.

The idea is to render invisible the many messy wires that are a byproduct of today's electronic components, whether they are computers or videocassette recorders. In addition to the two standard AC plugs, the TecPlate features a telephone plug and two other plugs for coaxial cables.

One of these coaxial cable inputs could easily be replaced with a fiberoptic cable input if that is desirable down the road. Fiberoptic cable is the darling of I-way engineers because of its incredible capacity for carrying all kinds of information. Most cable television companies, for example, plan to use fiberoptic cable to carry interactive programming to your curb, with existing coaxial cable providing the link from curb to door.

Fiberoptic cable hasn't made much headway inside the home yet, but this will change eventually. Already, entrepreneurs are experimenting with ways of using fiberoptic cable inside the home. One such company is ASM Labs Inc., of Marionville, Missouri, which sees fiberoptic cable as ideal for connecting audio and video components.

ASM's Mongoose system uses a small electronic transmitter that

plugs directly into a component to convert the analog audio or video signal into an optical signal that can travel over fiberoptic cable. A receiver at the other end of the fiberoptic cable converts the optical signal back to analog. The optical fiber strands are at the core of the wire and are surrounded by a variety of other materials (see diagram below left).

Fiberoptic cable for wiring components may be a bit of overkill at the moment since a Mongoose system for video lists for \$369 and one for stereo lists for \$649. But if you want trendy wiring, this is the way to go.

Still, there's little doubt that you will have to give wiring some thought if you want to go full-throttle on the

● What you're looking at just may be the wall socket of the future.

Granted, the wall socket may not turn out to be the most glamorous component of the information superhighway (I-way, for short), but it may turn out to be the most important. At issue is just how the I-way will arrive at your doorstep. Will it be via a telephone line, a coaxial cable like that used for cable television or by a load-intensive fiberoptic cable?

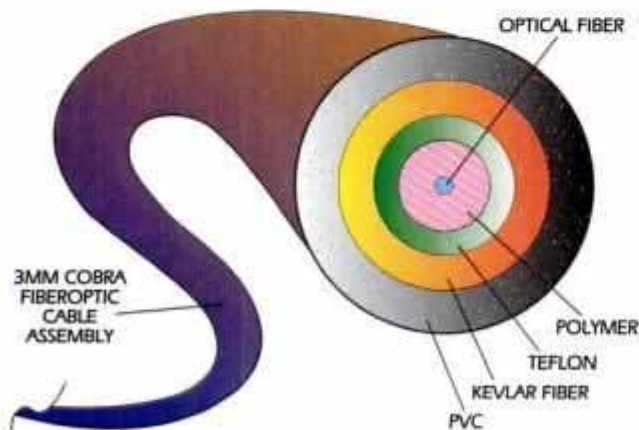
Chances are the I-way will be ac-

## Power Of Kong



A sneak preview of the movie-quality videogames of the future can be seen in "Donkey Kong Country" from Nintendo. This game uses advanced computer modeling techniques to achieve new levels of photo realism. These techniques will be used in the secret Ultra 64 system due next year.

## Inside The Mongoose



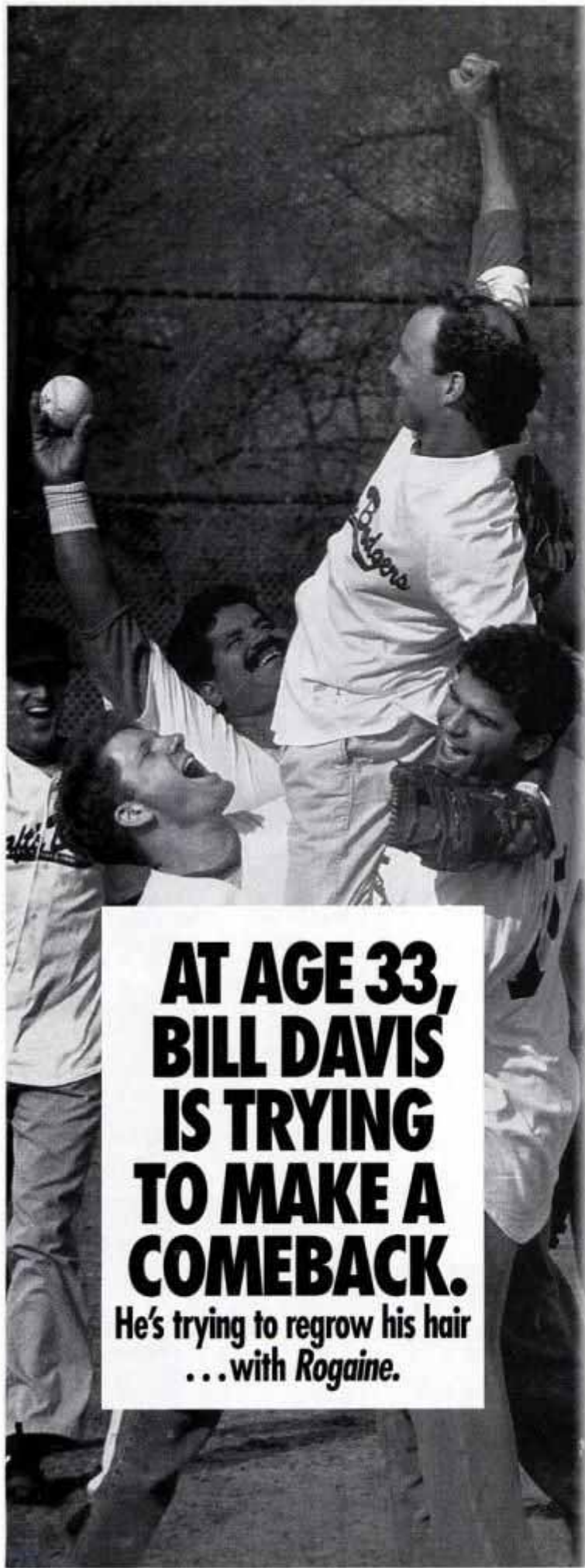
ASM's fiberoptic cable is designed for wiring audio/video gear.

information superhighway. One good resource is a computer software program called *Get Wired!* from Books That Work, of Palo Alto, California.

*Get Wired!* is full of useful information, even on the arcana of the I-way. For instance, let's say you're wiring a house but don't want to bet everything on which type of wiring will be the best for the future. *Get Wired!* suggests you run your wires through a 2-in. plastic conduit connected to metal or plastic boxes every few feet. Then if your existing wiring becomes obsolete, it's relatively simple to upgrade.

*Get Wired!* also shows you how to wire multiple rooms for audio, connect a second TV to a cable outlet, put a filter on phones to reduce static,

(Please turn to page 40)



**AT AGE 33,  
BILL DAVIS  
IS TRYING  
TO MAKE A  
COMEBACK.  
He's trying to regrow his hair  
...with Rogaine.**



Accepting loss on or off the field was never Bill's style. So when he saw he was losing his hair, Bill couldn't just accept it. He had to do something about it. But toupees and weaves, hair transplants and scalp reductions weren't for him. That's why Bill was pleased when he found out about Rogaine® Topical Solution (minoxidil topical solution 2%). For male pattern baldness, only Rogaine has been medically proven to regrow hair.

### How Rogaine works.

The exact mechanism by which minoxidil stimulates hair growth is unknown. But many scientists believe that Rogaine works, in part, by taking advantage of the existing hair's growth cycle. Prolong the growth cycle so that more hairs grow longer and thicker at the same time, and you may see improved scalp coverage. Bill liked that. He wasn't looking for miracles. Just having even a little more hair could make a difference in how he wore and styled his hair.

He also liked the idea that if he responded to treatment with Rogaine, the change would be gradual. Since natural hair grows slowly, over time, the change in his appearance wouldn't be instantaneous the way a toupee or a hair weave can be.

### Will Rogaine work for you?

Dermatologists conducted 12-month clinical tests. After 4 months, 26% of patients using Rogaine reported moderate to dense hair regrowth, compared with 11% of those using a placebo (a similar solution without the active ingredient in Rogaine).

After 1 year of use, almost half of the men who continued using Rogaine rated their regrowth as moderate (40%) to dense (8%). Thirty-six percent reported minimal regrowth. The rest (16%) had no regrowth.

Rogaine should only be applied to a normal, healthy scalp (not sunburned or irritated). Side effects? About 7% of those who used Rogaine had some itching of the scalp. (Roughly 5% of those using a placebo reported the same minor irritations.)

### Make a commitment to see results.

Studies indicate it usually takes *at least 4 months of twice-daily treatment before there is evidence of regrowth*. If you're younger, have been losing your hair for a shorter period of time, and have less initial hair loss, you're more likely to have a better response.

Keep in mind that Rogaine is a treatment, not a cure. So further progress is only possible by using it continuously. If you stop using it, you will probably shed your newly regrown hair within a few months. If you respond to Rogaine, you'll find it's easy to make it a part of your daily routine.

### The facts are free.

Want to try making your own comeback? Call **1-800-523-6226** right now and we'll send you a free, confidential Information Kit to help get you into the game. **And since you need a prescription to get Rogaine**, we'll also include a list of local dermatologists and other doctors who may be able to offer you a free, private hair-loss consultation.\*

**Why not make the call today?  
Call 1-800-523-6226 today  
for a free Information Kit on**

**Rogaine®**  
TOPICAL SOLUTION  
minoxidil 2%



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\*Not available in all areas.  
See next page for important additional information.

# Rogaine

minoxidil 2%  
TOPICAL SOLUTION

## The only product ever proven to regrow hair.

### What is ROGAINE?

ROGAINE Topical Solution is a prescription medicine for use on the scalp that is used to treat a type of hair loss in men and women known as androgenetic alopecia: hair loss of the scalp vertex (top or crown of the head) in men and diffuse hair loss or thinning of the front and top of the scalp in women. ROGAINE is a topical form of minoxidil, for use on the scalp.

### How effective is ROGAINE?

**In men:** Clinical studies with ROGAINE of over 2,300 men with male pattern baldness involving the top (vertex) of the head were conducted by physicians in 27 US medical centers. Based on patient evaluations of regrowth at the end of 4 months, 26% of the patients using ROGAINE had moderate to dense hair regrowth compared with 11% who used a placebo treatment (no active ingredient). No regrowth was reported by 41% of those using ROGAINE and 50% of those using a placebo. By the end of 1 year, 46% of those who continued to use ROGAINE rated their hair growth as moderate or better.

**In women:** A clinical study of women with hair loss was conducted by doctors in 11 US medical centers. Based on patients' self-ratings of regrowth after 32 weeks, 58% of the women using ROGAINE rated their hair regrowth as moderate (19%) or minimal (40%). For comparison, 40% of the women using placebo (no active ingredient) rated their hair regrowth as moderate (7%) or minimal (33%). No regrowth was reported by 41% of the group using ROGAINE and 60% of the group using placebo.

### How soon can I expect results from using ROGAINE?

Studies show that the response time to ROGAINE may differ greatly from one person to another. Some people using ROGAINE may see results faster than others; others may respond with a slower rate of hair regrowth. You should not expect visible regrowth in less than 4 months.

### How long do I need to use ROGAINE?

ROGAINE is a hair-loss treatment, not a cure. If you have new hair growth, you will need to continue using ROGAINE to keep or increase hair regrowth. If you do not begin to show new hair growth with ROGAINE after a reasonable period of time (at least 4 months), your doctor may advise you to discontinue using ROGAINE.

### What happens if I stop using ROGAINE? Will I keep the new hair?

Probably not. People have reported that new hair growth was shed after they stopped using ROGAINE.

### How much ROGAINE should I use?

You should apply a 1-ml dose of ROGAINE twice a day to your clean dry scalp, once in the morning and once at night before bedtime. Wash your hands after use if your fingers are used to apply ROGAINE. ROGAINE must remain on the scalp for at least 4 hours to ensure penetration into the scalp. Do not wash your hair for at least 4 hours after applying it. If you wash your hair before applying ROGAINE, be sure your scalp and hair are dry when you apply it. Please refer to the instructions for Use in the package.

### What if I miss a dose or forget to use ROGAINE?

Do not try to make up for missed applications of ROGAINE. You should restart your twice-daily doses and return to your usual schedule.

### What are the most common side effects reported in clinical studies with ROGAINE?

Itching and other skin irritations of the treated scalp area were the most common side effects directly linked to ROGAINE in clinical studies. About 7 of every 100 people who used ROGAINE (7%) had these complaints.

Other side effects, including light-headedness, dizziness, and headaches, were reported both by people using ROGAINE and by those using the placebo solution with no minoxidil. You should ask your doctor to discuss side effects of ROGAINE with you.

People who are extra sensitive or allergic to minoxidil, propylene glycol, or ethanol should not use ROGAINE.

ROGAINE Topical Solution contains alcohol, which could cause burning or irritation of the eyes or sensitive skin areas. If ROGAINE accidentally gets into these areas, rinse the area with large amounts of cool tap water. Contact your doctor if the irritation does not go away.

### What are some of the side effects people have reported?

ROGAINE was used by 3,857 patients (347 females) in placebo-controlled clinical trials. Except for dermatologic events (involving the skin), no individual reaction or reactions grouped by body systems appeared to be more common in the minoxidil-treated patients than in placebo-treated patients.

**Dermatologic:** instant or allergic contact dermatitis—7.36%. **Respiratory:** bronchitis, upper respiratory infection, sinusitis—7.16%. **Gastrointestinal:** diarrhea, nausea, vomiting—4.23%. **Neurologic:** headache, dizziness, faintness, light-headedness—3.42%. **Musculoskeletal:** fractures, back pain, tendonitis, aches and pains—2.59%. **Cardiovascular:** edema, chest pain, blood pressure increases/decreases, palpitations, pulse rate increases/decreases—1.53%. **Allergic:** nonspecific allergic reactions, hives, allergic rhinitis, facial swelling, and sensitivity—1.27%. **Metabolic-Nutritional:** edema, weight gain—1.24%. **Special Senses:** conjunctivitis, ear infections, vertigo—1.17%. **Genital Tract:** prostatitis, epididymitis, vaginitis, vulvitis, vaginal discharge/itching—0.91%. **Urinary Tract:** urinary tract infections, renal calculi, urethritis—0.93%. **Endocrine:** menstrual changes, breast symptoms—0.47%. **Psychiatric:** anxiety, depression, fatigue—0.36%. **Hematologic:** lymphadenopathy, thrombocytopenia, anemia—0.31%.

ROGAINE use has been monitored for up to 5 years, and there has been no change in incidence or severity of reported adverse reactions. Additional adverse events have been reported since marketing ROGAINE and include eczema, hypertrichosis (excessive hair growth), local rhytisms (redness/pruritus/itching), dry skin/scalp flaking, sexual dysfunction, visual disturbances, including decreased visual acuity (clarity), increase in hair loss, and alopecia (hair loss).

### What are the possible side effects that could affect the heart and circulation when using ROGAINE?

Serious side effects have not been linked to ROGAINE in clinical studies. However, it is possible that they could occur if more than the recommended dose of ROGAINE was applied, because the active ingredient in ROGAINE is the same as that in minoxidil tablets. These effects appear to be dose related; that is, more effects are seen with higher doses.

Because very small amounts of minoxidil reach the blood when the recommended dose of ROGAINE is applied to the scalp, you should know about certain effects that may occur when the tablet form of minoxidil is used to treat high blood pressure. Minoxidil lowers blood pressure by relaxing the arteries, an effect called vasodilation. Vasodilation leads to fluid retention and faster heart rate. The following effects have occurred in some patients taking minoxidil tablets for high blood pressure:

- Increased heart rate: some patients have reported that their resting heart rate increased by more than 20 beats per minute.
- Salt and water retention: weight gain of more than 5 pounds in a short period of time or swelling of the face, hands, ankles, or stomach area.
- Problems breathing: especially when lying down; a result of a buildup of body fluids or fluid around the heart.
- Worsening or new attack of angina pectoris: brief, sudden chest pain.

When you apply ROGAINE to normal skin, very little minoxidil is absorbed. You probably will not have the possible effects caused by minoxidil tablets when you use ROGAINE. If, however, you experience any of the possible side effects listed above, stop using ROGAINE and consult your doctor. Any such effects would be most likely if ROGAINE was used on damaged or inflamed skin or in greater than recommended amounts.

In animal studies, minoxidil, in much larger amounts than would be absorbed from topical use (on skin) in people, has caused important heart-structure damage. This kind of damage has not been seen in humans given minoxidil tablets for high blood pressure at effective doses.

### What factors may increase the risk of serious side effects with ROGAINE?

People with a known or suspected heart condition or a tendency for heart failure would be at particular risk if increased heart rate or fluid retention were to occur. People with these kinds of heart problems should discuss the possible risks of treatment with their doctor if they choose to use ROGAINE.

ROGAINE should be used only on the balding scalp. Using ROGAINE on other parts of the body may increase minoxidil absorption, which may increase the chances of having side effects. You should not use ROGAINE if your scalp is irritated or sunburned, and you should not use it if you are using other skin treatments on your scalp.

### Can people with high blood pressure use ROGAINE?

Most people with high blood pressure, including those taking high blood pressure medicine, can use ROGAINE but should be monitored closely by their doctor. Patients taking a blood pressure medicine called guanethidine should not use ROGAINE.

### Should any precautions be followed?

People who use ROGAINE should see their doctor 1 month after starting ROGAINE and at least every 6 months thereafter. Stop using ROGAINE if any of the following occur: salt and water retention, problems breathing, faster heart rate, or chest pains.

Do not use ROGAINE if you are using other drugs applied to the scalp such as corticosteroids, retinoids, petrolatum, or agents that might increase absorption through the skin. ROGAINE is for use on the scalp only. Each 1 ml of solution contains 20 mg minoxidil, and accidental ingestion could cause unwanted effects.

### Are there special precautions for women?

Pregnant women and nursing mothers should not use ROGAINE. Also, its effects on women during labor and delivery are not known. Efficacy in postmenopausal women has not been studied. Studies show the use of ROGAINE will not affect menstrual cycle length, amount of flow, or duration of the menstrual period. Discontinue using ROGAINE and consult your doctor as soon as possible if your menstrual period does not occur at the expected time.

### Can ROGAINE be used by children?

No, the safety and effectiveness of ROGAINE has not been tested in people under age 18.

**Caution:** Federal law prohibits dispensing without a prescription. You must see a doctor to receive a prescription.

**Upjohn** | DERMATOLOGY  
DIVISION

The Upjohn Company, Kalamazoo, MI 49001, USA

CB-5-S



The GreenPlug regulates electrical use.

create circuits, and even show you the tools you need for the job. A convenient search system makes finding data on a subject easy, and a variety of animated sequences also helps in your understanding. And at \$19.95, this program is a bargain to boot.

Get Wired! also allows you to estimate the power consumption and cost of operating appliances. This is also an issue being addressed by K-Electronics of Concord, Ohio. This company makes the GreenPlug, a device that acts as an arbiter of power consumption between the wall socket and an appliance.

Designed for use with refrigerators, freezers, gas dryers, air conditioners and humidifiers, the GreenPlug can reduce energy consumption by as much as 25%, says the company. The device is also supposed to help appliance motors run more efficiently by regulating the amount of voltage being supplied at an optimum level. In turn, this should help the appliance last longer. List price for the GreenPlug is \$39.

More literally speaking, getting wired for the highway is a job for a product called the Pocket Socket from Power Products of Sunnyvale, California. This little 8-ounce inverter plugs into a car's cigarette lighter to provide 100 watts of continuous power, as well as an 800-watt surge needed to start up many computers, VCRs and power tools. List price is \$79.

The Pocket Socket sounds like just the ticket for a tailgate party. Plug in the blender, please.

PM





# A FULL ACCOUNTING

Our government brings high tech to bear in the search for Vietnam War MIAs.

BY CLIFF GROMER, Contributing Editor

● The wounds of war heal quickly for some, slowly for others. But when the fate of a loved one has not been reconciled, the wounds never heal.

June 1965. The hard rain pelting the canopy of the Navy A-4 Skyhawk armed reconnaissance jet is muffled out by cumbersome flight gear. Deep into enemy territory, Lt. Cmdr. Max Golodner (not his real name) banks and pitches his craft in precise synchronization to the terrain not far below. Searching out targets of opportunity, Golodner stiffens, hammered by an adrenaline punch as he catches sight of an exploding black puff close to his right.



North Vietnamese militia pose with the remains of a U.S. aircraft shot down by deadly anti-aircraft fire.

Three more puffs explode in rapid succession. Viet Cong anti-aircraft units are rolling out the welcome mat.

A short distance away, Golodner's wingman darts a quick glance to his left. A sudden chill freezes his gaze, and his guts churn with the realization that he is suddenly alone in the sky. There is no distress call, no visible chute deployment. Golodner and his plane have been erased with the cold efficiency of some cosmic computer operator punching the DELETE key.

A search-and-rescue team mounts an extensive mission the next morning. They find nothing.

## A FULL ACCOUNTING



FM PHOTOS BY LARRY D. ANDERSON

March 1994. The road gets worse as it snakes away from the heart of Thanh Hoa province. Traffic is light, a far cry from the swarming bicycle free-for-all in Hanoi, about 100 miles to the north. There, in Lenin Park, loudspeakers that once delivered Ho Chi Minh's party line now blare out Western-style rock music. And dollars are accepted as readily as the national currency.

The trip to Thanh Hoa is made on 2-lane blacktop. There seem to be no traffic rules except that you must pass everything in sight and stay on the horn continuously from the moment you switch on the ignition. Our pace slows considerably now, as craters and boulders in the road seek to reduce our 3-car convoy—and occupants—into their respective component parts.

It's a short walk from our vehicles to the newly planted sugar cane field. Looking like anything but a site of violent death and destruction, it is the point, nonetheless, where local eyewitnesses say an American plane smashed nose first into the ground, punching out a crater 20 ft. deep.

Our 10-man recovery team includes specialists in explosive-ordnance disposal, life-support analysis and mor-



**Excavation project in various stages shows initial look at impact crater site, meter-wide test trench, and screening of soil for remains. The completed dig, after 11 days, covered 130 sq. meters. Recovered fragment of life-support gear indicates pilot was in plane at time of impact.**

tuary affairs, along with an anthropologist. A key element in America's quest for its war dead and unaccounted-for, the team is part of the Joint Task Force-Full Accounting (JTF-FA), a high-priority program that wants for nothing in the way of technical or financial support. JTF-FA has investigated and excavated cases involving more than 1700 unaccounted-for Americans in Vietnam, Laos and

Cambodia since 1992. "We're now down to the hard ones," says Lt. Col. Dave Fredrikson, chief of public affairs for JTF-FA.

While our unrepatriated servicemen are commonly referred to as POWs and MIAs, Fredrikson points out that the term MIA infers a certain legal status that has a bearing on benefits to spouse and family. For that reason, JTF-FA classifies the missing as Unaccounted For. And its mission is to resolve each case—to the satisfaction of the families involved—by finding and identifying human remains, where possible, or by building a case of circumstantial evidence that determines, as best as possible, the fate of the missing American.

Reports of live sightings receive the highest priority and trigger instant action. But these investigations have never panned out. JTF-FA has no evidence that Americans are being held against their will in Indochina at this time. Even so, one missing American, Col. Charles Shelton, an Air Force pilot shot down over Laos and captured, still is carried on the books—symbolically—as a POW.

As in the case that our JTF-FA team is probing, most of the leads relating to crash and burial sites come

from witnesses, many responding to ads placed by the Vietnamese government. There is no compensation for those who come forward with information—or with remains that they themselves may have buried. Additional leads emerge through research of Vietnamese archives that include films, newspapers and military field reports. There are also frequent face-to-face meetings between the JTF-FA and Vietnamese officials to address any problems that might come up and to help keep the program on a fast track.

### Bits and pieces

It was back in 1985 that the Vietnamese turned over some bits of aircraft wreckage from our Thanh Hoa site and claimed there were no more remains to be found.

Then, in October 1993, a JTF-FA investigative team visited the site. They interviewed local villagers and corroborated the claim that an American plane had crashed there. That team was able to recover some aircraft fragments and a portion of a flight suit. They also found evidence of a crater made by a high-speed impact, suggesting a fast aircraft as opposed to, say, a helicopter. The investigative team recommended a more intensive search of the site by a recovery team.

And that's what brings our unit to the site. The team now deploys, with ordnance specialist Larry Miyamoto pin-flagging areas that beep on his metal detector. The chance of encountering unexploded ordnance at this site is pretty remote. The beeps most likely indicate wreckage fragments under the surface.

Crash sites are not the stereotypical scene of a tail section sticking out of the ground like a monument, with large sections of engine and cockpit lying nearby. Vietnam, a poor country at best, had its resources pushed to the limit during the war. Crash sites were immediately scavenged—even mined to some degree. Vietnamese used aircraft nose cones for cooking kettles, wing flaps for hut doors. Thirty years of jungle climate took its toll on what was left.

While Miyamoto wields the metal detector here to locate aircraft wreckage, a ground-penetrating radar system is sometimes brought out to "look" 10 to 20 ft. beneath the surface. Used primarily in mining, this system works like conventional radar, send-

ing out a signal that is reflected by burned objects to show up as contour lines on the screen. It takes a trained operator to interpret the display.

### A question of survival

Once Miyamoto has done his job, Dr. Bert Davis, the team anthropologist, takes over. He determines the type of excavation—if any—that will take place to uncover human remains for positive identification.

A complexity of factors go into this

at steep angles leave a crater with a small debris field. Since any life-support gear would lie in the crater, an excavation would have a good chance of success. On the other hand, a slow aircraft, such as a C-130, chews up a lot of ground when it hits but doesn't leave a big hole in the ground. It just scatters debris. The problem in such a circumstance is there may be no clue as to the location of the cockpit. It's impossible to excavate a large debris field. Where do you start, and where do you end? Collecting boxes full of small metal fragments in itself has no value in determining the fate of a U.S. airman.

The anthropological investigation can also gain insight from the mind-boggling dynamic forces involved in a high-speed crash. Artifacts and remains often bear the peculiar and unmistakable effect of a 600-mph impact on the human body. Heavy leather flight boots and heavy wool flight socks will have the sides blown completely out of them, because the ankle bones literally explode. Feet are torn from the boots with such force that the metal lace eyelets show severe elongation from the pull of the laces. Jawbones and teeth break in a particular way, as the impact g-forces slam the mouth closed. Details like these serve to reinforce the evidence provided by the appearance of the crash site itself.

With all this in mind, the team cordons off the site. Initial fragment finds under the pin flags are promising, and the team digs an exploratory trench 22 meters long ×

2 meters wide × 1 meter deep. Soon the excavators unearth a 12-in. × 4-in. piece of torso harness. It is a strong indication that the pilot was in the plane at the time of impact. Also uncovered are fragments of container suspension lines and canopy of the pilot's personal parachute.

The area is then divided into a grid, and the earth dug from each sector is screened. Key finds here would include aircraft pieces bearing serial numbers that can be traced back to determine the type and model—and perhaps the specific aircraft. This information would be checked against



Crash site was in Thanh Hoa Province, 100 miles south of Hanoi.

determination. For example, finding life-support gear—fragments of items that would stay with the pilot, such as oxygen-mask components—is critical to determining the fate of the airman. Discovering such equipment would indicate that he went down in the crash, with chances of survival virtually nil. Not finding this gear could mean that Golodner bailed out before impact. Such an ejection might improve his chances for survival but raise questions about his fate.

In addition, the site itself can reveal a lot about the odds of finding human remains. As a rule, high-speed crashes

## A FULL ACCOUNTING



(Top and middle) Hanoi war museum exhibits U.S. aircraft wreckage and personal effects—a highly emotional experience for servicemen returning to Vietnam. Flight boots (bottom) with sides blown out from impact are among artifacts.

records to determine if an aircraft of that type had been lost in this area.

### Clues to Identity

More significant to the mission, however, would be the discovery of bone and bone fragments. The team anthropologist could determine if they were of human origin. He might be able to establish personal characteristics, such as race, height and age. Finding a recovered tooth, especially one bearing dental restoration, is like finding gold. The tooth can be matched against dental records in the massive database to which JTF-FA has access. A match in this case would mean positive identification.

Any human remains that the team recovers are sent to the Central Identification Laboratory in Honolulu, Hawaii (CILHI), for identification. One of the leading institutions in forensic science, the lab provides support for civilian, as well as military, investigations.

One room at CILHI is lined with neat rows of tables draped in white. Each table holds a puzzle, a box containing bones and bone fragments—all that's left of what used to be a highly skilled fighter pilot.

The bones are studied by an anthropologist and a forensic specialist. They work the identification process, independently, from different sides of the street to seek a common conclusion. The forensic odontologist tries to match recovered teeth against dental records. The anthropologist, on the other hand, analyzes the complete set of human remains to build up a profile of the subject. To avoid bias, he works without knowing the individual's characteristics or suspected identity. The box may contain remains of more than one individual. This becomes evident when bones that should fit together, such as the first and second vertebrae, do not.

### Banking on DNA

The latest in high-tech identification involves DNA matching. The Department of Defense began a DNA Depository program in 1992, preserving blood and saliva samples, which are stored permanently frozen. DNA reference material from these samples will be used to identify war dead and mass-disaster victims in the future.

Since no DNA reference data exist for Vietnam-era servicemen, geneticists have developed a new technique that relies on mitochondrial DNA for identification. Located outside the nucleus of the cell, mitochondrial DNA is inherited just from the mother, as opposed to nuclear DNA that is inherited from both parents. The mitochondrial method matches DNA



Transilluminator used in DNA identification emits UV light, which makes dyed DNA glow.

from recovered bones against blood samples of maternal relatives.

Extracting and processing this DNA, however, is a long and complex task. But it is such a significant advance in biological science that Dr. Kary Millis won the Nobel Prize last December for his work in this area. And because of its important role in the JTF-FA search, the process warrants a detailed look.

The initial step taken by CILHI involves cutting out windows in the bone and sending the slivers to the DNA Identification Laboratory of the Armed Forces Institute of Pathology in Washington, D.C.—the largest facility of its type in the world.

There, the bone samples are thoroughly cleaned with a small hand grinder and chopped into fragments. These, in turn, are pulverized into a fine powder in a blender. The powder

is dumped into a buffer solution that extracts DNA from the bone.

The DNA itself is a double molecular strand that looks like a microscopic ladder. Typically, it is present in quantities too small for analysis. Fortunately, a revolutionary process called the polymerase chain reaction (PCR) can take a section of DNA and replicate it more than a millionfold.

The first step in that process is denaturation—heating the DNA to about 94°C in an extract of the buffer solution. That “unzips” the double strands of DNA into single strands, each of which looks like one ladder rail with half-rungs attached. An annealing step is next. This introduces a small piece of single-strand DNA, called a primer, that finds and bonds to its complementary section of single-strand DNA. The result: a small section of double-strand DNA

within the total single-strand DNA.

The next step, known as extension, is what drives the entire process. An enzyme called DNA polymerase—found naturally in bacteria from hot springs—is added to the solution. This enzyme seeks out the single-strand DNA that contains the small section of primer-bonded double stranding. Once it keys in on this primer, the enzyme goes to work, causing the rest of the single strand to double-strand, effectively re-synthesizing the opposing complementary strand. The process is repeated as often as necessary, with DNA duplicated exponentially, until sufficient quantities for analysis are obtained.

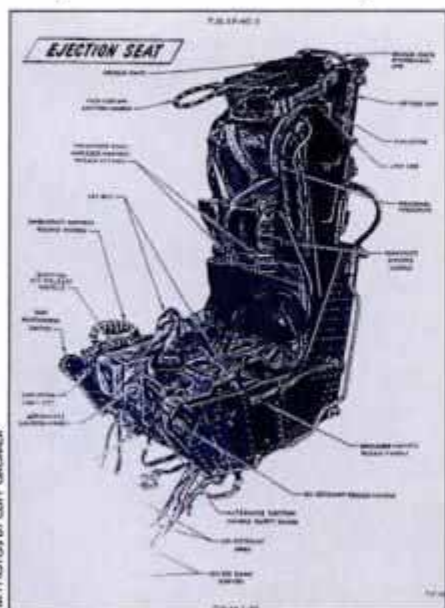
These days, reading the DNA is done on an automated sequencer. The legions of double-strand DNA ladders created by the polymerase reaction are once again unzipped down the middle of the rungs. Each rung consists of two molecular units, known as nucleotide bases, bonded together. There are four types of nucleotides, classified as A, T, G and C. An A always binds to a T, and a G always binds to a C.

The sequencing process starts with a group of DNA fragments. All the fragments consist of a stretch of the same overall ladder. Each fragment starts at the same point, but is cut off at a different nucleotide base. All fragments are identified by having this cutoff point—either an A, G, T or C base—tagged with one of four distinct fluorescent dye molecules. An electric current then lines up the fragments in order of length and moves them past an ultraviolet light, which causes the dye to flash its color. The order of the colors then can be correlated with the base sequence of the original stretch of DNA.

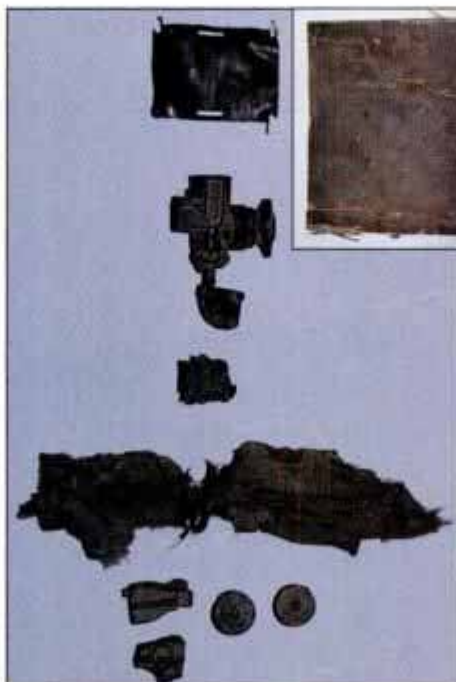
The sequencing process is then repeated for the opposing half of the DNA ladder, and the readout must be a complement to the first to confirm the results. Maternal blood samples also go through the DNA extraction and sequencing process, and they must match the DNA sequence in the bone sample for identification.

Back at our Thanh Hoa excavation site, the recovery team continues its painstaking digging and screening. The work will last 11 days and encompass an area of 130 sq. meters down to a level at which the soil was undisturbed. Ultimately, the team will uncover human remains, uniform items and life-support gear, which, by preliminary analysis, indicates that the pilot was in the aircraft at the time of impact.

The human remains were repatriated on April 12, 1994, and are currently undergoing analysis at CILHI. **PM**



Recovered fragments, like number-bearing armor plating and life-support gear can be identified by referencing manuals.

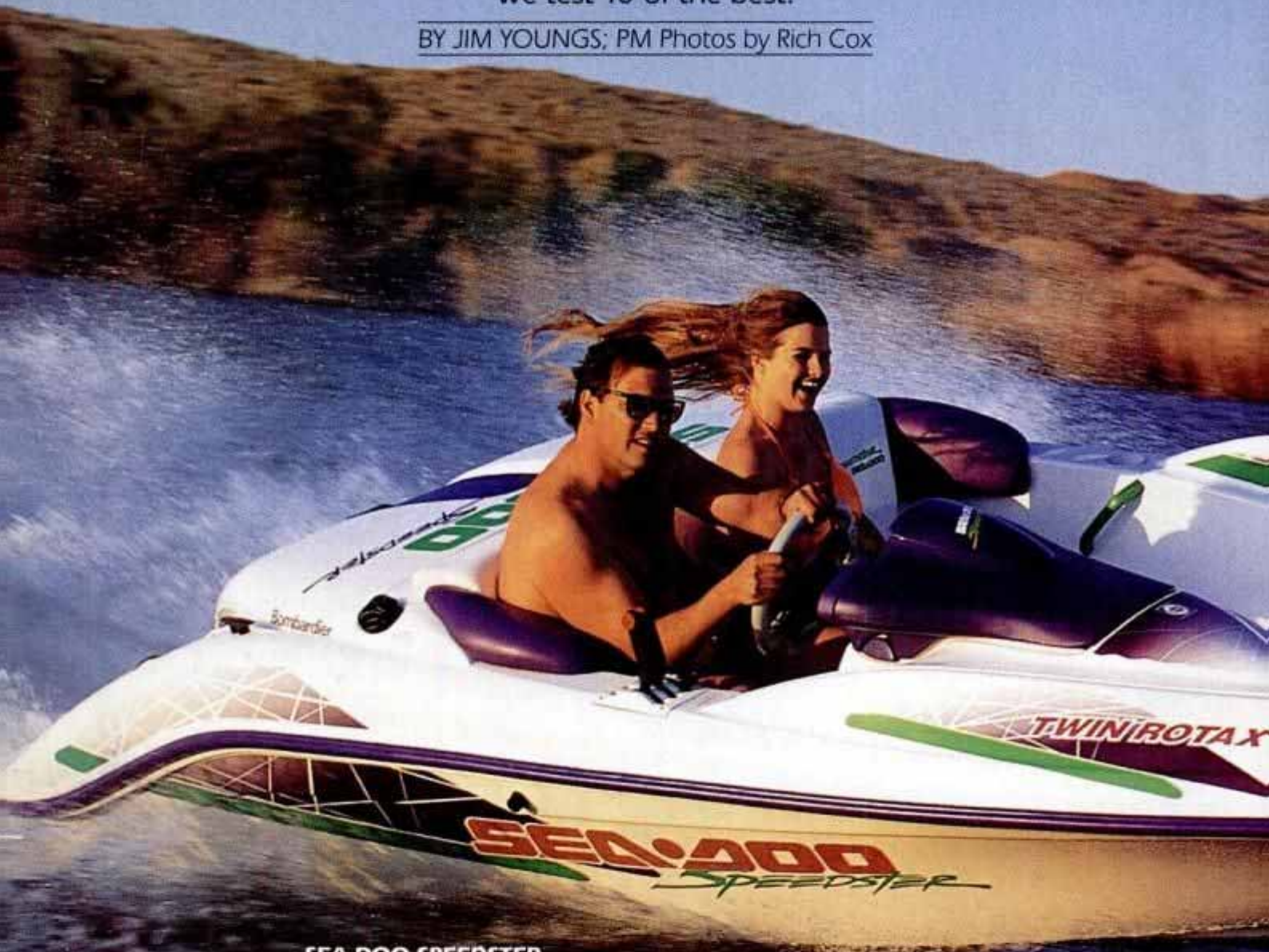


PM PHOTOS BY CLIFF GROMER

# JET SET

An armada of propless runabouts conquers the waterways.  
We test 10 of the best.

BY JIM YOUNGS; PM Photos by Rich Cox



## SEA-DOO SPEEDSTER

• There's a reason jet boats have exploded recently onto the waterways: They deliver more fun per foot than is usually legal. Boston Whaler started the boom in 1992 with the introduction of its record-setting Rage. Bayliner and Sea Ray joined the fray in '93 with the Jazz and the SeaRayder, respectively. This year, the floodgates have opened. Nearly two dozen builders now make minijets. Jet power is the boating story of the decade.

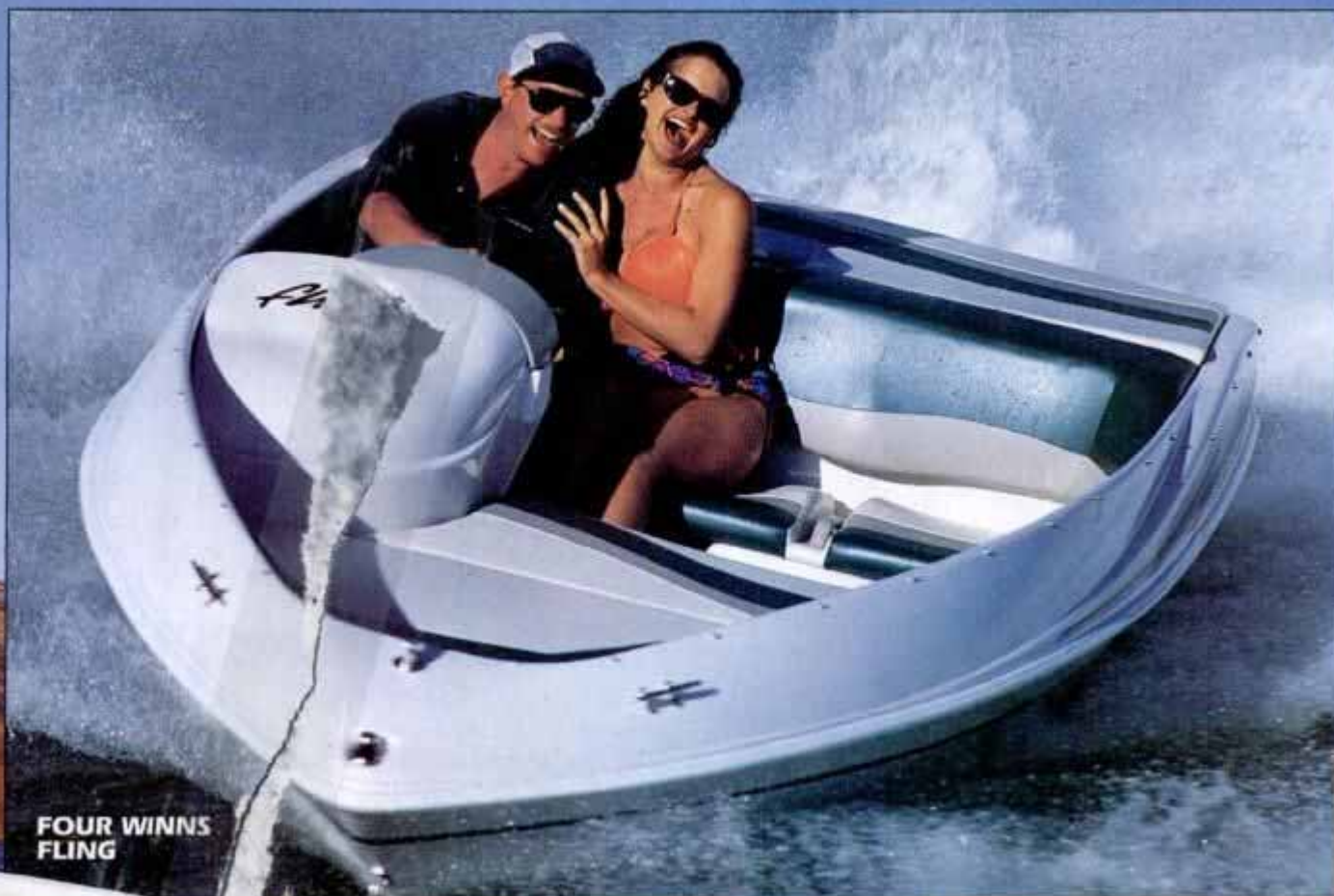
To get a feel for this phenomenon, the POPULAR MECHANICS test team gathered together 10 of the best minijets on the market and headed for the Arizona side of Lake Havasu, a boating paradise on the Colorado River. The huge, clear-water lake provided us with ideal conditions to wring out the fleet with

radar gun, stopwatch and measuring tape.

In addition to collecting hard data, we attempted to gather impressions that raw numbers can't provide. All jet boats are currently lumped into the same class. Yet it was clear to us that differences among the models are vast. So, in addition to providing head-to-head data, we looked between the numbers to identify several emerging classes.

### Zip city

If the Rage, Jazz and SeaRayder launched the current jet-boat armada, credit for igniting the horsepower wars goes to the new Sea-Doo Speedster. One 80-hp 650cc Rotax engine wasn't enough for Sea-Doo's first



**FOUR WINNS  
FLING**

real surprise came on the handling course, where the roomy and nicely detailed Mirage sliced through the wheel-lock turns with such control that it nearly beat the mega-powered Speedster.

The third performance-class minijet is the Baja Blast, which is also powered by the Merc SportJet 120. The Blast demolished the 40-mph barrier with an average top speed of 42.3 mph. It also turned in competitive third-place finishes in acceleration and on the 3-pin handling course.

jet boat.

That's right, this rocket has twin engines and a 40-hp advantage over its closest rivals.

With a top speed of 52.7 mph, the Speedster is 10 mph faster than the next fastest boat. It is also blindingly quick from 0 to 25 mph and a scorcher on the handling course.

Obviously, the Speedster is built for warp drive, but it's worth noting that, as with all Sea-Doo products, the Speedster's construction, graphics and fit and finish are top-notch. One note of caution: Like a lot of V-bottom hulls pushed to the limit, the Speedster can come walk at high velocities.

The Sugar Sand Mirage was powered by the new 120-horse Mercury SportJet 120, and it turned out to be the sleeper of the fleet. The Mirage is the brand-new company's first model. And what a model it is, taking second place in top speed and hole shot. But the

### **Fun, fun, fun**

To those not completely addicted to speed, the original concept of a minijet was to provide boaters with a small, affordable, safe, turn-on-a-dime roadster-type vehicle for the water. The Four Winns Fling, the Sea Ray SeaRayder, the Regal Rush and the Baja Blast carry out this mission to perfection. They are the popular heart of the minijet market.

The Regal Rush is a good-looker with a highly stylized combination of curvy lines and colorful graphics. It also has a wide side console that provides security for both the skipper and the center-seated passenger.

When it comes to rocking and rolling, the Rush is among the best in spins, hooks and nosedives. And while it doesn't take much encouragement to get radical, the boat's well-designed hull tracks true and pins well-behaved turns when called upon.

The Fling is built on the same award-winning Stable-V hull that's used on most Four Winns models these days. The design incorporates extensions on

## JET SET



**BAYLINER JAZZ**



**REGAL RUSH**



**DYNASTY JET STORM**



**SUGAR SAND MIRAGE**

either side of the drive, which quickens planing times and holds the boat tightly in turns.

Inside, the Fling has a wide-open cockpit with a bow filler cushion (optional), which converts the area into a lounge. Other optional gear transforms the minijet into a fishing boat. Like the Rush, the Fling can spin out or handle like a roadster.

The SeaRayder is a bit like a scaled-down, smooth-handling runabout. It has lots of room on the inside, comfortable seating for four and ample accommodation for hanging on tight. Yet, the Rayder can get as radical as a snowboarder in a half-pipe.

In the performance categories, the Rayder is approximately in the mid-

dle of the pack, which by no means spells sedate. The little Sea Ray is well built and lives up to the company's typically high standards.

It's hard to find a straight line on the Baja Blast, and it's even harder to keep a straight line when driving. As mentioned, the versatile Baja is a top performer, but it's also worth noting that the Blast is among the leaders in interior comfort, detailing, upholstery, fit and finish, and overall construction.

### Jumbo jets

Two of the boats are standouts for generous interior space—the Boston Whaler Rage 15 and the Dynasty Jet Storm. Both have hulls longer than 15

ft. and impart something of a big-boat, safe-for-the-family feel.

One reason for the feeling of spaciousness on the Rage is a center-position console that allows walking on either side of the helm. A large foredeck and copious storage are also hallmarks. The Rage is not a performance leader, but it compensates by featuring quality construction and detailing that is first-rate. Plus, it gyrates and spins with the best of them.

As the biggest boat, the Jet Storm is the closest thing to a conventional runabout in the fleet. Strong suits are abundant deck space, passenger room and storage. The Jet Storm's performance data is at the bottom of the chart, but like the other boats in our

## SPECIFICATIONS AND DIMENSIONS

MANUFACTURER/MODEL/ ADDRESS	BASE PRICE	LENGTH/ BEAM	WEIGHT/ FUEL CAPACITY	ENGINE/ DISPLACEMENT	ENGINE HP/ STORAGE SPACE	DECK AREA/ COCKPIT DEPTH	SEATING, LAYOUT/ RATED CAPACITY
<b>Baja Blast</b> P.O. Box 151, Bucyrus, OH 44820	\$8395	14'/ 6' 7"	875 lb./ 21 gal.	Mercury SportJet 120/ 102.9cc	120 hp/ 7.83 cu. ft.	9.65 sq. ft./ 17"	3-across aft, bow seats/ 4 persons
<b>Bayliner Jazz</b> P.O. Box 9029, Everett, WA 98205	\$8495	14'/ 5' 8"	1000 lb./ 17 gal.	Mercury SportJet 90/ 75.1cc	90 hp/ 8.3 cu. ft.	16.7 sq. ft./ 17"	3-across aft seat/ 3 persons
<b>Boston Whaler Rage 15</b> 4121 S. U.S. Hwy. 1, Edgewater, FL 32141	\$11,495	15' 4"/ 7' 1"	1200 lb./ 23 gal.	OMC TurboJet 115/ 99.6cc	115 hp/ 20.5 cu. ft.	20.5 sq. ft./ 17"	Aft, center, bow seats/ 6 persons
<b>Dynasty Jet Storm</b> P.O. Box 310, Vinemont, AL 35179	\$8495	15' 6"/ 7' 1"	950 lb./ 19 gal.	Mercury SportJet 90/ 75.1cc	90 hp/ 12.9 cu. ft.	22.5 sq. ft./ 22"	Aft, jump, bow seats/ 6 persons
<b>Four Winns Fling</b> 925 Frisbie St., Cadillac, MI 49601	\$9568	14' 2"/ 6' 4"	940 lb./ 19 gal.	OMC TurboJet 115/ 99.6cc	115 hp/ 11.2 cu. ft.	12.4 sq. ft./ 21"	3-across aft, bow seats/ 4 persons
<b>Regal Rush</b> 2300 Jetport Dr., Orlando, FL 32809	\$9995	14' 6"/ 7'	1030 lb./ 17 gal.	Mercury SportJet 90/ 99.6cc	90 hp/ 17.76 cu. ft.	14 sq. ft./ 20.5"	Aft bench, bow seats/ 4 persons
<b>Sea-Doo Speedster</b> 1900 S. Harbor City Blvd., Melbourne, FL 32901	\$11,499	14' 6"/ 7' 1"	1200 lb./ 27 gal.	Twin Rotax/ 650cc (each)	160 hp (total)/ 17.6 cu. ft.	12.85 sq. ft./ 20.5"	3-across aft seat/ 4 persons
<b>Sea Ray SeaRayder</b> 2600 Sea Ray Blvd., Knoxville, TN 37914	\$8495	14' 6"/ 6' 8"	950 lb./ 16 gal.	Mercury SportJet 90/ 99.6cc	90 hp/ 11.6 cu. ft.	14.7 sq. ft./ 20"	3-across aft, bow seats/ 4 persons
<b>Seaswirl Squirt</b> P.O. Box 167, Culver, OR 97734	\$8495	14' 4"/ 6' 10"	1050 lb./ 18 gal.	OMC TurboJet 115/ 99.6cc	115 hp/ 12.8 cu. ft.	20.4 sq. ft./ 20"	Aft bench, bow seats/ 4 persons
<b>Sugar Sand Mirage</b> 1617 Main St., Fargo, ND 58103	\$8395	14' 10"/ 6' 9"	900 lb./ 21 gal.	Mercury SportJet 120/ 102.9cc	120 hp/ 32.55 cu. ft.	7.2 sq. ft./ 21.5"	Aft bench, bow seats/ 5 persons





**BAJA BLAST**



**BOSTON WHALER RAGE 15**



**SEASWIRL SQUIRT**



**SEA RAY SEARAYDER**

fleet, the Jet Storm will spin and slide, if so desired. Otherwise, it has the attributes of an open-bow runabout.

### Separate reality

We put two boats—the Bayliner Jazz and Seaswirl Squirt—into a separate category mostly because they take a novel design approach. Aside from that they have very little in common except a penchant for horsing around.

The flat-bottom Jazz is the hip speedster of the fleet. The MTV generation can feel right at home with the Jazz's glitzy styling, hot performance and overall radical nature. No one can resist getting this sporty sled to spin with abandon and nosedive by throwing the stick into REVERSE. (Shifting

into REVERSE at speed does no mechanical harm to waterjet engines.)

The Jazz was the fourth fastest boat in our fleet, but suffered on the handling course because of a tendency to slip and slide. Bayliner will be replacing the current 90-horse SportJet with the bigger 120-horse engine for '95, so look for the thrill factor to go even higher. Our only complaint? Thinly padded seats.

The Seaswirl Squirt is the go-kart of the fleet, thanks to its center-pod steering console and sloping bow platform, which offers an ideal foot brace. With such secure seating, drivers can spin with reckless abandon if not overwhelmed speed.

The cockpit in the Squirt is actually

on the small side, but the bow is large and padded to accommodate sunbathing. One feature of note is engine access—the 3-across seat lifts up to offer a wide opening.

Our take for speed freaks to whom money is no object is that the clear winner is the Sea-Doo Speedster. For those who want performance and affordability, check out the Sugar Sand Mirage. For quality freaks to whom money is no object, the Whaler Rage is at the head of its class.

For overall runabout quality and fun, the Baja Blast, SeaRayder, Regal Rush and Four Winns Fling set the versatility standard. The sledlike Bayliner Jazz is unique, and it, too, is hard to beat.

**PM**

### TEST RESULTS

SPECIAL FEATURES	OPTIONAL FEATURES	TOP SPEED/ ACCELERATION 0-25 MPH	HANDLING COURSE	FIT & FINISH	FUN FACTOR/ JET CATEGORY
Trailer, swim steps	Bow filler cushion, Mercury SportJet 90	42.3 mph/ 5.38 sec.	21.5 sec./ Quick, nimble	Top-notch throughout, eye-pleasing	Fast and exciting/ Fun minijet
Twin bilge pumps, trailer, ski tie-down straps	Mercury SportJet 120	40.6 mph/ 6.54 sec.	25.9 sec./ Slippin' and a slidin'	Thin seats, affordability chief interior attribute	Wet and wild/ One of a kind
Stainless-steel rails, copious storage space	Cooler seat, bow cushion, nav lights	35.8 mph/ 7.12 sec.	25.5 sec./ Heavy hull holds it back	Second to none, easily the fleet leader	Big-boat feel/ Jet runabout
Boarding ladder, ski-tow eye, swim platform	Trailer, Bimini top, acrylic windshields	34.7 mph/ 6.67 sec.	24.5 sec./ Small engine holds it back	Details could use some attention, rough edges	On conservative side/ Jet runabout
Trailer, swim platform, padded aft sun deck	Bow filler cushion, fishing chairs, ski-tow pylon	37.8 mph/ 6.15 sec.	23.7 sec./ Pins turns, quick	Solid construction and workmanship	Maneuvers with abandon/ Fun minijet
Trailer, removable cooler, ski storage	Bimini top, mooring cover	38 mph/ 6.85 sec.	23.6 sec./ Corners with aplomb	Precedent-setter for this class	Safe, versatile thrills/ Fun minijet
Twin engines, racing throttle/shifter	Mooring cover, lifting kit	<b>52.7 mph/ 3.96 sec.</b>	<b>19.13 sec./</b> Great acceleration	Fine workmanship and attention to detail	Lives up to its name/ High performance
Trailer, removable cooler	Bimini top, snap-in carpet, 2-tone gelcoat	38.1 mph/ 6.95 sec.	22.75 sec./ Superb in corners	Excellent craftsmanship, attention to detail	Sets a high standard/ Fun minijet
Center steering pod, swim platform, Igloo cooler	Trailer, bow cushions, canvas cover	36.6 mph/ 7.7 sec.	24.4 sec./ Good control	Good, fundamental boatbuilding	Go-kart steering/ One of a kind
Abundant storage, ski-tow pylon	Trailer, windshield, Mercury SportJet 90	42.7 mph/ 4.99 sec.	20.05 sec./ A driver's favorite	Surprisingly solid for a first effort	Does it all/ High performance



# BATTLE OF THE BIZJETS



Two high-ticket globe-trotters are in a dogfight for aviation's loftiest clientele.

BY WILLIAM GARVEY; PM Illustration by Paul DiMare

• The customers are among the world's most pampered and demanding. The environment is equally rarefied—downright tropospheric, actually. But the competition rages as fiercely as any bare-knuckle fight in a dirt ring. That's because the stakes just don't get any higher.

Welcome to the world business-jet showdown.

The contest began in 1991 when Bombardier Aerospace—the Canadian giant that owns Canadair, Learjet and de Havilland, among other assets—announced that it was contemplating a super-plush, big-cabin business jet able to fly nonstop from New York to Tokyo. In short order, Gulfstream Aerospace of Savannah, Georgia—long the heavyweight champ among business jets—announced that it was developing a New York-to-Nippon nonstopper, which it designated the Gulf-

stream V. Meanwhile the French planemaker Dassault unveiled plans for its Falcon 9000, an elegant trijet able to fly from New York to...well, you get the idea.

An intractable rule in business-aviation economics holds that as you assign more range, weight, speed, comfort and space to any airplane, the number of potential buyers will decrease proportionally. Even though all three aircraft derive from existing models, development and certification could cost a manufacturer upward of \$1 billion. Consequently, a production aircraft would have to carry a price tag of about \$30 million. Each. Empty. Seats, bar, galley and potty would add another \$2 million to \$3 million, or more.

Just how many corporations and kings are willing to plunk down \$33 million for a flying carpet with fanjets?

# BATTLE OF THE BIZJETS



The Dassault crowd didn't like the answer they got and last year put the Falcon 9000 project on hold. But the Gulfstream V team is steaming ahead undeterred. And last December, Bombardier announced that it would proceed with design, certification and delivery of its Global Express.

At this point, neither the Gulfstream V nor the Global Express exists. But for those with the need and the money to travel 6000 miles quickly—and in style—the two choices are tantalizing.

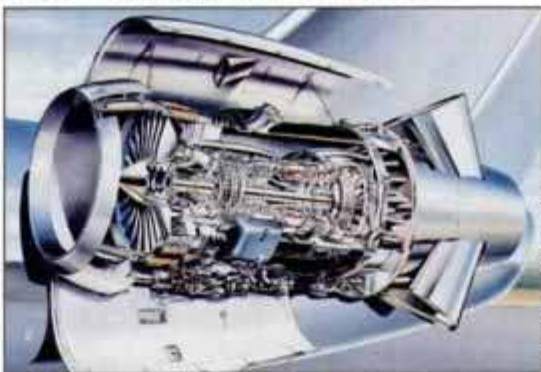
## Flying V

Far ahead in development is the Gulfstream V, which will fly next year. Customer deliveries will begin immediately after FAA certification is awarded, presumably in late 1996. By contrast, the Global Express hopes to get its papers in mid-1998.

Contributing to the GV's accelerated schedule is the airplane's heritage in the Gulfstream IV, which continues in production. The two aircraft share the same cabin, but two plugs totaling 7 ft. were spliced into the V, giving it a 51-ft. cabin and an overall length of 96 ft. 6 in.

What is new is the GV's wing, designed and built by Vought Aircraft of Dallas in conjunction with ShinMaywa Industries of Tokyo. Tip to tip, the V will span 90 ft. 10 in.—13 ft. wider than the IV. Nevertheless, notes a Gulfstream spokesman, the wing will have the same planform, sweep angle, device-free leading edge and mechanical systems found on the IV's airfoil.

Both rivals fly on fanjets from BMW/Rolls venture.



Both rivals fly on fanjets from BMW/Rolls venture.

## Bimmer's back

Both the GV and its Canadian competitor will be powered by a pair of BR710s—a new turbofan, and the first product from a partnership joining two of the most famous names in

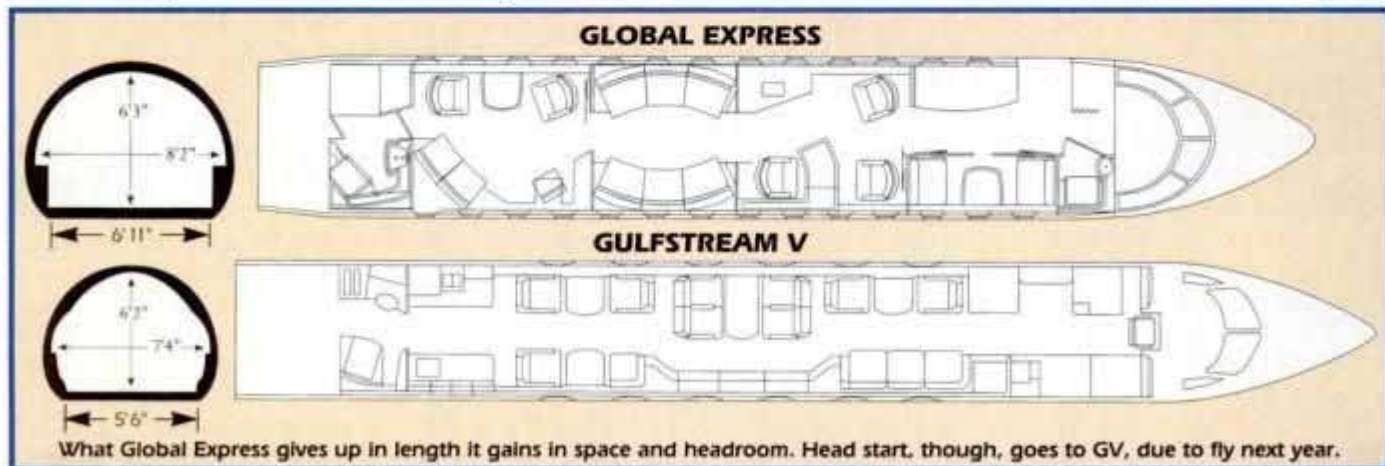
motive power: BMW and Rolls-Royce.

While Rolls is well known as a venerable aircraft-engine builder, BMW's aviation heritage is less appreciated. The fact is that the Bavarian Motor Works was founded in 1917 specifically to produce aircraft engines—even its familiar logo represents a spinning propeller. The company built radial engines for Junkers and Focke-Wulf and even developed some of the first jet engines to see service in World War II. But following the war its aviation business was suspended and it concentrated on cars.

The partnership with Rolls marks BMW's return to aviation. The return became triumphant in September 1992 when Gulfstream became its launch customer, spending more than half a billion dollars for 200 BR710-48s.

Rated at 14,750 pounds of thrust, the powerplant will rocket the 85,000-pound Gulfstream skyward at 4340 ft. per minute. Maximum cruise at 35,000

*(Please turn to page 123)*



MOTORSPORTS

# THE TOOLS OF NASCAR

There's nothing typical about the typical NASCAR toolbox.

BY RICH TAYLOR, Contributing Editor



• Most everything about NASCAR is purposefully and ingeniously deceptive. Take the cars, like this Chevy Lumina of Darrell Waltrip. Sponsors' decals aside, it looks just like any garden-variety Lumina. Only this one has rear-drive. Oh yeah, it also has a 700-hp V8, costs \$100,000 and can go over 200 mph!

Now look past the cars to the people. Don't be fooled by the down-home look of a good ol' boy with a chew of tobacco, holding a Dr Pepper and a barbecue pork sandwich. He has a Ph.D. in fluid dynamics and is a world expert in the aerodynamic behavior of cars at speed.

Yes, the same can be said of the mundane-looking tools used by the race mechanics. When Waltrip's mechanics use a piece of twine to check the car's suspension on race day, it's not because these boys

are crude. Not by a long shot. Back in their spotless 33,000-sq.-ft. shop, these same mechanics have a computerized laser alignment machine.

Some of this startling contrast between the low-tech public face of NASCAR teams and their high-tech private lives is deliberate—a way of psyching out the competition—some of it just happens because it's a lot more convenient to bring a piece of twine to the track instead of a laser alignment machine.

## Trackside

Even the rolling tool cart every NASCAR team brings to the races is not quite like any you're apt to find at your local hardware store. It may start life as the biggest toolchest Western Auto sells, but it sits on a

## THE TOOLS OF NASCAR


chassis of square tubing and golf-cart wheels that the crew members made themselves.

The bigger surprise is inside the toolchest. Open the drawers, and you'll recognize everything and own most of it yourself. Aside from the usual wrenches and screwdrivers, Waltrip's crew has a few special tools designed to do specific jobs quickly and easily under difficult conditions. For example, they have a length of square tubing that's been turned into a "toe bar." Thumb-screws adjust sliders to quickly and accurately measure front suspension toe-in or toe-out.

To check suspension alignment front to rear, Waltrip's mechanics really do use a 20-ft. length of chalkline string. They also check toe and camber with a 12-ft. carpenter's tape measure. By carefully measuring side to side at the top, bottom, front and back of each tire, they can get a surprisingly accurate picture of the suspension setup. To check camber and caster, they use a simple bubble gauge.

NASCAR race cars are built lighter than the rules require and weighted with lead plates bolted in different places on the chassis and floorboards to reach the 3500-pound minimum. Handling and tire wear are greatly affected by where these weights are bolted. Waltrip's crew brings four digital readout scales to the track. They're leveled in the paddock using an 8-ft. carpenter's level, then the location of each scale is marked on the ground so it can be repeated.

The Western Auto team does bring a few high-tech tools to the track, too. It has a computerized shock dynamometer, housed in the front of its new \$260,000 transporter. Team Manager Clyde Booth spends a lot of his time charting the performance curve of dozens and dozens of shock ab-



These hand-built floor jacks are a hallmark of NASCAR. Carved out of billet aluminum, they cost \$1100 each. Handles make them easy to swing over the wall during a race. Each jack gets cleaned, lubed and prepped before every race.

sorbers that travel to the races in a special rack built into the trailer. He then disassembles the shocks and adjusts them to his own specs.

### In the pits

On race day, the big rolling toolbox is towed out to trackside with its load of wrenches, screwdrivers and other common tools. There's also a 2-wheel cart built by the team to carry four tires and wheels stacked up. Each tire is good for about 70 laps of a half-mile short track, which means Waltrip may go through two dozen to three dozen tires in the course of an afternoon.

When each tire/wheel is received from the tire truck, the area around the five mounting holes is cleaned with a wire brush mounted in a portable drill, then fresh lug nuts are glued with weatherstrip cement to the wheel.

In order to change four tires


in 7 seconds, you can't take time to put each lug nut on individually.

As every race fan knows, NASCAR's pneumatic impact wrenches are as hot-rodged as the cars. Because of their oversize motors, they're much heavier than the impact wrench in your shop, and they produce two or three times as much torque. Before each race, each crew member carefully cleans and lubricates his personal impact wrench, checking it for binding.

Every fan also knows that the floor jacks used in the pits are unique as well. NASCAR racer George Brunnhoelzl hand-makes these \$1100 jacks, carved from billet aluminum. The jacks are equipped with handles for tossing them over the pit wall and, like the impact wrenches, are carefully cleaned and oiled before the race.

### The computer age

Besides the basic tools, your average NASCAR team is also fairly well com-



Large, heavy-duty impact wrenches deliver lots more torque than your standard-issue wrenches.



Lug nuts are carefully glued to the wheels before the race to expedite tire changes.

puterized—both at the track and back at the shop.

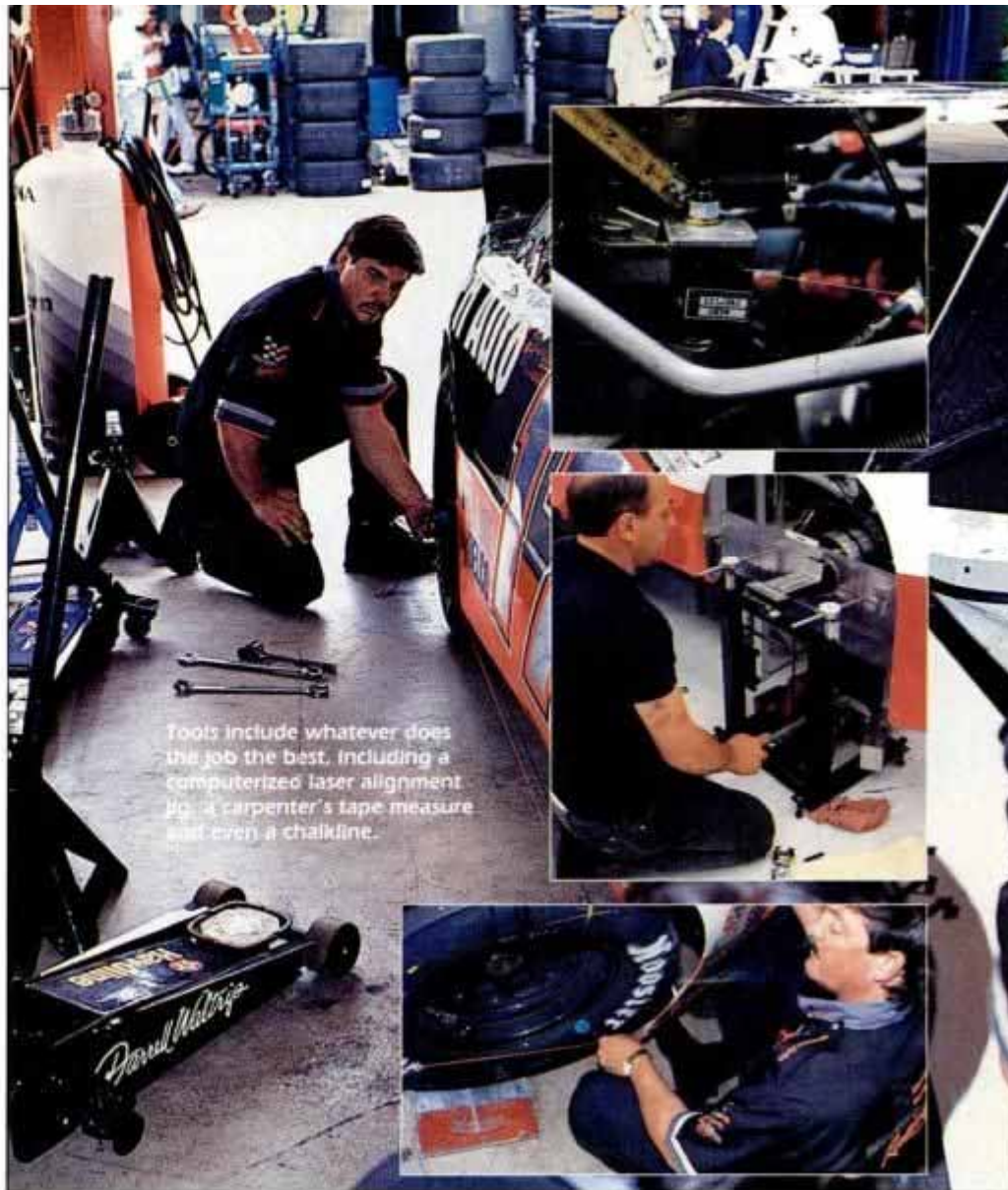
The Western Auto team uses three different computers during the race. Darrell's wife, Stevie, who does timing and scoring, sits on top of the big tool cart with a laptop PC, into which she enters the results of every race lap. Another PC is linked to NASCAR's own timing/scoring system, which shows a continuous readout of the position of each car on each lap according to NASCAR's scorers. And in NASCAR's trailer, there's a PC linked to the National Weather Service.

Back at Waltrip's headquarters—within earshot of Charlotte Motor Speedway—the team's 29 employees are busy getting all seven cars pretty race-ready. That preparation involves a very high level of computer sophistication, one that seems at odds with NASCAR's down-home image.

For one thing, Booth has written his own computer software to analyze and design front-suspension geometry. Additional software allows him to go straight from his design computer to computerized manufacturing equipment—with not one piece of paper. He applies industrial-quality CAD/CAM to a very specific problem in front-suspension design and construction.

He's also put together a program, based on Lotus 1-2-3, to analyze chassis balance. It analyzes roll heights, roll angles, ride changes and other chassis factors. This software originally came from General Motors suspension engineers, but was then modified by Booth for his own needs. It provides information that can be utilized on the perfectly flat surface plate for setting suspension geometry.

Another PC-based program allows Booth to draw a diagram of every NASCAR track, then graph lateral and longitudinal acceleration at every point around the course. This tells him how hard Darrell is cornering, whether he's lifting off the throttle too soon or not getting back on the gas



Tools include whatever does the job the best, including a computerized laser alignment rig, a carpenter's tape measure and even a chalkline.

soon enough. Waltrip can then compare his feelings from inside the car with the reality of the computer.

Since the team goes testing at least once every other week year-round, there's a constant flow of new information to feed Booth's computer. Raw data comes from a Pi System, a \$40,000 on-board data acquisition and telemetry computer also used by Formula One and Indycar teams. Because the Pi System is also PC-based, all the data can be downloaded into the

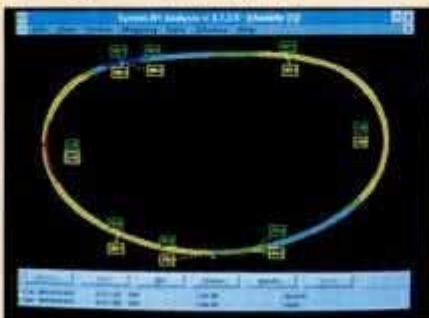
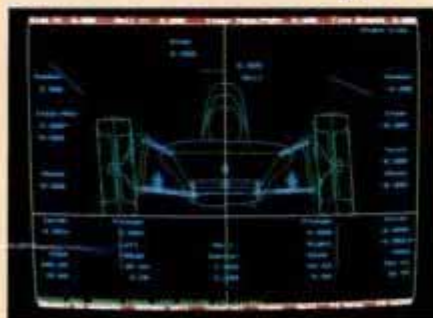
team's other computers. The result is an integrated computer network that will soon be able to interface with the D-Pac software used with the team's computerized 1000-hp dyno.

NASCAR allows on-board computers to be used only for testing, not during the race itself. The Pi in Waltrip's car keeps track of 28 parameters, including two steering sensors, three accelerometers, speed, rpm, throttle position, brakes, ride position of all four shock absorbers, exhaust gas temperature in eight different spots, both engine oil temperature and pressure, as well as aerodynamic lift/downforce.

### Sophisticated deception

Unlike most other forms of racing, NASCAR is a fascinating mix, high tech and low tech, of on-board computers and wind-tunnel shapes serviced by mechanics who can build a race car in a day and take it apart in an hour, using common screwdrivers and socket wrenches. Yes, most everything about NASCAR is deceptive—except the fender-to-fender racing, which is the real thing, and the best in the world. **PM**

## Better Racing Through Computers



Highly specific computer software allows Waltrip's team to sort out suspension problems before going to the track. Computerized input from the car during testing gives accurate information about a number of critical performance aspects.

# NEON COWBOY

Computer magic makes Vegas lights come to life.

BY CLIFF GROMER,  
Contributing Editor

• Unless your television set has been facing the wall for the past five years, you've seen those Miller Genuine Draft beer commercials. "Get out of the old. Get into the cold," etc. Most of them are predictable. The mucho

## How did they do that?

macho dude in skintight jeans walks into a hot, dreary bar and the place immediately becomes the coolest place on earth. But when they start making 50-ft. neon electric signs come to life, it makes even us want to have a cold one.

If those neon signs—a giant standing cowboy and a cowgirl—seem familiar, it's because the cowboy, "Vegas Vic," and the cowgirl are fixtures on Fremont Street in downtown Las Vegas. Vic has been overlooking the strip for years from his perch on the Pioneer Casino. The cowgirl is a more recent addition to an old casino-turned-bar called Glitter Gulch, which, by the way, was the street's name before it was changed to Fremont.

Vegas Vic and the cowgirl could

have been doomed to an eternity of separation, had it not been for the Miller Genuine Draft ad agency wizards. Those gray flannel suits came up with the idea of tickling Vic's neon tubes by having him and the cowgirl come to life in a little ménage à Miller.

The easy and relatively inexpensive way to breathe life into the neon fig-

ures would have been to use conventional Disney-style animation—hand render and then photograph each frame. But this technique cannot create a realistic, 3-dimensional look. The answer was computer-generated imaging (CGI), the same process that was used in the film "Jurassic Park."

The neon cowboy script called for a combination of live footage—Fremont Street, replete with actors flown in from Los Angeles and local extras—and CGI material generated by Steven Spielberg's company, Industrial Light & Magic (ILM), the acknowledged leader in this field. Using special Silicon Graphics computers and a barrage of proprietary software packages, ILM and others, in a 4-month production frenzy, created the 30-second TV commercial.

Live footage, including the final scene's fake snow shot against a black background, was digitized and input into the computer. This allowed the background to be retouched electronically, using a program called *Paintbox*. Unwanted elements—such as Budweiser signs—were eliminated, and buildings were repositioned in the scene to make the neon duo more visible when they were layered over the background. Everything else, including Vic and his female



Silicon Graphics computer may look like your home PC, but it has high-powered hardware for special graphics programs.



counterpart, was generated by computer.

But even with all the high-powered electronic artillery available, creating the neon figures themselves presented a unique problem. No one had ever brought a neon sign to life before, so there was no clue as to what Vegas Vic and his female pardner should actually look like in 3D animation when they stepped down into the street. Everyone, from the writer and cameraman to the director, had his own vision of the scene.

The complex process began by digitizing drawings to input the shape of the characters into the computer. A 3D software program mapped out x-y-z coordinates, which built the 2-dimensional images into solid figures. The computer essentially creates points in space that represent points on the model, then it "connects the dots."

The next phase applied another program to animate the figures to see how they interacted with the live background taking into account size and perspective.

Texture mapping gave the figures surface color and definition. The metal characters didn't have a smooth, shiny surface, but a rough, weathered look. The compu-meisters found the surface texture they wanted on another object, input the image into the computer and then were able to transfer, or electronically "glue," the desired texture onto the 3D images of Vic and the cowgirl. The characters, in effect, were created layer by layer—from computer wire model, to 3D object, to color and texture, to the separately generated neon outlines. Each layer was fine-tuned by the artists working with the computer folks before it was composited onto the existing layers, which included the background scenes.

Lighting was critical, as true 3D realism depended on the correct balance of lights, shadows and reflections between the characters and the environment. Different kinds of light sources—omnidirectional and spots—were simulated, as if the scene had been shot in a studio. A technique called ray tracing calculated the effect light had on each pixel in the image, and of how lights of specific intensity and color would hit your eye after reflecting off the characters and the environment. The final result is a fantastic scenario of Vegas Vic and the cowgirl stepping down into the street, grabbing a cold Miller and riding off into the snowset atop a Miller truck.

So if you're ever on Fremont Street, and you look up at Vegas Vic and he happens to wink at you, it's not computer imaging. You've just had one Miller too many. **PM**



Get Out Of The Old. Get Into The Cold.

Neon signs Vegas Vic and the [nameless] cowgirl come alive with truly amazing realism. Figures do everything short of exchanging inert gases.

ELECTRONICS



# LITTLE GIANTS

Small systems with multidisc changers pack a lot of music.

BY STEPHEN A. BOOTH, Contributing Editor



• Some players deal from the bottom of the deck or even the middle, depending on the call. Some use a quick lateral shuffle reminiscent of acey-deucey or, for that matter, 3-card monte. Others hold the selection in a fanlike pattern awaiting your pick. In this game, nobody gripes about sleight-of-hand so long as the play moves fast and the calls fall right. And you don't have to visit Las Vegas, Atlantic City or a casino on Native American turf to get in on the action. It's as close and as loud as the newest generation of downsized compact-disc changers.

As effort-saving ideas go, the record changer was too good to dump on the technological junkpile with the vinyl LP. Despite the longer playtime of digital compact discs, multi-CD changers

arrived on the scene quickly, first as magazine-loading stackers for home stereos and automobile trunks, later as horizontal, revolving platters sized to match home audio components and serve five CDs lazy-Susan style.

Both the magazine-fed player and the revolver style work elegantly, but they do require some real estate. Where space is really no object, there are changers that can juggle 100 or more CDs, either in jukebox-like racks or trays similar to carousel-type slide projectors. But the trend in audio gear is bigger bang from smaller boxes—all the better if they're portable.

Getting multi-CD play into home minisystems and DC-powered portables means some changes in changer geometry. And since it's more efficient to build up than out, companies such as Aiwa, Sony, Sanyo, Fisher,

## LITTLE GIANTS

Magnavox, JVC, Hitachi and Sharp are exploiting the airspace. Enter the elevator mechanism.

Elevator-style CD changers are the type used most frequently in downsized audio equipment. You find them in boomboxes, microcomponent towers and shelf-top minisystems. Depending upon the product and brand, they handle five to seven CDs.

Although details vary, all elevator changers work in basically the same way. Inside the player, usually at the rear, there's a motorized stack of trays for individual CDs. The stack moves up and down, both to load or remove discs and to play them. The actual CD-playing transport, with its laser mechanism and rotating spindle, remains in a stationary position under the hood.

You insert CDs in an elevator changer one at a time. A single front-loading drawer slides outward to receive the disc, closes, then slips the CD into one of the elevator's trays. Depending on the loading order, the elevator moves up or down to position



The elevator mechanism (below right) in Magnavox's micro FW14MX37 7-disc changer.

a tray for the next disc. The procedure is reversed when ejecting discs for replacement.

For playback, the drill is the same. The elevator rises or descends to bring the tray with the CD you've chosen to the level of the disc drive, and skates it across to the transport. The elevator remains at that level, with the empty tray-slot in place, ready to retrieve the CD when done. Then the elevator moves up or down to fetch your next selection.

As you've probably guessed by now, elevator changers can be programmed to play selected songs from their CDs in whatever order you've specified. You won't wait long for the



song to arrive, either. For example, in Aiwa's 7-disc Model LCX-70M micro-component system (\$500 list), CD changing time is less than 5 seconds, running express from the first to the seventh disc.

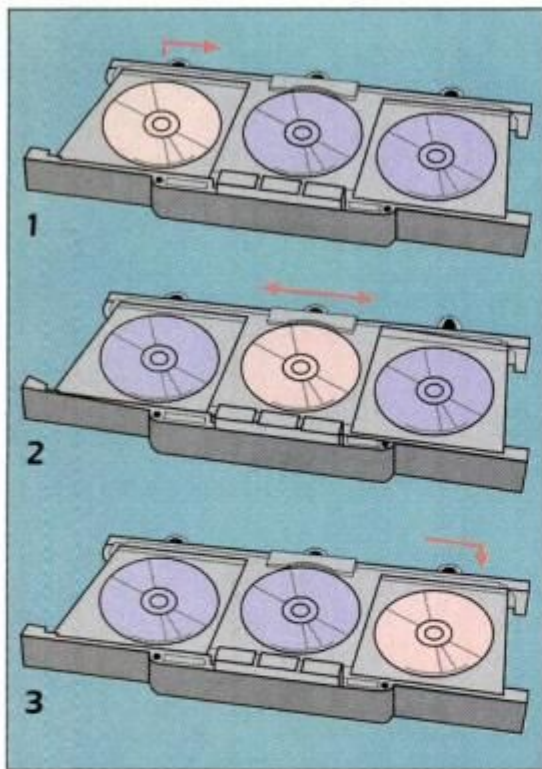
You'll find an innovative variation on the elevator design in the sliding-tray changer Sharp developed for its new WQ-CH800 boombox (\$250).

The company's WQ-CH600 (also \$250) was the first elevator boombox, a 6-CD model that changed discs in about 9 seconds. The new mechanism cuts that time in half by combining elevator operation with what amounts to a moving sidewalk. This is to say, the 5-disc WQ-CH800 shunts CD trays horizontally as well as up and down.

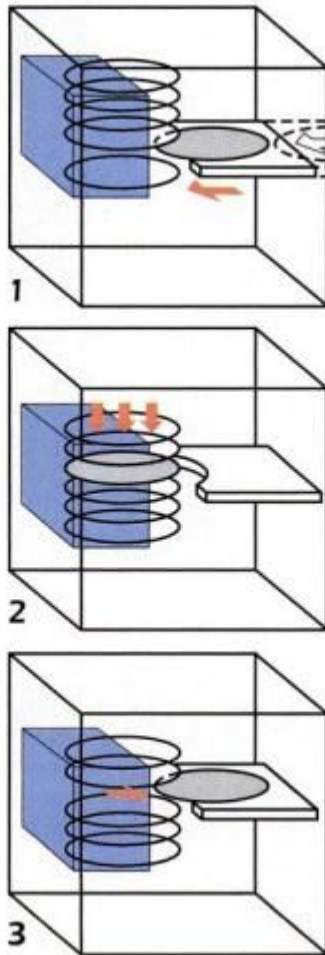
Instead of the front-loading drawer used for elevators, you stack CDs vertically, label-side up, from the top of the boombox. There are three positions across the top—two of them basically elevator shafts flanking the disc drive.

CD trays emerge from whichever shaft they happen to occupy at the time, and slide right or left across the top into position on the drive. When play has ended, the disc glides off the drive for stacking, in the direction opposite from where the next CD is coming. Unlike regular elevators, which give direct access to discs in the order you've programmed, the Sharp hybrid moves the trays sequentially through the disc drive in order to get to the next programmed selection. But despite the double shuffling, it

### SLIDING-TRAY CHANGER VERSUS ELEVATOR CHANGER



Sliding-tray changer (above) for Sharp boombox is a space-saving variant of typical elevator types (right). In elevators, stack of trays ascends or descends to load CDs from front-mounted drawer. Sharp unit adds lateral movement to elevator. CDs load from player's top, trays slide horizontally onto center-mounted disc drive.



deals fast—4.7 seconds max to swap the first tray for the fifth.

Sharp's sliding-tray technique and the elevator design make the most of the space available in boomboxes and slim microcomponent towers. Not every boombox is a one-piece design, incidentally. Sony's CFD-600, for instance, is a 6-disc changer (\$320) that features detachable speakers.

Meanwhile, for music fans who want more ammo than seven CDs and are looking at a quasi-permanent set-up, there are two changer mechanisms more suited to the cubic volume of shelf-top minisystems.

One is Pioneer's 50-disc CDFile system and the other is Fisher's Studio 24—as in two dozen discs. About the only thing they have in common is they store your CDs on edge and play them in this vertical position.

CDFile, as found in Pioneer's CCS-590 shelf-top (\$1215), stores 50 CDs in two dishrack-like files of 25 each. In jukebox fashion, an arm mechanism runs on a track behind the racks to pluck the desired CD and transport it to the vertical disc drive. It's plenty fast—5 to 8 seconds from zero to 50. To accommodate the racks, railroad and disc drive, the CCS-590 is just slightly wider and deeper than two 4.75-in.-dia. CDs.

Loading is quite different from other changers. The front panel of the CCS-590's CD section drops down to expose the two racks. These roll forward to let you insert or remove CDs. You can even perform this operation while a CD is playing, as long as it's not the rack for the CD that's currently in play. Actually, you can work on both racks and still spin tunes, because the CCS-590 is what Pioneer calls a "50+1" player. This means you can load an extra CD directly into the drive via the single-play slot on the front panel. It's a convenient way to audition a new CD without having to disturb your racks. For the record, some elevator changers permit single-CD play, too: Usually, they're called "6+1" models.

Fisher first introduced its Studio 24 as a separate changer (Model DAC-2403, \$300), then incorporated the rotary design in two shelf-top systems (DCS-994, \$1000; DCS-993, \$700). Either way, the changer works the same.

The "studio" stores 24 CDs vertically on a rotating platform, similar to the way film transparencies stand in a carousel-type slide projector. Like the Pioneer system, Fisher's disc drive is vertical and you can play a single CD by feeding it into the motorized front-panel slot.



Sony's new 6-disc changer, the CFD-600, also features detachable speakers.

This motorized slot is used to load and unload the carousel too, one disc at a time. Because the carousel rotates either clockwise or counter-clockwise, taking the shortest path to the next selection, disc changing time is blazingly fast—just 3 seconds for the CD farthest from the drive.

Programmability and multi-CD capacity sound swell, but you might be wondering just how you're supposed to keep track of what's in the changer and, with the heavy-duty models, adjust the spin-cycles.

you create three custom files for its 50 discs. You can categorize the CDs by genre, artist or other classifications, and this information is stored in computer memory. Depending on your mood, you can program the changer to play only the discs in a certain file. The custom-file system is quite versatile: You may even register a disc in more than one file. For example, you can put the new *Four Chords And Several Years Ago* CD from Huey Lewis and the News under both your Rock and Oldies classifications, so it'll play when either custom file is selected.

Fisher's Studio 24 offers seven preprogrammed genre categories, such as Classical, Country-Western, R&B. As you load a CD, you scroll through the genres and enter your classification. More impressive still, you can create your own categories and subcategories. For example, program by mood (Romance) or time (Night), by occasion (Party) or style (Dance), or by listener (He-Man) or performer (George Thorogood).

Better make that last one "George T"—you're limited to eight characters. But you can subcategorize and cross-index, for more programming versatility. GT and the Destroyers could go in the generic Rock file, and could be played along with similar CDs when you instruct Studio 24 to play Rock. Or, creating the subcategory "Rock: George T" would cue up only that band's discs. Filing George under "Rock: Party" would handle that occasion nicely, too. Your deal. **PM**




Sharp's WO-CH800 shuffles five discs.

At the very minimum, most new changers tell you which trays are loaded and which is playing. For example, the Magnavox FW14MX37 micro and FW36MX37 shelf-top minisystem (\$400) have indicator lights for each of their 7-disc trays. JVC's "6+1" micro-tower elaborates on this. The model UX-C7 (\$450) lets you classify the six CDs in the elevator under nine music genres—Jazz or Rock, for example. A front-panel LCD lets you check the genre in each slot, one by one.

As their CD capacity might lead you to expect, Pioneer and Fisher offer the most sophisticated programming options. Pioneer's CCS-590 lets







**IF WE WERE  
ANY TOUGHER  
ON DIRT, THIS  
WOULD BE A  
DETERGENT AD.**



**RACE-PROVEN TECHNOLOGY GOES  
INTO EVERY FORD FOR THE STREET.**

Once again, the Ford Rough Riders are cleaning up on the off-road circuit. Arizona. Nevada. Baja. No course had terrain tough enough to keep us from dominating the competition.

And we send our race-tested ideas about durability, from steering components to suspensions, all the way to the Ford Truck you can drive. Just think of it as running a full cycle.



**HAVE YOU DRIVEN A FORD LATELY?**

# LONG-TERM TEST CARS

A brutish hauler and a luxu cruiser join three veteran performers.

## Dodge Ram 1500 Laramie SLT

● It took the Dodge boys more than 10 years to redesign their full-size Ram pickup. So we just knew that when they were finished it was going to be one very cool truck. We were right. So right, in fact, that besides presenting the Ram with a PM Design & Engineering Award for 1994, we ordered one for our long-term fleet.

We configured our Ram much the same way most of you would spec out your own new truck. We specified a ½-ton 2-wheel-drive model with ABS, pulled around by a Magnum V8 and an automatic. We also opted for the Laramie SLT package—lots of storage, a/c, cruise control, power windows and door locks. We also went for the full-tilt Infinity sound system.

We also specified a plastic bed liner to protect the cargo box from the inevitable chips, dings and scratches.

This truck was just delivered to our office, yet it has already been driven

by three different staffers—seems all of a sudden everybody absolutely needs a pickup truck. —Don Chaikin

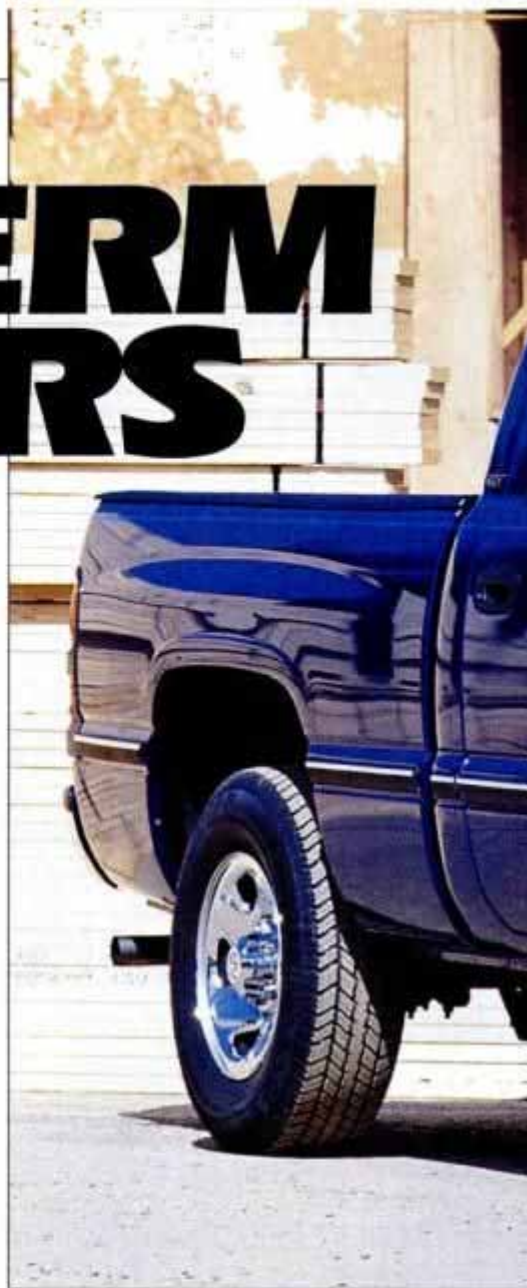
### TEST SUMMARY

Report number: 1  
 Base price: \$14,389  
 As-tested price: \$19,901  
 Extra-cost options: Laramie SLT package, 4-wheel ABS, 4-speed overdrive automatic, 5.2-liter Magnum V8, premium-sound AM/FM/cassette, bed liner  
 Drivetrain: 5.2-liter V8, 4-speed overdrive automatic, rear-wheel drive  
 Engine performance: 220 hp/300 ft.-lb.  
 EPA fuel economy rating: 13 city/17 hwy.

## Mazda Millenia S

When Mazda introduced the Millenia, certain words (“supercharger”) and phrases (“would have been the Amati”) were bandied about. These struck deep into our consciousness.

First of all, any car that has a supercharger with dual intercoolers bolted to its intake manifold warrants further investigation. And in the case of the Millenia S, that intake manifold is the



MAZDA MILLENIA S





**DODGE RAM 1500 LARAMIE SLT**

gateway to an interesting—and unique—engine technology called the “Miller-Cycle.”

Equally intriguing, Mazda had intended to follow the success of Acura, Infiniti and Lexus with its own luxury division, to be called Amati. However, further study showed it would not be profitable, so the plans were scuttled, but not before the Millenia was created to wear the Amati badge.

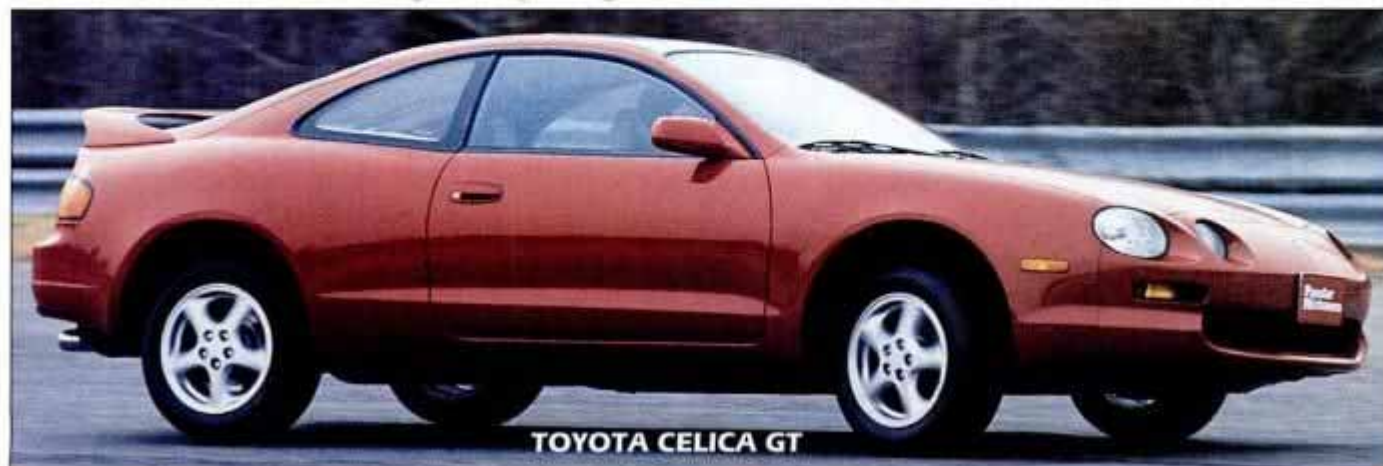
With this pedigree, the Millenia cried out as a natural long-term test car.

Of course, we specified a Millenia S—the one with the Miller-Cycle engine. Standard equipment includes traction control, 4-wheel disc ABS, remote entry, power everything, leather upholstery, a sunroof and more.

We are rapidly finding our Millenia S to be an elegant, competent and very willing cruiser. —D.C.

**TEST SUMMARY**

Report number: 1  
 Base price: \$31,400  
 As-tested price: \$32,820  
 Extra-cost options: floor mats, alloy-wheel locks, trunk-mounted CD changer  
 Drivetrain: 2.3-liter dohc 24-valve supercharged V6 engine, 4-speed overdrive automatic, front-wheel drive  
 Engine performance: 210 hp/210 ft.-lb.  
 EPA fuel economy rating: 20 city/28 hwy.



**TOYOTA CELICA GT**

## LONG-TERM TEST CARS



HONDA ACCORD EX

### Toyota Celica GT

We haven't put that many miles on our test Celica since our last report because it's spent most of the time in the body shop of Potamkin Toyota in New York City. Reason: In the last of the 17 snowstorms that blasted us this past winter, the Toyota and a stake truck tried to occupy the same square yard of Manhattan real estate. The truck won. The Celica's front bumper had to be replaced and its front

### Honda Accord EX

With 12,500 miles on the odo, this classy coupe is performing better than ever. It's been an excellent commuter for those long hauls into Manhattan from the Jersey shore. The VTEC 4-cylinder is more than ample for scooting the Honda out of the many tollbooths and passing slower traffic on the New Jersey Turnpike. The suspension is still taut—road feel, handling and comfort are terrific.

#### TEST SUMMARY

Report number: 3  
Total miles driven: 12,500  
Miles driven since last report: 6851  
Average fuel economy: 26.9 mpg  
Worst observed fuel economy: 17.3 mpg  
Best observed fuel economy: 30.7 mpg  
Maintenance/repair costs: \$138.28 maint.



ISUZU AMIGO XS

### Isuzu Amigo XS

This is my last report on the Amigo XS. The next report will be by one of the auto editors on the staff of POPULAR MECHANICS. Being a test driver has been a very rewarding experience—literally. I got to drive a brand-new car and they paid for all the gas. And speaking of gas, fuel mileage was one of the bright spots in testing the Amigo. No matter how hard I drove, no matter the weather, no matter the load, I could never get the mileage to drop below 17 mpg. For a 4wd vehicle, I consider that outstanding.

Unfortunately, I can't say the same thing about the Amigo's sound system. Frankly, it's pretty thin and weak. Isuzu markets this vehicle to college-age people who want a killer sound system.

The other maddening thing about the Amigo is the top. This is one fantastic vehicle with the top off. And it comes off very easily and quickly. Putting it back on is another story—especially on a chilly, windy night.

Other than the top and the sound system, I don't have any complaints. Oh, the Amigo is slow. You don't want to pick a fight at a stoplight in an Amigo. Yet, when you're driving, it's okay. This vehicle is solid and tough, but cute and cool at the same time.

—Steven Oldham

wheels realigned. Since the car was already at the shop, we had Potamkin perform the 7500-mile maintenance.

Between the bodywork and our heavy travel schedule, the Toyota had been doing more sitting than rolling. But now that the Celica is back on the road and the Northeast has segued from winter into a gorgeous spring, we expect to more than make up for the hiatus over the next three months.

—Joe Oldham

#### TEST SUMMARY

Report number: 3  
Total miles driven: 8741  
Miles driven since last report: 1454  
Average fuel economy: 25.3 mpg  
Worst observed fuel economy: 22.8 mpg  
Best observed fuel economy: 26.5 mpg  
Maintenance/repair costs: \$99.95 maint.  
4-wheel alignment, \$99.95  
replacement bumper, \$1150

While the car's mechanical attributes have been flawless—with the exception of a balky lock mentioned in our last report—the truly luxurious interior has shown a couple of minor chinks. For one, the upholstery has not been wearing as well as expected. For another, there's a gap in the trim of the center console, which really jumps out at you, given the quality of the rest of the car's tight, seamless fit and finish. In fact, the cabin is so tight, the silence inside is almost deafening. The car is so quiet that many parking valets try to start the engine while it's idling.

Oh, the door-lock problem turned out to be a bad actuator. Our dealer fixed it when we brought the car in for its 7500-mile regular service.

—Deborah Frank

#### TEST SUMMARY

Report number: 3  
Total miles driven: 7644  
Miles driven since last report: 3189  
Average fuel economy: 19.7 mpg  
Worst observed fuel economy: 17.0 mpg  
Best observed fuel economy: 21.0 mpg  
Maintenance/repair costs: None

# A WIRELESS WORLD

A proposed blanket of low Earth orbit satellites promises communication any time, anywhere.

BY GEORGE MANNES

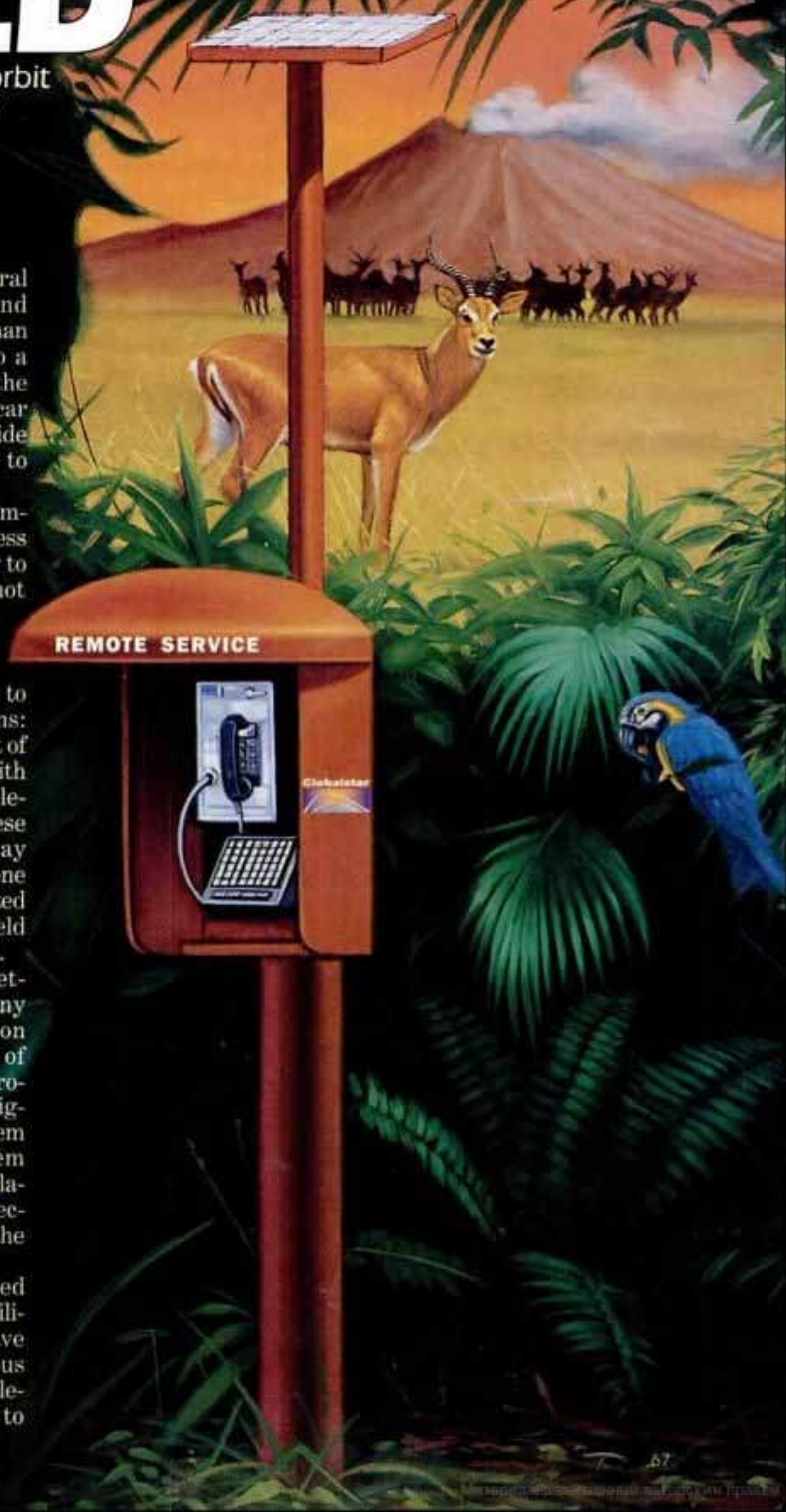
PM Illustration by Don Wieland

● An American businessman traveling in rural China pulls a phone out of his briefcase and checks in with the office in California. A woman living on a remote Indonesian island goes to a public phone booth and calls up her son in the capital city of Jakarta. And a family whose car breaks down on a desolate Nevada road outside the range of any cellular system is still able to telephone an auto club for a tow.

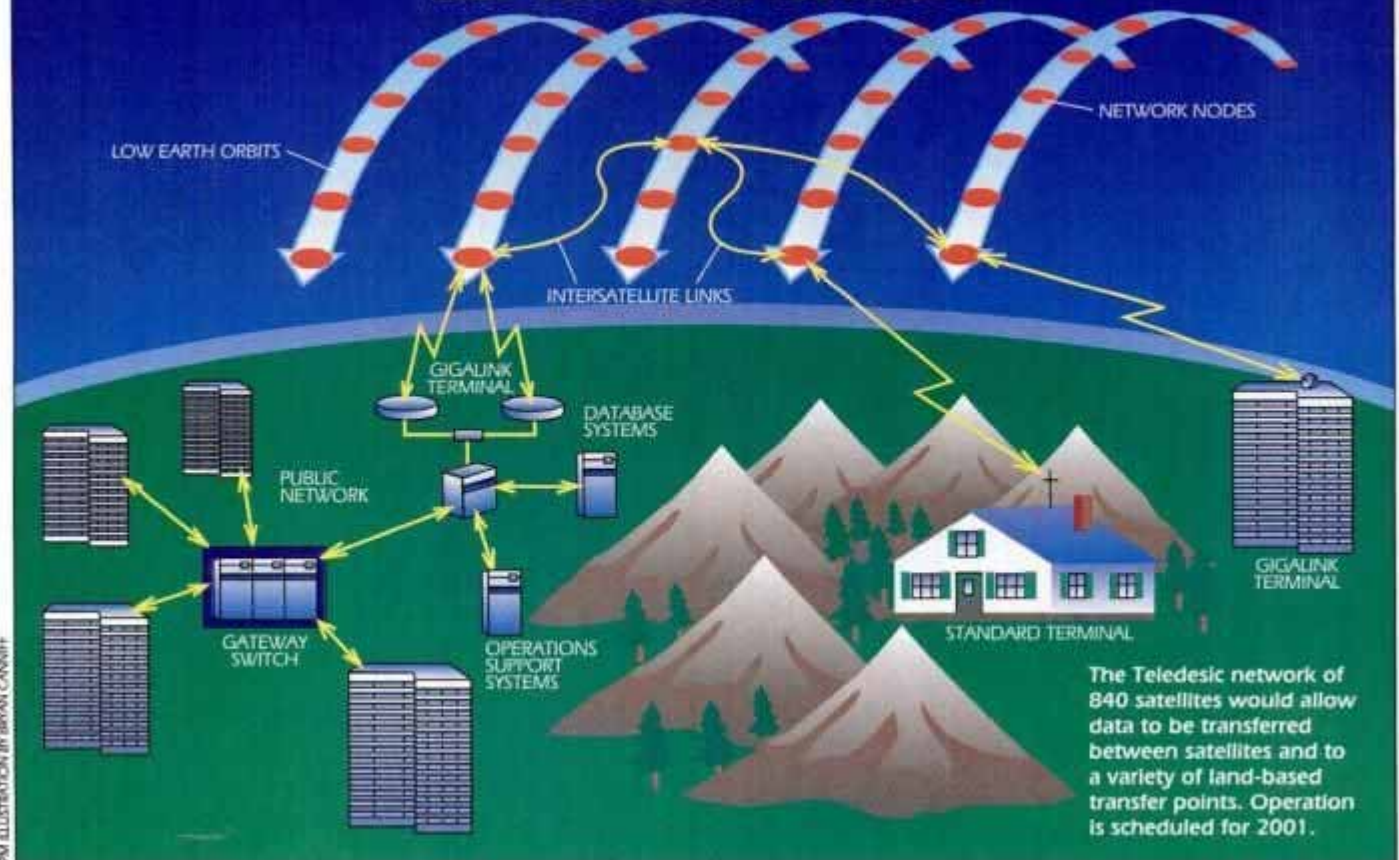
These scenarios have something more in common than a dial tone. They represent the business sought out by a handful of companies planning to offer a new type of telephone service—one not built on a backbone of copper wire and fiber-optic cable, but beamed through the air via a network of satellites circling in low Earth orbit (LEO). These satellite-based systems plan to fill in the gaps in present-day phone systems: places in the United States and other nations out of range of a cellular telephone system, along with communities around the world without any telephone service at all. In a developing nation, these networks could translate into a wireless pay phone in a rural town—the village's first phone ever. For high-paying customers in industrialized nations, these systems could provide a handheld telephone that operates anywhere in the world.

The ambition of these planned satellite networks is staggering. For example, a company called Teledesic intends to create a \$9-billion wireless data network requiring the launch of more than 840 satellites or "birds." Other proposed systems would employ fewer but still a significant number of birds. TRW's Odyssey system would employ 12. Motorola's Iridium system would use 66. Both the Globalstar and Constellation systems envision 48. To put that in perspective, commercial satellites currently orbiting the Earth number at about 100.

What's also significant about these planned global satellites is their orbit. Virtually all nonmilitary communications satellites in use today have geosynchronous orbits. These geosynchronous satellites—such as all of the ones that deliver television programming to backyard dishes and to



# The Teledesic Network



The Teledesic network of 840 satellites would allow data to be transferred between satellites and to a variety of land-based transfer points. Operation is scheduled for 2001.

PM ILLUSTRATION BY BRYAN CANNIFF

cable systems—orbit the Earth above the equator at a distance of 22,300 miles and at the same speed that the Earth rotates. That way, they seem to hover motionless above a single spot.

With one exception, the new satellite systems will be orbiting the Earth at a much closer distance—anywhere from 325 to 6430 miles. These lower orbits mean that the subscriber phones that send and receive signals via the satellites require relatively small antennas and transmission power. Subscribers will be able to hook into a satellite network with a phone the size of current handheld cellular portables.

Moving the satellites closer to Earth, though, complicates matters. Closer in, these satellites have a smaller footprint, meaning the area of the Earth that each satellite can blanket with signals is smaller than it is for high-flying geosynchronous birds. While three geosynchronous satellites sharing a single orbital path could send and receive signals all around the globe, LEO satellite systems require many more satellites in multiple paths to achieve similar coverage over the planet's surface. For example, the Iridium system envisioned by Motorola will use 66 operating satellites. They'll be divided into six different orbital paths—also known as orbital planes—each of the six containing 11 satellites that follow each other around the world in an endless game of follow-the-leader.

How would these systems work? Let's start out with a typical user trying to make a phone call—a traveling salesperson who's trying to check in with his New York office. He has a dual-mode portable phone—one that could operate on a satellite network or on a conventional cellular network. When he places his call, his phone will first try the cellular network, because the proposed satellite networks are expected to be more expensive. If the phone isn't in an area served by cellular, the call is instead routed to a satellite. A wireless connection is made to the nearest satellite traveling overhead. This process is automatic and requires no guidance from the user.

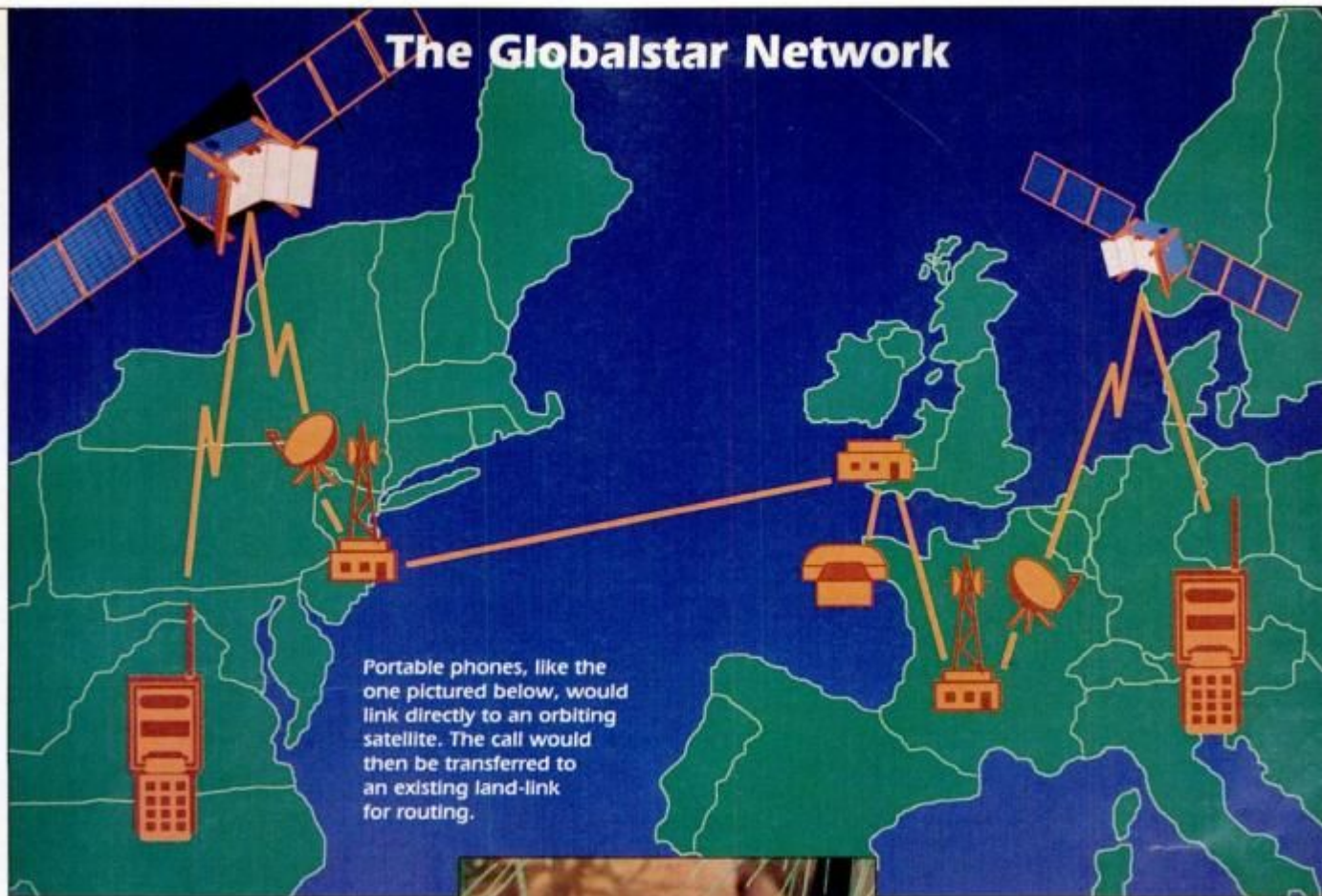
With most of the systems on the drawing board, once the call reaches the satellite, it's beamed back down to an Earth station that's in the footprint of the same satellite. This Earth station, or gateway, plugs the call into a wired phone network—the same way that calls made on cellular phones join the phone system to reach people who have conventional, hard-wired telephones. The call travels by land to the phone number the caller wants to reach. If the caller is another subscriber to the same satellite service, the connection would travel to another gateway close to where that caller is on Earth, beam up to another satellite in the system and then beam back down to the called party's phone. Once the conversation starts, the con-

versation flow would follow that path back and forth. The system might also be used to transmit data, such as a computer file or fax, or simply to page a subscriber to the satellite network.

Because these LEO satellites can take less than 2 hours to orbit the planet, a particular spacecraft may be able to serve a user on the ground only a few minutes before it travels out of range. That's why all the networks can hand off calls from one satellite to another. A call made via one satellite can be continued on the bird that follows it in its orbital plane as the first unit heads off into the horizon.

Virtually all nonmilitary communications satellites employ circular orbits, but the planned Ellipso system is built around satellites with elliptical orbits because the world's land masses and population are concentrated in the Northern Hemisphere, says David Castiel, president of Mobile Satellite Communications Corp., the company behind Ellipso. For Ellipso satellites orbiting the Earth on a diagonal relative to the equator, the apogee (or the highest point in their orbit) will be in the Northern Hemisphere. The perigee, or lowest point in the orbit, will be in the Southern Hemisphere. This way, satellites will stay over the north more than they will over the south, providing higher channel capacity. "An even orbit would be wasted," says Castiel. "You don't want to have eight dozen channels in New

## The Globalstar Network



Portable phones, like the one pictured below, would link directly to an orbiting satellite. The call would then be transferred to an existing land-link for routing.

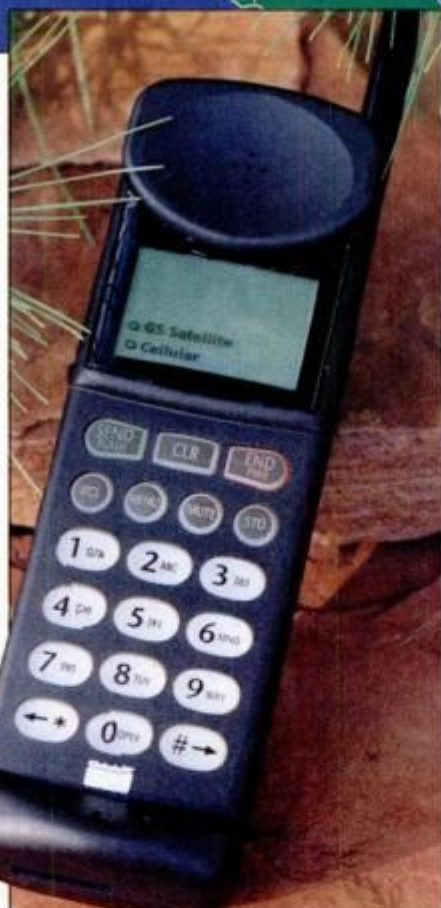
York and eight dozen channels in Fiji.”

The designs of all of the global satellite systems—including the number of satellites, their orbital heights and transmission power—reflect complex tradeoffs between the costs of various parts of the system. For example, the higher the orbit of satellites in a system, the fewer satellites necessary to provide coverage—saving money in terms of a lower quantity of units to manufacture. Conversely, the higher the orbit, the more money it costs to launch each satellite, and the more expensive each satellite is because it has to transmit at a higher power.

Two proposed LEO systems plan to bypass landline networks as much as possible and provide their own long-distance service. These two are the Iridium system, designed by Motorola, and the Teledesic system, supported by Craig McCaw, founder of the biggest empire of cellular phone systems, and Bill Gates, chairman of software giant Microsoft.

In the Iridium system, once a signal travels from handset to satellite, it doesn't travel back down to Earth to make the rest of its journey by wire. Rather, calls travel long distances without returning to Earth. They are handed off from satellite to satellite in the network, only touching down when necessary to reach a non-network phone at the end of their journey.

Signals in the Teledesic system



travel in the same manner, though its backers envision that Teledesic will be used more as a high-capacity data network than it will for voice communications. Rather than a handheld phone, the basic subscriber tool of the Teledesic network will be a larger,

less portable terminal that would connect to a laptop or other computer, according to Teledesic President Russell Daggatt. A basic terminal would be powerful enough to send or receive data-intensive video images.

The 840 satellites that Teledesic says it needs to operate its network are partly a function of the frequency band the company expects to use. In this 20-to-30-gigahertz band, which is higher than the frequencies other systems hope to use, the danger increases that rainfall will interrupt communications between satellites and the Earth. Teledesic hopes that putting satellites over users' heads, rather than low to the horizon, will help counter the rain problem. To make this happen, Teledesic has to launch more satellites.

How much will satellite phone service cost? One proponent, Globalstar, estimates that users will have to spend about 65 cents a minute to be hooked via satellite into the wired phone network. Long-distance phone charges over landline networks will be added to that figure. Iridium, which will bypass long-distance landlines with its inter-satellite communication, expects to charge \$3 per minute for delivering a call “from anywhere to anywhere,” a company spokesman says.

Before they can build their systems, proponents of these global satellite systems have a number of

## A WIRELESS WORLD



One of the 840 satellites Teledesic plans to place in low Earth orbit.

hurdles to overcome. One of these is regulatory—getting permission to operate in the countries in which they want to offer service. The focus for regulatory issues is currently at the U.S. Federal Communications Com-

mission, where five systems—Constellation, Ellipso, Globalstar, Iridium and Odyssey—are trying to get permission to operate in the United States. Teledesic, which publicized its plans only recently, is seeking permis-

sion in another FCC proceeding. Governmental permission will also be necessary in the other countries.

Another hurdle is raising the money necessary to build these systems. The FCC won't license an applicant until it can prove it has enough money to build and launch its satellites and operate them for a year. An important source of financing will be from partners in countries where the systems hope to offer cellular-style or basic telephone service. Iridium says it has raised \$1 billion of its \$3.4-billion cost, and Globalstar says it has raised \$275 million of its \$1.8-billion price tag. If other systems have raised that much, they aren't saying.

It isn't likely that all these global systems will get off the ground. Informed observers expect that only three or four will make it to the stage where they can provide service, and only two or three will be able to operate at what they might claim is an economically stable basis.

While most of the systems say they'll be operational within four years, those starting dates could slide because of delays in fund raising and the regulatory process. In fact, the FCC expects to give companies six years to get their systems operational once they have been granted a license.

Meanwhile, a rough preview of global satellite networks is expected to debut in the second half of next year, when American Mobile Satellite Corp. (AMSC) is expected to launch its Skycell Mobile Telephone service in the United States. Targeted at heavy users of cellular phones—people who talk more than 400 minutes a month—Skycell is intended to keep mobile phones working even when drivers are passing through an area not covered by a cellular system.

In the absence of a cellular signal, Skycell phones will transmit to and from a geosynchronous satellite floating in the sky, which in turn will hook the user into the wired phone network via a gateway located in Reston, Virginia. This process will be automatic, and the user need not know whether he's talking to someone via cellular or satellite. Because of the 22,300-mile distance between the Earth and AMSC's satellite (originally scheduled to launch this year, but delayed until 1995), Skycell phones will have to have more transmission and reception power than cellular phones. The units will be weighty and have antennas, making them appropriate only for vehicle use. The phones are expected to cost \$2000. Service charges are expected to be \$25 per month and 99 cents to \$1.45 per minute. The system is licensed for the United States, Puerto Rico and the Virgin Islands. **PM**

### A Guide To The Launching Pad

**System:** Constellation  
**Backer:** Constellation Communications  
**Intended debut:** 1998  
**Number of satellites:** 48  
**Orbital planes:** 6  
**Orbital height:** 635 miles  
**Orbital period:** 105 minutes  
**Estimated cost:** \$300 million  
**Notes:** Cost of system expected to rise

**System:** Ellipso  
**Backers:** Mobile Satellite Communications Corp., Westinghouse Electric Corp., Fairchild Space and Defense Corp.  
**Intended debut:** 1997  
**Number of satellites:** 16  
**Orbital planes:** 3  
**Orbital height (miles):** Apogee: 4875; perigee: 325, 2670 or 4875, depending on satellite  
**Orbital period:** 3 to 5 hours  
**Estimated cost:** \$750 million to \$1.1 billion  
**Notes:** Only system employing elliptical orbits

**System:** Globalstar  
**Backers:** Loral Corp., AirTouch Communications  
**Intended debut:** March 1998

**Number of satellites:** 48 (plus 8 in-orbit spares)  
**Orbital planes:** 8  
**Orbital height:** 865 miles  
**Orbital period:** 2 hours  
**Estimated cost:** \$1.8 billion  
**Notes:** Has raised \$275 million

**System:** Iridium  
**Backers:** Motorola, Lockheed Corp., Sprint Corp.  
**Intended debut:** 1998  
**Number of satellites:** 66 (plus 7 orbiting spares)  
**Orbital planes:** 6  
**Orbital height:** 485 miles  
**Orbital period:** 100 minutes  
**Estimated cost:** \$3.4 billion  
**Notes:** Employs satellite-to-satellite transmissions

**System:** Odyssey  
**Backer:** TRW  
**Intended debut:** Late 1998/early 1999  
**Number of satellites:** 12 (Minimum of 9 necessary for full global coverage)  
**Orbital planes:** 3  
**Orbital height:** 6430 miles  
**Orbital period:** 6 hours  
**Estimated cost:** \$1.5 billion  
**Notes:** Uses medium

Earth orbiting satellites

**System:** Skycell Mobile Telephone  
**Backer:** American Mobile Satellite Corp. (Owners include McCaw Cellular Communications and Hughes Communications)  
**Intended debut:** Second half of 1995  
**Number of satellites:** 1 (could expand to 3)  
**Orbital planes:** 1  
**Orbital height:** 22,300 miles  
**Orbital period:** 1 day  
**Estimated cost:** \$500 million  
**Notes:** Offering service to U.S., Puerto Rico and Virgin Islands

**System:** Teledesic  
**Backers:** Bill Gates, chairman of Microsoft; Craig McCaw, chairman of McCaw Cellular  
**Intended debut:** 2001  
**Number of satellites:** 840 (plus in-orbit spares)  
**Orbital planes:** 21  
**Orbital height:** 435 miles  
**Orbital period:** 99 minutes  
**Estimated cost:** \$9 billion  
**Notes:** Employs satellite-to-satellite transmissions

# BUICK LeSABRE

Plenty of luxury and lots of value.

BY MICHAEL LAMM, Contributing Editor; PM Photos by Scott Dahlquist



● The 1994 Buick LeSabre looks exactly like what it is: the Buick Park Avenue's kid brother. Both Buicks share a body/chassis platform sitting on the same 110.8-in. wheelbase. Interior dimensions are either identical or within fractions of an inch. The doors, cowls, floor pans and most body panels interchange. Both cars use the same 3.8-liter 170-horsepower V6 engine and front-wheel-drive transaxle drivetrain, same basic suspension and same instrument panel.

So what, you ask, is the difference? For starters, the LeSabre is about 5 in. shorter than the Park Avenue. That translates to a smaller trunk—LeSabre holds 17.1 cu. ft. versus 20.3 for the Park Avenue.

The other major difference is that LeSabre comes with less standard equipment and costs about \$6500 less. Part of the "less equipment" equation for the LeSabre is the lack of availability of a supercharged engine, which is standard in the Park Avenue Ultra.

Those differences are enough to increase the LeSabre's popularity over its larger, upscale brother. In fact, LeSabre was Buick's best-selling nameplate in all of the 1993 model year.

## Two to choose between

The LeSabre comes as a 4-door sedan only, in two flavors: Custom and Limited. Both come standard with dual airbags, antilock brakes and a 4-wheel independent strut suspension. There's an optional Gran Touring package that includes an automatic load-leveling feature, firmer damping, 16-in. alloy wheels and performance tires. Steering is variable-ratio, and traction control costs \$175 extra but is available only in top-of-the-line Limited models.

In addition, every LeSabre comes equipped with a 4-speed automatic attached to the V6 engine, as well as air conditioning and an AM/FM stereo. However,

# BUICK LeSABRE



Dashboard controls drew many nays.



Almost everyone opted for the power seat.



All LeSabres come with this 3.8-liter V6.



more than half of our respondents upgraded the sound system. The vast majority increased their comfort levels by opting for Buick's luxury package and nearly everybody (more than 90%) went for the 6-way power seat.

### Know what they want

Nearly 40% of our LeSabre owners were repeat Buick customers. More than half of them proudly admitted to being over 65 years old. And, they had solid reasons for buying their

LeSabres and the hard-earned experience to be ultracritical of their cars.

One of the least-liked features on the LeSabre is the 14 fussy little buttons that control the cabin's climate and ventilation. These dimly lit buttons

## SUMMARY OF BUICK LeSABRE OWNERS REPORTS\*

<b>Total miles driven</b>	1,197,776	<b>Specific dislikes:</b>					
<b>Average miles driven</b>	4889	No complaints	22.2%	Good	41.0	Windshield washer/wipers	12.8
<b>Purchase price:</b>		Instrument panel, switches	14.6	Average	12.3	Power windows	10.3
Average	\$22,120	Low/uncomfortable driver seat	12.9	Poor	3.7	Air conditioner	10.3
Range	\$18,000-\$28,000	Noises and rattles	5.3	<b>Instrumentation:</b>		Electrical system	7.7
<b>Why did you choose the Buick LeSabre?</b>		Central climate controls	4.1	Excellent	44.4%	<b>Repair it yourself?</b>	
Owned Buicks before	39.9%	Lack of storage bins, pockets	3.5	Good	36.9	No	94.9%
Liked the styling	27.5	<b>Suggested changes:</b>		Average	14.9	Yes	5.1
Good price/value	17.2	Revise instrument panel	17.6%	Poor	3.7	<b>Dealer repairs satisfactory?</b>	
Reputation for quality	13.3	No changes, leave as is	14.4	<b>Driver sightlines:</b>		Yes	72.2%
Rides well	9.9	More comfortable seats	8.5	Excellent	46.7%	No	27.8
Great comfort	8.2	Add storage bins, pockets	5.9	Good	41.0	<b>Dealer service opinion:</b>	
6-passenger size	6.4	Higher-quality materials	5.9	Average	8.6	Excellent	56.5%
Good handling	6.4	Simplify climate controls	5.2	Poor	3.7	Good	36.9
<b>Model choices:</b>		<b>Performance opinion:</b>		<b>Overall convenience:</b>		Average	4.8
LeSabre Custom	58.4%	<b>Engine power:</b>		Excellent	45.5%	Poor	1.8
LeSabre Limited	41.6	Excellent	63.8%	Good	44.2	<b>Dealer sales policy:</b>	
<b>Options/Accessories:</b>		Good	35.0	Average	9.5	Excellent	58.5%
6-way power seat	91.9%	Average	0.8	Poor	0.8	Good	36.3
Premium sound system	63.0	Poor	0.4	<b>Workmanship opinion:</b>		Average	4.3
Luxury package	60.2	<b>Handling:</b>		Excellent	64.1%	Poor	0.9
Gauge cluster	43.9	Excellent	69.9%	Good	32.7	<b>Number of vehicles owned:</b>	
Automatic ride control	40.0	Good	28.0	Average	2.4	This vehicle only	37.3%
Traction control	29.4	Average	2.0	Poor	0.0	Two vehicles	44.8
Prestige package	25.4	Poor	0.0	<b>Front-seat comfort:</b>		Three vehicles	12.7
Heated driver's seat	20.6	<b>Braking:</b>		Excellent	65.0%	Four or more	5.2
Gran Touring package	10.3	Excellent	70.2%	Good	25.6	<b>Principal driver:</b>	
Trailer towing package	3.4	Good	28.2	Average	5.3	Male	49.0%
<b>Average miles per gallon:</b>		Average	1.2	Poor	4.0	Female	45.3
In town	20.5	Poor	0.4	<b>Rear-seat comfort:</b>		Both equally	5.7
On the highway	27.4	<b>Overall performance:</b>		Excellent	60.1%	<b>Age distribution of owners:</b>	
<b>Specific likes:</b>		Excellent	67.3%	Good	34.5	Under 29	0.0%
Riding qualities	41.9%	Good	31.9	Average	4.9	30-49	11.8
Handling	39.4	Average	0.4	Poor	0.4	50-plus	88.2
Styling	35.9	Poor	0.4	<b>Had any mechanical trouble?</b>		<b>Based on your experiences, would you buy a Buick LeSabre if you had it to do over again?</b>	
Comfort	31.3	<b>Ergonomics and driving convenience:</b>		No	84.1%	Yes	71.3%
Engine power	18.7	Layout of controls:		Yes	15.8	Maybe	23.9
Overall economy	18.7	Excellent	43.0%	<b>What type of trouble?</b>		No	4.9
				Transmission noise	12.8%		
				Pulsing brakes	12.8		

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



are positioned low toward the center of the instrument panel and can be difficult to find even in daytime.

Some LeSabre drivers complained that even with the 6-way power seat set as high as it would go, "It's like sitting on the floor." You can't please everybody—some owners felt that the seats were too mushy and lacked support while others said they were too firm, particularly in cold weather.

But the majority found overall comfort one of the LeSabre's great strengths. "This is my third LeSabre," a New York retiree told us, "and I like the ride. All seats, front and rear, are deep enough so you don't have your knees hanging off the edge. Ride is very smooth and quiet, and the car handles easily." Ride and handling comprised another category for high marks all around.

The LeSabre also came in for its share of mechanical complaints, with noisy transaxles, out-of-true brake rotors and recalcitrant windshield wipers tied atop the list.

### Is bigger better?

The Buick dealer technicians cured these problems the first time in 72.2% of all cases. Interestingly, that's the same figure for Park Avenue fixes. More interesting is that in our survey of Park Avenue owners, dealer service was rated as excellent more often than in our survey of LeSabre owners by 10 percentage points. Either LeSabre owners are more critical of their treatment or the dealerships' service managers treat Park Avenue owners better than they do LeSabre drivers.

Then, when we asked buyers to rate their cars' overall quality, Park Avenue owners rated workmanship as excellent, a healthy 12 points higher than the 64.1% of LeSabre owners who gave the same rating. Again, either LeSabre owners are pickier than their Park Avenue-owning colleagues, or the Wentzville, Missouri, plant that built the Park Avenues did a better job than the Flint, Michigan, plant that built the LeSabres. (Since we did this survey, Buick swapped the plants that build these cars.)

When our respondents made unsolicited direct comparisons between the LeSabre and Park Avenue, they fell into two broad categories: those who moved down because they felt that the cars weren't all that different, and those who aspired to move up.

So when it came to deciding whether to buy another LeSabre next time, 4.9% reported that they wouldn't and another 23.9% said maybe. A lot of those who weren't sure hinted at moving up to a Park Avenue. The rest just didn't want to commit before they'd shopped the competition. **PM**



Thanks to its shorter rear deck, the LeSabre presents a less-formal profile than the larger Park Avenue. The conservative, clean lines were not a major buying motivator.

### EDITORS REPORT

## A Solid Ride And Smart Buy

● Give credit where it's due. And it's due in Flint, Michigan, at the headquarters of Buick Motor Division. By understanding the wants and needs of its customers and fulfilling same, Buick has steadily marched toward the leading ranks of various quality and customer-satisfaction surveys. This GM division has also accumulated solid sales success—without a single sport/utility vehicle or minivan in the fleet. Leading this march to prosperity is the LeSabre, which fairly well defines Buick's formula.

This car delivers more than adequate comfort, performance and elegance for—typically—under \$25,000. Well under, in fact. This car provides solid value with an adequate, if not startling, V6 engine and well-matched 4-speed automatic. The spacious interior comes complete with all the requisites from 6-passenger seating to air conditioning to AM/FM stereo sound. The four doors all open wide, and the trunk is commodious enough for most families. Styling is pleasant if not leading-edge. What can be bad?

Well, according to the LeSabre owners who responded to our survey, not too much, really. There's a fair share of elements that could be better to be sure, but all in all the LeSabre delivers on its promise of solid, comfortable transportation.

Of course, it's interesting to note that while Buick has the big stuff figured out—ride, handling, performance—for the majority of the folks

who are attracted to the marque, the designers in Flint seem to be oblivious to the less obvious but still critical needs of their customers. The folks at Buick know that with its hard-to-beat combination of styling, size, comfort and value, the LeSabre is a favorite of the mature crowd. Much of the car's advertising and marketing thrust is directed at this ever-growing audience, and rightly so. So how come the LeSabre is equipped with a climate-control system that requires the eyesight of an astronaut and the dexterity of a neurosurgeon to operate? As our respondents noted, the tiny, partially hidden and dimly lit climate-control buttons are an annoyance.

On the other hand, once you've got the interior's temperature set where you like it, and the cruise control set at a comfortable cruising speed, the LeSabre is quite an amicable ride. While the softness of the ride and the casual responsiveness of the handling—even with the optional Gran Touring package—are not close to our tastes, they do appeal to the broad spectrum of Buick buyers. And though the naturally aspirated version of the 3.8-liter V6 lacks the pleasing rush of the supercharged version to be found in the Park Avenue Ultra, the drivetrain has no trouble propelling the LeSabre to freeway speed in an appropriate amount of time and maintaining that speed over hill and dale.

Like I said, give credit where credit is due. —Don Chaikin

HOME IMPROVEMENT

# Installing A Ceiling Fan

*The quickest way to more comfortable year-round living starts here.*

TEXT AND PHOTOS BY MERLE HENKENIUS

● If you're tired of looking at that old outdated ceiling fixture, and you'd really prefer a ceiling fan/light combination in its place, don't be intimidated by the prospect of installing the components yourself. While the procedure varies slightly from one manufacturer to the next, the installation that follows is fairly typical of what you're likely to encounter.

Most folks install a fan to create a cooling effect during the warmer months. We installed our fan in a den, which, because of its western exposure, tends to gain more heat than the other rooms in the house. In other words, we put the fan where it would be most appreciated.

On the other hand, a ceiling fan is

an excellent means for circulating air during the winter. It's especially good at moving warm air from the ceiling to the rest of the room. This not only makes the room more comfortable, but you may be able to take the thermostat down a notch, as well.

Ceiling fans and light kits are available separately so you can mix and match styles and models to suit the look you're after. And in most cases, you can combine one manufacturer's light with another's fan to further expand decorative possibilities. For this installation, we chose a Hunter fan (Model EMB-03, Hunter Fan Co., 2500 Frisco Ave., Memphis, TN 38114), priced at about \$100, and a light kit, priced at about \$20.

## Before you start

Your ceiling light will be wired in one of two ways—with the power originating at the switch, or with the power routed first to the ceiling box and then through the switch.

Our wiring configuration has the power originating at the switch, with a 14/2 switch leg that brings current to the ceiling fixture. If your room has the power routed first to the ceiling box, there will be a switch loop extending to the switch box. The wiring connections to the fixture at the ceiling box differ only slightly in each case, and the manufacturer's instructions will provide wiring diagrams for both configurations.

If you have only a 2-wire switch leg,




**1** Shut off the circuit that powers the old ceiling fixture, and remove the lamp's diffuser to access the mounting plate.



**2** After removing the screws that hold the fixture mounting plate in place, twist off the wire connectors and set the unit aside.



**3** If the mounting plate was secured by a threaded nipple, remove the mounting bracket from the fixture box.



as we did, you can control the light and/or fan from the wall, but not each independently—the wall switch powers both. If you'd like to control the fan and light separately at the wall, you need to pull new 3-wire cable from the fixture to the switch box and install a second switch.

In our case, we chose to use the existing 2-wire switch leg and switch, and use the pull-chain switches on the fan and light fixture for independent control.

#### Removing the old fixture

Start by shutting off the power to the ceiling fixture circuit at the service panel. Then, remove the diffuser from the old fixture (Photo 1). This will re-

veal either a brass nut on a threaded nipple or two machined screws at the outer edges of the base. Remove the nut or the screws that secure the base to the ceiling box. This allows the fixture to drop away from the box, exposing the wire connections. Undo the wire connectors that join the like-colored wires and remove the fixture entirely (Photo 2). If the fixture base was secured by a threaded nipple, you'll find it attached to a box bracket. Remove the bracket from the box as well (Photo 3).

#### Securing the box

In all cases, you'll need to beef up the support for the ceiling box so it can safely handle the weight of the fan.



**4** Install a 2 × 4 brace to support the weight of the fan. If you don't have attic access, use a retrofit fan box kit.



**5** With the brace in place and leveled, use a drill/driver to firmly attach the box to the brace with wood screws.



**6** The fan that we installed has three rubber vibration-absorbing pads that fit in holes in the fan mounting plate.



**7** Drive screws through the mounting plate and box, and into the 2 x 4 brace until the plate rests against the ceiling.



**8** Use a small level to check that the plate is level in both directions. Tighten the screws into the brace to adjust the plate.



**9** With mounting plate firmly attached, install two of the three screws in the plate side for holding the motor assembly.



**10** With the fan components on the floor, attach the motor cowling to the fan canopy with the screws provided.



**11** Hang the assembly from the mounting plate using a wire hook. Then, attach like-colored wires with wire connectors.

Most electrical codes require one of two options. You can either install a wooden brace between ceiling joists and screw the existing box to the brace, or install a code-approved fan box that's designed to be able to carry the extra weight.

Access to the box will have a lot to do with your decision. With attic access, the simplest approach is to brace the box. Clear the insulation away and cut a 2 x 4 brace to bridge the joist space. Position this brace so that it rests on top of the box, level it, and nail or screw the brace to the joists (Photo 4). Then, from below, use wood screws to secure the box to the brace (Photo 5).

If you can't reach the box, such as when working through a first-floor ceiling in a 2-story home, a specialized retrofit fan box will be easier. These special-purpose boxes have a heavy, threaded joist support that is designed to be fed through the existing box opening. When positioned, you simply rotate the bar, which drives pronged ends against the adjacent joists. Retrofit fan-support boxes are available where you buy your fixtures, and cost about \$12.

### Installing the fan

The Hunter fan that we installed has rubber bushings and grommets at the most vibration-prone locations to help reduce noise when the fan is running. If you're installing a similar fan, be sure to insert the rubber bushings into the holes in the mounting plate. These three bushings act as vibration-absorbing cushions (Photo 6).

With the wooden brace in place and the box secured to it, attach the fan mounting plate with extra-long 4-in. screws, driven through the holes in the back of the box and into the brace (Photo 7).

Use a drill/driver to drive the screws just until the plate makes contact with the ceiling. Then, to assure a perfectly level installation, hold a torpedo level across the plate (Photo 8) and finish each screw manually while checking that the plate is level.

With the mounting plate installed on the ceiling and leveled, and the switch-leg wires pulled through the plate opening, install—but don't tighten—two of the three brass screws in the sides of the plate (Photo 9). Then screw the fan's metal canopy

to the motor cowling (Photo 10).

Make a short hook out of stiff wire and use the hook to hang the canopy/motor cowling assembly from the ceiling plate. Temporarily hanging the motor assembly in this way allows you to make the wiring connections without also having to hold the motor assembly. The hook makes the connection a one-person job.

To make the electrical connections, simply join like-colored wires with twist connectors—white to white and black to black (Photo 11). Then, join the circuit ground wire to the fixture's grounding pigtail and to a separate pigtail bonded to the metal box. If your circuit is an older, ungrounded type, ignore the fixture's green grounding pigtail.

With the wiring connections made, remove the assembly from its temporary hook and position the canopy against the ceiling plate. Align the slotted holes in the canopy with the two brass screws already started in the mounting plate. Install the third screw after the canopy is in place to complete the connection (Photo 12). Because these three screws hold the



**12** Hold the assembly in place on the mounting plate. Add the third mounting plate screw and tighten all firmly.



**13** After mounting the blades on their metal brackets, screw each bracket in its place on the motor assembly.



**14** To install the light kit, remove the two screws that hold the bottom cap onto the switch housing and take off the cap.



**15** Using the same screws and tapped holes, install the light kit adapter ring on the bottom of the switch housing.



**16** Lift the light kit and join the white leads with a wire connector. Then join the kit's black lead to the remaining lead.



**17** Screw the light kit to the switch housing and install the bottom cap, which contains the light's pull-chain switch.

fan to the ceiling, draw them down tightly.

With the motor assembly in place, mount each wooden fan blade on its metal bracket. Each blade receives three screws, each fit with a rubber grommet. With the blades and brackets ready, screw the brackets to the motor assembly using two screws in each bracket (Photo 13).

### Installing the light

To access the wiring that powers the light kit, loosen the screws that hold the cap on the fan's switch housing (Photo 14). With the cap removed, you'll see a bundle of wires. Of these wires, two will be labeled for use with the light kit. One will be white (neutral), the other, black, red or blue (hot).

Before wiring the lamp, however, install the adapter ring included with the fan kit (Photo 15). The adapter serves as a reducing ring for the lamp housing. Attach the adapter ring with the screws provided.

Pull the two labeled wires through the adapter ring, lift the lamp and make the wiring connections. Join the two white wires with a wire connector



**18** Set pull-chain switches so the light is on and the fan is off. Wall switch will control light while pull chain controls fan.

and the fixture's black wire to the remaining labeled wire (Photo 16). Because painted fixtures scratch easily, leave the plastic protectors on until after the lamp is wired. Finally, fasten the light kit to the fan with the two screws provided for this purpose (Photo 17) and thread vibration-resistant bulbs into the fixture. In most cases, 60-watt bulbs are the maximum. Anything brighter poses a fire hazard.

### Final adjustments

With the fan and light kit installed, return power to the circuit and test your work. If you turn the switch on and nothing happens, don't panic. The pull-chain switches are probably in their OFF positions. The fan will have four positions—OFF, plus three speeds. The light will simply have an ON/OFF switch. Set these as you prefer. In our case, we opted to have the light controlled by the wall switch and the fan switched at the pull chain. By doing it this way, the fan won't start every time you turn the light on and you save wear and tear on the fan motor (Photo 18).

Your fan will have the capacity to spin in both directions, and can be switched accordingly. Look to the side of the switch housing for the directional switch. Because fan blades are canted slightly, rotation in one direction will move air upward, in the other, downward.

Set your fan to blow downward in summer and upward in winter. The thinking here is that a summer breeze quickly becomes a winter draft when temperatures drop.



SHOP PROJECT

# Rest Easy

*An elegant pencil-post bed.*

BY NEAL BARRETT

• The bed presented here is a variation of a Shaker 4-posted design, often called a pencil-post bed because of the thin octagonal posts.

The bed looks good in contemporary homes, but its origins are in the Middle Ages, when canopied beds came into use. At that time, woven tapestries were often draped over a heavy frame for both decorative and practical effect because they kept the occupants warm in the absence of efficient heating systems.

Our plans accommodate a queen-size mattress without needing a box spring. If you want to use a box spring, position the framework to yield the proper bed height.

## The Posts

Begin by preparing the blanks for the bedposts. Glue up stock if necessary, then joint, rip and crosscut the blanks to 2¼ in. wide × 80 in. long. Use a long straightedge to lay out the tapers on each side of the posts (Photo 1). The taper on the inside edge of the headboard posts begins 15 in. higher than the other tapers. This allows for a square joint with the headboard.

Lay out and cut the mortises in each post at this point—it's easier to

do this now, while the posts are straight, than after the tapers are cut. The quickest way to cut the post mortises is by using a plunge router with a ½-in.-dia. straight bit. Clamp the workpiece between bench dogs, and use an edge guide on the router to make the cut (Photo 2). Cut each mortise in two or three passes to avoid overloading the router. After making each cut, use a sharp chisel to chop the mortise square (Photo 3).

To make the bed easier to move, its



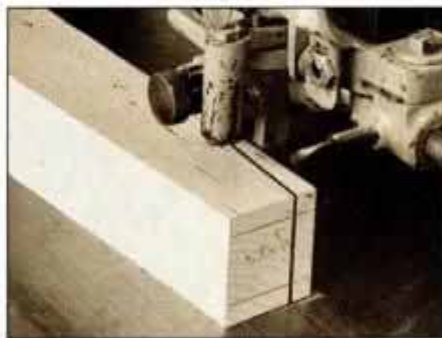
**1** Rip and crosscut the post blanks, and use a long straightedge to mark the taper. Also mark the mortise positions.



**2** Cut the post mortises before sawing the tapers. Use a plunge router or bore out the mortises on the drill press.



**3** Clamp the posts firmly to the bench, and chop the ends of the post mortises square using a sharp chisel.



**4** Saw two tapers, then use the marks on the ends of the posts to redraw the tapers on the sawed surfaces.

Color photo: J.R. Rost  
Step-by-step photos: Neal Barrett  
Technical art: Eugene Thompson  
Photo stylist: Gabe Herrick

joints are bolted together rather than glued. This construction requires that you bore a hole through the mortise bottoms and bore a matching hole into the tenons on the rails and headboard. Use the drill press to bore the 3/8-in.-dia. holes through the rail mortises and the 1/4-in.-dia. holes through the post mortises for the headboard.

Use the band saw to cut the tapers on each post. Note that the tapers are also marked on the posts' ends (Photo 4). Cut two tapers, then use the marks on the ends of the posts to draw the tapers on the newly sawed surfaces. Also, use a roller stand or have a second person help you when sawing the tapers. The posts are simply too long to saw without support.

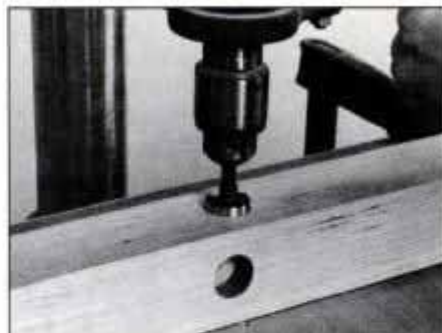
Use a sharp and finely set hand plane to smooth the cut surfaces and to refine the tapers (Photo 5).



**5** Smooth the sawed surfaces and refine the taper with a hand plane. Set the plane to take a fine shaving.

Next, use a Forstner or multispur bit to counterbore the bolt holes on the outside surface of each post (Photo 6). Then use a countersink to recess the holes for the headboard screws.

Cut the 3/8-in.-wide chamfers along the tapered edges of each post using a



**6** Counterbore the bed bolt holes and headboard screw holes in the posts. Use a Forstner bit in the drill press.

chamfer bit in the router. The chamfers on the inside post corners run the length of the post, while the remaining chamfers are stopped just above the point where the rails join the post. Use a sharp plane or chisel to cut the chamfers at the top of each post.

## The Headboard And Rails

Rip, crosscut and joint the stock for the headboard so it forms an oversize blank. Also rip, crosscut and joint the stock for the bed rails and the support rails.

Position the headboard stock so it forms a blank with the grain positioned attractively, then mark it for joining plate slots 6 in. to 8 in. on center along the mating board edges. Don't position a plate too close to the blank edge—you might expose the plate when cutting the headboard to shape. Hold the headboard pieces firmly to a flat, clean worksurface, center the plate joiner on the mark and make the plunge cut (Photo 7).

Apply glue to the board edges, slots and the biscuits. Clamp the assembly, and when the glue sets, plane and scrape it smooth.

The headboard joins the two front posts with two tenons that run nearly the width of the headboard. To ensure tight-fitting joints, it's important that the headboard be perfectly rectangular. Crosscut the headboard blank on the radial-arm saw or table saw. With either machine, be sure you are making a square cut.

Cut the tenons on the ends of the headboard and on the bed rails using the dado blade in the table saw (Photo 8). The headboard and rails have shoulders on the top and bottom of the tenon. To cut the shoulders on the rails, readjust the blade height on the table saw, stand the rail on edge and cut the shoulder. The headboard shoulders are cut later with a handsaw.

Lay out the curved shape of the



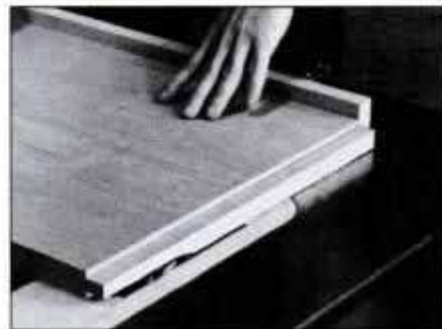
**7** Rip and crosscut the headboard stock oversize. Cut joining plate slots in the stock, then glue and clamp the stock.



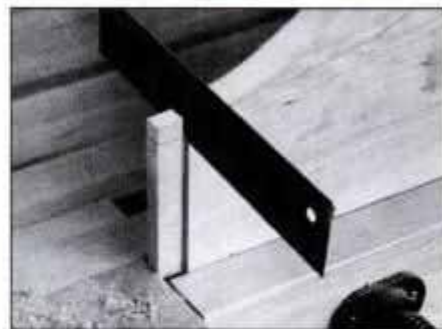
**9** Saw the headboard to shape. Smooth away saw marks and refine the shape using a smooth plane and spokeshave.

headboard, and make the cut with a sabre saw just to the outside of the line. Clamp the workpiece in a vise, and use a sharp and finely set plane and spokeshave to smooth the cut surfaces and work down to the line (Photo 9). Then mark the shoulders on the top and bottom edges of the headboard tenon, and make the cuts using a dovetail saw (Photo 10).

Next, using a router and chamfer bit, cut chamfers on the top edges of the bed rails and the top and bottom edges of the headboard.



**8** Saw the headboard tenons using a dado head on the table saw. The tenon width here requires great accuracy.



**10** With the headboard edges smoothed, mark and cut the shoulders at the top and bottom of the tenon.

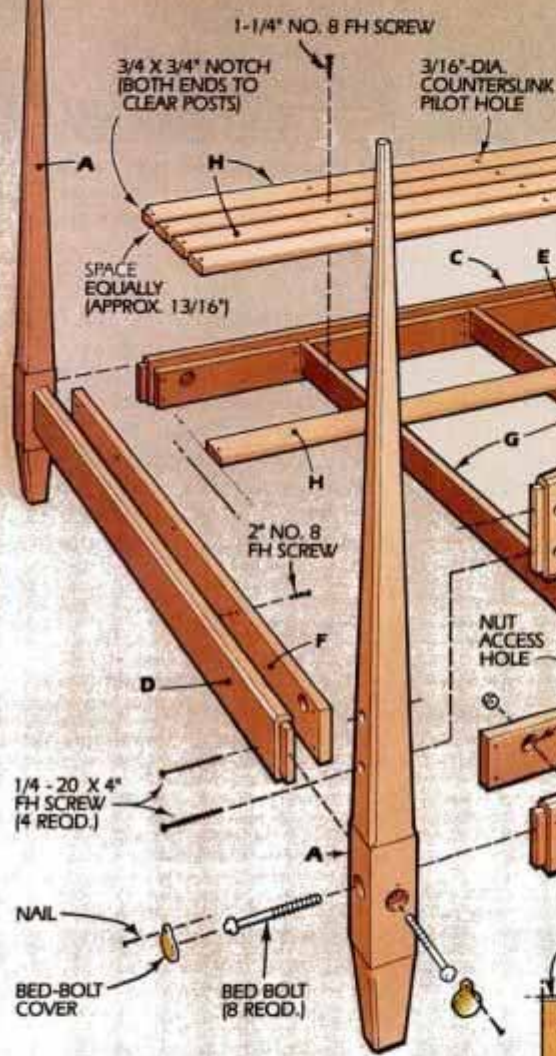
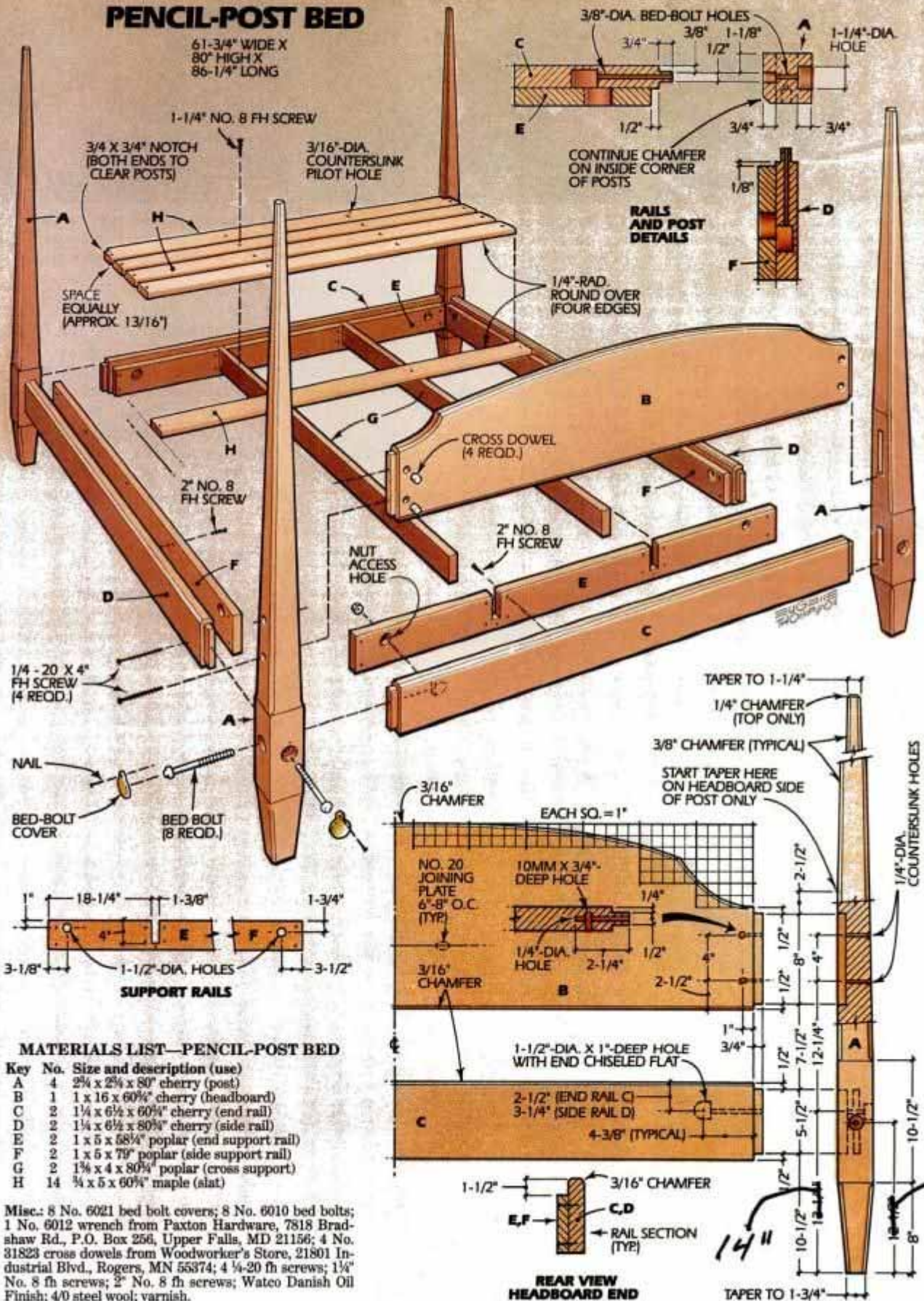


**11** Use a long bit to bore slowly through the post holes and into the headboard and rail tenons.



## PENCIL-POST BED

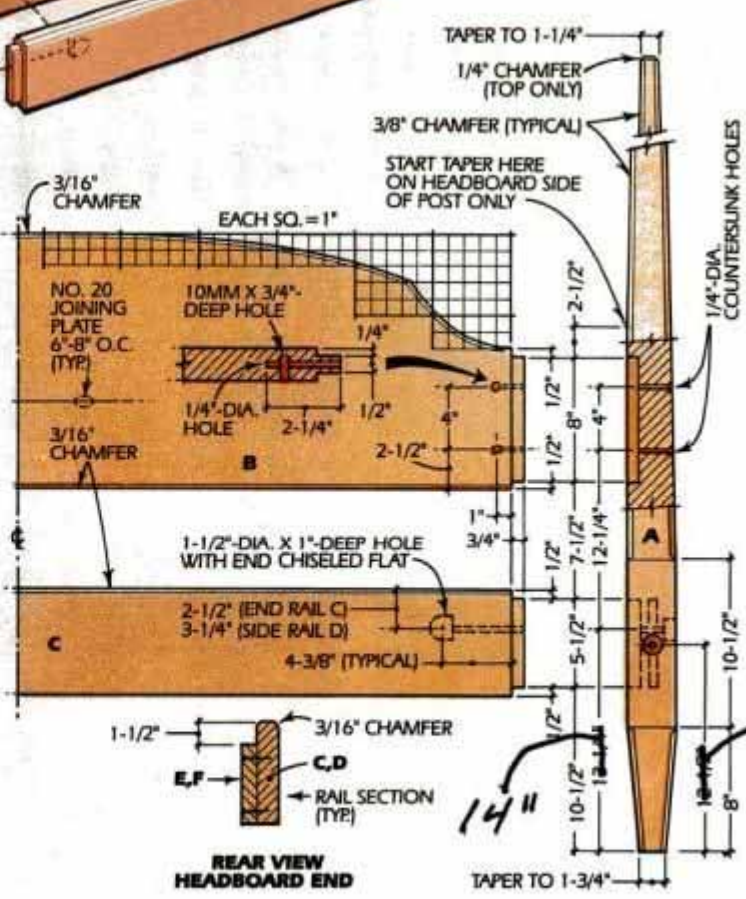
61-3/4" WIDE X  
80" HIGH X  
86-1/4" LONG



**MATERIALS LIST—PENCIL-POST BED**

Key	No.	Size and description (use)
A	4	2 1/4 x 2 1/4 x 80\"/>
B	1	1 x 16 x 60\"/>
C	2	1 1/4 x 6 1/2 x 60\"/>
D	2	1 1/4 x 6 1/2 x 80\"/>
E	2	1 x 5 x 58 1/4\"/>
F	2	1 x 5 x 79\"/>
G	2	1 1/2 x 4 x 80\"/>
H	14	3/4 x 5 x 60\"/>

Misc.: 8 No. 6021 bed bolt covers; 8 No. 6010 bed bolts; 1 No. 6012 wrench from Paxton Hardware, 7818 Bradshaw Rd., P.O. Box 256, Upper Falls, MD 21156; 4 No. 31823 cross dowels from Woodworker's Store, 21801 Industrial Blvd., Rogers, MN 55374; 4 1/4-20 fh screws; 1 1/2\"/>





**12** Use a chisel to cut a flat surface into the hole on the side rails. The bed bolt nut bears on the flat surface.



**13** Bore 10mm holes for cross dowels in the back of the headboard. Turn the dowel to align its hole with the screw.



**14** Clamp the end support rails firmly together, and cut the cross support notches in them using a handsaw.

Dry assemble the headboard and head rail to the posts. Clamp the sub-assembly, and use a long  $\frac{3}{8}$ -in.-dia. bit to bore slowly through the post into the end of the rail tenons (Photo 11). Use a  $\frac{1}{4}$ -in.-dia. bit for the headboard joints. Bore the other holes for each bolted joint.

Now, lay out and bore the pocket holes for the bed bolt nuts on the inside of the bed rails. Use a Forstner bit in the drill press to bore the holes,

then use a chisel to square the sides of each hole, forming a flat surface on which the nut can bear (Photo 12).

Using the drill press, bore the 10mm-dia. holes for the cross dowels in the back of the headboard. To get the hole in a cross dowel aligned with the hole in the end of a tenon, poke a screw into the tenon and twist the cross dowel with a screwdriver so you can thread the screw into the cross dowel (Photo 13).

Rip and crosscut the poplar stock for the end support rails. Then, bore the access holes for the rail bolts. Remember to bore the holes so they are offset from those in the outer rails. When the two rails are joined, this allows better access to the rail nuts than if the holes were aligned.

Cut the notches in the end support rails with a handsaw (Photo 14), and then chop the notches square with a chisel.

## Assembly

Bore and counterbore pilot holes through the poplar rails to screw them to the cherry rails. Bore a screw-hole below the notches in the head and foot rails. Clamp the rails together, and drive screws through the holes.

Screw the headboard to the posts (Photo 15), and use bed bolts to attach

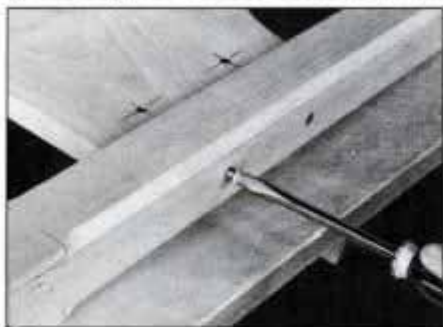
the head rail to the posts. Follow the same procedure for the foot rail and posts. Have an assistant help you bolt together the head and foot assemblies with the side rails. Tighten the bolts using a bed bolt wrench (Photo 16).

After the frame is assembled, install the cross supports by sliding each into its notches (Photo 17).

Rip and crosscut the maple bed slats, then cut the notches in the slats at the head and foot of the bed to fit around the posts (Photo 18). Bore and counterbore pilot holes in the slats, then use a  $\frac{1}{4}$ -in.-rad. rounding-over bit mounted in a router table to cut the slats' edges. Screw the slats to the cross supports using  $\frac{13}{16}$ -in. spacer blocks between each (Photo 19).

Disassemble the bed, and sand all parts with 220-grit sandpaper followed by 320-grit paper. Apply four coats of Watco Danish Oil Finish using a brush or rag, and let it soak in for 20 to 30 minutes, then wipe it off. Let the piece dry overnight between coats. After the final coat has dried, rub it smooth with 4/0 steel wool. The maple slats need no finish, but a coat of varnish seals them.

Reassemble the bed and nail the bed bolt covers in place. Each cover should be loose enough to swivel. **PM**



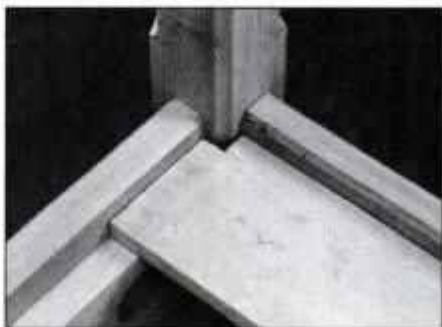
**15** Fit the head rail and headboard between two posts. Drive screws through the posts and into the cross dowels.



**16** Use a bed bolt wrench and an open-end wrench to tighten the connection between the rails and posts.



**17** Prepare for installing the slats by fitting the cross supports into the notches that are cut in the end support rails.



**18** Cut the slat stock. Cut notches in the slats at the foot and at the head of the bed so they fit around the posts.



**19** Position  $\frac{13}{16}$ -in.-wide spacer blocks between the slats, and screw the slats to the cross supports.

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BY ROY BERENDSOHN, Assistant Home Improvement Editor

**From The Top Down**

Bottom-mount refrigerators are handy because their fresh food compartment is at eye level and the freezer is at ground level. Older bottom-mount refrigerators tended to be more expensive to operate than top-mount models because their freezer compartments were located near the compressor and other heat-producing components. Amana offers a total of six 20- and 22-cu.-ft. bottom-mount models that, the company says, are 25% more energy efficient than the federal standard that



was required for last year's models.

If it's space you need, then you might consider the company's 25-cu.-ft. top-freezer appliances. They have a 6.6-cu.-ft. freezer and an 18.1-cu.-ft. refrigerator compartment. They also have spill-containing adjustable glass shelves and gallon-capacity refrigerator doors. According to the manufacturer, both refrigerators have temperature control systems for the fresh and frozen compartments that are sensitive to temperature changes as small as 1.5° F. The bottom-mount refrigerators cost \$1030 to \$1080 and the top-mount models cost about \$1100 at Amana appliance dealers. Write Amana Refrigeration Co., Consumer Affairs Dept. 800, Amana, IA 52204.



**Clean House**

The Steam Vac cleans on the forward and reverse stroke, unlike other steam cleaners that clean only as you pull them backward. Central to its design, says Hoover, is that it's as easy as a vacuum cleaner to use. For instance, the machine does not require a faucet hookup. Fill its 1-gallon tank

with detergent and hot tap water and use the machine like a regular vacuum cleaner. Dirty water is pulled into the machine's removable recovery tank. The Steam Vac's other good features are a toe pedal ON/OFF switch balanced by a dispenser control in the handle.



Three models of the machine are available: Two come with upholstery and stair-cleaning attachments, and a third has a bare-floor cleaning tool. They range in price from about \$130 to \$210, and are sold through department stores and appliance dealers. For more information about these steam cleaners, write Hoover, 101 E. Maple St., North Canton, OH 44720.

**Do The Twist**

The T-1000 is a toaster with a twist, or, we should say, several twists. First, it's insulated, so you can mount it right under a cabinet to free up counter space. Next, it's wide enough to accommodate a long slice of French bread, and it has a special setting for warming pastries.



Black & Decker says the appliance uses an infrared heating element, which is more efficient than conventional radiant toaster elements. To withdraw toast from it, just press the top button on the control panel. The glass door pivots down and the toaster rack slides out, presenting the food for easy reach. The toaster costs about \$60 at department stores. Write Black & Decker Inc., 6 Armstrong Rd., Shelton, CT 06484, or call (800) 231-9786.



### A Little Extra

New appliances are expensive, so it's not surprising that homeowners are looking for a little extra versatility when they shop. With that in mind, Frigidaire has introduced a line of ceramic-top ranges that have one convertible radiant



element in the rear. The right rear element can be switched using the control knob (see inset photo below) to function like a 6-in.-dia. element or an 8-in.-dia. element. A variety of features are available in the line, including halogen elements (the expandable element is



always a radiant type), touchpad temperature controls and a marble finish cooktop. The appliances are available in black, white and

almond finishes. Depending on features, the units cost between \$770 and \$1100. For more information, contact Frigidaire Co., 6000 Perimeter Dr., Dublin, OH 43017, or call (800) 451-7007.

### Keep It Quiet

Maytag says its Dependably Quiet dishwashers are whisper quiet thanks to 14 pounds of sound-absorbing coating that covers the top, sides, door and access panel. The appliances also have three layers of sound insulation wrapping the cabinet. As far as the inside is concerned, you can order nylon-coated dish racks with folding shelves and tines for maximum versatility and maximum corrosion resistance. The dishwashers come with a complete top-down warranty of one year, a limited 2-year warranty for free parts, a 5-year warranty on the wash system and several other components, and a 20-year warranty on the tub. The dishwashers cost from \$600 to \$630 at Maytag dealers. For more information, write Maytag Co., 1 Dependability Square, Newton, IA 50208.



### Clear The Air

There is no way to put this delicately, so we won't try. If you have an odor problem in your house, then maybe this countertop appliance (\$200) is the answer. Its manufacturer tells us it removes odors and it filters the air. The device pulls air through its rear grille and passes it over a membrane containing a pine-oil- or citrus-oil-based liquid. The liquid releases a minute amount of vapor through the membrane and into the airstream. Released into the room, the vapors react with and treat odors. The device also filters the air through a 3-stage filter that includes an activated charcoal element, foam and an electrostatically charged filter. Another model (\$250) comes with an air ionizer that electrostatically charges air particles to increase filtering efficiency. The devices can be ordered (\$4.95 shipping) from Vaportek, P.O. Box 148, Sussex, WI 53089.



### Nice And Low

The strong suit of gas cooktops is that they provide lots of heat quickly, but it can be more heat than you need. The cooktops here can be set so low they'll melt butter without burning it, says their manufacturer. Compared to comparable gas appliances that have a low-heat setting of about 1500 BTUs per hour, these cooktops can be set at 300 BTUs per hour, according to their manufacturer. They achieve the low-temperature setting by using an electronically controlled burner that cycles the flame on and off.

The appliances fit 30- and 36-in.-wide cutouts. They range in price from about \$850 to \$1150, depending on the model. Contact the company at: Thermador, 5119 District Blvd., Los Angeles, CA 90040, or call (800) 656-9226.

### Big Jobs

If commercial quantities of clothes are what you normally wash, then Admiral's 20/20 washer might be the answer to your laundry prayers. Powered by a 3/4-hp motor, the machine accepts a 20-pound wash load, and its 3.1-cu.-ft. wash basket has a 20-year warranty. Another nice feature is the machine's automatic lint removal. It floats lint into the space between the inner and outer tubs and then flushes it out during the spin cycle. The lid lifts back and has self-locking hinges to keep it upright. The machine costs from \$440 to \$460 at Admiral dealers. For more information, write Maytag and Admiral Products, 1 Dependability Square, Newton, IA 50208.



### Tough Bunch

KitchenAid is well known for its rugged stand mixers, so it pays, we think, to seriously consider its new food processors. They come in 9- and 11-cup sizes (about \$220 and \$240), and both are designed to be as simple to clean and operate as possible. They are equipped with a minibowl as standard equipment, allowing you to use them to chop and mince small amounts of food. The machines



have the feed tube positioned in front for easy access and have a smooth, rounded base with a touch control panel for easy cleanup.

The appliances are sold at department stores and catalog showrooms. For more information, write KitchenAid, 701 Main St., St. Joseph, MI 49085.

### Maybe The Ultimate

Whirlpool takes a shot at making the ultimate microwave with its Crispwave. Its top-of-the-line model cooks food from above, below and all around, enabling you to make anything from crisp bacon to pizza, the company says. The appliance browns food from above using a drop-down radiant quartz grill. It takes this heat and reflects it off a specially coated aluminum pan to brown food from be-



low. Food is cooked from all sides using a precisely tuned microwave pattern that fills the oven cavity evenly and cooks food thoroughly and efficiently. The appliance has a long list of nice features, including a stainless-steel oven cavity, dual-plate cooking rack, a glass turntable and preprogrammed settings for foods like pizza and popcorn. The Crispwave costs about \$350 at Whirlpool Appliance dealers. Write Whirlpool Consumer Assistance Center, Benton Harbor, MI 49022, or call (800) 253-1301.

### Fast Food

If you want cooking speed and countertop compactness, the Convectisserie is worth a look. This appliance features a built-in rotisserie, a 9-blade turbine fan and a parabolic heat reflector to ensure maximum circulation of heated air, its manufacturer says. How fast will it cook? It's supposed to cook a 6-pound chicken in 63 minutes, and a rib-eye round roast to a 140°F internal temperature in 45 minutes. Its manufacturer says it cooks the food evenly, giving it a pleasantly browned exterior. The appliance can also be used for defrosting and dehydrating foods. It's controlled with a touch pad that displays its information with digital time and temperature readings. The control panel menu includes settings for hold, broil, bake, defrost and dehydrating. To reach these, you simply press the SELECT button. It costs about \$300 at department stores. For more information, write Hudson Standard Corp., 90 South St., Newark, NJ 07114.



### A New Way To Wash

This horizontal-axis washer is designed to substantially reduce the water, energy and detergent used to do laundry. It uses 66% less water and 75% less detergent than a conventional top-loading washer, its manufacturer says. The machine is also designed to be easier on clothing because it doesn't use an agitator. And it's easier on your back because it loads from the top, unlike other horizontal machines that load from the front. It accomplishes the water/energy savings with a unique wash action that features inner and outer stainless-steel tubs. Water is circulated through the inner tub, which is perforated. The tub's unusual 6-sided shape provides a vigorous yet gentle wash action, says the manufacturer. The washer is available in several models, all of which cost about \$900, plus shipping (about \$100). For more information, write Staber Industries, 4411 Marketing Place, Groveport, OH 43125.

### A Penny Saved

Washing clothes costs you money any way you look at it: The clothes see wear and tear, and the cost of water, heat and detergent can really add up. White-Westinghouse says this front-load washer uses less water, energy and detergent than comparable top-load washers, and it's gentle on your clothes because it rocks them back and forth rather than working them around with an agitator. The appliance's 2.3-cu.-ft. tub requires 28 gallons of water per load versus 43.5 gallons for the average top-loader. This is supposed to result in annual costs of about \$23 for electricity versus \$88 a year for a comparable top-loading machine (assuming you have an electric water heater; with a gas water heater, the difference is \$11 versus \$34). Unlike other front-load washers, its water level never gets above the door's bottom edge, so you can stop the wash cycle and open the door without spilling soapy water. It's sold at White-Westinghouse dealers and costs from \$700 to \$750. Write White-Westinghouse, 6000 Perimeter Dr., Dublin, OH 43017.

PM



# Homeowners Clinic

BY NORMAN BECKER, P.E.,  
Contributing Editor

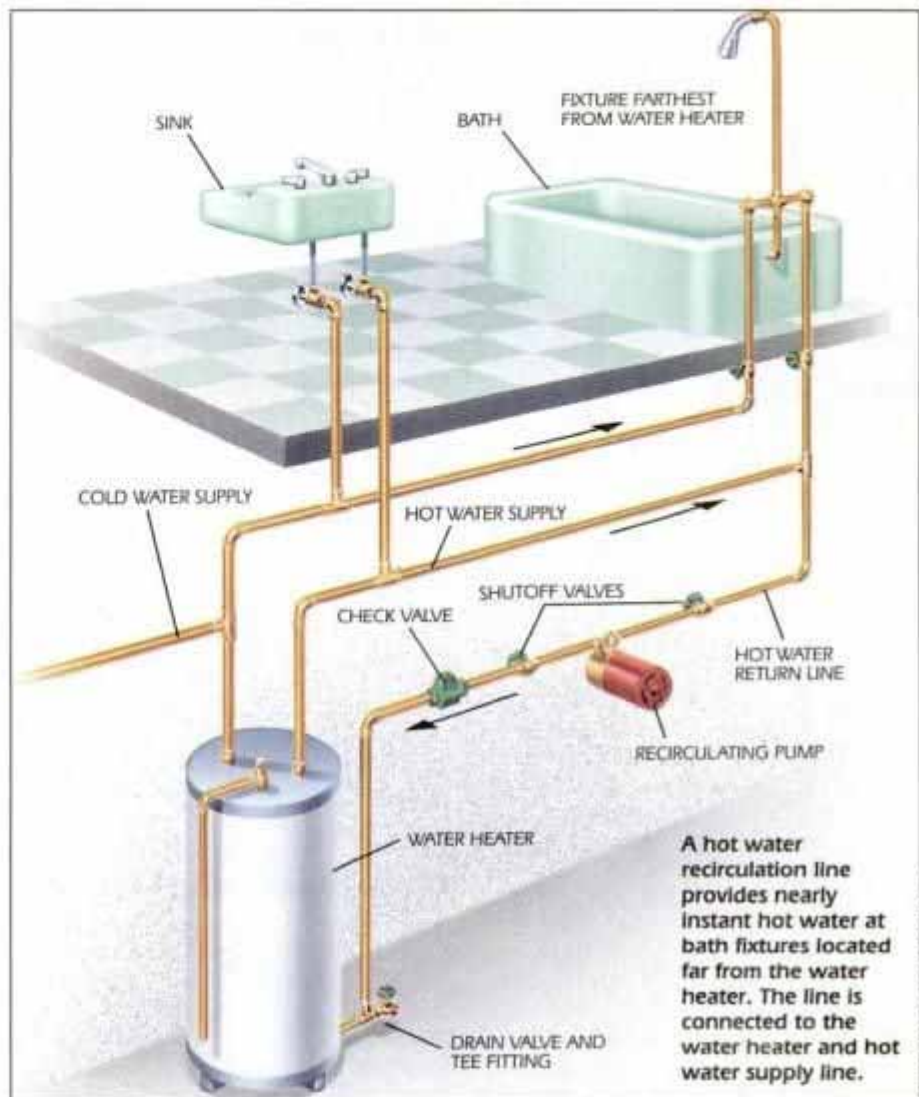
## Instant Hot Water

What can I do to provide instant hot water to every hot water faucet? My house is one level with the water heater at one end and the bathrooms at the other end, some 60 ft. away. The water pipes are attached to the floor joists. WILLIAM B. TURNER JR.  
ROCK HILL, SC

*If you want an instant hot water system, you'll have to install a recirculation line in the hot water piping. However, whether you can easily install a recirculating system depends on the accessibility of the pipes. Most homes have a noncirculating hot water system, which has the disadvantage of wasting time and water.*

*In your case, assuming there is a 3/4-in.-dia. water pipe between the water heater and the bathroom faucet, the 60 ft. of pipe will contain about 1.35 gallons of water that are wasted while waiting for hot water (assuming you let this water run down the drain). The disadvantage of a recirculating hot water system is that it will result in a slight increase in your fuel bill. However, to minimize heat loss and conserve energy, the hot water distribution pipes can be insulated.*

*To convert your system to a recirculating type, you need to connect a 1/2-in.-dia. pipe to the hot water supply pipe at the fixture that's farthest from the water heater and run it back to the water*



A hot water recirculation line provides nearly instant hot water at bath fixtures located far from the water heater. The line is connected to the water heater and hot water supply line.

PM ILLUSTRATION BY GEORGE RETSICK

heater. Several feet before the water heater, install a check valve, a globe valve, a recirculating pump and another globe valve (see diagram). Next, remove the drain valve at the bottom of the heater and install a T fitting in the opening. Reconnect the valve to one end of the T and connect the return line to the other end.

The globe valves isolate the pump, should a repair or replacement of the pump be necessary. You can buy a recirculating pump at most plumbing/heating supply stores. The check valve is installed so the water flows in one direction—toward the heater. Otherwise, if the pump is not operating, comparatively cooler water from the bottom of the tank could enter the line, flow parallel to the hot water supply line and out the tap at the sink or shower.

## Remodeling Referral

● At POPULAR MECHANICS, we are advocates of homeowners doing their own remodeling and home repair. However, there are projects where you may want to hire a remodeling contractor or at least get price estimates to help you determine whether to hire out the work or do it yourself.

If you hire a remodeler, you would do well to consult with family and friends who have hired one recently, but you should also contact the National Association of the Remodeling Industry (NARI). NARI operates a toll-free hotline, 24 hours a day, 365 days a year.

Call (800) 440-6274, and NARI will refer you to some of its 6000 members by sending you a list of those in your area. The organization will also send you a free brochure, "Selecting A Professional Remodeling Contractor."

The brochure is the best summary of working with a contractor that we have seen. Reading it should make you think about the things necessary to achieve high-quality results. That should always be the first step in a remodeling job.

## Polishing Marble

I have a long marble-topped table on which the top was scratched while being moved. What can I use to restore the luster and remove the scratches? How should I accomplish this?

BOB NOBLE  
HENDERSONVILLE, NC

NicSand Inc. of Cleveland, Ohio, has a product that you should consider. We have tried the company's Ultra Micro Fine Sanding Gel on a variety of surfaces and found it

PM PHOTO BY ROSARIO CAPORISTO



effective. Although we have not tried it on marble, the manufacturer says it will work on that as well. It's simple to use—just squirt it on, buff it using the foam drill pad that is supplied with the gel and wash it off.

An 8-ounce bottle of Ultra Micro Fine Sanding Gel, plus a foam drill pad, costs about \$10 at auto parts stores and some home centers. Write NicSand, 1215 Valley Belt, Cleveland, OH 44131.

## Truss Uplift

In our September 1993 column, we discussed roof truss uplift, a condition in which the joints between the ceiling and walls crack and open. The condition occurs in the winter and is caused in part by differential shrinkage between the bottom members (chords) of the truss, which are covered with insulation, and the upper truss members, which are exposed to the cooler attic. The bottom chords are exposed to high temperatures and a low relative humidity, and they shrink and shorten slightly compared to the upper members. This causes the upper chords to pull the bottom members up, lifting the ceiling below.

After reading our column, Dr. Frank Woeste, P.E., professor of wood construction and engineering at Virginia Polytechnic Institute, was kind enough to send us additional information on the subject. According to Dr. Woeste, the greatest impact on truss uplift is top chord swelling. In the winter, because of condensation on roof sheathing, the top chord can gain moisture and swell in length. This action is additive to the bottom chord shrinking, and together causes more truss uplift.

Truss uplift has been recognized as a construction problem for at least 30 years. Researchers exam-

## Filter Screens

● If your washer isn't filling with water rapidly, it may be that its supply hoses are kinked, the supply valves are not fully open or the filter screen washers may be clogged. The solutions to the first two are obvious. But the last problem is a bit more involved.

The first step in cleaning the screens is to unplug the washer and pull it away from the wall to gain access to the water-inlet mixing valve on the machine's back. Turn both the hot and cold water-inlet valves off, and unscrew the hoses from the mixing valve. A little water may leak out, so keep a towel handy.

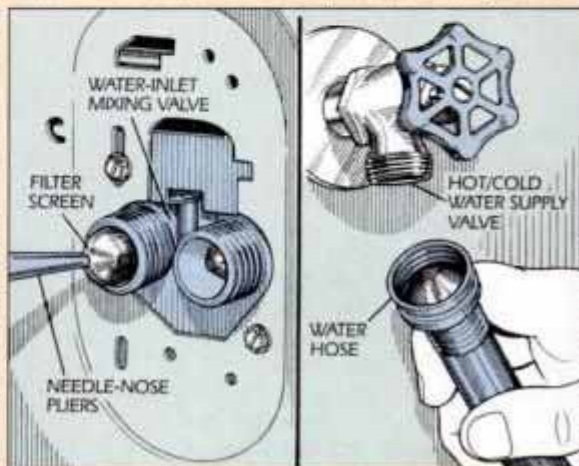
Next, using a thin-blade screwdriver or needle-nose pliers, carefully remove the filter from each valve inlet. Clean each screen under running water with an old toothbrush. Reinstall the screens with the rounded part of the screen facing you.

Before reattaching the hoses to the inlet mixing valve, unscrew the hoses from the hot and cold supply valves, and check for screens at this end. If you find screens here, clean or replace them if damaged.

—Steve Toth



## APPLIANCE CARE TIP



ining the problem found that it is reduced by lowering the relative humidity in the attic. Uplift, they say, is more common in homes where the lower truss chords are covered with thick insulation and where moisture from bathroom and kitchen exhaust fans and clothes dryer vents discharge into the attic. Moisture should be vented outside the house.

## Central Vacuum System

We are wondering if it is possible to use a shop vacuum for a central vacuum system. Are there instructions on using a shop vacuum in such a way?

CAROL VLASZ  
GAINESVILLE, GA

I have never seen instructions on how to use a shop vacuum in a cen-

tral vacuum system, and I suspect that retrofitting one for this purpose is so involved that it's not worth the effort.

There are two problems that have to be addressed in installing a central vacuum system. Normally, there is a long run of duct between the vacuum unit and the various wall outlets. The greater the distance, the greater the resistance to airflow. To overcome the resistance, a vacuum unit that produces a powerful suction is needed. A shop vacuum is generally not as powerful as a central unit, and as a result you are likely to get minimal or inadequate suction at the remote outlets.

The second problem is that, in a central system, there is a low-voltage microswitch in each wall outlet that activates the vacuum motor, which operates at 120 volts. Consequently, a relay and associated circuitry are needed so that each outlet can activate the vacuum motor. You would have to find the appropriate components and retrofit them to the shop vacuum.

## 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.

## Toll-Free Hotline

● Installing a garage door opener can be tricky, but the job is certainly within the grasp of a homeowner with less than professional skills. If you happen to be installing a Stanley garage door opener and run into trouble or have questions, help is a phone call away. Stanley Door Systems has opened a toll-free hotline that is staffed 24 hours a day, seven days a week.

In the United States, call (800) 521-5262 and in Canada, (800) 253-3976. The hotline technicians can answer questions about the installation or take orders for literature and parts.

PHOTO BY ROSARIO CARPOTRITO





## BOOK REVIEW

# Gardening Books

● If you want to be a better gardener and are curious about organic methods, then these two books provide a good start. We recommend reading *Organic Gardener's Composting* first, since it is central to successful organic gardening. This book defines compost (decomposing organic matter, usually from plants) and humus (completely decomposed compost).

Both compost and humus have a place in the garden, we learned, and it was interesting to find that you can use too much of either—we always assumed the more the better.

The book describes basic procedures, such as making free-standing compost piles or enclosing them with chicken wire. But it also covers information that's quite complex, such as maintaining the correct levels of nitrogen and carbon in the pile.

This is good because the book works much like a compost pile—you can take from it pretty quickly, or invest some time in it for maximum results.

For example, we quickly put some of the author's advice to work on our compost pile by increasing its air circulation and moisture. Last December we spread a nice, thick layer of compost around the base of some azalea bushes, and the results are very gratifying. The once-dormant bushes are, for the first time, showing signs of vigor and are flowering profusely.

As an overview, *Organic Gardener's Basics* does repeat some of the material in the composting book, but it also takes you through container gardening, watering, garden pests, beneficial insects, lawn care and pruning—to name a few of its subjects. It does not cover these areas in exhaus-

tive detail, but, as the title makes clear, these are the basics.

The compost book costs about \$10, and the organic basics book about \$13 at bookstores. The books are also available through mail order with \$3 postage per book from: Login Publishers Consortium, 1436 W. Randolph St., Chicago, IL 60607; (800) 626-4330. —Roy Berendsohn



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John Ratzenberger has plenty of ideas on how to spend your leisure time. And what better place to show you than on the Home & Garden Television Network (HGTV), a new 24-hour cable network.

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**APPLIANCE REPAIR**

# Replacing A Dryer Belt

BY STEVE TOTH, Contributing Editor; PM Illustrations by George Retseck

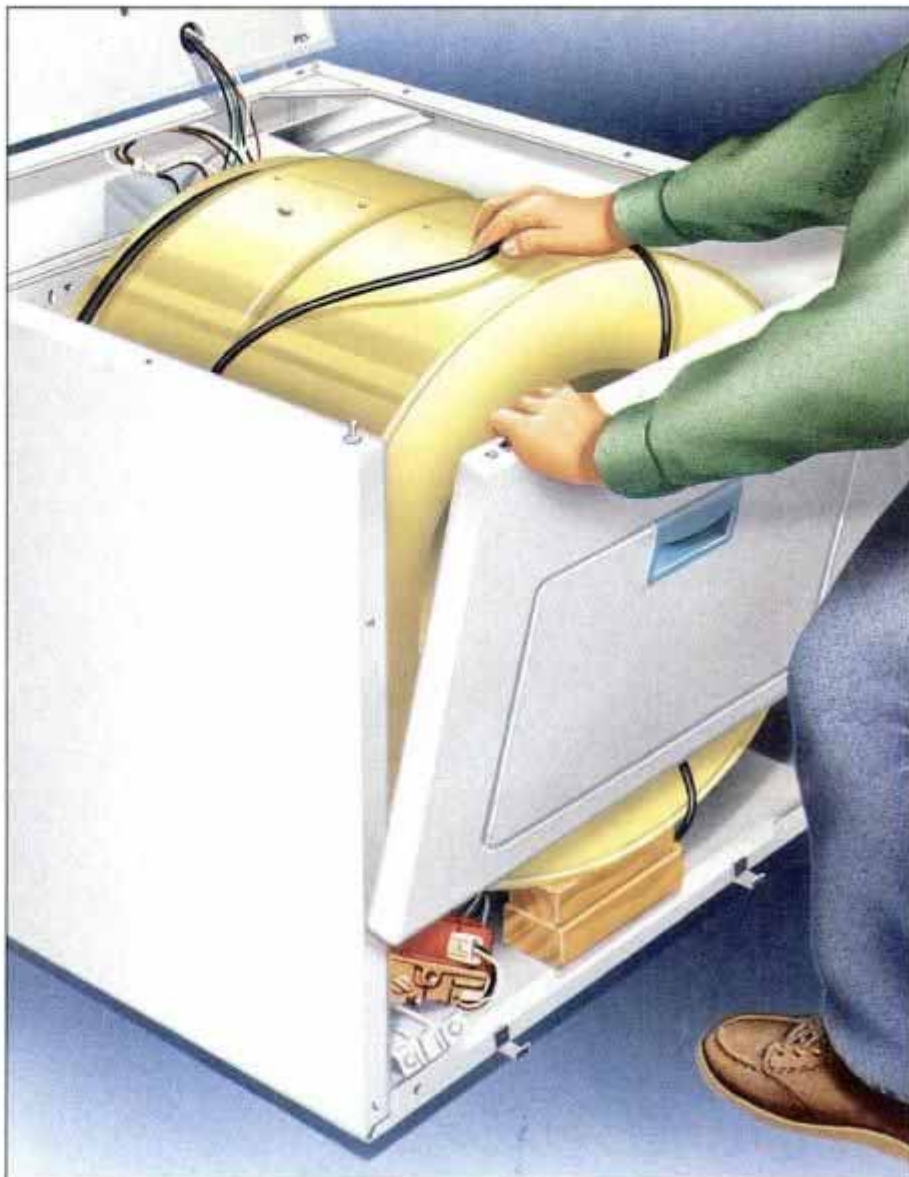
● If you hear a loud bang while your dryer is working, and you notice that the drum has stopped turning, chances are the drivebelt has snapped. Fortunately, replacing the belt is a fairly straightforward operation that can be handled with a few simple tools. We'll show you how the job is done on a Whirlpool or a Sears Kenmore electric dryer. The procedure is much the same on a gas dryer.

### Opening up the dryer

First, unplug the dryer. Lift the lint-screen cover and pull out the lint screen (Fig. 1). Then remove the two screws that are under the cover (Fig. 2). To unlatch the dryer top, insert a thin-blade putty knife between the top and front panel, about 2½ in. from one corner (Fig. 3). Push in on the knife to release the locking clip, lift the corner, then release the clip on the other side. Swing the top up and lean it against the wall.

Next, move to the lower toe panel. Slip the putty knife between the lower panel and the door panel at one side and twist the knife to release the clip (Fig. 4). Then release the opposite clip and lift the panel up and off the hinge springs. To support the dryer drum while the belt is being replaced, place scrap wood under the front of the drum (Fig. 5).

Loosen the two screws at each side



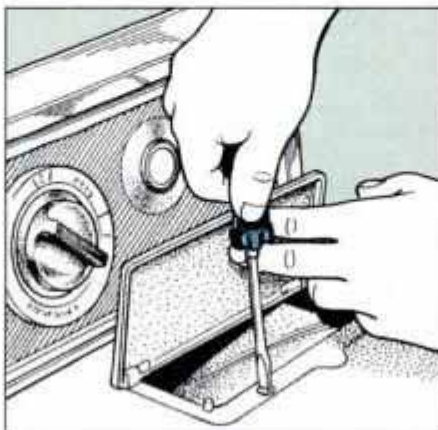
of the bottom of the front panel about 1½ turns (Fig. 6). Move to the top of the panel and remove the screws from the inside of the cabinet that hold the front panel to the sides (Fig. 7). Slide the old belt off the drum.

### Installing the belt

Lean the front panel out slightly and allow the drum to rest on the scrap wood support. Drop the new dryer belt between the front panel and the drum, and loop it over the drum



**1** Prepare for replacing the dryer belt by lifting the lint-screen cover on the top of the dryer. Then remove the lint screen.



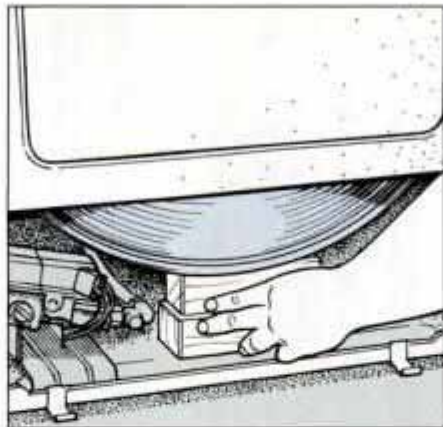
**2** After removing the lint screen, lift the cover and remove the screws that hold the lint-screen housing to the dryer top.



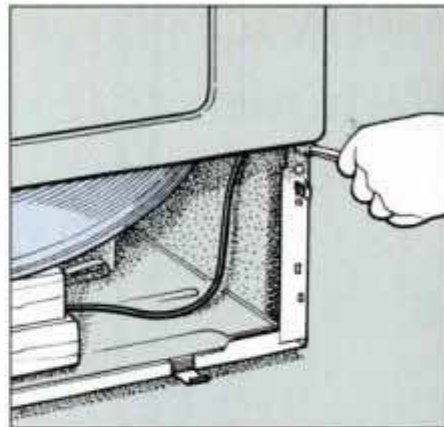
**3** Slide a putty knife between the front panel and the top near a corner. Lift the corner and repeat on the other side.



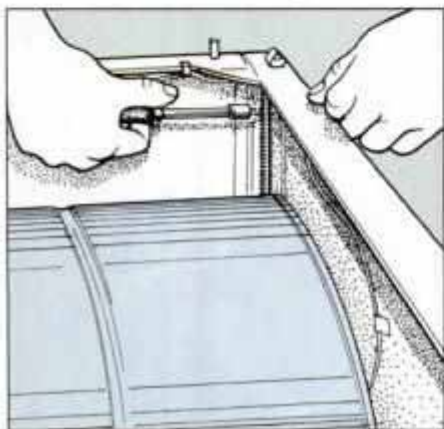
**4** To remove the lower panel, insert the putty knife between the panel and each side. Then twist to release clip.



**5** Place a few wood blocks under the drum. These support the drum when the front panel is moved away from the sides.



**6** Loosen the screws that secure the bottom of the front panel to the dryer sides. Do not completely remove the screws.



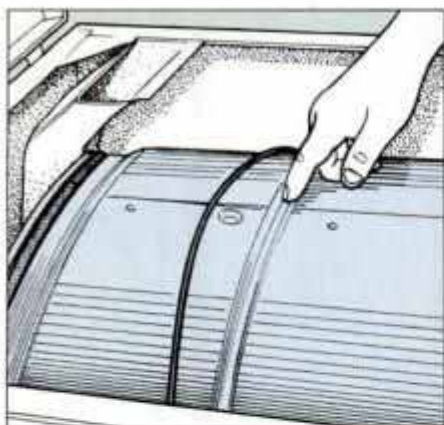
**7** Remove the screws that secure the front panel to the dryer sides at the top. These are accessed from the inside of the cabinet.



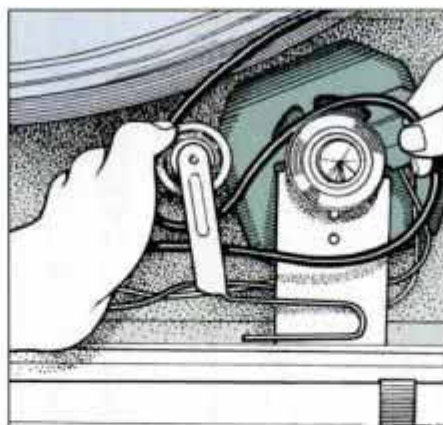
**8** Lean the front panel away from the sides and slip the new dryer belt over the drum. Then resecure the front panel.



**9** Check that the lip on the back of the dryer drum fits properly against the seal on the rear bulkhead of the dryer.



**10** Locate the original position of the old belt, and slip the new belt in place. Keep the grooved side of the belt down.



**11** Push the idler pulley toward the motor and loop the doubled-up belt around the idler pulley. Slip belt around motor pulley.



**12** Rotate the drum counterclockwise a few turns to check belt tracking. Then replace remaining components and test run.

(Fig. 8). Then, lift the drum slightly while pushing the front panel back into position.

Replace the screws at the top inside of the front panel, tighten the lower panel screws and remove the scrap wood from under the drum. Check to make sure that the rear drum seal fits properly over the lip on the rear bulkhead (Fig. 9). Position the new belt where the old belt was, with the

grooved side of the belt facing down (Fig. 10).

Now, move to the motor area and pull out the old belt. To route the new belt around the idler and drive pulley, first pass the entire belt, doubled up, under the idler pulley. Then, push the idler belt toward the motor, slip the belt around the motor pulley and release the tension on the idler pulley (Fig. 11).

## Finishing up

Open the dryer door and rotate the drum counterclockwise a few times to make sure the belt is tracking properly (Fig. 12). Lower the top and press down at each corner to engage the clips. Lift the lint-screen cover, replace the two screws and reinstall the lint screen. Finally, secure the lower front panel and turn on the dryer for a test run.

PM

REVIEW

# Klingspor Sanding Catalog

• If you buy woodworking tools and supplies by mail order, you know that catalog shopping is one of the best ways to get quality goods at reasonable prices. And, nothing could be more convenient. A simple phone call puts all the major manufacturers and just about every piece of equipment you can imagine at your fingertips.

Now, thanks to Klingspor, a major manufacturer of abrasives, you can buy industrial-grade sanding supplies at great prices without ever leaving home. All you need is *Klingspor's Sanding Catalog*—a specialized resource that includes everything from sandpaper to power sanders.

Klingspor has manufactured woodworking abrasives for the past 100 years and is a major supplier to large furniture manufacturers that demand

quality. In the sanding catalog, you can order the same abrasives that companies use in mass quantities and at prices you can handle. Whether it's a selection of belts for your belt sander or hook-and-loop discs for a random-orbit sander, the sanding catalog has it on hand in the grade you need. You'll also find bargain-box assortments—cutoffs often considered waste for industrial use, but just the thing for a small woodshop.

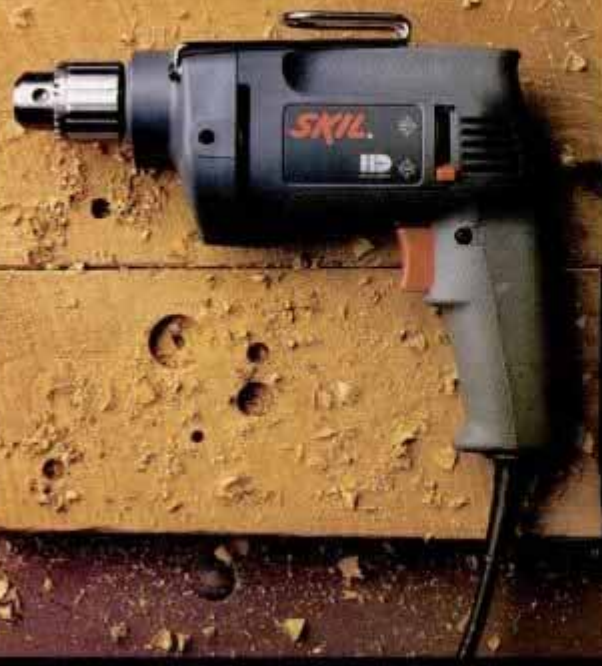
In addition to high-quality abrasives, *Klingspor's Sanding Catalog* has a full selection of power sanders from leading manufacturers along with some helpful information so you can choose the power tool that best suits your needs. For hand sanding, there are over a dozen varieties of sandpaper holders and sanding blocks available. And large shops will be interested in the stationary belt and spindle sanders on display. The catalog even offers shop vacuums and dust-collection equipment.

The Klingspor sanding catalog



costs \$2. For a catalog or more information, write Klingspor Sanding Catalog, P.O. Box 3737, Hickory, NC 28603.

—Thomas Klenck



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**ENGINE WEAR TEST**

This test measures an oil's capability to reduce friction and protect moving parts within the engine from fusing together. Certified oils use additives to form protective layers on the engine surfaces and they can help extend the life of an engine.



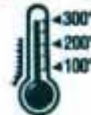
**PHOSPHORUS CONTENT**

Phosphorus is used in oil to prevent wear and control oil oxidation. But too much phosphorus can reduce the effectiveness of a car's emissions control system. Certified oils have limits on the amount of phosphorus to control engine wear and help maintain emissions system durability.



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# CAR CARE

## CAR CLINIC

BY MIKE ALLEN,  
Associate Automotive Editor

### Cubes Or Flakes?

My car will lose power at the strangest times. It usually happens on rainy days, but sometimes not. I'll be traveling along on the freeway—it doesn't usually happen in traffic—and the car will just gradually slow down until it stops. It won't restart for about 5 minutes, and it runs rough for about a few seconds after it does start.

Sometimes the gas pedal seems to stick open a little, but the engine doesn't run too fast—it barely runs at all.

Needless to say, my mechanic says he can't find anything wrong with the fuel injection or the ignition.

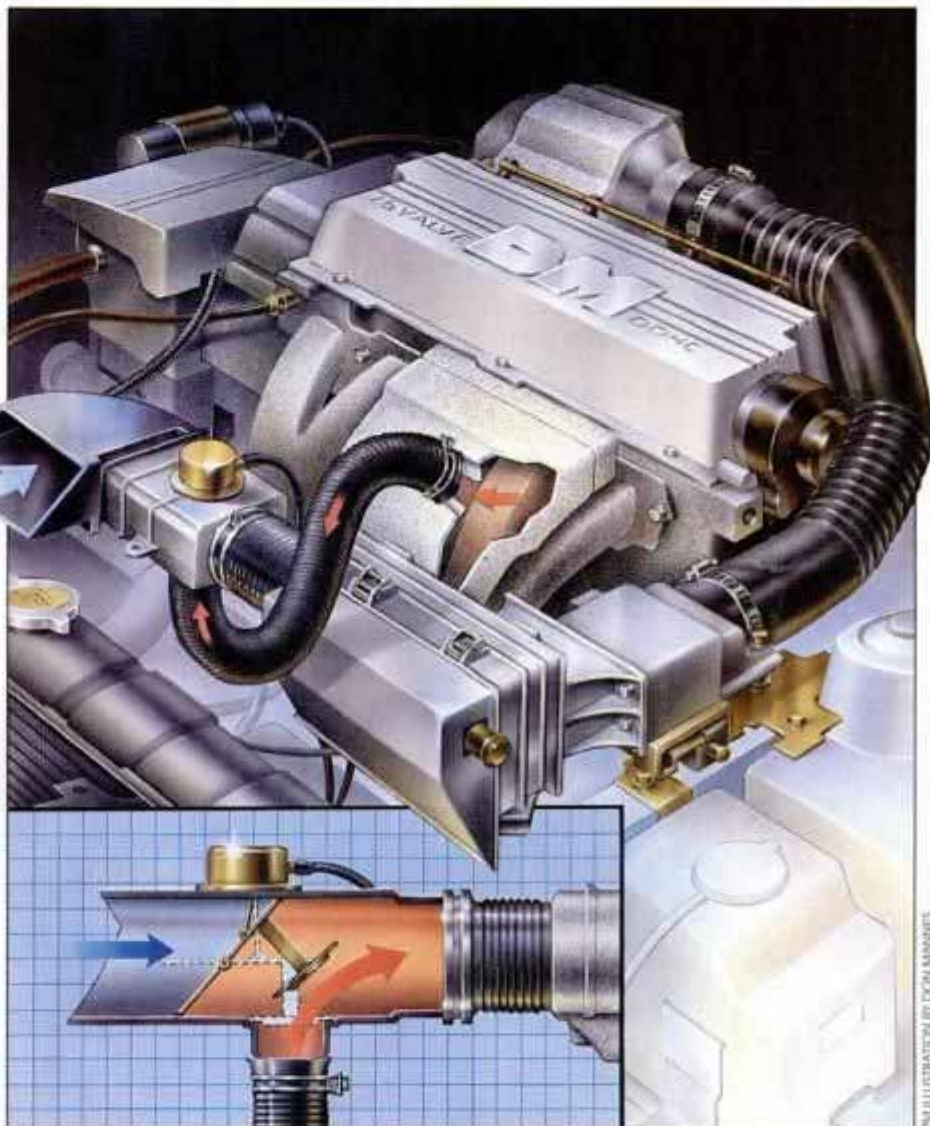
SARAH CLEMSON  
MENOMINEE, MI

*You've got carburetor icing—which might seem hard to swallow, as you don't have a carburetor. But you do have a throttle body on your fuel injection, and it's freezing up with atmospheric moisture.*

*How can this happen, you ask, if the air temperature is in the 50s, and there's no rain? The temperature of the air whistling past your throttle plate drops considerably as the pressure drops from atmospheric pressure (14.7 pounds per square inch) to a vacuum. Why? It's high-school physics—as the pressure drops, the temp goes down. And as the temp and pressure go down, so does the air's dew point, the point where the moisture drops out. And if it's cold enough, moisture drops out as ice. Ice is what's choking off your engine's air supply, and that's what's making the throttle stick.*

*When you shut off the engine, the ice rapidly melts, and the water is making the engine run rough when you restart it.*

*This isn't supposed to happen. There's a sheetmetal stove bolted to your exhaust manifold to preheat the air to your engine. A vacuum-powered motor moves a flap inside the*



*air intake to admit prewarmed air during cold weather, and cool air when it's warm out. So, either the flap is stuck, or the vacuum hoses or thermostat that controls the flap is bad. Perhaps the hose that connects the stove to the intake is plugged or missing. I've even seen older cars where the stove itself had rusted away. Have your mechanic troubleshoot the entire system.*

### Swingtime

I own a 1988 Mazda 323 and I'm concerned about the engine temperature. When I'm driving 60 mph, the needle is centered between C and H on the temp scale. In stop-and-go traffic, it swings up to nearly the H mark. I'm

concerned the higher temps will blow the head or intake-manifold gasket.

FRANTZY JEAN-LOUIS  
NEW YORK, NY

*The radiator cap will vent any excess pressure, so don't worry about your gaskets.*

*Smaller cars with thermostatically controlled electric fans will tend to let their coolant temps swing a little higher when there's no air blowing directly into the radiator. And if you're comparing the actions of your temperature gauge to what you've been used to with big American cars with monster V8 engines and belt-driven fans as big as helicopter tail rotors, you'll see a larger excursion*

## CAR CARE

of the needle in most small cars. It would be nice to see some numbers on the temp gauge, wouldn't it? But the car manufacturers seem to feel that we don't need or want absolute calibrations.

If your car shows no other signs of overheating, it's probably fine. If you're losing any appreciable amount of coolant, or actually experience a boilover, have a mechanic check your cooling system.

### Cruisin'

What's wrong with the cruise control on my Toyota? The dealer can't find anything wrong. It sometimes forgets the set speed after I slow down for traffic or a tollbooth. It always works if I accelerate manually, but the RESUME button doesn't work at all until I accelerate back up to a good clip and set a new speed. I really find this annoying, and the dealer is dead-set against fixing it.

SUSAN HENDERSON  
BRADLEY BEACH, NJ

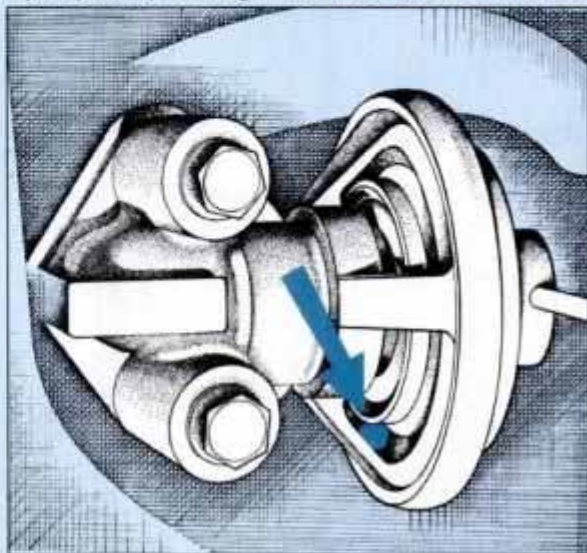
The dealer can't fix it because it's supposed to be that way. This is characteristic of many Japanese cruise controls. Domestic and most

### Let's Go Get Stoned

● I do enjoy an afternoon of off-roading, whether it's gently creeping through the forest headed to a remote campsite or fishing hole, or just a couple of hours blasting through an abandoned gravel mine where nobody cares if you drive like a maniac. The important thing is to leave the smooth tarmac behind.

Or at least to leave as much of it as possible behind. I had indeed been off-roading when the truck just plain quit idling. And since this truck had an automatic, starting it up at 3000 rpm and slamming it into gear wasn't exactly conducive to "Treading Lightly."

Time to investigate. No CHECK ENGINE light, no trouble codes. Time to actually open the hood. And there, wedged into the back of the EGR valve, was a small reminder that Mother Earth wants us to stay on the pavement—a small pebble just the right size to fit past the grille on the valve, but big enough to jam it open.



PH ILLUSTRATION BY AGOUPH E. BICHOIN



# Great Balls of



## CAR CARE

European cruise controls operate differently. Once a cruising speed is set on a domestic car, the controller "remembers" that speed until you turn off the cruise control completely or the ignition is turned off. It's only necessary to bring the car up to a minimum speed (typically 25 mph or so) before you punch the RESUME button, at which point the car will accelerate itself up to speed.

But in the Land of the Rising Sun, cruise controls "forget" the set speed as soon as the car drops below a threshold speed (also typically 25 mph or so). It's necessary for the driver to accelerate back up to the desired speed and set the speed manually by pushing the SET button.

### I Feel Drained

Why is it that manufacturers don't put drain plugs on their automatic transmissions? Changing the filter and fluid is a messy nightmare, and I can't understand why this is.

RON SWANSON  
NO ADDRESS GIVEN

The primary reason is cost—it's cheaper to leave off the drain plug.

And in some ways, that makes a perverse sort of sense. The so-called filter inside an automatic transmission is really only a piece of coarse screen, with a mesh larger than a window screen. It doesn't pick up and hold any wear particles, and if you really want to change the transmission fluid, it's probably best if you remove the oil pan. Then you can clean the sludge, composed of worn friction material and metal particles, off the inside of the pan.

Some car manufacturers don't recommend periodic ATF changes anyway. But in the interests of long transmission life, you ought to change the ATF every couple of years or every 30,000 miles or so.

There are aftermarket drain plugs you can add to your oil pan—but you have to remove the pan to install them. It wouldn't be a bad idea to plumb in an aftermarket spin-on oil filter adapter as well. **PM**

### DO YOU HAVE A CAR PROBLEM?

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

### SERVICE TIPS

• If your 1988-94 Chrysler Ram/Pickup, Jeep Grand Cherokee or Dodge Dakota has a driveline clunk at 18 to 20 mph when coasting down—associated with a 4-3 downshift—your overdrive unit may be causing the noise. Chrysler has a TSB that calls for replacing a spacer in the overdrive with one that's .030 in. thicker to reduce the noise.

• Some late-model GM cars may exhibit a squeaking noise from the front of the vehicle, most evident when shifting into REVERSE or DRIVE while stationary. The TSB covers 1990-94 Buick Century and Regals, Chevrolet Lumina, Lumina APVs and Celebritys, Oldsmobile Cutlass Cieras, Supremes and Silhouettes, and Pontiac 6000s, Grand Prix and Trans Sports. The noise might also be heard when exiting or entering the vehicle. The fix is to replace the springs that hold the exhaust pipe to the manifold at the flexible seal. Use Dampack dampers, PN 10218583, to replace the springs.



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## NEW PRODUCTS

### IMPROVE YOUR CAR



#### Exhaust Pipe Repair Kit

It's a lot less expensive to patch up holes in your exhaust system than to replace the entire system—if it is otherwise sound. The Seal-N-Place Exhaust/Tail Pipe Repair Kit uses a non-asbestos gasket that seals holes without tape or chemicals and is held in place by a 2-in.-wide metal band clamp. The kit not only seals holes but also reinforces the exhaust pipe. Cost is a reasonable \$6.95. From Syon Corp., 280 Eliot St., Ashland, MA 01721; (508) 881-8852.

#### Flat Tire Preventer

Whump! Whump! You know the sinking feeling in the pit of your stomach as you hear the sound of a tire going flat. You certainly don't cherish the thought of changing a tire on the highway shoulder with cars whizzing by, inches away. You'll reduce your chances of getting a flat if you first treat your tires with Slime. Squeezed into a tire through the valve stem, Slime uses a nonaerosol, biodegradable fiber-based formula that evenly coats the inside of inner tubes and tires. Slime seals punctures up to  $\frac{3}{16}$  in. in tubeless tires and  $\frac{1}{8}$  in. in tire tubes, to prevent flats from happening in the first place. Slime costs about \$8 to \$9 for passenger-car applications depending on tire size. From Access Marketing, P.O. Box 3109, Shell Beach, CA 93448; (805) 489-0490.



#### Repair Guide

*Popular Mechanics Saturday Mechanic*, from the editors of POPULAR MECHANICS, gives you the knowledge and confidence you need to tackle any repair job on your domestic or import car, truck or sport/utility. This 360-page, one-stop reference edition is packed with over 550 step-by-step illustrations to help you troubleshoot, repair and maintain everything from engines, drivetrains, suspensions and brakes to electronic ignition and fuel-injection systems. Chapters on repairing and maintaining your car's body and interior will help keep it looking—as well as running—like new, years down the road. This book is a bargain at \$22. From Hearst Books, 1350 Avenue of the Americas, New York, NY 10019; (212) 261-6708.



#### Dumptruck Pickup

If you've ever shoveled a load of sand, gravel, wood chips or fertilizer out of your pickup bed, maybe you thought, "There must be an easier way." Loadhandler's LH 1000 pickup unloader is an easier way, effectively converting your pickup into a dumptruck. Using a high-strength drag sheet wound on a roller mechanism that straps to the top of the tailgate, the device works by pulling the sheet out from the roller and laying it on the bed floor. The load is dumped on the sheet. To unload, you drop the tailgate, insert the winding handle in the roller and wind the drag sheet back onto the roller. This starts the load moving to the rear where it drops off the tailgate. The system will work with up to a 3000-pound load, sets up in 30 seconds and costs only \$349.95, plus shipping and handling. From Loadhandler Industries Inc., 3499 Grand Ave., Neville Island, PA 15225; (412) 771-4900.



#### Fender Cover

One of the first things any do-it-yourselfer should do when working in the engine compartment is drape a cover over the fender to protect the finish against buckles, buttons and zippers. All fender covers, however, aren't created equal. Vermont American's cover features a nonslip surface on the bottom side for extra grip, which comes in handy when working on cars with small, narrow fenders. The cover's top side uses a tacky finish to keep tools and small parts from sliding off. Nonabsorbent, to resist shop liquids, the cover, which costs \$13, washes easily with mild solvents or detergents. From Vermont American Tool Co., P.O. Box 340, Lincolnton, NC 28093-0340; (704) 735-7464. **PM**



## SATURDAY MECHANIC

# LOW-TECH WORK ON HIGH-TECH CARS

BY PAUL WEISSLER

• You've finally gotten the new car through the warranty period, and the dealer's ministrations aren't necessary—or affordable—any longer. Time to start performing some of that maintenance yourself, a daunting proposition on most computer-controlled techno-rides. Without returning to college for degrees in engineering and computer science, how's a Saturday mechanic supposed to stay

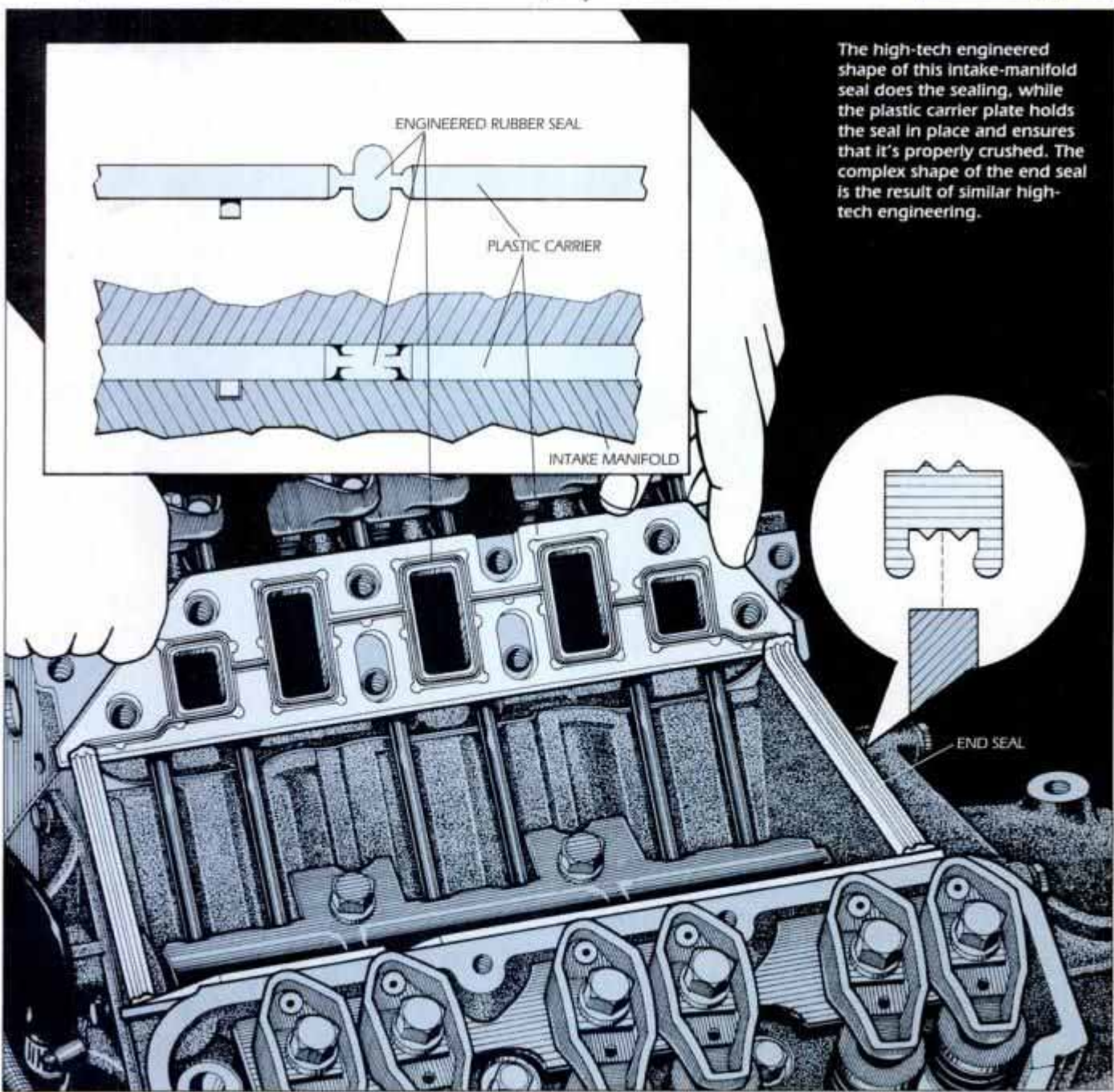
ahead of the maintenance curve? Not to mention having to buy a shop full of tools and test equipment.

Fortunately, most of the work necessary on your car is "low tech." It's routine maintenance such as replacement of lubricants and parts, basic electrical diagnosis, brakes, shocks and struts, spark plugs, cooling systems and belts, and gaskets. It's all the kind of work you can do without a

major investment in equipment and shop manual "book learning." However, there's so much high tech in today's cars that you can't avoid it, even if you stick to the basics.

Gaining respect for the sensitive items and learning how to avoid mistakes that produce problems is a learning experience (although less involved than the high-tech work

*(Please turn to page 106)*



The high-tech engineered shape of this intake-manifold seal does the sealing, while the plastic carrier plate holds the seal in place and ensures that it's properly crushed. The complex shape of the end seal is the result of similar high-tech engineering.



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May 10, 1993

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PM994

itself). Here are the important beginning steps.

## Cooling system

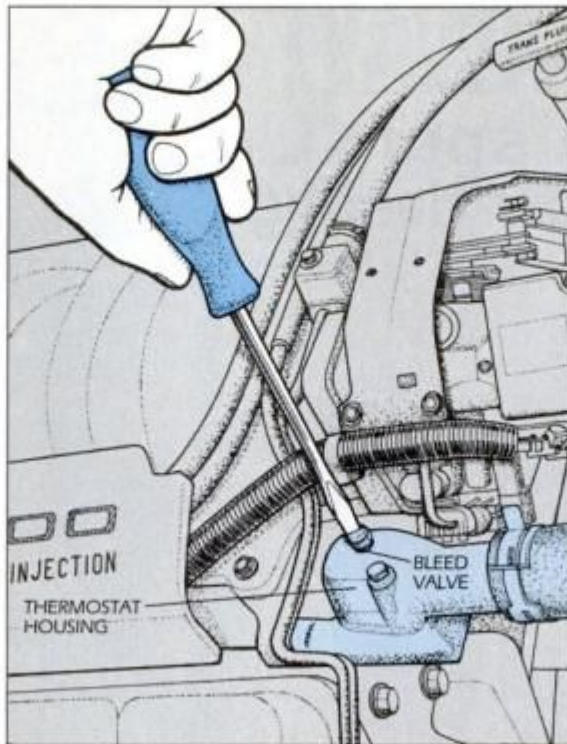
Draining the cooling system and refilling it with a fresh mixture of antifreeze and water is the No. 1 do-it-yourself job, and it's worth doing right. That means opening the engine block drain (if there is one) as well as the one on the radiator and getting out all the old coolant. You then face the problem of completely filling the cooling system. Because the radiator or surge tank neck on many cars isn't the high point of the system, air is trapped elsewhere. Even if it is the high point, there are nooks and crannies in modern systems, many of which were developed with sophisticated computer programs for an efficient flow pattern.

Start by jacking up the front of the car, to help expel air. Then fill the system as well as you can and start the engine. You have to either crack open the little bleed valves—and some systems have several—or you may have to remove a plug. Even with these precautions, you should check the coolant level repeatedly over the next few weeks and keep topping up as necessary. If you don't, the engine will feel the difference in summer and you'll feel it in winter, when the heater output is low. If there's a really big bubble trapped in the system, the engine could overheat. Check your service manual for specific bleeding instructions for your car.

Need to replace a drivebelt? The new multi-V ribbed type is almost universal. If you get the right belt (not just one that's close), follow the underhood decal's routing diagram and make sure the belt is properly aligned in all of its grooves, and it will transfer power smoothly.

If you have to change a thermostat, don't just get one that fits. Many late models have a stat with a bypass valve, intended to make *all* the hot water—not just most of it—flow through the radiator. If you replace the thermostat with one that doesn't have a bypass valve, the engine will warm up slowly, and it may run hotter in summer and heat poorly in winter. A thermostat also may have a jiggle valve, a pinlike device that balances pressures in the system and helps bleed air.

Even if you get the right thermostat, you have to install it correctly



Many late-model cars with low hoodlines require bleeding the cooling system, not simple topping up.

so it operates normally. On many Japanese cars with thermostat jiggle valves, for example, there's a specified position for the valve, such as being aligned with a tab at 12 o'clock.

The gaskets that seal the thermostat housing and water pump also are very different from the fiber/paper type you may be familiar with on older engines. In fact, new gasket designs are all over the powertrain.

## Gaskets

The simple precut gasket is still around, and it may even be a good choice on older cars for replacing

formed-in-place silicone, which can smear during installation and therefore seal poorly.

However, more of the gaskets used today are high-tech designs that resemble giant O-rings. Some of them have a round cross section, others are oval or even an indescribable engineered shape that is designed to seal when clamped down a precise amount. Still others, which resemble conventional gaskets, have torque-limit buttons, which are metal or hard plastic rings for the bolt holes, to resist over-tightening. Others use a hard-plastic carrier to carry an engineered-shape rubber sealing ring, as shown in the illustration on page 104. Intake manifold gaskets are traditionally difficult to seal on V-shaped engines, especially when there's a combination of aluminum cylinder heads and a cast-iron block.

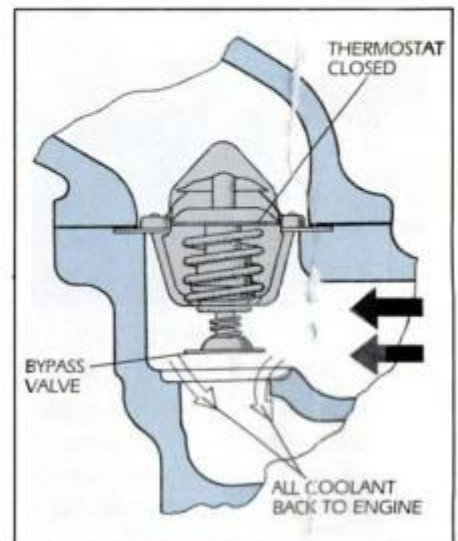
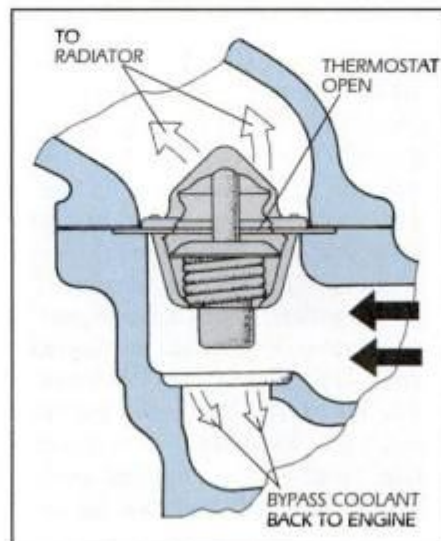
You could use a conventional gasket in place of these high-tech wonders, and it will cost less—but it had better be made by a reputable gasket company specifically listed for your car's exact year and application.

Usually the torque required to seal a gasket properly is a lot less than you would think feels right, and if you overtighten, you distort the O-ring and it will leak. You have to use a torque wrench to be sure.

## Exhaust system

Today's high-temperature stainless-steel exhaust systems are anything but cheap, and they're either welded

*(Please turn to page 110)*



Bypass-style thermostats force all the cold water back into the block during warmup, and all of the hot water into the radiator at running temperatures.

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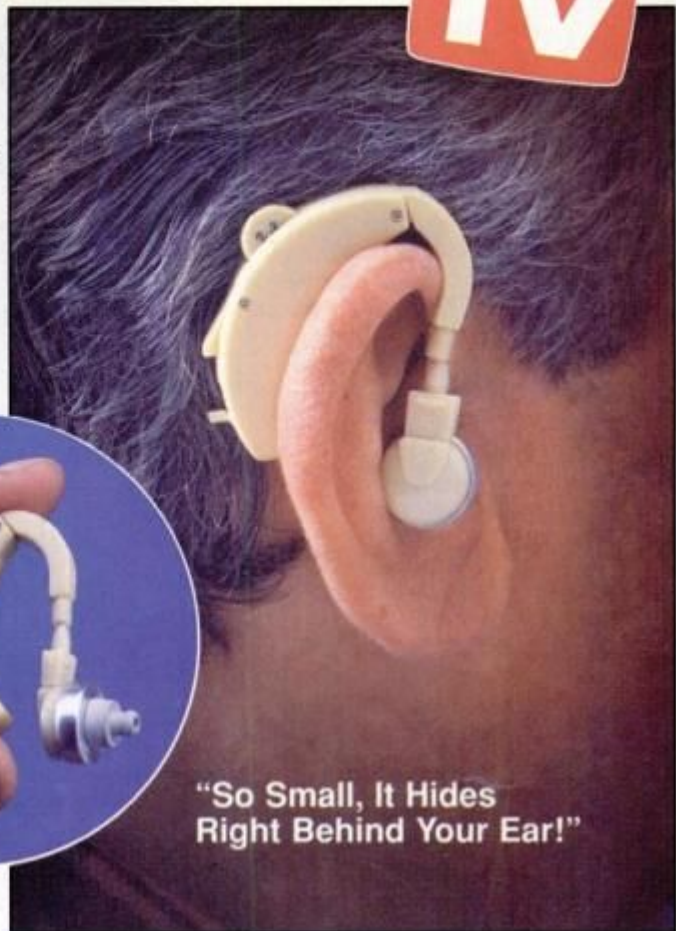
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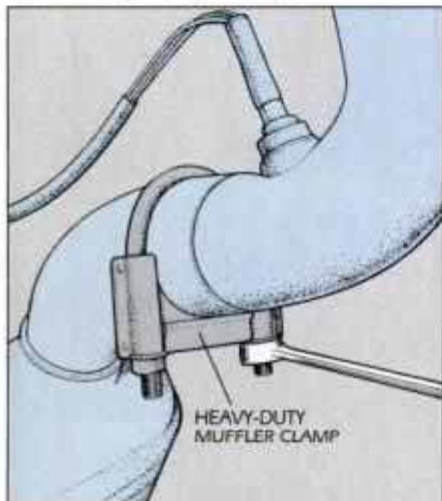
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together or held by super-duty clamps. If you have to cut a weld to replace a pipe or muffler, get a high-quality clamp to ensure it holds the joint on today's heavier pipes. You may have to shop around, or even place a special order, because many parts stores stock only the inexpensive clamps with bent metal saddles. The premium clamps have welded or double-cripped saddles and are probably two or three times the price of the more-common variety, but they are the only kind that can take the 60 ft.-lb. or more of torque needed to clamp the thicker pipes.

## Brakes

If your car has antilock brakes, be careful to not damage the wheel sensor when you pull a caliper for brake

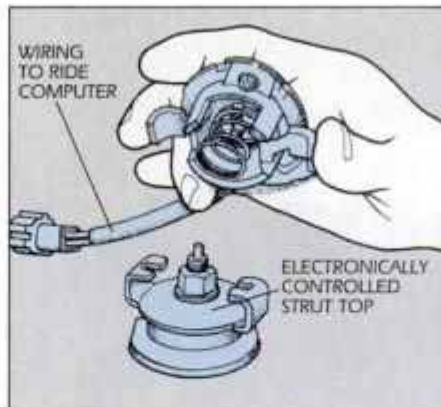


Stainless-steel exhaust systems necessitate heavy-duty clamps to properly seal pipes.

lining work. In fact, it's a good time to inspect the sensor connector for physical damage and the trigger wheel for badly chipped teeth. You may find a reason for misbehavior of your high-tech brake system that's repairable with some pretty common do-it-yourself parts replacements.

Bleeding brakes at the wheels after you replace a caliper should not be a problem with antilock brakes—just stuff a tapered plastic plug into the brake hose end when you disconnect the caliper, to help keep out air.

However, replacing the master cylinder might be a special problem. If it's physically separate from the antilock hydraulic components, you can bleed a master cylinder very well on the bench (or in some cases on the car, just before you reconnect the brake lines)—there are special kits available in auto parts stores for this. And when you install the master cylinder on the car or re-



Replacing ride-control shocks doesn't necessarily mean replacing the actuator.

connect the brake lines, the pedal should be firm. Just plug any hydraulic lines you disconnect to keep out as much air as possible when you start the job.

If the master cylinder and antilock system are a single assembly, you may have to follow a specific shop manual procedure to bleed it. Sometimes this is d-i-y doable, and sometimes it isn't. For example: The master cylinder/antilock assembly on many Fords requires a special procedure. But, the late-model Taurus/Sable also calls for a special electronic switching device and a breakout box (a special adapter for testing circuits) to bleed the single assembly, which (for now) makes it a job for a dealer.

## Shocks and struts

Those computer-controlled shocks may have seemed like a neat feature when the car was new, but they may cost hundreds of dollars a pair at replacement time. If you want to maintain the electronic control, on most cars you can transfer the electric motors that operate the originals to a pair of new shocks and save some money. Even with switching over the motors, you can be in for major expense with electronically controlled shocks, and it may not seem worth it on an older car.

Fortunately, on most cars you can unplug the computer at a connector in the trunk and then install conventional shocks. There are some cases where doing this confuses the car's electronics. This problem afflicts late-model Thunderbirds and Cougars with Programmed Ride Control, early Mazda 626s with Auto Adjust Suspension (but not the later models), Nissan 300ZX Turbos and more exceptions to come. We suspect, however, there will be computer bypass kits available eventually.

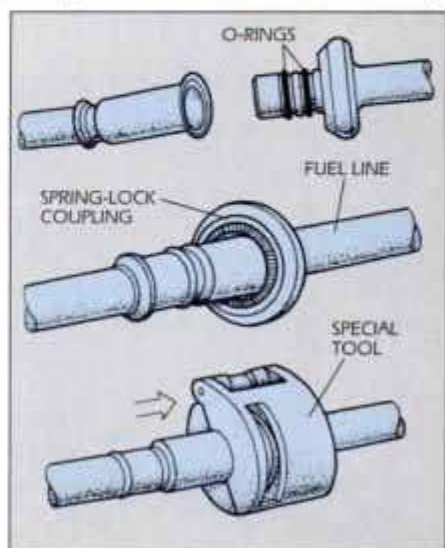
## Tuneup and general electrical

Tuneup and general electrical are areas where you have to be careful, but if you are, you should not let fear of smoking some expensive component keep you from doing work. Here are a few guidelines to follow:

- When you have to disconnect a fuel line on most Ford and Chrysler products, you'll generally find it doesn't have a threaded fitting, but a quick-connect type. It takes a special but inexpensive tool, available from auto parts stores. Don't try to pry the fuel fitting apart, or you'll damage it. These fittings often have O-ring seals, which should be replaced. Be sure to get these in a packet for the exact application. Ford, for example, uses spring-lock couplings on both fuel and a/c lines. The O-rings are not only a slightly different size, but a totally different rubber. Fuel-line O-rings won't live in a/c and vice versa.

- If you have to disconnect a wiring terminal from a plastic connector, such as for an electrical test, you can't just shove in a small screwdriver blade to disengage it, or you could damage the terminal and create a problem where none existed. Virtually all late-model cars have special terminals and plastic connectors for positive retention, and these usually require special tools. The pick-type tools for General Motors and many Ford cars are available from auto parts stores, but you could have difficulty with other makes. In '93, Chrysler switched to a new line of connectors that require a half-dozen special tools that aren't available in auto parts stores at this time.

- If you have to disconnect a battery



Spring-lock fuel and a/c connectors need a special inexpensive tool to open them.



cable, consider the use of a computer memory saver. It not only will keep the time on the electric clock and hold the preset radio stations, it will maintain the long-term calibrations of the powertrain computer. If you lose these, the car's driveability may be poor until the computer "relearns," which could take 100 or more miles of driving.

There are two basic types of memory savers. The 9-volt battery with one type is okay, but just a small voltage drop could kill the memory. So you must keep all electrical accessories and lights off (that means door dome-light switches, too, so either keep the doors closed or install hold-closed clips on the switches). An alternative is a saver that hooks up to a 12-volt battery. If your battery is okay, just carefully make the connections as you disconnect the cable. Or use the battery from another car or a lantern battery.

- Use a computer-safe test light. A standard 12-volt light may allow enough current draw through a circuit with electronics to measurably shorten the life (or even fry) some solid-state components. Computer-safe test lights start at under \$15, and even the best—which plug into a cigarette lighter socket and identify both power feed and ground—are under \$60, including one that has a built-in flashlight (for probing under the dash) and a buzzer if you're probing a power feed in a blind spot.

- The test meter should be a "high-impedance" type (10 megohms or greater), for the same aspects of safety for electronic circuits as the test light. Name-brand multimeters may go over \$500, but there are suitable volt-ohmmeters that start at under \$50.

If you have to probe a circuit and want to do it safely, one way is to buy a "bed of nails" test lead that makes mini holes in a wire, and when you disconnect the lead, they self-heal. You can pierce the insulation with a dressmaker's hemming pin, but it may not make good enough contact with the copper wiring inside.

- Don't move wires underhood. This applies not only to spark-plug wires, but to any harness, including a battery cable (particularly if you get a replacement that's a different length from the original, or is outside a harness and is not easy to route the same way). The reason is the high-voltage electricity from spark-plug wires may produce electrical interference in adjacent low-voltage circuits, particularly if they contain electronic com-



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ponents. Because many electronic components operate on 5 volts, even the sudden flow of 12-volt high-amperage electricity through a battery cable during cranking can cause big trouble.

- Never disconnect or connect a circuit, or an electronic module, with the ignition key in the ON position. In fact, to avoid static electricity damage, unplug an electronic module with one hand held to a body ground. Static electricity that discharges from your hand may not totally trash an electronic module, but it can shorten its

life from years down to weeks or even days. Professionals who face this problem all the time may wear a grounding strap on one of their wrists.

As you get familiar with your car and read the manuals, you will be able to move into higher-technology service. You'll discover that it takes careful attention to the diagnostic procedures in the manuals, but it isn't rocket science, and it doesn't take a degree in computer science, either. The high tech you've already learned in doing the low-tech service will get you started.

PM

## AUTOMOBILES

# The Alternate Fuel Report: Honda Dream Solar Racer

BY MIKE ALLEN, Associate Automotive Editor

● Iwata-san seemed concerned as he looked at me while his two assistants carefully lowered the bodywork over the naked skeleton of his race car. The look on his face reminded me of a similar situation many years in my past involving a worried father, a high-school cheerleader and a new, blue Porsche. Iwata began again the litany of instructions I had heard him give to another journalist, but after only a few words he sighed, shrugged his shoulders and said, "You know."

It was my every intent to bring his car back intact. I'll let history speak for itself in the case of the high-school girl.

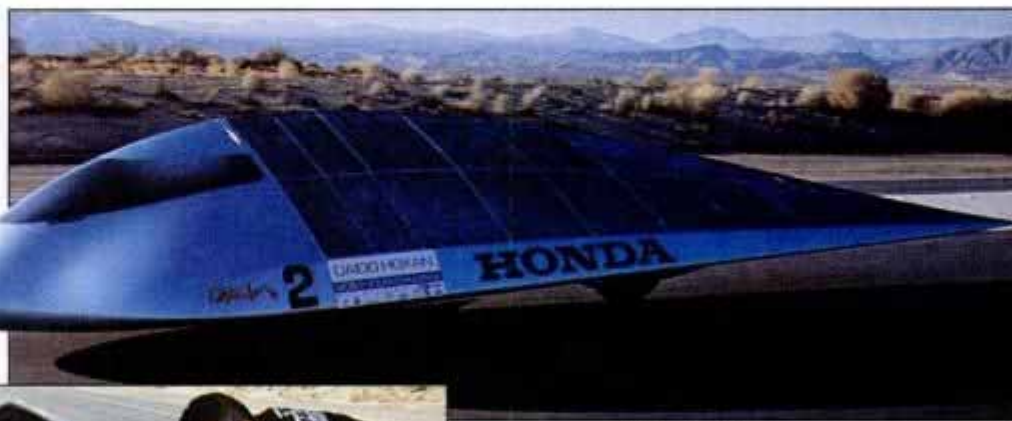
The car that I was strapping on is as exotic and finely crafted a vehicle as I've ever been near, much less been allowed to pilot around, even briefly. It certainly is the most expensive.

The Dream was commissioned for one purpose: to win the 1993 World Solar Challenge, 3000 km from Darwin to Adelaide, Australia. Not only was Honda the overall winner—with the Dream speeding to an all-time record of 52.79 mph—but the existing record, set six years ago by the GM Sunraycer, was bettered by over 21%.

Honda recently gave a select group of journalists an opportunity to briefly drive the Dream at HPCC, its test facility in Mojave, California. HPCC is far out in the desert where the land is cheap, and far from prying eyes.

According to Honda engineer and team leader T. Iwata, "Honda Dream was designed to go faster than other cars for exact length of race. No longer. So construction is precisely strong enough to go distance. And Dream has already gone this far and more. So remember when you drive, car already worn out. But you will see."

The relationship between this car and any product that Honda might sell to the public is about as close as Honda's Formula One efforts are to a Civic. The carbon-fiber backbone



Project manager Iwata assists editor Allen into solar racer.

frame is gemlike in its construction details, including such niceties as fairings for the bottom of the wheel wells that rotate with the steering for reduced wind resistance. The front suspension control arms are magnesium fabrications, no thicker than a pencil. Many of the nuts and bolts are aluminum.

Every component of the Dream is optimized to be as light as possible, which was pointed out to me in particularly graphic form as I tried to



Ultra-lightweight suspension is faired in top and bottom to reduce aerodynamic losses.

squeeze my full-size Western-journalist backside into a cockpit intended for 60-kilo Japanese engineers with thighs like pipe cleaners. There's almost nothing to hang on to while lowering yourself into the seat, and I managed to twist the handlebars completely free of the steering column before I realized it. The steering column is aluminum-alloy tubing, and not significantly thicker than a Budweiser can. Iwata-san declared lunch break, and he and his crew had a new steering column installed before dessert.

The neodymium-magnet brushless motor nominally runs on 124.5-volt DC, and is rated for 2 horsepower produced continuously, 8 hp for short periods. It's mounted in the hub of the single rear wheel to eliminate any losses from a drive chain or belt. Honda claims an amazing 95% efficiency.

Feeding the motor is a bank of 83 1.5-volt silver-zinc batteries, rated for a total of just under 5 kilowatt-hours. Divide that by the motor's 1.5-kw consumption and you get 3 hours of operation, hardly good enough. The real source of power is 4584 mono-crystalline silicon solar cells, capable of producing more than 1.5 kw in bright sunlight.





Peak Power controller and panel manage power from solar array and batteries.

Produced specifically for the Dream by SunPower Corp. in Sunnyvale, California, the race cells produce an average efficiency of 21.2%—SunPower's Dr. Richard Swanson claims the array achieved a world record for efficiency as measured by the DOE's Sandia National Laboratory. Using Point-Contact Photovoltaic technology, the cells have all of their metallic electrodes on the back of the cell to increase efficiency, as well as a mirrored back to trap as much energy as possible. The entire 89.1-sq.-ft. array, laminated by Honda into square-foot-size modules, weighs just under 43 pounds. Honda won't release figures, but estimates for the cost of the cells actually used on the race car—not including cells used for design and development—put the cost of the solar array at well over \$1 million. SunPower, essentially an R&D concern before receiving inquiries from Honda, had to set up a production line to produce cells for the Dream project.

Honda also chose to laminate the cells under a textured acrylic sheet, grooved with fine horizontal striations, to increase the ability of the cells to capture low-azimuth morning and afternoon light rays.

Integrated into the cockpit is a computer-controlled cruise control. There are no environmental controls of any sort, making for a very uncomfortable day for the driver in the hot Australian outback. Ducting air through to cool the driver would add parasitic drag to the Dream's low-drag shape.

Lowering losses throughout the vehicle was paramount in the priorities of the Honda R&D staff. The tires are specially made low-rolling-resistance bicycle tires with tubes. And in spite of starting out on fresh skins every morning, the team suffered a total of six tire failures in the 1800-mile trip. With tire changes taking only 2 to 3 minutes, the delays were more than made up for by the higher speeds permitted by thinner, more fragile tires.

All-up weight of the Honda Dream, sans driver, is 413 pounds. And although the construction seems more like a kite to a fellow used to piloting 300-hp stock cars at 150 per, there's no denying the racer's competence

in its intended milieu.

The heavily smoked Plexiglas windshield is rippled by distortion, but the 100-ft.-plus-wide track holds no surprises more dangerous than the occasional desert tortoise, most of which are still sleeping on this cool day. Squeezing the lawnmower-style throttle on the handlebars gives a gentle—very gentle—push in the small of my back, accompanied by a rapidly climbing thumping as the permanent magnetic motor reaches an rpm where it works more efficiently. Speed climbs steadily. The thumping noise smooths, or at least is overshadowed by road noise intruding into the cockpit. The wheel wells flanking my elbows are covered with an aerodynamic fairing the size of a turkey platter and about as substantial as a sheet of parchment. The fairings provide little noise reduction, and as the

speed continues to climb they start to rattle and resonate.

I level off at 100 kph, or 63 mph, just about at the entrance to turn one. With an arc nearly 2 miles long, it hardly seems like a corner—but the Dream's pushrod steering can be most kindly described as vague. It takes a few mild oscillations to settle in. But within a minute or two, I get the hang of the steering and bump the speed up to 110, constantly aware that Iwata is watching his multimillion-dollar car from a chase car only 100 ft. or so to my rear.

Eight miles and a scant 10 minutes later, I get a chance to try the Dream's brakes, which barely qualify as brakes at all. The intent was to use regenerative braking for all but emergencies. Regenerative braking, which recovers some of the vehicle's energy to recharge batteries, does not provide braking for normal traffic. And frankly, any brake action that locked the wheels would probably scrub through the thin rubber and blow the tire immediately.

Honda claims the Dream's top speed is in excess of 140 kph, on a sunny day with fully charged batteries, but the handling tends to get a little spooky above 110 or so. I elected to bring Mr. Iwata's baby back home in one piece. **PM**

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## AVIATION

# Training In Style

BY WILLIAM GARVEY

● If you are an air-minded type who stays abreast of technology, finance and law, then you might have predicted the arrival of the Katana. After all, an important piece of flying hardware is hard to miss. The Katana is such a machine.

To fully appreciate this airplane, you have to review the times in which it has emerged.

No basic 2-seat trainer—arguably the cornerstone of general aviation—has seen manufacturing in a decade or more. One big reason: The product liability laws in the United States hold manufacturers liable for the integrity of every aircraft they've ever produced, regardless of age. So rather than spend their time and money defending against lawsuits involving old planes, they've simply stopped making light planes altogether.

Consequently, flight schools have had to win and train students in 152s, Skippers and Tomahawks that are cold, tired and hungry for maintenance. Enticing nervous novices to aviate is tough enough. But it's all the more difficult when the trainer planes are decades old. Concerned about the absence of new trainers, the Federal Aviation Administration and its foreign counterparts have simplified certification procedures to stimulate light-plane development.

To complete the picture, consider the advanced state of composite technology. The manufacturing is well understood, and the durability of the finished material is pretty much accepted.

That's where Christian Dries comes in. A German industrialist and avid general-aviation pilot, Dries saw this scene ripe with opportunity. In 1991, he purchased HOAC, an Austrian firm that made the Super Dimona, an all-composite motor glider powered by the Rotax 912. Dries immediately set about new-product development, and the result was the DV 20 Katana, a tricycle-gear machine obviously derived from the Dimona.

As the Katana was winning its European approval, a group of Canadian entrepreneurs approached Dries with the idea of setting up a manufacturing facility in North America and going



for the gold—making the Katana the world-standard training plane.

Clearly the proposal had appeal. In 1993, Dimona Aircraft Corp. was established in London, Ontario—immune from the product-liability plague in the United States (Canadian courts frown on frivolous filings). And now an immense factory that once cranked out Mosquito bombers is

Toronto to the London factory, and both the airplane and the facility made strong impressions. You see, the firmament of my aviation experience is stamped aluminum from Cessna, Piper, Beech and Grumman American. Rightly or not, it's the undeniable measure for all that followed. The Katana challenges such fuddy-duddy standards.

First off, it looks different—low and lean, with an unobstructed canopy, wingtips, cinched empennage and T-tail. All-composite from prop to tail, the airplane's rivetless finish is mirror-smooth. Its European motor-glider roots are obvious.

Second, what drives this head-turner is a Bombardier/Rotax 912. The 4-cylinder mill puts out 81 hp while sipping 100LL or auto gas at a miserly 3.2 gallons per hour. That's a welcome development when the price of fuel is upward of \$2 a gallon—and climbing. Power flows to a constant-speed 2-blade Hoffman prop.

Third is the flying experience.

Pull the side levers, and the entire canopy yawns open, F-16 style. Grab the panel handhold, put your foot on the forward step and climb aboard. The Katana easily accommodates any pilot height with a simple pull-cord for

building trainers. Lots of them. The first one rolled out amid fanfare on June 29.

I recently flew

a Katana from



The Katana: clean lines, clear sightlines.

adjusting rudder-pedal placement. While no trainer is spacious, the Katana seems more commodious than most. I'm a 6-footer, and my right-seater was 6 ft. 5 in. We weren't even rubbing shoulders.

By comparison to yesteryear's trainers, the Katana's panel is low-profile, enhancing the plane's spectacular visibility. Although the panel design is being reworked slightly, the arrangement is standard: flight and navigation instruments on the left, Bendix/King radios in the center, power/systems indicators, right. The center console has throttle, carb ice and prop levers, but no mixture control—dual altitude-compensating carburetors keep things lean automatically. And significantly absent are yokes. You fly with a stick, as all pilots should. Just above the throttle is a 3-position electric flap and a most effective cabin-heat control knob. Although my airplane had a manual trim wheel, this is being replaced with an electric system.

Since this was the day's first flight, I pulled the choke before hitting the ignition. The engine started instantly. All little planes are noisy, but the Katana's din level was quite acceptable.

Because the Katana's nosewheel casters freely, you dance on the brakes to steer on the ground—a system that struck me as sluggish and ineffective. After a tortuous trek around Toronto International, I longed for a steerable nosewheel.

For takeoff, it was full throttle and prop to 2500 rpm. When the airspeed indicator hit 45 knots, I began tugging on the stick, and the machine got light on its gear. Moments later, we were climbing out at 65 knots. During climbout, you retard the prop 100 rpm, and you don't touch the control again until landing.

The sensitivity and responsiveness of the control impressed me immediately. Despite its light weight—1610 pounds gross—the Katana has a surprising heavy-plane feel, a characteristic that students will welcome.

Additionally, stalls—the maneuver that most often terrifies students—are docile beyond imagining. Neither power-on takeoff stalls nor full-flap landing stalls produced anything more than a horn blast, a shudder and altitude decline. Pop the stick forward, and the situation immediately rectifies itself. As for speeds, I held altitude and had full aileron control with the airspeed indicator fluttering below 50 knots.

The Katana cruises at 119 knots and has a maximum range of 523 nautical miles, so it makes a fine cross-country traveler as well.

Landings were straightforward.

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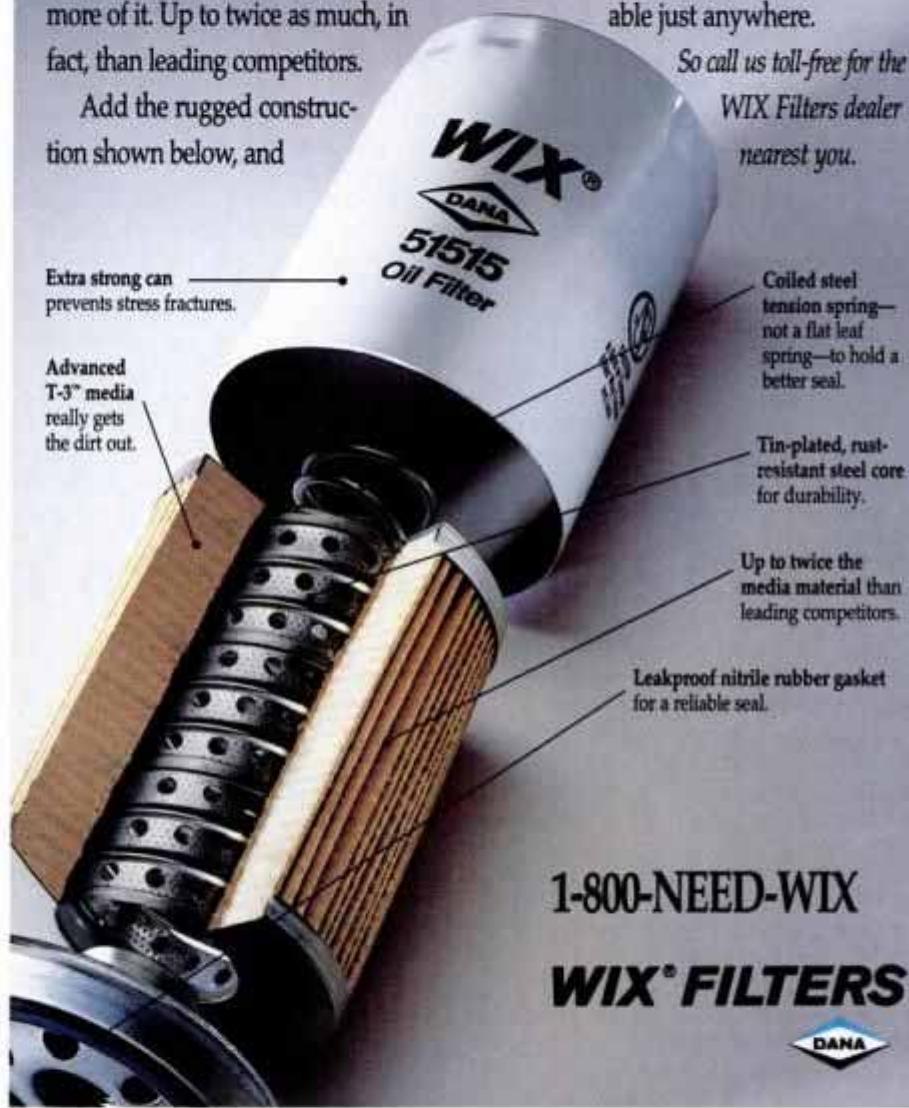
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The flaps are very effective and the aircraft is stable through descent. You can touch down as slow as 45 knots, but for a squeaker, put in 15° of flaps and hold the airspeed at 75. The steel spring gear will dampen any heavy-handedness.

One more feature worth noting in the trainer is its 14:1 glide ratio. Lose an engine at 2500 ft., and 7 miles of landing choices lie in any direction.

Back at the factory, I could see how the company's confidence in its product is underscored by the enormity of its investment. There's no doubt that these guys intend to be a major force

in aviation. Dimona sank \$40 million into refurbishing the plant. The facility is to build 60 Katanas this year, 250 more in 1995 and 360 the next year. It has the capacity to manufacture 600 trainers a year. To attain that number, the company is targeting flight schools. While the Katana lists at \$98,500, schools can realize substantial discounts off that figure with multiple buys.

And what of the students who earn their wings in a Katana and are ready for something more? A 4-place version is in the works... but then that's another story.

PM

# The Big Brother Chip

BY MURRAY SLOVICK

● Nobody likes an eavesdropper. In an era of E-mail and computer networks we all want our bank transfers, credit card numbers, employment records and medical data to be transmitted electronically without danger of theft.

At the same time, the nation's law enforcement community needs to retain the ability to intercept, capture and monitor the content of calls made on digital transmission services by mobsters, terrorists and the illegal drug crowd. Indeed, the ability of law enforcement officials to monitor cellular phone calls led to the apprehension of the men who killed the father of basketball star Michael Jordan.

The National Security Agency (NSA) thinks it has the ideal solution to the problem. NSA is the U.S. federal agency responsible for the design and use of nonmilitary encryption technology, developing sophisticated codes to scramble data, voice or video information, and making it unintelligible to all but the intended recipients.

NSA's most visible attempt to out-gun cybervillains is called the Clipper chip. Despite initially positive feedback from security experts who are confident that the Clipper chip can withstand an attack by high-speed computers trying to break its encryption code, the plan has drawn fire from the beginning from civil liberties groups, such as the Computer Professionals for Social Responsibility (CPSR) of Palo Alto, California, and the Electronic Frontier Foundation (EFF) of Washington, D.C.

These groups, concerned about government intrusion into personal privacy, argue that the Clipper chip is potentially more than a radar gun on the information superhighway. Indeed, Danny Weitzner, communications policy analyst at EFF, suggests that legislation to implement the Clipper chip could turn the Infobahn into a "nationwide surveillance system" that could be used by law enforcement officials "with few safeguards."

To make matters even more interesting, it appears the Clipper chip doesn't work exactly as advertised.

EFF and other public advocacy groups are up in arms over the Clipper chip because, in trying to balance the needs of communications security

with the needs of legitimate law enforcement agencies, NSA has included a wild card in the deck: a digital trapdoor. Each Clipper chip, installed in every phone, computer and Personal Digital Assistant in America, will carry a device identification number or electronic "key"—a family key and a unit key unique to each Clipper chip.

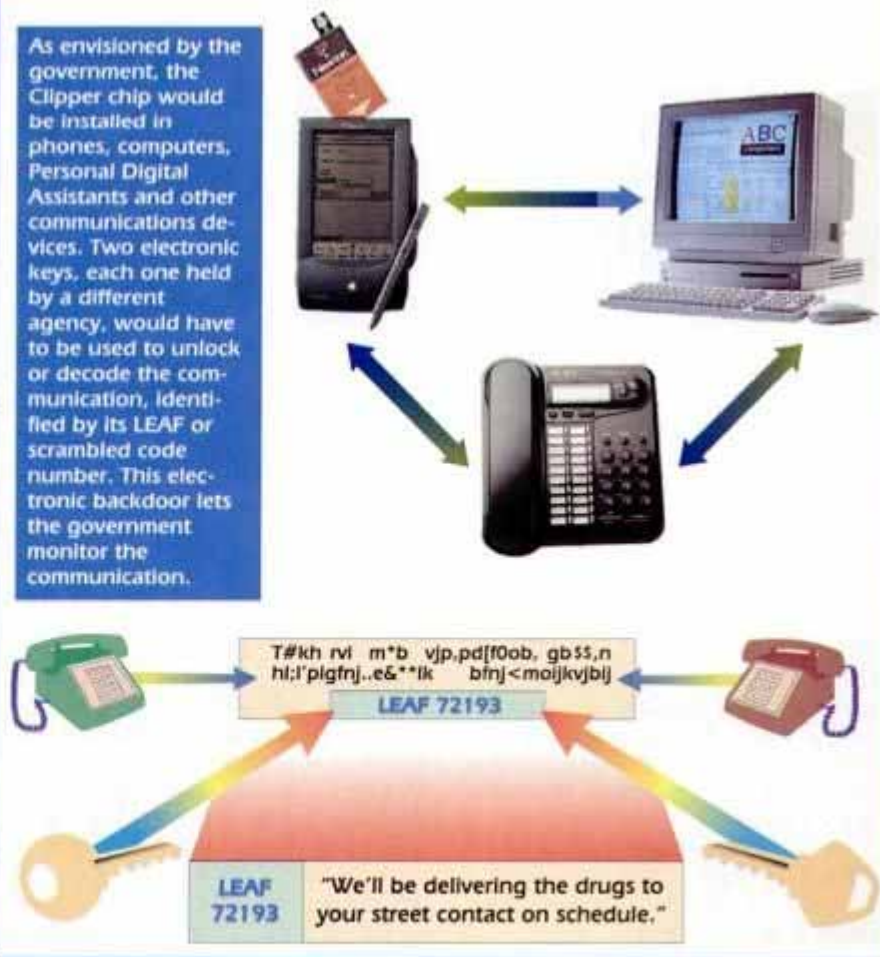
The device key is split into two numbers that, when combined into what's called a Law Enforcement Access Field (LEAF) number, can unscramble the encrypted messages. But here's the dicey part: The device keys and the corresponding device numbers would be kept by the U.S. government through key escrow agents. Under the current plan the attorney general would deposit the two device keys in huge, separate elec-

tronic database vaults. One key would be held by the National Institute for Standards and Technology (NIST) and the other by the Automated Systems Division of the U.S. Treasury.

Access to these keys would be limited to government officials with legal authorization to conduct a digital wiretap. When a law enforcement agency wants to tap into information encrypted by the Clipper chip, they must obtain a court order and then apply to each of the escrow agents. The agents electronically send their key to an electronic black box operated by the law enforcement agency. When these keys are electronically inserted, encrypted conversations stream into the black box and come out as standard voice transmissions or as ASCII characters in the case of E-mail.

## Tales From The Encryption

As envisioned by the government, the Clipper chip would be installed in phones, computers, Personal Digital Assistants and other communications devices. Two electronic keys, each one held by a different agency, would have to be used to unlock or decode the communication, identified by its LEAF or scrambled code number. This electronic backdoor lets the government monitor the communication.



## How it works

Current state-of-the-art encryption codes employ what is called asymmetric key cryptography. In this methodology, the user has two keys—one public and the other private. The two parts have a special property: What is encoded with one can be decoded with the other. The public key is widely distributed and the private key is kept secret and used only by its owner. In the Clipper chip, the unit key acts as the private key. If someone wants to send you an E-mail message, they encrypt it with your public key and you decode it with your private key.

NSA's current encryption standard is known as the Digital Encryption System (DES). The algorithm behind DES belongs to a class of ciphers known as block product ciphers because they operate on a fixed-length block of bits or characters. DES uses 56 bits.

The 80-bit Clipper chip uses a more powerful key-escrow type encryption algorithm called Skipjack that's embedded in the Clipper chip. Encryption experts estimate a powerful computer would take 36 years to crack Skipjack compared to 10 years for DES. Needless to say, the Skipjack algorithm is a highly classified secret.

What is known is that Clipper chip will encrypt at speeds up to 15 megabits per second and can support Integrated Services Digital Network (ISDN) gear. This information was released to answer critics who worried that the Clipper chip would be unable to keep up with modern, high-speed communications gear.

## The flaw

Despite its apparent impregnability, it appears that the Clipper chip technology is flawed. Dr. Matthew Blaze, a computer scientist at Bell Labs, discovered a flaw that would allow two people to have a conversation that could not be monitored or unscrambled.

To bypass Clipper, Dr. Blaze devised a computer program that tested thousands of separate LEAF numbers. Upon finding a valid key, he inserted it in place of a valid key created by the Clipper chip. The end result is that anyone attempting to unlock the communication would be unable to do so.

To date, according to NIST, the Justice Department has ordered 8000 Clipper chips from AT&T, the only present supplier, and the Defense Department is believed to have ordered 20,000 chips.

In the meantime, the first national debate of the Information Age rages. On one side, pressure to support law enforcement officials in their efforts against organized crime continues to mount. Dorothy Denning, a professor at Georgetown University in Washington, D.C., and a respected encryp-

tion specialist, wrote recently that failure to enact legislation to ensure a continued capability "for court-ordered electronic surveillance" would result in the information highway becoming a sanctuary "for criminality wherein organized crime leaders, drug dealers, terrorists and other criminals could conspire and act with impunity."

Given the current flaw in the Clipper chip, the Infobahn could still be a sanctuary for sophisticated highwaymen wanting to act beyond the law. The flaw in the Clipper chip may be correctable, but that remains to be seen. Meanwhile, the government is designing another Clipper-based device called the Tessara card for use with personal computers.

The Clinton administration remains firm in its support for the Clipper chip. President Clinton has said the Clipper chip technology "provides law enforcement with no new authorities to access the content of private conversations of Americans." And Vice President Gore has stated, "We have no intention of supporting a system that will create a de facto ease of entry into the information superhighway for law enforcement officials without proper legal proceedings."

CPSR, meanwhile, has an electronic anti-Clipper chip petition drive under way.

In any event, this promises to be

only the beginning of an ongoing debate about electronic security. New digital cellular phone systems and other, more global voice and data services will be difficult for police and security services to monitor.

Meanwhile, in the private sector, a company called RSA Data Security Inc. of Redwood City, California, is gaining computer-industry support for its encryption software. Somewhat like the Clipper chip, RSA employs a public key for sending messages and a private key for decoding them. Such a system could be used for filing tax returns or for using a credit card number for online shopping. The public key would be used by an online shopping service to advertise its wares. The private key would be used to transmit a credit card number when you make a purchase.

Unlike the Clipper chip, RSA's system has no electronic backdoor that allows the government to eavesdrop on the transmission. The government worries that if RSA's encryption technology is sold abroad, then federal agencies would be unable to eavesdrop on communications that may be a threat to national security. Ironically, it is the security of RSA's software that makes it attractive to business. RSA has already sold over 4 million copies of its encryption software. **FM**

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# Wet 'N' Wild Cameras

BY GEORGE SCHAUB

● Judging from the new cameras coming to market, this is the year for smaller, lighter and more compact versions of what came before. Compact and simple are in, as is single use.

The photographer has an infinite number of choices when shopping for a new compact zoom camera, or for a "simple" single lens reflex (SLR) model. And, if you just want a camera that you can give back after shooting, the so-called "single-use" camera (which is probably better named the "recyclable" camera) has more manifestations than ever before.

Rumors have been swirling through the industry about a smaller 35mm film format, one that will allow designers to produce cameras that fit into a shirt pocket or the palm of the smallest hand. The word is that this change is approximately two years away. But manufacturers must be anticipating the smaller film cartridge, judging from the miniaturized marvels that are now appearing. But smaller doesn't mean less features, as each of the new arrivals sports a retractable zoom lens, built-in flash, multimode exposure systems and other benefits usually associated with larger-bodied cameras. In short, high-tech miniaturization has taken hold of the camera industry.

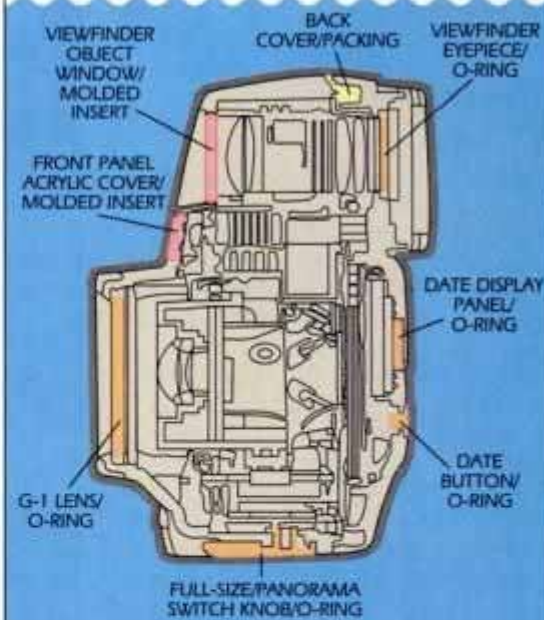
Bragging rights about who's got the smallest, lightest zoom compact is what much of this year's introductions are all about. Nikon's Lite-Touch Zoom (list price: \$240), dubbed by its makers as the "world's smallest autofocus zoom," is 4.6 in. wide and 1.4 in. deep and weighs in at 7.1 ounces. The Pentax IQZoom 735 ("ultralight, ultracompact"; list price: \$263) weighs in at a touch over 8 ounces and measures under 5 in. wide and about 1½ in. thick. Both units sport a 35-70mm



zoom, numerous flash modes and features that make them eminently useful snapshot cameras. And there is also the Konica Big Mini Zoom BM-510Z (list price: \$320), which also has a 35-70mm zoom, and measures 4½ in. high and 1½ in. thick and weighs in at 8.3 ounces.

While these cameras certainly impress with their compact size, there is somewhat of a price to pay for their portability—the fairly low lens speed at the maximum focal length. When zoomed out to 70mm, the Pentax's maximum aperture (widest lens opening) drops to f/8, the Konica's falls to f/7.4, and the Nikon hits a slightly more respectable f/6.5. In each case, the optical systems drop nearly or just over two stops from their widest focal-length setting. This loss of light-gathering ability can and does crimp flash range, and may pose a problem on overcast days or when light is low and the photographer wishes to shoot at the telephoto setting and/or without the aid of flash. The answer? These cameras certainly benefit from the use of fast film, such as an ISO 400 speed, in all but bright-light shooting

## Going Down Under



O-ring seals around the controls keep water out.

conditions. And, with the excellent ISO 400 print films available today, this will not mean any appreciable loss of picture quality.

On a slightly larger scale, the Samsung ECX 1 (list price: \$799) has a look with which Batman would feel at home. The camera has a certain wingswept feel that was designed by none other than F.A. Porsche. The re-



This is not a bathtub toy.





A camera with a Porsche design.

tractable zoom covers a remarkable 38mm to 140mm, can focus at less than 1 ft. and has something called "computer zoom mode," which makes adjustments if the exposure system deems the focal length (thus, the aperture setting) too long for proper flash coverage. With an f/9.9 maximum aperture at 140mm, this automatic (though cancelable) override solves some of the problems already described, though it will sometimes foil the picture you want to take. The Samsung ECX 1 has virtually every mode, feature and capability possible in a lens/shutter camera, which includes panorama format, 3-frames-per-second shooting speed, numerous flash modes and multiple-exposure effects.



Lightweight with a big zoom.

### Braving the elements

In the underwater category, the Canon Sure Shot A-1 (list price: \$310) can take you down to about 16 ft. The design is excellent for all sports, including skiing, with a tough fiberglass polycarbonate body, an oversize viewfinder and shutter-release button and O-ring seals around all controls and, of course, on the inner-body seals. Above water, the A-1 delivers autofocus operation. Underwater, where the IR beams used for AF would be thrown off, there are two focusing choices—macro (1.5 to 3.3 ft.) and normal UW (3.3 to 9.8 ft.). The A-1 Panorama Date model (list price: \$345) gives all the above, plus the ability to switch to wide-field panorama mode, even while underwater. All in all, an intelligent design in a cool camera.

For boaters, skiers or those who like walking in the rain and promise not to drop the camera underwater, there's the Olympus SuperZoom 2800 (list price: \$420), with a built-in 28-80mm lens. This



Takes the rain but not dunks.

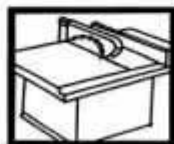
camera sports a "soft touch" skin, which we find makes for a much more grippable surface, a boon in the aforementioned conditions.

Finally, and to bring us into the single-use realm, there's the Konica Film-In Waterproof. Resembling a bathtub boat with a sports-finder mast, the cute Konica Waterproof can go down to about 9 ft., and has a shooting range of about 5 to 10 ft. Lack of a built-in flash means use is limited to close-to-surface scuba shots, though the loaded ISO 400-speed film helps. The plastic housing has an oversize shutter release and film-winding knob attached.

Meanwhile, the Nikon Zoom-Touch 105VR QD brings a camcorder concept—vibration reduction—to still cameras. Nikon claims that with improving lenses and excellent films, the issue of sharpness often resides in the hands of the photographer. When shooting in low light and/or with highly extended zooms, the photographer may lose picture sharpness because of the slow shutter speed or simply because he moves the camera to and fro while squeezing off the shot.

Nikon's answer is something it calls an Anti-Vibration Device (AVD), which senses the motion of the camera and induces a sympathetic counter movement to compensate for the yaw and pitch of the motion. Unlike some camcorder systems that use an electronic or shutter-speeding shake-reducer, the Nikon approach is mechanical, and it's built into the camera's optical system. Nikon was mum about applying this to SLRs, and right now we think it's waiting to see if this fascinating feature makes a difference to the consumer before it tries it out in other camera models. **FM**

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## COMPUTERS

# Finger-Pointing Laptops

BY STEPHEN A. BOOTH, Contributing Editor

● Cutting-edge technology and thoughtful design have long enabled Apple Computer to affect all areas of personal computing. The company's latest PowerBook portables should polish that image even further. Innovations that users will appreciate include a souped-up battery that lets you monitor its performance, dual-battery operation and a communications modem that adapts to phone systems worldwide. Also, a pointing device with no moving parts is something that any computer user will appreciate. Beyond these and other features, the mobile machines even look great.

There are two distinct kinds of PowerBooks. The four models in the 500 Series are virtually desktop computers designed for the road. They weigh between 6 and 7 pounds and even have the contoured styling of today's muscle cars. The PowerBook Duo 200 Series has two subnotebook-size models tipping the scales between 4 and 5 pounds. What they all have in common is a Motorola 68LC040 microprocessor for an engine—similar to the one used in Apple's high-end Macintosh Quadra desktops and comparable to the Intel 486DX2 found in IBM-compatible PCs.

To run this more powerful chip, Apple has gone to nickel-metal-hydride (NiMH) batteries. They'll fuel the 200s for 2 to 4 hours, and the more demanding 500s for 90 minutes to 3 hours. The

NiMH batteries recharge in just 2 hours.

Other manufacturers of portable computers use NiMH power packs, but Apple computers are so smart they have an on-board microprocessor all their own.

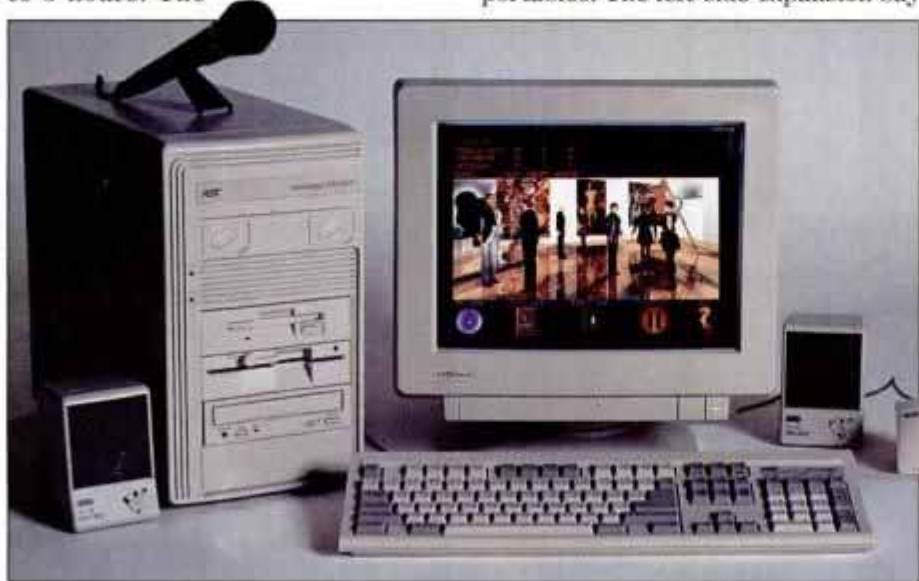
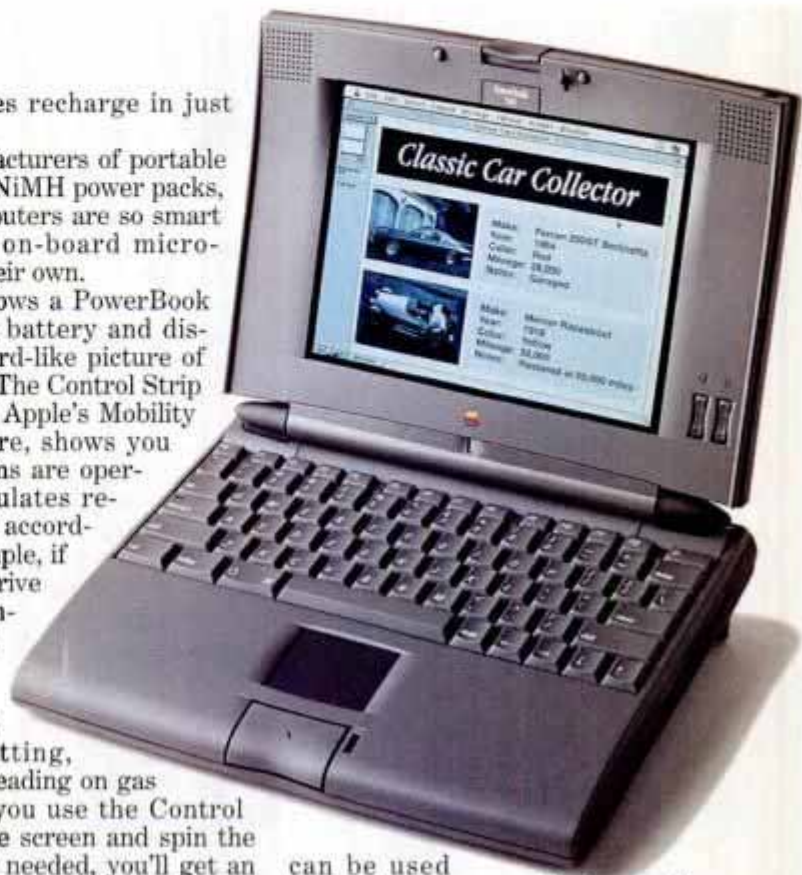
This chip allows a PowerBook to monitor the battery and display a dashboard-like picture of the fuel status. The Control Strip display, part of Apple's Mobility Bundle software, shows you what subsystems are operating and calculates remaining power accordingly. For example, if the hard-disk drive is spinning continuously and the liquid-crystal display screen is at its brightest setting, you'll get one reading on gas remaining. If you use the Control Strip to dim the screen and spin the disk only when needed, you'll get an updated power reading that's revised accordingly.

What makes this kind of feedback so useful is that you'll develop a feel for how the computer uses power, and learn how to conserve juice between refuelings—when you're flying, for example. Speaking of flight, you get two wing-tanks in the 500 Series portables. The left-side expansion bay

can be used either for accessory devices or for a second battery. Both power packs refuel simultaneously in just 2 hours when you hook up to AC. You can recharge while you work, too. In this case, the batteries charge sequentially, in 4 hours. Another aviation-like feature of PowerBooks is their construction. A polycarbonate-reinforced skin covers a magnesium frame—which also acts as a heat sink. Apple claims the casings are four times stronger than previously.

Perhaps the most innovative touch in the PowerBook 500 Series is Apple's new "trackpad," a pointing device that controls cursor movement in place of a more traditional mouse or trackball.

It's a rectangular panel, located on the keyboard between where your thumbs rest. To move the cursor around the screen, you simply move your finger around the trackpad. It's very precise. The trackpad uses a technology called capacitance-coupling. It's similar to those elevator buttons that light up as your finger approaches. Under the abrasion- and spillproof polymer panel, two layers of electrodes in a grid pattern sense the change in capacitance



A new shell program makes this AST multimedia computer easy to use.

created by the presence of your finger. As your finger moves, they calculate the direction and speed of the altered capacitance, and move the cursor accordingly. The trackpad is available only in the 500 Series of PowerBooks. Ditto for Apple's Express Modem II, developed to make telecommunications simple from anywhere in the world.

Compact-disc-quality 16-bit digital audio is also a feature exclusive to the 500 Series. The assumption is that you'll use these laptops for multimedia presentations, and want the best-quality sound. The sound is terrific—and the speaker placement is thoughtful. Built-in stereo speakers flank either side of the screen, at the top, and a built-in microphone is dead center. Eventually, you'll be able to play downsized 3.5-in. CD-ROMs in the 500s. Apple plans to offer an accessory drive that will dock into the expansion bay.

All this high-tech stuff doesn't come cheap. The base PowerBook 520 with monochrome screen costs \$2269, with 4MB (megabytes) of random-access memory (RAM) and a 160MB hard-disk drive. The top-of-the-line PowerBook 540c with active-matrix color LCD screen, 12MB of RAM, 320MB hard drive and modem costs \$5539. Remember, though, you're get-

ting a Macintosh desktop computer in a bag—one that will read files from IBM-compatible computers, too.

The PowerBook Duos range from \$2639 to \$4299, for the top-shelf Duo 280c. This color model has a neat twist—it will do color- and resolution-switching on the fly. For normal work, you'd use the setting for 256 colors. When color accuracy is critical, as for images from photos, you'd switch to the second mode for thousands of colors.

### More shell games

Although Apple's using the new PowerPC chip in its Macs and virtually every manufacturer of IBM-compatible computers builds Intel's powerful Pentium microprocessors into their top-shelf PCs, there's plenty of life left in the previous generation of 68040 Mac and 486 PC computer engines.

One of the more interesting 486s we've seen lately comes from AST Research. It's a loaded multimedia tower in the company's Advantage! Adventure line, aimed for family and home office use. Besides a 486DX2 powerplant running at a speedy 66 MHz, it's got just about every desirable feature at an asking price of \$2399. Perhaps most impressive is the preloaded software called AST Works, an interface

or shell that stands between you and the computer and makes the latter easy to use.

AST Works includes programs for communications, finances and graphics tasks. On the communications side, it acts as a phone-answering device. You can create voice mailboxes for every member of the family or business (up to 99), each with its own outgoing message. The program also has Caller ID capability.

You can always retrieve your messages from a remote location, but you can't fetch a fax when you're out of town. AST's on the job: Works will forward incoming faxes to another number you designate—say, a hotel. It's like having a 24-hour executive assistant back at the office.

AST Works performs some useful drudgery for you—like calculating bank loans and interest, creating updated records for home and car maintenance, taking household inventory for insurance records. On the graphics side, it offers preformatted forms for greeting cards, name badges, banners and other materials. The idea is, people don't do these things every day, so by providing the ready-made forms AST spares you the hassle of having to relearn your graphics software.

Ironically, as PCs get more powerful chips, they become easier to use. **FM**

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Want To Shoot An Eagle or Two ?

By Mike Hensen

MERIDEN, CT – A small golf company in Connecticut has created a powerful, new ball that flies like a U-2, putts with the steady roll of a cue ball and bites the green on approach shots like a dropped cat. But don't look for it on weekend TV. Long-hitting pros could make a joke out of some of golf's finest courses with it. One pro who tested the ball drove it 400 yards, reaching the green on all but the longest par-fours. Scientific tests by an independent lab using a hitting machine prove the ball out-distances major brands dramatically.

The ball's extraordinary distance comes partly from a revolutionary new dimple design that keeps the ball aloft longer. But there's also a secret change in the core that makes it rise faster off the clubhead. Another change reduces air drag. The result is a ball that gains altitude quickly, then sails like a glider. None of the changes is noticeable in the ball itself.

Despite this extraordinary performance the company has a problem. A spokesman put it this way: "In golf you need endorsements and TV publicity. This is what gets you in the pro shops and stores where 95% of all golf products are sold. Unless the pros use your ball on TV, you're virtually locked out of these outlets. TV advertising is

too expensive to buy on your own, at least for us.

"Now, you've seen how far this ball can fly. Can you imagine a pro using it on TV and eagle-ing par-fours? He would turn the course into a par-three, and real men don't play par-three's. This new fly-power forces us to sell it without relying on pros or pro-shops. One way is to sell it direct from our plant. That way we can keep the name printed on the ball a secret that only a buyer would know. There's more to golf than tournaments, you know."

The company guarantees a golfer a prompt refund if the new ball doesn't cut five to ten strokes off his or her average score. Simply return the balls—new or used—to the address below. "No one else would dare do that," boasted the company's director.

If you would like an eagle or two, here's your best chance yet. Write your name and address and "Code Name S" (the ball's R&D name) on a piece of paper and send it along with a check (or your credit card number and expiration date) to National Golf Center (Dept. S-642), 500 S. Broad St., Meriden, CT 06450. Or phone 800-285-3900 anytime. No P.O. boxes. One dozen "S" balls cost \$24.95, two to five dozen are only \$22.00 each, six dozen are only \$109.00. You save \$40.70 ordering six. Shipping and handling is only \$3.50 no matter how large your order. Specify white or Hi-Vision yellow.

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## BIZJETS (Continued from page 52)

ft. will be Mach 0.87 (577 mph). With eight passengers aboard, range will top out at 6300 nautical miles.

Gulfstream says it's got \$1 billion worth of GVs sold already.

### Express on track

But then Bombardier says the same thing about the Global Express, which will first fly in 1996. And while the Montreal-based company readily admits that its bird will be second on the scene, it insists that is the only category in which it will be beaten.

The Global Express is an adaptation of the company's Regional Jet, which itself evolved from the Canadair Challenger business jet. One characteristic shared by all three machines is their he-man cabins—at 8 ft. 2 in., the widest of any business jet. By rerouting wiring and hydraulic lines, the Global Express is able to boast a 6-ft. 3-in. cabin height, bettering the new Gulfstream by an inch.

Bombardier is making the most of its airplane's size advantage, arguing that when you're holed up in a tube for 14 hours at a stretch, inches of elbow room count for a lot.

Other advantages claimed by the Global Express are a faster cruise of Mach 0.88 and a range of 6500 nautical miles at Mach 0.80, which is 200 miles better than the Gulfstream's. Since the Canadian bizjet is 5900 pounds heavier at takeoff and presents more frontal area, its wing must fulfill these promises.

Whereas Gulfstream took a conservative approach regarding the GV wing, Bombardier has chosen a completely new airfoil. To be built by Mitsubishi Heavy Industries, the new wing features a 35° sweep (versus the GV's 27°) and a double-cranked trailing edge to reduce drag at high speed. The wing will have a higher aspect ratio to cut down induced drag as well. Externally the thick-chord wing will have a total of 28 control surfaces, all made from composites.

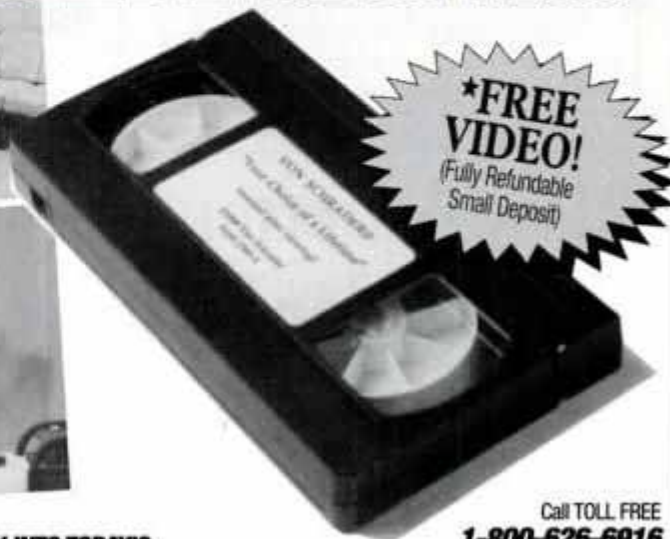
Despite formidable investment costs, dogged competition and marketplace ambiguity, both Gulfstream and Bombardier seem soaringly confident. Gulfstream estimates the total market for the GV and its competition at 600 to 800 aircraft.

"If the market turns out to be smaller," says one Gulfstream executive, "then I like the idea of being there first." Meanwhile, Bombardier says it had nonrefundable deposits for 30 Global Expresses when it launched the program and that it needed to sell only 70 more to break even.

In the end, the real winner in this contest will be anyone who gets to fly in these globe-trotters. Crossing the planet just doesn't get any better. **PM**



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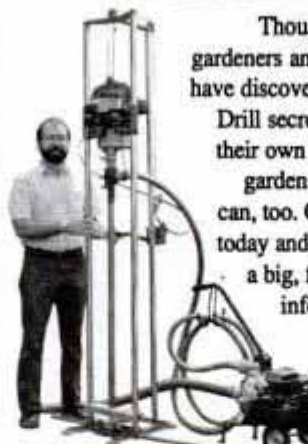
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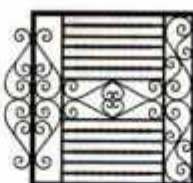
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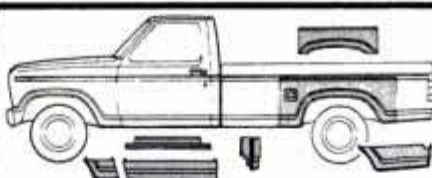
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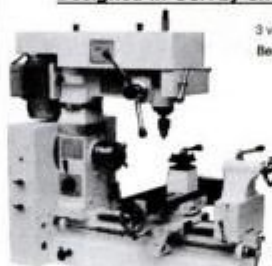
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8	9	10-\$116.50	11-\$128.15	12-\$139.80	13-\$151.45	14-\$163.10
15-\$174.75	16-\$186.40	17-\$198.05	18-\$209.70	19-\$221.35	20-\$233.00	21-\$244.65
22-\$256.30	23-\$267.95	24-\$279.60	25-\$291.25	26-\$302.90	27-\$314.55	28-\$326.20
29-\$337.85	30-\$349.50	31-\$361.15	32-\$372.80	33-\$384.45	34-\$396.10	35-\$407.75
36-\$419.40	37-\$431.05	38-\$442.70	39-\$454.35	40-\$466.00	41-\$477.65	42-\$489.30
43-\$500.95	44-\$512.60	45-\$524.25	46-\$535.90	47-\$547.55	48-\$559.20	49-\$570.85

YOUR NAME \_\_\_\_\_ (PLEASE PRINT) PHONE: \_\_\_\_\_

FIRM (NAME IN AD) \_\_\_\_\_

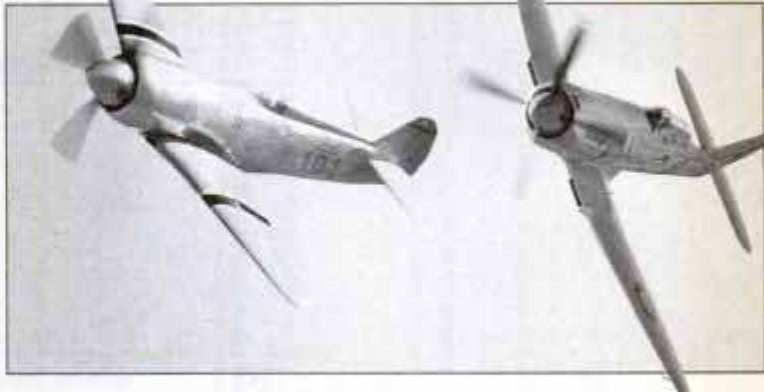
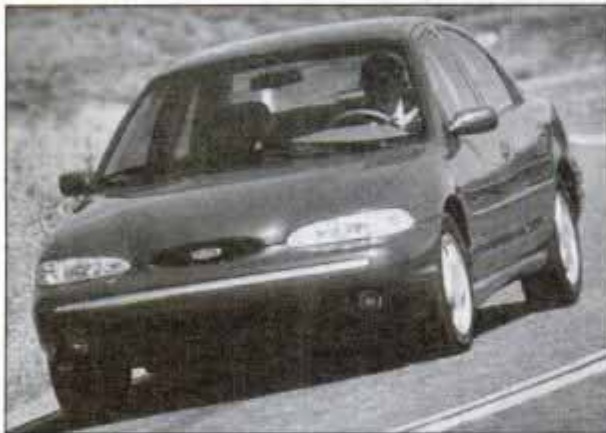
YOUR ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

DATE: \_\_\_\_\_ YOUR SIGNATURE \_\_\_\_\_

(PLEASE PRINT OR TYPE COPY • FOR ADDITIONAL WORDS ATTACH SEPARATE SHEET)

# COMING NEXT MONTH



## Fast-Forward Freighter

Trans-Atlantic cargo ships aren't supposed to look sexy, but this next-generation concept craft breaks all the rules. This ship will haul more freight and do so at luxury-liner speeds. Take a ride—it's next month's cover story.

## Detroit '95

The new models will get your attention, as styling and performance reach new heights. Get the complete story on the new cars, along with all the latest technical innovations.

## Information Unlimited

You've read about the information super-highway—here's your Infobahn roadmap. Our guide to computer information services, databases, bulletin boards and more lets you plug into the PC world.

## Thunder Pilots

Imagine a couple of P-51 Mustangs flying 50 ft. off the ground at 400 mph and you get a sense of the Reno air races. Here's a look at these aircraft and the thrills they provide.

## Is Stereo Dead?

Traditional 2-channel is dead, as audio moves beyond stereo. What's next? How about spatially enhanced 4-channel surround sound?

## Roofing Buyers Guide

Here's how to get the most roof for your money. Our roofing buyers guide explains the different materials available and details the strengths and weaknesses of each product.

*Editor's Note—Due to changes in production schedules, an article may not appear when originally planned. We apologize for any inconvenience this may cause.*



## IF YOU'RE SETTling FOR A NO-NAME ENGINE, BE SURE YOU BUY NAME-BRAND SHOES.



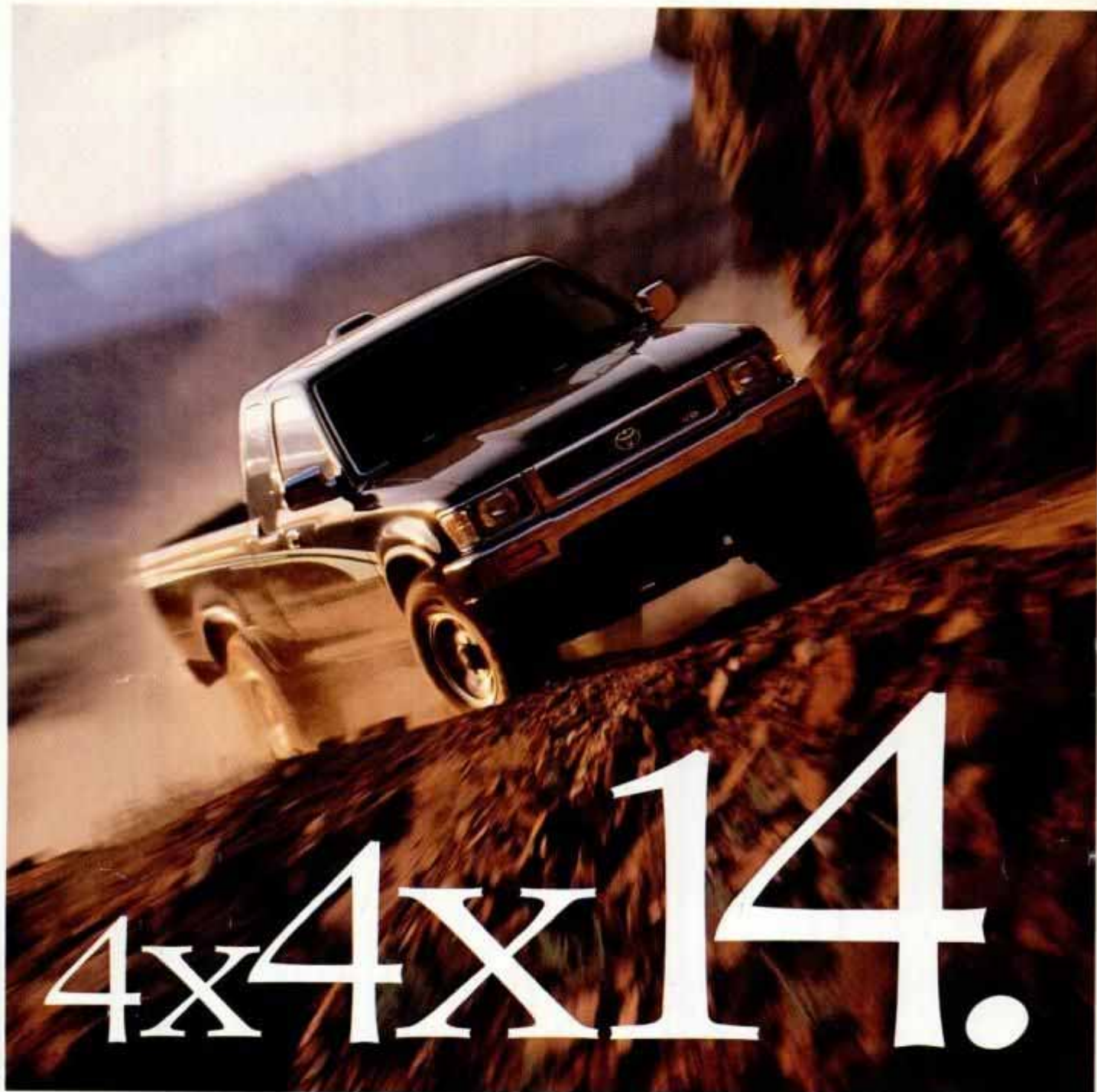
AC-Delco Engine

There are brand names you know and trust for just about all of life's necessities. But until now, no nationally known brand name for remanufactured engines.

But *now*, AC-Delco has put its brand on reman. You get a known and trusted name. A full line covering most makes and models. And a limited 12-month, 12,000-mile full parts and labor warranty, honored nationwide.

*Now* when you get back on the road with a reman engine, you can have confidence you'll be *driving* all the way. Call 1-800-AC-DELCO for details.

## AC-DELCO. IT'S LIKE BUYING TIME.



No, this is not a pop quiz. And no, the answer is not 224. Fact is there's never been any question about it. Toyota has simply been the *#1 selling compact 4x4 pickup for 14 years running.* Fourteen years without missing a beat.

How has Toyota pulled off a winning streak of this duration, you ask? Well, maybe it's our rugged

stance, distinctive styling and "shift-on-the-move" 4WDemand. Maybe it's the availability of a 3.0-liter OHC V6. Or maybe it's Toyota's Hi-Trac independent front suspension. Of course it could just be Toyota's reputation for quality that propels us to one sales peak after another, after another, after another...

Toyota Trucks. You just gotta love 'em.

 **TOYOTA 4x4**

*"I love what you do for me."*

**NOT FOR QUALITY**

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