

APRIL 1992 \$1.95

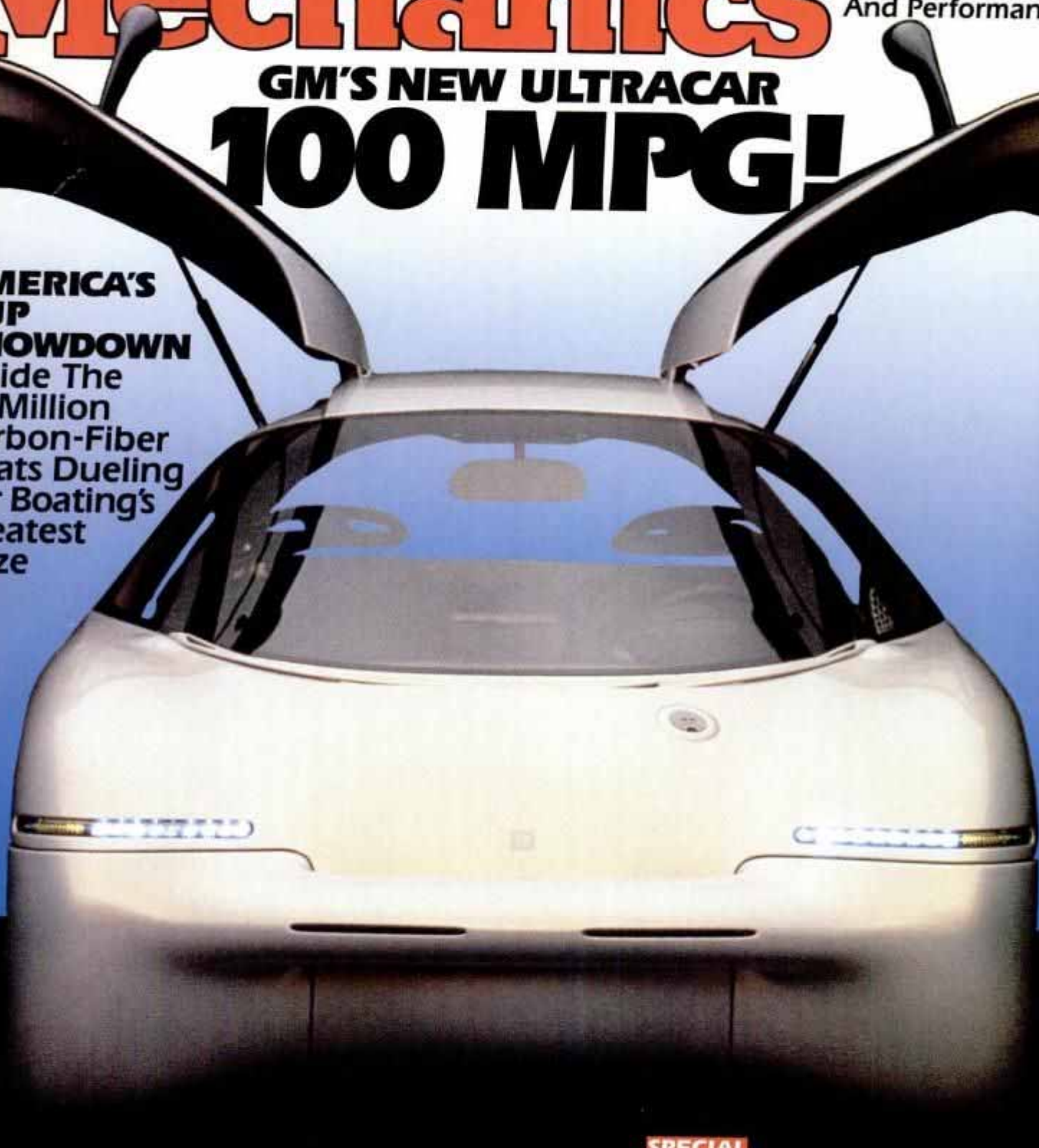


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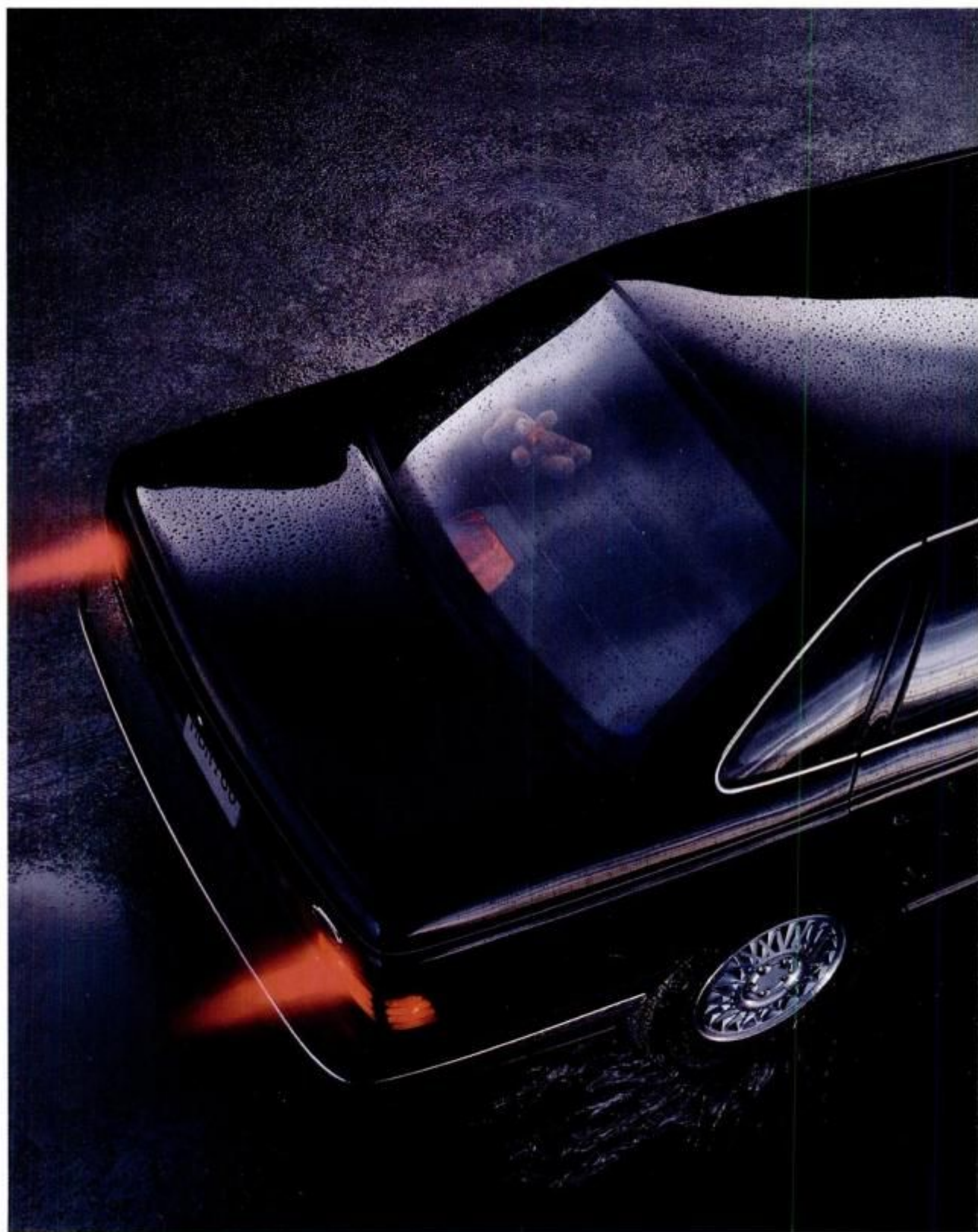
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AQUATRED. ONLY FROM GOODYEAR.

For full story, lift page. →



April 1992

Dear Friends of **Popular Mechanics**,

Ah, April...that time of year when this not so young boy's thoughts turn to ...baseball. Known to some as "the show." Known to all as our national pastime. I, and millions of others, can get pretty crazy over this all-American game.

In general, people get crazy over their favorite sports be they baseball or football, amateur or professional. At any given time during the year, you can suffer from ailments ranging from Pennant Fever to Wimbledon Whiplash. This year we'll suffer from a fever of olympic proportions - during the 1992 Olympic Games.

And when sports enthusiasts want to know all about the latest technology and futuristic equipment being used to train their favorite athletes, they turn to **Popular Mechanics** - for sports from a different perspective.

Since 1902, **Popular Mechanics** has been serving the interests of American men and, while we may not commonly be perceived of as a sporting publication, our 8,033,000 male readers know otherwise.

Only **PM** features articles that explain the scientific importance of a spiral spin when throwing a successful bomb pass, as well as the kind of force needed to "blast one out of the park." Two such examples of **PM's** sports style are featured within this April issue. "**Technology Comes To Bat**" reviews the recent advances in baseball equipment as well as the use of computer technology for improving players' hitting and pitching abilities, while "**War In The Wind**" looks at the technology behind Dennis Connors's \$15 million *Stars & Stripes* as it is readied to defend the America's Cup.

PM goes beyond scores and stats to the meat of the matter. This is what our Must-Know Men crave, and it's what we deliver. Month after month, for 90 years, **PM** has been and will continue to be the original men's service magazine.

The mechanics of sports and the technology behind the equipment. Found only in the pages of **Popular Mechanics**. Your arena for reaching 8,033,000* active male sports participants per month.

Sincerely,

A handwritten signature in black ink that reads "Bob Dillingham". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

Bob Dillingham
Vice President & Publisher

* And by the way, according to Fall 1991 MRI, *PM's* female readership has increased 200,000 to 1,468,000!

This One



2543-0N3-LKU1

1902-1992

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compact pickup called Syclone. Performance cognoscenti still speak of how *Car and Driver* pitted Syclone against a \$122,000 Ferrari 348ts. "In a blink, the Ferrari is looking at tailgate," they wrote.

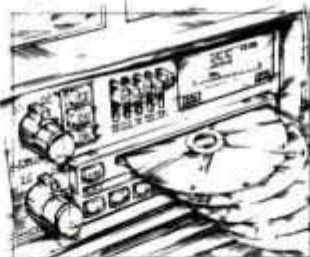
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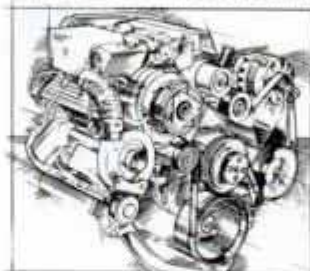
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Материал, содержащий никотин и смолы

EDITOR'S NOTES

● Remember those Shell Oil commercials where you'd see this bare skeleton of a car rolling down the road and the announcer would say that Shell engineers had achieved 165 miles per gallon or some other incredible number? That car had about as much to do with reality as "Terminator 2." But now, General Motors engineers have made that dream of 100 miles per gallon a reality, and in a real, roadworthy car. GM's new Ultralite experimental vehicle is a real car. You can drive it. A family can sit in it comfortably, and it is licensed for street use. The only trouble is you can't buy it—yet. But you can read about it in this month's cover story and wish. . . . Sailboats used to consist of a hull and a sail. Even the boats that competed for the coveted America's Cup were basically stock sailboats with some refinements. All that changed four years ago when the America's Cup competition became big corporate business. Now to be competitive, you need computers, carbon fiber, wind tunnels and the resources of a General Motors Technical Center behind you—as our Boating Editor Joe Skorupa found out when he prepared this month's story on the Cup, "War In The Wind." Skorupa spent considerable time at the GM Tech Center in Warren, Michigan, and out in San Diego with Dennis Conner as he prepared for this year's war. The bottom line: Don't expect things related to the America's Cup competition to get simplified or cheaper in the near future. . . . Speaking of things getting less simple, what-



Skorupa (left) and Dennis Conner in San Diego.

ever happened to baseball? Technology seems to be taking over the national pastime too, as we report in this issue. Can you imagine an electronic mitt? Or a bat wired to a computer? Hey, that's what it's come down to. Check out editor Frank Vizard's article beginning on page 36. . . . Our annual Home Improvement Guide in this issue focuses on something car buffs have known about for years—preventive maintenance. Most of us know that if you regularly take care of your car, you can extend its life and prevent costly failures later on. But for some reason, when it comes to our homes, we let most things go until they fail catastrophically. This year's Guide will help you add years to the life of your home and save you money in the long run. . . . I'm trying to find the PM subscriber who has been a subscriber for the longest period without interruption. When I find that person, I'm going to award a prize and write an article about him or her, as part of our 90th birthday celebration. If you think you qualify, send me a note, tell me how long you've been subscribing and how to contact you. If you turn out to be the winner, I'll get back to you. Till next time.


Joe Oldham

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Beyond Dumps: What to Do With the Grass?

By WILLIAM E. SCHMIDT
Special to The New York Times
MADISON, Wis., June 7 - On his way to work, Ray Mays took five

"I think it stinks," said Mr. Mays the other day as he heaved the 30-pound bags of clippings into a pile with hundreds of other bags, decomposing in the center of the parking lot. "You spend a couple of hours cutting your lawn and then you have to carry the stuff across town yourself to be collected. What kind of city service is that?"

Old Ritual, Not Topic

garbage in most municipal landfills. The first statewide ban, in Illinois, will take effect next New Year's Day.

New Jersey has already banned leaves but not grass clippings from its landfills, and Pennsylvania and Connecticut are preparing to do the same. And cities and towns in a number of states, including New York and California, have begun programs to keep leaves and grass out of local landfills.

It is recycled into mulch and raises a difficult question: how the grass is to be

Chicago Tribune Sunday, September 10, 1989

State's plea to lawn lovers: Let your grass clippings lie

By Stevenson Swanson
Environmental writer

URBANA—Want to help prevent a garbage dump in Illinois? Leave your clippings on the lawn.

If the connection seems tenuous, consider the usually bag their clippings then out with the trash. All of those left up at the landfill, and

the state's landfills is running out.

In fact, to extend their life, landfills will no longer be able to take grass clippings, leaves, twigs and

first of four meetings to be held around the state. On Thursday, the last of the meetings will be held in Schaumburg for the Chicago-area municipalities.

Tough haul for yard waste

Getting rid of it will cost more when state dumping ban takes effect July 1

By Jim Ritter

On July 1, Illinois becomes the first state to make it illegal to dump a single leaf, twig or blade of grass into landfills.

The trend-setting law will save landfill space, create a multimillion-dollar compost industry, boost lawnmower sales and cost homeowners as much as \$150 a

handlers will pick up your yard waste separately.

Grass clippings will be taken to a dirtlike substance called Compost can soil conditioner.

Some municipalities have begun picking up yard waste separately.

New yard waste rules take effect Monday

By Carol Lonetz and Lisa Neff
Staff writers

Easter basket grass is not prohibited from landfills, but lawn clippings, leaves, shrubs, twigs, branches and garden debris must be in specially marked bags or brush

which are no longer hidden under stores. The yard waste pickup season extends through November throughout most of the Quad-Cities area.

Residents who decide they want their yard waste picked up will need extra for that service when they use biodegradable bags that are marked with their city's logo or sticker. They must attach a sticker to each bag.

Some municipalities have begun picking up yard waste separately.

Rock Island officials will be different from other cities, the first time state residents to separate yard waste from other trash. In hard down coats, yard waste will be collected every other

Chicago Tribune Sunday, August 13, 1989

Yard waste bringing pile of problems

By Andrew Fegelman

That ritual of home ownership known as yard work is about to get more tedious not just for the mowers and rakers of Illinois, but for the municipalities that have to collect the stuff.

Beginning next July, the byproduct of yard work—branches, leaves and grass clippings—no longer can be dumped into landfills under an

Illinois law passed last year as part a program to conserve landfill space in the state.

State environmental officials had hoped the law would coerce municipalities into starting programs to turn the yard waste into compost, a soil-like substance produced when the waste decomposes.

But with less than a year left before the law takes effect, few municipalities have taken

such steps, and some local officials now doubt that they can carry out the

program puts it far ahead of other communities. They have no program



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LETTERS

Olympic Tech



I had no idea how much innovative technology is used for Olympic training and trials. Not only is the technology used for the sports that one would expect, but also for those unexpected ones, such as ice skating and archery. However, it's hard to tell if the great changes in world records are due to human evolution or machine technology.

DOUGLAS D. BROWN
MILWAUKEE, WI

You wrote a very informative article explaining the mechanics of skiing. However, you also confirmed a popular misconception that when a body moves through a circular path, a centrifugal force magically pushes and accelerates it away from the center of the circle. If so, net force would be opposite to acceleration, violating Newton's second law ($-F = ma$). Centrifugal force does not exist in science. Newton said that in order for a body to take a circular path, a net force (centripetal force) must accelerate the body toward the center of the circle, not away. This force is exerted by the skier's legs upon the edges of his skis. Any high-

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

school physics student, I being one, ought to know that.

WEI-YUEN TAN
VANCOUVER, BC

Science/Technology Editor Abe Dane replies: *While what you say accurately reflects what is taught in high school, it is not uncommon for technical professionals to describe differently the forces acting on a body following a curved path. In many situations, it is simply more convenient to think in terms of a centrifugal, rather than a centripetal, force. We chose to use the same terminology as the engineers from whom we gathered information for the story.*

Fast And Fancy

Thanks for the auto test on the Cadillac Seville STS, Lexus LS 400, Infiniti Q45, BMW 525i and . . . what? . . . the Lincoln Continental? Surely you meant to use the Lincoln Mark VII LSC. This type of miscomparison jeopardizes the integrity of the whole evaluation. The Ford Taurus would have been a better competitor than the Continental. Why not a Mercury Marquis or Ford Crown Vic? EDWARD H. SUHAY
LA MESA, CA

We compared the cars that compete in the luxury 4-door segment. The Continental Mark VII is a 2-door coupe and competes for sales against the Cadillac Eldorado, not the 4-door Seville. The Ford Taurus, Mercury Grand Marquis and Ford Crown Victoria are not in the luxury segment. —Ed.

I am amazed by the styles pressed out by American carmakers. Save for Cadil-

lacs, they're all squinting. Have Americans had an overdose of Oriental consumer goods? The Cadillac Seville looks good, and so does the Eldorado coupe. But it cannot claim to be an American style. The front resembles the Lagonda, and the rear is also familiar.

PAUL SABINO
(FAX WRITTEN MAIL)

What's Best?

You've done it again. In your "Tide Runner" article, you selected the most expensive boat as No. 1. I wish you would select the best for the money. Most fishermen are not interested in the hole-shot and performance-course tests, but rather how the boats perform in rough water and how much water they take over the bow. Top speed is not too important, either. Eliminating your ratings for top speed, hole shot and performance course, the Grady-White and Wellcraft are tied for first and cost about \$6500 less than the Boston Whaler.

LANSING T. SMITH, III
PENSACOLA, FL

Sounding Off

On behalf of dbx Technology Licensing, I commend you on making a technically complex subject easy to understand. Furthermore, PM was the only publication that assembled a listening panel to evaluate the difference between dbx-equipped stereo TV and pseudo stereo TV. You have provided a real service to your readers.

FRAN DYM, PRESIDENT
DYM COMMUNICATIONS
PR COUNSEL FOR dbx TECH

I do not feel PM adequately informed its readers of the rationale behind Thomson

Consumer Electronics' patented XS Stereo technology. XS Stereo was developed to give consumers a full stereo sound from compact television cabinets where small speakers are placed close together. Compact TVs diminish the effect of stereo unless remote speakers are connected to the television set. With XS Stereo, the consumer enjoys stereo sound without remote speakers. "Directional realism," as stated in the article, is the objective of stereo TV. Without XS Stereo, it is impossible to achieve directional realism when TV speakers are closely spaced.


You also leave the reader with the impression that there are mandated technologies for reproducing stereo in a television monitor, and that Thomson has violated these mandates. That is not the case. There is no requirement that any specific technology be used. However, in order to produce stereo sound, a TV set must be equipped with circuitry to separate the stereo signal and a system to reduce stereo noise. XS Stereo meets both of these requirements.

JAMES A. GATMAN
GENERAL MANAGER, CORE
TV GROUP, THOMSON
CONSUMER ELECTRONICS

Brute Error

In the Dodge Viper article, you stated, "The Nippondenso instrumentation is consistent with the overall theme of potent simplicity." As happy as this may have made Nippondenso, it is untrue. Nippon Seiki is responsible for the development and manufacture of the instrumentation.

JOHN F. MOLA
NIPPON SEIKI INTL.



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panels.

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area.

350-cu.-in. V8 standard.



"BEST BUY"
— *Consumers Digest.*

"FOUR WHEELER OF THE YEAR"
— *Four Wheeler magazine.*

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YWHERE

L-NEW CHEVY BLAZER



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AMERICA IS WINNING.™



TIME MACHINE

90 YEARS AGO: APRIL 1902

POPULAR MECHANICS

POWER PLANT THAT LIGHTS CHICAGO



Watts In Store

Now two decades old, the country's thirst for electric power was generating some mammoth machines—for its time. Chicago-Edison's Harrison Street station boasted "the enormous capacity of 27,000 kilowatts." Generators ran off pulsating 150-rpm steam engines to send both DC and AC currents coursing at low voltage throughout the city. Yet to make an appearance in this nation was electricity's modern workhorse, the steam turbine.

Deep Light

Efforts to recover the wreckage of the *Maine* led to the invention of the Yale submarine arc lamp, which cut through "the ocean's perpetual night" like no incandescent bulb could do. We also shed light on the diver's accoutrements, from his Jules Verne-style helmet to 20-pound lead shoes. Back then, a diver wore layers of flannel, rubber and canvas, and depended on two attendants manning shipboard air pumps. For really deep dives (204 ft. was the record), steam-driven air pumps took over.



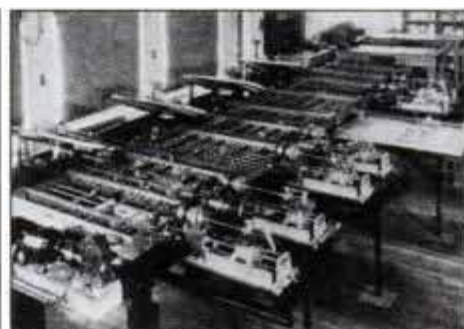
60 YEARS AGO: APRIL 1932

POPULAR MECHANICS



Thirty-Something

To mark our anniversary, the leaders of science, industry and government reviewed the progress we'd covered in the past three decades. Writers ranged from embattled President Herbert Hoover to his Democratic rival, New York Gov. Franklin D. Roosevelt. Even at the nadir of the Great Depression, the nation put great stock in technology—witness article titles like "Machines To Raise Wages" and "Luxuries For Everyone."



PC's Granddaddy

The world's first electronic analog computer filled a room at the Massachusetts Institute of Technology. Vannevar Bush's differential

analyzer crunched through calculus in seconds, although technicians often spent hours setting it up to solve an equation. A labyrinth of wheels, discs, shafts and gears handled the brainwork with precision unmatched by any contemporaneous machine. But its heyday was short, as digital computers developed after World War II put the analyzer out to pasture.

30 YEARS AGO: APRIL 1962

We Fished the Finest Spot in North America

POPULAR MECHANICS

Owners' Reports: Falcon and Pontiac

Lift-off Hardtop



Build This Safe Sidewalk Classic: It Runs on a Battery

Might Go Anywhere Power Plant

Pop Topper

Driving a big convertible was a uniquely American pleasure—until foul weather began leaking around the ragtop's edges. Now liftoff hardtops, which owners of small imports had enjoyed for years, were becoming available for domestics. Their molded fiberglass and spring-loaded hooks offered a waterproof seal and a scratch-resistant finish. Weighing only 80 pounds, the hardtop could support a small boat or several hundred pounds of luggage.



Short-Hop Chopper

Boosted by the reliable turboshaft engine, helicopters were vying for short-range air supremacy. Newly certi-

fied for commercial flights, the twin-rotor Boeing Vertol 107 offered quick hops between city centers. Airlines also eyed the Sikorsky S-61 and Britain's huge 57-passenger Fairey Rotodyne autogyro. But sky-high operating costs ultimately grounded the cop-terliners.

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That's why Rayovac batteries were chosen to power everything from the memory back-up systems in international telephone switching equipment to the chips in television satellite receivers that decode scrambled broadcast signals. And in more than 40 leading brands of personal computers, you'll find a Rayovac battery protecting the valuable applications and configurations in the computer's memory.

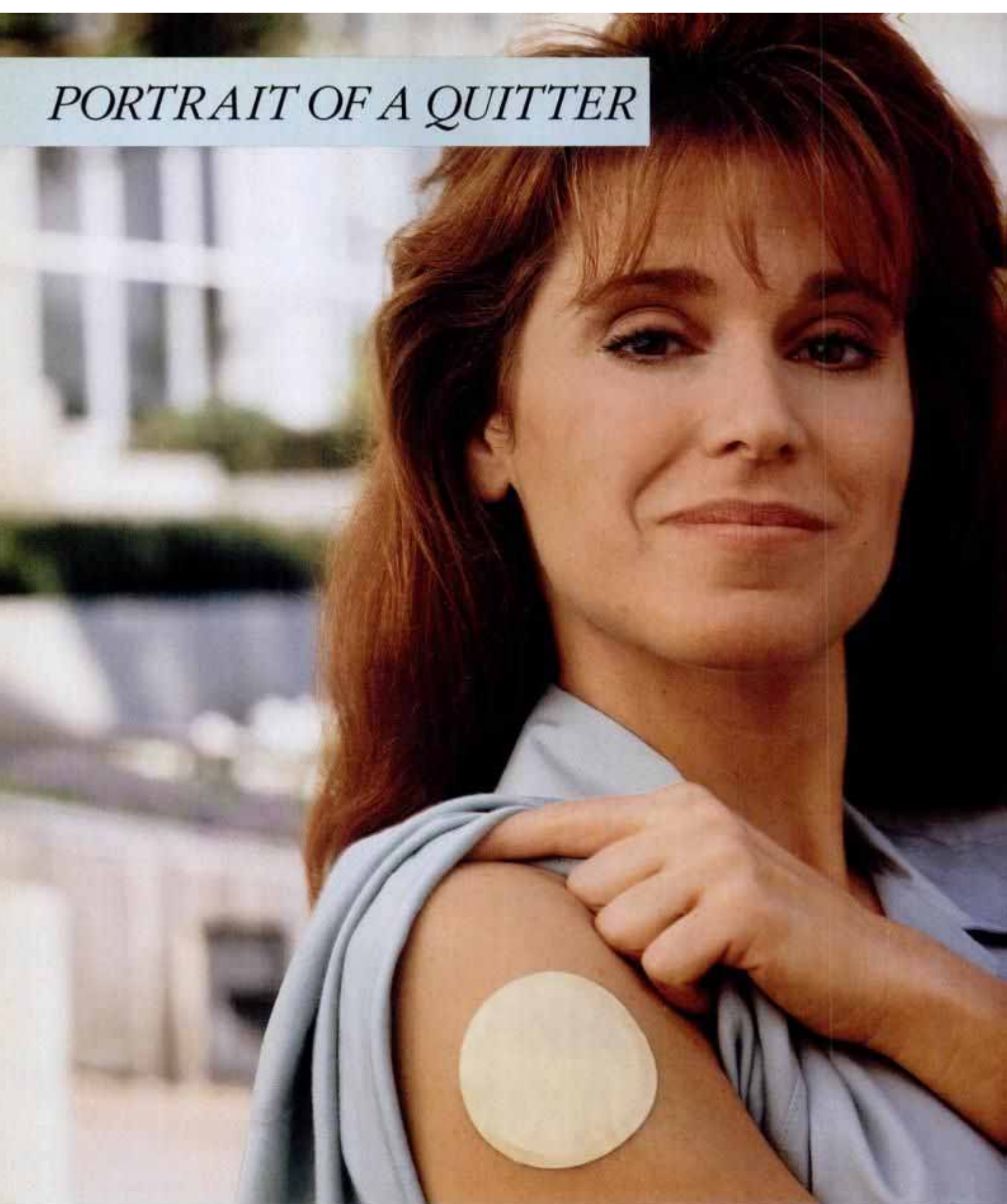
Manufacturers of cutting-edge technology have always relied on Rayovac Batteries. That's why you can rely on Rayovac at home.

RAYOVAC[®]

When Performance Really Counts.



PORTRAIT OF A QUITTER



IF YOU'VE GOT THE WILL,

 **BASEL
Pharmaceuticals**

Division of CIBA-GEIGY Corporation
Summit, New Jersey 07901

Материал, защищенный авторским правом

I'm embarrassed to tell you how many times I've tried to go cold turkey to quit smoking. But I never really lasted. Sooner or later, I'd start smoking again. Then, my doctor suggested a new approach that includes the Habitrol™ (nicotine) patch.

*'TIL NOW, I NEVER
THOUGHT I COULD
REALLY QUIT SMOKING.*



Habitrol is a skin patch. When used as part of a comprehensive smoking cessation program, it has been clinically proven to significantly increase the chances of quitting by relieving the craving for nicotine.

In addition to the smoking cessation program, I was given a free kit. The kit includes tips on getting through the rough times and an audio tape for relaxation and motivation. My doctor is a big support as well. He even gave me a list of support groups I could attend.

Of course, Habitrol won't work for everyone. Only your doctor can determine if it's right for you. If you're pregnant or suffer from any serious disease, be sure to tell your doctor. The most common side effect is skin irritation.

If you're really determined to quit, **ask your doctor** about Habitrol therapy. Or call 1-800-YES-U-CAN, for more information, today.

If you're tired of quitting and failing, this could be your chance.

NOW YOU CAN HAVE THE POWER.

NEW
Habitrol™
(nicotine)

Habitrol™
(nicotine)
Transdermal Therapeutic System
Systemic delivery of 21, 14, or 7 mg/day over 24 hours

BRIEF SUMMARY. FOR FULL PRESCRIBING INFORMATION SEE PACKAGE INSERT.

INDICATIONS AND USAGE

Habitrol treatment is indicated as an aid to smoking cessation for the relief of nicotine withdrawal symptoms. Habitrol treatment should be used as a part of a comprehensive behavioral smoking cessation program.

The use of Habitrol systems for longer than 3 months has not been studied.

CONTRAINDICATIONS

Use of Habitrol systems is contraindicated in patients with hypersensitivity or allergy to nicotine or to any of the components of the therapeutic system.

WARNINGS

Nicotine from any source can be toxic and addictive. Smoking causes lung cancer, heart disease, emphysema, and may adversely affect the fetus and the pregnant woman. For any smoker, with or without concomitant disease or pregnancy, the risk of nicotine replacement in a smoking cessation program should be weighed against the hazard of continued smoking while using Habitrol systems, and the likelihood of achieving cessation of smoking without nicotine replacement.

Pregnancy Warning

Tobacco smoke, which has been shown to be harmful to the fetus, contains nicotine, hydrogen cyanide, and carbon monoxide. Nicotine has been shown in animal studies to cause fetal harm. It is therefore presumed that Habitrol treatment can cause fetal harm when administered to a pregnant woman. The effect of nicotine delivery by Habitrol systems has not been examined in pregnancy (see PRECAUTIONS, Other Effects). Therefore, pregnant smokers should be encouraged to attempt cessation using educational and behavioral interventions before using pharmacological approaches. If Habitrol therapy is used during pregnancy, or if the patient becomes pregnant while using Habitrol treatment, the patient should be apprised of the potential hazard to the fetus.

Safety Note Concerning Children

The amounts of nicotine that are tolerated by adult smokers can produce symptoms of poisoning and could prove fatal if Habitrol systems are applied or ingested by children or pets. Used 21 mg/day systems contain about 60% (32 mg) of their initial drug content. Therefore, patients should be cautioned to keep both used and unused Habitrol systems out of the reach of children and pets.

PRECAUTIONS

General

The patient should be urged to stop smoking completely when initiating Habitrol therapy (see DOSAGE AND ADMINISTRATION). Patients should be informed that if they continue to smoke while using Habitrol systems, they may experience adverse effects due to peak nicotine levels higher than those experienced from smoking alone. If there is a clinically significant increase in cardiovascular or other effects attributable to nicotine, the Habitrol dose should be reduced or Habitrol treatment discontinued (see WARNINGS). Physicians should anticipate that concomitant medications may need dosage adjustment (see Drug Interactions).

The use of Habitrol systems beyond 3 months by patients who stop smoking should be discouraged because the chronic consumption of nicotine by any route can be harmful and addictive.

Allergic Reactions: In a 6-week, open-label dermal irritation and sensitization study of Habitrol systems, 22 of 220 patients exhibited definite erythema at 24 hours after application. Upon rechallenge, 3 patients exhibited mild-to-moderate contact allergy. Patients with contact sensitization should be cautioned that a serious reaction could occur from exposure to other nicotine-containing products or smoking. In the efficacy trials, erythema following system removal was typically seen in about 17% of patients, some edema in 4%, and dropouts due to skin reactions occurred in 6% of patients.

Patients should be instructed to promptly discontinue the Habitrol treatment and contact their physicians if they experience severe or persistent local skin reactions at the site of application (e.g., severe erythema, pruritus or edema) or a generalized skin reaction (e.g., urticaria, hives, or generalized rash).

Skin Disease: Habitrol systems are usually well tolerated by patients with normal skin, but may be irritating for patients with some skin disorders (atopic or eczematous dermatitis).

Cardiovascular or Peripheral Vascular Diseases: The risks of nicotine replacement in patients with certain cardiovascular and peripheral vascular diseases should be weighed against the benefits of including nicotine replacement in a smoking cessation program for them. Specifically, patients with coronary heart disease (history of myocardial infarction and/or angina pectoris), serious cardiac arrhythmias, or vasospastic diseases (Buerger's disease, Prinzmetal's variant angina) should be carefully screened and evaluated before nicotine replacement is prescribed.

Tachycardia occurring in association with the use of Habitrol treatment was reported occasionally. If serious cardiovascular symptoms occur with Habitrol treatment, it should be discontinued.

Habitrol treatment should generally not be used in patients during the immediate post-myocardial infarction period, patients with serious arrhythmias, and patients with severe or worsening angina pectoris.

Renal or Hepatic Insufficiency: The pharmacokinetics of nicotine have not been studied in the elderly or in patients with renal or hepatic impairment. However, given that nicotine is extensively metabolized and that its total system clearance is dependent on liver blood flow, some influence of hepatic impairment on drug kinetics (reduced clearance) should be anticipated. Only severe renal impairment would be expected to affect the clearance of nicotine or its metabolites from the circulation (See CLINICAL PHARMACOLOGY, Pharmacokinetics).

Endocrine Diseases: Habitrol treatment should be used with caution in patients with hyperthyroidism, pheochromocytoma or insulin-dependent diabetes since nicotine causes the release of catecholamines by the adrenal medulla.

Peptic Ulcer Disease: Nicotine delays healing in peptic ulcer disease, therefore, Habitrol treatment should be used with caution in patients with active peptic ulcers and only when the benefits of including nicotine replacement in a smoking cessation program outweigh the risks.

Accelerated Hypertension: Nicotine constitutes a risk factor for development of malignant hypertension in patients with accelerated hypertension, therefore, Habitrol treatment should be used with caution in these patients and only when the benefits of including nicotine replacement in a smoking cessation program outweigh the risks.

Information for Patients

A patient instruction sheet is included in the package of Habitrol systems dispensed to the patient. It contains important information and instructions on how to use and dispose of Habitrol systems properly. Patients should be encouraged to ask questions of the physician and pharmacist.

Patients must be advised to keep both used and unused systems out of the reach of

children and pets.

Drug Interactions

Smoking cessation, with or without nicotine replacement, may alter the pharmacokinetics of certain concomitant medications.

May Require a Decrease in Dose at Cessation of Smoking

Acetaminophen, caffeine, imipramine, oxazepam, pentazocine, propranolol, theophylline

Possible Mechanism

Derivation of hepatic enzymes on smoking cessation

Insulin

Increase of subcutaneous insulin absorption with smoking cessation

Adrenergic antagonists (e.g., prazosin, labetalol)

Decrease in circulating catecholamines with smoking cessation

May Require an Increase in Dose at Cessation of Smoking

Adrenergic agonists (e.g., isoproterenol, phenylephrine)

Possible Mechanism

Decrease in circulating catecholamines with smoking cessation

Carcinogenesis, Mutagenesis, Impairment of Fertility

Nicotine itself does not appear to be a carcinogen in laboratory animals. However, nicotine and its metabolites increased the incidence of tumors in the cheek pouches of hamsters and forestomach of F344 rats, respectively, when given in combination with tumor-initiators. One study, which could not be replicated, suggested that cotinine, the primary metabolite of nicotine, may cause lymphoreticular sarcoma in the large intestine in rats.

Nicotine and cotinine were not mutagenic in the Ames Salmonella test. Nicotine induced repairable DNA damage in an *E. coli* test system. Nicotine was shown to be genotoxic in a test system using Chinese hamster ovary cells. In rats and rabbits, implantation can be delayed or inhibited by reduction in DNA synthesis that appears to be caused by nicotine. Studies have shown a decrease in litter size in rats treated with nicotine during gestation.

Pregnancy Category D (see WARNINGS)

The harmful effects of cigarette smoking on maternal and fetal health are clearly established. These include low birth weight, an increased risk of spontaneous abortion, and increased perinatal mortality. The specific effects of Habitrol treatment on fetal development are unknown. Therefore, pregnant smokers should be encouraged to attempt cessation using educational and behavioral interventions before using pharmacological approaches.

Spontaneous abortion during nicotine replacement therapy has been reported, as with smoking, nicotine as a contributing factor cannot be excluded.

Habitrol treatment should be used during pregnancy only if the likelihood of smoking cessation justifies the potential risk of use of nicotine replacement by the patient, who may continue to smoke.

Teratogenicity

Animal Studies: Nicotine was shown to produce skeletal abnormalities in the offspring of mice when given doses toxic to the dams (25 mg/kg/day IP or SC).

Human Studies: Nicotine teratogenically has not been studied in humans except as a component of cigarette smoke (each cigarette smoked delivers about 1 mg of nicotine). It has not been possible to conclude whether cigarette smoking is teratogenic to humans.

Other Effects

Animal Studies: A nicotine bolus (up to 2 mg/kg) to pregnant rhesus monkeys caused acidosis, hypercarbia, and hypotension (fetal and maternal concentrations were about 20 times those achieved after smoking 1 cigarette in 5 minutes). Fetal breathing movements were reduced in the fetal lamb after intravenous injection of 0.25 mg/kg nicotine to the ewe (equivalent to smoking 1 cigarette every 20 seconds for 5 minutes). Uterine blood flow was reduced about 30% after infusion of 0.1 mg/kg/min nicotine for 20 minutes to pregnant rhesus monkeys (equivalent to smoking about 6 cigarettes every minute for 20 minutes).

Human Experience: Cigarette smoking during pregnancy is associated with an increased risk of spontaneous abortion, low-birth-weight infants and perinatal mortality. Nicotine and carbon monoxide are considered the most likely mediators of these outcomes. The effects of cigarette smoking on fetal cardiovascular parameters have been studied near term. Cigarettes increased fetal aortic blood flow and heart rate, and decreased uterine blood flow and fetal breathing movements. Habitrol treatment has not been studied in pregnant humans.

Labor and Delivery

Habitrol systems are not recommended to be left on during labor and delivery. The effects of nicotine on the mother or the fetus during labor are unknown.

Nursing Mothers

Caution should be exercised when Habitrol therapy is administered to nursing women. The safety of Habitrol treatment in nursing infants has not been examined. Nicotine passes freely into breast milk; the milk-to-plasma ratio averages 2.9. Nicotine is absorbed orally. An infant has the ability to clear nicotine by hepatic first-pass clearance; however, the efficiency of removal is probably lowest at birth. The nicotine concentrations in milk can be expected to be lower with Habitrol treatment when used as directed than with cigarette smoking, as maternal plasma nicotine concentrations are generally reduced with nicotine replacement. The risk of exposure of the infant to nicotine from Habitrol systems should be weighed against the risks associated with the infant's exposure to nicotine from continued smoking by the mother (passive smoke exposure and contamination of breast milk with other components of tobacco smoke) and from Habitrol systems alone or in combination with continued smoking.

Pediatric Use

Habitrol systems are not recommended for use in children because the safety and effectiveness of Habitrol treatment in children and adolescents who smoke have not been evaluated.

Geriatric Use

Forty-eight patients over the age of 60 participated in clinical trials of Habitrol therapy. Habitrol therapy appeared to be as effective in this age group as in younger smokers.

ADVERSE REACTIONS

Assessment of adverse events in the 792 patients who participated in controlled clinical trials is complicated by the occurrence of GI and CNS effects of nicotine withdrawal as well as nicotine excess. The actual incidences of both are confounded by concurrent smoking by many of the patients. In the trials, when reporting adverse events, the investigators did not attempt to identify the cause of the symptom.

Topical Adverse Events

The most common adverse event associated with topical nicotine is a short-lived erythema, pruritus, or burning at the application site, which was seen at least once

in 35% of patients on Habitrol treatment in the clinical trials. Local erythema after system removal was noted at least once in 17% of patients and local edema in 4%. Erythema generally resolved within 24 hours. Cutaneous hypersensitivity (contact sensitization) occurred in 2% of patients on Habitrol treatment (see PRECAUTIONS, Allergic Reactions).

Probably Causally Related

The following adverse events were reported more frequently in Habitrol-treated patients than in placebo-treated patients or exhibited a dose response in clinical trials.

Digestive system - Diarrhea*, dyspepsia*
Mouth/Tooth disorders - Dry mouth
Musculoskeletal system - Arthralgia*, myalgia*
Nervous system - Abnormal dream†, somnolence†

*Reported in 3% to 9% of patients

†Reported in 1% to 3% of patients

Unmarked if reported in < 1% of patients.

Causal Relationship Unknown

Adverse events reported in Habitrol- and placebo-treated patients at about the same frequency in clinical trials are listed below. The clinical significance of the association between Habitrol treatment and these events is unknown, but they are reported as alerting information for the clinician.

Body as a whole - Allergy†, back pain†
Cardiovascular system - Hypertension†
Digestive system - Abdominal pain†, constipation†, nausea†, vomiting†
Nervous system - Dizziness*, concentration impaired†, headache (1%), insomnia*
Respiratory system - Cough increased†, pharyngitis†, sinusitis†
Urogenital system - Dysmenorrhea*

*Reported in 3% to 9% of patients

†Reported in 1% to 3% of patients

Unmarked if reported in < 1% of patients.

DRUG ABUSE AND DEPENDENCE

Habitrol systems are likely to have a low abuse potential based on differences between it and cigarettes in four characteristics commonly considered important in contributing to abuse: much slower absorption, much smaller fluctuations in blood levels, lower blood levels of nicotine, and less frequent use (i.e., once daily).

Dependence on nicotine polacrifex chewing gum replacement therapy has been reported. Such dependence might also occur from transference to Habitrol systems of tobacco-based nicotine dependence. The use of the system beyond 3 months has not been evaluated and should be discouraged.

To minimize the risk of dependence, patients should be encouraged to withdraw gradually from Habitrol treatment after 4 to 8 weeks of usage. Recommended dose reduction is to progressively decrease the dose every 2 to 4 weeks (see DOSAGE AND ADMINISTRATION).

OVERDOSSAGE

The effects of applying several Habitrol systems simultaneously or of swallowing Habitrol systems are unknown (see WARNINGS, Safety Note Concerning Children).

The oral LD₅₀ for nicotine in rodents varies with species but is in excess of 24 mg/kg; death is due to respiratory paralysis. The oral minimum lethal dose of nicotine in dogs is greater than 5 mg/kg. The oral minimum acute lethal dose for nicotine in human adults is reported to be 40 to 60 mg (< 1 mg/kg).

Two or three Habitrol 30 cm² systems in capsules led to dogs weighing 8-17 kg were emetic, but did not produce any other significant clinical signs. The administration of these patches corresponds to about 6-17 mg/kg of nicotine.

Signs and symptoms of an overdose of Habitrol systems would be expected to be the same as those of acute nicotine poisoning including: pallor, cold sweat, nausea, salivation, vomiting, abdominal pain, diarrhea, headache, dizziness, disturbed hearing and vision, tremor, mental confusion, and weakness. Prostration, hypotension, and respiratory failure may ensue with large overdoses. Lethal doses produce convulsions quickly and death follows as a result of peripheral or central respiratory paralysis or, less frequently, cardiac failure.

Overdose From Topical Exposure

The Habitrol system should be removed immediately if the patient shows signs of overdose and the patient should seek immediate medical care. The skin surface may be flushed with water and dried. No soap should be used since it may increase nicotine absorption. Nicotine will continue to be delivered into the bloodstream for several hours (see CLINICAL PHARMACOLOGY, Pharmacokinetics) after removal of the system because of a depot of nicotine in the skin.

Overdose From Ingestion

Persons ingesting Habitrol systems should be referred to a health care facility for management. Due to the possibility of nicotine-induced seizures, activated charcoal should be administered. In unconscious patients with a secure airway, instill activated charcoal via nasogastric tube. A saline cathartic or sorbitol added to the first dose of activated charcoal may speed gastrointestinal passage of the system. Repeated doses of activated charcoal should be administered as long as the system remains in the gastrointestinal tract since it will continue to release nicotine for many hours.

Management of Nicotine Poisoning

Other supportive measures include diazepam or barbiturates for seizures, atropine for excessive bronchial secretions or diarrhea, respiratory support for respiratory failure, and vigorous fluid support for hypotension and cardiovascular collapse.

Safety and Handling

Habitrol systems can be a dermal irritant and can cause contact sensitization. Although exposure of health care workers to nicotine from Habitrol systems should be minimal, care should be taken to avoid unnecessary contact with active systems. If you do handle active systems, wash with water alone, since soap may increase nicotine absorption. Do not touch your eyes.

Disposal

When the used system is removed from the skin, it should be folded over and placed in the protective pouch which contained the new system. The used system should be immediately disposed of in such a way to prevent its access by children or pets. See patient information for further directions for handling and disposal.

How to Store

Do not store above 86°F (30°C) because Habitrol systems are sensitive to heat. A slight discoloration of the system is not significant.

Do not store unopened. Once removed from the protective pouch, Habitrol systems should be applied promptly since nicotine is volatile and the system may lose strength.

CAUTION: Federal law prohibits dispensing without prescription.

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TECH UPDATE

News Of Tomorrow's Technology Today



PM ILLUSTRATION BY PAUL DIMARE



Powerbeamed Drone Aims For The Stratosphere

BETHESDA, MARYLAND — Powered by a microwave beam, a small unmanned vehicle could hang in the air for months. But the concept has hung on the drawing board for years, because microwave powerbeaming systems have stayed big and costly.

Now things are changing. By jumping to a higher frequency, researchers feel they've vaulted the last obstacle to practical powerbeaming. A company called Endosat, Inc., has proposed a drone to fly at 80,000 ft., driven from a ground dish only 60 ft. across.

Key to the system: a Ka-band rectifying antenna, or rectenna, developed by

ARCO Power Technologies. The device converts a 35-GHz energy beam into DC current. Previous efforts in powerbeaming have used the S-band at 2.45 GHz, forcing either low-altitude operation or a prohibitively large dish to get enough power density on the rectenna.

Cut as conformal panels, the rectenna would attach to a disc on an airframe built for use with an earlier microwave system. Toronto-based Aeronautical Design, Inc., has already flown the vehicle with an internal-combustion engine.

Endosat is hoping to turn

the plane loose in the stratosphere, where it could carry instruments for atmospheric research.

Endosat drone, its rectifying antenna converting microwave beam into DC current, patrols the stratosphere.

Highlights This Month

- **Nuclear Blastoff**—Air Force unwraps secret atomic-rocket research.
- **Big Mouth**—Giant Airbus will outswallow Super Guppy.
- **Wet Suit**—Water-filled flightsuit fights g-forces.
- **Son Of Eggbeater**—Intermeshing rotors fly again.
- **Muscle Boat**—Pedal-powered hydrofoil shatters records.
- **Six-Legged Farmer**—Walking robot to tend crops.

Editor: Abe Dine
Assistant Editor: Greg Pope
Contributors: Philip Chien, Mike Fillon

Mile after mile of red
front of my handlebars.
I tried, I couldn't get her
of my head. As I came over
kicked it into fifth and
I couldn't hear a word
she said.

 **HONDA**
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NIGHTHAWK® 750 · 1991 MOTORCYCLE OF THE YEAR

First time buyer's and other financing programs available through ANFC. How you ride is just as important as what you ride. See your local Honda

*To qualified customers. See Dealer for details. [†]Motocyclist, Aug. and Rider, May 1991. Specifications and availability subject to change without notice. California version differs slightly due to emissions equipment.

A side-profile photograph of a Honda Hawk motorcycle, likely a Hawk 1000, parked on a paved road in a desert canyon. The scene is bathed in the warm, golden light of a sunset or sunrise, with the sun low on the horizon behind the rider. The motorcycle's chrome accents, including the engine covers, exhaust pipes, and front wheel rim, are highly reflective. The rider is wearing a dark leather jacket and pants, and a helmet is visible on the handlebars. The background shows rugged, dark rock formations under a hazy, orange sky.

rock canyon unfolded in
But no matter how hard
last words out
the ridge, I
suddenly

16-VALVE DOHC IN-LINE FOUR • 0-60 IN 3.65 SEC.

Dealer concerning free MSF rider training through the Honda Rider's Club of America. Please ride responsibly and read your owner's manual.
Hawk is a registered Honda trademark. For a free brochure, see your Honda Dealer or write: American Honda, Dept. 82, P.O. Box 7055, No. Hollywood, CA 91608-7055. © 1982 American Honda Motor Co., Inc. (4/82)

30-Million-Mile Checkup

PALMDALE, CA—Space Shuttle *Columbia* has put in 1800 hours in space, more than any other Shuttle in the fleet. It also recently put in six months undergoing a 30-million-mile overhaul at the Rockwell plant where it was built.

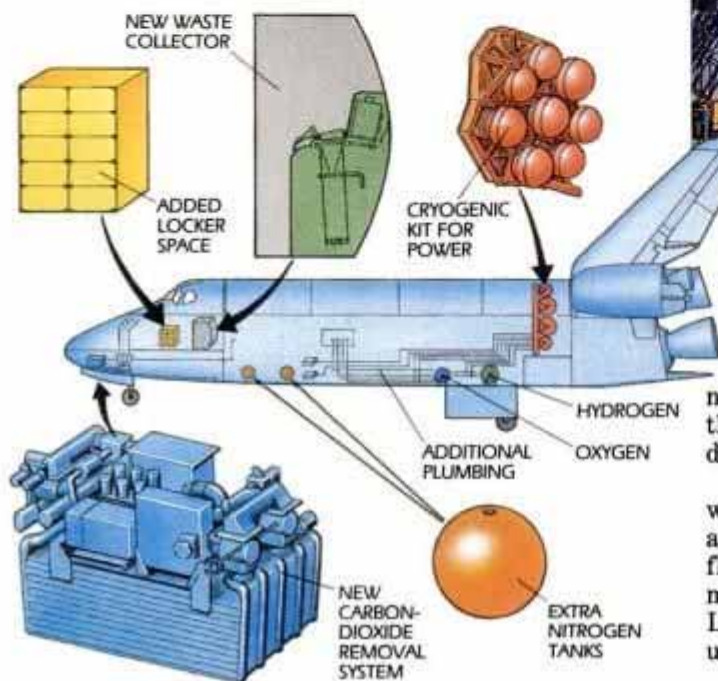
Workers there fitted the

11-year-old spacecraft with the extended-duration orbiter (EDO) modifications that are also installed on the new Shuttle *Endeavour*. These include a regenerative carbon-dioxide removal unit in the Shuttle's nose, more crew lockers, an improved toilet, added crew-atmos-



Shuttle *Columbia* is unloaded at Palmdale (above) to be refurbished with extended-duration hardware (left).

ROCKWELL PHOTO



PM ILLUSTRATION BY HANK IZEN

phere tanks and plumbing, and an extra pallet of cryogenic oxygen and hydrogen to keep fuel cells running overtime. Together they'll give the orbiter a 16-day mission capability.

The EDO improvements will get a workout right away. *Columbia's* next flight: the 13-day, 7-crew-member U.S. Microgravity Laboratory mission, scheduled for this summer.

While in Palmdale, *Co-*

lumbia sat through a complete structural examination to see what kind of a beating 11 spaceflights have given it. The inspection data will serve to schedule future structural checkups for other orbiters.

It's likely that this will be the last time a Shuttle orbiter spends much time at the Palmdale plant. Future inspections and retrofits will take place right at Kennedy Space Center.

Fission-Fueled Rocket

ALBUQUERQUE, NM—Futuristic nuclear-powered rockets figure into NASA scenarios for Mars missions, but it turns out the Strategic Defense Initiative Organization has been developing one in secret for four years.

Code-named Timberwind, the project has been partially declassified and integrated into an Air Force program called Space Nuclear Thermal Propulsion (SNTTP).

The rocket's particle-bed reactor heats hydrogen fuel to 5000° F, imparting twice the specific impulse of conventional chemical rockets.

Inside the reactor stand roughly 61 cylindrical fuel elements, through which the hydrogen flows. The elements contain thousands of

Hydrogen expands when passed over hot particles sandwiched between filters, or frits.

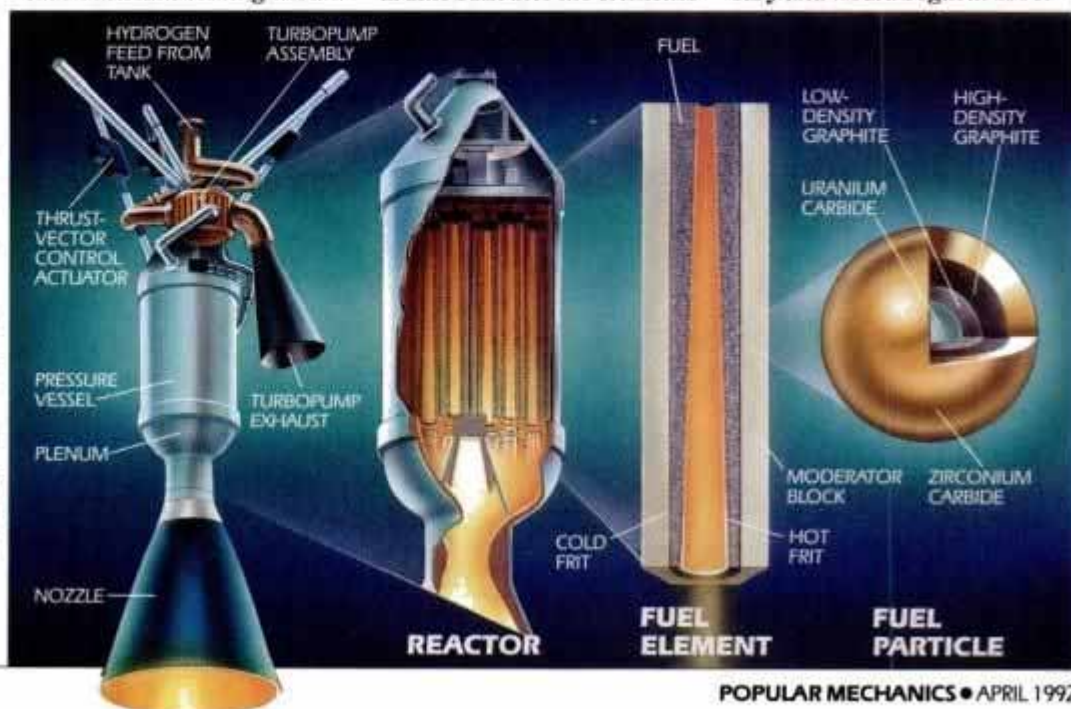
tiny beads of uranium carbide coated with graphite and ceramic. The temperature-resistant coating should

keep radioactive material safely locked up.

Hexagonal moderator blocks surround each fuel element, and so-called control drums built into the elements

regulate the fission reaction.

The Air Force says a working nuclear engine would be fired only in space, but ground tests would be necessary and would begin in 1994.



PM ILLUSTRATION BY PAUL DIMARE

New Air-Cargo Champ

TOULOUSE, FRANCE—For years, four Boeing Super Guppy turboprops have hauled Airbus components from plant to plant, but soon a new breed of flying monster will take over.

Airbus says its Super Transporter holds more than the Super Guppy's record 49,790 sq. ft. of cargo, although the exact figure hasn't been determined.

The goliath twinjet will be able to take in payloads through the front door, which swings up over a dropped cockpit. That will enable workers to load cargo without disconnecting cock-



AIRBUS PHOTO

Airbus Super Transporter features cockpit below floor level to allow fast front-end loading.

pit controls. The planes will move an entire A340 in 19 hours, as opposed to the 54 hours it takes the Guppies.

Based on the Airbus A300-600R, the new freighter will

tote 50-ton loads. The 25-ft.-dia. payload bay swallows the center fuselage of an A340 and both wings of the smaller A320. Other possible loads include Ariane rocket

stages or GE90 engines.

Aerospatiale and Deutsche Aerospace will convert at least four A300s into Super Transporters. First flight is slated for 1995.

Wet Suit For Fighter Jocks



ST. LOUIS, MO—McDonnell Aircraft engineers have tailored a g-suit that lets fighter pilots fly more aggressively without blacking out. Nicknamed Atlantis Warrior, the suit surrounds the torso, front of legs and feet with a bladder full of water.

G-forces typically drain blood toward the feet. But the same forces exert identical pressure on the suit's water, squeezing the extremities to maintain blood flow to the brain. Pilots not only stay conscious, they avoid fatigue, because they needn't fight the effects of g-forces as hard.

In addition, a positive-pressure breathing regulator assists a pilot's lungs against the suit's pressure while under g's. And by modulating air pressure in accordance with the breathing cycle, the regulator allows the pilot to speak clearly during high-g maneuvers.

The system outperformed conventional pneumatic g-suits in recent centrifuge experiments, and ejection tests show the suit may prevent spinal damage during high-speed bailouts.

This man pulled 10 g's for 3 minutes in centrifuge (above) wearing fluid-filled suit.

- FILL VENT
- RESERVOIR
- ELASTIC SLEEVE
- PRESSURE-BREATHING REGULATOR
- SLIDE FASTENER

BOOT FILL PORT

Cockpit's Vision Tunnel

KANEHOE, HI—A simple new gadget could offer pilots a lifesaving line of sight through a smoke-filled cabin.

Called the Emergency Vision Assurance System (EVAS), the device consists of an inflatable bubble that deploys from a small box at the pull of a tab. Inside, a fan keeps the EVAS inflated, while a filter keeps any smoke out of the bubble. The bubble also houses a small battery-powered light.

The pilot presses his goggles against the clear plastic of the bubble to get a clear look at the instrument panel,

checklists and flight path. The device stays inflated for 4 hours.

An EVAS could come either built into a cockpit or carried in its shoebox-size case, says manufacturer Vision Safe Corp.

The Federal Aviation Administration has certified the device for McDonnell Douglas DC-9s and MD-80s, but hasn't endorsed it in an advisory to airlines. This year, however, the FAA will review its regulations in light of several emergencies and a Senate appropriations mandate.

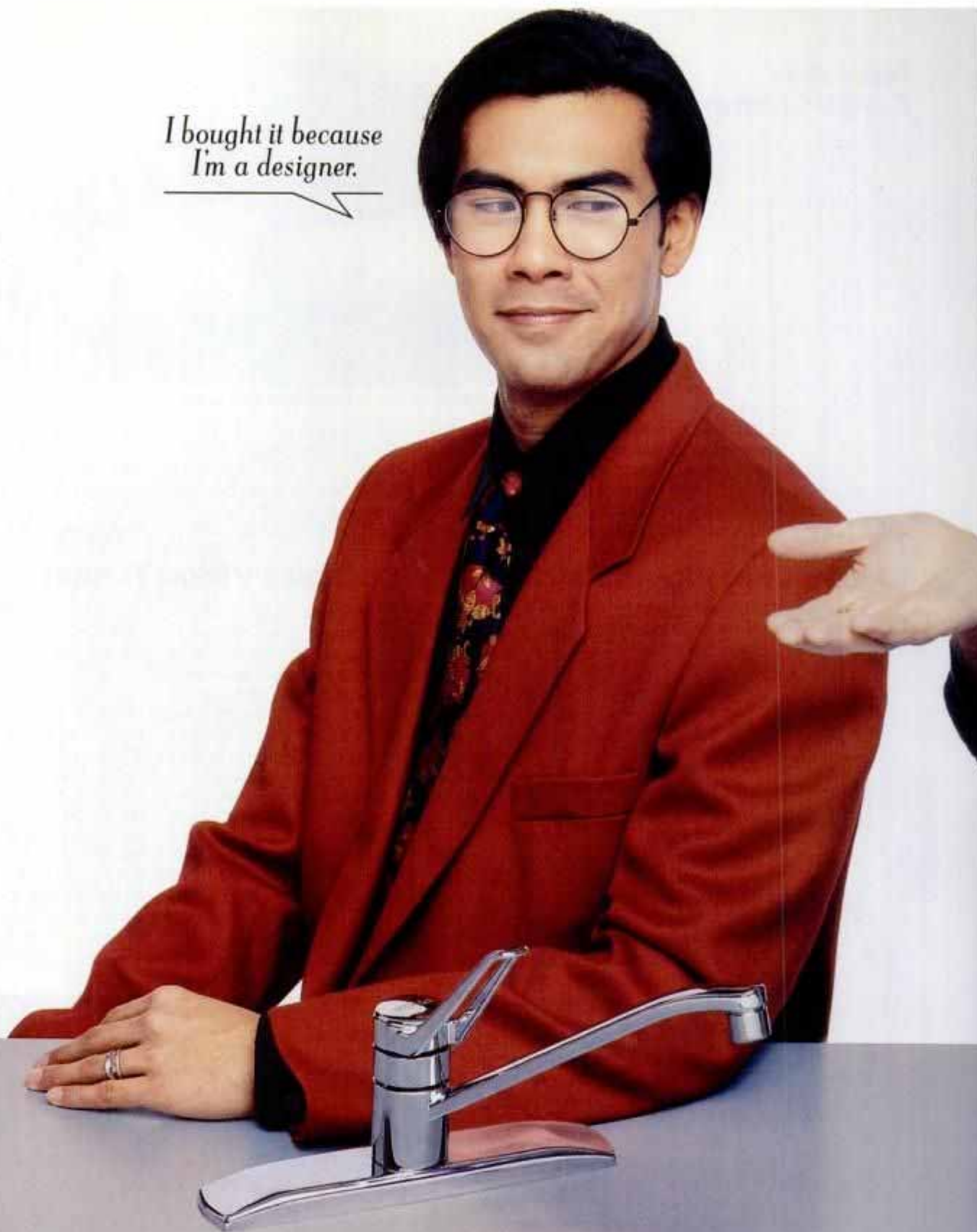


VISION SAFE CORP. PHOTO

Emergency Vision Assurance System inflates during smoke emergency to give pilot clear view of instruments and flight path.

MCDONNELL AIRCRAFT PHOTOS

*I bought it because
I'm a designer.*



A Moen faucet gives you more than just hot and cold water.

It's also designed to give you the perfect blend of style and performance.

Our CHATEAU™ kitchen faucet shown here is a shining example.

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*I bought it because
I'm a plumber.*

Buy it for looks. Buy it for life.™



Eggbeater Is Back

BLOOMFIELD, CT—Intermeshing rotors haven't made headlines since the H-43B Huskie, the Air Force's crash-fire fighter of the '50s and '60s. Now, the Huskie's developer, Kaman Corp., has revived the concept in a technology demonstrator that flew for the first time last December.

Kaman's Multi-Mission Intermeshing Rotor Aircraft, or MMIRA, updates the "eggbeater" configuration with composite rotorblades, a more powerful engine and a waspish silhouette.

While it's no speedster, MMIRA gets excellent lift from counterrotating rotors



Kaman intermeshing-rotor technology demonstrator lifts off during early tests.

—it can operate at 30,000 ft., hold station for hours and lift 6 tons in fuel and payload.

There's no tail rotor to drain power or generate noise.

Kaman is pushing the low-

maintenance technology for both manned and unmanned vehicles.

To The Moon, Artemis

HOUSTON, TX—NASA's plans to revisit the Moon won't command the same funding that fueled the Apollo program, so engineers at Johnson Space Center are brainstorming low-cost missions with big-science impact. One such concept is Artemis, a small unmanned lunar lander built from off-the-shelf NASA technology.

Boosted by a medium-lift rocket such as an Atlas II, Artemis would carry scientific payloads up to 440 pounds. These might be small telescopes, geophys-



ical sensors, mining-technology demonstrators or a terrain-sampling minirover. The lander would guide itself in using radar, fire retro-rockets to decelerate and land on shock-absorber legs.

The Artemis missions would precede the manned lunar activity envisioned in President Bush's Space Exploration Initiative. Later, the craft could also resupply manned Moon bases.

By lifting technology from the Surveyor, Apollo and Viking programs, says the Artemis study group, Artemis could be flying by 1996.

Minirover leaves radar-guided lunar lander in Johnson Space Center's Artemis scenario.

Pedal Boat's Speed Mark

CAMBRIDGE, MA—Last fall, a pedal-powered hydrofoil skittered off with two

speed records for human-propelled watercraft.

During 100-meter sprints

on the Charles River, the *Decavitator* hit 18.5 knots while piloted by a man, and 11.4 knots piloted by a woman.

The boat, built by MIT en-

gineers, has a recumbent-bicycle pedal system that drives a 10-ft. air propeller. Two hydrofoil wings beneath the pilot lift the craft's twin hulls off the water at speed. For an extra kick, worth about 3 knots, the pilot can retract one of the wings. The *Decavitator* weighs only 45 pounds.

The craft's designers believe that they will have captured a \$25,000 Dupont Prize if no one tops their mark before the end of this year.

Aeronautics grad student Dava Newman set women's speed record on *Decavitator*.



Future Rockets Take Shape

WASHINGTON, D.C.—Despite tepid funding support from Congress, engineers believe they can soon begin full-scale development of an engine design proposed for the National Launch System, the family of new rockets for NASA and the Air Force.

The Space Transportation Main Engine (STME) will be a disposable version of the Space Shuttle Main Engine. Since the engine won't be reused, many components can be simplified or eliminated altogether. In addition, improvements in the combustion chamber design will add 23% more thrust than the current Shuttle engine.

Planners will mull over several NLS configurations. One would combine four STMEs with two advanced solid-rocket boosters to put 80,000 pounds into a 200-mile orbit. Another would use six STMEs to orbit 50,000 pounds.

Neither version would come close to the old Saturn V's muscle, but they'd match or beat the Shuttle. Both would use the Shuttle's external tank as a fuel carrier.

First launch is scheduled for 2001—but only if Congress coughs up \$10 to \$12 billion.

Six-engine version of NLS kicks away four engines after blazing through atmosphere.



MARTIN MARIETTA ILLUSTRATION

Robots And Radishes

PITTSBURGH, PA—Ambler, Carnegie Mellon University's huge walking robot, may demonstrate technology for a future generation of mechanical farmers.

Developed as a planetary rover, Ambler can stride across unpredictable terrain by high-stepping obstacles such as Martian boulders—

Ambler's circulatory walking style isolates body and laser scanner from rough terrain.

or Earthly drainage ditches and vegetables. Farms designed for maintenance by Ambler-type machines wouldn't need exposed soil paths, boosting land utilization and reducing soil compaction. Ambler could analyze plants and carry out spot application of fertilizers and pesticides.

Engineers are now testing the machine's ability to run unattended for 5 hours.



CARNEGIE MELLON PHOTO

Portable Rebreather

MONROEVILLE, PA—Miners will no longer have to scramble for rebreathers to survive disasters, thanks to a small device that can be worn continuously on a belt.

Rebreathers protect a miner's lungs from poisonous gases, by recycling exhaled breath through a chemical bed that absorbs carbon dioxide and releases oxygen. Conventional designs, however, have been too cumbersome to carry around.

The new SR-100, developed by the U.S. Bureau of Mines and CSE Corp., weighs less than 5 pounds. The improvement stems from the inclusion of lithium

Portable rebreather offers more than an hour of air to trapped miners or tunnel workers.

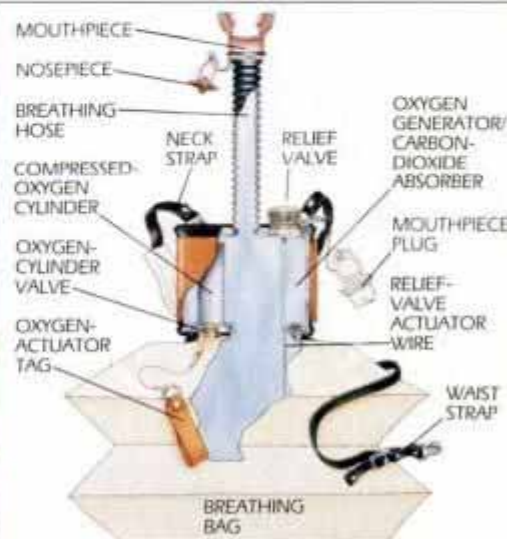
hydroxide along with standard potassium superoxide in the chemical bed. This mixed bed absorbs more carbon

dioxide per unit weight.

In addition, whereas older rebreathers cranked out twice as much oxygen as a miner could inhale, the SR-100 budgets oxygen release

to match the demands of a user's lungs. A small oxygen bottle supplies the first minute's worth of air.

The rebreather may also find use in construction. **TU**



CSE CORP. PHOTO AND ILLUSTRATION



POSSIBLE DREAMS

Building the good life in postwar America was part of everyone's dream.

BY MARY SEELHORST

● Certainly no exhibit about America's possible dreams or about **POPULAR MECHANICS** would be complete without a look at the skills of weekend craftspeople. At Henry Ford Museum & Greenfield Village in Dearborn, Michigan, a section of the "Possible Dreams" exhibit called "Building The Good Life" recaptures the hands-on dreams of the postwar era, from 1946 to 1975. It was just after WWII, as the economy expanded and families grew, that millions of Americans became homeowners for the first time.

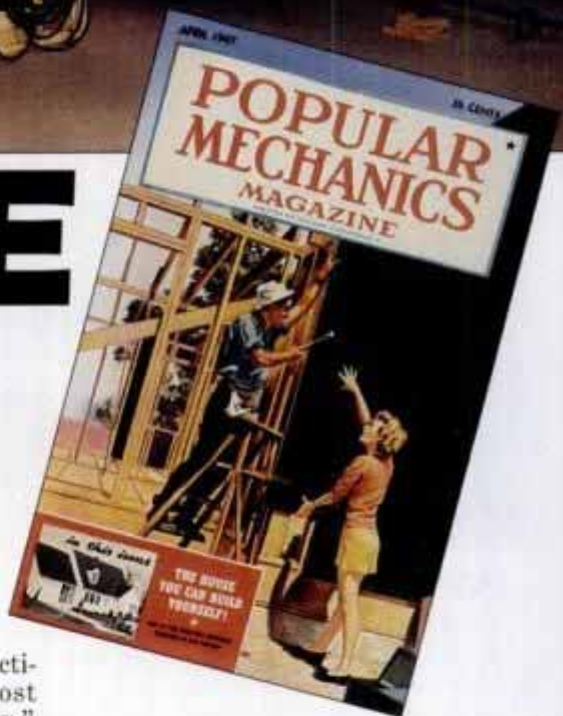
Projects and plans have been part of PM's lore since 1902. But the serious housing shortage following World War II spurred PM editors to plan something bigger than usual: "The House You Can Build Yourself." It

Mary Seelhorst is curator of the "Possible Dreams" exhibit at Henry Ford Museum & Greenfield Village in Dearborn, Michigan.

was "a small white house—the practical, expansible sort of house most young Americans dream of building."

The first was built in Aurora, Illinois, by a young veteran, Jacques Brownson, and his wife Doris. The Brownsons tested the Craftsman Editor's claim that "anyone who can saw a board straight and hammer a nail can build a house." Their experience was documented by PM cameras and presented to a home-hungry nation in 1947.

The "Possible Dreams" planning team decided that this house plan would make the perfect setting for exploring the leisure-time labor of postwar Americans—a full-scale walk-in version, furnished with some of the handmade items PM readers offered for the exhibit. However, to fit the exhibit's gallery space, only the living room and garage were built.



But this is no ordinary house. It is built to look like a diagram from the magazine, cut away to reveal the underlying structure. And, like all helpful diagrams, the parts are labeled for identification.

On the outside, the left end of the house is fully finished: roof shingled, siding painted, windows glazed. From left to right, layers of building paper, sheathing and insulation are progressively peeled away until only a skeletal framework of studs and joists remains.

Inside, visitors walk through the house, 8 in. below floor level, on a path cut through the structure to expose floor joists, bridging, subfloor and other underfoot mysteries. Beyond

(Please turn to page 127)

As Comfortable As Your Favorite Jeans And Just As Rugged.



**Ford Trucks.
The Best Never Rest.™**

Is this really the interior of a pickup truck? You bet it is. But you'll only find it in the 1992 full-size Ford pickup. There's a redesigned instrument panel that's more functional and user friendly, a more efficient console and easy-to-reach available power controls.

And it's not only America's best-built full-size pickup,* but it's been the best-selling pickup for fifteen straight years.

Isn't it time you tried a Ford on for size.

*"Best-Built" claims based on an average of consumer-reported problems in surveys of all 1991 models designed and built in North America. Sales by Division. **Buckle up—together we can save lives.** Optional captain's chairs and rear bench seat shown.



THE BEST-BUILT, BEST-SELLING AMERICAN TRUCKS
ARE BUILT FORD TOUGH.



The 1992 Full-Size Ford Pickup.



Is this a great country or what?

We're lucky. We live in a land where we're free to come and go as we please. No one can tell us where to go or how to get there. And it's one thing to take it all for granted; it's quite another to get up and do something with it.

So you've got your freedom. Great. Now what? You might want to see what this country's really made of. There's a lot of it out there, begging to be explored. This is what a Harley-Davidson® is for. And this is what led to the creation of the Electra Glide® Sport. No, it doesn't look like other touring bikes. On purpose. Leave it to Harley-Davidson to chalk one up for freedom of expression.

It is a machine that goes its own way. This is the American touring motorcycle in its purest form. And this is the experience that you'll get only from the seat of a Harley.® Rolling along at your own pace, you're not just looking at the landscape, you're in the landscape. Looking for even more of it to be in. It's a big country, and there are a lot of ways to see it. A Harley has a way of letting you take it as it comes. You gain a real appreciation for what this place is all about. For the freedom to see it as you see fit. To go or stay. Clear choices. Is that great or what?



Through and Through.

We care about you. Sign up for a Motorcycle Safety Foundation rider course today. Ride with your headlight on and watch out for the other person. Always wear a helmet, proper eyewear and appropriate clothing, and insist your passenger does too. Protect your privilege to ride by joining the American Motorcyclist Association. © 1991 Harley-Davidson, Inc. Call 1-800-443-2153 for the location of a Harley-Davidson® dealer near you.



ULTRACAR

Zero to 60 in 7.8 seconds. Top speed: 135 mph. And 100 miles per gallon!
General Motors turns a dream into reality.

BY CLIFF GROMER

● One hundred miles per gallon? Come on. It's a joke, right? No real car can get 100 mpg. It's got to be one of those skeleton cars you see running around in the Shell Oil commercials on TV. Or, it's another of those myths you hear about, like the Fish carburetor that "allows any car to get 100 mpg." It can't be for real.

It is for real. In fact, General Motors has never been more serious. It's the General Motors Ultralite. And not only does this car get 100 miles per gallon of gas on the road, it also goes from 0 to 60 mph in just 7.8 seconds and has a top speed of 135 mph. That, sports fans, is Mustang GT territory—a car that gets 15 mpg.

The Ultralite pushes the efficiency/performance envelope far beyond anything on the planet. And it does it with a blend of off-the-shelf hardware and cutting-edge technology. Unlike the elusive 100-mpg carburetor that the oil companies were supposed to have squashed, and numerous add-on



Gull-wing door allows easy access for front and rear passengers.

gas-mileage extenders (if you installed them all and added up the claimed fuel savings, you'd end up with more gas than when you started), the Ultralite is for real. You can drive it, and drive it hard, according to GM engineers we've spoken to. It handles well, has great acceleration, and it's fun to drive. It's a real car.

Wind-tunnel design

The starting point for this amazing little machine wasn't the drawing

board, but the wind tunnel. The engineers wanted a package that would deliver outstanding fuel economy and provide enough room and comfort for four adults. The wind-tunnel tests showed they could do it by designing a rear-drive, rear-engine car that had a 5-in. taper from front to back. The rear engine allowed a very small frontal area, which, along with the tapered shape (front track is 55 in., rear is 50 in.), resulted in a wind-slicing drag coefficient of 0.192.

An advanced computer-controlled, automatic-leveling suspension lowers the Ultralite's nose down 25mm and the rear down 10mm at highway speeds to further reduce drag.

Mod pod

Powertrain packaging took a novel twist. An interchangeable, modular powerpod attaches to the main structure at six points. The pod houses the engine, exhaust (the muffler is configured into the lower bumper area as



an aerodynamic wing), electronic 4-speed automatic transaxle and a computer-controlled, automatic leveling suspension. It is easily removed, making for all kinds of interesting possibilities. Say your engine requires service, a situation that normally might lay up your car for a couple of days at the dealership. Not to worry. Drive in for service, drop off your powerpod and drive home with a loaner unit from the dealer.

Even more intriguing is the concept of plugging in different types of engines—say, electric power for short hops around town, a conventional gasoline engine for longer trips, and possibly even a small, burn-anything gas-turbine engine when you need a change of pace or want to impress your area's environmentally friendly car crowd by popping your pod at the local drive-in. According to James K. Lutz, Advanced Engineering Staff



Speedometer uses electroluminescence lighting.



Powerpod rear section holds drivetrain.

program manager for the Ultralite, GM could "insert an appropriate powertrain depending on the market for which it would target the car."

Sitting tall

Passenger packaging is just as impressive as the powerpod concept, and was achieved by designing the car from the inside out—Ultralite's basic content and dimensions were sketched out before the stylists took

their shot. To appreciate the effective use of interior space, the Ultralite rides on a wheelbase of 110 in., while overall length is a mere 165.6 in. As Donald L. Runkle, Advanced Engineering Staff vice president, puts it, "We've got a car with a wheelbase equivalent to a Lexus LS 400 and the length of a Mazda Miata. That's what you call efficient packaging." There's enough head- and elbowroom to seat four adults as comfortably as they

Specifications

Vehicle type	Rear-engine, rear-drive
Body style	4-seat, 2-door sedan
Engine	2-stroke, direct injection, inline-3
Bore	3.39 in. (86mm)
Stroke	3.39 in. (86mm)
Displacement	92 cu. in. (1500 cc)
Horsepower	111 @ 5000 rpm
Torque	127 ft.-lb. @ 4000 rpm
Transmission	4-speed automatic
Wheelbase	110 in.
Length	165.6 in.
Width	64 in.
Height	50.8 in.
Curb weight	1400 lb.
Tires, f/r	175/65R-16, 175/65R-16 low roll resistant with puncture sealant





would be in a Chevy Corsica. But don't expect your wife to be able to pack in half the house like she does now for local trips. Rear-seat passengers don't need Houdini's bag of tricks to get in and out of the Ultralite, thanks to large, gull-wing doors that lift almost the entire side of the car.

Carbon-fiber shell game

From the beginning, light weight was a key goal. Weight strongly influences performance and fuel economy. So the GM engineers looked to the aerospace industry and its use of carbon-fiber composites for Ultralite's body structure. This material is half the weight of aluminum, but is twice as stiff. Compared to steel, carbon-fiber composites are slightly stiffer but with only one-fourth the density.

Carbon-fiber composites are made using off-the-shelf carbon-fiber cloths: a unidirectional type where the fibers are woven in the same direction, and a bidirectional where the fibers are woven at right angles to each other. The cloth is hand laid-up into plies—one or more layers of cloth with polyurethane foam sandwiched between the thin cloth layers using an epoxy matrix. Curing finalizes the shape of the part. The number and types of cloth layers and plies is determined by the specific strength and stiffness required by the various areas of the vehicle's structure.

The monocoque body design uses a carbon-fiber tunnel as a backbone.



Carbon-fiber body shell consists of six sections and weighs only 420 pounds.

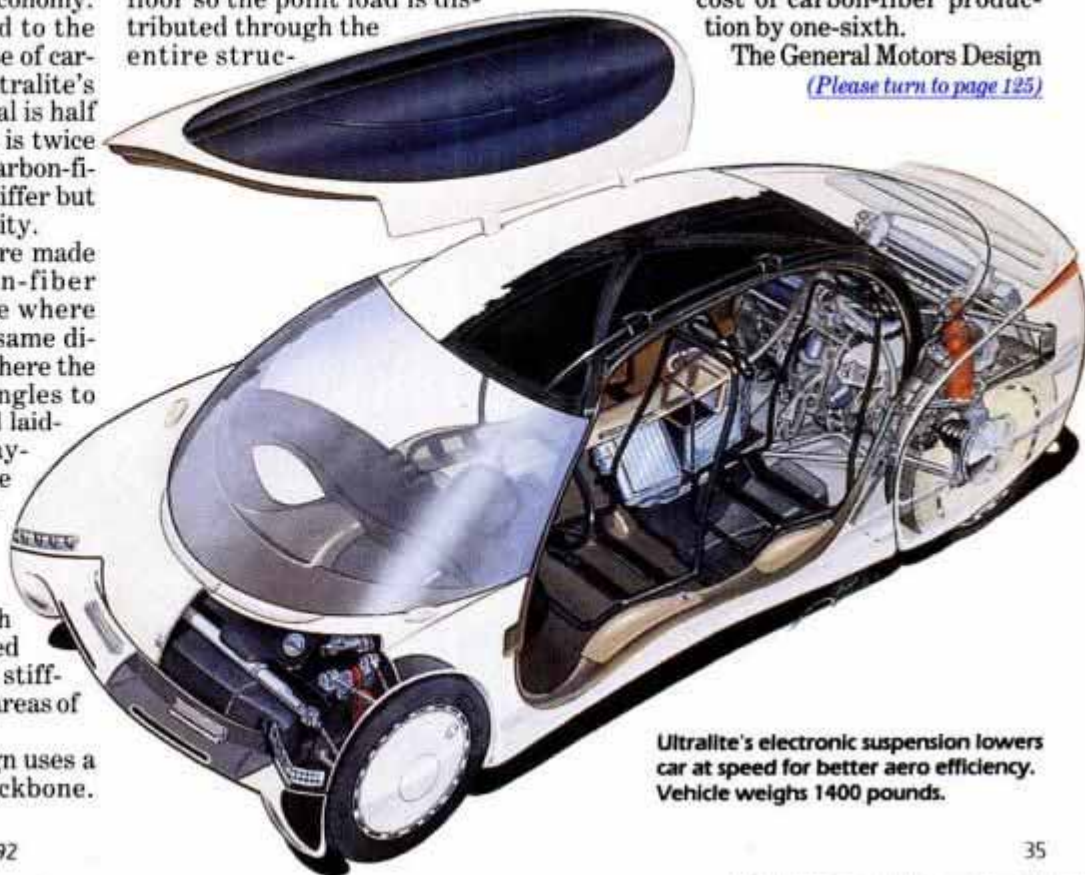
Running through the center of the car, the tunnel houses the heating, ventilation and air-conditioning system. The body structure, so strong in its single integral shell design that no center pillar is needed, is reinforced where required with carbon-fiber roving—rope woven from continuous carbon-fiber strands and then wrapped in the cloth plies. Roving is used, for instance, around the perimeter of the gull-wing door opening and back where the powerpod attaches to the carbon-fiber body. The pod uses a stainless-steel hoop frame that bolts up to threaded stainless-steel fasteners that are sandwiched into the body by the roving. The roving strands then unwind and flare out through the floor so the point load is distributed through the entire struc-

ture. Similarly, the double-wishbone front suspension, consisting of aluminum upper and lower A-arms and computer-controlled air springs, is attached through rubber bushings to steel backing plates sandwiched into the carbon-fiber body. Aluminum also saves weight by its use in wheel hubs, special aluminum/silicon carbide alloy brake rotors for the ABS VI brakes and 13-pound forged-aluminum rims.

The main drawback to carbon fiber is its expense. Ultralite's body totals in at \$13,000—several times the cost of aluminum, steel or fiberglass. But GM sees a future in the exotic material, and currently has a research program to grow carbon fibers in a lab, which promises to cut the current cost of carbon-fiber production by one-sixth.

The General Motors Design

(Please turn to page 125)



Ultralite's electronic suspension lowers car at speed for better aero efficiency. Vehicle weighs 1400 pounds.

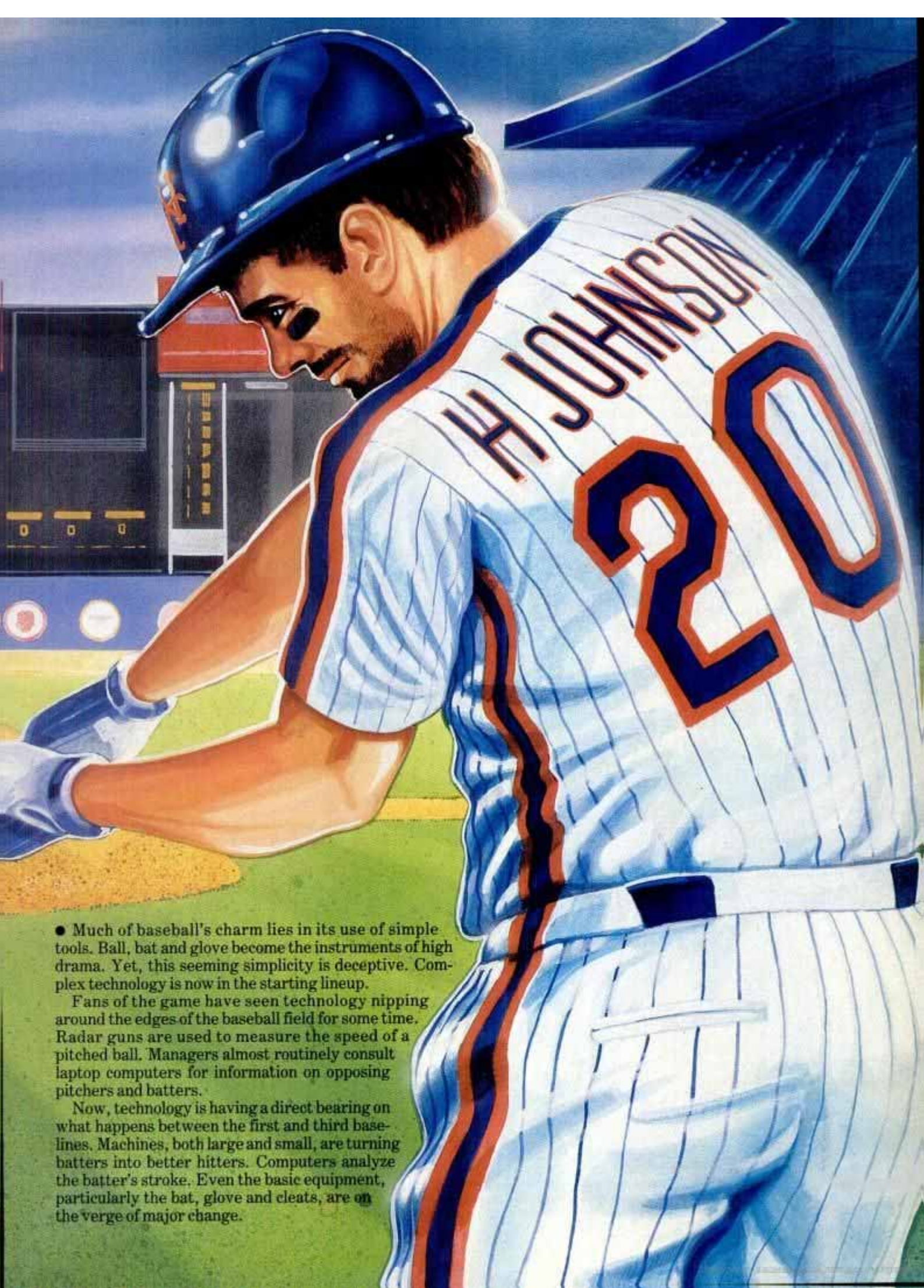
Computer science is playing a greater role in helping batters hit a pitched ball. Analysis even includes the speed of a batter's swing and how well contact was made with the ball.

HOWARD JOHNSON	
Bats L, Throws R	
COUNT: 1 Ball, 2 Strikes	
AVG. AGAINST:	
Fastball	.401
Curve	.352
Slider	.298
Changeup	.273
Swing Speed (sec.)	1.840

TECHNOLOGY COMES TO BAT

Baseball takes a high-tech swing for the fences.

BY FRANK VIZARD; PM Illustration by Steve Gardiner



● Much of baseball's charm lies in its use of simple tools. Ball, bat and glove become the instruments of high drama. Yet, this seeming simplicity is deceptive. Complex technology is now in the starting lineup.

Fans of the game have seen technology nipping around the edges of the baseball field for some time. Radar guns are used to measure the speed of a pitched ball. Managers almost routinely consult laptop computers for information on opposing pitchers and batters.

Now, technology is having a direct bearing on what happens between the first and third baselines. Machines, both large and small, are turning batters into better hitters. Computers analyze the batter's stroke. Even the basic equipment, particularly the bat, glove and cleats, are on the verge of major change.

TECHNOLOGY COMES TO BAT

Most of these changes will probably occur from the bottom up. That is to say, change will work its way up from the college and minor-league levels to the major leagues. Changes to the game are more successfully implemented at levels where money is less of a factor. Players with multimillion-dollar contracts are often reluctant to alter their "proven" methods despite the promise of improvement.

One exception is Howard Johnson, a New York Mets outfielder with a reputation as an excellent hitter. Johnson uses a machine that is basically a system of six lights sitting atop a tripod facing the batter. Johnson stands at a double batting tee that holds baseballs on both the inside and outside parts of the plate. Johnson reacts to a particular lighting cue—each one designates a type of pitch and its location—and tries to complete his swing before hearing an audible beep. The tone approximates the length of time it takes for the ball to reach home plate. The machine, developed by tennis pro Rick Elstein, is directly responsible for Johnson's ability to hit 38 home runs last season, or so Johnson believes.

For the most part, though, change comes from unlikely sources. For example, tiny Grove City College, located just north of Pittsburgh, Pennsylvania, finds itself on the cutting edge of baseball research. A team of mechanical engineers at the college developed a "Diagnostic Bat" for measuring the effectiveness of a batter's swing. The project, first proposed by engineering student Rich Davies, has caught the interest of the U.S. Olympic Committee.

Bat Comparison



The Baum wood composite bat (top) uses a variety of materials, as compared to the Worth aluminum bat (middle) or a hardwood bat (bottom). Wood bats are in very short supply.

PH ILLUSTRATION BY JEFF MANGIAT

Davies' idea was to produce a graph showing the length of a batter's swing and the amount of force a batter brings to the ball upon contact. Another area of interest was how well hitters use the "sweet spot" of the bat. The sweet spot of the bat is the area just below the bat head that produces the most solid hits.

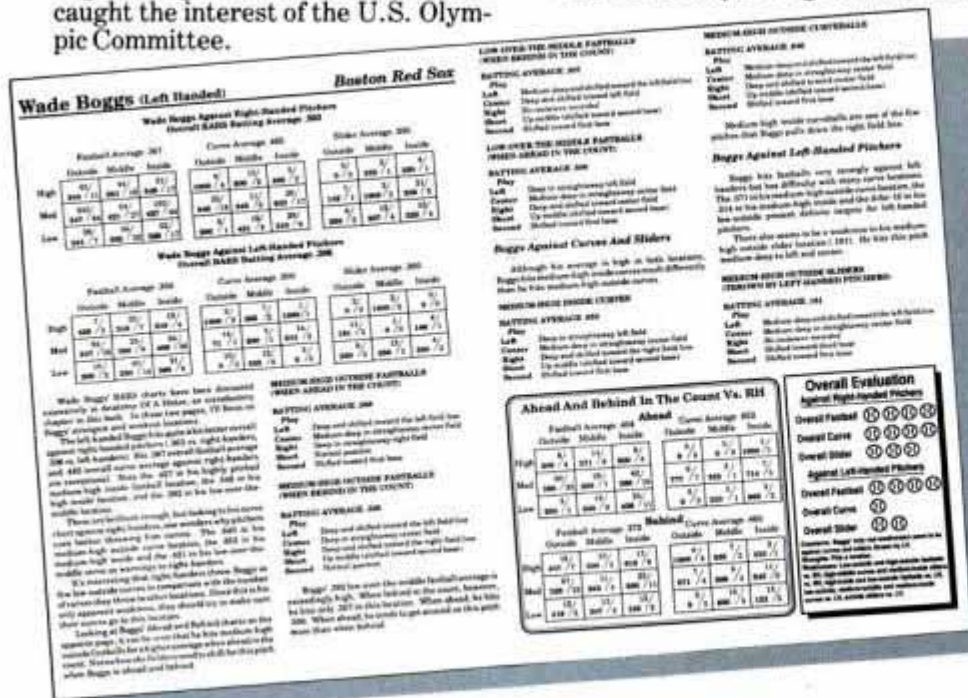
The Grove City College team wired

an aluminum bat to an amplifier which in turn was connected to some intermediary hardware and finally routed into a personal computer for analysis. The D-Bat samples bat stress 1000 times during a player's swing, which lasts just 0.2 seconds. The computer analyzes factors like swing response time, bat vibration, swing tremor and the degree of back swing.

Sid Bream, the first baseman for the major-league Atlanta Braves, and a player from the college were tested using the D-Bat. The results helped define the differences in hitting abilities between Bream and the Division III player. Bream's swing time prior to hitting the ball was longer, mostly because he was more adept at tracking the pitch. A .270 hitter at the time of the test, Bream's use of force as applied through his hands—the "moment"—is also minimal at contact, a characteristic of a free and easy swing. At contact, however, the force being put on the ball is of a considerable amount.

By contrast, the Division III player doesn't track the ball as well, and he is behind the pitch. As a result, the Division III batter tends to stab at the ball, using a lot of force to bring the bat into contact with the ball.

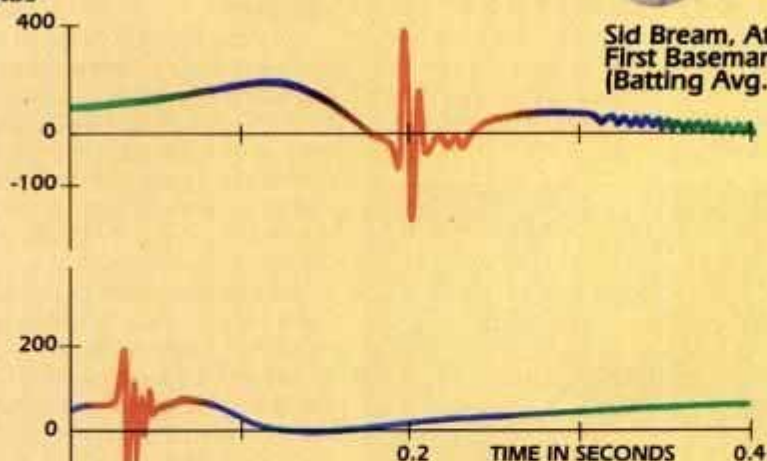
Vibration analysis also showed that Bream hit near the sweet spot more often than the college player. Data



An excerpt from *Baseball Analysis And Reporting System*, by Bill Welch, shows how complex batter analysis can be. A computer tracks how well Wade Boggs of the Boston Red Sox responds to specific hitting situations.

Swing To Swing

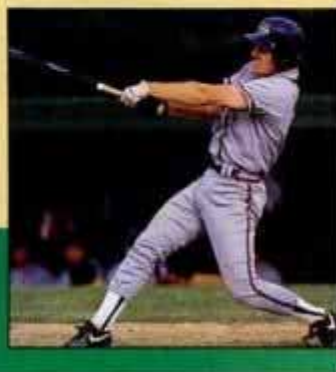
MOMENT
IN POUNDS



Sid Bream, Atlanta Braves
First Baseman
(Batting Avg. .270)

College Level Division III
Second Baseman
(Batting Avg. .208)

A Diagnostic Bat computer analysis compares the bat swing of a major-league professional against a Division III college player. The major-leaguer has a longer, smoother swing and uses a minimal amount of force to hit the ball. The college player is behind in his swing and is forced to stab at the ball to make contact. This "signature" can quickly tell coaches what kind of hits the batter is likely to make, and it can be used to correct flaws.



FOCUS ON SPORTS PHOTOS: PM ILLUSTRATION BY HANK BEN

also indicated that better hitters tend to slow the speed of the bat head just before contact.

D-Bat analysis is still in its early phases, and more sophisticated computer software is likely to yield even more interesting data. Organizations like the U.S. Olympic Committee are interested in the D-Bat project because of its aid to coaches. A "signature" that quickly tells coaches what type of hitter a player is will save coaches valuable time—important for international teams that don't normally play together.

Fans looking for this type of analytical data on hitters might consult the Baseball Analysis And Reporting System (BARS) guide developed by Bill Welch. With the aid of a computer, Welch tracks four pitches and determines batting averages for hitters across a 9-location grid superimposed over the strike zone. Using this methodology, Welch can determine batting averages for the four types of pitches and specific ball/strike situations. This information also tells pitchers how effective their pitches are, and lets fielders know where to position themselves. A new edition of the BARS book is being published this spring by Putnam for \$19.95.

The wood composite bat

Bats are also the concern of Steve Baum, a Michigan inventor who is developing a bat that looks, hits and

sounds like wood, but is much more durable than a wooden bat. Baum's bat uses two crisscrossing layers of a fiber-reinforced fabric/resin material wrapped around a core of foamed-plastic material. The core can also be made from other materials. The exterior is made of ash wood.

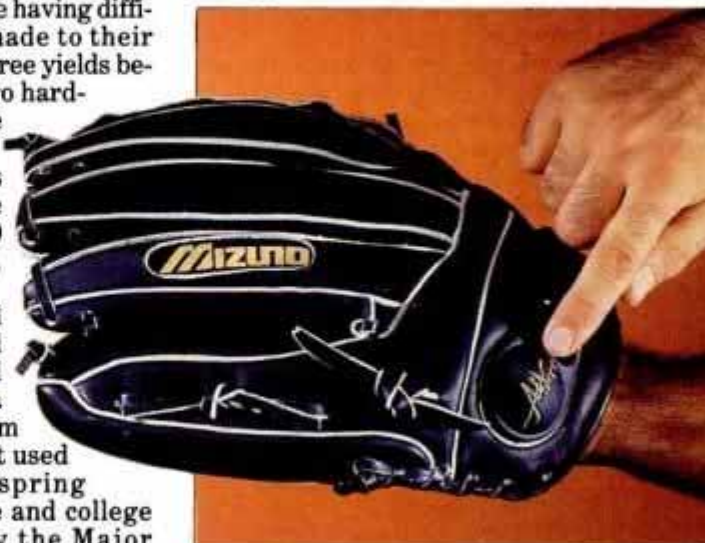
The basic problem, of course, is that wood bats break, and aluminum bats leave something to be desired from an aesthetic standpoint. The situation is becoming even more critical since ash wood is in short supply. Even major-leaguers are having difficulty obtaining bats made to their specifications. One ash tree yields between three and five pro hardwood bats. One ash tree suitable for making bats takes 15 to 25 years to grow. The same tree will yield between 300 and 500 Baum bats, says the inventor.

Baum doesn't intend to replace the hardwood that is now being used by major-leaguers in a game. But rather, Baum would like to see his bat used in batting practice, spring training, minor-league and college games. If adopted by the Major League Rules Committee, the Baum bat would effectively reserve hardwood bats for major-league games.

The Baum bat has been extensively

tested for stress by Tufts University's mechanical engineering department, and has been successfully used by 14 major-league teams in batting practice. The Baum bats recorded more than 3000 hits without any significant wear. A traditional hardwood bat withstands a maximum of 250 hits before breakage.

Players who have used the Baum bat found it to be indistinguishable from the hardwood variety. Even the "crack" sound made by the bat when hitting the ball was virtually identi-



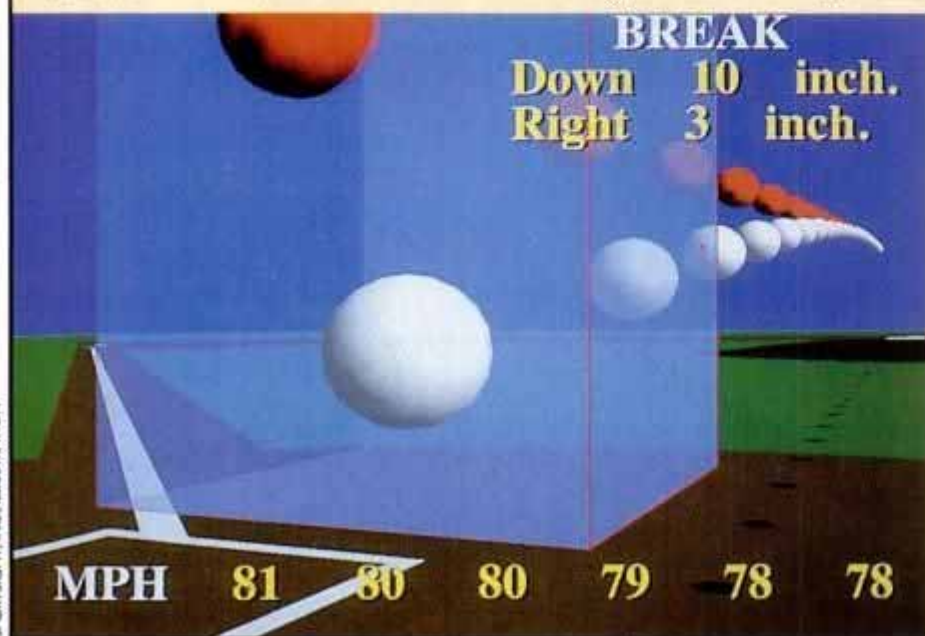
Both Mizuno and Spalding have gloves that use an air-bladder system for a tighter fit. The air bladder covers the back of the hand and portions of three fingers.

TECHNOLOGY COMES TO BAT

Tracking The Pitch

● Already in use by some broadcasters, Supervision is a new 3-dimensional computer graphic that traces the path of a pitch. The white ball shows the actual trajectory of the pitch. The red ball shows the theoretical trajectory of the ball if the pitcher had put no rotation on it. The mph number notes

the speed of the ball as it approaches the plate. Developed by Sportsight, Inc., Supervision immediately made an impact by proving the disputed existence of the rising fastball. The system uses two video cameras located on the first and third base sides of the pitcher's mound, 150 ft. above the ground at a 45° angle to the



SPORTSIGHT, INC., ILLUSTRATION

cal. Hitting distances and their distribution was statistically the same.

Baum says his bat is more cost-effective than aluminum bats. Certainly, this bat might help preserve one of the sweet sounds of summer—the crack of a wood bat hitting a ball.

Nonetheless, the “ping” of an aluminum bat hitting a ball is a sound that will be with us for the foreseeable future. Even here, however, there are technological advances that are reflected in the variety of prices these bats command.

Manufacturing an aluminum bat is a relatively easy affair. The bat shape is hammered out on long, large machines through a process called swaging. The bats are then immersed in a molten salt bath, quickly removed and then quenched in room-temperature water—a procedure that largely determines the strength of the bat. The bats then go through precipita-

tion age hardening and anodizing steps before they are ready to be sold.

New aluminum bats, such as the Worth Powercell bat listing for \$120, use a superthin CU31 aluminum alloy. The bat wall of the Worth Powercell is only 70- to 75-thousandths of an inch thick. Less expensive bats are generally 90- to 95-thousandths of an inch thick and use the more common 7046 aluminum alloy. The thinner bat wall of the CU31 bat produces a more spring-like, trampoline effect as the ball hits the bat's sweet spot. A specially designed, weighted bat head works to enhance the flex motion of the bat.

And since the CU31 alloy is lighter but stronger than the 7046 alloy, hitters can use a lighter bat without sacrificing plate coverage. One Worth Powercell bat, for instance, has a 34 in. length but weighs only 30 ounces. The Worth Powercell, and others like it from companies like Easton, combine control and power thanks to the lightness and strength of the CU31 aluminum alloy.

Batting aids

A bat isn't much good, though, if you don't know how to use it properly. One of the best teaching aids available is the Quick Bat II from the Sport-

field. A special-effects generator and computers combine the video images to produce a graphic representation from either a pitcher's or catcher's viewpoint.

Systems are also being developed to measure the distance of home runs, but they are currently too expensive to be practical. IBM's “Tale Of The Tape” technique, featured at many ballparks, uses a simple equation to determine a homer's distance. Line drives hit into the lower deck are measured from home plate to the point of impact, but shots into the upper deck require a more complex equation. First, an index number of 1.2 for a line drive, 0.8 for a fly ball and 0.6 for a towering fly ball is assigned. A stadium grid supplies the distance from the ground-level row to the upper-deck row above where the ball lands. The equation reads: type of hit \times height from ground-level row + distance of ground-level row from home plate = home-run distance. So, for example, a towering fly ball hit into the upper deck 50 ft. directly above the row at ground level that is 375 ft. from home plate would have an equation of: $0.6 \times 50 + 375 = 405$ ft. This equation, says IBM, has a margin of error of plus or minus 10 ft. —F.V.

Star Co. of Portland, Oregon, (800) 421-8325. It lists for \$300. Quick Bat II uses two optical sensors to time your swing through a set distance. This machine gives the batter instant feedback as to how changes in the mechanics of the swing affect bat speed. The readout is in miles per hour, and in our tests, simple changes in mechanics like tucking in



A circular traction ring on the Tanel shoe allows players to pivot much easier, avoiding any knee injuries.

FM PHOTO BY BRIAN KOSOFF

the shoulder produced increases in bat speed from 76 to 89 mph. An increase in bat speed of 10 mph translates into 40 ft. of added distance for a properly hit softball, says developer and company owner Scott Kelly.

By measuring the swing speed of differently weighted bats, Quick Bat II can also help determine a hitter's optimum bat weight. A similar result

(Please turn to page 141)



Quick Bat II uses two sensors to measure the speed of a batter's swing.

FM PHOTO BY BRIAN KOSOFF

PICKUP

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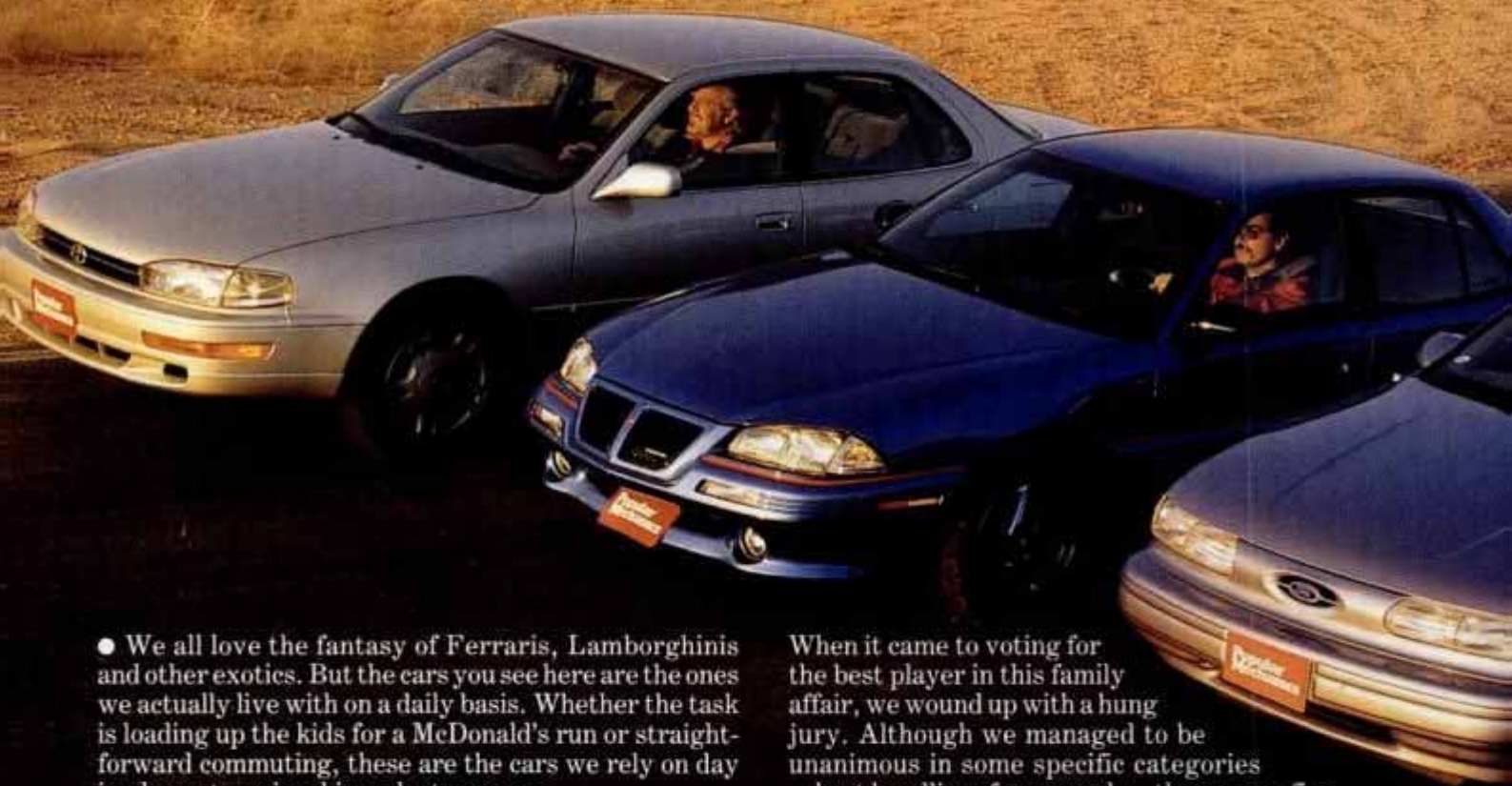
*Savings based on manufacturer's suggested retail price of individual options; actual dealer price of option package and customer savings may vary. Get More From Life... Buckle Up!

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FAMILY AFFAIR

A flock of 4-doors vie for the title of best family car of 1992.

BY TONY SWAN, Automotive Editor; PM Photos by Rich Cox



● We all love the fantasy of Ferraris, Lamborghinis and other exotics. But the cars you see here are the ones we actually live with on a daily basis. Whether the task is loading up the kids for a McDonald's run or straight-forward commuting, these are the cars we rely on day in, day out—rain, shine, sleet or snow.

And if their duties aren't exactly the glamorous activities we associate with the exotic cars, the truth is that these front-drive midsize haulers have capabilities that go beyond their modest mission parameters. After a week of track testing, freeway cruising and back-road touring in these 14 family sedans, we came away with a unanimous impression that family transportation has come a very long way in just the past five years. Not only is midsize a roomier concept than ever before, it also includes more comfort, better all-around performance, better fuel economy and better safety provisions.

That was about the only point of unanimity, though.

When it came to voting for the best player in this family affair, we wound up with a hung jury. Although we managed to be unanimous in some specific categories—best handling, for example—there were five or six claimants for the outright title of best-of-class family sedan. And aside from the absence of the Mitsubishi Galant (Mitsubishi was unable to furnish a test car), this group represents virtually the entire class.

Accordingly, our car-by-car reviews are presented in alphabetical order.

Buick Skylark GS

The old formal sedan roofline is gone, and so is the old N-car designation. GM's replacements—the Skylark, Oldsmobile Achieva and Pontiac Grand Am—have been completely redone inside and out. While there are still a

number of platform similarities, the suspension systems have been revised, producing improvements in both ride and handling.

There are also a couple of new engines for this family—a 2-valve version of the 2.3-liter Quad 4 and GM's new 3.3-liter 3300 V6.

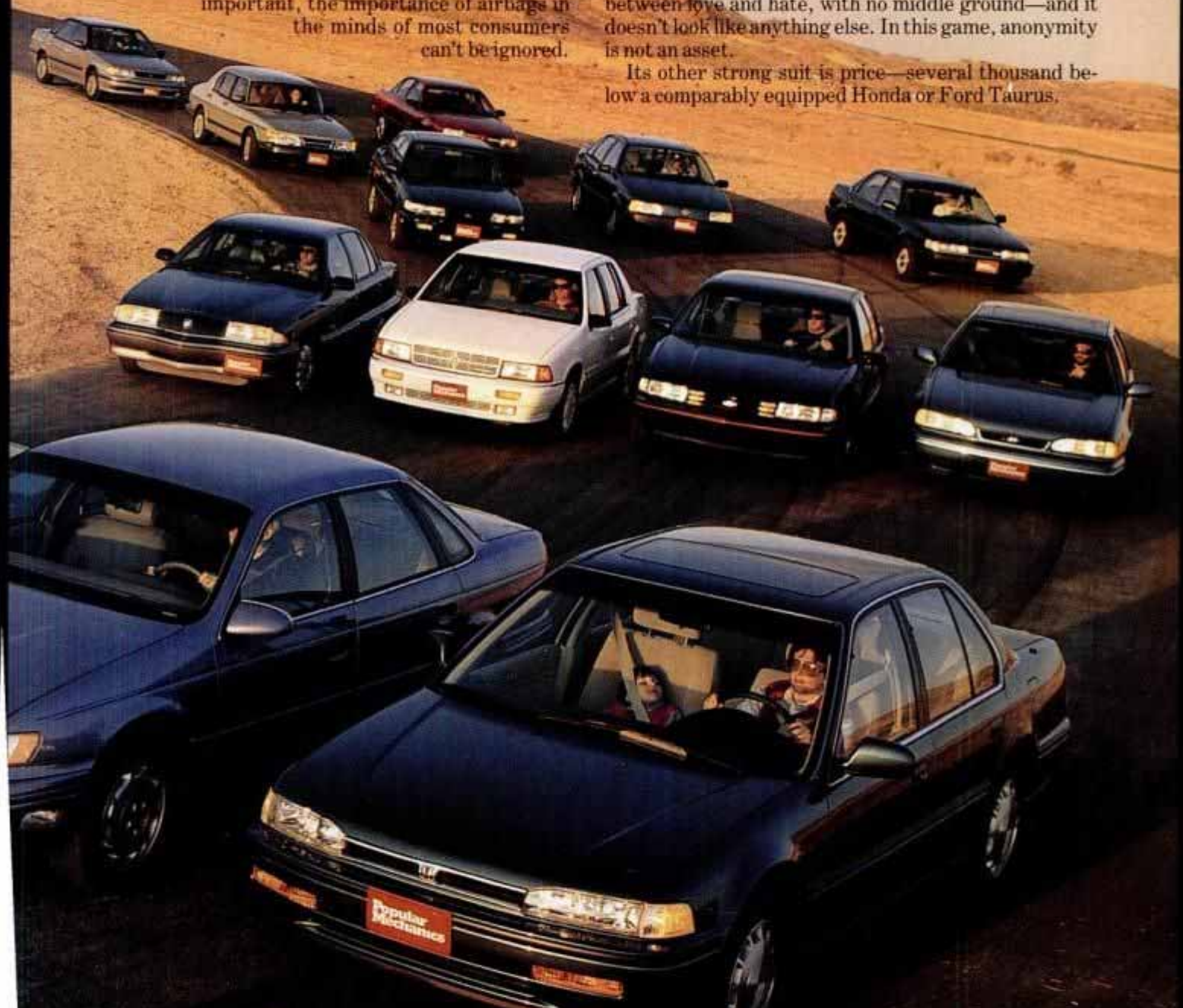
We think GM made a couple of unfortunate decisions in planning these new cars. Tops, given America's new-found preoccupation with safety, is the absence of airbags. GM's consumer-preference research took an either/or position on the question of antilock braking versus airbags. While we agree that ABS is far more important, the importance of airbags in the minds of most consumers can't be ignored.

Another short suit is the 3-speed automatic. Most of the competitors have 4-speeds, which are generally smoother and better matched to engine output.

As for the Skylark itself, we were impressed with the contemporary look of the new interior, its wealth of analog gauges and cleverly designed detail touches. The Gran Touring suspension package provides handling that's about midpack in this test group. Braking performance was near the top.

Judging by the reactions of our test crew, we think the new Skylark's styling will be a strong suit. It tends to polarize beholders—we were about equally divided between love and hate, with no middle ground—and it doesn't look like anything else. In this game, anonymity is not an asset.

Its other strong suit is price—several thousand below a comparably equipped Honda or Ford Taurus.



Poised for combat on the Willow Springs, California, test track, 14 midsize family sedans line up for battle. Flanking Pontiac's new Grand Am GT (second from left) are the segment's pacesetters: the new Toyota Camry, Ford Taurus and Honda Accord, America's best-seller for the past two years.



Chevrolet Lumina Euro 3.4

The Lumina was by far the biggest car in this test group. Even though the Chevy Corsica would have been more consistent size-wise, Chevy positions the Lumina as its Accord competitor, and we were guided by that.

Our Lumina Euro 3.4, equipped with GM's dohc 24-valve 3.4-liter V6, carried a higher sticker than the 4-cylinder Lumina, but it's no more expensive than a loaded Accord EX and less than a V6-powered Camry LE.

Besides the sporty styling, what sets this car apart is lots of muscle. Unlike so many 4-valve engines, the 3.4 V6 has plenty of low-end grunt and gobs of midrange go-power. Mated to a 4-speed automatic, the 3.4 produces 200 hp and 215 ft.-lb. of torque—enough to make this big (3361-pound) sedan the absolute quickest in our acceleration test runs.

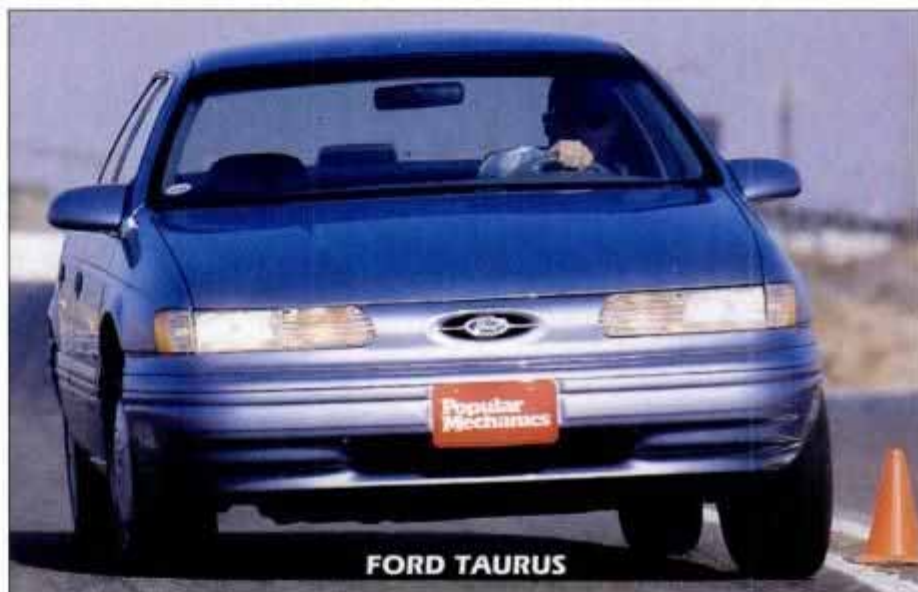
For all its size, though, the Lumina didn't offer as much rear-seat legroom as some of the other cars, and its control/instrument layout came in for considerable test-crew criticism, cosmetically and functionally. Like the other GM cars in this test, the Lumina lacks an airbag, although our Euro 3.4 did have antilock brakes.

ups tested here, but if they're short on glamour, they're long on value.

Our Spirit tester was equipped with a smooth 3.0-liter sohc V6—built by Mitsubishi—that gave it decent acceleration. It's also quiet at almost any speed, which helped us appreciate how little wind noise there is.

The Spirit's formal roofline provides good headroom fore and aft, but rear-seat legroom is a little tight. Trunk space is modest, and the lift-over is high. Interior appointments and materials seem merely adequate, something that can also be said for the instrumentation.

Still, we're talking about value here. The Spirit's combination of snappy exterior cosmetics, smooth



Although the Lumina's handling wasn't at the top of the test heap, its big 225/60R-16 Goodyear Eagle GT+4 tires gave it plenty of grip. They also did a good job of getting all that 3.4 muscle onto the pavement, which is what this Chevy is all about.

Dodge Spirit ES

The Spirit—and its Plymouth twin, the Acclaim—may seem humble parked next to some of the fancier set-

powertrain and quiet operation at a reasonable price should earn it a spot on tight-budget shopping lists.

Ford Taurus LX

It's hard to tell that the Taurus has had its first major redesign since it changed the shape of American sedans back in 1986—until you climb inside. Then a number of thoughtful revisions begin to present themselves. The power window and door lock





TOYOTA CAMRY

switches, for example, are mounted on the horizontal part of the armrest.

The instrument panel has also been improved, and the car's 3.8 in. of additional length have expanded rear-seat legroom and trunk space, both of which are among the best in this group. Our LX had antilock brakes, a \$985 option. A driver's airbag is standard across the line, and a passenger airbag is on the option list.

Ford has done an excellent job of blending ride and handling in the new Taurus. Ride quality, in particular, is neck and neck with the best. On the acceleration side of the ledger, our test car was equipped with the optional (\$555) 3.8-liter V6. It doesn't make any more horsepower than the standard 3.0-liter V6, but its substantial torque (215 ft.-lb. at 2200 rpm) gives the Taurus respectable low- and mid-range punch.

Quality construction, Ford's top priority these days, is apparent throughout the car, which has a solid feel and excellent level of finish.

Will all this be enough to help the Taurus regain its best-seller title? It



OLDSMOBILE ACHIEVA

was a co-champion when the question was put to our test jury on a forget-the-price basis. But with pricing stirred in—our LX was inflated by \$515 worth of leather upholstery and a \$1268 option package that included premium sound and keyless entry—the Taurus contends with the Camry and Accord strictly on its automotive merits.

Honda Accord EX

The Accord's controls are well located, well marked and easy to distinguish with your fingertips—you don't have to take your eyes off the road. Driver sightlines are exemplary, and

the cabin has the open feeling we've come to associate with most Honda designs.

Seating is comfortable, and our top-of-the-line tester was upholstered in tasteful materials. Rear-seat legroom is tight compared to some of the other cars we tested, but there's plenty of room up front and plenty of room in the trunk as well, augmented by a low liftover height.

Honda still doesn't offer a V6 for the Accord, and our tester's 130-hp dohc 16-valve Four gives something away to the 6-bangers, in noise and smoothness.

On the other hand, the Accord's all-



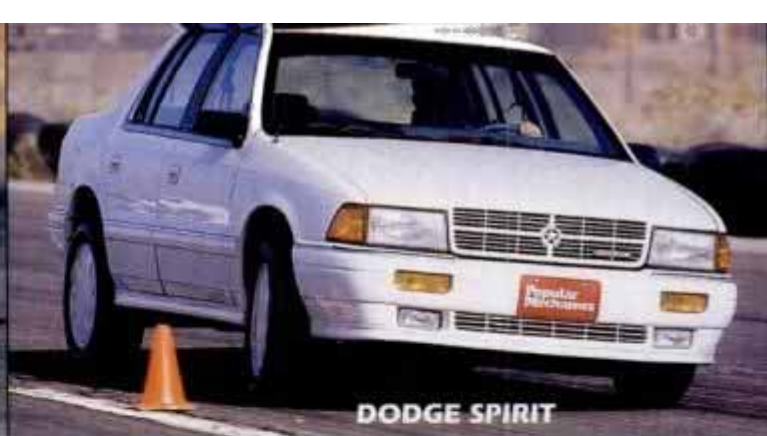
HYUNDAI SONATA



HONDA ACCORD



SUBARU LEGACY



DODGE SPIRIT



PONTIAC GRAND AM

around performance certainly measures up to its intended purpose. It doesn't excel in any particular area, but it does everything well, without fuss. Our EX model included antilock brakes, and a driver's-side airbag is standard in all Accords.

Like everything else in life, Accord prices have crept steadily upward. Our test car, festooned with a broad range of luxury equipment including a sun/moonroof, topped \$19,000.

The bottom line: Even at its most expensive, the Accord continues to be

an excellent automotive value. It's not hard to see why this is the best-selling car in America.

Hyundai Sonata G

We knew going in that the Hyundai Sonata rated as a good value. Nevertheless, the Sonata surprised everyone with its roominess, quality and all-around performance. It was quickest through the slalom, beating even the nimble VW Passat, and several drivers rated it tops in the fun-to-drive category.

The Sonata's usable interior volume is as good as the best in this group—plenty of leg- and headroom, front and rear—and the Hyundai designers have obviously studied at the Honda school of control layout.

There won't be an airbag-equipped Sonata until the next redesign, but our test car did have antilock brakes. It also had an extensive list of comfort/convenience goodies, including power windows, locks and mirrors,

SPECIFICATIONS AND DIMENSIONS

MANUFACTURER/ MODEL	BASE PRICE/ PRICE AS TESTED	ENGINE/ DISPLACEMENT (ci/cc)	ENGINE HP, NET/ TORQUE (ft.-lb.)	ENGINE/ DRIVE LAYOUT	TRANS- MISSION TYPE	WHEEL- BASE/LENGTH (in.)	TRACK FRONT/REAR (in.)	WIDTH/ HEIGHT (in.)	HEAD-, LEG-, HIPROOM, F/R (in.)	CURB WEIGHT (lb.)
Buick Skylark GS	\$15,555/ \$18,952	V6 OHV 204.0/3344	100 @ 5200 rpm/ 185 @ 2000 rpm	front/ front	3-speed automatic	103.4/ 189.2	55.6/ 55.6	67.5/ 52.2	F: 37.8/43.0/49.5 R: 37.0/34.8/50.8	2900
Chevy Lumina 3.4 Euro	\$13,400/ \$19,541	V6 DOHC 24V 204.4/3350	200 @ 5000 rpm/ 215 @ 4000 rpm	front/ front	4-speed automatic	107.5/ 198.3	59.5/ 58.0	71.7/ 53.8	F: 38.8/42.4/52.3 R: 38.1/36.9/52.3	3361
Dodge Spirit ES	\$11,955/ \$16,108	V6 SOHC 181.3/2972	141 @ 5000 rpm/ 168 @ 2500 rpm	front/ front	4-speed automatic	103.5/ 181.2	57.6/ 57.2	68.1/ 53.5	F: 38.4/41.9/54.3 R: 37.9/38.3/35.0	3089
Ford Taurus LX	\$14,980/ \$20,730	V6 OHV 231.9/3802	140 @ 3800 rpm/ 215 @ 2200 rpm	front/ front	4-speed automatic	106.0/ 192.0	61.6/ 60.5	71.2/ 54.1	F: 38.3/41.7/55.2 R: 37.6/37.5/54.8	3131
Honda Accord EX	\$13,225/ \$19,365	L4 SOHC 16V 131.6/2156	130 @ 5200 rpm/ 142 @ 4000 rpm	front/ front	4-speed automatic	107.1/ 184.8	58.1/ 58.3	67.9/ 53.9	F: 38.3/42.6/52.4 R: 36.7/34.3/54.1	2740
Hyundai Sonata GLS	\$11,150/ \$16,162	V6 SOHC 181.3/2972	142 @ 5000 rpm/ 168 @ 2500 rpm	front/ front	4-speed automatic	104.3/ 184.3	58.3/ 57.5	68.9/ 55.1	F: 38.5/42.9/58.0 R: 37.4/37.5/57.6	2851
Mazda 626 LX	\$13,225/ \$16,905	L4 SOHC 12V 133.3/2184	110 @ 4700 rpm/ 130 @ 3000 rpm	front/ front	4-speed automatic	104.1/ 179.3	57.3/ 57.7	66.5/ 55.5	F: 37.8/43.7/NA R: 37.6/36.6/NA	2825
Nissan Stanza SE	\$12,750/ \$19,415	L4 SOHC 12V 145.7/2389	138 @ 5600 rpm/ 148 @ 4000 rpm	front/ front	4-speed automatic	100.4/ 179.9	57.5/ 56.7	66.9/ 54.1	F: 38.6/42.6/55.6 R: 36.8/33.6/50.1	2855
Oldsmobile Achieva SL	\$13,290/ \$18,040	V6 OHV 204.0/3344	160 @ 5200 rpm/ 185 @ 2000 rpm	front/ front	3-speed automatic	103.4/ 187.9	55.6/ 55.3	67.2/ 53.1	F: 37.8/43.1/49.1 R: 37.0/34.8/51.1	2772
Pontiac Grand Am GT	\$11,999/ \$17,707	V6 OHV 204.0/3344	160 @ 5200 rpm/ 185 @ 2000 rpm	front/ front	3-speed automatic	103.4/ 186.9	55.6/ 55.3	68.8/ 53.1	F: 37.8/43.1/48.9 R: 37.0/34.8/51.3	2846
Saab 900	\$20,495/ \$21,185	L4 DOHC 16V 129.3/2119	140 @ 6000 rpm/ 138 @ 2900 rpm	front/ front	3-speed automatic	99.1/ 184.5	56.4/ 56.8	66.5/ 56.1	F: 37.8/41.7/48.4 R: 37.4/34.6/51.2	2735
Subaru Legacy L	\$16,899/ \$18,184	O4 SOHC 16V 135.0/2212	130 @ 5600 rpm/ 137 @ 4400 rpm	front/ 4wd	4-speed automatic	101.6/ 178.9	57.7/ 57.7	66.5/ 53.5	F: 38.4/43.1/54.1 R: 37.8/35.0/53.7	3140
Toyota Camry LE	\$14,368/ \$20,947	V6 DOHC 24V 180.4/2959	185 @ 5200 rpm/ 195 @ 4400 rpm	front/ front	4-speed automatic	103.1/ 187.8	61.0/ 59.0	69.7/ 55.1	F: 38.4/43.5/58.0 R: 37.1/35.0/56.8	3252
Volkswagen Passat GL	\$17,750/ \$19,410	L4 DOHC 16V 121.0/1984	134 @ 5800 rpm/ 133 @ 4400 rpm	front/ front	4-speed automatic	103.3/ 180.0	58.2/ 55.9	67.1/ 56.2	F: 38.2/42.5/52.8 R: 37.4/38.2/53.9	2985

1. Times from a steady-state 40 to 70 mph. 2. Best speed achieved while weaving through 8 cones placed in line, 100 ft. apart. Speeds provide index of transient response.



SAAB 900



VOLKSWAGEN PASSAT

and a sunroof. Stir that in with contemporary styling, alloy wheels and a \$16,162 price tag, and you have what we think is the best buy in the bunch.

Mazda 626 LX

The 626 is headed for change. We've already had a look at the next generation, and we'll be driving it soon. In the meantime, though, the current car continues to be a solid player.

The midsize Mazda's strengths are excellent workmanship inside and out, good directional stability and better-than-average handling. Its 110-hp sohc 12-valve Four is pretty tame compared to some of the engines offered here, but it gets the job done, and without excessive thirst.

Rear-seat legroom is tight by the new midsize standards, but the 626 is otherwise a comfortable place to be, with nicely shaped seats and quality materials throughout. Major controls and switches are well designed, and there's a fair amount of small-object



MAZDA 626

storage. Airbags aren't available. ABS is, as an option for \$1150.

Standard LX equipment includes power windows, door locks and mirrors, as well as cruise control and a good sound system. Our tester's sun/moonroof and a/c system helped bump the price close to \$17,000. But with a new 626 due soon, we bet you could find a current 626 LX for much less.

Nissan Stanza SE

If you like handling, the Stanza SE—S for Sport—should definitely be on

your list. Its all-independent suspension and stiff chassis give it a definite edge over its rivals when the road begins to wriggle.

The 2.4-liter sohc 12-valve Four is a little noisy when you're extracting maximum horsepower—138 at 5600 rpm—but there's decent torque, and its limited body roll helps put power down evenly in hard cornering.

The Stanza's formal roofline adds up to good rear-seat headroom, although rear legroom is limited. The

(Please turn to page 123)

				TEST RESULTS						
STEERING TYPE/TURNS LOCK-TO-LOCK	TURNING CIRCLE (ft.)	WHEELS/ TIRES	BRAKE SYSTEM FRONT/REAR	FUEL ECONOMY (MPG EPA city/hwy.) PM test	ACCELERATION 0-60 MPH (sec.) 1/4-MILE (sec. @ mph)	PASSING ¹ ACCELERATION 40-70 MPH (sec.)	BRAKING 700-FT. ² 60-0 MPH SLALOM (ft.)	200-FT. ³ SKIDPAD MPH (lateral g)	PM ⁴ SERVICEABILITY INDEX	
Pwr. rack & pinion/ 3.0	37.8	16 × 6-in., alloy/ 205/55R-16	F: 10.2-in. vented disc, ABS/ R: 7.9-in. drum	24/31 30.2	10.5 17.84 @ 77.0	9.4	129	59.4	.81	7
Pwr. rack & pinion/ 2.6	39.0	16 × 6.5-in., alloy/ 225/60R-16	F: 10.5-in. vented disc, ABS/ R: 10.1-in. disc	17/26 27.8	9.5 17.01 @ 82.7	8.8	136	60.5	.80	5
Pwr. rack & pinion/ 2.6	40.5	15 × 6-in., alloy/ 205/60R-15	F: 11.1-in. disc/ R: 8.7-in. drum	23/27 27.0	10.95 18.03 @ 74.3	9.7	171	58.5	.79	8
Pwr. rack & pinion/ 2.5	38.6	15 × 6-in., alloy/ 205/55R-15	F: 10.0-in. vented disc, ABS/ R: 10.0-in. vented disc	18/28 29.8	10.83 17.94 @ 76.6	10.6	132	57.4	.76	7
Pwr. rack & pinion/ 3.1	36.1	15 × 5.5-in., alloy/ 195/60R-15	F: 10.2-in. vented disc, ABS/ R: 8.7-in. drum	22/28 31.2	11.0 18.14 @ 75.9	9.1	145	58.6	.78	9
Pwr. rack & pinion/ 3.1	35.7	15 × 6-in., alloy/ 205/60R-15	F: 10.1-in. vented disc, ABS/ R: 10.0-in. disc	18/24 25.4	10.35 17.69 @ 76.9	9.2	169	61.4	.78	8
Pwr. rack & pinion/ 3.0	38.0	14 × 5-in., alloy/ 185/70R-14	F: 10.4-in. vented disc, ABS/ R: 10.2-in. disc	21/28 29.9	13.2 19.26 @ 71.4	11.9	161	57.4	.71	7
Pwr. rack & pinion/ 2.9	35.4	14 × 5.5-in., steel/ 195/65R-14	F: 10.0-in. vented disc, ABS/ R: 10.1-in. disc	22/29 26.5	11.2 18.29 @ 73.8	10.5	156	58.6	.80	9
Pwr. rack & pinion/ 3.2	35.3	15 × 6-in., alloy/ 195/65R-15	F: 10.2-in. vented disc, ABS/ R: 7.9-in. drum	24/31 29.9	10.4 17.76 @ 77.6	9.9	136	58.5	.75	7
Pwr. rack & pinion/ 2.5	36.4	16 × 6-in., alloy/ 205/55R-16	F: 10.2-in. vented disc, ABS/ R: 7.9-in. drum	24/31 27.4	10.5 17.84 @ 77.0	9.9	134	58.1	.80	7
Pwr. rack & pinion/ 3.7	33.8	15 × 5.5-in., steel/ 185/65R-15	F: 10.9-in. vented disc, ABS/ R: 10.1-in. disc	20/26 24.1	14.7 20.07 @ 71.2	10.1	177	53.6	.81	10
Pwr. rack & pinion/ 3.3	33.5	14 × 5-in., steel/ 185/70R-14	F: 10.2-in. vented disc, ABS/ R: 10.5-in. disc	23/30 26.2	11.9 18.47 @ 72.3	11.6	138	56.3	.73	9
Pwr. rack & pinion/ 3.0	36.7	15 × 6-in., alloy/ 205/55R-15	F: 10.8-in. vented disc, ABS/ R: 10.5-in. disc	18/24 25.3	9.8 17.37 @ 78.7	7.8	126	57.2	.81	8
Pwr. rack & pinion/ 3.2	35.1	14 × 6-in., steel/ 195/60R-14	F: 10.1-in. vented disc, ABS/ R: 8.9-in. disc	20/29 33.6	12.3 18.7 @ 73.7	10.0	158	61	.82	7

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

Look who "Pickup of

The Dodge Dakota Club Cab V-8 was voted pickup truck of the year by *Four Wheeler*



magazine. With good reason, too. After all, we put a 230 horsepower Magnum V-8 under the hood. Now, you'd probably expect that it would beat the compacts. But the big

news is that Dakota beat full-size pickups in *Four Wheeler's* rugged competition. Meaning a mid-size pickup was rated the number one choice of any new pickup on the road. Better than the Chevy K-2500 HD Turbo Diesel V-8.

The GMC K-3500 7.4L Crew Cab V-8. And the Ford Flareside F-150 5.0L V-8. Probably because Dakota's Magnum multipoint electronic



OFFICIAL SPONSOR
OF THE 1992 U.S.
OLYMPIC TEAM

The logo for the 1992 U.S. Olympic Team, featuring the letters 'USA' in red above the Olympic rings.

picked up the Year."

fuel injection system makes for a powerful 4x4 that can do it all. Like accelerate from 0-60 quicker than any of the competitors in *Four Wheeler's* tests.



5.2L Magnum V-8

But also tackle gravel roads and backwood mountain trails. *Four Wheeler's* rigorous tests proved it. Perhaps the best news about the 1992 pickup of the year is that the Dodge Dakota also has the lowest list price of any of the pickups *Four Wheeler* magazine tested. Which is an excellent reason for you to pick one up.

Call 1-800-4-A-DODGE
for a free product brochure.

Advantage: Dodge



BUY OR LEASE AT YOUR DODGE DEALER.
Dodge reminds you to "Tread Lightly!"
when you go off road. And buckle up for safety.

Dodge Dakota LE Club Cab

See limited warranties at dealer, exclusions and restrictions apply.

70
36



WAR IN THE WIND

An inside look at Dennis Conner's high-tech *Stars & Stripes*, the boat to beat for the most coveted trophy in the world—the America's Cup.

BY JOE SKORUPA, Boating/Outdoors Editor

● It's an awesome feeling to be at the wheel of *Stars & Stripes*, Dennis Conner's high-tech \$3-million America's Cup yacht. This is especially true today, the day Conner stuns the world by announcing he will not build a second boat. Most of his competitors are mounting expensive multi-boat campaigns, a technique pioneered by Conner himself, but the most famous sailor in the world is forced to defend the 1992



Stars & Stripes crewmen attack the primary winch grinders, while Conner (wearing white shirt) plans strategy.

America's Cup (AC) solo—a victim of the recession and a shortage of sponsorship funds.

I steer the one-of-a-kind carbon-fiber sloop out of San Diego Bay past the sandy cliffs of Point Loma. Just as we round the point, a blast of wind jolts the immense Kevlar and Mylar sails. The boat heels over sharply. The boom swings overhead. The cobalt-steel stays and Kevlar lines strain with groaning noises like those of a bass violin string tightened to the breaking point.

Instantly, the 16-man crew springs into action. Heavy winds can send 250,000 ft.-lb. of torque through the boat's 110-ft. mast. The crew hustles around the deck at full tilt—working grinders, adjusting lines and producing an assault on the senses that sounds more like a locomotive than a sailboat.

Suddenly, the words of competing AC skipper Bill Koch leap to mind: "The forces these boats generate are almost beyond comprehension. The best boat on the water will be the one that crosses the finish line first in the deciding race and then destructs because of the pounding it's taken." After watching the Japanese crew break a half-million-dollar mast and then breaking two himself, Koch

actually called the new AC boats "dangerous."

Will the mast break while I'm at the helm? Where is Conner, anyway? I look around and spot the steely-eyed skipper on the other side of the boat with tactician, Tom Whidden, calmly observing the data displays and the performance of his crew.

Finally, Conner comes over and grabs the wheel. He turns to starboard, and as suddenly as the

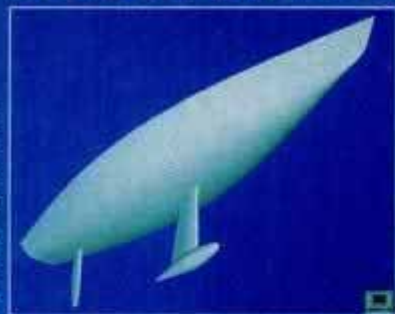
commotion began, calm returns. Later, after other guests take their turns at the wheel, one GM executive confides to me, "You know, I've ridden in an Indy 500 pace car on race day at 100 mph, but steering this sailboat at 15 knots is a much bigger thrill." I know what he means.

Computers and Cadillacs

Next to the huge motor fan at the end of the 100-ft. tunnel, a technician appears to be the size of an ant. Each of the fan's six fixed-pitch blades is a 24-ft. behemoth of laminated Sitka spruce. At full rpm—powered by a 4000-hp electric motor—the fan generates a precise flow of air that reaches an impressive 150 mph.

This is the state-of-the-art Aerodynamics Lab located on the 1000-acre compound of the General Motors Research (GMR) Technical Center Laboratories. I'm getting the grand tour from Nils Muench, GMR's executive director of physical sciences. Each of the engineers and technicians I meet on the tour is a recognized expert in the fields of artificial intelligence, structural analysis, computational flow, mathematical modeling, statistical reduction,

WAR IN THE WIND



Hull analysis using computer-aided design technology improves construction efficiency and boat speed.

STARS & STRIPES

1. SPINNAKER—ripstop nylon
2. FORESTAY—cobalt steel
3. TOPPING LIFT—Kevlar rope
4. AFTERGUY—Kevlar rope
5. FOREGUY—Kevlar rope
6. HULL—carbon fiber with Nomex core
7. MAST—carbon fiber
8. SPREADERS—carbon fiber
9. SPINNAKER POLE—carbon fiber and Kevlar
10. SIDESTAYS—cobalt steel
11. DECK HATCHES—sail stowage
12. MAINSAIL—Kevlar and Mylar
13. BATTEN—carbon fiber
14. JUMBO DISPLAYS—digital instruments
15. BOOM VANG—carbon fiber, hydraulic
16. BOOM—carbon fiber and Kevlar

17. PRIMARY WINCH GRINDERS
18. PRIMARY WINCHES
19. TAILER'S PITS—jib trimmer's position
20. MAINSHEET GRINDER
21. KEEL—carbon fiber
22. TRIM TAB—carbon fiber
23. BALLAST BULB—lead
24. POSSIBLE WINGLETS LOCATED HERE

25. MAINSHEET PEDESTAL—
island of hydraulic controls and winches
26. INSTRUMENT DISPLAYS AND COMPASS
27. STEERING WHEELS—
rudder controls
28. RUNNING BACKSTAY GRINDER
29. NAVIGATION COMPUTER
30. AFT HATCH
31. RUNNING BACKSTAY WINCHES

32. MAINSHEET TRAVELER
33. RUDDER BEARING
34. ANTENNAS FOR DATA TELEMETRY AND GPS
35. PERMANENT BACKSTAY—
cobalt steel
36. SPINNAKER SHEET—
Kevlar rope
37. RUDDER—carbon fiber and foam
38. WINCHES FOR HALYARDS, LIFTS AND HOISTS





STARS & STRIPES
1992



STARS & STRIPES
1987

Overall length: 65 ft.
Waterline length: 45 ft.
Beam: 12 ft.
Weight: 60,000 lb.
Draft: 9 ft.



Overall length: 75 ft.
Waterline length: 55 ft.
Beam: 18 ft.
Weight: 40,000 lb.
Draft: 13 ft.



GM AERODYNAMICS LAB PHOTO

Engineers prepare a one-third-scale model of *Stars & Stripes* for testing in the GM wind tunnel.

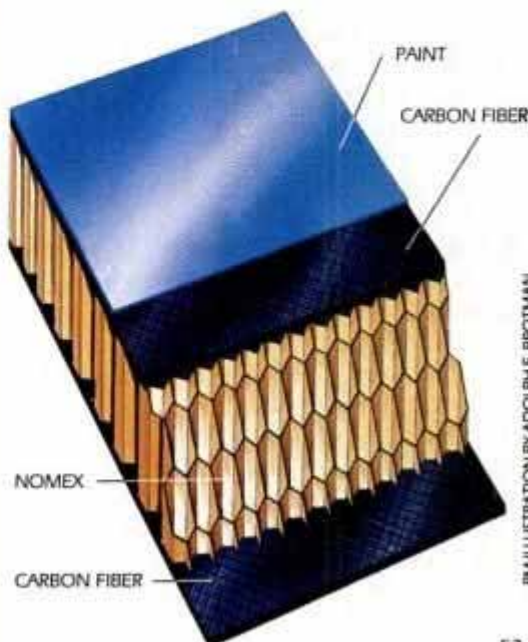
aerodynamics and wind-tunnel testing. One of Conner's first acts after lining up Cadillac as a prime sponsor, in June 1990, is to press for access to these experts and the leading-edge tools they work with. This is a controversial request for top GM brass, because work performed at GMR is highly sensitive in nature. After some internal debate, Conner's request is approved, but with two caveats: 1. No budget, and 2. Work is to be done afterhours.

Muench, a devoted sailor and long-time fan of AC racing, pitches the concept to his GMR colleagues. He finds it surprisingly easy to line up a team of top engineers. Fifteen months later, roughly 100 GMR staffers are involved in the project, with more than 70 required to sign strict confidentiality statements.

Full credit for designing *Stars & Stripes*, of course, doesn't reside with GM. That honor is reserved for a team headed by David Pedrick, Alberto Calderon and Bruce Nelson. This talented team, handpicked by Conner, created what many believe is the fastest boat of its kind within narrow AC confines, by balancing such factors as mast height, hull size, hull weight, sail area, keel depth and ballast.

But make no mistake about it, the volun-
(Please turn to page 126)

HULL CUTAWAY



PM ILLUSTRATION BY ADOLPHE BROTHMAN



LONG-TERM

A flyer joins the fleet.

● In the five months since our last long-term test update (see page 47, Nov. '91), the PM fleet covered lots of miles, most of them remarkably troublefree.

In this issue, we say goodbye to our Toyota Previa minivan and welcome a sexy newcomer—a '92 Corvette Convertible with Chevy's hot new LT-1 engine.

Chevrolet Corvette Convertible

The last time we tested a Corvette was 1987. Since that time, so many changes, upgrades and improvements have been made to the car that we thought it time to take another look at America's premier sports car.

In fact, so many changes have been made since '87 that you can almost consider the '92 an all-new car. The '87 we tested didn't have 17-in. wheels and tires (added in '88), bigger brakes with improved antilock capability ('89), a removable hardtop for winter ('88), fully adjustable sport seats (option in '87), electronically controlled suspension ('89), analog gauges ('90), Automatic Slip

Reduction (ASR) traction control system ('92), an all-new 350-cu.-in. small-block V8 ('92) and ZR-1 styling cues ('91). One other thing the '87 test car didn't have was our '92's \$46,000 sticker price. That's about \$10,000 more than the '87 cost.

We took delivery of our test car right after the first of the year. It had 904 miles on it when we picked it up at Chevrolet's garage in New York City. The car currently has 2200 miles on it, and, thus far, we are thoroughly enjoying our time with it.

The new LT-1 engine (see page 86, Oct. '91) pumps out a mighty 300 horsepower. We can personally attest that there are virtually no cars on the road that can keep up with the '92 Corvette should you want to mash your right foot to the floor and blow the doors off the opposition out of a tollbooth. And when you overcook it in a turn, the ASR traction control system regulates throttle, brakes and engine power automatically to keep you out of the weeds.



CHEVROLET CORVETTE CONVERTIBLE



SUZUKI SWIFT GT



TOYOTA PREVIA LE

TEST CARS

In fact, the ASR—plus the new Goodyear GS-C tires—keep you virtually locked to the road no matter how you drive this car. And in all weather. We've been amazed several times at how fast you can drive this Corvette on wet roads and still be safe and secure. By the way, if you want to act immature and smoke the tires coming out of the McDonald's parking lot to impress all the IROC-Z guys, all it takes is a flick of a dash button and the ASR shuts off.

Despite the mighty power output of the LT-1 engine, we are averaging 19.3 mpg thus far. That's in mixed highway driving and New York City traffic. And with a heavy right foot.

The one thing we do not like is the interior design. The newer interior feels much more cramped than the old design. And although we didn't care much for the old digital and graphic information panel, the current analog gauges are virtually useless except for the tach and speedometer. All the other gauges are tiny, hidden behind the steering wheel and indistinguishable from one another. We're passing the Corvette on to another edi-

tor for the next update to see if this is a universal complaint or just a personal negative. —Joe Oldham

Buick Park Avenue Ultra

We've been piling up the miles on our Park Avenue Ultra, and the odometer has just blipped past 10,000. Six-thousand miles in four months in this car has given us excellent insight into why Buick is the only car manufacturer that was up in sales in 1991 for both the model and calendar year. The only one, including imports.

The Buick Park Avenue is, simply, a fine automobile. We like driving the Buick. It is big and roomy inside, yet seems trim on the outside. In fact, the proportions of this car are about perfect for a car of this class.

Ditto on the car's ride and handling. Our test car is a Park Avenue Ultra, which means it has a special ride and handling package that is available only as an option on other Park Avenues. It works. Our test car rides like a luxury car should, soaking up bumps and road imperfections, yet remaining flat and stable when pushed hard along a country road. We would rate the ride and

LONG-TERM TEST CARS



BUICK PARK AVENUE ULTRA

handling of this car equal to much more expensive cars.

We're still getting over 23 mpg on our test car and we still wish the car had a little more power—a complaint supposedly cured in the '92 Ultra, which carries a supercharged 205-hp version of the 3800 V6 under the hood as standard. Our '91 test car has the normally aspirated 170-hp 3800.

Since our last report, we've had absolutely no mechanical problems with the car to report. So the only thing we can talk about that we don't like is the

commuting, our Swift GT has been out of town only once, an excursion of about 120 miles to Scranton, Pennsylvania. It's a better interstate ride than you might think—the sports car seats deliver surprisingly good cruising comfort, and fuel economy spikes up toward the 45-mpg mark.

But at heart this little pocket rocket is a street fighter, fast on its feet and small enough to make avenues of tiny seams in heavy traffic.

The only recurring complaint in the logbook continues to be excessively

the dodge-'em car derby of its everyday life. We can think of other econoboxes that would probably do better. But it's hard to think of one that would be this much fun. —Tony Swan

Chevrolet C2500 Silverado

Unlike most of our long-term test vehicles, this one has spent almost all of its 11,457 miles on the open road, usually with several hundred pounds of tools and racing spares in the cargo box and a U-Haul car transporter, replete with race car, hooked on behind.

The Chevy's big 454-cu.-in. V8 engine thrives on this kind of work, and seems to keep getting stronger as the miles accumulate.

About the only symptom of all this hard work is the 454's heavy thirst at the gas pump. Loaded fuel economy runs between just under 10 mpg in hilly going to almost 12 on long, level stretches. Without a load, it's turned in as much as 16 mpg.

About the only problem that's showed up in the logbook is an electronic aberration early on—an oil-pressure gauge that would occasionally indicate off-the-chart pressures. But that's long since leveled out. We also noted a bit of oil consumption—3 quarts in the first 5000 miles—but with the engine broken in, consumption has gone down to almost nil.

One other note: Our Chevy came with a semisoft plastic bed liner, which we recommend to anyone who plans to carry loads that might slide around in the cargo box.

—Tony Swan

Toyota Previa LE

At nearly 12,000 miles on the odo, our minivan is being returned to Toyota. Not unscathed, either. First off, there's some thankfully minor damage to the paint on the passenger side,



OLDSMOBILE CUTLASS SUPREME

color of our test car. It's silver with gray leather interior. But we can't complain too loudly since we ordered it this way. —Joe Oldham

Suzuki Swift GT

Driving in New York City is neither for the fainthearted nor the fragile. Which is why we continue to cherish the Suzuki Swift GT. With 6232 miles of mostly Manhattan motoring on the clock, it has yet to utter a squeak of protest—or a rattle.

Aside from a bit of New Jersey

high steering effort at low speed. But these same complainants also love the sports car feel that goes with it.

So far, our only problem has been a broken rear side window—a consequence of someone leaving a jacket visible on the back seat when the car was parked on the street. Otherwise, the Suzuki's subdued GT trim and tiny size have kept it from attracting much unwanted attention.

The Swift's average fuel economy continues to hover at 33.0 mpg, which we think is pretty good, considering



CHEVROLET C2500 SILVERADO

courtesy of the Stalag 13 parking lot ("I know nothing!").

The driver's-side power window was sticky, and needed a slight push by hand to make it slide home the last few inches. I say *was* because the problem healed itself before we got the thing into the dealer.

We've all been impressed with the in-dash CD player—best factory stereo sound of any vehicle we've driven under 40 grand. At least until one of the rear-seat woofers either unscrewed itself from the bracket or just self-disintegrated.

These minor annoyances aside, we've had no trouble whatsoever. Fuel mileage has been disappointing, but considering the service it gets—commuting to and from Manhattan through the gauntlet of the George Washington Bridge's commando-style traffic jam—we won't complain about not being able to break the 20-mpg barrier. Freeway driving, cruise-control style, does approach 21 mpg, not bad considering the interior volume and full-time 4-wheel drive.

—Mike Allen

Oldsmobile Cutlass Supreme

The real reason we ordered this long-term was an interest in the new 3.4L Twin Dual Cam engine. And an interesting engine it has been. While remaining docile under your right foot in normal driving, the 4-cam 24-valve V6 makes enough oomph to embarrass most sporty cars away from a traffic light. Here in the Big Apple the bogie to meet is the outrunning of the default taxicab to the far side of the default intersection by one car length plus 1 in. That gets you in front of the cab before you have to slam on the brakes for the double-parkers on both sides of the street. The Olds does this readily, much to the dismay of a lot of

guys driving yellow Chevy Caprices.

We reported in our last long-term update that the a/c had packed up. The dealer fixed it in about 3 minutes, as the problem was an electrical connector in the engine compartment.

The only other complaint has been a slight pulsing in the brakes. We can't tell yet whether it's the brake discs going out of true or just a square tire. Come to think of it, with the road surface as cratered as NYC manages to keep it, we'll bet on the tire. At any rate, it's minor and we're waiting to

our last installment of the long-term saga turned out to be an oil drain plug that wasn't snugged down more than finger-tight, something we rectified during an oil change. Since then, oil consumption/leakage has been close to zero. Fuel economy on the highway is a tad over 20 mpg. But between the stiff off-road-quality suspension and the tire noise from the M/S rated tires, we don't usually take this one very far on the turnpike.

We have had it in some seriously deep, fluffy sand—the kind that sucks



take the car into a dealer for its next scheduled maintenance to get it looked at.

—Mike Allen

Dodge Dakota Sport V8

This is one tasty-looking truck. The side graphics are perhaps a little more subtle in the metal than they seem on the magazine page, but nothing else is subtle about it. Its tall stance, chrome rollbar and seriously large tires attract plenty of urban cowboys here in the wilds of New Jersey.

The minor oil leak we mentioned in

up all the horsepower you have to spare. Some small pickups have a tough time here—because they have smaller engines. You wind up buzzing the engine, making a lot of noise and not making much progress in granny gear. The 318-cu.-in. V8 engine lets you stay in high-range 4wd, and just leave the gearshift in Drive.

Our only real complaint about driveability is overly harsh part-throttle shifting. Okay, it's a truck—that excuses the stiff ride, but not the shift quality.

—Mike Allen



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sedan that knows how
to handle Mother Nature.
A car engineered

to help keep you in
control when the road
or the weather takes a
turn for the worse.
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standard 4-wheel anti-
lock brakes (ABS).
(Once you've used

them, you'll never settle
for anything less.) The
response of a 200-
horsepower, 24-valve
Twin Dual Cam V6
(on 34 sedans).
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Corvette-inspired rear

FINALLY SOMEBODY'S
FOUND A WAY TO CONTROL
THE WEATHER.



Lumina Euro 3.4 Sedan shown. *See your Chevrolet dealer for terms of this limited warranty. Chevrolet, the Chevrolet emblem, Lumina and Corvette are registered trademarks of the GM Corp. ©1991 GM Corp. All Rights Reserved. Buckle up, America! 

suspension. Front and rear stabilizers. And touring tires mounted on aluminum wheels. So even if you can't change the weather, it doesn't have to spoil your day

1992 Lumina Euro Sedan

Features: • Unsurpassed corrosion protection.
• Room for six adults. • 24-hour Roadside Assistance for 1992 models.* • Full-coverage, no-deductible, 3-year/36,000-mile

Bumper to Bumper Plus Warranty for 1992 models.†



THE HEARTBEAT
OF AMERICA IS
WINNING.™

SIGNALS FROM SPACE

New technologies use satellites to expand television use.

BY STEPHEN A. BOOTH, Contributing Editor; PM Illustration by Jeff Mangiat

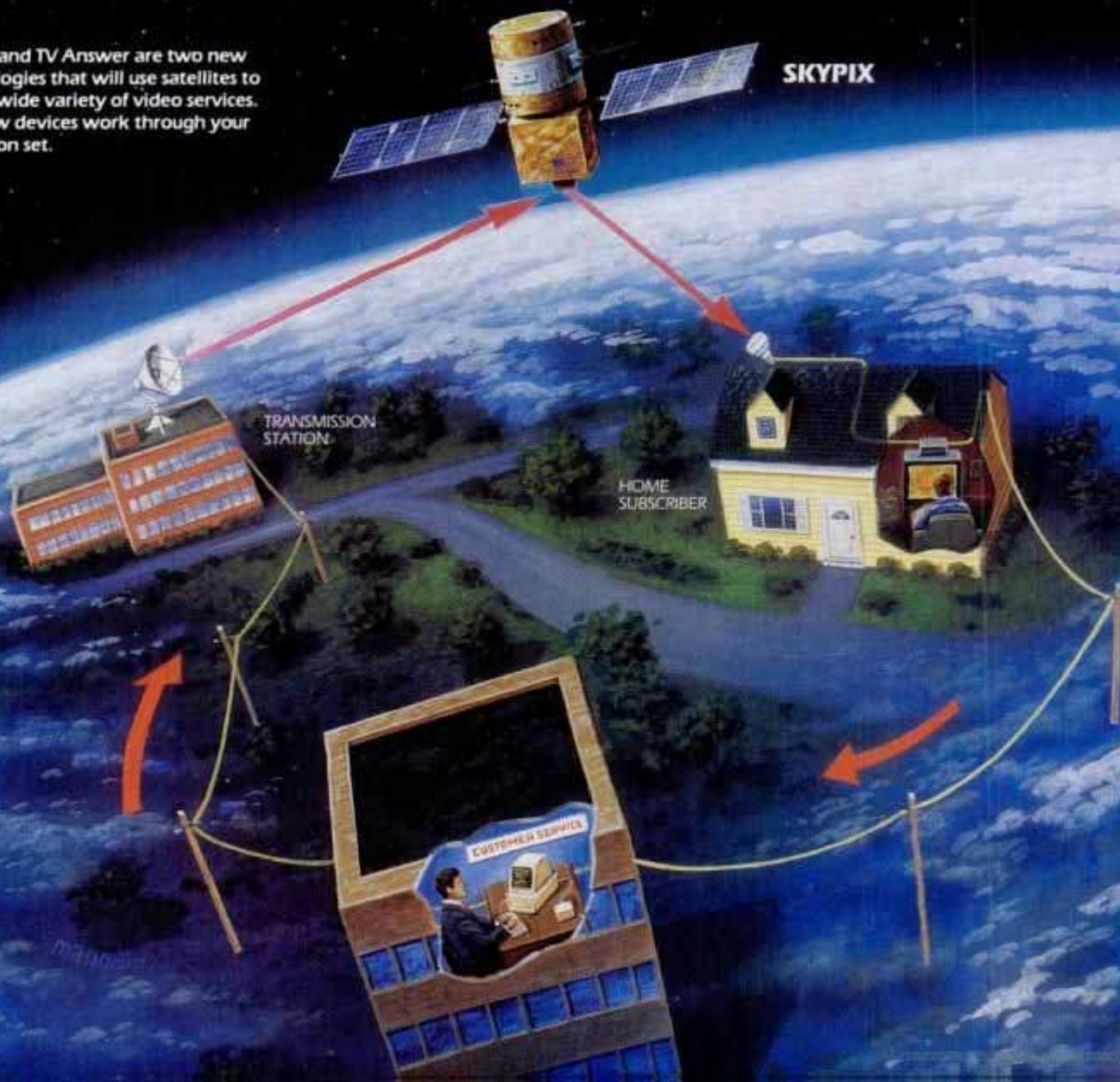
● To outer space and back—it's a long way to go for a movie, a pizza or to cast a ballot. But if two companies have their way, you'll be able to obtain all sorts of products or services without ever leaving your living room. You won't even have to dial the telephone. All you will have to do is aim your trusty remote control at the television and let space-borne satellites handle the rest.

Futurists predicted long ago that TV someday would evolve beyond its merely passive role and become an interactive communications link between the average household and the outside world. That someday could

arrive very soon in the form of two new technologies called SkyPix and TV Answer.

Both rely on geostationary satellites orbiting some 233,000 miles above Earth. Both make extensive use of digital computing. But the similarities end here. SkyPix puts you within a fingertip's reach of 35,000-plus movies or delivers a ballgame that isn't carried on local, network or cable stations. TV Answer lets you compete in game shows, participate in polls, pay your bills, balance your checkbook, shop from home and program your VCR in one step—all through your TV.

SkyPix and TV Answer are two new technologies that will use satellites to offer a wide variety of video services. The new devices work through your television set.



Direct-broadcast TV

With 80 channels of movies and entertainment operating around the clock, the SkyPix system might spare you those trips to the mall to rent videos. The heavens light up this month, when SkyPix receivers and their tiny dish antennas are slated to go on sale at electronics and department stores around the continental U.S.

SkyPix, based in Kent, Washington, bills itself as the first direct-broadcast satellite (DBS) service. Until now, home reception of satellite TV signals entailed aiming the dish antenna at one of many satellites, then tuning the satellite receiver to the frequency of a specific transponder or channel on that satellite to display the desired program on your TV set. Most "birds" have about 24 transponders, and each transponder can carry only a single program at a time. Although the satellite TV signals travel on microwave frequencies, these signals are analog waveforms, similar to the ones transmitted by land-based broadcasters and cable operators.

The SkyPix system represents a breakthrough in the way satellite-borne programming is transmitted and received. To begin with, the signal is digital—the computer lingo of zeros and ones used to store music on a compact disc. By using a complex process that SkyPix won't reveal, the signal is compressed before transmission and later reconstructed at the set-top receiver. Because of this digital compression, SkyPix can send eight channels of pro-

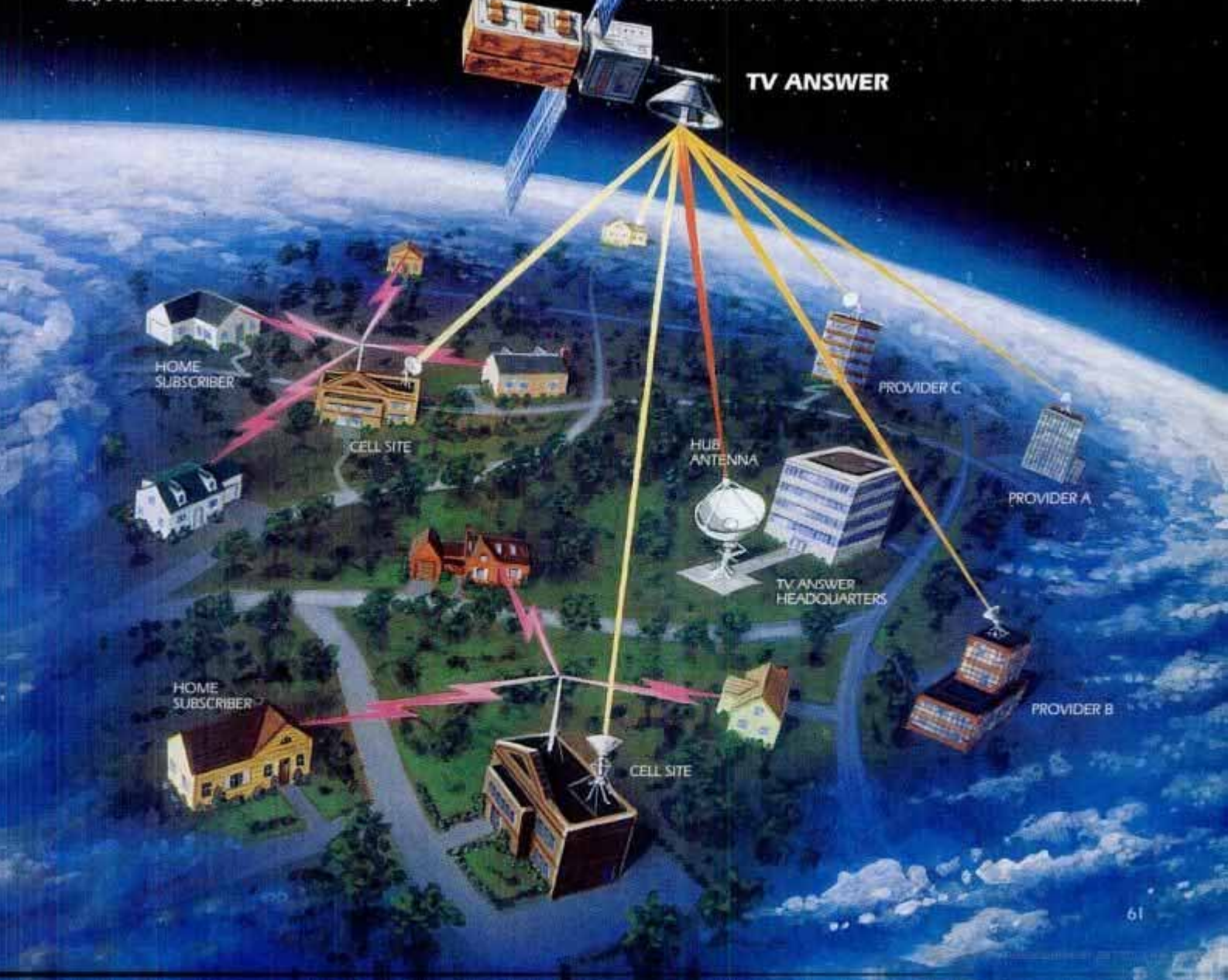
gramming simultaneously from a single transponder.

At the outset, SkyPix says it will transmit 80 channels from a single satellite. Overall, the system and the receiver are capable of handling 250 channels. Because the transmission comes from one bird, the 3-ft. dish antenna needs to be aimed only once. And since all 80 channels arrive at the SkyPix receiver simultaneously, there's no need for viewers to tune to specific transponder frequencies. Instead, users make selections on a program-by-program basis, using a wireless remote control to pick from on-screen menus. The sleek set-top receiver does the rest.

Fast viewing

The abundant channel capacity of the SkyPix system brings two benefits to TV households: variety of programming and frequency of scheduling. Unlike other TV delivery systems, a movie is not limited to showings, say, every 2 hours. By transmitting the same program over multiple channels, the movie can have different start times just minutes apart. This means you can call up the SkyPix menu at any time of the day or night, select a program you wish to view and see it from the start by the time you've nuked the popcorn.

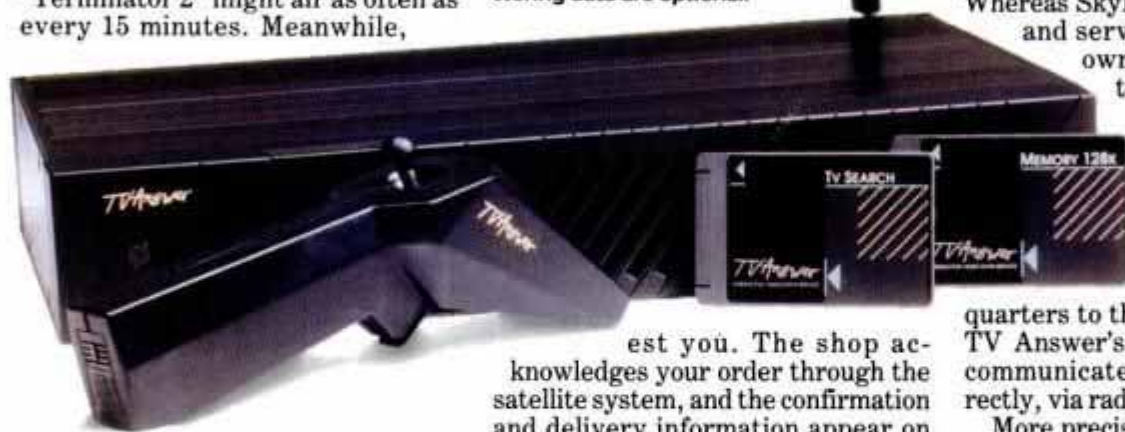
In fact, SkyPix says its programming schedule is really dictated by viewer demand. For example, of the hundreds of feature films offered each month,



SIGNALS FROM SPACE

the volume of viewer selections determines the number of channels allotted to any one movie and the frequency of its start times. A hot title such as "Terminator 2" might air as often as every 15 minutes. Meanwhile,

The TV Answer receiver is operated with a pistol-style remote. Memory cards for storing data are optional.



older movies might be available only every 2 hours.

Besides feature films, the DBS service will offer live events, including sports and concerts, as well as special-interest programs such as educational and kids' shows. A monthly subscription to SkyPackage will bundle several TV superstations, SkyNews (the system's own news network), Sky-Kids and other programs.

Variable pricing

SkyPackage, tentatively priced between \$9.95 and \$12.95, is the only regular subscription service SkyPix will offer. Anything else you watch you'll have to buy a la carte, or pay-per-view in TV jargon.

According to SkyPix, pricing has yet to be finalized, but it will vary according to the program. For example, a recent box-office hit might sell for \$3 or \$4, while an oldie-but-goodie goes for a buck or so. Live events would cost more. You can tape the programs on your VCR, but this will cost extra. There's an anticopying code on SkyPix programs, to prevent unauthorized recording. If you wish to tape the show—a choice you make through the on-screen menu—the anticopy code is removed for a fee that goes to pay a copyright royalty to the movie studio.

You also use the receiver to call SkyPix HQ for other transactions. These include sending messages to another SkyPix owner, perhaps even a gift of some programming. The telephone gets ready to dial whenever you call up the menu (literally) to order a pizza or any other shop-at-home item from a participating service. The tollfree line places your order with SkyPix Central, which beams up the order to the satellite for relay to a SkyPix receiver at the participating pizza joint near-

est you. The shop acknowledges your order through the satellite system, and the confirmation and delivery information appear on your TV screen. All of this transpires in less time than it takes to read this paragraph.

Besides the 250-channel capacity, the receiver can be upgraded for high-definition and widescreen TV reception. In the meantime, picture quality is the best around. At 480 lines of horizontal resolution, SkyPix not only exceeds broadcast TV (330 lines) and VCR (240 lines), but is the best reason to date for buying a 400-plus-line Super VHS VCR.

There's an RS232 computer port on the SkyPix receiver. In the future, this will permit computer-to-computer communications, including the downloading of upgraded programs from software suppliers. And finally, as more powerful satellites are launched, dish-antenna size might be reduced to 12 or 18 in. The SkyPix receiver with dish is currently priced



around \$700, plus a \$150-minimum installation charge.

Radio communicator

Whereas SkyPix is an entertainment and services provider with its own communications system, TV Answer bills itself as a communications hub that can tie together any number of independent, alternative programmers and services. Instead of linking its headquarters to the home via telephone, TV Answer's satellite-based system communicates to subscribers indirectly, via radio.

More precisely, TV Answer would use a new form of radio similar to the cellular radio-telephone technology now widely in use across the U.S. The concept, called Interactive Video Data Service (IVDS), has been approved by the Federal Communications Commission. So TV Answer's IVDS could reach your home this year.

The TV Answer transmitter/receiver is a sleek component that attaches to your TV set. It comes with a wireless remote control fashioned more like a ray-gun pistol than a conventional zapper. On the back panel there are inputs for a TV antenna or cable lead, VCR, videogame or other program sources.

A stubby antenna on the TV Answer box is your link to the outside world. The box communicates with the local cell site, or relay station, via low-powered radiowaves in the 218- to 218.5-MHz VHF frequency band. Each cell site can handle about 10,000 homes, or a 4-mile radius.

As the cell site receives radio signals from the home, it converts this data to microwave frequencies that its satellite transmitter uplinks to a communications satellite in space. The satellite relays the signals back to Earth, either to the TV Answer cus-

(Please turn to page 131)

SkyPix beams 80 channels into your home via a small dish antenna that is easily installed.



SPECIAL SECTION

HOME CARE



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GUTTER MAINTENANCE

TEXT AND PHOTOS BY
MERLE HENKENIUS

● If your home has a basement, nothing you can do to protect your foundation is more important than maintaining your home's gutters and downspouts. If your basement leaks, for reasons other than high seasonal or static ground water, improved gutters will also help.

Here's why. Basement walls leak and buckle inward because too much rainwater is allowed to collect against them, saturating the soil below.

The problem is compounded because the 3 ft. of soil next to your foundation is all fill. It was put there after the basement walls were installed. As such, it is likely to be the fluffiest, least compacted, most porous and most water-receptive soil on your property. And it will stay that way. Fill dirt can never be as solid as soil that hasn't been disturbed.

Because wet soil has greater density than dry soil, it expands disproportionately when it freezes. And because of the solid, undisturbed soil out in the yard, this expansion has nowhere to go but into the basement wall, which has design strengths that are mostly vertical, not horizontal.

Of course, when spring arrives, the soil thaws and compresses again. But unlike the horizontal expansion, this reduction in volume is likely to be vertical. That's right, the soil next to your home drops slightly, encouraging even greater accumulations of water. Even in areas where freezing is not a problem, the mere weight of saturated soil can do damage to basement walls.

As you can see, you don't need to travel too far down this road before gutter maintenance starts to make real sense, especially when you consider that the entire project will cost you next to nothing. It's simply a matter of directing the water that falls on your roof as far away from your house as possible.

Improving ground slope

If the soil around your home has settled, so that rainwater flows toward, instead of away from the foundation, you'll need to correct that problem first. Simply bring in enough soil to create a steady slope in the right



1 Use a narrow drywall or putty knife to remove old leaves and pine needles from gutters. Just scrape the bottom of the gutter clean so water will run freely.



2 Remove stubborn clogs from downspouts using a garden hose to force a strong stream of water down the pipe.



3 Seal gutter joints with a special lap sealant available in caulk tubes. Make sure the gutter is dry before applying.



4 To keep debris from clogging downspout, insert a ball-shaped screen in top of spout. The screen just slides into place.



5 To install a full gutter screen, just roll out screening, cut it to length and force the top edge under the bottom shingle course.

direction. Ideally, the grade should start 6 in. above level at the foundation, and slope away from the house for at least 4 ft. Keep in mind that these are finished grade dimensions, and that new soil will settle a couple of inches once in place. To avoid insect infestations and dry rot, however, hold the soil below the sill plate and siding by several inches.

Cleaning and repairing gutters

Gutters that spill water often do so because they are packed with leaves and other debris, or because gutter brackets have come loose. These two conditions are often related, as the weight of a full gutter often loosens the brackets.

The first order of business is to clean the gutters thoroughly. The best approach is to use a 3-in. drywall knife or even a child's sandbox shovel. Just scrape the blade along the bottom of the gutter, lifting out the mud-like layer of decomposed leaves, as well as the fresh leaves (Photo 1).

This done, clean the downspouts by forcing a garden hose (with water running) down each spout from above

(Photo 2). What the weight of the water doesn't knock loose, the end of the hose will, and you won't have to disassemble the entire downspout. Finally, go to the far end of each run and wash all remaining soil and leaves to the downspout, flushing the entire system. With the gutter clean, replace any loose or broken brackets, restoring the original slope toward the downspouts.

If the gutter has been leaking from one or more splice joints, you'll also

want to seal those. Wait until the gutter is dry, and then caulk each joint with gutter and lap seal (Photo 3). Because a good bond is required for longevity, be sure to clean any dirt from under the joints beforehand. Use a pocket knife or whatever tool you have that can be worked under the edge of the joint. Gutter sealant comes in caulk tubes and goes on easily. Just lay a bead along each side of the joint from one edge of the gutter to the other.



6 To secure the screening, attach it to the gutter brackets using wire or plastic electrical ties like the one shown.



7 To restore the proper slope to a sagging gutter, remove the gutter spike, lift the gutter and re-drive the spike.



8 To lift a sagging gutter that is supported by brackets, remove the nails, reposition the brackets and nail in place.



9 Secure all downspouts to the house with brackets. Attach the brackets to the spouts using sheetmetal screws or rivets.



10 To help carry rainwater away from the foundation, be sure to install splash blocks under all the gutter downspouts.



11 A folding downspout extension is a great substitute for a splash block. To attach, first drill pilot holes in both pieces.



12 Join the extension and downspout with sheetmetal screws. One screw on each side of the downspout is enough.



13 Once installed, the folding extension is easily lifted up and out of the way when you're mowing close to the house.

Installing gutter screens

One way to keep leaves and debris out is to install screening over the gutters. Gutter screens work well except in two situations.

The first is when the offending leaves or seeds are small enough to fit through the screen. Pine needles and Linden tree seeds, for example, turn cleaning screens into more work than cleaning gutters without screens.

The other situation has to do with climate. In the northern third of the country, gutter screening can cause some serious problems. The problems occur when a heavy layer of snow and ice is caught in the screening and on the eve of the roof when the snow starts to melt. As temperatures warm to above freezing during the day and then drop below freezing each night, melted snow is forced by the ice coating (on the screen) up under the shingles and down into the soffit. From there, it makes its way into an exterior wall, which becomes a costly mess. While this scenario can also occur without gutter screening, the screening does appear to exaggerate the problem.

It's also worth mentioning that often a gutter will remain relatively clean without screening, but will still overflow because the small downspout openings plug up. A solution here might be a simple downspout screen, which allows debris to build up around the screen but still permits water through the downspout opening. These screens are simply pressed into the downspout fitting and are held in place by gravity and tension (Photo 4). You will occasionally need to clear the area around these downspout screens.

But if complete gutter screening seems right for you, simply roll it out and tuck the upper edge under the bottom layer of shingles (Photo 5). Then fasten the screen to the gutter brackets with wire or electrical ties (Photo 6).

Poor gutter performance can also result from a sagging gutter that allows water and debris to accumulate far from the downspouts. To repair this condition, simply loosen the nearest fastener—either a gutter spike (Photo 7) or a gutter bracket (Photo 8)—lift up the low section and then reattach it in another place.

Downspouts and splash blocks

Downspouts are an important part of the system, because they are responsible for sending the water away from

the foundation. As such, make sure that each downspout is secured firmly to the house, and that all elbows and extensions are screwed or riveted in place (Photo 9).

Downspouts should not, therefore, terminate next to the house. Some form of extension is required. You can use a 3- or 4-ft. section of downspout, a splash block (Photo 10) or some other device to carry the water away from the house.

The problem with downspout ex-

tensions is that they are a constant annoyance when it's time to mow the lawn. To overcome this, you might try one of many products made with just that problem in mind. We chose a PVC extension that is screwed directly to the downspout elbow (Photos 11 and 12). In its lowered position, it effectively carries water away from the house. When mowing, however, it can be tipped up and out of the way (Photo 13). All and all, it seems to be a good compromise. **PM**

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DRIVEWAY REPAIR

TEXT AND PHOTOS BY
MERLE HENKENIUS

● A concrete driveway wouldn't seem to need much care. After all, it's just a simple slab, and concrete is certainly one of the most durable building materials that ever came on the scene. Still, driveways do deteriorate, and long before they're finished, they can look bad. There are a few preventive measures you can handle yourself to extend the life of your drive and keep it looking good for years to come.

Of course, one of the obvious appearance problems is an oil spill, usually from your car's crankcase or transmission, or from routine maintenance on your lawnmower and other gas-powered equipment. Fortunately, a fresh oil spot is easily cleaned with a common household product—cat litter. Simply sprinkle a liberal amount of cat litter onto a fresh oil spot, and allow it to absorb the oil.

When the granules turn dark, sweep them up and apply a second sprinkling. This time, use a soft brick to grind the cat litter into the oil (Photo 1). You don't have to bear down too hard. Just maintain a steady, circular motion to achieve the best results. When the litter is reduced to a fine powder and remains light in color, you will have removed all but a final residue that clings to the voids in the surface. Even this residue will be light in color, however, and it will lighten further the longer it's exposed to the sun.

The lesson? Even if you don't own a cat, an inexpensive bag of cat litter is a handy thing to have around. Lacking cat litter, a light sprinkling of Portland cement will also do the trick. For older, more stubborn oil spots, you might consider a commercial concrete cleaner, or degreaser. Commercial degreasers are available from any well-stocked concrete products dealer, swimming pool outlet and even an occasional auto supply center.

The brand we chose carries the Sure-Fix trademark, and is noncorrosive, nonacidic and biodegradable. It will also not harm grass or shrubs, which is a big plus for people who have invested a lot of time and money in landscaping. Simply pour a little degreaser on the affected area and scrub it in with a stiff-bristle brush (Photo 2). When the grease appears dis-



1 To remove an oil-spill stain from a concrete drive, just sprinkle the area with cat litter and rub the surface with a soft brick. Then sweep the area clean.

solved, hose down the area. Repeat the whole process if the stains are still visible. Keep in mind, however, that over time the sun will bleach away some of the more subtle stains.

Cracks and control joints

The adage in the concrete business is that all concrete will crack. This means that the only control the installer has is in encouraging the slab to crack in the best possible places. While this is not completely true, as a general rule of thumb, it's a sensible way to look at concrete. Controlling the crack is done by cutting a control joint roughly every 10 ft. and install-

ing expansion joints about every 30 ft.

A control joint is merely a groove cut across a slab that is roughly one-fourth the depth of the pour. In making this cut, the installer creates a weak spot, so that crack-producing ground movement and traffic will complete the job along that line.

An expansion joint is comprised of an oil-soaked fibrous material that separates one side of the slab from another. Because it is able to expand and contract with the seasons, it allows the slab to move slightly without causing the concrete to buckle under pressure. These expansion joints are what yield the regular bumps on con-



2 Remove stubborn oil stains with commercial degreaser. Brush area firmly to lift stain, then rinse off with clean water.



3 To properly seal an expansion joint, first remove all the debris from the joint using a putty knife or cold chisel.

crete highways and the cracks between sections of concrete sidewalk.

The problem is that this material breaks down over time much quicker than the concrete does. When this happens, the slab moves laterally but doesn't move back. As such, it leaves a gap at both ends. To keep this from happening, it's a good idea to seal the top of an expansion joint to keep it from deteriorating and to keep water (and resulting frost) from undermining the slab from below. The best approach is to seal the joint with a commercial-grade urethane caulk, which has amazing flexibility and adhesion.

In our case, the joint had already deteriorated significantly and had settled nearly 2 in. In addition to this problem, the top of the joint was covered with damp dirt and leaves. This presented two difficulties. First, urethane caulk will not cure properly when applied thicker than 1/2 in. Our joint was nearly 2 in. deep. Second, our joint material had breaks in it, but the urethane we prefer is self-leveling. As such, it will run out of any gap it finds and completely disappear. (Nonflowable urethanes are available for difficult situations.)

To bring the joint back to a workable height, we cleaned away the dirt (Photos 3 and 4) and packed the settled joint with concrete backing rod available at masonry suppliers. The generic name for this material is somewhat misleading, as it's not a rod but a plastic-foam coil. It is very easy to work with, and it comes in different sizes to bridge a wide variety of different cracks.

Because our original joint was 1 in. wide, we oversized to a 1 1/4-in. rod, which could be held in place by friction. We simply pressed the rod into the joint with a putty knife (Photo 5) and capped each end of the joint with a wooden stake. The stakes keep the self-leveling caulk from running out at the ends, but you could use any barrier that would create a dam for it.

With the joint ready, we simply pumped the top of the joint full of urethane caulk and let it flow into a level cap (Photo 6). Urethane takes a few days to cure properly, and it's best to leave it alone until it is dry. But if you must use the drive within hours, lightly sprinkle sand over the joint once it starts to skin over. This will keep the caulk from sticking to tires or, for that matter, the neighbor's cat.

If you have some scrap plywood around, you can also build a couple of simple ramps to cover the joints with. A 6-in.-wide piece of 1/2-in.-thick ply-

wood nailed to two pieces of 1 x 2 scrap wood—along each edge—easily bridges the joint. You can even drive over the ramps if you move slowly to keep the ramps from sliding over the joint.

Because the whole point is to keep water from entering the cracks in a slab, urethane caulk should also be used to fill control joints and any stray cracks that have appeared.

A sealer coat

Driveway sealants are a controversial topic in many areas of the country, primarily because they are often used by traveling bunco artists to bilk unsuspecting homeowners out of thousands of dollars. In many cases a sealer simply isn't needed, no matter how clever or persuasive the sales pitch.

But mass hysteria aside, driveway sealants do serve a purpose in some situations. They are nearly required when new concrete is poured in late autumn. In this instance, a sealant keeps water from entering the slab and popping the surface with the first deep freeze.

Ironically, the more years a driveway goes without a sealant, the less it

is likely to need one. The reason is that normal surface grime from dirt, car tires and, yes, oil spills help seal the concrete. If yours is a relatively new drive, or if you've noticed unusual surface degradation, then a sealant is probably in order. This is especially true if your drive has a rough surface that has been finished with a broom.

As for which sealant to use, most work well enough—but read the label directions and disclaimers carefully. These products require a clean surface and a careful, warm-weather application. Make sure that the sealant you choose doesn't leave a slick surface when wet. Some sealants are also incompatible with the curing agents used by some contractors, so be sure to explain to your sealer supplier exactly what your driveway conditions are. He or she should be able to choose the best product for you.

We chose a resin-base clear sealant with a stated coverage of 125 sq. ft. per gallon. As it's possible to put sealants on too thick, avoid using a paint roller or spray gun. Rather, brush it on lightly, making sure it doesn't puddle (Photo 7). Here's one case where a thin coat is a good coat. **PM**



4 Once the major debris is removed from a joint, vacuum out the smaller particles. The joint should be as clean as possible.



5 On particularly wide joints, it's a good idea to use flexible backing rod to fill the bulk of the void before caulking.



6 Complete filling of expansion joint by covering backing rod with self-leveling urethane caulk, available in tubes.



7 To seal driveway surface, it's best to apply a light coat of sealant with a brush instead of using a roller or spray gun.

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PAINTING TOUCHUPS

TEXT AND PHOTOS BY
MERLE HENKENIUS

● Does your home's exterior look dingy, with an occasional spot of peeling paint? If so, your options may not be limited to a costly, time-consuming repainting. Often, simply washing and spot-painting will bring back that freshly painted look, and for a fraction of the price.

The first thing you'll want to do is wash your home's siding. Simply hosing it down won't do, nor will using a power washer. Like it or not, you'll have to do a little light scrubbing with a mild household detergent.

To save steps, buy a hose-end brush, found in automotive stores and general retail outlets. With this tool, you can wet, scrub and rinse—all from one position. Just start at the top and work down, doing roughly 8 ft. at a time (Photo 1). Some hose-end brushes even feature detergent wells, which feed soap into the brush along with the water. A simpler version, shown here, will cost under \$10.

Washing also highlights those areas that need to be touched up with paint. As the water dries, it causes loose paint to curl out, which yields a more effective scraping.

When the water dries, use a paint scraper to loosen and remove all loose paint in the area (Photo 2). Then, to feather the edges of the remaining paint, sand the surface with a medium-grit paper and a sanding block (Photo 3).

For best results, prime the spots where the paint has come off, using a quality exterior primer. If the primer you use has an oil or alkyd base, and your finish paint has a latex base, use a small brush to touch up the primer (Photo 4). With a small brush, you won't need to worry about painting oil over latex.

When the primer has dried, apply the topcoat with a touchup brush (Photo 5). Remember that the paint on the house may have faded slightly, so keep the painted area small. Any discrepancy in color will be less noticeable on a smaller scale.

If you would like to go the touchup route, but have none of the original paint, don't despair. Just salvage 1 sq. in. of peeled paint chips and bring them to a paint store that offers computer color matching.

PM



1 To clean your siding, use an inexpensive automotive hose-end brush. Work from the top to the bottom of the wall, washing with a mild detergent and then rinsing clean.



2 To touch up small peeled areas, first scrape away any curled or peeling paint. Use a scraper with replaceable blades.



3 Once the scraping is done, sand the peeled paint edges to match the surface of exposed siding using medium-grit paper.

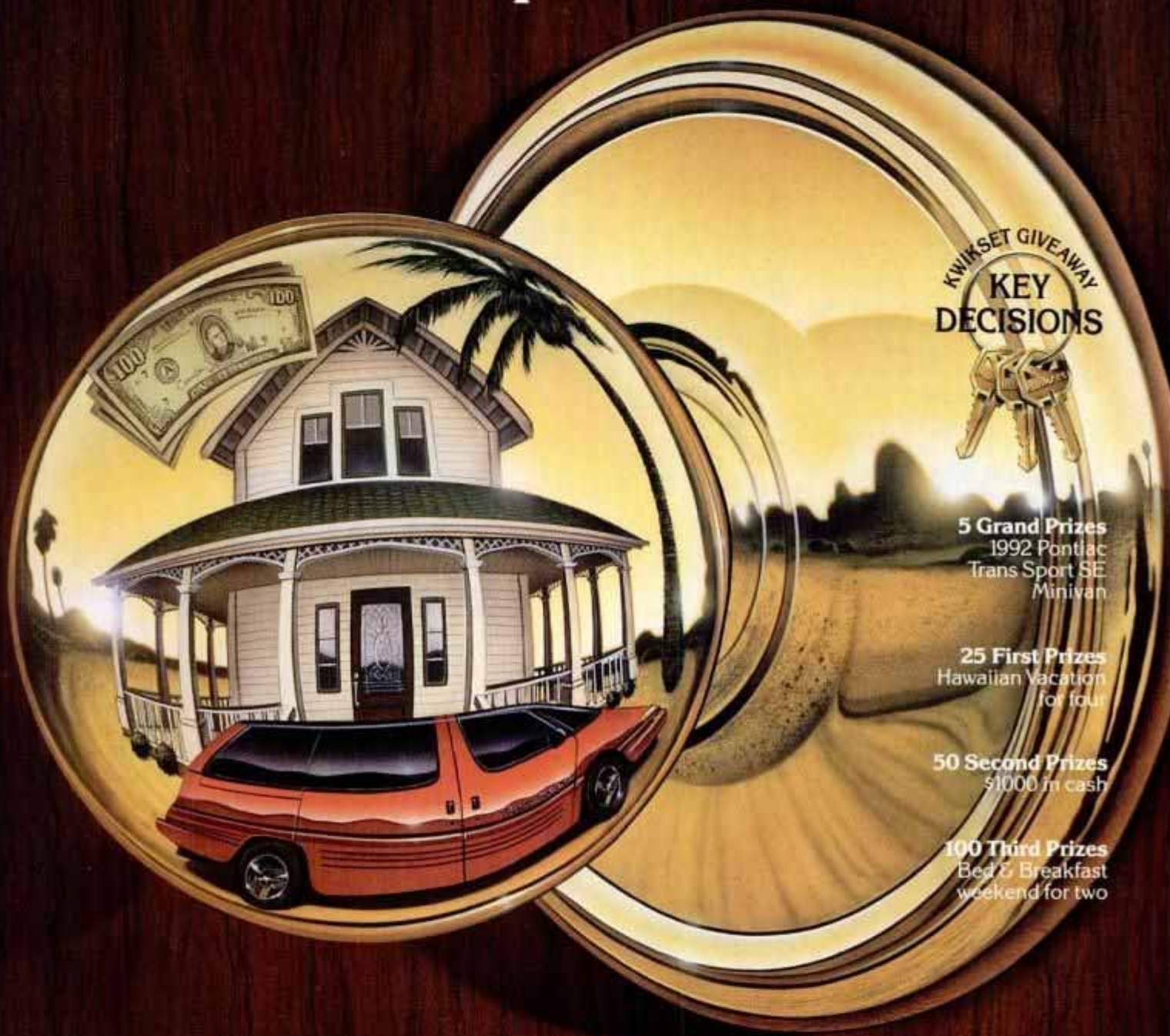


4 For best results, it's a good idea to re-prime the exposed siding with a small brush, like the artist's model shown.



5 Once the primer has dried thoroughly, apply the topcoat with a touchup brush or similar narrow bristle brush.

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HEATING/ COOLING SYSTEM TUNEUP

TEXT AND PHOTOS BY
MERLE HENKENIUS

● Many homeowners instinctively feel that fixed appliances, (furnaces, central air conditioners and water heaters) are simply too permanent and complex to be included in a routine maintenance schedule. If this is your position, it's a costly one.

An investment of an hour or two of your time will not only extend the lives of these appliances, it'll save plenty in operating costs.

Maintaining air conditioners

Of the three major appliances, central air conditioners probably suffer the most from poor maintenance. The problem is dust. In less than a season, the compressor fin tubes can become completely clogged with dust. As a large volume of air must be drawn through these fins with every cooling cycle, a matting of dust will stress the fan and compressor motors, and greatly reduce efficiency. When years of accumulation go unchecked, the problem grows exponentially.

To correct the problem, we suggest cleaning the inside of your compressor unit at least each spring. A second, midsummer cleaning is also a good idea.

When cleaning compressor units, begin by shutting off the power (Photo 1). This can usually be done at the dedicated disconnect switch near the unit. Then, remove the front access panel (Photo 2).



2 To gain access to the condenser unit, remove the front panel screws. Then lift the panel up and out to clear its bottom lip.



1 Before working on any central air-conditioning system, be sure to shut off the power at the compressor's main disconnect switch or at the house breaker panel.

This will reveal the compressor, and the electrical and refrigeration connections. You'll then be able to undo the top panel that supports the fan and fan motor. As the top panel is largely open, shielded only by a coarse screen, leaves and other debris are likely to have fallen into the unit. Carefully lift the fan unit, and pull out the debris (Photo 3).

With the area inside the condenser coil cleared, remove the shroud from around the coil. This will reveal the exterior of the coil, where the fin tubes support the accumulation of dust.

Using a soft-bristle brush, carefully sweep away the dust blanket (Photo 4).



3 Carefully lift up the top panel and remove, by hand, any debris from inside the condenser coil or the area below the fan.

to 4). Don't press too hard or you'll bend the edges of the fin tubes, which will also reduce efficiency. When all of the dust has been swept from the coil, vacuum it up so it's not pulled back into the coils when the unit starts up.

Next, check for oil ports at the top of the compressor. If you see any, lubricate them with all-purpose oil or turbine oil. If you find no oil ports, the compressor is sealed and no oil will be needed. With the compressor unit cleaned, replace the side and front panels, and restore electrical power.

Along with the outdoor condenser unit, your air conditioner will have an indoor evaporator coil, usually located within the furnace plenum. In most



4 Remove the side panels on the condenser and use a soft brush to remove the dust that accumulates on the fin tubes.

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cases, you'll have no direct access to this coil, short of cutting through the plenum. If an access panel has been left for you, clean the coil with water and bleach. The goal is to remove any accumulation of bacteria that may have collected at the base of the coil.

And finally, keep an eye on the condensate hose attached to the evaporator coil. This tube, which typically runs from the evaporator coil atop the furnace to the nearest floor drain, can often become clogged with bacteria.



5 To keep the condensate drain on the evaporator free of bacteria, pour a mix of bleach and water through the hose.



8 To thoroughly clean the blower unit, first remove it from the furnace housing, then vacuum clean the motor and fan.



11 Test the relief valve on your water heater by lifting up the test lever and checking that it snaps back completely.

The result is water spilling into the furnace or onto the floor. Your best preventive measure is to pour a 50/50 mix of water and household bleach through the hose midway through each cooling season (Photo 5).

Maintaining furnaces

Dust is also a culprit in furnaces. The reason is that air is pulled through it, along with a blizzard of airborne dust particles. Your furnace's first line of defense against dust is your furnace



6 To access the furnace blower—and in most cases the unit filter—remove the lower panel on the front of the housing.



9 If your blower motor has oil ports, fill the ports on both sides of the shaft using an oil bottle with a long spout.



12 If you must replace the relief valve, get a replacement that's properly rated, and install it securely in the top of the tank.

filter. While these filters do a good job in catching dust, they can also stress the fan motor and reduce efficiency when not changed frequently.

How often should you change your furnace filter? At the absolute minimum, once a month. And be sure to do it year-round if your furnace is also equipped with central air. All that's involved to make the change is to remove the lower front panel on your furnace (Photo 6), pull out the old filter (Photo 7) and slide in a new one.



7 Replace the furnace filter every month during peak use periods, and all year-round if the unit heats and air conditions.



10 To adjust the burner, loosen the set-screw on the air-mixture mechanism and slide it open or closed. Retighten the screw.



13 To remove rust flakes from the top of a water-heater burner, remove the inspection plate and vacuum out the debris.

Another important maintenance item is your furnace's blower unit. To access the blower unit, remove the lower panel from the furnace and check to see which mounting mechanism is in place. Expect one of two different brackets. One will have the blower unit sliding forward along a track. The other will allow the unit to tip down and out. The blower will be held in place by two screws or clips.

Remove the clips or screws, and pull the entire unit from the furnace. This will allow enough room to brush and vacuum the dust clinging to the fan and motor (Photo 8). Before returning the blower to the furnace, oil each shaft bearing on the motor. Each bearing will contain an oil port, sealed by a cap, rubber plug or threaded iron plug. Simply remove the seals and inject several drops of oil into the bearing housing (Photo 9).

If your furnace is gas-fired, you might also check to see if the flame burns evenly. If one or two burners have an orange-colored flame, instead of an even blue one, loosen the air-adjustment mechanism at the front of the burner, and open or close it until the burner flame burns mostly blue and steady (Photo 10). Then, secure the adjustment with the setscrew.

Maintaining water heaters

Water heaters are not so much plagued with dust as they are with hard water and rust. While hard water does shorten heater life, there isn't much you can do about it. But hard-water calcification does pose a safety threat when it comes to the T&P (temperature and pressure) relief valve. The T&P valve is designed to release excess heat and pressure from the tank in the event that a control valve or thermostat fails to shut off. Without a relief valve, the heater could build up enough pressure to explode.

The problem is that T&P valves can be rendered inoperable by calcified minerals that precipitate out of hard water. For that reason, you should periodically test the relief valve in your heater, to make sure it's offering the protection you need. Twice a year is a good starting point.

To test a relief valve, simply pull up on the release lever at the top of the valve, then let it snap shut (Photo 11). A brief burst of water should pass through the valve and then stop abruptly when the valve closes. If the valve behaves differently, replace it with one rated for your heater.

To replace a failed T&P valve, shut

off the heat source and water supply, and drain several gallons from the tank. Back out the old valve and thread the new one in place, using pipe-joint compound as a sealant (Photo 12). Be sure to restore water pressure before turning the power or gas back on.

Gas water heaters can become inefficient when rust from the heater's internal flue pipe falls onto the burner below. This happens at a rate steady enough to cover a burner in rust

flakes in just a couple of years. As these flakes slip over the edge of the burner, some gas ports are clogged, causing the burner to flame erratically and inefficiently.

To correct this problem, shut off the gas supply and remove the access panel near the bottom of the heater. Then, vacuum the rust from the burner with a common household vacuum cleaner (Photo 13). Finally, turn the gas back on, light the pilot and replace the access panel. **FM**

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1 To properly seal flashing components that lie on top of surrounding shingles, apply a thick bead of roofing compound to bridge the joint between the two surfaces.

ROOF REPAIR

TEXT AND PHOTOS BY
MERLE HENKENIUS

● Roofing is one job that most of us are happy to leave to the professionals. Still, there are a few important maintenance and repair procedures that can keep a roof from leaking in extreme-weather situations. It's often the occasional leak that starts a roof sliding toward total replacement.

When a roof leaks after 4 in. of rain but not after 2 in. of rain, or perhaps

only under heavy snow cover, chances are that the leak is not in the larger field of shingles. More often, an occasional leak will occur around plumbing or heating pipe flashings, above a skylight or near valley tin. Luckily, most of these conditions can be corrected with a few low-dollar maintenance and repair steps. Even roofs that do not leak deserve a yearly inspection.

Patching compounds

Often a leak is evident, but its source is not. The reason is that roofs are built in layers, often with a layer or more of roofing felt (tar paper) beneath the shingles. In other cases, the visible layer of shingles covers previous lay-

ers. As a result, water can move laterally, or even up the slope a little (by means of capillary action), before dripping into the attic. This makes pinpointing a leak, or predicting the source of future leaks, a little tricky.

Simply knowing about the problem helps. If there is no apparent problem with the field of shingles, look to the valleys or flashings, even if they are 3 or 4 ft. away from the leak.

Flue or plumbing stack flashings, as well as roof vent flashings and valley tin can be treated with a little roofing compound. Fiber-impregnated roofing compound is a tar-like substance that stays in place, even in hot weather. It's available in caulk tubes, and in 1- and 5-gallon buckets. For most applications, caulk tubes work well. They're less messy to use.

In the case of flashing that lies on top of the shingles, feed a neat bead of compound along the edge of the flashing, bridging the space between tin and shingles (Photo 1). If the shingles overlap the flashing, then lift the shingles all around it and apply a bead of compound under each one (Photo 2).

Because snow accumulations or extra-heavy rains can cause leaks slightly above the flashing, you should also apply a bead of compound to the shingle's edge just above the flue, vent or stack. To hide the compound, you might lift the bottom of the shingle slightly and feed the compound underneath, just as you would on the upper sides of the flashing.

The same procedure works well on sheetmetal valleys. Just feed a substantial bead of compound under the shingles on both sides of the flashing, from top to bottom (Photo 3). Then, press the shingles back in place.

Installing storm collars

Metal furnace flues can also leak where the flue passes through the



2 Where shingles overlap the flashing, lift up the shingles, apply cement underneath and then press them back into place.



3 If you find a leak where your shingles meet a valley, force roofing compound under the shingles to achieve the best seal.



4 To properly seal a flue pipe, install a storm collar. Just slide it over the top of the pipe and down onto the flashing.

flashing. In some cases, the joint may have been left exposed, or sealed with caulk that has since broken up under the constant expansion and contraction of the flue. In still other cases, ill-fitting collars were installed.

In any case, the best approach is to install a new, tight-fitting storm collar. These collars are made of stamped sheetmetal and literally need to be forced onto the flue. Begin by removing the flue cap and sliding the collar over the flue from the top. Push it down until it comes to rest against the flashing collar (Photo 4).

Then, for added protection, press a strip of permanently flexible sealing compound around the top of the storm collar (Photo 5). We used Thumb-Gum, a sticky, putty-like sealing compound used by heating and air-conditioning contractors. (Thumb-Gum is made by the Bramec Corp., P.O. Box 1434, Sioux City, IA 51102.)

If black roofing compound appears too obvious, keep in mind that you're not limited to tar-based products. We used white elastomeric caulking sealant, made by Macklanburg-Duncan, to fill a hole left by a removed TV-antenna cable standoff.

This product is made for roofing repairs. We simply unthreaded the standoff from the roof (Photo 6), and filled the hole with sealant (Photos 7 and 8). The patch blends better with our gray shingles, and the match will only improve as it becomes dirty over time.

Anticipating trouble at the skylight

Skylights have a habit of finding a way to leak. Often this is because they are cut into existing roofs, and a perfect seal is hard to establish from the beginning. In other cases, they are simply installed poorly. Period.

The skylight we've chosen does not leak, but looks as though it might someday. The problem is not just the fixture, but the pitch of the roof. With less than a 3-pitch (3 in. of rise for every 12 in. of run), this roof should never have been covered with shingles. It's simply too flat for shingles to endure for long. A built-up roof, or sheet-rubber material, would have been better.

The problem, as always on a nearly flat roof, is the daily freeze/thaw cycle. With each freeze and thaw, water is trapped by the ice and backs up under the shingles, forcing a leak. We've noticed that the top edge of the skylight holds a good deal of snow, not to mention rotting leaves and debris. In

fact, the shingles just above the skylight are starting to curl.

Our best approach here was to override the layered structure of shingles with roofing compound. By sealing under the shingles and against the skylight flashing, we'll prevent water from backing up under that first row of shingles and the flashing beneath it.

Every situation is different, but we started by cleaning away all the debris we could find (Photo 9). We then



5 Once the storm collar is in place, seal it to the flue with a permanently flexible sealing compound for added protection.



7 Fill the hole with elastomeric roofing compound. If it's more than 1/4 in. wide, put compound under the shingle, too.



9 To properly seal around a skylight, be sure to remove all debris from around the perimeter. The surface should be clean.

caulked the shingle under each tab and filled the flashing space with compound from a 1-gallon can (Photo 10). Compound in this form is easier to spread than that in a tube. We both applied it and smoothed it with a disposable plastic putty knife.

While this patch may be less than ideal, it is a good example of preventive maintenance, and it may just save us hundreds in a future ceiling repair. And that, it would seem, is what maintenance is all about. **PM**



6 TV cable anchors, guyhooks and other roof hardware are best removed if not needed. Most can simply be unthreaded.



8 Smooth the compound in place using a putty knife. A light-colored compound works better with light shingles.



10 Using a putty knife, liberally spread roofing compound across the top of the shingles and against the skylight flashing.

ROUTINE CAULKING

TEXT AND PHOTOS BY
MERLE HENKENIUS

● Caulking is one of the best energy savers you'll find for the money. With a couple tubes of caulk, costing about \$3 each, you can seal your home against the sort of air infiltration that wastes energy dollars. The object here is to stop air infiltration before it reaches the insulation buffer.

By far, the worst cold-air offenders are mechanical openings—those that pass plumbing, ventilation and electrical lines through exterior walls. Gas lines, phone cables, dryer vents and air-conditioner refrigeration lines are among the biggest offenders, but exterior light fixtures and receptacles are also troublesome. In addition, cracked or missing caulk in siding joints allow cold air into the insulation space. In fact, it's not uncommon for exterior caulks to fail before the house paint does, especially on heavily painted, older surfaces.

As for which caulk to buy, choose one that is able to flex with the seasonal shifts of your home. We chose a silicone acrylic caulk (which is optimistically called "25 Year" caulk). This is a quality caulk, and it does carry a 25-year guarantee.

When it comes to applying caulk, resist the temptation to smooth every joint with your finger. A smoothed, 45° joint will produce thin edges, which will be the first to lose their grip on the caulked surface. Instead, cut the applicator tip at a 30° angle and let the tube form the caulk in a neat, uniformly thick bead. This type of bead will last longer and is sufficiently inconspicuous when painted.

Start your project with a careful inspection of your home's exterior. Look for existing caulk that's cracked and any obvious service openings, especially those made by utility companies. For example, if your telephone company has recently added a line, and has drilled through an exterior wall, there's a good chance that the opening will be larger than the cable and that it will be unsealed.

Especially troublesome will be any flat-surface fixture or vent that spans lapped or grooved siding. Light fixtures and dryer vents often leak badly in these instances. As for lap siding, it is possible to splice a plastic or wooden adapter between the fixture and



1 Exterior light fixtures, especially those that are mounted on lapped siding, leak like sieves. The voids under the fixture plate can be filled with shim or a neat bead of caulk.



2 Exterior receptacles are another source of major air leaks. Caulk around the entire perimeter of the covering plate.



3 Because a dryer vent tends to span more than one course of siding, voids where the siding boards lap must be filled with caulk.



4 Silicone flanges rarely seat flush against siding. By caulking completely around the flange, air infiltration is eliminated.



5 To remove cracked caulk from siding joints, use a carpet knife to slice it from both sides. Then scrape out the waste.

lap. In our case, we simply caulked the shallow grooves between the siding and fixture base (Photo 1). To allow for better maneuverability, we first removed the fixture globe. Use the same basic approach on dryer exterior receptacles, dryer vents and sillcocks (Photos 2, 3 and 4).

When caulking piping or cables, it's simply a matter of running a bead into the joint until it's sealed. Hold the caulk gun at roughly a 45° angle, feeding just enough caulk into the joint to

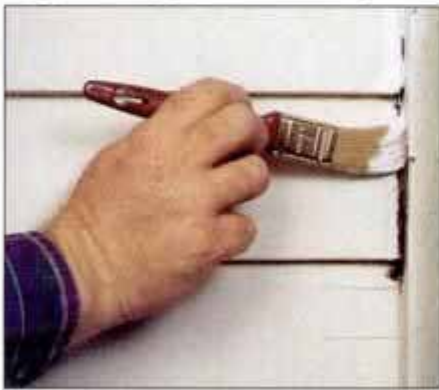
form a uniform bead. Avoid going over any joint twice. If you must touch up a void, do so after the first application has set.

When replacing cracked or separated existing caulk from siding seams, first cut away the old caulk with a traditional carpet knife. Its curved, hook-like blade lets you slice into the joint from both directions, lifting much of the bead intact (Photo 5).

In the case of older wooden siding (shown here), the paint that support-

ed the caulk will lift off, too. Before caulking a new bead, it's best to paint the joint with a high-quality exterior primer (Photo 6). Primer paint offers better adhesion than topcoat paint.

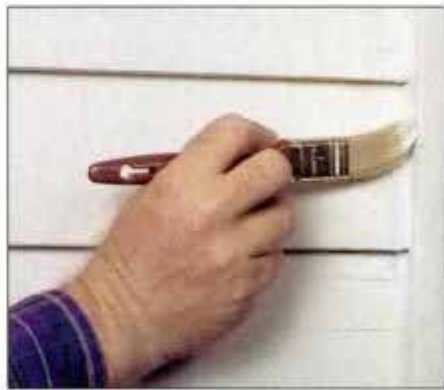
After allowing the primed areas to dry at least a day, recaulk the seam with a flexible, exterior-grade caulk (Photo 7). As always, resist the temptation to smooth it out. When the caulk has set long enough for it to skin over, in roughly 30 minutes, paint the joint, caulk and all (Photo 8). **PM**



6 After removing the old caulk, prime any exposed wood with an exterior-grade primer. Work the primer into the cracks.



7 Once the primer has dried thoroughly, apply a new bead of caulk using flexible and paintable exterior-grade caulk.



8 When the new caulk has set for at least 30 minutes, or until the surface glazes over, touch up the area with a topcoat of paint.



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FLOOR CARE

TEXT AND PHOTOS BY
MERLE HENKENIUS

● What can we say about routine floor care? It's just one of those things—a chore, like washing dishes. But there is a difference. If you let the dishes set overnight or, heaven forbid, longer, they'll still come clean when you finally get to them. But, let your floors go too long without care, and it can be a long way back. With flooring, there's a difference between neglect and damaging neglect.

What we seek here is a measure of middle ground. It's easy to imagine that when Emerson muttered something about foolish consistencies being the "hobgoblin of small minds" he was thinking of obsessive house cleaners.

As for the rest of us, we'd just like to get the job done and move on.

The gritty downside

Nothing is more damaging to flooring than the dirt that gets ground in deeper with every passing footstep. This is true of hardwood flooring, vinyl, earthen tiles and carpeting. As such, you should vacuum all of the above as frequently as time allows.

While we're all accustomed to vacuuming carpets, fewer of us think to run over the kitchen or bathroom floors while we're at it. This is not to say that you should throw out your broom, but that brooms are better at seizing larger prey. With a broom, the small stuff often just gets repositioned for a new assault. The fine, damaging grit that gets tracked in every day is better picked up with a vacuum cleaner.

Hardwood flooring

When it comes to hardwood flooring, often a damp cloth will handle spot cleaning, such as tracked-in mud or snow. For black heel marks, crayons and the like, a commercial, water-based hardwood floor cleaner is your best bet. Lacking that, you might try a light application of alcohol and a rag. Do only a small area, as the alcohol may dull some finishes.

When cleaning an entire floor, sweep and vacuum first (Photo 1), then spray the cleaner on an area about 4 ft. square. Use a sponge or damp rag to scrub only the sprayed area (Photo 2). Move across the floor



1 Cleaning a hardwood floor requires more than simple sweeping. Frequent vacuuming is the best way to remove dirt and debris that can easily damage the floor's finish.

in these manageable squares until you complete the room. Water-based cleaners require no rinsing.

If your hardwood floor seems to have lost its luster, especially in high-traffic areas, follow a thorough cleaning with a floor wax or a liquid refinishing product (Photo 3). Each has its advantages and disadvantages.

An application of wax will require buffing and perhaps rebuffering, but once that's done, you can pretty much forget about it. A liquid refinishing product, by contrast, is easier to put down and requires no buffing. It may also be more resistant to spills and stains.



2 To remove stubborn stains, like heel marks, apply a commercial cleaner at full strength with a rag or scouring pad.

The disadvantage associated with liquid finish coats is that they take a long time to cure properly. As such, you'll need to restrict traffic for at least 24 hours, and then only light traffic is recommended. It may take more than a week for the finish to cure completely. The practical upshot is that you may have to do the floor in sections, several days apart.

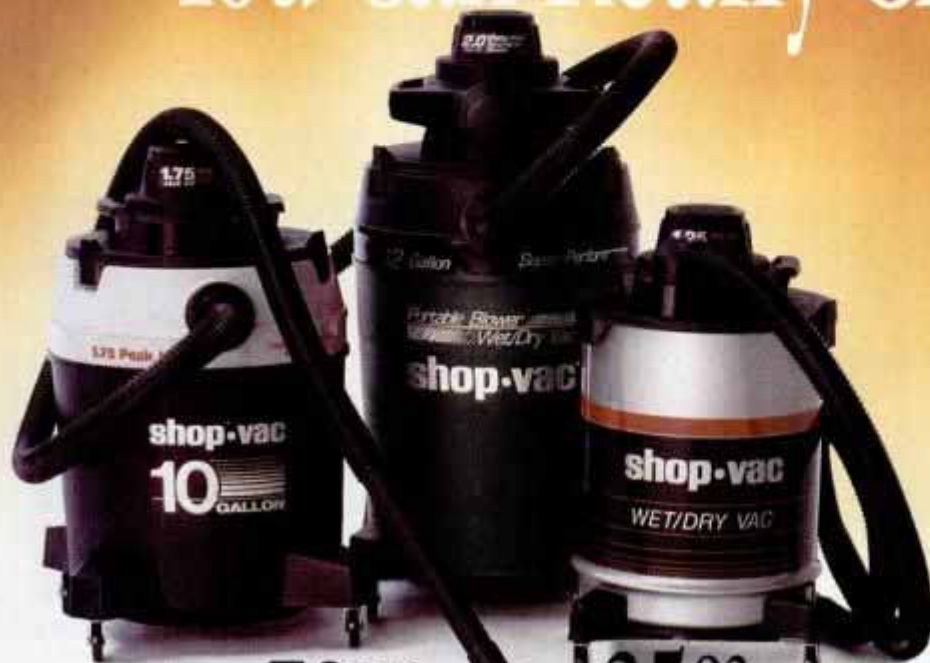
Carpet care

Aside from daily wear and tear, loose carpeting and stains are your biggest concerns. When a carpet stretches after installation, it's important to have it restretched by a professional as



3 To restore the shine to a dull hardwood floor, apply a liquid top-coat finish or several layers of common floor wax.

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soon as possible. If allowed to slip underfoot, both the carpet weave and the pad beneath it will break down. Also, inspect the surface of your carpet for any snags. Carefully pull up the loops and trim off with a pair of scissors (Photo 4). This will keep the snags from being caught again and possibly having more damage done.

As for stains, find a solvent that works well for you and stay with it. We've had good luck with an all-purpose solvent called Goof-Off (Atlanta

Sundries, Inc., Lithonia, Georgia), which works on carpet and a variety of other household headaches. It will, for example, do a quick job of removing stickers and labels from housewares, as well as lift latex paint from fixtures.

In any case, when removing stains, always apply the solvent to the rag first, not the carpet (Photo 5). Solvent can damage the back of the carpet. Also, make a point of using a white or nearly white rag, so that dyes from

the cloth don't bleed into the carpet.

And before using solvent on solid or sticky substances, like gum, try scraping as much of the material from the carpet as possible. It often helps to freeze solid substances with an ice cube before breaking them up.

When pulling stains from carpet fibers, use a wet-and-dab approach, always rotating the soiled area of the rag away from the carpet (Photo 6). This method may be a little tedious, but it works well.



4 To prevent carpet snags from being caught again and again, trim off any pulled loops with a pair of scissors.



5 To remove carpet stains, pour solvent onto a clean rag, not directly onto the carpet. A toothbrush helps clean tough stains.



6 Repeatedly dab with the clean area of a solvent-dampened cloth. Rubbing the surface often results in smearing the stain.



7 Ceramic tile floors do require periodic sealing. To do this, first apply sealer to all the grout joints with a stiff brush.



8 After the grout joints are sealed, apply sealer to the surface of the tile with a large sponge. Work with short, smooth strokes.



9 Like hardwood floors, vinyl floors should be vacuumed, as well as swept, to remove damaging dirt and other debris.



10 To clean vinyl flooring, scrub the surface with a sponge and no-rinse floor cleaner. Let the floor dry before using.



11 Once the floor is clean, apply a layer of wax or a thin coat of liquid floor polish. Spread the polish with a sponge mop.



12 To repair a slightly separated seam, first apply mastic to the underside of both pieces of vinyl using a putty knife.

Tiled floors

Unglazed flooring tiles are nearly maintenance-free, except for an occasional coat of sealer. The sealer, which contains liquid silicone, helps protect the surface from sand and grit, but more importantly, it seals the mortar/grout seams against spills. This is especially critical when the tiles are laid over wooden subflooring, as tiny grout cracks may appear.

Only when water penetrates to the subflooring will real damage occur. As such, apply a sealer coat twice a year or so, paying particular attention to the grout joints. You might start by sealing the grout joints with a brush (Photo 7), then using a sponge or cloth

to spread the excess over the tile surfaces (Photo 8).

Vinyl flooring

Aside from sweeping and vacuuming regularly (Photo 9), spot cleaning will go a long way toward keeping your vinyl (resilient) flooring looking like new. As always, anything that is gritty or sticky should be considered the enemy.

When a complete cleaning job is in order, use a mild, nonabrasive household cleaner (like Spic & Span) in warm water. Scrub the entire floor in manageable sections. To keep a dull residue from forming as the solution dries, rinse with a weak mixture of white vinegar and water. Finally,

wipe the floor dry with an old bath towel or soft piece of cloth.

If all this seems like too many trips across the floor, you might try a concentrated liquid cleaner designed just for vinyl flooring, like Armstrong's No-Rinse Floor Cleaner (Photo 10). The obvious advantage is that you won't need to rinse the scrubbed area to keep residue from forming. These cleaners can simply be scrubbed onto the floor and sponge-mopped to pick up the excess. Liquid concentrates can also be mixed in greater strengths for stubborn spot-cleaning jobs.

Waxing a no-wax floor?

Okay, it's not wax, but it is a polish, and one you'll need to use occasional-

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ly. There are many types and brands of resilient flooring on the market today. Some will need to be polished more often than others, and it's often a good idea to choose a polish made by or recommended by the manufacturer of your flooring.

Applying liquid polish is pretty simple, just spread it on the floor with a sponge or sponge mop and make sure that you don't miss any spots (Photo 11). Most liquid polishes will dry within 30 minutes, which will allow you to apply a second coat for a more durable shine.

After a few years of applying floor polish, you may begin to notice some yellowing. When this happens, it's time to strip off the polish and start anew. Again, choose a stripper made by the same company as the polish you've been using.

Minor vinyl repairs

As time goes by, kitchen utensils tumble to the floor and minor cuts may appear. You may also notice that a seam has begun to open up where two pieces of flooring were joined.

Major cuts and tears are pretty se-

rious, and you may wish to call your installer for a repair. But to close a simple seam is something you can easily handle yourself. You'll simply need to buy an inexpensive seam sealing kit. Again, buy the same brand as your vinyl.

To repair a separated seam, you may need to re-glue the vinyl to the floor. While this is easy enough to do, it's not usually required. In any case, you simply apply a little flooring mas-

tic to the undersides of the separated vinyl and press it back in place (Photo 12). To keep it there while it dries, set several books or a brick on the seam for a day or so (Photo 13).

With the vinyl stuck firmly in place, insert the applicator tip of the sealer bottle into the seam and pull it along until the entire seam has a coating of sealer (Photo 14). Then, allow it to dry completely before resuming traffic in that area.

PM



13 Hold the seam together by covering it with a brick or heavy book. Keep the weight in place for a day or two.



14 Once the mastic is dry, finish the repair by applying seam sealer. Just draw the tip of the applicator over the joint.

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1 For the overall health of any tree, it's a good idea to remove back growth limbs, like this one, that grow across the normal direction of other limbs.

TREE PRUNING

TEXT AND PHOTOS BY
MERLE HENKENIUS

● If your property has trees and shrubs, you can expect to do a little creative pruning and trimming from time to time. When left to their own growth patterns, trees and shrubs will often grow unevenly. While in many instances pruning is merely cosmetic, in others, it can save or extend the life of the plant.

Uneven growth may be endemic to a species, or it may simply occur in response to stressful weather conditions. In still other cases, a relatively well-shaped tree may simply grow into trouble, as when spreading branches threaten to damage a roof. In most cases, careful removal of the offending limbs, buds or sprouts can mean the difference between a troublesome eyesore and a healthy, attractive complement to your home.

When to prune

This is a question that stumps most of us, and for good reason. If done at the wrong time of year, pruning can pre-

vent flowering, expose the plant to damaging insects and rot, and actually produce abnormal growth in the following year. Because of the great variety of trees and shrubs grown today, and because climate and geography will often influence your decision, we suggest seeking professional advice through your county extension agent or garden center. Here, we'll concentrate on tools and techniques, while providing only basic guidelines.

When it comes to nonflowering trees, spring and fall prunings produce the least amount of stress. While this is a good rule of thumb, it may not fit into your schedule. If you must put



2 Use pruning shears to trim any small-diameter limbs. The wound produced is very clean and easily resists infestations.

off a major pruning job until your summer vacation, so be it. Arborists, after all, don't take summers off.

As for flowering trees and shrubs, you'll need to determine on which type of wood the flowers bud and bloom. Roses, for example, emerge on first-year growth, so a judicious, early-spring pruning will stimulate new growth and encourage more flower buds.

Forsythia, by contrast, blooms on second-year growth. In this case, you'll want to prune shortly after flowering, so this year's growth will support next year's flowers.

Apple trees, on the other hand, produce from growth that is several years old. As such, timing is not so critical. Your work in this case will involve shortening the branches to provide stronger support for a potentially heavy yield and trimming the limbs that grow back across the normal direction of growth (Photo 1).

How to prune

Limb size and position will determine which tools to use and how you'll approach the work. Small branches, no greater than $\frac{3}{8}$ in. dia., can be handled with pruning shears (Photo 2). Branches up to $1\frac{1}{4}$ in. dia. are easy to cut with loppers, which have long handles to offer plenty of leverage. Larger branches will require a saw—either a bow saw (Photo 3), which cuts on the forward stroke, or a limb saw, which cuts on the back stroke.

When approaching any limb or shoot, consider the weight that it supports. If the limb is too heavy, a single, top-down cut will likely cause the limb to break before the final strokes are completed. If the limb drops before the saw cuts completely through, it will likely strip its bark all the way back to the trunk. For that reason, all but the smallest and lightest branches should be cut twice.



3 An earlier pruning was not made close enough to the trunk, leaving an odd growth. Remove this with a bow saw.

Bang. Bang. Bang.



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The best approach here is to cut through the bark on the bottom side of the limb first (Photo 4). This will stop the bark from stripping past the branch terminal. Then cut the limb off from the top, just ahead of the bottom cut (Photo 5). With the limb removed, use the saw or shears to make a clean, close cut at the terminal point.

If the limb you remove is larger than 1 in. dia., you'll want to seal the wound against insects, molds and rot. This is best done with pruning seal, sometimes called wound seal or tree paint (Photo 6). This tar-like sealer costs only \$2 to \$3 for a small can that will last several seasons.

When using shears and loppers, take advantage of their unique cutting edges to make clean, self-healing cuts. Again, if the limb or shoot is heavy, make one cut several inches off of the primary terminal to remove the branch, then move closer for the final cut. Place the smaller, heavier cutting edge against the top of the branch terminal, and the larger, thinner blade against the bottom of the branch (Photo 7). Then, slice through the branch so that the resulting wound is nearly flush with the trunk, or primary branch. This will leave a clean wound that should heal itself in short order.

Trimming hedges

Trimming hedges is simple if you have a good start. Once you've cut the heavier branches to a uniform height, shrubs will fill in with shoots that can then be maintained by routing clipping (Photo 8).

A manual hedge trimmer works well, but some feel that an electric model is easier to control. Each has its compensating features, but the task is essentially the same. When leafy shoots sprout past the established plane of the hedge, simply trim them off. This not only keeps the hedge uniform, but encourages growth lower down, which fills in the voids. **PM**



4 Prune larger limbs with a limb saw. Make the first cut on the underside, to prevent stripping bark when top side is cut.



5 Once the undercut is made, saw through the limb from the top side. Keep the kerf just to the limb side of the bottom cut.



6 Once a limb has been cut, always coat the exposed wood with pruning seal, to prevent damage from insects and fungus.



7 Double cutting with loppers is a good idea. First remove the bulk of the limb, then make a second cut at the terminal.



8 Use hedge clippers to cut any shoots that grow past your established limits. This will promote growth lower on the plant.

PEST CONTROL

TEXT AND PHOTOS BY
MERLE HENKENIUS

● Your first line of defense against pests is your home, and the natural barriers it presents. To bolster that line of defense, create as many barriers as possible. This may sound simplistic, but it's essentially true.

In order for squirrels, mice, large insects and even smaller insects to take refuge in your home, they've got to find a way in. This holds true for all but the smallest of creatures. Spider mites, for example, stroll through the most microscopic sliver of daylight.

Plugging holes

Blocking likely avenues of approach works for the squirrel capitalizing on that rotted roof soffit, the mouse slipping through the hole left by an abandoned outdoor faucet or the water beetle swimming through your floor drain on its way to your basement.

To discourage water beetles, for example, which have a pretty easy time of it when floor drains dry out, just remove the screen from the drain and drop a tennis ball into the basin (Photo 1). This will not only hold back sewer bugs, but will keep the water in the drain from evaporating so quickly. It will also go a long way in checking the houseward flow of sewer gases. And best of all, the drain will still carry water. For the duration of the flow, the ball simply floats.

Don't overlook the obvious. A good number of insects enter right through the front door, over a worn threshold. Moreover, any mechanical component that passes through a wall, floor or ceiling is a potential point of access. This includes electrical conduits, phone and TV cables, gas lines and outdoor receptacles. A slow walk around the house with a caulk gun can accomplish a lot.

When homes are built over crawlspaces, insects and even mice can enter directly through openings around plumbing pipes and electrical wiring. This is especially true if your plumbing has been altered and you have empty holes in a kitchen cabinet or laundry room floor. Plug these immediately. If you haven't the time to tackle the job in earnest, stuff the opening with steel wool or cover it with tape (Photo 2). Be sure to caulk

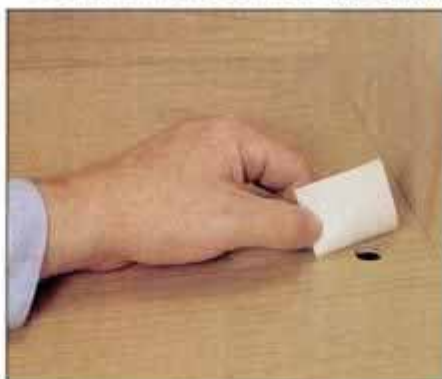


1 A basement floor drain can be a pathway into your house for various insects. A tennis ball placed in the drain can block the path and still allow water to pass.

any other passageways, no matter how small, especially in your kitchen cabinets (Photo 3).

The basement floor is another point

of access and refuge. Gaping cracks along walls and in the floor can be treated with a short-term pesticide and then sealed with caulk (Photo 4).



2 To temporarily plug holes in cabinet floors, just fill the hole with tightly packed steel wool and cover it with tape.



3 Apply caulk to the small spaces around plumbing pipes and electrical lines, particularly in kitchen and bath cabinets.



4 Caulk the cracks along basement walls and floors to keep insects from entering, or living in, these hospitable places.



5 Use pesticide foggers in enclosed places like attics or basements. Just activate the spray, and leave the house.

Pesticides and traps

Pesticides will always be needed in some situations. But before wading into pesticide application, a close reading of every pesticide label is a must. Some pesticides are now very insect-specific. If you don't use the right one, you won't get the job done.

Then there are the health and environmental concerns. We're not talking about snail darters here, but the confines of your own home. Before applying any chemical, read the direc-

tions. Insect sprays and foggers, for example, should not be used around food or cooking and eating utensils. You'll also want to cover the fish aquarium and take the kids out for a few hours. A little precaution can offer a lot of protection.

Pick your pesticides well. When going after wasps or hornets, for example, choose a pesticide specifically for those insects. The canister should be able to spray a stream that keeps you a safe 10 ft. away from your target.

One popular option for dealing with insects is an aerosol fogger. These foggers-in-a-can fill the air with atomized particles, and are therefore pretty thorough (Photo 5). Although they can be used in living spaces, a more targeted, baseboard application would seem the better choice in the kitchen and bath.

Where foggers do work well is in attics (for elm beetles) and in unfinished basements. Most canisters will treat a 25 x 25-ft. area. Turn off the furnace



6 For general pesticide chores, a spray solution works well. Apply it on baseboards and along the bottom of basement walls.



7 In areas where roaches are spotted, use enclosed roach traps. The product attracts roaches but won't bother household pets.



8 There are many options for trapping mice. This one has a door that closes behind the mouse once it's inside.

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or air conditioner, and leave for awhile after setting off foggers.

For the wide array of crawling household insects, a broad-spectrum formulation will take care of everything from centipedes to sow bugs. For general use, inside the house and out, we chose one that comes in a spray bottle (Camicide, from Campbell Chemicals, Inc.). It's ideal for spraying into cracks and along baseboards and doorsills (Photo 6).

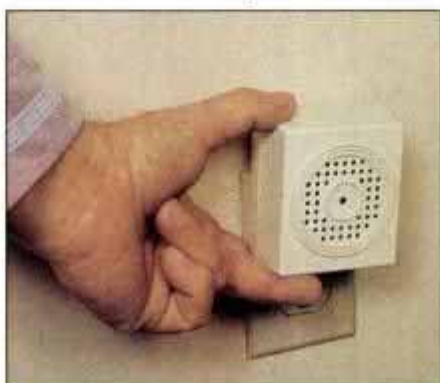
This type of pesticide has about a



9 Another mousetrap is simply an open tray with bait and a very sticky floor. Once on the floor, the mouse can't move.

2-week residual on surfaces. In other words, it can kill bugs crawling over it for about two weeks after application, which makes it useful for seasonal infestations. It can also be used in pet areas for ticks and fleas.

For roaches, you might choose one of the enclosed bait trays now available (Photo 7). Each tray contains a roach-specific pesticide that lasts up to three months. Because the bait is covered, the effects of the poison are not limited to the tray. Roaches leave



10 Ultrasonic devices emit maddening sound waves that are imperceptible to humans, but do repel mice and other rodents.

the tray and carry the pesticide back to the nest.

Another approach to roach control is boric acid, which can be purchased at any hardware store and sprinkled in out-of-the-way places, where pets are not likely to go. Boric acid is also carried back to the nest.

And if conventional mousetraps leave you a bit squeamish, you should know that the quest for a better mousetrap is alive and well. We used two alternative traps here. One is simply a box with a hinged door. The box is set on a hard surface and baited with peanut butter or cheese. As the mouse enters the trap, the door slams shut, keeping him incarcerated but alive (Photo 8). The other is a glue trap, which features a few seeds placed in the center of a very sticky plastic tray. The mouse sticks to the pad and remains there (Photo 9).

And finally, there is the ultrasonic rodent repeller (Photo 10). These devices plug into an electrical receptacle and emit ultrasonic sound waves, imperceptible to humans and pets, but annoying enough to mice to send them scurrying down the road. **FM**

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CAR CARE

MAINTENANCE BASICS

CHOOSING THE RIGHT ENGINE OIL

BY DON CHAIKIN

● Of all the maintenance you perform on your car or truck, none is more important than changing its engine oil. Regardless of what you own and what type of driving you do, change the oil—and filter—every 3000 miles.

Just as critical as draining the old, contaminated oil is replacing it with the right amount of the right oil—oil that's correct for your car.

Sticking with a name brand helps ensure the oil itself is of high quality and that it has the necessary additives to perform up to snuff.

The first critical oil specification is its SAE viscosity rating. Viscosity describes how the oil flows at a given temperature.

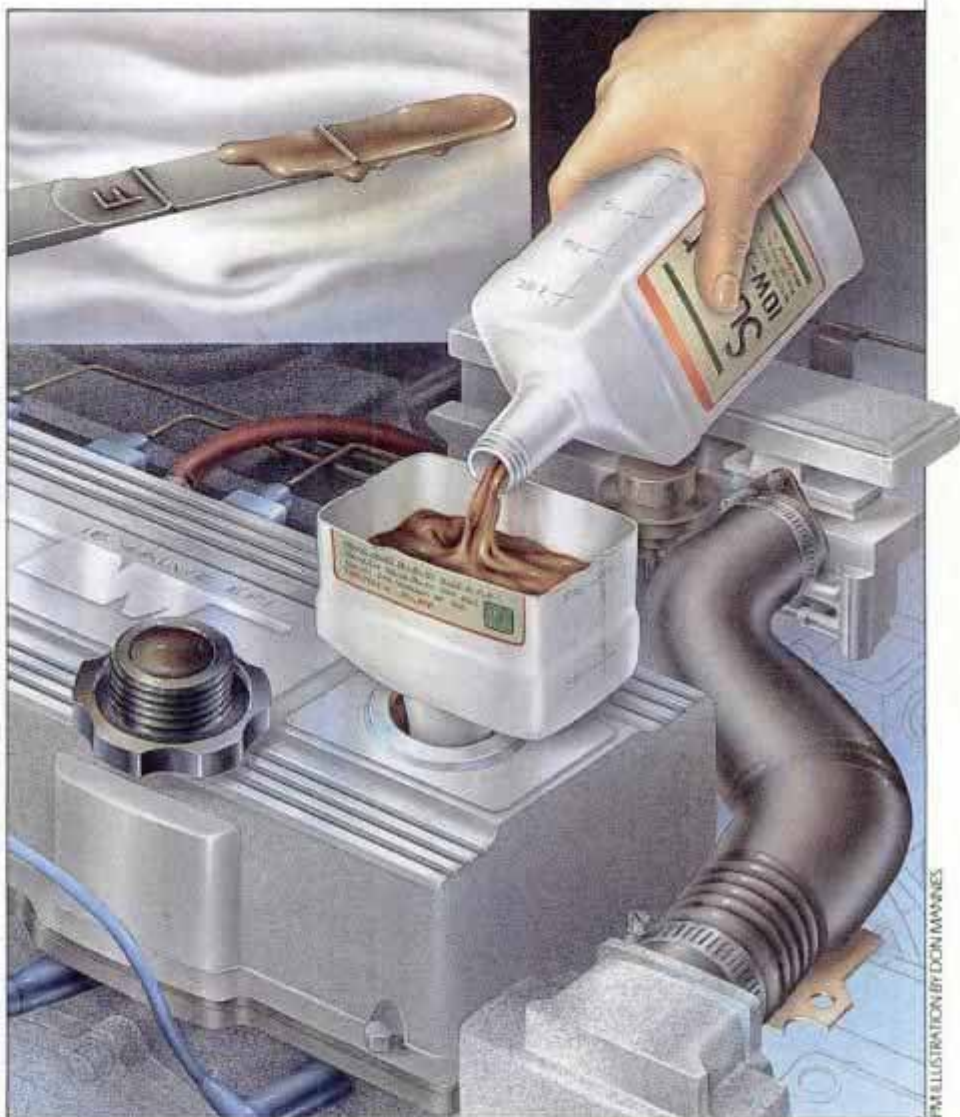
● Oil's viscosity changes with temperature. When hot, the oil thins and flows more easily. When cold, it thickens. Additives minimize the viscosity changes. A "W" after a viscosity rating indicates winter and describes how the oil behaves at 0° F.

● Multiviscosity oils behave like a thin, low-viscosity oil when cold and a thick, high-viscosity oil when hot. A single-viscosity—straight weight—may not adequately lubricate at one temperature extreme or the other.

● A quality multiviscosity oil that covers all temperature extremes of where you live and drive will do the trick. Check your owner's manual to see what viscosity oils are recommended for the temperature ranges you're going to be driving in.

● Since thinner oils flow more easily than thicker ones at the same temperature, the thinner oils have less friction. Reducing internal engine friction improves performance and reduces fuel consumption. Many newer, lower-viscosity blends are labeled "Energy Conserving."

Synthetic oils flow more easily than many natural oils, which further reduces friction—especially at extremely low temperatures. (They are



Add oil as necessary to keep the oil level between the FULL and ADD marks on your dipstick.

also more resistant to high-temperature breakdown.) If you live where winter temperatures stay at sub-freezing levels, a quality synthetic may better lubricate your engine, especially at startup.



This oil is API-rated as SG (gasoline), as well as CD (diesel), and it's energy conserving.

● Synthetic oils tend to be more expensive than natural ones. Don't think this is an excuse or a reason to extend oil-change intervals.

● Synthetic oils tend to flow so easily that even an otherwise minor oil leak can become a hemorrhage.

The other oil specification of concern is its service classification. This letter-grading system is set by the American Petroleum Institute (API).

● Service indexes beginning with "S" are for gasoline (spark-ignition) engines. Those beginning with "C" are for diesel (compression-ignition) engines. Many oils are rated with both an "S" and "C" classification.

● Higher-letter oil is better than lower. If your owner's manual recommends SE oil, you can use SF but not SD. API's current highest-rated oils are SG and CD.

PM

HOW IT WORKS

CATALYTIC CONVERTER

BY DON CHAIKIN

● As long as cars and trucks burn petrochemicals to produce power, they will produce exhaust gases. However, the vast bulk of the harmful combustion byproducts in that exhaust can be converted to harmless substances—primarily, CO₂ and water vapor—before they exit your car's tailpipe, thanks to the development of the modern emissions control system.

This is a complex collection of mechanical and electronic components working in concert to clean the exhaust, reducing the noxious emissions. And perhaps the most familiar piece of that system—as well as the least understood—is the catalytic converter.

Catalytic concept

A catalyst is an agent that aids or speeds a process or chemical reaction without becoming a part of reaction during the process—sort of a chemical middleman. In a modern car's emissions control system, the so-called 3-way catalyst helps the three major evil elements of exhaust—hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NO_x)—react with oxygen and each other. The catalyst helps the HC and CO become nonpoisonous carbon dioxide (CO₂) and water vapor, while the NO_x is converted into CO₂, nitrogen and water vapor.

Although some manufacturers are researching new catalytic elements, most current converters employ a mixture of rare (and expensive) metals—platinum, palladium and rhodium. The platinum and palladium act on the HC and CO, while the rhodium affects the NO_x. The rare metal mixture coats a very fine steel mesh or ceramic honeycomb, called a monolith. In older, bulkier designs, several thousand ceramic pellets or beads were used instead of the honeycomb.

This monolith is encased in a stainless-steel housing resembling a flat muffler that's solidly welded right into the car's exhaust plumbing. It's

positioned upstream from the car's regular muffler, under the car but not far from the exhaust manifold, to keep the exhaust gases from cooling too much before they get to the converter. As the exhaust flows through the converter on its way to the tailpipe, it passes through the mesh, washing over the catalyst.

O₂ factor

The chemical conversion of the exhaust gas requires oxygen to be present. As a result, many systems use an air pump to supply additional oxygen to the catalyst. The efficiency of the

modern cars with properly operating converters occur during this warmup period, many manufacturers are experimenting with preheating techniques that would eliminate this 1- to 2-minute period of dirty exhaust.

RX for NO_x

Another problem associated with some quick warmup techniques is excessively high exhaust temperatures, which increase the percentage of NO_x in the exhaust gases. To combat this phenomenon, most cars are equipped with a dual-bed converter that actually has two separate chambers. The



Three basic catalytic converter types (clockwise from top) include the older pellet type, the honeycomb ceramic brick and the steel-mesh type.

catalyst is also dependent on the air/fuel mixture that the engine is burning. In fact, for the rhodium to be effective in reducing NO_x, the air-to-fuel ratio must be precise within a very narrow range—between 14.6 and 14.7:1.

The engine computer constantly monitors the content of the exhaust as it leaves the engine, using an O₂ sensor in the exhaust pipe ahead of the catalyst, and alters the amount of fuel being injected into the cylinders.

Hot stuff

In addition, the platinum and palladium work best when they are heated to well over 300° C, their so-called light-off temperature. Carmakers have various methods of getting the catalyst up to optimum operating temperature quickly, since the converter isn't effective until the light-off temperature has been achieved. Since virtually all unwanted emissions from

first chamber is a standard 3-way converter. This is followed by a so-called oxidizing catalyst, which only acts on the HC and CO. An air chamber between the two catalyst beds allows for extra oxygen to be pumped into the partially cleaned exhaust before it passes through the second chamber.

Get the lead out

A word of caution regarding the care and feeding of catalytic converters. All modern catalysts are designed for use with unleaded fuel. The use of leaded fuel will quickly slag the converter's rare metals, rendering the converter useless.

Also, catalytic converters tend to stay hot long after the rest of the car's exhaust system has cooled. This is something to keep in mind when you're planning to work on the exhaust system, or perhaps parking the car in areas with dry grass or low brush.

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SATURDAY MECHANIC

REPLACING WINDSHIELDS

BY JIM PIECHOCKI

● The double-bottomed gravel truck lumbering along in front of you runs over a pothole in the road, shedding several bushels of 50-caliber pieces of limestone. And, sure enough, several of them ricochet off the surface of your windshield.

There goes your deductible.

Insurance is fine, but what's worse is that it doesn't cover everything. Moldings are notorious for allowing

moisture to gather and erode the rubber seals that hold the windshield against its mounting. Even the twisting motion of today's car bodies can be enough, over time, to break the seal and cause leaks.

How do you know when your windshield seal is shot? Your windshield is actually a sandwich of two molded glass panels around a thick sheet of Mylar—a small amount of damage to

regular window glass is amplified by this type of composite glass. A BB-hole or stone chip quickly expands when moisture or air between the two panels forces them apart.

Indicators of a broken seal at the windshield's edge include increased wind noise and the appearance of grit or soil between your car's headliner and the inside windshield joint. But the most obvious sign is a leaky wind-



Safely remove salvageable or broken windshields by carefully sawing them loose from the seal with a piece of steel wire.

CAR CARE

shield. To prevent the inside of your car from becoming a miniature rain forest, it is necessary to remove, reseal and, if necessary, replace the front glass panel.

Finding a replacement

For vehicles made in 1980 and on, it is recommended that you use Original Equipment Manufacturer's replacement glass. Auto companies (and licensed OEM glass manufacturers) spend millions in research and development to keep themselves on the cutting edge. The 25% to 40% you save on aftermarket products may cost you in mismatched tints, blemishes in the windshield and other surface imperfections.

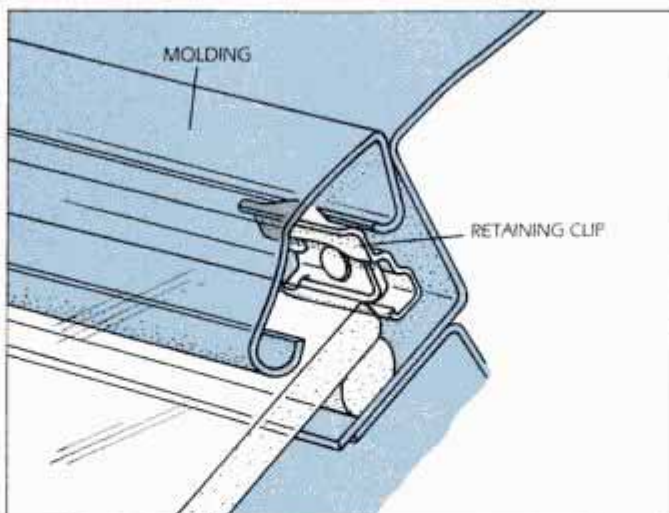
Yet, the best source of a replacement windshield may not be an aftermarket catalog or a dealership. Saturday mechanics will be pleased by the variety and low cost of original glass available at their local junkyards. (Sorry—local auto-parts recycling centers in today's ecology-conscious climate.) And since removing a junker's windshield is a lot like removing your car's, we will handle both together.

If your old windshield is broken already, we suggest practicing your removal techniques on this first, before trying them on the keeper you'll be paying for, successfully removed or not.

Removing the windshield

You should first prepare your car for the removal and installation. Tape off painted areas that will come in contact with tools. A tarp or large cloth will protect your interior from glass shards and messy urethane sealants. Unscrew and remove the antenna if it's in the way.

On most cars, a chrome or plastic decorative molding covers the outer seal. Moldings on GM cars are attached by studded retaining clips, and must be removed with a special tool that removes the tension as you lift off the molding. Insert the point of the tool behind the clip and rock it gently back and forth until you can free the clip.



Molding retaining clips can be loosened carefully with a special tool or flat blade. You may need to replace the clips afterward.

Repeat this section by section as you pull away the molding.

On some cars, upper or lower reveal moldings are held in place by screws which must be loosened before the trim can be removed. Your car's service manual will tell you which tools and removal techniques to use.

Now you are ready for the trickiest part of windshield repair, a stage which separates tinkerers from artists. You should notice a layer of rubber insulation covering the bond between the windshield and the front pillars. The bad seal must be removed by cutting the glass from its seating.

A small amount of the solvent methyl-ethyl-ketone (MEK) will soften the glue holding together your

car's urethane sealant. MEK evaporates so quickly that it should *not* damage painted surfaces on the body pillar. Try it on an unimportant area first. Factory paint should be fine—but we have no idea what's been sprayed onto your car. You can lay down a line of solvent with a clean oilcan. Do *not* use gasoline because it evaporates more slowly and can inhibit the bonding of the urethane sealant later.

You will now need about 2 ft. of piano wire, two handles and the help of a steady-handed friend. Using a sharp windshield knife (available at auto parts and hardware

stores), cut a pathway for the wire through one of the windshield corners near the base of the glass. Tie one end of the wire around a wooden handle. Then use needle-nose pliers to insert the free end of the wire through the caulking, and attach this to the other handle.

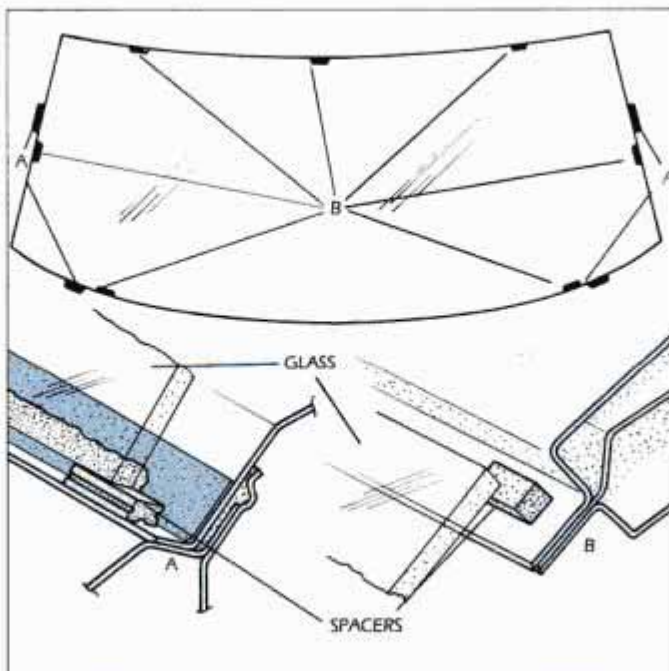
Working lumberjack style, saw around the perimeter of the glass until you have completely cut through. Apply even pressure and keep the tension on the wire as you cut. Kinks or breaks in the wire can force you to start over.

Before cutting the glass free, apply a piece of masking tape over each corner, and attach the tape to the car body pillar. Slit the tape, which will become your alignment point for installation.

Now the person inside applies even pressure without trying to force the glass. With the outside person supporting the glass, light outward pressure will separate the windshield from the body pillar. Remove the glass.

If you are simply resealing your original windshield or installing a used one, you want to leave a healthy bead of adhesive on the car. Urethane bonds well to itself, and old caulking works in favor of a strong seal.

You will also want to check the type of sealing material your manufacturer uses. Some older windshields are sealed with polysulfide, which can be determined by burning a small amount in a well-ventilated area. Polysulfide burns clear with a



Small plastic shims can be used to center and support the windshield in the opening. Some may need to be removed to install the molding.



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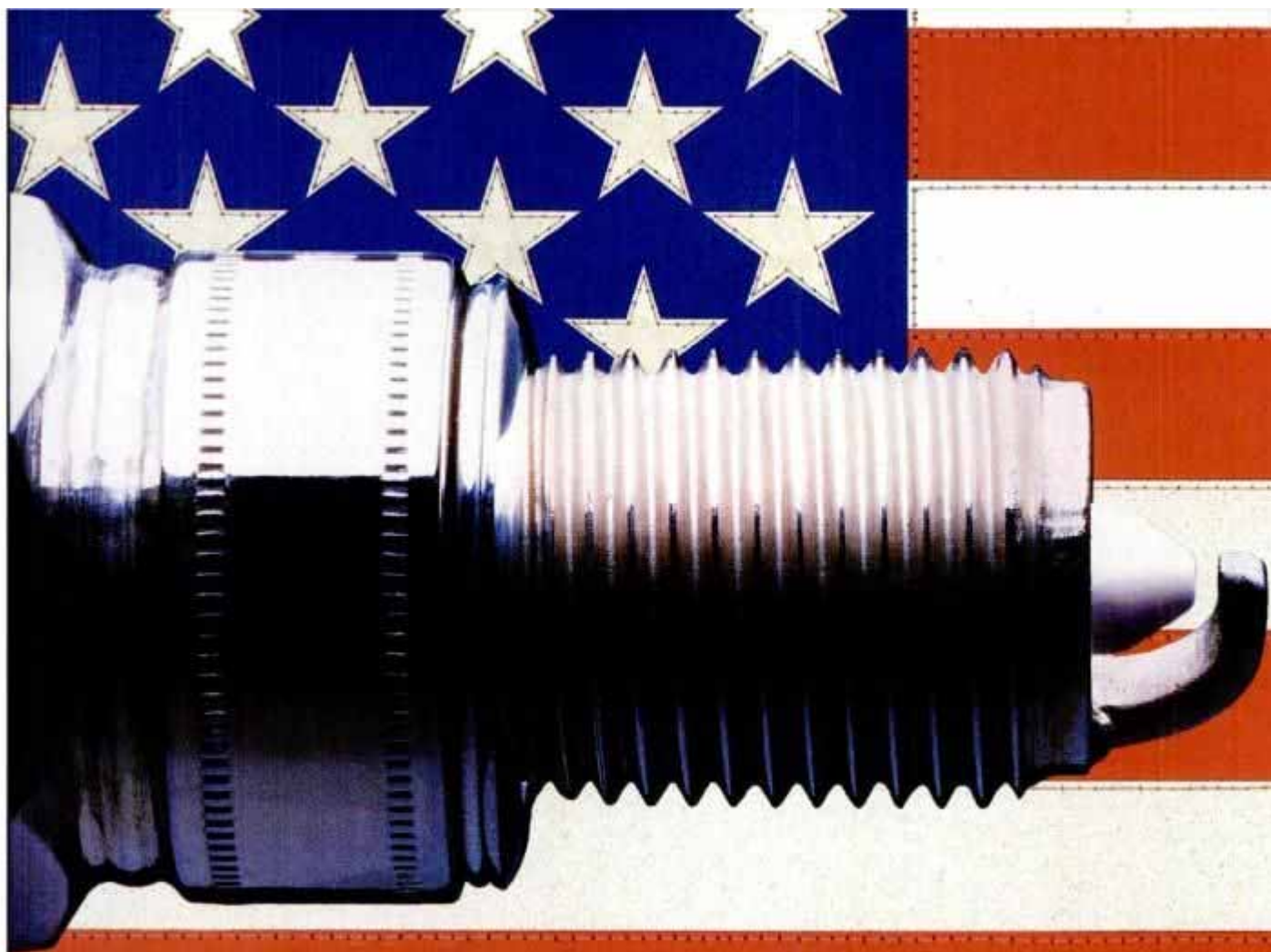


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strong sulfurous odor, while urethane emits a dirty black flame with little odor.

If there's no damage to the seal, the old sealant can serve as a basis for the new seal. Note here that you must take care to leave a uniform bead for bonding when cutting the windshield. Tape off the edge of the replacement glass to within $\frac{1}{4}$ in. of the seal to protect the surface.

Windshield adhesive kits are available from your auto parts store. Prime the perimeter of the glass outside your taped boundary, and allow 5 minutes for the primer to dry. Then, lay a smooth bead of adhesive over the primer—no more than three-sixteenths. Your adhesive kit contains a nozzle to help direct the adhesive flow.

If your windshield sealant must be replaced entirely, or if you are installing a new windshield, the procedure has a few extra steps. Check the lower windshield glass supports and clean away any excess caulking. Replace any molding clips that are bent more than $\frac{1}{32}$ in. away from the body metal. Small plastic shims will let you space the glass evenly from side-to-side and top-to-bottom, as well as ensuring the correct thickness of sealer as curing progresses.

Test the glass in position before sealing it—gap space should be no more than $\frac{1}{4}$ in. between the glass and body. Prime the glass, and caulk a $\frac{3}{8}$ -in.-high bead of sealant in a smooth, continuous line.

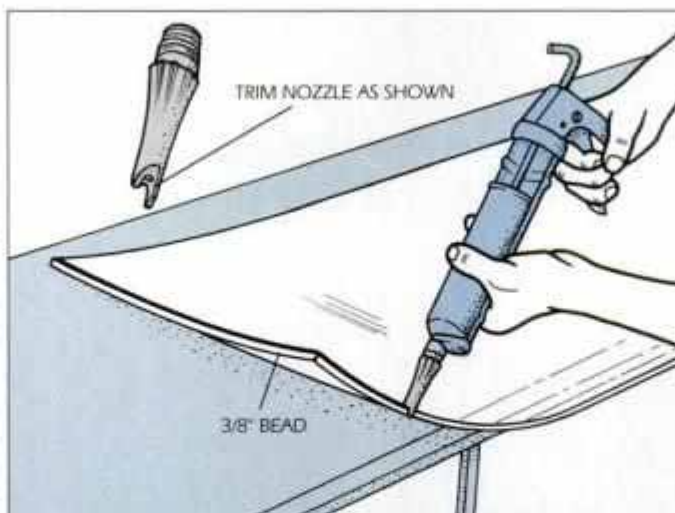
Now you can reposition the glass with a helper. Each of you supports the windshield on the sides with one hand in front, the other behind the glass. Gently lower the glass in the horizontal position, center it on the lower shims, then ease sides and top into place.

Make sure the glass is properly aligned with your tape markings. Then press the glass firmly to set the adhesive caulking.

You can immediately water-test the car. Direct a cold-water spray away from the adhesive joints, and notice if any leaks exist. You can then paddle in adhesive at the leak point with a sharp, flat tool.

Other windows

You've been thinking about that broken rear window, haven't you? Thinking that you ought to be able to use the



Use the appropriate windshield sealer and a caulkung gun to cement the glass to the body. Use the right primer for the sealer.

same procedures to replace *that* glass as well.

Almost. The back window is often attached to the car by a similar adhesive. But the windscreen is laminated safety glass, capable of shedding rocks without shattering. It's also much more resistant to the vagaries of being handled.

If you've got a rear window that's only cracked, we're surprised. It's made of tempered single-layer glass, and almost any surface trauma will leave you with a bushel-basket's worth of dime-size shards. So guess what will happen when you try to remove it and stress it just a little too much. It's worth a try. Just remember to wear safety glasses and gloves.

Removing scratches

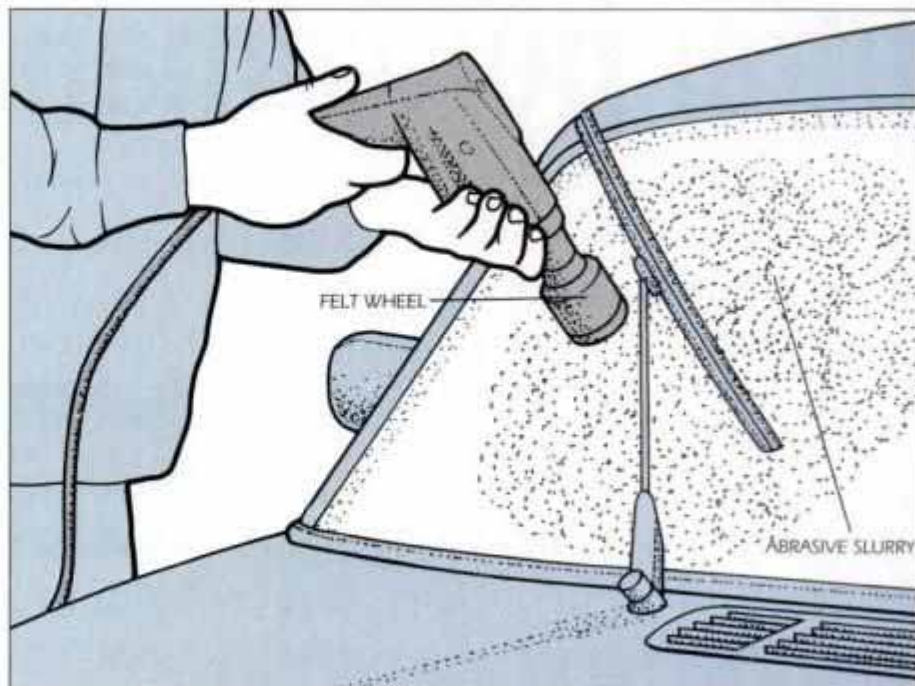
A close inspection of your windshield may reveal lots of small scratches from rocks, worn wiper blades and that last trip to the sandy shore.

If scratches are too shallow to catch your fingernail, they can often be buffed out. You'll need a low-speed polisher or drill, a felt polishing wheel and a jar of fine-grain cerium-oxide windshield polishing powder. This is similar to jeweler's rouge.

Dilute the polishing compound 2:1 with water to form a slurry. Soak the felt wheel in water for 1 hour and then mount it on the buffer. Be sure to thoroughly wash the windshield first. Dirt and grit can actually scratch the glass as you buff it.

Spread the slurry over a 1-ft. square area of your windshield and liberally apply the elbow grease as you begin buffing. Use circular movements, and don't let the oxide dry out as you move across the windshield. You may buff several times before you're happy with the results. The polishing compound washes away with soap and water.

Remember that deep scratches or stone chips cannot be buffed out. (Chips are air pockets where the glass separates from the inner Mylar layer.) Trying to rub these out will create surface imperfections that may impair visibility. **PM**



A low-speed drill, a felt wheel and abrasive slurry can safely polish out scratches. Try Brookstone, Eastwood or an auto parts store for the kit.

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New Wiperblade

● Replacing wiperblades may be a little simpler now, thanks to the fact that Trico has introduced a new line of blades. The new wiperblades, called 30-Series Wiperblade, which come in sizes and configurations to fit most vehicles, have been designed to exceed the vehicle-makers' quality standards. Perhaps as important is the fact that the new wiperblade line consolidates the most popular sizes from two other series of blades from Trico. Prices vary depending on wiper size and application. From Trico Products Corp., 817 Washington St., Buffalo, NY 14203; (716) 852-3184.



No-Spill Drink Holder

Vehicular cup holders tend to do a better job of holding cups—or cans—than they do holding the drink inside the cup. Problem is that the holders are too solidly fixed to the vehicle, so as you drive hard, your drink sloshes over the top of the immobile cup. Enter the Calypso. This 3-section drink holder insulates your cup from the base by a gimbaling center section. The result is that the base—which mounts to the dash or center console—can be at a 25° angle to your drink before the liquid starts sloshing over the top. Suggested price for the Calypso is \$19.95. Contact JB Unlimited, 1341 Ocean Ave., Suite 246, Santa Monica, CA 90401; (213) 459-0042.



Minivan Cargo Carrier

Minivans are great for hauling bunches of people or loads of cargo—there really isn't room inside for a lot of both at the same time. But you can increase the payload of your Dodge Caravan or Plymouth Voyager by using this sleek Aerospace rooftop carrier. The fiberglass Aerospace gives you about 20 cu. ft. of protected, secure storage atop the minivan. The unit, which weighs about 70 pounds, has a

hinged lid that opens with the help of gas-pressurized struts. An interior light helps you load at night, and a detachable ladder—which can stow inside the carrier—helps you reach inside the unit to fill it. Your van will still go through your 7-ft.-high garage doors with the carrier installed. Price is \$695, plus shipping. This rooftop carrier is available from Aerospace, 820 Waterbury Park Dr., Elkhart, IN 46517; (800) 535-5734.

Paint Sealant

Your car's finish stays cleaner and shinier longer if airborne grit and dirt simply slide off rather than eat into it. That's part of the thinking behind the formulation of Turtle Wax's new Clear Coat Paint Sealant. The new protective coating contains Teflon to help it shed dirt. Clear Coat is designed to stay on your car for longer periods than other products—up to a year. The coating has also been formulated to be safe for all types of paints, including basecoat/clearcoat paints. Cost is about \$18.99. From Turtle Wax, Inc., 5655 W. 73rd St., Chicago, IL 60638; (708) 563-3600.

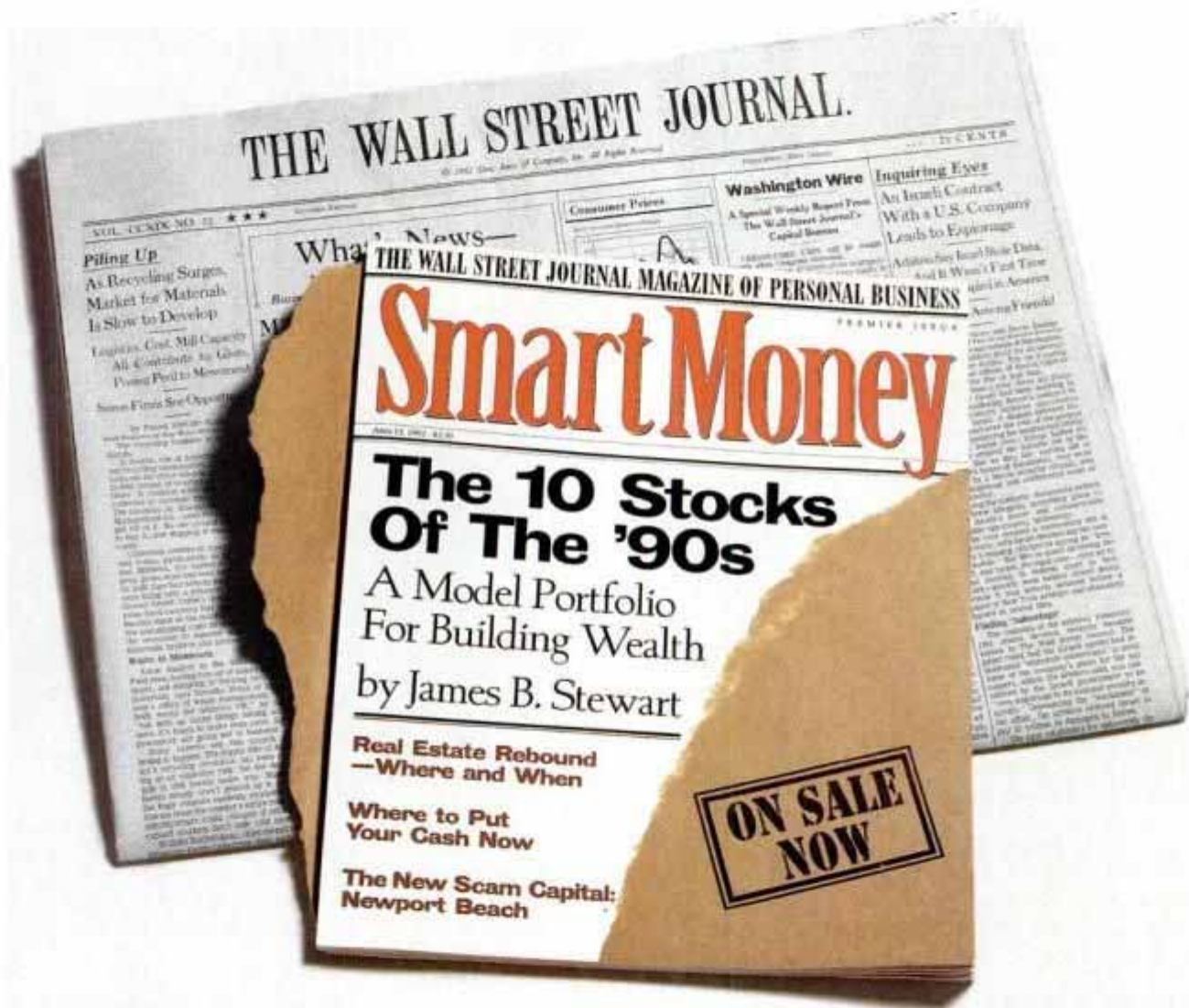


Portable Tire Step

Tall trucks are cool—until you've got to stretch to reach the center of the windshield to clean it, or maybe get to a deeply buried underhood component. Here's a simple and secure way for you to make that stretch. Called the Step-Up, it's a steel-grate platform that hangs via brackets over one of your rig's tires. Once in place, it gives you a boost in height to about the center of your wheel. The brackets fold relatively flat for convenient storage. Step-Up is available in three sizes. Prices range from \$54.99 to \$79.99. For your nearest dealer, contact Denco Step-Up, 825 E. 4800 South, No. 210, Salt Lake City, UT 84107; (801) 265-0940.



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CAR CLINIC

BY MIKE ALLEN,
Associate Automotive Editor

Rescue Me

Help! I'm rebuilding the engine in my pickup. I mail-ordered all the parts, and there are some little cellophane things in the gasket set that I have no idea where to put.

The guys at the auto parts store, even though I had them recondition the cylinder heads and turn the crankshaft, won't tell me what they are for. I think they're miffed that I didn't buy the gaskets and bearings there.

I'm sending you one of these things with a return envelope in the hope you'll be able to tell me what it is and where it goes.

ALLEN STARK
MASON, MI

Sorry you're having a hard time with the guys at the auto parts store—I've found, over the years, that it's in your best interests to cultivate a relationship with both the counter men and the gang back in the machine shop. They're almost always a reliable source of info.

The plastic sleeve you sent me isn't technically part of the engine. Its purpose is to prevent the keeper grooves on the valves from cutting the lip on the valve-stem seal as the seal is being installed. These grooves are plenty sharp, and without protection might easily nick the rubber seal. Once the seal is pushed down over the top of the guide boss, the plastic sleeve can come off, and be used for the next valve.

Also, if the machine shop assembled the heads for you, the valves were already installed. So you don't need the sleeves to complete assembly of your engine.

Shakin' Street

The outside rearview mirrors (especially the driver's side) on my 1988 Chevy pickup vibrate badly at any speed over 30-to-40 mph. I have an 8-ft. over-cab camper on the back, so I really need the wide mirrors.

I've tried two different types of stone deflector/bug shields, tightened the mirror base again and again, and even adjusted the rubber hood stops.

Once it shook so bad that the mirror glass fell out.

WILLIAM HAGUE
MAPLE SHADE, NJ

Those big West Coast mirrors will vibrate a certain amount no matter



PM ILLUSTRATION BY DOCK MANNING

what. But shaking the glass out of the grommet is too much.

Let me suggest two things:

- *Try changing the resonant frequency of the mirror. I've used stick-on mag-type lead wheel weights. Apply them to the back of the mirror in a strip near the edge.*

- *Use a turnbuckle as a brace between the mirror and door. I've done this by riveting a small sheetmetal tab to the mirror's back, and another tab to the hidden part of the door frame. Run a turnbuckle between the tabs, and adjust the mirror by turning the turnbuckle.*

Tall Dude

I have a 1991 RS Camaro. I want to change the 215/65R-15 tires for 245/60R-15s. These are about 1½ in. taller than the others.

The owner of the tire store said the taller tire will fool the computer and

cause performance problems. So I called two local Chevy dealers. One was unsure, and the other said the only problem might be clearance to the fenders.

JOE SOKOLSKI
WOODSTOCK, GA

You won't "fool" the computer. It will be confused about the true vehicle speed—but so will you, as the speedo and odometer will be off by a healthy percentage. There will be a difference in performance—your overall gearing will be a similar percentage taller, costing you acceleration.

The stock RS wheels are 15 × 7 in. A 245-section tire is a little too wide for my liking. My suggestion is to find some 16 × 8-in. rims—the same size that comes on the Z28. Then you can mount up some 50-series 245mm wide tires, which should be just about the same height as the 215s.

If you must keep the same rims, I'd

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CAR CARE

suggest settling for a 235/60R-15. This happens to be just a little bigger than stock, at least in the two tire catalogs I checked.

Be aware that not every identically labeled tire is the same physical size as the similarly labeled tire from another manufacturer.

More importantly, the tire dealer should have known and explained all of this to you. I suspect he's trying to peddle some tires he has too many of in stock already.

**Blowin' In The Wind,
Chapter Two**

The lead story in the Dec. '91 Car Clinic showed an illustration of a leakdown tester, a gadget I recommend instead of a compression tester for checking on the mechanical health of your engine.

A ton of readers have asked me where they can purchase one of these Mannes brand testers. Nobody seems to know about them—or any other brand of leakdown tester.

That's because that airbrush painting is done for us every month by Don Mannes—and that's his sig-

Frankly, Scarlett. . .

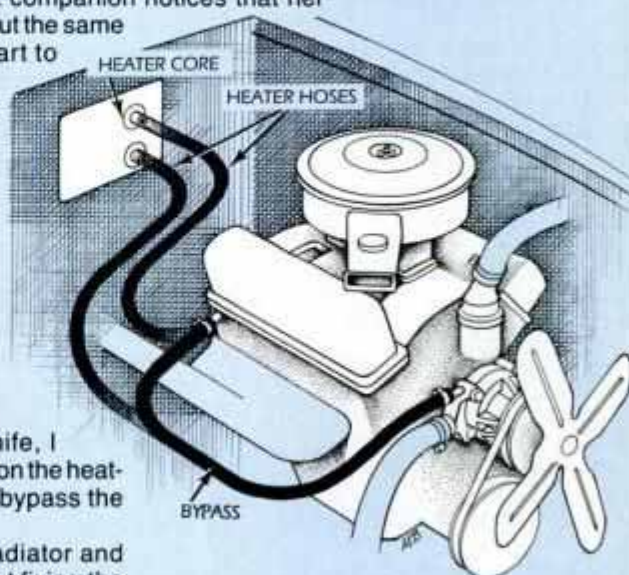
● There we were, cruising down the parkway one nice sunny Saturday. And we notice this sweet smell. We figure it must be an overturned ice-cream truck—but it doesn't go away.

Then my front-seat companion notices that her feet are wet. Right about the same time the windows start to steam up, and the interior of the car turns into a Turkish bath.

Nope, it's not pixies cooking down maple syrup under the back seat, it's a ruptured heater core. That sweet smell is coolant, and it's gushing out under the dash.

Ahh, it's too nice a day to worry. With my trusty Swiss Army knife, I undo the hose clamps on the heater hoses, and simply bypass the heater core.

I then top off the radiator and plan on worrying about fixing the heater core . . . tomorrow.



PM ILLUSTRATION BY ADOLPHE BROTMAN

CAR CARE

nature. There is no Mannes tool company. (Look for Don's name or initials in this artwork every month.)

At any rate, leakdown testers should be available at any auto parts store. They're listed in the MAC tools catalog, and are available from other sources as well.

As a last resort, I got mine (about 15 years ago) from U.S. Industrial Tool & Supply in Plymouth, Michigan; (800) 521-7394 or (800) 482-

4167 in Michigan only. It's part No. TP-104, and the latest catalog lists it for under \$50.

Blink, Blink, Blink

The turn signal indicator on my F-150 pickup has always been very faint. Combined with the dim indicator lights on the dashboard, both have resulted in my driving for many miles with one or the other blinker flashing. The dealer says that a number of oth-

er customers have complained, but there was nothing he could do. Is there anything I can do?

JEFF WEAVER
RIPON, CA

Start by digging around under the dash and finding the flasher relay. If possible, mechanically remove it from its fastening. Many of these relays just dangle from the harness.

There's usually a metal clip for hooking the relay to the underside of the dash. Drill a 1/2-in. hole in the bottom of a small can—tunafish cans should be about right—and clip the relay to it. This should amplify the sound considerably.

Not loud enough? Okay, several manufacturers make an extra-loud relay. Try the auto parts store. The counterperson may have to dig into the catalog and order one.

Still not loud enough? There are at least two aftermarket high-volume buzzer/beeper gadgets listed in the J.C. Whitney catalog. You also might look for these same gadgets at RV dealers. **PM**

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS

- Nissan service bulletin NTB90-079 describes the steps recommended in refilling and purging the cooling system of 1989 and later-model Maximas. The front bumper must be elevated over 3 ft. while the radiator is filled, and then the engine should be run until bubbles no longer appear in the radiator neck.
- If your 1985-'87 Chevy Spectrum has a rattle in the exhaust system, especially on short trips, you may need to replace the catalytic converter. TSB 87-299-6F
- If your Pontiac LeMans is hard to start under high humidity/cold temp conditions. TSB 88-6-65 suggests removing the plastic distributor splash shield, and then drying the inside and outside of the distributor with a soft, dry cloth. After this, it may be necessary to remove and clean or replace fouled plugs caused by the distributor misfire.
- If your 1991 Caravan or Voyager has a fuel gauge that reads full when there is room for 5 or 6 more gallons in the fuel tank, the dealer may need to replace the fuel-level sending unit with a revised part. TSB 08-01-91A

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NEW CARS



Chrysler Unveils LH Sedans For 1993

● One of the bigger unveilings at the recent North American International Auto Show in Detroit was the first public display of Chrysler's much-heralded LH sedans. Due this fall for the 1993 model year, the Chrysler Concorde, Dodge Intrepid and Eagle Vision are expected to restore good health to Chrysler Corporation's pas-

length will be about 200 in. Ford's full-size Crown Victoria, by way of contrast, has a 114.4-in. wheelbase and is 212.4 in. long.

All three cars will be front-wheel drive, with longitudinally mounted engines. Suspension will be all-independent, with a multilink setup at the rear. Chrysler plans to offer three levels of suspension tuning for the cars—Base, Touring and Perform-

automatic, capable of handling heavy torque loads, will transmit power to the drive wheels. Chrysler chose the longitudinal layout partly to improve crashworthiness and partly to accommodate future all-wheel-drive versions of the new cars.

The steep rake of the LH windshield and backlite means a substantial increase in glass area over conventional designs. Chrysler plans to deal with this by installing solar sensitive windshield glass to reduce heat buildup. The new cars' climate-control system will also use an environmentally friendly refrigerant instead of freon.

Interior safety touches include airbags for the driver and front-seat passenger as standard equipment, height-adjustable seatbelt anchors and an integrated child seat.

In addition to creating this new design concept, Chrysler simultaneously whittled down the development time. From inception to unveiling, the LH project took just over three years, far less than the traditional 5-year cycle. LH production is slated to begin in June at Chrysler's Bramalea plant in Ontario, Canada.

(Please turn to page 116)

Like other LH sedans, Eagle Vision rides a 113-in. wheelbase.



senger car sales and may also have a major impact on automotive design worldwide.

The key departure in the LH series is the cab-forward design concept, developed in Chrysler's Eagle Optima concept car. As the name suggests, cab forward moves the passenger compartment toward the front axle and moves the wheels out to the edges of the fenderwells.

The base of the steeply raked windshield starts almost at the front-axle centerline, and the hoodlines slope sharply downward.

Technical details were sketchy at the unveiling, but the Concorde, Intrepid and Vision promise to be exceptionally big for midsize cars, riding a wheelbase of about 113 in. Overall

ance—as well as optional antilock braking and traction control.

The standard engine throughout the range will be Chrysler's 147-hp pushrod V6, but an all-new port-injected dohc 24-valve 3.5-liter V6 rated at 200 hp will also be offered. A new electronically controlled 4-speed



Intrepid will carry Dodge colors, while Concorde (top) is Chrysler's entry.

The 1992 Buick To make



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With tuned-port injection for 1992, the 3800 V6 engine is rated at 170 horsepower. And a 4-speed automatic transmission with computerized shift control provides

on a legend.

that power with smooth precision.

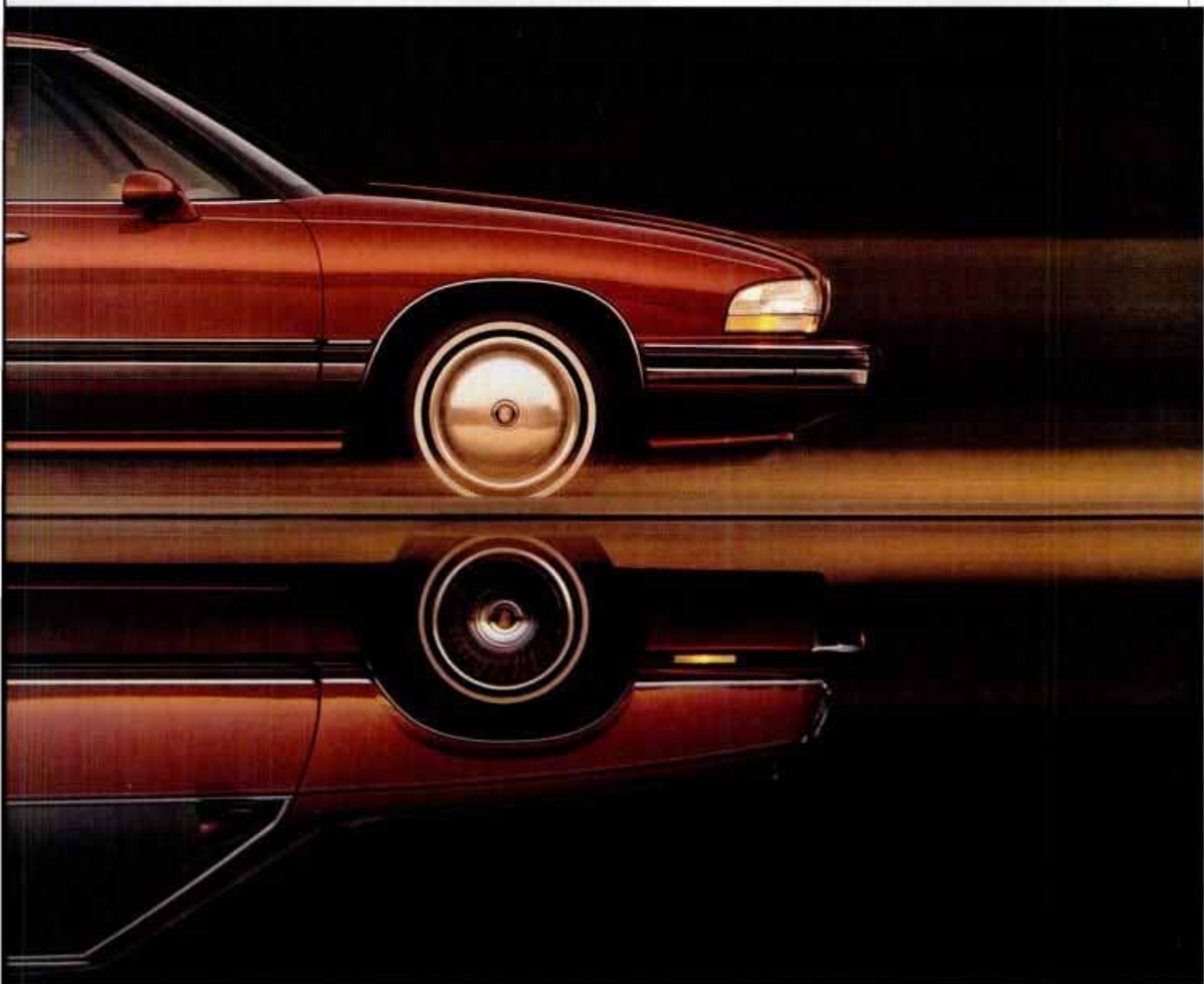
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Buckle up, America!



New Nissan 240SX convertible avoids targa hoop of topless 300ZX.

Topless At Nissan

After an absence that dates back to Datsun days, convertibles are returning to the Nissan lineup.

Following a number of preview appearances in spy photos, the fresh-air version of the Nissan 300ZX finally made its first appearance at last October's Tokyo show. The Z-vertible hides its folding top under a flat tonneau at the rear of the car, and retains a targa-style hoop over the top. Pricing for the 300ZX ragtop wasn't final at press time, but don't come to the showroom with less than \$30,000.

The 240SX offers a cleaner-looking conversion, with only a pair of ear-like projections—housing the upper anchor points for the shoulder belts—to remind onlookers that this design began life as a coupe.

Jeep Grand Cherokee

We'll be bringing you a report from our first hands-on encounter with Jeep's new Grand Cherokee next month, but here are some preliminary specifications.

The newest Jeep is sized between the current Cherokee and the old Grand Wagoneer. The wheelbase is 105.9 in., 4.5 in. longer than the Cherokee and 3.2 in. shorter than the Grand Wagoneer. The overall length is 173.3 in., 8 in. longer than the current Cherokee.



New Jeep Grand Cherokee has standard ABS and driver's airbag.

Besides more room for passengers, this provides 7.4 cu. ft. of additional cargo space, accessible through a rear door that's 4.3 in. wider.

Anticipating tougher safety rules for sport/utility vehicles, the Jeep design team gave the Grand Cherokee a driver's airbag, the first offered in a vehicle of this type. Four-wheel antilock braking will be part of the standard equipment inventory.

Initially, the Grand Wagoneer will be limited to the same 190-hp straight Six that also propels the Cherokee. However, by fall, a V8—borrowed from the Dodge pickup truck family—will be available as an option.

Infiniti J30

Nissan's Infiniti division rounds out its 3-car stable this spring with an all-new luxury entry that's certain to escalate the level of competition in the

Acura Legend-class market. Designed to replace the current Infiniti M30 at the end of the year, the J30 shape was conceived and developed by Nissan Design International, Nissan's San Diego-based subsidiary. The posh interior, with leather upholstery and walnut trim standard, was designed in Japan.

With its 108.7-in. wheelbase and 191.3-in. overall length, the rear-wheel-drive J30 is a little smaller than the Legend, but bigger than the new Lexus ES 300. Power comes from a modified version of the 300ZX 3.0-liter dohc 24-valve V6 rated at 210 hp.

Suspension consists of long travel struts at the front, multilink rear with antiroll bars front and rear. There are big disc brakes at both ends of the car, with a 3-channel antilock system.

Other safety features include two front-seat airbags and automatic pretensioning seatbelts.

Mitsubishi Montero

Although it was boxy and unlovely, Mitsubishi's original Montero sport/utility vehicle was a solid sales success. That leads us to believe that its replacement, which is not only improved in every conceivable mechanical area but good looking to boot, will be an even bigger success story.



Toyota Full-Size Pickup

● The question is no longer whether Toyota will invade the high ground held by U.S. Big Three pickup trucks, but when the invasion will come.

With the current balance-of-trade friction between the U.S. and Japan, Toyota is maintaining a low profile on its plans for a full-size truck, but the project is known to have been simmering for some time. The artist's rendering of the Toyota truck shown here was developed from

spy photography and information leaked to the Japanese press.

The big pickup will definitely offer a powerful V8, but whether this will be a variation of the 4.0-liter 32-valve 4-cam Lexus V8 or some other design is not known. Certainties include the availability of 4wd, extended-cab versions and competitive payloads. The Toyota truck is also expected to offer a carlike level of comfort and convenience amenities.

PM ILLUSTRATION BY MARK STEINBERGER



Riding a stretched (by 1.2 in.) 107.3-in. wheelbase, the new Montero is bigger in every dimension but height. The bluff bow has given way to contemporary curves, and the squared-off lines have been softened.

Power is still supplied by Mitsubishi's smooth 3.0-liter 60° sohc V6, but there's more of it—151 hp versus 143, and 174 ft.-lb. of torque versus 168.

models have 4-wheel disc brakes.

Inside, the new Monteros are comfortable and nicely finished, with some interesting—perhaps even useful—gadgets.

In a brief day of introductory driving, we found the new Montero to be a little sluggish in city traffic but quite handy in the rough. There's good ground clearance and the flexibility of



Refined styling, flexible 4wd system and innovative ABS option are highlight features for the new Montero. Instrument inventory includes an inclinometer.

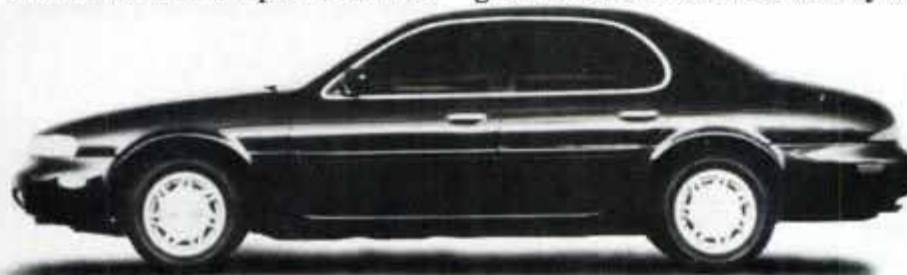
Antelope Valley for a day at Willow Springs racetrack, and back to Tinseltown, Viper proved itself equal to the best of the off-shore exotics.

This car has enough power to supply the electrical needs of many Third World nations. It also has brakes and handling to match. The 488-cu.-in. engine produces enough torque (450 ft.-lb.) to hang the back end out in 4th gear at well over 100 mph. Equally impressive is the fact that it's no big deal to keep it there. And collecting it afterward revealed no trailing throttle oversteer.

The interior is a little cramped. There's no place to rest your left foot. I burned my hand on the doorsill over the exhaust a dozen times. The wind buffeting is enormous, and the convertible top makes an MGB seem modern.

None of these things matter. This is a car carved from pure congealed testosterone, and on the road it cashes all of the checks it writes visually.

Get in line now—1992 production will be sparse. —Mike Allen



The Infiniti J30 challenges the Acura Legend and the Lexus ES 300.

This is a good thing, because there's more Montero for it to haul. The previous lineup topped out just under 4000 pounds, while the new 4-model range starts at 4120.

The heart of the new Montero's off-road capabilities is Mitsubishi's Active Trac 4wd system, which allows the driver to engage or disengage 4wd at speeds up to 62 mph. The system employs a center differential, a viscous coupling unit and a vacuum-actuated synchronized freewheel front differential.

When the driver shifts into 4wd, a synchronized clutch engages the front differential. Front/rear torque split is handled by the viscous coupling unit. The center differential can also be locked, for tough traction situations, and the Montero SR can be ordered with a locking rear diff.

Transmission choices are the standard 5-speed manual and optional 4-speed automatic.

Another interesting feature is Mitsubishi's new Multi-Mode ABS, which provides antilock braking regardless of drive mode. Unfortunately, the system is available only on the top two Montero models, although all

the 4wd system is as good as anything in the sport/utility field today.

Prices range from about \$18,000 for the basic Montero, to \$28,000-plus for the SR. —Tony Swan

Vipermania

Team Viper finally let a nest of Vipers out of the bag. Four engineering prototypes were left to the tender mercies of journalists and the wide-open spaces of the Mojave, accompanied by none other than Carroll Shelby.

Starting in Hollywood, out to the



With 400 hp and race-car chassis, new Dodge Viper delivers on its visual promise.

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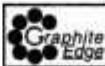
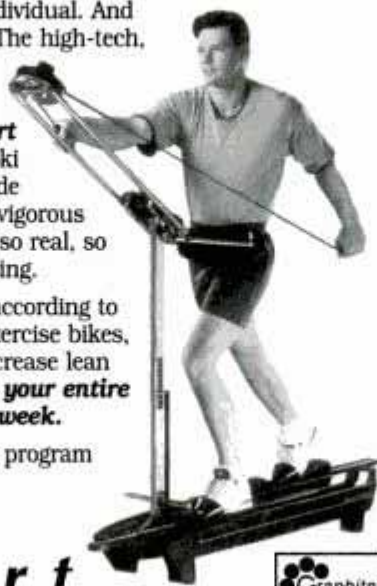
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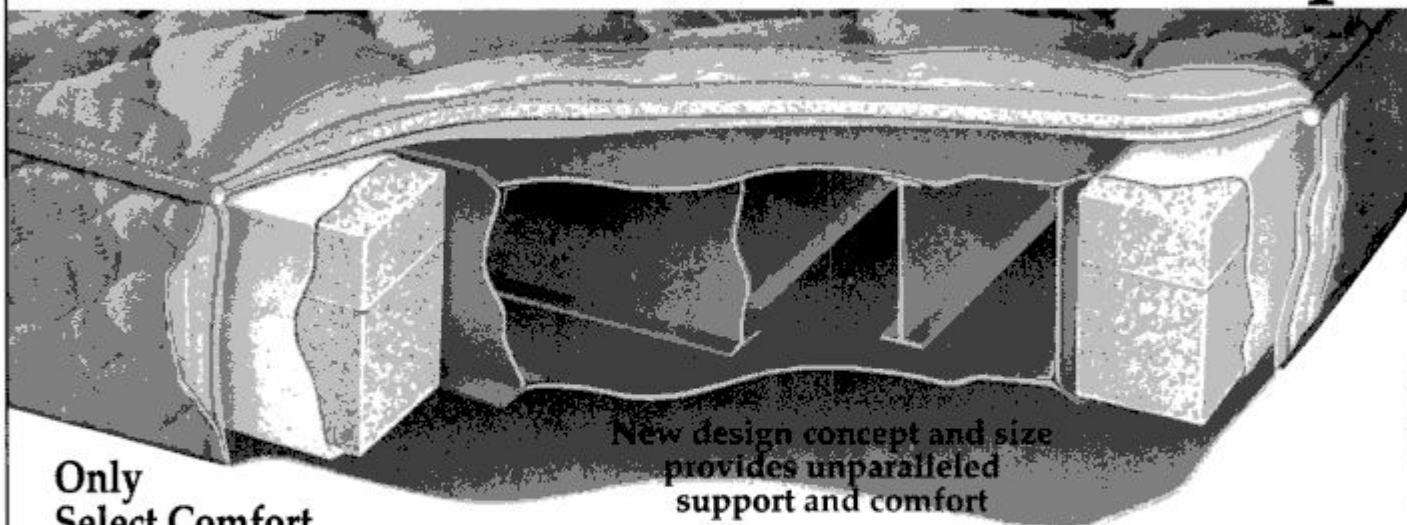
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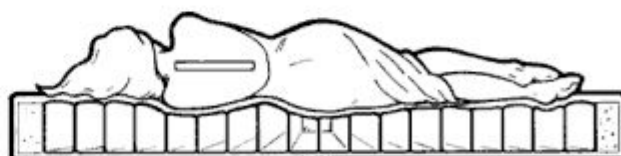
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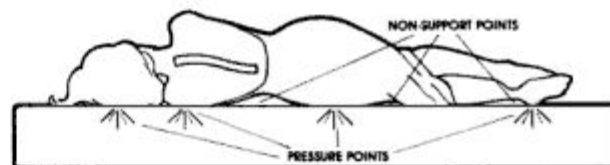
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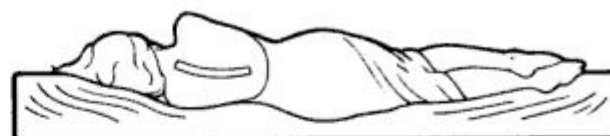
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WORDS TO GO

BY FRANK VIZARD, Electronics Editor

● The home office is practically becoming a fixture in the American home. Home information products—computers, fax machines and telephones—accounted for about 25% of all consumer electronics products sold in 1991, according to the Electronic Industries Association. And while many people are running businesses from their homes, most buy home office equipment in order to bring work home from the office.

Generally speaking, the personal computer is the anchor to the home office. But for many people, the capabilities presented by the home computer go underutilized. If all you want to do is an evening's worth of word processing or work on a spreadsheet, then investing in a personal computer might just be overkill.

A simple, less expensive and portable alternative is a machine like Panasonic's KX-WL55 portable word processor. Now electronic word processors are hardly new. However, this machine sports one feature that makes it useful to anyone bringing work home from the office. With the KX-WL55, you can download text onto an MS-DOS formatted 3.5-in. double-sided double-density disk. Because the conversion is to ASCII (a universal text format), you lose codes for margins, underlining and similar settings but this is just a minor inconvenience.

Of course, the KX-WL55 is not a laptop computer, and its list price of \$580 reflects that. Internal memory is about 48K, much less than a computer's. However, since you can store in-

Store text to MS-DOS disks with the Panasonic KX-WL55 word processor.

formation on floppy disks, data storage is not a problem. The KX-WL55 is also bigger than some laptop computers, measuring roughly 13 × 9 × 2.5 in. in size, and heavier than some, weighing in at 6 pounds. The machine can be plugged into a wall outlet or run on NiCd batteries, which must be bought separately.

Other nice features of the KX-WL55 include a backlit LCD screen which displays 14 lines of 80 characters across. An autosave function automatically saves copy to the disk every 2000 characters, so losses are minimal if there's a power failure.

Programs include a spreadsheet, a 63,000-word dictionary, a thesaurus with 500,000 synonyms and an address list function. There's also a port for connecting a printer. Panasonic also has a machine, the KX-WL45, which offers a 7-line display screen for a list price of \$470.

If there's a feature missing, it's the ability to fax or modem text over the telephone lines. This abil-

ity will be present on a new machine called the 8000LT laptop from Smith Corona. Similar in many respects to the Panasonic KX-WL55, the Smith Corona 8000LT carries a list price of \$700. Internal memory is larger at 256K, and there is also WordPerfect converter software—a plus for those already using this popular word-processing program. (It would be great if other programs such as XyWrite were available, perhaps as a dealer installed option.) The fax/modem capability, however, is a \$130 option. At this point, though, you're well on your way toward the price of a personal computer.

So far, everyone I've shown these machines to says: "Wow, I need one of those at home." Granted, most of these people are fellow scribes. Both machines' ease of use becomes quickly apparent, and therefore they become very attractive. This review, in fact, was written with the KX-WL55.

Correcting Disorders

Canon is upgrading Communicators for people with speech disorders. Listing for \$1100 and \$850, the two products allow the user to type, print and record messages wherever they are. Both new models feature expand-



Canon's Communicator helps people with speech disorders.

ed memory and added functions. The CC-7S, the more expensive of the two, adds sound recording and playback capability.

Expanding CD

If you own a portable compact disc player and you want to get a little more mileage out of it, you might consider a few of the many audio accessories made by Recoton and sold under the Discwasher brand.

The CD Bass is a cassette-shaped adapter that fits into the tape well of a car player or boom box. The mini-plug at the other end of the adapter fits into the portable CD player. There's also a bass booster to enhance low-frequency sounds. List price is \$40.

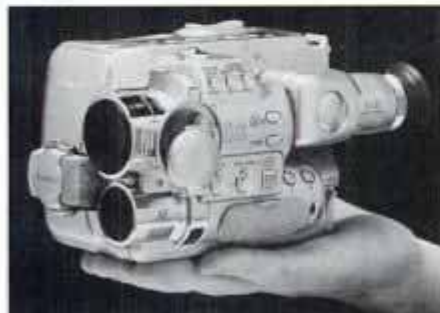
If you need to power your portable CD in the car, you can also get Discwasher's Universal CD Power Adapter. Just set the voltage indicator to the proper position and plug the cord into the car's cigarette lighter receptacle. Listing for \$33, the CD Power Adapter perfectly complements the CD Bass product. It can also be used to power portable tape units and other electronics devices.

Twin Camcorder

A new wrinkle in camcorders—a twin lens system—comes from Sharp. The VL-MX7U has a standard zoom lens as well as a fixed-focus wide-angle lens. The zoom lens lets you magnify your subject up to eight times, while the wide-angle lens can expand the view up to 62°, 17° wider than normal.

Both lenses can be used separately or together. When used together, the result is a picture-in-picture effect, with one image inserted as a box within the larger image. So, for example, one lens can provide an overview of a school play while the second lens zooms in for a closeup of an individual child. The picture-in-picture effect can be flopped at will.

The VL-MX7U also sports a color viewfinder and stereo sound for a list price of \$1699. Another version, the VL-MX6U, has a black-and-white viewfinder and monaural sound for a list price of \$1499. **PM**



Sharp's newest camcorder features two lenses and a color viewfinder.

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AUTOMOBILES

DETROIT SPY REPORT

BY JIM DUNNE, Detroit Editor



Socket To Me

Electric cars are definitely coming from GM, Ford and Chrysler. All of the Big Three are now working on their prototype electric models and they expect to have production versions humming in the showrooms by '95 or '96. Each of the U.S. automakers initially will field an electric vehicle for a different market segment: GM's Impact is a sedan, Chrysler is working on a futuristic passenger van, while Ford is pegging its hopes on a delivery van.

The big push behind electrics now is legislation for zero-emissions cars in California by 1998. And don't count the imports out of this high-voltage arena. Automakers in Germany and Japan are turning up the juice on their own electric car programs.

High Rollers

One reason Detroit's show cars look so tough is their huge-diameter tires. Both Buick's midsize Sceptre and GM's 100-mpg Ultralite, for instance, ride on 18-in. tires. And big tires have already come to standard production cars—the Corvette and Viper already roll on some of the largest rubber in the industry. Engineers say that large tires have lower rolling resistance. Designers like the look that the supersize skins lend to a vehicle. They are even considering using larger tires on the rear than on the front to give the car a high rear-end stance—something the hot-rodders have been doing since the '50s. **FM**

Hot-Rod Lincoln

● Stinging from Cadillac's decided performance advantage, Lincoln will be taking the gloves off this summer to challenge the top GM marque in a battle of the luxury coupes. The new Mark VIII will reflect its obvious heritage in the sheetmetal department by flashing a Continental grille and retaining the trunk spare-tire hump.

But the real news will be under the hood as Ford debuts its twin-cam 4.6-liter V8—the newest wrinkle of its modular engine. Our sources tell us the engine should be good for just under 300 horsepower, which is on a par with Cadillac's new Northstar 4.6-liter V8. Both these engines, which will move in between the frame rails of the Mark VIII and Caddy Eldorado respectively, are said to be a match in smoothness and fuel economy for the best of the imports. Price tags on the Mark VIII and Eldo are expected to be in the mid-\$30,000 range, which gives them a big price advantage over their import competition—Lexus, Infiniti, Mercedes-Benz and BMW.

Name Games

Oldsmobile and Buick are about to close the book on the Toronado and Riviera nameplates for their specialty sedans. Both these cars are scheduled to undergo radical design surgery for the 1994 model year, and the two GM divisions want fresh names to tack on their fresh models. The new monickers aren't finalized yet, but we think likely candidates are the Anthem (after the concept car introduced at the

Detroit Auto Show in January) and Troféo for Oldsmobile, while Buick may recycle the Sceptre name used for its concept car that debuted at the same show.

New Brougham Doesn't Sweep Clean

Tradition is big at Cadillac, at least in its big 1993 flagship Brougham sedan to be introduced soon. The biggest of the Caddys (and the entire GM passenger car fleet, for that matter) rides on a 121-in. wheelbase and measures 221 in. bumper-to-bumper. The king-size luxu cruiser still retains the traditional body-on-frame construction—a rarity in this day of unit body design—and rear-wheel drive, the only pusher Cadillac in the fleet. Built on the Chevrolet Caprice chassis and powered by GM's 5.7-liter V8 (down the road an infusion of Northstar 4.6-liter V8 power is a possibility), the Brougham does flaunt new sheetmetal. Styling, however, takes on a traditional bent with the familiar Cadillac eggcrate grille, massive fender, long hoodlines and an opera window in the C-pillar. Aside from sharing its drivetrain and chassis with the Caprice and Buick Roadmaster, Brougham also shares the curve and angle of its windshield posts with its B-body siblings.



1993 Brougham will stretch new skin over familiar rear-drive chassis.

SE's supportive front seats reflect its sporting spirit, and the no-nonsense analog gauges read at a glance.

We liked the blackout grille, alloy wheels and other sporty trim touches. It gives the SE a clean, integrated appearance, and we found the general level of fit and finish to be among the best.

Like the Mazda 626, the Stanza is headed for a redesign, due this fall.

Oldsmobile Achieva SL

Here's yet more proof that concept cars have become much more than mere attention-grabbers at auto shows. The new Achieva, which replaces the Cutlass Calais, is almost a direct derivative of last year's Achieva concept car.

The Achieva is all-new inside, with a nifty cockpit-style instrument panel and excellent front seats. It's limited for rear-seat legroom and lacks an airbag. ABS is standard equipment, however, and the basic braking system is improved over the Calais.

General Motors' 3300 V6 engine and 3-speed automatic transmission stir the Olds Achieva along respectably enough—its acceleration times were mid-pack—producing admirable fuel economy numbers in the process.

But the Achieva's real edges in this derby are, like the Skylark and Grand Am, its styling and attractive pricing—well below the Honda Accord and Ford Taurus with similar equipment.

Pontiac Grand Am GT

Did we hear you say that family sedan styling puts you to sleep? Try this one

on for size. With its excellent electric-blue paint job and unabashed GT trim, this new Grand Am will definitely get you noticed.

Like the other GM N-car replacements, the Grand Am is snug in the rear-seat area, and the shape of the doors makes getting out awkward.

The seats themselves are comfort-

don't deliver the kind of capabilities we found in the Passat, Stanza or even the Hyundai. We also found that the lower body cladding occasionally scraped against the front tires at full lock.

Still, this is a package that's well conceived to make young hearts glad. The new Grand Am turns more heads than all the other cars combined. And at just about \$17,000 fully loaded, it's an attractive buy.

Saab 900

The 900 series has survived for a long time on character and competence. Although its appearance is out of step with current design trends, that unique Scandinavian shape encloses impressive interior space, a cavernous trunk and superb seating.

The Saab's seating position provides a commanding view of the road, major control locations are good, and the climate control functions are simple.

We were also thoroughly impressed with the ease of the 900's routine service functions, which led all others in our serviceability index.

Although the Saab's 140-hp 2.1-liter dohc 16-valve Four is an excellent engine, it produces leisurely acceleration when mated to an automatic

transmission. We recommend a 5-speed. The suspension and stiff chassis combine to produce a satisfyingly European feel, and if the 900 isn't what you'd call nimble, it's devoid of surprises and strong on long haul comfort. But then, that's what Saab has always sold—enduring virtues in a car built to endure.

(Please turn to page 124)

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able and supportive, and Pontiac has done its usual good job of creating a comprehensive and attractive instrument panel with a decidedly sporty look to it. Some of the minor controls aren't up to Honda levels, however.

Handling is certainly competent, and the aggressive 205/55R-16 Good-year Eagle GA tires provide plenty of stick, but the chassis and suspension

NH Northern

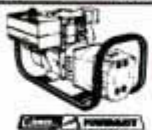
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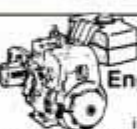
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P.O. Box 1219, Burnsville, MN 55337-0219**FAMILY AFFAIR** (Continued from page 123)**Subaru Legacy**

The Legacy was the only all-wheel-drive car in our test group, but the benefits of this feature don't really shine until the road starts getting slippery. Pushed hard on dry pavement, the Legacy's dominant handling trait is stubborn understeer.

Our test car was equipped with Subaru's familiar 2.2-liter sohc flat-Four. Although it sounds a little busy and doesn't make much in the way of peak power—130 hp—it's torquey, willing and bulletproof.

The Legacy gets a cautious facelift for '92, giving the car a conservatively contemporary appearance. The interior is also conservative, with straightforward controls and the only one-touch-down/one-touch-up power windows in the group. Our test car also had the optional driver's airbag.

But the Legacy's most compelling virtue, from a family point of view, is its interior volume. There's real move-around space for five here, excellent headroom fore and aft and plenty of space under the trunklid.

Toyota Camry LE

For the first time in its successful history, the Camry is bigger than its rival from Honda. The extra size—it's 6 in. longer, 2 in. wider and 1 in. taller than its predecessor—makes it much roomier inside, right up there with the best. This is real 5-passenger capacity here, and the Camry is fitted with comfortable, well-upholstered seats to go with it.

Toyota has done an excellent job of elevating the Camry's user-friendliness to the same level as the Accord. Besides the well-designed controls, there's the biggest glovebox in the group and an enormous trunk.

On the road, the Camry is supremely smooth, quiet and comfortable. Its handling is predictable and sure, and its braking (with optional ABS) is excellent. But the dynamic feature that really sets this all-new car apart is its optional 3.0-liter dohc 24-valve V6

engine. With 185 hp on tap—29 more than the previous 2.5-liter version—this smoothie gives the Camry real hustle.

In our book, the new Camry is a much better car than the very good car it replaces, and is now one of the pacesetters in this class. Our test crew rated its engine and smooth new exterior design tops in the group.

But with V6 power and the other goodies on our LE tester, it's also one of the most expensive cars we tested.

Volkswagen Passat G

If silence and serenity are near the top of your priorities in a family sedan, the Passat may not be for you. Its 134-hp dohc 16-valve Four tends to be buzzy, and there's more than a little harshness in the taut European sport sedan suspension setup.

However, if your preferences run to occasional sprints down twisty back roads, the Passat bears closer scrutiny. When it comes to crisp transient response and positive feel, the Passat stands at the head of this class. Virtually all testers called this car's handling best-in-group, most rated it near the top in terms of fun-to-drive, and three of our testers—the hot-shoes of the group—flatly rated it their favorite, its noisy operation notwithstanding.

From a family point of view, the Passat also surprised us with its roomy interior. Front and rear head- and legroom are generous, seating is sporty and the control layout rates with the best.

Airbags aren't part of the safety inventory, and antilock braking is available only as an option.

Basically, this is a car aimed at satisfying the weekend racer that lurks somewhere inside almost every family man. If you're after that kind of satisfaction, we recommend a Passat equipped with a 5-speed. For even more go, you can specify the new 178-hp 2.8-liter V6 engine, which was unavailable for our test.

PM**As Seen in****PM**
Popular
Mechanics

Studios, which evolved the design to a fiberglass mold stage, and Scaled Composites, in Mojave, California, used the molds to develop the tooling to form the carbon fiber into the finished structure. Scaled Composites is headed by Burt Rutan, the builder of the experimental *Voyager* light plane that went around the world without refueling. Rutan is also the designer of PM's light plane of the future that was featured on the cover of our August '87 issue. The Ultralite's entire body weighs in at a mere 420 pounds and uses only six basic components—the floor tub, the right and left halves, doors and the rear panel. According to GM, the composite gull-wing door has side impact strength similar to a conventional steel door.

As far as seeing carbon-fiber-body cars in the showroom, Runkle says, "You'll see carbon fiber go into production cars first as parts, not as complete bodies. We'll use it first in places where we need extraordinary stiffness and light weight, so you'll see it in a hybrid structure—some steel, some aluminum, some carbon fiber. We'll use it for interior panels first, not as the outside skin of the car. It has a surface texture that is not smooth, so we'll keep it in the structure, below the exterior skin."

Runkle expects carbon fiber to show up in GM production cars in the mid '90s. "Likely places for its use," he indicates, "are in the A-post (windshield pillars) and the firewalls."

Significant weight reduction is also achieved in the ABS VI braking system. Aluminum/silicon carbide rotors, containing 20% silicon carbide particulate for an excellent friction surface, weigh 50% less than an iron rotor, and lightweight aluminum calipers decrease drag. The system is designed so no power assist is needed.

Little engine that could

Ultralite achieves its remarkable fuel economy (100 miles per gallon at a steady 50 mph) by using a 1.5-liter 3-cylinder crankcase-scavenged 2-stroke engine, rated 111 horsepower at 5000 rpm and 127 ft.-lb. of torque at 4000 rpm. Code named CDS-2, the engine produces excellent horsepower per liter of displacement and power per pound of mass. According to Runkle, "Two-stroke engines are smaller and lighter in weight than the 4-strokes now in use. They also deliver about 7% better fuel economy."

GM's CDS-2 tips the scales at 173 pounds, and offers low height because of its flathead design. This, in turn, allows a very low cowl height. GM sees a real future for 2-stroke engines now that the biggest challenge—

meeting emissions standards—has been solved. Accomplishing the task is an air-assisted direct fuel-injection system and the electronics needed to handle the sophisticated fuel and spark timing requirements. The engine is an all-roller bearing design as is current practice in big 2-stroke outboards. It makes for low friction and reduced pumping losses.

GM has no plans to produce the CDS-2. Instead, the mini powerhouse will serve as a developmental mule for its 2-stroke V6 program destined for mid- or Chevy Cavalier-size cars. According to Runkle, GM has a number of V6 2-strokes undergoing dynamometer testing now. "That engine is ultrasmooth," he says. "It feels like a 12-cylinder."

Mating up to the engine is an electronic 4-speed transaxle right off the Saturn's parts shelf. The clutch-to-clutch automatic benefits from low spin losses and minimal internal friction. The only modifications needed were lower numerical gear ratios for top gear and final drive.

Easy rollers

With target efficiencies achieved in the aerodynamics and powerplant areas, the engineers turned their attention to the last energy sponge—rolling resistance. The engineers at Goodyear came up with a special 175/65R-18 tire that can handle inflation pressures up to 65 psi, which is the inflation pressure of the tires used on the Ultralite. To get around the bone-jarring ride of a tire this hard, a new profile was developed. The tire uses a narrower rim width and a rounder sidewall that is more shock absorbing. A special tread compound offers extremely low rolling resistance. This is combined with smaller tread elements that bend easier to use less energy when rolling in and out of the footprint. The bottom line is a rolling resistance of about 2.5 to 3 pounds per tire at highway speeds, compared to today's production-car tires which have about 9 pounds of rolling resistance per tire. The Ultralite tires are self-sealing to save even more weight because no spare is needed.

No, you can't go out and buy an Ultralite right now. And even if you could, you couldn't afford it. But the technologies you see here in this concept car are the breakthroughs Detroit has been trying to achieve for the past 100 years. Yes, they will filter down to the production lines, and, sometime in the near future, you will be able to go to your local dealer and buy a car that incorporates much of what you see here. And it will get 100 miles per gallon. **PM**

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WAR IN THE WIND

(Continued from page 53)

teers from GMR are responsible for significant contributions. In addition to checking the accuracy of the design and creating software that enables all the computer programs to talk to one another, the GMR team helps finalize the shape of the underwater appendages (especially the keel, rudder and bulb), the thickness and direction of the carbon reinforcing fibers and the stringer system that preserves the hull's integrity (especially the box supporting the mast and keel).

To accomplish this work, GMR volunteers book valuable time on supercomputers, use proprietary GM software programs, build one-third-working-scale models of the boat's wetted surface and work midnight-to-8 am shifts in the wind tunnel. In the end, Conner calls the GMR effort his "winning edge."

"Who's going to win?" I ask Muench and the other GMR engineers. Speaking for the rest, one engineer answers confidently, "We did our job. Conner, of course, will win."

New AC class

The 1988 AC race is often remembered for its catamaran-versus-mono-hull mismatch and nonstop courtroom maneuvering, but its most important

legacy was the formation of a committee to establish a new AC-class yacht. More than 40 technical experts from 10 countries collaborated on the project and created a light-displacement, high-performance speedster to replace the venerable 12-meter.

The new AC yacht differs from the Twelve in every important category. It will be about 10 ft. longer, 6 ft. wider, 20,000 pounds lighter, 30 ft. taller of mast, 4 ft. deeper of keel and carry 40% more sail. These specifications are expressed in a single mathematical formula known as the rating rule:

$$\frac{L + 1.25 \times \sqrt{S} - 9.8 \times \sqrt[3]{D}}{.388} = 42$$

(L stands for length. S for sail area. D for displacement.) Designers can experiment as long as the formula remains resolved.

While pure speed is the ultimate goal of every AC-class designer, other considerations are also important. For the first time, AC hulls will be made of high-tech carbon fiber—cored with a 1/2-in.-thick layer of honeycomb Nomex—instead of aluminum, so strength and integrity of shape are special concerns.

In the case of *Stars & Stripes*, the hull was hand-laid using multiple layers of unidirectional carbon-fiber weave (up to 10 at its thickest) that were pre-impregnated with resin.

This process ensures that resin, which adds weight but not strength, is kept to a minimum. When the layers are in place, using a computer-generated map to align the fibers for maximum strength, excess resin and air is vacuumed out. A huge oven at Goetz Marine, in Bristol, Rhode Island, was used to heat the hull to the resin's catalyzing point. Precise temperature control during curing is necessary to maximize strength.

Another important consideration is the location of the AC race itself. The boat is site specific, which means that the rating rule is manipulated in a way to take advantage of expected wind and water conditions off San Diego in early 1992. According to Chris Todter, technical coordinator for Team Dennis Conner, final calibrations were based on weather and sea-state data that went back 10 years.

Yacht wars

As *Stars & Stripes* returns to San Diego Bay at twilight, a camouflaged rubber boat passes us in the opposite direction. It's the Navy Seals heading offshore for night operations—a fitting reminder that AC competition is like a war.

During my brief time aboard *Stars & Stripes*, several helicopters and chase boats follow our movements attempting to get spy photos of the secret underwater keel. Spying, I'm told, is part of the AC game. Conner, Koch and the Japanese team have all repulsed divers attempting to take underwater photos, while the New Zealand team has captured an intruder and turned him over to the police.

The reason for the no-holds-barred approach is the international prestige of the Cup. AC challengers this year are mounting a campaign that costs more than \$300 million. Koch, Conner's rival to represent the U.S., will spend more than \$40 million. Conner, to his disappointment, has a budget of less than \$20 million.

Despite this disadvantage, Conner has several things going for him: 1. He's the best AC sailor in the world, 2. San Diego is his home town, 3. His team is composed of the brightest stars in the sailing world, and 4. His boat is fast.

Last spring, in a head-to-head race with top AC competitors, *Stars & Stripes* was the fastest boat. Many teams have since built second-generation boats, prompting commentators to label Conner an underdog. The front-runners are said to be teams from New Zealand, Italy and Japan.

Yet, if attention by spies is any indication of who's in the early lead, *Stars & Stripes* is still the boat to beat. **PM**

EXHIBIT (Continued from page 30)

this path, however, the living room is tastefully furnished from PM plans of the era. Along the way, a waist-high panel displays some of the plans for the items in the room.

Besides furniture, included are such toys and accessories as a bright yellow "Earth Hauler For Young Engineers" from 1954, and a small sculpture featured in "Modeling With Nuts And Bolts" from 1946. Though the focus is on the postwar era from 1946 to 1975, some pieces, such as a beautiful Star Lamp and a detailed model of the De Witt Clinton Train, were made from plans dating back to the 1930s.

No postwar dream home is complete without a television. A museum volunteer constructed a TV cabinet from 1951 plans to house a TV monitor running a short film about D-I-Y projects—complete with ads for power tools and home-movie footage of family projects.

In the '50s and '60s, weekend workshops sprouted up in basements and garages across America like mushrooms on a rainy day.

The dream home on exhibit has a small workshop in the garage, where PM's popular Hydro Dynamic boat is featured. This particular boat was built by a skillful Michigan reader from 1963 PM plans. Attentive visitors will notice that the last license is dated 1989.

Many boatbuilders wrote to PM, and some of their comments are reproduced on the reader rail. "So that I could work on it in the winter, I built it in my recreation room. However, I did not glue the joints," wrote another Michigan man in 1966. "When the boat was more than 90% complete and good weather returned, I disassembled and labeled each part, and reassembled and completed the boat in my garage."

Visitors to the exhibit are guaranteed to stroll through the dream house reminiscing about projects past, or dreaming of future undertakings in their own home workshop. **PM**

IF YOU GO . . .

• Henry Ford Museum & Greenfield Village is a national museum of American history and technology founded by Henry Ford in 1929. The museum is an independent, nonprofit educational institution that is not affiliated with the Ford Motor Co. or the Ford Foundation.

Henry Ford Museum & Greenfield Village is located at Oakwood Boulevard and Village Road in Dearborn, Michigan, about 12 miles west of Detroit. For complete information about museum hours and admission fees, nearby hotel/motel accommodations and other area attractions, call (800) 343-1929.

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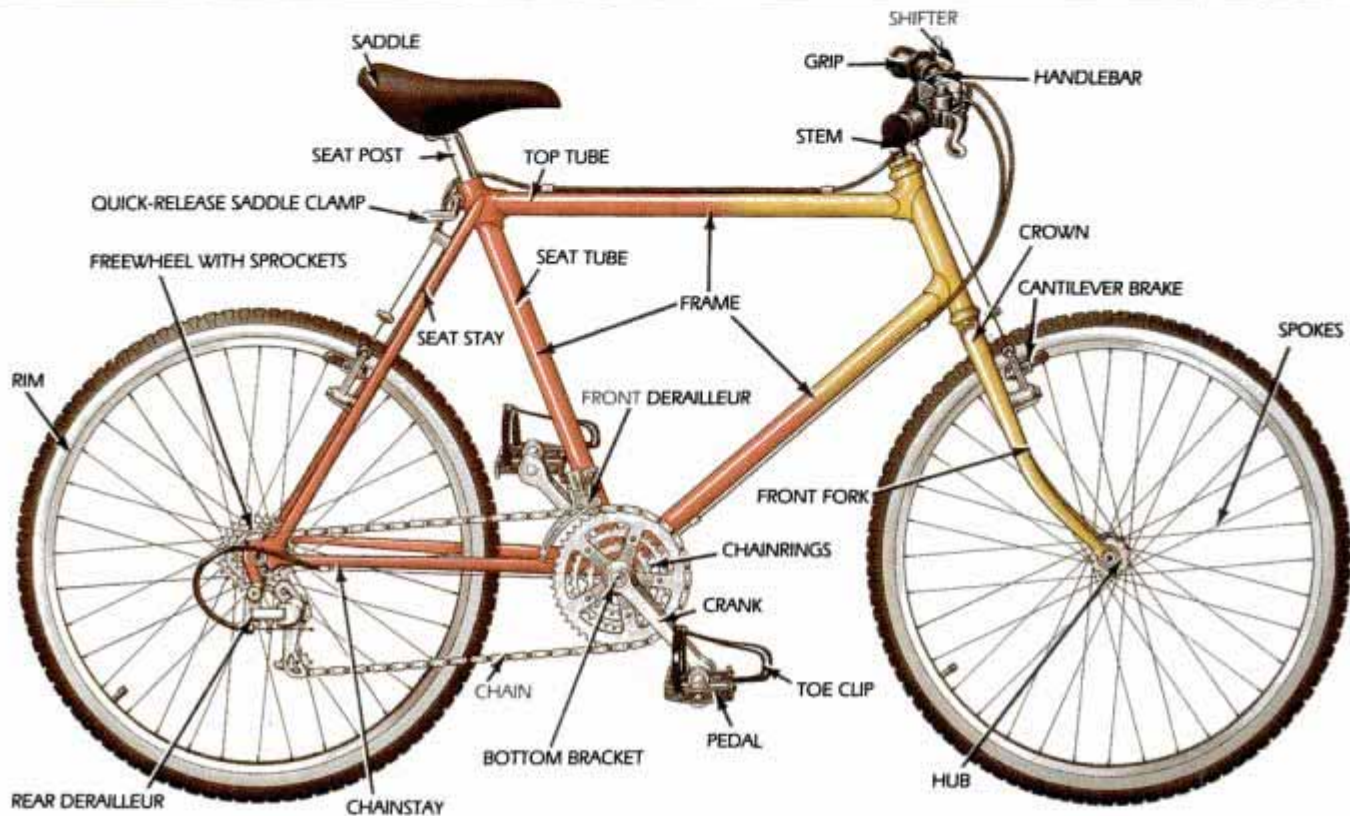
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OUTDOORS

MOUNTAIN BIKE D-I-Y

BY JOE SKORUPA, Boating/Outdoors Editor



PM ILLUSTRATION BY HANK IKEN

● The mountain bike is an impressive American success story. It's the king of the domestic bike market, and unlike other American-made products, it's in the process of conquering the rest of the world.

But is the mountain bike really American-made? Personally, I believe more important questions concern performance, quality, reliability and value. But the answer to the question is an interesting one.

To build, or not to build

The leading U.S. marquee in production mountain bikes are Specialized, Trek, Gary Fisher, Schwinn/Paramount, Raleigh and Cannondale. Aficionados will argue about who's on the list and who isn't (most of the missing are either non-hardcore players or foreign owned), but an interesting fact is that these manufacturers don't actually build bikes. They simply order parts and assemble them.

Here's how it works. Mountain bike designers start with the frame. They determine specifications for tubing

and then strike a deal with suppliers—mostly from the Far East—to supply the rough-cut tubes. The better companies, especially the names on my above list, fine-cut the tubes and weld, braze or epoxy the frames together.

Next come the components. Here too, takeout service is requested. The derailleurs, shifters, brakes, chainrings, cranks, saddles, pedals and so forth are off-the-shelf items made by such companies as Shimano, Sakae, Suntour, Tange, Hsing Ta, Cheng Shin and others. Is this manufacturing or assembling?

To give credit where credit is due, there are some excellent U.S. manufacturers of frames. These include Fat City, Klein and Ritchey, to name a few. And some production-bike assemblers actually make stemsets, handlebars, rims and tires. Ritchey even designs (and then orders) a fair number of components.

But the point is that if the big names can select parts off the shelf and assemble them, why can't we?

We can, and in some instances, designing your own mountain bike may save you money. For example, the top-of-the-line component group from Shimano is the XT. To get the high-tech XT STI Rapidfire shifters, you may be forced to buy a bike outfitted with the entire XT group, an expensive option. However, some riders don't want to bang up expensive pedals, derailleurs, cranksets and freewheels. For them, the Shimano DX line is suitable and cost effective.

Matching prices with bulk assemblers is probably impossible, so the main benefit of designing a bike is getting exactly what you want. The best way to do this is to study dedicated fat-tire magazines and then visit your local bike shop. For specific brand-name questions, try the Bicycle Wholesale Distributors Association, 1900 Arch St., Philadelphia, PA 19103; (215) 564-3484.

Once you assemble your custom bike, give it a colorful paint job and a catchy name. You may just launch a new American bike company. **PM**

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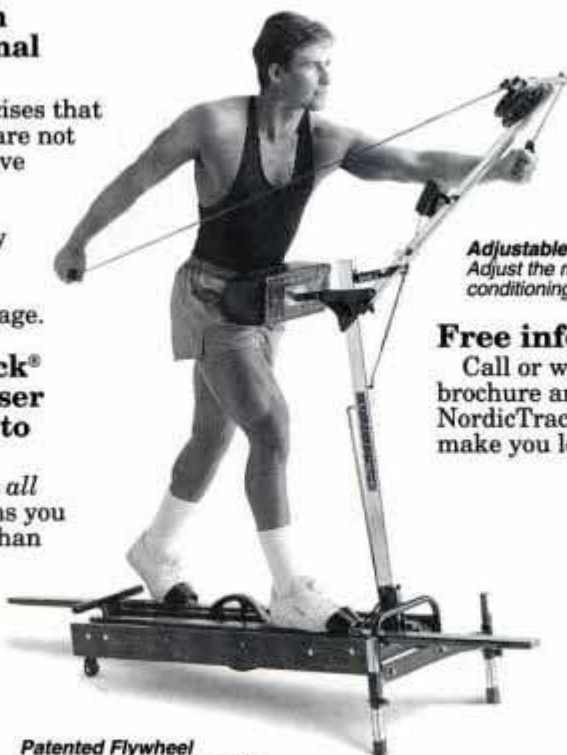
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HOME IMPROVEMENT

PROBLEM SOLVER OF THE MONTH

BY JEFF WILLIAMS, Contributing Editor

Mildew Check

● Mildew is one of those pesky problems that never seem to go away. The old standby—bleach mixed with water solution—is temporary, and requires scrubbing to remove the stains and remains of the organism. Until now, it was the only answer to the problem of fungi growth.

After years of research, PPG Architectural Finishes, Inc., patented a better solution. It's called Mildew Check and is currently marketed with labels from PPG (Pittsburgh Paint), Olympic and Lucite.

In many areas of the country, mildew enjoys a 365-day growing season. The southern coastal areas are particularly hard hit with high humidity and temperature. One experience with the product is through Gil Crouse with the Marriott Corp., located in Hilton Head, South Carolina, an area notorious for mildew and associated organic growth. A stucco north wall on a multi-story building facing the intercoastal marsh was a constant source of mildew growth. I was asked about a solution and could do no better than the bleach-and-water standard. The Mildew Check option was tested approximately 20 months ago and, to date, no regrowth has occurred.

In using the product I found no apparent problems. The application can be accomplished easily, using normal household equipment. The instructions are simple, and there are no foul odors. The label warns against exposure to lakes, streams, fish and animals and inhalation or exposure to humans. Due care should be exercised.

The active ingredient is a water-insoluble organic chemical. As such, it does not wash off in the rain. Tests have shown life expectancy in the 4-year range with the average at 24 months. The label instructions suggest that you "reapply every 24 months or as needed."

Mildew Check is sold in a short

filled gallon container. When ready to apply, the user fills the container with bleach and applies to vertical or horizontal surfaces with a pump-up garden sprayer. After 15 to 20 minutes, you must rinse the treated area thoroughly. The finished product is invisible and does not produce a surface film. The \$10 average retail price converts to a reasonable 4 cents per



square foot applied cost. The savings in time alone warrant investigating this product.

The product is patented and because it's EPA registered in all 50 states and Puerto Rico, there are lots of rules governing the marketing and promotion of the product.

One of those rules is that any product that actually kills organic growth

such as mildew and algae may be labeled as a fungicide. All others, like those blended with a bleach base, must be labeled mildew stain removers. Mildew Check is a fungicide. According to the inventor, the bleach additive for Mildew Check only satisfies the average consumer need for immediate visual gratification. In other words, it turns the stained surface clean while you watch. It has been tested and made safe for application around landscaping. It is not recommended for interior use, however.

Homeowners should also consider what Mildew Check might do to increase the life expectancy of painted exterior surfaces. Mildew and mold will embed deeply in the porous film of flat exterior house paints. One bad growth of mildew and all the bleaching in the world won't restore the integrity of the paint. Once the paint film is disturbed and moisture penetration takes place, peeling and chipping are bound to occur, which in turn will force you to repaint. If Mildew Check is applied on a newly painted surface and kept fresh with repeat applications, as described in the instructions, it could extend the average life of any exterior paint job.

Mildew Check is fairly new and is gaining acceptance on retail shelves with its various brand labels. You will find the PPG label in Pittsburgh Paint stores. The Lucite and Olympic labels will be found at independent paint and hardware dealers. Information about the product is available by calling PPG at (800) 441-9695; or writing to PPG Architectural Finishes, Inc., 1 PPG Place, Dept. 37E, Pittsburgh, PA 15272. **PM**

Jeff Williams is the host of "The POPULAR MECHANICS House Doctor," a satellite broadcast radio talk show about home improvement. Anyone interested in submitting problem-solving products for review in future issues of this column should send information to Jeff Williams, 4275 34th St. S., No. 340, St. Petersburg, FL 33711.

SIGNALS FROM SPACE

(Continued from page 62)

tomers-service hub or directly to the antenna of a service you've chosen—home banking, shopping, interactive advertisements, whatever. The pattern is reversed to transmit information to your home. Because the information is digitally encoded and scrambled, any confidential data remains secure even though it's radioed openly over public airwaves.

TV Answer generates no programming itself. It's merely the delivery system. For example, a pay-per-view prizefight from a cable-TV operator isn't transmitted via IVDS, only your request is. The cable operator then routes the fight to your converter box through its coaxial cable network.

Tentatively, a TV Answer transceiver will cost \$200 to \$300, and a monthly subscription to the service might cost \$12.95. The Reston, Virginia-based company contends that the service charge almost pays for itself, thanks to rebates from home-shopping purchases, by eliminating the need to write checks to pay bills and through other savings in time or money.

Pistol remote

Physically, you operate TV Answer through its pistol handset, which combines the functions of a pushbutton remote control with those of a video-game-like joystick. Besides operating the TV Answer transceiver, the remote can control any other electronics component, such as a TV, cable converter or VCR. You use the gun to make selections from menus of functions displayed on the TV screen.

Because of the 2-way communications that TV Answer offers, a variety of long-talked-about "interactive" programming innovations becomes possible. For example, home viewers can become participants in game shows, competing for prizes just as the on-screen contestants do—and at the same time. In sports, all sorts of call-that-play contests are possible, with instant gratification.

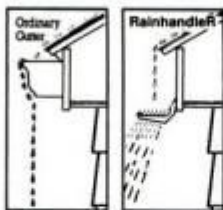
Some of the TV Answer data services can be stored in memory cards purchased optionally. The module has 16 slots for these credit-card-size memory banks. One card might hold the TV schedule, another your scores from playing interactive videogames with an opponent across the nation.

In a social and political sense, IVDS might revive the old town-meeting concept, electronically. For its entire history, TV has been a cool medium whereby the audience is talked to. A service like TV Answer might be worthwhile just for the opportunity to talk back. **FM**

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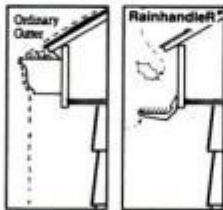
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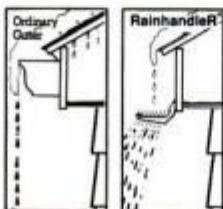
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COMPUTERS

THE PC PLAYS CD

BY RON SCIBILIA



● It's been 10 years since the compact disc, co-developed by Netherlands-based Philips and Japan-based Sony, ushered music into the digital age and became one of the most successful consumer electronics products in history. Now it looks as if 1992 may just be the year that CD's younger sibling, CD-ROM, the computer data version of the audio digital disc, moves into the mainstream after years of being a product in search of a market.

The medium's slow coming-of-age has been disappointing to computer buffs, because CD-ROM (compact disc read-only memory) has always had exciting potential. Consider the sheer capacity of the CD to hold data. Each tiny disc, with its 3 miles of spiral track and 2 billion microscopic pits that generate the digital code read by the CD's laser pickup, is a veritable bookcase of information. A single CD-ROM platter can contain up to 680 million bytes of data, equal to a mind-boggling 340,000 pages of text.

Today, with so-called multimedia applications that mix text, graphics, audio, animation and even full-motion video now starting to emerge, the CD-ROM clearly bodes as the vehicle of choice to deliver information—whether educational or entertaining—to a generation now increasingly

comfortable with computers.

What's stopped CD-ROM from taking off before now? Stubbornly high hardware costs, along with a relatively meager—and pricey—selection of software titles and sometimes tricky setup and installation. Most CD-ROM users to date have been either libraries or, more likely, corporations with high-volume data needs. Industry sources estimate that only about a half-million units are currently in consumer hands.

CD-ROM drives have stayed expensive because the CD-ROM is more than just an audio CD player by another name. The CD-ROM drive needs highly sophisticated electronics to eliminate digital errors that, though unnoticed in a music recording, would be fatal in other applications. And while searching requirements on an audio disc are simple, mainly confined to moving from mu-

sic track to music track, CD-ROM players need very precise head-positioning mechanisms to let users find data anywhere on a disc reliably and quickly.

The good news for users is that manufacturers have finally found ways to get the price of CD-ROM hardware down to levels that consumers can afford. Price-leader Tandy, for example, has introduced two low-cost drives: an internal model, the CDR-1000, at \$400, and an external version, the CDR-3000, for \$500. Software, while by no means inexpensive for the majority of titles, is often available as a low-cost or no-cost throw-in with hardware purchases. Sony's Laser Library package, for instance, combines a Sony CD-ROM player—the external CDU-7205 or the internal CDU-535—with six CD-ROM discs with a retail value over \$1000. Total price: \$700 for the external unit, \$650 for the internal one.

Computer suppliers are also a good place to find a CD-ROM bargain. Philips, with its CD-ROM-equipped Magnavox "Headstart" models, includes a set of CD-ROM titles at a relatively modest premium over a typical non-CD-ROM unit. That company's \$2100 Headstart SX-20, with an internal Sony drive ready to roll, comes with five programs on CD-ROM.

Meanwhile, buyers' software choices continue to expand, with titles in general information, business, the

(Please turn to page 136)



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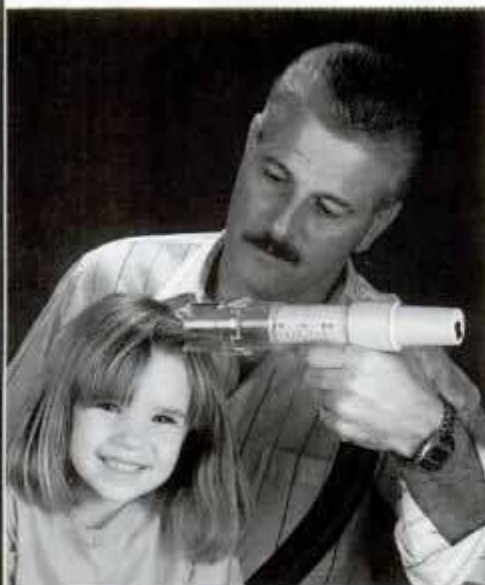
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COMPUTERS (Continued from page 132)

arts and sciences. Prices cover a broad spectrum. At the low end, you have "Desert Storm: The First Draft Of History" (\$40) from Time/Warner New Media and CMC Research's "CD-ROM Shakespeare" (\$49). Mid-priced titles include "Coate's Art Review: Impressionism" (\$129) from Quanta Press and National Geographic Society's "Mammals: A Multimedia Encyclopedia" (\$150).

Higher up the price ladder you find software targeting serious hobbyists and professionals like McGraw-Hill's "Science And Technical Reference Set" (\$495), which contains 7700 articles covering 75 major areas of theoretical and applied science, plus 1700 photographs, line drawings, graphs, tables and charts. Still more expensive are programs aimed at specialists or info-addicts such as Oxford Electronic Publishing's "The Original Oxford English Dictionary On Compact Disc" (\$950), the unabridged OED set or the "PhoneDisc USA Residential" (\$995), which contains current phone numbers for every U.S. household.

Update policies vary considerably, with some vendors who cater to corporate clients charging a hefty yearly subscription fee. One of the best-selling CD-ROM titles aimed at the gen-

eral consumer, "Grolier's Electronic Encyclopedia" (\$395), has been offering updates at \$125. McGraw-Hill offered an update of its "Science and Technical Reference Set" to current owners for \$250 last year. Most recent CD-ROM titles are available in both Apple Macintosh and IBM-compatible versions, with at least one distributor, the New Jersey-based Bureau of Electronic Publishing, offering a single disc that will work with either type of computer.

Why opt for the CD-ROM version, you ask, when a print version might be available as an alternative, perhaps at a lower price? Although some CD-ROMs are still basically just text by the ton, the clear trend is toward adding elements—audio, animation and video clips—that no printed book can provide. But perhaps the paramount reason right now is simply utility: CD-ROM "books" offer ex-

tremely powerful searching capabilities that let users find information much more extensively—and far more quickly—than a comparable printed text. In a well-designed program, key-word searches let users travel effortlessly through vast amounts of information, grouping related references and jumping instantly from one linked topic to another. In "Grolier's Electronic Encyclopedia," which contains 10 million words and 33,000 articles, every word, article title, picture and map is indexed.

What about installation? While adding a CD-ROM drive should be no harder than installing a typical PC peripheral, computer users who get queasy at the thought of opening their computer's case, much less attending to switches, jumpers and software drivers, should look for "turnkey" systems with everything pre-installed. More adventurous shoppers who want to mix and match will pay close attention to comparative CD-ROM access times (how fast a CD-ROM drive can find a piece of information) and, even more importantly, a drive's "throughput" capability (how much data it can move through its interface to your computer's memory).

Throughput is especially important if you're interested in multimedia applications where massive chunks of data, particularly graphics, animation and video, have to be rapidly transferred. The fastest throughput is found on CD-ROM drives with so-called SCSI (pronounced "scuzzy") interfaces. Some IBM-compatible units and all Macintosh CD-ROM drives use the more expensive SCSI data pathway. Don't worry about whether to buy an internal or external drive—that's a matter of how much desk space you have. Performance on comparable drives should be the same. **PM**



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COMPUTERS BREAK THE LANGUAGE BARRIER

BY ABE DANE, Science/Technology Editor

"Eh Bien! I no saw not that that frog had nothing of better than each frog."

● That is how a passage from Mark Twain's story *The Notorious Jumping Frog Of Calaveras County* sounds after suffering translation into French, and then a ham-handed translation back into English by Twain himself. Twain's point in doing this is that the journey from one language to another is a perilous one, often ending with statements butchered beyond recognition.

For Twain, it was a good joke. But for businesses trying to make it in an increasingly global economy, it's not funny. One estimate puts the worldwide cost of converting words from one language to another at around \$30 billion a year.

An obvious solution would be to automate the process. And as far back as the 1960s, computer scientists were working under Defense Department contracts aimed at easing access to Russian technical information and, during the Vietnam War, translating Air Force manuals into Vietnamese. These projects resulted in systems that worked in a very limited way. But on the whole, computers have proven to be about as linguistically adept as Twain was.

Although computers have not been quick to pick up foreign tongues, researchers around the world have persisted in the belief that the long-term potential is tremendous. Lately, after more than a decade of agonizingly slow progress, there are new indications that they may be right.

KANT can

For example, a system called KANT, now operating at the Carnegie Mellon Center for Machine Translation in Pittsburgh, Pennsylvania, is turning out flawlessly translated TV repair manuals in multiple languages. Able to translate an average sentence in 1.3 seconds, it is many times faster than the best human linguists.

Unlike previous translators, KANT is designed to work without a human supervisor helping it through difficult passages and polishing up the final product. To do this, KANT must actually have some understanding of



Carnegie Mellon's Jaime Carbonell monitors an early knowledge-based translator.

what it is translating, rather than just mindlessly matching up roughly equivalent words and phrases. Part of this ability comes from a tremendous database of knowledge, specially tuned to the subject area in which it is working.

This knowledge base provides KANT with the ability to figure out how to translate things on the basis of context. The word "bank," for example, might be translated in one way when talking about finance, and in an entirely different way when talking about the flight of an airplane. With the help of its knowledge base, KANT first breaks down sentence structures into parts of speech, then interprets these into a language called interlingua. "That's the goose that lays our golden eggs," says Jaime Carbonell, director of the Machine Translation Center.

Interlingua is a precise and unambiguous code that contains all the information necessary to generate text in any language. KANT currently has generation modules that can convert interlingua into Japanese, German, French and Spanish.

Although a considerable step forward, KANT is still far from being a

perfect solution. For one thing, the knowledge base has to be custom-tuned to deal with whatever kind of document it will be translating. This process can take as much as a year, but each tuning, or domain, can be stored for future use on similar documents. Another constraint is that documents must be authored in a style that avoids words and constructions that might trip up the machine.

Still, Carbonell believes that with improvements KANT could soon be viable as a commercial product. When and if it goes on the market, it will be well ahead of the current crop of machine translators.

But that status is unlikely to last long. According to Harvey Newquist, publisher of the newsletter *AI Trends*, researchers in Japan and Europe are far better funded than their American counterparts, and are pursuing machine translation on a number of fronts. Next-generation systems will take advantage of advances in computer processing speed, and new approaches such as neural networks and statistical correlations that enable them to learn from their own experience. "The technology is in its infancy," says Newquist. **PM**

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AUTOMOBILES

THE ALTERNATE FUEL REPORT:

FLEX FUEL TAURUS

BY JIM DUNNE, Detroit Editor



● Try this in your gas tank. You can burn pure gasoline. Or, you can burn 85% methanol and only 15% gasoline. Or you can burn any mixture in between. You save gasoline, and at the same time make this country less dependent on imported fuels. Driving this Ford Taurus makes you feel like a real hero.

Methanol is potentially plentiful. It can be made from sources like natural gas, coal or biomass—garbage or wood chips. When used in a car's engine, exhaust gases are cleaner.

Methanol holds so many advantages that Ford plans to put 2500 Tauruses with its flex fuel system in

the hands of buyers starting later this year. The sample fleet will be able to operate on straight gasoline, or as little as 15% gasoline, 85% methanol.

I drove a prototype of Ford's Flex Fuel Taurus a couple of months ago to see for myself. Are there any drawbacks to this seemingly ideal fuel? I found some. But, with the threat of gasoline shortages always a real concern, methanol fuel looks more attractive than ever.

You can't tell by looking that the Taurus is specially built for methanol fuel. Aside from a fuel mixture indicator on the instrument panel, its special items are hidden. Anticorrosive parts like stainless steel are used in the fuel delivery system. And the fuel injectors are larger in size to deliver a greater amount of fuel to the engine.

A sensor in the fuel line is a key to the success of flex fuel. It measures the mixture of gasoline and methanol going to the engine, and with the aid of an on-board computer, adjusts timing and fuel delivery. A bigger percentage of methanol in the fuel causes the computer to call for the fuel injectors to squirt a bigger charge into the engine. Timing is automatically advanced or retarded depending on the specific mix of gasoline and methanol being delivered to the engine at any given point in time.

During cold weather, a special starting system gets the engine running. Starting difficulties with pure methanol (which has lower volatility)



Fuel system mods include stainless tank, oversize injectors and revised F.I. software.

in cold weather mandates at least 15% gasoline in the fuel mixture.

Driving the flex fuel car is about as normal as you can get. Startup is immediate. Acceleration is strong. Ford's Chuck Risch, the engineer in charge of the Flex Fuel fleet, reports a 5% to 7% increase in performance due to more complete combustion.

A small gauge in the instrument cluster keeps you informed of the mixture of gas and methanol in the tank.

Miles per gallon drop significantly. Methanol economy, on a mileage basis, is 40% less than gasoline because volume for volume, methanol contains less energy than gasoline. However, methanol is about 40% cheaper than gasoline. Risch reports that the Flex Fuel car, using 85% methanol, carries fuel costs about equal to the price of premium unleaded gasoline.

And, if enough gas stations install methanol pumps—fewer than 50 methanol stations are in operation in the U.S. today—the cars will be just as convenient as any on the road. **PM**



M85 is a mixture of 85% methanol and 15% ordinary gasoline.

is being sought by Terry Bahill, a professor of engineering at the University of Arizona. Bahill's computerized Bat Chooser determines the ideal bat weight for a player based on how the player swings a number of differently weighted bats through a pair of light beams. All of the swings are used to create a mathematical model to show how the person is swinging the bat. The model is then coupled to equations that take into account factors like muscle/force relationships and the speed of a ball coming off a bat. The ideal bat weight for that individual is then calculated.

Another batting device comes courtesy of the inventive mind of another New York Mets player, Dave Gallagher. The Stride Tutor is a \$17 device reminiscent of a hobble used to keep cattle from straying. The Stride Tutor is designed to break a batter's tendency to overstride during the swing. By limiting the batter's stride, the device hopes to correct problems like loss of balance, gliding hips, excessive head movement, improper weight shift and an incorrect pivot. Stride Tutor is distributed by I.B.I. Sports, (800) 227-7331.

High technology is also being used in new gloves from Spalding and Mizuno. Similar in concept to the Pump system used for Reebok sneakers, both Spalding and Mizuno have adapted an air-bladder system for use in softball gloves. The air-bladder system covers the back of the hand and snakes along the base of the last three fingers. Like the sneakers, the idea is to provide a better, tighter fit.

Less trendy, perhaps, but more safety conscious are the Tanel line of cleats. Developed by Mike Tanel, a former football player for the Green Bay Packers whose career was ended by a knee injury, the Tanel cleats are characterized by a 360° circular traction ring on the sole. This traction ring allows a player to pivot easier than he would with standard cleats, thereby greatly reducing the risk of knee or ankle injury.

Tests done by the University of Wisconsin on natural grass showed that Tanel shoes have at least a 48% better pivoting motion and 28% better traction than standard cleats. A shoe designed for artificial grass showed even better results when compared against other artificial-grass shoes. Prices vary according to model, but softball shoes list at \$60.

Like the Tanel circular traction ring, the influence of technology on baseball may be hidden from view. But there's no doubt that technology is having a greater influence on the playing field. **FM**

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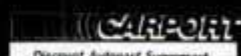


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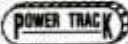
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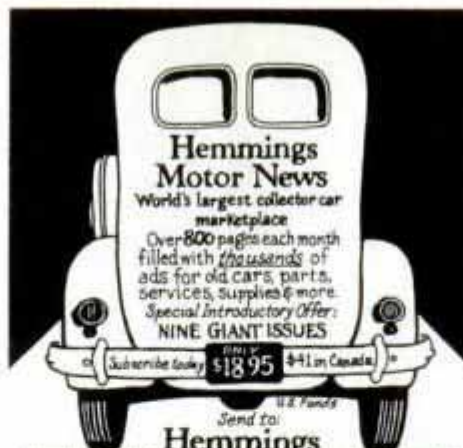
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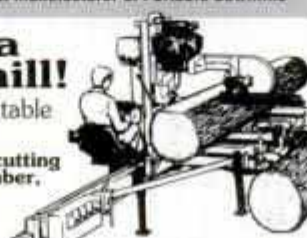
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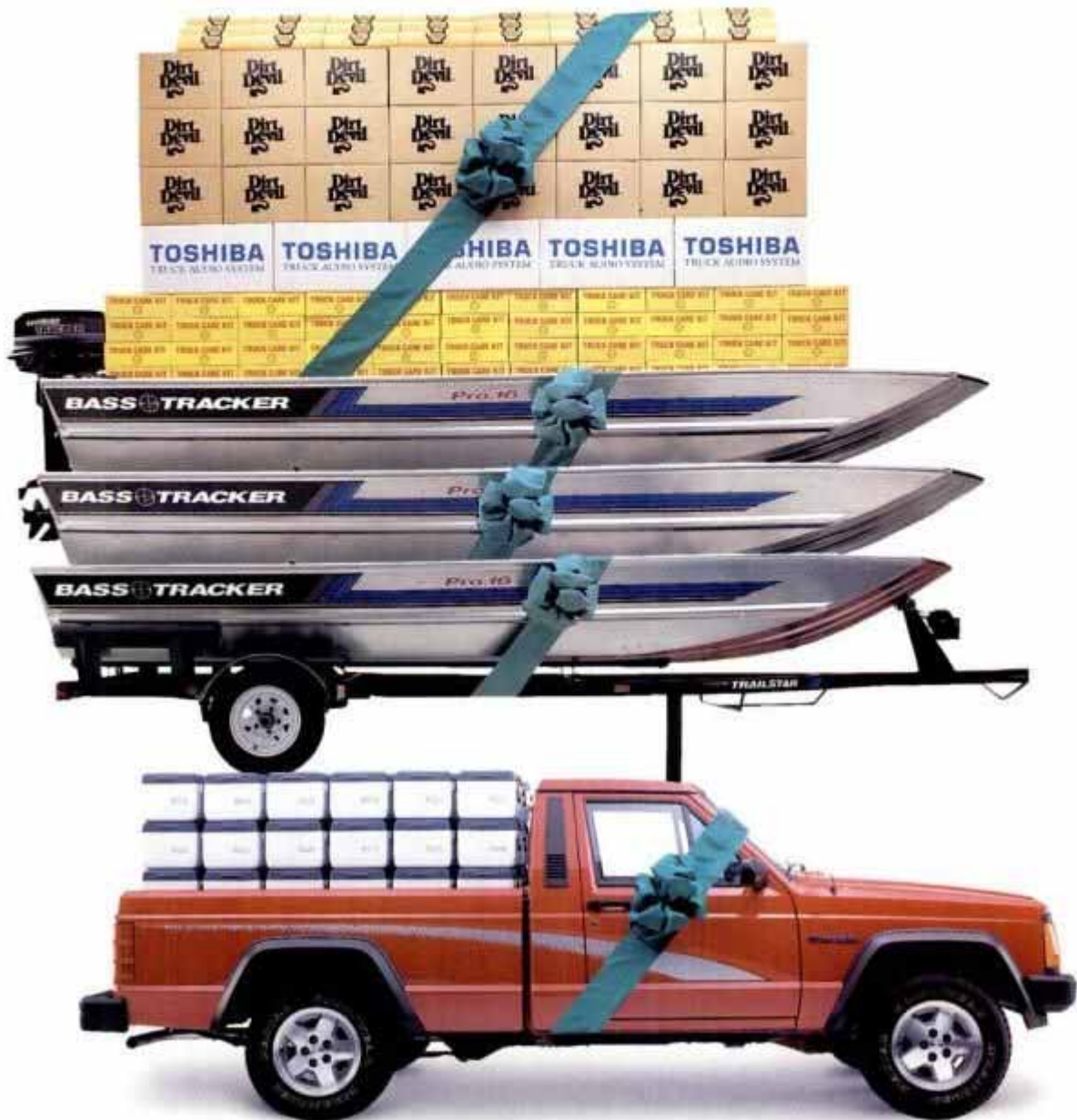
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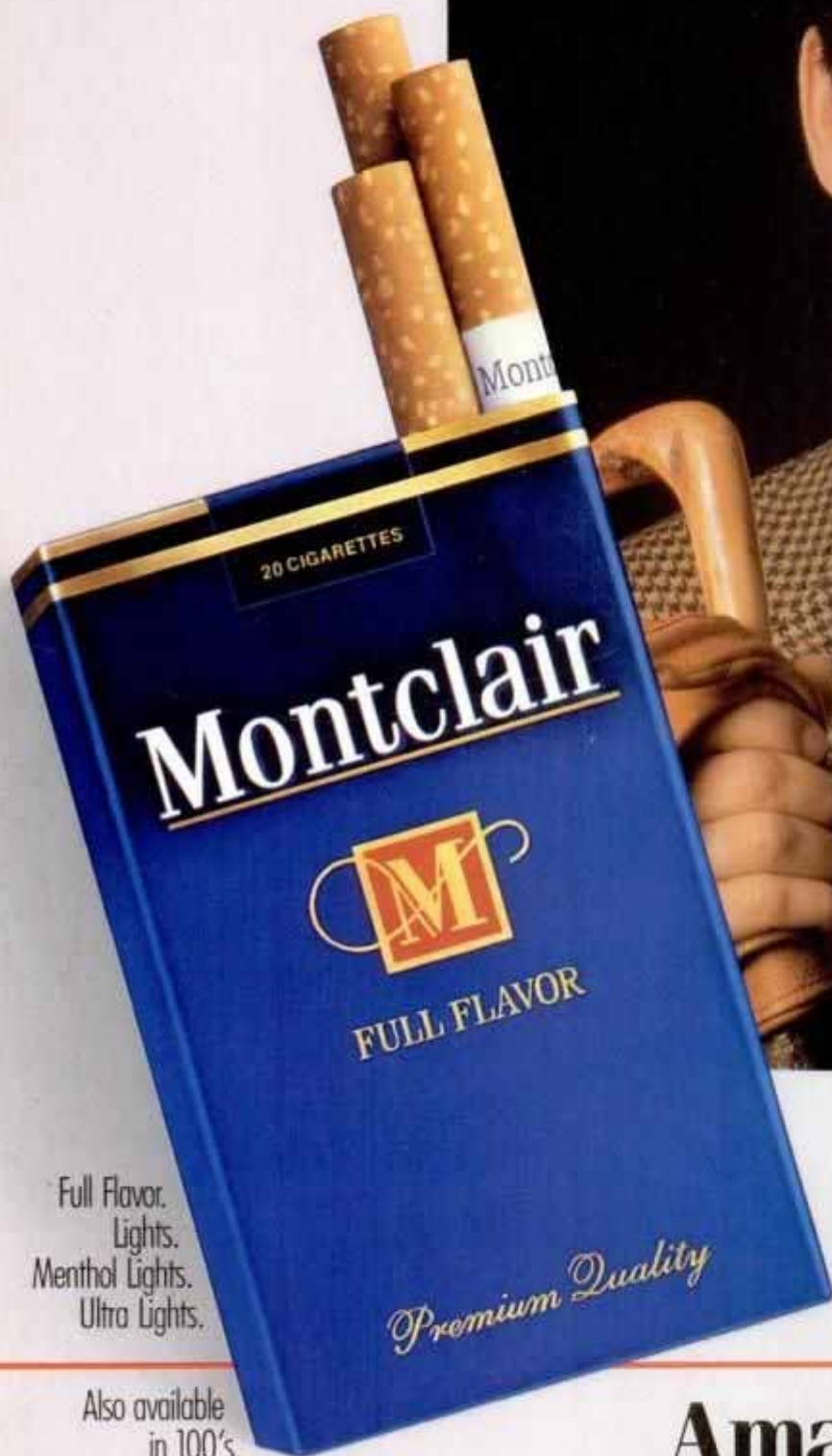


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