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This pick-up runs, or Fisher & Son doesn't. Dad says depend on number one. So we only use Quaker State. Its unique formula starts with Pennsylvania Grade Crude. Dad says always buy quality. The Big Q's stable viscosity keeps the oil flowing and protecting. Dad says there's no substitute for quality. Dad's a great partner. And so is Quaker State.

Quaker State. The Big Q stands for quality. Always has. Always will.

APRIL 1986

VOLUME 163 NO. 4



#### ON THE COVER

George Plimpton sits atop an F-18 lighter—"the hottest airplane in the sky." After training with fighter pilots at Cecil Field in Florida, Plimpton took off in a 2-seat F-18 trainer, then raced toward an aircraft. camer at Mach 2. "I was astonished at how sensitive the controls were," he writes Read about his exploits in the exciting story on page 75
PM photo by

Rich Cox



80 Go in snow



84 Surfbusters



75 Flying the F-18



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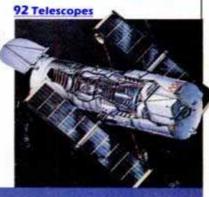
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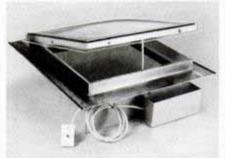
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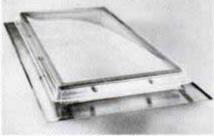


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#### Editor's Notes



was in Washington recently to participate in the kickoff ceremonies for the yearlong celebration commemorating the 75th anniversary of naval aviation. You probably saw our naval aviation history in the February issue (page 85). As part of the festivities, we had commissioned famed artist Ted Wilbur to paint a portrait of a Grumman TBM Avenger, an aircraft that distinguished itself mightily in World War II. We asked Wilbur to paint in Vice President George Bush as the pilot since Bush had flown an Avenger during the war, was, in fact, the youngest naval aviator in history (still is) and was a genuine war hero. The painting is a gem and will hang in the permanent collection of the National Air

and Space Museum at the Smithsonian In-

stitution in Washington.

Accepting the painting from Popular Mechanics and The Hearst Corporation on behalf of the Museum was none other than Vice President Bush himself. Also on hand were Secretary of Defense Caspar Weinberger; Secretary of the Navy John F. Lehman; Robert McC. Adams, Secretary of the Smithsonian Institution; Walter J. Boyne, Director of the National Air and Space Museum; Vice Admiral Edward H. Martin, Deputy Chief of Naval Operations-Air Warfare; and from our own organization, Frank A. Bennack Jr., president of The Hearst Corporation; K. Robert Brink, our Executive Vice President and Group Publishing Director; and PM Publisher Dan Coleman



VP Bush talks with PM's editor at National Air and Space Museum.

Director; and PM Publisher Dan Coleman; plus enough heavy duty Navy brass to sink a missile cruiser.

In chatting with Vice President Bush, he told me that he had read and enjoyed our article on naval aviation, but he told me he equally enjoyed another story in our February issue—our cover story on how the astronauts work and perform their miracles in space (page 103). The Vice President alluded to the fact that spaceflight is still in its infancy. The first U.S. manned spaceflight occurred only 24 years ago. There had been only 24 Shuttle missions. "Yet, we take spaceflight for granted today," said the Vice President. "Actually, every launch is a miracle."

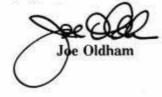
The miraculous nature of successful spaceflight was soberingly conveyed to us once again just a few days later when the Shuttle Challenger blew up, killing seven brave Americans, Americans from whom we had come to expect miracles. The blow was heavy. Every one of us felt the tragic loss, the sorrow. The Challenger disaster was a stunning reawakening that touched us all, perhaps more deeply than any event in years.

And almost immediately, there was a shrill cry for a halt to all manned spaceflight, especially in light of the sparkling success of the unmanned Voyager mission which, a few days before, had flooded TV screens across the nation with spectacular photos from Uranus, almost 2 billion miles away.

There is no doubt in my mind that man will venture into space again, and probably very soon. The very fact that the Challenger tragedy was such a crushing shock to us all is mute testimony to the fact that America's space program touches, and is embraced by, all of us. The daring exploits of the seven original astronauts and all who have come after them—people who, as Tom Wolfe wrote in *The Right Stuff*, are willing "to sit up on top of an enormous Roman candle . . . and wait for someone to light the fuse"—have captured our imagination and our fancy. The manned space program has become part of the

fabric of America. It's us, showing the world what we can do. We like it. We won't let them take it away from us because of a setback, tragic though it may be.

It means too much to all of us.



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I wash my car so it'll look good. So dirt and mud won't hurt the paint job. And I wax it so it'll be protected. So that "new car" look will last as long as possible.

But once the outside's been taken care of, I take care of the insidemy car's engine. Because I know a clean engine that's protected will run better-and longer.

I also know that getting it cleaned and protected by a professional will cost me-in time and money.

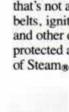
So I've found another way to clean and protect the engine, and still get the same great results. And that's Steamwork. The Steam Team. Steams Engine Cleaner and Steams

Engine Shine". From Gumout. The names will tell you exactly what they do. I'll tell you how fast,

easy, and effective they are.

First, spray Steam<sub>®</sub> Engine Cleaner on your hot engine. On contact, it'll cut through layer after layer of engine grease without using any elbow grease. Then wait ten minutes and wash it off with a garden hose. You'll really see the difference in how your engine looks.

But clean isn't as





effective as clean and protected. So continue the fight, and seal out the dirt, with Engine Shine".

After the engine cools and dries off, spray everything under the hood with new Engine Shine™ (I found that waiting for the engine to dry was a great time to wash and wax

> the car). Its protective coating of high-temperature silicone resins breathe with your engine. When the coating

dries to a tack-free, high-gloss finish, your engine is protected. But that's not all! Because now your belts, ignition wires, radiator hoses, and other engine components are protected as well. That's the beauty of Steam® Engine Shine™.

Remember, you get the best performance out of an engine that's free of dirt and greaseand protected to keep that dirt and grease away.

So extend the life of your car with Steams Engine Cleaner and Steam<sub>®</sub> Engine Shine"

Because getting your engine really cleanand keeping it really protected-requires Steamwork.

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#### Letters



#### Where's the chair?

Then I saw your cover on the November '85 issue, I eagerly opened the issue to the "Giant 58-page Woodworking Guide " where I expected to find plans for construction of the chair you used on the cover. However, after reading through the section I was disappointed to discover that the chair was not to become a part of my home where several other projects from PM now reside. I hope you're planning to feature the chair and its



construction in a future issue. If not, please tell me how to get plans as soon as possible. LARRY KIRKPATRICK SAN DIEGO, CA

I am very disappointed with your November '85 cover. In bright letters, "Make Beautiful Furniture" appears above the gorgeous chair back in the process of being built. Naturally, I assumed there would be a description in the magazine of how to make the chair. I was wrong. Nice photography, but it was a trick-the sort of thing I am not used to getting from PM. RICHARD K. COOLEY LONDON, ONTARIO, CANADA

We apologize to readers Kirkpatrick and Cooley—and to the many others who let us know that they were misled by the Woodworking Guide issue cover. We promise that we'll have the chair project in a future issue.

#### Twice in a life

The King Of Comets by Terrence Dickinson (page 89, Dec. '85) is an outstanding story and I will save it for viewing Halley's.

But it won't be a "once in a lifetime celestial view" for me. I saw it when I was 7 years old. Of the many magazines I read, PM has always been my favorite since childhood. C.E. GREGORY

Long life to reader Gregory! Our younger, first-time viewers may also want to refer to the Viewing Chart.

#### Thermo-static

The prices in your chart for Delta Dore's Tybox thermostats are way off-base (see Thermo Tech-Guide To New Thinking Thermostats, page 155, Oct. '85). Our Tybox 3A, an electronic thermostat, is \$129.50 not \$365!

And our Tybox model is \$99.99, not \$120. I hope readers will take a second look knowing the correct prices.

BERNADETTE DESCHAMPS DELTA DORE U.S. CORP ROCKVILLE, MD

#### Airship spotter

The description given in the caption for the Navy montage (see 75 Years Of Naval Aviation, page 85, Feb. '86) is incorrect on two counts. What you called the first Navy blimp is actually an airship. And, the side view of the airship you identified as the Shenandoah is actually the U.S.S. Akron or the Macon, which were sister RICHARD A. ISOLA COLLINS & AIKMAN CORP. AUTOMOTIVE DIV.

BLOOMFIELD HILLS, MI

#### Spade bit tip

Irwin Co. specifically warns users against using its spade bit in a drill press, and advises against using the drill for deep boring (see Workshop Wisdom, page 146, Nov. '85).

THOMAS A. BRENNAN GRAYDON, HEAD & RITCHEY CINCINNATI, OH

At too high an rpm and too fast a feed rate, the assembly could indeed buckle, but as contributing editor Rosario Capotosto replies: "In my opinion, Irwin's 2500-rpm limit for its extension in portable drills is equally dangerous. I have often used spade bits in a drill press for deep boring without mishap-but it must be emphasized I never operate the drill press in excess of 400 rpm."

#### Telling it the way it is

I wish to compliment you for a truly honest evaluation of automotive test results. I am referring to the January '86 article on minivans (see A Family Affair, page 86). In contrast, most magazines obviously favor the product, but throw in a few half-hearted negative comments.

> GERALD FOYE LEMON GROVE, CA

As a first-time Chevy owner who has driven them all, I say the standard, 7-passenger Astro wins for my family of sixin performance, interior space and design, workmanship, ease of handling and just being fun to drive.

KEVIN CAUTHEN LANCASTER, SC

Regarding the price of Starcraft's conversion of the Chevrolet Astro in your minivan test, it is grossly inaccurate.

Presumably you obtained the \$5823 retail package price from Chevrolet, because we do not publish suggested retail prices. The dealer price on the unit you tested is \$2850. Even allowing the dealer a 20-percent gross, the retail price would be only \$3562.50.

DD. CUZZOCREA STARCRAFT CO. TOPEKA, IN

Starcraft's Rhode Island rep gave us the suggested list price of \$18,911. By subtracting \$5800.





the list of the Chevy van Special Interior done by Starcraft for and its options, we got Chevrolet Astro is not as pricey as we PM said in test of 5 minivans.

MESA, AZ

# Ford power rocks the pickup world!

Tough Ford Pickups have climbed this brutal boulder mountain before—but now an '86 Ford does it <u>carrying</u> a Chevy and <u>towing</u> a Dodge!

On TV a few years ago you saw a tough Ford Pickup bite and claw its way up a monstrous mountain of boulders with a full-size Chevy on its back.

But now came an even tougher challenge.
Could Ford carry a Chevy and tow a Dodge all the way to the top?

You see the answer on the right, in scenes from an '86 Ford commercial now on television. Ford's big 4x4 with optional 7.5L V-8 engine made it—and with a big competitor on top, and one in tow!

#### Most Powerful V-8's.

If you want toughness and power in a pickup, you want Ford. This year Ford has the most powerful line of V-8's of any pickup, gas or diesel.

The biggest Six,
too. Plus the
brute strength to
haul up to 5,550
lbs.—or tow up
to 12,500 lbs!\*
It's easy to
see why the fullsize Ford Pickup is
America's best-seller,

for eight straight years \*\*

Built Ford tough.

Big Fords feature
Twin-I-Beam independent front suspension
with 2-wheel drive. TwinTraction Beam on 4x4's
(Mono-Beam front axle
on F-350 4x4's for extraheavy-duty applications).
And they all come Ford
tough—from rugged
ladder-type frame to
double-wall construction.

#### Choice of cab comfort.

No one equals Ford's choice of cabs: Roomy Regular Cab models. Exclusive Supercab with folding rear bench seat. Plus 4door Crew Cab.

#### Best-Built American Trucks.

At Ford, Quality is Job 1. A 1985 survey established that Ford makes the best-built American trucks. This is based on an average of problems reported by owners in the prior six months on 1981-1984 models designed and built in the U.S.

#### Lifetime Service Guarantee.

Participating Ford Dealers stand behind their work, in writing, with a <u>free</u> Lifetime Service Guarantee for as long as you own

your Ford car or light truck. Ask to see this guarantee when you visit your participating Ford Dealer.

- \*When properly equipped and with 5th wheel.
- \*\*Based on 1978 through 1985 model year manufacturers' reported retail deliveries.

Buckle up together we can save lives.



FORD PICKUP

**BEST-BUILT AMERICAN TRUCKS** 

















**Imports** 

BY BILL HARTFORD

#### Springtime for Audi



pril is the cruelest month-at least for Audi fans who see the new Cabrio GT and then find out that it's been built just for show. Just like a conservative, volume-oriented car company staffed with too many bean counters, Audi is cautiously delivering a familiar line when asked about the

will have a waiting list.

The Cabrio, developed by ASC Corp. in Michigan, is perfection-plus in its proportions, especially in the integration of boot, rear deck, spoiler and trunk lid. The convertible is properly luxurious and muscular enough with 110 horses from Audi's fuel-injected Five.

The Audis you can buy in '86 all have overhead sheet-

> metal, some of it stretching back to a tailgate, as in my choice of the line, the 5000CS Turbo Quattro Wag-

on. This astounding vehicle is the car to own if you can't own more than one. It feafull-time all-wheel tures drive and a 158-hp, turbocharged, intercooled Five. Know any other 4×4s that can hit 130 mph? When running up to speed in the Quattro, it's the 4wd that catches the skids; when hauling down, it's the Anti-Lock Braking System (ABS) that



Shoulder belts in some '86 Audis adjust to height of driver.

helps you come to a safe, fishtail-free stop.

With the new, fully galvanized body comes a new warranty of 3 years or 50,000 miles. whichever comes first, and a 6-year, unlimited-mileage corrosion perfo-

ration warranty. If you're not concerned about the nitty-gritty Quattro construction, you can just slide into leather interior, memory-position the

driver's seat, slide back the sunroof, check the computer panel, set the 10speaker stereo, buckle up, ease up to speed and go to cruise control. I can wait for the convertible.



Fully galvanized body of 5000 comes with 6-year warranty.

#### Century for Mercedes-Benz

It was called the Benz Motorwagen and Karl Benz received a German patent for it on Jan. 29, 1886. The 3wheeler, considered world's first automobile, is powered by a 1-cylinder engine of just under 1 hp. Today, you can see the delicate, spoked-wheel "car" in the Deutsches Museum in Munich, Germany. For the Mercedes-Benz centennial, 11 working replicas of the Motorwagen were constructed.



Benz Motorwagen of 1886 replica can be seen in L.A. 'til July 6.

They've been shipped to museums around the world and one can be seen in The Natural History Museum of Los Angeles County until July 6. Sponsored by M-B of North America, the exhibition includes much more than the Benz Patent Motor Car replica. There's also a replica of Gottlieb Daimler's 1885 motorized bicycle, the first selfpropelled vehicle powered by an internal combustion engine; Grand Prix cars; roadsters; 300SL Gullwing, C-111 rotary, and more—all at 900 Exposition Blvd., Los Angeles, CA 90007, (213) 744-3411.

#### Mileage record for VW Golf diesel

Their mileage is up, but popularity down. It's the diesel cycle-when the good times roll, most drivers want miles per hour, not miles per gallon. But highspeed traffic didn't keep VW from rolling up 1345 miles on a tankful (87 mpg), the longest distance driven by a standard production vehicle without refueling.



Golf diesel, Gerhard Plattner driver, did 1345 mi. on tankful.

vou know vou've got a winner. Your convertible looks better than Saab's, and besides, your cars are so golden right now that anything you make with four inter-

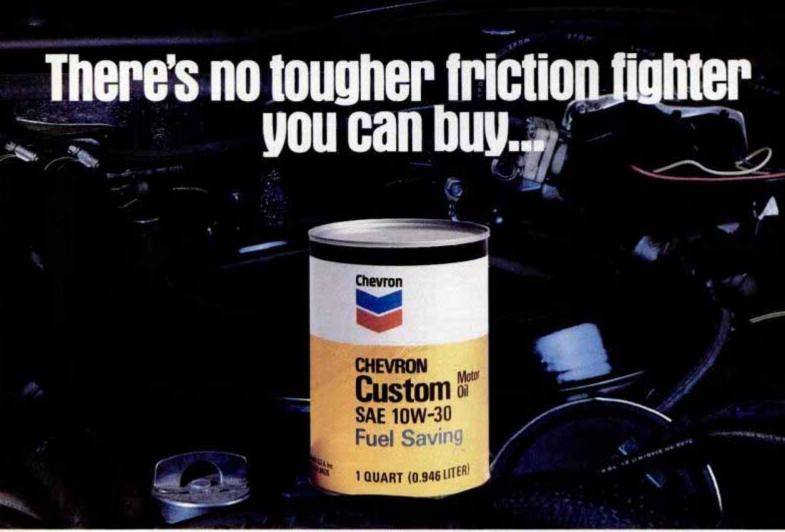
locking rings on the grille

Top is power operated, stores flush beneath boot in rear deck.

convertible: "We're testing

the potential acceptance in the market." C'mon, Audi,

10



# ...and it just got \$3.60 easier to take off the shelf!

All U.S. and foreign car makers set performance standards. We exceed them.

Quick starts. Stop-and-go. Rugged terrain. Heavy loads. Severe weather. They all can cause engines to work harder—and to need more protection than "ordinary"\* motor oils can provide.

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 Include the dated cash register tape or sales receipt with your Chevron oil purchase circled. Receipt must be dated no later than April 30, 1986 and no earlier than March 1, 1986.

April 30, 1986 and no earlier than March 1, 1986.					
Name	(Please pror	(Please print clearly)			
Address					
City	State	Zip			
Mail your proof	s of purchase and compl Special Chevron P.O. Box 5078A Tecate, CA 9208	Rebate			
	8 weeks to receive rebate be postmarked before <b>h</b>	Offer expires April 30, 198 day 31, 1986.			
November 1	more than one selector become	our a maximum of \$7.30 well be re			

You may submit for more than one rebate, however, a maximum of \$7.20 will be paid to any name, address and/or household. Ofter void where taxed, sestricted or prohibited by law and is good only in the USA. Ofter halfilled by American Cleaning Service, 10865 S.W. Pith Street, Basverton, OR 97005.

If product purchased does not have UPC symbols, send the portion of the label that contains "Sold by Chevron U.S.A. Inc., San Pancisco, CA 94120"

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Chevron

With Chevron Custom
Motor Oil, you get patented
viscosity stabilizers, antiwear compounds and rust,
corrosion and oxidation
inhibitors in every drop.
Net result? A tough, smooth,
"slick" oil. An oil that
delivers performance and
protection whenever and
however you drive your car.

\*Motor oils meeting minimum specifications.

#### Cycles

BY NORMAN MAYERSOHN

#### **Balloon tires boom**



California dreaming—a "beach cruiser" built up from Schwinn parts.

over in the part of this country where anything built 25 years ago is considered antique, there's a big revival going on in post-WWII bicycles. Of course, the restoration craze didn't start in California, but this new-found affection for nostalgic beach cruiser bicycles has become something of an

epidemic there. Classic balloon tire beauties like a Schwinn Black Phantom can fetch \$1500 in concours condition, and an exotic model

builder Larry Fator has a more tolerant interpretation

like the Elgin Bluebird brings in virtually whatever the buyer asks. Pro pinstriper and model

Aluminum-frame Silver King is rare 1947 limited-edition model.

of the craze, though. For personal pleasure, he favors a California Hot Rod like his Schwinn-based bike on the top half of this page. The original chrome front fender with streamlined headlight is gone (they're worth up to \$350 alone!), and the rear end has been chopped for a sleeker look, but the original style horn tank on the main frame tubes is there, as is the springer front fork. Some of the parts have been bought out of New Old Stock and some are reproductions manufactured to supply the restorers' demand.







tional enough to attract

friendly greetings and evoke

fond memories from all on-

Hex-tube, pictured below, is

more historically accurate.

Built by the Monark company of Chicago, this rare

(make that very rare) beauty

is constructed entirely of 6-

sided aluminum tubing with

cast frame lugs at tubing

junctions. Monark built oth-

er bikes in that era, includ-

ing a round-tube 24-in. mod-

equipped with 26-in, wheels

was apparently one of the

but the Hex-tube

Larry's 1947 Silver King

lookers.

Repro horn tank, late-model chain guard add period touches.

The "moonie" handlebars (named for their half-moon shape) are a must, of course, but Larry took the liberty to add alloy rims and 3-speed hub, cleverly hiding the shift lever under the seat. As a collection of pieces from the 1930s, '40s and '50s, this bike doesn't faithfully reproduce any one model, but it is tradimost expensive bikes of its

Unfortunately, it wasn't very light in weight, so Larry doesn't feel all that bad about pedaling around without the original front fender/headlight assembly. The bike uses one of the first springer forks of the era, and

(Please turn to page 15)









Old fashloned craftsmanship is evident in every detail of frame.

There's only one thing that tastes more like a fat, juicy peach than Original Peachtree "Schnapps." DEKUYPER® ORIGINAL PEACHT Straight, rocks, or with soda. Bite into one today. DeKuyper\* Original Peachtree\* Schnapps Liqueur, 48 Proof, John DeKuyper and Son, El

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(Continued from page 12)

many of the small details—the front chain sprocket, for example—were built of aluminum. The "tank" which fills the space between the top frame rails was fabricated by legendary California dragster builder Jocko, and Larry designed and built his own aluminum chain guard. Sure, that means tampering with a precious piece of history, but that's all the more reason why it should be ridden and enjoyed today.

#### Kawasaki '86: Note the new niches

One of the frustrations of today's efficient communication systems is knowing about all the machines available in



ZL600 is a junior version of Kawasaki's 900-cc Eliminator musclebike.

other countries that haven't been certified for sale in the U.S. This year, though, we are going to get our hands on some of the motorcycles Kawasaki has reserved just for the specialized overseas market in the past.

The littlest Ninja, a mere 250-cc 2cylinder road warrior, is typical of the bikes created to fill special license and insurance regulation classes in the home market. And the Concours mod-



Mini Ninja is just a 250-cc Twin, but carries superbike features, full-sized credentials.

el, originally introduced in Europe, will go after the serious sport-touring market with a performance level not yet offered by any builder.

On the home front, it will probably be the new ZL600 which makes American blood boil. A middleweight musclebike along the lines of Yamaha's Fazer (see Cycles, page 64, Mar. '86) it's a fitting little brother to the 900-cc Eliminator model. With the same mode of dragstrip-ready styling and all the right

touches for boulevard profiling, it's sure to be as popular as the closely related Ninja 600 is with the younger riders.

The dohc, 16-valve, liquid-cooled engine displaces 592 cc and breathes deeply through 30-mm flat side CV carburetors. Shaft drive cuts down on maintenance and a newly designed 2-piece clutch hub intentionally allows a bit of slippage on deceleration to cut wheel hop under severe engine braking conditions.

The mini Ninja is just as innovative. Integrated bodywork with a frame-mounted half fairing gives a Daytona-ready look to the pint-sized screamer, and the 14,000-rpm redline and 130-mph speedometer seems to back up the image. Seating is surprisingly roomy for full-sized folk, provided they already agree to the road-race ergonomics required by Ninja followers.

The new liquid-cooled Twin is backed up by a 6-speed transmission, and the chassis has credentials enough for a Grand Prix entrant: diamond-design frame, white-painted 16-in. wheels, Uni-Trak rear suspension and disc brakes at both ends. Even the Ninja 1000's Automatic Variable Damping front fork has been downsized for the application. This is no kid's toy.

Most important of the new releases is the Concours sport touring machine. The class has traditionally belonged to BMW, who could logically claim the invention of good handling, comfortable-to-ride long-distance bikes. Their RT models offer elegant accommodations with a full-protection fairing and slim saddle bags. What the Concours adds is 997 cc of Ninja-style power, tamed for a broad powerband and directed through a shaft drive.



Concours will capably challenge BMW in the high-performance sports touring market.

The road race profile stays in place, though the paint scheme has been toned down to a subtle silver gray. The windscreen is higher and more vertical for better bad-weather protection, and it's done without ruining the sleek lines. Add in the rising-rate single-shock rear suspension and Ninja-caliber brakes, and there's no way the Concours won't become the darling of high-speed tourists all around the world.

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#### Motorsports



BY STEVE POTTER

#### Price-is-right racing



Sports/Renault racing is close because all the cars are identical.

As anyone who has ever tried it knows, auto racing is an expensive sport. These days, Formula One teams operate on budgets of \$10 million to \$20 million per year, and a competitive Indy car or NASCAR effort can cost \$3 million per season.

Sponsors pick up most of the expenses for pro teams, but even on a club level, the cost of racing is climbing out of the reach of all but the wealthiest Americans.

The Sports Car Club of America's Formula Ford class represents the first step on the road to Indy or Formula One. At its inception in the late '60s, the single-seat, open-wheel class was intended to provide lowcost competition through the use of stock Ford Pinto engines and restrictive chassis. Today, you can purchase a state-of-the-art Swift or other competitive Formula Ford for a little under \$25,000. But the cost of operating the car for a season can run another \$75,000.

This isn't a new problem. Col. George Smith, a sailboat and auto racer, recognized it 25 years ago. He borrowed the notion of a 1design class from sailing and began the construction of a Volkswagen-based singleseater, the Formcar. It used a stock VW drivetrain and suspension, attached to a cheap single-seat chassis. Smith called on the SCCA to create a new racing class for the Formcar, to be called Formula Vee.

The SCCA adopted most of Smith's idea, but-if you'll nardon the pun-they missed the boat on the key element of Smith's plan. Rather than requiring one fixed chassis type, the SCCA decided to allow a variety of designs, providing that they fit a restrictive set of rules. Because car builders kept coming up with improved chassis designs, and engine shops continually refined the power output of stock VW Beetle engines, equipment soon became obsolete and the cost of being competitive kept going up.

Basically, the same thing happened with Formula Ford, and later with the Showroom Stock sedan classes. Something new always came along, and you had to buy it if you wanted to run at the front.

In Europe in the mid-'60s, Renault was searching for a training ground to develop French racing talent and came to the same conclusion as Col. Smith—to keep the price low, no mechanical variations should be permitted. Out of that concept was born the Renault Cup, a series of races for identical Renault sedans, and later Formula Renault, a similar series for Formula cars.

In the United States, Volkswagen finally did become the creator of a single-marque series, the Volkswagen Cup, which started out 10 years ago as an SCCA-sanctioned series for showroom-stock VW Sciroccos. Two years later, a switch was made to the Rabbit, and then last season to the new Golf model.

Renault's '86 domestic racing program with the SCCA probably comes the closest to Col. Smith's original 1-design concept. Sports/Renault is a single-seat, envelope body sports-racing car, and the SCCA organizes both amateur and professional races for them. At 1300 pounds, the car is overweight compared to other sports-racing machines. And underpowered, too, with a stock, factory-sealed 90-hp,

1.7-liter Renault engine. But that doesn't really matter because, except for their paint jobs. the cars on the grid of a Sports/Renault race are as alike as peas in a pod. And, as race cars go, about as expensive. The use of simple construction techniques and pieces production from

kept the price under \$13,000.

There are three other "spec" car series in America. In each case the car is a single-seater, fitted with an engine that the competitor is forbidden to work on. Springs, roll-bars, shocks and wings are adjustable, so a crew can put its chassistuning skills to good use.

Both the Jim Russell and Skip Barber racing schools have run excellent Formula Ford racing series for drivers who are more interested in matching their driving skills than their financial strength. In each case, the school provides equally prepared Formula Fords on a rental basis. A full session of racing costs less than \$10,000, and all a driver needs to do is show up the morning of the event with his helmet under his arm.

Each organization has also recognized the need for entry-level professional series. The Mazda-Russell Pro Series is faster and more challenging than Formula Ford. The identical cars are powered by 180-hp versions of Mazda's 13B rotary engine.

The Barber Saab Pro Series cars are single-seaters, powered by turbocharged Saab engines with 200 hp and shod with B.F. Goodrich tires. Running as a curtainraiser for selected Indy car and Camel GT events, the 12-race Barber series should prove a good training ground for future stars, especially at the announced price of \$3500 per race. The first race is on Memorial Day at Lime Rock, Connecticut.

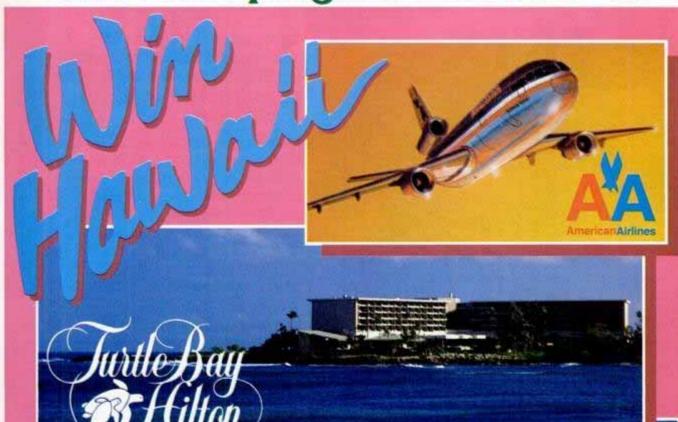


Renault sedans has A gaggle of Golfs leans into a turn in VW Cup.

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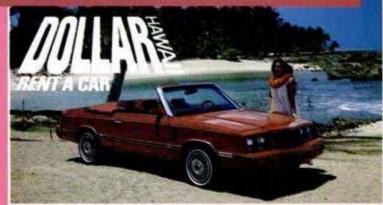
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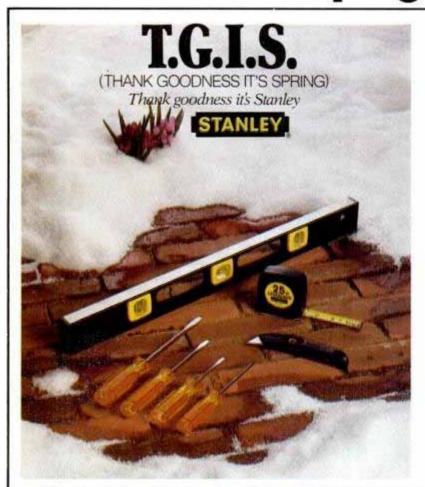
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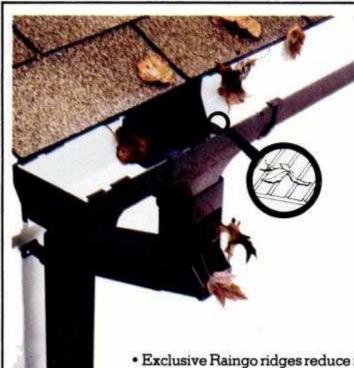


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# Tool Tests

#### Double-blade dado

hen I first saw the Sears Excalibur dado blade, I thought I was seeing double—and indeed I was. Its unique design features two 8-in.-dia. saw blades joined together by an adjustable collar. The dado can be adjusted easily for cuts from 1/4 in. to 13/16 in. wide—without removing the unit from the saw's arbor.

Each blade has 24 carbidetipped teeth. I found the cutting action very smooth and fast. The dado blade has a 1½-in. depth-of-cut capacity when used on my 10-in. radial-arm saw, and a 2-in.-deep capacity on my 10-in. table saw. It will fit most saws with a %-in.-dia. arbor.

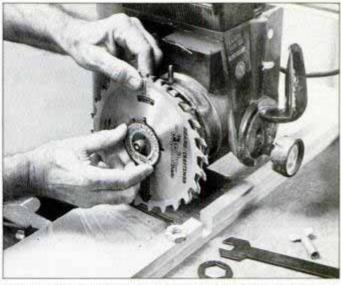
Unlike a conventional wobble-type dado, the Excalibur runs virtually vibration-free. The infinitely adjustable dial on the collar tilts both blades simultaneously on a double-cam hub to obtain a cut of the desired width.

Additional features include a reference point marked on the blade to indicate the area of the widest cut, a convenient depth-of-cut scale printed on the blade and a chrome coating that reduces gum and pitch build-up on the saw blade teeth.

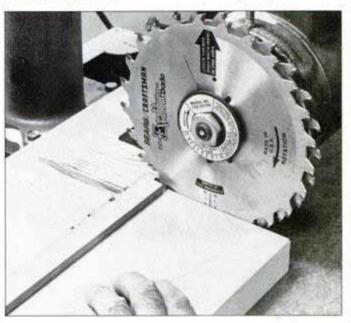
The Excalibur dado blade (model No. 32708) sells for \$99.99 at larger Sears stores and through the 1986 Sears Power and Hand Tools catalog. For additional information, contact Sears, Roebuck and Co., Dept. 703-PM, Sears Tower, Chicago, IL 60684.—Rosario Capotosto



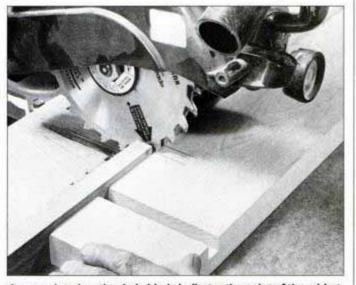
Dado has two 8-in.-dia. saw blades joined by an adjustable collar. The blades tilt on the hub to the desired width of cut (right).



Turn collar to adjust the width of cut from 1/4 to 13/16 in. wide. Be sure to disconnect the power cord before adjusting the dado.



A convenient depth-of-cut scale is printed on the blade. Hold work against the scale and adjust the blade to the desired height.



Arrow printed on the dado blade indicates the point of the widest cut. Use point to align blade with the cut line on the workpiece.

## Homeowners

BY NORMAN BECKER, P.E.

#### Cracked concrete walk

wo years ago, I had a porch slab and an adjoining concrete sidewalk replaced. The porch slab was poured on a 4-ft.-deep foundation of blocks and concrete. The walk was poured in one continuous piece with the slab, without a space being left between the walk and the slab. Now the walk has cracked badly near the slab after just one winter. Was the sidewalk installed correctly?

> JAY BROWN ROCHESTER, NY

Apparently, there is no isolation joint where the slab and sidewalk meet. This would accommodate the slight movement that takes place between them. The slab has a foundation down to the frost line and is not affected

by freezing temperatures. However, the sidewalk is on grade, so any dampness in the base below the sidewalk will freeze and expand, resulting in some frost heaving during the winter. When this movement-or movement caused by settlement or shrinkage—is restrained, the concrete will crack.

There are two basic types of joints used in walks, patios and slabs: isolation joints-often called expansion joints-and control joints-often called contraction joints. The illustration below shows typical locations for each joint.

Isolation joints permit slight vertical and horizontal movement along lines that separate dissimilar concrete emplacements. They

are formed by installing strips of asphalt-impregnated composition board.

Control joints create straight-line planes of weakness in the concrete. As a walk or driveway shrinks, a crack forms below the joint in a straight line, rather than creating unsightly random patterns.

#### Lightning zap

In one year's time, I've had two television sets damaged by lightning. It blows the tuner out even when the set is turned off, and the power

cord is plugged in.

A 15-amp voltage surge protector installed between the wall plug and the TV plug hasn't helped. We have cable TV that is grounded outside. What can I do to prevent this from happening again?

> AARON F. SPROUS EDWARDSVILLE, IL

Your problem sounds like the classic example of what happens when the cable TV coaxial cable is not grounded properly.

The National Electrical Code specifies that the CATV cable should not have a separate ground, but that it should share a common ground with the inlet electrical service to the house.

If the electrical system and cable TV are grounded separately, a lightning surge can generate a difference of many thousands of volts between the power cord and the coaxial cable, causing the TV set to blow out. You can avoid this problem in the future by making sure the ground for the TV cable is connected and properly bonded to the main ground for the electrical service to your home.

#### Infested joists

The 65-year-old-house I recently purchased has some bad floor joists. New wood framing members were placed beside the old. The old floor joists are peppered with 1/s-in. holes. They are thoroughly tunneled and full of wood dust.

I tore down some of the worst floor joists with my

hands and saw several insects that look like silverfish.

What can I apply to kill the insects and prevent further damage? Someone recommended coating the framing with used motor oil.

> GREG BICKFORD OLAMON, ME

Your description sounds like the work of powder post beetles rather than silverfish. Silverfish, though a common pest, do not eat or damage wood. Powder post beetles, however, do.

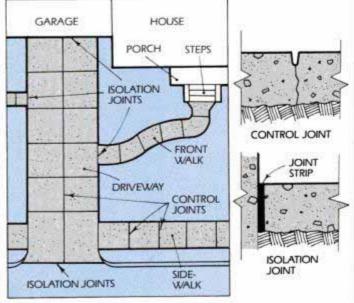
The beetles lay their eggs in cracks and crevices in the surface of unfinished wood. After the eggs hatch, the larvae feed and tunnel through the wood, reducing it to a powdery residue. Just prior to emerging from the wood, the newly formed adult beetles chew small round holes (1/32- to 1/s-in. dia.) in the wood surface. Shortly after emerging, the beetles mate and lay eggs, occasionally depositing them in the opening of an old exit hole, and reinfesting the same piece of wood.

Those joists that have extensive damage have been infested by several generations of powder post beetles. It's very possible that the floor joists were infested before being used in constructing your house.

Definitely do not use motor oil to coat the joists. The motor oil would create a fire hazard and produce unpleasant odors in your base-

Controlling active infestation is best handled by a licensed pest control operator using either liquid treatment or fumigation. Both methods present potential environmental hazards and should be administered by a professional.

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide,



Isolation joints between dissimilar concrete emplacements prevent cracking caused by frost. Control joints in walks, patios and driveways prevent random cracking as concrete shrinks and expands.

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filter change intervals.



#### Minicourse



BY ROSARIO CAPOTOSTO

#### Bending wood Perhaps the most dramatic wood-bending results are achieved by making a series of kerf cuts on the back side of the workpiece. Here, %-in. plywood is rendered extremely flexible.

There are a couple of simple wood-bending techniques that all shop workers can put to good use. One is kerf cutting, the other is bent lamination.

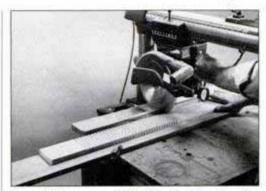
The former works well for plywood and solid stock while the latter is generally used for solid stock only.

Kerfing involves cutting a series of closely spaced kerfs in the back side of a work-piece to render it flexible. There are no hard and fast rules regarding the spacing and depth of the cuts because these will vary depending on the type of stock and degree of bend required. But kerfs spaced about % in. apart and cut within 1/16 in. of the finished surface will usually do the trick. Closer spacing permits tighter bends.

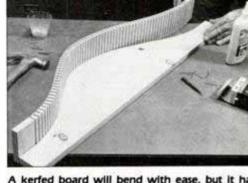
If the piece is to be freestanding, the kerfs must be filled with a mixture of glue and sanding dust before bending. This mix holds the desired shape and adds strength to the piece. You can also reinforce bent stock by attaching it to a solid support board.

The lamination process involves slicing the board into a number of thin strips, which are then reassembled with glue and clamped between a 2-part form that matches the desired shape.

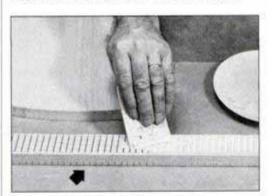
For some applications, 3ply, 1/8-in.-thick plywood commonly called skin—can be used to surface a curved construction. It comes in 4 × 8-ft. sheets and is usually faced with poplar veneer. PM



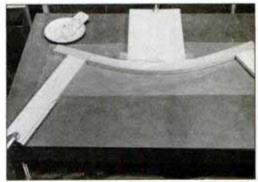
The radial-arm saw is ideal for kerf cutting. An index mark on the fence gauges spacing and a support board keeps work from breaking off.



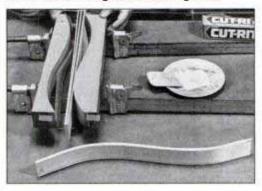
A kerfed board will bend with ease, but it has little strength until it is securely attached to a properly shaped support board.



Solid stock can be edge-kerfed on a band saw using spacing marks (arrow) as guides. Then, fill cuts with a mix of glue and sanding dust.



Final shape is achieved by bending the board between clamped blocks until glue has dried. Wax paper keeps work from sticking to bench.



Solid stock can also be sliced and clamped between two forms. Single nail at one end prevents shifting; wax paper prevents sticking.



Once setup is complete and all mating surfaces are coated with glue, progressively tighten clamps and let stand until glue dries.



#### Car Clinic



BY MORT SCHULTZ

#### Ignominious igniter

The car is a 1984 Toyota Corolla. The problem is stalling, but only on occasion and only while the car's cruising. Because the engine just quits suddenly, I and others driving with and near me are in danger. The engine restarts after several minutes and may not stall again for weeks. Several mechanics, including those at Toyota dealerships, have tried to help, but the engine won't stall for them. They are, therefore, unable to find the AL AUSTIN cause.

SHREVEPORT, LA

Beginning in 1980, Toyota put the igniter and ignition coil inside the distributor of many models. These two parts work together to develop high voltage. This system is called the Toyota Integrated Ignition Assembly (IIA). Its counterpart is the Toyota Transistor Ignition System (TIS), which has the igniter and ignition coil outside the distributor.

A Toyota from 1980 onward may have either IIA or TIS. Your Corolla has IIA. and because it does it's more prone to sudden stalling when the engine is warmed up. In most cases, the reason is a weakness in the igniter that causes the circuit to open when a specific temperature develops inside the distributor. When the circuit opens, current flow is interrupted, which leaves the engine sparkless. Replace the igniter.

There's no guarantee that a new igniter is going to last indefinitely. After being in a hot distributor for a while, it may go bad. Toyota is trying to solve the problem. I'll let you know if and when a permanent solution is found.

#### A hitch in time

I have a 1985 Mercury Marquis with 302-cu.-in. engine. When I let up on the accelerator so speed drops to between 50 and 25 mph, the car starts to jerk. The dealer says he replaced the EGR valve and made all other adjustments that have a bearing on the condition. A second dealer told me it's the nature of the automatic overdrive. Have you heard of this? R.A. MAITLAND HALIFAX, VA The boys at Ford call it trailer-hitching. And phooey on the theory that it's the automatic overdrive. Here's what to do.

Make sure the manifold absolute pressure (MAP) sensor hose runs true-no kinks, that is. If that's okay, install a new MAP sensor, since some '85 models got loose with MAP sensors that weren't correctly calibrated. The MAP sensor detects the degree of air pressure in the inlet manifold and converts it into a voltage signal that's used by the microprocessor to control ignition timing. If the MAP sensor is ill-calibrated, data will be wrong. Timing on deceleration, therefore, may not retard as it should, and the result could be trailer-hitching. It's all covered, by the way, in TSB 85-12-17.

#### Handicapped drivers

A letter from a reader who has reduced hearing and another from a man who lost his right leg led to my trying to track down car parts that would help them compensate for their handicaps. The information I found may be important to others, so here it is.

The person with the hearing impairment can't hear

the clicking of the turn-signal flashers. When signals fail to cancel automatically, they keep flashing until the driver happens to glance at the dash and notice the green indicator.

"This leads the driver in back of me to think I'm going to do something that I'm not going to do," this reader writes. "I've been rear-ended once because of this. Isn't there a flasher that gives off a noisier click?"

Presently, only General Motors has a flasher with a higher noise level, and this just since last November. You can get the device (part No. 10041073) from a GM dealer.

Unfortunately, the component won't fit other makes of cars and as far as I know, no other carmaker has issued a similar flasher.

The gentleman who lost his right leg unsuccessfully tried every facility he could think of that deals with the handicapped, including the Veterans Administration, to find a company that makes a left-foot accelerator pedal.

Originator Corp., 832 Northwest First St., Fort Lauderdale, FL 33311 (305-463-7231), sells this equipment by mail order. The device, which is not difficult to

(Please turn to page 32)



Holy cowl

We've received letters from some drivers complaining about an obnoxious odor from blower vents. The smell may be the result of decomposing leaves or decaying bugs that have gotten into the blower system through large holes in the cowl (see the illustration). To get rid of that smell, you either have to wait for total decomposition to take place, or pull vent ducts and clean them out. To keep the problem from occurring or recurring,



cover cowl openings with ordinary window screening. Use duct tape to hold screening to the cowl.

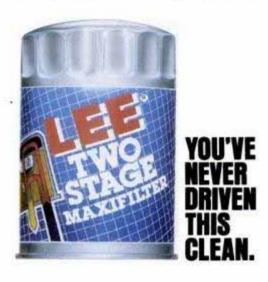
# ANNOUNCING A BREAKTHROUGH IN OIL FILTER TECHNOLOGY.

The Lee Two-Stage Maxifilter.

It's a clean breakthrough. That's fact, not opinion. In standard laboratory tests for filtering efficiency against other leading brands, Lee won hands down. The others left as much as 56.8% more dirt in the oil.

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Lee adds a second filter for the extra protection today's harder working engines demand. The Lee Maxifilter will effectively trap dirt as small as one-fifth the width of a human hair. If you want maximum protection. If you want cleaner oil, cleaner than it's ever been before, change to the incredible Lee Two-Stage Maxifilter.



#### CAR CLINIC

(Continued from page 30)

install, is positioned to the left of the brake pedal and is connected to the accelerator pedal by rods.

#### A little horseplay

My 1985 Dodge Colt Turbo ran great for 10,000 miles. At that point the engine got cranky and became hard to start when it was hot. The dealer replaced fuel injectors and the computer, but no dice. He now says the car needs a new starter. Since it's no longer covered by warranty—there's now 21,000 miles on the odometer—I'd like some assurance that this is the cause of my problem before paying for a new starter. What can you tell me?

JACK LU BOSTON, MA

Hold your horses. There are some other possibilities to consider before you give the go-ahead for a new starter. But whatever the solution is to this problem, who says it isn't covered by the warranty? It certainly is if you can document the fact that the trouble began before the 12-month/12,000-mile basic warranty on your car expired. If the condition was reported to the dealer at 10,000 miles as you say, I shouldn't think you'd have a problem proving it

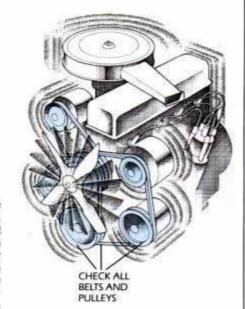


#### Shakedown cruise

Many Saturday mechanics tend to put the blame for vehicle vibration on steering, suspension or driveline components—not on drive belts and pulleys. But often that's where it belongs. So before you duck under the car to look for trouble, check on top to see if belts and pulleys are okay. It's easy enough to do.

Drive the car to determine at what rpm the vibration is most pronounced. Then, with the engine idling and transmission in PARK or NEUTRAL (parking brake engaged), look at each belt and pulley as someone in the car accelerates the engine to vibration-rpm speed.

If one of the belts looks wobbly, turn off the engine and take off the belt. Start the engine and speed up to vibration-rpm again. If the vibration disappears, you've tabbed the cause of your problem to that



particular belt or one of the pulleys supporting it. Reattach and tighten the belt to specification and test again. If vibration reappears, look for a loose or damaged pulley. Then, replace the belt or replace the component having the bad pulley.

Caution: To avoid engine overheating, do the test quickly when the water pump belt is disconnected.



to the Chrysler zone office.

The dealer has obviously checked the fuel and electronic engine control system, but he may have failed to recognize a trait of the 1.6-liter engine-that if timing advances by more than 10° as a warm engine is being started, cranking will be sluggish.

The first thing the dealer should do, therefore, is check ignition timing with the engine warmed up and running at an idling speed of 700 rpm. Timing should fall at 8° BTDC ±2°. If timing is adjusted properly, the dealer should look into the possibility that it's advancing when it should be retarding. The part that automatically controls spark timing is the igniter of the electronic spark control system. The device is supposed to set timing in accordance with signals it gets from pressure and detonation sensors. If on warm engine startup the device is causing timing to advance rather than retard, starting would be a problem. The solution is to replace the igniter.

If these possibilities don't eliminate the trouble you're having, it's time for the dealer to check the starter by doing a draw test with the engine warmed up.

#### Softening hard knocks

The automatic transmission in my 1985 Chevrolet Caprice station wagon, which has a 305-cu.-in. V8 engine and 4barrel carburetor, has an extremely

#### SERVICE TIPS

- Most complaints of excessive outer edge front tire wear on 1982-86 mid- and full-size Fords, Mercurys and Lincolns can now be resolved. Have a dealer apply the steps outlined in TSB 85-23-8 or TSB 85-23-9. Generally, they call for crossrotating tires, inflating tires to the maximum pressure indicated on the tire decal and setting caster, camber and toe-in precisely to the given specs. If your complaint was registered while the car was under warranty, the repair will be free.
- A new semi-metallic disc brake pad (part No. 41060-61A90) for 1982 and newer Nissan Sentras (gasoline engine models only) and Pulsars promises to last far longer than the pad originally put into these models. The new pad has been designed primarily for cars that experience heavy-duty braking
- If a 1985 or 1986 GM car develops a delay when accelerated, or slips on takeoff from a stop, or has a rough 2-3 upshift, check to see if it's equipped with a THM 440-T4 automatic transaxle. The unit is commonly used in GM A-cars (Celebrity, 6000, Ciera and Century). These problems can be the result of leaking seals in the 1-2 servo circuit. Each car division has issued a repair procedure calling for the installation of new seals. Ask your dealer to look at the technical service bulletin that coincides with Pontiac TSB 86-7-8 (12/85), titled "Delayed Forward Engagement, Slips on Takeoff, and/or 2-3 Upshift Bump or Shudder.

hard 1-2 upshift. My dealer says the hard shifting is normal. Do you agree? JAMES L. LIWO

TOLEDO, OH

I hope the dealer at least made sure the throttle valve (TV) cable isn't binding and is adjusted according to the service manual.

If he did this, the next step was to see if the provisions of technical service bulletin (TSB) 85-53 apply. The TSB talks about sluggish accumulator valves in Turbo Hydra-Matic 700-R4 automatic transmissions causing harsh or severe upshifts between FIRST

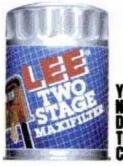
and SECOND gears. Depending upon which model of the THM 700-R4 transmission your car has, a new accumulator valve and spring or a new accumulator valve and sleeve could solve the problem. This repair, incidentally, may be the solution for other readers who have harsh 1-2 shifting THM 700-R4 transmissions in GM cars built from 1982 to early 1985.

#### DO YOU HAVE A CAR PROBLEM?

Just ask Mort about it. Send your question to the Car Clinic. Popular Mechanics, 224 West 37th St., New York, NY 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.

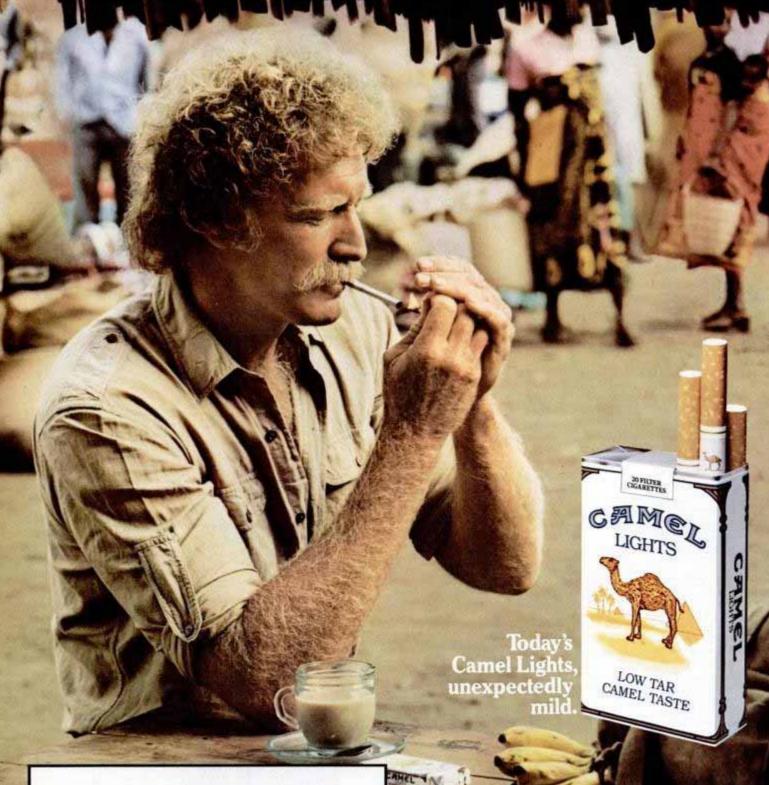
# EFFICIE U CAN RII'

In standard laboratory tests for tiltering efficiency against other leading brands. the others left as much as 56.8% more dirt in the oil than a Lee Two-Stage Maxifilter. No surprise here. Lee adds a second filter to effectively trap dirt as small as one-fifth the width of a human hair. Lee Two-Stage. The clean breakthrough in oil filter technology.



# CAMEL LIGHTS

It's a whole new world.



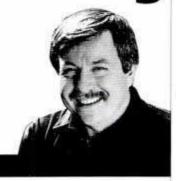
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### Freewheeling



BY WADE HOYT

### Mazda goes global



Part of Mazda's Global Test Track duplicates a California freeway.

swear you were on a section of California freeway, rain grooves and all. Suddenly, it changes to asphalt and curves gently uphill. The surface is cratered with New York-size potholes. Further up the hill, the road turns to cobblestone. Then you pass under a bridge and emerge on what could only be a German autobahn.

Where on earth are we?

On Mazda's new Global Test Track in Miyoshi, Japan, where engineers have gone to great lengths to duplicate some of the worst roads in the world. The cobblestones really were imported from Belgium. And casts were made to duplicate actual potholes in New York City.

The reason for all this, of course, is to help Mazda's suspension engineers design world-class ride and handling into their cars.





Real Belgian blocks (left) and New York potholes test suspensions.



Fastback window on Monte Carlo SS reminds us of boattail Rivieras.

### Speedway specials

Chevrolet has announced a "refreshing new sloped backlight" for the Monte Carlo SS (above) that lowers its C<sub>d</sub> from 0.375 to 0.365. While model option B5T won't save you much gas on the highway, it's expected to give GM's NASCAR stock car racing brigade a better shot at the sleek T-Birds on the superspeedways.

Last year, Bill Elliott's T-Bird won a record-setting 11 Grand National races. But due to NASCAR's unique point structure, the Winston Cup Championship was won by Darrell Waltrip's Monte Carlo, which actually finished first in only three races. Asked about the new fastback glass, Waltrip said, "It will give us stability on the banks, which we need. When we need speed, we can always draft a T-Bird."

Pontiac also has a street version of the NASCAR fastback called the 2+2. Based on the 165-hp 4-barrel 305 V8 with dual exhausts there are no options—a loaded 2+2 costs \$17,800.

Buick and Oldsmobile will try their H-bodies—Le-Sabre and Delta 88—on the high bankings next year. Although the street versions are front-drive V6s, NAS-CAR's ever-flexible rules will allow rear-drive V8 "stock" cars to sport Le-Sabre and 88 bodywork.

### Fuel shortage? Nah!

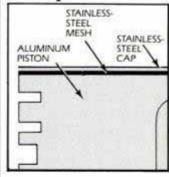
Experts keep telling us that the Earth's supply of fossil fuels will run out in the year 2000. Or was it 2010? Thomas Gold has a better idea.

An astrophysicist at Cornell University, Gold thinks that most hydrocarbons buried in the Earth don't come from decayed plant and animal matter at all, but from the Earth itself. Hydrocarbons like methane (natural) gas have been detected by NASA probes on Jupiter, Saturn, Uranus, Neptune and their moons where, presumably, there was no plant or animal life to decay.

Gold feels that methane and petroleum are produced deep within the Earth and forced upward. If so, there may be a nearly limitless supply in places where geologists have yet to look. That could mean no more OPEC, nuclear power or cramped economy cars.

If cars of the future can run on an endless supply of clean-burning methane, then smog, acid rain and the greenhouse effect would all subside. Most geologists poo-poo the theory, but Tommy Gold gets our vote.

### Meshpower



Most pistons are aluminum and can vary in temperature across the face, leading to hot spots and engine knock. Perfect Circle's Power Cap piston has a stainless-steel cap and mesh barrier said to run at a constant temperature, reducing knock and raising power. Available for Chevy 350 V8s, the Power Cap pistons and Super Kit can extract over 300 hp from the Chevy V8 on no-lead regular.

### Computers



BY RON SCIBILIA

### Apple II forever?

Predicting the successor to Apple Computer's venerable Apple II line has become a favorite pastime of Apple watchers.

Some seers believe the powerplant of this new computer will be a fast 16-bit microprocessor compatible with the versatile but aging IIe's vast library of 8-bit software.

Other soothsayers contend the New-Two will be a dual-processor machine, sporting Apple's current 65C02 engine with a 16-bit Motorola microprocessor riding shotgun. It's possible that this 16-bit chip will be the same 68000 Apple uses in its Macintosh—also found in the rival Commodore Amiga and Atari 520ST. Yet anoth-

er contingent thinks Apple will leapfrog the competition, migrating to the more powerful 32-bit Motorola 68020.

Whatever Apple finally decides to do—and it's possible these questions may have been laid to rest by the time you read this—the Cupertino, California, company is busy enhancing the current II series with a range of versatile accessories designed to prolong the life and utility of an undisputed industry classic.

New Apple products for the II line include the dualbandwidth ColorMonitor IIe and ColorMonitor IIc, both \$379. These two high-resolution, 13-in. color displays can also provide sharp 80-column

> monochrome text for easier-on-theeyes word processing.

Also new is the UniDisk 3.5 (\$499) external disk drive that provides 800

Franklin's ACE 2200 is first Apple competitor, and cheaper.



KB of storage on a hard shell,  $3\frac{1}{2}$ -in. disk. That's more than five times the storage available on the current model II's  $5\frac{1}{4}$ -in. drives.

Another welcome addition is the Apple II Memory Expansion Card, priced below \$300. This interface card increases the internal memory of the Apple II, II+ or IIe to over 1 megabyte, allowing

the creation of large RAM-fast electronic disks.

Apple is also making available a

Apple peripherals (clockwise from below) include 3½-in. disk drive, plug-in telephone modem and hard-disk drive (below monitor).



advantages.

runs most software designed

for the Apple II+, IIe and

Hc-while offering signifi-

cant price and performance

models. There's the 2-drive 2200 (\$999), the 1-drive 2100

(\$849), and for those who already own disk drives, the

All three versions come

equipped with 128 KB of

driveless 2000 (\$699).

The ACE comes in three

new mouse-driven version of Catalyst, a software program from Quark Inc. that stores and manages several applications on either the UniDisk 3.5 or in memory on the new Memory Card.

To get information out of the computer, there's the ImageWriter II, a \$595 dot matrix printer (for both Apple II and the Macintosh) that improves upon the speed and print quality of the original ImageWriter. Also for both Apple II and Mac is the \$399 Apple Personal Modem, a Hayes-compatible 300/1200 baud modem that plugs directly into a wall outlet or power strip to free up desk space.

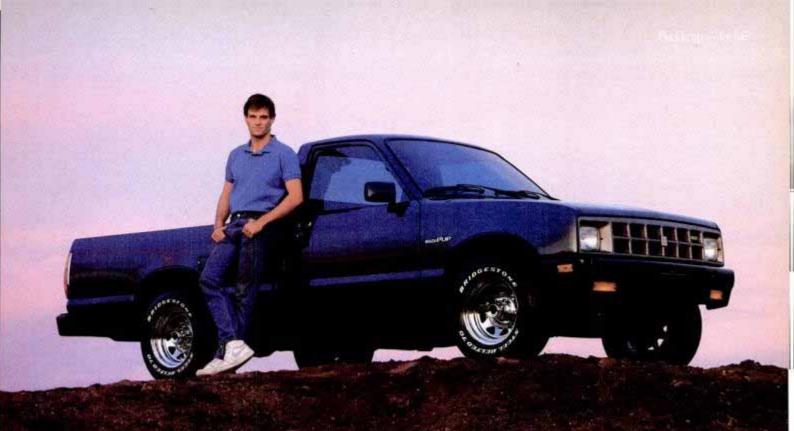
### But can it core an Apple?

A rival manufacturer with high hopes for Apple II longevity is Franklin Computer, which offers a spankingnew Apple II-compatible product line. The New Jersey-based company claims its Franklin ACE 2000 series RAM, built-in parallel printer card, switchable 40- or 80column display, and a game port with both 9- and 16-pin connectors. Replacement daughterboards, tagged at \$139 and \$199, boost available RAM to 384- or 576K.

Franklin believes that prospective buyers, business-oriented users in particular, will appreciate the solid feel of the 90-key detachable keyboard that features a numeric keypad and 12 fully programmable function keys-two things not found on Apple's IIe. Available for \$139 is a 22-megahertz bandwidth high-resolution monochrome monitor capable, the company claims, of up to 1000 lines of resolution and featuring a built-in tilt and swivel base. Franklin also offers an RGB interface card, \$78, for use with IBM- or Apple-compatible RGB color monitors.

### Apple friends

Outside suppliers haven't (Please turn to page 39)



## THE \$5969' ISUZU P'UP. BECAUSE NOT EVERYONE FITS INTO A JAPANESE SUBCOMPACT.

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A vehicle that does everything the average Japanese subcompact car does. But without being average.

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Or consider the comfort. This Isuzu P'UP gives you more leg, head and shoulder room than the front seat of a luxurious subcompact like the Mercedes 190E.

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As well as room for something far more important. A chance to express your individuality.

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The Indy Winner Sale is one winner-of-a-sale! So the sooner you see your participating retailer, the sooner you can stock-up on Pennzoil, and send in for your 20¢ Rebates!!

(Continued from page 36)

forgotten the Apple II either. AST Research, a frontrunner in IBM PC add-on hardware, offers four new products for the IIe.

The SprintDisk (under \$300 with 256 KB RAM) is an electronic disk and cache card that permits RAM disk drives up to 1 megabyte in size. This lets software that depends on heavy disk access-word-processing programs with multiple overlays, for example-run with RAM speed. AST's MicroStor, available in several versions, provides backup storage. A 10megabyte hard disk and 10-MB cartridge tape system is \$1995; 20-MB hard disk and tape units are \$2599 for the duo. Hard-disk drives or tape backup systems can be purchased alone, in either 10- or 20-MB capacities, for \$1295 or \$1595.

Additionally, AST's MegaRamPlus (under \$200 with 64 KB RAM) is a RAM expansion card that adds up to 1 megabyte of mainboard memory and includes AST's MegaRamCache software. Lastly, the Multi I/O-Clock/Calendar (\$155) is a clock and calendar card that offers ProDOS compatibility, battery backup capability, utilities, plus sockets for modem and serial printer port upgrades.

Quadram Corp., another leader in the peripherals market, now offers a multifunction board for Apple II, II+ and IIe systems. It's called MultiCore, and it provides up to 256K of RAM for electronic disk use, adds serial and parallel interfaces for printer and modem connections, and has a ProDOS-compatible clock/calendar (run by long-life lithium batteries) that permits time and date stamping of data files. The MultiCore retails for \$219 without additional RAM, \$279 for 64K, \$329 for 128K and \$399 for 256K.

Other Apple-aimed products in Quadram's product satchel include the Extended Multifunction Card (\$299). This 80-column expansion card for the IIe adds 64K of RAM and a ProDOS clock/calendar. For an extra \$46, you get an RGB color monitor interface for hookups to Apple's own RGB monitors, IBM color monitors, or Quadram's Quadchrome I and Quadchrome II color displays. Finally, Quadram's eRAM 80 card (\$135) bumps up random access memory by 64K and increases the text display on the IIe from 40 to 80 columns.

For RAM omnivores, there's a combination mainboard and piggyback board marketed by Applied Engineering out of Carrollton, Texas. The RAMworks II for the Apple IIe escalates memory by up to 3 megabytes and includes a built-in 64K printer buffer. Price is \$1699. A 1-megabyte RAMworks II without the piggyback board costs \$389.

### Computer gardening

Just in time for spring planting comes a combination software program and book package that promises to thrust home gardening into the personal computer age.

Ortho, long a household word in gardening products, breaks new ground with its Ortho's Computerized Gardening (\$50). It includes a handsome and profusely illustrated 192-page book; Gardening Techniques, that schools you in green-thumb basics. Moreover, there's a detailed vegetable planting guide that offers, in chart form, a range of proper planting times for 42 different vegetables, according to which of 10 climatic zones you live in.

Complementing the print information is the computerized part of the package, Ortho's Personalized Plant Selector. You tell the program your ZIP code, and Ortho's software confines its advice to those plants that thrive in your corner of the country—your own microclimate. You provide particulars on desired plant type (by botanical classification or use), plant height, flower color, blooming season, light and water requirements, and the program generates a personalized list matching your chosen criteria.

### **Machine-writing**

'Twas a time when kids with literary flair dreamed of writing the great American novel. For today's computer generation youngsters, though, literary aims are more likely to have an interactive flavor.

Recognizing this, Hayden Software offers budding computer-novel creators of all ages a software tool for spinning interactive text adventures. And you can use it whether or not you have any programming skills. Its Computer Novel Construction Set (\$50) is now available for the IBM PC, Macintosh and Apple IIc and IIe.

The Mac version lets you create rooms (adventure locations of whatever type) with the click of a mouse, and connect those rooms with another click. Writers can fashion custom landscapes, room descriptions, travel paths, characters and real-time events which change as time passes in the game.

The product includes a program disk, user's manual and the TimeQuest Guide to Adventures and Adventuring. The program disk features a Story Maker, which actually generates the text adventure, a Story Player, which permits actual playing out of the tale, a tutorial on adventure-making, and a full-length sample text adventure that displays the program's abilities.

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La Fargeville, NY 1-800-872-3315
Malone, NY 1-800-358-8304
Massens, NY 1-800-345-8458
Mayville, NY 1-800-872-2270
Cave Junction, OR 1-800-331-7784
Glencoe, PA 1-800-772-5647
Conroe, TX 1-800-325-3144
(dial tone 2228)
Wells River, VT 1-800-932-0202
Appomattox, VA 1-800-523-9881
or 1-800-468-3345 (VA)
Dillwyn, VA 1-800-623-1109
Mariinton, WY 1-800-825-263
Moorefield, WY 1-800-523-9023
Peterstown, WY 1-800-823-9023

1-800-555-1212 any area or town or 1-800-641-4266; (or write Strout #6190, Box 4528, Springfield, MO 65808. Please include \$2 shipping).



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## Appliance Clinic BY STEVE TOTH

### Stuck dishwasher button

We have a Kitchen Aid dishwasher, Model KDS-17, serial No. 1221. The full-cycle button stays in and you cannot start the machine unless you pull the button out manually, then push it in.

> AUGUST DOBBS MILWAUKEE, WI

The pushbutton program switch may be defective, or you may have a broken switch cancelling spring. This spring is inside the door, and is operated by the door latch.

To check these parts, dis-

Open the door and remove the four screws holding the front panel to the inner door. Next, remove the door handle and the control panel. This will expose the door latch, the 7-pushbutton program switch, and the white plastic cancelling spring located between the latch and the pushbutton switch.

If the spring is not broken, but the rivet has come loose, you can reinstall the spring on the door with either a small machine screw and nut or a pop-riveter and a

connect the electrical power.

CANCEL SPRING DOOR LATCH **PUSHBUTTON PROGRAM SWITCH** 0 SPACER RIVET INNER DOOR RINSE AGENT DISPENSER DETERGENT DISPENSER

Dishwasher full-cycle button that sticks may need a new plastic cancel spring, located behind door panel. If spring is intact, an entire pushbutton program switch may be required.

standard 1/s-in. rivet. Also. be sure to reinstall the separate spacer that inserts into the spring pivot hole. Without it, the spring will not move freely. The spring, part No. 108985, costs about \$1. The spacer, part No. 108984, costs 35 cents.

If the spring is intact, then your problem is most likely the program pushbutton. The slide mechanism inside the switch may be worn or the lubricant dried out. If this is the case, replace the entire program switch, part No. 108913; it costs about \$21. Be sure to mark each wire and the switch terminal it came from so you can reconnect the new switch correctly.

### Ovenwon't clean

We have a Tappan Gallery electric range with a continuous cleaning oven. But it doesn't clean itself and never has. It continues to build up a burnt residue. The instructions that came with the stove warn against using commercial oven cleaners. Do you have any suggestions? RICHARD KUHLMAN NEWFANE, VT

In a continuous cleaning oven, if spillovers or residue are allowed to build up, they block the porous surface material and prevent the cleaning process.

With the oven cooled, spray on a cleaner like 409 or Fantastic. Rub the cleaner into the soiled area with a nylon bristle brush or a nylon pad. Place a paper towel over the area and saturate it with the cleaner. Let the cleaner soak for about 30 minutes. Scrub the softened soil with the brush or pad. Blot up loosened residue and rinse with cold water. Use a sponge to squeeze water over the area, then blot.

Set the oven temperature to 450° for 2 or 3 hours. This will thoroughly heat the oven and help with the cleaning process. If the soiled area is especially stubborn, repeat the process. If some stains still won't disappear, repeat the cleaning process using full-strength ammonia.

### Noisy ice box

On vacation I slept with my head next to an old refrigerator. It was nearly silent. My own refrigerator, by comparison, is annoyingly noisy. Its whine forces me to turn up the TV, and it runs more than it's off. It is a Hotpoint CTF16EBC, serial SH364870. Is this normal or is there something I can do? WESTLY T. CUNDIFF

ANN ARBOR, MI

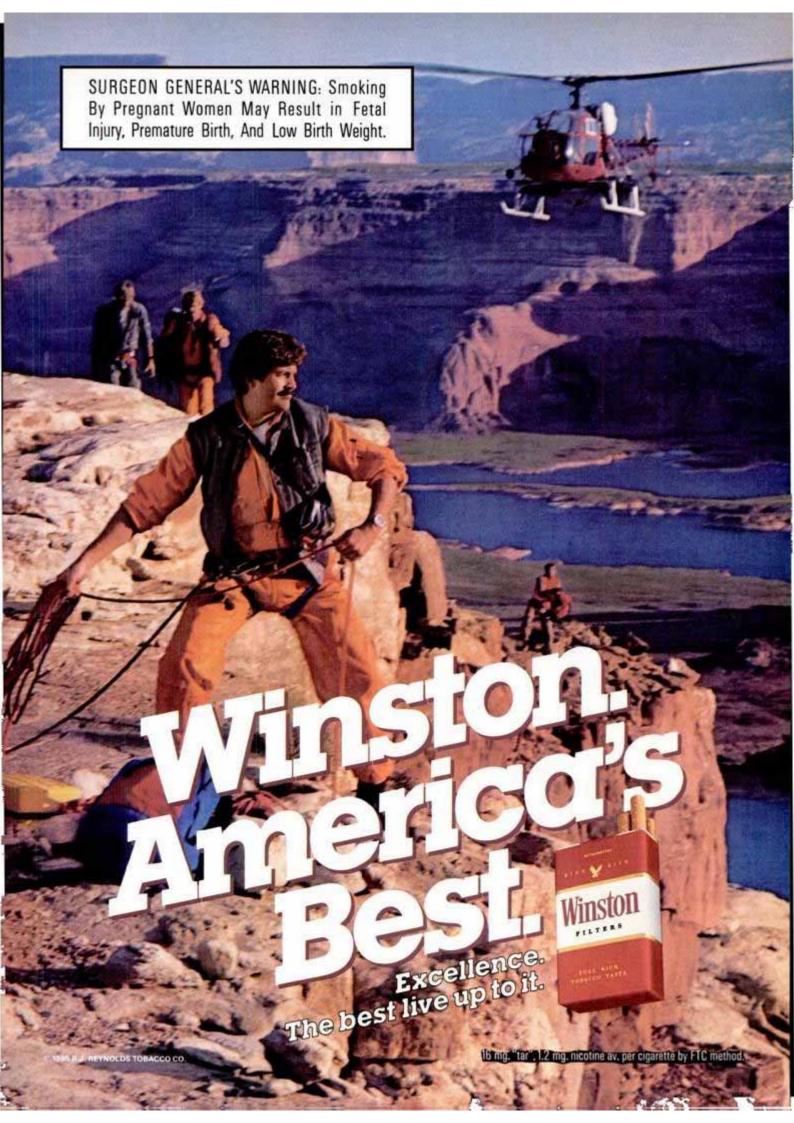
There are many operating components in your refrigerator that contribute to its overall noise level. The highefficiency compressor used on your model takes less energy to run, but runs more often to maintain even box temperature. Your refrigerator also has a condenser fan motor and an evaporator fan motor that contribute to the overall sound level. It may be that the sounds you're hearing are normal operating sounds.

The motor compartment under the refrigerator produces the most sound, so check the floor under the refrigerator. It should be vibration-free. All four legs or wheels should be in contact with the floor. Place a piece of dense carpeting under the refrigerator to muffle noise. Check the rear access cover to be sure it's secure.

While the compressor is running, check for vibration in the drain tube, condenser tubing, compressor mounting bracket, the defrost water drain pan or any part that is not firmly fastened in

There are two sound-level reduction kits that can be of help. A vibration damper kit, G.E. part No. WR-49X236, costs about \$3. A sound-block kit, G.E. part No. WR49X292, costs approximately \$20. Both are sold at G.E. or Hotpoint distributors.

If you have a problem with any appliance, send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.



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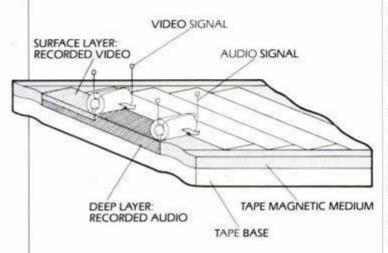
don't get that big

### Home Video



BY JAMES B. MEIGS

### Hi-fi hitches



VHS HI-FI uses one set of heads to record audio signals on the deepest layer of the tape, and another set to record video on the tape's surface layer. Sometimes, problems arise when a VCR tries to play a hi-fi tape recorded on another recorder. If the heads on the two decks have slightly different alignments, one deck might pick up the wrong signals, creating audio and video disturbances.

By now, almost every video enthusiast has heard how hi-fi VCRs lend such startling realism to music and movie soundtracks. What you probably haven't heard is that they don't always work right.

While most hi-fi VCRs perform flawlessly, owners of some VHS Hi-Fi decks have experienced problems when they try to play back a hi-fi tape recorded on another VHS Hi-Fi machine. The most common problem is a low fluttering noise-some people compare it to the sound of a motorboat-that intrudes into the soundtrack. Some people even report occasional picture disturbances.

To understand why this incompatibility among machines afflicts VHS Hi-Fi

decks, it helps to understand how the system works.

In the VHS format, the high-fidelity stereo signal is recorded beneath the video signal on the tape. This process, called depth multiplex recording, uses an extra pair of audio heads mounted on the spinning drum that also holds the video heads.

The audio heads first move diagonally across the tape, recording an FM audio signal deep into the tape. Then the video heads follow along the same path, recording video signals in a shallow layer along the surface of the

Why don't the two signals get mixed up? In theory, two things prevent interference, or crosstalk, between VHS Hi-Fi audio and video.

For one thing, the audio

signals are embedded deep in the tape where video signals can't penetrate. Additionally, the audio and video heads touch the tape at slightly different angles, or azimuths. Audio heads, therefore, are supposed to pick up only those signals recorded at the proper audio azimuth, while video heads play back only signals laid down at the video azimuth. This, apparently, is where the incompatibilities arise.

If two VCRs have slightly different head alignments, they might not be able to keep their signals straight when tapes are traded between them. The result of the mix-up is herringbone patterns that distort the picture, and motorboat noises in the soundtrack.

Fortunately, you can correct mild cases of incompatibility by fiddling with your VCR's tracking control. In fact, most VHS Hi-Fi VCRs have a special tracking knob just for adjusting hi-fi audio. But if you've got a serious case of incompatibility, you may have a real problem getting it corrected.

For one thing, there's no way to be sure which of the two VCRs involved is out of alignment. But more troubling is the fact that people who've tried to discuss compatibility problems with manufacturers' service departments encounter a wall of silence.

I've spoken to technical experts at some large video companies, and they claim they've never heard of the problem. The usual suggestion is, "If you're having a problem, send in your VCR and we'll realign the heads."

Unfortunately, head alignment for VHS Hi-Fi must be more precise than with conventional VCRs. I'm not certain that techni-

cians in U.S. service centers can do a better job aligning the heads than the specialists in the Japanese factories where the decks are made. In the end, replacing the problem heads might be the only solution. Although I wouldn't let it scare me away from buying a hi-fi deck, I believe you should be aware that incompatibility exists. If you already own a VHS Hi-Fi deck, and are shopping for another one or a second one, bring along a hi-fi tape recorded on your current deck. In the store, use this tape to check whether the deck you're planning to buy is compatible with the tapes already in your collection.

### Projecting an image

Projection television's reputation for having indistinct, fuzzy pictures is starting to fade. Two new sets that should help improve largescreen TV's image come from Kloss, the original innovator in projection TV, and Pioneer Video.

The new Kloss Novabeam 100 is a luxury model perhaps best suited to those with the space-and the budget-to set aside an entire room to hold it. It comes in three versions: The largest projects a 10-foot picture, and will probably cost over \$3000. Kloss has always been a leader in front-projection picture quality. This model raises the standards a notch higher with the intro-

(Please turn to page 44)



Projection TV's projecting a better image. Kloss Novabeam 100 (left) and Pioneer SD-P40 boast high resolution.





#### **HOME VIDEO**

(Continued from page 43)

duction of special Faroudja circuitry, designed to boost picture detail to studio-level quality.

Pioneer's first projection TV is another product not intended for the budget-minded. Its \$3500 price tag is a bit high for a 40-inch rear-projection model, but it provides one of the sharpest and brightest projection images I've seen. Pioneer claims it delivers 450 lines of resolution. More important, I think, is the way the picture stays in focus, even in the corners of the screen, when viewed from an angle.

### Name games

As long as I'm pointing out possible snares for unwary video consumers, I'd like to vent my personal gripe about the way video companies label their products. All too many plaster their equipment and product literature with psuedo-technical names and initials that are at best confusing and at worst completely meaningless.

Some companies, for example, prom-



Name-games: A stereo-ready TV needs adapter (atop TV) to decode stereo broadcast. True stereo TVs have decoder built in.

inently display the letters HD on the faceplates of their VHS Hi-Fi VCRs. The companies say this stands for High Density, and explain that it describes the recording process used in hi-fi. But are their hi-fi VCRs any different from VHS Hi-Fi models without the HD insignia? No. As far as helping make informed buying decisions, the letters might as well stand for Hot Dog.

Even more confusing is the welter of terms TV makers use to describe stereo television. The proper name for stereo TV is MTS, meaning Multichannel Television Sound. But instead of leaving it at that, some manufacturers try to make their sets appear more sophisticated by adding other names.

Because the circuitry for the MTS system was developed by Zenith and dbx, some sets add the words "Zenith/ dbx." Others don't make it clear whether they contain an MTS tuner to receive stereo broadcasts or just have stereo speakers. To make matters more confusing, many broadcasters identify stereo TV with the letters BTSC, the initials of the committee that helped choose the standard. Some products even include those letters.

I think the video industry should come up with a standard symbol, like the one used to identify closed-captioned programs on TV. Until this happens, be sure to read the fine print.

In another area, JVC's pictureboosting HQ (High Quality) technology is one of the most exciting things to happen to VHS VCRs since hi-fi sound. But now it seems the HQ tag might become another confusing catchphrase, one that means different things to different people—and to different VCRs.

The way JVC first introduced the technology (see *Electronics Monitor*, page 14, Dec. '85), HQ had three components: a higher "white-clip" level to boost certain parts of the signal, and two types of video-noise reduction. But when JVC recently held a meeting to hammer out the details on HQ so that all VHS manufacturers could begin including it, the company hit a snag.

Some manufacturers wanted their own picture-boosting technology included, and the whole HQ concept got watered down in the process. It was decided that any VCR can be called HQ if it includes the white-clip circuitry and at least one of the two types of video noise reduction or a new picture-sharpness circuit not developed by JVC (but reportedly less expensive to build).

What does this mean to you? It's likely that less expensive VCRs will include only white-clip and the sharpness circuit, while expensive models might include the whole package. How will you know the difference? I can see it now: We'll soon have VCRs tagged "Super HQ," "HQ Plus" and more.

#### Hot combos

TV sets with built-in VCRs are about to start landing on these shores.

Sony made a splash at January's Consumer Electronics Show with an 8-mm VCR couched inside its 25-in. XBR Trinitron monitor/receiver. The VCR portion features all the capabilities of Sony's tabletop 8-mm recorder, including excellent special effects and 24 hours of digital audio recording. The TVCR should sell for about \$2200.

Less of a financial strain—and easier to carry—are two combos from Lloyds. The company's L950-TVCR packs a VHS recorder into the chassis of a 13-in. color TV with wireless remote control. Another 13-incher, the L940-TVCP, contains a VHS playback-only deck (VCP). You'll find them selling for about \$550 and \$500 respectively.

### New Home Security Device Stops Burglars

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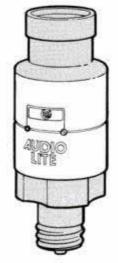
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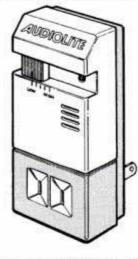
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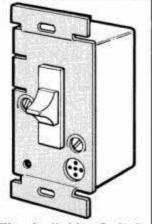
### Three Easy Ways to Protect Your Home in Minutes



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### Outdoors



BY TIM COLE

### Best all around?

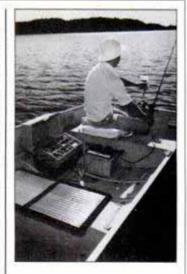


Mad River Grand Laker—high-tech building and proven lines.

sk 10 different outdoorsmen their opinion on the ideal Aoutdoor boat and you'll get 10 different answers, all of them entirely plausible. Low-freeboard, shallow-water skiffs perform admirably in the Florida Keys, but may flunk the rough-water performance test up in Maine. Inflatables may be appropriate as large-boat tenders or sport boats, but may suffer in the all-around utility department. And aluminum jon boats may be perfect for lakeland fishing, but are hardly adequate for true salt-water work. So what's the answer for the waterborne outdoorsman who won't settle for anything but the best of all worlds? Ask Jim Henry of the Mad River Canoe Co. and he'll tell you the North American indian had it all figured out 200 years ago. Jim has designed the Mad River Grand Laker motorized canoe with a high-tech twist to satisfy his diverse outdoor boating needs, arguing that modern building materials in this albeit anachronistic hull form will fill most requirements handsomely. At 21 ft. and 120 pounds, the boat can be car-topped and portaged easily by two. And a 9.9-hp Merc pushes the Grand Laker along smartly, as I discovered during a test run in New Hampshire. Moreover, Mad River builds it tough. The boat is made out of three layers of unidirectional S-glass and three layers of Kevlar over a 1/2-in. Airex core. Two more layers of Kevlar are laid over the Airex. A high-strength ash keel (never underestimate the power of wood) adds longitudinal rigidity. Jim has chosen a high-tech Kevlar/Airex/S-glass combination because of its impact resistance, obviously crucial in a design meant to skirt past the odd outcropping or take life's little groundings. For more information about this \$3750 workhorse, contact Jim at the Mad River Canoe Co., Box 610, Waitsfield, NH 05673.

### Portable power

Under the heading of "nifty ideas" this month we find the portable photovoltaic system from Sovonics. The Sunpak Model 110, priced at \$210, is small enough to fit in your knapsack and weighs only 31/2 pounds. But this diminutive solar arraycomprised of Sovonics' "flexible amorphous solar cells"offers enough sun-produced 6- or 12-volt DC juice to power many audio and video products, toys, tools or to recharge batteries. Contact Sovonics Solar Systems at 6180 Cochran Rd., P.O. Box 39608, Solon, OH 44139.



Sunpak can provide solar power for many applications.

### Small-boat radar

it's intended for powerboats 20 ft. and up. And while it's definitely on the pricey side-try \$2700 a copy-the Vigil greatly advances the state of the art, introducing technologies that even the casual boat owner should know more about. For starters, the Vigil is designed in two distinct modules-the monitor and the control panel. These two components can be separated by up to 15 ft, using wireless infrared remote control. So, if you're pressed for

space on that mid-20s canyon

runner, you can position the

Vigil's key panel under a gunwale adjacent to the helm and squeeze the monitor on the dash under the windscreen. The Vigil's monitor, key panel and topsides scanner are also designed for self-installation.

But move beyond these rather innovative touches to what the engineers like to call the user interface-the screen itself, in other words. The Vigil achieves higher resolution in its 2-tone rasterscan monitor through a 512 by 256 pixel density. Contact Mars Electronics, Marine Systems Division, 801 Carpenters Crossing, Folcroft, PA 19032.



Vigil advances the state of the art in rasterscan radar technology.



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### Audio



BY TERRY SHEA

### Bye-bye turntable





Two approaches to car CD: Sanyo unit (top) has a jack for a portable tape player. Jensen radio/cassette has a jack for CD.

here's a Las Vegas show that attracts 100,000 people over a 4-day run and features more bigname acts than any single hotel/casino extravaganza in town. It's the winter edition of the Consumer Electronics Show, where the home entertainment industry shows off its latest developments amid the cacophony of music videos mixed with Mozart.

Not surprising to anyone, the digital Compact Disc dominated the new audio introductions. Compared to earlier CD players, the new models are more versatile. This should make the laser-based machine an even more attractive alternative to the conventional analog turntable. Indeed, 1986 will go down in hi-fi history as the first year when we Americans buy more CD players than turntables.

Hastening the demise of the turntable—and weakening the cassette's position as well—is a new crop of portable and car stereo CD machines that make digital disc a truly universal medium.

Where once only two personal-sized portable CDs were available, you'll soon see about half a dozen more, from such companies as Hitachi, Magnavox, Quasar, Sanyo and Toshiba. Most unique among the new portables is Toshiba's XR-P9 (\$300). It's the only miniplayer that offers wireless remote control as an option-obviously for those times when you use the player as a home unit. A nonremote portable, the XR-J9, costs \$200.

Despite all these portable CD players, automotive CD generated the most excitement at the Las Vegas gala. Sony introduced the world's first car CD changer, called the DiscJockey. It stows away in your car's trunk and

holds 10 discs. You operate and program the player with a remote control module. This can be permanently mounted in your dash or you can leave enough slack in the cable to pass the controller among your passengers, then hide it under a seat when you leave the car.

Sony's DiscJockey comes with or without an AM/FM tuner. By the time you read this, you'll find it in hi-fi stores for about \$1000.

In other car CD developments, Jensen is the latest company to make it easy for you to use a portable CD player with your car. The company offers two in-dash cassette receivers with rear panel inputs for connecting a CD player. Jensen goes a step further than many of its competitors by offering an optional adapter that plugs into the back of the unit, then runs forward to provide dashboard access to the CD input. This allows easy connection of a portable CD player to your car system. The new models are the JXL-45 (\$330) and JXL-55 (\$400).

Sanyo, meanwhile, takes just the opposite approach to the cassette vs. CD dilemma. The company now offers two in-dash car CD players that feature front-panel inputs to connect a portable tape player to your car stereo system. The FTEC1 and

FTEC2 are priced at \$600 and \$700 respectively. Both are AM/FM/CD combination units, but the FTEC2 has more features and includes Sanyo's Viper auto security system (see Safe And Sound, page 180, Oct. '85).

In conventional in-dash CD players, Denon, JVC and Philips also have addressed the problem of theft. Each company lets you easily remove its player from the dash (you can stow it in the trunk or take it away). The Philips and JVC units, CD-only, can be used away from the car.

In home CD, developments are less dramatic, though several recent moves will doubtless speed the digital format's acceptance.

Mitsubishi, for example, is the second company to introduce a home CD changer, this one a 5-disc model. The DP-309 carries a suggested retail price of \$450. (Pioneer's \$500 PD-M6, a 6-disc changer was the first.)

Yet another trend nailing down the CD player's place as successor to the turntable is the appearance of prepackaged audio component systems offering a CD player as standard equipment with the turntable optional.

Until now, CD-equipped systems were common, but all also came packaged with an analog turntable. Pioneer

(Please turn to page 50)



New Players Lights 25's because...

Kings & 100's

Mfr's. suggested pricing based on full-price brands.

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

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"if the territory still is open

#### AUDIO

(Continued from page 48)

is taking the lead in breaking away from tradition by offering four CDstandard/turntable-optional systems. Fisher also will offer such systems.

### Taping tax debated

Through the years, the audio industry has boasted that its products don't hurt anybody. Hi-fi components don't pollute the environment, they don't maim people and they haven't yet been shown to cause any dread disease.

But in the record industry's eyes, the audio component and blank tape industries are nothing but a pack of thieves. What the audio gang is accused of stealing is royalties due to recording artists and songwriters. How? By selling audio tape recorders and the tape that goes with them.

Accordingly, two bills have been introduced in Congress that would levy a tax on the sale of blank audio tape and recorders. The record industry's position is that people who copy an LP, cassette or Compact Disc at home are depriving the artists of what's theirsa royalty on the sale of their original work. To the record companies, justice demands a tax on the devices that permit consumers to copy these works without paying. Proceeds from the taxes would be distributed to the artists as compensation for lost royalties.

The House bill, H.R. 2911, was introduced last year and at press time still hadn't been scheduled for hearings. But the Senate Copyright Subcommittee has heard testimony on its version of the bill, S. 1739.

The two bills are similar, differing only in the amount of the tax on recorders. The House version calls for a 10 percent levy on the wholesale price of a standard tape deck, 25 percent on the wholesale price of a double-deck (those cassette units with two tape transport sections) plus 1 cent per minute of playing time on blank audio tape. The Senate bill puts the same penny-perminute on tape, but only 5 percent on the wholesale price of any recorder.

Most representatives of deck and tape manufacturers say the cost of such taxes will have to be passed on to consumers. They contend that the proposed bills would tax tape and recorders that might never be used to reproduce copyrighted material.

Both industries have a lot at stake, so they've marshalled their forces for the congressional battle. In fact, the Audio Recording Rights Coalition (202-457-4919) ran large antitax ads in the hometown newspapers of the senators on the copyright subcommittee. The ad asked consumers to voice their objections to their elected representatives.

POPULAR MECHANICS • APRIL 1986

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### Aviation



### Sikorsky ceiling rising



The first update of Sikorsky's S-76 has more lifting power.

The Federal Aviation Administration has certified Sikorsky's new S-76B corporate helicopter for day and night takeoffs and landings from sea level to 3200 ft., and en route altitudes of 10,000 ft. The S-76B is the first major update of the decade-old S-76, which also

flies as the H-76 Eagle for the Army.

The basic craft is known for its excellent flight stability and lifting power, but the new version is billed as more stable and better at lifting. Among the improvements is an engine with 46 percent more takeoff power.

### 1-man chopper

The Army has moved a step closer to the dream of a 1-man attack helicopter. In tests of the McDonnell Douglas AH-64 at Mesa, Arizona, the experimental chopper has made its first successful flights with fully operational advanced digital flight controls. The chopper is outfitted with a flyby-wire control system similar to the controls of a jet Eventually, fighter. Army plans to create a light attack helicopter called the LHX. It would be outfitted with air-to-ground and air-toair missiles, a cannon and other fighter-type weapons to accomplish in jungle terrain what a fighter does over open land.

### Props with thunder

Weekend fliers count thrills and chills among the benefits of taking to the sky. And the upcoming AVTEK 400 Jetfan is promising all that and more in flight tests. The twin-engine craft made of Dupont Kevlar and Nomex is gunning for FAA certification as a 400 mph craft. During tests, certain design changes are being considered in the wing configuration. But the plane shown in the photo at right is basical-

ly what the AVTEK 400 will look like when it tries for FAA approval next year.

### The Porsche of aviation

The West German automaker Porsche is getting into the aviation engine business following last year's stunning Texas to Stuttgart 46-hour flight of a 2-place Mooney with a 212-hp Porsche engine. The 6-cylinder, 3.2-liter engine is similar to the powerplant used in Porsche cars. The engine is being tested this year on a new Dutch-made corporate prop plane. But more interestingly, the British Skyship company has mounted an experi-Porsche mental on tethered Skyship 600. Meanwhile, Messerschmitt-Bolkow-Blohm has ordered a Porsche Formula One racing engine for experimental use in a helicopter.

### Props again

Jet-age baby-boomers seem fascinated with the propeller. An increasing number of airplane designers and owners are looking to props for high-speed flight at low fuel consumption. It seems that the oil stampede of a decade ago bowled over the industry.

Now United Technologies' Hamilton Standard Division has begun full-power testing of the first large-scale propfan under a NASA contract. The tests, under way at Wright-Patterson Air Force Base, are the last major step toward flight-testing a propfan plane later this year. The big deal about prop-fans is they theoretically can push an airliner-size craft at jet speeds.

But they use 30 percent less fuel than comparable turbofan engines.

### Fix-it aircraft

You and I may soon be flying in a plane that can repair itself in flight.

I'm not dreaming. I'm just following work being conducted by the Air Force Aeronautical Systems Division toward development of an automatic self-repairing flight-control system.

The present design is for jet fighters. But the system could translate to lightning-damaged aircraft that are flown by civilians in a decade or so. The system would have backup flight controls to stabilize an airplane if one of the craft's main controls, or a chunk of a wing or tail, were blown away.

Rudders, flaperons, ailerons or stabilators would be brought under the control of a flight computer and would take over the tasks of the missing flight control functions. An automated maintenance computer would even be able to detect any mechanical breakdowns requiring that one healthy part of the airplane take over for another broken-down part.

Grumman and General Dynamics have already been awarded contracts to construct and test prototypes of the self-repairing system. They are examining current jet aircraft design to see if they can improve the inflight repair chances of the equipment as it now exists.

In the next phase of the program, new flight-stabilizing equipment will be added to experimental aircraft to begin tests. Full-fledged flight tests of the automatic self-repairing system are scheduled to begin in 1989.

Computer software for the system is already being flight-tested under an airborne damage control diagnostic program.



The AVTEK 400 will attempt to get FAA certification this year.

### Save Gas, Save Engine with "POLY"

The following introduces one of the most fully tested and proven gas saving, friction-reducing engine treatments ever to reach the market!

The Secret is "Poly"

"Poly" is short for polytetrafluoroethylene (TFE), the slipperiest substance known to man. (1981 Guiness Book of World Records). Petrolon Corporation, makers of Slick 50, invented a way to permanently bind this slippery chemical to your engine with one treatment. Just one quart of Slick 50 can reduce engine friction, increase gas mileage and horsepower and reduce engine operating temperature, causing your oil and engine to last longer. . . plus it reduces metal wear, defraying costly overhauls.

#### Years of Testing and Use Have Proved it True!

Slick 50 has been thoroughly tested in independent laboratories and out on the road;

The March/April 1982, p. 35 issue of "Consumer Digest" magazine stated, "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about 2 or 3 miles per gallon."

One of the country's most respected research institutes reported applying a powerful ultrasonic cleaning process to a Slick 50 treated engine and were surprised at its permanence. "We actually expected the Petrolon Slick 50 TFE Resin coating to also be removed, but later found it was still there."

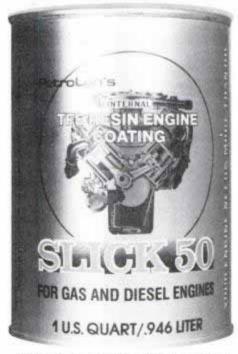
"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear! . . . for the price of one treatment when compared to engine rebuild, we feel that you'd be money ahead using Slick 50."

The Federal Aviation Administration has fully accepted a similar product for aircraft—Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). This FAA endurance test simulated 1400 hours of engine use.

The senior engineering researcher at a leading southern California university stated, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university."

The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a torture test overseen by the Automotive Services Council for Pennsylvania and shown on WTVE television. Three cars with 75,000 to 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage.



There isn't room here to tell you about the dozens of other tests proving that Slick 50 is everything we say. However, if you're still skeptical, send \$2.00 to cover printing and postage costs, and we'll send you detailed test results plus actual letters from users who report how Slick 50 saved their engines and saved them money!

### It's Easy to Treat Your Engine

A few minutes before oil and filter change, add the engine flush you get free with each order to clean out the engine. Let the engine idle for 5 minutes. Then drain the oil, change the filter and add the proper amount of oil, less one quart. Add one quart of Slick 50, drive for 30 minutes, and leave it in the crankcase for at least 3,000 miles. As the engine operates, the oil carries the "poly" between the parts where it is burnished into the pores of the metal.

#### **Only One Treatment Necessary**

It's permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4, 6 and 8-cylinder gasoline and diesel engines.

#### **Works with Most Oils**

Slick 50 will work with all petroleumbased oils and all synthetics compatible with petroleum-based oils with the exception of graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

#### 4 Ways Slick 50 Saves You Money

Your actual percentages may vary depending on your driving, vehicle condition, weather and geographic location, but no matter what your conditions, Slick 50 can:

- 1. Increase mileage
- Increase horsepower (small economy cars and large RV's really need this)

- Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine
- Minimize or eliminate costly overhauls by reducing engine wear

Up to 90% of the engine wear on a car can be caused by lubrication starvation cars experience when first started before the oil begins to circulate. Slick 50 can eliminate this problem for less than the cost of two tanks of gas.

#### Slick 50 Will Not Affect Your Warranty

Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturer's engine warranty requirements. In addition, this oil carries an American Petroleum Institute service classification SF-CC-CD.

### There's No Risk with Our Money Back Guarantee

Use Slick 50 for 3000 miles. If you don't notice an improvement in engine performance, return your invoice with a short note telling why, for a prompt full refund — no questions asked.

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Here's an opportunity to make handsome profits. Having such solid test results from major institutions make Slick 50 easier to sell than many other products. Free dealership information is sent upon request.

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### **Inside Detroit**



BY JIM DUNNE

### Four tops engine list

In 1985, for the first time in the memory of most folks, the 4-cylinder topped the list of engine installations for a year. Not since the '20s, if then, has the smaller engine been so popular. Last year, a Four was used in just over 50 percent of the 4.3 million cars built in the United States. Import car manufacturers who have plants here, like VW, Honda and Nissan, helped tip the count in favor of the smaller engine.

Second most popular was the V8 engine, installed in 28 percent of the U.S. cars, mostly those made by Ford and General Motors. Sixes dropped to just 20 percent of all engines, but this was attributed mainly to a shortage of V6 engines, not to lack of demand. With new Sixes in production from Ford, and a better supply for front-wheel-drive cars at GM, the V6 engine should show the biggest gain in 1986.



Carefully integrated hatchback is hard to spot on the '88 Corsica.

#### Corsica 1988

A 5-door version of the Citation replacement will be introduced as a 1988 model by Chevrolet (above). Notable in the design is the carefully hidden hatch door at the rear. From just about any angle except the rear, the car has the appearance of the 4-door Corsica that is set for 1987 model year introduction (see Detroit Listening Post, page 32, July '85).

### Return of LeMans

"It's a familiar name, so we think customers will like the car right off." That's the way one of the nation's biggest Pontiac dealers explained his reaction to the "LeMans" label being used for the Korean car GM will import in 1987. LeMans was the name of the midsize Pontiac sedans sold from 1962 to '82, when it gave way to the 6000. Now, Pontiac plans to use it for the Opel Kadette lookalike to be assembled by Daewoo in Korea.

LeMans prototypes have been undergoing shakedown tests at GM's proving grounds in Milford, Michigan, for the past year. In appearance and mechanical details, they are identical to the Kadette and, according to Pontiac, the production mod-



Plymouth Sundance 2-door caught on its way to Chrysler test track.

els will not be much different. Overall, the design is similar to Honda's pugnacious-looking CRX. Front-drive with a 1.2-liter (73-cu.-in.) 4-cylinder engine and 4-speed manual transmission will make this an economy car. Price, with the low-cost Korean source, will be near the lowest of the Japanese cars sold here, but nowhere near the \$3995 of the Yugo or Skoda.

### Tapper handle

That's what GM insiders are calling the unique door handle that will show up on the 1987 Chevrolet Baretta and the 1988 Pontiac Grand Prix. The outside handle is in the upright portion of the window frame, its black finish blending in with the B post so that it becomes invisible from a distance. Why the tapper label? To open the door, you pull down and out on the handle, just as you would tap a glass of beer. Does this tell us something about where GM designers spend their offwork hours? Orange juicers also work that way.

### Sundance

Newest model in Chrysler's lineup of small cars is this Sundance subcompact coupe. It fits between the Horizon and Reliant and will be on sale next fall. This finished pilot model (above) was caught en route from Chrysler Engineering in Detroit to the proving grounds in Chelsea. Michigan. Two body styles are planned: a 4-door sedan and this 2-door. Chassis details include a 2.2-liter 4-cylinengine, front-wheel drive, and a choice of automatic or manual transmissions. Dodge will have similar models, with their own grilles and taillights, that will sell under the Shadow nameplate.

### Ciera coupe

Among GM's midsize models, Olds will get an exclusive on this 2-door roof style (below), at least for the 1986 model run. The Mercedes lookalike roofline is intended to set Ciera apart from Buick, Chevrolet and Pontiac models in the A-Body line.

A GT version has a special air dam and rear spoiler, plus halogen headlights. Olds was chosen as the lead division for this body style as a reward for its sales lead among GM's midsize sedans.

(Please turn to page 56)



Oldsmobile is the first GM division to get Mercedes-clone roofline.

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These offers are good from March 1 to June 30, 1986. Ask your participating Ford Tractor dealer for complete details, and ask to see the warranty. Or call toll-free 1-800-528-6060, Ext. 1865 for his location.

FORD TRACTORS





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#### DETROIT

(Continued from page 54)

### Eyeballing gauges

GM researchers believe that the instrument panel can be redesigned to make the most of the human eye. We have different ways of seeing objects. As expected, the objects directly in front of the eye are seen most clearly, and their colors are most distinct. That's where the important gauges should be mounted. Other gauges, those of less importance, can be moved to the side where they are seen less acutely.

That makes sense, and has been the

rule since engineers started laying out instrument panels. But now, with more scientific knowledge of how the eye sees, the technique can be refined. Blue colors, for instance, are not seen as sharply, and should be used for background on instruments instead of for details. Another example: Gauges set off to the side may be made larger for better viewing. Or, movement in the gauge—like a blinking light—will catch the eye's attention.

Also, the human brain is wired to see color, lines, edges and angles more quickly than other shapes. GM researchers are trying to take advantage of the eye's trick by making certain parts of a line pattern either brighter or darker. However, that development, like the others, will not show up on an instrument panel of a production car before much human testing.

About 10 years ago, GM did a project that watched the driver's eyes as they moved from the roadway to the instrument panel and mirrors. It was found that gauges set up high, and to the left of center, were the ones first checked, and most frequently checked. Then came the gauges above and just to the right of center. Finally, the driver's eyes checked gauges to the far left and right. Look at the gauges on your own car. If GM's findings are correct, the speedo should be center or left-center. Sports car drivers may prefer the tachometer in that position, because it can be seen and read more quickly.

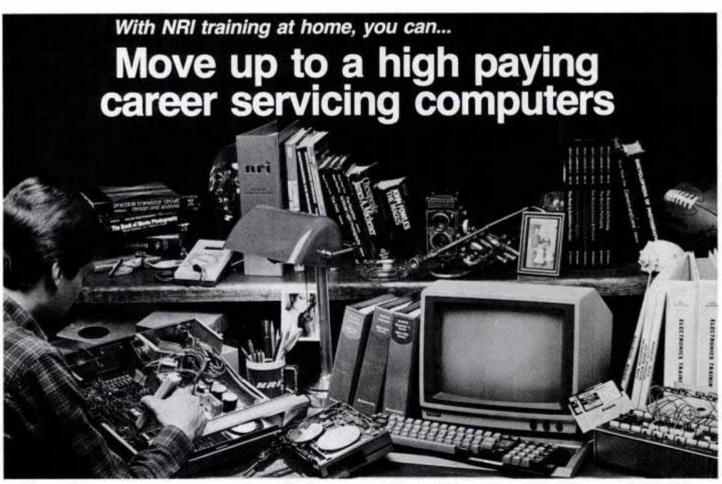
### Saturn rumblings

GM wanted to make a small car that could compete in price with the imports. Something in the \$5000 to \$6000 range. That was the idea behind Saturn, a \$5 billion company that would operate separately from GM's regular divisions and not be tied into any old-fashioned ideas of car building. But now the Saturn focus has shifted. Some reports say Saturn is planning a car for Yuppies, one that will carry a much higher price tag. And that has Pontiac, Olds and Buick hopping mad. Why dump \$5 billion into a new company, they argue, when the same car could be built on existing lines by the older car divisions? Make no mistake, \$5 billion is a ton of money. GM could build 10 ultramodern assembly plants for what they plan to spend getting Saturn off the ground. The older divisions will lose a chance at that bonanza, and at the same time find themselves with a new competitor, the Yuppie-scale Saturn. Meanwhile Saturn-which will get into production in 1989-is forging ahead, even without a firm focus on what kind of car it will ultimately build.

### Diesel downturn

The unlikely marriage of Mercedes to the diesel engine, one that saw the luxury carmaker lead in diesel sales for more than a decade, is coming on hard times. Mercedes plans to sell only 25 percent of its 1986 models with diesel engines, a precipitous drop from the 75 to 80 percent peak in 1980. Three reasons for the downturn: Gas prices are holding steady, high-powered engines are back in vogue, gas-guzzler taxes are not the scandal they once were.

Bigger V8s and high-output 16-valve Fours are taking the place of the diesels. As for gas-guzzler taxes, Mercedes is passing the costs on to its customers, who don't seem to mind the extra grand or so tacked onto a \$25,000 to \$55,000 price sticker.



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You can create your own bright, high paying future as an NRI trained computer service technician. The biggest growth in jobs between now and 1995, according to Department of Labor predictions, will occur in computer service and repair, where demand for trained technicians will double. There is still plenty of room for you to get in on the action—if you get the propertraining now.

#### Total computer systems training, only from NRI

To learn how to work on computers, you have to get inside one. And only NRI takes you inside a computer, with total systems training that gives you hands-on experience with computers, peripherals, and software. You'll build a Sanyo MBC-550 series computer, which experts have hailed as the "most intriguing" of all the new IBM-compatibles. The Sanyo even surpasses the IBM PC in computing speed and graphics quality.

Even if you've never had any previous training in electronics, you can succeed with NRI training. You'll start with the basics, rapidly building on the fundamentals of electronics until you master advanced concepts like digital logic, microprocessor design and computer memory. You'll probe into electronic circuits, using the exclusive

NRI Discovery Lab® and professional Digital Multimeter, that you keep.

You'll assemble Sanyo's intelligent keyboard, install the power supply and disk drive, and attach the high resolution monitor—all the while performing hands-on experiments and demonstrations that reinforce your skills.

### Learn to service today's computers

As you complete your Sanyo, you grasp the "secrets" that qualify you for a new career. You'll learn to program in BASIC and machine language. You'll use utility programs to check out the operation of the Sanyo's 8088 microprocessor (the same chip used in the IBM PC). And you also get over \$1,000 worth of software, including WordStar and CalcStar.

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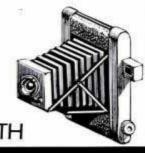


### COME UP TO KOOL

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

Kings Box, 16 mg. "tar", 1.1 mg. nicotine; Filter Kings, 16 mg. "tar", 1.0 mg. nicotine av. per cigarette, FTC Report Feb. '85.

### **Photography**



BY STEPHEN A. BOOTH

### New camputer: T90



T90 boasts built-in motor drive, auto-exposure, multi-metering.

puters before—those 35-mm single lens reflex cameras whose on-board computers do nearly everything but compose your picture for you. Now meet the Canon T90.

It even looks like a camera, though more like something you'd expect Darth Vader to own. The matte black polycarbonate body has the molded curves popular in today's aerodynamic automobiles. The contoured rubber hand grip lets your index finger rest naturally across the angled shutter release. This makes the T90 feel more like a custom target pistol than any SLR you've ever used. It's expected to cost about \$850 with a 50-mm f/1.4 lens.

Unlike its sibling T80 (35mm Shootout, page 148, Jan. '86), the new T90 lacks automatic focusing. But its 28ounce body packs just about every conceivable feature a professional photog or sophisticated amateur could desire. So many, in fact, that the T90's manual runs 124 pages. We'll just be able to hit the highlights here.

Canon says its goal for the T90 was to automate all the routine and noncreative functions of picture-making. This means you can expect the camera to load your film, set the proper film speed, advance and rewind it automatically (the built-in motor drive advances 4½ frames per second). But there's more.

The T90 is an auto-exposure program camera. In the standard program, it will pick the correct shutter speed and aperture (f/stop) for you. All you do is focus. If you want to choose a shutter speed, it will pick the aperture—and vice versa. It's even smart enough to make the necessary compensations when you're using a telephoto or wide-angle lens.

In all, the T90 has 15 autoexposure programs. You select them by pressing the MODE button, then rotating a thumbwheel that's conveniently located near the shutter release. A large liquid-crystal display (LCD) atop the camera tells you what program you're using.

You use the same thumbwheel and LCD to pick one of three light-metering systems, plus special functions such as multiple exposure. Secondary controls, such as battery check and self-timer, are hidden inside the handgrip. Light metering includes center-weighted averaging, partial reading and spot-metering from up to eight items in the viewfinder. You can expose for one of these, or let the T90 average for the best exposure.

Thanks to its economical motor design, the T90 uses only four AA batteries—good for 100 or more 36-frame rolls. Shutter speeds range from 1/4000 of a second to 30 seconds, film speeds from ASA 6 to 6400.

For flash photography, Canon recommends its dedicated Speedlite 300. This bounce-flash rocks and swivels to prevent washouts. More important, its advanced through-the-lens metering system measures subject distance and ambient light to emit just enough brightness for correct exposure. You can even set the Speedlite 300 to project light according to the focal length of the lens you're using.

If you enjoy macrophotography, Canon's ML-2 ring light fits around the lens and gives you lots of creative options. Like to shoot wildlife? The LC-2 remote control uses infrared to snare anything that lurks in range.

### PM Photo Album—Tips for Better Pictures

Spring flowers make ideal subjects for putting your hibernating camera back in use, and close-focusing macro zooms make it easy to fill the frame with small subjects.

Use the depth of field preview on an SLR to see if there's anything distracting in the background of your planned photograph. If so, put it out of focus with a larger aperture (smaller f/stop). With autofocus 35-mm compacts, stay within the minimum focus distance (or use a closeup lens adapter).

MIN STATE OF THE PARTY OF THE P

For creativity, try shooting from low angles for a different point of view. Sprinkle the flowers with a water-glycerine mixture to add sparkle and texture. Use backlighting to highlight the delicate petals, but watch your exposure. When shooting into bright backgrounds with an SLR, take your light reading off the ground or from a gray card held in front of the flowers. With auto-compacts, activate the backlight button, or set the exposure bias dial to +2.

-Armand Ensanian





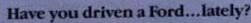


### RD TAURUS. CE ISN'T LIMITED DER THE HOOD.

Right down to the smallest detail.

The best-built American cars.

At Ford, Quality is Job 1. A 1985 survey established that Ford makes the best-built American cars. This is based on an average number of problems reported by owners in a six-month period on 1981-1984 models designed and built in the U.S. The secondary sun visor helps eliminate glare from the front and side simultaneously, so you don't have the inconvenience of constantly swinging the visor back and forth. It's not available on the L model.







### Science



BY DENNIS ESKOW

### Still a Shuttlebug

veryone is asking me the Big Question, and no one deserves an answer more than you. Am I still trying to be the first journalist on the Space Shuttle? It has been two months since a Shuttle explosion took the lives of seven people, including schoolteacher Christa McAuliffe. Many were talking before that explosion about the problems with the Shuttle. Many more are calling today for a switch to unmanned spaceflight in the wake of the disaster.

Forget it. It is behind us. We have to press on in the push to populate space. The issue is bigger than the Shuttle program. Bigger than the Space Station program. Bigthe conquest of frontiers.

We have to go on with manned space travel because we need the new territory and resources offered in the expanses of space. Think of the thousands of men, women and children who gave their lives in the settlement of the West. At each death, surely someone asked: Is it worth the tragedy? Is it worth the risk? Cowards, who die a thousand deaths. said no. But men of vision saw something greater. We needed room to grow. We needed the resources. And we won them. Even as I write this column, France is rushing ahead with its unmanned space program. Its success could rob America of ger even than the romance of the satellite business now

> tle. The Russians are building their first space shuttles. They, too, want to expand territory. Many runners enter the race, but only one will win the crown. I hope it will be us. And I still hope to be part of it.

And so my preparations continue. If that serious exercise is part of the

For the rotund.

going to the Shut-

you've been following my training program, you know

that can be a tall order. It involves dieting and regular

But when you're grossly overweight, exercise can cause injury. For example, I hurt my lower back trying to do sit-ups.

On investigating ways to continue working on my stomach muscles without further injuring my back, I came across some routines that anyone might use to prevent back injury. The following two exercises are forms of modified sit-ups.

The first involves a device called the Roman chair, shown at lower left. You sit on the bench and secure your feet under the lower bar. Then, place your fingertips behind your ears and extend your elbows. Bend your back about a third of the way toward the floor, then pull yourself back up into a sitting position.

Do just 10 of these and you will feel the upper muscles of your stomach, the rectus abdominis, stretching and tensing. Yet there will be little pressure placed on your lower back.

The lower stomach area muscles, including the external oblique and adductor muscles that run down to the loins, need a different type of exercise.

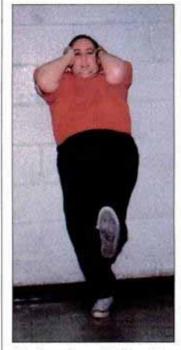
Stand against a wall with your fingertips and elbows positioned as with the Roman chair. Then, raise either leg slowly to just below halfway up. Lower the leg and start with the other. Do each leg 10 times and you'll feel it in the lower stomach and loins.

Repeat each of these exercises four or five times every day, and your stomach will begin to firm up within a week or two.

If you are overweight, make sure you don't do anything until you've discussed the exercise program with a doctor. Every human body is unique, so what is good for most people may be harmful to you.

### Living thin

I've just come across a book that will help you get into condition. Living (Scribner, \$14.95) is not just a book. It's an attitude-adjustment course. Author Edna Schneider gives the reader 305 vignettes that describe the pitfalls of trying to adjust your diet and exercise regimen and at the same time offers solutions. It's a good book to have by your bedside, and it contains hundreds of hints on how to get started and stay on your program.



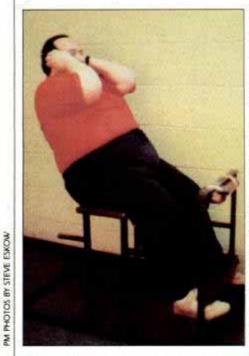
The leg raise will strengthen lower stomach muscles.

### Fusion step up

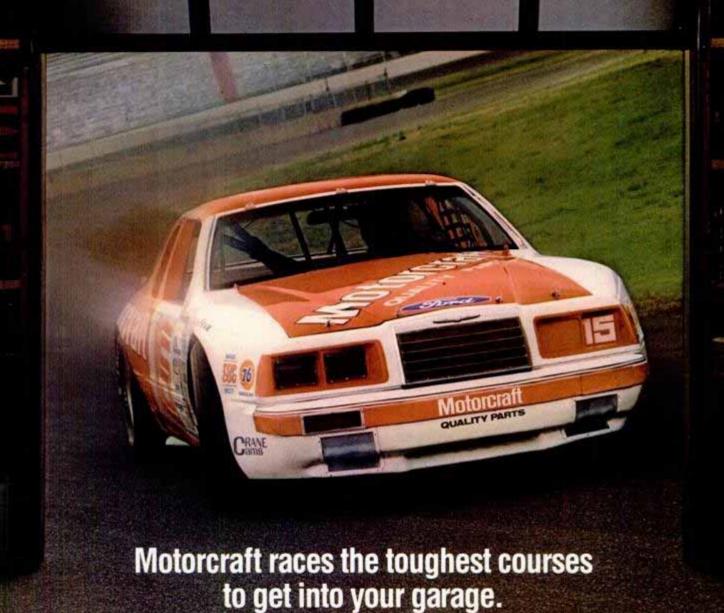
Laser fusion power has come a step closer with the successful creation of fusion neutrons at Lawrence Livermore National Laboratory. Livermore's Nova laser was used to ignite a tiny capsule filled with deuterium and tritium fuel. The result was the creation of heavier neutrons plus energy.

This experiment is the first major step toward producing energy from the joining of neutrons.

In fusion, two lightweight neutrons are driven together. As they collide and join, they release more energy than was required to join them. After fusion is accomplished, the fuel can be reused in certain types of atomic reactors. If fusion power can be accomplished safely on a large scale, it will be the most economic energy of the 21st century.



Roman chair strengthens upper stomach. exercise.



High-performance racing cars that generate about 600 horsepower demand tough, quality parts. So does your car. And Motorcraft spark plugs, filters, batteries and motor oil deliver top performance, out on the race course or on the highway. Because the technology used to develop Motorcraft racing parts is the same technology used to develop Motorcraft quality parts for your car or truck.

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### **Motorcraft from Ford**

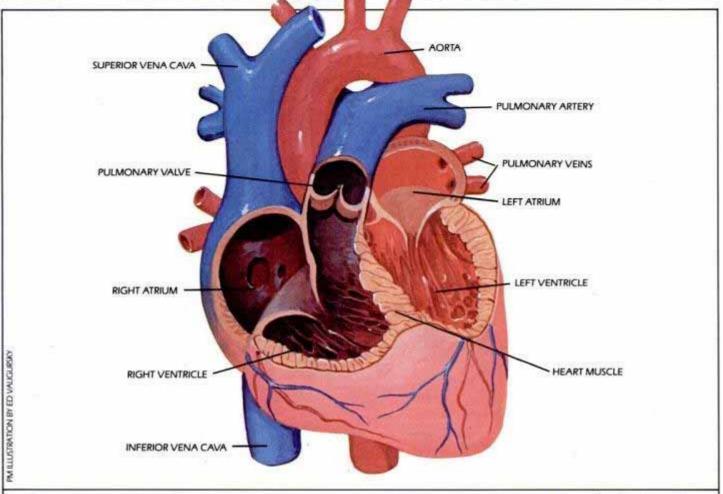
EXCEEDS THE NEED



Buckle up-together we can save lives



### TECHNOLOGY UPPATE 4/86



### Hidden heart revealed

when doctors want to look deep into the human heart, they usually have to insert a catheter into an artery and flood the circulatory system with chemicals. But a Duke University team has developed the Scinticor. The \$200,000 outfit includes a gamma-ray counter, an exercise bicycle, a high-speed computer and an imaging screen.

The patient is injected with a low-dose radioactive chemical as he pedals an exercise bike. In seconds, the harmless chemical enters the heart and the gamma counter registers the radiation. The computer translates the data into a series of

pictures visualizing what is actually going on in every part of the heart shown in the painting above. Thus, the medical team can "see" the patient's heart going through a complete bloodpumping cycle, something that was not possible before without catherization.

"During exercise, the heart acutely enlarges to compensate for decreased cardiac function," says Duke Prof. Robert Jones. "The Scinticor indicates exactly what changes occurred."

Editor: Dennis Eskow Contributors: Ted Francis, Steve Eskow, Wade Hoyt, Jim Dunne, John Domberg, Richard Schrader, Frank Lusk Duke is using the machine to determine a patient's need for major heart surgery. In the future, it will also monitor the patient's heart during surgery. About 20 medical centers are expected to use Scinticor next year.

Scinticor device includes exercise bike facing a gamma-ray counter that produces images of a complete heart pumping cycle.

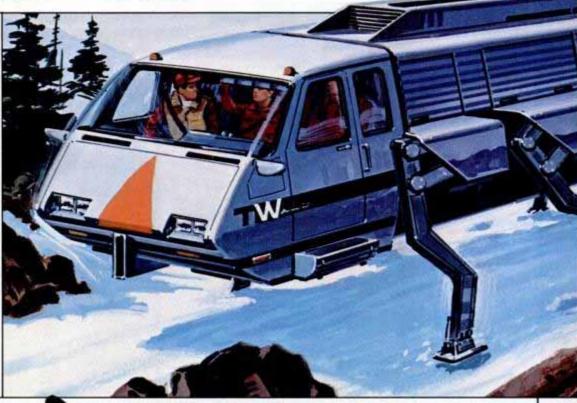
### TECHNOLOGY

UPDATE 4

#### ROBOTICS

### Robot truck takes steps

The Defense Department funded it, but by the next decade, Ohio State University researchers hope their Adaptive Suspension Vehicle will find more peaceful uses. The 17-ft. ASV moves on six legs at speeds near 8 mph. Experiments are under way in which a prototype machine is being grammed to scale 7-ft, walls and cross 9-ft. ditches. It is powered by a 70-hp 900-cc motorcycle engine. searchers are looking for other ideas. Submit yours to Tech Update, Popular Mechanics, 224 West 57th St., New York, NY 10019.

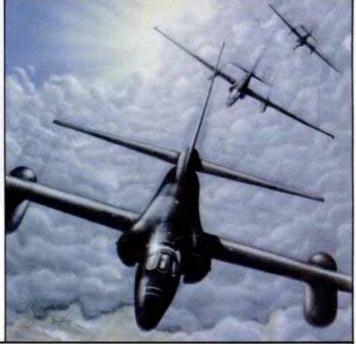


### A robotic squadron

Remotely Piloted Vehicles (RPVs) have been used by the Israeli army to locate artillery targets and take pictures behind enemy lines. Now the American Defense Department is developing RPVs that may be used in formation like a reconnaissance wing. The Lockheed Aquila RPV (right) takes off on a pneumatic rail launcher. then flies on a 2-cylinder piston engine. It has a 12.7-ft. wingspan, weighs about 200 pounds with its cameras installed and hardly shows up on radar. A future mission for an advanced turbofanpowered RPV wing might be



to penetrate a nuclear battlefield and take pictures of damage or embattlements. No manned craft currently in the fleet could penetrate a nuclear battlefield and fly low enough to take useful spy photos.



### MILITARY

### Unmanned tank killer

British Aerospace's new antitank off-route mine puts out a laser pulse that can sense the presence of a tank at 150 yards. If a tank crosses the path of the tripodmounted weapon, an AT4 antitank projectile is fired



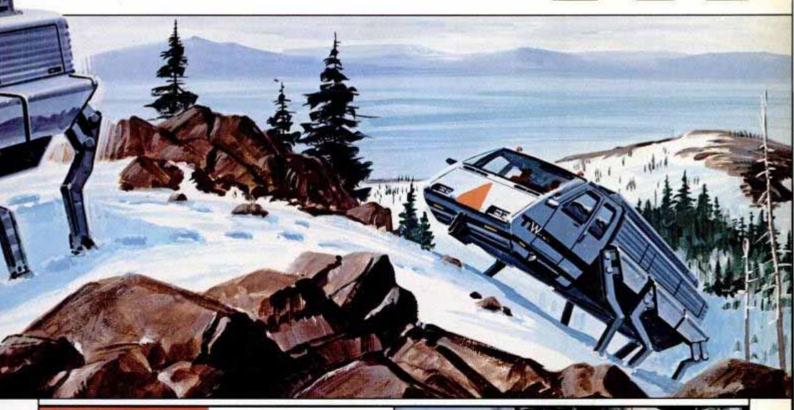
automatically. The Defense Department is evaluating the off-route mine.

### The Penguin strikes again

The villain in the Batman comics specialized in knocking over banks. But this Penguin is a new fire-and-forget missile from Norway. Shown under the wing of a Norwegian F-16, the Penguin will be used as an antisubmarine weapon in an area where Soviet subs run rampant.



## PM



### MARINE

### New vessel explores lake

Michigan State University scientists are using the 2man submersible Johnson Sea-Link II to conduct the first studies of the bottom of a large freshwater body. Timothy Wilson and David Long are shown 1319 ft. below Lake Superior in preliminary dives last summer. Among other things, they discovered freshwater cod (below) at the lake's deepest points. This summer, the scientists will conduct in-depth research on the lake's life and structure.





### The swift and the strong

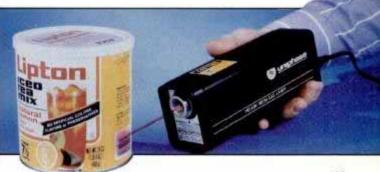
Sweden's Weedo Batar boat works has introduced a prototype 14-man rescue boat that runs through icy waters at 40 knots on a jet engine. The 1-ton graphite hull has passed capsize-resistant tests in Sweden and England. The Swedish Coast Guard will begin trial runs with the boat next winter. Trials in England are under way now



### LASERS

### Laser fits like a glove

Uniphase has announced the most compact laser, a helium-neon model that takes highly accurate readings of chemically treated surfaces. Small grocery and dry goods stores can now use the same laser coding available to mass marketers. It will be available from Edmund Scientific this summer. It's also useful for amateur experimenters.



POPULAR MECHANICS • APRIL 1986

### TECHNOLOGY UPDATE 4/86

#### **ELECTRONICS**

### The Mercedes of simulators

It pulls out of a parking space with the smoothness of a Mercedes. Sitting behind the wheel, you get the sense of a good quality drive. Of course, it is a Mercedes. But this \$9 million model never goes anywhere. It's the Mercedes driving simulator, located in West Berlin. The machine is a 24-ft.-dia. capsule hoisted off the ground on pneumatic arms. Inside, you can park anything from a sports car to a heavy-duty truck. An image-generating computer gives any driver using the simulator up to 300 miles of varied road and weather conditions. The dome in which the car rides during simulation gives the driver the sense of motion involved in everything from negotiating a steep bank at high speed to slogging through mud. Natural driving controls are linked to hydraulic servos and sensors so







the dome and the computer scenery can move to the gearing, steering, braking, turning and other maneuvers of the real driver. Six video projectors provide a seamless 180° landscape. And the driver even encounters other drivers on the road. The one-of-a-kind Mercedes driving simulator is being used to help Mercedes design cars for the 1990s. And yes, it's also designing a new simulator.

# O CONTRACTOR OF THE PROPERTY O

### Killer bee of gyroscopes

Guided missiles are getting smaller with each passing year as guidance systems become simplified. British researchers have developed the world's smallest gyroscope—the slightly more than 1-ounce Microflex rate gyro shown above. The instrument is expected to be used in NATO missiles in the next five to 10 years.

### AUTOMOTIVE

### Plastic wheels

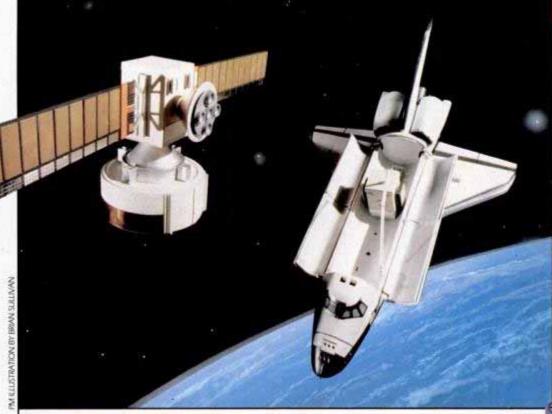
Motor Wheel Corp. of Lansing, Michigan, is building all-fiberglass wheels for a 1988 GM car. Compared to steel or aluminum wheels, the plastic model (on top in photo below) is lighter, easi-



er to make into exotic shapes and has near-perfect balance. Fiberglass must be 2½ times thicker than metal for the same strength, and the wheels must be painted, because fiberglass deteriorates

in sunlight. The wildest wheel is a \$360 design from Fushimi Racing in Japan combining cast, drawn and honeycomb aluminum with carbon fiber-reinforced plastic (below).





SPACE

### Europe's 'little' station

Until recently, the European Space Agency has done most of its scientific work in orbit aboard America's Shuttle-based Space Lab. But the ESA plans to go at least partly independent in the 1990s with a mini space lab of its own. The leading candidate is an unmanned station that would be Shuttle-based at first (left). The station could, within the confines of a capsule smaller than the Space Shuttle's cargo bay, run automated factory processes. Two factories ready to fly on the ESA capsule would make pharmaceuticals and computer chips with a robot system controlled from the Shuttle.

#### AVIATION

### Good device for ill wind

Sperry is developing a windshear detector for small commercial airplanes. A computer connected to a wind-shift detector measures the wind, the plane's position and speed, and the approach path of the craft. If windshear is approaching within 30-seconds, the pilot receives a simple warning and can change the position of the airplane. The wind-shift detector will undergo test flights later this year.

### MAN OFF APPROACH EPR ERROR WINDSHEAR EPR LIM ENG EPR TGT CMD 168 CMD KIAS MACH 166 L MEASURE -

### Dashing off from airports

From Canada's DeHavilland company comes the new twin turboprop Dash-8 commuter. The 39-passenger plane flies somewhat like a STOL aircraft, needing just 3000 ft. for takeoff. The Dash-8 cruises at 300 mph, and it has a docile stall speed

of 74 mph, a point that growingly safety-conscious commuter airlines may consider important.

The airplane uses a Sperry automatic flight control system, connected to a bank of digital readout computers that flash only essential information during takeoff or landing, but provide an array of flight information during the less hectic parts of a flight. It will be flying American commuter

## Electronics BY STEPHEN A. BOOTH

### Wireless alarm

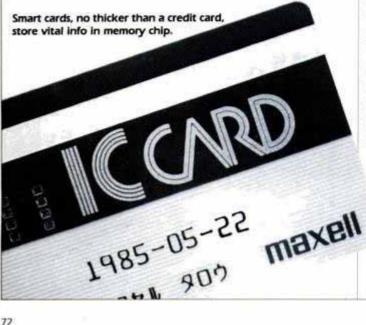


Keepsafer (top) handles multiple security detectors (bottom).

Sixty years ago, Walter Schlage invented the type of deadbolt lock you secure by turning a key through the doorknob. Since that time, the company he founded has become a household word. Now, Schlage Lock Co. is going electronic-not with a lock but with a wireless home-security sys-

tem you can install yourself. The Keepsafer will guard

any number of entry points including doors, windows and garages. How many depends on the number of switches you install around the home. If any one is tripped, it informs the base unit via radio waves. The base unit then begins wailing



like a banshee through a built-in siren or optional remote horns.

According to Schlage, Keepsafer has the approval of Underwriters Labs and the Federal Communications Commission. To satisfy the latter, Keepsafer went through extensive testing to make sure that other radio frequencies won't set off false alarms, and that its own emissions won't interfere with other signals.

Besides entry switches, you can outfit the unit with an optional smoke-alarm interface. Keepsafer also emits two kinds of alarms. One makes a whooping sound to denote break-in or fire. The other alarm, for emergencies, wails steadily. You activate the emergency alarm by pressing a button on the base unit, or, through a pendant-like panic button (optional) you can carry with you.

The emergency mode functions 24 hours a day, at your whim. The break-in is programmable, through the base unit. You set the hours you want it to operate. You even decide how long a delay you want between entry and alarm. This gives you time to get in or out of the house without terrifying yourself or the neighbors. Programming is as simple as setting an alarm clock.

Keepsafer comes with two entry switches and transmitters for \$180. Later this year, Schlage plans to introduce a deluxe model that offers five different alarms (and the necessary switches) plus a remote control.

#### Smart cards

The day is coming when you'll carry a document the size of a credit card that will hold your medical history, financial health and even the phone numbers you always forget. These smart cards are being developed right now by many of the world's leading electronics companies and financial institutions,

fact, Toshiba and Visa International have one in the works for field testing



You can translate 4000 English words into Spanish, and vice versa, with Langenscheidt 8000.

sometime next summer.

What makes these cards so smart is a battery and a microprocessor memory molded right into the plastic. On one side of the card, there's a flat calculator keypad and liquid-crystal display. You use the keypad to enter your security code and store or retrieve information in the memory for display. All this fits within the standard size and thickness of today's credit cards. One potential use: Hand over your smart-card at the supermarket register and have the grocery tab deducted from your bank account. Or, have your medical history instantly available for emergencies.

### Bilingual calculator

Does your high school French often desert vou just when you need it most? Langenscheidt, the bilingual dictionary publisher, has a \$69 cure. The company's Translator 8000 calculator will convert 4000 English words into another language-and vice versa. Just spell the word you want on the keypad, and the translation appears on a liquid-crystal display. French, German and Spanish versions are available. The 8000 also functions as a numeric calculator—quite handy for currency conversions.

# The Dual Range Auxiliary Transmission-It lets you pull or cruise with Performance and Economy.



If you're one of the millions who asks your vehicles to do "double duty," read on. DNE's new Dual Range™ Auxiliary Transmission now makes it easy to always have the right gear for pulling a load, climbing a mountain pass or cruising economically down the interstate.

Match your gear ratio to your load

If your vehicle's axle is geared low for hauling a load, a

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and load are properly matched! How the Dual Range™ works

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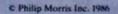
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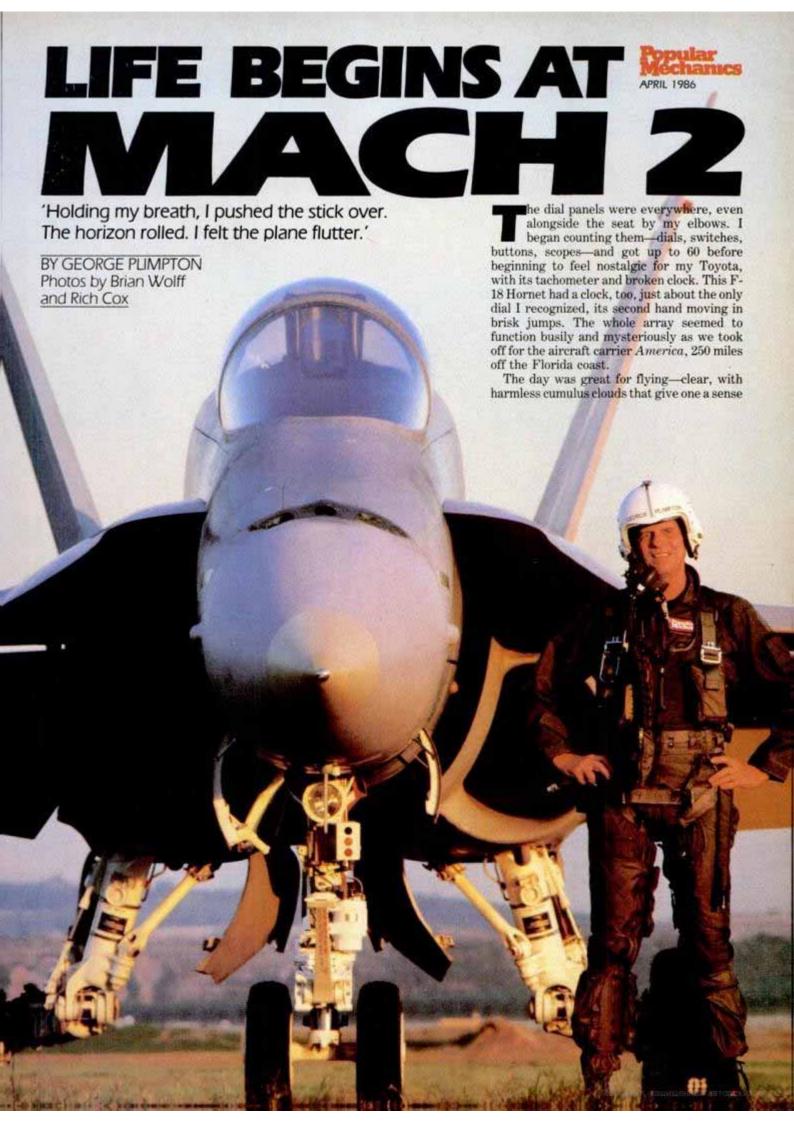
Get a taste of it.



Werit The low tar flavor break.

Kings: 8 mg "tar," 0.5 mg nicotine av. per cigarette, FTC Report Feb. 85.

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



of flying in semi-transparent ravines. Fluffs of cloud whipped soundlessly against the windscreen. The F-18's canopy was breathtakingly clear. Even by focusing on its surface, it was almost impossib to pick out a smudge or speck. I felt that if I raised an arm, it would extend into the slipstream.

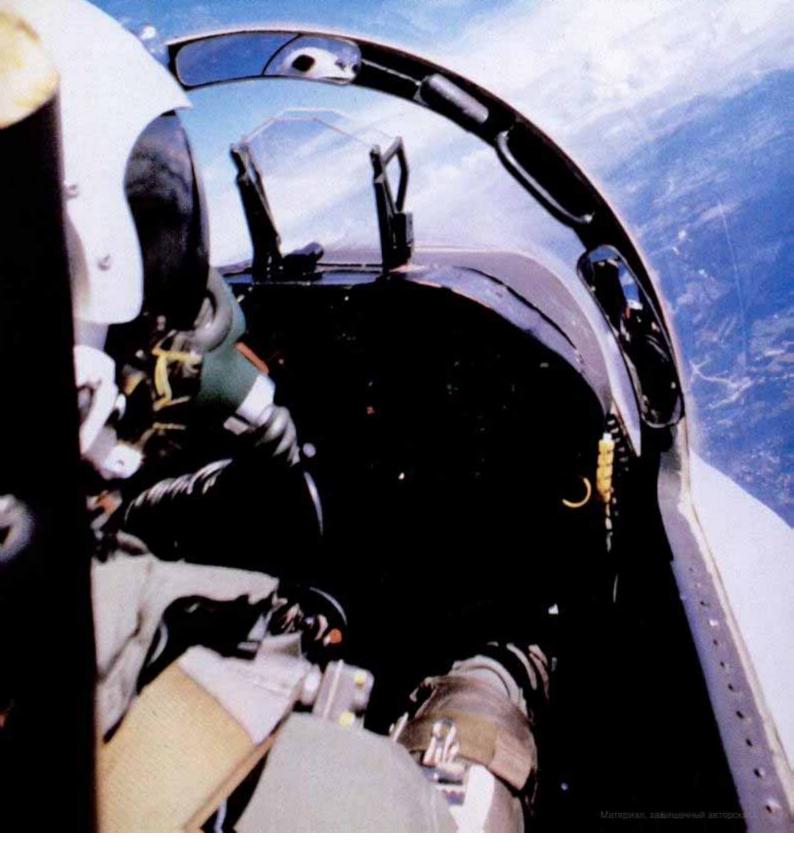
The plane moved through the air noiselessly. The loudest sound was of my own breathing through the oxygen apparatus. About halfway out, the pilot, Lt. Tim "Timbo" White, who was sitting in the front seat, held up his hands so I could see they were off the controls. "Are you sure?" I

asked. I could hear my breathing begin to get heavy in the oxygen tube as I took control of the \$18 million craft, or by my reckoning, 4500 Toyotas.

The F-18 I flew was a 2-place mission trainer. The differences between the trainer and the fighter are minor—a slightly longer canopy and, of course, the back-seat equipment, which takes up space in the fuselage ordinarily used for about 500 pounds of fuel. The plane is distinguished by its dihedral twin-tail configuration. It is the hottest plane the military has. It can go straight up to over 50,000 feet. It can carry an enormous amount of weaponry—rockets,

bombs, missiles, along with its internally mounted cannon. Its top speed is a little under Mach 2—about 1400 mph—slower than the Concorde's. I had flown in the Concorde. "What was it like?" Tim asked. He was genuinely curious. It struck me as odd that I should be telling a pilot who flies the hottest airplane in the sky what it was like to travel in a commercial airliner.

The military does have a class of high-speed planes called interceptors (the F-4 and F-14) whose primary function is to get to an area quickly at better than Mach 2. But once there, their ability to maneuver is compromised.



"You can't fight at those high speeds," Tim said. Interceptors take minutes to make a turn, he said. "The F-18, on the other hand, can turn on a dime."

Tim said the most violent maneuver possible in the F-18 is a defensive evasion tactic called a break turn—pulling the stick back as abruptly as possible, which subjects the plane to a kind of snap-turn. It's used to evade an incoming rocket or missile.

"How do you know if someone is firing at you?" I asked.

"You have instruments in the cockpit that tell you radar is locked on you. Then you can see them—the weapons leave a heavy trail of white smoke. That's when you'd better start thinking about the break turn. It subjects you to a g-force of about 7.5, which will give you some idea of the sharpness of the maneuver."

I asked Tim if there was any maneuver I could make at 25,000 feet—any spastic twist of the control stick—which would damage the F-18. "Well, you can fly it into the ground," he said solemnly.

"No, I meant at 25,000 feet."

"Not a chance," he said, to my relief.
"If you departed from what we call
controlled flight and the plane went into

a spin, then you took your hands completely off the controls, the plane would recover by itself. You can look out the canopy and see the surfaces changing. The airplane is constantly saying, no, dummy, that's not the way to do it, and compensating on its own."

Earlier in the day, we had left the briefing room and, outfitted in our flight suits, went out to inspect the plane. I walked around the front and looked in the mouths of the jet engines (F 404s made by General Electric)—smooth tunnels that lead back to distant fans. It vaguely reminded me of the maw of a giant shark.



Plimpton shares the view from 25,000 ft. (facing page). Chase plane captures his F-18 from below (left). Just before his takeoff, Plimpton surveys control panel.



# COMPARISON SPECIFICATIONS

America's Premier Sky Fighter vs. America's Premier Street Fighter



F-18

**Chevy Corvette** 

\$18,700,000 Two GE 404 turbine jets 16,000 lbs. thrust each 672 in. 56,000 lbs. 20 sec. 25 sec. 200 sec. Sticker price
Engine type
Power output
Overall length
Curb weight
0 to 60 mph
0 to 100 mph
0 to 1000 mph

\$27,800 One 350 cu.in. V8 230 hp @ 4000 rpm 176 in. 3257 lbs. 6 sec. 16.8 sec. No way



Sure enough. I became so heavily immersed in what to do if something went wrong during my flight—such a solid set of emergency procedures, delivered with such solemnity—that after a while the sullen thought got into my mind that something was going to go wrong. If not, why all the fuss?

My teeth were inspected. Why? A bad tooth can *pop* at high altitudes. I was put into an altitude pressure chamber. The symptoms of a lack of oxygen were explained: fatigue, headache, dizziness, euphoria, hot and cold flashes, belligerence, blurred vision, tingling, cyanosis—which is the phenomenon of

one's fingernails turning blue—mental confusion, poor judgement, and so forth. As I jotted these down, I remarked to the lieutenant that often at sea-level I suffered a number of these complaints. He did not seem amused. "The big thing is not to John-Wayne it," he said. "If you get these symptoms at 25,000 feet, you've got about four minutes to do something about it. Go to 100 percent oxygen. Check to see that the hose is connected. Control your breathing. Descend to 10,000 feet."

I was lectured on survival kits, rafts, the various components of my flight suit—it weighs 16 pounds in all—in particular the wonders of the g-suit, which during tight aerial maneuvers automatically presses against the thighs and stomach and impedes the flow of blood into the lower extremities.

"When the blood drains out of the brain, you've got about three seconds of oxygen," the lieutenant said, "then the loss of peripheral vision, gray out, tunnel vision and blackout. Without a gsuit, about all you can take is 4.5 g's. With the g-suit, you can take about 6. Anything over 6, and you have to complement the g-suit with what we call the M-1 maneuver."

(Please turn to page 152)



Pilot Tim White guides F-18 toward the middle trap for a landing [facing page]. Plimpton endures simulated ejection [above]. The trainer in dusk (right) levels off. Our pilot takes a practice dip (below) after flying simulator (bottom). After flight, he visits carrier bridge. Outside, a crewman gives the thumbs up sign, and the F-18 takes off for the Florida coast (bottom right).







PM COMPARISON TEST: 4x4 WAGONS

# GOINSNOW

We check out seven on-road 4wd vehicles to find out which ones get going when the going gets tough.

AMERICAN MOTORS EAGLE WAGON



**AUDI 5000CS TURBO QUATTRO WAGON** 



MITSUBISHI COLT VISTA 4WD



**NISSAN STANZA 4WD WAGON** 



TOYOTA TERCEL SR5 4WD WAGON



HONDA CIVIC 4WD WAGON



SUBARU 4WD TURBO WAGON

station wagon—not a 4×4 truck designed for rough-country off-roading, but a sure-footed wagon for slippery street work. Next came AMC's clever Eagle, then Toyota's inexpensive Tercel. Nowadays we count seven station wagons in the 4-wheel-drive club, with more poised to join in the next few years. By 1990, we think 4-wheel drive will be consid-

ered normal rather than exotic for family cars.

The 4×4 wagons in this group are definitely cars. Their limited ground clearance keeps them from venturing into the rough stuff. They're most at home on icy asphalt, snow-covered gravel or a muddy dirt road. Ram them into a foot of snow or down a boulder-strewn dry wash and you're likely to be hiking home.

In their element, however, these 4×4 wagons are



quite competent. Any one of them offers noticeably superior traction over the comparable 2-wheel-drive model. Four-wheel drive won't shorten braking distances or let you pull more sideloading in a high-speed corner, but it will get you through rain, snow and ice with added safety and security.

To see for ourselves what a difference 4-wheel drive can make, we assembled all seven production 4×4 station wagons and drove them from Los Angeles out to San Bernardino, then up the treacherous switchbacks to Lake Arrowhead. We spent the next two days driving in a variety of poor conditions only a California mountaintop could whip up: ice, sand, snow, gravel, mud and simple wet asphalt.

All seven drivers drove each car, shifting in and out of 4-wheel drive as needed, and each commented on each wagon. Then they ranked them in order of preference, price-no-object. Our overall rating is the average of all seven rankings by our test group.

# Subaru Turbo Wagon

We like the Subaru wagon. At \$13,000, it costs less than half what Audi gets for the 5000 CS Quattro, but it sure is more fun to drive and more useful. It's also as comfortable as an old shoe. What's Subaru's secret? Balance. This isn't a car designed to impress your neighbors or your accountant, it's an unobtrusive Japanese economy car that just happens to have a customer satisfaction rating second only to Mercedes-Benz. Obviously, Subaru owners like their wagons as much as we do.

The Subaru looks and feels familiar. It's a conventional 5-door station wagon, a known quantity compared to the more van-like Colt Vista or Nissan Stanza. The Subaru looks straightforward and functional from the exterior, and the interior matches it. The cloth upholstery is rather zoomy with stripes and unusual textures, but it's an interior you can live with.

The top-line Turbo bristles with every gadget for which Japanese carmakers have become famous. The dashboard is digital, the radio is great, there are electronic controls for everything from the mirrors to the sunroof, and the ergonomics—especially the adjustable bucket seats—came in for special praise from drivers of all sizes. The controls are different from those in any other car, but so logically laid out that a minute is enough to become intimate with all of them.

The most unusual part of the Subaru is the Flat-4 engine. Imagine a Volkswagen Beetle engine—water-cooled, with overhead cams and a turbocharger—mounted at the front and driving either the front or all four wheels, depending on whether you press a button on the shifter. Like the old VW, the Subaru Flat-4 is noisy, rough and low-revving, but the turbo encourages it to pump out enough power with excellent fuel economy. Don't be misled, however. In this instance, "turbocharger" equates only with adequate performance, not spectacular.

The Subaru's 4-wheel-drive mechanism is the smoothest, easiest to use and most convenient on the market. At any speed up to 50 mph, you can pop in and out of 4wd with the touch of a finger. Only the light on the dash and the traction on the road tell the tale—handling, acceleration and noise levels are unaffected.

The Subaru Turbo is not perfect. We certainly wouldn't order the automatic transmission, for example. It simply saps the engine's marginal strength.

One tester thought the interior too fancy for family use, another worried about maintenance on the turbo engine and a third complained about the lack of legibility in the digital dashboard.

On the whole, however, our group made comments like "more comfort and convenience features than even the Audi . . . the best buy in this group" and "the best blend of 4wd and comfort on the market." Add in customer satisfaction, timeless styling, typically Japanese quality and a low price, and the Subaru Turbo comes out a runaway winner in the 4×4 wagon sweepstakes.

# Toyota Tercel 4×4

The Tercel is an unabashed copy of the Subaru wagon, deliberately engineered by Toyota to fill an obvious niche in the marketplace. Like all Toyota products, it's beautifully crafted, conservatively styled, impeccably engineered and beloved by its owners. Toyota's customer satisfaction is topped only by Subaru and Mercedes.

The lightweight Tercel feels zippier and handier than the Subaru, probably because it's lighter and smaller.

Other than that, there's not much to choose between them. The Toyota returns higher fuel economy, the Subaru has a smoother 4-wheel-drive system. The Toyota is quicker, the Subaru is better looking. The Toyota is easier to repair, the Subaru has more comfortable seats. Our testers scored the Subaru higher than the Toyota primarily for its cornucopia of gadgets, its value-formoney and its "old shoe" comfort.

The one area in which we unanimously preferred the Subaru was in exterior styling. The boxy Toyota is almost willfully ugly, the way small cars used to be 20 years ago. Today, we expect our small cars to be pretty.



# Audi 5000 CS Turbo Quattro Wagon

We knew going into this test that comparing a \$30,000 Audi with a \$13,000 Subaru bordered on the proverbial apples vs. oranges. So our instructions to the test group were clear: If you could take any one of these wagons home with you, which one would it be . . . regardless of price? The answer was overwhelmingly in favor of the Subaru and Toyota.

This is not to say that we didn't like the Audi. Its styling is striking, and the white pearlescent paint on our test wagon was absolutely breathtaking. Sexy, beautiful, lovely and aerodynamic were among the comments. If you need to make a style statement while trundling your kids to soccer practice, the Audi is up to the task.

Trouble is, it would be criminal to let your kids in the Audi. The black leather interior of our test car was undeniably sumptuous, but it wouldn't survive a week of soccer practice, golden retrievers or even ski trips. If you have a wagonload of soft-edged luggage to carry to a resort hotel at the end of an icy road, the Audi is your car. For real life, you need more of an appliance and less of a showpiece.

The Audi is a big car, but the interior is cramped. The wagon is very long—so it contains nearly as much space as the Colt Vista—but because the roof is so low, this space is of limited use. Our testers complained about lack of headroom and cargo room. The low roof also makes for poor visibility, especially to the rear where a forest of headrests and a rear spoiler across the glass block what little view there is.

Surprisingly, our group also complained about the ergonomics, a field in which German designers are consid-

> Produced by the PM Auto Dept. Text by Rich Taylor Photos by Rich Cox

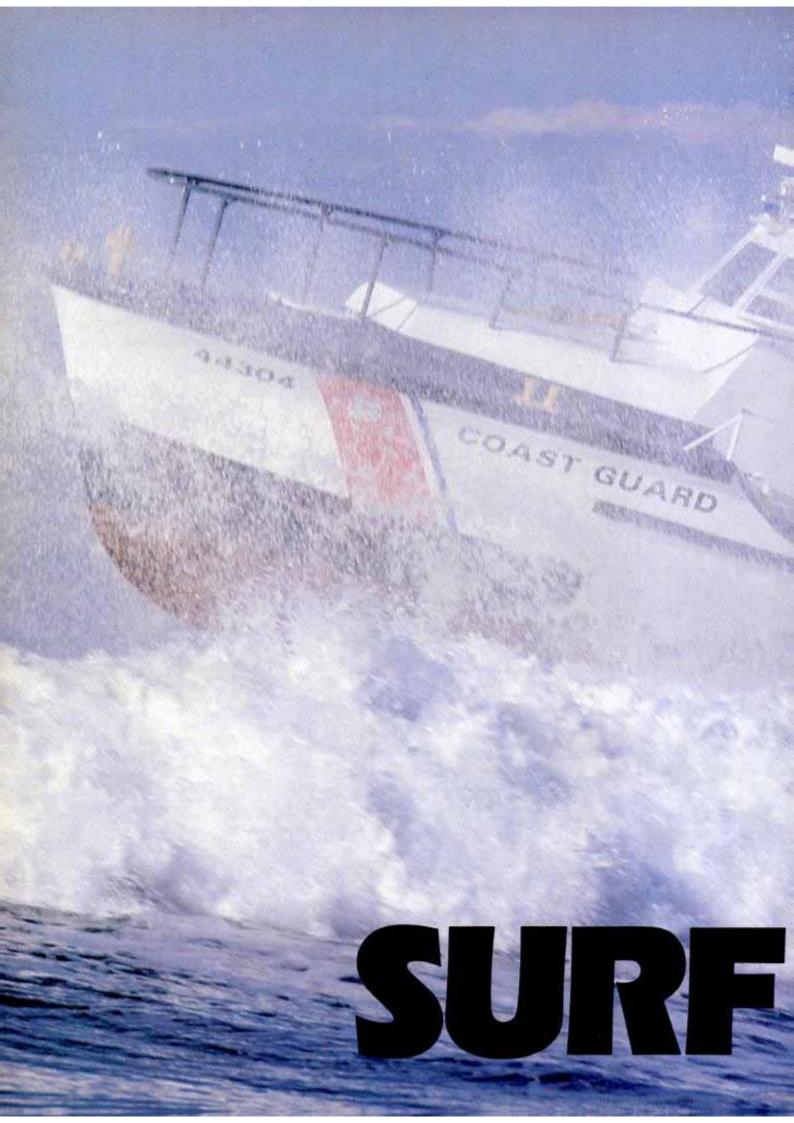
ered to be world leaders. The bucket seats came in for considerable criticism: "Back is too soft, not enough lumbar or lateral support. Looks great, but doesn't fit me." The controls were also criticized. The steering is very heavy, the shifter balky, the dashboard switches unlabelled. As one tester put it, "The ergonomics are elaborate, but nonfunctional."

The same criticism might be levelled at the Quattro chassis. The 5-cylinder turbocharged engine makes lots of horsepower, but because of the car's weight and the turbo's lack of low-speed torque, it's very slow to get moving. There's lots of understeer, especially in tight, low-speed corners. On the freeway, the Audi is grand; on a winding mountain road, it's a handful.

Unlike the other cars in this test, the Audi's 4-wheel-drive system is fulltime. You can't shift into gas-saving 2wheel drive on dry roads, which is part

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TEST SPECIFICATIONS									
	GAS MILEAGE (EPA city/ PM test)	INTERIOR SPACE (cu. ft.)	BASE PRICE	PRICE AS TESTED	ENGINE	WHEEL- BASE (in.)	LENGTH (in.)	WEIGHT (lb.)	OVERALL
AMC Eagle	16/11.21	155.4	\$11,385	\$12,981	120-hp OHV 4.2-liter inline-6	109.3	180.9	3400	6
Audi 5000 CS Turbo Quattro	17/16.25	183.0	29,185	29,520	158-hp SOHC 2.1-liter inline-5 turbo	105.8	188.7	3300	3
Dodge Colt Vista 4×4	19/28.44	188.4	10,266	12,473	88-hp SOHC 2.0-liter inline-4	103.3	174.6	2600	4
Honda Civic 4×4 Wagon	25/20.60	154.2	8999	9199	74-hp SOHC 1.5-liter inline-4	96.5	163.4	2100	7
Nissan Stanza Wagon 4×4	20/21.36	169.3	11,629	12,734	97-hp SOHC 2.0-liter inline-4	99.0	170.3	2900	5
Subaru Turbo Wagon	24/27.29	152.2	12,994	13,173	110-hp SOHC 1.8-liter flat-4 turbo	97.2	173.6	2650	1
Toyota Tercel 4×4	27/29.73	149.5	8268	9338	62-hp SOHC 1.5-liter inline-4	95.7	169.7	2300	2





Riding the waves with the Coast Guard's rough-water elite.

BY TIM COLE, Boating/Outdoors Editor Photos by Rich Cox



Coast Guard Motor Life Boat School Instructors prepare to challenge the angry waters of the Columbia River bar. Front to rear: Boatswain's Mates First Class Steven Taylor, Stephen Bielman and Brad Steigleder.

he Columbia River bar. Possibly the world's meanest piece of ocean. Innocent wisps of spray dance along the top of the advancing mountain of gray-green water. From inside the coxswain's enclosure on the Coast Guard 44-footer, you have to look up through the extra-thick windshield to take it all in. It rises ever higher, threatening to devour the boat and the Coasties on board.

Boatswain's Mate First Class Steve Taylor grasps the 44's oversize aluminum wheel in one hand and deftly removes a tin of Copenhagen chewing tobacco from a pocket in his life jacket with the other. He casually flicks a gob of the brown susbstance past his lips, tightens the chin strap on his crash helmet and announces with cool detachment, "Hang on, guys!"

To our amazement, Taylor turns the helm hard to starboard and drives the 44 into the towering wall of water sideways. The boat hunkers down on its starboard rail. A gusher of frothy seawater enters the coxswain's deck from the port side. The crewman to port slaps against his thick web safety harness snapped to a beefy steel padeye. The water blasts past him and fills the cockpit. He's on the high side now, and blue sky shines past his arms, the sun backlighting the grin affixed to his fresh young face. The 44 rolls—they say it's made for this—from 70° to 90°

in an instant, a testament to the force of all that water plastered against this brawny 40,000-pound amalgamation of Corten steel and aluminum.

The roll stops at roughly 90° from the vertical. Water continues to fill the coxswain's enclosure, swirling up to our hips and pressing darkly against the windshield. Are we going under? And then, like a sheep dog emerging from a farm pond, the 44 begins a casual roll to the upright, shaking itself and lumbering toward the next breaker at a powerful, yet sedate, 12 knots.

"Like I said," Taylor advises, a brown speck of tobacco perched in the corner of his mouth, "she'll handle just

about anything."

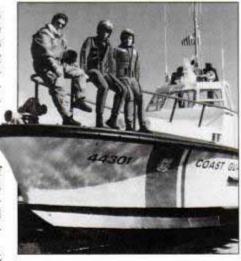
He takes the next one bow-on. The 44 cleaves through the surf, its blunt nose rising. The amidships sections follow as the wave rolls aft, the fantail kicking out of the water with merry nonchalance as the comber retreats. The object of the exercise this brilliant afternoon is to demonstrate the capabilities of the 44, the Coast Guard's rough-water mainstay for over 20 years, and to get a taste for a major component in the curriculum of the Coast Guard Motor Life Boat School at Cape Disappointment, Washington. It's the only facility in the world that teaches rough-water rescue technique in-you got it-rough water.

The unbelievably rough conditions at the mouth of the Columbia River are the reason why the Coast Guard MLBS is situated in this lonely corner of southwestern Washington state. The Pacific's Humboldt Current swirls unimpeded across thousands of miles of ocean. It piles against the accumulated detritus of the Columbia River-soil and rock deposits that have traveled in watery suspension for thousands of miles from the nation's interior, to be ultimately freed on the shoals just offshore. Waves build against this shallow underwater shelf and roll higher and higher. The frequency between peaks is short, steep and usually a frothy white.

The Corp of Engineers has built a long riprap jetty extending for a mile or so out to sea on the south side of the river mouth. The combers roll and thunder along this man-made feature and glide out to a sandy spit to the southeast. Add to the area's unique bottom features the sheer volume of river water colliding against the roily Pacific and you get the toughest surf conditions on earth. It's at this spot, in this ceaseless maelstrom of wind and wave, that the Coast Guard teaches men and women how to save lives in monster water off places like Barnegat Inlet and Cape Hatteras.

"We're the only search-and-rescue school in the world that conducts training in these kinds of breakers," explains Chief Warrant Officer John P. Jennings, commanding officer of the Motor Life Boat School. "And we do it for a reason. We want our people to be able to handle themselves during a real emergency. If you've learned lifesaving techniques in these seas, everything else seems easy."

Jennings has designed a 3-week heavy-weather coxswain training course that teaches boatswain's mates how to handle, staff and otherwise equip the 44. The men and women come from Coast Guard stations across the



Editor Cole (left) suits up with Seaman Dan Hettman (center) and Fireman John Murry.

country, and return to their respective coastal assignments with the skills and disciplinary style it takes to navigate a 44 through all conditions. The course focuses on the 44 itself—a remarkable if anachronistic vessel designed for the sole purpose of big-sea survival. And that means 360° rollovers in extreme cases, catastrophic and somewhat expensive occasions that tend to inundate the 44's electronics, snap off its radio spars and splatter its engine room with lubricating oil.

The physical characteristics of the Coast Guard-designed 44 are imposingly burly: Length on deck, 44 feet, 11/2 inches. Beam, 12 feet, 8 inches. Draft, 3 feet, 6 inches. Displacement at full load, 39,500 pounds. Hull construction, 3/16inch Corten steel plate with an aluminum deck and superstructure, foampadded on the ceiling and headliner belowdeck. Fuel capacity, 334 gallons, offering a 215-nautical-mile range at a 12-knot, 2500-rpm cruise. Maximum speed, 14 knots at 2800 rpm. Power via twin GMC 6V53 Detroit diesel engines rates at 185 hp each, turning fixed-pitch 30-inch props. Time to self-bail, four to seven seconds. Time to self-right (the

ultimate bummer), eight to 10 seconds, while the crew, completely submerged, holds its collective breath and prays.

In addition to the engine room, a sanctuary of spotless functionalism at the MLBS, the 44 has two cabins forward and one cabin aft, both sealed by watertight hatches. Stretchers, life jackets, survival suits, medical kits and resuscitation gear occupy the after compartment, also known as The Turtle owing to its squat, half-round profile. Benches equipped with seat belts run longitudinally port and starboard, and survivors of ocean mishaps are deposited here for a safe return to port. A similar survivors' cell is positioned forward in the eyes of the ship. The mid-cabin has a small galley area and standing tool lockers.

On deck, each 44 is equipped with stout grab rails fore and aft, a massive towing bit and 300 feet of 1½-inch yacht braid towline. The Coast Guard also carries a 2-cycle pump with fuel inside a Day-Glow orange cannister, which can be passed to foundering vessels. The coxswain's deck where the helm is located is surrounded by a partially enclosed superstructure where personnel reside, confidently snapped to steel padeyes located at random. A piece of cyclone fence separates the coxswain's station from the after portion of the vessel.

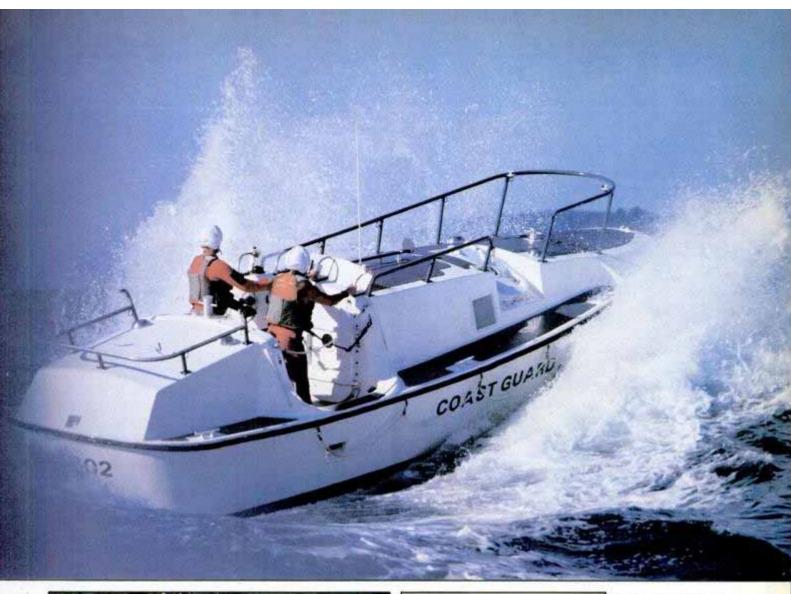
The fencing shields the crew from injury should the towline snap. The helmsman's seat occupies center stage on the coxswain's deck, a padded, height-adjustable affair within easy reach of the oversize wheel, dual throttles and VHF. The coxswain and crew monitor engine instrumentation and radar sweeps on deck, preparing, in some cases, to go overboard clad in standardissue wet suits, boots and crash helmets to assist people and vessels in trouble.

Prospective coxswains undergo an intensive series of classroom lectures and surf drills intended to convey such crucial arcana as safe towing speeds (the square root of the waterline length in feet of the boat being towed, multiplied by 1.34), line stress (20 percent stretch measured by an onboard strain gauge is considered safe), and environmental interpretation (when wave height and wind speed total 30, you know you're in for it).

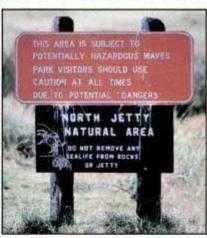
But acquiring helmsman's skills is the primary objective at the Motor Life Boat School. And as John Jennings points out, "It's really an art form."

Steve Taylor positions two crewmen facing aft while running in following seas. That way, he's better prepared to dodge mounting waves that could po-

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A 30-foot Surf Rescue
Boat (above) imitates
her big sister, the 44.
Students clad in crash
helmets and wet suits
(far left) perform a rerighting drill. Ominous
warnings (left) near
the Columbia River bar.
Towing hawser and
pump can (lower left)
are made fast behind the
coxswain's enclosure.
The 44's immaculate
engine room (lower
right) has twin GMC
6V53 185-hp diesels.





POPULAR MECHANICS • APRIL 1986

# -PM LONG-TERM CAR TESTS-



# COLT VISTA 4 WD

Fun for everyone

s this report is written, we've just picked up a new 4-wheel-drive version of the Mitsubishi Colt wagon, which should see us nicely through the winter. Our Chevy Astro van and Merkur XR4Ti continue to soldier on. What our fleet lacks in numbers right now it makes up for in variety.

# Colt Vista 4x4

You think you've got it tough? We just took delivery of a Dodge Colt Vista station wagon for our test fleet, and with it we lost our best excuse for staying out of the office on snowy winter days. This wagon, you see, has 4-wheel drive, so it should be an unstoppable all-weather commuter car.

Though the Vista Wagon is a member of the Colt family in Dodge's import lineup, it's quite different from its 2-and 4-door siblings. Due to an overall height of 60 in., 10 in. greater than the Colt sedans, this tall box with seating

# MERKUR XR4Ti

Fast but fragile

for seven can offer nearly 64 cu. ft. of cargo space with the rear seats folded down. Wheelbase is also 10 in. longer, 103 in. vs. 93. It comes with a 2.0-liter Four (good for 88 hp) that's not available in the 2- and 4-door models.

In its first few days around here, the Vista has opened our eyes to whole new worlds of convenience in mini 4x4s. The

# CHEVROLET ASTRO A nice personality

4-wheel drive engages with a click of a button mounted in the center of the 5-speed transmission's shift knob and ride quality is quite acceptable. Finding REVERSE has been tricky, though that may improve with familiarity.

The first thing a driver notices in the Vista is tallness—the seats are high off

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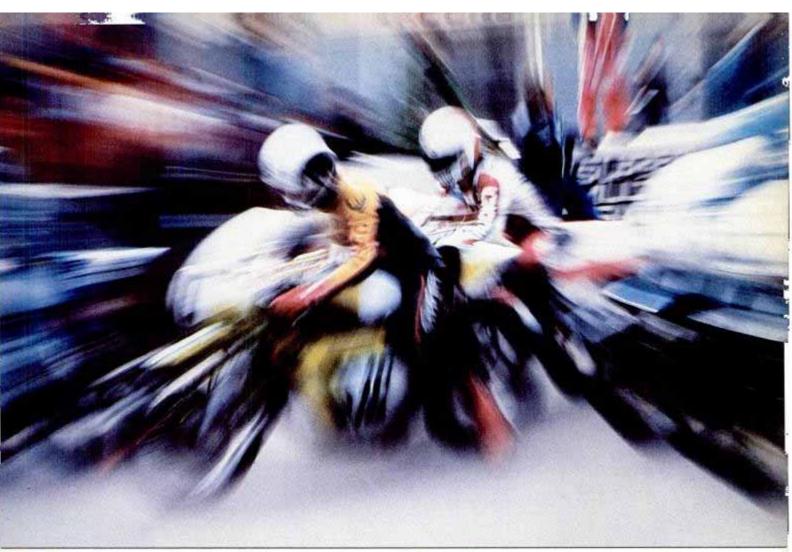


German-built Merkur has been fast and fun, but getting parts proved to be a problem.



Chevy's rear-drive Astro van has been useful, but is plagued by minor irritations.

POPULAR MECHANICS • APRIL 1986



# ZOONI

Zoom lenses can give you greater control over composition, more dramatic astrophotography and some very far-out special effects.

# BY CARL CAIATI

ow quickly would you like to snap a panoramic view then catch a closeup detail of the action on film? Is the wink of an eye fast enough?

That's about all it takes if you've equipped your camera with a zoom lens. These versatile performers earn their speedy nickname because they actually serve as several lenses in one.

It's the instantly variable focal length of zoom lenses that make them so attractive for fast action photography—especially when

you don't have time to fumble with changing lenses. You change the zoom's focal length by sliding or rotating the lens barrel in or out. This lets you alter the size of the subject and the amount of



Flaring effect, seen above and at top, is one zoom trick that imparts motion, even to buildings.

background in the frame, without changing your position.

No other single lens lets you control magnification, angle of view and depth of field so easily—an important consideration at sports events, where you might not be able to wander freely. Besides sports, you'll find zoom lenses useful for other types of photography, too.

In portraiture, you can zoom out to compose your subject full-figure against the surrounding scenery. Or, you might zoom in for a tight head-and-shoulders shot that focuses attention on your subject by obscuring the background. Zooms also give you creative leeway for skyscapes and astrophotography — and they're capable of special-effects.

### Magnification

Skyscapes illustrate how useful a variable focal-length zoom lens can be.

Say you want to shoot a moonrise. Though the moon seems huge to your

### **ZOOM LENSES**

eyes, it doesn't to the normal 50-mm lens that probably came standard with your camera. In fact, when the satellite registers on the 1 by 11/2-in, rectangle of a 35-mm film frame, it won't appear any larger than a period on this page.

You can make this silvery speck four times larger by using the 200-mm focal length of your zoom. The focal length of any lens is measured in millimeters. The larger the number, the greater the magnification and the narrower the angle of view. A 50-mm lens has an angle of view that takes in about as much of a scene, from left to right, as the human eye does. Compared to this, a zoom at 200-mm will make an object four times larger, but its left-to-right viewing angle is much narrower.

# Focal range

Because zoom lenses let you vary their focal length, you might decide to



Zooms make multi-image overlay easy. Simply alter focal lengths on same frame.

Tamron SP 80-200-mm f/2.8 telezoom

Soligor 28-200-mm f/3.9 full-range



Zooms have varying focal and aperature ranges. Tamron gives moderate to extreme range, Soligor adds 28-mm wide angle, Sigma Apochromatic runs normal to telephoto.

magnify the moon only twice (100-mm) or three times (150-mm) its normal size. This will let you capture more of the overall scene. How much you can vary a zoom's focal lengths depends upon the focal range of the individual zoom. There's a wide assortment of ranges on the market.

Some zooms, for example, range from 35-mm to 105- or 135-mm. These give you a choice of moderate (35-mm) wide-angle effects to moderate telephoto (double 50-mm magnification).

Compared to a 50-mm lens, the popular 75- to 200-mm zooms provide 50 to 300 percent more magnificationthough you start off with a narrower angle of view thanks to the lens's minimum 75-mm focal length.

More versatile, and costly, are those wide-angle-to-telephoto zooms that range from 35-mm (or wider) to focal lengths of 200-mm and beyond. The most expensive zooms, called apochromatics, offer the greatest light-gathering ability and picture resolution.

No matter what zoom range you use, it will let you perform some creative special effects. The easiest to learn are the expansion-flare and multi-image overlay techniques.

# Expansion-flare effect

This trick, also known as racking or zooming, causes strong lines or flares to radiate out from the center of interest. This imparts a sense of motion—even to stationary subjects.

To achieve this effect, use a shutter speed slower than 1/30th of a second. About halfway through the exposure, you rack the zoom barrel (by sliding or rotating it) between focal lengths. This causes the lighter-toned elements in the scene to flare out from the center.

You can rack from a wide angle (short focal length) to a narrow one (long focal length) or vice versa. Experiment with each method to find the effect you like. But since the center of the image will show the least exaggeration, you should position your subject dead-center in the frame.

For intensified streak-motion effects, use bright-colored or light subjects against dark backgrounds. A fullrange zoom-say 75- to 200-mm-will give you maximum flare effects. The speed at which you rack also will determine flare intensity. If you pause at the beginning or end of a rack, while the shutter is still open, you'll freeze a sharp image of the central subject.

Under strong light, you might have to use a slow speed (low ASA) film. This will counteract possible overexposure from the slow shutter speeds needed to achieve the expansion-flare effect. To prevent blurring due to camera shake during the long exposure, use a tripod and shutter-release cable.

# Multi-image overlays

To create multiple exposures with multiple images overlayed on each, you'd normally have to move in (or out) and refocus your camera for each image exposed. A zoom lens lets you do this from one position, simply by changing focal lengths.

To make this kind of picture, first set up and shoot the initial image. Then, zoom in (or out) to establish a second or multiple exposure pattern.

You might want to place the second (and subsequent) images off-center in relation to the first. Shooting them slightly out of focus will create additional interest. Always use a dark background for your subjects. If you rimlight them (from the side and behind) they'll appear to float in space.

If you're using a camera that does not allow multiple exposures on the same frame, you should expose the first image normally. Then, before cranking the film advance lever, press the camera's film-rewind button. This will prevent the film from advancing, and let you make another exposure on the same frame. Do this for each image you intend to overlay.

### Handle with care

As with the expansion-flare technique, you'll need a tripod and shutterrelease cable to create flawless multiimage overlays. Here's why:

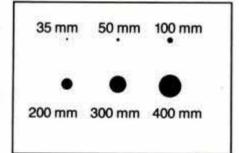
One drawback of long, variable focallength lenses is that they have less light-gathering ability compared to normal lenses. While a 50-mm lens might have a large f/1.7 aperature, a 75to 200-mm zoom might offer a smaller f/4 opening.

This means you'll need longer exposure times (slower shutter speeds) to make pictures. Trouble is, zooms are bigger and heavier than normal lenses. Any shaking during the necessarily long exposure will be magnified and blur your photo.

There are two ways to eliminate this handicap. One is to use a shutter speed that's slightly faster than 1-over-focal length. In other words, use a 1/250-sec. shutter speed when your focal length is 200-mm, 1/125 sec. at 100-mm.

This might prove difficult if you're shooting with slow-speed films such as Kodachrome 64, which need lots of light. If so, you'll have to use a tripod (or monopod) and shutter-release cable to maintain steadiness.

Another way to make up for the zoom's relatively low light-gathering ability is to use fast films with higher ASA ratings. These need less light to make an exposure. You'll find 400-, 1000- and the new 1600-ASA films a real plus for sports photography, where you'll want fast shutter speeds to freeze the action.



Diagram, 50 percent larger than a 35-mm film frame, shows relative sizes of moon according to focal length of lens used.

# How to buy

There's no shortage of zoom lenses on the market today. Just about every camera manufacturer offers a selection. Additionally, you'll find zooms from companies that specialize in lenses: Cosina, Kiron, Sigma, Soligor, Tamron, Tokina and Vivitar, to name a few. Photo dealers sometimes package one of these specialty-brand zooms with a famous-make camera.

Though most quality zoom lenses will appear similarly sleek and shiny from the outside, there are a few features you should check for.

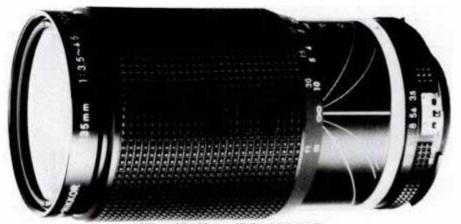
Make sure the zoom you buy has multicoated lens elements. This treatment not only increases light transmission, but reduces the chance of unwanted flare in your pictures.

Check out the amount of friction in the control slide or barrel. There should be just enough to hold the lens in focus when you aim it up or down. Otherwise, movement should be smooth and fast never jerky.

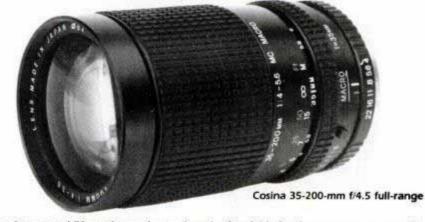
If you're hung up between the choice of two lenses, go for the one with the lower f-stop (bigger aperture). This will let you use faster shutter speeds when you're shooting in low light.



Kiron 70-210-mm f/4.5 telezoom



Nikon 35-135-mm f/3.5 wide-to-tele



Compared to normal 50-mm lenses, longer length of variable focal range zooms generally reduces their ability to gather light. The lower the f-stop number, the more light admitted.

# 20/20 STAR VISION



Do distant stars have planets? That's just one question expected to be answered by NASA's orbiting telescopes.

BY GEORGE FIELD Senior Physicist Smithsonian Institution

that of Pluto in 1930. Discovery of another planet has eluded us until now, in spite of the great advances in instrumentation which have occurred in the meantime. The reason is not hard to find: If Pluto is the last planet in the solar system—and we think it probably is—the next one must be sought in the vicinity of a nearby star, and the nearest stars are 6000 times more distant than Pluto.

Searching for a new planet in a distant solar system is just one of a halfdozen major challenges we can expect to meet in the next decade as NASA



Hubble Space Telescope (painting at top) will look for planets. Earlier orbiting telescopes captured the first full image of the

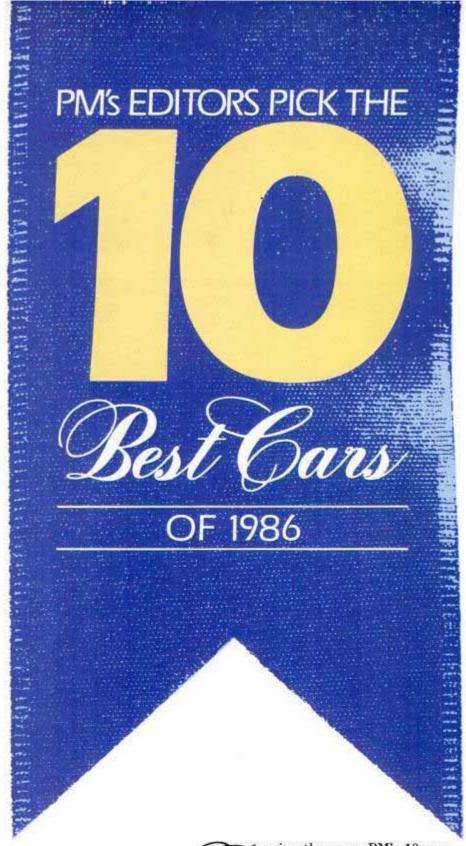
launches a new armada of space telescopes, beginning this year with the launching of the Hubble Space Telescope (HST). In coming years, NASA also plans to launch three more—the Gamma-Ray Observatory (GRO), the Space Infrared Telescope Facility (SIRTF) and the Advanced X-ray Astrophysics Facility (AXAF).



Andromeda Galaxy (above left) and the glant elliptical galaxy called M87 (right). New scopes will expand our view.

In the 40 years since World War II, astronomy has been completely revolutionized by technological advances. For centuries limited to observations in the visible band of the electromagnetic spectrum, astronomy can now use virtually all wavelengths, from gamma rays to radio wavelengths.

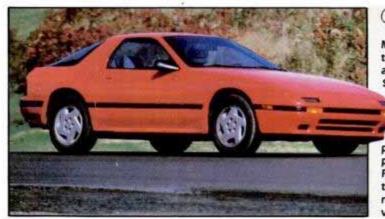
(Continued from page 159)



uring the year, PM's 10-man automotive staff drives virtually every car sold in America. As a result, friends often

ask: "What's the best car?" That's a real tough question, but we decided to poll our auto experts to make a list of the 10 Best. We didn't want to be hampered by artificial categories like "best 5-door, 4-seat sedan from \$7995 to \$9495 with metallic paint." Suppose there were three great sports cars and no great station wagons? So we asked our experts to vote for the 10 cars that work best at what they were designed to do. The results are on the following pages. A few brand-new cars with 10-Best potential are not on our list simply because we felt that assembly-line versions still had a few rough edges. Maybe next year.







Mazda's totally redesigned rotary-powered sports car is available in three strengths: the \$13,000 base model, \$17,500

GXL (both with 146 hp) and a 182-hp Turbo that will go for about \$19,500. All three models have su-

perb handling and outstanding performance. The styling is Porsche-like (no bad thing), and the interiors are typical Japanese-tech. It's the best sports car value in America.



# VOLVO 760 TURBO

Here's a sports sedan that looks like a proper limousine and goes like a C/Altered coupe. Specs include 160-hp turbocharged and intercooled 2.3-liter Four, 4-wheel disc brakes, self-leveling suspension, heated seats, a killer sound system, just about every power assist known to man, and a 3300-pound towing capacity. The unit body has a builtin roll cage, protective "crumple zones" and tons of interior room.



# $\mathscr{J}_{\mathsf{EEP}}$ CHEROKEE

Jeep Just about Invented 4wheel drive. With the Cherokee, they've taken the Bronco/ Blazer sports utility concept one step further by offering a choice of 2-door or 4-door body styles. The interior has room for adults front and back plus useful cargo space. The Off-Highway suspension is comfortable enough for commuting. Selec-Trac 4wd flips on and off with a toggle switch, a limited-slip rear end offers superior traction, and the Jensen stereo is world-class. It's like owning two cars in one.



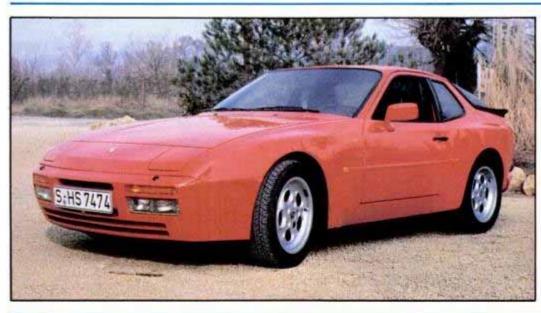
# MERCEDES-BENZ 190 2.3-16

Everybody loves a hot rod. When Mercedes engineers bolted a Cosworth 16-valve cylinder head and a bunch of spollers onto their smallest sedan, they created a 167-hp, 135-mph autobahn screamer that'il leave 'em breathless at the country club. ABS brakes and Mercedes' innovative 5-link suspension with self-leveling hydropneumatic struts control the car's performance. Inside are leather seats and all the amenities you'd expect in a Mercedes.



# CHEVROLET CAPRICE CLASSIC

When it comes to a traditional American family sedan, Chevy's big rear-drive V8 was the overwhelming choice. Low-tech and old-fashioned as an arrvil, it's also about as durable and easy to maintain. With the F41 supension option and good tires, it handles surprisingly well, the trunk is enormous, and there's really room for six inside. At \$10,600 to \$16,200, it's one of the great auto bargains still left.



# PORSCHE 944 TURBO

In the exotic world of cost-noobject sports cars, there are a lot of outrageous machines-Ferraris, Lamborghinis, Panteras, and so on. While they all go fast, most are so impractical that their charm wears thin real fast. too. The 944 Turbo is a sports car that's as comfortable and easy to drive at 150 mph as it is to slip effortlessly around city streets. Sophisticated German technology extracts 217-hp, and 6-second 0-to-60 performance from a 2.5-liter Four with 27-mpg fuel economy. You have to drive it to believe its handling.

# **MERKUR XR4TI**

Combine Batmobile styling, European sports sedan performance and the practicality of a small station wagon, and you'll get our vote any day. This transplanted German Ford, with its 175-hp turbocharged 2.3-liter Four, spaceship interior and voluminous hatchback, is a hard combination to beat. We've used one to haul lawnmowers and peat moss one day and outdrag V8s the next. Excellent disc/drum brakes and 4-wheel independent suspension make the XR4Ti an all-around performer, not just a rocket sled. Its \$16,500 list price puts the Merkur at the low end of the imported sports sedan spectrum. The Merkur is not everyone's cup of tea, and Lincoln-Mercury dealers are ready to deal on this baby.







# HONDA CRX SI

Here's an economy car that thinks it's a racer. The basic 58-hp, 52-mpg CRX HF is an EPA champ. The 91-hp fuel-injected Si trades off 30-mpg fuel economy for 16-second ¼-mile times. Extremely light weight (1950 pounds) and clever suspension design permits true sports car braking and handling. Cute as a button outside, inside there's room for two people, all their luggage and the family dog, in a package only 12 ft. long.



# BUICK ELECTRA

Talk about high tech. This frontdrive 5-passenger sedan has a 4speed overdrive lockup automatic transaxle, a 142-hp V6 with sequential direct-port fuel injection, a hot film mass airflow sensor, roller valve lifters, antilock brakes and 4-wheel independent suspension with automatic level control. Robots using gamma rays and electronic probes assure assembly quality. And it goes and handles like a European sports sedan.



# DODGE CARAVAN-PLYMOUTH VOYAGER

Sometimes, old friends are the best. Introduced at the beginning of 1984, Chrysler's T-wagons defined a whole new class of car. Many imitators have hit the market since, but none of them have duplicated Chrysler's unique combination of frontdrive sure-footedness, easy engine service access and carlike driveability. While other manufacturers were rushing new designs to market, Chrysler was honing its entry with a clever array of features—the Convert-A-Bed camper package, 8-passenger seating with a 60/40 split front bench, power outside mirrors, and a load-sensing front/ rear brake proportioning valve. The Caravan/Voyager twins have more room than conventional station wagons, park in less space, and give a great view of the road. With Chrysler's 5year/50,000-mile warranty, who could ask for anything more?

# SATELLYOUR OWN SATELLITE TV ANTENNA

The money you'll save on rigging a dish can buy you better satellite gear. But you'll need help from your dealer and friends.

# BY FRANK VIZARD

he day will come when installing a home satellite TV antenna will be as easy as rigging the standard broadcast television variety. Meanwhile, tackling a dish installation is a decision to be made on a case-by-

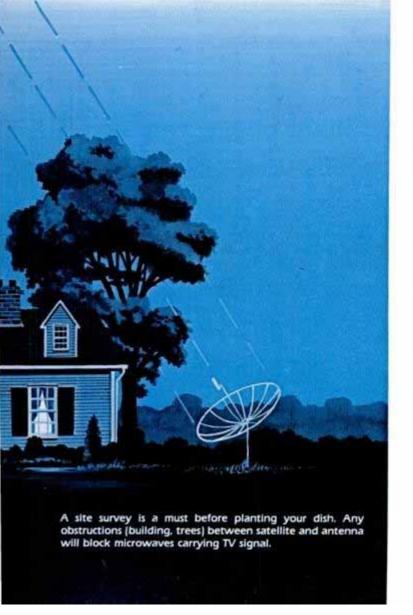


You'll need an inclinometer to get the right elevation angle when sighting dish on the satellites. Note handheld unit above.

case basis, keeping in mind the difficulties of your particular location and the level of your technical skills.

If the installation involves anything more complicated than a simple ring or easel mount for a small portable dish, the decision to tackle the job yourself should be based on a site survey. You can take your own, but satellite TV dealers charge about \$100 for this—a fee usually deducted from the price of the system if you buy from them.

A site survey is basically a 2-part process, the first being purely geographical in nature. Satellite transmissions are beamed toward the center of the country. Consequently, dishes 6 or





signals. Make sure you account for tree growth.

### SATELLITE TV ANTENNA

8 feet in diameter are usually satisfactory in the Midwest, while 10- to 12-foot antennas might be required on the East and West coasts. Dish size will also be determined by your budget and the number of channels you desire: The larger the dish, the more channels clearly received.

The second part of a site survey is a more localized affair. There must be a clear line of sight between the dish and the transmitting satellite. Since all these "birds" float 22,300 miles above the equator in what is called geostationary orbit, they are not visible to the naked eye. How, then, do you find a good spot for the dish?

If you're going it alone, you can determine the viability of a particular site by standing in the potential dish location, facing due south and scanning the horizon from east to west. If there are no visible obstructions such as trees or buildings in the way, then you might have a good location. Chances are that some obstruction will exist. The problem then, is to determine if these obstructions will block a signal. In large part, this will depend on how high above the horizon the satellites are, relative to your location and the obstructions. The farther from the equator you live, the lower on the horizon the birds will appear.

# Navigational aids

Unlike rigging a broadcast antenna, you don't simply assemble a satellite dish and then rotate it to find the clearest picture. You've got to locate the birds first in order to sight for obstructions from a variety of potential spots—before you plant the dish.

To locate the satellites, you'll need a compass, an inclinometer and a chart that shows the longitudes of the satellites. The first two items can be purchased from hardware stores. The chart printed here (or one from a dealer) will give the birds' longitudes.

Before you can go bird hunting you'll also need some information—namely, the magnetic correction factor for your area, and the elevation angles of the satellites relative to your latitude. Satellite longitudes are referenced to true north, which can vary from the magnetic north on your compass by as much as 30° in some parts of the country. You can call the nearest airport to get the correction for your locale, or look it up on a Geodetic Survey Map in the library.

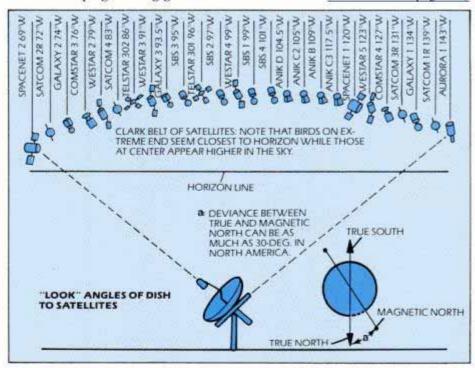
You might also get the correction factor from a nearby friend who has already installed a dish. You can also get the elevation angle this way, using your inclinometer to measure the elevation of your friend's dish. Elevation, by the way, is roughly equal to the number of degrees of latitude for your location.

With this information in hand, use your compass and satellite chart to mark the east to west span of the satellite belt. The Spacenet 2 and Aurora birds, at opposite ends of the arc, should be your end-posts. With your inclinometer angled to the proper elevation, sight along its top at the exact location (longitude) for each satellite. As you scan the sky from east to west, note any obstructions—and which satellites they're blocking.

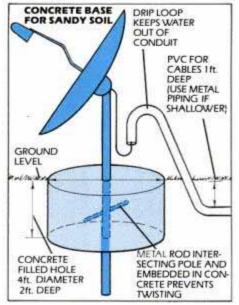
An obstructed view of some satellites does not imply disaster. You might not be interested in the programming they carry, anyway. To find out, consult a satellite TV programming guide. If there are obstructions between your dish and the birds you'd like to receive, it might be necessary to mount the dish on your roof or on top of a tall pole. Under these circumstances, it's best to engage the services of a professional installer. By the way, when sighting for obstructions, keep in mind that a perfect line of sight when trees are bare might be obscured by foliage when the trees are in leaf. Also, you should account for tree growth in years to come—or the need for pruning.

### Hidden obstacles

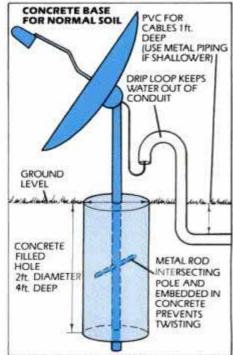
While you might detect most visible (Please turn to page 168)



Satellites are positioned 22,300 miles above the equator. Here's what the belt would look like if you could see it. Elevation angle of your dish depends on your latitude.

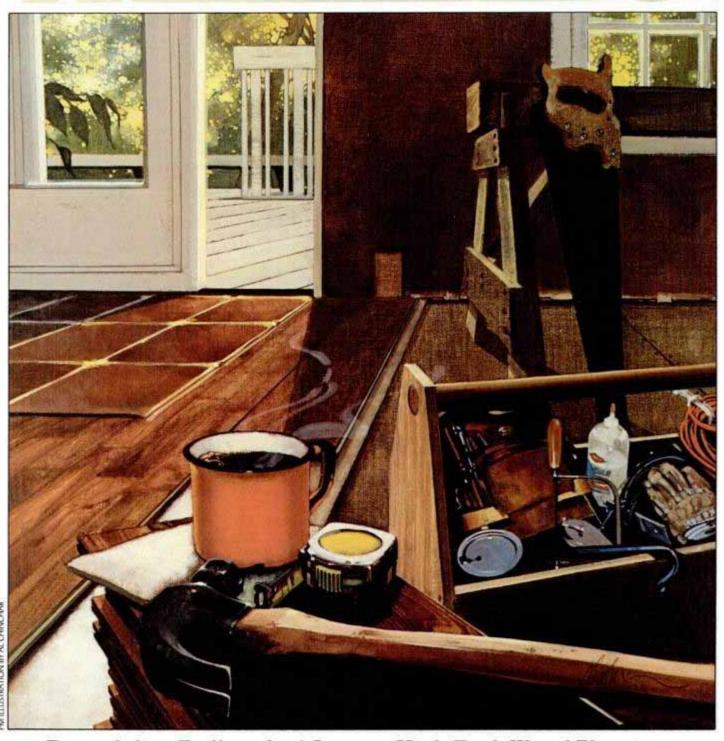


Soil conditions should determine the depth and width of the dish foundation. Keep the pole plumb while concrete sets, or satellite tuning won't be accurate.



# Popular Mechanics

# FOME IDEAS GUIDES



Remodeling Dollars And Sense • High-Tech Wood Flooring • Wrap-Around Deck • Quarry Tile Foyer • What's New In Water Heaters • Replacement Parts For Your Home



# Home Remodeling Dollars And Sense

Not every home improvement is a moneymaker when it's time to sell. Here are the winners and losers.

BY WALTER L. UPDEGRAVE; Photos by Mark Kozlowski

here are many good reasons to consider remodeling your home. Building a room addition or converting an attic into an extra bedroom, for instance, could be the perfect solution to the space squeeze faced by a growing family. Or you might want to modernize the kitchen or bathroom, where dated fixtures and appliances are the quickest giveaway to the age of your home. Energy considerations can also play a role in the decision since adding insulation or replacing dilapidated doors and windows can pay immediate dividends in the form of lower fuel bills. Then again, you may simply have grown bored looking at the same old four walls and tired decor.

But, in addition to these aspects of home renovation, you should also weigh the economic consideration of how the work will affect the market value of your property.

Many homeowners operate under the belief that any improvement will automatically increase the resale value of their home. "That is a misconception," says Frank Kelly, a home remodeling contractor in Georgetown, Massachusetts. "There are a number of projects that will add value to your home. But some will not add any value and others might even detract from your home's value."

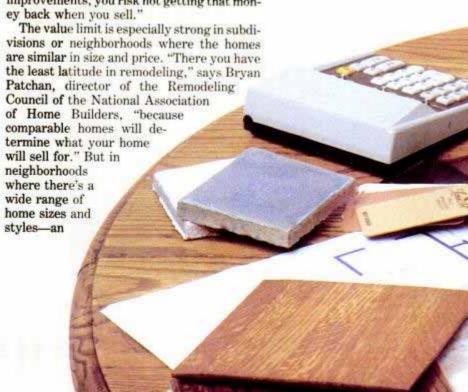
So, before undertaking any major renovation, it makes sense to ask yourself such questions as: Does money put into a large remodeling project represent a smart use of my funds? Is this an improvement that will increase the value of my home? Could it hurt it? How much should I spend? Can I get back the money spent on a remodeling project if I later decide to sell the home?

There are no absolute answers to these questions and it's important to keep in mind that, ultimately, the enjoyment you derive from feathering your nest according to your own sense of taste should be your guide. Still, by examining some key factors and following a few guidelines, you should be able to increase your enjoyment and your home's market value at the same time.

The value of your home, no matter how well improved, is primarily determined by the

value of the homes around you. That's because when someone buys a home, he or she is not just buying the structure, but the neighborhood, its services and its prestige.

As a result, it is possible to "over-remodel" your home-that is, spend more on improvements than you could ever hope to recoup should you later decide to sell. You're not likely to recover remodeling costs that take you well above the values of similar homes in the area. If, for instance, your home is currently worth \$95,000 and the top homes in your area are selling for \$100,000, it doesn't make much economic sense to renovate to the tune of \$30,000. Your chances of getting \$125,000 for a home in a \$100,000 neighborhood are slim, since people looking for \$125,000 homes don't shop in neighborhoods where the best homes go for \$100,000. Notes Lee Finch of Re/Max, a real estate brokerage in Atlanta, Georgia, "If your home is at the top of the market and you make expensive improvements, you risk not getting that money back when you sell.'





# HOME IDEAS GUIDE

area with many custom-built homes, for instance-there's usually more leeway in market values and resale prices, so you stand a better chance of recouping money spent to improve your home.

To guard against over-remodeling, NAHB's Patchan offers this rule of thumb: The market value of your home, the cost of improvements, shouldn't exceed the value of the neighborhood's top homes by more than 20 percent. In our example of the \$95,000 home in the \$100,000 neighborhood, that would mean limiting improvements to \$25,000 maximum, keeping the home's total value-current value plus improvements—at \$120,000.

You'll also get a better return on projects that bring your home up to par with others in the neighborhood. For example, if you own the only 1-bath home in the neighborhood, adding a second bath is probably a good investment. But going beyond the neighborhood norm-adding a fourth bedroom, for instance, when three is the standard-will make it harder to recoup your investment since most shoppers want bargains.

If you're considering a major improvement, ask a local real estate agent how the improvement might affect the market value of your home. An agent should know the neighborhood norm for the number of bedrooms, baths and the size of the homes and should have access to the latest assessments and selling prices.

### The time factor

The amount of time you plan to live in a home should also play a role in determining your remodeling plans. If you know you'll never move, then you should remodel purely to please yourself and forget considerations such as resale value and the market value of other homes in the neighborhood. Your remodeling budget-what you can afford to finance from savings or income-is your only constraint.

However, if you know that at some time in the future you will sell the old homestead and move on, time does become a real factor. Essentially, the shorter the length of time you plan to stay in your current home, the less chance you have of recouping the cost of major improvements. If you think you'll move within the next three to five years, NAHB's Patchan advises against major renovations. doesn't mean you're necessarily stuck with your '50s-looking kitchen for the next five years. What it does mean, though, is that instead of spending \$20,000 to install new appliances, new cabinets and an expensive tile floor,

> you should keep the cost down to a more modest \$5000 or so-perhaps replace just one or two major appliances and, instead of buying new cabinets and counters, refinish the existing ones.

### Remodeling for whom?

If at some time in the future you'll be selling your home, then you're remodeling not just for yourself but for that future buyer. Since you don't really know that buyer's tastes and preferences. vou should avoid tailoring a project too much to your personal tastes and, instead, remodel in a way that will have broadest possible appeal. "Keep improvements neutral," suggests Lee Finch of Re/Max. "Neutral color, neutral styles-you don't want 2-inch-deep green shag carpets."

In general, you can expect the lowest return from improvements that have a single purpose. If you're a fitness buff, for instance, you might consider it a great investment to put in a swimming pool and turn the basement into a fitness room. But to recoup that investment, you'll have to find a buyer who shares your enthusiasm for home workouts and who doesn't mind the hassles of owning a pool.

Similarly, you want to avoid outlandish decors or faddish architectural treatments. In particular, make sure any additions you make complement your home. A Victorian wing on a suburban split-level, for instance, would probably spell "white elephant" at resale time.

For large projects, such as a room addition or an overhaul of your home's interior, you might want to go to a professional designer. "Design-build" remodeling contractors usually have inhouse designers who, for a fee, will plan the work, draw up renderings and blueprints, spec the materials and give an estimate of the cost. You can then either have that contractor do the project or take the plans and specs and have other contractors bid on the job.

Architects and interior designers also offer such services, as do certified kitchen designers, or "CKDs," (members of the National Kitchen and Bath Assn.) who specialize in kitchen and bath renovations.

### Cost vs. value

One way to look at the cost effectiveness of a renovation is to compare its cost to the value it adds to the home at resale. Although the cost of specific home renovation projects and their probable returns can vary by region and by the quality of the individual project, the prices and returns cited below are what you should find for most

Remodeled kitchen: "The kitchen is the room that sells the house," says Bryan Patchan of NAHB. As a result, kitchens are one of the most popular remodeling projects. The cost of a major remodeling-new cabinets, new countertops, all new appliances and complete redecorating-runs about \$15,000 and you can expect to recoup about 80 percent of that if you sell within five years.

If you plan on staying much less than five years, you're better off keeping the cost down to about \$5000-refinish cabinets, replace only one appliance. You can recoup close to 90 percent on the smaller project.

Bathroom: Adding a second bath when you only have one is one of the most cost-effective renovations you can

# COMPARATIVE RETURNS

PROJECT	COST RANGE*	COST*	SHORT-TERM RECOVERY**
Room Addition (15' by 25')	\$22,000- \$30,000	\$27,000	57%
Consider adding a roo if addition brings you u			
** 1 1411 1			0.00.

Major Kitchen Remodeling	\$6700- \$22,000	\$15,000	80%	
	100000000000000000000000000000000000000			

A modern kitchen is a strong selling point for a home, but don't do total renovation unless you plan on staying at least five years.

Minor Kitchen Remodeling	\$3500- \$7000		87%	

A good investment if you want a modern-looking kitchen but also plan to move in a few years. Recovery rate of up to 90%.

Add A Full Bathroom	\$4000- \$10,000	\$6000	100%
------------------------	---------------------	--------	------

A good short-term or long-term investment. You can recoup the full cost— maybe more—if you add a full second bathroom to a 1-bath home.

Wood Deck	\$2500-	\$4000	50%
(16' by 20')	\$6000		

The warmer the climate, the higher the return. In snow-belt states, add a deck only if you'll be staying in the same home at least several years.

			and the second second
Fireplace	\$2400- \$3700	\$3000	133%

Perhaps the best investment. You can recoup the cost of the fireplace and more at resale. An energy-efficient fireplace can even cut fuel bills.

Swimming Pool (16' by 32'	\$13,000- \$28,000	\$17,000	29%
in-ground)			

It might enhance your social life, but from an investment standpoint it's money down the drain.

\*Assumes the project is done by a home remodeling contractor.

\*\*The percentage of the project cost you're likely to recover if you sell the home within five years of making the improvement.

Dollar figures and recovery percentages from Remodeling World magazine's Cost vs. Value Study.



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Nothing Runs Like a Deere

# **HOME IDEAS GUIDE**

do. The average cost is about \$6000 and you can usually recover 100 percent of that. Remodeling an existing bathroom with new fixtures, wall and floor coverings costs a little less—about \$4400 on average—but only fetches about a 50 percent return on resale. Large, luxurious whirlpool tubs are increasing in popularity, but stick to standard fixtures if you plan on moving within a few years.

Room addition: This is one of the most expensive projects—more than \$25,000, on average, for about a 400-sq.-ft. addition—and doesn't bring a particularly good return on resale: about 60 percent. That return may be higher if the addition—a third bedroom, say—brings you up to par with the neighborhood. In general, this is not a good project to undertake if you'll be moving on in a few years.

Converting an attic or garage into an extra bedroom, family room, den or library costs less than an addition from scratch, but the return is usually lower. Basement conversions can be expensive and troublesome, especially in areas where moisture is a problem. Many real estate agents contend an elaborate finished basement adds little or nothing to the resale value of a home.

A wood deck: A 320-sq.-ft. wood deck costs anywhere from \$2500 to \$6000. The return, as you might expect, varies according to region. In colder climates, where buyers expect to get less use from it, a deck might bring a 50 percent to 60 percent return. The return is higher in the Sunbelt where outdoor entertaining can occur almost year round.

**Energy-conservation** measures: Energy-related improvements bring a return even before resale by lowering fuel bills. Still, you should limit yourself to improvements that have the lowest payback period and, consequently, the highest return. Attic or ceiling insulation offers a good return since it's relatively inexpensive and easy to install. Adding insulation to walls is far more expensive and the cost could outweigh savings. Weatherstripping, sealing cracks around window frames and other low-cost measures cost little, and yield a high return.

Fireplace: Probably the best improvement from a cost-value standpoint is a fireplace. It's proven itself as a strong selling feature in virtually all parts of the country. Generally, the cost is about \$3000 and it can bring a return as high as 133 percent. While a conventional fireplace will suck out more heat than it will contribute, energy-efficient models are available that can help lower heating bills.

Swimming pool: If you enjoy lolling around a 16- by 32-ft. inground pool on a summer day and don't mind spending about \$17,000 to do it, a swimming pool is for you. But, as far as resale value is concerned, it's money down the drain. You might get a 30 percent return; you might get less. Expect a low return for a tennis court too, since it has only one possible use to potential buyers.

### A contractor or DIY?

If you've got the time, tools and talent, you should consider doing the renovation yourself. Labor typically accounts for 50 percent or more of the cost of large remodeling projects, so you can save a lot of money by going the DIY route. Even if you don't want to do the entire job yourself, you can still save by having a contractor do the construction and leave smaller tasks such as painting and wallpapering for you.

But the money you save by doing the work yourself won't do you much good if you botch the job. "The acid test," says Patchan, "is that your work should look professional."

Anything less, he warns, could actually hurt the resale value of your home since the prospective buyer figures he'll have to spend money undoing the socalled improvement.

If you decide to have a contractor do the work, take the time to shop around and pick out a qualified and reputable one. Home remodeling contractors ranked 12th on the Council of Better Business Bureau's 1984 annual consumer complaint list, with 6055 complaints lodged against contractors at BBB offices around the country. The complaints range from disagreements about the quality or scope of a project to

outright fraud—contractors simply absconding with the customer's money.

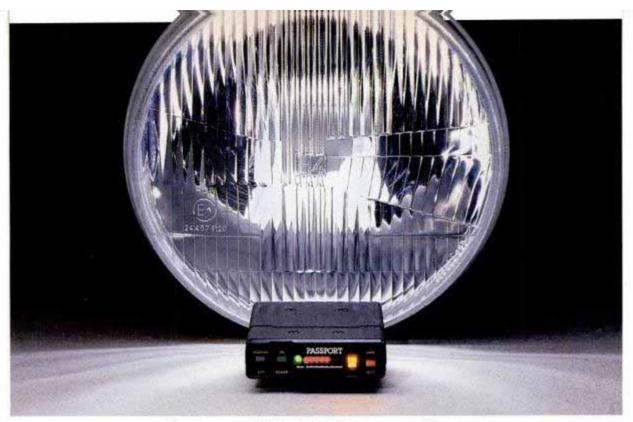
You can prevent yourself from becoming a statistic on next year's BBB list by following a few simple guidelines. First, have at least three different contractors give written bids or estimates on a project. To make sure the contractors are all bidding on the same job, spell out details such as the brand names of appliances and cabinets and the quality and grade of materials. In general, legitimate bids should fall within a 10 percent range of each other. A contractor who prices a job far below that range may resort to cutting corners to keep the job within budget.

Ask the local Better Business Bureau if any complaints have been filed with the contractor you've selected. If the contractor's record is clear, get the names of some recent customers and call them to see whether they were satisfied with the contractor's work.

Finally, make sure the contractor carries liability insurance and completed operations insurance. These protect you in the event someone is injured on the job or if someone is injured by the contractor's work after it's completed. Once the work is finished, the contractor should also provide a lien waiver or release of mechanics lien.

A final bit of advice: Take a day or two to read any contract and don't be afraid to suggest changes. Above all, don't sign under pressure. If you feel a contractor is pressing you for a quick decision, then that decision should be to find another contractor.





# Small Wonder

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# Small means nearly-invisible protection

That could only be PASSPORT. It has exactly what the discerning driver needs, superheterodyne performance in a package the size of a cassette tape.

This miniaturization is possible only with SMDs (Surface Mounted Devices), micro-electronics common in satellites but unprecedented in radar detectors. It's no surprise that such a superlative design should be greeted by superlatives from the experts.

"In a word, the Passport is a winner," said Car and Driver.

The experts report excellent performance. Simply switch PASSPORT on and adjust the volume knob. Upon radar contact, the alert lamp glows and the variable-pulse audio

# Small means the size of a cassette tape

begins a slow warning: "beep" for X band radar, "brap" for K band. Simultaneously a bar graph of Hewlett-Packard LEDs shows radar proximity.

As you get closer, the pulse quickens and the bar graph lengthens. Should you want to defeat the audible warning during a long radar encounter, a special switch provides silence, yet leaves PASSPORT fully armed for the next encounter. A photocell adjusts alert lamp brightness to the light level in your car. PASSPORT was designed for your protection and your convenience.



In PASSPORT, 102 SMDs (right) do the work of ordinary transistors, resistors and capacitors.

PASSPORT comes with a leather case and travels like a pro, in your briefcase or in your pocket—to the job for trips in the company car, on airplanes for use in far-away rentals. Just install on dashtop or visor, then plug into the lighter PASSPORT keeps such a low profile. It can be on duty without anyone noticing.

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# Fantastic Flooring

Here's a do-it-yourself hardwood floor that features no-nailing installation.

BY JOSEPH TRUINI, Shop And Tools Editor; Photos by Carl Weese

nstalling a traditional hardwood strip
floor is an ambitious undertaking even
for the most skilled and enthusiastic
do-it-yourselfer. But now you can enjoy the beauty and durability of a strip
floor with a new, easy-to-install floor from
Harris-Tarkett called Longstrip Plank.

The flooring comes in ½-in.-thick x 5%-in.-wide x 8-ft., 3%-in.-long boards, or planks. The edges and ends of the boards are milled with a tongue or a groove. Unlike traditional solid wood flooring, Longstrip is a laminated product. Each board consists of three laminations: hardwood top surface, core layer of cross-banded pine strips and a pine veneer backing (see the drawing on page 108). The three layers are pressure-glued to provide greater dimensional stability. This enables the floor to be more resistant to expansion and contraction than a solid wood floor.

The floor's top surface consists of  $\frac{1}{6}$ -in.-thick x  $\frac{2^{11}}{16}$ -in.-wide hardwood strips. The strips are of varying length and are laminated 2-across on each board. The floor shown is surfaced with merbau, a Malaysian hardwood

that is 150 percent harder than oak, according to Harris-Tarkett. Longstrip Plank is also available in beech, ash, four styles of oak and kambala, an African hardwood. The flooring comes prefinished with four coats of acrylic polyurethane varnish. The finish is hardened under ultraviolet lights to create a tough, nonyellowing surface.

Floating floor

Longstrip Plank features a unique installation method that requires no nailing. The boards' tongue and groove joints are glued together. The floor is not attached to the subfloor in any manner. It's simply laid over a ½-in.-thick foam underlayment. A ½-in. space between the flooring and the four walls allows for expansion. The space is concealed by the baseboard molding. This installation method, known as a floating floor system, has been proven effective throughout Europe for more than 40 years. In fact, the floor shown is manufactured in Sweden.

I installed the flooring over a plywood



1 Cover the subfloor with 1/6-in.-thick foam underlayment. The foam provides a cushion for the floor, it silences squeaks and acts as a sound barrier. The foam is available in 5-ft.-wide rolls.



2 Cut the foam with a knife to fit from wall to wall. Here, an aluminum wallboard T-square is used to ensure straight, square cuts. Be certain to sweep the subfloor clean before laying the foam.



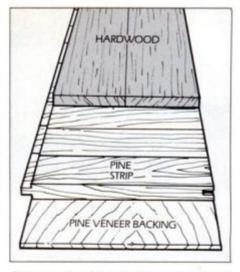
# **HOME IDEAS GUIDE**



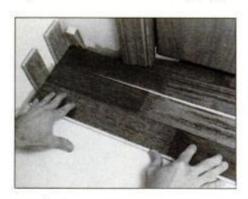
**3** Use a handsaw to cut existing door casings to accommodate the new floor. Use a section of the flooring and a piece of foam as a guide to determine new flooring height.



4 Apply glue to the grooved edge only of the first board. Be sure groove is clear of any debris to ensure a tight joint. Avoid overgluing to eliminate messy squeeze-out.



Cutaway drawing shows the laminated flooring's three components: prefinished hardwood surface, cross-banded pine strips and pine veneer backing. Note that tongue and groove is milled in pine core.



5 Press down and in to align the glued-up groove with tongue on first board. Note the use of ½-in. plywood spacer blocks against the wall to maintain the expansion space.

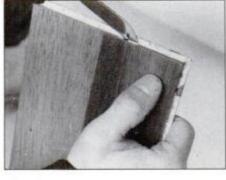


**6** Drive the joint closed using a hammer and a hardwood block. Tap the block in several places along the board's edge. Heavy pounding will damage the tongue.

subfloor, but Longstrip Plank can also be "floated" on nearly any level, sound surface, including particleboard, sheet vinyl, asphalt tile, existing wood floors, rubber tile, terrazzo, metal decking and concrete. The merbau floor shown costs about \$4.75 per square foot, including the foam underlayment. For more information regarding this system, contact Mr. Tom Akers, Harris-Tarkett, Box 300, Johnson City, TN 37601.



7 Here's a quick way to mark the last board in a row without measuring. Place one end against the wall separated by a ½-in. spacer. Then, mark the line of cut on the board.



8 End joints must be obstruction-free in order to fit together tightly. Here, a small hemp cord, used in the manufacturing process, is cut away to prevent its interference.

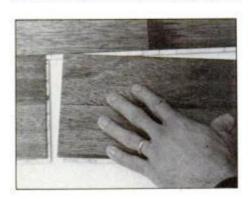


The first step is to remove all the baseboard molding from the room. Be sure that the subfloor is dry and swept clean of all debris. Next, cut a length of foam underlayment to fit from wall to wall. The 1/2-in.-thick x 5-ft.-wide foam provides a cushion for the flooring while also acting as a sound barrier.

Lay the first row of boards on the foam separated from the wall by 1/2-in. plywood spacer blocks. Also, cut the boards so that there is a 1/2-in. space at each end of the row. Be sure that the groove edge of the boards is facing the wall. Now take measurements from the starter wall across the room to the opposite wall to determine if the two walls are parallel. If the walls are out of square, rip the groove edge of the first row of boards as necessary to obtain a straight, parallel working line. Taking the time to detect and correct this situation at the outset will make your job easier when it's time to install the last course. Apply carpenter's glue to the end joints only on the first row.

the end joints only on the first row.

Next, lay out and cut the boards for the second course. Be sure to stagger the end joints at least 24 in. from the joints on the previous course. Then, apply glue to the *edge* groove of the first board (photo 4). Use a hammer and a hardwood tapping block to join the board to the first course (photo 6). Now



9 Apply glue to end and edge grooves. Slide board in place and tighten end joint first. Tap along board's edge. Stagger end joints 24 in. from adjacent row.



10 To close the end joint on the last board of each row, add a ½-in. spacer and then drive in a hardwood wedge. Leave spacers and wedges in place until the glue is dry.



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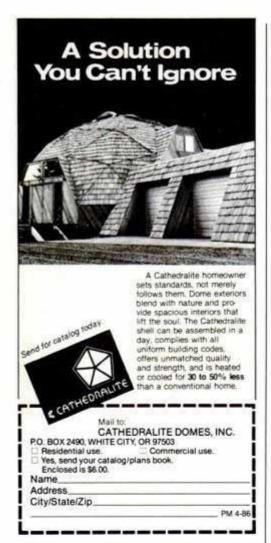
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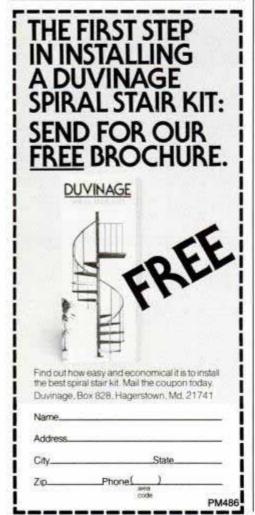
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apply glue to the edge and end grooves of the remaining boards to complete the second course. To close the end joint on the last board of each row, add the ½-in. spacer and then drive in a wedge to force the end joint closed (photo 10).

Continue laying courses of flooring, but keep in mind the following rules: Always leave a ½-in. space at both ends of each course. Cut only the first and last board of each course. Stagger end joints at least 24 in. from the adjacent course. Hammer lightly on the tapping block to prevent damaging the protruding tongue and wipe off any glue squeeze-out using a moist cloth.

#### Nearing the finish line

As the flooring approaches the finishing wall, there won't be enough room to swing a hammer to install the second to the last course. There are two solutions to this problem. Use two wedges and a wood block to force the board in place (photo 13), or use a crowbar to pry the joint closed (photo 14).

Most often, the last course won't fit properly without being ripped to the correct width. Follow this simple procedure for installing the last course. First, lay a row of boards face up, tongue toward the wall directly on top of the last installed course. Next, take a short piece of flooring about 12 in. long and hold it face down, tongue against the wall. Then, slide the short flooring piece along the wall while using a pencil to scribe the boards for the last course (photo 15). The resulting pencil line gives the proper width of the last course, including the ½-in. space. Rip the boards on the pencil line using a portable circular saw or sabre saw.

Now apply glue to the groove edge of the last course and use a crowbar to pry the boards in place (photo 16). Once the entire course is installed, drive wedges in between the flooring and the spacer blocks to hold the edge joints closed (photo 17). Leave the wedges and spacer blocks in place until the glue dries.

Next, remove all the wedges and spacers. There should be a 1/2-in. space around the entire floor. Finally, install baseboard molding to conceal the expansion space. I made the baseboard



11 After installing each course, sweep the foam underlayment clean of all dust and dirt. Area under tongued edge must be clear of debris to ensure a tight-fitting joint.



12 Longstrip Plank is a laminated product that comes in 5%-in.-wide x 8-ft., 3%-in.-long boards. Here, a full, uncut board is installed immediately after glue is applied.



13 When installing the second to the last course, there won't be room to use a hammer and tapping block. Close the edge joint using two wedges and a wood block.



14 You can also install the second to the last course using a crowbar, as shown. Be sure to position the vertical wood block in front of a wall stud for maximum support.



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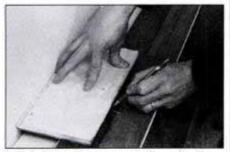
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using a 1x3 topped with a 1/2 x 1/2-in. cove molding (photo 18). Be certain to nail the baseboard to the wall and not to the flooring. This will permit the floor to move freely as it expands and contracts. Now simply dust-mop the floor and bring in the furniture.



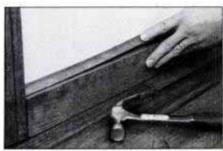
15 Scribe the last course to the wall using a piece of flooring, as shown. Place last course on top of second to last row. Slide flooring piece along wall to mark boards.



16 Rip the boards for the last course along the pencil lines using a portable circular saw or a sabre saw. Then, apply glue and use a crowbar to pry the edge joints closed.



17 Once the last course is installed, add 1/2-In. spacer blocks and then drive in hardwood wedges, as shown, to close the edge Joint. Leave the wedges in until glue is dry.



18 Remove wedges and spacers. Conceal 1/2-in. expansion space with baseboard molding. Here, baseboard is made of a 1x3 topped with a 1/2 x 1/2-in. cove molding.



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utdoor decks, backyard decks, patio decks, call them what you will, adding a deck to your house is still one of the most popular home improvement projects. In fact, their appeal is so widespread that many new homes include one as standard equipment. These usually have room for one chair and a newspaper or two small children and a glass of orange juice. But seldom do they inspire visions of backyard galas from the Jazz Age.

If you have one of these or nothing at all—which is just about the same thing—the deck shown here may be for you. It's loaded with good ideas, many of which can be added to an existing deck. But if you are looking for something more, building the whole structure will yield an attractive and livable environment for entertaining friends and family alike-including those two kids with the orange juice! All you have to do is make some sensible adjustments for the lay of your land.

Design: William Winans Color photos: Mark F. Molesky Black and white photos: William Winans Technical art: Eugene Thompson Lumber: Dura Pine decking, Wolmanized Pressure-Treated lumber, Wolmanized 30-Pear Lamp Posts, Wolmanized Laminated Posts, Wolman Driftwood gray stain from Koppers Co. Inc., Forest Products Group, Pittsburgh, PA 15219

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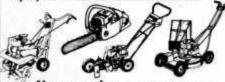
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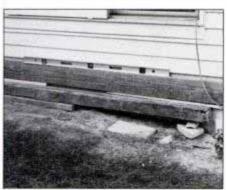
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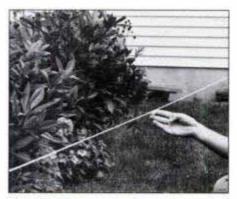
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#### Worth noting

All the lumber used on this job is pressure-treated stock. This material has been impregnated—under pressure—with wood preservative that makes it nearly impervious to insects and weather exposure. It is more expensive than standard construction lumber but considerably less expensive than naturally resistant woods such as redwood. Because of its sensible pricing and remarkable durability, we strongly recommend its use for any outdoor structure. However, the preservative may be irritating when burned. So never dispose of scrap pieces in your fireplace or wood stove.



1 Begin construction by attaching ledger to foundation wall. Prebore anchor bolt holes, then shim and level ledger in place.



4 Create level reference line for laying out deck piers using string and line level. Attach to ledger and single batter board.



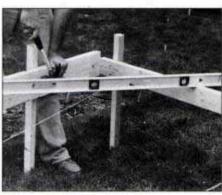
7 Flat-pad piers are laid out like round piers. But this time anchor bolts fall under string intersection, not column anchors.

#### Construction details

No matter how you position this type of deck on your property, it must abutt the house somewhere. This is normally done at the sliding glass door that exits from the kitchen or family room. Establish this point by temporarily supporting a ledger alongside the foundation wall underneath the glass door. Prebore staggered clearance holes in the ledger board about every 12 in. to accommodate the lead anchors as shown in Detail 5 on the drawing. Level the ledger in place and then transfer the precise location of the clearance holes to the foundation wall using a center punch and maul as shown in photo No. 2. Bend aluminum flashing in the shape shown and work it under the siding and over the top of the ledger.



2 Transfer position of bolt holes to foundation using ledger as template. Slide punch or cold chisel into hole and strike with maul.



5 Install second batter board at right angle to first. Make sure top of second board is level with top of first and with string.



8 Cut wood posts to length and slide bottom and between column anchor flanges. Bolt in place using lagbolts and washers.

Attach the ledger by tightening the anchor bolts.

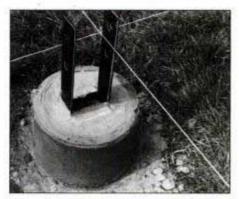
This is your reference point for laying out the position of the foundation work for all the different decks. (Note: For purposes of clear identification, the various areas of this deck will be described in the following way: The area immediately below the sliding glass door is called the *bridge deck*. The area to the left that is bordered by the privacy screen is called the *private deck*. The three stepped decks on the right are numbered from left to right, 1, 2, and 3, with 1 being the largest surface and the only one attached to the bridge deck.)

#### Foundation layout

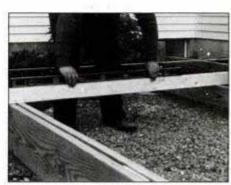
Laying out the position of the sup-



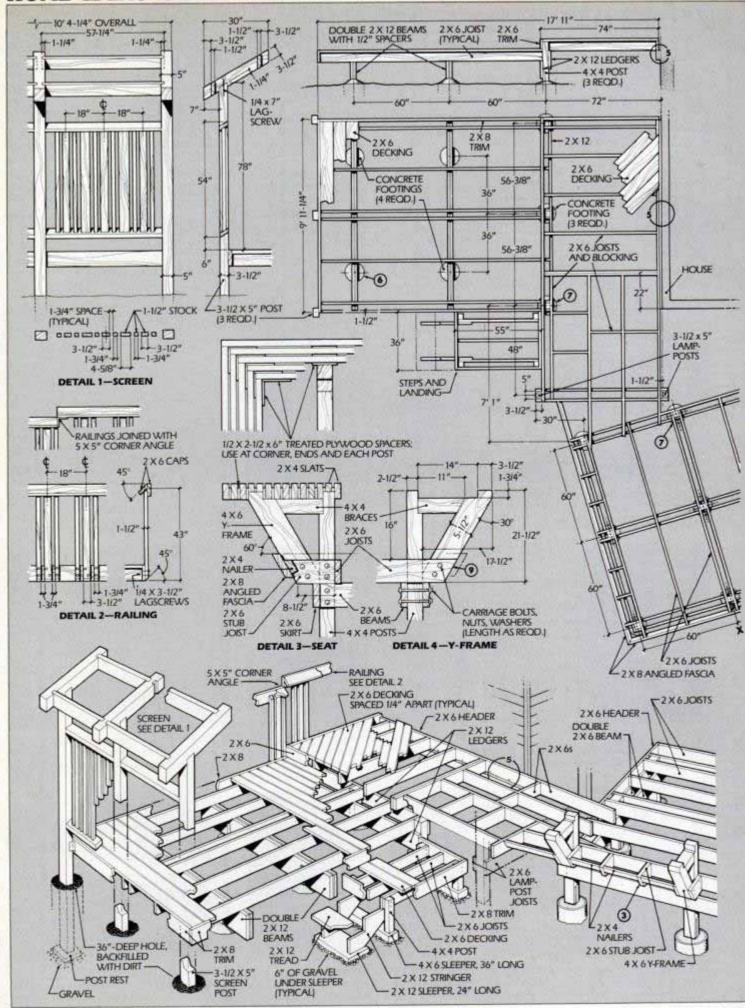
3 Bore matching bolt holes in foundation using masonry drill bit. Hole diameter and depth must match size of anchors.

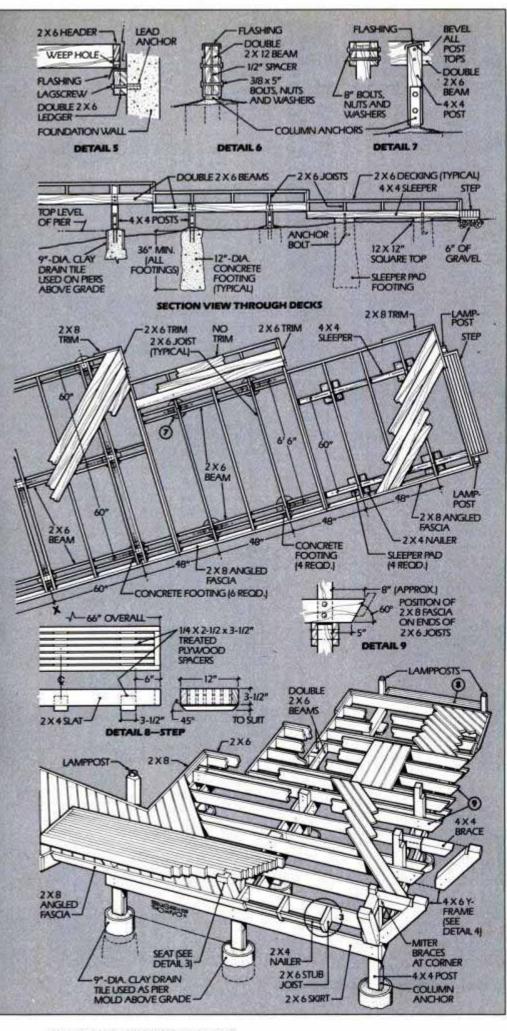


6 Where strings intersect marks exact location of piers. Above, a finished pier with column anchor falls directly below strings.



9 Slide deck beams into place and check with level and straight 2x4 to make sure all align perfectly. Shim beams where required.





port piers on this job is probably the most crucial step in the whole construction. Take plenty of time to study the drawings on these pages, particularly Details 5, 6 and 7 and the Section View Through Decks. Note that the private deck is supported by beams that rest directly on piers that have column anchors imbedded in concrete. The bridge deck and stepped decks 1 and 2 are supported by posts that are attached to column anchors in piers. Stepped deck 3 is supported by 4 x 4 sleepers that bear directly on flat concrete piers. And finally, the platform step off deck 3 and the posts that support the privacy screen off the private deck rest on gravel instead of concrete. The latter, however, do require excavating below the frost line.



10 Attach decking joists to header joist with joist hangers. Note that header sits on top of flashing that covers top of ledger.

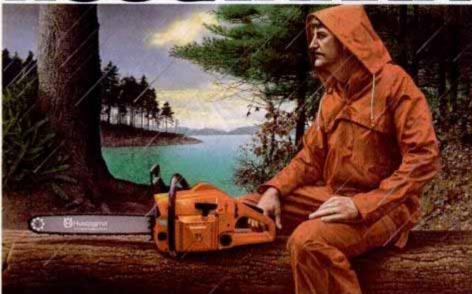


11 Nail decking in place using galvanized nails. To reduce wood splitting, blunt all nail points with hammer before driving.



12 Construct angled decks using same methods as straight decks. Keep in mind that deck posts also support benches.

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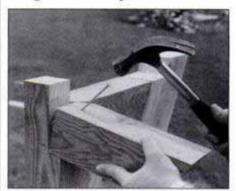
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#### HOME IDEAS GUIDE

One clever design feature of this deck is the use of terra cotta clay drain pipe as forms for the round piers. This was done to "dress up" the piers that extend above grade.

A tried-and-true method for accomplishing the layout is by using mason's string and batterboards. Once your ledger is attached to the house, measure out a couple of feet past the building line of the deck and drive two stakes in the ground at each corner of the private deck. Then attach mason's string—with a line level hooked in the middle of the span—to the top of the ledger. Have a helper wrap the free end of the string around a scrap board that is held



13 Seat supports consist of deck posts and Y-frames that are nailed together. Corner post (above) has Y-frame on both sides.



14 Once seat frames are complete, install decking across joists at 45° angle. To maintain alignment, use ¼-in. spacing blocks.



15 Allow decking boards to run over edge of deck. Then snap chalkline and cut ends in one pass to ensure precise alignment.

against the outboard side of these stakes. Move the board up or down until the string is level, then nail the board to the stakes. Make sure the board is level as well.

Next, check to make sure the string is square to the house using either a framing square or a 3-4-5 triangle. To use the latter, mark the ledger 4 ft. away from the point where the string is attached, and mark the string 3 ft. away from the ledger. If the string is square to the house, the distance between these two marks should be exactly 5 ft. Adjust the string on the batterboard to achieve precisely 5 ft.

Once this is done for both corners of the private deck, install another set of batterboards and string at right angles to the ones in place. These will establish



16 Bevel bottoms of railing posts, then damp in place and prebore clearance holes. Attach each with two lagscrews and washers.



18 Cut angled mortise on top members of privacy screen by making saw kerfs. Clean out and flatten mortise with sharp chisel.



20 Frame step landing, then excavate for sleeper that supports stringers. Cut stringers to size, clamp in place, check for level.

the intersection point for the outside piers. Do the same for the remaining piers on the bridge and stepped decks. Keep in mind that on this job, the stepped decks come off the bridge deck at a 15° angle.

Drive stakes at all string intersection points, then temporarily remove the strings to excavate for the piers. When you are ready to pour the concrete, replace the strings and use them as a guide for measuring down to the top of each pier. Keep in mind that there are many different pier elevations in this deck and they will vary depending on the contour of your yard. Study the drawings carefully and make the necessary adjustments to our plans to suit your situation.

Before you begin framing the deck,



17 Excavate for privacy screen posts, then pour in 6 in. of gravel. Cover gravel with scrap 2x6 to support post. Backfill with soil.



19 Bevel rail edges on privacy screen using table saw or portable circular saw. One side of top railing boards also needs bevel.



21 Nail seat boards to support frames, making sure that all ends align perfectly. Then cover by nailing end boards in place.



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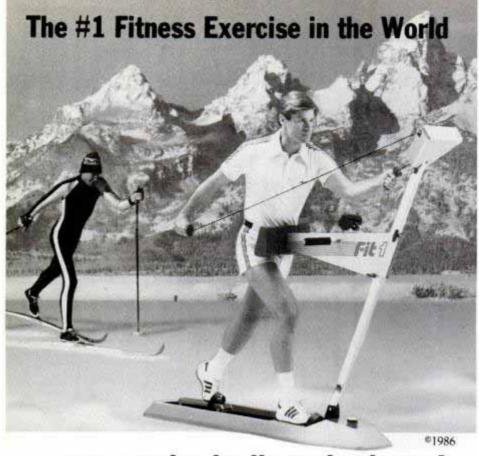


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#### **HOME IDEAS GUIDE**

it's a good idea to remove the sod from the area that will be covered by the deck. Then cover the ground with black polyethelene plastic, which is covered, in turn, with gravel. Punch a few holes in the plastic to permit drainage. The plastic will discourage weed growth underneath the deck and the gravel will give a finished look to the job.

Framing the deck

Begin by setting all the beams, sleepers and posts as shown in the drawing. Keep in mind that the outside posts on stepped deck 1 are much longer than the others because they also support the bench seating above as shown in Detail 3 and 4. Also note that the lamp posts are prefabricated specialty items called 30-Year Lamp Posts. (For information, write Koppers at the address given on page 115.) These have a hollow channel in the middle and turned tops that are capped with an aluminum sleeve. The channel makes wiring the lights a breeze and the sleeve is dimensioned to accommodate the base of standard light fixtures.

Next, begin installing the joists. Start with the private deck, then move to the stepped decks. Do No. 3 first, followed by No. 2 and No. 1 and finish up with the bridge deck. Keep in mind that the outboard joist ends on the stepped decks are cut at a 60° angle to yield a bevelled fascia look, as shown in

Detail 9

Once all the joists are in place, build and attach the Y-frames for the bench seats as shown in Details 3 and 4. Then install all the decking using 16d galvanized nails. Maintain uniform 1/4-in. spacing between the boards. Also, it's always a good idea to let decking boards run over the perimeter of a deckespecially when the boards are installed diagonally-and then cut them off afterward in one pass. This yields the straightest possible line and greatly reduces the amount of time required to install the boards. There is bound to be some waste, but careful planning should minimize it. Once all the cuts are made, add the perimeter trim boards as shown in the drawing.

Finishing up

Next, build the privacy screen, the railings, the steps and landing off the private deck, and the seating benches on stepped deck 1. Finish up with the platform step off deck 3. Leave the wood to weather naturally or stain it a color of choice. We used a gray stain called Wolman Driftwood. When the deck is dry, wire and install the lighting fixtures, hang some plants from the privacy screen and throw a party. You deserve it.



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Now, when experts refer to the high-water mark in radar protection, they automatically turn to ESCORT. In March of this year, Car and Driver published its latest detector test, this one comparing remote-mounted models. ESCORT is designed for dashtop or visor mounting. But the magazine included ESCORT in the test anyway, as the reference against which the performance of the others would be measured. ESCORT scored 412 points in the final rating, compared to 274 for the highest-finishing remote. You might say the comparison showed that there is no comparison.

#### A gilt-edged reputation

Seven years is a long time in the radar warning business, but there is no shortcut to a good reputation. Car and Driver said, "The ESCORT radar detector is clearly the leader in the field in value, customer service, and performance..."



These excerpts were taken entirely from advertisements for other radar detectors.

So it's easy to understand why other detectors would try to stand in our limelight. ESCORT has seven years worth of credibility, the one quality that money can't buy in this business.

#### Check our references

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ESCORT pioneered superheterodyne receiving circuitry. Ask if our radar warnings always come in time.

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## Restyle With Tile

Here's how to create an attractive and durable entranceway floor with ceramic tile.

#### BY WILLIAM BEYER

f you have a foyer with hardwood, vinyl or carpeted flooring, you know how tough it can be to protect the surface from dirt and water and keep it looking neat and clean. A large throw rug can help control the mess, but it can also create a hazard under foot.

We found a solution to all these problems in glazed ceramic tile. Ceramic tile is about as durable as any flooring material you can use. It's easy to maintain and looks new almost indefinitely. And it comes in a variety of colors and patterns—subdued earth tones, bright pastels, or with hand-painted figuring.

We chose a dark maroon 8%-in.-square tile with a lightly mottled surface. Its color complements our foyer, and its satin glaze makes cleanup easy.

#### Preparing the subfloor

A solid foundation is essential if you want your ceramic floor to last. You can lay the tile directly over an existing floor, and this will make the job simpler. But be sure this floor has no give, and that its surface will provide a good bond for the tile. We removed our oak flooring to achieve a near-level transition from tile surface to the adjoining oak flooring of the living room. This also allowed enough clearance for the door to swing over a small throw rug.

First, we removed the quarter round and baseboard from the walls, and the metal carpet edging. If you plan to reuse the wood trim, remove it carefully. We then established the line where the tile would adjoin the living room floor. In most cases, this line will be determined for you by the location of a wall corner. However, if your wall configuration permits you to choose an arbitrary line, you might want to consider the tile size, plus the width of the grout spaces, and allow for full, uncut tiles along the front and back edges.

After marking the cutoff line at exact right angles to the adjacent walls, we used a circular saw to cut the division between tile and oak flooring. The blade was set at a depth equal to the thickness of the oak flooring. We then removed the flooring and all the protruding nails.

With our subfloor exposed, we glued and nailed down an exterior-grade plywood sub-



1 Remove quarter round and baseboard carefully if you plan to re-use it. Pull out nails from unfinished side.

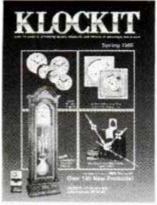


2 To keep the tile surface flush with the adjacent floors, cut at the joint line where the tiles will meet the floor. Remove the existing flooring in the area to be tiled.



**3** Giue and nail down the exterior plywood subfloor to bring the finished tile surface to a fraction of an inch below the adjoining floor. Place the plywood's good face up.





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#### **HOME IDEAS GUIDE**

floor. The plywood should be an appropriate thickness to bring the surface of the tile just a fraction of an inch lower than the surface of the adjoining floor. When calculating this height, allow slightly less than 1/8 in. for the thickness of the tile mastic. To assure a smooth and stable surface, we covered the plywood seams with a latex underlayment sealer.

#### Tile layout

There are several different ways to lay out a grid for the placement of the tiles. Your main layout concern is to locate a starting point. Since you will almost certainly need to cut some tiles to size, your starting point should allow you to end up with cut tiles of approximately equal widths at opposite sides of the tiled area.



4 Lay out tiles, leaving appropriate grout spacing, to determine tile placement and the starting point for installation.



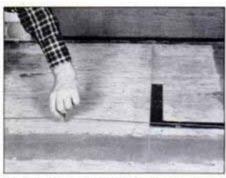
6 Wherever possible, cut tiles to size before spreading mastic. Cutter scores tile surface square, then snaps tile apart.



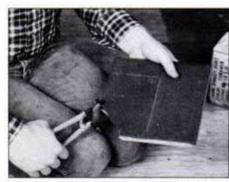
8 Spread mastic evenly over a small area using a %-in.-deep notched trowel. Leave chalk lines visible for tile alignment.

Our foyer was fairly small, so we laid out tiles on the subfloor to determine our starting point, carefully setting each tile along a steel rule and leaving equal grout spaces between tiles. You can also use precision tile spacers, available at tile suppliers, to assure uniform spacing. Some tiles are made with built-in separators to keep the grout spaces equal.

With the tiles in position, we marked the floor area into squares. If you're tiling a relatively small area, you can mark each tile on the subfloor. This provides precise tile placement and helps to assure straight lines and consistent grout widths. For larger areas, lay out workable squares of four, six or nine tiles in each direction. After you have made your marks, pick up the tiles and snap chalk lines.



5 Snap chalk-line grid pattern about nine tiles square to locate tiles during installation and assure straight lines.

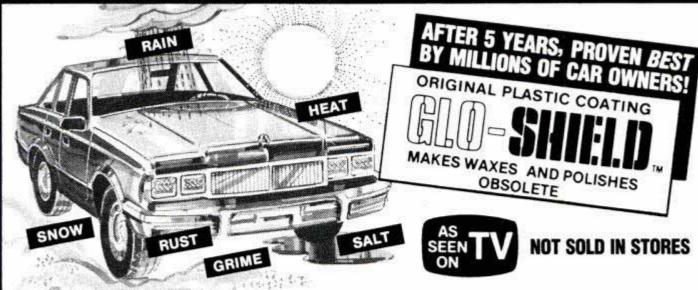


7 Use nippers to make cutouts or curved edges. First score the tile with a sharp awl, then nibble away small bites.



9 Begin first row along a central chalk line, then align adjacent tiles. Press so mastic squeezes out slightly at edges.

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#### **HOME IDEAS GUIDE**

For larger areas, you can also lay out your grid with a guide stick, rather than setting tiles in place. Use a long, straight scrap of wood or a yardstick, and mark off a space equal to one tile, including space for one grout line. Repeat this several times, ending with a grout space. Use the guide stick first to find your starting point, then to mark the location of grid lines.

#### Tile installation

We used a 3-part epoxy mastic mortar, blending all parts together to the viscosity recommended on the product container. Tile adhesives are also available premixed and ready to use, but for a heavy-traffic floor, the 3-part epoxy will probably provide greater durabil-

To spread the mastic, use a notched trowel with %-in. teeth. Apply the



10 After mastic has set for 12 hours, spread grout using a rubber float. Force grout into grooves with float edge.



11 Wipe up excess grout, then strike joints with a smooth, round instrument. When dry, remove residue with burlap.



12 Replace baseboard and quarter round. After three days, seal grout with silicone sealer to protect it from dirt.

POPULAR MECHANICS • APRIL 1986

mastic evenly within a marked square, leaving the chalk lines exposed. Work a square consisting of six to 15 tiles at a time, depending on how fast you work and how many tiles you will have to cut. If you spread the mastic too far in advance, it may dry before you can place all the tiles. You should be able to do most of your cutting before spreading the mastic. This will reduce the risk of dry-out.

**Cutting tile** 

Cutting ceramic tile is not difficult if you have the proper tools. Most tile dealers will rent you the necessary cutting tools. A tile cutter like the one shown in the photo scores a squared line across the surface of a tile, then breaks it cleanly along that line. A hand-held tile nipper is used to trim away small amounts of tile, and for shaping it to fit around obstructions such as the door casing. We didn't concern ourselves with a perfectly straight line at the wall since baseboard and quarter round would cover this space. However, make clean cuts around door casings, where the edges will be visible, and leave space for grout.

Place each tile carefully within the square, aligning the first row with a central chalk line. Align the second row with adjoining tiles. Give each tile a slight twist as you place it to assure a good transfer of adhesive onto the back of the tile.

Press down firmly on each until you see mastic squeeze out slightly from under all four bottom edges of the tile. Periodically check your work for straight alignment and equal spacing.

Applying grout

Allow the adhesive to dry at least 12 hours before applying grout. Grouts, like tile adhesives, are sold both in powder form and premixed. We used a powder because we wanted to match the color of the tile. Mixing is easy and takes only a few minutes. We also included a grout reinforcer to strengthen the mix for floor use. Allow the mix to set for several minutes before starting to assure complete integration of the latex additive blend.

Spread the grout generously over the tiles using a rubber grout float to force it down into the spaces between tiles. Remove excess grout by drawing the float across the tiles. After 20 minutes, wipe the surface with a damp sponge.

Generally, the grout line should be kept slightly below the curve of the top edge of the tile. This reduces cleanup maintenance later. However, you can set the grout lower in the grooves if you would like the overall surface to have a more textured appearance. Strike the grout lines with a smooth, rounded instrument. The rounded handle end of an old toothbrush works well. For a nearly flush grout line, use the wide side of the handle. To strike the grout deeper, use the narrow edge of the handle.

Final steps

Allow the grout to dry overnight, then use a coarse cloth, like burlap, to scrub away the powdery film that remains on tile surfaces. Scrub along the rounded edges of the tiles to remove any excess grout. This done, you can renail the baseboard and quarter round.

As a final step, approximately three days later, seal the grout with a silicone grout sealer. This helps keep it from absorbing dirt and stains, and makes cleaning easier. The sealer takes only a few minutes to dry.

Your completed floor will require only minimal maintenance. No special care is required, but avoid dropping heavy objects on it, which can crack the tiles. Wax or other surface coatings aren't usually recommended. About once a year you may want to scrub the grout thoroughly and apply another coat of silicone sealer.

## You can clean up the mess burglars leave. But you can't clean up the awful memories.



Do you have any idea what it's like after burglars have been in your home?

Most people feel dirty. Violated.
Some people never quite get over it.
Many eventually move. Almost all burglary victims immediately put new locks on their doors—after it's over...when it's too late!

The most important lock is a security deadlock. Many law-enforcement experts agree that a good, heavy-duty deadlock

with a one-inch deadbolt is probably the single most effective way you can keep your home and family safe from intruders.

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EMHART





## In Hot Water

No reason to get burned up over a gluttonous water heater. Simple solutions will save some money, and a new energy-efficient model can save you even more.

BY LEE GREEN; Photo by Brian Kosoff

our water heater may be keeping you in more hot water than you're looking for when it comes to your gas or electric bill. It's often hard to tell just how much it costs to heat your water, since most utility bills don't split out the energy consumption of specific appliances. But unless you've taken steps to keep it under control, it's a safe bet that your household's water heating cost is a sizeable one.

For most homes, water heating ranks second only to central heating and cooling as an energy glutton. For some energy-efficient buildings, it's the major energy consumer.

A household of four with an electric water heater is likely to be spending \$300 to \$600 every year. Gas-fired water heaters usually cost less to run, but you'll still find yourself paying \$150 to \$300 annually.

Is there anything you can do about this? Yes, there is. You can cut your bill by a third or more. But to pick the money-saving strategy that's best for your needs, you should first know where the energy goes in water heating, and how the various energy-saving strategies work—or don't work.

It takes a good deal of energy to convert cold water to hot water: about 8½ BTUs (British Thermal Units) to raise 1 gallon of water 1°F. So, if water reaches your house at 60°, and your dishwasher requires 140° water, it would take 664 BTUs (8½ × 80) to heat each gallon of water—10,000 BTUs to heat the 15 gallons of water per load the typical dishwasher uses. That represents 6 cents worth of natural gas, at the national average price of 62 cents per therm, or 23 cents worth of electricity at 8 cents per kilowatt-hour—if your heater is 100 percent efficient.

Your water heater, unfortunately, isn't 100 percent efficient. An electric heater comes fairly close, converting just about all its energy into heat. But even the best-insulated electric water heater leaks heat to its surroundings, typically to the tune of about \$65 each year. A gas water heater, on a percentage basis, does even worse, although its lower efficiency is more than offset by the less expensive energy.

A conventional gas water heater—the plain vanilla kind found in most homes with natural gas—loses about one quarter of its energy up the flue while it's actually heating water. Storage, or standby, losses for this type of heater typically account for about \$30 a year.

Saving energy on hot water calls for a 2pronged attack: use less heat and less hot water either by lowering the temperature or reducing the number of gallons used, and reduce your water heater's standby losses. Of the two approaches, the first is easier, and can produce the greatest savings.

You don't need a lot of new equipment to use less heat. Check your water heater's temperature setting. You could be throwing money away by running your dishwasher and washing machine at excessively high temperatures. You're also incurring unnecessarily high storage costs: Storing water at, say, 150° instead of 140° will cost you an additional \$9 or so each year if you have an electric heater, and more than \$4 with gas.

How hot should your hot water be? A dishwasher is your most demanding water user, and most manufacturers recommend 140° water for best dishwashing results. There's no reason to keep the water heater's thermostat higher than this, and you might try it even a bit lower to see if your dishes still get clean. Your savings will depend on your utility rates, the temperature of the cold water in your supply line and the temperature for which your water heater is set. But dropping your water heater's thermostat setting 10° can save about 5 cents each time you wash a load of clothes if you heat water electrically, and about 3 cents if you use natural gas. The same 10° reduction will cut your dishwashing costs about 3 cents per load.

Bathing and hand washing are, generally speaking, constant temperature hot water uses. That means if the hot water is supplied at a lower temperature, you'll just add less cold water. So you're not likely to realize any savings here by lowering your heater's thermostat. You can, however, use less water to do the same job. Installing inexpensive flow

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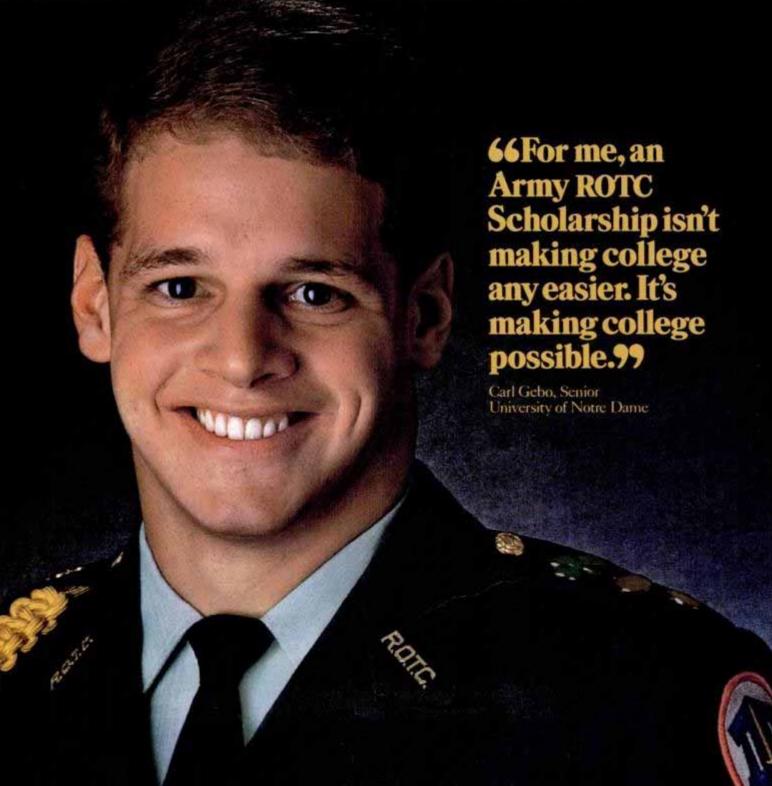


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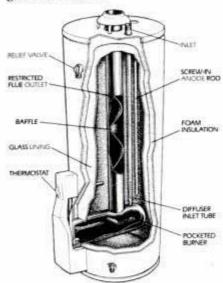


restrictors on showers and sink faucets is one way. Changing your washing habits is another. And make sure your hot-water faucet doesn't leak. A hotwater faucet that drips at a rate of one drop per second will dump more than 400 gallons of expensive hot water down the drain in a year.

The cost of heating water at least gives you hot water when you want it. But standby loss gives you nothing. It's wasted energy. If you lower the heater's thermostat setting as we've suggested, you're already taking one of the best steps toward cutting these standby losses. The lower the temperature of stored hot water, the lower the rate of heat loss to the air.

If your water heater is located in a 70° area, lowering the thermostat from 140° to 130° will reduce those storage losses by almost 15 percent.

Older water heaters can benefit handsomely from the insulation blanket kits available from utility stores and home centers. Typically, one of these can reduce standby loss in an older gasfired heater by one-third (about \$21 per year) and with an older electric heater by one-quarter (about \$33 annually). Later model energy-efficient heaters are better insulated to start with, so insulation kits will make less of a difference. Even so, a properly applied insulation blanket can reduce the hot-water storage losses of even a well-insulated gas water heater.



Energy-saving gas hot-water heater has airtight foam insulation and a gradually restricted flue outlet to minimize flue-heat waste. A pocketed burner, submerged within the tank, utilizes all the flame's heat. A 40gal. high-efficiency gas heater costs about \$300—roughly double the cost of a conventional fiberglass-insulated heater with under-the-tank burner. However, during its 15-year life expectancy, the average family of four can expect to burn about \$700 less in gas with the more efficient unit.

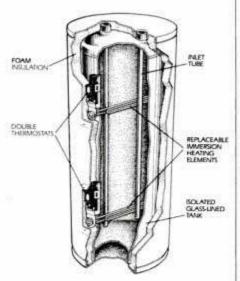
If you opt for an insulation kit, be sure that you follow the installation instructions carefully. It's important to avoid blocking air inlets on gas models, and some electric heaters require trimming away of insulation in the area of the heater's thermostats.

About the only other thing you can do to reduce storage losses from your existing water heater is to make sure it's turned off when you go on vacation, or for other prolonged periods of nonusage. Read your water heater's instruction book. It will usually tell you the easiest way to do this. Turning a water heater off for short periods-less than 24 hours-won't save much. Water heaters don't lose energy that fast, and any savings you achieve while the heater is off for a few hours will be offset by an increased heat-up load when it's turned back on.

#### A new breed of heaters

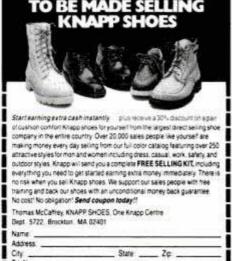
If you want to enjoy real savings on your hot-water costs, you may be ready for a new heater. But which one? The market is loaded with a variety of models and types unheard of only a few years ago. The list and the advertising claims seem endless.

Luckily, there's some help available. Some types of water heaters-storagetype gas, electric and oil-fired modelsare now required by law to carry an energy-cost label. They must be rated for efficiency with an energy factor, a measure of the heater's overall efficiency, including both heating efficiency



Super-insulated electric water heater completely isolates the fused-glass lining from the tank's exterior jacket with rigid polyurethane foam insulation. Replaceable screw-in-type immersed heating elements are activated in sequence by separate thermostats. As with gas heaters, an energysaving electric, at about \$300, costs twice as much as a conventional electric model with fiberglass insulation. During its 15-year life, however, it will use about \$1000 less electricity to heat water for a family of four.





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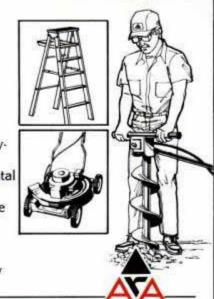
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#### **HOME IDEAS GUIDE**

and storage losses. This energy factor is something like a car's EPA mileage rating. It's not necessarily an accurate estimate of how any particular purchaser will do, but can provide a useful basis for comparison among the models that are rated.

Unfortunately, this labeling program doesn't yet cover all types of water heaters. Thus, it's more difficult to assess the performance of many of the newer types of water heaters including instantaneous gas heaters, electric heat-pump models and desuperheaters. Here are some guidelines.

Conventional electric water heaters are devices with few opportunities for innovation. Most have a pair of electric heating elements immersed in the water tank, one near the top, and one near the bottom. The top element heats the upper portion of the tank, then the bottom one switches on to finish the slower process of heating the rest of the water in the tank. Most heaters are designed to operate only one heating element at a time, to keep from overloading the house's electric service. The heating is virtually 100 percent efficient, so that the only performance improvements possible are to increase the tank's insulation to reduce standby losses.

That undramatic step, however, can produce some dramatic savings. Where an old-fashioned electric water heater may lose \$143 per year in storage losses, the best performing models available today, such as the Rheem 81GX52D or the Sears 220.325300, can cut standby loss to under \$20.

In some communities, special electric rates are available to encourage use during off-peak hours. Utilities often will help you set up a larger-thannormal electric water heater with its own electric meter. Water is heated only during off-peak periods, usually at night, and stored for use all day. Offpeak electricity rates, when available, are usually lower than normal rates. Check with your local electric company.

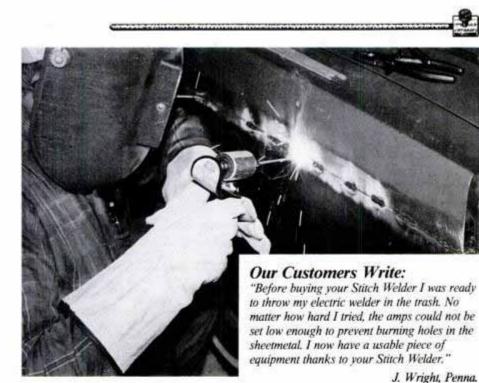
Gas water heaters, as we've noted, lose most of their energy up the flue. There isn't much that can be done about this, since a minimum heat level is required to carry spent gases up the chimney. However, there have been some recent innovations to improve burner and storage efficiency.

Many of the latest high-efficiency water heaters feature such energy-saving innovations as polyurethane foam insulation, micro pilot lights, improved flue baffling and redesigned combustion chambers and flues.

#### **Tankless heaters**

Tankless, or instantaneous, water heaters eliminate storage losses entirely. While relatively new to this country, they've been sold in Europe and Japan

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There was a time when I was so broke I could not put diapers on my baby or feed my family. Maybe you are living like I was — I pray that you are not. Maybe you are hurting financially just a little. Maybe you are thousands of dollars in debt and can't see your way out, or maybe you are just dissatisfied with your present way of life. If any of the above applies, you will be interested in what I have to say!

I am on top of the world - but it wasn't always that way; in fact, 13 months ago, I was hurting and hurting badly. Almost 2 years ago I got involved in a business that turned out to be a disaster. Unfortunately, when it went down the tubes, all my life savings went with it. I thought my life had come to an end. I had no money to pay the rent, the car payment, the phone bill, the gas bill nor the light bill. That's right, I didn't have a penny to my name. The thing that was really bad, was that my family was suffering with me.

In a matter of 9 months, we were \$14,000 in debt. We had a place to live only because a friend was kind enough to let us stay rent free. Life was bad, and every day it was getting worse. Despite the disappointments of being in debt and unemployed, we kept hanging in there — looking and searching for something — anything!

This might sound like a familiar song to a few of you, but in my situation, the results were rare.

In one miraculous day, everything changed. That particular day, I woke up very early. I went into the kitchen, sat down and dropped my heat to the table. I was so miserable and full of hurt and grief watching the hours pass by. All of a sudden, I was overcome with an incredible idea: an idea that was so strong. I instantly picked up the phone. I made that one certain phone call. Just one phone call and 2 days later, we were making \$8,000 a month! guaranteed! All I made was one phone call and in 2 days our miseries were gone!

In the next 60 days, we paid off our \$14,000 debt and began buying things that even people who have worked all of their lives can't afford: my dream car - a Mercedes 450 SL. It was a symbol of my small discovery and my victory over defeat.

Five months after this discovery, I bought my wife a BMW 533i for Valentine's Day. It was just a little something to let her know how much I appreciated and loved her for sticking with me through those trying 9 months.

Eight months after my discovery, I asked my wife where she would like to live if given the freedom and the choice: "California." So we packed up everything and moved to the most beautiful spot in the state. Those of you who have been to Santa Barbara know what I'm talking about. We moved to a beautiful \$250,000 home right by the ocean. And we still had \$30,000 in the bank!

Yes, our lives changed entirely in only 2 days-all because of one, simple phone call - a phone call that anyone, anywhere can make. All you need is to know the secret. This is such a great little secret, I just had to write a simple book telling you how to make the ONE, SIMPLE 3 MINUTE PHONE CALL. This call will entirely change your financial picture in only 2 days, as it did mine.

Believe me, it works - it works big - and it keeps on working. Day after day, week after week, month after month - it keeps on working for as long as you want it - guaranteed!

My money making method is so simple that it is almost hard to believe. Just imagine, you are sitting by your phone and you make one phone call that takes approximately 3 minutes. In a maximum of 2 days, you can be making a minimum of \$8,000 per month, guaranteed, for as long as you want it. Pick up the phone again, and make another 3 minute phone call and in 2 days, you can be making a minimum of \$16,000 per month, guaranteed, for as long as you want it.

THE FORMULA WORKS LIKE THIS: EVERY 3 MINUTE PHONE CALL = \$8,000 PER MONTH INCOME GUARANTEED FOR AS LONG AS YOU WANT IT.

There is nothing magical about this. You just need to know who to call. It's that simple.

Every successful person has his secret to success. But some are harder to follow than others. I know that my secret is by far the easiest. How difficult can it be to make a 3 minute phone call - which can be making you \$8,000 per month in just 2 days. YOU JUDGE FOR YOURSELF:

I promise, there is NO CATCH. You just need to know who to call.

My program is something that has never been done, seen nor advertised before!

I don't want to waste valuable space telling you what it is not, but I guarantee you that you have never seen anything like this before. Although you make a 3 minute phone call, you do not sell anything over the phone. I repeat, YOU DON'T SELL ANYTHING.

My program is absolutely legal and the most moral and ethical work you will ever do.

This is something anybody, living anywhere, in any kind of circumstance can do.

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"After receiving Doug Holmes' book, it took me two days to secure an income of \$12,000 per month guaranteed, for as long as I wanted it." Mike Kohler, Texas

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"I'm 32 years old, high school education and a housewife. Once receiving Doug Holmes' book, within a few days I secured enough income to become financially independent for IIIe."

Karen Skelly, Illinois

#### Sworn Testimonial:

"I was flat broke when I received Mr. Holmes' book. After 2 days of applying his method, I locked in an income of \$8,400 per month guaranteed!"

Dan Cockrell, Texas

#### Sworn Statement:

"I have personally been a witness and do testify that Mr. Douglas G. Holmes has been able to secure in 2 days \$8,000 per month, guaranteed - after one 3-minute phone call." Milt F., S.L.C., Utah

#### Sworn Statement:

"As the personal accountant and brother of Doug Holmes, I testify that Mr. Holmes has, indeed, been able to lock in an income of \$8,000 per month, guaranteed, within a 2 day period. I also testify that the statements made on this page are accurate and true."

Robert M. Holmes, Accountant
Oregon



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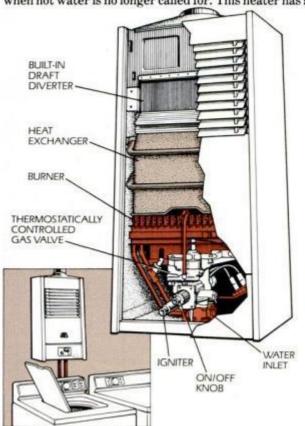
Douglas G. Holmes 5290 Overpass Rd., Suite 215 Dept. 187 Santa Barbara, CA 93111

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for a number of years. Instead of heating water when there's no demand and storing it until it's needed, instantaneous units heat water only as it's needed, shutting down when hot water is no longer called for. This heater has some



definite advantages, but some disadvantages as well.

On the plus side, standby losses are negligible—near zero for electric models. However, the pilot light on a gas unit accounts for some energy consumption even while the heater is off. Efficiency while heating the water is about the same as for storage-type units, so overall energy costs of the tankless models are lower, by about 10 percent for gas heaters and 13 percent for electrics.

A more dramatic advantage of an instantaneous heater is that it can sustain its maximum delivery rate of hot water indefinitely. You'll never run out of hot water in the middle of a shower. The bad news is that an instantaneous water heater's maximum delivery rate is likely to be lower than you're used to. Since there's no storage tank, one of these heaters can't heat water over a period of hours and deliver it in a rush. You can only get what the heater can heat as you use it. As a result, gas tankless water heaters are typically limited to a delivery rate of about 2 gallons per minute or less. A 10 kilowatt electric heater, larger than many utilities will permit, delivers even less.

#### Heatpump water heaters

A fairly recent innovation in electrically powered water

Tankless water heaters, also called instantaneous heaters, have no storage tank, but heat water on demand, as it is called for. This means standby losses are negligible. Most measure about 30 in. high  $\times$  18 in. wide  $\times$  12 in. deep, and are wall-mounted and vented through the wall. A gas-fired tankless heater costs about 5700—more than double the cost of a high-efficiency tank-type heater. But in its 15-year life it will use about 5600 less gas for the average family of four. Maximum delivery rate for a tankless gas heater is about 2 gal. per minute. Electric tankless heaters deliver at a considerably slower rate, so they are usually used as boosters rather than a self-sufficient hot-water supply.



heaters is the heatpump type. Instead of simply converting electrical energy to heat as most electric heaters do, heatpump models take heat from the surrounding air and transfer it to the water in a storage tank. This heat pumping is very energy efficient, often moving two or more units of heat for every unit of electrical energy used—an efficiency of 200 percent.

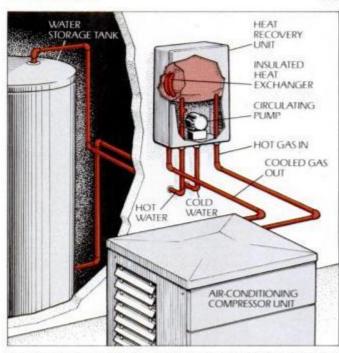
But heatpump heaters have their disadvantages as well. They are usually quite slow heating water, so if you run out of hot water, you'll have a long wait before more is available. Also, the heat that's pumped from the surrounding air will cool down that room—a pleasant bonus if you're air-conditioning, but an extra load on your home's heating system in winter. Heatpump water heaters are noisier than conventional ones, with a compressor noise level similar to that of a window air conditioner. And heatpump water heaters are expensive to purchase, costing two or three times as much as a conventional high-efficiency heater.

Desuperheaters

For homes that use central air-conditioning much of the year, a desuperheater offers a logical solution to hot-water needs. A desuperheater is simply a heat exchanger that plugs into the air-conditioner line just before the condenser. It takes heat from the hot refrigerant and transfers it to your hot water, instead of dumping it into the outdoor air. A desuperheater is one of the few cases in which you can get something for nothing, since the heat it recovers is otherwise wasted. And because your cold water supply is usually cooler than the outdoor air, your air-conditioner's performance often is improved. If you opt for a desuperheater, though, you'll still need some other water heater for the times that your air-conditioner isn't running.

Taken individually, the savings you're dealing with here

may seem inconsequential. However, taken as a whole, especially over a period of time, your overall savings could be considerable.



A desuperheater, or heat-recovery unit, utilizes heat produced by an air-conditioning unit to reduce the work load required of your tank-type water heater. An exchanger transfers compressor heat to the water, which is then pumped to the storage tank. The system is not a self-sufficient hot-water source, and is cost-effective only in the Sunbelt, where your air conditioner is likely to be operating for a good part of the year.

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# How To Install A Waste DISPOSER

garbage disposer, or food waste grinder as some manufacturers call it, is an appliance whose popularity has grown substantially in the last 20 years, and with good reason. These units provide for efficient and sanitary disposal of waste food within the kitchen where the waste is generated. This reduces the amount of refuse that must be stored until collection day, and at the same time eliminates many of the unpleasant odors caused by decaying food. These sturdy appliances can provide years of troublefree service for a relatively small initial investment, especially if you do the installation yourself.

BY STEVEN WILLSON Home And Shop Editor Illustrations by George Retseck

There are two basic kinds of disposers: batch feed and continuous feed. Both are mounted under the sink and grind waste in the same way. Both require a constant flow of cold water during use. Their difference is in how they are operated. The batch feed models are activated only when a stopper, or cover, is placed in the throat of the disposer. It functions as a switch that turns on the motor. To dispose of the waste, the stopper is removed, the

waste dropped in, then the stopper is inserted and the material is ground up and washed down the drain.

Continuous feed models are activated by a remote switch that's mounted on the unit itself, inside the cabinet, or on the wall above the sink. The disposer throat remains open when the unit is operating and waste can be fed continuously without inserting a stopper switch. Continuous units can handle a larger volume of waste quickly, but the batch models have the safety advantage, which should be a consideration if you have small children.

Most disposers have two basic parts: the lower housing that contains the



1 Begin by removing the existing waste line. Loosen the P-trap nuts with pilers or a pipe wrench and let the water drain from the trap into a bowl or pall.

motor and the upper grinding chamber that contains a flywheel-equipped with flyweights, or hammers-and a shredder ring. The flywheel is connected directly to the motor shaft. As the waste particles are fed into the unit, they are struck by the flyweights and thrown out against the shredder ring. This ring is perforated with a series of sharp-edged holes that cut the particles into small pieces. When sufficiently reduced, the waste passes through the shredder ring, washes down below the flywheel and out the drainpipe. Larger deposits are thrown repeatedly against the shredder until they are ground to



2 Loosen the slip nut that joins the tailplece to the threaded sink sleeve and pull the tailplece from the fitting. Empty the remaining water from the trap.

the appropriate size.

All disposers are designed to operate with a heavy stream of cold water running at all times. The water not only flushes away the waste, it also lubricates the seal around the motor shaft. If the unit is operated without water, the seal will be destroyed, allowing moisture to reach and ruin the motor. Cold water also congeals grease and fat particles, which permits them to be shredded. Run the water for 15 to 20 seconds after the disposer is switched off to be certain the drain lines are flushed clean.

All disposers are equipped with some form of overload switch that protects



3 Next, loosen and remove the slip nut that joins the drain pipe to the plumbing stack within the wall. Keep all fittings and gaskets for later use.

the motor by shutting off the power if the flywheel becomes jammed. Some have automatic or manual reversing switches that allow the shaft to turn in the opposite direction to free any obstruction. Other models are equipped with a red reset button. If these units jam, the obstruction must be removed manually and then the button pushed in before the unit will operate again.

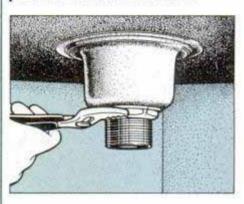
Most disposers also have a connecting fixture for mounting the waste line from a dishwasher. The unit shown here is equipped with such a fixture, but was not used for this installation.

But before buying anything, check your local building codes to determine if a disposer installation is permissible. Some municipalities do not allow their use, and others have such convoluted requirements that installing a disposer becomes financially impractical.

According to the National Standard Plumbing Code, your waste disposer installation must conform to the following minimum requirements: First, the sink waste hole must be 3½ in. in diameter. Second, the drainpipe must be no smaller than 1½ in. inside diameter. And third, if installed in a double sink (like the one shown here), each basin must drain into a separate trap.

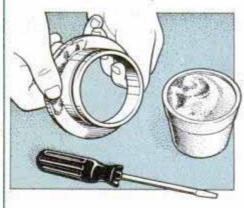
#### Preparation

Begin work by removing the cabinet doors for easy access. Then disassemble the existing drain trap using a pipe wrench or widemouth pliers. Keep in mind that the trap is filled with water to prevent sewer odors from coming up through the drain hole, so put a bowl or pail under it to catch the water.



4 To remove the sink strainer, unthread the locknut, then pull off the bell-shaped washer and its rubber gasket. Push the strainer up into the sink bowl.

Next, remove the tailpiece from the bottom of the sink strainer and the drainpipe that enters the wall. Then remove the locknut, washer and gasket that secures the strainer to the sink bowl and push the strainer up. If it doesn't move at first, you might have to tap it lightly with a hammer. Keep in mind that the strainer is not threaded into the sink, it is merely imbedded in



**5** Begin the disposer installation by applying a generous bead of plumber's putty to the underside of the sink sleeve lip. Be sure the entire lip is covered.

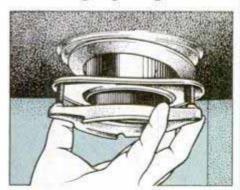


6 Thoroughly clean the sink opening to remove the old putty and then press the new sink sleeve into place. Wiggle the sleeve back and forth for uniform seal.

plumber's putty. But over time this putty can harden and the strainer will seem like it's attached. When it's free, remove all the old putty from the sink depression and scour the flange clean.

Take the sink sleeve that comes with the disposer and apply a generous amount of plumber's putty to the underside of its flange, as shown in drawing 5. Then, insert the sleeve into the sink waste hole and push down with your thumbs until some of the putty squeezes up around the sleeve.

From below, slide the disposer mounting assembly in place over the sleeve. This assembly has a fiber gasket, a backer ring and a mounting ring with three setscrews. Slide these in place, then attach the snap ring underneath and begin tightening the screws.

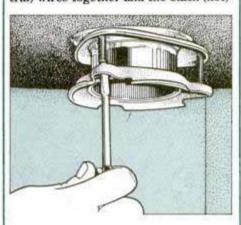


7 Once the sink sleeve is seated in the drain hole, install the mounting assembly parts in the following order: fiber gasket, backer ring, mounting ring and snap ring.

Tighten each only a few turns before moving on to the next. This prevents the backer ring from becoming distorted, which would cause a poor seal.

At this point, it's a good idea to install the electrical power cable in the underside of the disposer unit. Once the unit is mounted, this connection is much more difficult. Determine where you want to place the remote switch, then cut a suitable length of cable. Be sure to use the proper gauge cable specified for your unit.

Remove the protector plate on the bottom of the disposer and pull out the black and white electrical leads. Install a cable connector in the hole provided on the base of the unit, then push one end of the switch cable through it and tighten the cable in place. Strip off the outer insulation from the cable and the last ½ in, of insulation from the black and white wires. Join the white (neutral) wires together and the black (hot)



8 Secure the sleeve and mounting assembly by tightening the setscrews on the mounting ring. Work progressively, driving each screw a few turns at a time.

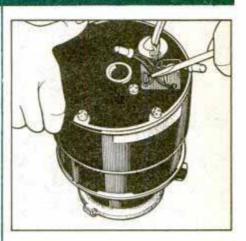
wires together using wire nuts of the appropriate size. Peel back any insulation that may be around the ground wire, then bend the end of the ground wire around the green-colored grounding screw in the unit's base and tighten the screw securely. Push the wires into the cavity and replace the cover.

Next, install the drain tailpiece and gasket that comes with the disposer. On this unit, the rubber gasket fits within a depression on the housing and then the tailpiece slides over the gasket. A separate mounting plate is screwed into the housing to secure the whole assembly.

#### Mounting the unit

Mount the disposer by lifting it up against the mounting ring and hand-turning the lug ring—on the disposer—in a clockwise direction. Finish tightening the lug ring using the small wrench supplied with the unit.

Next, install a tailpiece extender onto the tailpiece with a slip-nut gasket. Then, install the P-trap and handtighten its slip nut. Measure the dis-

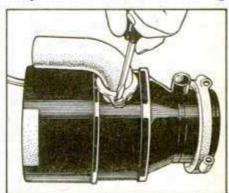


9 Install the electrical cable by removing the cover plate and Joining the white wires together, the black wires together and the ground wire to the green screw.

tance from the open end of the trap to the wall nipple at the stack opening, and cut the drainpipe to length using a hacksaw. (The drainpipe usually extends into the nipple approximately 1½ in.) Make the connections and securely tighten all nuts with a wrench or pliers.

Attach a utility switch box to a convenient place, either inside the cabinet or above the sink on the wall. The inwall installation is much more involved because it requires cutting a hole in the plaster or drywall, attaching a box through the hole, and fishing the wire into the box-all without damaging the wall finish beyond the point where it will be covered by the switch covering plate. Unless you feel up to the challenge or want to hire an electrician to make the installation, the in-cabinet switch is the better idea. Merely screw it to the cabinet partition and make the electrical connections described below.

Begin by removing two of the knockout plates on the box and installing



10 To install the tailpiece, insert the gasket between the tailpiece and disposer housing, then slide the tightening plate into position and attach with screws.



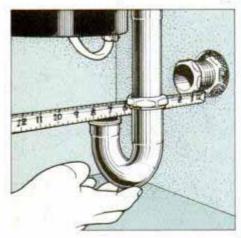
11 Lift the disposer into place, then turn the lug ring by hand until all lugs catch. Finish tightening the lugs with the angled wrench supplied with the unit.

cable connectors in the holes so that their threaded ends are inside the box. Then insert the disposer cable into one of the connectors and tighten the screw clamp. Make sure the cable extends 6 in. into the box.

Fishing wire

Next, bore a 1-in.-dia. hole in the back of the sink cabinet for the new feed cable from your fuse or breaker box. You'll have to fish new cable up through the floor and into this cabinet hole, which is the most difficult part of the whole disposer installation. It requires boring a hole up through the floor from the basement.

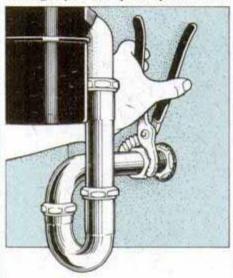
To do this, first determine where the hole should be by measuring from some common reference point that would ap-



12 Install a tailpiece extender and a Ptrap, hand tightening the slip nut for each. Position trap to align with stack opening and measure length between them.

ply to both the kitchen and the basement, such as the juncture of two outside walls. Then find the corresponding point in the basement and bore up from there. You must be extremely careful when boring into any enclosed area. There may be other electrical cables hidden from view. Bore slowly and do not push so hard that the bit jumps through when the hole is complete.

A straightened coat hanger is one of the best fishing tools you can use. Simply push one end into a hole and move the hanger around until it finds the other hole. If you get someone to help by looking in the second hole with a flashlight you can speed up the whole



13 Install the drainpipe, making sure that it's pitched slightly toward the stack opening. When satisfied with the fit, finish tightening all nuts with pilers.

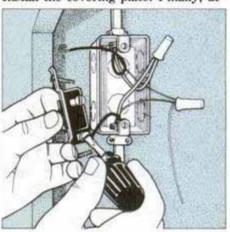
process and avoid a good deal of aggravation. Once the hanger slides through the second hole, loop the end of your cable onto it, then carefully pull both through the openings.

The other end of this cable must be installed in the house service panel, a connection that is a job for a licensed electrician. But if you have managed to mount the switch box, fish the wire from the panel to the box, and have made all the appropriate connections, then the charge will be minimal. Keep in mind that the disposer must be placed on its own circuit, not ganged with another appliance or receptacle.

Once the new cable is through the cabinet hole—but before it's attached to the service panel—install it in the switch box. Leave 6 in. of cable inside just as before and strip the wire in the same way. Join the white wires togeth-

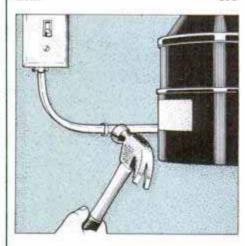
er with a wire nut. Then cut a 5-in.-long grounding pigtail from some extra wire and join to the other two ground wires with a wire nut as shown. Take this pigtail, bend a loop in the end and wind it around a green-colored grounding screw at the back of the box. Tighten the screw securely.

Next, bend a short loop in the end of each black wire and attach the wires to the corresponding switch screws. Push all the wires back into the box and screw the switch unit into the threaded holes on the top and bottom of the box. Make certain that when the switch lever is pointing down, it reads OFF. Install the covering plate. Finally, at-

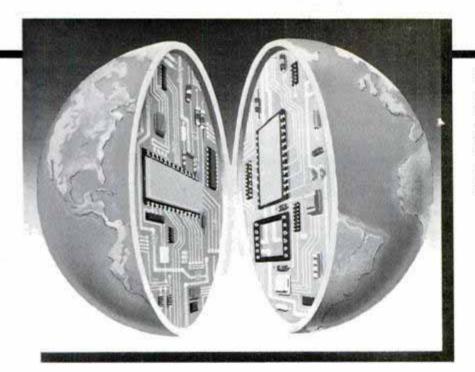


14 Join both white wires with a wire nut, and both ground wires and a grounding pigtall with a wire nut. Attach each black wire to a switch screw as shown.

tach the loose cable to the cabinet partition using electrical cable staples spaced approximately 10 in. apart. Be careful not to puncture the cable insulation.



15 Attach the electrical cable to the cabinet side with cable staples driven about 10 in. apart. Be careful not to cut the insulation with a staple point.



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Elegant entry-Elegant styling and energy efficiency are designed into this door. It's made from vertical-grain Douglas fir with finger-joint and dowel construction. The raised panels are 1% in, thick; the stiles and rails are 1% in. thick. The central oval lite and sidelites are double glazed for energy efficiency and have beveled edges. It measures 36 x 80 in. with 14-in.-wide sidelites. Called the Hyde Park model, it costs about \$1400 (finish and hardware extra). It's available at lumberyards and home centers. For details, contact Nicolai Co., 500 Northeast Multnomah St., Portland, OR 97232.

Cozy corner shower-Requiring less than 9 sq. ft. of floor space, the Kinkead shower enclosure can convert a halfbath into a three-quarter bath. The 36 x 36-in. neo-angle model, shown, costs about \$850. It comes with brown-tinted glass in a gold or bronze anodized frame or with pebbled glass in a silver frame. A 38 x 38-in. neo-angle (\$875) and a 36 x 36-in. square model (\$900) are also available. Models are available with surrounds of high-impact polystyrene plastic or ceramic tile. Features include a full-length magnetic door seal and a leakproof threshold. They are sold at home centers and plumbing supply stores. Contact USG Industries, Kinkead Division, 101 South Wacker Dr., Chicago, IL 60606.





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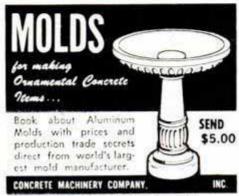
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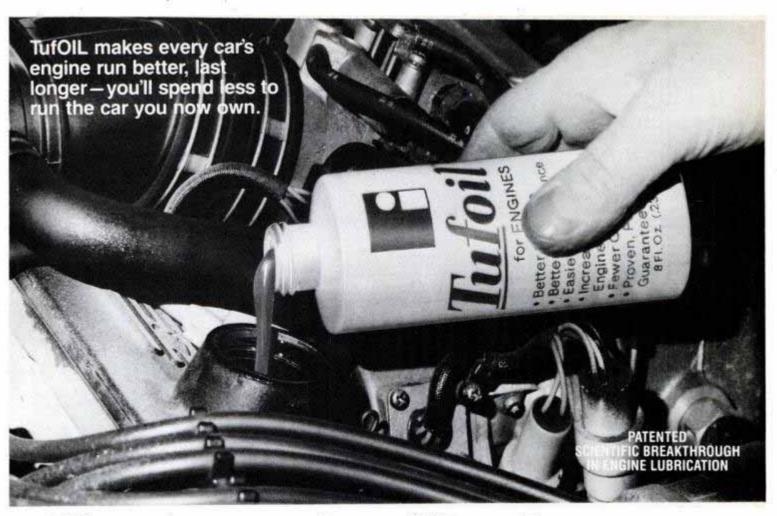


Door prize-Dress up your front door with a handsome door surround. Instead of nails, the 3-piece surround fastens to the house with metal clips. Made of high-impact polystyrene, the surround comes in two sizes; 36 in. wide and 42 in. wide, shown, (about \$180 installed). Its manufacturer claims it won't warp, crack or rot, like wood, and is washable with mild soap and water. The pilasters that support the pediment are cut to fit the door height. The surrounds have a baked-on white acrylic finish, but can be painted. Mastic surrounds are sold at siding dealers. For information, write to Mastic Information Center, Dept. PM, St. Joseph, MI 49085.

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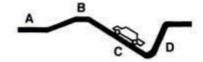
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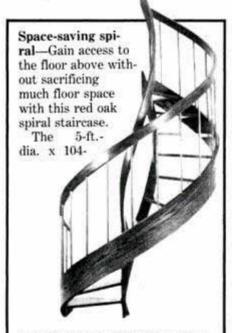
Pine paneling-Select-veneer gives this plywood paneling the look of solid wood. The 4 x 8-ft. color-matched panels feature grooves, three-plys and a lowmaintenance, satin topcoat. The 1/16-in thick panels install with mastic and nails. Blue Pine (shown) costs about \$25 a panel. Panels with walnut, birch, oak and cedar veneers are also available. For a Georgia-Pacific dealer, call 800-447-2882 (in Illinois: 800-322-4400).





View-all bath cabinet—This oakframed bath cabinet features a pair of swinging mirrors for 3-angle viewing. Behind each 10-in.-wide swinging side mirror is a 3½-in.deep storage space with 3 adjustable glass shelves. The fixed center mirror is 26 in, wide. The cabinet measures  $37½ \times 49½$  in, wide.

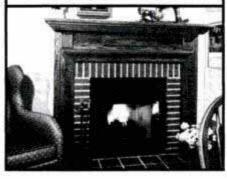
The oak mirror frame is available with a light or dark oak finish or painted white. The mirror and cabinet costs about \$438. The 240-watt, 6-lamp valance costs \$169. The units are sold at electrical distributors and home centers. For information, contact NuTone, Madison and Red Bank Roads, Cincinnati, OH 45227.



in.-tall staircase (\$2500) has no unsightly centerpost, but uses dual stringers and handrails. The oak stringers are laminated to a spruce core to facilitate bending. The treads are tenoned to the stringers and held with concealed hardware.

Shipped assembled, except for the accompanying balusters and handrails, its manufacturer will custom cut the floor-to-ceiling height. It comes finish-sanded and can be bought with a 2-coat varnish finish. Write to York Spiral Stair, Rt. 32, North Vassalboro, ME 04962.

Red oak mantel-You can add a touch of class to any fireplace with this traditionally inspired red oak mantel. The Shorewood model, shown, costs about \$800 and measures 61 in, high x 80% in, wide and fits a fireplace with a maximum opening of 44 x 56 in. wide. The mantel is shipped with premitered stiles and moldings, a shelf, pilasters and a frieze board. The parts are cut to fit and ready for installation. The oak shelf can be installed alone, and its mounting hardware is provided. The mantel is sold at building supply dealers. For more information, contact Morgan Products Ltd., Box 2446, 601 Oregon St., Oshkosh, WI 54903.





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(Continued from page 79)

This turned out to be a series of strains and grunts (the image of constipation was offered), along with slow exhalations of breath at 3-second intervals. I practiced this loudly in the classroom. I was the only student. I hoped no one was coming down the corridor. The lieutenant was saying, "You'll need to know this out in the real world.'

We moved around the facility. One room contained a tower-like mechanism that reminded me of a guillotine. It was an ejection seat simulator-in which I was strapped, oxygen mask and all. I pulled a yellow-and-black-striped ring between my legs and was abruptly catapulted up a set of rails 30 feet or so.

Much of our time was spent in a huge swimming pool-a facility which every naval aviator in the area must visit once every four years to go through a series of lectures and survival-at-sea tests. Classes of 20 pilots are put through the course every working day. However glamorous the fighter-pilot, he hardly fits that concept in a bathing suit, or worse, in 16 pounds of water-soaked flight suit with the water draining out of the eyelets of his flight boots.

Among the required drills were learning that you can actually float wearing 16 pounds of equipmentdrown-proofing, it's called, a practice we once referred to as dead man's float, but which is apparently too graphic a

descriptive for the Navy.

There were other drills. Being towed through the water and having to disengage from a parachute harness. Having a parachute canopy dropped on top of the swimmer in the water, a curious summery sail-loft smell of silk, and yet knowing it's deadly: If the person underneath cannot extricate himself from the shrouds and get out from under, the parachute will softly submerge him.

#### Dunker and Garbage Pail

The two most interesting devices used in the pool are the 925 Alpha and the 9U44. Both simulate aircraft fuselages smacking into the water, submerging quickly, and out of which the pilots must unbuckle themselves and swim out to the surface. The 9U44, known poolside as the dunker, seemed the more terrifying to me. It is a singleseat cockpit which, when tripped, runs down a steep pair of tracks into the pool, hits the water with a great splash, turns upside down and begins to settle toward the bottom. Inside, the pilot must adjust himself to being underwater, unsnap his Koch fasteners to get himself out of his harness, and then swim out. Moviegoers will remember the dunker as the device which panics one of the students in the film "An Officer And A Gentleman."

But the other device, the 925 Alpha, nicknamed the Garbage Pail, caused far more consternation. Much larger than the dunker, it seats eight and is supposed to represent the fuselage of a passenger-carrying plane, in particular a helicopter. The Garbage Pail is designed to turn upside down in the water, which is apparently what helicopters tend to do when they hit the sea.

Once everyone is seated and buckled in, a release mechanism lets the device go. It hits the surface of the pool and the green water pours in the open doors and windows. One has time to take one last gulp of air and experience the abrupt shift of the hollow echoing sounds above water to the eerie gurgling world of being underwater.

#### Herd panic

The pilots are required to take four trips in the Garbage Pail, the last two blindfolded to simulate a crash-landing at night. Sometimes a kind of underwater herd panic sweeps through those aboard. They fight each other for the exits. They clutch at each other, hoping the other will lead them out of their confinement. One pilot got himself out of an overturned Garbage Pail so discombobulated that he stood on the floor of the pool in his heavy boots with his arms upraised like an underwater statue of Rio de Janiero's Christ the Redeemer, signalling that he had simply given up and would the frogmen please come by and take him up.

The next day I met Lt. Tim White, who would be accompanying me out to the carrier. He promised me an easier day. We would go through some flight simulation in which everything would work perfectly-no crashes, no air-sea rescues, no physical hardships.

He took me over to a large building which houses the Weapons Tactical Trainer (WTT). Inside, I was reminded of a planetarium. An exact representation of the F-18 cockpit stands on a tower in the middle of a great domed room whose walls are illuminated by a representation of the sky, horizon and ground. The whole image, thrown on the wall by some kind of multi-lens camera, moves to the controls in the cockpit, giving an astonishingly authentic sensation of being high in the sky. Lt. White described it as "neatthe neatest thing that has happened to fighter pilots since the happy hour."

The lieutenant settled me into the cockpit and gave me a quick rundown on the dials and controls. He showed me the control stick, a small, gnarled shillelagh-covered with the warts of control buttons. The pilot can do just about everything without taking his hand off the control stick-steer, ma-

neuver, fire his weaponry.

We "took off." Tim showed me how to do a few maneuvers-the aileron roll, the wing roll. He said we would do some of them the next day out in the "real world." It was very life-like. The horizon wheeled. The simulated cockpit is actually made to shudder slightly in the force of the g-turns.

I was helped in these maneuvers by the most advanced bit of technology in the cockpit-the Head-Up Display. The transparent screen on the windscreen directly in front of the pilot is a faintly luminous display of altitude, airspeed, Mach numbers, g-forces, com-

pass heading, and so forth.

Also available on the HUD is all the information the pilot needs to deliver a weapon, either air-to-air, or air-toground. A simulation of a target, say 20 miles away, shows up on the HUD. The pilot maneuvers a square-like aiming reticle over it, locks on, and a command pops up on the HUD: SHOOT SHOOT SHOOT.

Tim was saying that in the WTT, it was possible to plot into the system any kind of airplane in existence and simulate a dogfight against it. "You can program the opponent to fight at various levels of their flight capabilitiesright up to the ultimate."

"What country's planes give you the most competition?" I asked. "Our own planes," Tim replied.

"What about the Foxbat?" It was the only Russian plane whose name I could remember.

"The F-18'd tear it apart in a second. No match. The MiG 29 is better, but it's more challenging fighting our own planes."

#### The real thing

However realistic the interior of the WTT, it was no match for flying in the "real world" the next day. When I took control of the F-18 25,000 feet over the Atlantic, I was astonished at how sensitive the controls were. One slight push of the stick to one side would drop a wing abruptly, and I'd look out in alarm at the blue of the ocean far below. I spent my first minutes trying to keep the plane level.

On the HUD display in front of me, I tried to match the image of the plane on the screen and keep it even with the artificial horizon. My breathing in the oxygen apparatus became less shallow.

'You're doing fine," Tim said. "How about trying your aileron roll?" We had practiced this in the WTT the evening before, rolling the plane 360°, wing over

"Are you sure?" I asked. The pace of my breathing went up again. "Could we have a refresher course?"

Tim explained once more: "Bring the stick back until the nose of the plane is on a 20° incline-you'll see that on the HUD—and then put the stick hard over to the right."

"I remember." I eased the plane up and then, holding my breath, I pushed the stick over. In front of me, the horizon rolled. I felt the plane flutter, and the strange caress of the g-suit inflating against my body. When we were upside-down, I began easing the stick back. The horizon appeared at a violent slant and then evened out. We were flying straight again.

The maneuver had only taken two or three seconds. I produced a couple of exclamations of awe, then asked Tim if

we could do it again.

We did some more turns, each more exhilarating than the last. On occasion I tried to give the airplane back to Tim. He kept refusing it, showing me his hands above his head.

About an hour out, we spotted the carrier. It seemed absurdly small—about the size of a thumbnail viewed at arm's length. On either side, a couple of miles off the America, were her accompanying frigates—thin, dark shapes at the head of the long white furrows of their wakes. Tim took over the controls and we dropped down. We came along the beam of the carrier and then 2 or 3 miles out we "rolled into the groove"—as Tim put it—and began coming up on the carrier, skimming the water. I

heard Tim say into his radio to the flight officer on deck: "I have the ball in sight." He was referring to a device on the stern of the carrier known as the meatball—the modern-day adaptation of the LSO officer of the World War II flattops who, equipped with a flag in each hand, brought in the planes or waved them off.

When Navy jet fighters came into being, their speeds made it necessary to find a mechanical system to bring in the planes. A complex of lenses, the device shows as a row of green lights with the meatball in the middle, which glows amber if the pilot is on the right glide path, red if he is too low, and so forth.

The landing speed of the F-18 is about 130 knots. The carrier is making a speed of 8 to 10 knots into the wind, which cuts the air speed relative to the carrier's surface to around 100 knots. Tim coaxed in the F-18 as if he were settling an elderly person into a chair.

There are five arresting wires (or traps) on the deck. The preferable wire and the one the pilots aim to catch with their hooks is the third, halfway up the length of the carrier. Not to have the hook catch hold at all, or to bounce beyond or short of the wires, is a touch-and-go practice in humiliation known as "bolting"—requiring that the pilot give

it full throttle and get off the deck to go around again. It is not a pleasant experience. One of the more vivid descriptions I heard of the shock of bolting is that the sensation is like sitting down on a toilet bowl, not realizing the seat has been lifted.

Tim had no such trouble. We hit the third wire and I felt the enormous backthrust of the retaining wire keeping us from going over the bow of the carrier just yards away. Tim must have heard my grunt of relief.

"They tell me the admiral wants to see you," he said. "When you get back, we're off. You'll like the steam catapult. I'll take you straight up. You'll be able to look back down over your shoulder and see the carrier directly beneath."

We were on the bridge—small and crowded—looking out over the sea. I told the admiral what an extraordinary experience it had been. He asked me which service I would be rooting for in the Army-Navy game coming up in a couple of weeks. I looked at his officers. Some of them were wearing baseball-type caps. I said I would be rooting for Navy—a somewhat startling revelation, even to myself. I am an ex-Army man—a tank-driver at one point. But it occurred to me later that I had truly meant what I had said. At least for a year or so.



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Set your goal at 500 converters a week -\$1,000 per week profit. Use Yellow Pages to locate possible suppliers. It will take three or four visits to possible suppliers before they believe you will collect converters regularly. Start visiting in your spare time, after work, at weekends or on days off. Your persistence will pay off and you will develop a strong collection route. You will find the Major Collectors want to help you grow because it helps them to grow too.

You will need some capital, but it will grow as you grow. And you will need a vehicle, preferably a pickup. Then it comes back to the four factors of personal success mentioned above...and you.

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#### SURFBUSTERS

(Continued from page 86)

tentially poop the boat and roll it without giving him time to react with the helm, another reason he prefers to quarter through following seas at an oblique angle.

Likewise, he'll use the power of the swells to help him maneuver. When moving from a down-surf position 180° to a position pointing directly up-surf, he'll time his turn so that the 44 is on the up slope of a comber that's about to break. Breaking surf at the top of the wave can then be used to force the stern around, allowing a 180° pivot virtually within the 44's own length.

Throttle work becomes important when you're taking the surf bow onagain, surf that can be two or three times higher than the boat itself. Taylor powers up the face of a comber, then pulls back on the juice at the crest to prevent too much of the boat from exiting the water. Even with this easydoes-it approach, half the 44, sometimes three-quarters, departs the surface of the water and slams down the opposite side. Failure to reduce power at the crest could literally launch the boat into the air.

#### Beached-boat retraction

Graduation day comes after students successfully complete what's known as a "beached-boat retraction," where a small open boat is cast off and allowed to clatter through the foam onto the beach at the end of the jetty.

The Coasties come away with an ability to size up dangerous situations and the instincts to avoid or at least alleviate the veritable cascade of hazards the sea can deliver.

"When you first put in through the surf, it can scare you to death," says Boatswain's Mate Second Class Ted Horton of Newport, Oregon. "But you have to learn what the boat can do.

It can do a lot, acknowledges MLBS staffer Leon Hummel, who lived through one knockdown that caused \$11,000 damage one afternoon.

"I knew the wave coming after us was way too big, and it wasn't a good feeling. And when it hit, you could feel the pressure mounting on the boat. I knew it was going to be a bad one, particularly when the water came up to my shoulders and the windshield blew out. All that glass hit the coxswain in the face and cut him quite badly. But he still brought the 44 back home."

It's a mental game in an environment of harsh, physical violence—yet incredible beauty. You find a heightened reality as rolling mountains of wind-swept water tower high above you.

"It's scary," one Coast Guard student concedes, "but it's also a lot of fun." FM (Continued from page 83)

of the reason for the Quattro's mediocre fuel economy. The Audi does have one feature that we wish was on every car . . . ABS brakes. Especially in slippery conditions, ABS provides a dramatic improvement in control and braking distance.

The Audi is impressive, but not funa Teutonic Buick. It seems like a ponderous, complicated, expensive answer to a simple question, a question that the Japanese have answered effortlessly. It's a narrow-focus car, as limited in its way as a Porsche 911 Turbo or a Jeep CJ. The small group to whom it appeals will think it's the best car ever built, but most people won't understand it.

#### Dodge Colt Vista 4×4

Interesting car, this. Throw away all your preconceptions of what a car should be, and appreciate the Vista for what it can do, not what it looks like. The Vista is essentially a Mitsubishi Mirage chassis-a 2.0-liter frontwheel-drive economy car-fitted with a driveshaft running to the rear wheels and hidden beneath a van-like body with tons of interior space.

Inside, there are seats for seven close friends, reached through conventional front-hinged doors rather than the sliding doors of a van. Access is terrific, making the Vista one of the most versatile vehicles on the market. If you can't fit it into the Vista, it probably isn't worth carrying home.

Unbelievably, the Vista is even great fun to drive. The shift in and out of 4wheel drive is imperceptible, the regular shifter is great, the steering is light and precise. The handling is truly excellent, and the front-to-rear balance made this the most secure 4×4 in the group on slippery surfaces. Under that boxy body is a very competent chassis.

The Mitsubishi engine is one of those easy-revving, fun-to-use reminders of Japanese motorcycles. The Vista is certainly not quick, but it feels zippy, which is sometimes more important. The fuel economy is also extremely good, second in this group behind the Tercel, and the straightforward mechanics should be easy to maintain.

The driving position is as bus-like as you'd expect, but one quickly adapts. The velour seats were praised for great lumbar support and good lateral support, while the ergonomics of the controls are excellent. There are a number of map pockets, drink holders and other handy conveniences. The biggest flaw we found was obviously inexpensive materials used throughout the interior, especially on the door panels.

In our overall rankings, the Vista nearly tied the Audi Quattro, and some

testers preferred it to the Toyota, as well. Certainly, this is the most versatile vehicle in the group. We even went off-roading with the Vista at no detriment to it or ourselves. This car came as a nice surprise because it looks too stodgy to be this much fun.

#### Nissan Stanza Wagon 4×4

While the Colt Vista turned out to be better than we expected, the Stanza was mildly disappointing. The concept is similar to the Vista: a boxy van-like body on the chassis of a front-wheeldrive economy car, with the added benefit of 4-wheel drive. The concept is obviously valid, but flawed in Nissan's execution. The Stanza is prettier than the Vista, but not as competent.

Unlike any other van, the Stanza has sliding doors on both sides, plus pillarless construction between the front and rear doors. With all five doors open, the Stanza is virtually sideless and backless. It's the easiest vehicle to load this side of a flatbed truck. Our only hesitation is over safety. The extremely open nature of the Stanza's construction seems like it might not handle side impacts or rollovers as well as more conventional wagons.

The exterior and interior of the Stanza are both pleasantly styled and quite straightforward. The front seats are van-like captain's chairs complete with arm rests, and the quality is good throughout. All the controls are easy to use, and the high driving position is both comfortable and commanding. Mechanically, the Stanza is not so satisfactory. The handling is quite wobbly, and the car always feels tall and tippy. The engine is rough and buzzy at every speed, and interior noise levels are Unfortunately, annoyingly high. there's no compensating surfeit of horsepower. All in all, the Stanza is okay, but hardly our favorite 4×4 wagon. It needs a more sophisticated suspension, more horsepower and upgraded interior to hang in there with the competition.

### AMC Eagle

The Eagle is in a tough position. It's the only pure passenger car that AMC still builds-if you don't count Renaults assembled in Kenosha-and it's bordering on being an antique. This is basically a 15-year-old AMC Hornet fitted with an excellent 4-wheel-drive system that has to be considered state-of-theart even in 1986. It's a curious combination that does remarkably well in some areas, but falls down in others.

In performance, the Eagle does just fine. The old 4.2-liter AMC inline-6 is one of those long-stroke workhorses that's quiet, dependable and long-last-

(Please turn to page 158)

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(Continued from page 155)

ing. And AMC's 4wd system is easy to shift, effortless and well-balanced. The Eagle is very much a passenger car, yet it will go 4-wheeling like a Jeep until it simply runs out of ground clearance.

Where the Eagle falls down is ergonomics. The late-'60s interior seems terribly antiquated, with its too-light power steering, uncomfortable seats, plastic wood-grain trim and awkward driving position. The handling is poor and the fuel economy abysmal, yet the Eagle, as a 4wd wagon, actually does its job quite well. AMC plans to retire the Eagle, and presumably buyers searching for a 4×4 wagon will be directed to the contemporary Cherokee/Wagoneer. We think this is a pretty good plan. The Cherokee/Wagoneer can do everything the Eagle can do, plus a lot more. In fact, it's one of our favorite vehicles, and probably the best machine AMC builds.

#### Honda Civic 4×4 Wagon

It's nice to know Honda is not run by robots, but by humans, capable of making mistakes just like the rest of us. Every car Honda builds is the leader in its class, except for the 4×4 Wagon. This Honda is built off the award-winning Civic chassis, but something got lost in the translation.

Instead of a zippy little economy car with the added versatility of 4-wheel drive, Honda has come up with a slow gas-guzzler.

The best part of this car is the 4×4 mechanism. The shift is controlled by an electric switch in the dash, and it's undetectable.

Unfortunately, there's not enough power, and steering efforts are very heavy. Handling is mediocre, and the noise levels high. The interior is cheaply finished, though the seats are typically comfortable Honda buckets.

This is basic transportation. The only reason you'd buy this car is to get cheap 4-wheel drive, and realistically that's not worth it. The low ground clearance restricts this car to light snowfalls, and the traction is not that much better than a good 2-wheel-drive Civic. We expect a lot from any Honda product, and frankly, we were disappointed.

#### Getting the most from 4-wheel drive

Tires make a big difference with any 4-wheel-drive vehicle. Most of these wagons came equipped with OEM-quality passenger-car tires. The Audi was fitted with high-performance radials that were all wrong for slippery conditions. For the type of driving in which you need 4wd, M+S rated tires are what you should have on all four wheels. Some of the best snow tires in the world are made in Sweden. They combine a quiet, soft ride on dry pavement with excellent snow traction.

Four-wheel drive provides a definite feeling of security and measurably better traction. There is a corresponding fuel-economy loss, of course, and maintenance costs will be higher due to the added complexity of the drivetrain. Four-wheel drive is not a panacea, but when you need it, it's the only thing that will do the job. That's why we're seeing more and more 4-wheel-drive passenger cars these days.

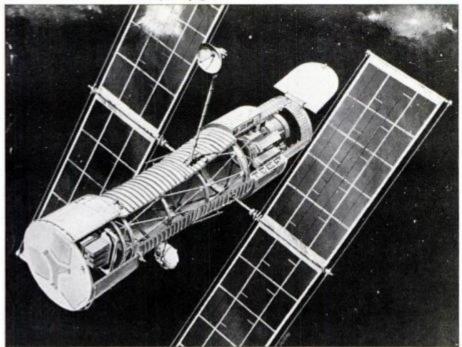
Most high-tech auto design starts on the racetrack and eventually filters down to everyday passenger cars. In the case of 4wd, just the opposite is true: It first became popular on small trucks and agricultural vehicles, then went on to passenger cars like the Eagle and Audi, and today is the hot setup in international rallying. Competition 4wd Audis have had a lock on the World Rally Championship until last year, when it was won by a 4wd Peugeot. Now that it's become fashionable, a long list of carmakers from VW to Porsche are rushing 4wd cars to the market.



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The Space Infrared Telescope Facility will be able to study the formation of new stars, planets and galaxies. Congress has yet to give its approval to the SIRTF project.

Each different wavelength reveals phenomena totally unexpected from studies of visible light-some so important that they've definitively changed our understanding of the universe. In the radio band we learned for the first time of quasars, whose enormous amounts of energy seem to require a radically new energy source. And the cosmic microwave background discovered in 1965 gave us physical evidence to explore the Big Bang theory. Gamma-ray bursters may be neutron stars, a state of matter predicted theoretically, but studied for the first time by radio and X-ray astronomers.

All of the cases in which we suspect the presence of a black hole were discovered by X-ray astronomers. Ultraviolet astronomy revealed that our galaxy is filled with superhot gas, and infrared studies, still being assessed, have for the first time revealed stars with discs of dust in orbit around them, much like that from which the solar system formed, as well as galaxies which radiate unprecedented power almost entirely in the infrared.

#### Visible wavelengths

The Hubble Space Telescope, operating over mostly visible wavelength, will be the first great space observatory. Its launch will be the culmination of over a decade of planning and development.

The Gamma-Ray Observatory to be flown in 1988, like HST, will also permit in-orbit maintenance, so it is expected to have a long life in orbit. This mission will be able to observe gamma-ray bursters, evidence of new atomic elements in the remnants of exploded



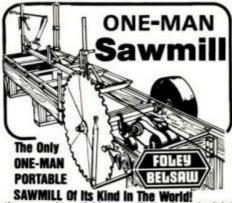
The Advanced X-ray Astrophysics Facility will look for new galaxies. It will also be able to find age-old galactic remnants.

stars, and the structure and chemical makeup of the thin gamma-ray background throughout space.

Recognizing the need for facilities that will also address the infrared and X-ray parts of the spectrum, a number of reports by the National Academy of Sciences over the last decade have urged the construction of long-lived observatories for these spectral bands. The Astronomy Survey Committee in 1982 strongly urged that NASA proceed with what was then called the Shuttle Infrared Telescope Facility or SIRTF, a 1-meter class cryogenically cooled instrument. At that time SIRTF was part of the Spacelab program.

NASA restudied SIRTF and decided to redesign it as a free flier, calling it the Space Infrared Telescope Facility.

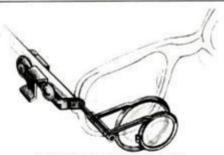
(Please turn to page 160)



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#### STAR VISION

(Continued from page 159)

In this mode, it will be able to study the formation of stars, planets and galaxies. Instruments have now been chosen for SIRTF and work is continuing toward the goal of congressional approval of the project in 1989.

The Advanced X-ray Astrophysics Facility (AXAF) was unanimously voted the highest priority major new program by the Astronomy Survey Committee in 1982. A 1.2-meter focusing Xray telescope, AXAF will be able to study distribution of mass in galaxies and clusters of galaxies.

The combination of GRO, AXAF, HST and SIRTF will make possible high-sensitivity observations. This is dramatically portrayed by the fact that a 24th magnitude quasar will be readily accessible to all of the instruments but GRO, which will be limited to about 20th magnitude. A 24th magnitude star is thousands of times fainter than any object seen from Earth.

#### Finding stars and planets

The infrared radiation recorded by SIRTF alone can penetrate the dark clouds of matter in space where stars are forming. Moreover, since newly forming stars emit most of their energy in the infrared, SIRTF will be a superb tool for finding such stars. With its spectroscopic capability, it will also be possible to study the emission by specific molecules, such as carbon monoxide and ammonia, which will be abundant in such objects. These emissions will yield detailed information about the density and temperature near the newly forming stars, enabling us to reconstruct the formation process.

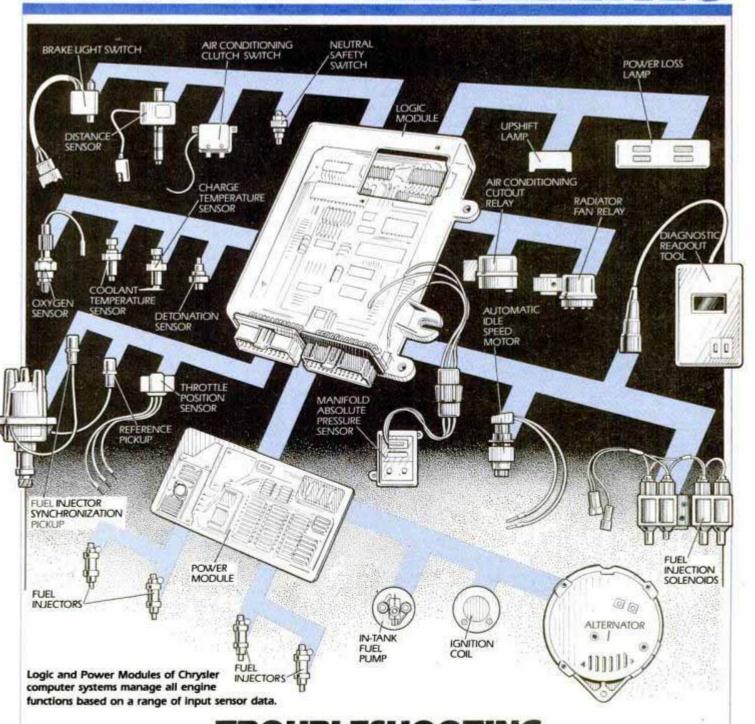
Recent studies of a technique known as super resolution indicate that SIRTF should be able to directly image planets like those in the solar system if they are in orbit around nearby stars. In light of the 1982 discovery by the Infrared Astronomical Satellite (IRAS) of discs of small particles orbiting stars. I am optimistic that planets do accompany other stars, and look forward to when SIRTF finds one.

Cosmologists tell us that in principle we can observe whole galaxies being born, too. Although they believe that galaxies were born when the universe was between about 3 percent and 10 percent as old as it is now, we can take advantage of the finite speed of light to observe now the birth of galaxies taking place at great distances from us. Newly born galaxies should be 100 times as luminous as our own. They should be seen in the infrared band, so SIRTF provides a way to find them.

AXAF also offers a method of finding

(Please turn to page 165)

# SATURDAY MECHANIC



# TROUBLESHOOTING CLIDVSI ED ELIEL IN JECTIO

# CHRYSLER FUEL INJECTION

since 1984, many Chrysler powerplants have been equipped with electronic fuel injection. The single-point throttle-body injection is found on Chrysler 2.2- and 2.5-liter engines and the multipoint direct-port injection is used on turbocharged 2.2-

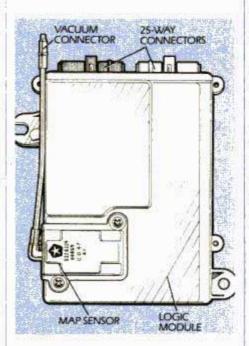
#### BY PAUL STENQUIST

liter engines. Like most contemporary fuel systems, Chrysler's fuel-injection systems are controlled by a computer.

Fuel-injection control function is contained in two separate units: a Logic Module located within the passenger cabin, behind the right kick panel (Fig. 1), and a Power Module located in front of the air cleaner duct (Fig. 2). The Power Module contains the circuits that power the ignition coil and the fuel injector. The Logic Module is the computer. By isolating the high current power supply circuits from the fuel injector, the system is less prone to electrical interference problems.

The Logic Module receives input signals from a variety of sensors, switches and components (see lead illustration). Important sensors include exhaust gas oxygen, coolant temperature, distance traveled, distributor reference and manifold absolute pressure (MAP). On turbocharged multipoint systems, charge temperature, detonation and fuel-injector synchronization sensors are also used.

Armed with the information received from sensors, the Logic Module regulates ignition timing, air-fuel ratio, igni-



Logic Module has two electrical connectors and vacuum hose to intake manifold.

tion coil dwell, emission vapor canister purge, exhaust gas recirculation (EGR), idle speed, cooling fan operation, alternator operation, and—on turbocharged models—boost level. So the computer system is much more than a means of regulating fuel injection, it is a multifeature engine-control system.

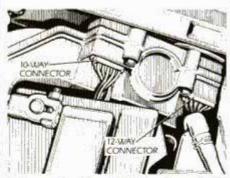
Diagnostic function

Like most other sophisticated engine control systems, the Chrysler Logic Module tests its own input and output circuits while you're driving. If a fault is found, the information is stored in the module's memory. The stored fault codes can be read by using a special diagnostic display tool or by observing a flashing POWER LOSS lamp on the instrument panel.

In addition to providing fault-code readouts, the POWER LOSS lamp will alert the driver to a condition that causes the fuel injection to go into a "limp mode." A limp mode is a special operating program that can sometimes keep the car running even if a major component has failed. If the Logic Module receives an incorrect signal from either the coolant temperature sensor, the charge temperature sensor, the MAP sensor or the throttle position sensor, the POWER LOSS lamp will be illuminated, indicating that diagnostic procedures should be performed as soon as possible.

Chrysler sells a diagnostic readout tool, part No. C-4805, that simplifies the reading of codes. PM readers can order the tool from Hickock Diagnostic Test Tools, (216) 541-4467. For '85 and '86 models, the tool will also test the operation of various system components by actuating them. On 1986 models only, the tool provides voltage readouts for the testing of suspect sensors.

For some Saturday Mechanics this tool, at \$249, is prohibitively expensive, but the component actuator, sensor voltage and switch tests for the '85 and '86 model vehicles cannot be performed without it. If you own an '85 or '86 model and you're a serious driveway technician, you should consider this tool



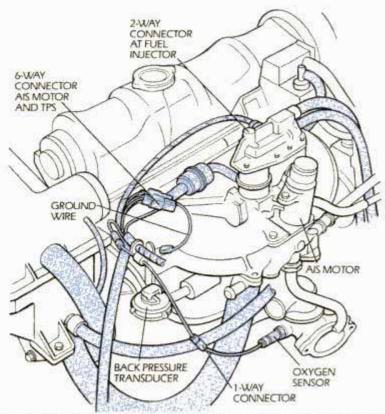
2 Power Module with high voltage circuits is mounted near air cleaner duct.

a potential money-saving investment.

Even without it, home mechanics can perform all of the visual checks that Chrysler recommends, and they can read the fault codes by observing the flashing POWER LOSS lamp. Chrysler service experts report that most problems can be traced to poor wiring or hose connections. The visual checks that follow can help you locate these common problems.

#### TBI visual inspection

Begin by locating the throttle-body unit. Make sure the vacuum connections on the front and rear of the unit are secure and not leaking. Check the vacuum connection and the 2-way electrical connector at the purge solenoid



3 Throttle-body fuel injector (TBI) is where the carburetor would normally be. Backpressure transducer is mounted near the exhaust manifold. AIS motor and oxygen sensor are nearby.

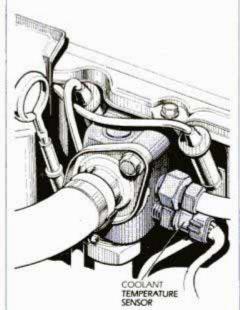
# SATURDAY MECHANIC

and the hoses on the vapor canister. Make sure the hose from the PCV valve is attached to the intake manifold vacuum port. Locate the backpressure transducer (Fig. 3) and make sure its vacuum hoses are secure.

Under the throttle body, you'll find a couple of hoses that join an exhaust air heater to the air cleaner. Make sure they're secure. Then locate the MAP sensor, which is attached to the Logic Module in the passenger cabin (Fig. 1), and make sure its vacuum hose is attached. While you're looking at the Logic Module, make sure the 25-way white connector is fully inserted into the white socket, and the 25-way black connector into the black socket.

Locate the Power Module, which you'll find in front of the air-cleaner air duct, and make sure both the 12-way and 10-way connectors are fully insert-

DIAGNOSTIC FAULT CODES				
CODE FAULT DESCRIPTION				
11:	Engine not cranked since battery was dis- connected			
12	Memory standby power recently lost			
13	Map sensor circuit (vacuum)			
14	Map sensor circuit (electrical)			
15	Vehicle speed sensor circuit			
16	Loss of battery voltage sense; (84) not used			
17	(all '84, '85 TBI) Not used; ('85 turbo) Knock sensor; (all 1986) Engine running too cool, possible thermostat problem			
21	Oxygen sensor circuit			
22	Coolant temp sensor circuit			
23	Charge temp sensor circuit; (all TBI) not used			
24	Throttle position sensor circuit			
25	AIS motor driver circuit			
26	('84) not used; ('85) peak fuel injector current not reached); ('86 TBI) fuel injector driver circuit; ('86 turbo) injector one circuit			
27	('84) not used; ('85) no current to logic module, fuel injector circuit; ('86 turbo) injector two circuit			
31	Purge solenoid circuit			
32	Power loss lamp circuit; ('86) not used			
33	AC cut-out relay circuit			
34	EGR solenoid circuit; (all TBI) not used			
35	Fan control relay circuit			
36	Wastegate solenoid circuit; (all TBI and '84 turbo) not used			
37	('86 TBI w/manual trans) shift indicator lamp; ('86 turbo) Baro read solenoid circuit; ('84, '85) not used			
41	Charging system, excessive or no field current			
42	Auto shutdown circuit			
43	ignition spark interface, logic module to power module; ('84 TBI) power module interface for spark and fuel			
44	Battery temperature circuit; ('84) incompati- ble prom			
45	Overboost shutoff; (all TBI) not used			
46	Battery voltage too high			
47	Battery voltage too low			
51	Fuel mixture lean, closed loop fuel system latched up; ('84) fuel mixture too rich or too lean, closed loop fuel system latched up			
52	Fuel mixture rich, closed loop fuel system latched up; ('84) logic module processor memory failure			
53	Logic module prom memory failure			
54	Distributor synch pickup circuit; ('84 TBI) Logic module peripheral memory failure; ('85, '86 TBI) not used			
55	End of message, no more fault codes in			



4 Coolant temperature sensor is screwed into water box behind thermostat housing.

ed into their sockets (Fig. 2).

Check the connections at the AIS motor and the throttle position sensor (TPS), the 2-way connector at the fuel injector, and the 1-way connector at the oxygen sensor (Fig. 3). Locate the coolant temperature sensor in the water block behind the thermostat housing and verify that its 2-way connector is attached (Fig. 4). Locate the distributor and check its 3-way connector.

Finally, chock the wheels, place the transmission in PARK or REVERSE (manual transmissions), apply the parking brake, raise the car and support it on jack stands. Then crawl underneath and make sure the 2-way connector is attached to the distance sensor, located right behind the speed-ometer cable connector on the transmission.

#### Multipoint inspection

Locate the throttle plate unit that admits air into the manifold and make sure its vacuum hoses and 6-way electrical connector are secure. Make sure the ground wire on the injector wiring harness is attached to the intake manifold at the point where the engine-toframe ground strap is attached. Find the detonation sensor and charge temperature sensor on the intake manifold and make sure their connectors are attached (Fig. 5). Then check the 2-way connectors at each fuel injector. The distributor is joined to the wiring circuit by two 3-way connectors (Fig. 6). Make sure both are firmly attached.

Locate the oxygen sensor connector

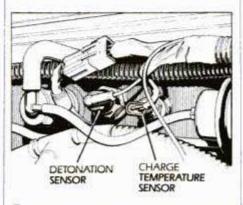
in the exhaust manifold and make sure it's in place (Fig. 3). Then check both connectors at the Power Module and the two connectors that join the harness to the EGR and purge solenoids. Check the water temperature sensor, which you'll find in the water box behind the thermostat housing (Fig. 4).

Check the vacuum hose connections between the PCV valve and the turbocharger (Fig. 7) and between the vacuum source and the fuel pressure regulator. Examine the vacuum connections between the vacuum source and the EGR, purge, waste gate and barometric-read vacuum-control solenoids (Fig. 8). The solenoids are under a shield on the right fender well. Pull the shield forward (toward the engine) to remove it. Then check the hose connections between the purge solenoid and the charcoal canister.

Check all vacuum connections in the EGR system, and electrical and fuel line connections in the fuel pump circuit. Make sure both connectors at the Logic Module are plugged in tightly and that the MAP sensor vacuum connection is secure (Fig. 1). When all other visual checks have been completed, make sure the 2-way electrical connector is securely attached to the distance sensor on the transmission (see TBI visual inspection at left).

#### Reading diagnostic codes

The Chrysler computer system is programmed to monitor various circuits of the engine control system. When a problem is sensed, a fault code is stored in the Logic Module. The technician can read these codes by watching the POWER LOSS lamp on the instrument panel or by using Chrysler's diagnostic readout tool. If the problem that provoked the system to record a fault code is repaired or simply ceases to exist (as in the case of an intermittently loose connection), the recorded



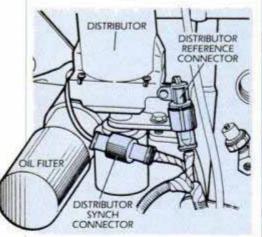
5 Check connections on sensors mounted on intake manifold of turbo engines.

# SATURDAY **MECHANIC**

fault code will be canceled after 30 on/ off cycles of the ignition key.

To display fault codes, start the engine, cycle the air-conditioning switch and move the transmission shift lever through the gears. Then turn off the engine. Switch the ignition on, off, on, off, and on again within five seconds without starting the engine. The POW-ER LOSS lamp should then light for two seconds and switch off, indicating that the bulb is okay. Following this, any fault codes stored will be displayed by the flashing lamp.

The codes are displayed one digit at a time. For example, two flashes of the



6 Make sure connectors in wiring harness at the distributor are securely attached.

lamp, followed by a brief pause, followed by four flashes of the lamp, indicates a code 24. The diagnostic fault code chart shows that code 24 indicates a problem in the throttle position sensor circuit. If other fault codes are stored, they will be presented as well. The pause between codes will be longer than the pause between digits. After all codes have been transmitted, code 55 will be displayed.

For the technician with the Chrysler Diagnostic Readout Box, the codes will be presented on a digital display after the ignition switch has been cycled as described above.

#### Servicing fault codes

Once fault codes have been identified, clear them by disconnecting the battery ground strap. Make sure the ignition switch is turned off before you do so. Then reconnect the battery and drive the car. Shut off the engine, reenter the diagnostic mode and see if the same codes are still displayed.

If the codes have disappeared, either you fixed them during the visual checks or else the car hasn't been driven long enough for the condition to appear.

If the fault codes you previously recorded are repeated, you have to determine what provoked them. Repeat the part of the visual check that relates to that circuit. If you can't find anything out of sorts, you'll have to dig deeper.

Replacing a component is not always the solution, as the problem could be in the wiring or in the Logic Module itself. Your best bet is to examine the wiring harness and connectors very carefully before you replace a part. If you can't find anything wrong with the wiring and you don't have a Diagnostic Readout Box, you'll have to get professional help or else take a chance and replace the sensor or switch in question.

#### Switch test

If you have Chrysler's Diagnostic Readout Box and own an '85 or '86 model, you can perform the switch and actuator tests. These will help pinpoint problems and test some components whose failure won't be indicated by a fault code.

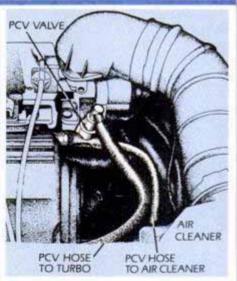
The switch test must be done while you're in the diagnostic mode, immediately after code 55 indicates the end of the fault-code cycle. To perform the switch test, step on the brake, move the gear shift selector, and turn the air conditioning and a/c fan on. The digital display should change its numbers each time a switch is activated and released. The display numbers will alternate between 88 and 00.

If the switches are not being monitored by the Logic Module, the display numbers won't change. This indicates a failure in the switch or the circuit that joins it to the Logic Module.

#### Actuator test

Depress the actuator test mode (ATM) button on the Diagnostic Readout Box while code 55 is being displayed. Eleven different actuator tests will follow, and you can see if the component that's supposed to be actuated is, in fact, operating. As each actuator test is performed, the number corresponding to that test (listed in the factory shop manual) is displayed on the Diagnostic Readout Box. Each actuator test will continue for up to five minutes or until the ATM button is pressed again. If you want to perform one particular actuator test, hold down the ATM button until the desired test code appears.

Actuator test number 01, for example, causes the ignition coil to produce a spark every two seconds. If the coil fails to do so, either it or the wiring that joins it to the Logic Module is defective.

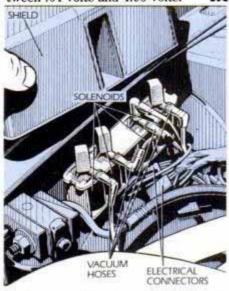


7 Check all vacuum hose connections between PCV valve, turbocharger, air cleaner.

#### Sensor voltage displays

On Chrysler's 1986 engines, the Diagnostic Readout Box can help you troubleshoot sensors by providing a display of sensor output voltage. Move the switch located next to the display screen to HoLD while the various actuator tests are being performed. This will cause the Diagnostic Readout Box to display a voltage for a particular sensor (listed in the factory shop manual). Each actuator mode provides a different sensor voltage readout.

For example, while in actuator test 01 (ignition spark), switching the Diagnostic Readout Box to HOLD will cause battery temperature sensor voltage to be displayed. This information is displayed in units equal to volts multiplied by 10. The shop manual indicates that an acceptable readout would fall between .04 volts and 4.96 volts.



8 Check solenoids' vacuum and electrical connections under shield on fender well.

#### STAR VISION

(Continued from page 160)

newly forming galaxies. The same massive stars that make young galaxies so luminous will evolve rapidly and finally blow up as supernovae. The shells thrown out in these explosions will collide and be heated to a billion degrees. Even with large red shifts, these X-rays will be in the AXAF band, and it has been calculated that newly forming galaxies can be detected by AXAF even if the radiation left them when the universe was only 10 percent as old as it is now. If newly forming galaxies are not detected by AXAF or SIRTF, a major revision will be called for, for evolution of the galaxies is a key feature predicted by big-bang models of the expanding universe.

#### Invisible matter

For more than 20 years, astronomers have known there's a lot of matter in the universe that's not readily visible. The stars and gas within galaxies are observed to be moving at such high speeds that the gravitational forces exerted by the matter which has been observed are completely inadequate to contain them. Current estimates are that for every gram of visible matter in a galaxy, there are about 10 grams of matter hidden from us. This invisible matter, whatever it is, goes part of the way toward making up the total amount of matter predicted by particle physicists, but by no means all of the way. On a scale on which the total amount predicted is 100, the visible matter in galaxies constitutes about 1 unit, and the invisible matter in galaxies constitutes about 10 units. The other 90 units, if they are present at all, must be located between the galaxies.

The recent discovery of a brown dwarf—a star with such a low mass that nuclear reactions have not ignited inside it—suggests that the matter within galaxies may not be invisible after all. SIRTF can detect several hundred such brown dwarfs if they are as numerous as would be required to constitute the hidden matter in our galaxy.

It may be surprising that AXAF will also provide a powerful method of searching for faint stars (but not as faint as those accessible to SIRTF). Although such stars are cool and therefore emit no X-rays from their surfaces, they are surrounded by hot envelopes with temperatures measured in millions of degrees, much like the corona of our sun. AXAF should be able to detect faint stars through their coronal emission if they are numerous enough to make a substantial contribution to the mass of our galaxy.

Even if the hidden matter in galaxies

turns out to be normal matter, this would not account for the other 90 units of matter that are present if the particle physicists are right. It is an important aspect of the new theories of particle physics that they allow for strange forms of matter that haven't yet been detected in the laboratory. Could such strange matter lying between the galaxies constitute the missing 90 units these theories predict? Proving or disproving this proposition presents a formidable challenge to astronomy, as strange matter is expected to interact with normal matter almost solely through its gravitation.

#### **Gravitational effects**

The trick, then, is to search for gravitational effects that can't be accounted for except by a large amount of matter between the galaxies. Here AXAF may be able to play a role, by revealing the presence of very hot gas between the galaxies which can be used to trace gravitational fields.

AXAF will also be used to carry out another experiment with important implications for the hidden matter problem. Soviet astrophysicists long ago pointed out that if the hot gas in a cluster of galaxies is observed by both radio and X-ray telescopes, one can infer the distance of the cluster independently of other determinations. If this information is combined with the red shift of the cluster, one can deduce the large-scale geometry of the universe, which is directly related to the total amount of matter in the universe.

If history is any guide, the most exciting discoveries to be made by SIRTF and AXAF are those we cannot now predict. Among the speculative possibilities are:

An infrared dwarf star about a lightyear distant, which proves to be orbiting the sun, and responsible for periodic and global extinctions of species.

"Shadow galaxies" in space, composed entirely of strange matter, and revealed by the X-rays emitted by the hot gas attracted to them.

 An infrared planet orbiting a nearby star, whose period is identical to that of some unusual radio signals from that part of the sky.

Black holes near the sun, having about the mass of small stars, and detected by X-ray emission of the interstellar gas they are accreting.

"Cosmic strings" moving at the speed of light through our galaxy, and revealed by X-rays.

A dark cloud of interstellar matter nearby, which proves to be headed for the solar system.

When SIRTF and AXAF join HST and GRO in NASA's family of observatories, the potential for discovery will be enormous.

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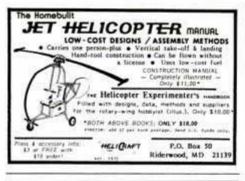
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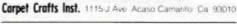




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#### LONG-TERM CAR TESTS

(Continued from page 88)

the floor and the dashboard is down at the knees. That's all a result of the exterior package shape, and it does provide generous cargo capacity. We'd like to see a tilt steering wheel option.

You'll not have to suffer to drive this little 4x4, as power windows, door locks and air conditioning are all available, and power steering is standard on 4wd versions. Even decked out with all that luxury, our Vista comes in at a reasonable \$11,877. At this point, all we can say is, let it snow!—N.S.M.

#### Merkur XR4Ti

In our last episode (PM Long-Term Car Tests, page 87, Dec. '85), our Merkur was about to go into the dealer's service department to address a longish list of complaints—power steering fluid loss, high oil consumption, clogged windshield washer and a leaking windshield. We also asked them to check the top bolts on the manual transmission, since we suspected a leak back there, too.

Imagine our surprise when these repairs kept the car off the road for six weeks! Although Ford had assured us that an "adequate" supply of parts existed in the U.S. for this German-built hot rod, the dealer had a long wait to get a gasket for the transmission and grease seals for the front wheel bearings, despite a lot of pressure from the local public relations office.

The work, all covered by the warranty, must have cost Ford a pretty penny! It seems that the steering rack corroded and the pits had ruined the seals. Because new seals were still not available, the dealer replaced the entire power rack and pinion steering assembly. When the grease seals finally arrived, he replaced the front brake pads and the rotors, rather than machining them to eliminate the pedal pulsation. The front end was realigned and all four wheels rebalanced. Although he waited for the new transmission gasket to arrive, he might have simply retorqued the top bolts, which he found only finger tight! He also unkinked a windshield washer line and sealed the leak in the windshield. We never saw a bill.

Our complaint that the engine used a quart of oil every 1000 miles was dismissed by the explanation that "Ford doesn't define that as excessive consumption for this engine" (the 2.3-liter turbo Four). We know that some turbos are hard on oil, but it makes you wonder how much oil this unit will be burning at 50,000 miles.

Anyway, we were glad to get the car back because, despite all the bugs, it remains the favorite car in our fleet, and the one most people want for any given weekend. Its combination of performance and practicality is unmatched. The 4000 miles since the service have been trouble-free.—W.H.

#### **Chevy Astro**

Only a year ago, minivan buyers had but one choice in the marketplace— Chrysler's Caravan and Voyager.

Compared to the Chryslers, Chevy's Astro (and the GMC Safari) is far more truck-like. The Chrysler has a low, cartype driving position and a noticeably longer hood to contain the front-wheel-drive package. Our Astro, with a stubby nose and rear-drive layout, is a more conventional design as vans go.

What really separates it from the competition, though, is the availability of a powerful and durable 4.3-liter V6, giving it the ability to haul heavy loads without strain. Truthfully, we've often wished the Astro was smaller and more convenient in everyday use, but for a mid-sized cargo box, it never lacks the ability to lug all the payload you can stuff in it.

Our problems since last report have been small but numerous. The electric door locks only work 3/3 of the time, on the other occasions refusing to activate from the front door buttons. The driver's shoulder belt continually refuses to self-tighten when slack develops, the only solution being to unclip it at the lap buckle, let it entirely reel back in and then refasten it. We love the 27-gallon gas tank for its 300-mile highway range, but the gas gauge has at times mysteriously locked itself onto the FULL position in mid-tank and forced us to gauge fillups by the trip odometer. The oil pressure gauge also has acted quirky, darting to the top end of its scale even at idle speeds. Also, the window latch on the sliding-door's glass works itself open regularly, adding a rattle we don't need.

The second and third rows of seats have proven convenient to remove and replace, with only their bulk preventing it from being a 1-person, 10-second job. I've done it alone, though getting the bench up on my back cost me a pulled shoulder muscle and reminded me that I'm not the kid I used to be.

Of prime concern to us for future usefulness is the lifespan of the 4-speed automatic transmission, which dwells a long time in Low on takeoff and seems to rev too high for the road speed. It lurches on each shift and doesn't feel terribly solid. Thus far it's never failed us, but it doesn't inspire confidence.

At this point, our 4200 miles accumulated on the Astro since last report have given an average 15.5-mpg fuel consumption. All complaints are minor, and the dealership will get a crack at rectifying them. Otherwise the Astro has met all of our requirements with reliability.—N.S.M.

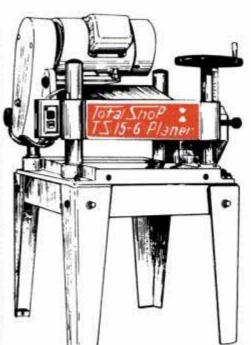
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(Continued from page 98)

obstructions, the invisible kind could prove a problem to reception. The main offender is called terrestrial interference (TI). It's caused by microwave telephone transmissions, and could cause poor signal reception in some areas during part or all of the day.

Though it's possible for most people to find a dish location and install the antenna themselves, testing for TI is beyond the ability of most homeowners. Moreover, terrestrial interference is very directional. Don't assume that because your neighbor's site is free of it, yours will be, too.

It's for this reason that we strongly recommend hiring a professional to do your site survey. Besides saving you the trouble of locating a dish site, the cost includes a TI test. Competent satellite dealers are aware of microwave interference in their area, have the equipment to test for it and the proper filters to remedy it. In the case of extreme TI, they'll tell you that a satellite TV installation isn't feasible.

If you're fortunate, your dish site will be close to the house, thereby avoiding long cable runs. If a distant location is necessary, use a thicker gauge wire than what's specified, in order to avoid signal degradation.

No matter how long, you'll have to dig a trench to conceal the cable. Check your local building codes for outdoor wiring requirements concerning trench depth. PVC tubing makes a good conduit if your trench is at least a foot deep. If shallower, use metal tubing to protect against the lawnmower and creatures with a taste for cable insulation.

Dishes come in a variety of shapes and sizes. Some dishes, such as those made of fiberglass, are 1-piece units. Others are comprised of multiple sections or "petals" that must be assembled. Either way, a dish installation is not a

1-man job. Two or three people may be required to lift the dish onto its pole. And, given the multitude of nuts and bolts that must be installed, the more hands doing the job, the better.

Generally, instructions for assembling and grounding the dish are clearly explained. But you ought to remind helpers of some fine points. Once in the house, for example, don't cut or crimp wires with a staple gun in an effort to be neat. Crimping or cutting can result in some signal loss. Instead, moor your cable to moldings with coaxial cable clips of the correct gauge.

Laying the foundation for the pole is as critical as dish assembly. Do this before mounting the dish. There is no formula for hole depth versus dish size, but generally, the taller the pole, the deeper the hole.

In normal soil, dig the foundation at least 4 ft. deep by 2 ft. in diameter. Sandy soil might require a wider configuration-say 2 ft. deep by 4 ft. in diameter. Quick-drying cement available in most home improvement shops is perfectly adequate. Before pouring the cement, though, bore a half-inch diameter hole through a part of the pole that's embedded in concrete. Slide a 12- to 18-in.-long metal rod through the hole. This will prevent the pole from twisting in the event of high winds. In cold weather areas, remember to set the foundation below the frost line, to avoid an icy upheaval.

In every case, the pole must be kept perfectly plumb while the cement is hardening. If the pole shifts, you won't be able to tune the dish accurately. Due to the depth of the hole, the pole is not likely to move. But to be safe, place leveling stakes around the pole to prevent shifting. Long strips of plywood will do.

If every procedure is followed correctly, tuning in to satellite television should be a breeze.

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Build it yourself from subassemblies. No wiring necessary (just plugs together). Hook-up diagram included. Includes: Keyboard, 2 cassette digital data drives, 2 game controllers, power supply, all memory boards, and one cassette. Is capable of running CP/M, has built-in

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13.2V @ 1.65 AH Contains 11 C cells. For model boats, toys, etc.

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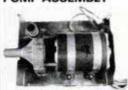
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Variable output from 20-25VDC Input: 105-125; VAC @ 60Hz Maintains constant voltage output between 5 & 6 amps at rated input. AC fuse protection. Size: 4" x 8 ½" x 7 ½" Mfr - Acme PS59134

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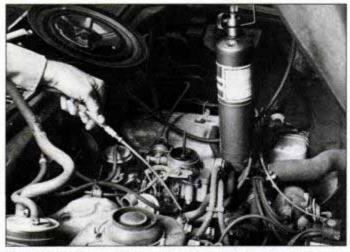
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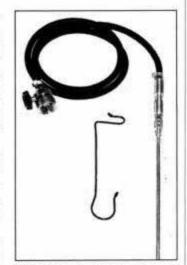
# NEW/AUTO

# **Chief of detectors**



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Kit has tank adapter, hanger, flex hose and aluminum probe.



Toggle Cords loop together like a hair braid to hold in cargo.

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Drop-light reel hangs out of the way, keeps cord neatly stowed.

#### Pump-up scissors

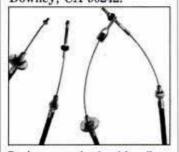
Scissors jacks are becomming popular as original equipment in many cars because they're light and fold to a compact size. Trouble is, they are often painfully slow because of their screw-type raising mechanism. Norco Industries gets credit for devising this hydraulic scissors jack, which expands from 5 to 15 inches and can raise up to 1760 pounds by cranking the lever. The top saddle is shaped to fit typical rocker panel rails. The jack lists for \$62 from Norco Industries Inc., 365 West Victoria St., Compton, CA 90220.



Scissors jacks are handier, especially with faster, more powerful hydraulic lifting mechanism.

### Shifty fix

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Replacement clutch cables allow manual linkage adjustment.

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Grease-cutting aerosol speeds job when replacing C.V. boots.

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# REPAIRS WALLS IN MINUTES ENDS SPACKLING FOREVER CRACKS NEVER COME BACK!





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APPLY—Self Adhesive WALL MATE covers damages instantly — no spackling or "plugging up" deep holes



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This amazing new patented polymer transparent film is so thin (only 3/1000th of an inch) that repairs are invisible when painted or wall papered.

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#### WALL MATE REPAIRS CRACKS, HOLES AND DENTS FOREVER!

How often has that wall crack above the door frame opened up again after you spent hours spackling, sanding and repainting? Has a door knob banged against the wall leaving an ugly dent or hole or your kids bike slammed into the wall gouging it? How about those gaping holes left by toggle bolts, mollys and picture hooks? Now you can fix this in just minutes with WALL MATE.

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## AVAILABLE IN TWO SIZES TO SOLVE ANY WALL PROBLEM

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amps @ 240 volts. List \$1174.00. Item# 16404 \$599.00

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# **NEW/HOME**

# Panoramic patio door

The Panorama patio door combines the strength of a steel door with the look of wood. The model shown features 15 hand-beveled, leaded-glass panes per door. The left door opens, the right one is fixed. The lead strips are true, structural members.

The door's body is 20gauge sheet steel with an insulated core. Its inside face is veneered with ash. birch or oak, its outside face is painted with primer. As shown, the door costs \$1500 at home centers and building supply stores. Write Perma- Panorama steel and wood doors Door, 9017 Blue Ash Rd., Cincinnati, OH 45242.



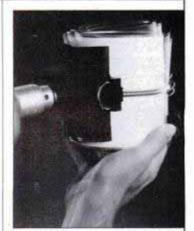
feature triple-glazed, leadedglass with beveled panes.

that pulls up spills underneath it and to the side, so it can clean up to the edge of baseboards and into corners, and a swivel handle to allow access to difficult areas.

Quick Up costs about \$50 at hardware and department stores. For more information, write the Eureka Co., Bloomington, IL 61701.

#### Phone home

Travelers or vacationers can phone home in cold weather to check if their home's heating system is working properly with Phone-Stat. The device plugs into a modular phone jack or wires into systems without jacks. Set its thermostat for any temperature between 30° and 110° F.

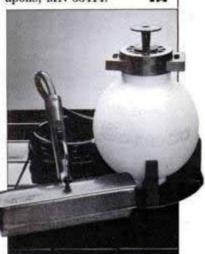


Use your portable electric drill to mix paint, without the mess, using the paint shaker.

It's sold at hardware and automotive stores. Write Vermont American Tool Co., Box 340, Lincolnton, NC 28093-0340.

#### Pressure painter

This power paint roller (\$40) supplies its own pressure. Fill its 1-gal, tank with latex or oil-based paint. Screw on the cover, which has a pump built in, and pressurize the unit by pressing the pump handle 25 times. It's designed for simple disassembly and cleaning, its maker claims. The Padco system is sold at hardware and paint stores. Write Padco Inc., 2220 Elm St. S.E., Minneapolis, MN 55414.



Padco's power system gets its pressure from a built-in pump paint flows smoothly.

#### Quick vac

Eureka's Quick Up cordless vacuum is designed to pick up small, dry spills. It hangs on a wall-mounted recharging bracket for easy access.

Unplug the 3.8-pound vacuum from the recharger and it's claimed to give 15 minutes of continuous cleaning. According to the manufacturer, it requires two to

three hours to recharge if used for five to 10 minutes and it recharges overnight if used for 15 minutes. The unit has a removable dust cup. To empty, unclip it and dump its contents. The vacuum's filter is reusable.

Measuring about 4 ft. long, this vacuum is the same size as a standard upright. Included are a nozzle



To empty vacuum, unclip and remove the built-in dust cup.



The cordless, rechargeable vacuum's handle swivels so it can reach into difficult areas.



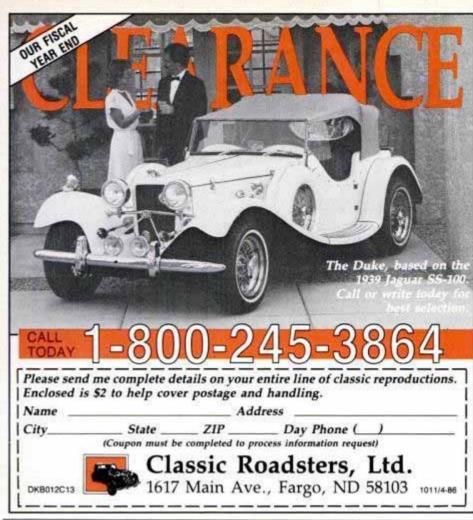
Call home to check that your heating system is working properly with Phone-Stat.

To check your heating system, dial your phone number. The device gives off a busy signal if the temperature has dipped below the preset level, alerting you to the danger of frozen pipes.

The device is available by mail from Phone-Stat for \$89.95 postpaid, Box 18035g. Lansing, MI 48901.

#### Paint mixer

This paint shaker (\$5) was designed to do away with messy stirring sticks. Chuck it in an electric drill and wrap its spring around the can. Turn on the drill and hold the can's bottom while it mixes with 5000 vibrations per minute. It fits half-pint to one-quart cans and holds spray cans, too.





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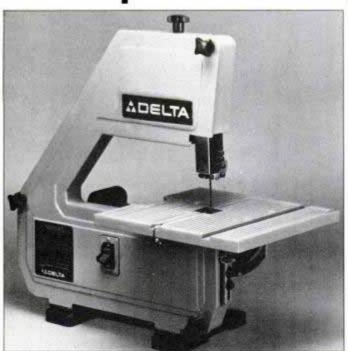
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# NEW/WORKSHOP

# Benchtop band saw



Delta's 10-in. band saw fits on a workbench. It has a table that tilts in two directions and it also has a 3-in.-thick cutting capacity.

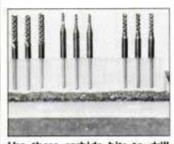
This 10-in. band saw (\$158) is designed for the do-it-your-selfer. It can saw through a 3-in.-thick board and can cut to the center of a 20-in.-wide panel. Yet, it's small enough to fit on a workbench, measuring 12¼ in. wide x 22½ in. high x 23¼ in. deep. The diecast aluminum table tilts 45°

right and 10° left. Features include a ½-hp motor that delivers 1720 rpm and a removable, locking on-off switch. It's sold at hardware stores and home centers. For more information, write Delta International Machinery Corp., 246 Alpha Dr., Pittsburgh, PA 15238.

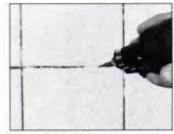
#### Carbide cutter bits

These carbide bits are for cutting and degrouting ceramic tiles or drilling other tough materials, like brick or steel. They come in  $\frac{1}{16^-}$ ,  $\frac{3}{32^-}$  and  $\frac{1}{16^-}$  in. dia. Each  $\frac{1}{12^-}$  in. long bit has a  $\frac{1}{12^-}$  in, long cut-

ting edge and can be used in either drills or routers (with the free router bushing). A set of three costs \$26 postpaid (\$10.90 each postpaid) from Truebite, 245 Anderson Rd., Vestal, NY 13850.



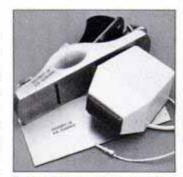
Use these carbide bits to drill and cut many hard materials.



The carbide bits can be used to cut or degrout ceramic tile.

#### **Tool marker**

Identify your metal valuables with the Etch-O-Matic marker (\$52.50 postpaid). Rub the electric marker over a stencil with your identification typed on it. An electrochemical solution inside the marker etches through characters on the stencil. Write Woodcraft Supply Corp., 41 Atlantic Ave., Box 4000, Woburn, MA 01888.



Etcher comes with enough solution to identify 2000 tools.

#### Roller sharpening guide



Roller sharpening guide will hold tools up to 5/16 in. wide.

This honing guide (\$6.50 postpaid) was designed for sharpening small carving tools. It has two openings to match honing angles. To use, place the carving tool in the guide so that, when tipped forward, its bevel meets the stone at the correct angle. Tighten the screw, then roll the guide along the stone to hone the tool's bevel. Remove tool and hone its back surface. It's sold by Woodcraft Supply Corp., 41 At-lantic Ave., Box 4000, Woburn, MA 01888.

#### Portable planer kit

Joint and plane boards, cut bevels or remove saw marks after ripping lumber with

this portable power plane designed for the home craftsman. Its 4-amp motor delivers 16000 rpm, which means that the 2-blade cutterhead makes 32000 cuts per minute. The blades are also removable for sharpening purposes. The 31/4-in.wide planer comes with a plastic carrying case, adjusting and blade-setting tools and a fence for edge-jointing. The kit costs about \$140

Write to Makita USA Inc., 12950 East Alondra Blvd., Cerritos, CA 90701.

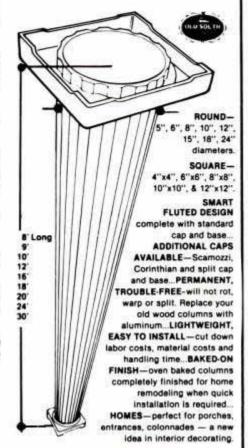


at hardware stores. The 31/4-in. planer kit comes complete with and home centers. accessories and a handy carrying case.

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FORD 144 1/5 206 250 260 269 302 2519 400 252 250 2519 400 252 250 2512 429 429 429 460 252 460	61 M 94 M 94 M 94 M 94 M 94 M	84.00 114.00 114.00 124.00 124.00 124.00 124.00	TH 50 UL 50 UN 50	154.00 154.00 164.00 164.00 154.00 154.00 154.00	175.00 126.00 106.00 126.00 176.00	134 00 104.00 104.00 104.00 104.00 104.00	754 50 195 50 279 50 195 50 195 50 229 50	294.9 218.8 248.9 279.0 366.9 278.0
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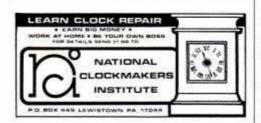
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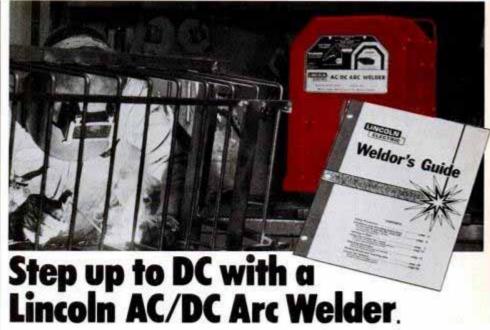


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# — **- FIRSTHAND** DRIVE REPORT**-** —

# HYUNDAI EXCEL

America's first Korean import takes aim at the econocar market.

BY STEVE PARKER West Coast Editor

hen a new car company hits American shores with a powerhouse executive team—the top four members are all Toyota alumni—vowing to sell cars for under \$6000, it's time to take notice.

Hyundai, the largest industrial corporation in South Korea, has been selling cars in Canada for two years and is setting its sights farther south. What American consumers will get is an influx of value-heavy, low-priced imports—100,000 the first year—in a poorly populated segment of the import car market that could use the excitement of a new competitor. At a time when the Japanese are selling larger and more expensive cars, leaving the bargain-basement sales to light truck buyers, Hyundai offers a ray of hope.

Hyundai (pronounced hun-day) wants to go head-to-head with the Colt, Sentra, Sprint, Civic, 323, Tercel and Mirage. The initial Hyundai offering, a front-wheel-drive model dubbed Excel, is on sale at 100 dealers in 31 states.

A single-overhead-cam 1468-cc engine supplies 68 hp from a 9.5:1 compression ratio. The Excel is slow to accelerate, and an annoying throttle lag provided even less of a chance to make use of what power the car does have. The Excel cruises easily at freeway speeds, but don't expect to zoom over even small hills at more than 55 mph.



Interior has basic plastic dash, but plenty of room and very comfy seats. A 5-door hatch (top) and 4-door sedan are initial models.

The car simply can't do it.

Handling is secure enough for average maneuvers. High-speed lane changes showed quick turn-in from the rack-and-pinion steering, but the car's recovery was slow and lots of body roll discouraged too many attempts. It felt like the wheels had turned, but the body wanted to keep on going. Braking was adequate with the disc-drum setup. MacPherson struts in front and coil springs in the rear provided a fairly quiet ride, but the amount of vibration transferred into the passenger cabin was annoying. Perhaps an out-of-balance tire was the culprit. Hyundai should also check out fumes that entered our passenger compartment, ostensibly from an overabundance of preservative sprayed on metallic parts in readying the car for its ocean voyage from Korea.

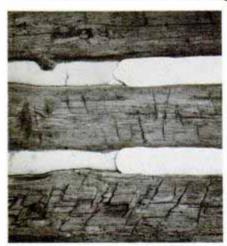
Hard cornering is not the Excel's forte, and the throttle lag didn't add to our confidence level when we wanted to throw the car into a turn at high speeds.

The L and GL level models come with a standard 4-speed transmission. The GLS comes with a 5-speed, which can be ordered for the lower levels, as can a

(Please turn to page 183)

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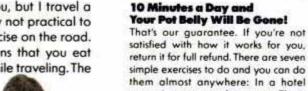
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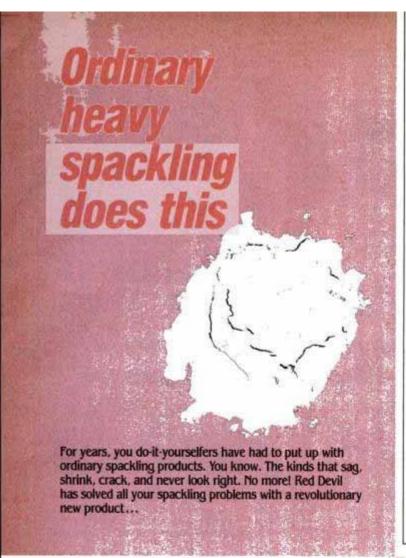
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THE PM REPORT CARD		
1986 HYUNDAI EXCEL	GRADE	COMMENTS
Acceleration	С	Throttle lag robs an already overtaxed powerplant
Handling	B-	Somewhat darty and occasionally unpredictable
Braking	В	Adequate, consistent, with good progressive feel
Steering	В	Good road feel
Transmission	В	Loose feel to shift linkage
Ride	B-	Excessive vibration a sore point
Fuel economy	Α	33/45 mpg city/highway estimates outstanding
Seating	B+	Comfortable and roomy front and rear; nice upholstery
Vision	B+	Only slight over-shoulder obstructions
Gauges/controls	B+	Large and easy-to-read; tach on GLS only
Ventilation	B-	A/C worked poorly in our prototype
Noise @ 55 mph	Α	Surprisingly quiet
Cargo capacity	B+	Large covered storage area; rear seats fold down
Engine serviceability	B+	Simple, straightforward and accessible
Fit and finish	В	Good for a new entry

#### HYUNDAI EXCEL

(Continued from page 181)

3-speed automatic. Transmission linkage was somewhat vague, but the 5-speed in our test car held up well to some pretty hard usage.

The car's overall construction is good for this price range. The hatchback weighs 2127 pounds, the sedan about 25 pounds more. This 1-ton rides on Goodyear Corsa GT P155/



Technical help from Mitsubishi may account for Excel's Japanese appearance. Hyundai is now the No. 1 import in Canada.

80R13 all-season radials. Lower-profile P175/70R13s are an option, as are aluminum wheels.

The 13.2-gallon fuel tank offers outstanding range with Hyundai's estimated 33/45 mph figures for city and highway driving. EPA figures for the Excel were not available at press time.

The Excel will be available in three versions before 1986 is over—a 4-door sedan, 5-door hatchback and 3-door hatch. The 5-door, 4-speed hatch made available to us will be the

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Stowaway Picnic Table—A clever one-piece design made from long-lasting redwood. After the picnic season, just fold it up for convenient indoor storage. Easy to build. (PL-1716—\$5.95)



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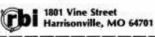
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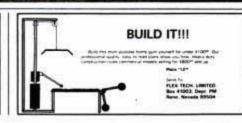
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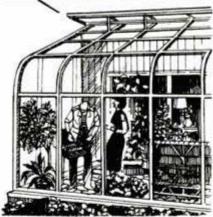
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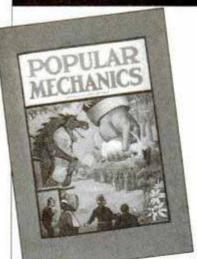
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POPULAR MECHANICS • APRIL 1986 1

## TIME MACHINE

75 YEARS AGO: April 1911



Constructing a giant.

Stage giants

The height of the summer season in English theater was pantomime. And in 1911, the rage was a unique production of Jack And The Beanstalk in which the characters walked and wobbled about the stage on 10-ft. stilts. The giant's head was constructed of plaster and sat atop the shoulders of a man on stilts with a bird cage harness stabilizing the whole affair. Today, pantomime is still a popular summer pastime in England, and props are still as low tech as they were 75 years ago.

#### Fair city

Congress voted for San Francisco as the site of a World's Fair commemorating the opening of the Panama Canal. To help secure the congressional vote. Francisco started working for the fair in 1904, and sold over \$7.5 million in a World's Fair corporation to operate the big event. New Orleans officials lost in an effort to bring the fair to their festive city. But when New Orleans officials learned that San Francisco would be the site, they immediately voted to open a pavillion.



#### Motorcycle mask

This was the latest in motorcycle helmets in 1911. It was warm, but few cyclists would buy it. Safety equipment, however good looking, is still a tough sell.

#### 50 YEARS AGO: April 1936



Successful tests were made in England in 1936 of a Doughnut Boat designed to save not only the lives of the pilots, but also a plane lost at sea. The doughnut-shaped boat popped out of the wing top on impact with the water. It inflated automatically. The pilot and copilot leaped out of the plane into the water, then swam to the boat, to which the submerged plane was tethered. Further testing of the device, however, showed that it would work only rarely. The idea was scrapped.



#### **Before bullets**

Japan's first high-speed train was a bevel-nosed streamlined steam machine that hauled cars at 90 mph from Osaka to Nagoya. That's 70 mph slower than today's bullet train.

#### The next war

Hitler and his German forces were well on their way across Europe, and Popu-LAR MECHANICS predicted that a soon-to-start global war would be won by the side that "controls the ether." That was in reference to radio transmissions, which analysis said would become an extremely important factor for movement of troops, submarines and airplanes. To a great extent, radio transmissions did become a major factor in the fighting, particularly in the war's big air operations.

## 25 YEARS AGO: April 1961

#### Pooling resources

We showed our readers how to keep cool in the summer with a 16 × 32-ft, swimming pool and patio for just under \$300. Other than a strong back, all you needed was a shovel, some garden hose, concrete blocks and readymix 3000-pound test concrete. The earth dug out for the pool was used for fill. The patio was essentially a concrete walk about 3 ft. wide. The walk itself required about 11 sacks of cement. If you could build such a pool today, the materials would cost about \$3000.

#### Dam good idea

Egypt, with the help of Great Britain and France, was building the Aswan High Dam. The purpose was to solve the age-old problem of extensive flooding in the upper Nile each summer. At the height of planning and excavation, archaeologists stopped progress by protesting the possible submersion of the Temple of Isis because of the dam construction. Much of the temple was moved to another location. But it was only one of many serious problems involved in the dam building.



#### Vectored thrust

Britain flew the first successful vertical takeoff and landing jet, the English Hawker 1127. America had already flown a prop-driven VTOL, but it was slow and ungainly. The British jet was the forerunner of today's carrier-based Harrier jet fighter.



Doughnut to the rescue.

A pool you build.

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Many contests try to give away things you probably wouldn't want at <u>any</u> price. But our GMC Truck Great Escape Sweepstakes offers something you can't put a price on: Escape. It's a chance to win the freedom to get away and experience the great American

outdoors. And the opportunity to take off in a brand-new GMC truck. Even if you haven't entered the more mundane sorts of sweepstakes before, you should consider the unusually attractive opportunities presented by the GMC Truck Great Escape Sweepstakes:



GRAND PRIZE: A 1986 GMC SAFARI VAN, YOUR CHOICE OF A REGAL SEBRING 195XL BOWRIDER BOAT OR A 1986 STARCRAFT 20-FT TRAVEL TRAILER, PLUS A GREAT ESCAPE FOR FOUR.\* You could win a stylish and accommodating 1986 GMC Safari with the towing capacity no front-wheel-drive mini-van can match, plus your choice of a Regal Sebring 195XL bowrider boat or

a 1986 Starcraft 20-ft travel trailer, plus a ten-day, nine-night trip for four to the Grand Canyon, Yellowstone and Yosemite National Parks. Air fare, lodging, \$1,000 spending money, and use of a vehicle at each site included.

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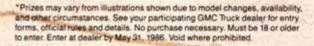


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PLUS TEN THIRD PRIZES OF COLEMAN CAMPING OUTFITS AND THOUSANDS OF INSTANT WINNER PRIZES, TOO!





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Light my Lucky."



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