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Alaska-Siberia Link
Across The Hostile
Arctic Would Be
The World's
Longest
Span

HOME
IMPROVEMENT
GUIDE

**CUSTOMIZE
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EDITOR'S NOTES

● Enormous doings recently at Henry Ford Museum in Dearborn, Michigan, as we held our annual gala, the POPULAR MECHANICS Design & Engineering Awards banquet. Condolences to our friends at Woods Hole Oceanographic Institute who were snowed in and couldn't make it to Detroit. Everyone else was there, though, and what a great evening it was. But that was then, and now it's time to start the nominating process for our 1995 awards. The details are on page 54. I invite you to participate this year with a nomination. . . . **If you're like me**, your thoughts turn to home around this time each year. Good time to check out the old homestead and see how it fared through the winter. It's also a good time to add those little customizing touches you've been thinking about—some new shrubs, a little more lighting in the kitchen, that extra deadbolt on the garage back door. All this and more is in this year's Home Improvement



Francis Castaing (left), vice president of engineering for Chrysler Corp., and Robert A. Lutz (right), president of Chrysler, accept the PM Design & Engineering Award for the Dodge Ram pickup.

Guide, which begins on page 69. Home Improvement Editor Steve Willson chose six projects that will make any home a nicer place to live and that just about everyone can complete. . . . **It's not a new idea.** In fact, it has been kicking around since the Eskimos first made the trip across the Bering Strait. But now with the end of the Cold War and with relations with Russia never better, the dream of a bridge between Alaska and Russia is closer to reality than it ever was. Several private architectural and engineering firms are seriously investigating the possibilities as we speak. It would be a stupendous engineering feat accomplished in the harshest of surroundings—probably the last great engineering challenge here on Earth. But with the unbelievable natural resources on both sides of the strait, the bridge might be just the ticket to jump-start the Russian capitalist economy. For more on how it could be done, turn to our cover story on page 56. . . . **The telecommunications revolution continues** this month with "The Magic Box" (page 39). This aptly named appliance will probably be obsolete in about 10 minutes. But right now, it's still pretty amazing to us. Literally, it can put you in touch with the world, and maybe even other worlds, electronically, on paper or in several other mediums. But stay tuned. This is just the beginning of the revolution that will change the way we all live. . . . **Back on Earth**, come along for a ride on the scariest roller coaster yet. It's Batman—The Ride (page 42), and guess what? There's no floor. You just hang there in your chair for the whole ride. The whole ride? Uh huh. Even the upside-down part? Yup. No way. Way. Till next time.


Joe Oldham

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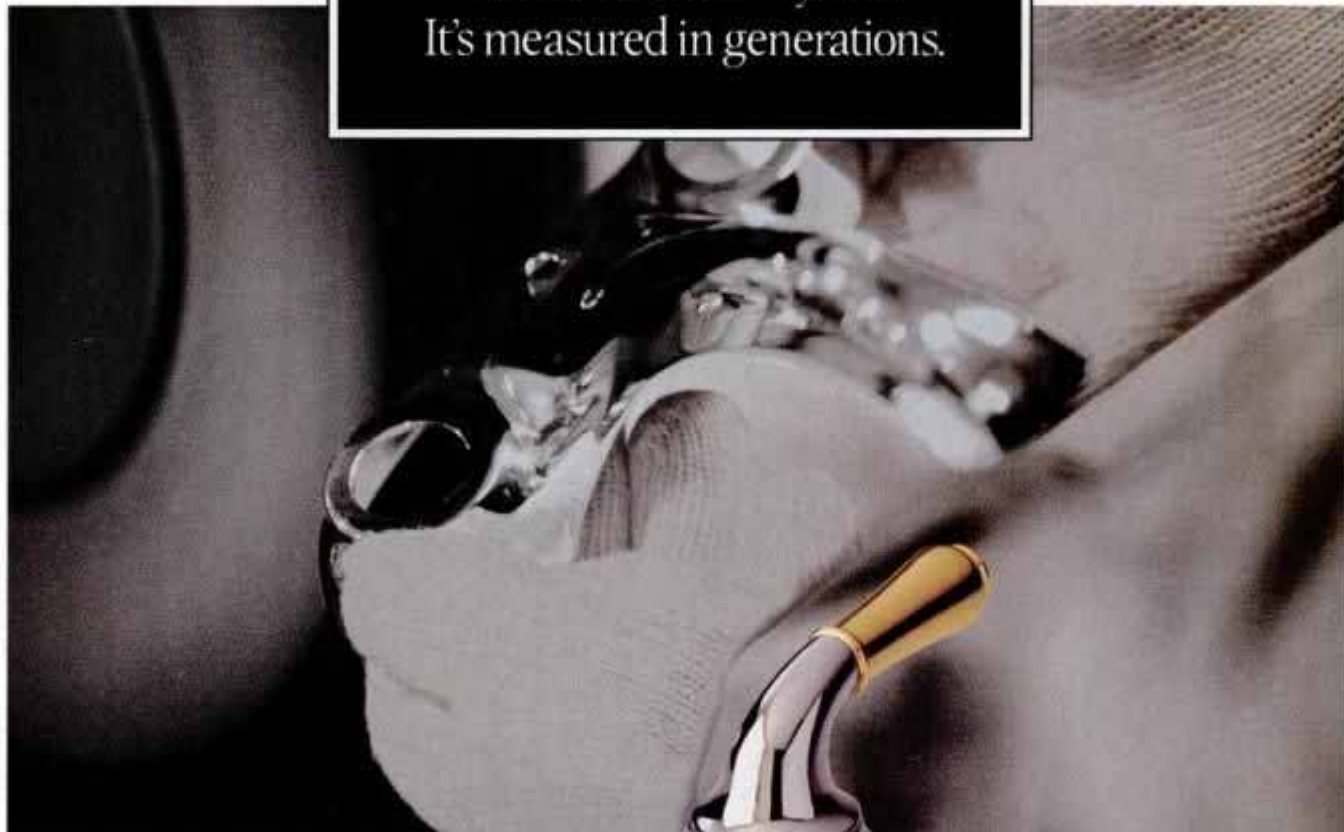
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TIME MACHINE

90 YEARS AGO: APRIL 1904

Popular Mechanics

The Torpedo—War's Deadliest Weapon

One of the World's Most Dangerous Inventions—Description of Its Construction and Operation

The torpedo is a small, self-propelled, explosive missile, which is capable of striking and sinking a battleship or other large vessel. It is a most dangerous weapon, and its use has revolutionized naval warfare. The torpedo is a small, self-propelled, explosive missile, which is capable of striking and sinking a battleship or other large vessel. It is a most dangerous weapon, and its use has revolutionized naval warfare.



Water Bomb

Torpedoes were the cruise missiles of the Russo-Japanese War, wreaking havoc on even the sturdiest battleships. Combat's costliest projectile, the torpedo combined the precision of a Swiss watch with the force brought by 220 pounds of guncotton. Navies were experimenting with steel nets to snare these fish before they hit home. Meanwhile, the submarine was proving an effective, stealthy platform from which to launch the "cigars."



Train Of Law

Circuit judges once rode from town to town, administering justice on the move. But to settle a bitter feud between two Nebraska

towns over the location of the county courthouse, there was but one solution: The building was forced to ride the rails from one town to the next.

60 YEARS AGO: APRIL 1934



Little Fleet

Scaled-down ships were cruising up and down Germany's rivers, bringing the lore of the sea to landlubbers. One of note was the oceanliner *Bremen*, which in model form stretched 47 ft. in length. Inside lay sleeping berths for six and a galley. The armada also included the battle cruiser *Hindenburg*. Fashioned from sheetmetal, the model fleet was the brainchild of a former U-boat seaman, buoyed financially by German industrialists.

Sky Liner

At the same time, the ultimate transatlantic vehicle



was taking shape on drawing boards in England—a stupendous catamaran flying boat for 1500 passengers. Each wing, with six engines, would accommodate kitchens, lounges and dining rooms. An elevator would connect the wings with the hull fuselages, which would carry cargo and fuel. At the rear: a catapult for launching an auxiliary airplane. No need for sleeping berths—the vehicle would have flown from New York to Southampton in less than 15 hours.

30 YEARS AGO: APRIL 1964



Home Remedies

To snap your house out of the winter doldrums, we offered a bouquet of spring projects. Slate, always a fixer-upper favorite, was a recurring theme this year. A slate entry floor kept spring's mud off the living-room carpet, while a slate-tiled patio stretched a porch into a party space. Elsewhere, spacesaving projects made bunk rooms out of the dead area beneath a slanting roof, and tucked hobby tables and sewing areas into recessed walls.

Rocket Wrench

Meanwhile, NASA was grappling with zero-gravity home improvement. Normal power tools flipped astronauts with reactive torque. Trust Black & Decker to come up with a fix, however. Working with the Martin Co., B&D engineers designed a tool that isolated the rotation of the motor but still trans-

ferred power to the output shaft. NASA loved the tool's mechanism—after all, it was a planetary-gear assembly. **FM**



To treat symptomatic benign enlarged prostate: Only one medicine can shrink the prostate.

PROSCAR.[®] (FINASTERIDE)

Until recently, there wasn't a medicine that could help the condition known as symptomatic benign prostate enlargement or BPH. But now there is PROSCAR, the first oral prescription medicine that can shrink an enlarged prostate.

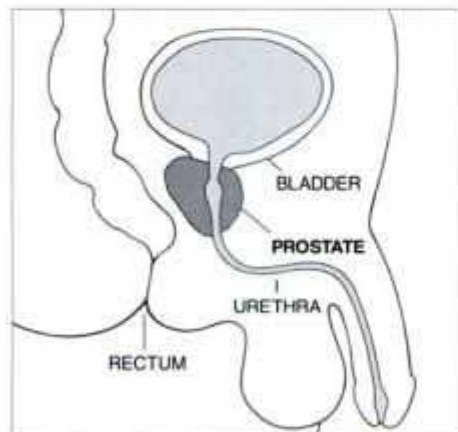
However, it is important to know the following: PROSCAR doesn't work for everyone. Even though your prostate may shrink, you may not see an improvement in urinary flow or symptoms. And you may need to take PROSCAR for 6 months or more to see whether it helps you.

How PROSCAR can shrink an enlarged prostate.

As a man ages, a key hormone can help cause the prostate to grow. PROSCAR actually blocks the production of this hormone, so it helps shrink the prostate to a smaller size in many men. As a result, some men treated with PROSCAR experience an increased urinary flow and an improvement in urinary symptoms.

Why you should see your doctor soon.

Your doctor has several options for the treatment of symptomatic BPH: watchful waiting (monitor-



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



ing the condition with regular checkups), medication, or surgery. It's important to see your doctor because the problem doesn't usually get better by itself. In many cases, the prostate continues to enlarge and the symptoms may get worse. So if your urinary symptoms are bothering you, have your family doctor or a urologist assess your condition and ask if PROSCAR is an appropriate treatment for you.

It is also important to have regular checkups. *While benign prostate enlargement is not cancer and does not lead to cancer, the two conditions can exist at the same time.*

Remember, only a doctor can evaluate your symptoms and their possible causes. So, if your urinary symptoms are bothering you, don't wait any longer. You may find that your enlarged prostate can be made into a smaller problem.

For more information about prostate enlargement and PROSCAR, call 1-800-635-4452 today.

TABLETS
PROSCAR 5mg
(FINASTERIDE)



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

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

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

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

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

What is BPH?

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

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

Treatment options for BPH

There are three main treatment options for BPH:

• **Program of monitoring or "Watchful Waiting".** If a man has an enlarged prostate gland and no symptoms or if his symptoms do not bother him, he and his doctor may decide on a program of monitoring which would include regular checkups, instead of medication or surgery.

• **Medication.** Your doctor may prescribe PROSCAR for BPH. See "What PROSCAR does" below.

• **Surgery.** Some patients may need surgery. Your doctor can describe several different surgical procedures for BPH. Which procedure is best depends on your symptoms and medical condition.

What PROSCAR does

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

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

What you need to know while taking PROSCAR

• **You must see your doctor regularly.** While taking PROSCAR, you must have regular checkups. Follow your doctor's advice about when to have these checkups.

• **About side effects.** Like all prescription drugs, PROSCAR may cause side effects. Side effects due to PROSCAR may include impotence (or inability to have an erection) and less desire for sex. Each of these side effects occurred in less than 4% of patients in clinical studies. In some cases side effects went away while the patient continued to take PROSCAR.

Some men taking PROSCAR® (Finasteride) may have a decrease in the amount of semen released during sex. This decrease does not appear to interfere with normal sexual function. Rarely, some men have reported breast swelling and/or tenderness or allergic reactions such as lip swelling and rash.

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

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

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

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

PROSCAR is for use by MEN only.

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

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

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

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

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

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

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

How to take PROSCAR

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

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

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

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



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LETTERS

In The Clouds

Having followed aviation since my first ride in a Jenny in Fort Worth, Texas, in 1928 (I paid \$3 for a 10-minute ride with my frightened mother sitting beside me in the front cockpit), I never miss an article like your excellent one commemorating 90 years of flight. I have, however, picked many bones with publications over the item in the piece on the Douglas DC-3. The forerunner of the DC-3 was designed mainly by Jack Northrop, as was the Douglas Dauntless SBD dive bomber. When Donald Douglas bought out Northrop at

the El Segundo, California, plant, these two designs went with the deal. As a tool designer for Douglas from 1941-44, I worked from engineering blueprints of the aircraft, most of which had "Northrop" in the lower righthand corner. Anyone who takes a close look at the DC series up to the DC-6 will notice that these were simply DC-3s with the dimensions multiplied and with the additions of more engines. Douglas was a master at aircraft production management. I worked in four of his WWII plants, and it was obvious that the Air Force preferred that he get contracts because he could see to their successful completion. However, he was not as much a designer as he has been given credit for.

JAMES A. LEE
PROFESSOR EMERITUS
OHIO UNIVERSITY
ATHENS, OH

You didn't mention the SR-71, a true aircraft taking off and landing under its own power and capable of sustained flight above 30,000 ft. at Mach 3-plus. The crowning blow, though, was giving Boeing credit for the F-22. The F-22 was conceived, designed, built and flown by Lockheed's famed Skunk Works, as was the Stealth Fighter, the F-117.

DON K. BURNS
CHERRY VALLEY, CA

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

The biplane on page 28 is a Consolidated NY-2, not a Continental NY-2 as you indicated. Consolidated of Buffalo, New York, was one of the leading aircraft manufacturers of that time, and the Doolittle "blind" flight was a milestone in aviation history.

D.T. CAPASSO
HADDONFIELD, NJ

You failed to give credit where it was due. The first nonstop trans-Atlantic flight was made in 1919 by John Alcock and Arthur Brown of Britain in a Vickers. The first jet airliner service began in 1952 between London and South Africa in a de

Haviland Comet. Frank Whittle of Great Britain designed the first jet airplane engine in 1930. These are very important firsts that should have been included in your article.

ARTHUR R. FELCE
MEADOW VISTA, CA

In the segment on the Red Baron, Manfred von Richthofen, you state "the truth of the endeavor was killing, and none was more accomplished at it." A WWI pilot who was just as accomplished, if not more so, was Rene Fonck, the ranking ace of the Allies.

Statistically, he had 75 confirmed and 52 unconfirmed victories. He holds records for the most number of planes shot down in one day (six), and the speed of victories (three shot down in 10 seconds). Also, Fonck was never shot down. These records are well-deserving of credit considering that much of the air combat in WWI was behind German lines. Flying a red, tri-winged Fokker

certainly may have aided in Richthofen's notoriety and fame as the top ace in WWI, but please remember that the Allies had an ace who was equally impressive.

CHRIS FONCK
CORALVILLE, IA

The first scheduled airline was not the "brainchild of Tom Benoist." It was P.E. Fansler's idea—my father. He is the recognized founder. This can be verified by the Smithsonian Air and Space Museum. The air transport curator is Ron Davies, who is the recognized world authority on commercial aviation. In 1913, my father read an article about a trip down the Mississippi River in a Benoist flying boat. He wrote to Benoist about carrying people in a flying boat and, after two or three letters, Benoist agreed to supply a boat if my father did the rest. Benoist met my father and they solidified this agreement with a handshake. My father thought Tom Benoist was "the most honest man he'd ever met." Benoist went back to St. Louis to run his company and my father began the task of organizing an airline. He managed to raise the money he needed for the facilities and, during this time, he communicated with Benoist and kept him informed. He had promised his backers that the

(Please turn to page 12)

Reader Project Of The Month



I built this trio of porch swings from plans featured in your July 1983 issue ("Build PM's Old-Fashioned Porch Swing," page 94). One is for a friend, the other for our cabin and the third for our home. I am now starting one for my son's new home. My daughter wants one also. Mass production anyone?

JACK HADLEY
CAREFREE, AZ

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LETTERS (Continued from page 11)

airline would have its inaugural flight on Jan. 1, 1914. The rest is history.

J. DAVID FANSLER
OXFORD, CT

In "Birth Of The Jumbo Jet," the C-141 had nothing to do whatsoever with the engineering of the 747 airplane. From the very beginning, the 747 was designed as a passenger airplane, capable of hauling lots of cargo. While the 747 was under construction at the Boeing Everett Plant, the United States Air Force released the specs for the C-5A airplane. After many presentations to the C-5A Select Committee, the Boeing team offered the cargo version of the 747 to the USAF team in place of the C-5A. I was told, personally, by a member of the Select Committee that the reason Boeing lost the C-5A contract was that it did not offer an airplane meeting the C-5A specs. I retired in 1983 from Boeing after 30 years of service. I worked as an experimental flight engineer on the 707, 727 and 747 airplanes. I was also qualified as an instructor on those airplanes and simulators. They were 30 years of sheer pleasure.

STAN GILLIAM
PUYALLUP, WA

Igor Sikorsky did indeed make many significant contributions to the development of the modern helicopter (principally the cyclic rotor), but he is not the inventor of the modern helicopter. The first successful helicopter was Heinrich Focke's Fa-61, developed in Germany in 1936. German aviator Hanna Reitsch flew the Fa-61 on many flights in Germany in the late 1930s. Another German helicopter that preceded WWII was the Kolibri or Hummingbird, designed by Anton Flettner. This machine was in serial production early in WWII. So you see, the Germans must be given credit for the first modern helicopter.

RICHARD E. IGOU
CWO, U.S. ARMY RET.
GARDEN RIDGE, TX

Batteries Reborn

After reading your article on rechargeable batteries, I purchased the Rayovac Model PS2, which recharges sizes AAA through D. As advertised, it has recharged the AA batteries I purchased back to 1.5 volts or better after use. I have noted one further item of interest, though. I used some AA batteries in a motorized toy. The toy was left on for an extended period of time and drained one battery down to .25 volts. The other had actually reversed polarity and was reading a negative .25 volts. The Power Station would not activate on

these batteries since their charge was less than 1.0, or whatever its design cutoff may be. I very carefully subjected these batteries to a series of jolts of less than 1 second duration each from a 12-volt battery charger set at 2 amps. After two to four jolts, the battery got warm, not hot. After cooling, I repeated this process until the batteries registered a temporary voltage of at least 1.0 volts. At this point, the Power Station recognized the batteries and took over charging. They charged up to the full 1.5 volts and have operated normally thereafter. Anyone who tries this should be very careful and only use very short bursts of high voltage. It can rejuvenate batteries that would be junked otherwise.

JOHN S. RYALS
WARNER ROBINS, GA

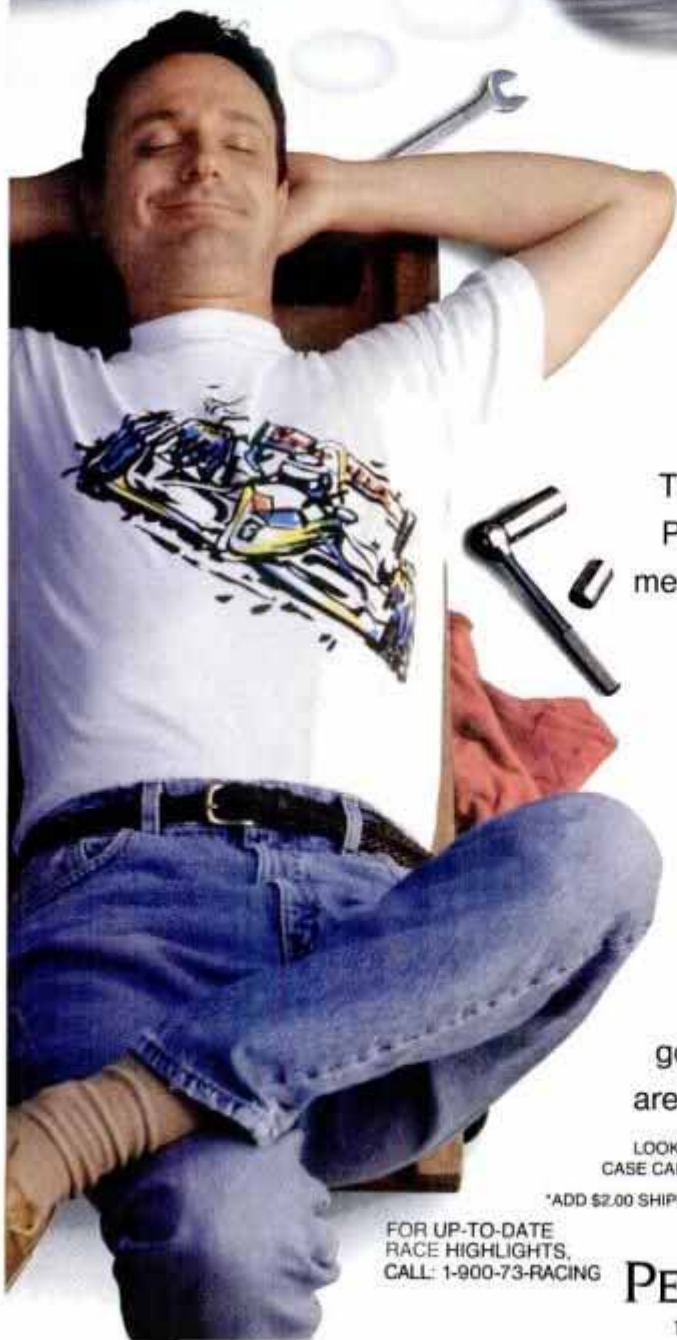
Winter Wonderland

Your wonderful article on "The Mechanics Of Speed Skiing" brought back childhood memories. I was present when the Italian skier Leo Gasperi was clocked at 89 mph in a downhill run. But it happened in Samedan, not St. Moritz. This is just two tiny towns down the Engadin Valley away from St. Moritz. Samedan had the perfect slope for what was then called the "Kilometre Lancee." I was a teenager going to school and on weekends we would go up to Samedan and watch this feat. The skiers wore jumping skis with the three grooves on the bottom. Just in front of the toe of the boot they screwed hand-holds into the skis. In those years, the bindings were very primitive. The men had cone-shaped gear strapped to their backs to act like a slip stream. They wore the same basic type of headgear you showed in your article.

WALTER R. McCORD
LOUISVILLE, KY

Your article on bobsleds was much appreciated. However, there is a better explanation of why a low, empty sled weight is beneficial. The bobsled and crew's total weight should be as near as possible to the legal maximum total weight of 860 pounds for a 2-man bobsled. The real benefit of a lighter-than-normal empty sled is that it allows more flexibility in crew selection. If the team's 180-pound pusher gets the flu and the reserve pusher weighs 210 pounds, a light sled allows the team to run without being overweight. Spent uranium weights can be added or subtracted from the sled to come up to the optimum weight of 860 pounds at all times.

JEROME C. BAER
PROJECT MANAGER, BOBSLEDS
FLIGHT RESEARCH INSTITUTE
BELLEVUE, WA



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TECH UPDATE

News Of Tomorrow's Technology Today



PH ILLUSTRATION BY ATILLA HELIN

Flyback Rockets Could Boost Shuttle's Life Span

HOUSTON, TX—No matter how many new spacecraft look good on the drawing boards, the fact remains that the shuttle is likely to hold down its job for years. New spacecraft cost billions of dollars to develop, and even NASA can't drum up that kind of money these days.

All the more reason, argue some engineers, to develop ways of enhancing the shuttle fleet's value. For example, NASA has long sought to upgrade the pair of solid-rocket boosters that usher the orbiter up through the atmosphere. Now the agency is studying a proposal to replace these rockets with reusable liquid-fueled boosters, which would wing their way home to an airstrip.

Each booster would soar on a pair of F-1 engines, the powerplants of the old Saturn V rocket. After splitting

off from the shuttle, 35 miles up, the rockets would reenter the atmosphere at a Mach-6.5 glide. Once at cruising altitude, they'd fire up 747-caliber turbofans and fly back to Cape Canaveral.

Where NASA would save money is in maintenance between missions. Solid-rocket boosters must be fished from the sea, hosed down, taken apart and distributed to various contractors for rebuilding, with meticulous care

Flyback boosters separate from shuttle. Note boattail on orbiter and engines on fuel tank, other upgrades under study.

paid to O-ring seals and the like. By contrast, the flyback boosters would simply taxi to a hangar to be inspected and reloaded with liquid fuel—ideally, a matter of a few days.

Behind the idea is none other than Max Faget, engineering spark plug of both the Apollo and shuttle programs, and now head of Space Industries Inc.

Highlights This Month

- **Flat And Fat**—Radical wide-body airliner.
- **Eye Spy**—CIA's stealth drone over the Balkans.
- **Missile Shootout**—Latest Army designs.
- **Flight Officer**—Airborne police robot.
- **Shot Spotters**—Sensors track urban gunfire.
- **Rock The Bottom**—Vehicle bombs the oceanfloor.
- **Shoot The Rapids**—New wet roller coaster.

Editor/Writer: Gregory T. Pope
Reporters: Philip Chien, Abe Danc, Mike Filon,
Scott Gourley, Paul Ruben, Bob Scheier

Bat-Plane Megaliner

HAMPTON, VA—Who says every future airliner has to look like a DC-8 on growth hormones? Not McDonnell Douglas Aerospace. Working with NASA's Langley Research Center, engineers there have designed a unique multideck aircraft sized to swallow 800 passengers.

While flying-wing airliners have graced drawing boards since the 1930s, this one is different. Known as a blended wing-body, the

concept lifts some of the best features of the B-2 bomber, particularly its high lift-to-drag ratio. Meanwhile, the aft-mounted engines not only balance the aircraft but also suck away a thin, drag-inducing boundary

layer of air that surrounds the central fuselage. The result is highly efficient propulsion.

The cabin itself is a deeply cambered lifting body, engineered structurally to behave as a rigid lozenge and reduce the load on the outer wings. It's also a more elegant solution to enclosing and lifting a payload than is a cylinder with wings.

If McDonnell Douglas decides

Tailored to fly 7100 miles at Mach 0.85, blended-wing-body airliner combines structural and propulsive efficiency.

to develop the aircraft, it's unlikely to see service until the year 2020. Good luck getting a window seat.



NASA ILLUSTRATION

Old Jet Tests Shuttle Wheels

KENNEDY SPACE CENTER, FL—An obsolete airliner is helping to stretch the space shuttle's operating envelope.

NASA is using a Convair 990, a former American Airlines transcontinental, to stomp on a runway with the force of a shuttle landing fully loaded. Engineers have installed a shuttle-gear retraction system between the Convair's main landing gear.

During tests, as the old jet touches down at 166

knots, a hydraulic ram presses the shuttle wheels to the tarmac. The force simulates the load the shuttle gear would encounter when landing after an aborted mission—with a heavy payload still in its cargo bay. Sensors on the shuttle gear reveal how much strain its tires experience.

Data from the experiments will aid development of emergency-landing procedures.



As NASA's Convair 990 lands, shuttle gear emerges from cavity in fuselage to simulate aborted-mission touchdown.

NASA PHOTOS

Blowin' In The Wing

ATLANTA, GA—Future airliners may need all the lift they can muster, especially on takeoff and landing. To help out, Georgia Tech Research Institute and NASA's Langley Research Center hope to parlay technology developed for military jets into the civilian fleet.

Under investigation is a design called the circulation-control wing. Inside, piping shunts high-pressure air from the jet engines through slots in trailing edges. The effect is to increase suction on the wing's upper surface.

Because pulling air from the engines reduces the takeoff thrust, an aircraft's auxiliary generator could supply the force.

The new system should permit the use of shorter runways and a means to combat wind microbursts.



Circulation-control wing releases air through flaps to boost lift by decreasing pressure on wing's upper surface.

GEORGIA TECH PHOTO

CIA's Superfly Spy

SAN DIEGO, CA—Warring factions in the Balkans probably won't notice the sleek drones that may even now be patrolling overhead. And that's the idea. After all, the stealthy unmanned air vehicles are run by the Central Intelligence Agency.

Built by General Atomics, the modified Gnat-750s are reported to be operating out of Albania, spending nearly a day at a time in the air over the volatile



southern states of the former Yugoslavia. Modified with data-relay links, the Gnats train electro-optical sensors on ground activity. Despite their 35-ft. wingspan, they give up virtually no radar signature, since they are slow of flight and masked with composite materials.

General Atomics is also building 10 bigger versions that will carry synthetic-aperture radar.

CIA unmanned operative is modified Gnat-750 carrying reconnaissance sensors over former Yugoslav republics.

GENERAL ATOMICS

Contender Could Be A Contender

RENO, NV—In the dog-eat-dog category of aviation that includes business jets and commuter short-hoppers, a new contender may soon enter the fray. The 12-passenger Contender 202 and its 19-passenger tri-jet variant 303 promise to bring bizjet performance to the small-airliner world.

Looking like no other small twin-jet, the Contender is the brainchild of Larry Heuberger, who had a major role in designing the Learstar 600—fore-runner to Canadair's big Challenger business jet—among other craft. Contender distinctions include the large



Canards distinguish Contender, which could serve as a commuter, cargo or executive jet.

canards and highly swept fuel tanks that blend with the main wing. The aircraft will fly on two Rolls-Williams FJ-44 jets and offer a transcontinental operating range, topping out at

Mach 0.72. Lightweight construction from a new high-strength aluminum alloy contributes to that performance.

Contender Aircraft hopes to be flying a prototype in 18 months.

Electric Motor Is Compact Disc

HUDSON, MA—A brushless DC motor that puts out 430 hp but weighs only 320 pounds is impressive enough. But at less than 2 ft. across, with an output shaft less than 8 in. long, this is no ordinary powerplant.

The disc motor, developed by Kaman Electromagnetics, is an outgrowth of

Electromagnetic disc motor is a third the weight and the size of a conventional DC equivalent.



research into military electromagnetic launchers and propulsion (see [Tech Update, page 32, Oct. '93](#)). The key to its slim silhouette is its fly-wheel-like rotor, embedded with rare-earth magnets. Integrated power electronics allow output at a continuously variable speed.

Kaman says the motor would be perfect to propel electric buses and other battery-driven vehicles.

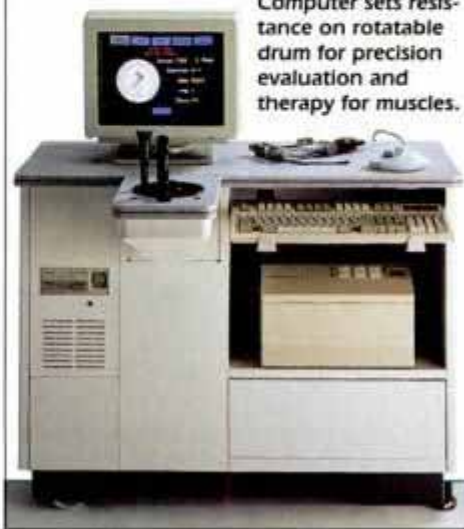
NASA's Handy Muscle Machine

DAVIS, CA—A device originally developed for zero-gravity exercise on the Space Station allows individual hand and arm muscles to undergo evaluation and strengthening.

Dexter, as the machine is called, presents two bars—one fixed and one attached to a rotatable drum—that the user squeezes together. The drum itself turns on a clutch-like resistance mechanism filled with magnetic powder and wrapped with an electric coil. A computer feeds current to the coil to control resistance.

Offered by Cedaron Medical, Dexter can help analyze muscle, endurance, range of motion and reaction time. With attachments, the device can isolate muscles for physical therapy.

Computer sets resistance on rotatable drum for precision evaluation and therapy for muscles.



Easy-Flight Microlight

MARLBOROUGH, ENGLAND—Like its unpowered cousin the hang-glider, a microlight requires the pilot to throw his weight around to control the aircraft. A new British design, however, lifts some of the burden off the pilot's shoulders.

Made by Solar Wings Aviation, the Quasar Pegasus features an in-flight trimming mechanism. A rigging system allows the pilot to reshape the trailing edge of the flexwing, then lock it in place with a wheel on the control bar.

Powered by a Rotax 582, the fiberglass Pegasus also flies with air-intake silencers.

Lofted by flexible wing, Quasar Pegasus features in-flight trim setter to relieve pilot of endless weight shifting.





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Whatever it is about the new Impala SS, before you even think about buying one, we feel we owe you a few friendly words of advice: this is not a car for those who prefer to arrive unnoticed.

Are you sure you can live with that?

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is ready."

One Missile, Many Missions

HUNTSVILLE, AL—You're in a Bradley fighting vehicle. Your target: a helicopter. Which missile do you use? Now you're in a helicopter bearing in on an armored personnel carrier. Quick, what's your weapon?

Yes, it's hard to keep track of missiles and their missions. Wouldn't it be easier if they were all the same? The U.S. Army Missile Command (MICOM) is exploring that very idea under a research program called The Army Combined Arms Weapon System, or TACAWS.

A one-size-fits-all missile would need custom technology. High-resolution infrared seekers would lock on either before or after launch, working against both sky and terrain backdrops. Controllable-thrust motors would use gel fuels. A radio datalink would allow an abort in case of accidental friendly fire—a feature MI-



COM terms "regret avoidance." All may find homes in a future Joint Advanced Weapon System, or JAWS.

Fired from any platform, multimission missile could target aircraft or armored vehicles with equal proficiency.



Four discarding boosters flank ADKEM penetrator. Orientation motors at rear guide missile during vertical launch, then drop away.

The King Of Kinetics

HUNTSVILLE, AL—TACAWS won't solve everything, however.

Relentless advances in armor technology are shifting more emphasis toward kinetic-energy penetrators in tank battles.

MICOM, al-

ready developing a new line-of-sight antitank weapon called LOSAT, is also looking ahead to the next generation: ADKEM, or Advanced Kinetic-Energy Missile.

ADKEM will operate at a range of 6 miles, twice that of LOSAT. In addition, a vehicle will unleash the missile via an unusual "virtual launch" feature. ADKEM will first pop vertically from its stowage in a horizontal attitude. Orientation motors will then slew it around to its target.

Steel Rain On Wheels

DALLAS, TX—The M270 Multiple Launch Rocket System just got a smaller, lighter cousin. Known as the High-Mobility Artillery Rocket System (HIMARS), the weapon puts a 6-pack of the M270's rockets on the back of a 5-ton tactical truck.

HIMARS, which was developed by Loral Vought, weighs in at only 15

tons, about 13 tons lighter than the M270. For that reason, it can fit aboard a C-130 cargo jet and reach areas off-limits to the bigger C-141s and C-5s that bring in the tracked M270. Light rapid-reaction forces would thus be able to deliver the system's heavyweight artillery punch.

Six-wheeled multiple-launch rocket system could travel with rapid-strike forces.



Heads Up For Stingers

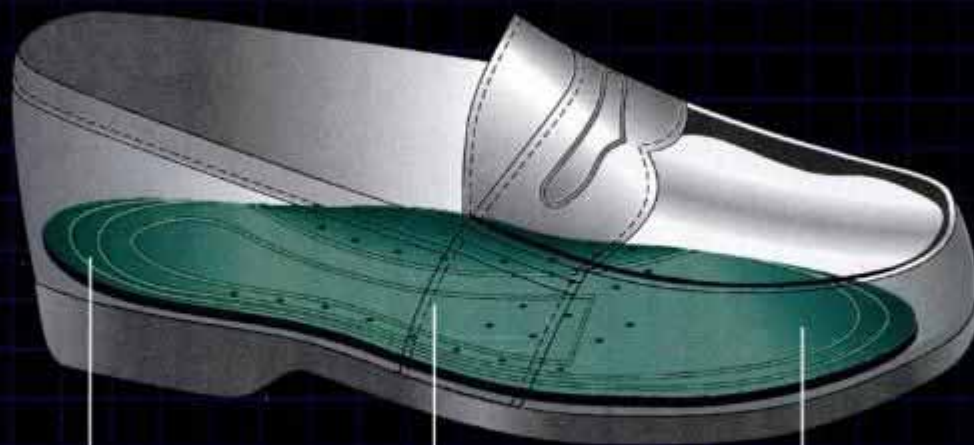
FORT CAMPBELL, KY—Frontline infantrymen aren't used to getting advance warnings of air attacks. But that may change with the forward-area air-defense command and control system now in service with the 101st Airborne Division.

Instead of waiting for radio relays from platoon commanders, gunners will get threat data that is only 6 to 10 seconds old. A handheld computer receives information from long-range airborne and ground radar, including friend-or-foe distinctions, range and time to closest approach. Squad leaders can track highest-priority targets from 18 miles away.



Commander tracks air threats, while Stinger gunner waits for target to clear horizon.

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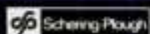
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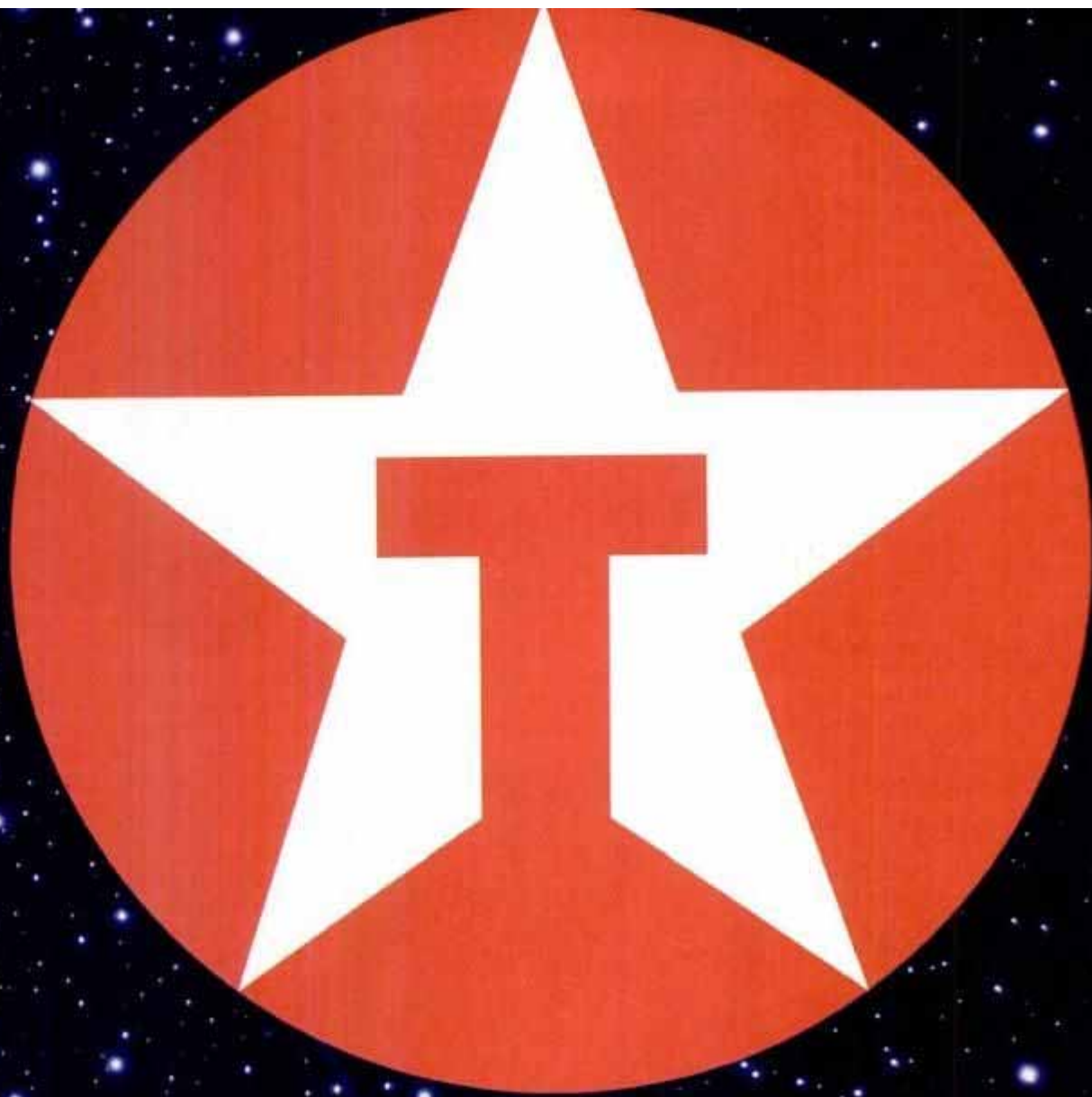
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Lower Emissions, Improved Mileage**

Deposits are harmful to an engine's
overall performance—from power to emis-
sions to mileage. They clog up port fuel
injectors, stick to intake valves and end



up in combustion chambers.

But New CleanSystem³'s unique cleaning power helps remove, reduce and prevent these deposits. This helps provide the highest performance, lower emissions and improved mileage in every octane grade.

Buildup of Deposits

The buildup of deposits on fuel injectors and intake valves can obstruct the flow of fuel and can upset the critical air/fuel ratio. This can cause driveability problems such as hesitation, power loss, poor acceleration, rough idle and even stalling. These deposits can also lead to excessive exhaust emissions and a decrease in fuel economy.

Deposit buildup in the combustion chambers, where the air/fuel mixture is combusted, can cause harmful side effects such as an increase in oxides of nitrogen (NOx) exhaust emissions.

Recently, auto manufacturers have reduced the top-dead-center (TDC) clearance between the piston and the cylinder head in an effort to lower exhaust emissions. This reduction in clearance has resulted in a need to control or even reduce combustion chamber deposit levels.

Deposit Cleanup

In an effort to clean up these deposits, Texaco Research and Development created a patented detergent/dispersant molecule for New CleanSystem³ gasoline.

This unique detergent chemistry was designed specifically with engine deposit



prevention in mind, from its molecular weight to its chemical elements, all of which are important in controlling deposits in an engine.

With continued use, New CleanSystem³ not only helps prevent deposits from forming, but can remove existing deposits from fuel injectors, intake valves and actually begin to attack the combustion chamber deposits.

With this total cleanup, New CleanSystem³ gasoline can help restore lost fuel economy, lessen exhaust emissions and produce and maintain the highest performance possible.

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With one regular and two high-performance grades, New CleanSystem³'s improved cleaning can allow every car—from new high-performance cars to small economy cars to older cars—to get their best performance and mileage in the octane grade they need.

If you would like performance benefits like these for your car, visit your local Texaco station and fill up with any grade of New CleanSystem³ gasoline.

And experience the new generation of clean gasoline.

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Scud-Buster With Mustard

SEATTLE, WA—Sheer kinetic energy remains the quickest solution to the tactical-missile threat, the Air Force reckons. With that in mind, officials had high hopes for a hybrid air-launched Scud-buster that would climb into space to pick off missiles. But now it looks as if planners will have to aim a little lower.

The original interceptor, conceived by Boeing, consisted of a supersonic Short-Range Attack Missile, or SRAM, tipped with a kinetic-kill vehicle. Originally designed to carry a nuclear warhead, the SRAM has proved capable of reaching space, where it would have released Boeing's Light-weight Exo-Atmospheric Projectile



LEAP vehicle would have slammed Scuds in space. Boost-phase interception is now Air Force priority.

(see Tech Update, page 26, Oct. '91). Instead, however, either a high-speed antiradiation missile or an AM-

RAAM will unleash a kinetic projectile. In this scheme, interception would occur below a 36-mile altitude—within 90 seconds of a Scud's launch.

Crash Course In Anatomy

MILFORD, MI—General Motors safety engineers are inflicting damage more anatomically precise than ever on their long-suffering team of crash dummies.

They're putting foam-block inserts into the dummies' heads and abdomens to mimic facial bones and internal organs. In crash tests at the company's proving ground, the foam



GENERAL MOTORS PHOTO

sustains deflections that medical researchers can correlate to specific internal injuries. The facial inserts will aid refinement of airbag technologies, while the abdominal inserts will allow designers to tailor seatbelts more realistically.

Meanwhile, crash testers are also swinging a huge punching bag to simulate dangerous vehicle collisions with deer.

Crash dummy receives foam insert that will help engineers design safety systems to avoid internal injuries.

Greenhouse-Effect Greenhouses

BANGOR, WALES—If global warming boosts our atmosphere's greenhouse effect, will plants go wild or will they wilt? To find out, the University of Wales' Institute for Terrestrial Ecology has set up a series of "solar domes."

Built of special glass that lets in the Sun's ultraviolet rays, the domes enclose different versions of future climate predicted by global-warming

models. Inside, the plants propagate under various temperatures and concentrations of carbon dioxide. Air monitors gauge levels of ozone, nitrogen oxides and water vapor.

The research effort dovetails with similar projects in the United States and abroad.

Solar domes hook up to ventilation system that controls mix of atmospheric gases under which plants are grown.



LOWRIE/STANLIS SERVICE PHOTO

Manhole Maneuverer

OVERLAND PARK, KS—The next hard hat you see descending into an electric-utility manhole may belong to a robot. Kraft Telerobotics has developed the M5-A Scout to inspect underground transformer vaults if dangerous conditions are suspected. The machine can measure gases, detect temperatures and relay color video images to human co-workers on the surface.

Scout can maneuver through tight spaces, panning and tilting its color TV camera to inspect utility vaults.



KRAFT TELEROBOTICS PHOTO

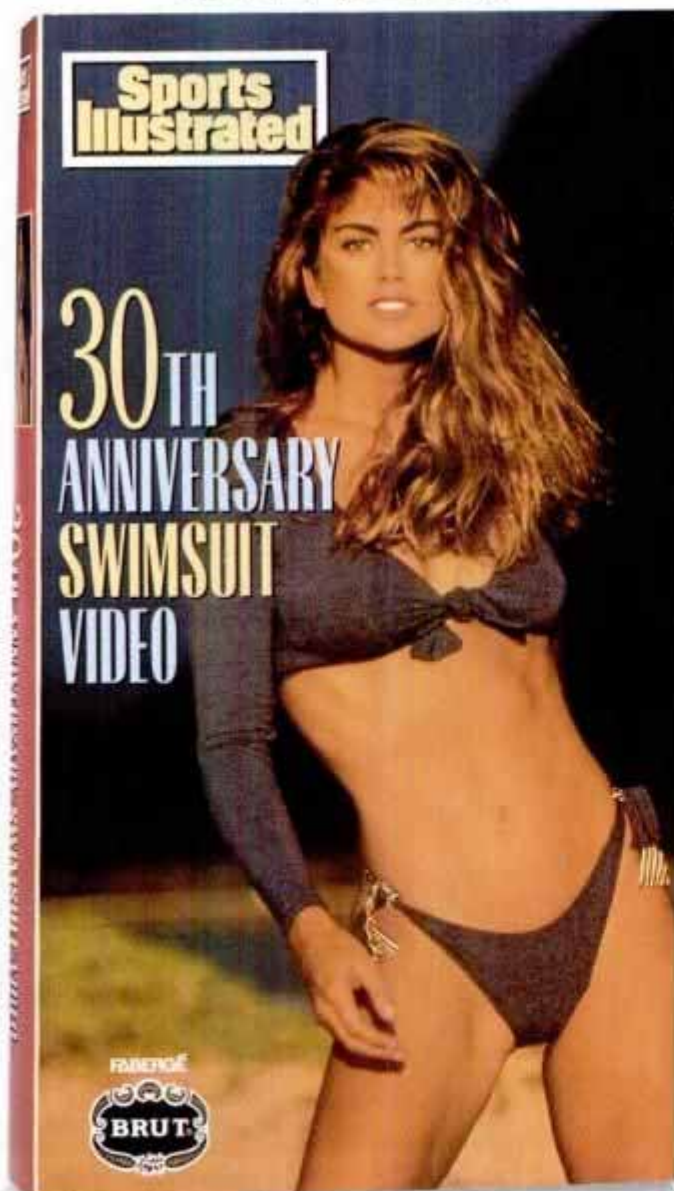
(More Tech Update on page 32)

Материал, опубликованный на территории сервера

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Plug up to six appliances into one outlet. With 15-AMP circuit breaker. #701

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Softens or brightens any room. Single pole, for use with one-switch circuits. #DIU61SLM5



594
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Popular Mechanics™ Toilet Tank Repair Kit
Save water and fix leaky toilets with this silent flush toilet repair kit. It's easy to install, a crescent wrench is all you'll need. #30875

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General Electric Push Dimmer Switch
Full range of brightness control at the touch of a button. Single pole, for use with one-switch circuits. #DI61ULM5



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Popular Mechanics™ Massager Shower Head
Go from an invigorating massage to a relaxing spray. Water saver uses up to 40% less water. #30922

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MADE IN THE USA

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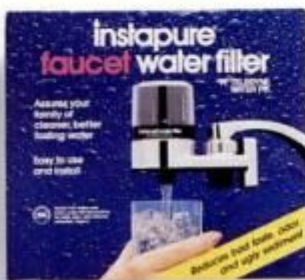
Popular Mechanics™ Lavatory Faucet with Pop-Up Drain
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Security Camera Protects Itself



Computer-guided motors allow Yorick to follow objects even if they take unpredictable turns.

OXFORD, ENGLAND—If you ever have the urge to heave a brick at a security camera, make sure it isn't Yorick. Named for the lively skull in Shakespeare's *Hamlet*, Yorick is a motorized camera that can duck projectiles, then recover its composure to focus on the perpetrator.

The device, developed at Oxford University, consists of two cameras mounted on a T-shaped robotic arm. Yorick's computer can be programmed to allow the camera to track objects of a particular shape, such as a car or a person. By calculating how fast the object is moving, the cameras can predict its future positions and track it. But it also reacts quickly to surprises. If threatened by an object whizzing toward it, Yorick can spin over backward and shut its lenses.

Drones Of The Highway Patrol

FORT WORTH, TX—A proven high-tech military asset, the unmanned aerial vehicle (UAV) may now be poised to buzz into the civilian world. Vault Industries is developing a flying robot aimed squarely at commercial applications.

Known as the Hummingbird, the vehicle arose from a classified defense project, spun off for dual-use conversion. Vault is building Hummingbirds in both 8- and 16-ft. versions, each with a configurable mission pod on its underbelly.

Two ducted propfans provide lift for vertical takeoff and hovering, while a third controls horizontal motion. The bird's twin powerplants are geared so that the vehicle can fly and land safely on one engine—unlike other UAVs. In addition, its flight-control system enables autonomous launch and landing.

Vault believes that law enforcement abounds with applications for the Hummingbird, including



Configured for law enforcement, Hummingbird could carry cameras to track criminal activity.

surveillance, pursuit and even criminal apprehension. Firefighting, construction, agriculture and package delivery may supply other roles for Hummingbirds.

Tracking Down The Sound Of Crime

EDINA, MN—How many lives could be saved and crimes solved if police had instant notification of gunplay? That thought has triggered a novel solution to urban violence proposed by Alliant Techsystems.

Alliant calls it the System for the Effective Control of Urban Environment Security, or SECURES. The apparatus would comprise a grid of street-corner acoustic sensors coupled to a network of radio transceivers. The sensors would detect airborne energy from the discharge of firearms.

Signal-processing circuitry would then distinguish the noise from other sharp sounds such as car backfires. Several sensors reacting at once could localize the sound source by the process of triangulation.

The units would modem the information via digital packet radio to a local communications node, which in turn would relay the data to a command center. The entire process would take less than a second.



Acoustic sensors detect and pinpoint gunfire, then relay data via digital radio to command post, which dispatches emergency services.



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*Based on manufacturer's reported model year deliveries 1987-1993. **Based on an average of consumer reported problems at 3 months ownership in a survey of '93 models designed and built in North America. †Three years/36,000 miles. See dealer for details. Some features shown are optional.

Robot Makes It Shipshape

UNIVERSITY PARK, PA—Built to repair a crippled nuclear reactor, a unique 2-armed robot may have a new lease on life repairing ships. Penn State University engineers are refitting Manfred (short for Manipulator For Reactor Defueling) as a dockside diver.



PH ILLUSTRATION BY AGOUNI E. BROTHMAN

An underwater robot, capable of paint removal and other repairs, could keep ships from going into dry-dock.

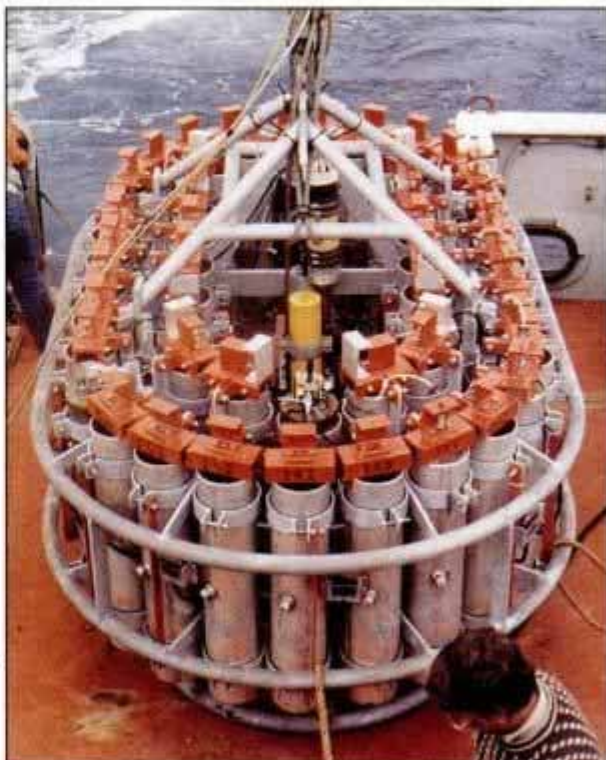
Manfred got a last-minute reprieve from a work detail at Three Mile Island, mainly because the machine had trouble positioning its arms. The reason: Ocean Systems Engineering built Manfred to use water, not oil, as its hydraulic working fluid. Not only will Penn State change that, but engineers will also upgrade its actuators. The improvements would permit such high-precision work as paint removal, hull grooving and nickel-cladding.

NOBEL, The Prize Water-Bomber

WOODS HOLE, MA—The best way to probe the seafloor's deep structure? Set off explosions at precise locations, then listen as tremors propagate.

For that purpose, Woods Hole Oceanographic Institute has developed a Near Ocean Bottom Explosives Launcher, or NOBEL.

NOBEL houses 47 small barrels loaded with explosives. Weighted with a lead nose cone, each charge can drop individually from the frame on the end of a primacord line. One detonator releases the charge, while the force of the charge reaching the end of the primacord triggers a second detonator. The double action ensures that each blast goes off well away from NOBEL's other charges. A hydrophone then picks up seismic waves traveling through the seafloor crust.



WOODS HOLE PHOTO

NOBEL is towed behind ship, distributing explosives and timing seismic waves with data from hydrophone.

Chart A Course For ECDIS

NORTH VANCOUVER, BRITISH COLUMBIA—It's full steam ahead for the digital revolution, as both U.S. and Canadian coast guards, along with a major Canadian shipping firm, have embraced Electronic Chart Display and Information Systems (ECDIS).

Right now, the International Maritime Organization is finalizing worldwide standards for the displays, which replace pencil-and-paper charts (see Tech Update, page 19, Aug. '92). An ECDIS would combine readings from radar and GPS with nautical charts that show water depth, shorelines, buoys and obstacles. The result: up-to-the-second navigation information.

The U.S. Coast Guard will install units from Offshore Systems Ltd. on *Juniper-* and *Keeper-*class vessels.



OFFSHORE SYSTEMS PHOTO

Canadian coast guard icebreaker/buoy tender uses ECDIS in Great Lakes area.

Waterjet Roller Coaster



NEW BRAUNFELS GENERAL STORE PHOTO

NEW BRAUNFELS, TX—Physics once separated water slides from roller coasters: Water doesn't flow uphill. But the world's first water-powered roller coaster will wash away that distinction.

Master Blaster, under construction at the Schlitterbahn Waterpark, will squirt inner-tube riders uphill at speeds of 10 mph, then let gravity take over on the dips and curves. The key: patented water injection jets licensed by Water Ride Concepts.

Right now a 200-ft. prototype, built by New Braunfels General Store, features two inclines and two curved downhill tunnels. The principle could be applied to elevated stairless people movers in amusement parks, says the manufacturer.

Master Blaster prototype could foreshadow water-coaster amusement rides and people movers.





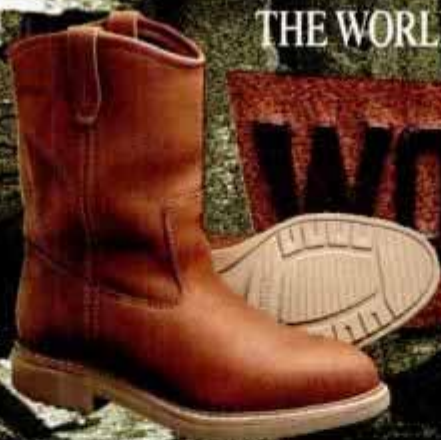
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PRESENT

THE NATIONAL AUTO QUIZ

1. This 1994 concept car is the:



A) Pontiac Sunfire. B) Ford Power Stroke. C) Dodge Venom. D) Subaru Sagres.

2. One cylinder of an automotive four-stroke cycle engine completes a cycle every:

A) 90° B) 180° C) 360° D) 720°

3. What car was repackaged and sold by mail order under the Allstate name through the Sears Roebuck catalog?

A) Model T Ford. B) Henry J. C) Crosley. D) American Bantam.

4. AMC introduced their Concord model in 1978. What car line used the same name for a new model that debuted in 1951?

A) Plymouth. B) Chrysler. C) Willys. D) Pontiac.

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5. What race driver is the only one ever to compete in Indy Car racing, Top Fuel drag racing and Winston Cup stock car racing, all in the same season?

A) Mario Andretti. B) John Andretti. C) A.J.Foyt. D) Richard Petty.

6. What type of vehicles, other than exotic sports cars, is Lamborghini known for?

A) Airplanes. B) Boats. C) Bicycles. D) Farm tractors.

7. When gasoline and air in any engine burn, about how much of the total energy in the fuel (gasoline) is available at the crankshaft of the engine?

A) About 15-20%. B) About 25-35%. C) About 40-50%. C) About 75-80%.

8. In 1948, the largest producer of station wagons in the U.S. was:

A) Jeep. B) Ford. C) Chevrolet. D) Crosley.

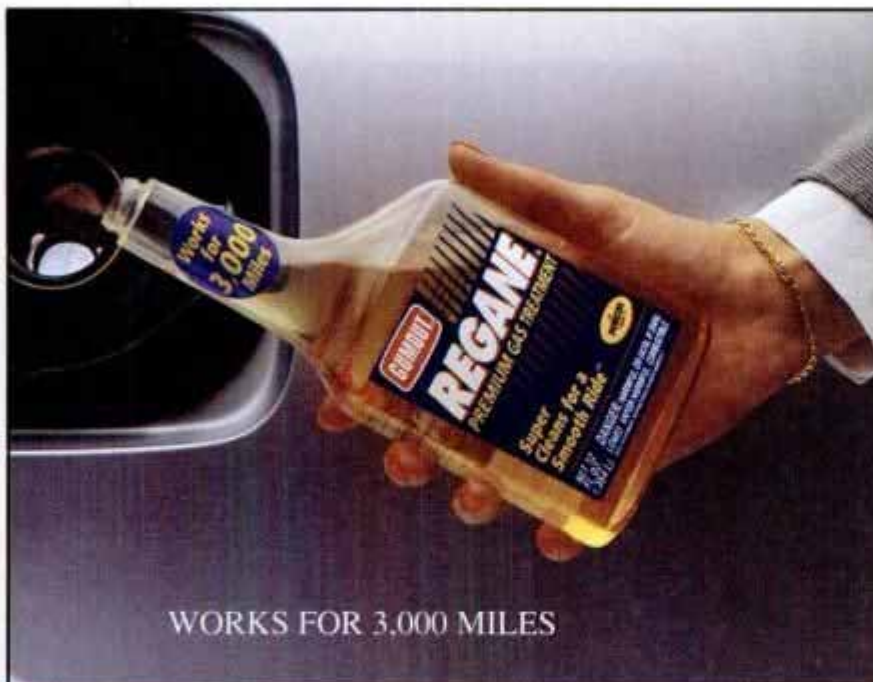
9. What was the name Ford gave to the 289 cu. in. V8 engine that was optional in the 1964-1/2 Mustang?

A) Cobra-Jet. B) Challenger. C) Tiger D) Boss 289.

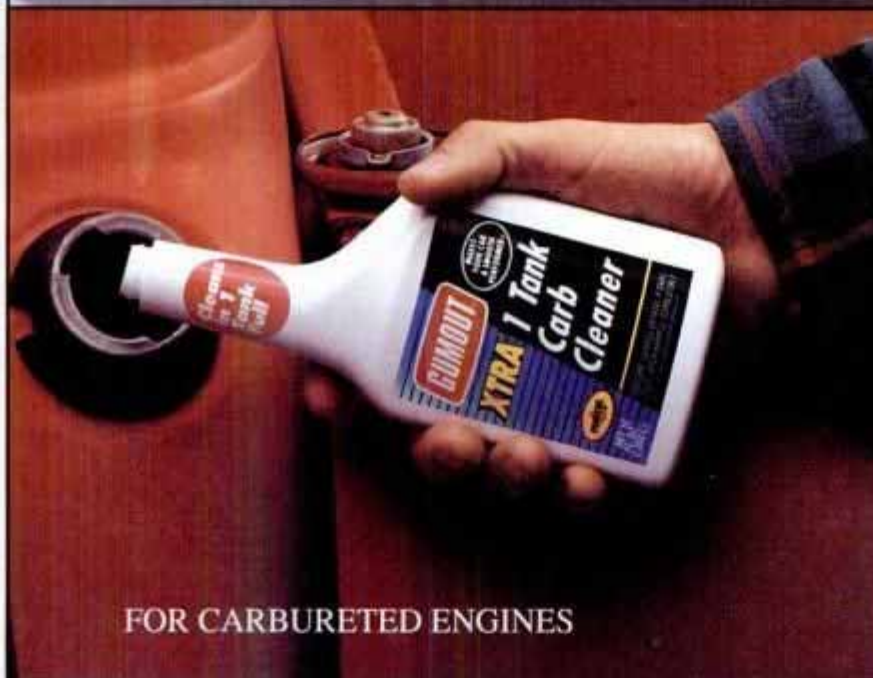
10. The highest price paid for a car at the Barrett-Jackson collector car auction was \$2 million. What car was it?

A) Ferrari. B) Mercedes-Benz 540K. C) Hispano Suiza. D) Duesenberg SJ.

ANSWERS
1. C 2. D 3. B 4. A 5. B 6. D 7. A 8. D 9. B 10. C.



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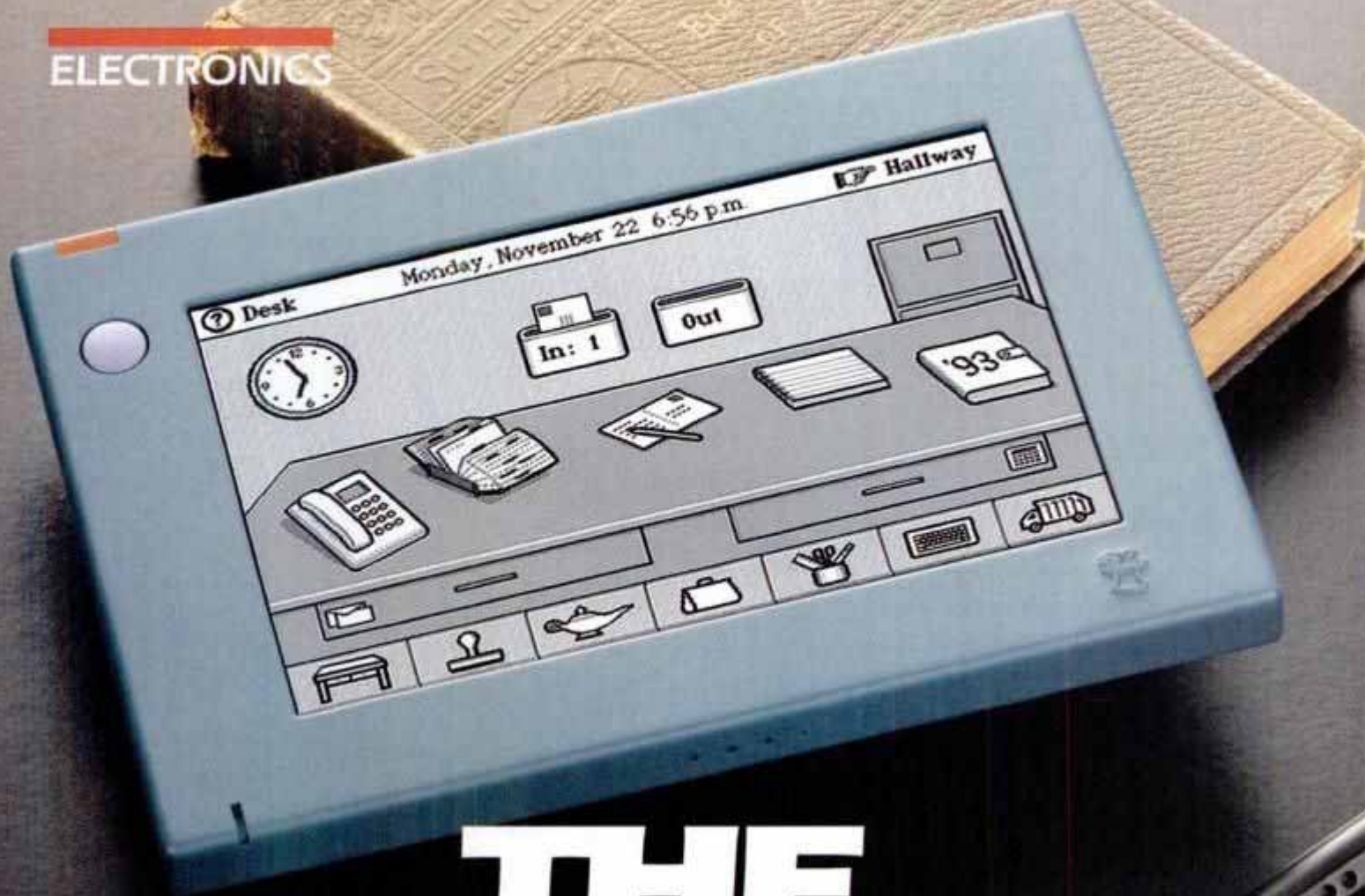
At their price...



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THE MAGIC BOX

● Imagine having your own personal agent—someone who would interact with the world on your behalf. Your agent would take care of all the little chores that are ultimately so time-consuming. The agent could go shopping for new clothes, buy food, get tickets for tonight's theater performance, make your travel arrangements for business the next day and even take care of your financial transactions. And, of course, the agent would get messages to friends and business associates with dispatch.

While all these jobs are being done, you haven't even broken into a sweat. At most, you might have to pick up an item or two, presuming it's something that can't be delivered or mailed.

If this sounds like a fantastic figure straight out of Aladdin's lamp, well, you're right—except in this case the magic is electronic. But instead of a lamp, what we have is a Magic Cap. Like Aladdin's lamp, there is more to this than meets the eye.

The Magic Cap, in fact, doesn't look like a hat at

Communicate with anyone, any time, anywhere with this wireless wonder.

BY FRANK VIZARD, Electronics Editor

communicator and it represents a new generation of products—one that makes portable communication easier than it was just a few months ago.

What's magical about the Magic Cap is the wealth of ideas under its lid. Inside the Magic Cap is your personal agent, waiting to do your bidding.

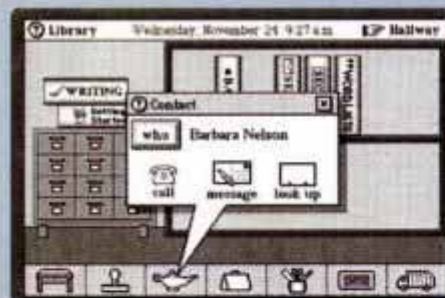
Like other electronic organizers and Newton-type personal digital assistants already on the market, the Magic Cap has a lot of data-organizing features. What's remarkable about Magic Cap, though, is the way you access information and communicate with the world.

Every Magic Cap function has its own graphic interface, but the three most novel and important are the Desk, Hallway and Downtown scenes.

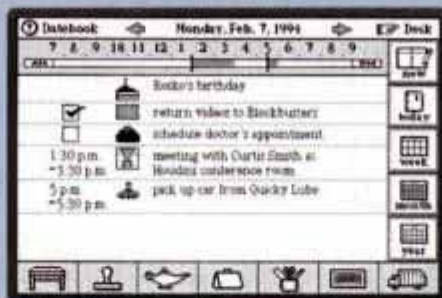
The Desk scene looks much like an office. There is a

all. It looks more like a scaled-down Etch-A-Sketch, a toy from decades ago that, in retrospect, may have been the model for today's tablet-size devices. Magic Cap, developed by General Magic Inc., is a book-size personal

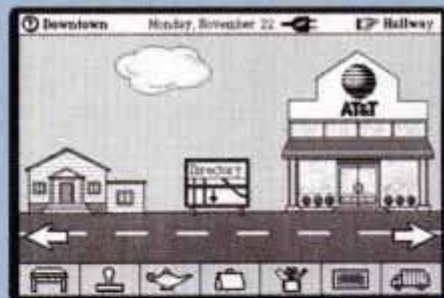
THE MAGIC BOX



CONTACT: A chat from the library.



DATEBOOK: Compile a to-do list.



DOWNTOWN: Visit service providers.



E-MAIL: Go on-line.



TELECARD: Send postcards.



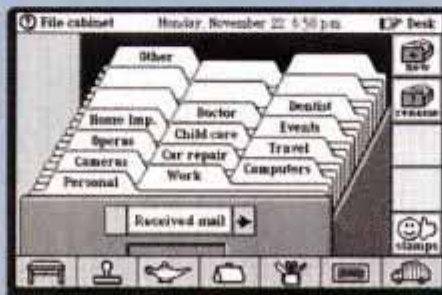
STATIONERY DRAWER: Stores forms.



WORLD CLOCK: Tell time anywhere.



STAMPS: For emphasis on messages.



FILE CABINET: Stores data folders.



GROCERY LIST: Organize food shopping.



Magic Cap may be incorporated into telephones.

to your personal taste. As in real life, things start to get really interesting when you head Downtown. Every service purchased or subscribed to appears as its own building on Main Street. To access the service, just tap the building and you're in. Now here's where your agent goes places.

Let's say you subscribe to the new electronic shopping service called Eshop.

file cabinet for storing folders of information, a phone, a name-card file, calendar, drawers for message forms, an inbox and an outbox for messages, and other familiar desktop features. Just tap an icon to access the function.

Magic Cap, by the way, handles messages like an experienced secretary. Thanks to a communications software program called *Telescript*, messages can be pre-screened, prioritized, filtered, filed or re-routed elsewhere, automatically.

Like an office, you can leave your Desk and go for a stroll down the Hallway. Here you'll pass a variety of rooms. You might walk past the Library, where reference material is stored like books on a shelf. Or you may enter the Game room to play with entertainment packages downloaded from independent service providers. The Hallway has a lot of rooms and these can be customized

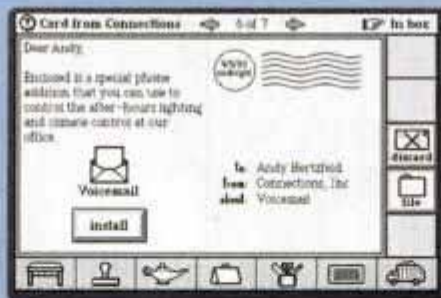
Rather than roaming endlessly through a cyberspace mall in search of a desired item, your electronic agent, using *Telescript* as a *lingua franca*, jumps onto the new Personalink host network developed by AT&T. *Telescript's* importance lies in its ability to be the common language spoken by incompatible computer networks. A *Telescript* agent, or information assistant, can cruise through any network, thereby making the idea of a national information superhighway practical.

Your agent, carrying identification codes that show it is working in your behalf, finds the item in question in one or more stores, compares prices, interacts with store agents and completes the transaction using your credit card.

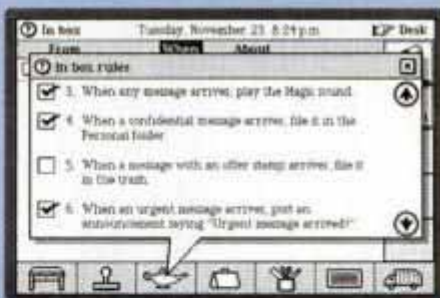
Of course, you can browse through a 3-dimensional store complete with aisles, working with an on-screen sales assistant and getting informa-



HALLWAY: Rooms with a data view.

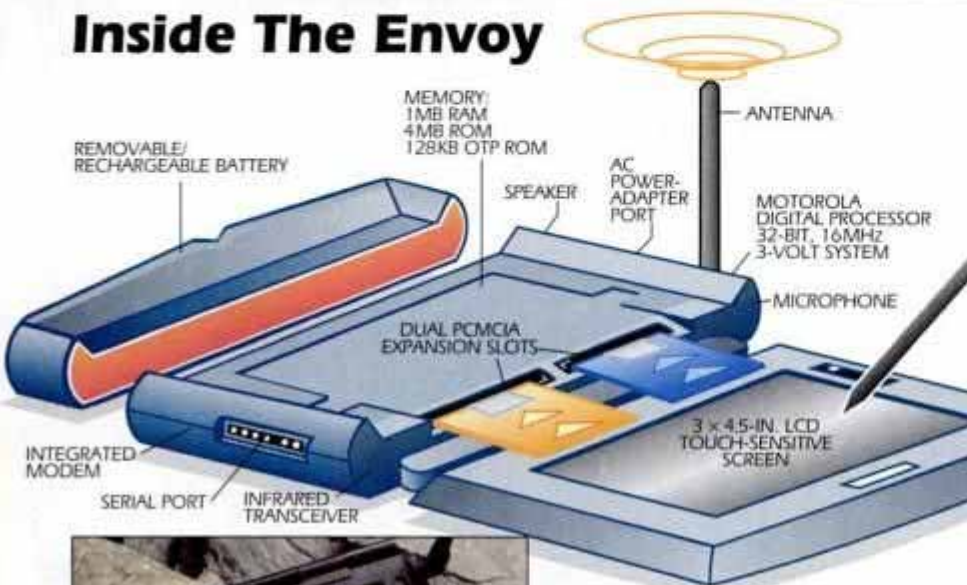


INBOX CLIMATE: Special instructions.



INBOX RULES: Setting priorities.

Inside The Envoy



Motorola's Envoy (left) is to be one of the first Magic Cap devices.

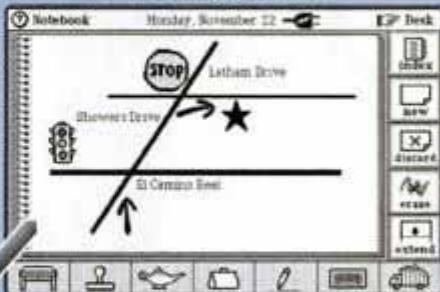
Corp., a San Mateo, California-based company that operates as a gateway between RAM Mobile Data and ARDIS radio frequency networks and wired networks. Magic Cap can also be linked directly to personal computers.

Magic Cap also comes equipped with PCMCIA slots for use with credit-card-size data packs designed for specific tasks, such as navigation. One of the first Magic Cap devices, the Envoy from Motorola, has two PCMCIA slots, in fact. The Envoy will be available this spring for about \$1500. Sony, Panasonic and other members of what's called the General Magic alliance are expected to have Magic Cap products of their own later this year. Magic Cap may even be included in other telecommunications products such as telephones. **PM**

tion on products as you see them.

Your agent can do more than just shop. Some of the services intended for Magic Cap include access to the stock market, airline flight information and a hotel/restaurant and entertainment guide.

The Personalink network also lets Magic Cap access on-line services such as America On-Line, Prodigy and the Internet. Communication is via a phone line or wireless services like that provided by RadioMail



MAP: Destination directions.



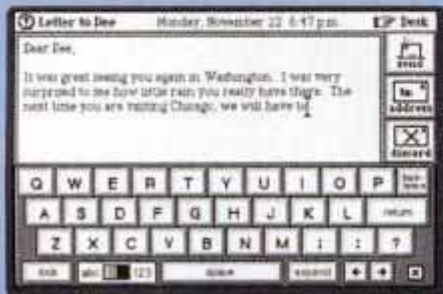
NAMECARD: Lists the particulars.



PERSONAL/BUSINESS: Fast replies.



PHONE DIALER: Speed dialing.



LETTER: Tap out your message.



MAGIC LAMP: Command control.



FAXING: Another message tool.

TECHNOLOGY

FLYING ON RAILS

New technology lets Batman—The Ride offer thrills never before possible on a roller coaster.

BY CLIFF GROMER, Contributing Editor

● Suddenly, the floor drops down from under your feet and you're hanging in your seat, seemingly in midair, held in place by a ratcheting over-the-shoulder padded restraint harness. The car begins its long climb 105 ft. into the sky with the familiar roller coaster clankety-clank. You start to sweat. There's no floor! Your legs dangle in thin air supported solely by their knee joints.

The chairlift-style seat reminds you of your ride up

Whiteface Mountain five years ago, when you went skiing and broke your leg. You look down past your shoes at the peoplescape below. A mass of humanity scurries about, bent on subjecting their bodies to unnatural acts offered by the various thrill machines peppered about the Six Flags Great Adventure amusement park, which is shrinking as you climb higher.

You sense the approaching apex and your stomach



Inverted coaster can do maneuvers like the zero-g roll where passengers rotate around their own centers of gravity for a weightless sensation.

tightens hard like it always does before the big drop. The track should be falling away any second now. You push back into the seat, hoping to avoid certain doom by forcing your body into the very molecular structure of the car itself. You look ahead for that ominous curve where the track bed rises to its crest, rolls over and disappears. But there is no track bed rising up in front of you. There's just... nothing. Then, Holy Moly! The bottom drops out

and you're propelled on a journey unlike any other on the face of the planet. Welcome to Batman—The Ride, arguably the high roller of roller coasters.

Designing a roller coaster to start the adrenalin pumping of even the most jaded coaster fan requires something radical. Drops, loop-de-loops and the like are rather ho-hum these days. So when the Swiss coaster builder firm of Bolliger and Mabillard was contacted by

FLYING ON RAILS

the Six Flags Great Adventure people in Jackson, New Jersey, for something really different, they started with a clean sheet of paper. The coaster-meister has to combine all the drops, banks, loops, spins and other goodies in his bag of tricks into a flowing rhythm or pace, with smooth transitions between the thrill sections. Safety, of course, is a necessary ingredient, as it's recommended to have the same number of riders return as started.

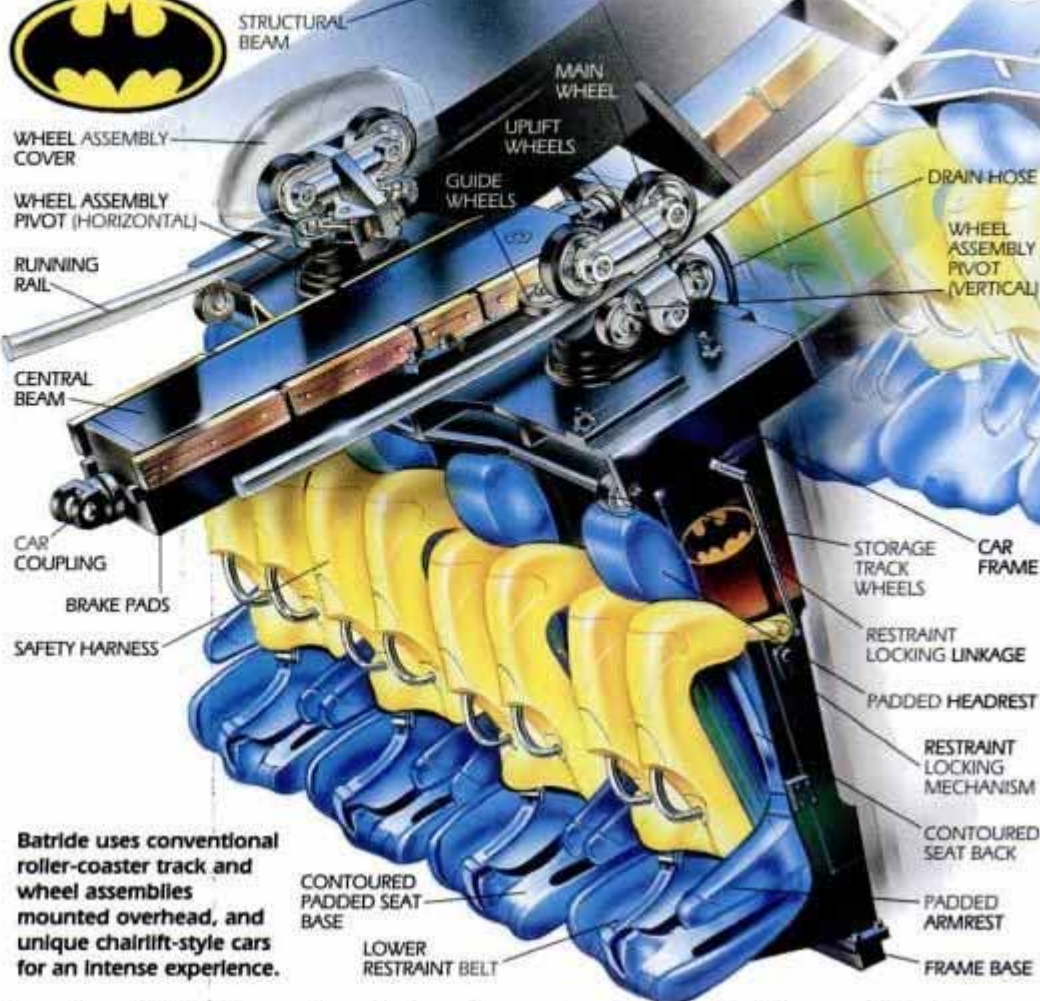
Contrary to what your senses may tell you, a well-designed coaster ride is smooth and will not shake you around inside the car. The designer knows that visual cues can be deceiving, and he uses them to good advantage. Disney World's Space Mountain coaster, for example, runs in a dark environment with flashing lights to give the impression of great speed. That coaster, in fact, maxes out at only 28 mph.

Also, contrary to what your body is telling you, coaster rides are designed to exert a positive g-force on your body at all times—yes, even those moments when you feel that some giant hand wants to pluck you from your seat and hurl you across half the state, the (positive-g) force is with you, keeping you safely planted. What your body feels as weightlessness is actually the rapid transition from a relatively strong g-load, such as 4 g's, to something like a 0.2-g positive load. Even if you rode the Batcoaster with no restraint system at all, the positive g's would keep you from being ejected.

Unlike conventional roller coasters that are supported from the underside and ride the rails much like a train, the Batride hangs (bat-style) suspended from overhead rails. Supporting the track from the topside involves using a lot of cantilever structures to handle loads that are in tension rather than compression. The track's main structural element is a rectangular beam made of individual panels, welded into the main beam and reinforced with steel diaphragms every meter or so where the track is attached by supports.

Other suspended coasters use cars that connect to overhead wheel assemblies and track via a bar or beam. But the Batride is innovative, riding the overhead rails on wheels attached directly to the car's roof. The Bat-

How It Works



Batride uses conventional roller-coaster track and wheel assemblies mounted overhead, and unique chairlift-style cars for an intense experience.

ride's other unique feature is a car with no floor or sides, giving the Batrider a new sense of freedom in being able to swing his arms and legs, and the Batcrew less to clean up in case of a stomach mishap.

Batride rates high on the thrill-o-meter scale with its unique maneuvers, pace and visual perspective. Conventional coasters run loops on the inside of the circle, while Batride's inverted track design blasts you around on the outside of the loop. You can see the sky by looking straight up—past your feet. With no visual reference to the track or the car structure, it's the closest thing to flying.

The rigid and direct attachment of car to track brings the center of gravity of the rider—known as the heart line (as opposed to heart-attack line)—closer to the track. To maintain balanced dynamic forces, coaster rides are designed around this line. Every portion of track is calculated and laid out in relation to the heart line. It's easier to control the dynamic forces and design more aggressive maneuvers when the passenger's center of gravity is closer to the track. The direct car-to-track attachment also offers more control over unwanted car movements that could make an other-

wise smooth ride uncomfortable.

The car is plummeting toward earth now, at what feels like 200 mph (actually, 50 mph), and you jerk up your feet as high as they'll go and brace for the impact that never comes. Instead, you're swept up into an outside loop. Then comes the zero-g roll—a parabolic curve that also rotates you 360°. It's sort of like roasting a chicken on a rotisserie while the oven itself is spinning in a circle. You feel weightless for about 3 seconds while hitting every point on the compass—in three dimensions.

Another loop, and now you're skimming over the ground at high speed, the g-forces pressing back your lips and cheeks. Some transitional banks, a flat spin, and now you're flying over Gotham City. Gee, maybe Batman can come to the rescue and get you off this thing. Another corkscrew, and you're upside-down for the fifth time in all of 2 minutes. Good thing you didn't eat lunch.

And then it's over. What, ride again? Sure, maybe later. Right now, where are the bumper cars? **PM**

You can experience the Batride at Six Flags Great Adventure in Jackson, New Jersey; Six Flags Magic Mountain in Valencia, California; and Six Flags Great America in Gurnee, Illinois.



DODGE VIPER GTS COU

24 1/2

The hot midyear introductions—domestic and imported.



CHEVROLET MONTE CARLO



CHEVROLET LUMINA



● Welcome to the leading edge of the 21st century. You might as well get used to everything in life coming at you in continually shrinking and increasingly intense segments. Today's cut-and-run staccato television commercials and 30-second microwave meals are merely harbingers of what's coming. The blur of modern existence is accelerating right through warp speed, and what we used to consider normal, digestible life segments are being compressed into shorter pieces of time as we go.

This means, among other things, that the auto industry has essentially evolved into a 6-month model year.

The once-hallowed ritual of discovering each year's new models is rapidly becoming as ancient a memory as the vacuum tube and the rotary telephone. And while traditionalists may mourn the passing of this annual rite of autumn, the rest of us should rejoice in the unceasing cornucopia of fresh personal transportation.

As good as the multitude of new car and truck offerings now materializing any time of the year is the magnitude of their quality. It may be a fast ride

on the '90s new-car highway, but it's a sweet one. Consider this roundup of midyear models as your seatbelt.

Fantasy to fulfillment

Loudly strutting at the brazen—and distant—end of the new-model spectrum, there's the Dodge Viper GTS



BUICK RIVIERA

gins with an arousingly svelte, muscular shape. Truth is, the new Riv projects more of a dynamic image than many people may associate with a car wearing the Buick name. The Riviera's beauty goes beneath its skin. In fact, the coupe's body structure is as stiff as most anything on the road—a fact that helps the independent suspension make full use of the power from either of the Riv's two 3.8-liter V6 engines. The naturally aspirated version is good for

Coupe. The long-rumored hardtop version of Dodge's 2-seat retrorocket will be reality, albeit in limited volume. Since all Viper production for 1994 is sold out and dealers are already taking orders for 1995, the GTS Coupe won't appear until early 1996. This most awesome of Dodges boasts a 180-mph top speed—despite its power windows and dual airbags. Other than the steel top, a different chassis, suspension, exhaust and wheels help differentiate this grizzly bear of a coupe from its roadster brethren.

More readily within grasp of the masses are the 1995 Chevrolet Lumina and Monte Carlo. In fact, the masses have been waiting for these midsize cars to arrive and rejuvenate GM's cornerstone division. As of June, the wait will be over. Built off the same platform and sharing vital dimensions, chassis and drivetrains, the cars differ by some appointments and number of doors. The Lumina designation stays with the new sedan, while the coupe revives the Monte Carlo name. Together, the two new models should help strengthen Chevrolet's



CHRYSLER CIRRUS



DODGE STRATUS



PONTIAC 25TH ANNIVERSARY TRANS AM

205 horsepower. The optional supercharged variant adds 20 hp and boosts torque by 45 ft.-lb. from 230 to 275.

If the Riviera embodies the essence of the mature luxury coupe for GM, the company's definition of controlled, yet raw, youthful exuberance is contained behind the Camaro and Firebird badges. For 1994½, there's a celebration of that unique driving experience in the form of the Pontiac 25th Anniversary Trans Am.

aching backbone. Base power is from a 160-hp 3.1-liter V6. The more serious can equip the Lumina LS with an optional 24-valve dohc 210-hp 3.4-liter V6, which is the only engine in the Monte Carlo Z34. All versions come with a 4-speed overdrive automatic, dual airbags, air conditioning, anti-lock brakes and power door locks.

While Chevrolet was content to let the Monte Carlo name hibernate since 1988, Buick has brought back the Riviera after only a one-year hiatus. As it should, the '95 Riviera defines Buick's vision of a cutting-edge personal luxury coupe. That vision be-



DODGE/PLYMOUTH NEON

The limited-run (2000 copies only) coupe starts life as a

Trans Am GT (5.7-liter V8, 6-speed manual and 3.42:1 rear axle are standard) and adds several exclusive touches, including a blue stripe up the middle of its white exterior. The original '69 Trans Am had twin blue racing stripes, bumper to bumper.

Rather than resurrecting or commemorating past names, Chrysler has opted for brand-new ones for its slew of brand-new cars. The newest of the new are the '95 Dodge Stratus and Chrysler Cirrus sedans. These two 5-passenger front-drive sedans are aimed mercilessly at the heart of the imports' greatest success—the compact sedan market. You spell that market segment Honda Accord and Toyota Camry. The elegantly swoopy Stratus and Cirrus continue the cab-forward design trend Chrysler started with its successful LH sedans. Make no mistake, though, these are far from being ½-scale LH cars. They look like nothing else on the road, including each other. Looks aside, they do share chassis and drivetrains: a 16-valve sohc 2.0-liter Four with a 5-speed manual and a 16-valve dohc 2.4-liter Four or a 24-valve sohc V6, both with a 4-speed automatic. Standard equipment includes dual airbags



GMC JIMMY 4-DOOR

Mercedes-Benz C-Class, Lexus GS 300 and Infiniti J30. And this elite group would do well to take the sleek Olds sedan seriously. The Aurora comes armed with more interior space than any of them, as well as traction control, ABS, self-leveling suspension and dual airbags. By the way, did we mention the V8? Oh yes, the Aurora is pulled around by 250-hp worth of 32-valve dohc 4.0-liter V8.

While the passenger car divisions of GM have been busy, its truck division has quietly given separate and



GMC JIMMY 2-DOOR

a 4.3-liter V6. But they come in larger and distinctly different wrappers.

Busy hands across the sea

Nor have the imports been sitting in Neutral while waiting to see what fiendishness the domestic makers have up their sleeves. For



OLDSMOBILE AURORA

and ABS (except on the base Stratus).

Chrysler's older news is the arrival of the long-awaited Dodge/Plymouth Neon. The subcompact with one name—regardless of which dealership you see it in—enters a market crowded with more than a dozen direct competitors, most of them Asian imports. With aggressive pricing—\$8795 base MSRP—styling, spacious interiors and trunk, performance and quality all part of the package, the Neon may well become the benchmark vehicle in its segment before the end of this model half-year.

Like the Neon, the Oldsmobile Aurora has been basking in so much advance publicity that many may think it's been around for years. The truth is, you should just now finally find this sophisticated front-drive sedan at your Olds dealer. Created to elevate both Olds and GM to the next tier, the Aurora takes dead aim at the likes of the

equally modern new faces to its compact sport/utility. The 2-door and 4-door versions of the 1995 GMC Jimmy ride on the same wheelbases as their predecessors and are still powered by

one, the major-domo of the foreign car-makers has two typically competent new models. The Toyota Avalon, in fact, ventures where no Japanese import has gone before—into 6-passenger

Ford Mustang Cobra Indy 500 Pace Car



The car leading the field around the Brickyard this year will be an essentially production Ford Mustang Cobra convertible. The Cobra motor is a 5.0-liter V8 with GT-40 cylinder heads, a special cam, intake manifold and exhaust headers. For those who must have one, Ford is building 1000 replicas, available through Ford SVT dealers.

'94 1/2



**MITSUBISHI 3000GT
SPYDER VR-4**

sedan territory, one of the sacred markets of the domestics. (See *New Cars*, page 104, March '94, for details.) Aimed at a smaller market segment, the giant from Toyota City is also dialing up the heat in the fun-to-drive-in-the-sun category with its Celica GT Convertible. Based on the recently introduced 1994 Celica GT Coupe, the ragtop version offers



automatically open, the trunklid opens to swallow the roof and even the rear quarter windows disappear into the top's C-pillars. Naturally, the turbocharged awd roadster's chassis

is reinforced to compensate for the lack of a fixed top.

A novel engineering feat of a different bent can be found under the hood of some versions of the '95 Mazda Millenia. This front-drive luxury sedan is the only tangible proof that Mazda had plans to open its own second channel of luxury models, following the Acura, Infiniti and Lexus plan. Mazda's new division was to be called Amati, but the project died a cash-starved death in a down market. The car that is the Mazda Millenia was to be one of the Amati models. Regardless of what it says on the decklid, this is one slick sedan. Equipped with all the requisites—dual airbags, ABS, 4-speed automatic, automatic climate control, available leather and a sound system that is the only thing audible inside the passenger compartment—the Millenia can be had with something no other car has to offer. The Millenia S offers a 24-valve dohc 2.3-liter Miller Cycle V6. The Miller Cycle is your basic 4-cycle engine with a twist. The intake valve does not close before the piston begins to rise in the cylinder. A Lysholm supercharger, operating at up to two atmospheres, keeps the intake charge from escaping out of the valve before it does close. The result is 210 horsepower, 210 ft.-lb. of torque with a broad curve and fuel economy of 20 city/28 high-



TOYOTA AVALON



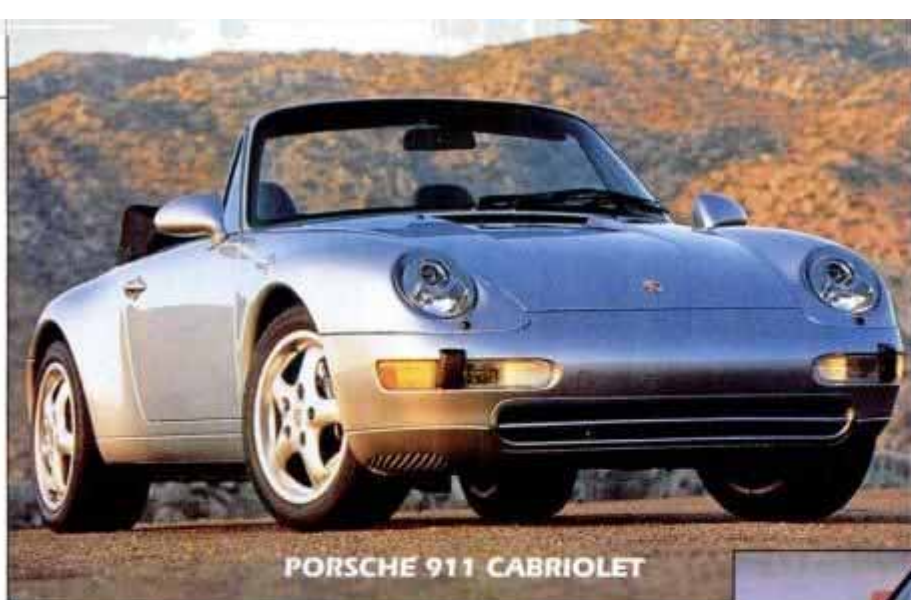
**TOYOTA
CELICA GT
CONVERTIBLE**

everything that its metal-top brother has except the fixed roof.

While Toyota has swapped the steel roof for a cloth one for the Celica, one of its competitors has chosen a different route. The 1995 Mitsubishi 3000GT Spyder VR-4 offers a fully automatic retractable hardtop. Engineered for Mitsubishi by Michigan-based ASC, the folding-top mechanism relies on four hydraulic cylinders, 12 links and an assortment of relays and switches all operated by one button. To expedite the opening and closing, the car's side windows



MAZDA MILLENIA S



PORSCHE 911 CABRIOLET

way. Non-Miller Cycle Millenias come with Mazda's 170-hp 2.5-liter V6.

Of course when it comes to getting power from six cylinders, few automakers approach the results obtained by that little old family-owned business in Zuffenhausen. Found in the back of the '95 Porsche 911 Cabriolet is the same naturally aspirated, horizontally opposed 270-hp Six found in the 911 Carrera Coupe (see *New Cars*, page 89, Jan. '94). The open-air Cabriolet also shares the Coupe's upper/lower control arm rear suspension. Performance and handling are at Porsche's level of excellence and even incrementally better than the previous 911 series, which is still embodied in the awd Carrera 4, Speedster and

rollbar, ABS, power windows and a new 115-hp sohc 2.0-liter Four. More near the practicality zone is the 1995 Mercedes-Benz E300 Diesel. This sedan is like the others in the Mercedes E-Class, except that it is powered by the country's only 50-state legal and squeaky-clean diesel engine. The engine is a 24-valve dohc naturally aspirated 3.0-liter Six that cranks out 134 hp and 155 ft.-lb.

One nameplate that's brand-new here is Kia, a Korean company.



VOLKSWAGEN CABRIO

Dodge Caravan-fighter (see *New Cars*, page 92, Feb. '94).

One model that's quietly sliding into the midyear market is the Subaru



FORD WINDSTAR

Impreza Coupe. Unlike its sedan and station-wagon namesakes, current plans for the Impreza Coupe only call for all-wheel drive.

Other midyear news includes the '95 Hyundai Sonata fwd sedan and the Honda Passport. The Sonata offers ABS, a V6 and enough interior room and luxury equipment to fool you into thinking it costs \$10,000 more than its low-teens price (see *New Cars*, page 93, Feb. '94). The Passport is Honda's version of the Isuzu Rodeo (see *New Cars*, page 105, March '94). **PM**



KIA SPORTAGE

Turbo. In a surprise move, prices of both 1995 models are nearly \$6000 less than the models they replace, indicative of Porsche's desire to get back into the U.S. market.

Porsche is not the only German automaker looking to reestablish itself in this market. At the high-end of the meter, there's the new Volkswagen Cabrio. Like every VW ragtop before it, the '95 Cabrio is hand-built at Karmann Coachworks. Larger than the previous Cabriolet, the new model comes with dual airbags, an integral

After introducing the Sephia sedan, it is entering the sport/utility market with the entry-level Kia Sportage.

While the Kia name is new

SUBARU IMPREZA COUPE



LETTER TO A BEEPER

New paging technology lets you send a lengthy message—or get one—via satellite.

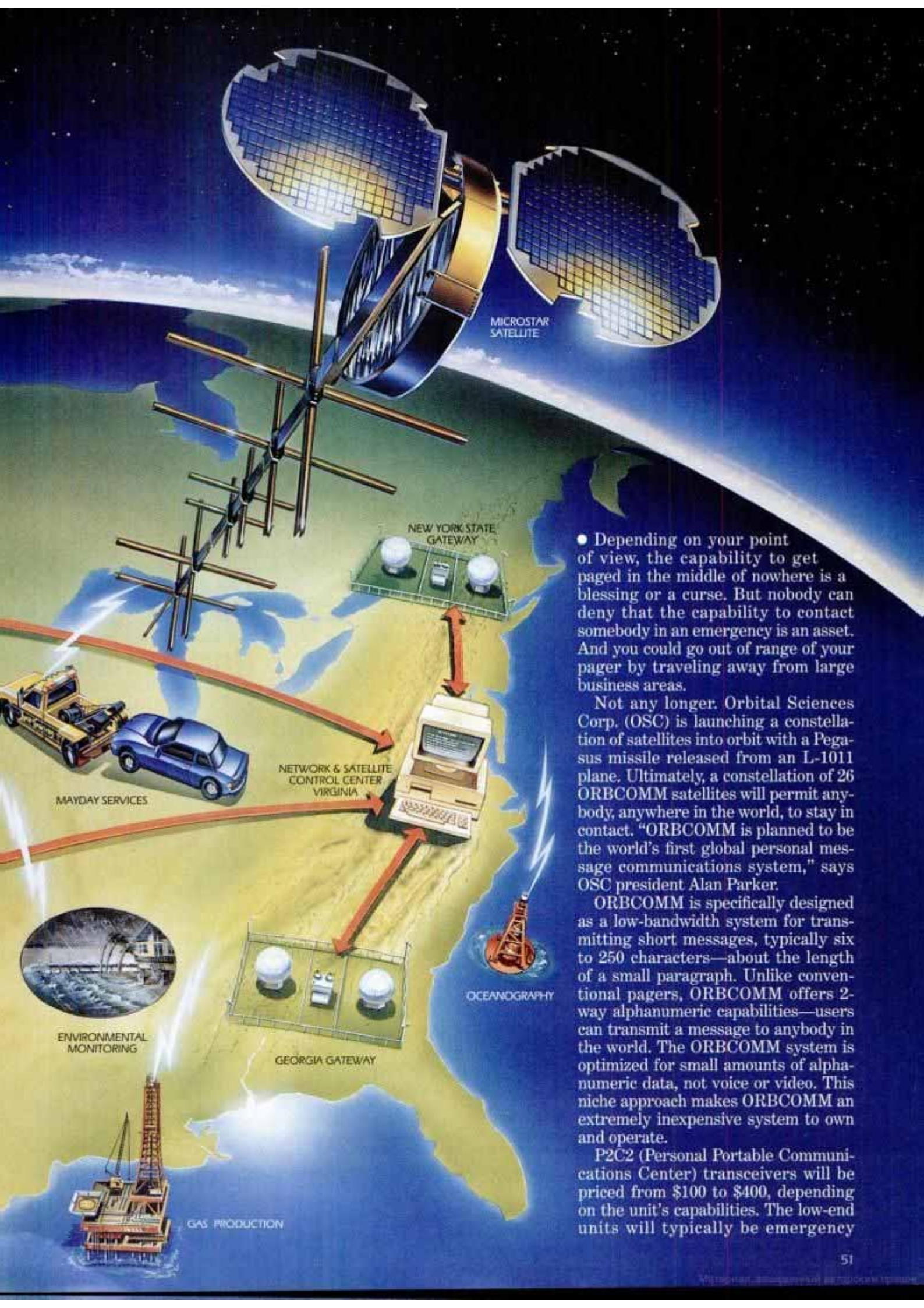
BY PHILIP CHIEN

PM Illustration by Paul DiMare



ORBCOMM Communications System

An array of 26 satellites will provide paging and monitoring services nationwide. Four gateways help direct the flow of messages to the intended recipients and work as a link to other communication networks.



● Depending on your point of view, the capability to get paged in the middle of nowhere is a blessing or a curse. But nobody can deny that the capability to contact somebody in an emergency is an asset. And you could go out of range of your pager by traveling away from large business areas.

Not any longer. Orbital Sciences Corp. (OSC) is launching a constellation of satellites into orbit with a Pegasus missile released from an L-1011 plane. Ultimately, a constellation of 26 ORBCOMM satellites will permit anybody, anywhere in the world, to stay in contact. "ORBCOMM is planned to be the world's first global personal message communications system," says OSC president Alan Parker.

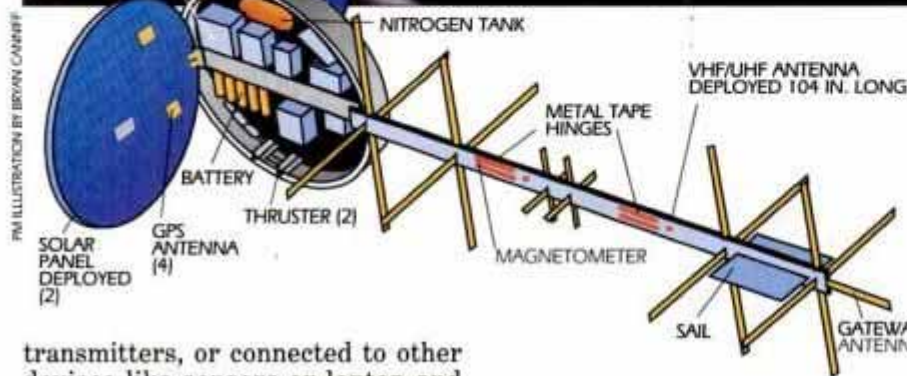
ORBCOMM is specifically designed as a low-bandwidth system for transmitting short messages, typically six to 250 characters—about the length of a small paragraph. Unlike conventional pagers, ORBCOMM offers 2-way alphanumeric capabilities—users can transmit a message to anybody in the world. The ORBCOMM system is optimized for small amounts of alphanumeric data, not voice or video. This niche approach makes ORBCOMM an extremely inexpensive system to own and operate.

P2C2 (Personal Portable Communications Center) transceivers will be priced from \$100 to \$400, depending on the unit's capabilities. The low-end units will typically be emergency

LETTER TO A BEEPER



ORBCOMM SATELLITE



transmitters, or connected to other devices like sensors or laptop and palmtop computers. The high-end units will include an alphanumeric keyboard and display.

Existing alphanumeric satellite transceivers with similar worldwide capabilities cost thousands of dollars and fill a small suitcase. In comparison, ORBCOMM transceivers will be about the size of a handheld radio and weigh about 12 ounces.

Messages sent on the ORBCOMM system will cost about the same as a postcard. When an ORBCOMM unit wants to send a message, it's transmitted from the user to one of ORBCOMM's 26 satellites, whichever one happens to be above the horizon. The satellite transmits the message to the nearest gateway, which is a large automated switching center. Four



The ORBCOMM paging satellite (left) relays a signal to one of four strategically placed gateways (above) that act as switching centers.

gateways are planned for the United States, located in Georgia, New York, Washington and Arizona. If the satellite is not within view of a gateway, it stores the message until it passes over one. The four gateways are strategically placed. Once the full constellation of satellites is operational, gaps where satellites are not within view of a gateway will be limited to fairly infrequent, short periods for continental U.S. users.

The gateway determines where the message should be sent. If an ORBCOMM message is intended for someone in an office, it can be transmitted by electronic mail, a fax or a phone call—even if the receiving party isn't an ORBCOMM subscriber. If the message is intended for another ORBCOMM receiver, the message is transmitted back up to a satellite and then to the user's receiver. If you

One-Way Notes

● Two-way paging may be the future, but in the short term you can now send messages one way via pagers.

New pagers from companies like Motorola and AT&T now have what's called alphanumeric capability. This means the pager can receive letters as well as numerals.

For instance, Motorola's Memo Express pager, listing for \$219, receives and displays messages up to 120 characters in length. The pocketable Memo Express is lightweight at 2.4 ounces and is available in a variety of fashionable colors.

The comparably priced AT&T 3550 model, meanwhile, ups the ante by offering the ability to receive electronic-mail messages.

Alphanumeric messages are sent to a pager in a variety of ways. A dispatch service can relay spoken messages from a caller. Or you can type the message yourself using a computer and modem it with software supplied by the service provider for a nominal fee. There are also stand-alone keyboards that can plug into a phone line.



Alphanumeric pagers can also receive stock quotes, news updates, weather reports and other types of text information from service providers. These new alphanumeric services are available thanks to new high-speed transmission technologies like the Flex system from Motorola. Fees for alphanumeric pagers run from \$55 to \$80 per month for nationwide service. —Frank Vizard

want to transmit a message to an ORBCOMM user, you can phone in a message to an operator or E-mail the message through a computer network.

Under worst-case scenarios—an ORBCOMM user in an isolated area without a gateway nearby—it could take a couple of hours for the message to get through. For most users, though, it will take just a couple of seconds to transmit a message.

The first two ORBCOMM satellites will be launched together into polar orbits. They'll be followed by three more launches, each carrying eight satellites, to cover mid-latitude regions. When the constellation is complete in 1995, the two polar satellites will provide intermittent service to very-high-latitude users in the sparsely populated high-latitude regions. The other 24 satellites, arranged in three planes of eight satellites per plane, will provide near-continuous coverage to users in mid- to low-latitude regions where more than 90% of the world's population lives.

The ORBCOMM satellite is the brainchild of satellite designer Jan King. Each satellite is just 6.5 in. high and 41 in. in diameter and weighs 39.5 kg (87 pounds) at launch. The satellites are stacked like a roll of Life Savers mints within the Pegasus' 48-in.-dia. fairing. In orbit, the satellite opens to expose two disc-shaped solar panels and a 104-in.-long antenna boom. The state-of-the-art design includes a Global Positioning Satellite receiver, the world's thinnest rigid solar arrays and ultrasmall solar array drive motors, earth sensors and magnetometers. Each satellite has seven antennas and 17 computers.

The satellites use VHF frequencies and have sophisticated circuits to permit them to share those frequencies with other VHF users, such as police units and businesses, without interference. Each satellite can transmit up to 50,000 messages per hour. While an individual satellite is fairly small, the entire constellation is one of the largest, most sophisticated satellite constellations ever designed. The satellites have a design life of four to six years, and second-generation satellites are already under development.

For the 48 lower states, coverage will be available at least 95% of the time with blackouts limited to very short periods. ORBCOMM managers are evaluating adding eight satellites to fill in most of those gaps. Alaska will be serviced primarily by the two polar satellites. Messages to and from Hawaii would be stored on satellites

until they pass over a gateway.

The ORBCOMM system not only gets a message to you but it can also tell you where you are. Since each ORBCOMM satellite has a GPS receiver, it can determine its location in space with a high degree of accuracy. ORBCOMM transceivers can determine their approximate locations by listening to the Doppler shift of the ORBCOMM signals—how the signal's frequency changes as the satellite passes overhead. ORBCOMM receivers cannot determine their locations as accurately as GPS receivers, but over time they can triangulate their location to an accuracy of approximately 100 meters (330 ft.).

ORBCOMM's applications are numerous. OSC forecasts a market for 2.5 million units by the year 2000, plus a potentially lucrative market for units as optional accessories in automobiles. The value of the potential market, according to OSC's Parker, is equivalent to the current income of alphanumeric paging systems.

Currently, the company forecasts four primary categories for ORBCOMM applications: SecurNet—emergency alerts, MapNet—position determination, DataNet—remote data collection, and VitalNet—personal communications.

ORBCOMM is confident that the SecurNet

aspect will make the existing COPAS/SARASAT satellite emergency transceivers obsolete. ORBCOMM has many more satellites, ensuring almost instant response. It can determine your location more accurately, and the hardware is less expensive than existing ELTs (Emergency Locating Transmitters). In addition, ORBCOMM is a 2-way system, so you can send back a message specifying what kind of help is required.

Mapping applications for ORBCOMM include tracking high-value items, such as endangered animals, hazardous materials or high-value shipments. Just attach an ORBCOMM transmitter to the object that has to be tracked and it will transmit its approximate location directly to your computer. Environmentalists can use this capability to track rare animals, governments can use it to track movements of nuclear materials, and commercial firms can track important shipments. MapNet can also be used for vehicle fleet management. For example, a taxi dispatcher can automatically determine the location of each taxi in an entire fleet, and each taxi's status.

One of the most esoteric applications is stolen-property recovery. Imagine if your car, equipped with an ORBCOMM unit, is stolen. You can transmit a special code to the car's receiver—hidden within the car and invisible to the thief. The ORBCOMM unit then transmits back its location, to within a couple hundred yards.

Remote data-collection applications are more specialized, probably limited to environmentalists and large businesses. ORBCOMM units can be

(Please turn to page 124)



Handheld transceivers like this one allow you to transmit short messages via satellite virtually anywhere. Depending on the features, the device will cost between \$100 and \$400.

CALL FOR NOMINATIONS

Popular Mechanics

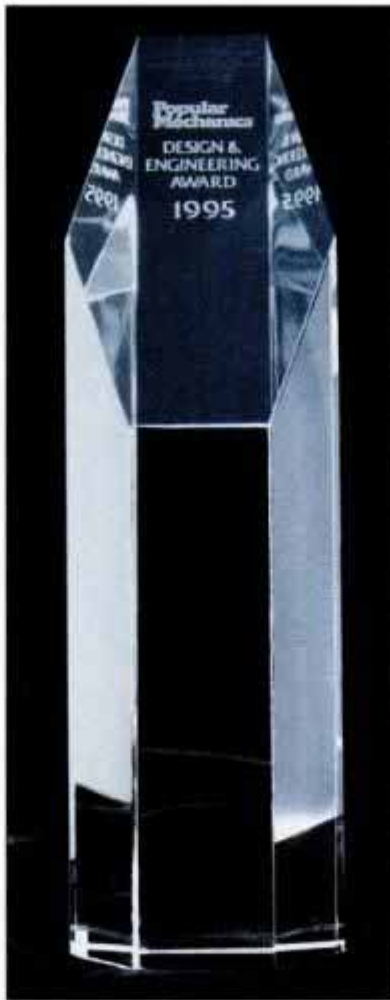
DESIGN & ENGINEERING AWARDS 1995

• It's time again to begin the nomination process for our annual Design & Engineering Awards. As you know, each year we honor innovation, invention and just plain good ideas in each of the areas we cover editorially—automotive, home improvement, shop tools, boating, outdoors, electronics, telecommunications, photography, science and technology.

The winners will be announced in our January 1995 issue.

If you look back at this year's list of winners, you'll get a very good idea of the wide range of innovations we recognized. Everything from a staple gun to a stealth ship, from a new sports car that can go 160 mph to a mountain bike that might get up to 30 mph on a good downhill run.

There is every indication that the 1995 award winners will be just as diverse a group, and just as interesting in their cutting-edge creativity.



Anyone can make a nomination for a POPULAR MECHANICS Design & Engineering Award—readers, manufacturers, distributors, public relations people, anyone. The rules are very minimal. There are no categories or set number of awards. We'll give as many as we think are appropriate. If you want to make a nomination, send a good, clear photo or illustration of the product, project, or whatever it is you are nominating. Include a complete description with all the details of what it is, what it does, why it's innovative and why you think it deserves an award.

The judges are our editors and their decisions are final. Deadline for nominees is Aug. 26, 1994. Mail entries to Design & Engineering

Awards, POPULAR MECHANICS, 224 W. 57th St., New York, NY 10019. Good luck.

Joe Oldham
Editor-in-Chief

So Many Awards. So Little Time.

FOUR WHEELER MAGAZINE
"Pickup Truck of the Year"

POPULAR MECHANICS
"1994 Design and Engineering
Award"

KIPLINGER'S PERSONAL FINANCE MAGAZINE
"Best New Pickup"

HOME MECHANIX
"Versatile Vehicle Award"

CONSUMERS DIGEST
"A Best Buy"

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Last Great Engineering Challenge

ALASKA-SIBERIA BRIDGE

As the Soviet Union fell, so did the final obstacle to perhaps the ultimate civil-engineering project.

BY GREGORY T. POPE, Contributing Editor
PM Illustration by Alan Gutierrez

• Big bridges are back. After years of focusing innovation on the short span, civil engineers again have far-reaching ideas in the blueprints. By the year 2000, the title of world's longest single span will have jumped from England's Humber Estuary to Scandinavia's Great Belt to Japan's Akashi Kaikyo Bridge, with its 6528-ft. main crossing. And even longer bridges loom on the horizon. Sicily to Italy? Spain to Africa? Today, neither seems too much of a stretch.

But to one maverick engineer, a final gap still beckons. It's the gap between East and West, between two worlds closer now than they have been in decades. It's a gap across time as well as space, because it spans the international date line. By geographic standards it's trivial—about 55 miles—but by engineering standards it's an ocean to cross.



PM MAP BY GRAPHIC CHART & MAP CO.

It's the Bering Strait. T.Y. Lin wants to bridge it.


Preposterous? Not so fast. Lin is no crackpot. Yes, he's daring, but he's also a decorated engineer, with the President's National Medal of Science among many honors under his belt. He's written top texts on concrete construction, designed dozens of groundbreaking structures, taught at the University of California at Berkeley for 30 years—in short, enjoyed a glorious 6-decade career in civil engineering.

But the Alaska-Siberia crossing—which Lin has dubbed the Intercontinental Peace Bridge—has been

this man's dream for 25 years. In 1969, he founded a charitable organization to finance feasibility studies. In 1986, he nonplused Ronald Reagan by handing him Peace Bridge construction plans after the president had spoken fervently on the Strategic Defense Initiative. And in 1994, as Russia reaches out to the West, the Peace Bridge has returned in a new incarnation.

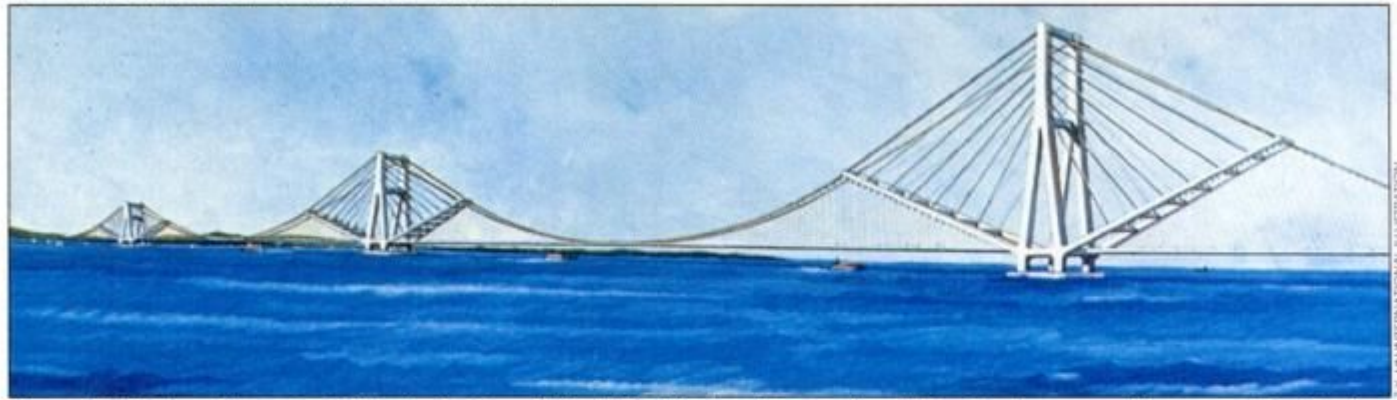
Only this time it's no longer just about peace. It's about oil.

That's because the attention of petroleum companies is shifting toward Krasnoyarsk, Irkutsk, Yakut—



Intercontinental Peace Bridge would carry road and rail traffic along with oil and gas pipelines. Curved piers would deflect blows from shifting ice, while concrete would cover everything, including cables. The result: a super-rigid, weather-resistant structure.

ALASKA-SIBERIA BRIDGE



Lin and Philip Chow blueprinted Gibraltar bridge with hybrid cable-stayed/suspension design. Each span would run more than 3 miles.

the vast, unexplored eastern stretches of Siberia. Already, Japan and South Korea are considering pipelines to siphon natural gas out of the region. Supplies there could dwarf the current exports into Western Europe: Last summer, geologists at Russia's Academy of Sciences prophesied that quadrillions of cubic feet of natural gas and billions of barrels of oil await exploitation in Siberia's hinterland.

This potential bonanza may just provide the financial underpinnings of the Peace Bridge. Lin wants to leverage construction by running oil and gas pipelines below the bridge's roadbed. "I've switched to an economic front," he says. "You see, the bridge will cost a few billion dollars. The road on both sides will cost \$50

billion. The petroleum resources are worth trillions of dollars. But to get to the oil and gas you need roads. And you need the pipeline."

Stepping stones

Laying the economic groundwork for the bridge will probably be harder than building the structure itself. In Lin's scheme, the bridge practically rolls off an assembly line in modules. A total of 220 spans—each a double cantilever, stayed by two pairs of heavy-duty steel cables—march across the strait, the sequence hooking slightly north at the Diomed Islands.

Every unit crosses a modest 1200 ft., except for two 1800-ft. spans for the major navigation channels east and west of the islands. The deck

consists of a double box. While road traffic rumbles across the top face in summer months, the upper box accommodates an all-weather twin-track railroad, and the lower box provides space for pipelines.

Drawing from offshore oil-rig techniques, Lin rests this modular superstructure on a series of concrete gravity piers, curved like fat bugles to fend off marauding ice floes. Each of these is towed to its position, sunk onto a base raft and weighed down with ballast. Then a huge catamaran barge floats each span to its pier. The waters themselves offer little challenge—the strait runs no deeper than 180 ft.—but as in all Arctic construction, timing is critical: Weather restricts activity to only five months out of the year.

And because of the climate, concrete must swaddle everything, even the cables. "That's important from two points of view," explains Lin. "Number one, the concrete protects the steel. It simplifies maintenance in an icy area. Number two, it stiffens the bridge, so it's not just hanging from rope." Only at the deck's expansion joints would steel—coated to resist rust—see daylight.

The Peace Bridge is typical of Lin's designs: At first glance they fly in the face of logic, but eventually they fly. Case in point: an award-winning proposal for a bridge across the Strait of Gibraltar, linking Spain and Morocco. Lin and colleague Philip Chow picked an 8.75-mile route that European engineers had written off because it crossed water too deep. The Lin solution: straddling the depths with two enormous main spans that leap 16,000 ft., made possible by cable-stayed cantilevered struts that trim each suspended length to 9842 ft.—still a record span, but within reach of current technology.

Only time will tell if the Intercontinental Peace Bridge gains similar acceptance, or if fortune leads two nations to forge this link. If so, then the bridge will redefine not only geopolitical boundaries, but also the boundaries of civil engineering. **FM**

Trans-Bering Express



Trains race through WorldLink tunnel made from prefab double-tube segments.

● Think the Bering Strait connection is a bridge too far? How about a tunnel instead? That's the proposal of California architect Stuart Resor—in fact, it's the linchpin of a globe-spanning railroad called WorldLink.

Resor's concept calls for an elevated track from Washington, D.C., to Paris through "the world's backdoor"—swinging up through Canada, diving below the Bering Strait and arcing across Russia and Europe. The 300-mph needle-nose trains would run on side-mounted wheels locked into grooved channels.

For the sub-strait tunnel, Resor would

adopt the procedure now under way at the Central Artery tunnel project in Boston Harbor. Prefabricated steel-tube sections are sheathed in concrete, lowered into trenches, pumped dry, buried with rubble and gasketed together.

As with the Peace Bridge, the quest for oil would fuel construction of Resor's tunnel. But Resor also envisions a day when ebbing petroleum supplies will render airline travel too costly. "There won't be any easy solution replacing aviation fuel for the long-distance haul," he predicts. Further justification, in Resor's view, for WorldLink. —G.T.P.

RISE AND SHINE

When the ice melts, it's time to give your hibernating boat a spring wake-up call. Here's how.

BY MARK WEINTZ



● After the big chill of winter, the big thaw of spring means it's time to dewinterize your boat. Preparing your boat for another season of wet fun should be a happy time. Thoughts of a summer's worth of skiing, fishing and cruising should make spring tune-up chores practically fly by.

Yeah, right. Instead of warm thoughts of summer, most of us are filled with icy dread. What will we see when we take off the shrink wrap? A cracked block, corroded pistons, frozen bilge lines, split hoses, splintered belts? Or will there be something less obvious, a difficult-to-spot problem that turns into a major headache once the boat gets under way?

The reassuring answers to these questions can only be found by putting your boat through a thorough spring recommissioning composed of three basic elements: checking and repairing long-term storage damage, undoing preventative measures taken in the fall and giving the boat regular

maintenance. The following are tips to help you do it right.

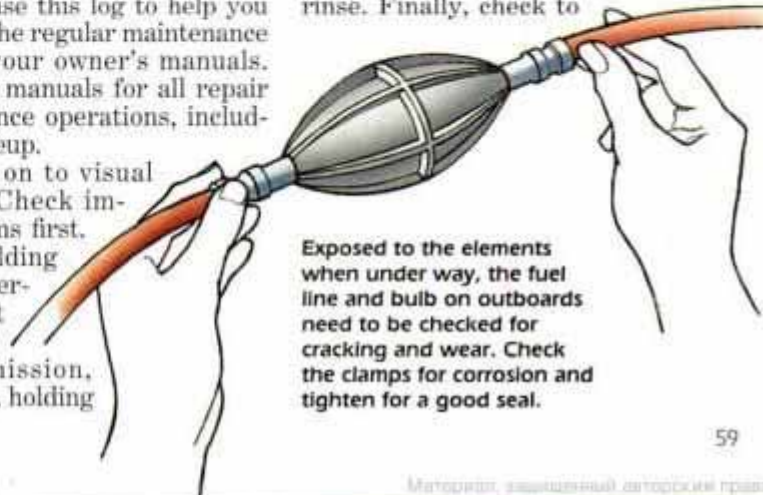
Log on

If you didn't use a checklist to winterize in the fall, start one now. Once you start, keep it up to date for all future decommissionings, recommissionings and repairs. The list will serve as an ongoing maintenance log, an important part of every boat's operating life. You can use this log to help you keep track of the regular maintenance indicated in your owner's manuals. Consult these manuals for all repair and maintenance operations, including spring tuneup.

Now move on to visual inspections. Check important systems first. Start with holding tanks and reservoirs. Inspect the bilge, fuel tank, transmission, tilt/trim pump, holding

tanks, lower unit, oil reservoir and any place where fluids collect. Look for puddling or signs of leaks. If none are found, top off levels where necessary. This is an important step before attempting to crank the motor.

Marine sanitation devices and freshwater holding tanks additionally need to be inspected for mold, mildew and insect invasion. Clean and repair where necessary. Then disinfect and rinse. Finally, check to



Exposed to the elements when under way, the fuel line and bulb on outboards need to be checked for cracking and wear. Check the clamps for corrosion and tighten for a good seal.

RISE AND SHINE

see if the systems are operational (after installing batteries), and do one more visual inspection for leaks.

Since so many of the boat's systems depend on the batteries, they should be among the first things checked, although they already should be in good working order. Why? Because they should be sitting in a protected basement or garage after removal in the fall. Also, they should be in good condition, because they've been recharged every 30 days. Right? Leaving your battery idle and uncharged can kill it. But you already knew this.

For some batteries you will want to check with a hydrometer for accurate testing of the specific gravity. Double check the manufacturer's specification and charge as necessary. Generally, slow charging is best. A hint: Be careful not to overcharge. This can damage the grids and cause internal corrosion. Whenever possible, use battery chargers with timers, auto shutoffs and a variable output.

Before charging, remove the vent caps and add water (some batteries require distilled water), if necessary. The water should cover the plates in the cell. Remember that batteries emit highly volatile hydrogen with the vents open, so charge them in an area isolated from sparks, smoking and other potential sources of ignition.

Maintenance-free batteries cannot be checked by using a hydrometer and do not require additional water.

However, they may require charging. Make sure the charger is properly set. Monitor the charger

gauge frequently if it doesn't have an automatic shutoff.

Finally, check all battery terminals, connections, fuses and wiring harnesses for corrosion. If you find signs of corrosion, scrape them away and use a corrosion retardant. This is also a good time to check all wire connections for solid contact, and all wire insulation for cracks.

The hull picture

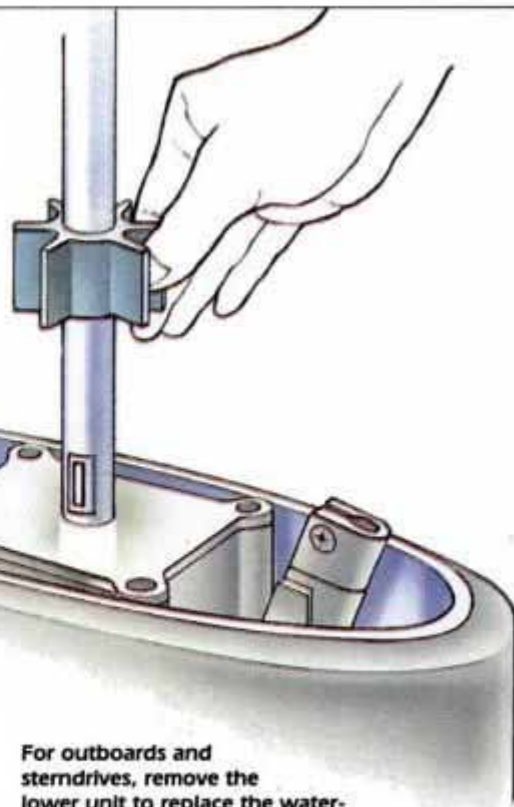
Inspect the entire hull for soft spots, blistering and hairline cracks. Closely check the integrity of the transom, especially around the outboard motor mounts and sterndrive cutout. Since transoms are typically cored with wood, they routinely need rebuilding every 10 years—an expensive and complex proposition. Improper storage, manufacturing defects and unsophisticated repairs can lead to premature failure. So, be sure to take every hairline crack seriously. Water intrusion between fiberglass layers can cause wood rot or delamination.

This is a good time to finish inspecting all the wood in your boat. Look under seats, helm, storage compartments, engine compartment and in the bilge. Repair any rot if necessary with protective coatings and marine-grade plywood. Don't forget to open all the inspection plates to check the stringers, and also to look for signs of collecting water. If you have serious questions about the stringers, seek professional advice.

Now, go to the dashboard and turn on the running lights, blower, anchor lights, bilge pump, radio, accessories, instruments and any other electrical systems. Typical problems in this area include burned-out bulbs, loose connections, burned-out fuses and faulty switches. Check live-well motors and bilge pumps by filling them with water from a garden hose.

Another area that requires cleaning and greasing is the slider assembly for the hydraulic steering. To ensure complete grease coverage, turn the steering wheel through a couple of wheel-lock turns. On a standard steering system, don't forget

To bleed hydraulic trailer brakes, connect a rubber hose to the bleeder fitting and submerge the loose end in a container holding some new brake fluid. Then loosen the bleeder screw and bleed until air bubbles are no longer visible.



For outboards and sterndrives, remove the lower unit to replace the water-pump impeller, a critical hard-to-inspect component that's easily damaged.

to check the cable and all connections. Ditto for the trim tab hoses, jack plate assemblies and trim/tilt hydraulics.

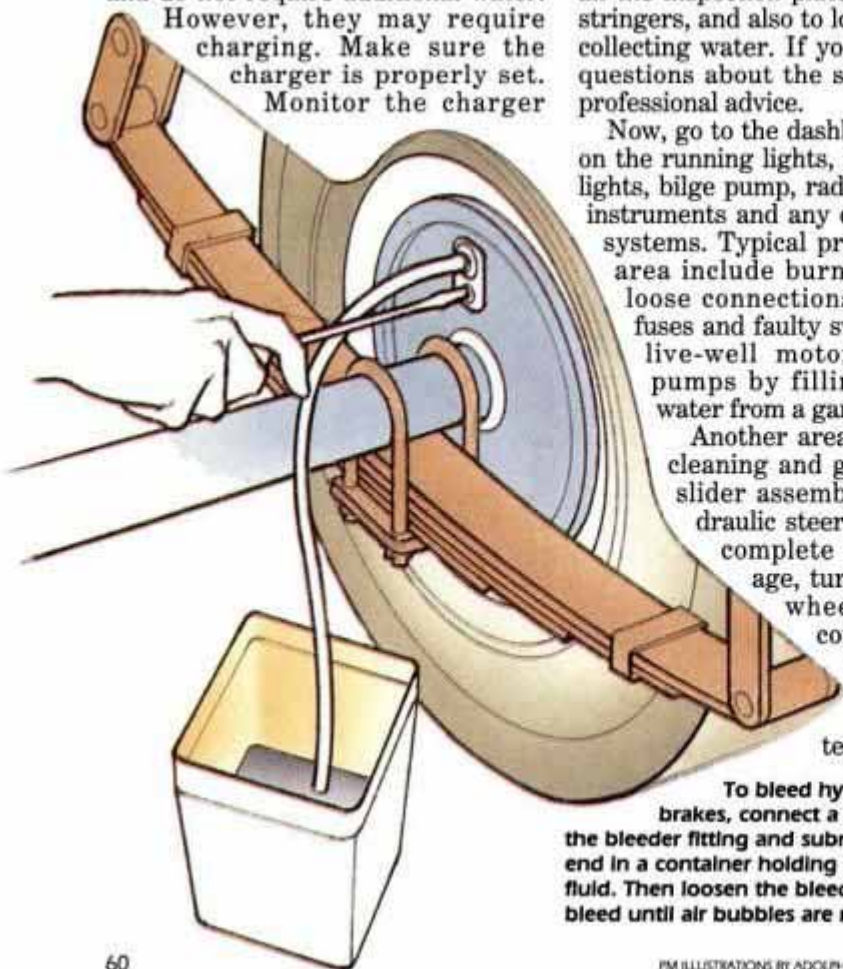
At the helm, check the throttle or binnacle, the key switch and emergency stop switch. Adjust and lube where necessary. Now, put the transmission in Neutral, remove the key and move to the engine. Make sure the spark plugs are clean, dry and properly gapped. If any reservoir is filled with corrosion-inhibitors, drain and replace with proper fluid. Reconnect all parts you disconnected in the fall, and check to see that all wires, hoses and belts are in good condition, properly in place and torqued tight where necessary.

Time to crank up the motor. As mentioned, refer to your owner's manual or a repair manual for all spring engine tuneup procedures.

Marine power

One thing that all marine engines have in common is a cooling system that uses a water pump. Manufacturers recommend that replacing the unit's impeller should be an annual duty. This task involves removing the lower unit on outboards and sterndrives, so if you aren't comfortable with this procedure you may prefer to have this done at your service shop.

Impellers are easily damaged by running them dry (caused by either raising them too high out of the water or by blockage of the water intake) or by sucking in sand and grit. After you remove the old impeller, and before



installing the new one, be sure to clean and grease the pump assembly. This is also a good time to check the level of lubrication in the lower gear case.

For specific tips, let's start with outboards.

Fuel filters and separators should be examined, cleaned and replaced, if necessary. If no leaks are apparent, squeeze the primer bulb to check for firmness, cracking and pin-hole leaks. Check adjacent hoses and clamps. Replace any parts that show signs of wear.

Check oil in lower unit. If water is present, or if oil is milky or burnt, you may need to replace the seals. Finally, check the seal and fasteners for the engine cowling.

For sterndrives, you should also check the oil in the lower unit. Then inspect the bellows and replace if they are showing signs of wear. Do the same for the air filter and thermostat. Then, give a close visual inspection to the raw-water cooling system, paying special attention to the hoses and clamps.

For inboards, start with a visual check of the stuffing box and follow manufacturer's recommendations for paying particular attention to the glands and torque on the locknuts. Clear all drain cocks. On diesels, drain water traps in gas tanks, and crank engine for a few seconds to prime oil.

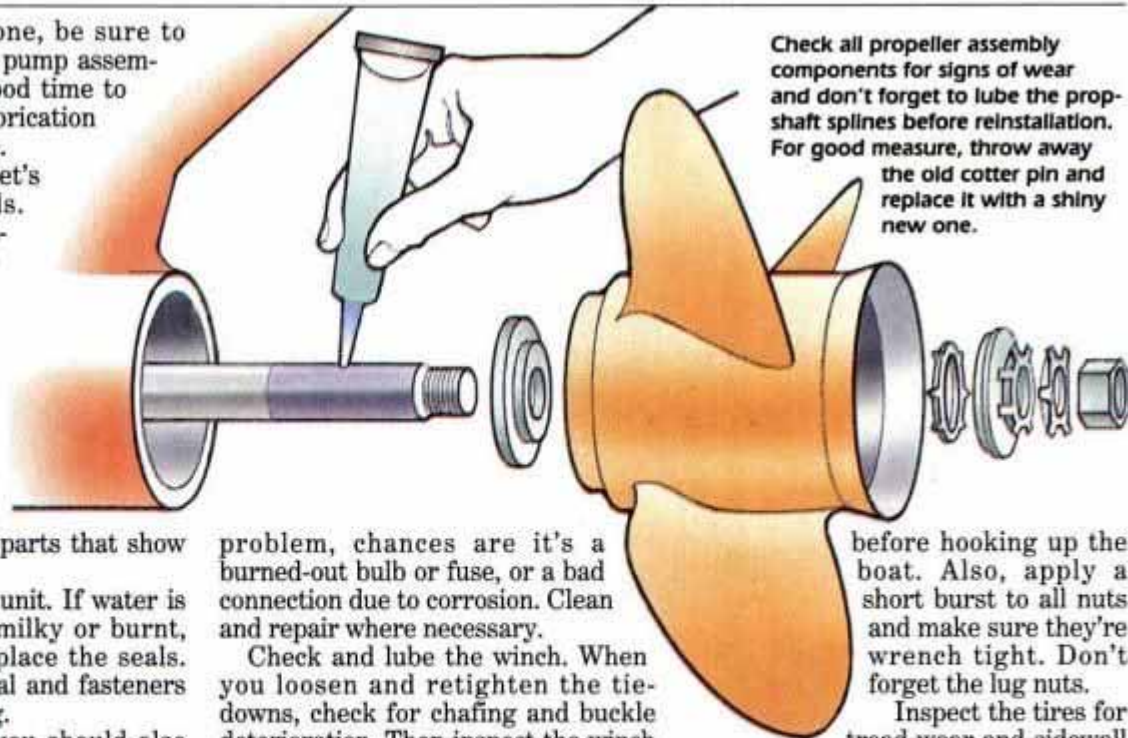
Now it's time to test-start the engine. You can either connect a garden hose to the motor or you can drop the boat in the water and let it idle while inspecting for leaks, peculiar noises and smoke. Adjust idle and timing if necessary.

When you're satisfied with how the engine runs, it's time to install the prop. Inspect the blades for nicks, the hub and washers for wear, and the splines for damage. Use manufacturer-recommended lubrication on the splines and shaft before reinstalling. Torque the prop nut to spec and insert a new cotter pin.

The final duties are to inspect your safety gear. Check the expiration dates on the flares and fire extinguisher. Replace if necessary. Check all lines for chafing and rot. Last but not least, run your electronic instruments in their test mode.

Trailer time

Hook up the wiring harness and test all trailer lights. If there's a



Check all propeller assembly components for signs of wear and don't forget to lube the prop-shaft splines before installation. For good measure, throw away the old cotter pin and replace it with a shiny new one.

problem, chances are it's a burned-out bulb or fuse, or a bad connection due to corrosion. Clean and repair where necessary.

Check and lube the winch. When you loosen and retighten the tie-downs, check for chafing and buckle deterioration. Then inspect the winch cable or strap.

Check wheel bearings for water intrusion, foreign matter, pitting and wear. Replace or repack them with marine-grade wheel-bearing grease. Watery or milky grease is a telltale sign that the seals are shot. A burnt smell or appearance is a sign that the bearings are running hot.

If you find any leaks or breaks in the hydraulic-brake system or if the fluid level in the reservoir is lower than the master-cylinder ports, the system must be bled. To do this, connect a rubber hose to the bleeder fitting and submerge the free end in a container holding some new brake fluid to ensure that no air is returned to the system. Then loosen the bleeder screw. Make sure the master cylinder is filled during this procedure. Bleeding is completed when the expelled brake build is free of bubbles.

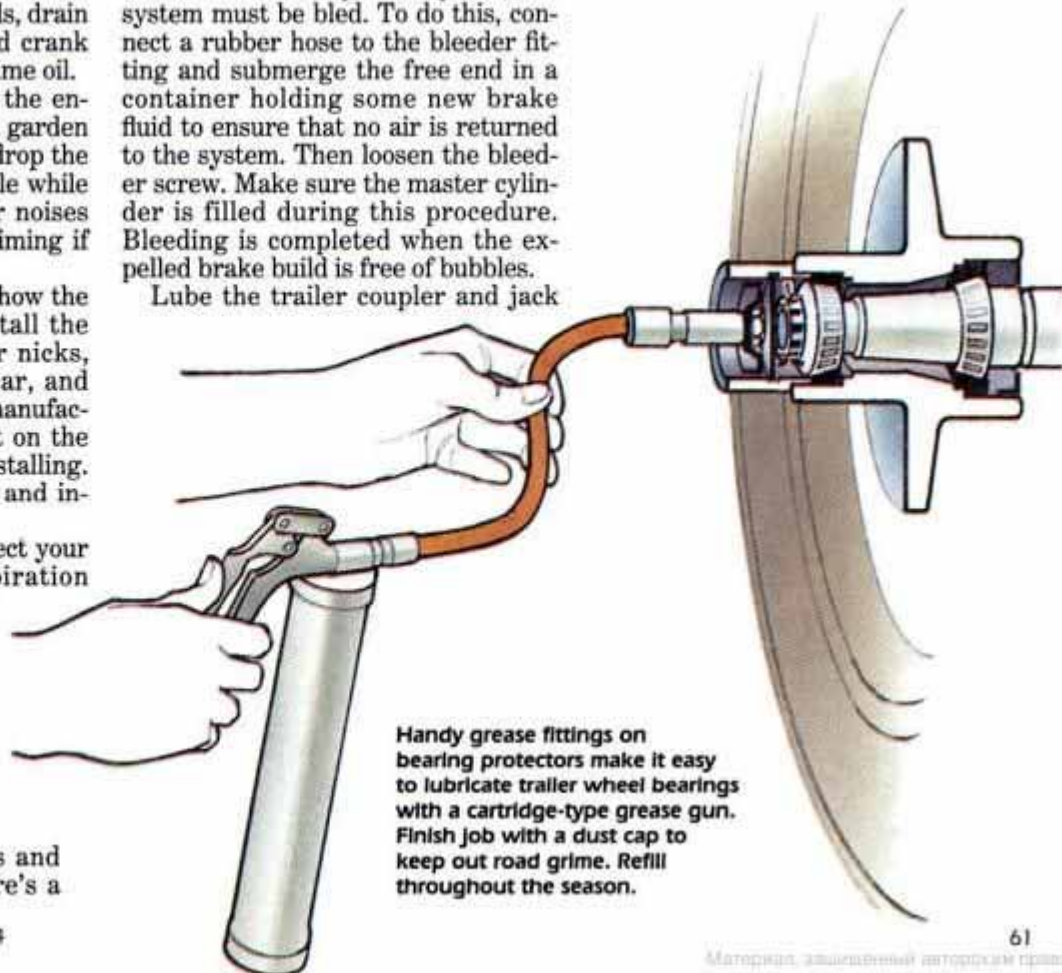
Lube the trailer coupler and jack

before hooking up the boat. Also, apply a short burst to all nuts and make sure they're wrench tight. Don't forget the lug nuts.

Inspect the tires for tread wear and sidewall cracking, including the spare. Then inflate to spec.

What else? Lots, including inspection of the toolkit, first-aid kit, galley, fishing equipment, skiing equipment and too many others to cover in a story of this length.

A good dewinterization plan will not only help ensure a safe, trouble-free season on the water, but it will help your boat retain its maximum value. As always, a pound of prevention is worth tons of cure. **PM**



Handy grease fittings on bearing protectors make it easy to lubricate trailer wheel bearings with a cartridge-type grease gun. Finish job with a dust cap to keep out road grime. Refill throughout the season.

POWER UP!

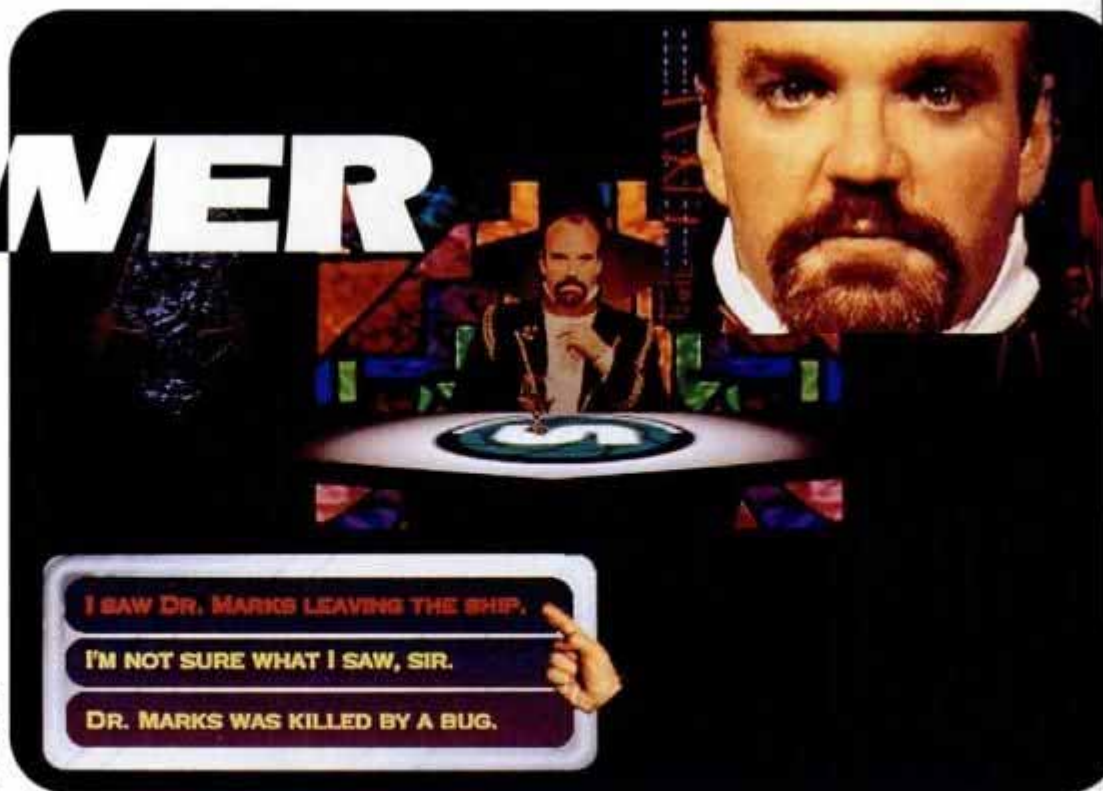
At COMDEX, multimedia and laptop computers take center stage.

BY STEPHEN A. BOOTH,
Contributing Editor

● No doubt about it: This is the year computers get up close and personal and come home to stay. All the indicators warrant this fearless forecast.

Amid the dizzying cornucopia of new products displayed at COMDEX, the world's fair of computing, in Las Vegas, Nevada, one trend emerged that will be welcome to the vast majority of people who have yet to see a reason for owning a PC. Simply stated, this year's crop of personal computers and peripherals let you do more things, and do them more easily than ever before.

For example, you'll find more usefulness than novelty in multimedia PCs, which access video, graphics, data and sound from compact discs. A growing library of CD-ROM titles includes how-to programs, interactive games and reference works ranging from movie guides to encyclopedias. Innovative add-on boards let you manipulate this multimedia data in new ways. Clever input devices will let you assign chores to the PC by means other than a keyboard, while new output devices offer versatility beyond printing text. Here's a sampling of the future.



Interactive Movie

If you're going to save the world sci-fi style, then the place to do it is with *Quantum Gate* (\$80), a piece of PC software that's on the leading edge of interactivity. This CD-ROM title is packed with 1000 pages of text and almost 2 hours of video (45 minutes of which is full-motion). The real difference, though, is in the use of animated video actors—real actors whose actions have been animated—and a multilayer Virtual Cinema landscape that creates a realistic sense of depth and perception.

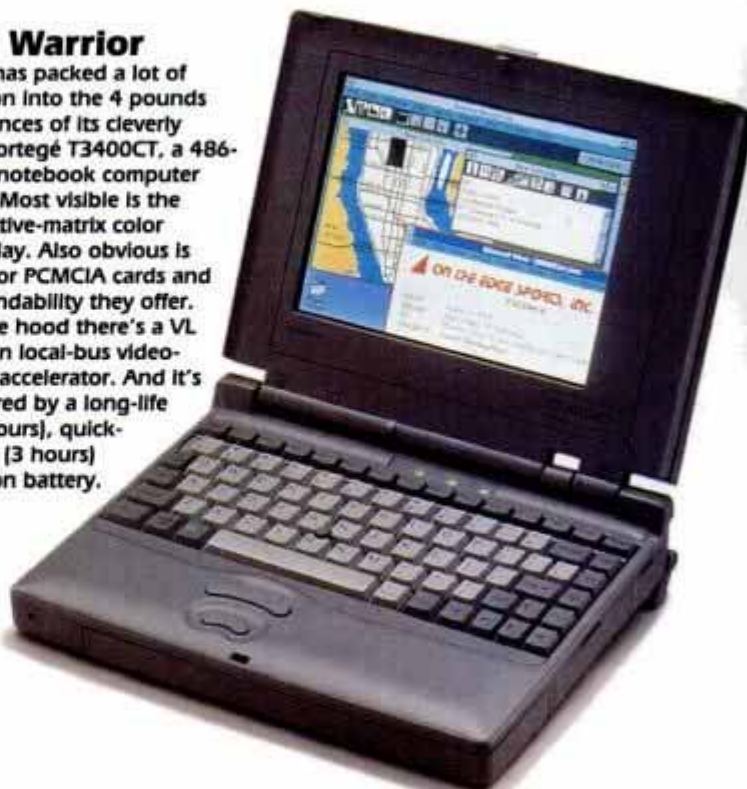


Not Just The Fax

Besides squirting ink, Ricoh's latest output device resembles an octopus for the number of tasks it can handle. It's a plain-paper fax machine, which means it's also a convenient photocopier. With the addition of an interface module, it becomes a computer printer. The ink-jet engine prints sharp text or images on plain, cut-sheet paper. You can feed it 10 sheets at a time, for sending faxes or making photocopies. Its name? Simply and deceptively, FAX800 (\$1695, optional printer interface \$150).

Road Warrior

Toshiba has packed a lot of innovation into the 4 pounds and 6 ounces of its cleverly named Portégé T3400CT, a 486-class subnotebook computer (\$3999). Most visible is the 7.8-in. active-matrix color LCD display. Also obvious is the slot for PCMCIA cards and the expandability they offer. Under the hood there's a VL Bus—as in local-bus video-graphics accelerator. And it's all powered by a long-life (3 to 6 hours), quick-charging (3 hours) lithium ion battery.





Better Mousetrap

Want to draw on your computer? This used to be a costly hobby, but Aristo's College Board/Digital (\$295) makes graphic input as easy as feeding cheese to a mouse. The company, a division of Koh-I-Noor, of graphic-arts fame, combines a mouse, digitizer tablet and drawing board in one package with the necessary software to run with Microsoft Windows. You simply draw on the digitizer tablet with the mouse, and the rodent conveys the input to computer and screen. It doubles as a regular mouse for routine cursor chores, too.

Scan 'N' Can

One aspect of desktop multimedia is the ability to incorporate images in a computer presentation by scanning objects with a video pickup device. Most scanners, though, are optimized for capturing flat objects or are designed so that the object has to be brought to the scanner. VideoLab's FlexCam/Document (\$895) is more versatile. Its gooseneck design adjusts for the job at hand, a boon for scanning 3-dimensional objects. Also, the video camera's lens can be focused to within a quarter-inch of an object, effectively permitting magnification. Now you can scan your stamp or coin collection into PC memory.

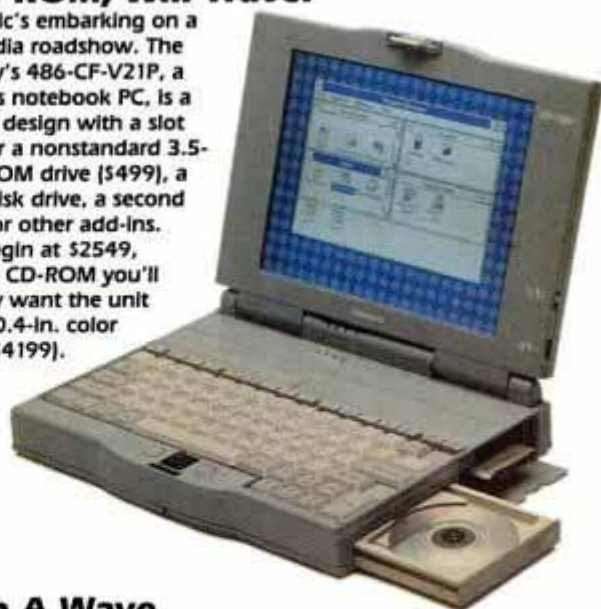


Golden Age of Wireless

That's where personal computing is headed, and Motorola is airborne with its NewsCard wireless receivers for electronic information. These credit-card-size modules are designed to fit into PCMCIA-type slots on portable PCs, as well as those on the new personal digital assistants such as the Apple Newton, Casio Z-7000, Tandy Z-PDA and GRID 2390. Prices will be established by the respective companies.

Have ROM, Will Travel

Panasonic's embarking on a multimedia roadshow. The company's 486-CF-V21P, a 486-class notebook PC, is a modular design with a slot for either a nonstandard 3.5-in. CD-ROM drive (\$499), a floppy-disk drive, a second battery or other add-ins. Prices begin at \$2549, but with CD-ROM you'll probably want the unit with a 10.4-in. color screen (\$4199).



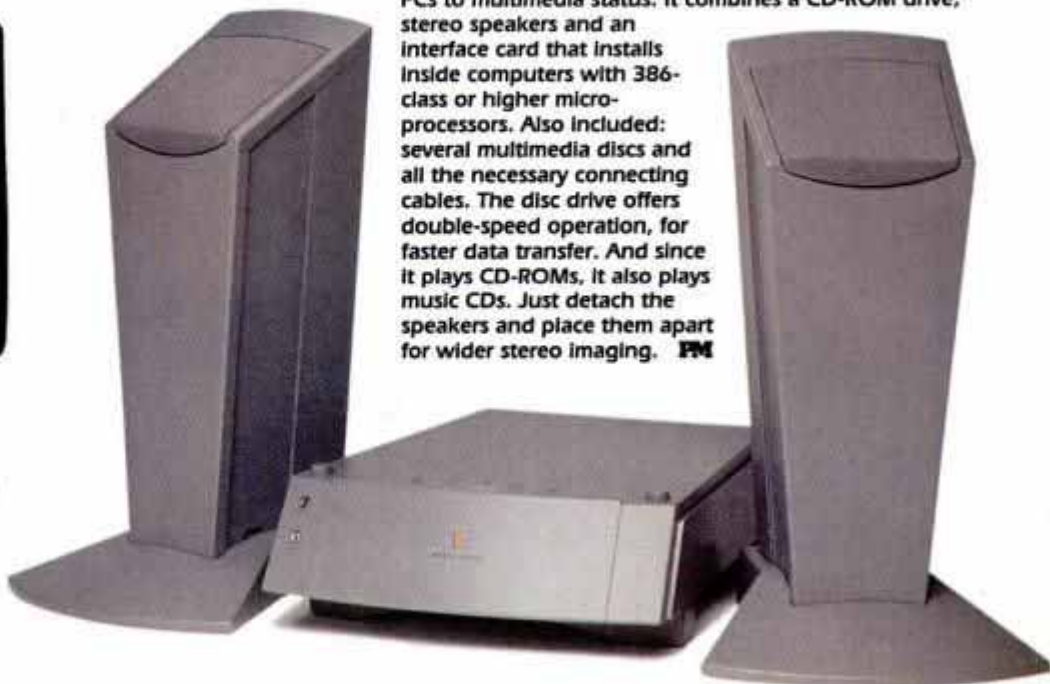
Catch A Wave

What's better than going gold on the *Billboard* charts? Going platinum. Multiwave Innovation is taking digital soundcards to the next level of performance with its Audiowave Platinum 16 (\$299) for multimedia PCs. The 16-bit card has too many features to mention —among them the ability to create a 3D surround-sound field from 2-channel stereo material. But its unique feature among all boards is its capability for simultaneous digital recording and playback. This means a PC-savvy musician can record and mix new soundtracks by playing live to the accompaniment of previously recorded ones in computer memory. The AP16 is compatible with Creative Labs' SoundBlaster, Microsoft's Windows Sound and other audio standards.



The Memphis Sound

If Memphis makes you think of Elvis, you're on target. Media Vision's Memphis (\$999) is a kit for upgrading PCs to multimedia status. It combines a CD-ROM drive, stereo speakers and an interface card that installs inside computers with 386-class or higher microprocessors. Also included: several multimedia discs and all the necessary connecting cables. The disc drive offers double-speed operation, for faster data transfer. And since it plays CD-ROMs, it also plays music CDs. Just detach the speakers and place them apart for wider stereo imaging. **PM**



WORKAHOU

Transforming our Buick Estate Wagon into a contemporary Gran Sport with new looks, power and suspension.

TEXT AND PHOTOS BY CLIFF GROMER, Contributing Editor



● As if our commute to New York City wasn't bad enough, we had to have a Dodge Stealth on our tail. I mean, right on our bumper as we rolled into the Raritan Tolls on the Garden State Parkway. Like, if we didn't spill our coins into the exact-change basket fast enough, the Stealth was going to push us through the toll-booth. After slam-dunking his 35 cents, Mr. Stealth came storming up, whipped out alongside us and surveyed our Buick Roadmaster Wagon with disdain. His look said it all: Just get that parade float out of my way. Then he

BULLIC—PART 2



punched it to whip back across our bow and leave us wallowing in his wake.

But it didn't work that way, because we punched it too. Not that we were in the habit of playing boy racer; mind you, but sometimes it's just necessary to deal with a situation. Mr. Stealth's eyes widened in direct proportion to the swinging speedo needle, astonished that his sports car could not pull an inch on our wagon. At 75, he let up and meekly turned in behind us. It was just one instance of our project Buick (turning a roly-poly wagon into a haulin' hauler) exploring its new-found capabilities.

To say that those new-found capabilities are formidable would be a gross understatement. To say that our Roadmaster Gran Sport Wagon is, arguably, the best-performing station wagon we've ever driven would not be an overstatement. To say that we are delighted with the way our project turned out would be, simply, the truth.

In our initial episode (Nov. '93), we established baseline performance numbers for our stock 1993 Roadmaster Estate Wagon. Now we get to the fun part—more horsepower, better handling and looks to match.

The stock 5.7-liter LO5 throttle-body injected engine

WORKHAULIC—PART 2



With its 300-horsepower LT1 V8 and special Bilstein Police Pursuit shocks, our custom Buick Roadmaster Gran Sport Wagon pulled like a champ without its former white-knuckle handling ills. Buick factory chrome wheels and dual exhaust add to performance image.

in our Buick put out 180 horsepower. For '94, Buick ups the ante to 260 hp with the LT1 multiport injected version of the engine. As of this writing, however, Buick has yet to build its first production car with this powerplant. We went even one better than Buick by installing the 300-hp Corvette LT1. A specific camshaft and aluminum cylinder heads help squeeze more ponies from the same displacement. The actual engine swap was handled by Specialized Vehicles Inc. (SVI), Troy, Michigan.

Unlike the old days when swapping an engine was basically a matter of fitting it all into the engine bay and lining up the motor mounts, late-model computer-controlled engines present a whole different kettle of worms. First there are the usual underhood clearance considerations. Differences in frame rails and engine mounting points between '93 and '94 Roadmasters meant that the LT1 would not simply drop in and line up. Seems that the frame rail and the Corvette engine's accessory drive were fighting for the same real estate. While others have notched the frame rail for clearance, SVI used a different tack.

To keep accessory components, such as the air-conditioning compressor, close to their original Buick locations for the easiest fit, SVI mounted a Camaro accessory drive on the engine, and then spaced it out to line up

with the Corvette balancer pulley.

Another worm in the kettle was the LT1's reverse-flow cooling system. The trick here was to reverse the inlet and outlet nipple positions on the stock radiator and run dual electric cooling fans in place of the LO5's engine-driven fan.

A dual-exhaust system with larger-diameter 2½-in. pipe to and from the single catalytic converter frees up the LT1's breathing.

The biggest problem, though, involved the electronics. A Camaro (F-car) computer was determined to be a better choice than the Vette ECM to handle the requirements of the engine and body. Then, using factory schematics and determining computer input and output values for every circuit, SVI fabricated a new umbilical cord, one wire at a time.

Once the drivetrain, using the stock 700R4 transmission with modified shift points, was buttoned down, the suspension was beefed up with Delco front shocks from the Chevy Caprice police package. As a nod to Buick's performance heritage, factory 15×7 chrome road wheels were shod with P245/60R15 Goodyears. The fat tires filled out the wheel wells and added a more serious performance look.

A police-option steering box for B-bodies, with a 12.7:1 ratio, gave us a snappier response to steering inputs for a sportier feel.

Our wagon took on a really distinctive appearance after we had Lentz Auto Body in Belford, New Jersey, swap Roadmaster sedan front-end body parts (hood, grille, headlights, bumper, fascia and fenders) for the wagon pieces. Theoretically, this should have been a direct bolt-on, but Lentz had to fabricate and add spacers to the radiator core support to make the fenders line up evenly with the doors. Another bugaboo was a hard-to-obtain factory wiring harness to hook up the new headlights.

For a more custom look, we had Lentz shave the hood ornament and black out chrome on the body and grille. Once again reaching back into Buick's performance heritage of the muscle-car '60s, we added reproduction Gran Sport and GS emblems to the grille, rear quarters, tailgate and engine compartment.

As a final sinister touch, we had AutoWorks in Middletown, New Jersey, dark-tint all glass, except the windshield, of course.

Visually, our wagon's transformation was complete. Performance-wise, it was lacking. The police Delcos didn't give us the control we had hoped for. The wagon still porpoised and floated. At higher speeds, we felt the need to contact air traffic control for takeoff clearance.

Doing some research, we found a factory-option shock package—8X3-



PM PHOTO BY G PHOTO

Heartbeat of our project is the Corvette 5.7-liter LT1 multiport injected V8, which replaced the Roadmaster's stock throttle-body injected LOS engine. An F-car accessory drive was used for easiest engine fit without the need to notch the frame rails. The wiring harness (right) had to be strung wire by wire, following factory schematics, to mate the F-car ECM with the Vette engine and Buick body.



PM PHOTO BY G PHOTO

Police Pursuit option on the already optional Caprice sedan police package. Consisting of heavy-duty Bilstein gas shocks, front and rear, we found that the shocks were a simple bolt-on replacement. What a difference! The Bilsteins dramatically improved handling and solved the float problems.

The transmission proved to be another headache. Working fine when the wagon was stock, it was now giving us mushy shifts under heavy throttle, and eventually quit shifting altogether. Inspection by the high-performance specialists at Lombardi Bros./Gibraltar Transmissions in Brooklyn, New York, showed the 700R4's internals to be thoroughly cooked. A rebuild with heavy-duty and high-performance parts—a new input housing to replace the original that was cracked, competition-style clutch packs, Kevlar band, beefy torque converter with slightly higher stall speed, larger servos, mild shift kit and big oil cooler—put us back in the tow 'n' go business.

Steve Lombardi also found a GM service bulletin recommending drilling a hole in the valve body to increase hydraulic pressure to the 2-3 shift clutches to avoid premature failure.

So what's the bottom line on our haulin' hauler? For openers, our quarter-mile times dropped from 16.8 seconds/79.6 mph to 15.1 seconds/87.3 mph. Our firmer-shifting trans now chirped the tires in Second and Third. Slalom speeds increased from 50.6 mph to 53.2 mph.

Handling and response overall were greatly improved, primarily because of the more stable platform resulting from the Bilsteins. Transient response was more crisp, and the big Buick was better able to answer the helm, especially with its quicker-ratio steering.

Towing now became a more predictable exercise. Our wagon was less susceptible to crosswinds and those dreaded side-to-side oscillations. More often than not, our knuckles retained their natural color instead of glowing white all the time. The increased

power was especially noticeable in the midrange, where, previously, carpet-crunching throttle stomps were necessary for any kind of acceleration. Fuel mileage increased from 5 mpg to more than 10 mpg when towing, and from 17 mpg to 21 mpg unhooked. So on top of everything else, our hauler rewarded us with a little savings that we could haul to the bank. **PM**

SOURCE LIST

The following is a list of some of the suppliers for this project:

- Buick Motor Division, Flint, MI.
- Delco Chassis Division, Dayton, OH.
- GM Powertrain Group, Pontiac, MI.
- GM Service Parts Operations, Flint, MI.
- Saginaw Division, Saginaw, MI.
- AutoWorks, 66 Leonardville Rd., Middletown, NJ 07718; (908) 495-0330.
- Lentz Auto Body, 902 Main St., Belford, NJ 07718; (908) 787-0800.
- Lombardi Bros./Gibraltar Transmission Corp., 8699 18th Ave., Brooklyn, NY 11213; (718) 236-0121.
- Specialized Vehicles Inc. (SVI), 1401 Piedmont Ave., Troy, MI 48083; (313) 680-1400.

TRACTION MASTERS

New tires from Goodyear and Michelin push the technology envelope.

BY MIKE ALLEN, Associate Automotive Editor

● Computers have changed virtually every aspect of modern life, even in the design of what otherwise seems to be a prosaic commodity such as a tire. Round and black, right? Comes in different sizes, and the tread pattern is different depending on whether you want a quiet highway ride or good snow and off-road traction at the expense of a smooth, quiet ride.

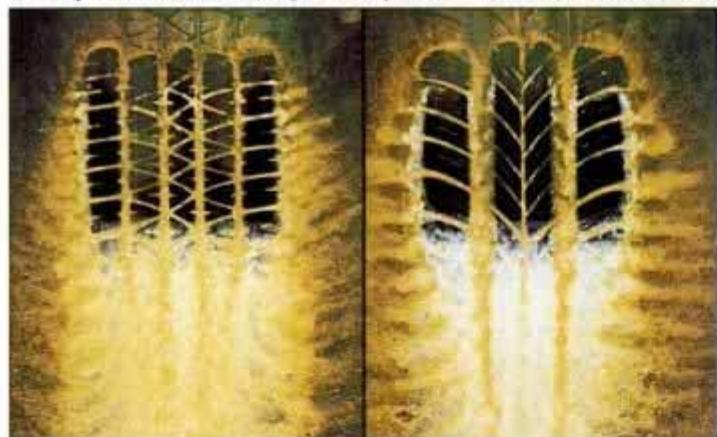
The days of when the art department of a tire company designed a tread pattern to catch the customer's eye are long gone. With the use of computer modeling and CAD/CAM (Computer Aided Design/Computer

sign to life has shrunk from years to months.

The obvious advantages are the ability to optimize the different elements of the tire's construction separately and together, the ability to bring a tire to market in a short period of time, maintaining a competitive advantage and reducing costs.

Goodyear Eagle Aquatred

Goodyear recently introduced a high-performance version of its passenger-car Aquatred all-season tire, dubbed



Note green patches of fluorescein-tinted water under the tread of Goodyear's GT+4 (left) as tires pass over wet glass plate at speed.

Aided Manufacturing), tire engineers are able to optimize a new tire's construction in a fraction of the time formerly necessary.

In years past, test tires were fabricated to a new design from the engineer, tested and evaluated, and then in turn a better tire was designed. It took months for every iteration, making the overall design process for a truly new or innovative design lengthy and expensive. Now it's possible to change a single parameter in the computer model of a tire design and evaluate a simulation of the tire's projected performance within a few hours in the lab before a tire physically exists.

Test tires still need to be built to validate the simulation data, but the lead time to bring a new tire de-

signed by rubber meeting the road. The rest is composed of grooves, or, in the case of the Eagle Aquatred, aquachannels. The Aquatred has a larger percentage of void space, but that's not the whole story. With increasing void space, it becomes more difficult for tire engineers to control the individual blocks of rubber as they squirm their way along the pavement. Especially when the tire is called on to generate cornering, acceleration or braking force, the tread blocks distort. If they distort too much, you'll have a loss of traction or, in extreme cases, chunks of rubber being separated from the tire carcass.

Look at the images at left contrasting Goodyear's GT+4 with the new

the Eagle Aquatred, which was almost totally developed on the computer. The Eagle Aquatred is available in low-profile sizes to fit a wider range of vehicles than the original Aquatred's intended market of mid-size and large sedans. In fact, the Aquatred matches the Eagle GT+4 pretty much size for size.

Hydroplaning, or aquaplaning, is a simple-to-understand phenomenon—water normally is squeezed out from under the separate rubber blocks of a tire as it travels down a wet road. When the water is deep enough or the speed is high enough, the water simply builds up in a wedge between the road surface and the tire. When the rubber leaves the road, braking and steering are no longer possible—and your car goes out of control.

The largest single variable in the design of a tire that influences hydroplaning is void space—the percentage of the tread's footprint that is actually repre-



The Goodyear Eagle Aquatred is a high-performance all-season tire that's available in low-profile sizes.

ented by rubber meeting the road. The rest is composed of grooves, or, in the case of the Eagle Aquatred, aquachannels. The Aquatred has a larger percentage of void space, but that's not the whole story.

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Look at the images at left contrasting Goodyear's GT+4 with the new (Please turn to page 133)



Rubber tread blocks are different sizes to change drone of tread to white noise.

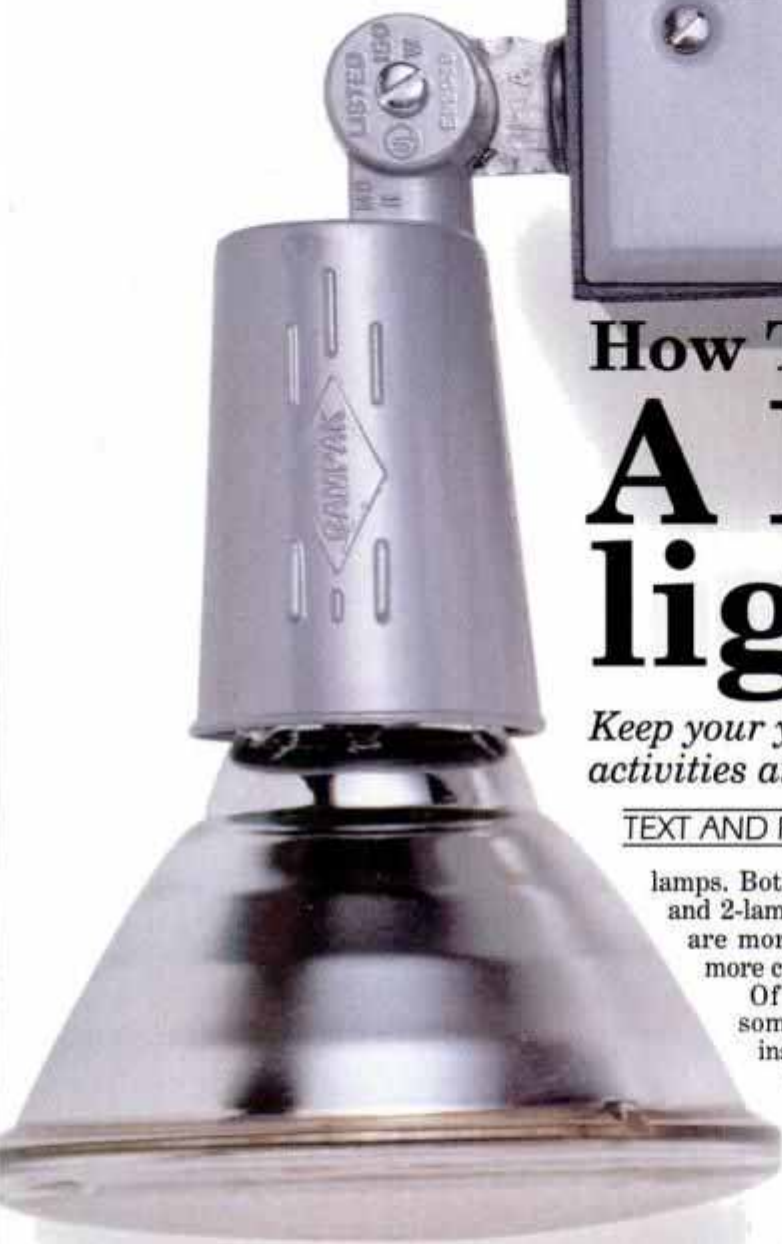
HOME
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- Install A Floodlight
- Plant Trees And Shrubs
- Install A Garage Door Opener
- Install A Deadbolt Lock
- Install Under-Cabinet Lights
- Seal Concrete Floors





How To Install A Flood- light

Keep your yard well-lighted for outdoor activities and improved home security.

TEXT AND PHOTOS BY MERLE HENKENIUS

There's no better way to extend a day than with a house- or garage-mounted floodlight. If this idea doesn't appeal to you, rest assured that it will appeal to the youngsters around the house. Aside from offering a measure of added security (and safety), a floodlight can improve a range of outdoor activities, from backyard barbecues to driveway basketball. And to top it all off, floodlights are relatively easy to install.

Variations on a theme

Floodlights take a variety of forms and are installed in a variety of ways. A quick trip to your local home center will reveal several design options. You'll see the traditional fixture—like the one we installed—but you'll also see rectangular quartz-halogen

lamps. Both are available in 1- and 2-lamp kits. Quartz lights are more efficient, but also more costly.

Of these, you'll find some designed for wall installations (like ours), and others for soffit installation. The primary difference is that wall installations are weatherproof. Soffit lights, because

they enjoy eave protection, are less so. Some will have motion-sensing ON/OFF switches, and some will have light-sensing photocells. Still others can only be switched manually.

When it comes to wiring a floodlight, you'll have several options. You can fish cable into finished walls, thereby providing indoor switch control, or you can surface-wire with conduit, placing the switch on an exterior wall or post. Another option is to surface-wire some of the installation and fish the rest. If you opt for surface-wiring, all boxes and connectors will need to be weatherproof. Where allowed, plastic boxes and conduit make these installations quick and easy.

As for our installation, we opted for a standard, 2-lamp fixture with a light-sensing photocell. When the

switch is left in the ON position, the light comes on automatically when it gets dark. This feature, while not foremost in our thinking, does offer some security when no one is home. On the majority of days, however, we plan to switch our light manually.

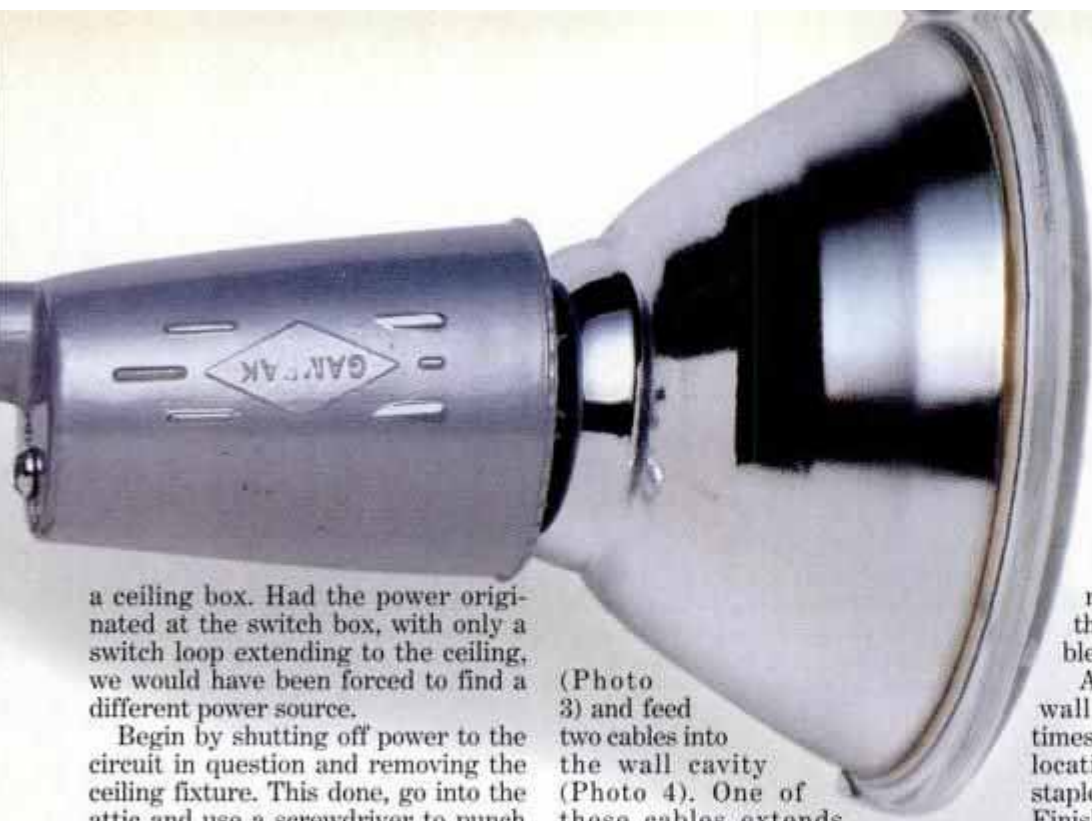
Our light, made by GAMPAK (475 Bloy St., Hillside, NJ 07205), accommodates two 150-watt, weatherproof floodlamps. We paid about \$15 for the fixture and \$5 for each lamp. The fixture came with its own weatherproof, surface-mount box.

Electrical access

In many cases, the easiest access to existing power is through the garage. Unfinished garages make wiring easy, especially if you don't mind having the switch in the garage as well.

In our case, we chose to install our light on a gable end of our house, accessing power in the attic (from an overhead hallway light below). We also wanted our switch inside, near the back door. This required a little more work, but not much more.

The hallway light we wanted to tap had its power originating at a ceiling box, with a 2-wire switch loop running down to a wall switch on the main floor. This configuration, which is very common in newer homes, is required if you hope to pull power from



a ceiling box. Had the power originated at the switch box, with only a switch loop extending to the ceiling, we would have been forced to find a different power source.

Begin by shutting off power to the circuit in question and removing the ceiling fixture. This done, go into the attic and use a screwdriver to punch through an unused knockout in the existing ceiling box (Photo 1). After feeding 14/2 (with ground) cable into the ceiling box, staple the cable next to the box and every 4 ft. alongside the ceiling joists (Photo 2).

After reaching the top plate of the wall that will hold your new switch, bore down through the top plates

(Photo 3) and feed two cables into the wall cavity (Photo 4). One of these cables extends power to the switch from the existing ceiling box, while the other will carry power from the switch to the new floodlight. Be sure to push through enough cable to reach well past the switch location in one direction and the floodlight location in the other.

If your cable needs to travel across several ceiling joists (like ours did) to

reach the floodlight location, bore through each joist and pull the cable through these holes (Photo 5).

After pulling cable to the gable wall of the attic, staple it several times more on its way to the fixture location (Photo 6). Codes require a staple within 8 in. of the fixture box. Finish running the cable by bringing it through a 1½-in.-dia. hole bored through the outside wall where you want the light to be.

Installing the fixture

Our fixture consisted of a weather-proof metallic box, two adjustable lamp holders, a rubber weather gasket and a cover plate, which contained



1 To access power from an existing ceiling box, first use a screwdriver to punch a new box hole for the supply cable.



2 Staple the new cable alongside the ceiling joist within 8 in. of the ceiling box and every 4 ft. thereafter.



3 Determine the wall location of your new switch, then bore through the top plates of the same wall from above.



4 Feed two cables—one for the switch, and one for the floodlight—through the switch box hole and into the wall cavity.



5 When crossing ceiling joists, bore a cable hole through the center of the joists and pull the cable through.



6 Bring cable up the attic or the gable wall that will support the floodlight and staple it alongside a convenient stud.



7 Turn a nipple or threaded adapter into the back of the box and feed the new cable through this extension.



8 After installing a lamp holder on each end of the box, mount the box on the outside wall with two wood screws.



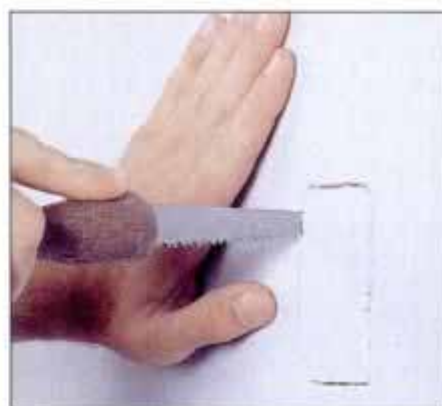
9 Join all white wires together and all ground wires together. Then hook the black (hot) wires to the photocell.



10 Push the sensor into the box, then press the fixture's rubber weather gasket in place. Tighten the cover securely.



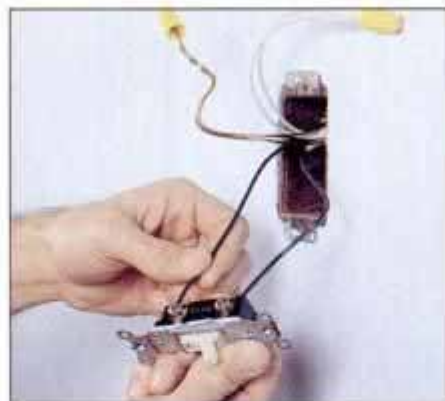
11 Determine the precise location of your switch box, then hold a cut-in box in this spot and trace around it.



12 Use a drywall saw or sabre saw to cut the opening for the new box. Be sure to cut right on the line for the best fit.



13 Pull the cables into the cut-in box and press the box into the wall. Then tighten the bracket screw securely.



14 Join both white wires together and all ground wires together. Then attach both black wires to the switch.



15 To access power, join all white, black and ground wires. Then join the black fixture wire to the white switch wire.

the photocell. To keep water from entering the box through the cable opening, it's a good idea to install a nipple in the rear opening of the box. A threaded-steel nipple will work here, but we opted for a plastic conduit adapter. After wrapping Teflon tape around the threads, tighten the adapter into the box opening (Photo 7).

We also threaded the two lamp holders into the sides of the box. Again, use Teflon tape to seal the threads. The lamp-holder fittings come

with locknuts, like those used on box connectors, which lock in the angles of the holders. With the adapter and lamp holders in place, pull the switch cable through the adapter and screw the box to the house siding (Photo 8).

To wire the fixture, begin by joining the cable's bare-wire ground to the fixture's grounding lead wire, and to an insulated grounding pigtail. Then bond the pigtail to a screw hole at the back of the box. Next, join all white (neutral) wires in a twist con-

ductor. To power the fixture, join the circuit's black wire to the black wire of the photocell, and the photocell's red wire to the black wires from the lamp holders (Photo 9). Finally, install the cover plate, making sure that the edges of the box are covered on all sides by the fixture's rubber weather gasket (Photo 10).

Installing the switch box

To install a new switch and switch box, begin by identifying the stud

space that contained the cables pushed down from the attic. Because a cut-in box needs to be held several inches away from a stud, choose a spot in the center of the stud space and 42 in. above the floor, as measured from the bottom of the box. Hold the cut-in box against the wall, face forward, then trace around it with a pencil (Photo 11), and cut along the traced lines with a drywall saw (Photo 12).

With the box opening cut, reach into the stud space to retrieve the cables. After trimming them to length, feed each cable through its own box opening and press the box into the wall (Photo 13).

Finally, tighten the screw that draws the support bracket against the drywall, and strip the cables of their

sheathing within the box. At this point, you can also strip 1/2 in. of insulation from all black and white wires.

To wire the switch, join the white wires in one twist connector, the ground wires in another one and press the two black wires into their stab-in slots in the back of the switch. After screwing the switch yoke to the box, install the cover plate (Photo 14).

Wiring the access fixture

As stated earlier, our hallway light was powered from the ceiling box, with only a 2-wire switch loop diverted through the switch box. At first glance, the wiring in this box can seem a bit confusing. The best way to work through the confusion is to wire the obvious—the ground and white

(neutral) wires—and deal with the black (hot) wires later, when there are fewer wires to think about.

Begin by joining all white wires in a twist connector, except for the white wire from the switch loop. If this white wire is not already marked with black tape, mark it now. Then, join all ground wires in a twist connector.

This will leave only three unconnected wires—the black lead from the fixture, plus the black and white switch loop wires. To complete the job, join the white switch wire, (marked with black tape) to the black lead wire from the fixture. Then join the black switch wire to the rest of the black wires in the box (Photo 15). Finally, install the fixture and globe and return power to the circuit. **FM**

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How To Plant Trees And Shrubs

Dress up a barren yard with these staples of the landscaping trade.

TEXT AND PHOTOS BY MERLE HENKENIUS

The nice thing about building a home in a new development is that everything is new and clean and uncluttered. Unfortunately, these are also the primary disadvantages. Without well-established trees, and the sense of permanence they confer, that spanking-new home can appear misplaced—even foreign to its environment.

Of course, after the down payment, and after that breathtaking cash drain known as “new-house incidentals,” there’s often precious little left for landscaping. And it’s all compounded by the nagging realization that trees take a long, long time to mature.

A \$300 compromise solution

While contemplating \$3000 to \$5000 worth of landscaping can cause the average new-home buyer to break out in hives, a few hundred dollars is more manageable, at least conceptually.

What can you buy with \$300?

A start, consisting of a few trees and shrubs. But this is a good and reasonable start. By planting a few trees now, they’ll have several years of growth while you work on the finishing touches. In this sense, trees and shrubs are more timely investments than perennials along the walkway.

This is compromise thinking, of

course, and compromises are best measured against the all-or-nothing alternatives. In the ALL corner are those who advocate rolling the cost of plantings into the mortgage. But do you really want to pay interest on those plants every month for the next 20 or 30 years? If you do, expect them to cost up to three times their purchase price.

In the NOTHING corner, of course, are those dear and sensible souls who don’t mind living on a moonscape until they’ve saved the money to do it all at once. Each theory has merit, but in the end, compromises aren’t so bad.

Inexpensive professional help

Our first suggestion is to have an architectural landscape plan drawn up. Not only will this give you some professional help in designing an attractive yard, but it will help focus priorities. It’s a simple matter of scale. One look at a blueprint and you’ll know which plantings should come first, second and so on, as finances allow.

A professional landscape plan need not be expensive, and shouldn’t be, when expense is the primary incentive for doing your own work. Many nurseries and garden centers have certified landscape architects on staff or on retainer, and they also make



good use of university students majoring in this field.

For \$50 to \$150, you'll get a workable plan, and in many cases this fee will be refunded with the purchase of a given amount of merchandise. Once you meet this minimum, of course, there's nothing to stop you from buying the rest of your plants elsewhere. We paid \$50 for a landscape blueprint, which will be refunded when we reach \$500 in purchases.

Timing your plantings

The best times to transplant trees and shrubs are in early spring and fall. While summer plantings are common, owing mostly to mortgage company

closing dates, summer heat can take its toll. Even if you were to water religiously, and at the same time not overwater, a summer-planted tree is going to just hold its own. It probably won't grow, but will hunker down and use all of its reserves to stay alive. In that sense, a tree planted in July has little growth advantage over one planted in September.

Planting bushes

We began with a black haw bush (*Viburnum prunifolium*) near the front corner of our house. Our first step was to scale off of our blueprint to determine its exact placement. A quick check with a ruler will get you

pretty close. Our print, for example, was scaled 1 in. to 10 ft.

If you'll be planting without the aid of a scaled plan, try to avoid the common pitfalls of scale. When determining placement, remember how big your tree or bush will be when fully mature. A bush that will spread to 8 ft., for example, should not be planted 3 ft. from the house.

After pinpointing your preferred location, measure the depth and diameter of the temporary planting pot, and dig a hole to match this size. Then over-excavate the diameter by several inches and recheck all dimensions with a tape measure (Photo 1). The slight over-excavation provides room



1 Dig the hole slightly larger and deeper than the nursery pot and check all measurements with a tape measure.



2 Measure liquid fertilizer in the proper amount and pour into a watering can. Dry fertilizers can also be used.



3 Pour 1 gallon of fertilizer solution into the hole, making sure that the sides of the hole are also treated.



4 With a helper holding the pot, raise the bush by its stem until the root ball is completely free from the pot.



5 Lower the root ball into the hole and center it from side to side. Make sure the stem is as straight and plumb as possible.



6 Small, irregular branches may be trimmed at planting, but most shaping should wait at least one growing season.



7 Determine the best location for the plant. Then using a spade, cut the sod and lift it out for use elsewhere.



8 Excavate the soil for larger trees using a shovel or spade. Keep this soil on hand for future gardening needs.



9 Pour liquid fertilizer on both the root ball and around the inside of the hole to encourage new root growth.



10 Use a 2 × 2 to tamp the soil firmly around the sides of the root ball. This reduces the need for support stakes.



11 Use wood-chip mulch to help hold in moisture. Cypress mulch is good because it's long-lasting and rot-resistant.



12 With ball and burlap plantings, make sure to wet the ball thoroughly before planting. A garden hose works best.



13 Once the ball is lowered into place, use a utility knife to cut off all the burlap from the top of the root ball.



14 To help support the tree, drive a 2 × 2 stake—diagonally across the trunk—at least 16 in. into the ground.



15 Wrap the trunk a couple of times with a strip of sturdy cloth. Then loosely tie the trunk to the stake.

for a layer of uncompacted soil next to the root system.

To feed the plant, mix liquid starter fertilizer in a watering can (Photo 2) and pour the mixture onto the sides and into the bottom of the hole (Photo 3). The recommended volume, in our case, was about 1 gallon. Lacking a specialized starter fertilizer, you can use any blend that has a high phosphorous content, such as 5-10-5 (the middle number denotes the phosphorous percentage). When using granulated fertilizer, 1 to 2 tablespoons sprinkled into the hole will be adequate.

With a helper holding the pot, lift the

bush by its stem (Photo 4) and separate the root ball from the pot. Then lower the ball into its hole (Photo 5) and pack the area around the root ball with soil. Water the area generously. Finally, to slow evaporation, and to make mowing a little easier, cover the excavated area with wood-chip mulch.

Traditionally, the over-excavation gap has been packed with peat moss, to encourage root growth and to hold moisture. But these days, most experts recommend packing this gap with some of the soil that was taken from the hole. The thinking here is that the plant needs to make its way in real

soil eventually, and that prolonging an artificial, potted-plant environment does more harm than good.

Finish up by using pruning shears to remove any small, irregular branches that may have sprouted below the primary branches on the bush (Photo 6). More of the lower branches will need to come off eventually, but it's a good idea to allow a full season of growth before doing any real shaping.

Planting potted trees

Next we turned to some river birch trees (*Betula nigra*) that we wanted to plant on an open area of the lawn.

We began by establishing the best locations, and then we cut through and removed the sod in these places with a spade (Photo 7). You can use these pieces of sod to repair thin spots in your lawn or simply add them to your compost pile.

Our river birches came in larger pots than our black haw bush and thus required larger holes. As with bush planting, use the dimensions of the pot to determine the size and shape of the hole. Shovel all excavated soil into a wheelbarrow, and save it for use elsewhere on your lawn or in your garden (Photo 8).

Because of the larger root mass of these trees, pour some liquid fertilizer directly onto the root ball (Photo 9). After placing the tree in its hole, use a length of 2 x 2 lumber to tamp down the soil around the root ball (Photo 10). Because trees are naturally taller, and therefore more susceptible to wind, a loose soil pack can allow too much movement at the root level. Once all the soil is packed in, water the root system and cover the area with cypress mulch to slow evaporation (Photo 11).

Planting ball and burlap trees

The last tree we planted was a large autumn purple ash (*Fraxinus americana*) with a large burlap-covered ball that was far too heavy for much movement. When dealing with such a large tree, be sure to measure the ball carefully then dig a hole to match its dimensions, including several extra inches around the perimeter to allow for easier alignment.

Typically, the burlap is left in place, so after rolling the ball to the edge of the hole, wet it thoroughly with a garden hose (Photo 12) then sprinkle it with fertilizer solution. Also fertilize the sides and bottom of the hole, then roll the ball into place and straighten the trunk.

Use a utility knife to trim all burlap from the top of the ball (Photo 13). Then tamp soil around the edges and over the top, and finish up by covering the excavated area with cypress mulch.

Many people believe that all large trees should be staked. But the verdict is still out on this practice. Your choice most clearly depends on the size and shape of the tree. Evergreen trees should be staked, because their needle-laden branches offer greater resistance to wind. A strong, bracing gust could conceivably lever them right out of the ground. But other trees are less likely to need additional

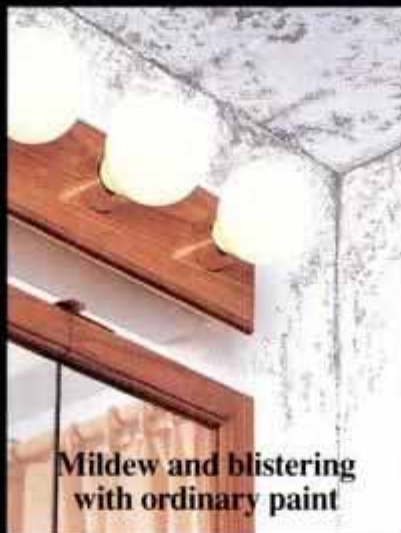
support, at least for long periods. If pushing and pulling on the trunk produces much movement in the hole, go ahead and stake the tree. But if it doesn't, leave it alone.

When staking evergreens, drive three stakes—about 120° apart—several feet from the tree and run wire or rope supports to the trunk. To keep the supports from cutting into the trunk, pad the wire or rope with short lengths of garden hose. When

staking trees like our autumn ash, drive a 2 x 2 stake diagonally across the trunk (Photo 14) then tie the tree to the stake with a length of sturdy cloth. To keep the stake from damaging the tree, the trunk must be protected. You can either wrap the trunk in cloth before tying the two together or you can wrap the trunk to the stake with several figure-eight twists making sure plenty of cloth separates the two (Photo 15).

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How To Install A Garage Door Opener

New extra-safe models protect children and pets.

TEXT AND PHOTOS BY MERLE HENKENIUS

Overhead garage doors can be dangerous things. Just ask emergency room attendants about door-smashed fingers. These injuries occur when hapless homeowners try closing sectional-panel doors by sticking their fingers into the gap between panels and pulling down. Naturally, the gap closes.

You might expect a few mishaps with manually operated doors, but electric door openers have their own grisly history. According to the Consumer Products Safety Commission, 54 children have been killed by automatic garage door openers since 1982.

So what's new in garage door

openers? Safety. Redundant safety. Since the early 1980s, manufacturers have built auto-reversing mechanisms into their power units. As soon as the door hits anything above floor level, the motor automatically reverses itself. While this was a welcome improvement, safety officials wanted more. As a result, every opener manufactured after Jan. 1, 1993, must have a backup, or redundant, auto-reverse mechanism located at the door.

Manufacturers responded to this requirement by providing infrared sender/receiver units, which are installed just inside the doorway, several inches off the floor. The moment the

infrared beam is interrupted by an object or person, the descending door stops and reverses.

Preliminary considerations

With redundant safety mechanisms built in, there's little chance that a door opener will cause serious injury or damage. This is the good news. The bad news is that equipment designed to be this sensitive requires careful adjustment and a host door that works perfectly. If your overhead door will not stay put when opened halfway, if its tension springs are adjusted unequally, if one side binds or drags when used manually, a safety-

sensitive electric opener will sense a hazard and refuse to cooperate.

If your garage door could use some adjustment, consider calling a professional before installing the new opener. Door adjustments are not as easy as they appear, and the tension springs and related hardware are often under extreme pressure.

While manufactured safety is mandated by federal agencies, installations will be regulated at the local level, through building and safety-code statutes. Check with your local codes office for permit and inspection requirements.

Your installation will also require electrical power, in the form of a permanently installed receptacle, located within reach of the unit's power

cord. Don't be tempted to run an extension cord from a wall outlet to the power unit. The resulting voltage drop could shorten the life of the motor.

In our case, the garage was pre-wired for an opener when it was built. If yours wasn't, you'll need to bring power from an existing circuit.

And finally, you'll need overhead ceiling joists to support a site-built support hanger. And because few openers come with their own hanger assemblies, you'll need 6 to 8 ft. of angle-iron, bolts, lockwashers and lagscrews.

Putting it all together

We chose a Stanley garage door opener with infrared sensors for this installation. Stanley makes a variety of openers and you can expect to pay about \$140 for a standard ½-hp Stanley opener, and close to \$300 for the professional model.

Begin by assembling as much of the unit as possible on the garage floor.

The first step is to insert the endcap in the pipe or tube that spans the gap between the power unit and door header. The cap goes into the power-unit end of the pipe (Photo 1).

Next, install the traveler, which is the tube-mounted bracket that joins the two ends of the drive chain (Photo 2). It travels forward and back along the tube when the door is opened or closed. It also provides a manual disconnect latch, if you ever want to bypass the power unit. The traveler simply slides onto the tube, but its positioning is critical. You'll find the word "Door" stamped into one end of the traveler. This end must face the door. With a track-mounted door, the traveler should be positioned 39 to 41 in. from the power unit.

With the traveler in place, install the idler assembly (Photo 3). The idler assembly is a sprocket-fitted length of square tubing that connects the tube to the door-header bracket. After



1 Lay out all parts on the floor, then slide the cap onto the power-unit end of the tube until it hits the retaining flange.



2 Slide the traveler assembly onto the end of the track tube and position it 39 to 41 in. from the power unit.



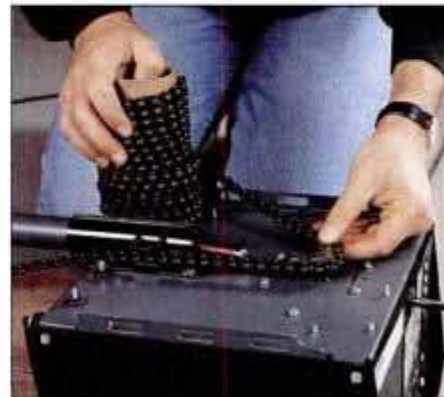
3 Slide the idler assembly onto the door end of the tube. The idler will later fit into a header bracket.



4 Carefully slide the capped end of the track tube into the bracket that's mounted on top of the power unit.



5 Attach the drive chain to the traveler with a repair link supplied in the kit. The retainer clip must face up.



6 Bring the chain around the drive sprocket on the power unit, making sure all the links are completely engaged.



7 At the idler assembly, remove all remaining chain from the spool and feed it through the return sprocket.



8 After connecting the return end to the traveler, tighten the chain by adjusting the bolt on the power unit.



9 Establish and mark the centerline of the door, then transfer this mark to the bracket support board above the door.



10 Attach the support bracket to the brace with lag screws and lock the idler into the bracket with a keyed pin.



11 Attach a 2 x 4 cleat to the ceiling where the joists fall. Then lag a piece of angle-iron to the side of the cleat.



12 To control side-to-side movement, bolt a third piece of angle-iron diagonally between the two vertical hangers.

placing the idler assembly on the door end of the tube, insert the remaining end into its support fitting on the power unit (Photo 4).

Next, attach one end of the drive chain to the traveler (Photo 5). This connection is made with a 2-piece repair link, similar to that of a bicycle chain. This link is secured by a slotted key, which must be installed face-up. Once the link is in place, feed the chain out a little at a time until it reaches the power unit. At this point, bring the chain around the drive sprocket on the unit (Photo 6), and pull out more chain toward the idler assembly.

At the idler assembly, remove the remaining chain from the spool and feed it through the sprocket (Photo 7), pulling out most of the slack between the sprocket and the traveler. Connect this end of the chain to the traveler as well, using a second repair link. Then take all but $\frac{1}{2}$ in. of sag from the chain by rotating the adjustment bolt on the power unit (Photo 8).

Installing the unit

The first step in the mounting process is to establish the exact center of the door opening. Simply measure the opening, divide by two and mark dead

center on the header above the door. To establish the correct bracket height above the floor, you must first determine the maximum height of the door as it arches over its curved track. To do this, raise the door until the top panel rolls to its highest point on the track, just before it turns horizontal. Then prop the door open at this height and measure from the top of the door to the floor. Add 2 in. to this height to clear the door, which yields a workable bracket height.

In our case, the bracket height fell above our structural header, so we nailed a 2 x 4 brace above the header to support the bracket. After marking the bracket height on your 2 x 4, use a level to extend the center-of-door mark up to the brace (Photo 9).

With the bracket marked for position, anchor it to the 2 x 4 support, using lagbolts and a socket wrench. Then lift the idler assembly end of the tube up to the bracket and lock it in place with its pin (Photo 10).

With the idler arm locked into the bracket, lift the power unit and rest it atop a stepladder. Then open the door completely. The door in the overhead position gives you the required height for the power unit. While the tube does

not need to be level, it does need several inches of clearance above the door. We opted for a position about 3 in. higher than the door, and this time we took our measurement off the ceiling.

This distance told us how long to cut the angle-iron we'd purchased to make the support hanger. While building the support, close the door and return the power unit to the floor.

While there are any number of reasonable support designs, we secured ours to a 2 x 4 brace (Photo 11), which was anchored to the ceiling joist with 4-in.-long screws. Once your brace is firmly attached, measure from a common wall to establish the center point, and attach two support legs to the brace, using $\frac{1}{4}$ -in. lagbolts. After lifting the power unit in place, attach it to the hangers, using bolts provided in the kit. To keep the power unit from twisting the hangers sideways, bolt a length of angle-iron diagonally across the vertical hanger supports (Photo 12).

Make the door-to-traveler connection with a 2-piece L-shaped bracket, known as a bar link. Attach this at top and bottom with keyed pins. Then bolt the two halves of the bracket together, using the bolts provided in the kit (Photo 13).

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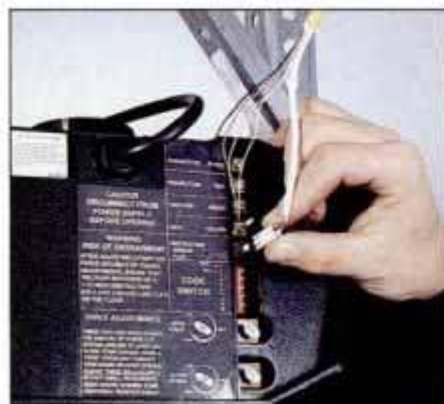
13 Attach the bar link to the door and traveler with keyed pins. Then bolt the two halves of the link together.



14 Insert the low-voltage wires into the receiver/sender-terminal slots and tighten with a small screwdriver.



15 Install the L-brackets on the jack studs for the door opening. Then attach the infrared sensors to the brackets.



16 Attach the low-voltage receiver cable to the back of the power unit. The cable has a 2-pin stab connector on the end.



17 Screw the base of the control to a garage wall and tighten each color-coded wire to the control's terminal block.



18 Make the necessary performance adjustments by turning the screws located at the back and bottom of the power unit.

Installing the redundant sensors

Because direct sunlight striking an infrared receiving unit can trigger a default, the first order of business is to determine which side of the door opening will get the most sun. With this in mind, install the sending unit on the sunny side and the receiving unit on the shady side.

The binding terminals on these units are recessed and surprisingly small, so be sure to wire the units before installing them (Photo 14). The kit comes with two low-voltage, 2-wire cables. One has a stab-in pin connector on one end, while the other does not.

Wiring configurations will vary, but our Stanley unit required that the cable with the pin connector be attached to two terminals on the receiving unit. The remaining 2-wire cable is then joined to the receiver and sender.

To install the infrared units, begin by establishing a common height above the floor and then screw the L-brackets to jack studs on both sides of the door. Then bolt the sender/receiver units to the remaining two brackets (Photo 15), and bolt these brackets to those mounted on the jack studs. (Adjustment can be made by rotating the

sensors or brackets.) Bring the low-voltage cable along the walls and across the ceiling, securing it with shielded staples. Finally, plug the pin connector into the back of the power unit (Photo 16), and install a 60-watt bulb behind the unit's light diffuser.

Wiring the control switch

When shopping for a garage door opener, you'll find a few options you may not have known about. In addition to operating the power unit and light, both manually and remotely, some systems allow you to hard-wire a passage door so that the light comes on for 5 minutes after it's opened. You can also use your remote control to turn on an entry light or porch light. The hard-wired control switch may also allow you to lock the overhead door or use the power unit's light without activating the power unit.

While simple open-and-shut systems will require only a doorbell switch with only two terminals, more complicated controls will require four or five wires and more connections. For the sake of illustration, we opted to show the multifunction control offered with Stanley's professional series. Because our prewired cable had

only two wires, we chose to run new cable along the surface of the drywall, securing it with staples every few feet.

Hookup was still easy, as all wires are color-coded and all terminals are color-labeled. It's a simple, like-color to like-color arrangement (Photo 17).

Final adjustments

As stated earlier, these units require a bit of fine-tuning. In our case, our first attempt yielded a fault, as indicated by a flashing light. The problem was that the unit was calibrated to carry less of a load than our door required. By adjusting a screw at the back of the unit, we were able to correct the problem. This is done incrementally, to avoid setting more load capacity than is needed.

We then found that the door would only travel 2 or 3 ft., stopping neither fully closed nor fully open. This problem was corrected by advancing one of two adjustment screws on the bottom of the unit (Photo 18). When turning these screws, the traveler advances or retracts a few inches at a time.

For more information about Stanley garage door openers, write to Stanley Home Automation, 800 S. High St., Covington, OH 45318. **PM**



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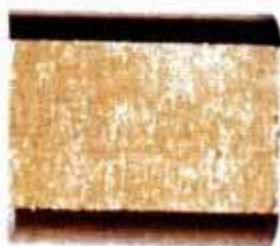
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How To Install A Deadbolt Lock

Here's step one in improving your home security.

TEXT AND PHOTOS BY MERLE HENKENIUS



Most thieves are opportunists, so much so that mere inconvenience is often a substantial deterrent. A deadbolt lock, for example, can make an otherwise easy break-in a lot less appealing. It's not that doors with deadbolts can't be forced or picked. It's that deadbolts increase the amount of noise and time needed for the break-in, and therefore increase the likelihood of being caught. When other common-sense precautions are also used, such as outdoor lighting and heavy-duty window latches, most thieves would rather do their shopping elsewhere.

Using deadbolt locks is unquestionably a good idea. But the type of deadbolt you choose is a bit more complicated, especially if your door has glass window lights or glass side lights. Should you install a single-cylinder deadbolt, which can be operated from the inside with a knob, or a double-cylinder lock, which must be keyed from both sides?

The problem with a single-cylinder lock is fairly obvious. To get in, an intruder merely needs to break the glass, reach in and turn the knob. For this reason, many sources advocate a double-cylinder deadbolt, which can only be thrown with a key, from both outside and inside.

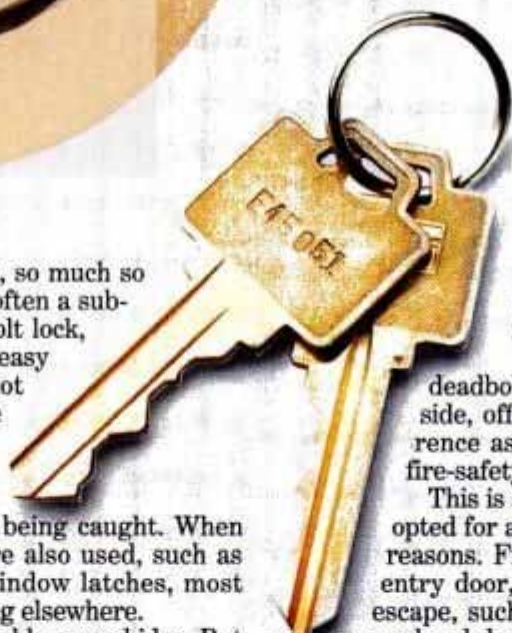
The problem here is that you not only make it harder for a keyless intruder to get in, but for keyless family members to get out in a hurry, especially in the event of a fire. As such, many building and safety codes prohibit the use of double-cylinder deadbolts on residential entry doors. Their argument is bolstered by the fact that glass can

make a lot of noise when broken, and that the last thing an intruder wants is a lot of noise.

Seen in this light, a single-cylinder deadbolt, which is only keyed from the outside, offers nearly as much real-world deterrence as a double-cylinder lock, without the fire-safety hazard.

This is a well-constructed argument. Still, we opted for a double-cylinder deadbolt, for several reasons. First, our installation was in a garage entry door, and our garage has other routes of escape, such as a house-to-garage passage door and an overhead door. Second, this door is separate from the two primary entry doors of the house, and is not in the path of the most likely routes of escape. And finally, our garage will eventually house a small fortune in tools, and the added security offered by a double-cylinder bolt appealed to us.

We opted for an architectural-grade, double-cylinder deadbolt with a 1-in. throw and a saw-resistant bolt, made by Weiser Lock (6660 S. Broadmoor Rd., Tucson, AZ 85746). It costs about \$30. To beef up the doorjamb, which is often the weak link, we opted to replace the standard strike plate with an oversize, heavier version. This strike plate was made by M.A.G. Engineering & Manufacturing (15261 Transistor Ln., Huntington Beach, CA 92469), and costs about \$7. It's nearly 8 in. long, and includes six mounting screws, four of which are 3 in. long. These screws are long enough to pass through the jamb and into



the jack stud of the wall framing. The advantage is greater strength, spread over a larger area.

Boring the door holes

Every deadbolt and lockset comes with a paper template that will help you spot the locations of the edge and side holes in the door. In most cases, the template offers two or more setback depths and two edge widths. Our lock required a 2 $\frac{3}{4}$ -in. setback, and our steel-clad door was 1 $\frac{3}{4}$ in. thick. We chose to position our deadbolt 8 in. up from the lockset, to accommodate the oversize strike plate. If you use a smaller plate, you can lower the lock mechanism an inch or two.

Begin by folding the template along its dotted line and taping it to the door. Then use a pencil to mark the two hole locations (Photo 1). After removing the template, use a holesaw to bore through one side of the door (Photo 2). As soon as the pilot bit pierces the opposite side of the door, remove the saw and complete the bore from the other side (Photo 3). Working in from both sides of the door is important. In the case of a wooden door, boring completely

through can splinter the opposite side. In the case of a steel-clad door, the lightweight steel skin can tear away as the saw teeth poke through.

To bore the edge hole, which will accept the lock bolt, use a Forstner bit or a spade bit (Photo 4). The trick here is to bore the hole as straight as possible. While you'll be able to sight along the top of the drill, thus correcting any side-to-side error, it pays to have a helper sight the vertical orientation. In any case, bore through the edge of the door until the bit enters the lock hole.

Installing the bolt plate

Lock-bolt slides come in two forms: those with faceplates that must be mortised into the edge of the door, and those that have no plates and are simply driven into the bolt hole.

Our bolt came with a plate, so our next step was to chisel out a recess in the edge of the door to accept the plate. Begin by inserting the bolt into its hole and marking the door edge around the perimeter of the plate. Because pencil lines can be too wide for close work, we used a utility knife to mark the perimeter (Photo 5). Then



1 Locate the hole template on the edge of the door between 6 and 8 in. above the lockset. Mark the hole locations.



2 Use a holesaw to bore a hole for the lock bolt. Stop when the pilot bit breaks through the other side.



3 Remove the holesaw and slide it into the pilot hole on the other side of the door. Finish the cut from this side.



4 Bore the hole in the edge of the door, making sure the bit is perpendicular to the door in both directions.



5 Slide the bolt assembly completely into its hole, then scribe around the bolt plate with a sharp utility knife.



6 Remove the bolt assembly, then chisel out the stock below the plate (about $\frac{1}{8}$ in.) so the bolt plate fits flush.





7 Slide the bolt assembly into place again. Then bore pilot holes and attach the assembly with the screws provided.



8 Slide one side of the lock mechanism through the slot in the bolt assembly. Then slide the other side into place.



9 Securely join the two sides of the lock mechanism by driving two screws through the inside lock mechanism.



10 Mark the face of the deadbolt with a grease pencil. Then throw the bolt against the jamb to mark the jamb hole.



11 Locate the centerpoint of the pencil marks left on the jamb. Then bore the jamb hole to the proper depth.



12 After testing the operation of the lock, secure the jamb plate by driving long screws into the jack studs.

use a 1-in. chisel to remove enough stock so the bolt plate will fit flush with the door edge (Photo 6).

As always, the danger is that you'll overcut, so work carefully, shaving out thin ribbons of wood with each pass of the chisel. If your chisel is sharp, mere hand pressure will be enough.

Assembling the lock

With both holes bored and the edge of the door recessed for the bolt plate, slide the bolt into its hole and press the plate into the recess. Bore two screw pilot holes through the bolt plate and into the edge of the door. Then attach the bolt assembly by driving screws into the door edge (Photo 7).

Next, install the two lock cylinders. Begin by feeding the inside cylinder through its slot in the bolt assembly. (The inside cylinder has screwholes, the outside cylinder does not.) Then tip the outside cylinder into the slot next to the inside cylinder, and press both cylinders against the door (Photo 8).

Our lock came with three long bolts that join the two cylinder halves. Two of these bolts have standard Phillips-heads, but the third has a nonremovable slotted head. This bolt lacks the

slot surfaces needed to back it out from the lock with a screwdriver. We used the two Phillips-head bolts to join the two halves of the lock (Photo 9) until the entire installation was completed and tested. Only then did we back out one of the Phillips-head bolts and replace it with the nonremovable bolt.

Setting the strike plate

Strike plates, especially oversize ones, need not be mortised in when there is adequate space between the door and jamb. Because we had plenty of clearance, we opted to surface mount our plate.

If you'd prefer to mortise in your strike plate, simply proceed as shown here to determine the proper position of the bolt hole. Then center your plate over this hole and trace its perimeter on the jamb. Remove the waste with a sharp chisel.

The most critical aspect of setting a strike plate lies in pinpointing exactly where to bore the doorjamb. You can do a good job with careful measuring, but an easier method is to let the bolt tell you where to bore. We opted for the easy way and marked the four corners of the bolt face with a grease pencil (Photo 10). A

crayon or lipstick will also work.

Begin by withdrawing the bolt and closing the door. Make sure the lockset is engaged. Then use a key to throw the bolt hard against the doorjamb several times. The bolt will transfer the grease-pencil marks to the jamb. Then simply bore the jamb at the centerpoint of the marks (Photo 11). Because our bolt's throw was longer than our jamb's width, we drilled completely through the jamb and into the wall framing slightly.

Finally, close the door and throw the bolt into the jamb hole. Then position the oversize strike plate and bore holes in the jamb to accept the plate's 1/4-in. screws. Make sure that the plate is oriented so the two shorter screws are near the inside edge of the jamb, and the 3-in. screws are nearer the doorstop, in line with the wall studs.

With the strike plate secured by the two shorter screws only, open and close the door several times, locking and unlocking the bolt on each occasion. When you're satisfied that the lock works smoothly, bore the remaining pilot holes and drive the 3-in. screws through the strike plate and jamb, and into the jack studs (Photo 12).

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SKIL

How To Install Under-Cabinet Lights

Shed some light on your kitchen countertops with these great fixtures.

TEXT AND PHOTOS BY MERLE HENKENIUS

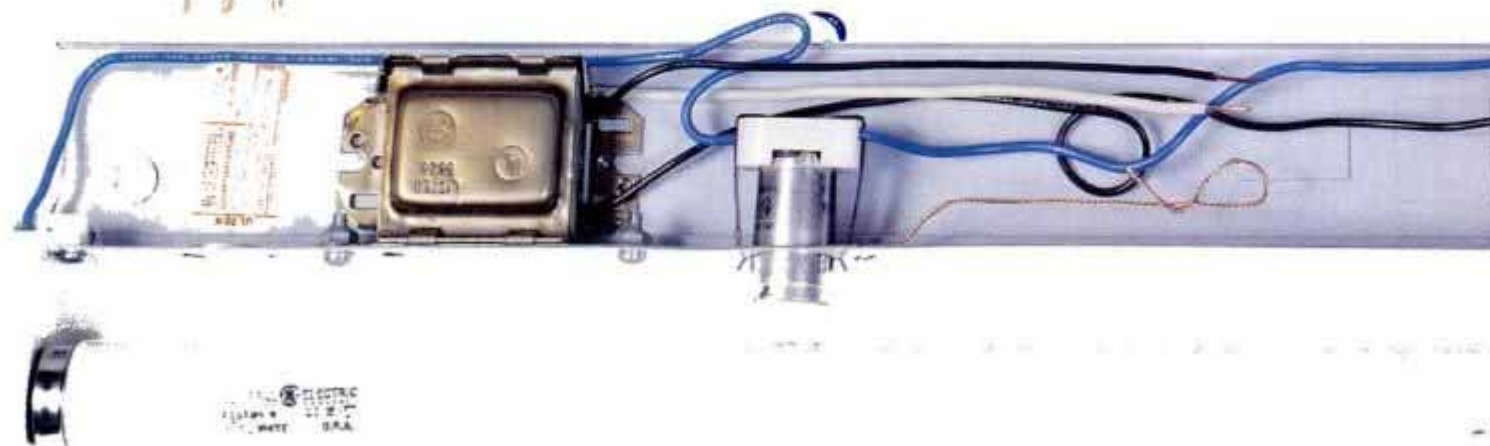
When building a new home, it's not easy to anticipate all the spots where task-lighting will be needed. After a few months, however, sins of omission become painfully obvious. One such area is the kitchen counter, where upper cabinets tend to block the light from overhead fixtures. Given the amount of work done on kitchen counters—and not all of it food related—under-cabinet lighting can prove especially useful. Luckily, these fixtures are not that difficult to install even after the house is finished.

In our case, we wanted the counter under two overhead cabinets to have direct light. Each cabinet was 21 in. wide, so we opted for fluorescent fixtures that were 18 in. long,

4½-in. wide and 1¼-in. deep. This shallow depth allowed us to conceal the fixtures behind each cabinet's lower front rail. Viewed head-on, neither fixture is visible.

We chose fixtures made by Seagull Lighting (P.O. Box 329, Riverside, NJ 08075). Each fixture requires a single 15-watt fluorescent lamp, which is sold separately. We paid \$22.50 for each fixture, and \$3 for each lamp.

Our fixtures came with their own switches, which are designed to be installed in one of several channel knockouts. But we chose not to use these dedicated switches. Instead, we wired both to a new single-pole switch mounted in the wall below the cabinets. Both fixtures are controlled by this switch.





Electrical access

The first order of business is to determine where you'll gain access to electricity. Because electrical codes prohibit tapping into kitchen receptacles dedicated to small appliances, your best bet is to access one of the existing, general-lighting circuits.

To find a circuit with the capacity for expansion, use this simple rule of thumb: Assign 1.5 amps to each light and receptacle on a circuit. At this rate, a 15-amp breaker would accommodate 10 devices (light fixtures or receptacles), and a 20-amp breaker, 13 devices. To determine the number of devices on a circuit, shut off the

power and count all the dead light fixtures and receptacles.

In our case, we found the easiest point of access was an unfinished area of our basement, just below the kitchen. Because our basement lighting circuit was underrated, we tapped into an existing porcelain fixture with a pull-string switch.

Where to begin

Begin by locating an open stud space between the overhead cabinets and the countertop. Your goal is to keep all supply wiring, plus the new switch box and cabinet-access hole, within this stud space. An electronic stud

sensor can help pinpoint the best box location. Tapping on the wall and listening for a change of sound as you move across the studs will also work.

Once you've settled on a location, bore a hole through the rear cabinet rail at this point (Photo 1). This is a good time to also bore a hole through the adjoining cabinet sides (Photo 2). This hole allows joining two fixtures with flexible conduit.

Next, locate the switch box, using the height of the other switches in the room as a guide. Plan on using a non-metallic cut-in box for this job. Simply press the box against the wall and trace around its perimeter (Photo 3).



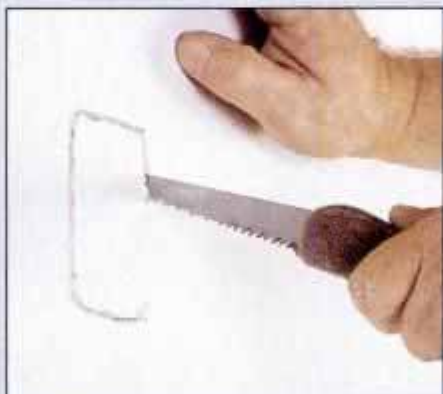
1 Locate the best position for the electrical cable, then bore a hole through the rear cabinet rail and into the wall.



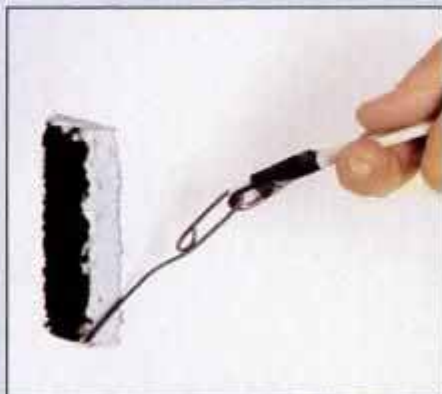
2 If necessary, bore a hole through the side partitions of adjoining cabinets so the fixtures can be joined with conduit.



3 Position a cut-in switch box at the same height as other switch boxes in the room. Then trace around the box.



4 Use a drywall saw to cut along the traced line. Work close to the line to eliminate any patching required later.



5 Feed a fish tape into the box hole from the basement. Then attach the cable to the end and tape the connection.



6 Using the fish tape, gently pull the cable into the basement. Avoid cutting or abrading the cable insulation.



7 To get power from a ceiling fixture, join the like-colored wires from the new cable to those of the power feed in the box.



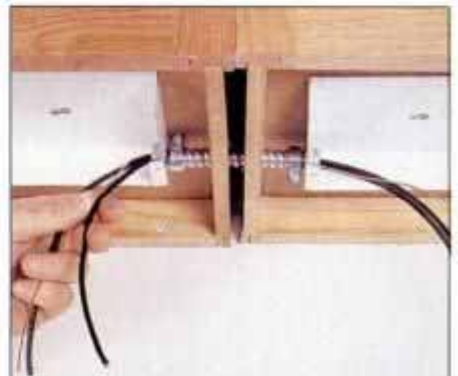
8 To run the cable between the fixture and the switch, feed the cable through the cabinet hole, down to the opening.



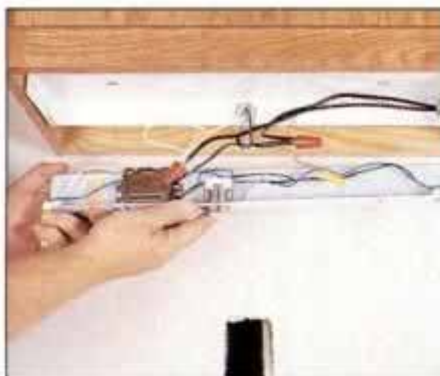
9 Protect exposed cable lengths with flexible conduit. Join the conduit to the fixtures with box connectors.



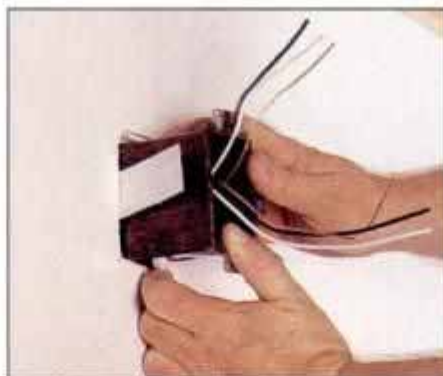
10 Once the cable is fed through the conduit, attach the fixture channels directly to the bottom of the cabinet.



11 Install flexible conduit between fixtures, too. Use box connectors to secure it, then run wires through it.



12 Using wire connectors, join the like-colored switch and fixture wires with those going to the other fixture.



13 After pulling both cables into the cut-in box, press the box into its opening. Then tighten the support bracket.



14 Join the wires to the back of the switch, then press the switch into the box. Install a cover plate and test.

Then cut out the hole using a drywall saw along the traced line (Photo 4).

Installing cable

With the opening for the cut-in switch box made, go into the basement and bore a hole into the stud space from below. To make sure the hole falls in the correct stud space, measure from a feature common to both sides of the floor. In our case, we used a plumbing drain.

Use an inexpensive fish tape to pull new cable between the new box opening and the basement. Feed the tape up from the basement, while a helper

pulls it through the cut-in opening. With the fish tape through the box opening, fasten 14/2 (with ground) cable to the tape's hooked end, and tape the cable securely in place (Photo 5). Then pull the fish tape and cable into the basement (Photo 6).

Once in the basement, pull the cable to your target ceiling box. When moving across joists, bore holes through the middle of the joists and pull the cable through. When running along a joist, staple the cable along the side of the joist every 4 ft. and within 8 in. of the box.

To wire the circuit extension, first

shut off the power to the circuit at the service panel. Then remove the existing fixture and drive a screwdriver through an unused knockout in the box. Feed the new cable into the box and strip the sheathing from the cable, leaving at least 8 in. of wire exposed below the box.

Then strip 1/2 in. of insulation from each new wire, and cut three insulated pigtails—one white, one black and one green. Next, fasten one end of each pigtail to its terminal screw on the fixture, and join all like-colored wires with wire connectors (Photo 7). As always, the brass terminal gets the

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black wire; the silver terminal, the white wire; and the green terminal, the green wire. With all connections made, replace the fixture and move upstairs. Complete the rough wiring by pulling a short length of cable between the cabinet and the switch box opening (Photo 8).

Installing the fixtures

Most electrical codes require exposed lengths of wiring to be encased in con-

duit. In our case, this meant two short pieces of conduit, one between the fixture and the wall, and the other between the two fixtures. Begin by cutting a 6-in. length of 1/2-in. flexible conduit and fastening it to a standard cable connector. Then remove the appropriate knockout plug from the first fixture, slide the connector into this hole and tighten it in place (Photo 9).

Also remove a knockout from one end of each fixture and install cable

connectors in these openings. These connectors are later joined by a short length of conduit.

Under-cabinet fixtures are designed to be screwed directly to the bottom of the cabinet. While this is easily done, beware of a common pitfall. With some factory-made cabinets, the floor of the cabinet is made of thin composition board. If your cabinet is made in this way, an alternate fastening method is in order. You might drill the cabinet floor and use machine screws, with the nuts concealed inside the fixture channel. Or, you can beef up the floor with a piece of plywood, stained or painted to match the cabinet.

In our case, we used short screws and tightened each fixture directly to the bottom of the cabinet, approximately 4 in. in from the wall (Photo 10).

With the fixtures mounted and cable fed through the flexible conduit at the rear of the first fixture, join the two fixtures with a second length of conduit. Then feed individual jumper wires through this conduit, so that the two fixtures can be wired together (Photo 11).

Because fixture ballasts are heat producing, use high-temperature wire—available at hardware stores—for these jumpers. You can use bare wire to join the grounding pigtails that are attached to each fixture channel.

To wire the two fixtures, use wire connectors to join the black and white switch wires to the black and white lead wires from the first fixture, and to the jumper wires for the second fixture. Tie all blacks together in one wire connector and whites in another (Photo 12). Then join the black and white leads from the second fixture to the jumper wires, and finally join all the ground wires.

Wiring the switch

To complete the wiring, pull both cables in the box opening into a new cut-in box. After stripping the sheathing from the cables, press the box into the opening (Photo 13) and tighten the screw that binds the support clamp to the wall.

As always, only the hot (black) side of the circuit is switched. Join both neutral (white) wires with one connector and both ground wires with another connector. Then press the black wires into their stab-in slots in the back of the switch (Photo 14). To finish the job, install the switch and cover plate, then put a lamp in each fixture and snap the light diffusers in place. Turn on the circuit power and make sure everything works.

PM

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How To Seal

Concrete Floors

Reduce the dust on slab floors and keep stains from taking permanent hold.

TEXT AND PHOTOS BY MERLE HENKENIUS

At first glance, painting a garage floor—or any concrete floor—may seem simple enough. You just scrub the floor as best you can, buy a few gallons of enamel porch paint and roll it on. While this is exactly the way it has been done for years, the results have often been disappointing. And new EPA limits on paint solvents have not been a big

help. These limits have driven some of the most rugged paints from the consumer marketplace.

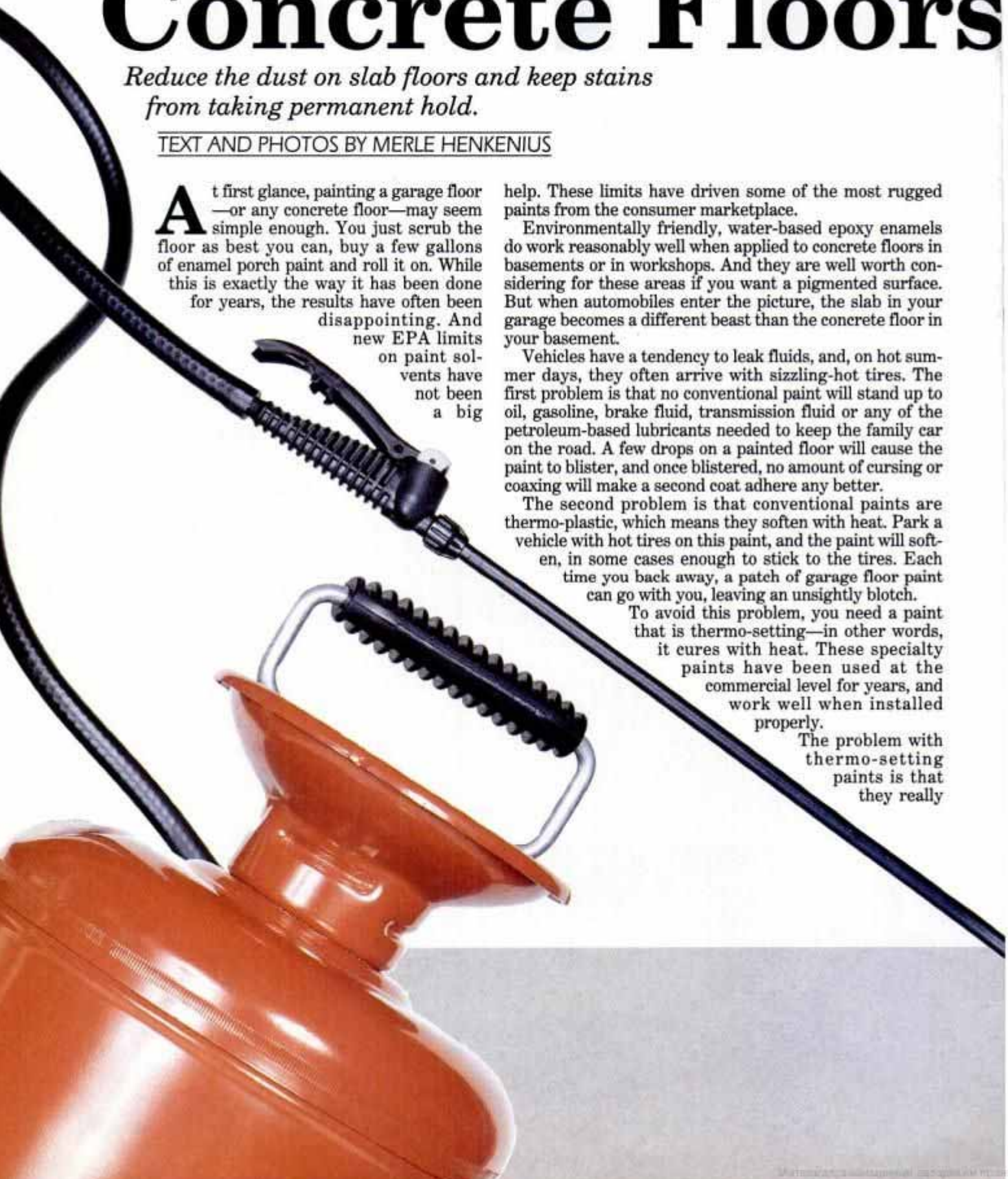
Environmentally friendly, water-based epoxy enamels do work reasonably well when applied to concrete floors in basements or in workshops. And they are well worth considering for these areas if you want a pigmented surface. But when automobiles enter the picture, the slab in your garage becomes a different beast than the concrete floor in your basement.

Vehicles have a tendency to leak fluids, and, on hot summer days, they often arrive with sizzling-hot tires. The first problem is that no conventional paint will stand up to oil, gasoline, brake fluid, transmission fluid or any of the petroleum-based lubricants needed to keep the family car on the road. A few drops on a painted floor will cause the paint to blister, and once blistered, no amount of cursing or coaxing will make a second coat adhere any better.

The second problem is that conventional paints are thermo-plastic, which means they soften with heat. Park a vehicle with hot tires on this paint, and the paint will soften, in some cases enough to stick to the tires. Each time you back away, a patch of garage floor paint can go with you, leaving an unsightly blotch.

To avoid this problem, you need a paint that is thermo-setting—in other words, it cures with heat. These specialty paints have been used at the commercial level for years, and work well when installed properly.

The problem with thermo-setting paints is that they really





1 Use a putty knife to scrape any paint splatters, construction adhesive or other debris from the surface of the floor.



2 Be sure to vacuum any loose debris from control joints. Any material left behind will be trapped permanently.



3 Use a stiff brush and a strong degreaser or concrete cleaner to remove oil spots and tire grime from the surface.



4 Pour sealant into a paint bucket for cutting-in purposes, then fill a low-pressure sprayer for the larger areas.



5 Begin applying the sealer by cutting in the entire perimeter of the floor. Be sure to use a stiff-bristle paintbrush.



6 Take extra pains to apply sealer around areas that are open to the weather, like this garage door opening.

aren't made for homeowners. They are generally 2-part epoxies, which must be mixed on-site and applied very quickly, often in less than 30 minutes. Moreover, while many such paints may now meet VOC (volatile organic compound) limits, depending on your state's regulations, they still require extreme caution. You need plenty of ventilation, protective clothing and a good respirator to apply these paints safely. In other words, you need professional equipment and expertise. Expect to see "Not For Residential Use" printed on each can.

Liability has a lot to do with manufacturer reluctance to sell these products to consumers, but warranties are also at issue. As it turns out, no matter how good the paint, surface preparation is critical. As such, most sources recommend sandblasting or acid-washing a concrete floor before painting. With sandblasting and two coats of paint, a typical garage floor job could easily cost more than \$500.

A safe, easy alternative

In our search to find something that would repel oils and road salts and still be easy to clean, we discovered Enviroseal Surface Guard (Hydrozo Inc., 1001 Y St., P.O. Box 80879, Lincoln, NE 68501). Surface Guard is a clear latex sealant that repels oils, antifreeze and road salts. These materials simply bead up, and can be swept or wiped away. It goes down thin and milky, but cures clear in 3 to 4 hours. And best of all, it is not hazardous to breathe, and all tools can be cleaned with water.

Unfortunately, it's a little pricey. Coverage ranges from 150 to 200 sq. ft. per gallon, depending on surface roughness, and costs about \$65 per gallon. Moreover, at present, the smallest available container holds 5 gallons. As such, you may want to split the cost with a neighbor. Or, as this sealant contains a UV stabilizer, you might want to use the remainder to treat your driveway.

Application

Our 24 x 24-ft. garage floor was less than a year old, but it still required a

good cleaning. Had it been treated with a curing agent when poured, we would have needed to strip the curing agent with a power washer. The first step is to sweep the entire floor, then scrape up any paint drips and other debris left behind during construction (Photo 1).

Next, vacuum the entire floor, including the control joints (Photo 2). Then wash all soiled areas and oil spots with a commercial concrete cleaner (Photo 3). We used Sure-Fix, manufactured by W.R. Bonsal Co. (P.O. Box 241148, Charlotte, NC 28224). A solvent degreaser or even an oil-lifting dish detergent can also work. The trick is to keep scrubbing until only the faintest trace of a spot remains. If oil spots are fresh, cat litter or portland cement scrubbed in with a standard masonry brick can save a good deal of time. When finished, hose down the entire area with water and allow it to dry for 24 hours.

Because sealants will separate in storage, use a drill-driven paint mixer to blend the solution. Pour a quart or so of the sealant into a paint bucket and then about 2 gallons into

HOME IMPROVEMENT GUIDE



7 Using a standard garden sprayer, start in one corner of the floor and begin applying sealant in manageable segments.

your garden sprayer (Photo 4).

Working from the bucket, use a 3-in. brush to cut in a 6-in.-wide path around the walls (Photo 5). Also carefully cut in along the expansion joint between the garage floor and driveway, and around all permanent floor features, such as the overhead door tracks (Photo 6).

With the perimeter cut in, use the tank sprayer to apply a fairly thick layer of sealant to an area about 10 x 10 ft. (Photo 7). Before moving on, allow each area to saturate for



8 After allowing the sealant to penetrate for about 5 minutes, use a push broom to even out the coverage.

5 minutes, then work the sealer in with a medium-bristle push broom (Photo 8). Sweeping increases penetration and also eliminates any voids created by air bubbles. By working backward, and by pulling any excess sealant into the dry areas, you can keep the sealer from puddling.

If puddling occurs that can't be removed with the push broom—in control joints, for example—simply sweep out these areas with your cut-in brush (Photo 9).

Plan your work so you won't be



9 Any excess puddling of sealant in control joints or other depressions should be swept away with a brush.

crossing over the newly coated areas when they are still wet. We began in a back corner of the garage and moved toward the garage door opening in sections that were about 10 ft. square. Then we returned to the back of the garage and began another strip, continuing in this way until the floor was done. Of course, working in the confines of a full basement can be quite a bit harder. Just plan your escape route beforehand and never apply sealer to an area larger than can be easily reached with your broom. **FM**

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CAR CARE

CAR CLINIC

BY MIKE ALLEN,
Associate Automotive Editor

A Noisy Proposition

There's a howling, buzzing noise coming from the radio in my '88 Buick Century. It constantly varies up and down in pitch as I drive. The dealer's service department has replaced the ignition wires and some incredibly expensive little gadget they said controlled the sparking, but there's been no change. They say they have no idea what's wrong.

Another shop put some sort of gadget in the wire to the radio, and it helped some, but the noise is still there all the time.

JOHN PESCADERO
OCEANSIDE, CA

Likely candidates for your buzzing:

- *The ignition. Yes, they've changed the wires and the ignition controller, but there could very well be a bad coil or a poor connection on the primary side.*
- *The alternator. Or the voltage regulator. Or both.*
- *Any one of a number of electrical connections under the hood. The noise may be caused by a poor connection, which is then broadcast to your radio through the wiring.*

But how do you find out which it is? Get a cheap transistor radio—the cheaper the better, as more expensive radios are more resistant to man-made noise. Turn the dial to an unused channel on the AM band, and run the volume way up. If the radio has an extendible antenna, leave it folded away—it's not used for AM reception. Headphones might help, but be careful to keep the wires out of any moving objects such as the belt or fan.

Start the engine. Prospect around your engine compartment with the radio, like a Geigercounter. The radio's internal bar antenna is directional—turn the radio through 90° arcs to pinpoint the source of the noise. It might help to have a helper rev the engine up and down so the noise will constantly change in



PM ILLUSTRATION BY DON MANNES

pitch. But don't get run over—make sure it's a responsible adult behind the wheel.

More tips: If the problem is the alternator, the noise might change in intensity—but not pitch—if you turn on a heavy electrical load such as the headlights or rear-window defroster.

Don't forget to check electrical grounds as well as hot leads, including the ones under the dash.

Toxic Avenger

What's the story on this nontoxic antifreeze? They claim it's safe to drink, but is it as good at preventing corrosion in your engine? Is it safe to

dispose of in my septic tank without poisoning it?

JOHN SAVAK
JOHNSONVILLE, MO

The stuff you're talking about is on the market under several brand names. It essentially replaces the ethylene glycol with another alcohol called propylene glycol, which is more expensive to manufacture—justifying the premium price.

The literature for this stuff, while not exactly outright lying, is, at best, misleading. Yes, the FDA allows propylene glycol to be used as a food additive. It's found as a moistening agent in spices—but the amount you might ingest is almost microscopic.

CAR CARE

The oral LD50 dose of ethylene glycol (the amount that kills half of the test subjects) is 8.5 gm/kg. That means that a small child or pet needs to ingest only a few spoonfuls to put them in serious trouble. The LD50 dose of propylene glycol is 20 gm/kg, meaning it would only take about twice as much to be fatal if it is swallowed.

One major advantage of propylene glycol is that it doesn't have that syrupy sweet smell or taste—however, little kids and dogs will put anything in their mouths regardless of its taste.

The companies peddling this stuff also claim it's biodegradable. So is conventional antifreeze—but if you've got a copper radiator, there's bound to be some lead contamination from the solder holding it together regardless of what kind of antifreeze you've been using.

Having said that, these products work just fine, and you may well consider the reduced toxicity worth the premium price.

I would never drain any kind of antifreeze or chemical into a septic

The Missing Link

• I had a friend bring me her car last week, terrified by a mechanic who had told her that it might cost hundreds of dollars to repair a malfunctioning headlamp dimmer switch. The switch, he said, was integral with the steering column and might require replacement of the entire steering column, airbag and all. Her car was due for its annual state inspection, and couldn't get a sticker unless all the lights were operational.

Sigh. Either the mechanic she consulted was severely misinformed, or there was a substantial rip-off brewing. Her particular vehicle, like many, has a dimmer switch that's actually mounted on the steering column under the dash far from the actual dimmer wand. There's a metal connecting link to hook the two together. Hers was bent so I straightened it. Total cost for parts: zip.

Admittedly, there was a good half-hour of disassembly of the plastic cover, and some fiddling around to get things just right—but hardly the \$500 bill she was warned about.

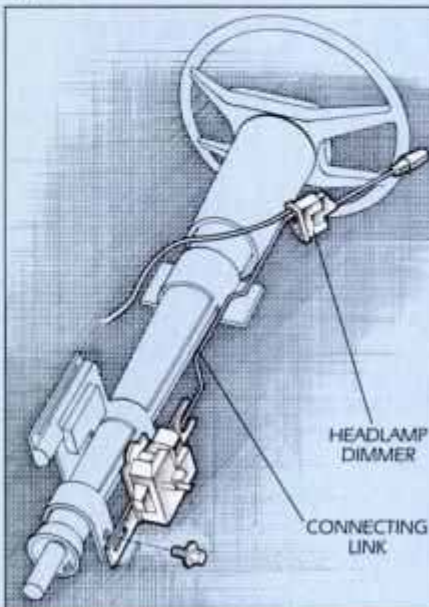


ILLUSTRATION BY ANDREW L. BISHOPMAN



CAR CARE

tank. While both are biodegradable, they require considerable oxygen to break down and they may well starve your system's normal bacteria, leading to a premature need for digging up your tank.

Pushy Guy

I had a discussion with a guy who was a mechanical engineer. He said you can push a car with an automatic transmission up to about 40 mph and drop it into gear to start the engine. Any truth to this?

JACK 36

(FROM THE PM BULLETIN BOARD)

Most all modern cars with automatic transmissions have only one oil pump, driven from the torque converter (input) side of the tranny. So no matter how fast you go, there'll never be any hydraulic pressure to make the tranny go into gear. If the trans was still in Neutral, there would be, of course, no way to rotate the engine to start it.

Some early cars with auto trans had a rear oil pump as well, driven from the transmission output shaft. This ploy would work with them, as

the output shaft would spin whenever the rear wheels were turning and generate hydraulic pressure to put the trans in gear.

So while this is possible for some vehicles, it's not a good idea. You're likely to shock-load the U-joints or internal clutches inside the tranny to the breaking point.

Pushing a car with a manual transmission is acceptable mechanically, but still not a good idea. I've done it, but only with another adult driver who understood a lot about cars, and whose driving skills and judgment I trusted.

Aside from the obvious damage to bumpers, remember that the pushed vehicle will have no power steering or power brakes until the engine comes up to speed.

By the way, did I mention that this is illegal to do on any public road?

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

● Here's a TSB that names virtually every Ford car and truck since 1985. If your vehicle has a buzz or rattle from the exhaust system, it may be caused by a loose heat-shield on the catalytic converter. The fix is to install two inexpensive stainless-steel hose clamps around the shield and converter.

● It seems that some 1991-92 Chevrolet Cavaliers and Lumina have fuel tanks that were not rinsed by the tank supplier before being installed in the vehicle. Traces of the stamping die's lubricant may form a gel and cause a noisy fuel pump or low fuel pressure.

● If your 1990-92 Jeep Wrangler's fuel gauge reading has little connection to the amount of fuel in the tank, the bottom of the tank might be bowed upward. This restricts the amount of fuel in the tank, and interferes with the float for the fuel gauge sender. You need to have the dealer replace the tank, and perhaps the sender as well.



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MAINTENANCE BASICS

AIMING HEADLIGHTS

BY DON CHAIKIN,
Automotive Editor

● If you never disturb the aim of your car's headlights, you should never have to re-aim them. However, it may take less than you think to disturb their aim.

Obviously, if the front of your car or truck is involved in even a seemingly insignificant fender-bender, the headlights may be out of whack. Less obviously, each time you replace a sealed beam or halogen bulb in a composite headlight, the accuracy of the light's aim might be affected.

Therefore, periodically, and after replacing a light, you should check the headlight aim.

Before beginning, be sure the tires are all properly inflated, there isn't a huge load in the trunk or cargo bed, and none of the springs is sagging. Also, the vehicle must be parked on a level surface.

All headlights have adjusting screws, in addition to their mounting or retaining screws. However, you may have to remove a trim ring or bezel to gain access to them. You will find one adjusting screw along the top or bottom edge of the light, which adjusts the beam's direction up and down, and another similar screw on either side of the light, which adjusts the beam left and right. The adjusting screws are spring loaded.

● Some newer car and truck models with composite headlamps have bubble-type sight-glass levels built into each headlight housing.

To aim these, turn the adjusting screws until the bubble is centered in the marks in the sight glass.

If your car or truck is not equipped with these sight-glass levels, try the following procedure.

- Pull the car or truck right up against a flat, light-colored wall.
- Make chalkmarks on the wall opposite the center of each headlight. If you have a 4-headlight system, make the marks in front of all four lights.
- Move the car straight back from the wall and make large, easily seen crosses through the chalkmarks.
- Park the car or truck so the lights are 25 ft. away from the wall.



● Then turn on the headlights to low beam—the outer two or upper two in a 4-light system. The bulk of the light pattern should fall just below and to the right of the centers of the crosses that correspond with the centers of these lights.

● Turn the appropriate adjusting

screw in or out, in 1/4-turn increments, to move the beam as needed.

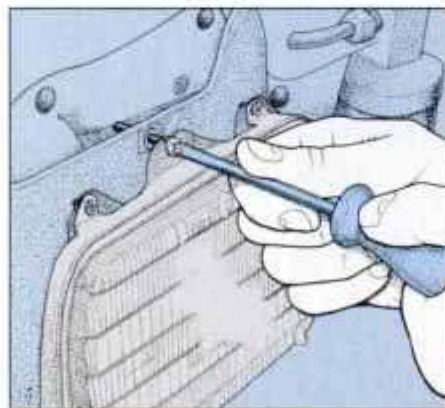
On 2-light systems, adjusting the low beam should also adjust the high beam. On 4-light systems, however, you have to repeat the low-beam adjustment process with each of the separate high-beam lights.

● Since the low beams will also be on when you switch to high beams, you must block their light so you can clearly see the high beam on the wall.

● Mask the low-beam units with a small piece of wood or heavy cardboard.

● The centers of the high beams' light should fall about 2 in. below the centers of the crosses on the wall.

Double check your headlight aim by driving down a dark road. The low beams should illuminate the road only in front of the car. The high beams should light up the road to about 300 ft. ahead of you, as well as illuminating trees and lamp posts along the right shoulder.



Turn adjusting screws in slow, 1/4-turn increments to adjust headlamp's aim.

SATURDAY MECHANIC

REPLACING MacPHERSON STRUTS

BY JOHN DECKER

● When you first drove your new car home from the dealer's showroom, you were amazed at how well it handled. No shakes. No shimmies. And there wasn't a rattle to be heard anywhere.

But that was 50,000 miles ago. That new-car smell is long gone. And lately you've noticed that your once-nimble steed is as lively as an old plow horse around corners. Worse still, the front end takes a healthy nosedive when you hit the brakes. You've also noticed some pretty odd tire wear on the front

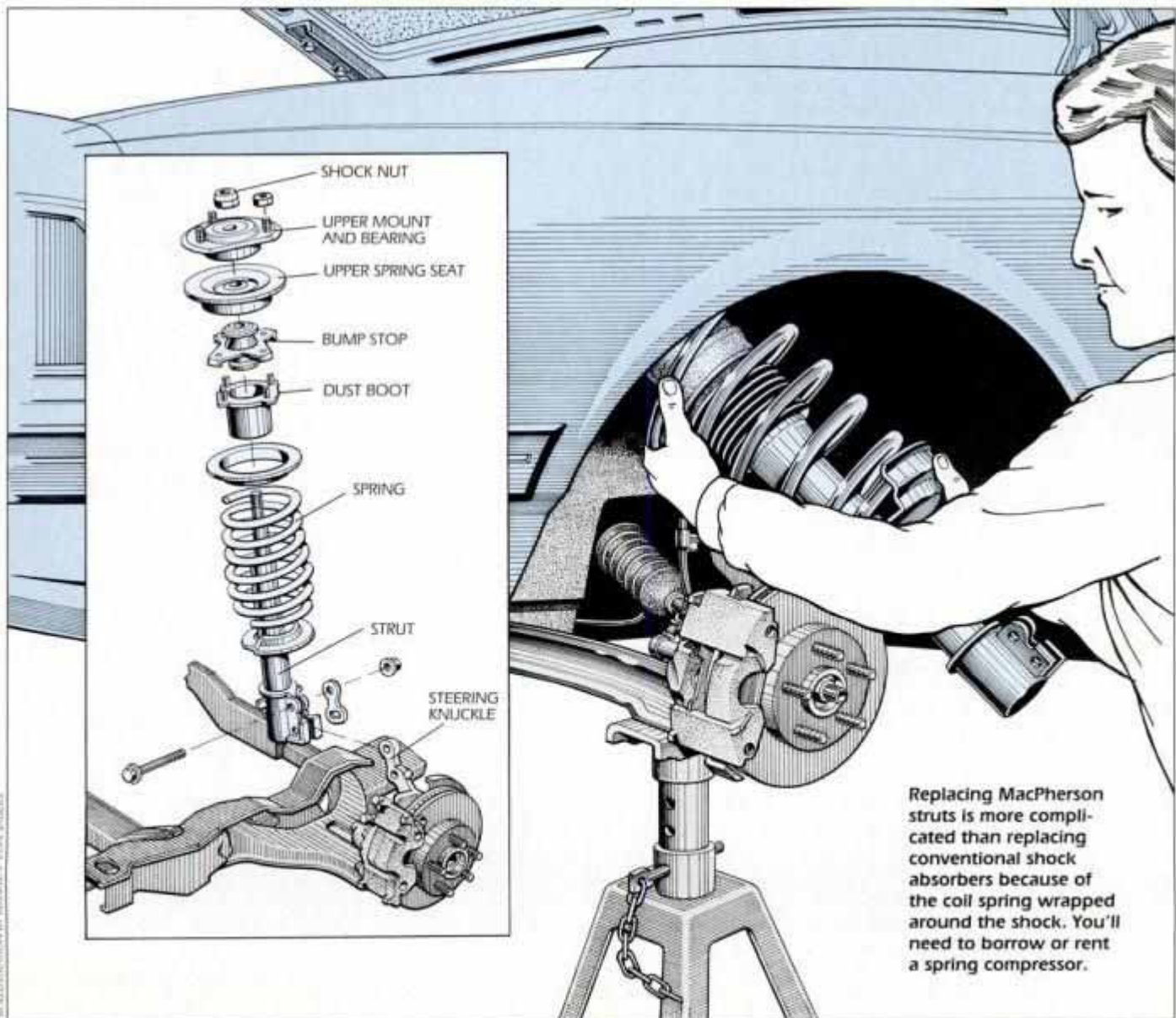
tires. Time for a new car? Maybe. But new MacPherson struts will probably bring a lot of that new-car feel back, if not the new-car smell. At the very least, your car will be safer to drive.

Shock talk

Like standard shock absorbers, MacPherson struts dampen the jounces, bounces and oscillations that the suspension springs create.

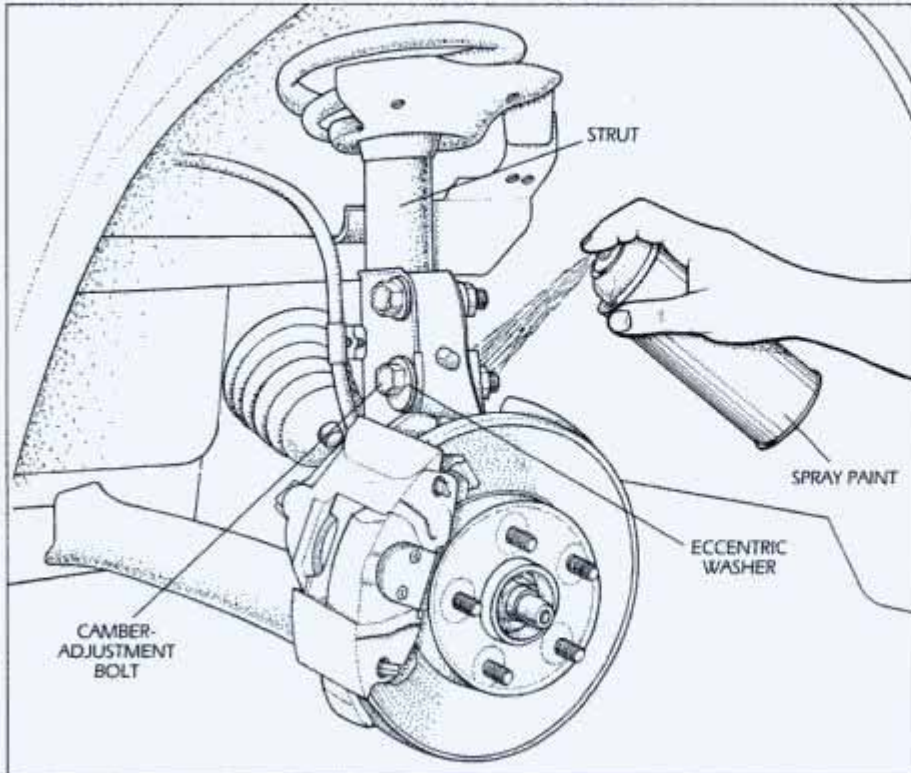
When the struts wear out, your car's wheels begin to act as if they have minds of their own, bouncing up

and down like well-dribbled basketballs, over even the slightest roadway irregularities. While turning, your car heels over and the tires squeal. And once the turn is completed, the car comes back to the straight and narrow about as well as the *Exxon Valdez* trying to avoid a big rock. At speeds above 50 mph, the steering wheel may shimmy as the front wheels dance along the pavement. This, in turn, causes the tires to develop a cupped-wear pattern at the edges, called scalloping, which makes the tires noisy.



Replacing MacPherson struts is more complicated than replacing conventional shock absorbers because of the coil spring wrapped around the shock. You'll need to borrow or rent a spring compressor.

PHOTO ILLUSTRATION BY MICHAEL J. VOYAK/VALDES



A quick shot of silver spray paint on the camber-adjustment hardware on the strut will aid in alignment when it's time to reassemble.

Stronger by design

Think of a MacPherson strut as a regular shock absorber that has extra duties, such as holding the suspension spring, and, at the front end, serving as the upper pivot point for the steering, not to mention supporting the weight of the car. A MacPherson strut's telescoping shaft is thicker and a lot stronger than the shaft on a conventional shock. The guts of a strut work just like a shock absorber. Hydraulic oil passes through valving to dampen suspension movement.

Inspecting struts

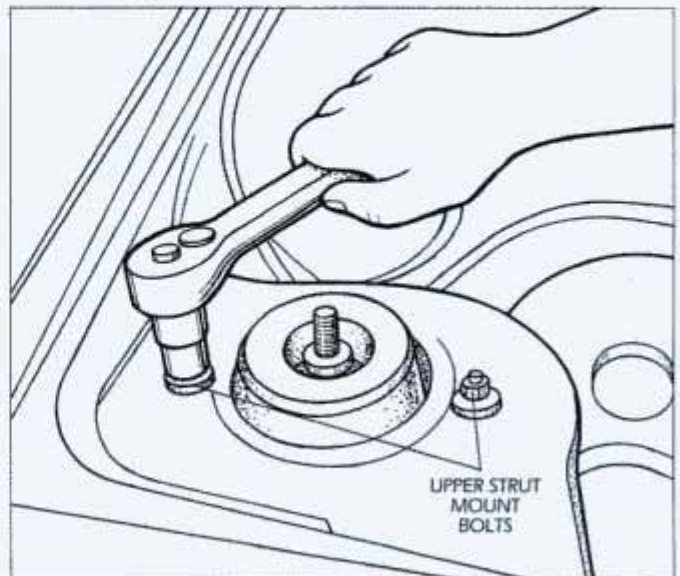
According to a spokesman at Perfect Circle Chassis Parts, a leading manufacturer of strut replacements, MacPherson struts should be inspected every 20,000 miles—more frequently if your car travels over bumpy or dusty dirt roads. In the days of big heavy cars with soft cushy rides, you could check a shock absorber by pushing down on the bumper. If the car went up and down more than twice after you quit bouncing it, the shocks weren't doing their job. This test is no longer valid. Many cars are smaller, especially those with MacPherson struts. They also have stiffer springs and valving inside and therefore damp suspension movements much more heavily. Performing a jounce test on many cars will only reveal struts whose damping action has failed completely.

To inspect the struts, begin by parking the car on level pavement. Next, support the front of the car on jack stands so the front wheels hang freely, and remove the front wheels. Like shock absorbers, one sign of a failing strut is fluid leakage at the seal where the telescoping shaft exits the strut housing. To check the seal, use a screwdriver to gently lift up the dust boot. A slight film on the shaft is normal. But an accumulation of fluid at the seal or signs of heavy fluid leakage down the side of the housing are sure clues that the strut has failed. Keep in mind that a strut doesn't necessarily have to be leaking for its damping ability to be weak. Look at the bump stop on the shaft. If the bottom is shiny, the suspension has been hitting the stop fairly regularly, which means the strut is probably not doing its damping job too well. Another sign is cupped or scalloped tires. These wear patterns are created as the tire re-

peatedly pounds the pavement as the wheel oscillates. Even if the damping portion of the struts are okay, also check the upper bearing pivot, the upper mount, lower spring seat, spring and strut housing. Check the strut housing for dents or bends. Both can hurt damping ability or throw off wheel alignment.

To check the bearing pivot at the top of the strut, grasp the top of the strut and push and pull on it. If it moves at all, the bearing is bad and the upper mount must be replaced. Installing a new strut with an old worn-out pivot can lead to premature strut wear, according to Al Utter, an engineer with Monroe, another manufacturer of replacement struts. A worn bearing can allow the strut shaft to vibrate. That wrecks the seal and pretty soon the strut is leaking again. The bearing pivot can also bind because of corrosion or dirt. Make sure it turns freely by turning the steering wheel lock-to-lock in both directions. A broken spring should be obvious, but you should also inspect it for cracks or excessive rusting.

There are many different types of MacPherson strut designs and the removal and installation procedures vary from one car to another. For instance, on many front-wheel-drive cars the lower strut housing is bolted to the steering knuckle above the drive axle. That means you can remove the struts without removing the disc brake caliper and lower control-arm ball joint. On rear-drive cars, however, the lower housing of the front strut may include the steering knuckle and spindle. If that is the case, the brake caliper (or its brake line) must



If the upper strut bolts are adjustable, mark them before taking them off. This will help maintain wheel alignment.

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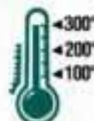
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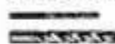
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CAR CARE

be removed, the ball joint must be separated from the strut, or the control arm and the tie rod must be disconnected from the steering knuckle.

Removal

Following is a general procedure for removing and replacing the struts. To do strut work on your car, consult the service manual for specific instructions and follow all safety precautions. Make sure the steering wheel is unlocked. Then, after the car body has been firmly supported and the front wheels have been removed carefully, mark the camber adjustment bolt with silver spray paint so you will know what position it was in when it's time to reinstall it. Sometimes the upper mounting plate provides for camber adjustment as well. If that's the case, scribe a line between the body mount and the plate. Next, remove all but one of the upper mounting plate nuts, leaving the remaining nut on only finger tight.

If necessary, disconnect the brake caliper or hose from the strut, then remove the bolts that connect the strut to the steering knuckle. If the steering knuckle is actually part of the strut, then disconnect the ball joint and tie rod from the strut. To take out the strut, remove the finger-tight upper-mounting-plate nut and lift the strut out from under the fender.

Replacement

To replace the strut, you need a strut vise and a spring compressor. Both are available at rental centers. Mount the strut vise in a regular vise, and then mount the strut in the strut vise. Don't even think of clamping your strut in a regular vise because it will dent the housing. Next, mark the bearing mount, spring and upper spring mount so they can be lined up during reassembly. Then attach the spring compressor to the spring coils, tightening the compressor until spring pressure on the upper mount has been relieved. (Warning: There's a considerable

amount of energy stored in that compressed spring—enough to pitch you or some parts across the shop at high velocity.) Remove the retaining nut from the top of the strut shaft, then remove the upper mount, spring seat, dust shield and bump stop. Get a new bump stop if yours is worn.

Today, most strut replacements come as complete units. However, some strut replacements consist of replacement cartridges that slide into

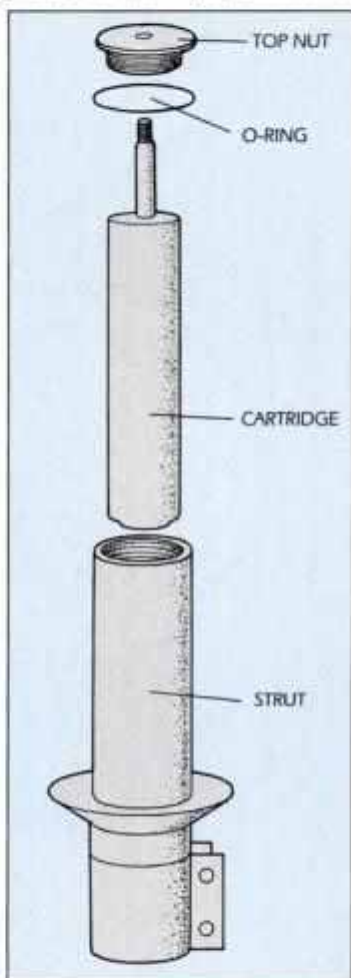
the strut housing after the old shock-absorber components have been removed. To remove these internal components, a large nut is removed on the strut where the shaft slides into the housing. Then the shaft and internal components are slipped out of the strut and discarded before the replacement cartridge (and a few ounces of engine oil, to provide a thermal pathway to cool outside air) are installed in the strut housing. If you are using this type of cartridge, be sure to follow the manufacturer's instructions.

Using complete replacement struts is much easier. You simply pull the shaft to its fully extended position, then reinstall the compressed coil spring and the other parts before you reinstall a new retaining nut that comes with the replacement strut. Be sure to torque this nut to the manufacturer's

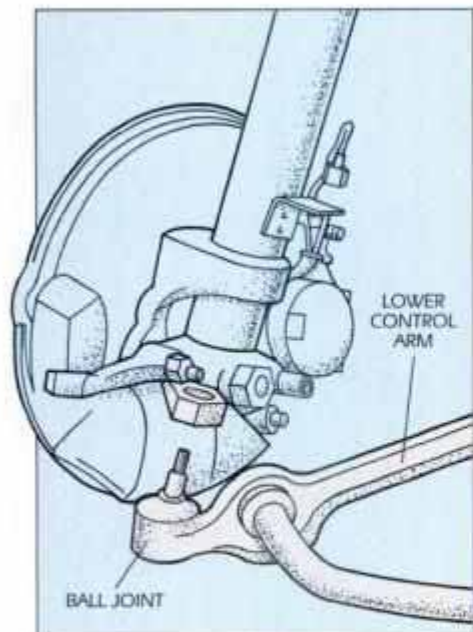
specification. Then, make sure the marks you made on the upper strut mount and spring are aligned and slowly release the spring compressor.

Installation

To reinstall the strut, slide the upper mounting plate into the inner fender, making sure to align any marks you made. Then install the mounting nuts and torque them to specification. Reattach the steering knuckle to the strut (or reattach the ball joint, tie rod and braking components, if you removed them), making sure the eccentric camber bolt is aligned with the paint marks you made. Retorque all



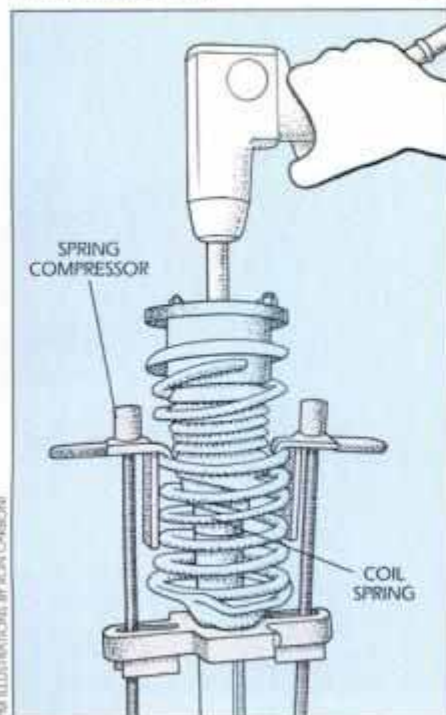
Some struts use a replaceable cartridge inside the main tube.



You may need to separate the ball joint connecting the strut to the control arm.

fasteners to the proper specifications and reinstall any cotter pins through castellated nuts in the ball joint or tie rod, install the wheels, lower the car and you're done.

It would be wise to schedule a front-end alignment soon, as you may have disturbed the camber settings, in spite of your careful marking of the parts as they were disassembled. Remember, your struts were worn and the alignment settings may have been off the mark before you picked up that first wrench. **PM**



Relieve tension on the spring before removing the shock's upper nut.



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Free Car-Care Brochure

The Maintenance Awareness Program of the Automotive Parts & Accessories Association, the Car Care Council and the U.S. government have joined forces and are offering a free auto-maintenance brochure. Called "How to Find Your Way Under The Hood & Around The Car," the brightly designed, easy-to-follow pamphlet helps anyone

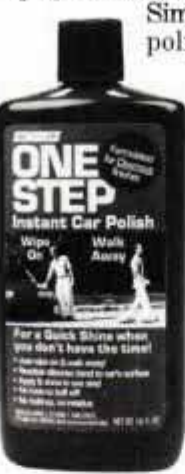


HOW TO FIND YOUR WAY UNDER THE HOOD & AROUND THE CAR

interested in the efficiency and reliability of his vehicle perform the most essential maintenance tasks. An easy-to-follow, simply arranged chart lists 15 different common tasks, giving the recommended frequency of the job and referring to more detailed instructions for each. To obtain your free copy of the brochure, write to the Consumer Information Center, Pueblo, CO or to MAP, 4600 East-West Hwy., Bethesda, MD 20814.

Polishing Made Simple

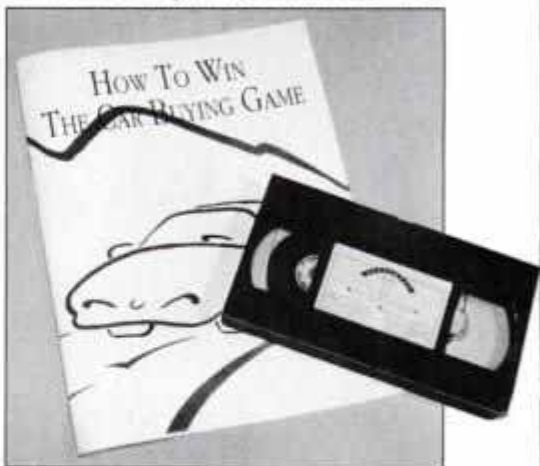
The old cliché of laboriously rubbing and buffing the polish on your car to get it to shine has been further shattered by Simoniz' newest polish, aptly called One Step. According to



Simoniz, simply apply the polish to the car's clean finish—the entire car at once—and you're done. There is no need to buff, rub or otherwise remove the polish from the car. Sold in a 16-ounce bottle, One Step costs about \$4.99. From First Brands Corp., 83 Wooster Heights Rd., Danbury, CT 06813; (203) 731-2300.

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now price sticker, how you can find out what the dealer paid for the car, how to negotiate, whether or not to opt for dealer financing and other factors. The video is accompanied by a 24-page workbook that allows you to figure your real costs. "How To Win The Car-Buying Game" costs \$79.95 from Ideations Inc., 2904 McCullough, Yakima, WA 98903; (800) 644-3327.

PM HOTLINES

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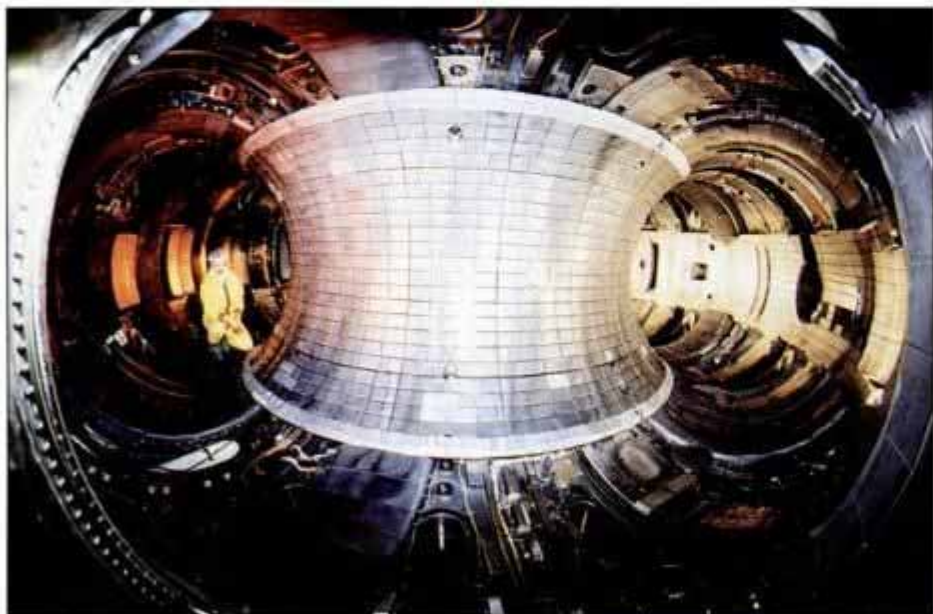
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Sun In A Bottle

BY GREGORY T. POPE, Contributing Editor



● In a building just off Route 1 in New Jersey stands a machine that, for a second at a time, drains 30 megawatts out of nearby transformers. If the local electric utility declares an energy emergency—as it did during last January's record cold snap—technicians must shut the machine down. The irony is almost amusing, because this machine is supposed to herald an era of limitless energy.

The machine is the Tokamak Fusion Test Reactor at Princeton University's Plasma Physics Laboratory. On Dec. 9, 1993, researchers there whooped when the reactor tripled the previous mark for power output. After more than a decade of buildup, the tokamak was finally doing what it was created to do.

For years, fusion-energy research has struggled to live up to its advance



Inside tokamak, donut-shaped torus vessel (left) confines deuterium-tritium plasma (above), which glows at 600 million° F.

billing. Once harnessed, say its proponents, nuclear fusion—the process that stokes the Sun and stars—will solve everything. Fusion consumes bountiful hydrogen, generates only short-lived radioactive leftovers, is inherently fail-safe and supplies clean energy.

There's just one catch. You have to bottle the Sun on Earth. That means confining a plasma—a cloud of atoms broken into free electrons and positively charged nuclei. And it means cranking the thermostat to a toasty 600 million° F. After all, fusion energy is only released when two atomic nuclei cleave together. But being like-charged, the nuclei normally won't go near each other. The Sun and stars get around this problem by forcing them together with immense gravity. We don't have that luxury on Earth. So the next best solution is to superheat the nuclei to overcome their mutual repulsion.

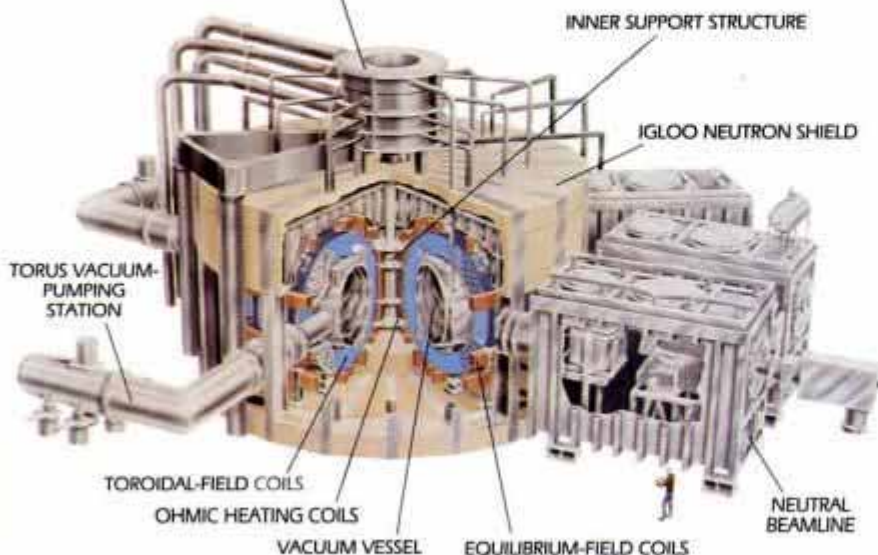
A tokamak is designed to do all that. But the reactor needs an array of mighty magnets and electric currents to form a "magnetic bottle" in which to trap the plasma, and a neutral-particle beam to blowtorch the plasma up to fusion temperatures.

All this equipment adds up to an electric bill from hell. No fusion reactor has ever reached breakeven, putting out as much energy as it takes in. Even the record at Princeton required 30 megawatts in to get 6.4 megawatts out.

Still, the Princeton breakthrough is the biggest step yet toward breakeven. Conceived during the oil crisis of the mid-'70s, the Princeton toka-

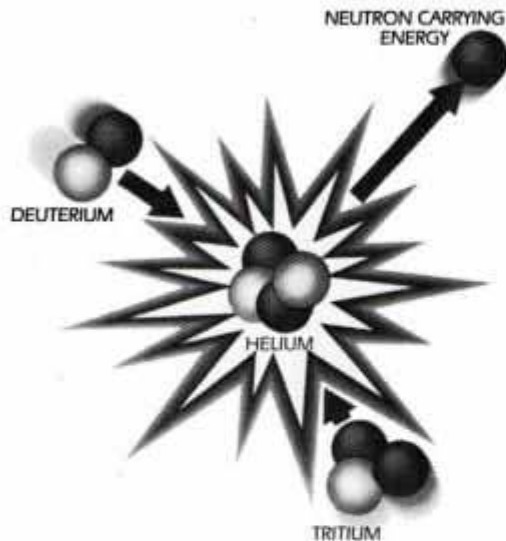
Tokamak Fusion Test Reactor

VACUUM-VESSEL HEATING AND COOLING SYSTEM



Magnetic coils suspend plasma, while neutral-particle beam provides heat for fusion.

How Fusion Works



To understand why, look at the two products of a deuterium-tritium fusion reaction. One is a highly energetic neutron. Because it's free of electric charge, the neutron can escape from the magnetic bottle, carrying 80% of the fusion energy. That energy will produce electricity.

But just as important is what stays in the tokamak—a helium nucleus known as an alpha particle. Rattling with 20% of the fusion energy, this particle will careen around the plasma, colliding with other particles and heating things up. Physicists hope that by unleashing enough alpha particles a fusion reaction could become self-sustain-

ing without further blasts from the neutral-particle beam. The phenomenon, known as ignition, would put the reactor over breakeven.

“We haven't reached breakeven,” admits Dale Meade, deputy director of the laboratory, “but the physics data needed to get there is what we're after. For us, it's not so much whether we're a third of the way to breakeven, it's to study the alpha particles. We look at good effects like heating but also bad effects like plasma instability. The good news is that we haven't detected any new instabilities.”

If the plasma keeps behaving itself, the experiments will continue until September, as physicists try to hit the 10-megawatt mark. Then, sadly, the tokamak's life draws to a close.

Princeton hopes to pass the fusion torch to a follow-on device known as the Tokamak Physics Experiment, or TPX. Unlike the current tokamak, which operates in pulses, TPX would run in a continuous mode. Meanwhile, physicists worldwide want to collaborate on a huge International Thermonuclear Experimental Reactor, or ITER (see [Tech Update, page 22](#), June '91). Here, at last, would come ignition and breakeven, the device generating 1000 megawatts for 15-minute spells. Ideally, results from TPX and ITER would feed into a demonstration commercial reactor by the year 2025. All this, of course, would require billions of dollars.

Physicists hope that the Princeton achievements convince sponsors that the money is well spent. Long cast as incurable romantics, fusion researchers at last have something solid on which to build their dreams. **PM**

Deuterium-tritium reaction unleashes the most energy.

mak was built for high-octane fusion fuel: a half-and-half cocktail of deuterium and tritium, the two heavy isotopes of hydrogen. Until now, fusion-energy researchers have made do with straight deuterium, mainly because tritium bedevils matters by being radioactive. But a 50-50 ratio is the ideal mix for the commercial fusion plant of tomorrow.

ing without further blasts from the neutral-particle beam. The phenomenon, known as ignition, would put the reactor over breakeven.

“We haven't reached breakeven,” admits Dale Meade, deputy director of the laboratory, “but the physics data needed to get there is what we're after. For us, it's not so much whether we're a third of the way to breakeven, it's to

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BOATING

Ready For The Road

BY JOE SKORUPA, Boating/Outdoors Editor



PHOTO BY SUE GANDY

● Trailer boaters aren't only kings of the water, they're also kings of the road. Their rigs may be modest—typically less than 26 ft. long and 8 ft. 6 in. wide—but no one commands more of boating's watery domain.

As a typical trailer boater, when the weekend rolls around, I face a dilemma: Where will I launch? From my home in New Jersey, nearby options range from Greenwood Lake and Lake Hopatcong to the Hudson and Delaware rivers. Longer runs take me to Lake George, Lake Champlain, Long Island Sound or my favorite, the Jersey Shore.

But as wonderful as these locations are, every now and then I get an urge to travel to exotic waters. In recent years, I've piloted a 20-ft. boat up the Mississippi River from New Orleans to Minneapolis, and a 22-footer up the Intra-coastal Waterway from Miami to New York. I've towed a 26-ft. boat 1800 miles from Michigan to Key West, Florida, and crossed the Gulf Stream from Palm Beach to the Bahamas in a 25-ft. center console.

As a trailer boater, I've always felt that my boating options were only as limited as my dreams. But I must admit that early in my towing career, I sometimes thought of it as a white-

knuckle affair. Naturally, I'd heard war stories about boats shifting in cradles, trailers swaying on the road, surge brakes failing and, worst of all, trailers becoming unhitched and going their own way.

Today, with my tow vehicle and trailer properly set up, I hardly know I'm pulling a load. The difference is confidence, which I've gained from pre-trip preparation, regular maintenance and a good working knowledge of my rig. Here are some tips to help you find the confidence you need for trailering peace of mind.

Let's start with the tow vehicle. The first thing you need to know is the vehicle's maximum tow rating, which can be found in the owner's manual. This figure is often stated

as the Gross Combined Weight Rating (GCWR), which includes the weight of the tow vehicle and trailer. It also takes into account the weight of passengers, luggage and gear.

To determine the GCWR of your rig, determine the weight of the tow vehicle (listed as curb weight), the trailer, the boat and everything carried in the boat and tow vehicle (including passengers).

With this information, you will know exactly how

close your tow vehicle is to its maximum weight limitation. Leave a cushion of at least several hundred pounds in the tow rating and GCWR for safety.

Another important figure you need to know is the maximum tongue weight rating, which is generally set at 10% of the trailer's Gross Vehicle Weight Rating (GVWR). The GVWR refers to the sum of the trailer's weight plus its maximum carrying capacity. A boat trailer with a GVWR of 2500 pounds generally has a maximum tongue weight rating of 250 pounds. However, many towers find that a 5% to 7% tongue rating works well and eases the load on the tow vehicle's suspension.

As you go about determining GCWR and GVWR, you will notice a



PHOTO BY JIM YOUNG

Boating adventures start on the highway (top), long before you reach the launch ramp (above).

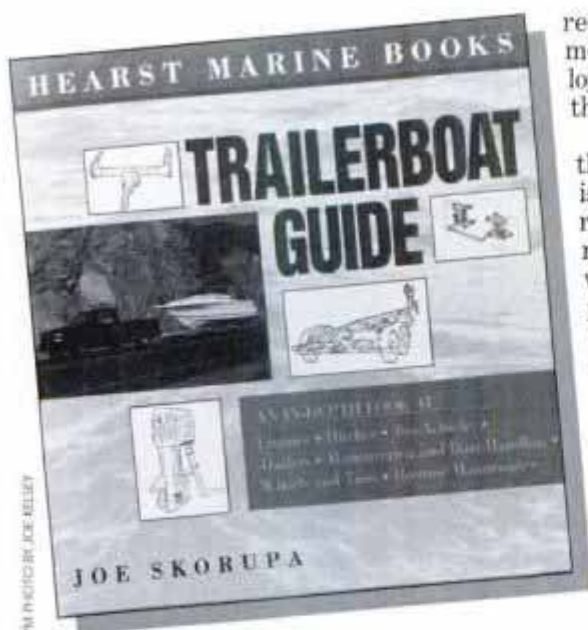


PHOTO: JUDGE KELLEY

For more in-depth trailering tips, check out the book.

large number of weight limitations listed in your tow vehicle owner's manual and posted on your rig. Virtually every component in trailering has a maximum weight limitation, including the hitch, coupler, trailer, tires, safety chains, hitch ball and winch strap. Check the figures listed for these components, and make sure none exceeds its maximum rating.

Now, let's move to the hitch. Since you've already checked the hitch's weight rating, you know which of the four classes it falls into: Class I up to 2000 pounds, Class II up to 3500 pounds, Class III up to 5000 pounds, and Class IV up to 10,000 pounds.

In addition to weight-rating classes, trailer-boating hitches come in different types. The most common are: a frame-mount hitch, mounted solely to the frame; a bumper/frame-mount hitch, mounted to the frame and the bumper; a step bumper, which is a rear bumper with an integrated ball-mount platform; and a bumper-mount hitch, attached solely to the bumper.

Of these types, the frame-mount hitch is the best because it is bolted or welded to the frame to distribute weight off the bumper and onto the tow vehicle's rear axle. The step bumper is the second-best hitch because it, too, relies on solid attachment points on the frame. However, towers should be aware that some aftermarket step bumpers are without frame attachment points. These are not recommended for trailer boating.

Bumper/frame-mount hitches can be useful for light towing, but they tend to impede the crash-resistant nature of the bumper. The least desirable type is the bumper-mount hitch. Automotive and trailer manufacturers

recommend not using bumper-mount hitches because light-alloy modern bumpers can't handle the stresses of towing.

Now for the trailer. Probably the first thing you need to check is the brakes. The National Marine Manufacturers Association recommends that every trailer with a GVWR of at least 1500 pounds should be equipped with brakes that operate automatically when the tow vehicle's brakes are applied and, also, in an emergency when the trailer becomes separated from the tow vehicle.

Hydraulic surge brakes, which are activated by a sudden slowing of forward momentum or dipping of the tow vehicle's rear bumper, are the most common type found in boating. Electronic

brakes, often used for non-marine towing, tend to short out after being immersed. To provide an emergency stop system, a short lanyard or cable from the trailer's master brake cylinder is hand-connected to the hitch on the tow vehicle.

The coupler makes a metal-to-metal contact with the hitch ball, and as such should be securely clamped by tightening a hand-wheel or lever. Good couplers will also have a safety latch or trigger lock. Other important trailer components are the wiring harness, which provides voltage to the trailer's lighting system; the hitch safety chains, which are a fail-safe system to keep the trailer attached to the tow vehicle; the winch strap or cable, which secures the boat to the winch stand; and the boat safety chain, which is a fail-safe system to keep the boat from sliding off the trailer.

Make sure you have a thorough familiarity with the above components for a first step toward building trailering confidence. For the second step, there are a number of other important components you will need to learn about, including the trailer cradle, tires, wheel bearings, axles, suspension, lights, winch, differential, transmission, cooling system and many others.

Without doubt, trailer boating is a big subject, big enough for a book. Somehow I found the time to write such a book last year. It's called *Hearst Marine Books Trailerboat Guide*. If you're interested in the subject, look for it in your local bookstore or contact: Hearst Marine Books, William Morrow & Co., 1350 Avenue of the Americas, New York, NY 10019. **PM**

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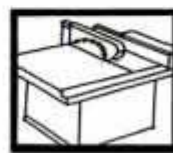


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Detroit Spy Report

BY JIM DUNNE, Detroit Editor



Suburban Shorty

GM gave the final okay to a 4-door version of the Blazer and Yukon. The



Explorer gets rounder look, new suspension.

new vehicles will be similar to the Suburban, but shorter in overall length—about 10 in. will be chopped off the



F-Series pickups also share lowered hoodlines, rounder fenders and new suspension.

rear section. Styling will be similar to the new Blazer and Yukon models that are set for introduction in 1997. Ford has also been planning a full-size 4-door utility vehicle, so it is expected that a 4-door Bronco will be built as competition for the new GM vehicles.

Ford Pickup

This F-Series pickup is another prototype that reveals much of what Ford

has planned for the 1995½ full-size pickup line. What you see is a more rounded shape to the cab and hood, with the hoodline sloping downward. Also, the cab appears to be extended a couple of inches rearward, a design similar to that of the Dodge Ram. What you don't see is a whole new front suspension. As with the Explorer, the change will permit a lower engine position and lower hoodline, and it will extend front tire life.

1995½ Explorer

This view of the new Explorer shows a full covering over the new front styling. But that is only part of the new Explorer's story. Yes, the entire body will be restyled, with the emphasis on softer, more curved shapes in

the sheetmetal. But it will also get a new front suspension. Like the F-Series pickup, the Explorer will drop its unique Twin-I-beam geometry and go to a conventional upper-and-lower A-arm system. The suspension change for '95½ has a number of benefits. With upper-and-lower

control arms and coil springs, the new suspension promises to reduce abnormal tire wear. Also, the cost of manufacturing is probably lower—with stampings replacing more expensive forgings. And, for better styling, the new suspension allows the engine to be lowered more than an inch. This permits a lower, more sloping hoodline.

1995 Cavalier

Make it even better. That seems to be the aim as Chevy redesigns its top-selling Cavalier line for 1995. The new



1995 Cavalier gets styling cues from Geo.

car will have softer, more rounded body lines that resemble Chevrolet's Geo Prizm. This car is way past due for a change. Chevy has boosted sales in recent months with a dramatic price cut. That extended the car's popularity. Now, with the new lineup—minus the station wagon, but including a convertible—look for Cavalier to offer even fiercer competition in the compact sedan field.

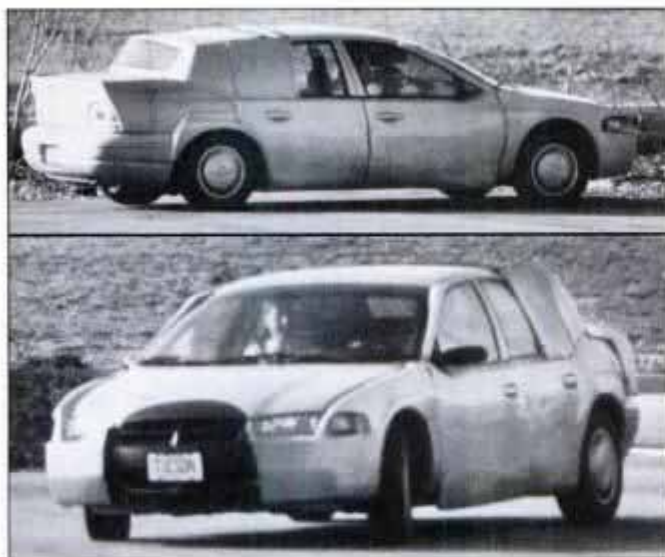
Continental, 1995

You've seen the finished product, now here's a look at how Lincoln tries to hide the appearance of its future Continental (see photo below). The black paint has a matte finish. That eliminates the reflections that give shape to the sheetmetal.

But the over-



Next version of Continental sports a 4.6-liter V8.



The Dodge JA sedan is under all that tape and foam.

all bigger size and softer curves of the new car still show through. Under the hood, the Continental will have a V8 engine for the first time—the same 4.6-liter sohc that Lincoln uses in the Town Car.

Dodge Prototype

We've seen disguises before, but this may be the most extreme. Dodge is running tests on a future sedan hidden somewhere under this elaborate disguise (see photos above). Note the extra cladding on the sides and the use of blackout paint in the front. The intention is to hide the true lines of the car from unofficial photographers like us. In this case, they've done a good job. However, a few real features show through. The bar grille is a Dodge trademark. Also note the severe slope to the hood and the wide expanse of windshield glass. Little can be gleaned from the rear view. It appears completely covered with the angular lines of a limousine. Best guess is that, underneath all that cladding, this is Chrysler's 1995 mid-size JA body. (See "'94½," on page 45.)

Aurora Hardtop

Oldsmobile's 1995 Aurora hardtop has a design from years past—frameless windows. Frameless windows are rare in today's cars, but Olds has a couple of good reasons for building them in its new sedan. "It simplifies the seals," explains Larry Lyons, Olds' engineering manager. "We only need one seal between the glass and the body. With a frame you need two seals: one for glass to frame, the other for frame to body." Lyons says the single seal results in a quieter interior and less chance of wind whistle. Opportunities to drive preproduction Auroras have proved that Lyons knows what he's talking about, as the Aurora's interior is very quiet.

Honda Minivan

Look for a smaller, lightweight van from Honda next spring. Honda will not copy Chrysler's leadership features in its vehicle, but will build a more compact van that will also be designed for Japanese roads and traffic. That means a 4-cylinder engine and an exterior with dimensions about the same as Mercury's Villager. Honda's van will increase the

pressure on Chrysler to maintain its dominant position as the minivan sales leader. About 50,000 Honda vans are planned to be for sale each year, or about the same number as Chevrolet's Lumina—far less than industry-leading Chrysler.

Small Cougar

Change your way of thinking about Ford's personal luxury cars, Thunderbird and Cougar. Reports out of Dearborn planning centers have both

cars getting a complete change for the 1997 model year. Cougar will be smaller, probably a running mate to the Ford Probe, but with its own sheetmetal styling. That means the Mercury will become a sporty subcompact, with front-wheel drive, a V6 engine and all the performance details of a top-of-the-line Probe.

For Thunderbird, the changes include a front-drive system lifted from Taurus and reductions in exterior dimensions and weight. Thunderbird's changes make more sense, since its competition—Chevy's Monte Carlo—is also based on a front-drive midsize sedan (Lumina).

Top Quality

A study of startup 1994 production cars by J.D. Power and Associates rates Canada with three of the top quality plants in all of North America. The Canadian assembly plants that build Toyotas, Fords and Hondas are the quality winners. One Mexican plant, where Ford builds Escorts and Tracers, is also ranked among the top 10 for quality. Other quality leaders are plants in the U.S., including those that build import brands such as Toyota and Nissan and domestics such as Lincoln, Bonneville and Olds Eighty Eight and Ninety Eight. **PM**

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Bellcore's Highway

BY FRANK VIZARD, Electronics Editor

● While the business pages of your daily newspaper are filled with reports about how various companies are positioning themselves for access to the information superhighway, the nuts-and-bolts technology needed to make the concept work hasn't received as much attention.

That's why it was interesting recently to get inside Bellcore, the research laboratory for the regional telephone companies. Bellcore, as distinct from AT&T's Bell Labs, is supported by the Baby Bells—Ameritech, Bell Atlantic, BellSouth, NYNEX, Pacific Telesis, Southwestern Bell and U.S. West.

Needless to say, the interest of these companies in the information superhighway is high.

The occasion, however, was Bellcore's announcement of a "collaboratory" project on the infrastructure required for data highway construction. The collaborative effort includes some heavy contributors:

- Capital Cities/ABC—a major multimedia publisher, providing everything from television shows to books.
- Digital Equipment Corp.—the well-known computer network supplier.
- Hewlett-Packard—another supplier of computer hardware, best known for its printers.
- JCPenney—important in this instance for its catalog shopping.
- Los Alamos National Laboratory—has the reputation of solving complex computational problems.
- The Media Lab at the Massachusetts Institute of Technology—where the future of information technology is often already in a prototype stage.
- Microwave Systems—a leader in interactive real-time operating software for set-top TV decoders.
- Northern Telecom—provider of digital telecommunications switching systems.
- WilTel—owns and operates a digital fiberoptic network for business communication.

As you can see, the Bellcore collaboratory represents a good cross section of business and academia, all of whom have an interest in making the information highway work.



With this TV, you can switch to different camera angles by touching the screen.

While the fruits of the Bellcore collaboratory project remain to be seen, the occasion did provide an opportunity to look at some of the technologies Bellcore is currently developing.

One demonstration, in fact, occurred during the project announcement. While Bellcore Executive Di-

rector Lanny Smoot and other collaboratory representatives were physically present, other collaboratory representatives appeared on-screen behind the dais. These off-site participants could be seen and heard in real time via Bellcore's Aurora Gigabit testbed network.

The significance here is that the voice and video data was transmitted over existing twisted pair copper wires using a technology called Integrated Services Digital Network (ISDN). While the images were not as clear as those provided by fiberoptic cable, the demonstration was still remarkable. Only a short time ago it was considered impossible for video to be transmitted over copper wires because of video's high bandwidth requirements.

ISDN was also used to demonstrate the capabilities of a video-on-demand system. This system would allow you to get movies delivered into your home over existing phone lines whenever you wanted them. To the naked eye, the video quality approached



Bellcore Director Lanny Smoot introduces the collaboratory.

that offered by VHS videotapes.

Another system using ISDN technology is called DEMON—Delivery of Electronic Multimedia Over the Network. The experimental DEMON system transmits a combination of text, graphics, still images and slow-motion video from one computer workstation to another. DEMON is envisioned as a system that would be used for directories, catalogs and training materials.

Somewhat related to DEMON is an electronic document browser called SuperBook. With SuperBook, you can easily find information contained in one document or 100 documents. For instance, you could quickly find all the references to "operating systems" within thousands of pages of technical information.

Cruising may be something singles do on a Saturday night, but Bellcore envisions cruising as an activity for the workplace as well. The experimental Cruiser system allows you to use desktop, video-capable personal computers to see, hear and talk with co-workers in other offices.

Basically, the system cruises down an office hallway to see if your colleagues are in and want to talk. People can join in or leave the conversation easily and can exchange graphs or pictorial displays. There are also privacy controls built into the system.

Connected to Cruiser is a technology called Rendezvous. This system allows people in different locations to work on an on-screen document at the same time.

A version of this technology is newly available from Intel. Called ProShare Personal Conferencing, this software lets two people view the same computer document simultaneously.

There are actually three variations of ProShare available. The standard edition, listing for \$99, is for simultaneous text editing. The premier edition, listing for \$299, lets two users share an application, even if one person doesn't have the application.

The third version of ProShare adds video for face-to-face encounters. Called ProShare Video System 2000, it lists for \$2499. Equipment includes a monitor-top camera and a hands-free headset with microphone. Video windows can be sized up to one quarter of the screen. High-resolution still video images can also be shared.

As if to endorse Bellcore's research, all the ProShare software operates on ISDN technology. The ability to use ISDN as an information roadway becomes important if customer charges are related to the amount of bandwidth being used. Video, for example, uses more bandwidth than simple text

and therefore may cost more to use. However, ISDN could keep the price lower than expected. Higher resolution video, meanwhile, sent over fiberoptic cable might be priced at a higher rate.

Bellcore is even interested in the television you watch. One research project involves an electronic panning camera that is essentially five cameras in one. Each lens is focused on a different aspect of a football game, for example, and offers a mix of wide-angle and closeup shots of the action from different perspectives. What each lens sees appears in a little on-

screen window. Each window scene can be flipped with the main picture at the touch of a remote control. The viewer becomes the director by picking the camera angles.

The different windows can also be accessed simply by touching the screen. The TV in this experiment utilizes a touch-sensitive screen, allowing you to simply drag the picture left or right across the screen with your finger. As you drag the video image, the picture slowly rotates across the camera's 150° field of view.

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Import Spy Report

BY MIKE ALLEN, Associate Automotive Editor



Audi 80/A4

● Look later this summer for the new Audi 80—which may or may not be labeled Audi 80. It may be called the A4, denoting the fact that it will be propelled by a 4-cylinder powerplant. The 80 has been missing from Audi's U.S. product mix in recent years.

The color photo we show here is computer-enhanced, using the small inset black-and-white spy shot as a guide.

World's Fastest Ragtop

Based on a Formula One technology carbon-fiber and Kevlar chassis, this Ferrari 2-seater may be called either the Barchetta or F 130. It's a limited-edition model, in the tradition of the 288 and F 40, and will compete in the stratosphere of the exotic car marketplace along with the Jaguar XJ 220, Bugatti EB 110 and McLaren F1.

The external bodywork is designed by the Italian design studio Pininfarina, and this prototype seems to use a wing lifted from the F 40's parts bin. There's a removable hardtop, but in its top-down configuration, the Barchetta will undoubtedly be the fastest open-cockpit car ever licensed for the road.



Nissan's Maxima is freshened for the first time in six years.

Power comes from a 3.5-liter V12, rated somewhere in excess of 500 hp, which should be ample to propel the beast to speeds in excess of 200 mph.

Maximum Nissan

Long overdue is Nissan's new Maxima, to replace a model left largely

unchanged since its introduction in 1988. Hardly a departure from the older model, the new Maxima is really rather somewhat conservative, shown here during wintertime testing.



S-Class Goes On Diet

Well, not really. The leviathan-size Benzes, saddled with criticism ever since introduction that they are far too large and heavy in ecologically conscious Europe, will undergo a facelift a year earlier than planned. While no substantial changes to the chassis—or overall massive weight and complexity—are planned, there will be a flatter front grille, narrower headlights and a revised rear end. The intent seems to be to reduce the appearance of massiveness.

Bimmer Stalls

While Mercedes-Benz steps up revision of the S-Class cars, BMW has delayed the introduction of the new 7-series replacement for at least several months. Look for a family resemblance to the 3-series cars, a new interior and wrap-around taillamps. Also included in BMW's plans is punching out the current 300-hp 5.0-liter V12 to 5.4 liters and 330-plus ponies.



Open-top Ferrari is based on Formula One chassis technology.

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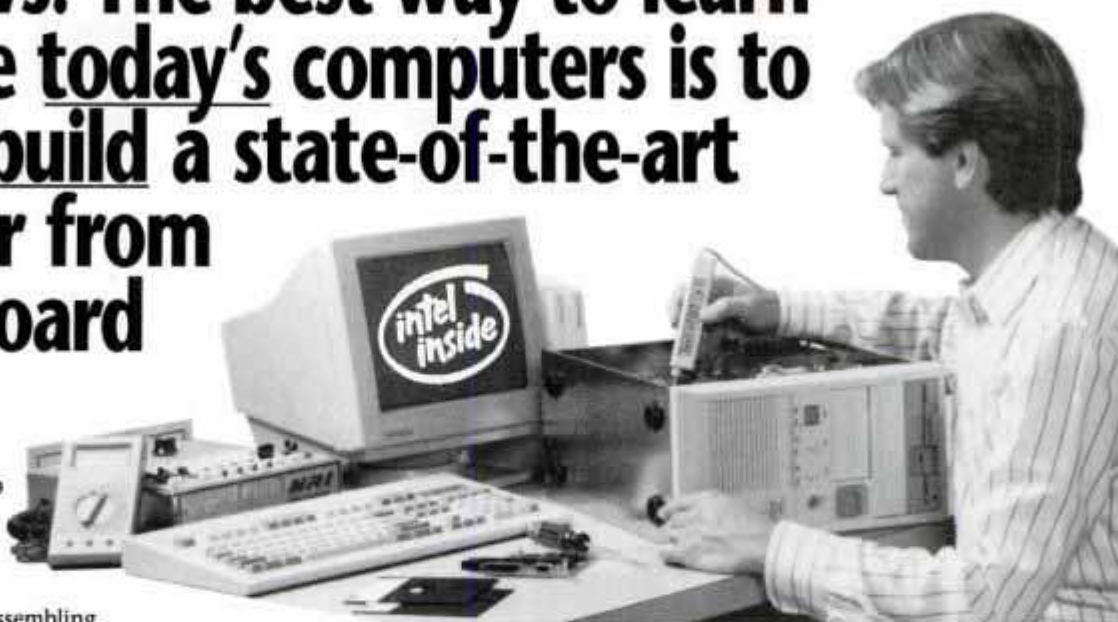
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Power Sailing

BY WILLIAM GARVEY

● There's an irony to flying sailplanes. Supine in a transparent cocoon, thin high-lift wings stretching forever from your shoulders—you are one with the atmosphere. The sounds of land, of man, are absent. You search the clouds and fields for signs of rising air and then dash to that invisible quest. With luck you join a parade of wheeling hawks and, turning sharply, you follow their lead to the heavens. Could human flight ever be more unencumbered?

Well, actually, yes. And that's where the irony comes in.

Because sailplanes are as impractical as they are beautiful, they are frequently owned by groups—and so to fly one, you must first wait your place in line. Next, becoming airborne is typically accomplished by being dragged aloft at the end of a long rope attached to the butt of an old Cessna or Bellanca. So a tug pilot and ground crew are necessary participants as well. And should the gods of lift abandon you somewhere beyond gliding range to home base, you'll need a chase crew and truck to fetch you. Unencumbered? Hardly.

Enter Dr. Reiner Stemme. Like many of his colleagues in German academia, this high-energy-laser physicist was intrigued with soaring. His goal was to design an aircraft that would not only compete with the finest high-performance machines, but also dispense with the hassles.



Highlights of the high-flying Stemme S10: retractable folding propellers, all-composite construction, high-performance wingspan and panoramic views.

He did it. And how.

One look at the Stemme S10 and you know you're in the company of a thoroughbred. The lines and detail of the side-by-side, all-composite craft are classic and fanatically clean, from the 77-ft. laminar wings to the flap-gap seals and the antenna buried in the tail. Watch it in flight, and there's nothing to suggest it's anything other than a pure performance competitor—which, with a 50:1 glide ratio, it is.

But look again seconds later and something odd has occurred. Cowls have opened amidships and on the rear belly, the nose has slipped forward, and a spinning blur has filled the resulting 6-in. gap. The unmistakable sound of a 4-stroke emanates from the sleek, white vessel.

Stemme has buried a 94-hp Limbach in his aircraft's center fuselage. And the entire propulsion system is so ingenious, sensible and well-executed, it could revolutionize the sport.

While the S10 is not the first sailplane to feature motorized self-propulsion, its predecessors invariably suffered from design compromises. One type—the motorglider—mounts its motor and prop on its nose.

(Please turn to page 124)



STEMME PHOTOS

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When lift is found, the pilot shuts down the engine and feathers the prop. The second type encloses the engine in the fuselage behind the pilot. When lift is lost, the pilot opens doors atop the fuselage and cranks up a pylon to which the engine and prop are affixed. The problem, of course, is that the external hardware degrades a sailplane's lift-to-drag ratio.

The Stemme S10 is different. Not only does it compete with the pure performers and best of the motorized hybrids, but it can mix with regular powerplanes wherever they congregate. A recent visit to St. Louis, Missouri—home of Stemme USA, the aircraft's American distributor—demonstrated the S10's virtuosity.

Chest-high and squatting on bowed, conventional gear, with wings intentionally broken, folded and trussed, the sailplane looks like an interesting mistake. But Stemme's Marc Arnold assured me all was in order. We easily pushed the 1400-pound bird into the sun, popped the big canopy, and Arnold slid in. Within moments, the nose cone slid forward, the Limbach began to rumble and—presto!—centrifugal force unfolded two spring-held prop blades from their hiding space. They began beating the humid Mississippi River air.

With its wing folded, the S10 taxied easily around a mid-tarmac construction site. Once in an open area, Arnold and company president Barbara Pfifferling unstrapped the wings. In minutes, with minimal heave-hoing, they locked the extraordinary appendages in place.

I hopped into the right seat, fastened chute and seat straps, and made myself comfortable in the cockpit. Arnold took the left seat, and we pulled the canopy down. Although overhead clearance was tight, the uninterrupted view quickly dispelled any claustrophobia. We taxied to the active runway just like any other tail-dragger, albeit a low and wide one. Cleared for takeoff, Arnold set the flaps and shoved the throttle forward until the Limbach whined to 3400 rpm. The Stemme started slowly down the runway and the wing tips began to dance up and down. Tail up at 40 knots, and at 50 Arnold eased back and raised the main gear. The S10 edged into its element.

Takeoff and climb weren't brisk—the manual shows a 590-ft.-per-minute climb on a 59°F day—but they went off with no fuss and no assistance. And that's the point. We had loaded up at a busy airport and launched into the middle of a serious traffic-control area, and yet to the tower and other airport denizens

we were just another airplane.

Fifteen minutes later, we were something else. Arnold cut the engine, and the props snapped back to their stowed position. A hard tug on the panel-mounted handle closed the nose and engine cowl, and instantly we became a competition sailplane. The transition took less than 5 seconds.

Two things stood out immediately about the S10. First, on engine cutoff there was no perceptible change in attitude, altitude or speed. This is one clean machine. And second, when you exercise the pushrod controls, you must do so with authority, because this is a ponderous aircraft with long moments.

After some steep turns and stalls—41 knots clean, with no surprises—and half-hearted hunting for elusive bubbles of lift, it was time for a return to self-motivation. Slide open the nose cone, master on, fuel open, hit the starter and then ignition. Again, 5 seconds or less to full power transition. And what if the engine fails to start once the cowls open? Glide declines to, maybe, 45:1. That gives you lots of time to consider your options.

As we motored across the Mississippi, our HUD-presented variometer indicated some bursts of lift. We shut down the Limbach, stowed the props and began the peculiar, spiral chase of that which can't be seen. Powerless, silent and slicing elegant circles in the sky beside St. Louis' gleaming silver arch made for a special moment. However, if your schedule won't accommodate the vagaries of rising-air power, the Limbach can. Cruising speed is a respectable 103 mph at 3000 rpm, and when fueled with its maximum 32 gallons of regular avgas, the Stemme can cruise a bladder-busting, face-frying 7 hours. Arnold and Pfifferling crisscross the country in their Stemme without hesitation (or luggage, since ditty bags are about the biggest thing you can shove into the storage crevices).

And when it's finally time to come down, the S10's double-height airbrakes assure a quick return to earth. Landing is conventional, although I imagine crosswinds can be a challenge. Since there's no differential braking, directional control is all through the steerable tailwheel.

All this capability and performance does not come cheap. A base S10 goes for about \$150,000, and that figure can quickly increase by tens of thousands with avionics—and the Stemme's panel can accept them all. Still, if you are looking for complete flying freedom, the only choice better than a Stemme S10 is to grow your own beak and feathers. **PM**

hooked up to monitor equipment in remote locations. An environmental unit in a wetland region could be programmed to transmit back the water's temperature, salt content, pollution and other factors each day less expensively than sending out a person. Oil companies could use transmitters mounted in pipelines to transmit status reports and warnings if there's a leak. It's even possible to imagine putting an ORBCOMM unit in a second home with instructions to send back warnings if the water freezes or if there is a burglary.

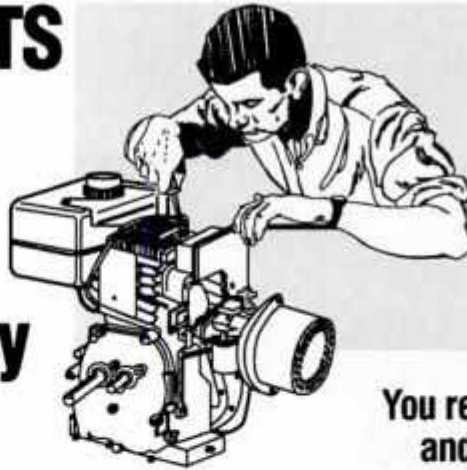
Personal communications is expected to be the most common ORBCOMM application. Imagine the equivalent of a portable telegraph machine that can be carried anywhere you go. Alphanumeric paging is an expanding application, and ORBCOMM is planning to work with paging companies. If you're in a large city within range of a terrestrial paging network, you'll automatically be routed through their circuits for a less expensive rate. When you're outside of terrestrial paging zones, the signals will be automatically routed through ORBCOMM's satellites.

Does ORBCOMM sound too good to be true? It may be—at least for a while. The system is at least a year behind schedule, although the first two satellites should be in orbit by the time you read this article. While services should be available by the end of this year, it will be limited to intermittent services with a satellite passing overhead about once every 3 hours. The full constellation, under the most optimistic schedules, will not be in operation until late next year. ORBCOMM has permission to market its services and sell transceivers in the United States and 19 other countries.

In addition, the company has had many technical problems. ORBCOMM-X, an evaluation satellite launched on an Ariane vehicle in July '91 to test out the concept, failed shortly after launch. The company secretly put in orbit another diagnostic satellite, the Capabilities and Demonstration Satellite (CDS) in February '93. Its existence was announced only after it was determined that the satellite was operational and its signal had been received by several ground stations. That satellite has continued to operate properly.

When ORBCOMM does fill in its constellation and achieve its goal of worldwide communication, you will be able to receive messages anywhere in the world. But don't feel so bad about not being able to avoid your office. You can always leave your transceiver at home or shut it off. **PM**

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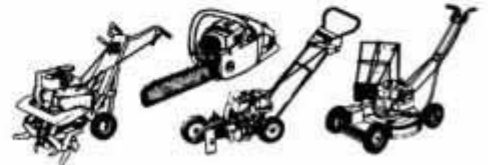
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Talk To Space

BY PHILIP CHIEN



of the following frequencies: 144.91, 144.93, 144.95, 144.97 or 144.99.

Five separate uplink frequencies are used to try to minimize interference among the many hams attempting to contact the shuttle at the same time. The astronaut will listen to one of those frequencies, selected randomly. If you've selected the correct frequency and the astronaut hears your call sign, he/she will respond. As a general rule the astronauts try to talk to as many hams as possible.

No special equipment

● As a space writer, I've talked with scores of astronauts in interviews, press conferences and even while they're in space during in-flight press conferences. But the most exciting time had to be when I talked with Bill McArthur, call sign KC5ACR, during last October's STS-58 space shuttle mission—via amateur radio.

Any licensed amateur radio operator in the world can talk to shuttle astronauts when the Shuttle Amateur Radio Experiment (SAREX) flies. In addition, many cosmonauts on *Mir* are enthusiastic ham operators. In fact, the few times shuttle astronauts have talked to their *Mir* counterparts is via amateur radio.

SAREX is flown primarily as part of NASA's education program. Any school in the world can submit a proposal for a SAREX educational contact, and more than 100 contacts have been successfully completed. Selected schools are scheduled into the crew's timeline as long as it doesn't interfere with the mission's primary objectives.

But you don't have to be in school to talk to an astronaut. Whenever the astronauts have free time, they can use the amateur radio equipment just to chat with hams around the world. The shuttle transmits on 145.55 MHz in the 2-meter amateur radio band. For voice operations over the United States, hams should transmit on one



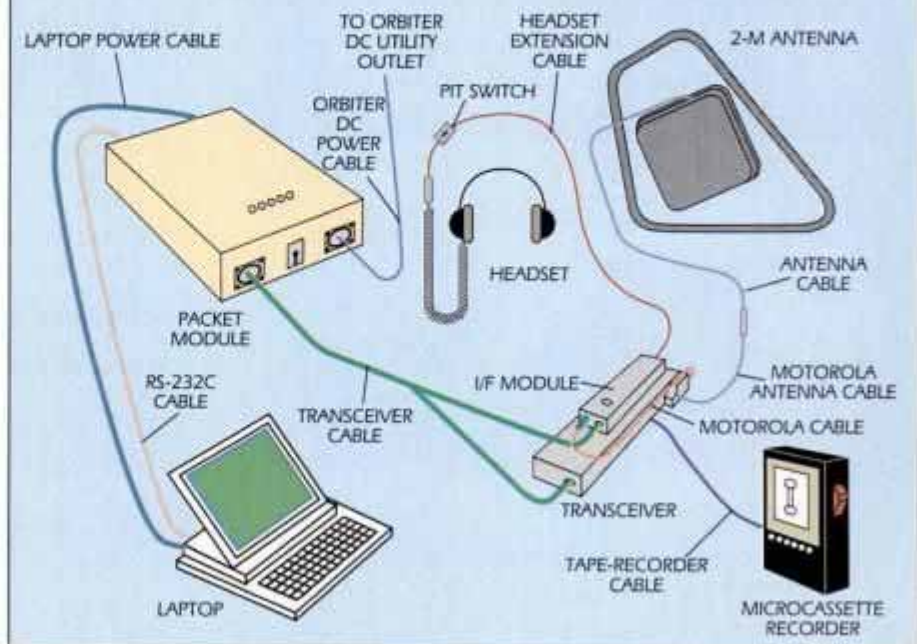
Astronaut McArthur chats with ham operators aboard *Columbia* (top left), while the SAREX group checks transmission gear.

is needed to make a SAREX contact. A handheld transceiver or even a \$50 VHF scanner with a rubber-duckie antenna is adequate for listening to SAREX transmissions. High-power and tracking antennas are not required for successful transmissions to the shuttle. A medium-power (30 to 40 watts) transceiver with an omnidirectional antenna is adequate. The challenge is competing with hundreds of other hams also trying to contact the shuttle at the same time. VHF 2-meter transmissions are line-of-sight—the shuttle has to be above the horizon. At a typical shuttle altitude of 242 km (150 miles), hams on the ground from an area of 8 million sq. km (3 million sq. miles)—the equivalent area of the United States—can theoretically contact the shuttle.

The amount of time a ham operator has available to contact the shuttle varies depending on the mission's orbit and altitude and on the latitude of the ham operator. Under ideal circumstances, with the shuttle passing overhead, there is, at best, a 9-minute window within which to make contact.

For my contact, *Columbia* was on the 193rd circuit of a 225-orbit mission. As I was listening to Bill McArthur pass over central Florida, I heard him responding to hams

A Ham Radio For Astronauts



throughout the Southeast, hundreds of miles from my location. I tried several of the transmit frequencies, calling with my call sign and location. Suddenly I heard Bill's North Carolina accent saying "Kennedy Space Center—go ahead." I made it through! After the mission was completed, I had a chance to talk to Bill, and he did remember our contact.

Hams who make special contacts, especially with hams in other countries or unusual locations, like to trade postcards verifying the contact. These cards are treasured souvenirs, and ham astronauts will send autographed postcards to each of the hams they contact during their missions. If you've contacted an astronaut or heard a SAREX transmission, you should send details on your contact (frequency, time heard, call sign, your location) to the Amateur Radio Relay League in Newington, Connecticut.

Voice contacts are extremely enjoyable, but limited to the astronaut's availability. Most SAREX missions also include a packet radio setup, the amateur radio version of computer modems. Hams use computers connected to packet modems which transmit tones over the radio, similar to how modems transmit tones over phone lines. The shuttle's packet set-

up can respond to 10 packet signals simultaneously, and it's common for more than 1000 hams to make contact, using the shuttle packet setup during a week-long mission.

Hams on the ground transmit many different types of information, including Morse code, voice, computer data packets, faxes, still-frame (slow scan) television and fast-scan television. Most SAREX flights include voice- and computer-packet capabilities. On several SAREX missions, slow-scan communications to and from the ground and fast-scan transmissions from the ground to the shuttle have also been accomplished.

SAREX has flown on 12 shuttle missions to date. SAREX flies whenever there's space available and enough interest from the astronauts. Upcoming missions include the STS-59 Space Radar Laboratory mission planned for April with Jay Apt, call sign N5QWL, and Linda Godwin, call sign N5RAX, and the STS-65 second International Microgravity Laboratory mission in July. The SAREX team also is examining several potential missions in which the astronauts have expressed interest.

Mir has had a ham radio setup since 1988. Most of the *Mir* cosmonauts understand enough English to

communicate with hams around the world. When the Soviet Union dissolved in 1991, the cosmonauts found out most of their news from hams. Amateur radio plays an extremely important role on *Mir* as a crew recreation activity. Vladimir Titov, call sign U1MIR, the first Russian ham in space, said "The ham radio is very helpful during long duration missions [for combating boredom]" and he should know—he has spent more than a year in space.

There are more than a dozen amateur radio satellites in operation, built by hams in the United States, Germany, Russia, Great Britain, Brazil, Argentina, Japan, South Korea and Czechoslovakia. However, communications through most of these satellites require very sophisticated ham equipment (e.g., multiband, tracking antennas and so on).

For information on SAREX school contacts write: Amateur Radio Relay League, Attn.: Education Activities Department, 225 Main St., Newington, CT 06111; (203) 666-1541.

For information on the schedule of upcoming SAREX missions and astronaut activities, contact NASA Headquarters, Attn: Educational Activities, Mail Stop: FE, Washington, DC 20546; (202) 358-1977. **FM**

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Grenades On Wheels

BY PAUL WEISSLER

● You may be driving a grenade. The danger may be lurking not only under your hood but in the passenger compartment as well. And the danger may have been created unwittingly by a service shop trying to be helpful by "fixing" your air conditioning last summer.

For environmental reasons, the long-used refrigerant gas R-12 is being phased out of production. Reduced supply along with increased taxes have made it an expensive commodity and hard to get in some areas during the hot summer. The new refrigerant R-134a being installed by carmakers is not compatible with R-12, and can only be used in an R-12 system after retrofit procedures, which are still in final development. At present, there is no simple and safe—emphasis on *safe*—drop-in substitute for R-12 that has been approved by any carmaker. Repair shops can't legally vent your system's R-12 to the atmosphere, so they have expensive machines to recover and recycle (purify) it for reuse.

As a result, some unknowing shops throughout the country have been installing R-12 substitutes that are being sold to them without realizing the dangers. These substitutes, which are probably still being installed in auto a/c systems, may be poisonous, flammable or both, and could damage the car's a/c system or a shop's equipment. The only substitute refrigerant that the EPA will okay is R-134a.

Almost any gas that can be compressed can work to some degree as a refrigerant, including toxic ammonia. However, to be put into an existing R-12 system, the gas has to be usable (and preferably change from liquid to gas) at temperatures and pressures similar to R-12, and be compatible with mineral oil. This has led to combining various gases so that the blend performs close to R-12.

One R-12 substitute, called OZ-12, is made of propane and butane. It's one thing to have these gases in a torch tank or a cigarette lighter, and another in your car's a/c. The Florida chapter of the International Association of Arson Investigators ran a basic test in which it introduced just over 5 ounces of OZ-12 into a passenger car interior and triggered an ignitor.



OZ-12 is one of several R-12 substitutes not approved by the EPA. Some contain flammable or explosive gases, and at least one state (Florida) is pulling them off the market.

There was an explosion that blew out the car windows. Your car's a/c has a capacity of 2 to 5 pounds of refrigerant, many times more than that used in the Florida test of OZ-12.

If you have had your car serviced with OZ-12 or any of the other non-approved products on the market, you have a problem besides the danger of fire or explosion: getting someone to service the system.

A shop cannot legally vent even a mischarged R-12 system to the atmosphere, because it probably contains some R-12 even if the substitute refrigerant did not. The shop will not pull what's in the system into its

recycling machine, because the non-R-12 gases could contaminate it. In fact, there's a risk that the gases could blow open an air purge valve, allowing all the recycled R-12 to be lost.

What can be done with a mischarged system? Well, if the shop knows what you've got inside and wants to do something, one possibility is to draw the gas into a special container, chilled to liquefy the gas. Then the shop can make arrangements to have the tank shipped to a facility equipped to analyze and handle it. Potentially expensive? You bet.

A similar problem occurs if you, perhaps unknowingly, topped up your

system with R-22, a household/commercial refrigerant. Many stores have been selling small cans of this product from the same shelf space where they used to sell small cans of R-12. Well, they now can only sell small cans of R-12 to professionals certified in recycling refrigerant (you still can buy a big tank of R-12 if you want to invest hundreds of dollars). The R-22 cans may have the same size tops as the cans of R-12, so the simple can tappers used by do-it-yourselfers do work.

Using R-22 in a system designed for R-12 may not pose a fire or explosion danger, but the fact is R-22 won't work at the system pressures at which the R-12 system does. Because it operates at higher pressures, R-22 is far more likely to leak out than the R-12, so it's a waste of money just from that standpoint.

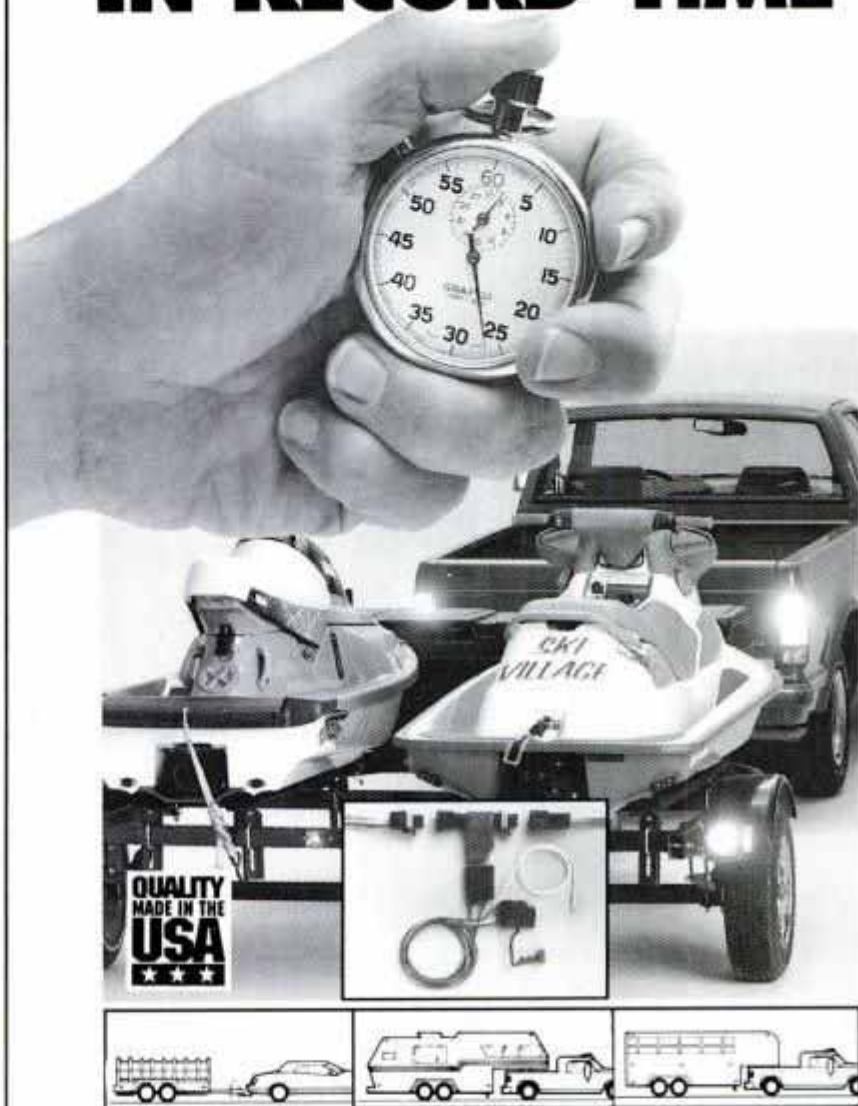
System pressures are an important issue for any possible substitute refrigerant, including R-134a, unless suitable modifications are made. With some substitutes, performance just drops. In others, ice coats the surface of the evaporator, and after perhaps 10 to 15 minutes, depending on humidity, the ice blocks the flow of cool air into the passenger compartment.

Just putting in a few pounds of R-12 used to be an inexpensive way to keep the system going without repairing the leak. Now that R-12 is getting scarce and expensive, that option is out. Shops know they don't have a lot of spare R-12 to keep pouring in. A shop that now finds a leak will want to do the socially responsible job of fixing it. If your system has a leak, get it traced. It just might be a low-cost O-ring seal that's leaking.

As long as you can get R-12, have the leak repaired and the system refilled with R-12. The system was designed for it and will live longest and perform best with R-12 and mineral oil in the system. When you can't get R-12, retrofitting to R-134a is the only safe option.

Yes, a retrofitted system will involve some new parts, including R-134a service fittings and perhaps a container of a new desiccant that works better with R-134a. Although many older cars might need a lot of work (and won't be cost-effective candidates for retrofit), most late-model R-12 systems include many parts that work acceptably with R-134a. If you are lucky, the cost of the retrofit alone, over and above a repair of a leak and a simple recharge, just might be less than \$100. Most carmakers are developing retrofit recommendations that should cost well under \$350 at most. So you should be able to keep your cool, and stay solvent in the process. **PM**

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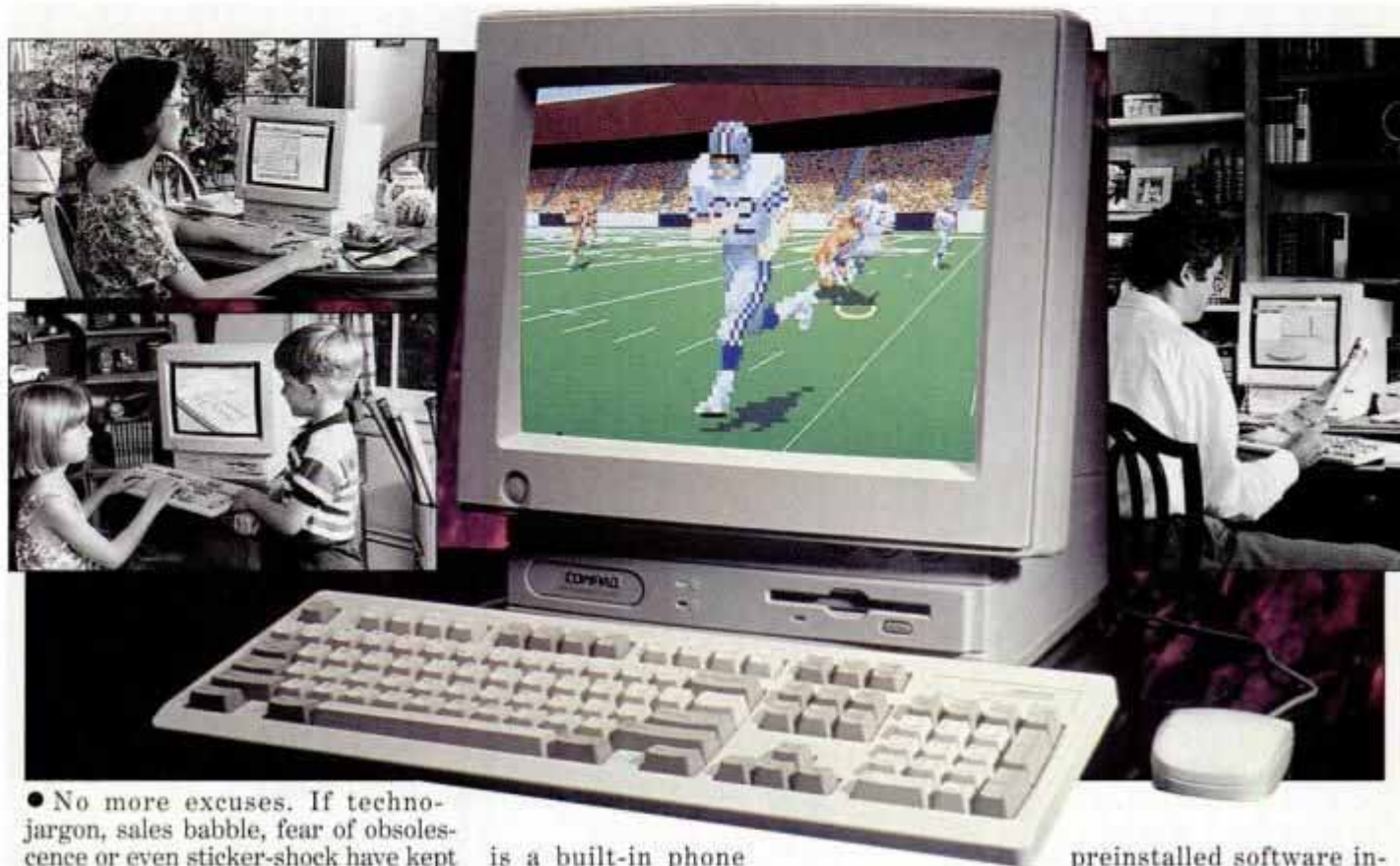
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PM

COMPUTERS

The All For One

BY STEPHEN A. BOOTH, Contributing Editor



• No more excuses. If techno-jargon, sales babble, fear of obsolescence or even sticker-shock have kept you from acquiring a computer thus far, Compaq's new Presario 425 is about to eliminate all your anxieties and objections. You won't even be able to grumble about the cost of electricity to run the machine.

The Houston, Texas-based maker of cutting-edge high-value computers has taken its first shot at a PC targeted for home and family use, and scored a bull's-eye. Don't read "home" and "family" to mean a retread office machine. This initial entry in the Presario line might offer something for everybody, and there are no compromises to leave any particular family user shortchanged.

The home-and-family concept of the 425 begins with its design. It's an all-in-one computer, a compact 15-in. cube that houses both the computer and a 14-in. high-quality color screen. Compaq boasts that first-time users can set it up and get it running in less than 18 minutes. We'd call that a slow learner. The only outboard parts are the keyboard, mouse-pointer and, if you choose, joysticks or trackball controllers for the half-dozen games that come preinstalled.

Another feature of the Presario 425

is a built-in phone answering machine. Make that *machines*, as the system lets you set up separate voice-mailboxes for every member of the family—up to 999, each with its own outgoing greeting and on-screen message pad.

The 425's communications center also includes a fax/data modem, and the phone system automatically distinguishes between machine-talk and human callers. You can send or receive paperless facsimiles, compose them or read them on-screen, store them in computer memory or route them to an optional printer. You use the data modem to communicate with other computers or with on-line services. All the software for Prodigy Interactive and America On-Line is preinstalled—you even get a free month's service on each.

There is very little you can't do through on-line services these days. The kids can research libraries for school, or play games. Mom can get airline tickets and book hotels for vacation, or compare microwave-oven specs and order delivery. Dad can play rotisserie baseball, or pay bills and bank electronically. Speaking of banking, the 425's generous bundle of

preinstalled software includes *Quicken*, an easy-to-use financial program. It helps you balance the bank accounts, track family budgets and investments, tally up the tax records and otherwise handle all your fun-with-numbers activities.

While the Presario 425 is tackling these varied assignments, it won't be making your local utility richer or the environment poorer. The computer rates the Environmental Protection Agency's Energy Star, which means it's power stingy. You can leave it on all day, and, when it's not in actual use, it goes into a hibernation mode that consumes less power than a 25-watt bulb. You can rouse it from its sleep at the touch of an instant-on button.

This kind of thoughtful concern for design and features carries right on through to the way the Presario 425 works with you—it's user-friendly, to use an overworked phrase.

Compaq has eliminated all the usual technojargon that frightens or alienates would-be computer buyers. Once you've hit the power switch and chosen English, Spanish or another language to work in, you're greeted by the Compaq Welcome Center. The

selections on this screen introduce you to the 425 and it walks you through its operation.

This is not to say that the 425 comes without an owner's manual and reams of "documentation"—a term that persuades many people into thinking that the bathroom tiles need immediate regrouting. But what a refreshing change these Presario booklets bring. They're written in easy-to-follow English instead of the usual Tekkish, and organized and indexed in a way that anticipates the information you'll need—so that you can find something even when you're not sure what it is. More remarkable, there's a helpful and civil tone where the standard-issue manual is preemptory or downright condescending. Lots of useful illustrations, too. And there's a full-time toll-free support hotline.

Under the hood

While we're in the technical corner, let's look at what Presario's got under the hood and how this stacks up against current and anticipated technology.

With the seemingly daily advances in computing, many would-be buyers fear that what they buy today won't be fit for kindergarten work tomorrow. Electronically, the Presario 425 isn't likely to become obsolete anytime soon, nor are you likely to outgrow its memory and other operating features.

The 425-suffix in Presario's name comes from the microprocessor that runs the system. It's an Intel 486SX chip, running at a speed of 25 MHz. The 486 brain will suit most needs for a long time, and the processor speed is adequate for most tasks.

The computer's standard 4 megabytes of random access memory (RAM) is plenty to run Microsoft Windows—preinstalled with the supplied DOS 6.0 operating-system software—and its various applications programs. Again, if you ever want more RAM, you can add chips for a total of 20MB.

These upgrades and other additions (there are slots for two expansion boards) are easy to do, as Presario's inner workings are mounted on a slide-out tray. Odds are you won't be making these upgrades, but it's nice to know that Presario isn't a dead-end system. The 200MB hard disk, for storage, ought to hold you a while—especially since its capacity can be doubled by the compression software in DOS 6.0.

A super view

Image-wise, the Presario 425 has nothing to be ashamed of. The 14-in.

screen is a Super VGA monitor with 0.28mm dot-pitch—meaning it's really sharp. You can pick your resolution and color palette, too: 1024 × 768 pixels with interlaced scanning and 16 colors, or 800 × 600 progressively scanned with 256 colors. Progressive, or noninterlaced scan, means you won't see the washboard-pattern of video's typical scanning lines—a benefit with some kinds of programs.

If we've got one quibble with the 425, it's the lack of a built-in CD-ROM drive. For a family computer, and especially one likely to be used by kids, the ability to run multimedia educa-

tional, reference or even entertainment programs from compact discs would have been great. You can add CD-ROM as an external option. Compaq says future Presario models will have a built-in drive.

Overall, Presario offers a lot of performance and features—especially considering its \$1399 street price. And since so much is preinstalled and built-in, you won't have to listen to a lot of pseudo-tech jive on the sales floor. Still, we think it's always best to take a test drive before you buy, so call (800) 345-1518 for a dealer near you. **FM**

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EDITORIAL

Clunker Bills Threaten Old-Car Hobby

BY CLIFF GROMER, Contributing Editor

Editor's Note—Some readers have asked where POPULAR MECHANICS stands on so-called "clunker bills." This is where we stand.

We confess a love for old cars. We're taken by the look of flowing, faired-in fenders and art deco dashes of the '40s; the chrome, gadgetry and fins of the '50s; and the stance, graphics and muscle accoutrements of the '60s and '70s. We're captivated by the mellow throb of a 6-volt gear-reduction starter cranking over a flathead Six, or the intake howl of eight wide-open throttle bores gobbling down huge chunks of atmosphere to feed 425 hungry high-compression horses.

Smokestack industries love old cars, too. They're taken by the look of crushed-in fenders and decimated dashes of the '40s, crumpled chrome and flattened fins of the '50s, and mangled muscle accoutrements of the '60s and '70s. They're captivated by the piercing screech of tortured, compressing steel and the crash of exploding glass.

And therein lies a problem.

Back when the EPA introduced its master plan for mobile (cars and trucks) and stationary sources of air pollution to clean up their respective acts, the idea was for everyone to shoulder his fair share of the financial burden. But one large company—Unocal Oil Co. of San Pedro, California—flush with money and influence, came up with a better idea. Working together with the government, Unocal convinced the law boys to delay Unocal's implementation of the required—and very expensive—smog controls on its refineries. Instead, they would buy pre-1971 vintage vehicles—"clunkers"—that were in current service, pay owners \$700 apiece and then crush the cars out of existence. The logic was that the pollution coming from Unocal's refineries would be offset by getting these cars off the road. The program,



PHOTO BY CLIFF GROMER

between June and October 1990, netted some 8376 cars for the crusher.

The clunker idea picked up steam in March '92 when President Bush and his administration got behind it and endorsed the EPA's "Cash For Clunkers" program, which allows state governments and companies in various industries that pollute heavily to buy and crush old cars. In return, those companies would receive pollutant reduction credits—or an easy way out of their own air-fouling problems.

The states were not slow to follow suit. Louisiana, for one, rammed through a clunker program in spite of stiff public opposition.

Under scrutiny, the clunker campaign doesn't fly. First of all, it's not fair. If industry is a foul-air culprit, it should address its own problem instead of trying to buy safe passage through EPA waters for another year by crushing old cars.

Besides depleting the supply of older, less expensive cars, which fulfill most of the transportation needs of the poor, clunker bills also deplete a source of valuable parts for hobbyists who are restoring older cars. Let's not forget that old-car restoration is one of the purist forms of recycling. Then there's the threat to a huge multimillion-dollar industry that's geared to supporting the restoration and preservation of old cars.

Clunker bills only consider the year of the vehicle, not what's coming from its tailpipe. Even the EPA concedes that old cars are not always nor even often uniformly high emitters.

Add to this the Sierra Club's position that it is unlikely that the Cash For Clunkers program would actually reduce pollution, and you can see the real agenda behind these proposals.

Chevron Oil Co. of Southern California also jumped on the clunkers for credits bandwagon in mid-1993. But instead of sentencing all the pre-'71 cars it would buy for \$700 apiece to the crusher, Chevron recognized the concerns of car collectors. First, it is offering the better vehicles for sale through a sealed-bid auction. Second, Chevron has hooked up with a local parts outlet to sell some cars and/or their parts—minus the drivetrain, which Chevron needs to turn in for its pollution credits. A step, we feel, in the right direction.

What to do if you're an old-car buff? The same thing you should always do when dealing with governmental issues that affect you personally: Make your voice heard to your state and federal legislators. Let them know you don't buy the clunker program because it saves real polluters a lot of money and doesn't necessarily even help solve the problem. Also, check with national car-hobby and related organizations, such as the Automotive Restoration Market Organization, 1575 S. Valley Vista Dr., Diamond Bar, CA 91765-4173, and the Council of Vehicle Associations, 10400 Roberts Rd., Palls Hills, IL 60465, to join in a unified lobby effort. Because when it comes to old cars and clunker bills, clean air is really just a smokescreen. **PM**

TRACTION MASTERS

(Continued from page 68)

Eagle Aquatred. The photos are taken by a high-speed camera through a glass plate set level with the surface of the road. The glass plate is covered with 0.080 in. of ordinary water tinted with yellow-green fluorescein dye. The tires are traveling from the bottom to the top of the page. The left image shows that much of the GT+4's tread has lifted from the road surface.

Under similar conditions, the Aquatred shows no sign of hydroplaning. This is because the tread blocks most likely to hydroplane are absent. But by computer-designing the shape and contour of the rubber tread blocks, Goodyear's tire engineers have maximized void space while retaining good handling and wear characteristics.

The design bogie for the Eagle Aquatred was the GT+4, a tire that has won a considerable portion of the original-equipment market because of its strong performance in good and bad weather. The mission was to equal the GT+4 in dry traction and handling, and surpass it in wet conditions. Driving is the proof, of course, and a day at Firebird Raceway at Bob Bondurant's School of High Performance Driving verified Goodyear's claims. That included driving on a short handling course kept wet by a water truck.

Oh yes—Goodyear claims that the Eagle Aquatred also gets longer tread life than the GT+4, but we obviously didn't get a chance to test that claim.

Michelin LTX A/T

Decoding this tire's name is simple, starting at the ends. The A/T denotes All Terrain, while the LT stands for Light Truck. And the X is there because all Michelin tires have an X in the name.

This tire also benefited from the expenditure of considerable computer time in its development. We had an opportunity to test it by slithering around some back-country trails in Vermont, along a route set up by long-time Pro Rallyist John Buffum. Testimony to the LTX A/T's off-road traction is our making it virtually all the way to the top of a leaf-covered fire-road hilltop before bogging down. What's impressive about that, you say? Well, our Blazer was only in 2wd. When we put it into 4wd, it easily crawled to the top without spinning a wheel. And traveling along the freeway to and from the backwoods showed how smooth and quiet the ride is, flying in the face of conventional wisdom about how loud good off-road tires have to be. **FM**

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500 miles from nowhere, it'll give you a cold drink or a warm burger...

NASA space flights inspired this portable fridge that outperforms conventional fridges, replaces the ice chest and alternates as a food warmer.

By Charles Anton

Recognize the ice cooler in this picture? Surprisingly enough, there isn't one. What you see instead is a Koolatron, an invention that replaces the traditional ice cooler, and its many limitations, with a technology even more sophisticated than your home fridge. And far better suited to travel.

What's more, the innocent looking box before you is not only a refrigerator, it's also a food warmer.

NASA inspired portable refrigerator.

Because of space travel's tough demands, scientists had to find something more dependable and less bulky than traditional refrigeration coils and compressors. Their research led them to discover a miraculous solid state component called the thermo-electric module.

Aside from a small fan, this electronic fridge has no moving parts to wear out or break down. It's not affected by tilting, jarring or vibration (situations that cause home fridges to fail). The governing module, no bigger than a matchbook, actually delivers the cooling power of a 10 pound block of ice.

From satellites to station wagons.

Thermo-electric temperature control has now been proven with more than 25 years of use in some of the most rigorous space and laboratory applications. And Koolatron is the first manufacturer to make this technology available to families, fishermen, boaters, campers and hunters—in fact anyone on the move.

Home refrigeration has come a long way since the days of the ice box and the block of ice. But when we travel, we go back to the sloppy ice cooler with its soggy and sometimes

spoiled food. No more! Now for the price of a good cooler and one or two seasons of buying ice, (or about five family restaurant meals), all the advantages of home cooling are available for you electronically and conveniently.

Think about your last trip. You just got away nicely on your long-awaited vacation.

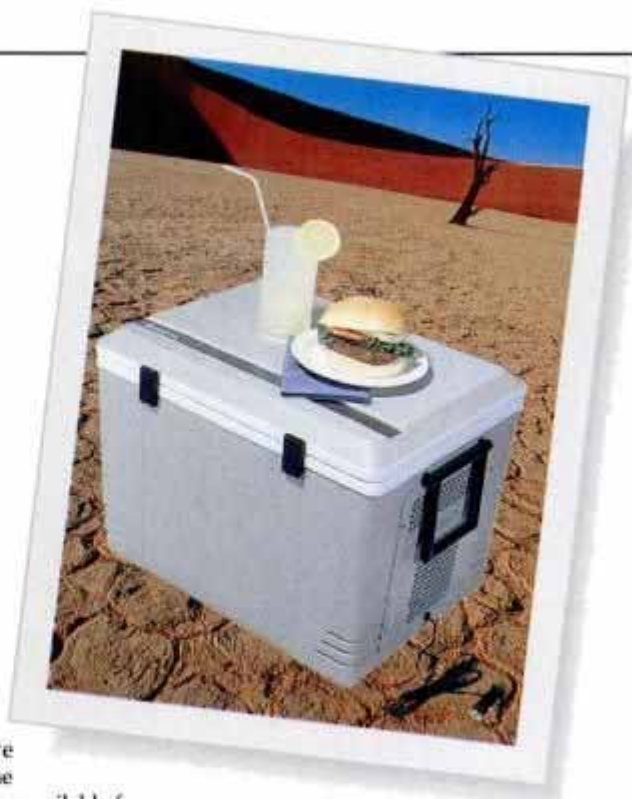
You're cruising comfortably in your car along a busy interstate with only a few rest stops or restaurants. You guessed it... the kids want to stop for a snack. But your Koolatron is stocked with fruit, sandwiches, cold drinks, fried chicken... fresh and cold. Everybody helps themselves and you have saved valuable vacation time and another expensive restaurant bill.

Hot or cold. With the switch of a plug, the Koolatron becomes a food warmer for a casserole, burger or baby's bottle. It can go up to 125 degrees.

And because there are no temperamental compressors or gasses, the Koolatron works perfectly under all circumstances, even

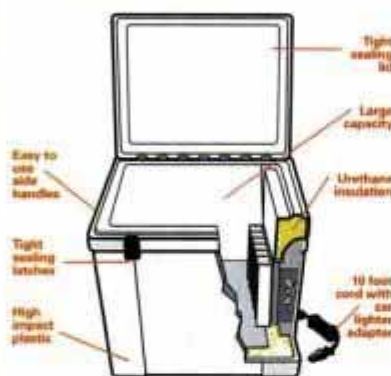
upside down. Empty, the large model weighs only 12 pounds and the smaller one weighs just seven. Full, the large model holds up to 40 12-oz. cans and the smaller one holds six.

Just load it up and plug it in. On motor trips, plug your Koolatron into your cigarette lighter; it will use less power than a tail light. If you decide to carry it to a picnic place or a fishing hole, the Koolatron will hold its cooling capacity for 24 hours. If you leave it plugged into your battery with the engine off, it consumes only three amps of power.



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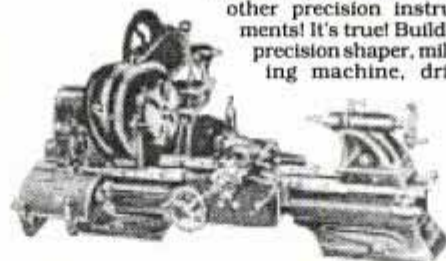

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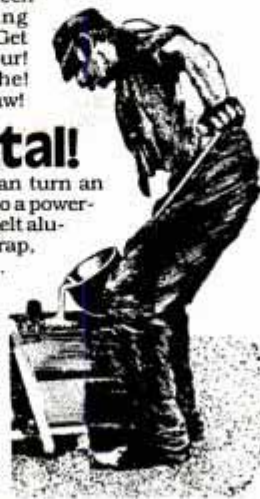


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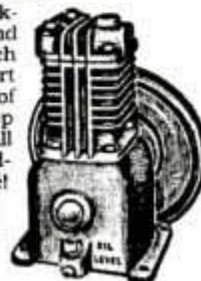
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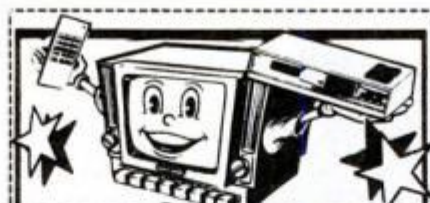
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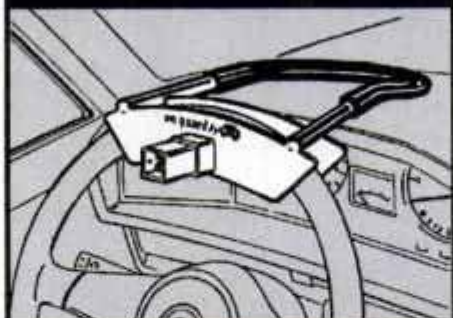
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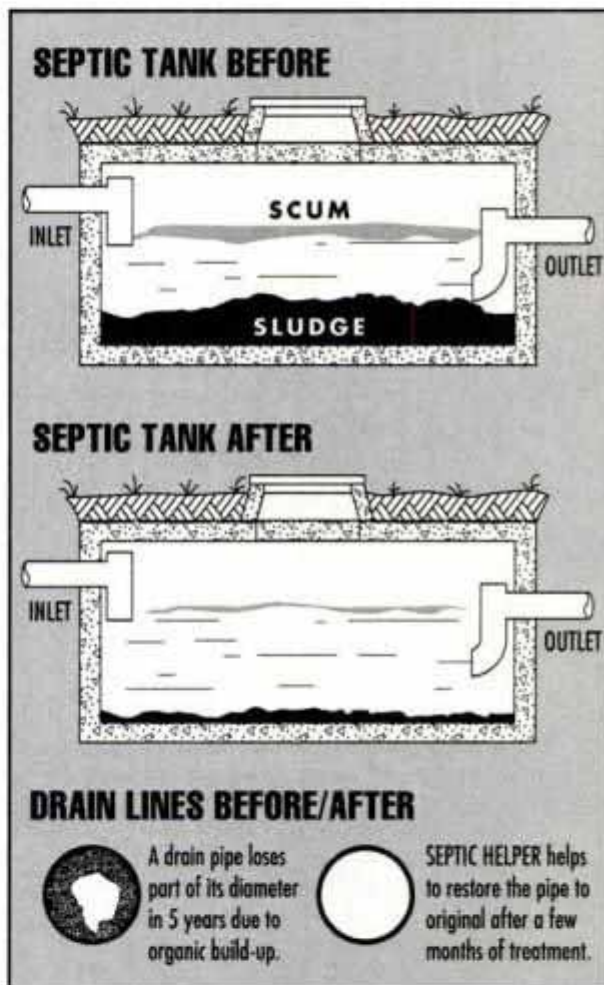
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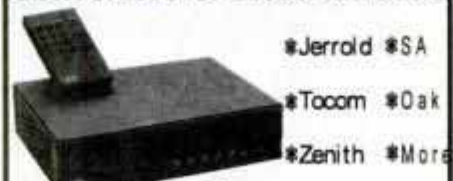
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Spring Car Care

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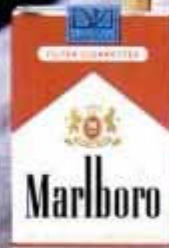
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