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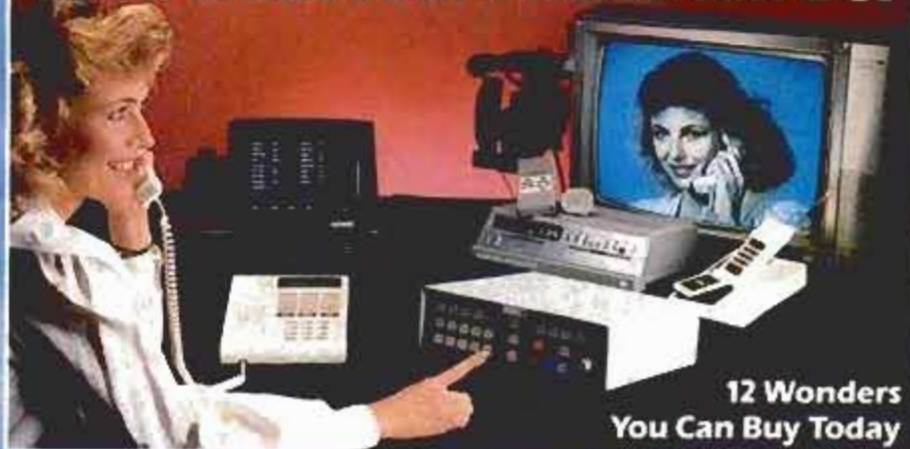
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Introducing the all new Regency MX5000, a 20 channel, no-crystal scanner that receives

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MX5000



MX3000

**Regency ELECTRONICS, INC.**

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ON THE COVER
It's hard to believe, but this 3/4-scale WWI Jenny is one of the many new ultralights that anyone can fly without a license. Read how these authentic-looking fun planes are revolutionizing sport flying in the exciting story starting on page 96.
—Photo by Howard Levy

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JANUARY 1984

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F9WJ-1S0-7432

POPULAR MECHANICS (ISSN 0032-4558) is published monthly by The Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A. Subscription prices: United States and possessions, \$11.97 for one year, \$21.97 for two years. Canada and all other countries, add \$16.00 for each year. Second-class postage paid at New York, N.Y. and additional mailing offices. Authorized as second-class mail by the Post Office Department, Ottawa and for payment of postage in cash. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 20, 1950. © 1983 by The Hearst Corporation. All rights reserved. Printed in U.S.A.
POSTMASTER: Please send address changes to Popular Mechanics, P.O. Box 10064, Des Moines, Iowa 50350.
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Editorial offices: 224 West 57th St., New York, N.Y. 10019. We cannot be responsible for loss of unsolicited queries, manuscripts, or photos. For return, they must be accompanied by adequate postage.

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Published by The Hearst Corporation
President: Frank A. Bennack Jr.
Chairman: Randolph A. Hearst
President, Magazines Division: Gilbert C. Maurer
Publisher, Popular Mechanics: Daniel J. Coleman
Publishing Consultant: Richard E. Deems

POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 959 Eighth Avenue, New York, N.Y. 10019. U.S.A. Frank A. Bennack Jr., President; Randolph A. Hearst, Chairman; Harvey L. Lipton, Vice President and Secretary; Hearst Magazines Division: Gilbert C. Maurer, President; K. Robert Birn, Executive Vice President and General Manager; Raymond J. Petersen, Executive Vice President; Thomas J. Hughes, Vice President and Resident Controller; William S. Campbell, Vice President, Director of Circulation; Daniel J. Coleman, Vice President for Popular Mechanics.

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EDITOR'S NOTES

When the bells ring on New Year's eve, will we really begin living out George Orwell's kind of 1984? Or will things be pretty much the same as they've always been?

We posed the question to a group of prominent men who, quite expectedly, do not agree among themselves (page 60). Their lack of agreement is reassuring, but chances are you'll find little comfort in Malcolm Forbes's conclusion: "By George, how awfully right Orwell was."

Put a 30- or 40-year-old copy of PM in the hands of an editor here and you'll have a hard time getting his attention away from it again. We're all hooked on the fascinating "new" devices that were being announced to the world during the early part of this century. We think today's readers will be just as intrigued as we are, so we're starting PM's *Time Machine*—a selection of highlights from our archives—with this issue. You'll find it on page 141.

When Chevrolet introduced the '84 Corvette last spring, we figured we ought to challenge 'em on the audacious claim that the Vette is the fastest sports car sold in America. It's not the kind of challenge one makes lightly.

We waited until we got hold of a Corvette with the unique new Doug Nash 4+3-speed manual transmission and then pitted it against 10 of the best competitors available. (For the results, see *Corvette Takes On The World*, page 88.)

As I say, it's not something one does lightly. Our two-day test at Lime Rock, Conn., involved 19 people, who burned some 232 gallons of super unleaded gasoline during the tests. It was far from an exercise in economy. The combination of high-performance engines and spirited driving gave our "corporate fleet" a dismal average fuel economy of 12.7 mpg. And the food bills seem to indicate that something equivalent to 20 hamburgers per hour are required for bold driving.

PM



Gassing up PM's test fleet created a parade of high-priced sports cars at the local pumps a couple of times a day, but it didn't win any awards for fuel efficiency.

John A. Lillenton

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The line



The line is low and long.
The line is straight through
a curve. The line is strong.

The line of Honda Civic
Hatchbacks for 1984. Their
new design and advanced
engineering make these new
cars absolutely remarkable.

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Sit in the front seat of the
new Civic and your vision
improves. The hoodline is
lower. There's more room
above your head in the back
seat because the roofline is
longer. Behind the back seat
is a generous cargo area.

These are among the most
space-efficient automobiles
ever manufactured by Honda.

You can easily reach the
controls. They are logically
placed. They work smoothly.
And all of the instruments
read both quickly and clearly.



is drawn.



The outline of the new Civics makes the best use of aerodynamic design. Even the doors wrap over the top to conceal the drip rails and reduce wind drag. The rear spoiler also deflects air down the rear window to help keep it clear from dust.

There is a totally new and compact suspension system. It gives excellent directional stability. Yet it rides like a

much larger automobile.

The practical Honda Civic Hatchback comes with a peppy 1342cc engine and a manual 4-speed. While the new, larger 1488cc 12-valve engine powers the deluxe Civic DX and also the sporty Civic S. These two come with a manual 5-speed shift.

But there is a new 3-speed automatic with a torque converter lock-up available

in the Civic DX Hatchback.

All three Civics have new interior features that must be seen and experienced in person to be fully appreciated. And they are all standard.

All things considered, the new line of Civics is one line you will love being handed.

HONDA
The New Civics

LETTERS TO THE EDITOR



Getting a kick out of kit cars

We were really inspired by your story on kit-built cars (*The Real Fun Of Building A Kit Car Is Driving It When It's Finished*, page 96, Oct. '81). We had always wanted to build a car and liked the looks of the Blakely Bernardi because it has classic styling, yet is an original design.

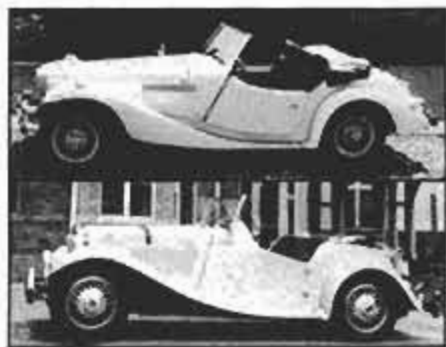
We bought a wrecked '74 Pinto to provide the mechanicals and had very few problems putting the car together. Its quality and appearance are excellent, and it turns heads wherever we drive it. If it hadn't been for your arti-

cle, we'd never have known about this great car. Many thanks.

HARVEY AND BONNIE BERUBE
(NO ADDRESS GIVEN)

I built a 1952 MG-TD from one of the many body kits on the market. It's designed to fit on a Volkswagen chassis, requiring only slight modification. The sharp turning radius of the VW makes the replica handle like a real sports car.

JOHN A. COX
EAST HARTFORD, CONN.



Two classy kit cars: A Blakely Bernardi original design built by readers Harvey and Bonnie Berube (top) and a replica '52 MG-TD built by reader John Cox (bottom).

Sticker doesn't tell all

I very much enjoyed your road test of the new Impulse (*Driving The Isuzu Impulse*, page 66, Nov. '83). However, in calling attention to the low sticker price of \$9,995, you neglected to point out that most dealers tack on a hefty surcharge. In my area, it's \$1,997, which boosts the actual price to almost \$12,000.

The reasons given for this charge are limited availability, cost of advertising and so forth. I guess one excuse is as good as another when you want to push up the sticker price.

D. J. SCHOER
PINE BLUFF, ARK.

As we have explained on other occasions, the suggested retail price (SRP) is just that—a suggestion. Dealers, who are independent businessmen, are free to charge what they feel the traffic will bear in their particular areas. When this is less than the SRP, everyone is happy; when it's more, everyone gets mad, including the carmakers themselves, who prefer to keep prices low to be competitive. Incidentally, the Impulse's SRP has been upped to \$10,500 for 1984.

Finishing a cathedral

It was marvelous to see your article on our building program (*Medieval Talents Finish A Century-Old Cathedral*, page 62, Aug. '83). Your technical people told me things about the Stoneyard that no one else had ever told me. What

a superb staff you have, both from the literary point of view and the nitty-gritty end.

THE VERY REVEREND
JAMES PARKS MORTON, DEAN
THE CATHEDRAL CHURCH
OF ST. JOHN THE DIVINE
NEW YORK

A different ballgame

It is disturbing that a magazine with the reputation of *Popular Mechanics* would carry an article evidently designed to destroy football (*Dressed To Kill*, page 89, Oct. '83). The title alone was enough to scare off the average parent.

You implied that the equipment used by football players is to injure an opponent rather than to protect the wearer, and you completely ignored efforts by the National Federation Football Rules Committee to make high school football safer.

I am sorry that some youngsters will not be privileged to participate in football because their mothers or fathers will have been frightened away by your writing.

RICHARD C. SCHAFER
ASSISTANT PRINCIPAL
CARY-GROVE HIGH SCHOOL
CARY, ILL.

We appreciate your concern, but must point out that our article pertained to professional football, not the game as it is played at the high school level. Also, the story's subtitle stressed

that modern football equipment is the "high-tech armor that could save life and limb."

While it was not our intention to imply that the game is unsafe, statistics compiled by the National Safety Council do indicate that the rate of serious injuries is higher in high school football than in either the professional or college game.

Your article *Dressed To Kill* was very informative, but contained an error. You said that "shin protectors were developed by Joe Rosenstein." I represent Casco/USA, which makes Casco Leg Guards. The guards are endorsed by Rosenstein, but were designed by Dr. Klas Buring, an orthopedic surgeon, and Dr. Jan Ekstrand of the Swedish National Soccer Team.

MARIA MARIONI
GARY BITNER PUBLIC RELATIONS INC.
FORT LAUDERDALE, FLA.

Crossed wires

You had a great story on the California Bullet (*Coming: The Fastest Train In The West*, page 90, Nov. '83). But I wonder if you really meant that d.c. power from overhead is converted to a.c. to drive the train. Normally, a.c. is used for power transmission, while d.c. drives the wheels.

BRUCE E. MYERS
DOWNEY, CALIF.

You're right. We inadvertently got our wires—or currents—crossed. P.M.

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

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ALL OUTDOORS



The kayaks are coming

Rough-water kayaking is only for the heartiest paddlers. Most kayakers are happy in quieter waters. The attraction of kayaking is based partly on taking charge of your own life, and partly on the Winnie-The-Pooh attraction of "messaging about in boats." You leave the world and your troubles behind, and maybe that's why kayaking is a rapidly growing sport, with more than 25,000 participants.

Technology has produced kayaks like the Spirit, a real one-man sports car of rivers and lakes. A good kayak is as much fun to aim through the rapids as driving a taut sports car around a challenging track. With the right boat you can run a white-water river like the Chattooga (where the film *Deliverance* was made) or spend a quiet weekend on a camping trip lazing down quiet streams to remote backwoods areas.

The boats themselves combine the latest in plastics technology with designs developed by the Eskimos over millenia in the North Country. Most hulls are rotomolded of cross-linked



South Carolina's Chattooga River gives Perception kayak builder Bill Masters a wild ride.

polyethylene. And the one-piece hulls come in sizes, like pants, to fit individual paddlers. The 37-pound Perception Spirit shown here stretches 12 feet, 10 inches, measures 2 feet wide, and comes in red, yellow, blue, neutral or black for \$549.95. Designed for a 160-

to-220-pound paddler, it's one of a family of sports kayaks. It paddles easily and responds to the novice or the experienced competitor.

For more information on kayaking and the Spirit, write Perception Inc., Box 686, Liberty, S.C. 29657.

Enclosed ski carrier

Ever thrust your foot into a ski boot half full of snow? Yipes! Or, have you avoided that difficulty by carrying your boots inside an overfull automobile where they kicked you all the way to the slopes? Now, there's a rooftop ski carrier that can tote your skis, with bindings attached, plus boots, poles, and other gear while protecting them from weather, road dirt and theft.

The Skipod comes in three models ranging in price from \$145 to \$195 and in complexity from a simple box to a

complete cartop system. The UCM shown here is the basic 8 x 26 x 27 1/2-inch molded urethane carrier box. It has foam plastic seals around the openings for up to six pairs of skis to keep snow and dirt off the contents. The fancier GLM combines the box with its own cartop rack system. All Skipods can be locked so you can leave your car loaded, either on the road or at the slopes, without worrying about theft.

The Skipod is available from Gerber-Group Ltd., 2149 Seaview Ave., Bridgeport, Conn. 06510.

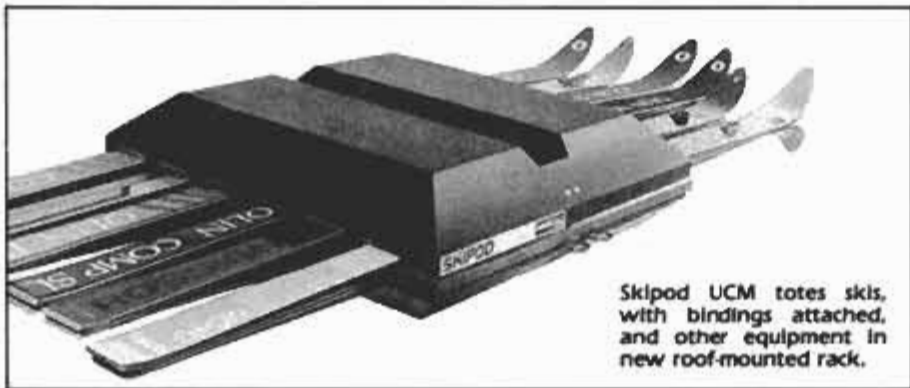
Of bears and bullets

Despite the sometimes hilarious stories told of human encounters with bears, any confrontation can, and often does, lead to injury or death—if not for the man, then for the bear.

Alaska Bear Tales, a 318-page soft-cover book by Larry Kaniut, tells, among many less happy stories, how a bear broke into the office of the commander of the Ballistic Missile Early Warning System at Clear, Alaska. He (or she) knocked over the hot-line phone that called police at a listening post. Having nothing to say, the bear breathed heavily into the phone.

The book sells for \$9.95 plus \$1 postage from Alaska Northwest Publishing Co., Box 4-EEE, Anchorage, Alaska 99509.

Even a gun may not be the answer if you're called by a bear. In fact, like automobiles, various lots of rifle and shotgun ammo have been recalled in the last couple of years. It might be a good idea to check with your sporting goods store. It can give you the address to ship it back, C.O.D., for free replacement by its maker.



Skipod UCM totes skis, with bindings attached, and other equipment in new roof-mounted rack.



YAMAHA

MICRO COMPUTER IGNITION SYSTEM

The first outboard with a brain. Kind of makes you stop and think.

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Another Story Night |
| 316414 THE WHO
IT'S HARD | 317156 EDDIE RABBITT
RADIO ROMANCE | 319788 VIC DAMONE
Over The Rainbow |
| 318287 COLLECTOR'S RECORDS
OF THE 50'S & 60'S | 318022 Grover Washington, Jr.
THE BEST IS YET TO COME | 320309 A Flock Of Seagulls
LISTEN |
| 316331 RICKY VANALS
NEVER SAY NEVER | 317149 DAN FOGELBERG
GREATEST HITS | 319681 STEVE MILLER
BAND LIVE |
| 318188 MICKEY GILLEY
BIGGEST HITS | 317990 WILLY VANDIANO
& BILLY MELINDA
MUSIC AND LEFT | 319586 AL JARREAU
JARREAU |
| 316364 KIM CARNES
"YOUEUR" | 321380 Barbra Streisand's
Greatest Hits, Vol. II | 321349 CRYSTAL GAYLE
Greatest Hits |
| 318154 DURAN DURAN
RIO | 323688 CARPENTERS
The Top 100 2013 | 318994 KENNY ROGERS
We've Got Tonight |
| 316257 AN EVENING WITH
ROGER WILLIAMS | 312686 FRANK SINATRA
She Shot Me Down | 318319 MICKEY GILLEY
Fool For Your Love |
| 219477 SIMON & GARFUNKEL'S
GREATEST HITS | 313817 Charlie Daniels Band
WINDOWS | 318881 LAURA BRANIGAN
BRANIGAN 2 |
| 316335 NEIL DIAMOND
HEARTLIGHT | 320256 A CHORUS LINE
Original Broadway Cast | 319888 BOB JAMES
THE GEM |
| 318097 BILL COSBY
HIMSELF | 313734 WILLIE NELSON
ALWAYS ON MY MIND | 318873 FRIDA
SOLO TRAVEL'S
STREET JAM |
| 321372 Barbra Streisand
SONGBIRD | 313701 KENNY ROGERS
GREATEST HITS | 318931 BRYAN ADAMS
Cuts Like a Knife |
| 318063 LEE RITENOUR
RIT/2 | 312801 JOHN 5 & THE BLACKBILLS
THE LOVE MUSIC & MORE | 318547 PAUL ANKA
Walk A Fine Line |
| 286914 FLEETWOOD MAC
RUMOURS | 320380 GEORGE BENSON
IN YOUR EYES | 318519 EARTH, WIND & FIRE
POWERLIGHT |
| 318055 FOREIGNER
RECORDS | 313049 Barbra Streisand
MEMORIES | 319301 GEORGE JONES
SHINE ON |
| 313485 JOHN LENNON
DO YOU REMEMBER | 320386 CONWAY TWITTY
Lost In The Feeling | 318774 ANGIE BOFILL
TOO TOUGH |
| 320888 BARBRA STREISAND'S
GREATEST HITS | 313632 BARBARA ANN ALPER
BARBARA ANN SINGING THE BEST | 318915 Hank Williams, Jr.
STRONG STUFF |
| 313304 FERRANTE & TEicher
GOLDEN PARTNERS | 311720 BRUNO MAGLI
RARE RECORDS
LA SCELTA 1954 - 1980 | 318876 WILLIE NELSON
TODAY'S TRAD |
| SELECTIONS WITH TWO NUMBERS ARE 2-RECORD SETS OR DOUBLE LENGTH TAPES AND COUNT AS TWO SELECTIONS—WRITE EACH NUMBER IN A SEPARATE BOX | | |
| 317859 ABBA* The Singles, The
First Ten Years | 317131 KRIS WILLIE DOLLY &
397133 SRENDIA | 318838 CONWAY
TWITTY
RARE RECORDS |
| 321396 MARTY ROBBINS
391359 *A Lifetime Of Song | 322149 BEE GEES
332143 GREATEST | 318224+ EDDIE MURPHY |
| 321026 The Doobie Brothers
391029 Farewell Tour | 318984 MARRIED WITH
398585 DREAM PRICES | 316708 DAVID FRIZZEL
THE FAMILY 67
BEST OF THE 60'S & 70'S |
| 318147 GEORGE JONES
398148 HEARD OF HITS | 302265 392266 FRANK SINATRA
THE BEST OF FRANK SINATRA
THE RECORDING YEARS | 319931 EARL KILGOR
LOW RIDE |
| 314294 JANE FONDA'S
394296 *WORKOUT RECORD | 313650 SWIN & GARFUNKEL
393652 THE CONCERT
IN THE GREAT ROOM | 318550 DEF LEPPARD
PYROMANIA |
| 313221 SHIRLEY BASSEY
393223 GREATEST HITS | 312912 GEORGE BENSON
392914 COLLECTION | 315762 JOE JACKSON
NIGHT AND DAY |
| 313373 LENA HORNE
391375 THE LENA HORNE SINGERS | 311001 WILLIE NELSON'S
391003 GREATEST HITS
THE BEST OF THE BEST | 319563 SERGIO MENDES |
| 322164 SATURDAY NIGHT
392167 FEVER | 321943 LAMARCA WITH
391946 THE DRUM AT ALL TIME
BIG BAND REVIEWS | 316871 CHICAGO 16
THE BEST OF CHICAGO |
| 310219 390211 JOHNNY MATHER
SINGING WITH THE 50'S | 322156 HERE AT LAST...
392159 BEE GEES—LIVE | 315685 FLEETWOOD MAC
MIRAGE |



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321992 NICKI BARTI DEVOTED TO YOUR WEBCAST	318303 CLAYTON KUMER NO BE CLEAR	321703 NEIL YOUNG Everybody's Rockin'	321497 CHEAP TRICK Next Position Please	321638 HERB ALPERT Blow Your Own Horn	321448 JEFFREY OSBORNE Star With Me Tonight
319608 MEN AT WORK CARGO	318386 MARTY ROBBINS BIGGEST HITS	317776 SUPERTRAMP "Famous last words..."	321414 DOTTIE WEST NEW HORIZONS	317370 BILLY SQUIER Emotions In Motion	321430 SESAME STREET MUPPETS BORN TO ADD
320291 WYNONA MARSHALLS THINK OF ONE	317917 PHIL COLLINS UNDISCOVERED COUNTRY	321406 Barbra Streisand GUILTY	316446 JANIE FRICKE IT AIN'T EASY	313635 OAK RIDGE BOYS BOBBIE SUE	315176 TOTO TOTO IV
319574 JOAN JENSEN MUSICALLY A NEW GENERATION	317586 PAT BENATAR GET NERVOUS	311662 BARBARA MANDRELL LIVE	310094 OAK RIDGE BOYS FANCY FREE	317263 DONALD FAGEN THE NIGHTFLY	316992 LIONEL RICHIE
320143 EDDIE GRANT KILLER ON THE RAMBLER	317867 Christopher Cross ANOTHER PAGE	291302 JAMES TAYLOR'S GREATEST HITS	318538 BILLY JOEL The Nylon Curtain	307710 38 SPECIAL WILD-EYED SOUTHERN BOYS	315135 ORIGINAL BROADWAY CAST DREAMGIRLS
319550 WARTY BROWN SOME MESSAGES JUST WON'T GO	321358 Barbra Streisand WET	311490 JOHNNY LEE Bel Your Heart On Me	309039 AEROBIC DANCING (AN INSTRUCTIONAL)	317206 MARVIN GAYE MIDNIGHT LOVE	316877 RUSH SIGNALS
318741 STYX KILROY WAS HERE	317800 LITTLE RIVER BAND GREATEST HITS	318133 LACY J DALTON M/M AVENUE	316430 MICHAEL DONOVAN 4777'S WINDY CITY	316638 BILLY JOEL The Nylon Curtain	314708 JOHN COUGAR AMERICAN FOOL
320135 PATRICK SIMMONS ARCADE	318351 JOHNNY MATHIS FRIENDS IN LOVE	322131 THE MOODY BLUES THE PRESENT	301473 CHRISTOPHER CROSS	317412 DIORNE WARWICK HEARTBREAKER	316711 MARK WILLIAMS, JR. GREATEST HITS
318733 MELISSA MANCHESTER'S GREATEST HITS	314047 ASIA	318803 Marshall Tucker Band TUCKERIZED	310432 DEBBY AND THE DOTS GREATEST HITS	315915 HUBERT AND ANNE SOMEBODY IN THE SHOE	308198 ROSANNE CASH Seven Year Ache
318717 PETER DINKEL Polar Goes Pop	287003 EAGLES Their Greatest Hits	310487 STEVIE NICKS BELLA DONNA	306571 BOZ SCAGGS GREATEST HITS	317750 BARRY MANILOW Here Comes The Night	314443 NEIL DIAMOND 12 GREATEST HITS ...
320085 JOHN WILLIAMS THE GURIN & THE AWOL	322123 THE GAP BAND V-Jammin	315648 GO-GO'S VACATION	310839 THE ALLMAN BROTHERS BAND BROTHER OF THE ROAD	315382 REO SPEEDWAGON GOOD TROUBLE	316703 MEL TILLIS GREATEST HITS
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321323 NATALIE COLE I'm Ready	321315 Gordon Lightfoot SALUTE	321109 AMERICA YOUR MOVE	321057 THE CHARLES DANIELS BAND - A DECADE OF MUSIC	310735 The Oak Ridge Boys Greatest Hits	316663 LARRY GORDON & THE GURIN & THE AWOL SOME FEELS LIKE LOVE
320713 BOB WOODWARD & THE BIRD BULLET BAND WANT WORDS	320556 THE HUMAN LEAGUE FASCINATION	320549 ROBERT PLANT THE PRINCIPLE OF MOMENTS	321034 ELECTRIC LIGHT SECRET MESSAGES	320523 ELTON JOHN Too Low For Zero	320515 Little River Band THE NET

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How the Club operates: every four weeks (13 times a year) you'll receive the Club's music magazine, which describes the Selection of the Month for each musical interest... plus hundreds of alternates from every field of music. In addition, up to six times a year you may receive offers of Special Selections, usually at a discount off regular Club prices, for a total of up to 19 buying opportunities.

If you wish to receive the Selection of the Month or the Special Selection, you need do nothing—it will be shipped automatically. If you prefer an alternate selection, or none at all, fill in the response card always provided and mail it by the date specified. You

will always have at least 10 days to make your decision. If you ever receive any Selection without having had at least 10 days to decide, you may return it at our expense.

The tapes and records you order during your membership will be billed at regular Club prices, which currently are \$7.98 to \$9.98—plus shipping and handling. (Multiple-unit sets and Double Selections may be somewhat higher.) And if you decide to continue as a member after completing your enrollment agreement, you'll be eligible for our money-saving bonus plan.

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Note: All applications are subject to review. Columbia House reserves the right to reject any application.



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Write in numbers of 11 selections

Send my selections in this type of recording (check one only):

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(But I am always free to choose from any category)

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Mr. Mrs. Miss

Print First Name Initial Last Name

Address _____ Apt. _____

City/State _____ Zip _____

Do You Have A Telephone? (Check one) Yes No 774-584

Do You Have A Credit Card? (Check one) Yes No

This offer not available in APO, FPO, Alaska, Hawaii, Puerto Rico; please write for details of alternative offer. Canadian Residents will be serviced from Toronto.

Also send my first selection for at least a 60% discount, for which I am also enclosing additional payment of \$2.99. I then need buy only 7 more selections (at regular Club prices) in the next three years.

Fill in this box to get your Bonus Album

DPA/BJ DPB/AF DPC/ZE DPD/ZF

IMPORTS & MOTORSPORTS



Winter-weather rocket sled



The year 1984 is beginning just as I predicted—cold. And the more bluster it gets, the more I think about owning the perfect cold-weather car—if there is such an automobile. By my standards, a set of winter wheels should have four-wheel drive, fuel injection, heated seats, heated side mirrors and an unbeatable interior

Audi GP, based on 5000S, will have full-time four-wheel drive and Porsche's 310-hp V8. heating and defrosting system. Hold the snowplow, since we're talking cars here, and not big 4x4s which could hang such an accessory up front. And my winter car shouldn't sacrifice a flake of performance for the sake of going in snow.

Right now, the only car that comes close to being the ideal sled is from Audi (see *Audi Quattro: Germany's 4x4 Cruise Missile*, page 147, June '82). I know we'll hear from Subaru, Toyota and Eagle owners, but those 4x4s, as practical as they are, are not fast snow leopards like the Quattro. In Audi's master plan the Quattro was only the first of many 4x4s. The second 4wd in the lineup is the "baby" Quattro, the 4,000S, which was just introduced. It's a car we hope to put some miles on soon. Farther down the road is the 4wd GP, which is shown at left in artist Mark Stehrenberger's concept drawing. It's bound to be the world's quickest production sedan. With a V8 from the Porsche 928S, it'll be good for 310 hp. Top speed will be 164 mph, and to help hold it on the road it'll get a drop nose, flared fenders to mount 225/50VR-15 tires and a rear deck spoiler. Now that will be a cold-weather car to make winter fun.

Mazda convertible



Convertible version of Mazda's GLC may be made in America and sold worldwide.

We have a tremendous choice of sporty compacts and minicars, but only one choice when it comes to convertible models of those cars. That's the VW Rabbit, of course.

In Europe the situation is very different, with convertibles based on the Ford Escort, Talbot Samba and others. Noting this lack of competition in the United States and the popularity of convertibles in Europe is Toyo Kogyo, maker of Mazdas. TK is 'aiming to launch a ragtop of its own. And I agree: A GLC with top down would be a ball to drive—come summer.

Racing with Renault

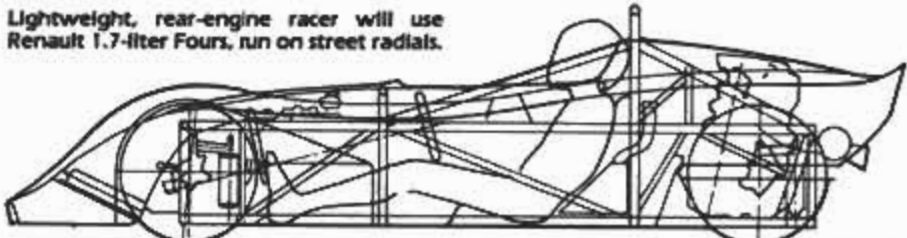
Okay, it's not a Renault elf RE40 Formula 1 car with a Gordini turbo V6. And you're not Eddie Cheever racing in international Grand Prix competition. But at the wheel of a Sports Renault racer you'll have plenty of performance and the safety of enclosed wheels (in open-wheel racing there's no fender bending; you go catapulting).

The new SCCA-sanctioned Sports Renault competition kicks off this year with regional and national races. This



Single-seater Sports Renault racers will be ready for SCCA competition this year. month, final specs and pricing for semi-kit Sports Renaults (target is under \$10,000) will be announced by the Renault/Jeep subsidiary of Renault and AMC.

Lightweight, rear-engine racer will use Renault 1.7-liter Fours, run on street radials.





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ABC-TV's telecast of the
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There's a gap between "cheap" and "inexpensive" you can drive a truck through.

That gap is value—how much truck you get for your buck. And the truck

that fills the gap is the new Nissan Regular Bed. See the chart. No other truck includes all these standard fea-

tures for a sticker price of only \$5999*.

Muscle, hustle, economy and tough

guts at an easy price. Nissan technology advances the new Regular Bed beyond ordinary trucks to... Major Motion.

AT YOUR DATSUN DEALER.

Base models	Engine size (cc)	Horsepower/rpm (std)	Torque/rpm	Payload (lbs.)	Transmission (base)	Mfr.'s sug. retail price* (base)	Turning circle (ft., curb to curb)	Ground clearance (in.)	Ventilated power front disc brakes	Double wall bed
NISSAN	2389	103/4800	134/2800	1460	5 spd./w overdrive	\$5999*	34.1	7.9	STD.	STD.
TOYOTA	2366	100/4800	130/2800	1400	4 speed	\$5998*	34.1	6.5	STD.	N/A
FORD RANGER	1995	73/4000	107/2400	1235	4 speed	\$5993*	36.7	6.6	STD.	STD.
CHEVY S-10	1940	82/4600	101/3000	1000	4 speed	\$6408*	36.8	6.4	STD.	STD.

COME ALIVE, COME AND DRIVE

TRUCKS MAJOR MOTION FROM NISSAN

*Mfr.'s sug. retail price excluding title, tax, license and destination charges.



PM ELECTRONICS MONITOR



GT, phone home!

Maybe it's because I lead a life replete with antacids and appointment books, but there have been hundreds of times when I've wished that I could reach down to the dashboard and pick up a telephone. Unfortunately, mobile telephones have always been an extravagantly priced item and, even if you could afford one, limitations on the number of channels often result in not being able to use it.

But it looks like my next car may have a phone—a cellular mobile telephone. The cellular system uses several low-power transmitters arranged in

"cells" to relay calls automatically within a geographic area. Unlike today's system of using just one high-power transmitter, this computerized system of linking cells allows for 666 phone channels, compared to today's 25. The system also has better audio results (see *New Mobile Phone System: Grids For Gab*, page 32H, July '81).

Chicago was the first city to get this system. Major manufacturers of both phones and automobiles are moving to take advantage of this new market. Buick has announced that its 1984 Riviera will have a factory-option cellular phone. Others in Detroit are waiting to

see if Buick's call will be answered.

Meanwhile, the phone people are trying to get phones that are representative of the two cellular standards into the hands and dashboards of the public. AT&T's American Mobile Communications System and Rodgers Radio Communications Service (a Metromedia subsidiary) will each be trying to knock the other one off the hook.

No matter which system rings the most chimes (all right, all right—I'll hang up the puns for a while) it is easy to prognosticate a future that includes a lot of people in cars phoning home, offices and even each other.

See what you buy

Suppose you went into a used car lot and all the cars were in crates. On each crate was a picture of the car inside. The salesman might come over to you, kick a picture of a tire and comment on the fine shape the invisible vehicle was in. But suppose you asked to see inside the crate and were told, "Sorry, but we never open the boxes." Would you buy the car? Not very likely.

Yet, the same conditions apply when a person purchases often expensive software for home computers. Many stores cannot, or will not, demonstrate what a program does, and the consumer buys, at best, a promise.

A new company called ViMart (Los Gatos, Calif.) will be selling to retailers video-discs which preview software packages in TV documentary form. So, in many cases, the consumer will be able to "test drive" the software without opening the crate.

Finger computing

When I was a kid, I used to read a lot of science-fiction stories in which the hero would be walking on Venus with a tiny computer that fits into his shirt pocket. This was not a calculator, but a full-fledged computer, much like today's desktop or lap-size models.

But, how small can today's computers get? Oh, you can miniaturize the electronics more and more—that's not the issue. It is the size of your fingers that limits the size of your computer. If

you make a keyboard too small, it is far too awkward to use.

Solution? Forget completely about typewriter-style keyboards on computers. Instead, invent a whole new way of typing.

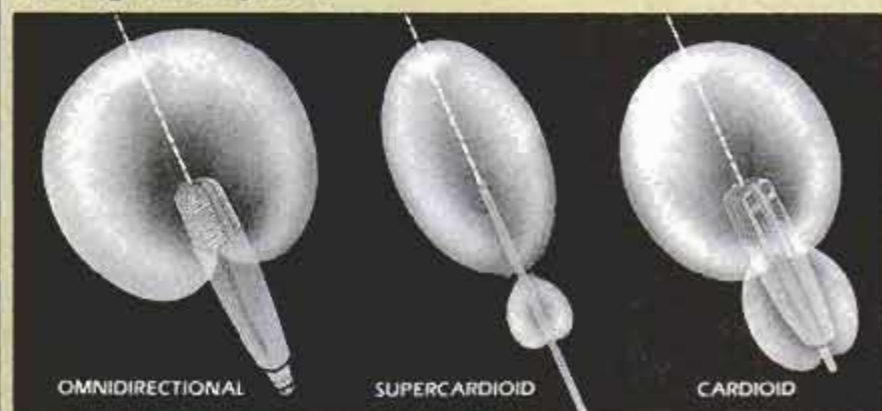
Take five keys, hold them in the palm of your hand and maybe you're holding a ticket to the future. At least, that's what a new company called Microwriter (in New York City) is hoping. The company's Microwriter device is a handheld word processing unit. Five keys allow you to touch-type all the letters of the alphabet, numerics and

punctuation by simultaneously pressing keys in various combinations. According to the company, anyone can learn the system of typing "within one hour." The unit features a built-in LCD (liquid-crystal display) as well as a built-in word processing program.

We have not yet used the unit, although we are familiar with the concept of the five-key keyboard. But, this type of method is very likely the shape of tomorrow's keyboards.

By shrinking the keyboard, the last vestige of yesterday's "giant" computers has finally fallen away. **PM**

The Right Microphone



An omnidirectional microphone picks up sound from all around. You can't "point" it at a source to be recorded because it will respond to all ambient noises. The supercardioid is very directional. Noises from behind the microphone are cut way down

while it concentrates on the noise in front. The cardioid style is like the supercardioid, but its heart-shaped pattern of response will allow for noises from the sides of the microphone to be recorded, as well as any noise coming from the front.

Wouldn't you like to have a new skill you could call your own? Learn TV, audio, and video servicing with at-home training from NRI.

You can learn to service and repair TVs, stereos, electronic musical instruments and amplifiers, car and portable radios, record and tape decks, videocassette recorders and disc players, almost any kind of electronic equipment on the market. And you can learn to do it at home, in your spare time, without quitting your job or wasting time and gasoline on night school. NRI will train you. We've trained over a million and a quarter others, with effective methods proven over 69 successful years.

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for remote calling. You also get a front-loading remote-controlled videocassette recorder to play your videotaped lessons and learn about servicing this complex instrument.

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Exclusive NRI Training on Videotape

In addition to profusely illustrated lessons, you get NRI Action Videocassettes . . . videotaped lessons that show you graphic presentations of electronic systems, vivid closeups of servicing techniques and professional "shortcuts" to study and replay as often as you want.

Training For Success

NRI not only prepares you to become a top technician, we get you ready for independence. NRI Video/Audio servicing gives you a great new way to earn extra money doing part-time servicing for appliance and department stores . . .

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We'll give you tomorrow.



Reliant K 2-door prices start at \$6837.**

Introducing the 5/50 Plymouth Reliant

A five-year or 50,000-mile Protection Plan.* Match it, anyone! For 1984, Plymouth challenges the competition: Match it! Match Reliant K's 5-year or 50,000-mile protection on the engine, powertrain and against outer body rust-through. No extra cost. The quality and durability you demand is built in. The New Chrysler Technology sees to it.

The 5/50 Reliant K. 41 est. hwy. [29] EPA est. mpg:† Match it for mileage. Reliant K is America's highest mileage 6-passenger car. It has advanced front-wheel drive and a 2.2 liter engine, perhaps Chrysler's best ever. It's also a car that's computer designed to give you maximum fuel efficiency. No wonder Reliant K's competition find that tough to match.

*5 years or 50,000 miles, whichever comes first. Limited warranty. Deductible applies. Excludes leases. See dealer for details. †Use EPA est. **Base sticker price excluding title, taxes and destination charges. ‡Based on Ward's Automotive

Manufactured by Chrysler Corporation



2-door SE as shown \$7959.

K for 1984. Match it! (If you can.)

The 5/50 Reliant K: Match it for price. Reliant K is the lowest priced 6-passenger front-wheel drive car in America. And standard are power disc brakes, an electronically tuned radio with digital clock, a new instrument panel displaying more vital information including voltmeter and trip odometer, steel belted tires and more. And with 5/50 protection, that's a great deal to match.

The 5/50 Reliant K: Match it for resale value! Reliant K's resale value[†] is the highest of any American compact. Combined with Reliant K's lowest price and 5-year or 50,000-mile protection, you've got a lot to match. **The 5/50 Plymouth Reliant K: Match it! (If you can.)** Buckle up for safety.



Reliant K. A product of The New Chrysler Technology.

mpg for comparison. Your mileage may vary depending on speed, trip length and weather. Actual highway and California estimates lower. Report classifications of domestic compact cars and recent issues of NADA Used Car Guides.



All's not sweet in Sugarland

My 1981 Buick Regal Limited is about to need its third blower fan motor. The problem is failure of the lower bearing. Do you have any idea why I'm having this trouble?—H.S. Taylor, Sugarland, Tex.

Two ideas. It's possible that the repair is not being done correctly. When the fan blade is put on the shaft of a new motor, the motor should be turned on, so you can observe the fan blade as it's rotating. If there is vibration, turn off the motor, remove the fan blade, turn it 180° and put it back on

the shaft. If the fan still vibrates, replace the out-of-balance blade.

My other thought concerns bootleg parts. There have been cases of non-Delco (non-GM) parts having been placed in Delco boxes and sold as Delco parts. These motors are pretty bad and don't hold up too long. If you suspect this to be the case, tell your story to the Buick zone office in Dallas (214-659-5170) or Houston (713-641-7906). The people there will probably ask you to send them one of the bad motors for inspection.

Danger: Freeze plug failure

Because of severe erosion, I recently had to replace three freeze plugs in my 1981 Oldsmobile Cutlass. One was leaking—the other two were about to start. When I complained to my dealer that a car having only 24,000 miles should not experience this problem, I was given a blank stare and the bill.

Am I the only Olds owner who has this trouble? Or is this bomb about to explode and cause engine damage for many because of a sudden, unexpected loss of coolant? You may wish to sound an alarm.—Paul Daniels, Kissimmee, Fla.

I'm sounding it loud and clear for all who own GM cars with 3.8- and 4.3-liter V6 engines. Those with V8s are also advised to listen.

Freeze plugs (also called core plugs) are metal discs that are force-fitted into the water jacket of an engine. If coolant freezes, plugs are supposed to pop out and relieve pressure, so the block doesn't crack.

An Oldsmobile official I questioned admitted to having seen "three or four cases" like Paul's, which raises the question of how widespread this problem might be. "Naturally, if the condition occurs during the warranty period, Olds will be responsible for repairs," he said.

When asked whether there's recourse for a customer when a car has exceeded the warranty period, he indicated that there may be. "First take the matter up with the dealer. If that fails to result in an amicable arrangement, call

in a representative from the company zone office," he advised.

What's causing freeze plugs to go bad in such a short period of time? At this time, GM service personnel don't know.

But now that the alarm has been sounded, it would be advisable for car owners with one of these engines to inspect freeze plugs at 12,000 miles and every 6,000 miles thereafter. Look for rivulets of rust on the engine block under the plugs. This is a sign that erosion has reached the critical stage and coolant is leaking. You must replace the freeze plugs.

Hunt in Huntingtown

My car is a 1982 Chrysler LeBaron Town and Country station wagon. It has a 2.6-liter engine, automatic transmission and air conditioning. Occasionally, when slowing down to stop or make a turn, the engine cuts out. It restarts immediately. I've changed the fuel filter, but this hasn't helped. Can you offer some suggestions?—Paul Reamy, Huntingtown, Md.

Not some, Paul—lots! Start by checking basic ignition timing and curb idle speed. The former should be at 7° BTDC; the latter, at 800 rpm. Then, make sure the carburetor float isn't damaged and is adjusted properly.

To check float adjustment, remove the carburetor air-horn gasket and invert the air horn. Use a depth gauge to measure the distance from the bottom of the float to the edge of the air horn. That distance should be 19.8 mm ± 2 mm. If it isn't, remove or add shims, which lie between the needle-seat assembly and fuel filter. Shims for this Mikuni carburetor are contained in kit No. MD606952.

Your letter is dated August, which presents the possibility that this trouble occurs only in hot weather when the air conditioner is on. If this is true, the idle-up vacuum modulator may not be working. This part, which is on the carburetor, keeps the throttle open wide

(Please turn to page 24)



CAUSED BY A TINY STONE CHIP

Chip can chip the old block

Our friends at Champion Spark Plug Co. warn, "With some of today's four-cylinder powerplants having plug port cavities that face forward, there is more chance than ever of foreign material getting into the plug boss area, so be extra careful." This illustration shows what can happen when a small chip or pebble goes unnoticed and lodges in a spark-plug port seat when plugs are being installed.

To keep out chips, do this:

1. Loosen plugs a few turns. Don't remove them.
2. Use compressed air or blow through a length of vacuum hose to blast debris from plug ports. Now, remove plugs.
3. Before installing new plugs, wipe threads of plug ports with a clean, dry cloth.



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the music is hot,
the taste is KOOL. At any
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Lights Kings, 9 mg. "tar", 0.7 mg. nicotine,
Filter Kings, 17 mg. "tar", 1.1 mg. nicotine
av. per cigarette, FTC Report Mar. '83.

(Continued from page 22)

enough so idle speed doesn't drop to the stall point, when the air conditioner switches on and places additional load on the engine. If the idle-up vacuum unit is damaged, replace it.

There's another possibility if the trouble occurs after the engine has been driven awhile, shut down 10 to 20 minutes (hot soak) and then driven again. In this case, premature kick-in of exhaust gas recirculation could be the cause. If so, install parts from driveability package No. 4271970—that is, a primary enrichment jet and an EGR vacuum delay valve.

Volcanic predicament

My 1980 Honda Accord gives off a strong gasoline odor when parked in the garage. My gas-water heater, which has a full-time pilot, is also housed in the garage and I fear an explosion. The Honda dealer went over the car, charged \$85 and found nothing wrong. Please help.—Robert Stewart, Rancho Cordova, Calif.

The most important advice is to keep the car parked outside the garage until this situation is resolved. The fact that your dealer found nothing wrong doesn't mean anything. You shouldn't smell gasoline. The fact that you do indicates a disruption somewhere in the sealed fuel system. Where?

One area that frequently isn't suspected is the fuel-tank cap. The cap for your Accord contains a vent valve that opens when pressure in the fuel system exceeds 4 p.s.i. It's possible that this valve is stuck open. It's also possible that the wrong replacement cap was installed.

If all's well with the fuel-tank cap, and you aren't spilling gas as you fill the tank, replace the charcoal canister of the fuel evaporative emission system. There's a hose leading out from the bottom of the canister that's open to the atmosphere and serves to let fuel vapors escape when the charcoal canister is saturated.

If none of this stops the odor, there's a leak somewhere in the fuel system—probably a pinhole that's difficult to find. Look for unusually clean spots near the fuel lines, carburetor and fuel pump.

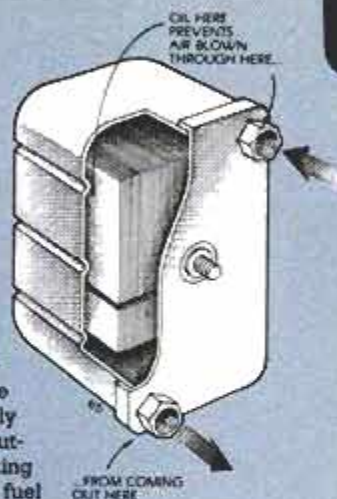
If your dealer can't correct the trouble, call the Honda district service manager at (213) 327-8280.

DO YOU HAVE A CAR PROBLEM?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.

Fuel filter fantasy

Some people test fuel filters for their diesel engines by removing them and blowing through the intake fitting. If they don't feel air at the outlet, they assume the filter is plugged and throw it out. Well, they're wasting money. Many makers of diesel engine fuel filters treat the units with lightweight oil, which coats the filtering element and prevents low air pressure—the kind delivered by blowing through the filter—from passing through. One way to determine if a filter's really clogged is to loosen the fuel filter outlet fitting. Hold a can under the fitting to catch fuel. Crank the engine. If fuel doesn't spurt from the fitting, replace the filter. If in doubt, throw it out. Many experts recommend replacing filters 20 to 50 percent sooner than the carmaker's service interval.



Expert diagnosis

No one's been able to tell me why the turn signals of my 1982 Ford Fairmont don't work when the air conditioner is on. When it's off, the signals are okay. Every "expert" says, "Bad connection." But where?—Robert LeFeure, Evanston, Ill.

No problem. The blower, turn signals and backup lights (which may not be working when the air conditioner is on) are tied into the same circuit. What's happening is that there's a voltage drop in the circuit because of a resistance buildup. The air conditioner is taking all the current and none is left for the turn signals to flash.

First, check the ignition switch; resistance induced by corrosion on terminals causes a voltage drop. Then check the eight-terminal connector under the instrument panel where wires for turn signals, air conditioner and backup lights are connected. To find the connector, trace the yellow wire from the ignition switch back to the left-hand side of the instrument panel. Clean the terminals. If they're badly corroded or burned, replace the connector.

If those two checks don't locate your problem, get the wiring diagram for your car and trace the whole circuit.

Jolt's no joke

My 1981 Ford Fairmont is equipped with the 3.3-liter engine and C4 automatic. There's a terrific jolt when shifting from NEUTRAL to REVERSE.—Rudy Turnquist, Stockton, Calif.

Remove the lower reverse servo and

use a No. 68 drill to put a .031-in. hole in the servo piston-top surface. The hole allows pressure to escape during REVERSE gear engagement. Pressure is causing the bang-bang shifting. **PM**

SERVICE TIPS

■ If it takes a lot of effort to press the accelerator pedal in your 1983 Escort, EXP, Lynx or LN7 with manual transmission, the car was probably built between Nov. 1, 1982, and Jan. 15, 1983. The problem is that the car needs a revised accelerator return spring (part No. E3FZ-9737-D), which is colored silver. The old "give-em-the-force" spring is black in color.

■ It's easy to install a thermostat the wrong way in a Toyota 22R engine (Celica, Truck), which will cause the thermostat valve to stay partially closed. This will lead to overheating. Turn the part over and find the air-bleed hole in the housing above the valve. When you place the thermostat in the engine, keep the air-bleed hole toward the rear of the vehicle.

■ Sometimes, a low-speed metallic click from the wheels of a car can't be blamed on "walking" wheel covers. Take the noise in some 1979-82 Omnis and Horizons and 1981-82 K-cars. It may be caused by a front hub castle nut that rattles. If that's the case, install a curved washer (part No. 5212684) so that the curled-up edges are against the castle nut. The next step is to install a new cotter pin, with its legs secured against the castle nut.

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THE PM GARAGE



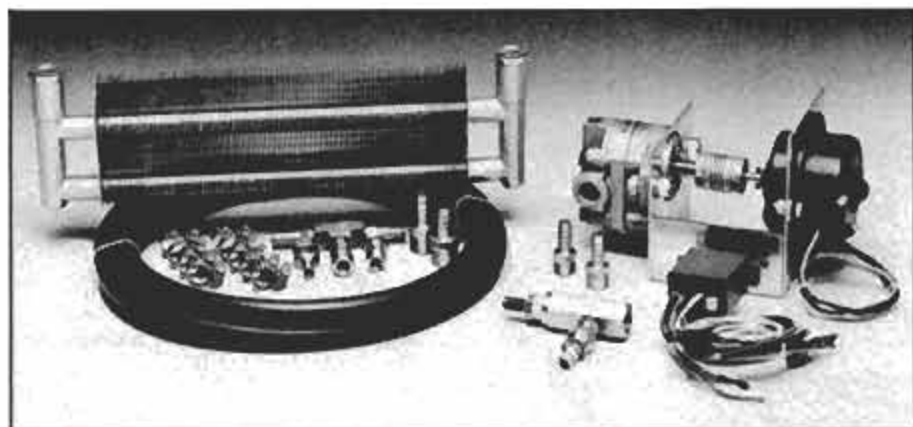
A turbo's best friend

Turbochargers may provide "free" power, but they're pretty costly items and there have been enough failures to justify investing in extra protection. Failures are typically in lubrication. Oil breakdown can occur since oil runs through an exhaust-heated chamber to lube the turbo bearing. And when the engine is turned off, a turbo can still be spinning at 30,000 rpm, so while it coasts to a stop, it is running without lubrication.

Both these problems are prevented

by a new turbo oil cooler kit from Hayden. Its list price of \$289.50 is not cheap, but discounts can be had. Hayden claims that the cooler lowers engine oil temperature by up to 60° F., enough to prevent oil breakdown in the hot turbo. When the engine is shut off, a thermoelectric circuit turns on an electric oil pump to maintain oil pressure to the bearing during coastdown.

The kit is made by Hayden Inc., Box 848, Corona, Calif. 91720 and sold in auto parts stores.—Paul Weissler



The kit contains an engine oil cooler (left) and an electric oil pump (right), plus fittings.

A fitting ending

Trim-to-fit sparkplug cable kits are cheaper than custom cable sets, but few people trust the do-it-yourself attachment at the trimmed end of each cable. Now, however, there's a kit that seems to be as good as, or better than, custom cables with factory-attached ends.

To install them, you must first strip off 3/4 in. of insulation to expose the nonmetallic conductor. Bend the conductor back against the insulation and push the terminal over it, trapping the conductor. Drive the staple furnished with the kit through the holes in the terminal and through the cable. Bend over the staple prongs with pliers. The staple goes through the center of the cable, making contact with the conductor, in addition to the contact made by the terminal. The

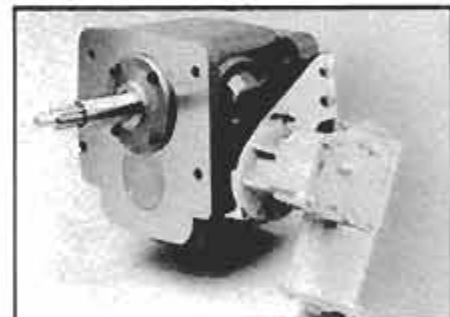
connection is mechanically and electrically sound.

Cable kits come in so many sizes and types, and are so heavily discounted, that it's impossible to quote meaningful prices. For information, write to Wells Mfg. Corp., 26 South Brooke St., Fond du Lac, Wis. 54935.—Paul Weissler



Staple provides belt-and-suspenders security for the cable ends with no price penalty.

More gears



Auxiliary two-speed tranny acts on all gears to turn four-speeds into eight-speeds.

If you're tired of winding out your pickup truck engine and then lugging it in the next gear when hauling heavy loads, you need more gears. The Double Torque 2XT Auxiliary Transmission converts your four-speed domestic pickup (two- or four-wheel drive) into an eight-speeder by splitting each gear electrically. The unit bolts between the original transmission and bell housing with only minor vehicle modifications. It costs \$1,350 from the manufacturer: Power Torque Industries Inc., 1001 Commercial Blvd., North Arlington, Tex. 76017.—Cliff Gromer

Filter adapter

Chevrolet and other GM engines from 1956 to 1983 that use the canister-type oil filter can switch to the larger capac-



Adapter converts engines with canister oil filters into bigger spin-on filters.

ity. (up to two quarts) Chevy spin-on filters with 13/16-in. threads by using PermaCool's No. 1134 spin-on filter adapter.

The adapter costs \$9.50 at most auto parts outlets. It's made by PermaCool, 671 East Edna Pl., Covina, Calif. 91723.—Cliff Gromer

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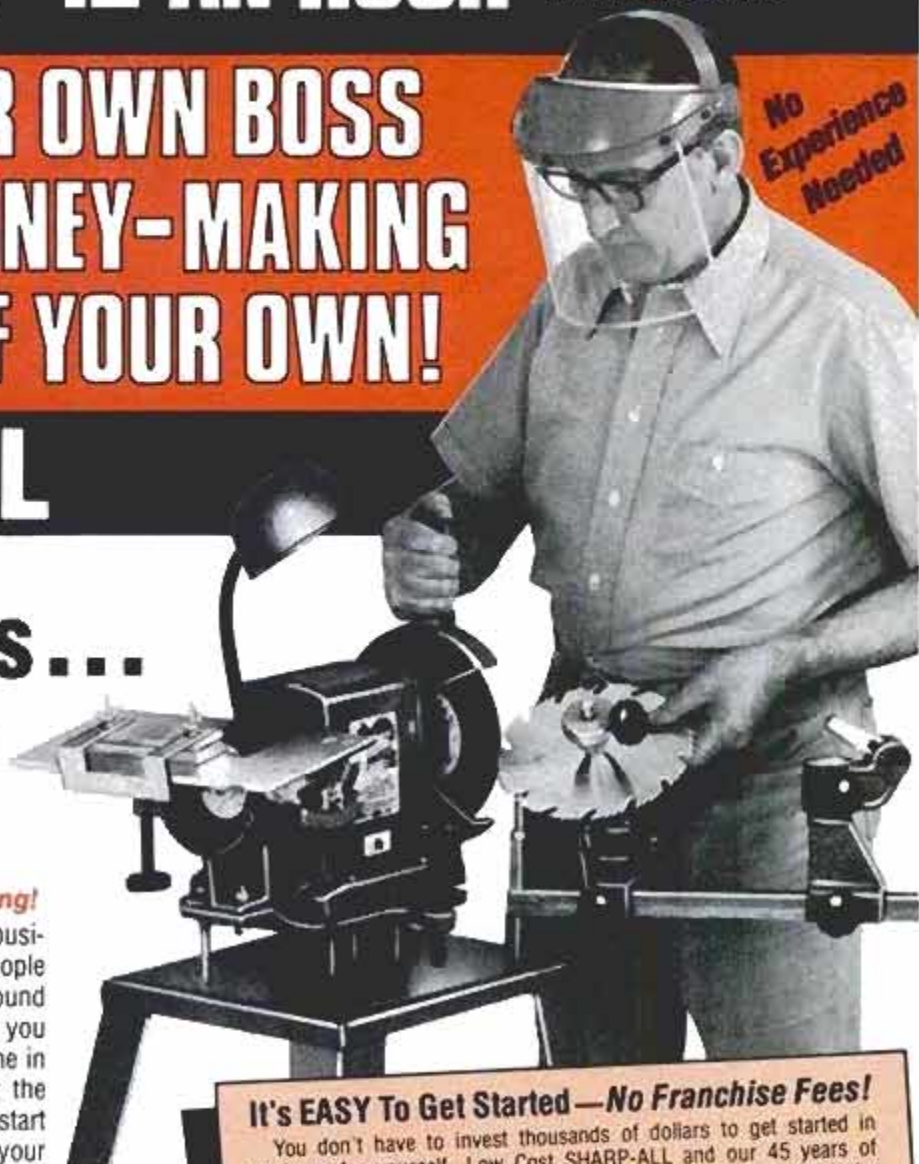
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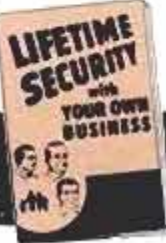
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DETROIT LISTENING POST



The road ahead for Chrysler

The federally guaranteed millions that Lee Iacocca borrowed to rebuild Chrysler is now paid back, but having it for a while enabled the company to get a lot of projects going.

Being readied for 1987 is a neat shrunken version of the Ramcharger 4wd offroader, to be among the candidates for Chrysler's new 1.8-liter and 2.5-liter engines now in development.

A so-called P-car—not to be confused with the Pontiac trend-setter—will debut in 1986 to replace the Omni/Horizon commuter cars. In '85, we'll get the H-body touring sedan,



Two-seat Mercedes look-alike with front-drive turbo-power is Chrysler's next ragtop.



The deTomaso Pantera may reappear in the U.S. with a 360 Chrysler V8 or turbo Four.

which will be a hatchback four-door only. Chrysler wants the H-sedan to have European performance levels, while offering buyers items we usually associate with Japanese cars—like cup holders, coin slots and storage bins wherever they'll fit. This theme is already in the new Caravan minivan.

In 1987 Chrysler will unveil a J-body car which is intended to "out-Thunderbird" Ford. It will be a two-door coupe in a luxury category, but with performance that will better the Thunderbird Turbo Coupe. This could be done with

the supercharged 2.2-liter engines Carroll Shelby is developing out West for his namesake Chargers, which are due to debut in the next several months.

Handling has been given particular attention in the J-body, as has the intercooled, turbocharged, 2.2-liter Four. Chrysler says this intercooled four-pot motor has gone up to 175 hp.

Two new sports car adaptations are being considered, too. One is intended to get sports cars on the street as soon—and as competently—as possible after the go-ahead is given. Sentiment in this case runs to putting a big Chrysler engine in a foreign-built sportster, in much the same way the Pantera was done by Iacocca at Ford. How curious, then, that a deTomaso Pantera was seen being unloaded from an enclosed trailer at Chrysler's Highland Park nerve center. Its side bore

the legend "Pantera—Powered by Chrysler."

What stirred its spirit is a version of the 360-cu.-in. V8 now being used only in some Chrysler trucks. Our Chrysler guy thinks this is the "down-and-dirty" way of getting a Chrysler performance image across. Rumors persist that this mid-engined sportster will eventually be powered by a two-stage turbo version of Chrysler's ubiquitous 2.2-liter Four, although it was originally designed to house the 351 Ford. Maybe Chrysler doesn't want buyers complaining, "I coulda had a V8!" Either version could hit the streets by 1986, with prices in the Corvette range.

Iacocca and crew have also had talks with Lotus on Chrysler's second sports car option: a big-bucks (\$30,000-plus), wedge-shaped, two-seat exotic car, powered by the intercooled turbo or supercharged 2.2-liter Four. Though built by Chrysler in the United States, it would bear a startling resemblance to the Lotus Esprit Turbo.

More two-seaters pending

Chrysler's unabashed takeoff on the Mercedes-Benz 380SL is taking final shape very rapidly. Prototypes will be touring the Chelsea Proving Grounds by the time you read this. Engines will be limited to the 2.6-liter Four from Mitsubishi or Chrysler's own 2.2-liter turbo Four, which will be standard. Other standard equipment will include a five-speed manual transaxle, A/C, premium sound system and power

accessories, including the convertible top mechanism.

This car may not put a serious dent in the Mercedes market, but Chrysler will no doubt find lots of customers due to a price *many* thousands less than the 44-grand Mercedes.

GM insiders report that Buick and Cadillac are considering sports-oriented two-seaters for 1987. Left out of the rumor mill is Oldsmobile. Olds has a sporty car tradition going back through

the Hurst/Olds Cutlass and Olds 442s, so we wondered why Oldsmobile would be uninterested in having one of GM's new generation of fun cars.

Turns out they *are* interested. We hear now that an Oldsmobile version of GM's '85 front-drive N-car has been seen in convertible trim. Reports indicate Oldsmobile may mold their version of the compact N-car (or GM20, under a new naming system) into a

(Please turn to page 32)

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CHEVROLET

taking charge



DETROIT LISTENING POST

(Continued from page 30)

street stromer, equipped with a neat 16-valve four-banger Olds is known to be working on. The N-car coupe will seat four passengers, but the convertible appears to be headed for the two-seater market.

This miniboom in two-seaters is curious, since Americans have shown a distinct desire for full four- to five-seat sporty cars. Mike Lamm points out that, in the boom years of 1955 to '57, Ford sold only 53,166 two-seat Thunderbirds, but in recessive '58 to '60 they

sold 198,191 four-seat T-Birds, which is nearly quadruple the two-seater's impact. Of course, the two-seaters remain the classic 'Birds, so the car-makers may be counting on them as showroom "traffic-builders" and crowd-pullers, rather than hot sellers.

Caddy's Bimmer beater?

Word from Cadillac is that the 1986 Cimarron will be a BMW buster. To accomplish this formidable task, Cadillac will extend the Cimarron's bodywork 4 in. and install General Motors' 2.8-liter, 60° V6. Altering the sheet

metal will be less expensive than the other V6 option—trimming one of Cadillac's own V8s to a six-cylinder.

Compare the specs: The 2.0-liter EFI Four now powering the littlest Caddy puts out 88 hp at 4,800 rpm, with torque of 110 lbs.-ft. at 2,400 rpm. The two-barrel 2.8-liter V6 pumps out 135 hp at 5,400, with torque of 145 lbs.-ft. at an early 2,400. Now we're talking.

"It's a difference you can feel," a Cadillac man reported. "You don't have to be told it's there." More muscle in the small Cadillac would finally set it apart from the other J-cars.

GM studying diplomacy

General Motors executives are stalking the halls of Washington, D.C., in an effort to hammer out a supplement to the voluntary Japanese import car restrictions. The current agreement, which limits imports to 1.7 million, expires this March.

The fever is fueled by Chevy's desire to import as many as 100,000 Suzuki Cultus minicars in 1984. Suzuki, a newcomer to these shores, is frozen out of the mix under current restrictions. Chevy also wants to bring in up to 200,000 Isuzu R-cars next fall, although Isuzu is allotted only 40,000 cars now. Chevy execs believe a deal can be cut. Japanese trade officials have hinted that they want to raise any new quota to 2 million cars, a number that meshes neatly with GM's desires. One question remains: Who will buy 300,000 minicars at a time when small-car sales have stagnated?

Citation revived

A Citation by any other name is still a Citation, but Chevrolet hopes that the buying public will think differently. The Citation has been renamed Citation II, though the only change was to the script and badges on the sides.

The Chevy X-car has been recalled for assorted faults 14 times since it was introduced in 1979. Several of the recalls, most notably those involving allegedly faulty brake systems and a certain difficulty in keeping the rear axle attached to the car, have severely stagnated Citation sales.

Chevrolet is making big hay out of the Citation's successful reign in SCCA's Showroom Stock Class B club racing. But racing prowess hasn't sold many family cars.

In a related X-car note, Buick's Skylark and the Chevy Citation (II) will remain in service through the 1987 model year, and not be furloughed in '86 as previously believed. GM is staying off for a year the expenditure of about a billion bucks by retaining several lines due for replacement. **PM**

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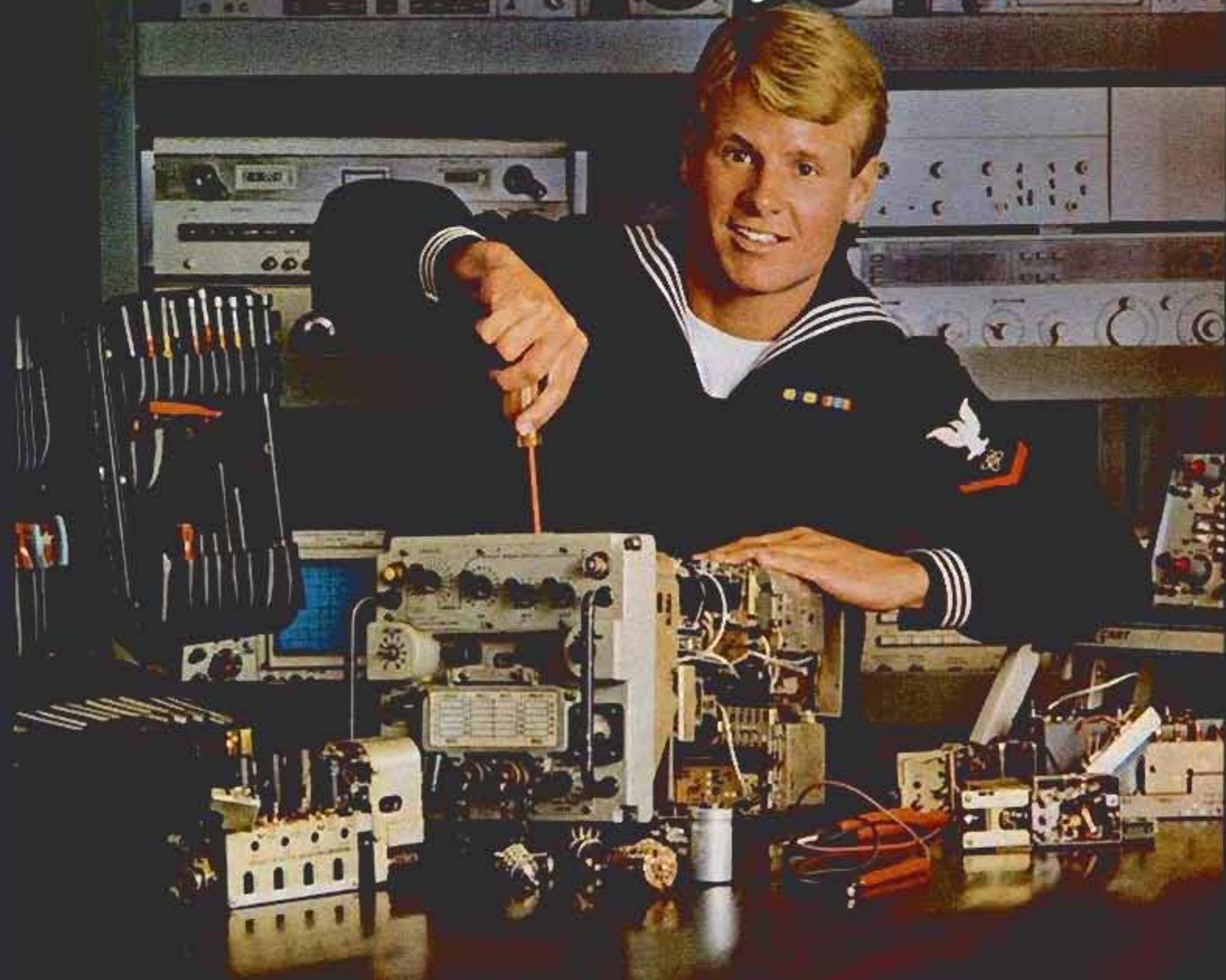
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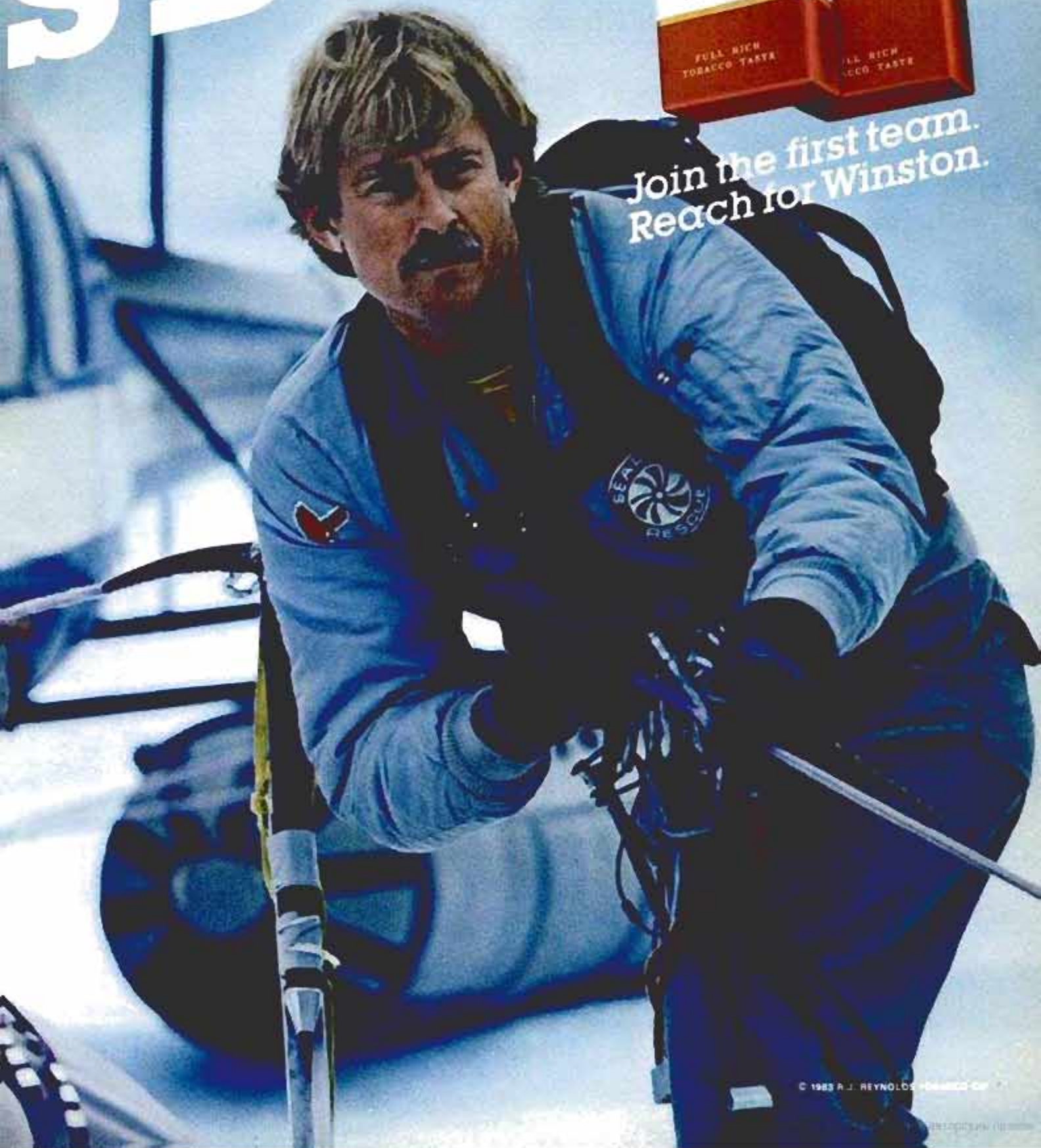
Winston. America's

Warning: The Surgeon General Has Determined
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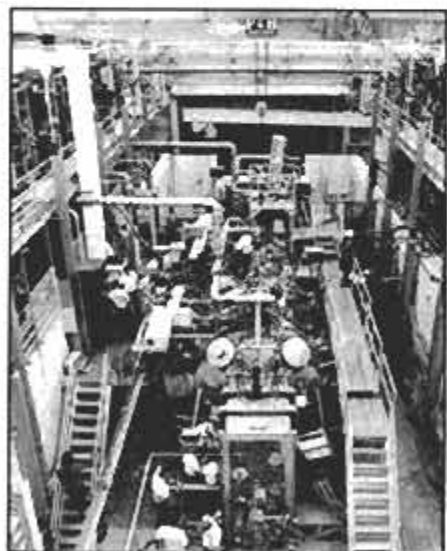
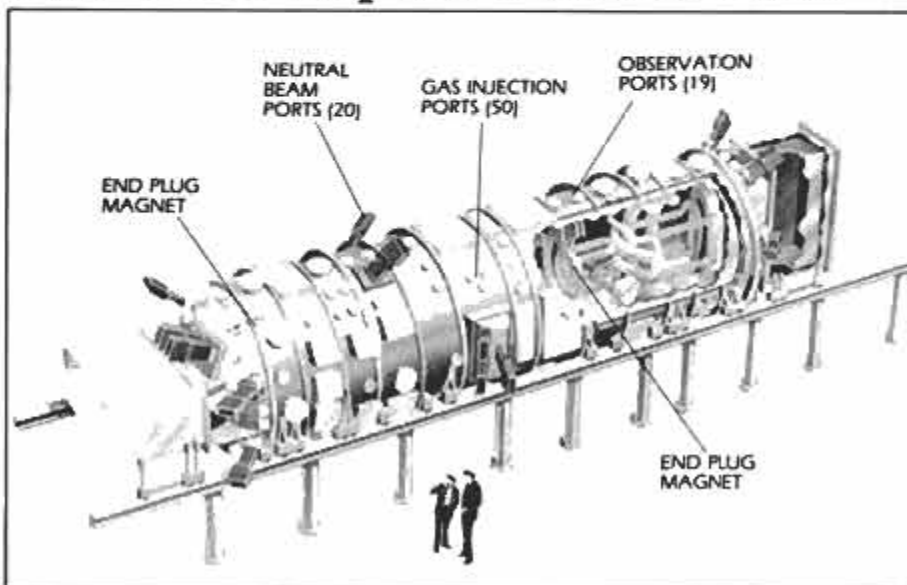
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SCIENCE WORLDWIDE



This is the way we slosh electrons



Fusion experiment unit (above) uses end plug magnets and neutral beams (left) to "slosh" electrons for safe nuclear fusion.

Put a few ball bearings in a fish bowl, shake it and the metallic balls will slosh around. At the bottom edges of the bowl, the bearings move fast and close together. But moving toward the center, they slow down and spread apart. Ideally, electrons would slosh that way in a nuclear fusion reactor to keep them

from colliding and building up too much heat in one spot. Sloshing is one of the goals of Lawrence Livermore Labs' TMX-U.

The huge titanium TMX-U chamber heats an experimental gas. Neutral atoms are then pumped in through beam ports at different angles, creating

the sloshing motion. End plug magnets pointing toward the chamber center maintain the sloshing effect.

TMX-U, now undergoing diagnostic tests, will be fully operational next year. If sloshing works, nuclear fusion may become the safest form of energy production.

Enemy of the people

A sharp decline in confidence by the American people in their physicians is largely due to a mistrust of machines. So writes Dr. Lawrence D. Grouse in the *Journal Of The American Medical Association*. He points to a recent survey in which 60 percent of the American public expressed a loss of faith in doctors. Grouse says the results show people think doctors are depending too much on machines.

Calling all inventors

You've invented a better way to heat a home. But you need money to develop the concept. The Federal Department of Energy, working through the National Bureau of Standards, will evaluate any serious proposal for new non-nuclear energy processes and products. If the NBS thinks your idea might work, you can receive a grant. The

average grants are expected to top \$70,000.

To submit an invention concept, write to: Office of Energy-Related Inventions, National Bureau of Standards, Washington, D.C. 20234. Ask for Evaluation Request form NBS-1019. If possible, photocopy your proposal and send it to me, too. I'll report on them occasionally. (Due to the heavy volume of mail, I won't be able to return any materials.)

Hard news

Scientists at the American Dental Assn. and the National Bureau of Standards have developed a cement with a composition and structure similar to tooth and bone mineral. The cement is a mixture of two types of calcium phosphate powder. It is moistened and applied to a broken tooth, and then hardens just like the real thing.

Moon's moons

British astronomer Keith Runcorn says the Earth's moon once had tiny moons of its own. These, he says in the British journal *New Scientist*, hit the lunar surface more than 3 billion years ago when our moon's then-liquid core began to harden. If Runcorn's theory holds water, it will explain how the vast lunar craters were formed.

Meteor shower

If you can find the constellation Leo in the late-night sky, you may see some meteor showers next month. For most of America, Leo will appear on the Eastern horizon about 10:00 p.m. local time. The intermittent showers of meteors coming from Leo's direction can be seen with the naked eye. The best viewing days are Feb. 25 and 26. The showers may start a few days before that and end a few days after. **PM**

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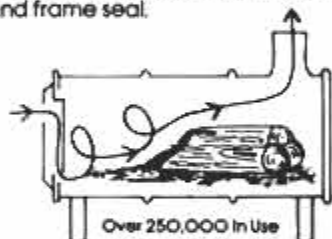
SIZE KIT	ORDER MODEL #	FACTORY PICK-UP	DEL.
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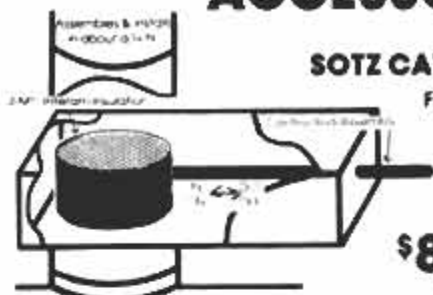
Use a Satz Heavy Steel Internal Draft Channel 2-Drum Stove Kit, a Corning® Combustor and Auto Draft for one year. If you find a more efficient, longer burning, higher capacity Woodstove, we will give you at your money back + shipping both ways. That's how sure we are Satz is the best! All Kits guaranteed for life against cracking, warping and burn-up.

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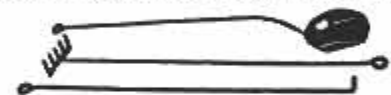


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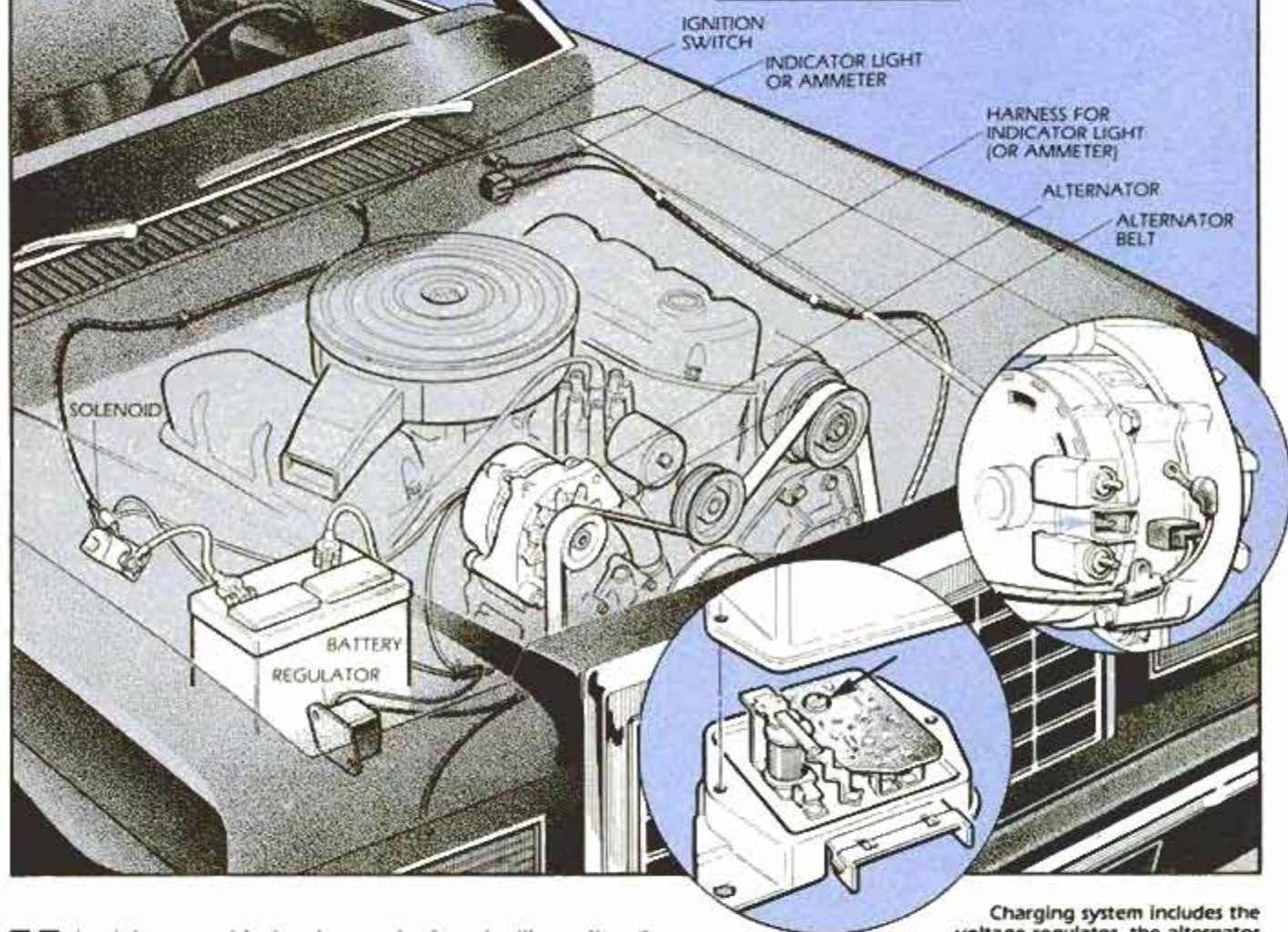
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Testing The Charging System

BY MORT SCHULTZ



Charging system includes the voltage regulator, the alternator (shown in insets), the battery and the wiring harness that connects them.

Maintaining, troubleshooting and repairing the units responsible for producing and controlling electricity in your car isn't such a big deal. They are the alternator, voltage regulator and the wiring that connects them to each other and to the units they serve.

As a team, they are called the charging system. The alternator is referred to by some as the a.c. (alternating current) generator and by GM as the Delcotron generator.

Maintenance is a breeze; there's practically none. General troubleshooting is easy, too, because a glance at the warning light or gauge on the dash-

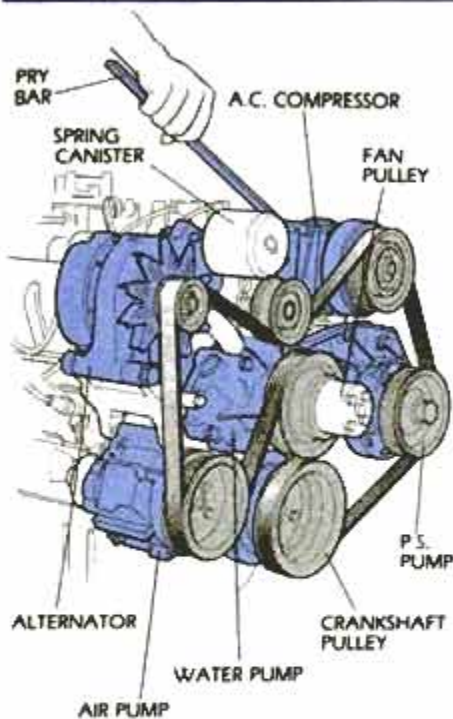
board will usually tell you when the system isn't putting out enough juice. Even if the light or gauge isn't working, the battery will serve as a warning. It will soon discharge (go dead) if the charging system fails.

However, one condition you have to be cautious about is failure of the voltage regulator to limit alternator output. Without regulation, an alternator will overcharge the battery, which can ruin components that use electricity.

For instance, bulbs and fuses that can't handle excessive current will burn out. Battery electrolyte (sulfuric acid) will vaporize quickly if too much charg-

ing current is supplied. Unless you spot the depleting electrolyte supply soon enough, dry plates will deteriorate, and the battery will die. An overcharged battery can even explode.

In this respect, you're better off with a conventional battery, especially if you're in the habit of removing vent caps and checking electrolyte level once every week or two. If the electrolyte is frequently found to be low, the system is probably overcharging. Even if you don't check electrolyte level you may



To remove a serpentine belt, place pry bar into tab on spring canister and pull down to raise tensioning pulley. The belt can then be removed easily from the other pulleys so that you can install a new one.

get whiffs of the gas. It smells like rotten eggs.

A sealed maintenance-free battery offers no latitude. The first sign that overcharging is destroying the battery is when the battery indicator turns pale yellow or clear, but by then it's too late. However, if your car is equipped with a voltmeter or ammeter, you can easily spot an overcharging condition. If battery voltage frequently exceeds 14.5 volts, or if an ammeter shows continuous high charge rates, overcharging is likely and a basic charging system diagnostic test should be performed.

No task too tough

Specific troubleshooting procedures that determine if a fault lies with the alternator, regulator or wiring is a bit more difficult than maintenance and general troubleshooting, but it's not as tough as some people would have you believe.

Only when you uncover a fault inside the alternator does the situation become hairy, but even then you have a choice. You can replace the alternator, which is easy but expensive. Or you can tear it down, test internal components and try making repairs to save yourself some money. Advanced Saturday mechanics certainly have the capability to do these things on some cars. Even Saturday mechanics with limited experience may want to try it. There's nothing to lose.

The only maintenance needed is to

check the drive belt, which is something you probably do anyway when servicing the cooling system.

Look for cracks on the underside of the belt, since a cracked belt can break without warning. Also look for oil, grease and hard glaze on the underside of the belt, which will cause a belt to slip on its pulleys. A belt that fails to grip pulleys can't turn the alternator rotor fast enough. The result is a reduction in electrical output.

A belt that has stretched and lost tension may also be the reason why your warning light or gauge is showing reduced current output. Make a quick test by pressing down on the belt with your thumb midway between two pulleys. If the belt deflects more than 1/2 inch or so, that belt is too loose.

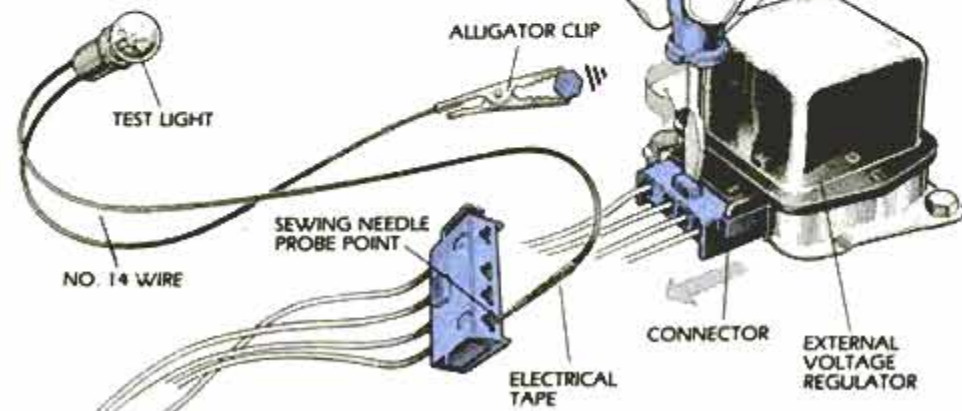
Adjusting belt tension

To remove or adjust an alternator drive belt in most vehicles, loosen the pivot and adjusting arm bolts. If you want to slacken the belt so you can remove it, push the alternator toward the engine. When the belt goes limp, pry it off its pulleys. Then, roll a new belt back on the pulleys. *Caution:* Be sure to get a belt of the correct size for your vehicle.

To adjust belt tension, hold a pry bar against the solid part of the alternator housing and pull the alternator away from the engine until the belt tightens. Pick a solid point. Do not pry against the cooling fins or fan, or you'll damage the alternator.

What's proper tension? That depends on whether you're using the finger method or a belt tension gauge to make the judgement. For accuracy, use a gauge. The most common type has a tang that slides under the belt and two arms that fit on top.

A homemade test light can be used to troubleshoot circuits, if you can locate a wiring diagram. Note that a screwdriver is used to disconnect the wiring harness from this Ford voltage regulator.



Vehicle manufacturers provide "new" and "old" belt tension specifications in service manuals. Instructions that accompany gauges also give some. Remember: A belt is no longer "new" after it's been used for 10 minutes.

If you don't have a gauge, press down on the belt and continue pulling back on the alternator until the belt deflects about 1/4 to 1/2 inch in the center of the belt's longest span. Then, tighten the adjusting arm bolt and the pivot bolt in that order. Do not tighten a belt so much that it gives less than 1/4 inch. A too-tight belt can damage alternator bearings.

Some alternators are equipped with a jackscrew belt tensioner. This is simply a screw that is threaded through part of the alternator bracket. When the screw is turned clockwise, the alternator is forced away from the engine and belt tension is increased.

Some Ford V8s from '79 onward and the '84 Corvette use a single serpentine belt to drive all engine accessories. It has a spring-loaded tensioner, so it never needs tightening. But it should be checked and replaced if it is cracked, glazed, oil-soaked or frayed on either side (both sides of the belt drive various pulleys).

Squeal is a common sound produced by a slick drive belt or one that possesses minor surface irregularities. An alternator that is developing a bearing problem can also squeal. How can you tell if the squeal is coming from the belt, alternator or somewhere else in

the engine compartment? Apply aerosol belt dressing to the belt. If the squeal is no longer present or changes pitch, you have a noisy belt. If the noise stays the same, the trouble may be inside the alternator. Remove the belt and run the engine. If the problem is in the alternator, the noise will disappear.

Test the battery first

When something happens that suggests a charging system problem, you can't overlook the battery.

The battery, alternator and voltage regulator are closely intertwined. When a problem arises that affects one, it affects all. Watch for the following trouble signs:

- If the vehicle has a warning light and it stays lighted with the engine idling or until engine speed is increased to about 2,000 rpm, the system should be tested. If the warning light doesn't come on when the ignition switch is turned on (engine not running), forget the charging system and test the light circuit (see below).

- If the car has a gauge and it shows DISCHARGE with the engine running at a speed just above idle, the system should be tested. If the gauge shows neither CHARGE nor DISCHARGE with the engine running, test the gauge circuit before turning your attention to the battery and charging system (see below).

- If the battery has to be charged or refilled with water often, the system should be tested.

- If headlights dim excessively with the engine running at idle (but brighten when accelerating), the charging system should be tested.

- If the engine cranks sluggishly, the system should be tested.

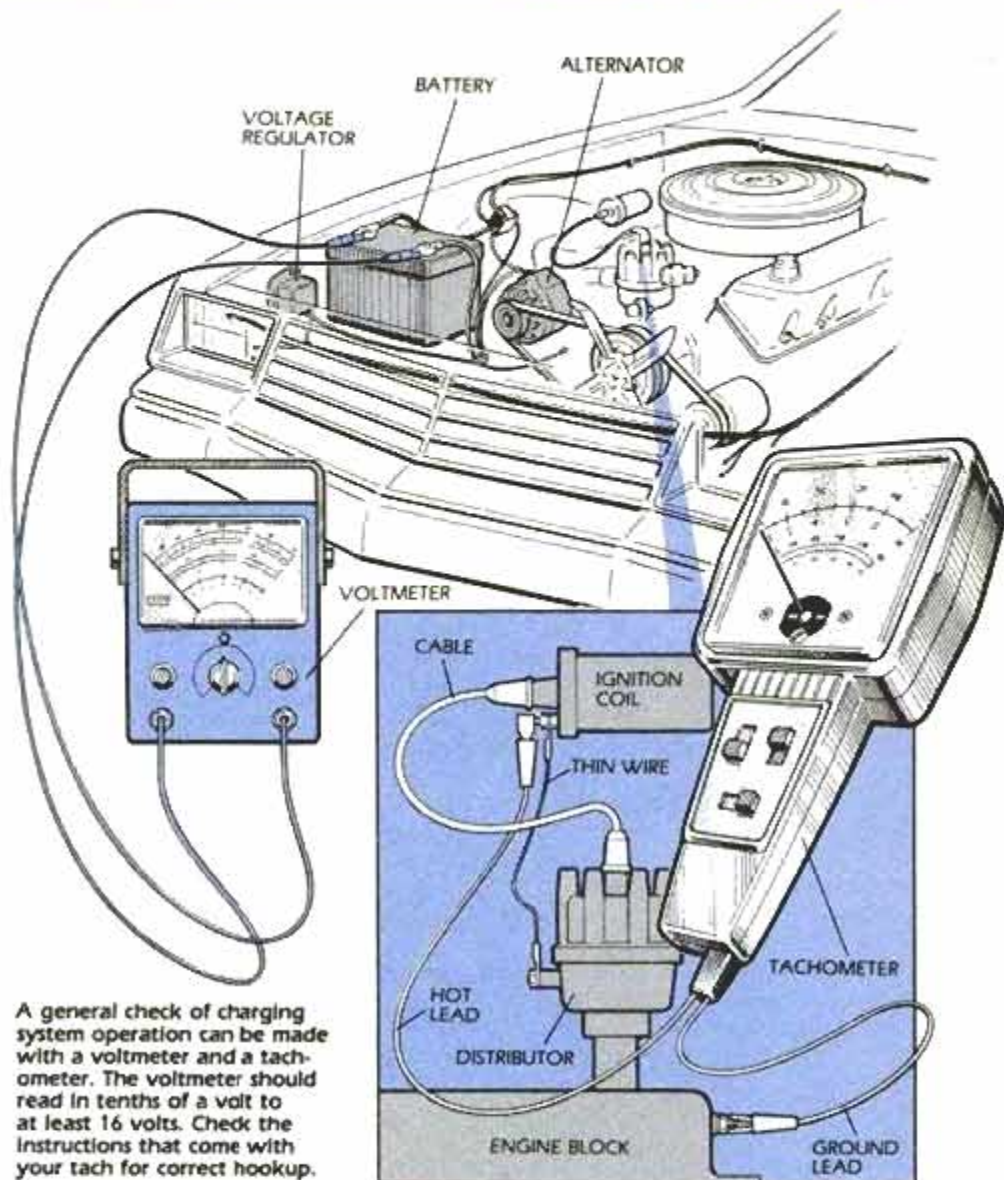
- If you suspect overcharging, the system should be tested.

- If the battery discharges completely and the vehicle fails to start, the system should be tested.

The first part of any charging system test is battery inspection and diagnosis (see *Getting The Most From Your Battery*, page 37, Dec. '83, for specific battery service pointers). Once you've determined that the battery is okay, you can proceed to other tests. But first, let's backtrack and discuss what you should do if your warning light fails to glow when you first turn the key or if your gauge needle stays dead center, showing neither charge nor discharge with the engine running.

Checking the warning light

If a warning light fails, the bulb may be shot or there may be an open circuit. You can find out by fabricating a warn-



A general check of charging system operation can be made with a voltmeter and a tachometer. The voltmeter should read in tenths of a volt to at least 16 volts. Check the instructions that come with your tach for correct hookup.

ing lamp test light, using a socket that accepts a No. 97 bulb, two lengths of No. 14 wire, an alligator clip and a probe such as a sewing needle. The drawing on page 42 shows how to assemble these parts.

With the ignition switch off, connect the test light alligator clip to a clean metal part, such as a bolt. Then, place the test light probe in contact with the wire terminal on the warning light.

Turn the ignition switch on (do not crank the engine).

If the test light glows, but the warning light doesn't, the warning light bulb is burned out or the bulb socket is defective.

If neither the test light nor warning light glow, there is a problem in the warning light circuit.

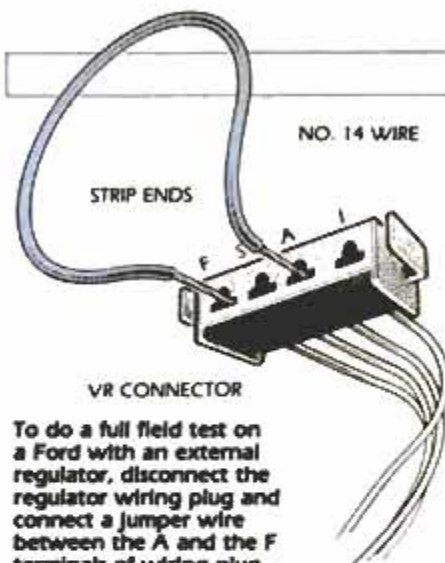
Testing the warning light in a GM vehicle with an internally mounted voltage regulator (VR) is done differently. Let's use the Delcotron as an example, since the vast majority of internal VRs

are found on GM cars. You don't need to use a test light—only your eyes and hands.

If the warning light glows with the ignition switch off, disconnect the two leads from terminals 1 and 2 on the back end of the Delcotron. If the warning light stays on, there's a short in the circuit between the two leads. If the warning light goes out, the rectifier bridge inside the alternator is defective, so replace it. (I'll explain how next month.) If your battery has been losing charge, the rectifier bridge could be the source of the problem.

If the warning light does not go on when you turn the ignition switch on without cranking the engine, the warning light fuse has blown, the warning light bulb or socket is defective, or there's an open circuit in the No. 1 wire between the regulator and light. This condition can also be caused by a faulty rectifier bridge.

Finally, if the warning light stays on



To do a full field test on a Ford with an external regulator, disconnect the regulator wiring plug and connect a jumper wire between the A and the F terminals of wiring plug.

with the engine running, there's most likely trouble with the alternator or regulator.

If a gauge needle doesn't move off dead center, you don't have to go through this fuss. With the ignition switch off, turn on the headlights. If the needle deflects toward *discharge*, the gauge is working. If the needle doesn't move, there's a loose connection at the gauge, an open circuit in the gauge wiring, or the gauge itself is on the fritz.

Troubleshooting alternators

When it comes to testing an alternator and regulator, someone may ask, "Don't we have to use an adjustable carbon pile (rheostat) and ammeter?"

No, you don't have to. However, you can't be absolutely certain that a charging system is capable of delivering full current without doing a carbon pile load test.

But a basic test of charging system effectiveness can be performed with a voltmeter. The voltmeter should read in tenths of a volt and be capable of measuring at least 16 volts.

While this test can't actually measure alternator effectiveness under all conditions, it can determine if the battery is being charged by the system. It can also tell you what part of the charging system is at fault if the battery is not being charged.

To test a charging system that has an *externally* mounted regulator, warm up the engine to avoid the possibility of a cold regulator giving false test results. Then, turn off the engine and all electrical accessories and lights. Connect an engine tachometer, following the instructions that come with the tach. Then, attach the voltmeter's positive lead to the battery's positive post and the voltmeter's negative lead to the battery's negative post.

Make a note of the voltmeter (battery voltage) reading. It should be no less than 12 volts. If it is less, the battery is undercharged, so charge the battery.

Take another reading and record this battery base voltage.

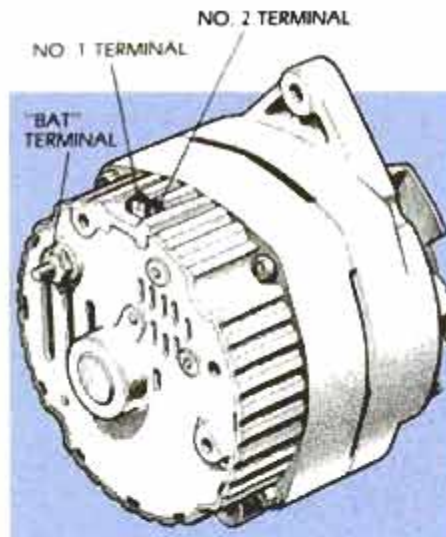
Now, start the engine and slowly increase speed until the tachometer records 1,500 rpm. This is called the *no-load* test. When the voltmeter needle stabilizes, read the meter. You'll get one of two indications:

1. If the voltage reading exceeds the base voltage by 2.0 volts or less, skip down this page to the load test.
2. If the voltage reading exceeds the base voltage by *more* than 2.0 volts, you're faced with a faulty regulator, a bad regulator ground or a short circuit in the wiring harness between the regulator and alternator.

Remove, clean, reinstall and tighten the regulator attaching bolts. Also, clean off the surface on which the regulator sits to assure a good ground.

Do the no-load test again. If you now get a reading that exceeds the base voltage reading by *more* than 2.0 volts, either the regulator is defective or there is a short in the wiring harness. Check the harness for abuse. If you don't detect any, try replacing the regulator.

Note: When mounting a new regula-



To check warning light of a GM charging system with an internal regulator alternator, remove wires from terminals 1 and 2.

tor, see that the mounting surface is clean, bolts are as tight as possible and the ground wire from the alternator, if there is one, is secured under one of the mounting bolts.

If you find a short in the wiring harness, you may still have to replace the regulator and the wiring, since the short may have damaged the regulator.

Doing a load test

Do the load test next to find a problem in a charging system having an externally mounted regulator. With the

tachometer and voltmeter connected as for the no-load test, start the engine. Turn the heater or air conditioner on and set the blower at high speed. Turn headlights and all electrical accessories on. Increase engine speed to 3,000 rpm and note the voltmeter reading. One of the following will result:

1. If the voltage exceeds base voltage by 0.5 volts or more, the charging system is at least capable of keeping your battery charged under normal conditions.
2. If the voltage increase is less than 0.5 volt, either the regulator, the wiring or the alternator is defective. "Full fielding" the charging system can help you pinpoint the problem.

How to full field a vehicle

To full field a late-model Ford with an externally mounted regulator, turn the engine off, disconnect the regulator connector and connect a jumper wire between the "A" and "F" terminals of the regulator plug.

To full field a late-model Chrysler with an externally mounted regulator, turn the engine off and disconnect the green field wire that connects the regulator to the alternator field terminal at the alternator. Then connect a jumper wire from the alternator field terminal to ground.

With either system full-fielded, repeat the load test. If voltage exceeds base voltage by 0.5 or more volts, the regulator is defective and must be replaced. If the increase is less than 0.5 volts, the problem is in the wiring or alternator. There are tests that can help determine which, but they vary a great deal from vehicle to vehicle. However, the alternator is usually the source of the problem. If a visual check of the wiring harness for the alternator/regulator doesn't show signs of abuse or heat, you can be reasonably certain that the alternator is the source of your difficulty.

If the alternator is defective, it will have to be removed from the vehicle for further testing and repair.

We'll get to this next month. We'll also discuss how to test a GM Delcotron charging system without having to use an ammeter and carbon pile.

Caution: In doing the tests we've just discussed on a vehicle that has a catalytic converter, try to wrap things up within a total engine running time of five minutes. If you exceed this, there's a possibility you'll damage the converter. If you must go beyond five minutes, turn the engine off for 30 minutes so the catalyst can cool down before you continue testing.

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Choice of four engines, including the most powerful 2.8L V-6 and 5-speed shift options. Plus comfort for three in the widest cab of any small truck.

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Great MPG

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Std. 4x2 2.0L engine and 4-speed shift. Use for comparison. Mileage may differ depending on speed, distance and weather. Actual highway mileage less.

BEST-BUILT AMERICAN TRUCKS



THE PM WORKBENCH



Versatile trailer-cart in kit form

The new Garden Way trailer-cart can turn your riding mower or lawn tractor into a full-time, all-purpose hauling system. This sturdy, compact trailer combines a 300-pound load capacity with 20-in.-dia. pneumatic wheels to make hauling chores a breeze around the home, garden and farm. The trailer-cart is also a dumping cart; simply disengage the quick-release tailgate.

The trailer box measures 12 x 24 x 40 in. (volume: 6½ cu. ft.) and is constructed of ½-in. exterior plywood.

The cart comes in kit form with easy-to-follow assembly instructions. It sells for just under \$200, with shipping charges extra. For more information, contact Garden Way Research, 315 Ferry Rd., Charlotte, Vt. 05445.—J.T.



By disengaging the dump release, the trailer box tilts back for dumping loose material such as sand, gravel and peat moss.

Spinning tool saves paint rollers



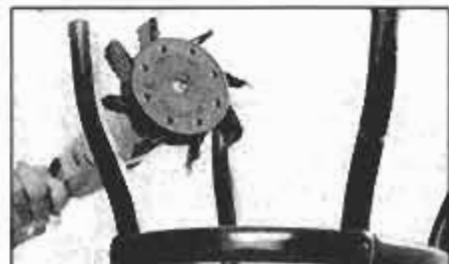
Use the centrifugal force provided by an electric drill motor to restore your paint roller covers to like-new condition.

It's easy to clean traces of latex paint from a roller cover, thanks to Spin-Away roller cleaner. Spin-Away is made with a long shaft on one end. After rinsing the cover, slide it onto Spin-Away. Then chuck the long shaft into an electric drill and spin the cover clean inside a bucket or bag. Send \$6.10 postpaid to: Belle-Ann Inc., 566 High St., Warren, Ohio 44483.—Rosario Capotosto

Sander tackles tough spots



The 3M Flap Sander houses eight abrasive strips supported by stiff-bristle brushes.



Abrasive strips and support brushes flex to make sanding irregular surfaces a snap.

The 3M Flap Sander (\$16) sands curved and intricately carved surfaces. The sander contains abrasive strips supported by eight stiff brushes. Use the sander in an electric drill for hard-to-reach spots. From the Household and Hardware Products Div./3M, Box 33053, St. Paul, Minn. 55133.—J.T.

Smoke insurance

You can protect yourself from smoke inhalation with the SmokeFighter emergency escape mask. The lightweight unit consists of a filtered mouthpiece and a clear visor. The SmokeFighter doesn't contain oxygen, but it is effective provided that there's at least 17 percent oxygen in the air. There are few situations, according to the maker, where the oxygen will drop below that level. It's available from Dolby Inc., 1215 South Laramie, Chicago, Ill. 60650. It's priced at \$42.45 postpaid.—Rosario Capotosto



Emergency smoke mask is a smart investment for home, workshop and hotel visits.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

HOMEOWNERS' CLINIC



Filling gap between house and steps

My brick home is about 20 years old. It has a concrete porch about 5 ft. square, with steps going down to the back yard. The steps and porch have settled and pulled away from the house about 8 in. at the top. The gap narrows toward the bottom. The foundation goes deep underground. Even if I could find a house jack big enough, I couldn't fill in under the porch foundation. There's no opening under the porch slab and steps to build a form.—C.D. Rhone, Hueytown, Ala.

If you're certain that the porch is not still settling, you can fill in the gap between the steps and the house foundation wall starting at the bottom where the gap is narrowest. You may have to pour a little mortar sand in first to support the mortar. Wedge a 2x8 board vertically against the gap at the back of the steps. Rod a mortar mix at least 6 in. back from the 2x8 between the tilting porch and the house to seal the vertical gap. When that mortar has set (next day), you'll have made a plug

all around the gap. Carefully fill the gap between the house and the porch with mortar sand up to about 3 in. from the top of each step. Although mortar sand flows easily, a slight rodding with a hoe handle may help compact it.

Finish by pouring a top slab using a concrete mix. Where the edge of the patching meets the wall, finish the joint with an edging tool or a piece of steel shaped into a V. This leaves a space for final sealing with a good grade of silicone caulk. If this joint continues to enlarge, the porch should be removed and rebuilt on proper fill.

Paint touch-up kit

When it comes to paint touch-up, MSI Inc. is well ahead of the pack. The company has come up with a patented mohair applicator with a controlled flow. The unit lets you store a small quantity of touch-up paint for those annoying nicks and marks that appear on freshly painted walls and baseboards. Known as Nikit, I found it helpful in covering the filler on my never-

ending supply of holes left by an inveterate picture mover.

The kit of four bottles, applicators and airtight caps comes with instructions. It even includes four paper cups to aid in filling the bottles. Send check or money order for \$5.95 (postpaid) per kit to MSI Inc., 3005 Hadley Rd., South Plainfield, N.J. 07080.



The Nikit kit (top) for paint touch-ups comes with four bottles. A mohair applicator (above) controls paint release.

Insulating walls

My foundation is 10-in. concrete block up to ground level. From there, it is 6-in. block with a 4-in. stone facing. The inside surfaces of the outer walls are plastered directly onto the block. These walls are cold to the touch.

I recently visited Florida and saw similarly constructed houses, but their block walls were covered with sheets of insulating material, furring strips and plastic vapor barrier. Would that be an answer to my problem?—Don Rhinehart, Gallion, Ohio

It sure would. The dry wall should be installed over the vapor barrier. Check the type of polystyrene you use. Some are effective water barriers in themselves. The ability to deter the passage of moisture is measured in perms. Any material having a perm rate of less than 1.0 is considered an effective vapor barrier. Styrofoam brand insulation (SM/SB/TG) has a perm value of 0.6 for each inch of thickness. Since polyethylene (plastic vapor barrier) film is inexpensive, I'd still use it to ensure a continuous vapor barrier over gaps and joints in the insulation.

Dripping in Denver

Our house sweats inside when it's cold outside. The windows steam up terribly on winter days. Water runs down the sill to the walls, and down to the baseboard. The house is framed with R-30 insulation in the attic. Other homes in the area have the same problem. They were all built in 1954. I know storm windows would help, but they're expensive. Do you have a cheaper solution?—Frank Pilkington, Denver

We've run into excessive humidity in the home for years now, and it sure appears that yours is a classic case. To cut down on humidity, an exhaust fan in the bathroom and kitchen (vented to the outside) is a must.

Although storm windows may appear as an unwanted expense to you now, stack their cost (approximately \$25 times, say, 15 windows) of maybe \$375 against the value of your home. Condensation is caused by warm, moist air coming in contact with the cold glass windows. Storms will help keep the window glass from getting so cold. Storm windows are considered energy conservers, so they qualify in part as an income tax credit. This can be applied against their cost. **PM**

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

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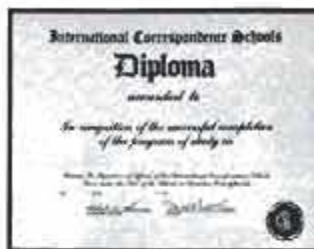
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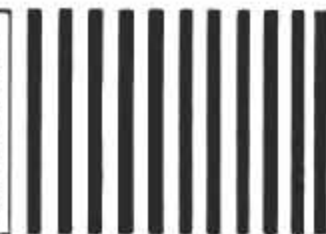
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APPLIANCE CLINIC



Replacing a refrigerator door gasket

I must replace the door gasket on our Admiral duplex refrigerator, which is model No. ND2566-BM6352B and serial No. 5684258. I am handy, but I could use some instructions on how to go about it.—Guido Quinn, St. Petersburg Beach, Fla.

First, remove the door from the cabinet. To do this, remove the three screws in the top door hinge. Then lift the door up and off the lower hinge and lay it on a flat surface. Use a blanket underneath the door to protect it from any damage.

Next, take out all the inner panel mounting screws, which are under the inner lip of the door gasket. These screws hold the door gasket and the door liner to the outer door panel. After removing the old gasket, lay the new gasket in place and reinstall the screws finger-tight. Lift the door and place it in the bottom hinge, then reinstall the top hinge.

Adjust the door hinges so that you have an equal distance between the cabinet and the door at both the top and bottom when the door is open.

Close the door and make sure there is a good gasket seal all around. If the door is sticking out too far at the bottom, hold the top stationary and push in at the bottom until the door lines up with the cabinet. Now open the door and tighten all the mounting screws. Take care not to tighten these screws too much, as you may damage the inner door panel.

The part for the refrigerator door gasket is No. 27406-4. The freezer door gasket is part No. 27406-3. You can order these parts from Marcone Appliance Parts Co., 1515 Cypress St., Tampa, Fla. 33606.

Overflowing refrigerator

I have a Whirlpool Mark 1 frost-free refrigerator, Model EAT 151 PKARO. About five months ago, it started expelling too much water from the overflow tube. Now the pan must be emptied frequently. Before this, it rarely required emptying—summer or winter. The door gasket looks okay.—Walter Rogers, Smithtown, N.Y.

This sounds like too much moisture inside the refrigerator. Possible causes include excessive humidity, a door gasket not sealing properly, or keeping the door open too long or too often.

You can minimize moisture in the box by covering liquid containers tightly, wiping off any cold items that have been sweating while out before returning them to the shelf in the refrigerator, and planning so you open the door as infrequently as possible.

You might try installing a rubber check valve, part No. 849307, on the end of the drain pipe where it empties into the condensate pan. It costs about 45 cents. The check valve helps keep hot, humid air from entering the refrigerator through the drain pipe. This has been a problem in some locations.

If all else fails, you can install an electric defrost drain pan heater kit. This \$25 kit, part No. 978387, includes an electric heating element to evaporate excess drain water from the pan under hot and humid conditions. Of course, it will increase the operating cost of the refrigerator because it draws a certain amount of current. The kit comes with complete installation instructions for

various Whirlpool refrigerator models. Both the check valve and the drain pan heater are available from any Whirlpool parts distribution center.

Ice in defrost pan

I have a Gibson side-by-side refrigerator, Model RS22E6W16A and Serial 107072313. The problem I'm having with it is that ice builds up in a small tray. The tray has a hole in the center of it that passes down to the defrost pan. The hole is not plugged. This tray is located below the evaporator.—Dean Knox, Portland, Ore.

You may have a defective drain trough heater, or possibly a bad electric connection. To check the heater, first unplug the refrigerator. Remove the shelves in the freezer. Next, take off the rear cover in the back of the freezer. The cover is held in place with a series of screws. Check the drain trough heater, which is taped inside the drain trough with metallic tape.

Follow the two wires from this heater up to a junction block on the rear wall. Disconnect the two heater wires from the junction block. Use a continuity meter to check to make sure the heater is open and that there is a good connection between the heater wires and the junction block.

If the heater is defective, order drain trough heater part No. K1231886. It costs about \$12, plus tax and shipping. You can purchase this part from Fowler Distributing Co., 3300 Southeast 17th Ave., Portland, Ore. 97202.

SERVICE TIP



New on the market is a product called Corrosion Guard, a ready-mixed liquid used to retouch or recoat worn and rusted dishwasher racks. It comes in clear and eight colors to match the more popular colors of dishwasher interiors.

Corrosion Guard is available in a 2-ounce bottle (from appliance dealers or \$6.95 postpaid from the maker) complete with cap-and-brush applicator and simple application instructions. Squeeze bottles are also available in 1- and 8-ounce sizes. Corrosion Guard is approved by the FDA.

For further information, contact Advanced Materials for Industry, 502 Highway 74 North, Peachtree City, Ga. 30269.

PM

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

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Conray Vu-Light Helmet has high intensity halogen-tungsten lamp above visor to clearly illuminate work and electrode before arc is struck. Brochure explains how this improves safety and efficiency. Free

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Complete 1984 garden catalog from Burgess Seed & Plant contains all varieties of vegetables, plants, flowers and shrubs. 48-colorful pages provide description and characteristics. Receive a jumbo packet of climbing tomato seeds. All for \$1.00

790 That Old Black Magic

16-page, full-color manual and fact sheets from Black Magic help you get started in a part-time or full-time career as a chimney sweep. Includes training program as well as equipment available. \$1.00

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793 Fly Your Own Plane Without A License

Ultralight aircraft can be built from kits or bought ready to fly. Single seaters cruise from 30 to 63 mph and get 60 mpg. New catalog tells you how you can learn about over 60 makes/models, engines, flight principles and techniques. From Ultralight Publications. \$1.00

794 Fabulous Fireplaces

Full-color catalogs describe the complete line of heat-circulating fireplaces from Heatilator Inc. The catalogs also contain information about fireplace accessories including fan kits, solid brass-trimmed glass doors and a complete line of chimney components. 50¢

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32-page catalog from Precision Optical includes over 20 models of magnifiers. For many uses . . . reading, sewing, crafts . . . these magnifiers are helpful to jewelers, craftsmen, homemakers and do-it-yourselfers. Free

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Brochure from Arrow Fastener describes and illustrates the many time-saving, do-it-yourself applications of the Arrow Staple Gun. Includes helpful how-to home hints. 40¢

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Bottle tip



Keep track of chemicals by dating the bottles with a felt-tip, water-resistant marker pen.—Robert Hertzberg

Shoot over crowds

Hold camera by its tripod or monopod legs with camera lens at largest aperture number for maximum depth of field. Use the fastest shutter speed possible and let the camera's self-timer take the shot.—Wayne Fugate

HINTS FROM READERS

Chopping block



This handy chopping block is a 7½-in.-dia. x 20-in. section of a tree trunk. It is firmly nailed with spikes driven upward from its bottom to a foot-square piece of ¾-in. plywood. The wooden handle grip is from a shop junk box, and the bail is hefty aluminum clothesline wire. Wire ends are looped around 1¼-in. No. 12 roundhead wood screws installed about 2 in. from the top.

The chopping block is useful in the shop, garage or outdoors for sharpening stakes, straightening metal rods and other jobs requiring a firm base that won't harm edged tools.

—Walter E. Burton

Plywood cutting aid



To prevent pinching the saw blade when cutting plywood, use a three-way clamp attached to a length of vertical 2x2 or 2x4. This makes an easily adjustable platform for holding a corner of the plywood.—Parry C. Yob

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Versatile table saw rip fence



A new saw guide has been introduced by Rockwell International, 400 North Lexington Ave., Pittsburgh, Pa. 15208. Called the Unifence (\$350), it's designed to handle large panels easily. It locks accurately to $\frac{1}{64}$ in. for true cuts with less chance of pinching. The fence is equipped with a steel table frame and legs. It attaches quickly to 10-in. Rockwell saws or it can be adapted to fit other makes.

Choke chain saw bite

The Racine Glove Co. now offers protection from accidental injury from a chain saw—Woodcutter's chain saw chaps. The chaps, worn over work pants, are made of tough, lightweight Dupont Cordura nylon and Kevlar woven cloth and felt. They're available in three lengths (regular length: \$79.95). For details, contact the Racine Glove Co., Box 276, Rio, Wis. 53960.



Oak-handle faucet

The warmth of oak and the beauty of brass come together in this kitchen faucet (\$47) by U.S. Brass. Fixtures for the tub, shower and bathroom sink are also available. The choice of finishes includes polished brass, antique brass and chrome. For details, contact U.S. Brass, Box 37, Plano, Tex. 75074.

Electronic router



The precision and reliability of solid-state electronics has been built into the Sears Craftsman electronic router (\$150). After selecting material hardness and cutter diameter, the router monitors feed rate and maintains the proper bit speed. Electronic feedback senses speed reductions due to loading then adds power. It's available at Sears stores and through its tool catalog. Contact Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684.



New glass

PPG Industries' clear, energy-efficient glass is called Sungate 100. A double-glazed window of Sungate 100 claims heat retention and price comparable to triple-glazing, without the additional weight and expense of an extra glass pane. For further information, you should contact Jean Wright, PPG Industries, 1 PPG Place, Pittsburgh, Pa. 15272.

Unit ends clutter on night stand

General Electric's Wake-Up-Call (\$99.95) combines a clock radio and a telephone. The phone features one-touch redial of busy numbers and a lighted keypad. The radio has automatic muting when the phone is in use. Contact General Electric, Audio Products Dept., Electronics Park, Syracuse, N.Y. 13221. **FM**



A FOUNDATION FUNDS CONTROVERSY

Harry Frank Guggenheim left behind

a fortune that supports unusual research.

Harry Frank Guggenheim was a philanthropic gadfly, given to supporting unpopular causes and promoting unfashionable ideas. In the 1930s, for example, he backed the experiments of rocket pioneer Robert Goddard after the U.S. government had shown no interest. A nephew of Simon Guggenheim, whose Guggenheim Foundation had provided millions of dollars to the arts and sciences, Harry created a foundation of his own—usually referred to as the “other” Guggenheim Foundation. He directed it to support the scientific study of human nature, an area in which research has often proved to be at considerable variance with conventional wisdom.

Recently, we dropped in at a day-long seminar held by the “other” foundation, and were pleased to learn that it is carrying on in the opinionated, even combative tradition of its founder.

One scientist who has received support is Napoleon Chagnon, professor of anthropology at Northwestern University. Chagnon has spent many years studying the Yanomamö Indians, who live deep in the Amazon jungle, along the border between Brazil and Venezuela.

One of the Yanomamö's favorite activities, he discovered, is fighting. In fact, the most common cause of death among adult male Yanomamö is violence. According to mainstream anthropological theory, the bellicose Indians should have been fighting over scarce “strategic material resources”—especially protein. But through hunting and gardening, the Yanomamö manage to provide themselves with an abundance of protein by working only a few hours a day. Why then do they fight so much? According to Chagnon, the Yanomamö explain that they fight over women. The wars between villages, he says, usually start with an insult to a woman, which is avenged by her near kin, triggering a chain reaction of revenge and counter-revenge that can continue for decades.

By interpreting a cultural phenomenon—war—in terms of a biological variable—kinship—Chagnon placed himself within the camp of the sociobiologists, who are anathema to mainstream social scientists. Many critics fear the political implications of sociobiology: Conservatives could use this deterministic theory to argue that radical social reforms run counter to a genetically determined and unchangeable human nature.

But it is more than a sociobiological orientation that



has earned the Harry Frank Guggenheim Foundation its maverick reputation. Last year, roughly a tenth of its grants went to researchers in the new field of “cognitive ethology”—animal awareness. In one study, Robert and Dorothy Seyfarth of Rockefeller University found that vervet monkeys in East Africa have three distinct calls to warn one another about three different kinds of predators—leopards, eagles and snakes. When a monkey sounds the “leopard” warning, for example, the others jump into trees and head for the tips of the thinnest branches. At the sound of an “eagle” warning, they cling instead to the trunk of the tree, where they are protected by the low, dense foliage.

Donald Griffin, president of the foundation and author of the controversial book *The Question of Animal Awareness*, admits that the

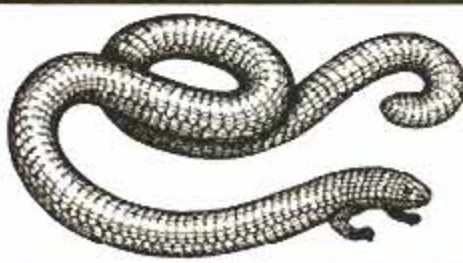
monkeys may not be conscious of what is being communicated; they may simply have learned to respond in a particular way to a particular call. Nevertheless, Griffin insists that if scientists are going to use animal behavior as a model for human behavior—as many do—it is unscientific of them to assume that self-awareness is a uniquely human trait.

Funded projects are sometimes located closer to home. D. Eugene Redmond of Yale University has discovered that a drug known as clonidine completely suppresses the symptoms of opiate withdrawal in longtime drug addicts. Unlike methadone, which replaces one kind of addiction with another, clonidine does not appear to be habit-forming. It allows addicts to go cold turkey without suffering. Redmond believes that at least some of the violent behavior of heroin users is attributable to their highly agitated state during partial withdrawal. At the very least, he says, clonidine can reduce the danger to society posed by such behavior.

Harry Frank Guggenheim, who died in 1971, would probably have enjoyed the current reputation of his foundation as a backer of scientific long shots. After all, Robert Goddard's rocket tests portended the space age. Perhaps the research now being funded by Guggenheim's legacy will carry us as far in the next 50 years as Goddard's work took us during the last.

—Gerald Jonas

REPTILE TAKES TECTONIC TRIP



Two-legged worm lizards now live in three areas of Mexico (shaded), but scientists believe a single population split when Earth's crust moved 15 million years ago.

Strange, nearly blind, nine-inch "worms" with forelegs are found in three separate places in North America. Plate tectonics theory may explain how they got there.

The two-legged animal is actually a reptile (genus *Bipes*), says herpetologist Theodore Papenfuss of the Museum of Vertebrate Zoology in Berkeley, California. "Worm lizards use their feet to dig burrows and live underground, surfacing only in floods. They eat beetle larvae, termites and other small insects they find near tree roots." There are only three species—one found on the remote Baja peninsula, the other two in different parts of Mexico, 500 miles to the southeast.

How did these close relatives get so far apart? They certainly didn't raft across the water, says evolutionary ecologist Benjamin Dial of Texas A&M. "The worm lizards crawl very awkwardly,

Moreover, prolonged exposure to salt water would kill them." Other scientists have proposed that *Bipes* migrated from Baja around the Gulf of California. But no trail of fossils has ever been found.

Plate tectonics theory—which holds that Earth's crust is made up of sections that shift independently of one another—provides the most likely explanation: The three populations began as one and were split by plate movement. Papenfuss's evidence comes from a biochemical technique that reveals when species diverged from a common ancestor.

"Fifteen million years ago, there was a single population of *Bipes* in southern Mexico," he says. "Then part of Baja broke off and moved north toward California, and the Sierra Madre del Sur rose on the mainland, yielding three populations—one on Baja, one behind the mountains and the third near Acapulco." ■

DINOSAUR EMBRYO WARM-BLOODED?

Paleontologists have unearthed a fossilized dinosaur still in its egg—only the second ever found. Yet the scientists are elated less by its rarity than by the evidence it offers that dinosaurs were warm-blooded.

Although all modern reptiles are cold-

blooded, some paleontologists speculate that perhaps dinosaurs were not: Warm-blooded birds, for instance, are thought to have evolved directly from dinosaurs. The structure of the 75-million-year-old embryo's skeleton, which turned up in a "dinosaur graveyard" in western Montana, looks decidedly warm-blooded.

"Warm-blooded animals generally have more channels in which blood runs through the bones," notes paleontologist

ANCIENT MAN HAD GOURMET TASTES

Whitefish in mustard sauce sounds like *nouvelle cuisine*. Actually, it's *ancienne cuisine*. In fact, neolithic.

Archeologists Rolf Rottländer and H. Schlichtherle, of the University of Tübingen's Institute for Prehistory, in West Germany, have found a way to extract traces of baked-in food—fat residues—from the tiny pores found in almost all pottery except fine porcelain, no matter how prehistoric.

When combined with water, the food's fatty-acid composition can be chemically analyzed to find out what was once cooked in the pot. Our previous knowledge of Stone Age delicacies came only from the charred but recognizable remnants of grains, bones or seeds that are unearthed at digs.

Since fats deteriorate over time, Rottländer and Schlichtherle compare the residues they extract with known, dated samples of other ancient fats. To put together their reference list, they analyzed the fat content of seeds, grains and bones uncovered in prehistoric garbage dumps. The age of these petrified leftovers was then determined from artifacts found in the same layer.

Recently, the two researchers found traces of fish fat and mustard-seed oil in neolithic shards uncovered on the shores of Lake Geneva. Astonishingly, whitefish in mustard sauce is a popular Swiss delicacy, even today.

Rottländer and Schlichtherle have used their analytical tool for five years, but American pottery experts have yet to do so—partly, some say, because they lack the funds to buy lab time. ■

IF THE EARTH'S surface were completely smoothed out, both above and below the water, the ocean would cover the entire globe to a depth of 12,000 feet.

—Submitted by Christina Rama
Beacon, NY

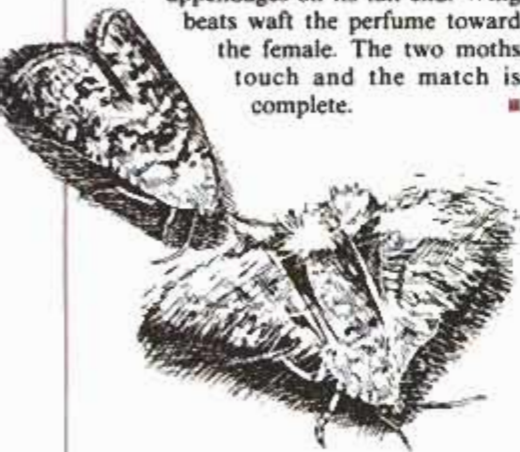
Jack Horner, of the Museum of the Rockies in Bozeman, Montana. Horner is studying the embryo using a medical imaging process that yields cross-sectional pictures. "This embryo," he says, "has a densely packed system of these canals, suggesting that a lot of blood ran through, and that it grew very fast—too fast for a cold-blooded organism." Horner guesses the dinosaur would have reached seven or eight feet in length. ■

PERFUME POPULAR WITH MOTHS, TOO

Men often give their loved ones perfume. So does the Oriental fruit moth.

The male of this species, a pest to farmers but a gentleman in other respects, produces a scent that is almost identical to a mix of jasmine and cinnamon, according to Japanese and American researchers.

Reporting at a recent American Chemical Society conference, they described an intricate olfactory duet: A female moth attracts a male by producing a pheromone, a chemical attractant. With most moths, that's where the chemical courtship ends. But the male fruit moth responds by releasing a shower of fragrant compounds from its hair pencils, feathery appendages on its tail end. Wing beats waft the perfume toward the female. The two moths touch and the match is complete. ■



THE NOSE KNOWS

One of the most effective devices for monitoring pollution may be as plain as the nose on your face. So say scientists from the University of Utrecht, in the Netherlands.

Two psychologists have recruited several hundred residents of that industrial city to pop their heads out of their windows every Tuesday evening and take a deep whiff. If they smell anything, they're to classify it—from innocuous to extremely annoying.

The air will be simultaneously monitored by more accepted sampling devices. The human and automated results will then be compared. The scientists hope to establish a nationwide network of noses that would help track polluters. ■

MALE EMPEROR MOTHS can smell a female seven miles away—and each female carries less than a millionth of a gram of attractant.

IS ACID RAIN A MYTH?

Acid rain is not harming our forests, insist two soil scientists. Though rain at the Hubbard Brook watershed in New Hampshire has been as acidic as vinegar at times, these experts say that the soil, plants and bedrock in the area could neutralize 21,000 times more acid than that found in local annual rainfall.

Normal rain is always acidic, say Charles Frink and Edward Krug, of the Connecticut Agricultural Experiment Station in New Haven, with a pH of about 5.6. The pH scale runs from 0, which is acidic, to 14, with the midpoint, 7, being neutral. And the soil in forests is made more acidic by the normal weathering of bedrock—which leaches out neutralizing bases such as calcium, potassium and sodium—and the decay of plants, which creates acids.

As a result, the runoff from healthy forest soil is always acidic, Krug and Frink argue in *Science*. They point to a Norwegian study of two snowpacks, one with a pH of 4.3, another neutralized to 7.0. As the snow melted, there was no difference in the acidity of the runoffs.

Moreover, forest floor in the Adirondacks where trees have never been cut or burned has a pH of about 4. But Adirondack soil where trees were felled 20 to 50 years ago has a less acidic pH of about 5.

"Scientists have known about soil acidity since 1900," says Frink. "We just completed an experiment in which we sprayed artificial rain on tobacco plants twice a week for five weeks. A pH of two [hydrochloric acid] puts holes in the leaves. But pHs of two and a half or higher had no observable effect."

In fact, despite constant acid rain, the researchers note, the amount of standing timber in New England's forests increased by 70 percent between 1952 and 1976. ■

STURGEON ARE large and long-lived. One weighed over 3,000 pounds. And, at 82, the oldest ever caught was far younger than the estimated maximum age of 120.

AMERICA ENTERS STURGEON WAR

The Russians think they have a lock on the world caviar market, but researchers at the University of California, Davis, are taking the first steps to ensure that cocktail-party goers will never lose their hors d'oeuvres to cold-war bickering between the superpowers.

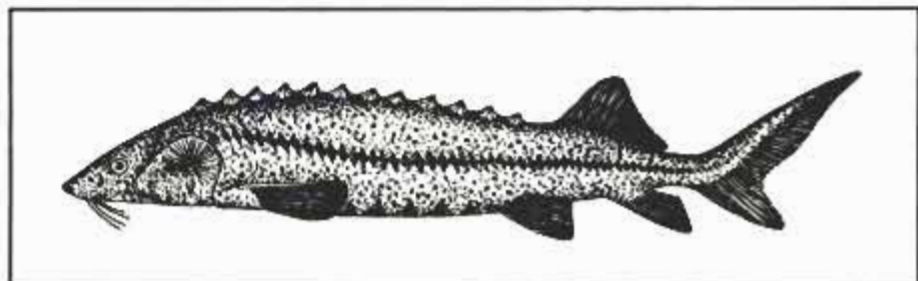
Improving on established techniques, they are putting together a sophisticated hatchery that will bolster American populations of sturgeon, the ancient, endangered fish whose lustrous eggs can command hundreds of dollars a pound.

In the USSR, the native population of sturgeon is augmented by hatcheries on the Caspian Sea. To propagate sturgeon artificially, the Russians inject female fish with hormones known as gonadotrophins, which stimulate egg production. The hormones, as well as the roe, are ob-

tained from sturgeon killed in commercial fisheries, says George Monaco, who directs the California project.

Monaco's staff cannot rely on killed fish, however. "We have a limited supply of sturgeon, and we're interested in keeping them all alive," he says. They get the gonadotrophins they need from carp. They have also tried using a synthetic hormone. "Initial tests have been very promising," he adds.

To obtain roe without killing fish, an incision is made in the abdomen of a pregnant female. "We spoon out the roe and sew it up," says Monaco. The fry, fed a special diet, grow twice as fast as the Russian fish. Once released, the hatchery fish have a survival rate of 7 to 12 percent, compared with 0.1 percent for those born in the wild. ■



Sturgeon have persisted almost unchanged for 200 million years. But the tasty eggs of this fish have made it a prized commodity. It has disappeared from most rivers.

DID THE MOON HAVE MOONLETS?

Once upon a time, the Earth's moon had dozens of moons. But one by one, each fell from orbit, crashing into the lunar surface, smashing itself into dust and carving another lunar sea.

Each of the moon's moons was at least 60 miles across, several times bigger than the moons of Mars, says Keith Runcorn of the Institute of Lunar and Planetary Sciences at the University of Newcastle

upon Tyne in England. And their tumbles occurred between 4.2 and 3.8 billion years ago.

Runcorn theorizes that the moonlets fell because their orbits around the moon's equator were unstable. Each impact blew awesome amounts of rock from the surface, unbalancing the spinning moon. As the moon wobbled, trying to regain the equilibrium of its spin, its lopsided crust shifted slowly over its then-liquid core. Eventually, the newly scooped-out basin settled at one of the poles.

The theory fits the evidence: Magne-

tism in moon rocks retrieved by Apollo astronauts implies that the moon's poles did shift by 90 degrees several times, billions of years ago—just the distance a basin would have had to move to get from equator to pole.

Runcorn further points out that the lunar basins are scattered across the moon in bands, suggesting that they could once have been lined up beneath the equatorially orbiting moonlets. "If the basins had been carved out by falling meteorites or asteroids," he says, "they would be peppered at random." ■

OCEAN DIP STYMIES SCIENTISTS

There's a valley 300 feet deep in the surface of the Indian Ocean. You could sail across it and never notice it, because the dip descends and rises again gradually over its 1,200-mile width. This watery depression was discovered only after scientists noticed a slight bulge in the orbit of a satellite passing overhead, suggesting that there is a reduction in the Earth's gravity below.

Although in constant gravity water always seeks the lowest level, the Indian Ocean's gravitational lapse keeps the valley from leveling off. In fact, since the amount of pull between objects depends on their mass, gravity at sea is slightly stronger above undersea mountains and slightly weaker over depressions.

"We think there's a lack of mass in the Earth's crust somewhere below the Indian Ocean's depression," says geophysicist

James Whitcomb, whose study of the sea-surface valley with University of Colorado colleague Steven Ihnen was published in a recent issue of *Geophysical Research Letters*.

But wouldn't reduced gravity produce a hump rather than a dimple? Not at all, says Whitcomb. "Water right over the low-gravity area is pulled away by the higher gravity areas around it. The opposite happens with seafloor mountains; the ocean bulges as water is drawn in."

Whitcomb and Ihnen theorize that the circulation of deep molten rock toward the center of the Earth could be pulling the Earth's crust down with it, reducing the undersea mass. Or perhaps the northward movement of India's tectonic plate over the past 10 million years has left depressions in the rock, like the wake of a ship plowing through the ocean. ■

THE COAST OF Antarctica's Eastern Adelle Land is the windiest spot on Earth. Average wind speed is 48 knots—all year long.

VAST STORMS RAGE UNDERSEA

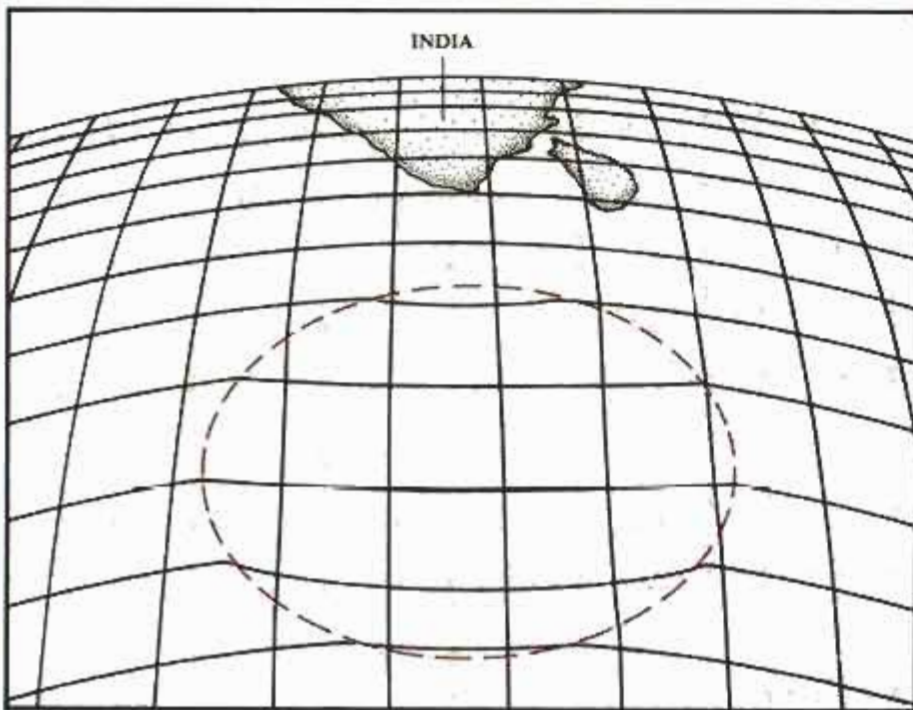
The bottom of the sea has always been considered essentially unchanging by oceanographers—dark, cold and stagnant. That view is wrong, according to recent research: Vast undersea "storms" rake the seafloor for months at a time, scrubbing the bottom and clouding the water with mud.

The implications are more than a scientific curiosity. The deep-sea bottom has been proposed as a dumping ground for radioactive waste. "Based on what we've seen, you can't assume anything will stay where you put it," says Georges Weatherly, of the High Energy Benthic Boundary Layer Experiment, an attempt to study the benthic, or bottom, ocean currents in detail.

Weatherly and his colleagues have placed sensors on the seafloor east of Boston, three miles underwater. Anchored 30 feet off the bottom, these three-legged devices are laden with thermometers, cameras and meters that monitor the direction and flow rate of the water.

Bottom currents have been clocked at up to one mile per hour. That may seem slow, but powerful forces are required to move the huge volumes of water involved. What are the forces? They seem to be influenced by surface currents, but the answer is still elusive. ■

AN EXPLOSION OF nitroglycerin creates a shock wave that travels outward at a rate of about 17,000 miles per hour.



A local gravity deficit beneath the seafloor is causing a 300-foot dip in the Indian Ocean. The deep-Earth dynamics responsible for it are, so far, poorly understood.

SMART SEAT SEEKS THE SKY

A new computer-controlled ejection seat will improve the pilot's chances of escaping a crash.

The crippled jet fighter is losing control. The pilot fights to keep it in the air, but it's a losing battle. Finally, the plane is only 50 feet above the ground. The decision is inevitable: eject. A lever is pulled. Explosives blow the pilot's seat free of the plane. But the erratic aircraft has spun upside down. The pilot has ejected himself, at high velocity, directly toward the ground.

Until now, such a scenario would mean almost certain death. Ten percent of all ejections are fatal, and by far the most common reason is that pilots have had to ditch their planes too close to Earth; current escape mechanisms require at least 200-foot clearance.

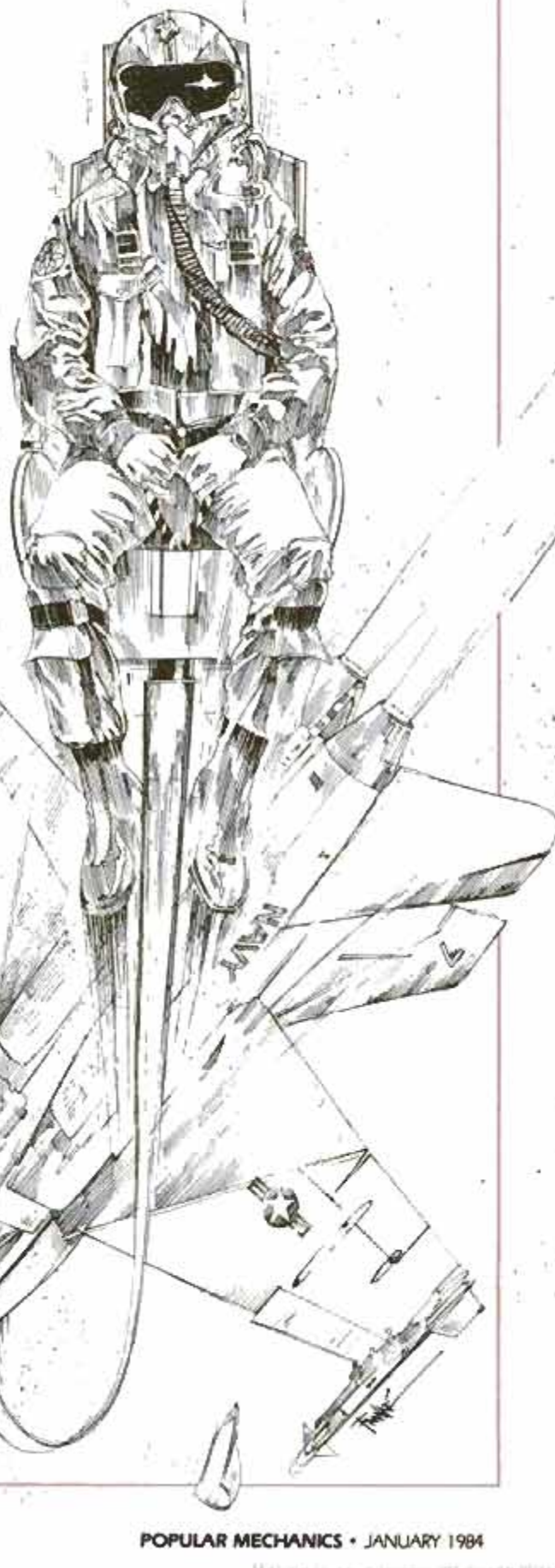
To solve the problem, the U.S. Navy has developed a new system—called the Maximum Performance Ejection System (MPES)—that will automatically point and propel an ejecting flier upward, no matter what the orientation of the plane. Tests done from ground-based ejection towers and in the air prove it works. A prototype of the device managed to reverse itself after falling only 43 feet. When the plane is flying on its side, there is even more leeway. A pilot can theoretically eject just as a wing tip touches the ground and still be able to survive.

The heart of the system is a microwave-antenna array. It senses the difference in heat coming from the relatively warm Earth and the cooler sky. (Spots of heat from the plane or the sun are not recorded; the MPES microprocessor ignores pulses and concentrates on background heat.) As soon as the MPES determines which way is up, it fires a rocket underneath the seat in the appropriate direction. The rocket flips the seat and pilot upright, allowing a parachute to open safely.

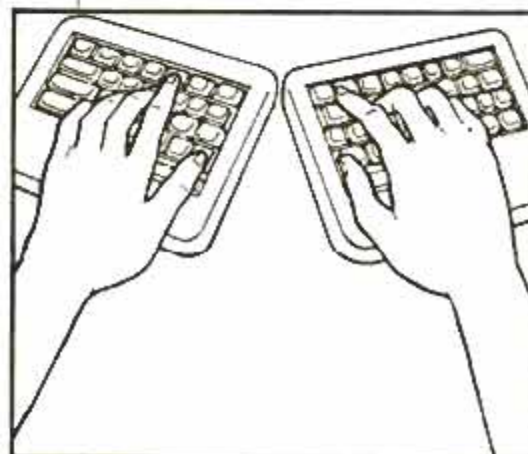
Simply getting the seat upright is not the only problem, however. Because it can whip 180 degrees in only 1.3 seconds, it must also blast free fast enough to prevent the pilot from being swatted by the plane's tail as it races by at up to 700 miles an hour. The force on the pilot can add up to 18 times that of gravity, shooting his weight temporarily to a ton and a half. The head alone can weigh hundreds of pounds. To keep the pilot from being pulverized, MPES has straps that reel in automatically and nearly instantaneously, anchoring shoulders, hips and legs firmly to the seat. Airbags support the neck, head and lower back.

Finally, if the seat should end up in the water, a life raft inflates. So does a flotation vest that can keep an unconscious victim's head above water. And the parachute self-detaches, eliminating the danger of wind dragging the seat.

Current ejection-seat technology is already very good, says John Tyburski, project manager for the MPES, but it should always be looked at for improvement. "It's not that aircraft—even ones that are about to crash—fly upside down very often," he says. "But when an emergency happens, all bets are off. We're trying to save the guy who finds himself in the worst-case situation. We can afford to lose planes once in awhile, but it's a real tragedy when you lose the pilots. Our job is to protect these guys and get them safely back down to Earth again."



NEW KEYBOARD CUTS TYPING PAIN



Typing strains arm and wrist muscles, forcing them to bend unnaturally (top). But a keyboard that has been split and angled appears to relieve the discomfort (bottom).

Typing hurts. Every full-time typist knows that after a couple of hours, an ache climbs from the small of your back to your shoulders, then travels down your elbows toward your wrists.

Based on studies of typists' muscle actions, a research team has proposed a solution: Split the keyboard to spare the tortured typist.

The standard typewriter, say scientists at the Technical School in Darmstadt, West Germany, turns the typist into a contortionist: To support the fingers, the shoulders must be lifted, the elbows splayed outward and the wrists twisted sideways almost to their limit.

Instead, the researchers, writing in *Applied Ergonomics*, propose dividing the keyboard up the middle from the bottom and pivoting each half outward by 10 degrees. They say that the keyboard should also be tilted toward the typist by 60 degrees. This, however, would make it difficult for the novice, who must look at the keys in order to find the right one. Even a 10- or 20-degree tilt would help, according to the designers. And the outermost keys could be placed between the two keyboard halves, to be hit with the thumb rather than the little finger.

Have any manufacturers looked into this idea? "I don't know of any in the United States who have tested it," says Richard Hirsch of IBM. "We've experimented with a number of keyboards, but none seems significantly better than the standard design."

TEST TELLS CLOTHING COMFORT

Are your clothes comfortable? You're not sure? Relax. Now the frontiers of science can answer the question for you.

A team of chemists and textile engineers, led by Norman Hollies, at the University of Maryland has developed a test that measures the absorbency of cloth, a major component of comfort. First, fabric is treated with a salt that takes on a range of hues from blue to pink as it gets wetter. Then the fabric is held over a piece of wet chamois, which is heated. As it traps the evaporating moisture from the chamois, the salt changes color. The amount of

moisture absorbed can be gauged by matching the color of the salt with a standard color chart.

But does anyone need to be told his clothes are comfortable? Actually, the test was created for fiber and fabric manufacturers, who, until now, have had to weave the materials and wait around for subjective comfort reports from wearers. Hollies's test is cheaper and faster.

So far, there have been no surprises: The test has shown that polyester's surface gets wetter, does so faster, and is therefore less comfortable than cotton. ■

THE FIRST TYPEWRITER was patented well over two centuries ago. In 1872, Thomas Edison invented an electric model—which later became the ticker-tape printer.

LEAF-CUTTING BEES use plant material to build brood cells. Some interweave leaves inside fenceposts; others wall up the hollows of abandoned snail shells.

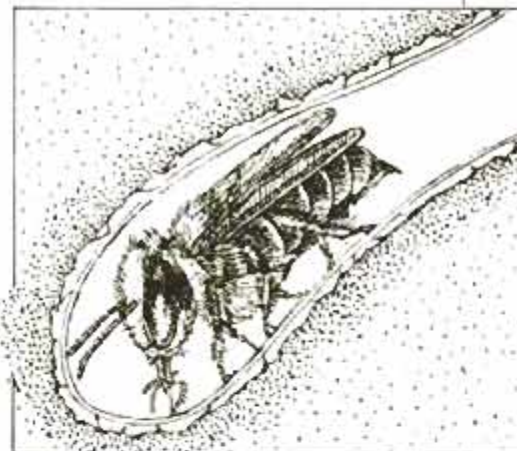
PARK INSTALLS SOLAR TOILET

It looks a little like a UFO, 12,800 feet up in Colorado's Rocky Mountain National Park. But it's actually a solar-powered toilet, designed and built by the park's engineers.

At high altitudes, there's not enough soil to dig a trench and there's no water, either. So the engineers decided to accumulate wastes in a perforated basket that separates liquids from solids. Air, heated by a solar panel and blown by a solar-powered fan, is wafted across each substance. This evaporates the liquid and dehydrates the solids. "We get about a thousand pounds of solids down to about one hundred pounds," says engineering technician Joe Arnold, "and then we pack it out and burn it."

Two solar amenities are now in place at the park and working well, say maintenance personnel, flushed with pride. ■

INSECT CHEMIST MAKES PLASTIC



Myriad insects secrete chemicals, but only a few of the 20,000 species of bees synthesize plastic bags that protect an offspring's food supply.

Colletes thoracicus females dig burrows one to two feet deep in tempting suburban lawns in the eastern United States. The tunnels have up to 10 side branches that terminate in brood cells. Each female lines her cells with polyester secreted by an abdominal gland, brushing the shiny, transparent liquid onto the walls with her flat, fringed tongue.

"The bee then fills each cell half-full with nectar and pollen, lays an egg and fastens it to the cell's roof," explains Suzanne Batra, of the USDA's Beltsville Agricultural Research Center. "The polyester protects the food for a year, when the new bees emerge." ■

SPACE-BASED COMPUTERS WILL FIX THEMSELVES

When a computer in space starts to transmit gibberish, NASA can't send repairmen aloft to fix it. But by 1990, that probably won't matter. Sick software may be able to heal itself.

Despite relentless preflight testing, computers on satellites or space probes can fail, and hazards such as cosmic rays and micrometeorites can damage vital circuits. To protect the craft, designers build in duplicates of almost everything: computers, cameras, radios. But the extra equipment adds weight and consumes precious energy, since most of the redundant systems stay turned on throughout the mission in order to collect as much data as possible.

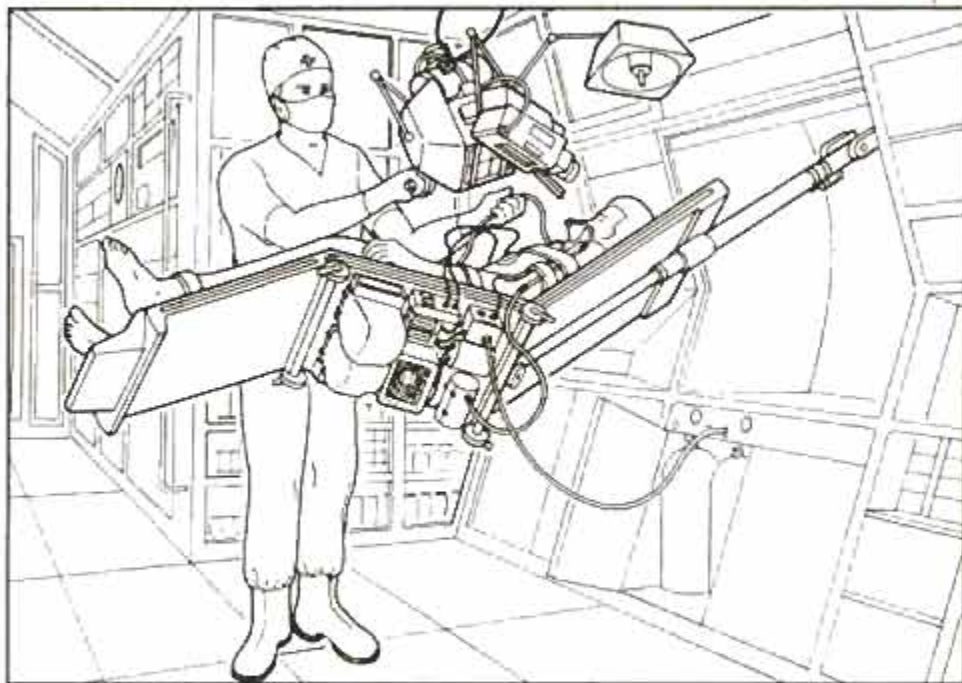
Now, engineers at the Jet Propulsion Laboratory in Pasadena, California, led by Dwight Geer, are developing circuits called "building blocks" that will be able to monitor a spacecraft's systems, correct errors and even replace malfunctioning parts.

For example, a building block that "knows" the degree of light and dark a camera can detect will review pictures from the camera. If the block detects a picture element, or pixel, that is impossibly bright or dim, it will correct the information before sending it back to Earth for interpretation.

Or, if a microprocessor is consistently recording impossible data, a building block will instruct the system to review the last few steps. If the block finds a faulty chip, it will shut it down and instruct another chip to take over. This could prevent, among other calamities, a disastrous change of course.

For most decisions, building blocks will act independently of the ground crew. This could prove essential on missions to the outer planets. Some of these projects will take years. Full-time monitoring by scientists would be costly and time-consuming; from that distance, radio signals indicating trouble would take hours to reach Earth. ■

FROM A SPACESHIP going nearly the speed of light, stars would seem shifted from their positions and appear to be coming from ahead. Just as vertical raindrops look slanted to a moving bicyclist, the perception of light rays depends on the observer's speed and direction.



To help a doctor perform an operation in space, a TV camera and screen would be set above the patient. Vital medical data could then be relayed to and from Earth.

ORBITING EMERGENCY ROOM

Future space stations may house as many as 20 people at a time. Although gravity-free, these orbiting habitats won't be free from accidents. Nor will they be immune to disease. So NASA, always thinking ahead, is currently designing a space infirmary that will be able to handle anything from a sprained wrist to acute appendicitis.

"We are trying to imagine what will be needed, keeping in mind that Earth may be physically out of reach for several weeks," says flight surgeon Joseph DeGianni of the Johnson Space Center's Medical Sciences Space Station Working Group. It could take as long as 21 days round trip, he explains, before a shuttle was able to rescue a sick person and bring him back to Earth.

What NASA has in mind is a compact, but complete, health care center that would include a surgical suite, a small

two-bed clinic to provide nonemergency medical care and an adjoining exercise and recreation room. Along with standard medical equipment, the facility would house a computer programmed to serve as a medical encyclopedia for the attending physician.

Many surgical procedures and medical equipment routinely used on Earth will have to be modified for use in space. DeGianni reports that the Russians—by conducting tests with animals under simulated weightless conditions—have found that space surgery is extremely difficult. For example, after an incision is made, body fluids tend to flow every which way. And because the air doesn't settle, contaminants circulate constantly, and it's therefore difficult to keep a sterile environment. NASA is confident, however, that it can solve these problems in the reasonably near future. ■

I.V. WITHOUT GRAVITY

A weightless astronaut floats through the shuttle—and crashes headfirst into an open cabinet door, badly ripping his scalp. He needs an intravenous solution in a hurry. But I.V.'s need gravity to drip. Is the astronaut out of luck?

Not on future shuttles, thanks to a device developed by Umpqua Research of Myrtle Creek, Oregon. The company has already produced a system to purify fuel-cell water for cooking and drinking in space. To get an I.V. solution to flow from a pouch, down a tube and into an

astronaut's arm, Umpqua's scientists have invented an apparatus, similar to a blood pressure cuff, that forces fluid from the pouch. A valve controls the flow.

There is an additional problem: I.V. solutions are mostly water, and with shuttle loads priced at \$440 per pound, they're too heavy to carry into orbit. So Umpqua is now perfecting lightweight I.V. concentrates—as well as an improved purification system to make recycled water suitable for injection. NASA's tests should begin later this year. ■

BOILING BACTERIA: BIG BUSINESS

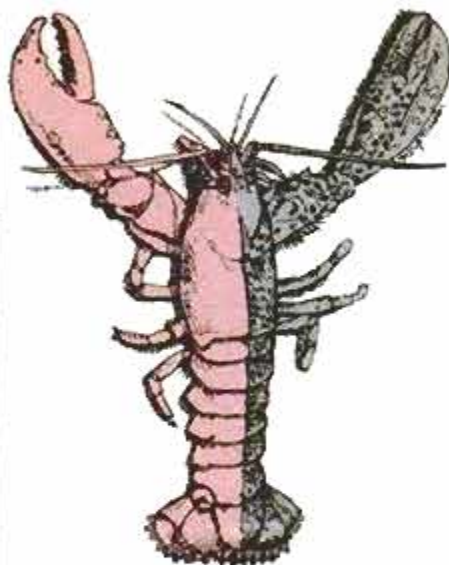
Two and a half tons per square inch is a lot of pressure. And 500 degrees Fahrenheit is enough to broil beef. But these daunting conditions are just a summer day to a recently discovered bacterium.

Writing in *Nature*, scientists from Oregon State and Johns Hopkins universities report successfully culturing bacteria recovered from deep-sea thermal vents. These rents in the ocean floor spew an acid chemical brew and support many unique—and hardy—organisms.

Their work has a lot of industrial chemists excited. The tough microbes could have dozens of applications, particularly in bioengineering. Genes conferring temperature tolerance may be spliced into *E. coli*, the workhorse of the field. Many important chemical processes run best at high temperatures. Moreover, the bacteria themselves may become a new breed of workhorse, accepting genes for valuable products. Finally, by studying just how life can exist in such extreme conditions, researchers may learn how to make organic substances more rugged. ■

HORNY DILEMMA

Most male antelope use their heavy, twisted horns in head-butting jousts. In some species, females have horns, too—usually a simple set of spikes—whose purpose is less clear. Craig Packer, a University of Minnesota ecologist, reports in *Science* that they may use these to fend off predators. Many experts disagree, claiming that females rarely spike an attacker. But Packer says a correlation between an antelope's size and the presence of horns supports his theory. Small species, whose females never have horns, evade predators by running away. In most big species, which tend to stand and fight, females do have horns. ■



DESIGNER LOBSTER

A red-and-blue striped lobster sounds like a bad dream after a large seafood dinner. But in fact, color-coded lobsters are being used to trace the migrations of their normal brown relatives.

The striped lobsters, along with solid blue and spotted varieties, have been bred from rare blue and red ones that occasionally occur in nature. John Hughes, director of the Massachusetts Lobster Hatchery and Research Station, reports that the colors make ideal "tags" because they are maintained as shells are shed and regrown each year.

Since 1981, Hughes and assistants have been seeding local lobster populations with the hybrids. A long-term study will indicate population changes. ■

EXPLODING PATIENT

Emergency room physicians have to deal with a lot of problems. But it is rare that a patient *explodes*.

Just such a thing happened recently at the Naval Regional Medical Center in Charleston, South Carolina.

A woman being treated for heart disease collapsed in the throes of a heart attack. Captain Charles Babka, in a letter to the *New England Journal of Medicine*, reports that they quickly tried to restart her heart, not noticing that she was wearing a Transderm Nitro patch—a skin-applied device that dispenses nitroglycerin, a treatment for chest pain. A jolt of electricity was sent through her chest. With a flash, a small bang and a puff of yellow smoke, the skin patch exploded.

Subsequent tests showed that electricity had sparked to the aluminum patch cover, detonating the material within. The patient was unharmed. ■

VITAMINS IN BEER

Beer in Australia may soon be vitamin-enriched. Researchers at the University of Queensland report that chronic vitamin deficiencies in alcoholics could be offset if brewers were to add vitamin B₁ to their products. While yeast used for brewing is rich in B₁, it is lost in processing. A lot of drinkers stand to benefit: The average person in the Northern Territory consumes 60 gallons of beer yearly. ■

LIGHTING HAZARD

Fluorescent lighting has long been associated with headaches and eye strain because it produces a rapid flicker. But little scientific evidence supported the notion. Until now, the flicker rate was considered far too fast to affect the eye or brain, which can't sense more than 30 flashes per second.

By measuring signals in nerves leading from a cat's eye to its brain, researchers at the University of Essen in West Germany say they've detected a response to fluorescent light flickering at 100 cycles per second. Their findings are reported in the *Archives of Pharmacology*. ■

HYPNOTIZED MIND MAKES MISTAKES

Hypnosis is used routinely by both lawyers and law enforcers to jog the memory of witnesses. But new research indicates that it may hurt more than it helps. Jane Dywan and Kenneth Bowers, psychologists at the University of Waterloo in Ontario, say that hypnotized test subjects made far more mistakes than controls did when asked to recall 60 drawings of common objects. Those most sensitive to hypnosis made the most mistakes. The researchers suggest that the hypnotized mind actually manufactures memories that are nothing more than vivid figments of the imagination. ■

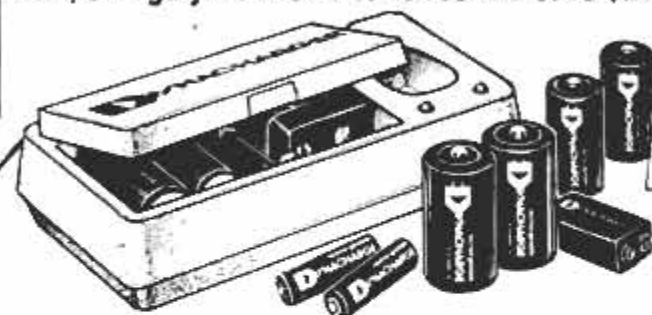
MAN VERSUS MOLE

Moles continue to outwit British government efforts to keep them from damaging crops. According to *New Scientist*, Ministry of Agriculture researchers have gone so far as to try gluing poison onto earthworms, one of the mole's favorite foods. They even tried Super Glue, but the moles weren't taken in. When eating a worm, a mole naturally draws it through its paws, removing any dirt or, in this case, poison. ■

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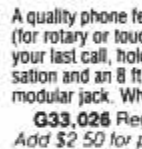
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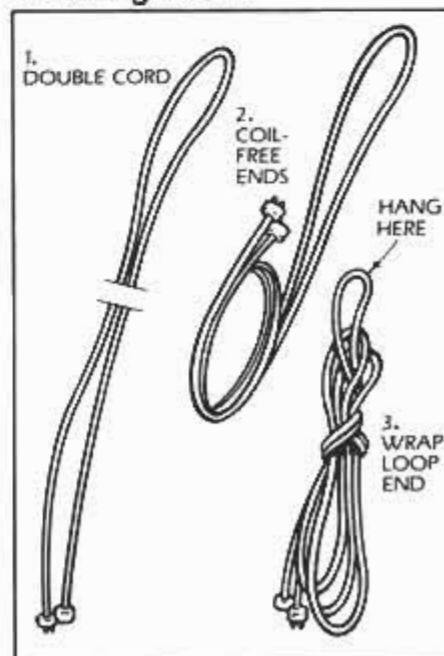
Holding chisels



A safe way to use a cold chisel, star drill or other hammered tool is to hold it in a locking plier. This keeps your hand out of the path of the descending hammer. However, the plier jaws create unwanted grooves in the tool. To prevent this from occurring, sandwich sheet metal or scrap aluminum siding between the jaws and the tool shank.

—Walter E. Burton

Bundling cords



To bundle rope or cord for storage, fold the cord in half. Coil the doubled cord beginning with the free ends. Wrap the loop end around the bundle one or more times and thread it through the upper end. Now you can hang the cord.—C.B. Eller

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1984

THE DREADED YEAR

Has the arrival of 1984 brought any surprises?
We asked some powerful men for their views.

When George Orwell's novel *1984* was published in 1948 it stirred generations of controversy. Was it prophetic? The book spoke of a Big Brother watching us on two-way television and keeping tabs on our lives on computers. It was written before the microprocessor entered American living rooms the way it has today. Surveillance in 1948 wasn't the science it is today. Has Big Brother come to be? Here are the thoughts of some of America's scientific and corporate leaders.



George Orwell proved right in everything except the title. His description of how Stalin restored and extended the deadly grip of the Czars

came to pass well in advance of 1984, but Orwell was completely right in his prediction that the changes Stalin introduced would become permanent. Expansion of this system to the changeable scene in China and infiltration to the Persian Gulf and Africa indicates that the system is intended for the world as a whole. However, resistance to 1984 is not yet dead in the free world. Less than a year ago, the President of the United States announced research leading to true defense—an alternative to horrors of nuclear war. Indeed, the year 1984 may prove that Orwell's book is an inspired vision, but not a prophecy.

—Edward Teller
Physicist



Orwell's chilling vision alerted us to the dehumanizing potential of technology. But technology is neutral. Technologies such as those that allow us to see our planet from space and to hear the whales sing also deepen our understanding and appreciation of the human experience. Orwell's *1984* was a plausible extrapolation of what he saw around him at the time. It turned out differently, which is evidence that, despite all our follies and our tragic mistakes, common sense tends to prevail over the course of history.

—Joseph G. Gavin Jr.
President, Grumman Corp.



The reality of 1984 illustrates a point I made at the start of *2081: A Hopeful View Of The Human Future*—most prophets tend to over-

estimate the effects of social and political change, and to underestimate the effects of technological change. The people of the 1880s had the same goals and responses we do...and the 2080s will be no different...We resist Orwellian dictatorships.

—Gerard K. O'Neill
Princeton University Futurist



I can't help but wonder what we would tell Orwell if he appeared and asked how the world has changed since his death in 1950. We might

begin by handing him *Popular Mechanics*. As he turned from page to page, I think that Orwell the humanist would be delighted by the ingenuity displayed here. And I think Orwell the socialist would be instructed by the fact that most of *PM's* readers could afford most of the products reviewed and advertised here. But political life in some parts of the world casts a sweeping shadow. In dozens of countries, Big Brother is more than an emblem and daily life is dreary hardship. Seeing all this Orwell might begin a new book: *2019*. How that book might reconcile these contending forces would make for another fascinating reading.

—Colby Chandler
Chairman, Kodak Corp.



Big Brother's got all our numbers. By means of those numbers on plastic and in the computer, all sorts of Brothers can, and often do, know more

about everyone than one's family and best friends. Your credit rating, driving record, travels, income, health, insurance, mortgage—you name it, it's in somebody's computer somewhere. Instead of reducing us to numbers, numbers in the computer have made us each and everyone a readily, near totally documentable individual. By George, how awful right Orwell was.

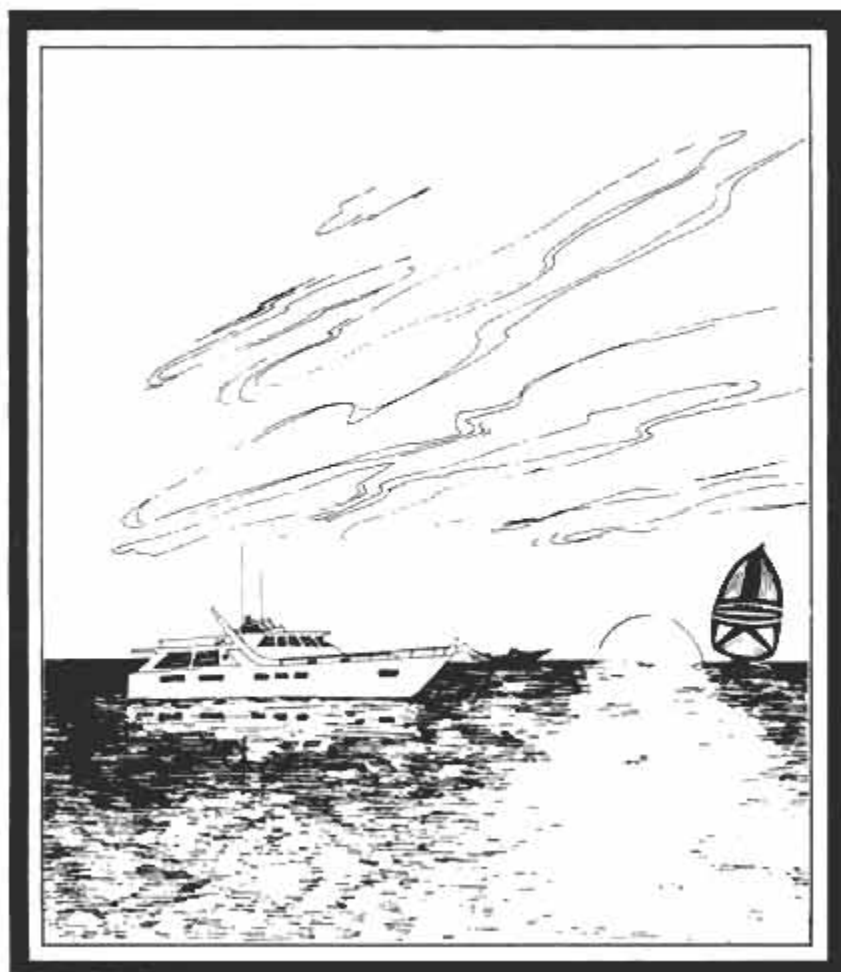
—Malcolm S. Forbes
Publisher



When Orwell wrote *1984* he raised an alarm about some very long-term human problems—tyranny, invasion of privacy, deceit and war. He warned

that these maladies might find a new and more potent expression through advanced technology. No doubt Orwell's warning helped alert us to these negative possibilities. But the same factors that have encouraged the development of advanced technology have also helped protect us against the negative extreme Orwell predicted. In order to flourish, technology requires an atmosphere of free inquiry, enterprise and uninhibited exchange of ideas—the antithesis of the 1984 world Orwell feared. Those in the business of innovation have a crucial stake in freedom and privacy.

—John F. Akers
Chairman, IBM



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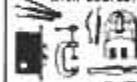
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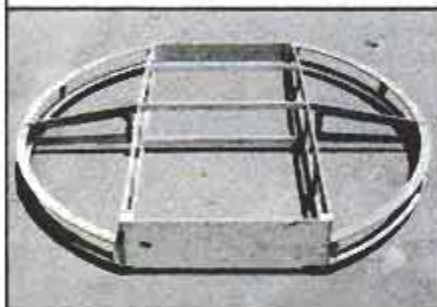
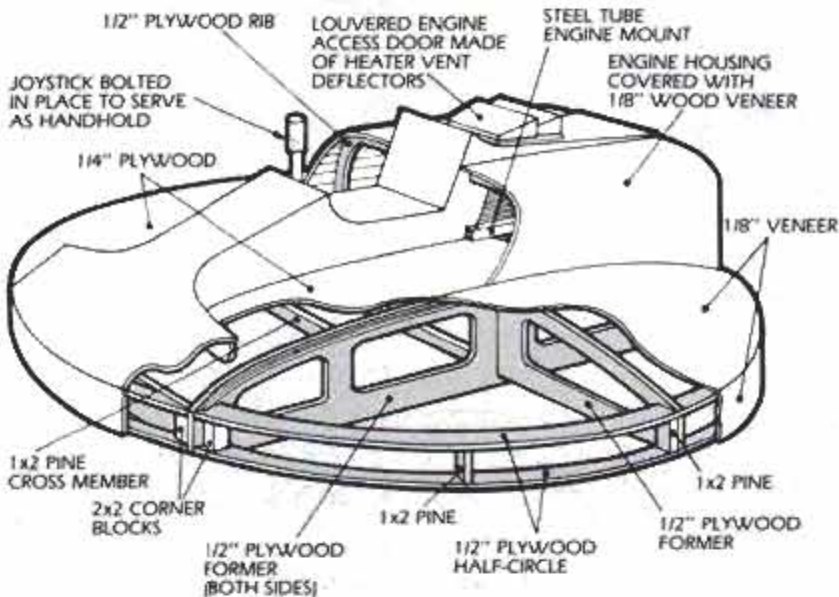
What youngster wouldn't love to have his own personal flying machine—even if flying is only 10 in. off the ground?

PM's Pegasus is just such a vehicle. It's an 87-in.-dia. floating machine that's powered by a lawnmower engine. The Pegasus is designed to be used in open fields, unused parking lots and even large back yards. It carries over 200 pounds and clears obstacles up to 10 in. high.

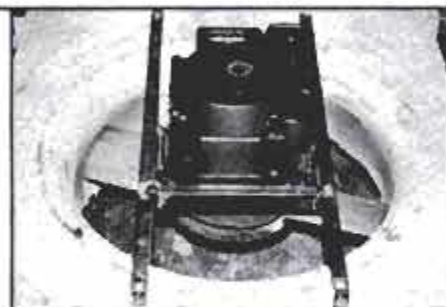
Pegasus is not a serious transportation vehicle. It's a have-fun-on-weekends machine that's easy and inexpensive to build, and thrifty with fuel. The craft will run nearly three hours on a gallon of regular gasoline. You can build Pegasus yourself for about \$150 worth of plywood and paint, plus an engine from a retired lawnmower and a mail-order prop (about \$25). PM's plans show you how to do it, and include drawings and a photo-illustrated booklet.

Riding the Pegasus is the closest thing to flying without actually flying. It hovers just a few inches above the ground, supported by a cushion of air. The air escapes continuously around the edges between the bottom of the flexible skirt and the ground. That's where the engine comes in. The 3½-hp lawnmower engine, fitted with a 2-ft.-dia. prop, blows air under the craft just as fast as it escapes around the edges—that's what keeps the Pegasus floating.

The two-bladed wooden prop is located in the rear, centered in the frame and directly below the lawnmower engine. It's connected to the crankshaft. The back and front entries leading to the prop are covered with screen. The Pegasus will lift a heavy



The center section and half circles are ½-in. plywood with 1x2 cross members. The center supports the cockpit and engine and is covered with ½-in. plywood; the half-circle sides are covered with ½-in. veneer, which can be bought as door-skin material.



The engine is on a steel framework that's mounted on the top rear of skinned deck. The unit unbolts and drops out the bottom for servicing. Two-bladed wooden propeller is connected to engine's crankshaft. The prop helps to smooth out vibrations.

HOW TO ORDER PLANS

For complete plans, including six 17 x 22-in. drawings and a 32-page illustrated booklet, send your check or money order for \$9.95 to: PM Air-Cushion Pegasus, Box

1014, Radio City Station, New York, N.Y. 10101. Allow three to four weeks for third-class mail; add \$1.50 if you want faster, first-class mail delivery.

load with very little power because the air underneath doesn't have to be highly pressurized. Instead, the craft gets its lifting capacity from the disc area, which is 41.28 sq. ft.

Mounting the engine

The engine is mounted to steel framework inside the engine pod behind the seat. It's started with a pull rope which is exposed by lifting the louvered access door on top of the engine pod. The lawnmower engine should run smoothly when it's mounted in Pegasus. The prop acts as an extra fly-wheel which smooths out vibrations so you can hardly feel the engine running.

If no one is aboard, the idling engine blows enough air to lift the nose off the ground. To board Pegasus, step over the front and onto the walkway on either side of the raised cowl. This 3-ft.-wide center section, which makes up the cowl, the seat and the walkway on either side, is the only part of Pegasus that will support your weight. This whole center section is covered with 1/4-in. plywood; the rest of the surface is covered with lightweight 1/8-in. wood veneer.

Controlling Pegasus

The dash, located just ahead of the seat, holds the throttle and a kill switch. The throttle is made from a universal control cable (about \$4 from your local auto parts store) that's routed underneath the deck. The kill switch is a simple ON/OFF switch that grounds out the ignition and stops the engine.

Pulling the throttle out increases power. At about half throttle, Pegasus lifts to the height of the skirt (10 in.) and bobs a few times. Increasing the power lifts the craft higher. At full throttle, it's hovering with the bottom of the skirt 3/4 in. above the ground.

The stationary joy stick protruding above the dash serves as a handhold to help control the lean and tilt. To control Pegasus, just lean in the direction you want to go.

It's built in four weekends

Building Pegasus is about a four-weekend job. The center framework that carries the cockpit and engine is built of 1/2-in. plywood formers, then covered on top with 1/4-in. plywood. The next step is to fit the engine and prop assembly. Then you install the 1/4-in. plywood cockpit and cowl. The half-circle sides are glued and nailed to this center structure. The sides are covered on top with 1/8-in. veneer, which is purchased as door-skin material at a local building supply store. The bottom is left open to form the air chamber. For more information, see the plans box on page 62. **PM**

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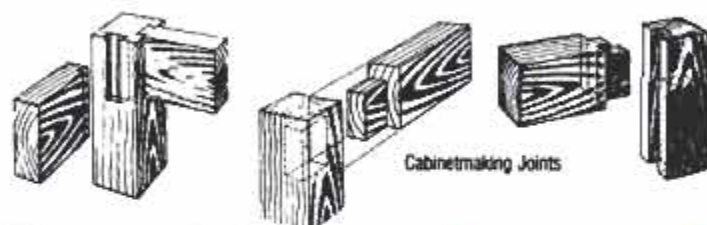
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PM SOFTWARE MONITOR



Go FORTH and (maybe) conquer

Computer languages may seem dry or dull—but when you find one you like, it's as if a veil of fog lifts from your eyes. All computer languages are a way of connecting your own brain's creativity to a silicon-brained, recalcitrant, even stupid machine. When a language helps your own thoughts come alive with fast-running, short and even attractive programs, then it's worth getting to know that language better.

Enter FORTH-79 from MicroMotion. We've seen other FORTHS before, but this is the first implementation of it that has actually made us use it on a daily basis. FORTH can be as confusing to learn at first as, with practice, it is easy to use later on. The manual makes the

learning of this language as easy as possible—not entirely painless, but certainly within reach of anyone who can already program in BASIC.

What is FORTH like? FORTH can best be described in one word—"wordy." In a language such as BASIC, you program by manipulating previously defined command words. A word such as PRINT does one thing and a word such as MID\$ does something else.

In FORTH, you make up your own words for just about everything. And, once you have defined what a word does, you can use it as part of the definition of a longer word. An entire program is just one word, defined by layers of other words.

Let's program, in FORTH, a very simple word which we will call PM.

```
: PM CR . 'Hooray for Popular Mechanics!';
```

The colon starts the definition. PM defines the name of the word. CR causes the word to first print a line space. Then comes what the word does (in this case prints a message). The semicolon tells FORTH that the word is over.

Now we have a word called PM. So whenever we type PM and hit return, the computer will print "Hooray for Popular Mechanics!"

It's a fun language with many features. If you have an Apple or a CPM computer, check out FORTH-79 (MicroMotion is at West Los Angeles, Calif. 90025 (213) 821-4340).—N.S.

Rigging computers

Next to actually climbing into a time machine and enlisting aboard one of Admiral Nelson's tall ships, *Broadsides* from Strategic Simulations Inc. is just about the best way to enter the world of Napoleonic sea wars. The graphics are simply beautiful, the play is excellent and the simulation of the type of battles fought by those wave-rolling ragwagons is like nothing else you've ever seen.

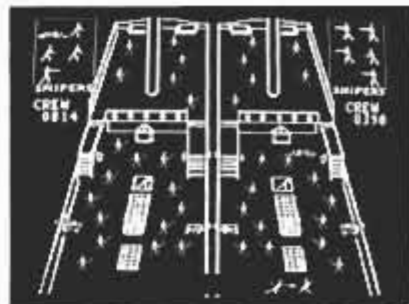
The main screen, or Sailing Screen, shows each ship from overhead and in silhouette. The captain can ready his guns with chainshot, roundshot or grapeshot, aim at an opponent's sails or hull, and, meanwhile, maneuver like crazy to get a positional advantage. As



Sailing screen shows action at sea.

shots land, the silhouettes detail damage.

If the two ships touch, the crews can board and slug it out in true swashbuckling fashion. Meanwhile, snipers can fire from the rigging.



Swashbucklers clash in new *Broadsides*.

Sound effects are great (the Apple's can be enhanced with the addition of a circuit-board called The Mockingboard from Sweet Micro Systems). *Broadsides* is for the Apple II and Atari 800 at \$39.95.—N.S.

Tin can video

Avalon Hill's latest excursion into simulation gaming has produced a real winner in the form of T.A.C., or Tactical Armor Command (for the Apple and Atari computers at \$40). Two of you can play or you can play alone.

At the beginning of the game, players choose from "menus" which list choices of just about all WWII-era tanks, tank destroyers and armored infantry units. You can even do such things as play the Russians against the U.S.

Units "spot" each other, can hide in trees, fire smoke, shoot directly or



Two tanks and infantry under attack.

request support bombardment. Movement is handled using a keyboard system which makes you feel almost as if



Menu details the available U.S. gear.

you are driving the military vehicles. T.A.C. liberates the General Patton in us all.—N.S.

FIRSTHAND REPORT



Civic lineup for '84 includes the stubby CRX two-place coupe (left) and a squareback that Honda calls a hatchback. Other Civics include a four-door notchback sedan with a trunk and a four-door wagon with a deep rear window.

Driving The New Honda Civic And CRX

They're not simple, but the new Civics are practical, economical and exciting.

BY MICHAEL LAMM
West Coast Editor

I suspect you've heard the word: Honda's new CRX minicoupe delivers 67 mpg, according to the EPA. That's with the smaller of two 1984 Civic engine sizes—a 1.3-liter transverse Four. There's also a 1.5-liter upgrade that gets 36/49 mpg in the CRX coupe, so it's no slouch either.

But on top of that, the CRX 1.5 delivers amazingly good performance. When I drove two different 1.5 coupes recently, both with five-speed sticks, 0 to 60 came up in about 10 seconds flat. Top speed is said to be 100 mph. I didn't get a chance to drive a Civic with the 1.3, but I hear that the smaller engine—at 60 hp versus 76 for the 1.5—moves right along, too.

The question I had from the outset was: Is the CRX practical? The answer: Absolutely! I found the two coupes I drove to be roomy, great fun, lively,



All versions are well instrumented and have many handy little amenities, like coin trays.

sporty and just thoroughly pleasant and cooperative.

The third Civic I got my hands on was a two-door DX hatchback, which has room for four adults plus about four bags of groceries.

Honda has revamped and rebodied its Civic fleet for 1984. Of the four new Civics, the smallest is that little Olga Korbut of cardom, the CRX: a two-place coupe with about 14 cu. ft. of luggage space—enough for a couple of family-sized suitcases. If you're over 6 ft. tall, your head will touch the ceiling. But otherwise, two average-size adults can sit in comfort.

One of many pleasant surprises

inside the CRX is its seats. They're supremely comfortable—firm, with excellent lumbar and lateral support, and yet the seatback wings aren't obtrusive. The DX hatchback's seats, on the other hand, are just seats.

The CRX cargo deck is fairly shallow (only 14.5 in. to window level), and there's no security screen. However, you do get a lockable storage compartment about the size of two cigar boxes.

In addition to the CRX coupe, you can also choose between two slightly larger but still petite Civic wagons—the two-door I drove, which Honda calls a hatchback, and a high-roofed four-door wagon whose silhouette looks something like the Toyota Tercel wagon. Finally, there's a new four-door Civic notchback sedan with totally new sheet metal.

In all, the four body styles come in seven series, depending on engine and standard equipment. The base CRX and HB hatchback come only with the 1.3 engine and manual transaxle. All others give you a choice of a five-speed stick or a three-speed Hondamatic with torque-converter lockup. The five-

(Please turn to page 70)

HONDA CIVIC AND CRX

(Continued from page 69)

speed practically shifts itself, except for FIFTH and REVERSE, which take about four tries to get used to.

Both all-aluminum Civic engines use Honda's CVCC stratified-charge principle. The smaller 1.3 (1,342-cc) Four has 10:1 compression and a fairly conventional ohc valve train, the main difference being a prechamber atop the main combustion chamber. A relatively rich fuel/air mixture in the prechamber ignites a fairly lean mixture in the main combustion chamber.

The prechamber contains a small intake valve that lets in the richer mixture, and it also houses the sparkplug. The prechamber's flame front shoots



All the '84 Civics have totally new sheet metal, including four-door notchback (top) and the high-roofed wagon, which takes styling cues from Toyota Tercel wagon.

out into the main chamber to make for more even and controlled burning of the leaner mixture.

The longer stroke 1.5 (1,488-cc) version of this engine sets two conventional intake valves into the head, opposite a single exhaust valve. The 1.5 prechamber has four little ducts that shoot flame into the main squish area between the twin intake valves and the single exhaust. The intakes are timed so they open 10° apart. This cuts fuel scavenging and makes the engine idle more smoothly. This three-valve configuration was introduced last year in the Prelude.

Complicated, yes, but the system certainly works. Not only do these CVCC engines deliver fantastic fuel mileage, but they are among the smoothest Fours I've ever driven. That includes Mitsubishi's countershaft engines. The Civic's 1.5 engine, by the way, uses a three-barrel carburetor, as opposed to the 1.3's two-barrel. One barrel of each of these carbs feeds the prechambers.

Another thing that helps fuel economy is these cars' light weight. The CRX

1.3 weighs a mere 1,713 pounds, thanks in part to the alloy engine and the liberal use of plastic body skins. The coupe's front fenders, front airdam, both bumpers, plus lower door and fender panels are all formed from a variation of polypropylene developed by Honda. It's painted silver, resists dings and chipping, and can't rust.

The 1.3 CRX emphasizes economy, but the 1.5 is set up for performance and handling. The 1.5 coupe and Civic S hatchback use stabilizer bars front and rear, while the 1.3 has a front bar only. The 1.5 cars also come with 175/70SR13 Michelin radials on wider wheels.

The CRX 1.5 handles very well, showing very little lean in hard cornering and great predictability. It's an amazingly neutral car on dry pavement, but if you push it very hard, the front end begins to plow. On loose surfaces like gravel, the car can be made to understeer fairly easily.

The same goes for the Civic hatchback, although I drove only the middle series DX. The sportier Civic S hatchback has antiroll bars fore and aft plus the stickier Michelins, so I suspect its handling might be slightly better than the coupe's due to its greater overall length.

The 1.5-liter CRX has a choppy free-way ride. Its wheelbase is the same as the original 1975 Civic (86.6 in.), and the suspension tends to be fairly stiff. The DX hatchback showed me a lot smoother ride, but its handling wasn't up to the CRX's.

Some minor demerits

On the minor minus side, I noticed that the CRX's paint job had what I'd call too much orange peel in its three nonmetallic colors: red, white and blue. Civics with metallic paint didn't show any orange peel.

As for the hatchback, there's really not much carrying space behind the rear seats when they're upright. Nor do the seatbacks fold totally flat, although they're split 50/50 so you can carry one rear passenger plus cargo. Little things.

In praise of these cars, all Civics have extremely well laid-out, straightforward, easy-to-read instrument clusters, and I especially like their roadster-like wraparound dashboards. It adds to the feeling of spaciousness, and these cars actually are very spacious considering their external dimensions. The CRX in particular gives the impression of being a much larger car as you drive it.

At a base price of \$6,149, the CRX 1.3 represents a tremendously good deal, I think, as do all these remarkable new Civics. Honda might not make it simple, but it certainly engineers and builds its cars extremely well. **PM**

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Silence Those Noisy Water Pipes

Water hammer may sound unrepairable, but you can eliminate the noise easier than you think.

BY RICHARD DAY

Besides its disturbing noise, water hammer can do a great deal of damage to your house water-supply system. The knocking can burst a pipe or fitting behind the wall. But air chambers at kitchen and laundry sinks and at bathroom washbasins can prevent water hammer. In fact, many plumbing codes require air chambers everywhere but at toilets and sill cocks. If you have water hammer, or if you plan on changing faucets, you should add the protection that a pair of air chambers provides.

Water hammer is the audible result of tremendous overpressures created inside a water-supply system as fast-flowing, pressurized water comes to a sudden stop when a valve is closed quickly. Water hammer in pipes is like knocking combustion in an auto engine: The pressures developed can break through the walls surrounding them, doing extensive damage in the process. The good news is that air chambers placed in the water supply near a faucet make soft cushions for running water to land on when the faucet is turned off rapidly.

When changing faucets, you may be setting yourself up for a bout with water hammer that wasn't on the program before. This is because older, slower-acting, two-handle faucets—the kind you'll likely be removing—tend to minimize the effects of water hammer. But single-handle faucets, because of their fast action, can encourage water hammer where it never existed.

The typical house air chamber is a 12-in. length of ½-in. pipe capped at its upper end and installed as part of the water-supply system. The air chambers shown on the next page are better. Some of them—shown for floor-supplied fixtures, which are the most likely ones to be without built-in protection—offer about three times as much cushioning capacity. That's because they're made of 18-in. lengths of ¾-in. tubing, capped on top. Because of the height limitations with wall-supplied fixtures, shorter air chambers must be fitted on them. However, they can still offer more than standard protection by being



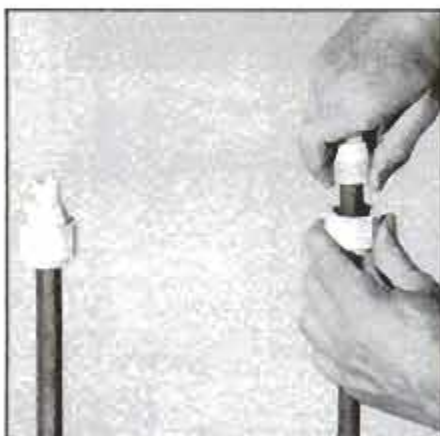
The fast shutoff of a modern single-lever faucet can lead to water hammer. When you install a new faucet, you should also consider adding air chambers to guard against hammer.



To begin installation, turn off the water. Then cut through the water-supply tubes leading to the old faucet. If floor-supplied, make the cuts at least 24 in. below the sink. Here, a close-quarter tubing cutter makes neat work of it. You can also use a hacksaw. Threaded supply pipes should be cut and unthreaded at the joint. (Drain parts and trap are removed for photo.)



Remove the attaching nuts and washers under the old faucet and lift it out. This one has a female pipe adapter hook-up without shutoff valves or riser tubes. Copper tubes went from the floor slab to the faucet.



To avoid sweat-soldering, install fittings like these Genogrip street adapters to the copper pipe stubs. They push on with a metal grab ring and are tightened by hand to form a metal-to-plastic transition.



Solvent-weld line valves with waste outlets as shutoffs. Be sure the flow arrows point upward. The undersink parts must provide transition to the plastic, incorporate air chambers, furnish shutoffs and reach up to the faucet to connect it.



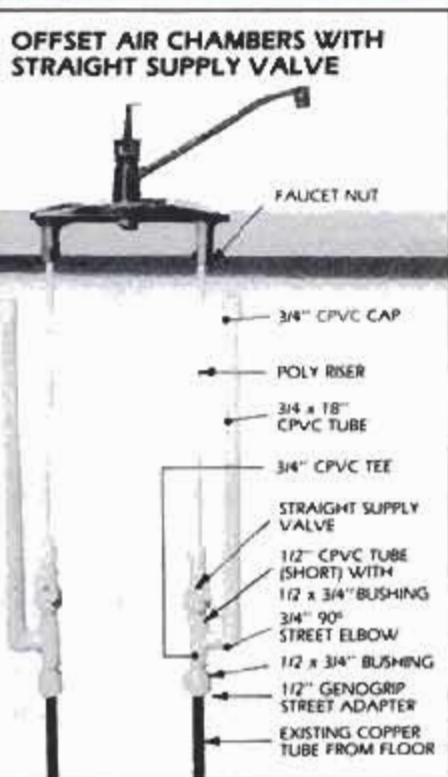
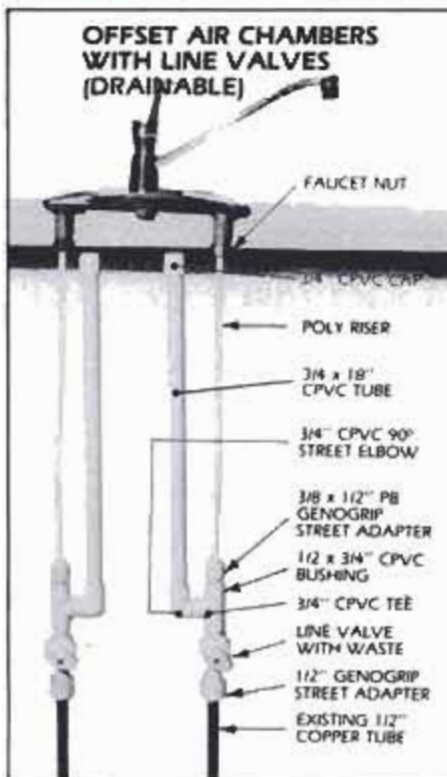
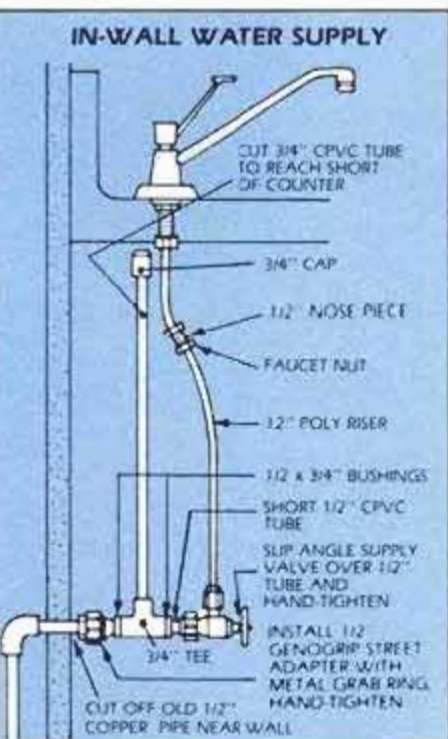
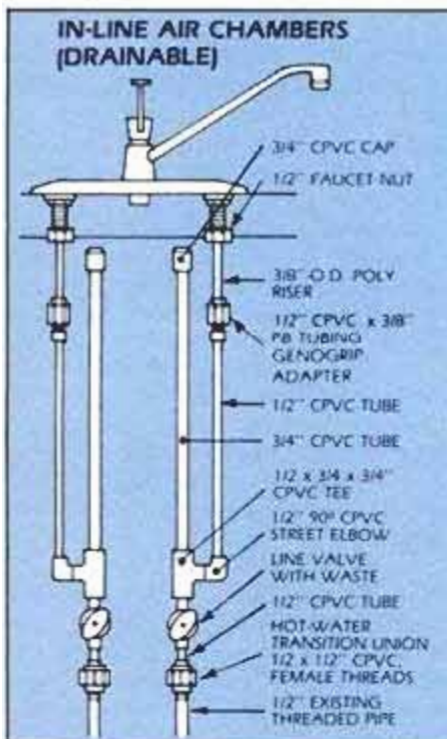
Solvent-weld a cap on one end of each 3/4-in. air chamber tube. Hold for a few seconds until the cement cures. Install this end up to trap air and cushion against hammer.



This air chamber is fitted with a 90° elbow and solvent-welded into a tee, where it protects against water hammer. Let the assembly cure for two hours.



An installation having a line valve with waste in the water-supply line ahead of the air chamber can be recharged by turning off the valve and unscrewing the drain plug. Water will drain; later, air will enter and take its place, thus curing waterlogging.



made of 3/4-in. tubing. Both hot and cold sides of the water supply need air chambers.

The four air chambers we show (see designs at left) are made of readily available plastic tubes and fittings. Plastic is used for its ease of assembly and long life. No pipe-threading or sweat-soldering is required. These materials serve both hot and cold water. Parts are from Genova's Hot/Cold CPVC/PB Series 500 line of water-supply tubes and fittings. (Genova plastic plumbing parts are available at plumbing supply stores, or write to Genova Building Products Div., 7034 East Court St., Davison, Mich. 48423, for the dealer nearest to you.)

You must join the CPVC tubes and their fittings by two-step solvent welding. This uses a cleaner/primer followed by an all-purpose solvent cement, or else a solvent cement made specifically for use with CPVC tubes and fittings.

Supply valves with adapters at both ends (Genova's Genogrip adapters in this case) permit hand-tightened connections between 1/2-in. (3/8-in. o.d.) CPVC, copper or PB water supply piping and the 3/8-in. o.d. PB or copper riser tubes to the faucet. With a floor water supply, use the straight version of a supply valve; with a wall supply, use the angled supply valve.

These supply valves come with either plastic or metal grab rings. Use the metal grab rings on rigid tubing such as CPVC and copper. Use the plastic rings on flexible tubing, like PB. No tools are needed to make the joints; it's all done by hand.

The valves will not fit directly onto threaded metal pipes. You must adapt them to CPVC tubing with transition unions (see *In-Line Air Chambers* at left). Don't adapt plastic to metal without some form of transition adapter other than a simple male adapter.

You can face the air chambers in any direction when you install them just by positioning the tees. However, once they're installed, you can't change their

(Please turn to page 74)

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NOISY WATER PIPES

(Continued from page 73)

direction without revising the lengths of the riser tubes. None of the four air-chamber designs shown requires tearing into the wall or floor. All are assembled beneath the sink or washbasin. Each offers a handy shutoff for emergency use as well as for making faucet repairs.

Any of the designs would work just as well at stopping water hammer on an existing faucet—single- or two-handle. In this case, you could install air chambers without removing the faucet.

Recharging chambers

All chambers need to be recharged with fresh air periodically. You can do this by turning off the water and draining the piping to admit the air. There are differing opinions as to whether an ordinary air chamber can be fully recharged by draining the system. However, the air chambers shown are located much closer to the drain point for more effective recharging.

You don't need to cut off the water to the whole house to recharge the two drainable designs (*In-Line Air Chambers* and *Offset Air Chambers With Line Valves*). They may be turned off and drained as shown in the photo on page 73.

To drain the other two designs (*In-Wall Water Supply* and *Offset Air Chambers With Straight Supply Valve*), turn off the house water supply and slip out the riser tubes. Check to be sure the toilet tank is full, then turn off its shutoff valve. This helps to keep tank water from being back-siphoned into the water supply system. After draining, replace the risers in their adapters and retighten the hand nuts.

A set of add-on chambers is a useful backup, even if your house plumbing already has built-in air chambers behind the walls. Of course, if the supply pipes come from the floor, it's obvious if no air chambers have been used with them.

The cost for all the hookup parts, including valves, air chambers and flexible riser tubes for both hot and cold water sides, is about \$30. Besides the other benefits, the parts make a new hookup much easier to do. They also help to update an old plumbing system.

If you hear no water hammer, there's no need to be concerned about it. One thing it is *not* is a silent destroyer. But if you are changing from a slow-acting to a fast-acting faucet, or if you already have the thundering problem, it will pay you to add some air chambers to your system.

PM



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Perfect Joints From Your Router

Finger or box joints look like dovetails, but without the flair. While box joints are not as strong as dovetails, you can cut them easily on a table saw or with a router using this simple jig.

Not having a router table with built-in miter gauge, I built a miter tabletop from $\frac{3}{4}$ -in. A-C plywood. Dimensions can vary to suit your materials and space, but make sure all four sides are square. Cut a dado about 3 in. from the front edge. If you have a miter gauge

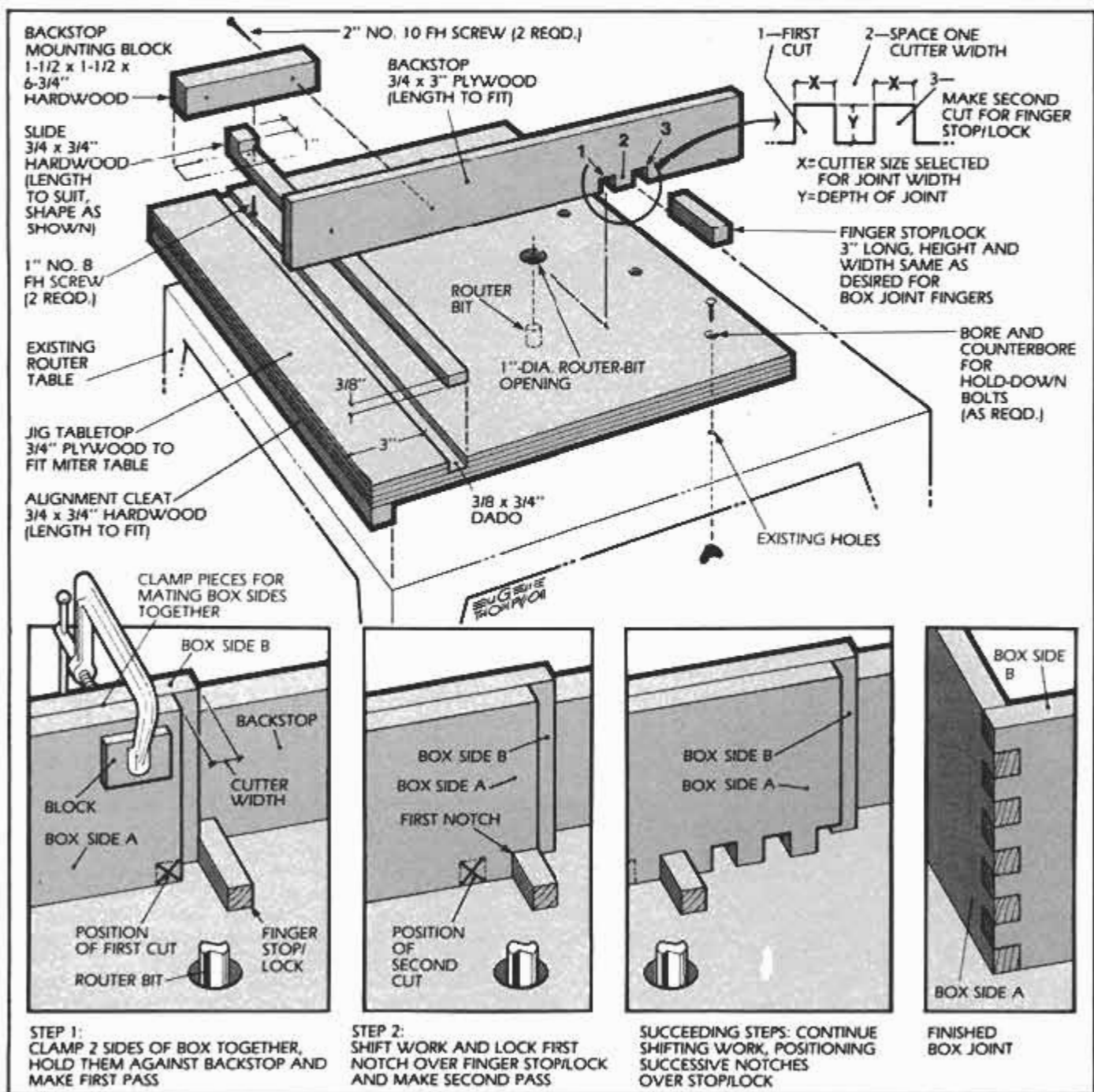
from a table or band saw, cut the dado to fit it. Not having one, I made my cut $\frac{3}{8}$ in. deep by $\frac{3}{4}$ in. wide.

Glue a hardwood strip along the front bottom edge of the top to help align it with the router table. Flip over the top to mark and bore countersunk mounting holes to align with those for the router table fence which will not be used. Also bore the hole for the router bit. The jig table mounts with bolts and wingnuts.

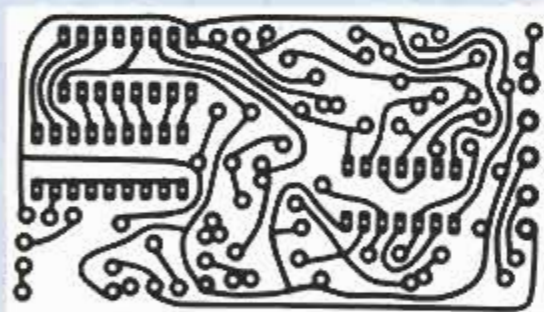
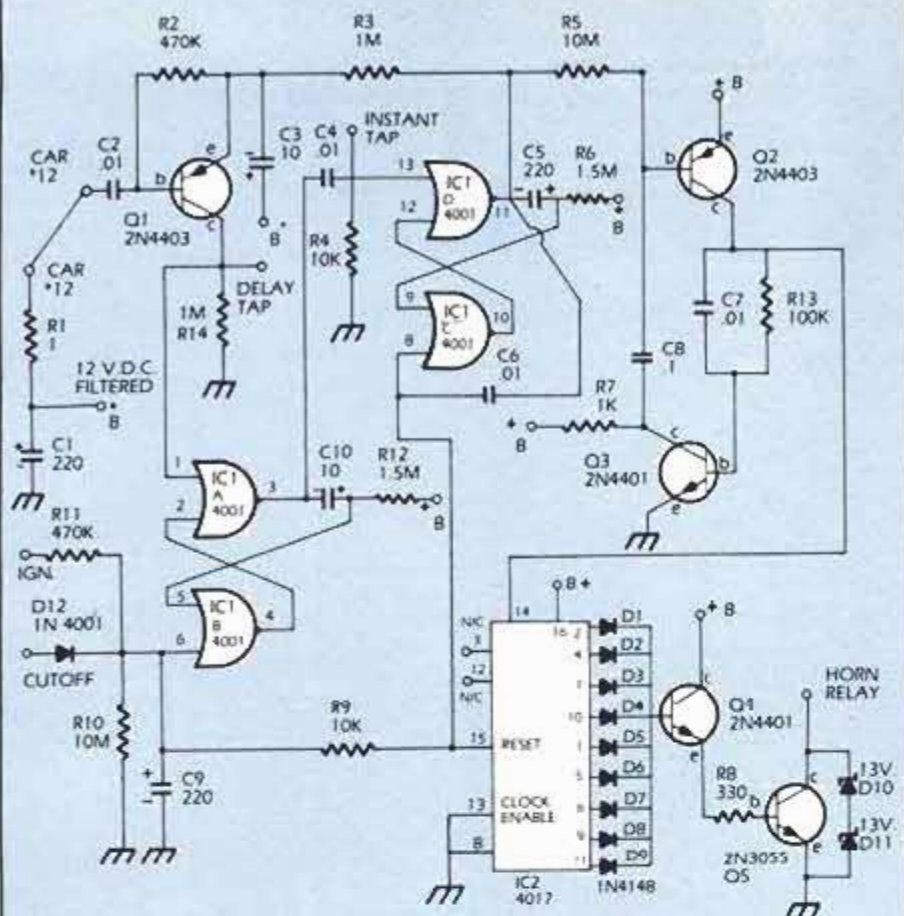
The slide fits the dado in the top without slop, but loose enough to slide easily. Notch the backstop for each size finger joint you want to make. A 3-in. strip of $\frac{3}{4}$ -in. plywood a little wider than the table works well. Cut a hardwood finger stop lock to joint-finger width and height by 3 in. long. Notch the backstop for a working cut and again for the finger. Glue the finger in the end cut, making sure that it is square.

Make box joints by raising the router bit so its cut equals the thickness of the stock. Clamp two sides of the box together offset by finger width after figuring it so you don't end up with half a finger or less at the end. Match finger width to joint width to avoid 1-in. fingers in a joint only 2 in. long.

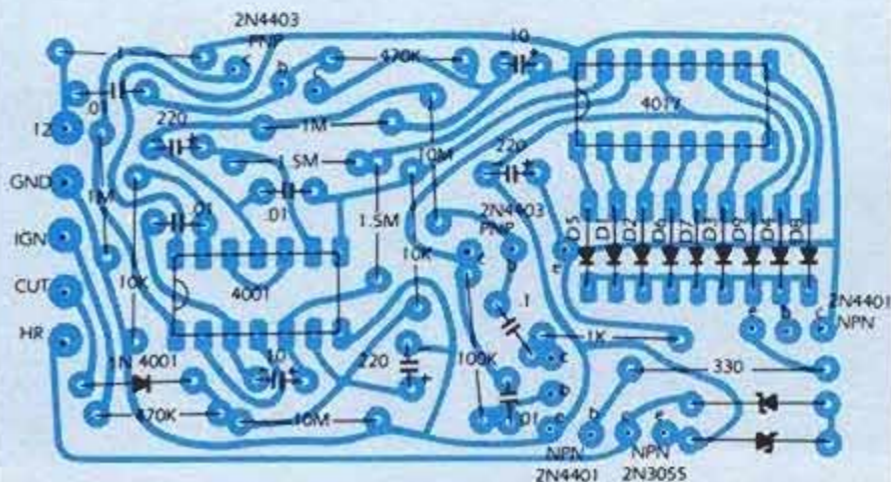
—Steven J. Anderson



PM'S NAME CALLER—SCHEMATIC DIAGRAM



Schematic (above) details how alarm hooks to the existing horn or other alarm device. The car switch (headlights, ignition) you want to act as disarmer should be connected to cutoff line. Connect outputs of any existing alarms to instant and delay tap lines. The foil pattern (left) will allow you to roll your own printed-circuit board, or you can order a kit.

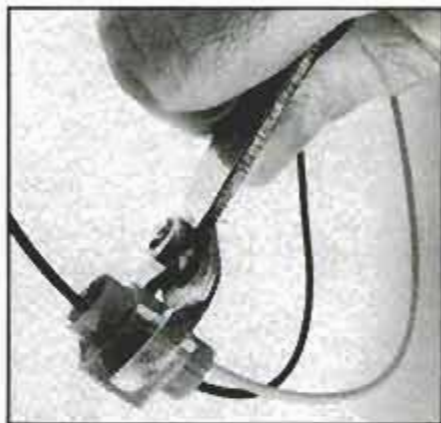


The component overlay locates all the parts on top of the printed-circuit board.

you can put them anywhere in the car. (If you want to bypass the entrance delay, connect to the instant tap shown on the schematic.)

It's desirable to be able to disarm the alarm without needing the ignition key—for example, when the car is in for service or at a parking garage. Use a hidden switch as a disarmer. Flipping the switch (off-on-off) disarms the Name Caller for about two minutes. Keeping the switch on disarms the unit indefinitely.

If you don't want to add a switch, you can use a "secret" dashboard control such as the headlights to disarm the



Crimp a solderless connector tight around an existing wire. Interior blade cuts insulation just enough to connect to wire.

Name Caller. Again, it would be highly unlikely that the thief would figure this out. Both variations (which you connect to the "cutoff" line shown on the schematic) are only one wiring change to the Name Caller.

Let's follow the path of action in the Name Caller circuitry once it detects a voltage spike. Transistor Q1 amplifies the spike, which starts the 12-second

(Please turn to page 157)

PARTS LIST—NAME CALLER

- C2, C4, C6, C7—01-mfd. capacitor
- C8—1-mfd. capacitor
- C3, C10—10-mfd. electrolytic capacitor
- C1, C5, C9—220-mfd. electrolytic capacitor
- D10, D11—13-v. zener diode
- D12—1N4001 silicon diode
- D1-D9—1N4148 silicon diode (number needed is determined by the code selected)
- IC1—CMOS 4001 quad NOR gate integrated circuit
- IC2—CMOS 4017 decade counter integrated circuit
- Q1, Q2—PNP 2N4403 silicon transistor
- Q3, Q4—NPN 2N4401 silicon transistor
- Q5—NPN 2N3055 silicon transistor
- All resistors are 1/4 w. carbon, 10% tolerance
- R1—1- Ω resistor
- R8—330- Ω resistor
- R7—1,000- Ω (1K) resistor
- R4, R9—10,000- Ω (10K) resistor
- R13—100,000- Ω (100K) resistor
- R2, R11—470,000- Ω (470K) resistor
- R3, R14—1,000,000- Ω (1M) resistor
- R6, R12—1,500,000- Ω (1.5M) resistor
- R5, R10—10,000,000- Ω (10M) resistor
- Misc.—Drilled, etched and labeled printed-circuit board; four snap-on, self-splicing terminals; case; wire; solder.
- Note: A kit, with all parts included, is available for \$29.95, or completely assembled for \$34.95. PC board without parts is \$3.95 from Circuit Craft Inc., 10 Idell Rd., Valley Stream, N.Y. 11580. Prices include postage and handling.

How To Keep Your Diesel Running This Winter

The problem is cold. The answer is heat.
A Rabbit Diesel owner tells us what worked for him.

BY ANGUS LAIDLAW



Fuel-line heater uses engine coolant to warm fuel to the point where it will not clog filters or injectors. Extra hose and Y-connectors are needed for installation.

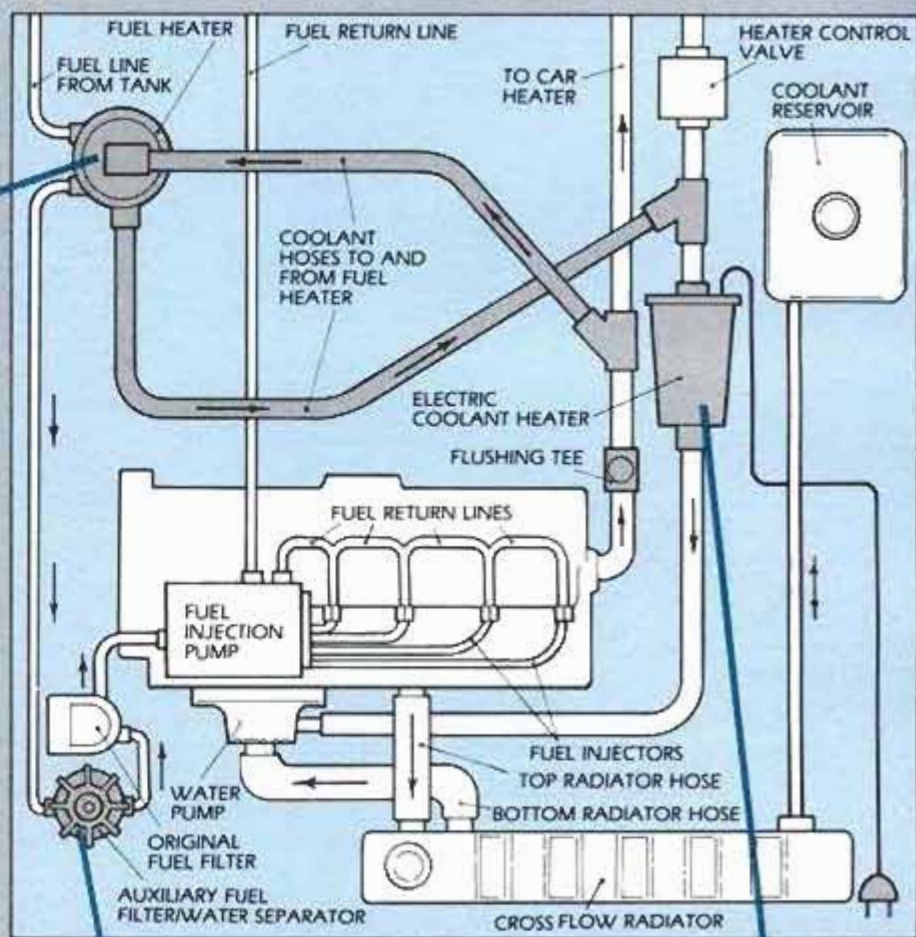
Diesel automobiles have the reputation of being hard or impossible to start in really cold weather. They can also be hard to keep going. One owner tells of taking his Mercedes on a skiing trip and keeping the engine running for 54 hours straight because the local service station told him he'd never get it started until spring if he shut it off.

Such problems need not affect your diesel if you use the correct fuel—fuel that's been treated to flow in the cold—and give it a little extra help so it can start and run in the cold. Help takes the form of heat.

No. 2 diesel fuel should flow freely down to 3° F. At lower temperatures, it will cloud or form solid grains of wax that can clog filters and keep the car from running. A partly clogged filter may let the engine start, but not let enough fuel through for it to run faster than an idle. At temperatures well below zero, No. 2 diesel fuel can solidify like Jell-O.

Sometimes, a diesel car will run for a mile or so and then stall. Waiting a few

(Please turn to page 80)



Fuel filter/water separator fits next to stock filter. In schematic above, the add-on parts are shaded, the VW parts are in white.



Electric coolant heater is spliced into car's heater return hose. Plugged in overnight, it warms coolant and engine block.



THE RADAR CONNECTION

You've probably noticed that every time the magazines test radar detectors, ESCORT comes out on top. Its performance has become something of a legend, because we believed the only way we could have the best detector possible was to make it ourselves.

Credentials

Our success is a matter of record. In ESCORT's first magazine test, *Car and Driver* rated it highest by a wide margin. Recently, the same magazine tested a new ESCORT with ST/O/P™ (Statistical Operations Processor) and concluded that it "is clearly the leader in the field in value, customer service, and performance..."

STOP Digital Processor Circuitry

We're particularly proud of that quote because it credits ESCORT with *more* than just industry-leading performance. Just as we designed ESCORT to be the best detector possible, we knew there had to be a way to take better care of customers than the usual retail distribution system. That's why we have no dealers. From the beginning, we've sold all ESCORT's direct from the factory.

No Middlemen

You see, we know how difficult it is to buy a camera or stereo component, or any precision gear. Every store has different prices so you feel obligated to shop around. Then you have to wait for a salesman. He may not know much about the products or may try to get you to choose another brand. And the week after you buy, they go on sale.

We don't want any middlemen speaking for us. The ESCORT is a precision microwave receiver made to warn you of police radar. On that sort of purchase, we think you'd prefer to deal with experts. When you dial our toll-free number, you're talking to the factory: **One Microwave Plaza**. All of our engineering, manufacturing, sales and service happen under this one roof. The buck stops here, you might say. And you always know where to find us.

No Respect

If you've ever taken any high-tech equipment back for service, you may have noticed another problem with retail distribution. Once in a great while, the dealer can fix the equipment. But sometimes they fix it wrong, or say they can't get parts and try to sell you a replacement.

Or you find they "don't carry that brand anymore." Then you're stuck with the task of tracking down another dealer, or trying to deal direct with a factory that isn't set up to serve consumers. And if the manufacturer happens to be in another country, well, you get the picture.



THE RADAR DEFENSE KIT

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At Cincinnati Microwave, we treat customer service differently, and for a very good reason. We don't have a network of hungry dealers, we've got something far more persuasive: *Hundreds of thousands* of satisfied owners. In fact, the chances are pretty good someone you know owns an ESCORT. We try our best to please our customers after the sale, because they are the biggest source of new sales. It's that simple.

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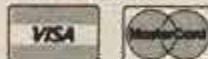
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KEEP YOUR DIESEL RUNNING

(Continued from page 78)

minutes with the motor off allows engine heat to warm the filter enough so fuel can flow again. It may start and run for another mile or two before you have to repeat the procedure.

In cold climates where fuel suppliers understand the problem, they sell fuel that does not gel. By blending No. 2 with lighter No. 1 fuel, they can keep your diesel going at subzero temperatures with only a small penalty in fuel economy. Or, you can blend your own cold-weather fuel by using flow-improver additives, adding white kerosene, or even unleaded gasoline, although the latter can damage the engine and void your warranty. You can buy flow improvers from auto stores, diesel car dealers and some service stations catering to diesel drivers. Follow the directions on the can. Blending kerosene with diesel fuel also works, but it can create legal problems if the kerosene is not taxed as a motor fuel. White gasoline works, too, and was recommended by owner's manuals at one time. However, it can cause engine damage if overdone and is no longer recommended.

Add-on heaters for your car

The trouble with all these homebrewed fuel blends is that by the time you know you need one, it's usually too late. Once the fuel in your tank has gelled, the only practical way to get it flowing again is to warm up the car by getting it into a heated garage and letting it thaw out. Add-on heaters are a more practical answer for many car owners. Heat the engine for faster turning and easier starting. Heat the fuel to keep it from clogging the filter. Heat the battery to increase the power available to turn the starter.

Engine heaters are electric coils that warm the coolant, much like an in-the-coffee-cup water heater that's plugged into a 115-v. outlet. There are two common types: a core plug block heater or a tank heater inserted in a coolant hose.

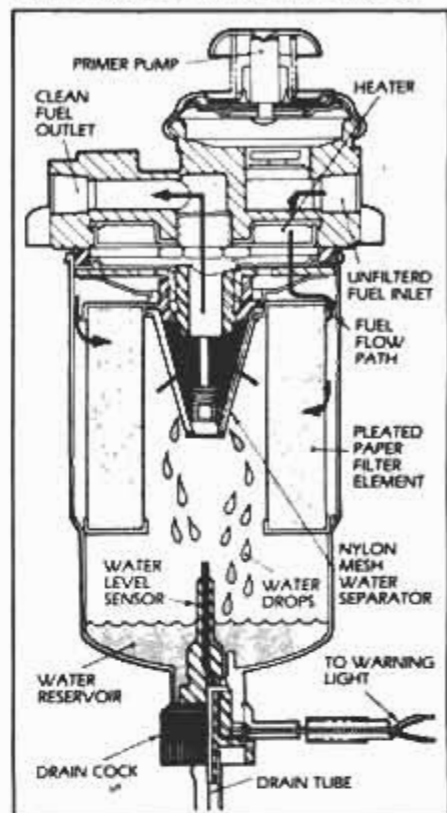
A core plug heater is more difficult to install, but it can be ordered as optional equipment on some new diesel cars. On most engines, you cannot easily reach the core plug to remove it and install the heater, and you must drain the coolant to do so.

Putting in a tank-type heater is much easier. You can install one on most cars without draining the coolant. It goes in the hose that returns coolant from the car heater to the engine block. Most tank-type heaters should be installed so they are level and as near the engine block fitting as possible.

Installation is a matter of cutting a 6- to 8-in. section from the heater return

hose, plugging in the tank heater and installing hose clamps. Make certain the coolant flow direction is correct—the heater should pump warmed coolant to the engine block, not away from it. Route the heater's electric cord so it won't get chewed up by the fan or other moving parts, and bring it out through the grille so it can be plugged in without opening the hood. Use a heavy-duty, three-wire extension cord and keep it as short as possible.

ONE CARMAKER'S ANSWER



For 1984, Ford diesels use a Fram-designed unit that combines a 1.5-micron filter, heater and water separator. When the water reaches the top of the sensor, a warning light goes on. The car owner opens the drain cock and operates the hand primer pump to force out the water without admitting air into the fuel system.

Plugged in for several hours, an engine coolant heater should make most cars easy to start in the morning. It should also enable the heater to supply instant heat.

Nearly all fuel heaters work by running hot engine coolant through a jacket around a coil of fuel line. Engine heat from the coolant warms the fuel. If you also have a coolant heater, it will keep the fuel above the cloud point so the engine can start and run in the cold.

Fuel heaters can be installed wherever convenient. However, the ideal place is in the fuel line ahead of the fuel filter, but as close to it as possible. Keep the line to the filter short to reduce heat loss. Excess warmed fuel is returned to the tank when the engine is running,

and this can help reduce gelling in the main supply.

Installing a fuel heater is a plumbing job that's not difficult to do yourself, but it does require some thought. The best way to plan your installation is to make a flow diagram of your cooling system. You want to connect the heater so it won't cut off the flow of coolant to the car's heater.

Most fuel heaters have a thermostat to control coolant flow and keep the fuel from becoming overheated during the summer. You want to install the fuel heater in parallel with the car heater so that either system can be shut off without impeding the flow of coolant to the other.

On my VW Rabbit Diesel, I used two 1/2-in. i.d. Y-fittings (originally designed to go in an Oldsmobile air-conditioning system) to splice the fuel heater into the cooling system. These were available in a local auto parts shop along with hose clamps and extra heater hose.

When connecting coolant lines to the electric engine heater and to the fuel heater, sharp bends must sometimes be made. Since you will be cobbling up a system to fit your car, you may need a special bent hose or two. You can often make short ones by cutting down hoses designed for some other car's cooling system.

Longer hoses may have to be shaped from regular heater hose. If the hose flattens on a sharp bend, put one or more hose clamps at the bend to keep it round and open.

Another problem arises when one of the new hoses must pass close to a sharp edge where vibration could cause it to chafe and eventually wear through. The cure for this is to split a short section of heater hose and fit it over the coolant line to take the chafing. Examine all these hoses for signs of wear several times a year and add or replace split sections as required.

Install a water separator

The next-to-last step in cold-proofing your diesel is to install a water separator in addition to the one built into the original fuel filter. This goes in the fuel line between the fuel heater and the original fuel filter. The Scavenger III water separator that I chose has a dash-mounted warning light to tell you if there's water in the fuel. Flipping a switch drains trapped water from the separator housing.

One problem that can develop on diesels that have fuel transfer pumps built into the injection pump is vacuum leaks in the fuel lines. Every element you add to the line increases the number of fittings and connections. A slight leak in

any of them will cause the fuel transfer pump to suck air, resulting in hard starting or no starting. The cure is to seal all the fittings with thread locking compound such as Loctite's Lock N'Seal.

If the combination of a coolant heater, fuel heater and water-separator filter save you the price of one towing and servicing, they will have paid for themselves. And, of course, the aggravation of installation is far less than that of being unable to use the car in the cold.

The ultimate step in cold-proofing your diesel is a battery warmer. Lead/acid storage batteries lose more than half their cranking power at 0° F. compared to what's available at 60° F. Plug-in electric battery quilts or heating pads that fit under the battery can help start the car.

Many auto parts houses and diesel service shops sell fuel heaters, filter/water-separators, engine coolant heaters and battery warming blankets. CR Industries Inc., 900 North State St., Elgin, Ill. 60120, supplied the Scavenger III filter/water-separator and the Heat Star fuel heater shown. Tank-type coolant heaters are available from J.C. Whitney & Co., 1919 Archer Ave., Chicago, Ill. 60616, as well as local suppliers in cold parts of the country. **PM**

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OUR FAST NEW ARMADA



By 1990 our Navy will be able to assemble a combat-ready task force and carry it to any trouble spot within days.

BY BOB SHERMAN

Few listened in the 1960s and '70s when America's admiralty warned that our Navy was weak and in need of more ships with more muscle. But the message has grown loud and clear in the past years as the Navy has been ordered to respond to a series of crises in Latin America and the Middle East.

Initially, calls for quick delivery of naval strength to Latin America were answered slowly. But the pace was noticeably faster by the time U.S. Marines answered the call to action in Lebanon last year. An armada built around the *Nimitz*-class supercarrier USS *Eisenhower* rushed in with our peacekeeping forces and stood off the coast of Lebanon to ferry supplies and fresh troops to the combat area.

We were watching the first vestiges of a new kind of rapid-response task



Supercarrier *Nimitz* and the guided-missile cruiser *California*, seen during Mediterranean exercise (top), will be joined by guided-missile destroyers (inset) to form special new fleet.

force that will be completely organized by the 1990s. Originally dubbed Rapid Deployment Force, the combat delivery group this year changed its name to the Central Command. Whatever you call it, the new armada received high marks in a baptism of fire last summer.

Marines in the peacekeeping force in Lebanon had been under artillery fire for several days, but were ordered to keep their weapons holstered. Two of the 1,200 leathernecks stationed on the outskirts of Beirut had been killed by Druse artillery, and six more were wounded. When the Pentagon finally

gave the go-ahead for the Americans to defend themselves, the frigate USS *Bowen* unleashed a barrage from its 5-inch, 54-cal. guns and the Druse artillery was silenced. The test had begun.

Over the next several days the battle group flew warning overflights around Beirut with Harrier jets and F-14 Tomcats, while A-7E Corsair and A-6E Intruder bombers stood poised on the deck of the *Eisenhower*. As the growing force appeared off the Lebanese coast, diplomats found it easier to bring off a cease-fire. The tensions and sporadic fighting continued, but the U.S. Marine

By 1990s, high-speed armada will include surface-skimming landers (foreground) and (left to right) tank landers, Nimitz-class carriers, Harrier carriers and Aegis cruisers. Aircraft (from left) include spy planes, advanced fighters and Harrier jump jets to support Marines.



positions were more secure than they had been since the peacekeeping project had begun.

When the Central Command is completed just a little more than five years from now, it will be able to answer calls like the one in Lebanon in less than a week. Headquartered at MacDill Air Force Base in Florida, the Central Command will ultimately be split into several two-, three- and four-ship units scattered around the Atlantic, Mediterranean and Indian oceans. Built around the *Nimitz*-class nuclear carrier, the command will include conventional frigates, battleships, cruisers, landing craft and other vessels. But new speed and strength will come from ships like the surface-skimming landing craft nicknamed "JEFF-B," and the *Aegis*-class cruiser, both now in the experimental stages.

The command's mission is simple: Clear the sea lanes to a troubled area. Establish a presence off the coast. Move into one or more trouble spots and provide safe airfields and seaports for landing troops and supplies. Stand by to provide backup artillery and aircraft if the troops engage an enemy. And be on hand for the long term to supply additional troops as they are called in for a protracted struggle.

When completed, the Central Command will be able to deliver a carrier force with four to six escort vessels; a "surface action group" of cruisers, destroyers and about 13,000 men; and a full range of surveillance and engineering equipment. Size, speed and stamina start with the *Eisenhower*, a 1,095-foot-long floating city powered by a pair of nuclear reactors that can bring her up to 30 knots. The *Nimitz*-class carrier is fueled for 13 years of normal service. There are four ships in this class today, but if the Reagan administration gets its wish, there will be 15 by the next decade.

The supercarrier supports an air wing of 95 planes and can house more than 6,000 men. It has 4½ acres of flight deck, four aircraft elevators and a hefty 93,405-ton displacement. In addition to the helicopters, fighters and carrier-based bombers traditionally hauled by this class of vessel, the Central Command version will also be able to carry huge, high-flying recon aircraft. That was proved in a secret test conducted in the 1960s when the Navy let a U-2 spy plane—with its 103-foot wingspan—land on a much smaller carrier.

Backing up the big carrier by the end of this dec-



ade will be the *Aegis*-class, or *Ticonderoga*-class, guided-missile cruiser. Armed with Standard (SM-2) missiles and a pair of triple torpedo tubes, the ship generated considerable controversy in early tests. Critics charge that its heavy armament makes it top-heavy and impossible to turn quickly in a combat situation. So the vessel, still in the test stages, is undergoing a weight-reduction program, mostly by replacing heavy steel parts with lighter metals and composites.

The founding vessel of the *Aegis* family, the *Ticonderoga*, was commissioned last January. The 563-foot, gas-turbine ship cruises at more than 30 knots. It's been described by Vice Adm. Robert Walters—its staunchest defender—as “the most advanced anti-air warfare system in the world.”

The all-weather, quick-reaction air defense system built around the SPY-1A phased array radar can continue operating while damaged and burning. In a phased-array radar system, hundreds of computer-controlled detectors fire intermittent signals and receive the reflections that help spot enemy vessels as if there were dozens of radar stations on the ship.

Current plans call for the construction of 15 more

Aegis ships by the turn of the century. The armaments undoubtedly will evolve as new ships are built, but the vessel is lethal even with its conventional 5-inch, 54-cal. MK-45 guns that back up the surface-to-air Standard missile. A pair of MK-15 automatic gun systems are designed to knock out sea-skimming cruise missiles that fly like the Exocet, which sank the HMS *Sheffield* during the 1982 Falklands war. The MK-15s use fire-control guidance systems that measure the location of the incoming missile and correct the aim of the MK-15s.

When the *Aegis* first went to the drawing boards, it was slated to displace 9,200 tons. The added armament raised that to 10,200 tons. And the Navy is working that weight back down toward 9,000.

The *Ticonderoga* is closely related to another controversial ship in the Central Command's future: the as-yet unnamed DDG-51. This guided-missile destroyer was planned to be a less costly and slightly smaller version of the *Aegis*-class ships. Smaller was the easy part. A classified congressional audit last year predicted the DDG-51 will cost half a billion dollars more than the \$1.2 billion *Ticonderoga*.

While the *Aegis*-class ship was built to stand off-



The *Ticonderoga*, the prototype *Aegis*-class destroyer, fires sophisticated Standard guided missile. Work is being done to trim some of weight from the fast ship's topside.

shore and knock air-to-sea missiles out of the sky, the DDG-51 is seen as a supersurvivable vessel that can get in close to the beach and give Marines strong artillery and missile support. The 466-foot DDG-51s will have steel hulls and steel-plated superstructure.

Getting those troops ashore is the job of standard landing vessels today. But by the end of the decade, the JEFF-B surface skimmers will be launched from huge vessels that can support over 1,800 men, or from smaller and faster landing-ship docks that can carry just under 1,000 men.

The bigger vessel, the LHD-1 Amphibious Assault Ship, will be 840 feet long with a troop capacity of 1,873 and cargo space for 42 CH-46 Marine helicopters. It will be convertible into a Harrier aircraft carrier, if necessary. The smaller vessel, the 609-foot LSD-41, is to be a landing dock that carries about 1,000 men. The LSD-41 is expected to carry missiles and torpedoes that let it get close to shore and help protect JEFF-B surface skimmers as they debark and head for the beach.

The JEFF-B vessels can hit up to 40 knots in rough surf with troops, equipment or both aboard. They can carry up to 60 tons as far as 200 miles. Former Marine Commandant Gen. Robert H. Barrow says the vessel provides "a quantum advance in amphibious capability. . . . The craft provides us with a unique tactical opportunity for surprise landings from over the horizon on widely separated beaches." Six craft already have been contracted and an experimental model is at sea now. The Marines hope to have 100 of the high-powered landers by the year 2000.

Getting the troops and weapons to a combat zone quickly is just part of the Central Command's naval mandate. Supply for the long haul is also vital. In Vietnam, about 96 percent of America's supplies arrived by ship.

To prepare for the long term, the Navy has assigned an array of Indian Ocean-based vessels to the Central Command. Break-bulk cargo ships that can be converted to carry Harriers, tankers fully loaded with military supplies and roll-on, roll-off cargo vessels have been commissioned for the job.



The quick, sealift-type vessel in drawing above will be on standby in the Indian Ocean. It will be part of a fleet that will reduce the necessity for C-5A cargo aircraft.



Artist's conception shows a fleet of near-term "pre-positioning ships" loading cargo. The ships will also be capable of moving an entire brigade of Marines.



Days are numbered for the traditional landing-ship docks and landing boats seen here. In the new fleet, faster docks will be used to carry high-speed surface skimmers.



Photos of a secret 1960s test, recently declassified, show that a U-2 spy plane could land on a carrier deck. The new armada will be able to launch such planes, too.



Tank-landing vessel will carry an array of armored vehicles from Indian Ocean or European stations to any battle front. Vessels can travel up to 30 knots with cargo.



Surface-skimming lander JEFF-B is shown in artist's conception. The jet-powered landers will carry armor and troops up to 200 miles at speeds of better than 30 knots.

This fleet of 13 ships is called the "Near-Term Pre-positioning Force." In a crisis, it could supply a Marine amphibious force after the troops dig in. Just five ships can supply one brigade with 1,200 vehicles, 36 pieces of artillery, 100 amphibious vehicles and 53 tanks. Marines airlifted to back up the initial Central Command force could be kept supplied for 30 days by the pre-positioning force.

Why not airlift the initial force? The Marines estimate it would take 252 C-5 aircraft, 829 C-141s and 166 cargo 747s to deliver 30 days worth of supplies for an amphibious brigade. Assuming no major equipment breakdowns, the cargo planes would take 19 days to accomplish what the pre-positioning arm of the Central Command could do in about one week.

Some may consider the Navy's rebuilding program overly ambitious. The goal is to complete the Central Command as part of a 600-ship fleet by the 1990s. In testimony before the Senate Armed Services Committee, Adm. Walters estimated the Navy will spend almost \$93 billion over the next five years to update the total fleet. A cost-conscious Congress has been questioning the extent of the spending.

But no one is questioning the wisdom of creating the Central Command and its new concepts of speedy delivery and support. The ambitious program began slowly in the 1970s and gained full steam in the first two years of the Reagan administration. In the previous decade, the U.S. Navy declined from 1,000 ships to 468, and from 23 aircraft carriers to 13. The administration and the Joint Chiefs of Staff consider that to be an unacceptable level of readiness.

In his 1984 annual Defense Report, Defense Secretary Caspar W. Weinberger estimates the Pentagon will spend \$13.6 billion on the Central Command through 1988. But, he points out, it's a period of basic rebuilding which may well be followed by a longer period of spending smaller amounts for the simple upkeep of a superfleet. **FM**

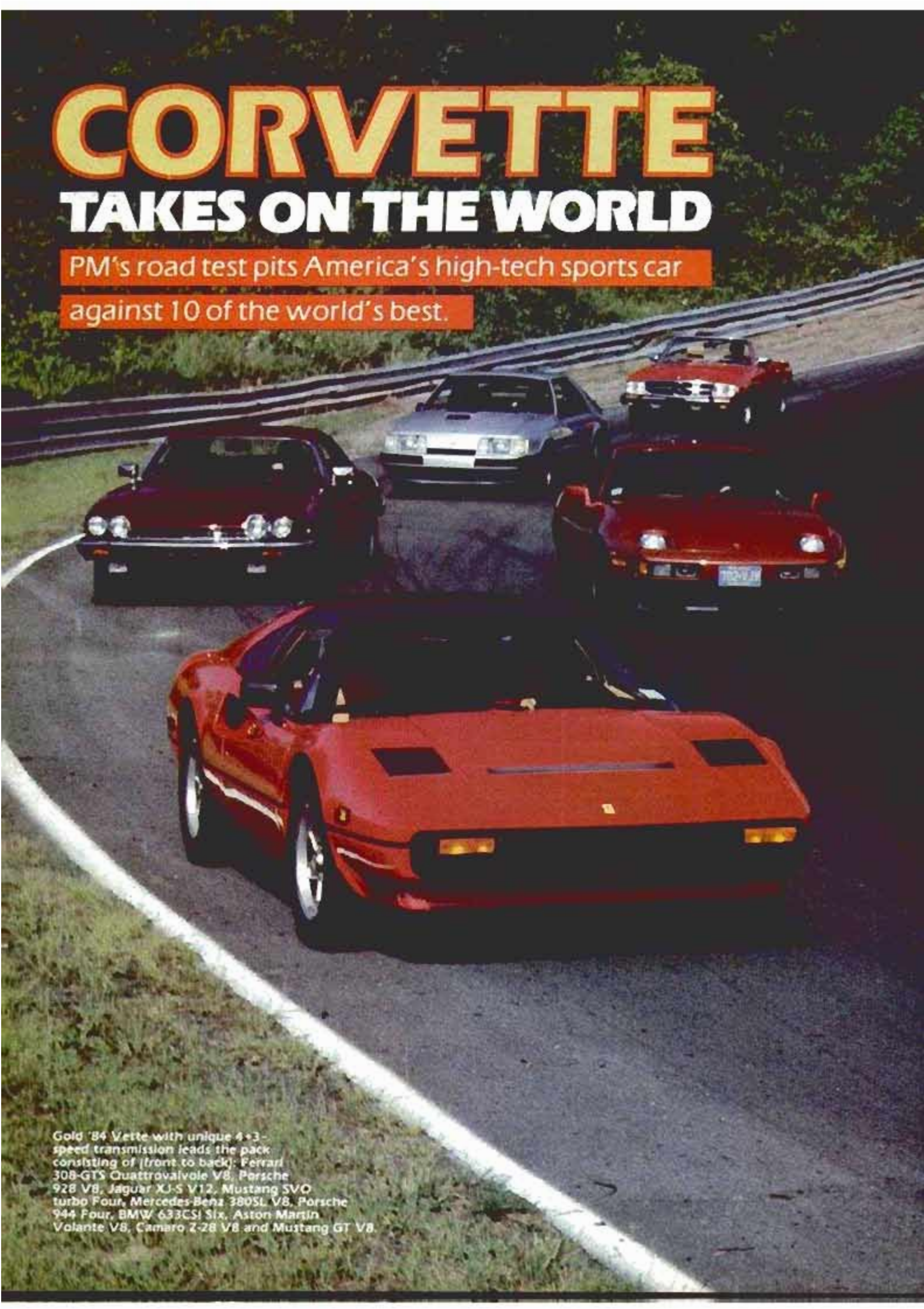


Marines will hit the beach in a variety of armor carried by the new armada. A platoon moves in (left) with a personnel carrier, while a tank (right) fires an experimental TOW missile. Troops will also be equipped with handheld missile-launching devices.

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against 10 of the world's best.



Gold '84 Verette with unique 4+3-speed transmission leads the pack consisting of (front to back): Ferrari 308-GTS Quattrovalvole V8, Porsche 928 V8, Jaguar XJ-S V12, Mustang SVO turbo Four, Mercedes-Benz 380SL V8, Porsche 944 Four, BMW 633CSi Six, Aston Martin Volante V8, Camaro Z-28 V8 and Mustang GT V8.



Chevrolet got us into this. Its advertising for the new Corvette carries the headline "The Best Production Sports Car In The World." Well, who could resist an invitation like that. We *had* to find out whether the Corvette really is The Best, or whether this cocky challenge is just an advertising copywriter's wishful thinking.

So we selected 10 other two-seaters, the Corvette's direct competitors, most of which are also considered by *their* respective designers to be "The Best Production Sports Car In The World." As a result, this is much more than a comparison of high-performance, expensive sports cars, although there's plenty of tire-squealing, smoky burnouts and hot laps. What we really

have here is a comparison of philosophies, of the way engineers in Detroit and Stuttgart and Modena define The Best.

Our first step was to assemble all 11 cars—an aggregate value of \$425,757.42, by the way, or an average of \$38,705 per car. Then we decamped to Lime Rock Park in Connecticut—1.53 miles of hills and corners that put a premium on good handling and acceleration, rather than top speed. A day at Lime Rock would establish, without a doubt, which of our contenders is really The Best at the track.

Our first test day was spent at the track, and on Day Two we ran the cars over an 11-mile loop in the countryside around Lime Rock. The loop included roads

CORVETTE



Braking test involves stopping in the shortest possible distance from 60 mph. Here, the big Jag locks up one front wheel and the driver turns wheels to correct skid.



Steamroller-sized Goodyear tires on the new Vette provide so much traction that it's almost impossible for you to spin the wheels, even during a drag-racing start.

Road work involved successive laps of an 11-mile loop that included a variety of road surfaces to test cars in everyday driving.

that were smooth and rough, straight and twisty.

At the track we ran each car through our standard road test procedure (see *Test Results* chart).

Our fuel economy figures were calculated over 170 miles of driving at normal speeds on country roads, plus a handful of full-throttle acceleration runs and 60-mph runs through the slalom and brake test. They do not include any high-speed test laps at Lime Rock.

What did we find out? Well, in racing, The Best is an absolute . . . the fastest lap is the best. But a passenger car is more complex. It has to function at speeds other than flat-out, in all sorts of weather, on all sorts of roads, carrying two or more people and some luggage in comfort and safety.

So The Best is not an absolute, it's a compromise. We ended up with two rankings . . . The Best at the track, and The Best as voted by our group of testers. And there's very little correspondence between them.

Chevrolet Corvette

The Corvette is "The Best Production Sports Car In The World" on a race track, no question about it. It was 1½ seconds faster around Lime Rock than the Porsche 928S, which is a significant difference on a track this short. In the slalom, however, both the Ferrari 308

Produced by the PM Auto Dept.
Text: Rich Taylor
Photos: Bill Stahl



TEST RESULTS

CARS	OVERALL RANKING	1/4-MILE (sec. @ mph)	BRAKING 60-0 mph (ft.)	SLALOM (mph)	'BIG BEND' TIME (sec.)	LAP TIME (min.)	FUEL ECONOMY PM Test/EPA City
Porsche 928	1	15.37 @ 90.0	125	58.10	8.08	1:09.0	12.5/17 mpg
Porsche 944	2	16.41 @ 84.5	139	55.71	8.77	1:12.2	16.9/22 mpg
BMW 633CSI	3	16.37 @ 84.0	170	56.71	8.72	1:14.7	15.7/19 mpg
Ferrari 308-GTS	4	15.40 @ 91.4	166	59.76	8.12	1:10.4	11.7/11 mpg
Jaguar XJ-S HE	5	15.93 @ 85.0	154	57.95	8.20	1:11.1	11.1/14 mpg
Camaro Z-28	6	15.81 @ 91.0	158	59.23	8.02	1:11.3	10.4/16 mpg
Corvette	7	15.10 @ 91.5	155	59.46	7.67	1:07.5	11.8/16 mpg
Mercedes-Benz 380SL	8	17.64 @ 77.2	126	55.71	8.80	1:14.9	15.0/18 mpg
Mustang SVO	9	15.80 @ 90.1	170	62.41	8.04	1:09.1	11.2/17 mpg
Aston Martin Volante	10	17.23 @ 84.5	146	53.29	8.94	1:17.4	9.5/10 mpg
Mustang GT	11	15.93 @ 90.1	140	56.71	8.58	1:13.5	14.4/17 mpg

The braking column lists the distance needed to stop from 60 mph without skidding. The slalom column shows the speed achieved while weaving through seven cones placed 100 ft. apart; the higher the speed, the better the handling. Because there is no skidpad at Lime Rock, we timed each car

through Big Bend—a 180° turn at the end of the main straight. Lower times indicate better steady-state cornering (as opposed to the transitional left-right handling in the slalom). Overall ranking was determined by averaging subjective ratings of cars on track and street by PM testers.

and Mustang SVO were able to beat it, and the Corvette was a disappointing seventh in braking.

We had the first Corvette in the country with the Doug Nash "seven-speed" manual transmission. This is nothing more than the old Borg-Warner four-speed with an electric overdrive on the top three gears. At the track, we found it fastest with the overdrive turned off. On the street, most of us used it as a straight five-speed. The most frequently asked question was: "Why didn't Chevrolet just use the excellent five-

speed that's already in the Camaro?"

The Corvette uses the same small-block V8 first put into the '55 Chevy. Even with throttle body fuel injection, the 350-cu.-in. version in the Vette runs out of steam quickly. It's yellow-lined at 4,300 rpm, and the torque peak is at 2,800 rpm. By the standards of Corvettes from the '60s, this is a low-revving, "cooking" engine.

Even Chevrolet's engineers admit that much of the Corvette's phenomenal cornering power is due to the 255/50VR-Eagle tires that Goodyear de-

signed just for this car. Our professional racers guessed that the Corvette's 1.5-second margin over the Porsche 928 was due primarily to tires.

It's impossible to spin the tires even with a drag-strip start . . . the Corvette simply hooks up and goes. The same in hard cornering. There's no slip, no sway, not even any tire squeal. You just keep cornering faster than you ever imagined in a passenger car.

The Corvette won the performance portion of our test, but when all the street driving ballots were added up, it ranked seventh out of eleven.

As Sam Posey said, "The Corvette (Please turn to page 122)



Porsche's futuristic 928 was our testers' favorite on road and track. Of course, it costs almost twice as much as the Vette.



Slalom tests transient handling as car zig-zags through a 700-foot row of pylons. BMW threaded through cones at 56 mph.



Track test was the most complex, combining acceleration, braking, handling and top speed on each lap. Here, the Ferrari blurs the scenery as it blasts down a straight.



Skip Barber (left) runs a racing school at Lime Rock. Sam Posey started racing there before he was old enough for a license. The track is second nature to both men.



ComBow sling by NonFireArms doubles tubing over rollers and shoots arrows or balls. \$45.



Repeater by Marksman feeds shot from reservoir in the handle if you don't fumble. \$5.

NOW: SUPER ACCURATE **SLINGSHOTS**

Slingshot renaissance opens up a new world for serious competition shooters and hunters.

BY ANGUS LAIDLAW; Photographs by George Ancona



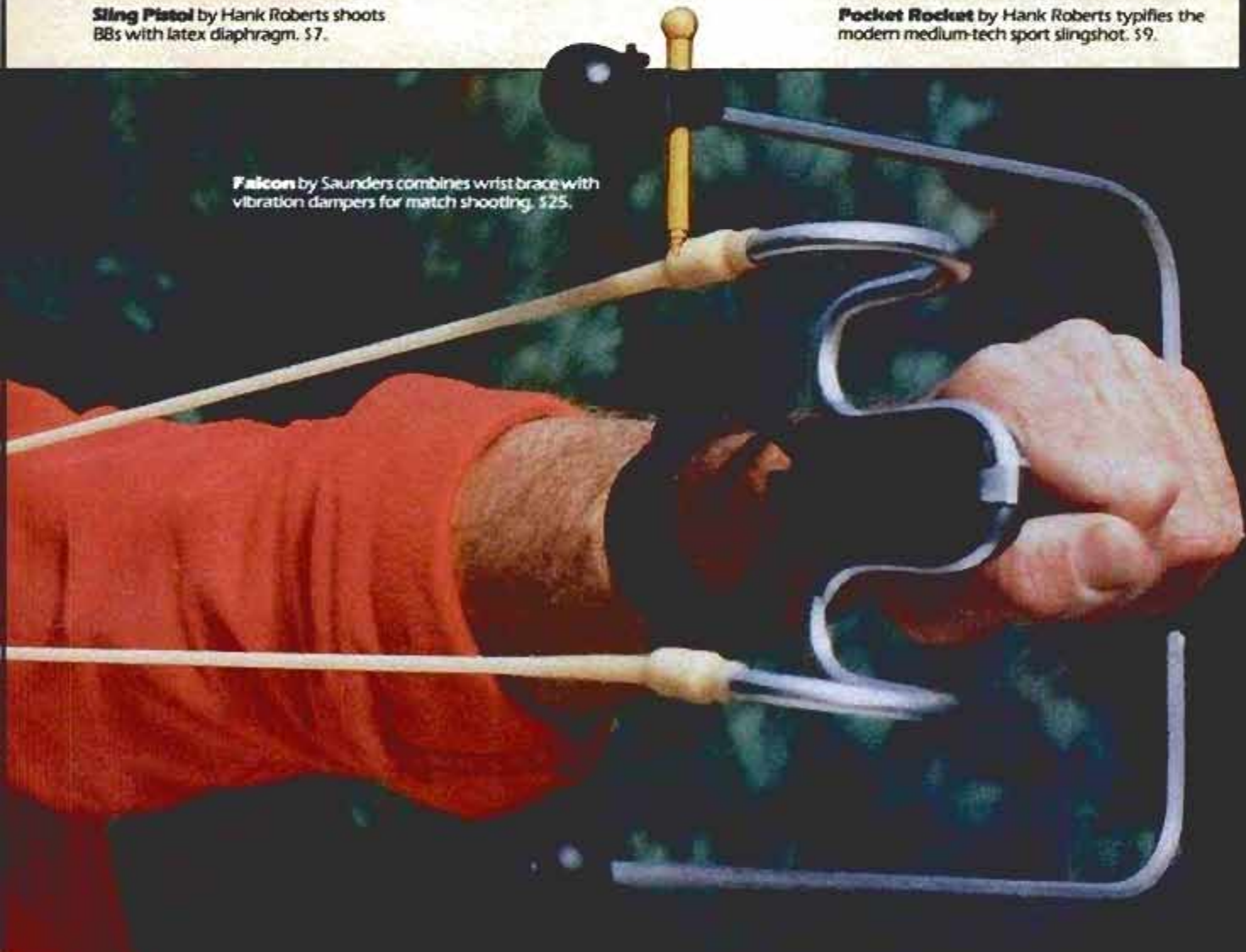
Sling Pistol by Hank Roberts shoots BBs with latex diaphragm. \$7.



Maxima folder by Marksman extends the fork for a longer draw to increase power. \$10.



Pocket Rocket by Hank Roberts typifies the modern medium-tech sport slingshot. \$9.



Falcon by Saunders combines wrist brace with vibration dampers for match shooting. \$25.

Catapultry—to give the shooting of slingshots its upscale name—has burgeoned quietly in the shadow of the compound bow, the crossbow and black powder shooting sports. Still struggling to overcome a bad-boy image fostered by generations of kids, serious catapult shooters have been holding national and international matches as well as local competitions. Big game hunters also find effective uses for slingshots as auxiliary equipment.

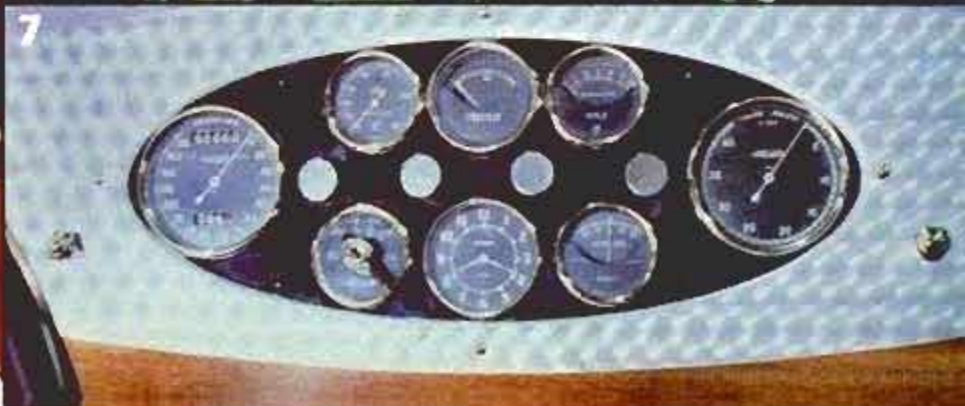
Although slingshot patents taken out since the 1860s make a stack nearly an inch thick, it's only in the last 30-odd years that the once simple wooden-crotch slingshot has received the full attention of serious engineers working with the latest materials.

The results of their efforts make the applefork with bands cut from an old inner tube, like the one hanging out of cartoon-character Dennis the Menace's hip pocket, look like an antique. Now we have designs using flat latex driving bands, surgical tubing, shaped molded tapered

(Please turn to page 152)

DASHBOARDS

FROM DIAL TO DIGITAL



Over the years, instrument panels have gone from Spartan to overload.

BY MICHAEL LAMM
West Coast Editor

In horse-and-buggy days, the dashboard protected the carriage driver from road splash. Or worse. Along came the motorcar at the turn of the century, and among the holdovers from horsedrawn days was the dashboard.

People who design today's auto interiors don't like to hear you call it a *dashboard*, and rightly so. When the Curved Dash Olds became obsolete, so did the concept of the dashboard for automobiles because, as the engine moved from underneath the seat to the front of the car, the dashboard in its ances-

(Please turn to page 150)

- 1** Computer-driven, liquid-crystal display from 1984 Corvette contrasts sharply with earlier instruments.
- 2** Brooklyn's first and finest sports car, the 24-hp 1906 BLM runabout, had only a fuel-pressure manometer.
- 3** And the driver of this 1910 Hudson relied strictly on his ears and eyes, because dashboard had no gauges!
- 4** Warner accessory speedometer and fuel-pressure gauge graced the brass-trimmed wooden instrument panel of a 1913 Mercer.
- 5** While aftermarket gauges for Model T abounded, most '23 Fords came with ammeter only. The gas "gauge" was nothing more than a stick.
- 6** Flush-fitting, built-in gauges began to appear in more expensive cars of '20s, as in this '26 Jordan Playboy.
- 7** By 1930, most cars had full instrumentation. Ambitious fwd 1930 Bucciall had a neat centered gauge cluster.
- 8** Dials grew larger during '30s, and designers copied aircraft motifs, as with handsome 1936 Cord panel.
- 9** Plastic embellishments of the early '40s often split or warped, but not these massive pieces on 1940 Nash.
- 10** First Corvette of 1953 lent its fan-shaped dial pattern to '55 Chevy.
- 11** Lincoln's new-for-1960 pod put four large, visored gauges near eye level for easy viewing, with controls and radio handy to driver, passenger.
- 12** 1961 Buick speedo appeared in mirror, which driver tilted to suit view. Moving red marker showed speed.
- 13** To heighten personal appeal, the 1966 Thunderbird surrounded both the driver and passenger in cozy wraparound compartment.

Photos taken at Harrah's Automobile Collection, Reno, Nev., and Bob Bowen Car Collection, Lodi, Calif.



LOOK WHAT'S HAPPENING TO ULTRALIGHTS

Now they're more like real airplanes than ever and—believe it or not—you still don't need a license to fly one.

BY SHELDON M. GALLAGER; Photographs by Howard Levy

Yes, it's an ultralight—a 1/4-scale replica of the famous WWI Curtiss JN-4 Jenny trainer. It weighs 253.1 pounds, does 62 mph, sells as a complete kit with 35-hp engine for \$6,500. Rear cockpit is dummy to comply with FAA's single-seat rule for unlicensed operation.





It's been only a little more than a year since the FAA made its historic pronouncement that ultralight aircraft with a maximum weight of 254 pounds and a maximum speed of 63 mph would be considered nonairplanes—a surprisingly benevolent gesture that exempts

such craft from N-number registration and pilot licensing. What's happened in the brief interval since then is fascinating, but may not be exactly what the FAA had in mind.

Take, for instance, the Curtiss JN-4 Jenny shown at left. A remarkable 3/4-scale replica of the famous World War I Allied trainer, it just sneaks in under the ultralight parameters at 253.1 pounds and 62 mph—and can thus be flown without a license—but a “nonairplane” it hardly is. With a wingspan of 28 1/2 feet, it can carry pilots weighing up to 225 pounds, climb at 800 feet per minute and reach a service ceiling of more than 20,000 feet. That's a lot of airplane for something that isn't one.

The Jenny, in fact, is just one of a whole new breed of bold and imaginative ultralight designs that have evolved from breezy little wire-braced kites into what, for all practical purposes, are true airplanes that just happen to be slow and light enough to escape FAA regulation. Not only do they look and fly like real planes, but they've reached a level of sophistication undreamed of when John Moody first

1 Sporting twin tall booms and a bullet-shaped cockpit pod, sleek-looking Sadler Vampire shows just how far ultralights have come since the wire-and-fabric flimsies of only a few years ago. Wings fold for trawling and incorporate full-span flaperons that serve as both flaps and ailerons. The price with 20-hp engine is \$7,950. Future options will include full bubble canopy, disc brakes and even retractable gear.

2 Aerotique Parasol is patterned after the nostalgic high-wing monoplanes of the early '30s. It can be built from plans (\$75) for about \$2,500, including 28-hp mill. Complete kits will be available later.

3 A classic J-3 Piper Cub? Not quite, but close enough to fool the eye. It's the Fisher Koala, a 250-pound, 60-mph, scaled-down look-alike that's kit-priced at \$4,750 with 40-hp engine.

4 Like the historic Jenny above, the Hovey Delta Hawk is another trim little biplane from a bygone era. The 40-hp craft is marketed in three ways: plans only for \$80, plans plus materials kits, or fully assembled for \$9,250.

5 One of the most sophisticated new ultralights is the NAC Dream, a Cessna-like tri-gear cabin plane that boasts such advanced features as leading-edge wing slots for improved stall control—a safeguard for unlicensed neophytes—and spoilers for glide-path control in addition to ailerons. It will be sold ready-to-fly with 35-hp engine at a target price of approximately \$7,200.



ULTRALIGHTS

stuck a small engine on an Easy Riser hang glider a decade ago, starting a whole madcap movement.

Genuine three-axis control, with separate rudder, elevator and ailerons—once thought silly and unnecessary by some—is now standard on virtually all new models. Some even incorporate such advanced features as flaps, spoilers, disc brakes, retractable landing gear and steerable nose or tail wheels. And all do one thing that real airplanes can't: They come apart—often in ingeniously tricky ways—for easy transport and storage.

Intriguing new shapes

Until recently, ultralights all looked pretty much the same—a big parasol wing, open-air seat and spindly tail strung together by a rat's nest of cables. Now you have a choice of configurations ranging from nostalgic old-timers like the Jenny to exotic new shapes like the bullet-nosed, twin-tailed Sadler Vampire and the amphibious, canard-winged Sun Ray. (For source information on the aircraft shown here, see the listing at the end of this article.)

For warplane buffs, there's a Fokker Eindecker, a full-scale—yes, full-scale—replica of the famous, or infamous, German fighter of World War I. The Eindecker (German for one wing or monoplane) may not look fearsome *(Please turn to page 129)*



Clever breakdown into three sections makes this slick biwing ultralight easy to transport. Called Somethin' Else, it's shown without fiberglass nose cowling. It will sell as kit with 28-hp engine for about \$7,000.



Sky Pup is an economical, build-it-yourself, wood-and-fabric design made entirely from locally purchased materials. Plans are \$50; construction cost is about \$2,100 with 20-hp mill. Materials kits are also available.



French-designed Sirocco is a slim, frisky motor glider with a climb rate of 600 f.p.m. and a power-off glide ratio of 12 to 1. Of composite construction, kits cost \$8,553 to \$11,302 with three power options.



Futuristic Sun Ray features forward canard, twin tails and unusual "tunnel" wing over engine to channel airflow for added lift, better cooling, lower noise—all this plus amphibious operation. Kits start at \$7,595.



Fokker Eindecker is a 254-pound, full-scale replica of the dreaded WWI German fighter that Allied pilots dubbed the "Fokker Scourge." A kit with 30-hp engine will be \$5,500.

New ARVs: Half Ultralight, Half Airplane

It was bound to happen. Just as ultralights get more like airplanes, now airplanes are getting more like ultralights. The latest manifestation of this curious irony is the so-called ARV—short for Air Recreational Vehicle. What's an ARV? Good question. Actually, it can be anything you want to make it so long as it weighs no more than 350 pounds—the only limitation. The objective is simple: ultralight economy with real-plane performance. Some ARVs can top 100 mph and climb at better than 600 f.p.m. on no more power than that of a typical ultralight.

Unlike true ultralights, ARVs enjoy no special privileges under FAA regulations—you still have to be a licensed pilot to fly one. But their heavier wing loading makes them stable in gusty winds that would ground most ultralights, and their bitty engines, burning less than two gallons per hour, can run all day on a few bucks' worth of fuel. Try that in your Cessna 150 or Piper Tri-Pacer!—S.G.



Best of both worlds? Topa Scout is a true airplane, but with the wide-open looks and low-power economy of an ultralight. It cruises at 45 mph on 47 hp. It's designed for easy Pop-rivet construction. Plans are \$100.



You can't get much closer to a real airplane and still be an unlicensed ultralight than this striking Sorrell Hiperlight, a negative-stagger biplane reminiscent of the famous Staggerwing Beech. It's \$8,500 prefabricated or \$6,500 as a kit, both with 28-hp engine.



A motor glider with STOL capability, 38-hp Zipper CL-1 has a power-off glide ratio of 18 to 1. Price has not yet been firmed up.



At 195 pounds, tiny Star-Lite could be an ultralight if it weren't so fast. It does 110 mph on only 20 hp, costs about \$6,000.



Avid Flyer is a two-seat ARV with the trim looks of a Piper Tri-Pacer. It cruises at 80 mph on 43 hp. Kit costs \$8,495.



One of most radical new ARVs is Acro-X, a box-wing, canard biplane said to be super-easy to fly. About \$8,000 with 50-hp mill.



Tri-gear Questor weighs only 270 pounds, cruises at 120 mph on 37 hp and burns less than 2 gal. per hour. Kit is about \$7,500.



A real airplane for only \$4,000? That's the projected construction cost for 28-hp, 110-mph Zippy Sport. Plans are \$100.

BEAT YOUR HANGUPS

Here's Your Ultimate Telephone Center

Everything from digitally controlled remote telephones to slow-scan TV phones can be yours right now. Here's how to choose from the most exciting phones and accessories ever.

BY MARC STERN; Photographs by Layman/Newman

TYMSHARE SCANSET XL
(Terminal)



AT&T GENESIS
(Telephone)



Imagine sitting down at your phone tonight, calling a friend and talking while he *watches* you. Or, going to your phone, dialing a number and having the world's latest news flash onto a screen. Does it sound like science fiction? It isn't, it's just part of the Popular Mechanics "Ultimate Phone System."

These features and more are available right now, thanks to the electronics revolution and microelectronic technology. We set up the system you see here and explain how it works, step by step.

Genesis of the system

Genesis looks much like an everyday electronic phone, but it is actually much more. The keypad is a dead giveaway. Instead of having the traditional buttons, it has a touch-sensitive membrane keypad with which you enter your phone numbers. Inside the unit is microelectronic circuitry that handles many chores.

For instance, the circuitry allows one-touch calling of seven programmed numbers and emergency numbers. In addition, it has a save-send feature, which

ZENITH CV1950
(Color monitor)

ZENITH VC1810
(Color camera)

DUOFONE TAD-150A
(Phone answerer)

UNIDEN EX-2600
(Remote telephone)

ROBOT 450C
(Color slow-scan TV unit)

With her picture being previewed on the monitor, and ready to be sent to another phone equipped with the Robot 450C television unit, our model chats on the fully computerized Genesis telephone. Meanwhile, she'll be able to do everything from getting stock quotes to booking an airplane flight on the Scanset XL terminal. If she does take that airline flight, the Duofone TAD-150A will take messages while she's away. But if she leaves only for a different room, the Uniden will keep her in touch.

recalls any previously dialed number with one push of a button. The phone also will act as a speakerphone so more than one person can sit in on a conversation, and will present you with a readout of the time, date, day, month, number dialed, call status and step-by-step user instructions. Further, anyone using this phone can begin a call without lifting the handset.

Like a home computer, the Genesis accepts plug-in cartridges which expand its functions to include greater memory and an electronic datebook, and to act as a general dialing directory. You also gain one-touch access to such features as call-waiting, forwarding and long-distance access restriction.

Dialing for data

Now that you can tie any phone device into the system, there's a new generation of terminals. These units look much like the computer terminals you see at an airline ticket counter, and they can give you access to the world of information.

A typical terminal is the Tymshare Scanset XL, offered by a wide variety of companies. Not only does it feature a traditional terminal keyboard and screen, but it has a built-in telephone handset so you can use it to call a friend or business associate.

Streamlined, the Scanset XL is designed to tie into any of the many information utility services available, such as CompuServe, The Source and Dow Jones. These services can bring you the latest stock quotes, airline information, current news events and more. Some of these services also offer want-ad listings and bulletin-board listings, and let you talk with anyone on a CB channel. You can also use this device at home to communicate with a computer at work.

You should be aware of the cost with any of these services. Typically, if you use these services during the daytime, they will cost anywhere from \$15 to \$25. At night, after peak usage hours, the rates become far more reasonable, \$5 or so per hour. If you spend a great deal of time at the keyboard, you may find yourself with huge bills.

Walking and talking

The PM Ultimate Phone System wouldn't be complete without the portable phone. In reality, portables are little more than two-way radios. They connect to the phone system via a base unit/transmitter-receiver. The base station is tied to the phone line and a.c. power and sends calls to the handset. The battery-powered handset, in turn, is a handheld transceiver which takes the signals from the base station and turns them into a telephone conversa-

(Please turn to page 132)



Webcor's Zip 758 (above) is a phone with many state-of-the-art features, such as memory and automatic redialing, but with a fairly conservative style and shape. The Uniden EX-1050 (top left) is also a full-feature phone with memory and a hold button, along with a speakerphone function. The Webcor Zip 757 (left) can store often-called phone numbers in memory, has a hold button, and has a volume control in handset. Phones like these can help you to automate business and personal calling.

Amaz-A-Tron from U.S. Tron (left) is a memory dialer which stores up to 60 phone numbers. The Sensaphone from Gulf + Western (right) is a home-mon-

itoring unit: When you call home, a voice synthesizer gives you (or anyone else who calls) the house temperature and the status of your burglar alarm system.

The Uniden 2600 (left) is a remote phone that's truly a pocket portable: The handset folds to fit in the palm of your hand. The AP-710 from U.S. Tron (right) is a

more conventional remote phone. Both, like all remotes, enable you to take your phone anywhere in your house or yard; only the base unit is plugged in.

PM OWNERS REPORT:

BY MICHAEL LAMM WEST COAST EDITOR

NISSAN PULSAR NX

"Has the styling of an expensive sports car."
—KENTUCKY PHARMACY TECHNICIAN

"Wish I had turbocharged engine."
—WYOMING SAWMILL WORKER

"Oil filter is hard to change."
—ILLINOIS FARMER



"Economical vehicle for around town, without the econobox look."
—WEST VIRGINIA MECHANICAL ENGINEER

"Rear seat not comfortable for adults. Front is roomy. An excellent two-person car."
—MICHIGAN TEACHER

"Dealer would not talk anything less than sticker price."
—CALIFORNIA SPEECH PATHOLOGIST

Owners love its looks, quality and economy, but want more power.

When Nissan first showed the Pulsar NX to the automotive press, the coupe's tall, angular styling caused some concern. Some of us didn't especially like it. One editor whispered to me during a slide presentation that he thought the car looked like an old Triumph Herald in drag. We were even a little apprehensive about how the Pulsar might fare in the marketplace.

But we needn't have worried because, according to our owner survey, the car's styling definitely quickens the pulse of Pulsar buyers. Oddly enough (oddly to me, at least), the Pulsar sells itself. Dealers don't even stock Pulsar literature anymore. They found that the salesmen didn't need it. People come

A NATIONWIDE SURVEY BASED ON 1,403,757 OWNER-DRIVEN MILES

in, see the car and drive home happy. Buyers aren't motivated by looks

alone, but that's the biggest part of their purchase decisions. Nearly 86 percent of the owners we surveyed confessed that the Pulsar NX's styling proved totally irresistible. Keep in mind that the Pulsar, like the cultish VW Beetle, appeals mostly to younger people.

(Please turn to page 146)



One of the biggest problems was poor factory aim of pop-up lights.



Owners liked the trunk space and fold-down seat-backs, but they found the rear seats cramped.

Getting An Edge The Japanese Way

Innovative Japanese sharpening equipment and techniques are influencing the way shop workers get an edge.

TEXT AND PHOTOS
BY DAVID A. WARREN

In these days of fast-moving high technology, it seems that innovation has become almost routine. Everywhere you look we're trying to hammer out new solutions to both old and new problems. However, it's refreshing to occasionally learn something new about a practice that's been around for a long time, such as the water sharpening techniques of the Japanese. At first, they may seem like a radical departure for some Western shop workers, but the advantages are real. The bench stones and electric-powered grinders shown here not only make sharpening easier, but also yield a more durable and precise edge, which should be the bottom line for any craftsman, East or West.

The basic difference between the Japanese approach to sharpening and the typical Western approach is two-fold: First, the Japanese use water instead of light oil as a lubricant, and second, the design of their bench stones and grinders differs substantially from ours.

Typically, Western chisels and plane irons are manufactured to a hardness of about 61 on the Rockwell "C" scale. In our tests of some Japanese cutting edges, we found them to be about 64 or 65 on the same scale. Because this scale is logarithmic, this three- or four-point spread is significant. In fact, a 64 or 65 hardness is almost the same used for metal lathe tool bits.

The advantage of the harder steel is that once it's sharpened, it will hold its edge longer. The disadvantage is that it's more brittle. To minimize the chipping caused by brittleness, Japanese steel is given a tough grain like forged steel instead of cast steel.

A harder cutting edge demands a softer honing stone because the hard



Japanese grinding wheel is aligned horizontally to provide a wider sharpening surface than typical Western grinders. It also uses water, instead of oil, as a lubricant.

steel quickly dulls the sharpness of the abrasive particles. Soft stones wear faster and, in the wearing, continue to expose fresh, sharp particles to abrade the steel edge. Not only are the Japanese man-made stones softer, but also their abrasive particles are held together by a milder bonding agent. This agent is weakened by water. So when the stones are soaked, the surface renews itself quicker still. The water

also prevents the surface of the stone from glazing over with trapped debris.

Historically, water was the original lubricant used by both East and West, even before Marco Polo. However, it had one drawback then that it still has now: It will rust carbon steel. Oil won't. So, when kerosene lamps became popular and their light oil was readily available, Western sharpening took to oil lubricant. We still use the term "whet-

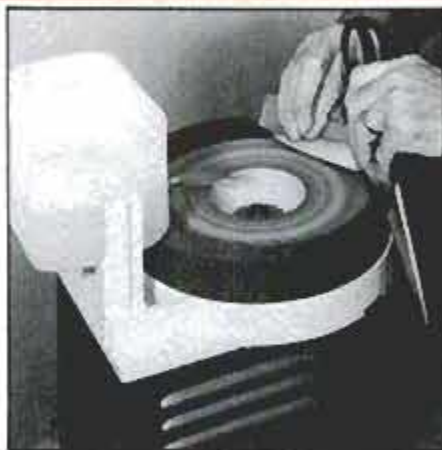
Horizontal grinders have a large surface to grind wide chisels and plane irons.



Water grinders like the Rakuda model shown can easily accommodate entire width of standard plane irons. Slow motor rpm and constant water lubrication reduce heat buildup, protecting temper of blade.



The curved profile and extreme length of a kitchen knife are problems for vertical wheels; the blade pivots during grinding. More blade contact—which yields a more uniform arc—is possible with type shown.



Most scissor blades are short enough to rest completely on wheel. Use slight pressure and a slow rocking motion when grinding. All carbon steel blades should be wiped dry after sharpening to prevent rust.



Not all water grinders are Japanese-made. Some American makers offer their own versions, like Wen unit above. It features an adjustable toolrest and an innovative guide slot (arrow) to sharpen twist drill bits.



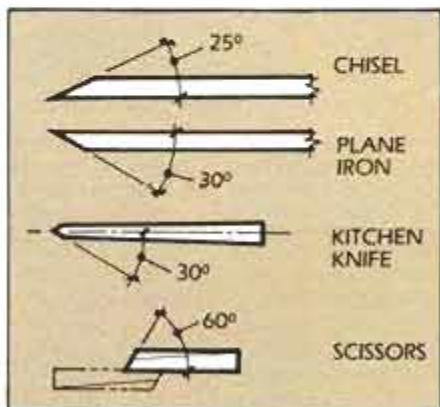
The advantages of horizontal wheel alignment are not limited to water grinders. Hone-Rite unit above has a ground-glass wheel on which you spread abrasive compounds, suspended in light oil.



The configuration and composition of sharpening discs vary widely. Glass disc (left) and cast-iron disc (middle) both require adding abrasive to surface. Others shown are synthetic stone.

stone" and "whetting the edge" even though the water in most cases has fallen by the wayside.

All shop workers know how time-consuming it can be to remove a nick or chip in a plane iron or chisel on a bench stone. Power grinders make this job a great deal easier. However, the standard Western grinder, with its thin 6- or 8-in.-diameter abrasive wheel mounted vertically, does have some drawbacks which the horizontal Japanese design does not have. First, Western grinders operate at high speeds with no lubricant. The heat generated in this process can easily draw the temper from the edge unless the operator continually dips the tool in water to



The best sharpening practice is to follow bevel originally ground by the tool manufacturer. If it's been distorted, use these bevel angles for the tools shown.

keep it cool. The vertically aligned wheel also creates a concave profile on the cutting edge, which weakens the edge by reducing the supporting metal immediately behind the edge. Because of this, some shop workers have sharpened their chisels and irons on the side of the wheel. But this is extremely dangerous and is in no way recommended. A standard grinding wheel is not designed to withstand this side-to-side stress and definitely can break when in use.

The horizontally aligned grinders have a much larger work area so you can easily grind the widest chisels and plane irons to a dead-flat cutting edge. These machines also operate more

Getting An Edge The Japanese Way

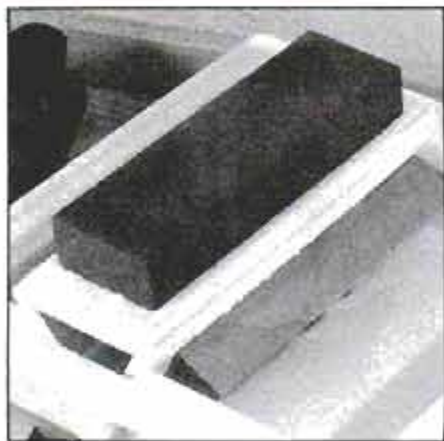
Japanese bench stones are very porous. You should soak them before use.



Japanese hand stones use water as a lubricant and come in a wide range of grits. Coarse stone above cuts fast but wears fast, so its large size is crucial. All four sides can be used before stone needs flattening.



Medium-grit water stone works well for bringing a dull edge back to life, but it won't quickly remove nicks or chips in a cutting edge. Wipe slurry off blade before using tool on a fine polishing stone.



Water sharpening system from Fine Tools has 800-, 1,200- and 6,000-grit stones attached to a single holder. Change stones by lifting out and turning block, then sliding back into water container grooves.

slowly—around 500 rpm—which minimizes friction.

Basically, there are two different types of horizontal grinding discs: flat discs of glass or iron, and man-made stones of various grits. The glass or iron discs require adding powdered abrasive to their surface—suspended in a light oil or water carrier—to do the actual grinding. These systems have

the advantage that the disc itself always remains flat and will not wear as quickly as the stone. These machines are made by American and European firms as well as the Japanese.

But most of the Japanese horizontal grinders are of the stone type and they employ a constant wash of water as a lubricant and cooling agent. The water flows from a machine-mounted reser-

voir into a central well from which the water is drawn out by the centrifugal force of the wheel, and it then spreads evenly across the grinding surface.

Standard discs are 1,000 grit, which is considered coarse by the Japanese and relatively fine by Westerners. Many coarser and finer discs are available. The stone discs will show wear depressions over time, but the suppli-

Japanese Tool Design

The distinctive design of Japanese chisels and plane irons is the result of painstaking refinement over many centuries. The Japanese take considerable pride in their idea that craftsmanship in tool design is every bit as important as craftsmanship in tool use. It is not uncommon for Japanese woodworkers to consider first whether the individual is worthy of a particular tool, instead of the other way around.

To the Western eye, the most notable difference in Japanese tools is their concave or fluted backs. Less noticeable, but equally important, is the type of steel used in the blades. These blades are laminated from two different kinds of steel. A thin layer of very hard steel forms the back and edges of the blade, while a softer steel is used for the upper blade surface. The great advantage of the hard steel is that it holds a sharper edge longer, which makes for better tool performance. But it's also more brittle, which makes the cutting edge less stable. By bonding a layer of softer steel to the hard steel, the whole blade becomes resilient and able to absorb the common shocks a tool suffers.



Japanese cutting tools like these chisels and plane iron have concave or fluted backs. This makes flattening back easier and more accurate, which yields a superior edge.

The concave depression on the blade back, or "hollow" as some manufacturers call it, further reflects the Japanese obsession with getting the sharpest possible edge. By reducing the amount of steel on the blade back, it is easier to hone the back absolutely flat—the crucial first step in sharpening any chisel or plane iron. Actually, you are sharpening only the perime-

ter of the blade, and because of this, all three edges can be aligned easily and exactly in the same plane. (Some Western chisels are, in fact, made with a very slight depression on the blade back for the same purpose. But according to experts, the extreme hollow on the Japanese tools is preferable.) Once the back has been properly flattened and honed to a high polish, the blade is turned over and the bevel is sharpened according to the tool's individual requirements.

The one drawback to the concave back becomes evident after many sharpenings: Eventually, the cutting edge will approach the depression and the tool will need a slight modification. At this point, the hollow must be "tapped out" by gently striking the upper side of the bevel with a hammer. These blows will flatten out the front of the hollow, providing more steel for forming a new cutting edge.

However, this technique is delicate and requires a good deal of expertise. If you are planning to try some of these Japanese tools, be sure the supplier can provide you with the proper tools and clear directions for this procedure.—D.A.W.

Japanese sharpeners use water instead of light oil as a lubricant.



Honing guide promotes uniform sharpening whether you use a water or oil stone. With both hands, push full strokes across the stone face. Be sure to vary grinding path slightly as you go so stone wears evenly.



Japanese water stones wear faster than Western oil stones, so they must be flattened regularly. To do this, soak stone in water, then rub it over fine waterproof sandpaper until it is flat.



High-quality sharpening setup has four stones: 1,000-grit coarse (left), medium-grit natural blue (middle), 6,000-grit fine (right) and small Nagura stone which is rubbed onto fine stone for a fast-cutting slurry.

ers of these machines have dressing stones available, specifically designed to flatten the water discs. These machines can cost from \$130 to \$300.

While power water grinders can make quick work of dulled and nicked blades, if the price puts you off, a bench stone of 700 to 800 grit will do the same job, especially if you use a sharpening guide like the one shown in the photo to assure the same angle with every pass.

Japanese bench stones are very porous. When you submerge one in water, air bubbles will flow out of it just like champagne. You should always soak the stone for five minutes before using it, then occasionally splash fresh water onto the grinding surface when working. You can store the coarse stone on one end in a small amount of water, and capillary action will keep the stone wet. (Storing in water only applies to man-made stones. If you do the same thing to natural Japanese stones, they will disintegrate.) Or you can work the stone in a container of water as shown in the photo. Finishing stones must also be soaked in water beforehand to function properly.

When cutting, a water stone produces a slurry of broken abrasive that sits on the surface and aids in the cutting. These particles, having been worn off the stone, are finer than those still bonded in the stone. Therefore,

they act as a sort of intermediate grit between the stone you are working on and the next finer one.

A typical bench sharpening operation usually includes three stones: a coarse 800-grit, a medium 1,200-grit and an extremely fine 6,000- or 8,000-grit (Gold) stone for polishing once the blade is sharpened. As you finish with each stone in succession, be sure to wipe the slurry off both the stone and the tool so you won't carry the coarser grit onto the finer stone.

Eventually, these stones will reveal wear marks that will prevent them from accurately flattening the back of a blade or sharpening the bevel evenly. At this point, the stone should be flattened by first soaking it in water and then rubbing it over a 300- to 400-grit piece of waterproof sandpaper. Be sure to do this operation on a flat surface.

The first step in good sharpening is to make the back of the blade absolutely flat. Do this by placing the back of the blade flat on the stone and rubbing back and forth until the surface shows uniform abrasion patterns. This process, normally called "lapping" the blade, is crucial. If the underside of a chisel or plane iron is not flat, the bevel will never meet it properly in one straight line and the tool will lose much of its effectiveness.

Next, sharpen the bevel to the angle originally established by the manufacturer, or to one of your own choosing. There is a good deal of debate about proper bevel angles and many sophisticated woodworkers will adjust their

bevels, depending on the steel in the blade or the type of wood they are working. But as a rule, the angles shown in the drawing on page 105 should be adequate for Western tools.

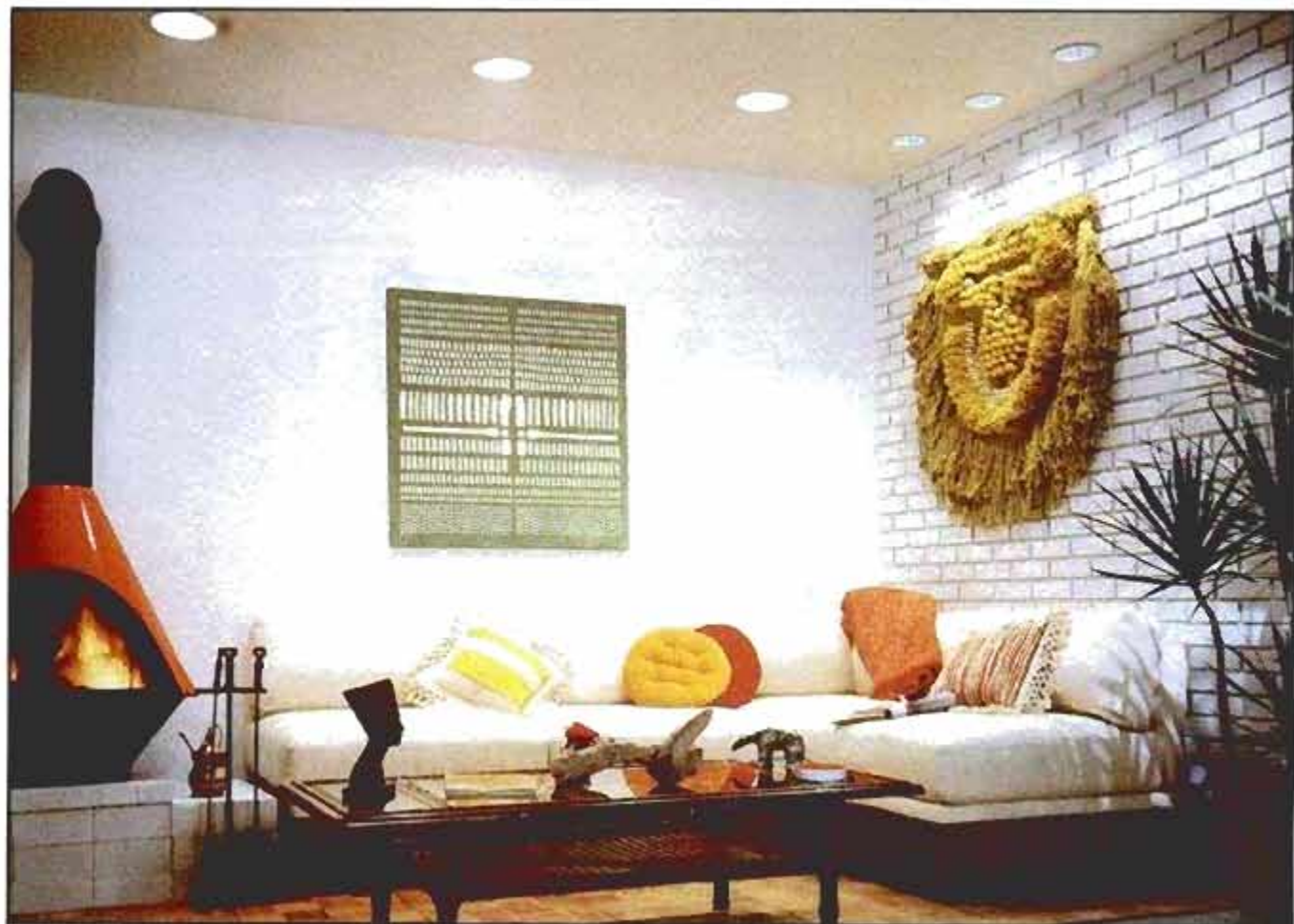
When the bevel is finally honed on the fine stone, turn the blade over again and lightly polish the back until the thin wire burr left on the edge from sharpening the bevel falls off.

Because these stones are soft, they are highly susceptible to damage. For this reason, it's a good idea to chamfer the edges slightly, using 300-grit abrasive paper. This will reduce the chance of the stones being chipped. **PM**

SOURCE LIST

- Constantine & Son, 2050 Eastchester Rd., Bronx, N.Y. 10461.
- Craftsman Wood Service, 1735 West Cortland Court, Addison, Ill. 60101.
- EZ Sharpener Products, Box 41, Rossville, Ill. 60963.
- Fine Tool Shops Inc., 20 Beckus Ave., Box 1262, Danbury, Conn. 06810.
- Frog Tool Co. Ltd., 700 West Jackson Blvd., Chicago, Ill. 60606.
- Garrett Wade Co., 161 Ave. of the Americas, New York, N.Y. 10013.
- Hone-Rite, Box 3177, Shawnee, Kan. 66203.
- J. Cheaps & Sons, Cheaps Pond Park, Box 1799, Warrensville, Ohio 44128.
- Leichtung Inc., 4944 Commerce Parkway, Cleveland, Ohio 44128.
- Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684.
- Shopsmith Inc., 750 Center Dr., Vandalia, Ohio 45377.
- Woodcraft, 41 Atlantic Ave., Box 4000, Woburn, Mass. 01888.
- *Woodline The Japan Woodworker, 1731 Clement Ave., Alameda, Calif. 94501.
- Woodworker's Supply of New Mexico, 5604 Alameda N.E., Albuquerque, N.M. 87113.
- Wood Tender, 4611 Macklind Ave., St. Louis, Mo. 63109.
- *Most complete inventory of Japanese tools, bench stones and water grinders.

The tools, bench stones and power grinders shown in these photos were supplied by Woodline, Shopsmith, Garrett Wade, Fine Tools and Hone-Rite. The address for each is given in the source list.



Discover Low-Voltage Lighting

Here's how to save energy and create dramatic effects using low-voltage lighting in your home.

Low-voltage lighting isn't a new concept, but one that only recently has come of age. Fixtures for these lights operate at voltages stepped down from standard line current. They've been used for more than 20 years in museums, art galleries, restaurants and jewelry stores for display purposes. The highly concentrated light beam is easily controlled to shine precisely on an individual object such as a sculpture, painting or centerpiece.

Now, with the availability of low-voltage track lighting and the introduction of two new recessed fixtures, more homeowners are discovering low-voltage lighting as an attractive supplemental light source. In addition, low-voltage lamps produce more beam intensity per watt than standard voltage bulbs, and that means energy savings.

Low-voltage fixtures use a transformer to step down standard 120-v. house current. Most fixtures operate at either 5.5 or 12 v. But this doesn't mean low-voltage light is dim light.

BY MORT SCHULTZ



These photos show two common residential applications for low-voltage accent lighting: flush-mounted, recessed fixtures (top) and track lighting (above).

Low-voltage lamps provide greater candlepower (candelas) than conventional incandescent lamps of the same wattage. By design, many low-voltage lamps provide *more* candelas than greater wattage incandescent lamps. For example, the maximum candlepower provided by a 150-w./120-v. R-40 incandescent spot bulb is 5,400 candelas. The maximum candlepower of a 50-w./12-v. MR-16 narrow-spot low-voltage lamp is 9,150 candelas. And a 25-w./5.5-v. PAR-36 pin-spot low-voltage lamp provides a whopping 30,000 candelas.

The automotive industry provided one of the two main lamps used in low-voltage lighting systems today—the PAR-36 (parabolic aluminized reflector) lamp. It's also known as the sealed beam. The second lamp, the MR-16 quartz halogen, was developed by the photographic industry. One such lamp is the General Electric Precise Multi-Mirror lamp.

The 4½-in.-dia. PAR-36 lamp features a glass reflector coated with a thin

layer of vaporized aluminum. Both the reflector and the lamp's hemispherical shield trap stray light, bringing the full intensity of the beam to an exact area.

The 2-in.-dia. MR-16 lamp has a reflector that's divided into hundreds of shiny segments to direct the light. A dichroic reflector coating reduces heat and helps prevent colors from fading. A variety of beam spreads is available for both lamps, ranging from narrow spots to wide floods.

There are several factors to consider when choosing between PAR-36 and MR-16. It's an important decision because a PAR-36 lamp won't fit an MR-16 fixture and vice versa.

The rated life of the two lamps differs significantly when dealing with narrow-beam lamps. The narrowest beam PAR-36 (25 w./5.5 v.) has a rated life of 1,000 hours. The narrowest beam MR-16 lamp (20 w./12 v.) is rated at 2,000 hours. The wider beam spreads of both lamps are between 3,000 and 3,500 hours, depending on the wattage and beam spread.

Another consideration is versatility. There are PAR-36 fixtures available with a dual-output transformer which accommodates both 5.5- and 12-v. PAR-36 lamps. The MR-16 fixtures all operate on 12 v.

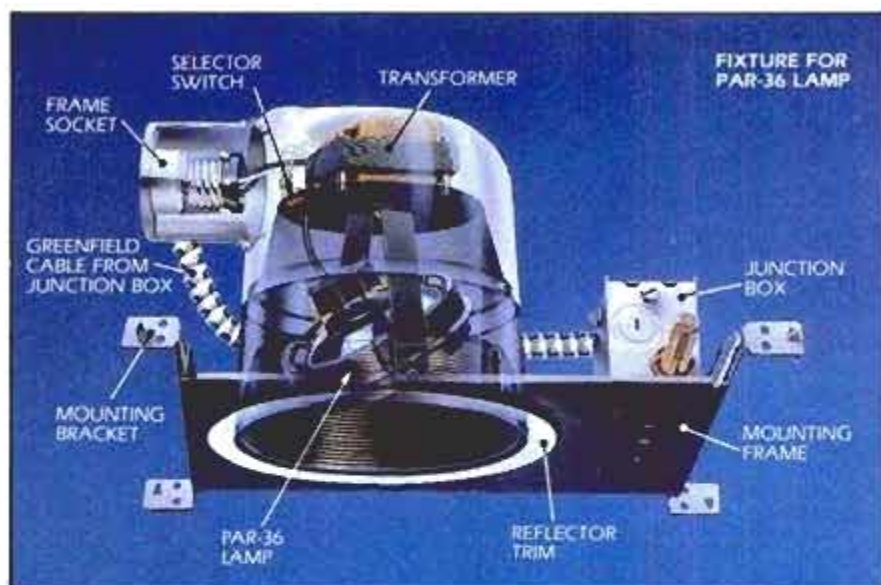
Next, consider the light beam color. PAR-36 lamps direct heat out the front of the unit, creating a warmer, yellower light. The dichroic coating of the MR-16 lamps allows heat to escape out the rear of the lamp, producing a whiter, brighter light.

The final consideration is price. PAR-36 lamps range from \$8 to \$10; MR-16 lamps start at about \$14.

Where to use them

Since low-voltage lamps provide concentrated beams, they're not intended to be a substitute for general lighting. For example, the widest beam MR-16 flood (75 w./12 v.) has a beam spread of only 5.8 ft. on a horizontal surface when placed 8 ft. away. Use low-voltage lighting to highlight certain areas or particular objects. It can also draw attention to an entrance hall, staircase or loft area. Avoid installing low-voltage lighting fixtures in areas used for reading. The sharp contrast between lit and unlit areas could cause eye-strain.

To drop line voltage to low voltage, you need a transformer, and there are two types: remote and integral. The old method is to use a remote transformer, such as a TF60 or TFC60. The T stands for transformer, the C for cord and plug and the 60 for capacity in watts. The F stands for fused, which means that if there's an overload, the transformer won't burn out. Some transformers



Here are two recessed low-voltage fixtures with integral transformers: the PAR-36 lamp fixture with an adjustable lamp socket (top), and the MR-16 lamp fixture (above).

aren't protected by a fuse. Be sure to avoid them.

With a TF60, connect the standard voltage source (120 v.) to the input side of the transformer. Then, connect the low-voltage wire (No. 12 or 14 nonmetallic sheathed cable is recommended) to the transformer and run it to one or more fixtures recessed in the ceiling. Add a switch, autotransformer dimmer or electronic dimmer designed to be used with a transformer. Never use a standard dimmer switch—it could damage the transformer.

With a TFC60, the wiring is the same except that the transformer has a three-wire primary cord and grounding plug. Power is received by plugging the cord into a 120-v. outlet.

If installing more than one fixture in a room, the remote transformer method is the least expensive. However, there may be problems caused by voltage drop. If the circuit is of appreciable length, lamps near the transformer will

operate at a higher voltage than lamps farther away. This will reduce lamp life, produce uneven lighting and result in irregular lamp operation. *Note:* Systems with remote transformers don't use MR-16 or PAR-36 lamps. They use other lamps, ranging from 5.5 w. to 37.5 w.

Many low-voltage fixtures come with a built-in transformer, such as the Lightolier units shown in the drawings. These fixtures are easily installed in a new structure when the ceiling joists are accessible. But they're also designed for installation in existing ceilings.

Here's how: First, you install the wall switch to operate the new fixture. If a dimmer is used, be certain that it's a variable autotransformer or electronic dimmer designed for low voltage. Run a standard voltage cable to the switch from a junction box or house service panel. Be certain to disconnect the fuse or circuit breaker *first*. **Caution:** Any-

INSTALLING RECESSED FIXTURES



Hold the frame firmly against the ceiling. Then pencil outline of the frame opening.



Cut along outline using a small keyhole saw or compass saw. Be sure to wear goggles.



Remove a knockout plug from the junction box using a small slotted screwdriver.



Join the junction box wires to the cable that leads from the switch using wire nuts.



If the frame isn't being attached to the ceiling joists, remove the mounting brackets.



Snap bridge off the frame opposite the junction box using pliers and a twisting motion.



With the bridge removed, maneuver the frame through the opening and into ceiling.



Secure the anchor clips into plasterboard. Then rotate locking clips into position.



With the frame securely locked in position, push the fixture up into the ceiling.

one unfamiliar with electrical wiring should call a licensed electrician to wire the switch to the fixture location.

Next, connect the fixture to the switch. Remove the cover from the junction box on the fixture. Then pry out one of the knockout plugs from the box. Feed the cable that leads up from the switch through the knockout hole and into the junction box. Join the cable wires to the wires in the junction box using twist-on wire nuts. Be certain to connect white to white and black to black. The bare wires are ground wires. They should be attached under the screw in the junction box.

Snap the bridge off the frame opposite the side with the junction box. This

opens one end of the frame and allows you to maneuver the fixture into the ceiling. Secure the frame to the ceiling by pushing the anchor clips into the plasterboard.

Before installing the fixture, pull off the reflector trim and adjust the selector switch. The MR-16 lamp fixture's switch offers a 20-w. or 50/75-w. position, depending on the lamp wattage

you're using. If you're installing a PAR-36, the switch lets you vary transformer output for 5.5- or 12-v. lamps.

Insert the male end of the fixture line cord into the frame socket to bring power to the lamp. Then push the fixture into the frame so it snaps into the locking rings. Install the lamp into the socket and replace the reflector trim. Finally, turn the power back on. **FM**

MANUFACTURERS LIST—LOW-VOLTAGE FIXTURES

Capri Lighting, 7020 East Slauson Ave., Los Angeles, Calif. 90040.
Esco Lighting, 30 Walter St., Pearl River, N.Y. 10965.
Halo Lighting Products, 400 Busse Rd., Elk Grove Village, Ill. 60007.
Lightolier Inc., 346 Claremont Ave., Jersey City, N.J. 07305.

Intermatic Inc., Intermatic Plaza, Spring Grove, Ill. 60081.
Prescolite, 1251 Doolittle Dr., San Leandro, Calif. 94577.
Progress Lighting, Erie Ave. and G St., Philadelphia, Pa. 19134.
Swiveller Co. Inc., Rte. 304, Nanuet, N.Y. 10954.
Thomas Ind., Box 35120, Louisville, Ky. 40202.

WORKSHOP MINICOURSE



Using abrasives



Closed-coat paper (left) has abrasive over entire surface for fast cutting. Open coat (right) has less coverage, won't clog as fast.



When sanding wood, work with grain (left), not against it (right). Latter yields deep scratches. Same grit was used on both boards.

Sanding is one of the most common construction and repair tasks performed around the home and shop. It's also one of the easiest. But unless you select the correct abrasive and use it properly, you'll have a hard time achieving good results.

To begin with, sandpaper, or "coated abrasive" as it is technically known, is identified by three things: the type of abrasive particles on its surface, the grit (or coarseness) of the particles and the actual amount of abrasive on an individual sheet. Your choice depends on the work you are doing.

Two of the most common sandpapers are flint and garnet. Flint is less expensive than garnet and thus is the logical choice when you're sanding surfaces that clog the paper quickly and spoil it such as soft, gummy woods, or when you're removing paint and other finishes. Garnet is tougher and longer lasting and works better for sanding all types of hardwoods.

The closest thing to an all-purpose abrasive is aluminum oxide paper. It can be used on wood, metal, plastics and fiberglass. Its abrasive coating is the same material used in grinding wheels, so it's very durable and holds up well when used in power sanders.

Silicon carbide is the hardest abrasive generally available for consumer use. Its particles are nearly as hard as a diamond, so it's ideal for sanding non-ferrous metals, composition boards and plastics. It can also be used with water or mineral oil for rubbing down varnish, polyurethane and lacquer finishes, as shown in the photo.

The grit of an individual sheet of sandpaper is identified by the number on its backing. These numbers range from a very coarse No. 12 to a super-



When sanding rounded corners and contours, abrasive works best if it's backed with a resilient block. Padding allows the paper to conform to workpiece's shape.



Sandpaper can also be used to achieve a true flat edge with the aid of two straight-edged boards clamped to the workpiece as shown. Use an unpadded sanding block.

fine No. 600, with 22 increments between. The finer papers frequently are available with cloth backings as well as the standard paper back. The cloth is more flexible and better for sanding curved shapes.

On many abrasives, you'll also have a choice between closed and open coats, which indicate how many particles are on the surface of an individual sheet. Closed coat means coverage over the entire sheet, while open coat indicates 50 to 70 percent coverage (see photo). Open coat does cut slower, but it won't clog as quickly. **PM**



To sand sculptural shapes, cut cloth-backed abrasive into narrow strips and use like a shoeshine rag. Paper-backed abrasive will work if you apply masking tape to back.



For rich luster on finish coat of varnish or polyurethane, use waterproof silicon carbide paper, available in grits from 360 to 600. Use water or mineral oil as lubricant.



For final sanding on irregular shapes such as the molding shown, use a nonwoven nylon fiber pad in medium or fine grit. These are often sold for cleaning kitchen pots.

3 EASY PIECES To Make For Your Kitchen

Build all three and your kitchen
will be more organized than ever before.

TEXT AND PHOTOGRAPHS BY KATIE AND GENE HAMILTON

Hardwood dowels and oak combine to form three contemporary kitchen accessories: a utensil rack, a casserole cradle and a bookrack. If you're a weekend or rainy-day woodworker with moderate skills, you should have no trouble making these

projects using a few hand or portable tools. Each item can be cut, assembled and finished in a few hours. You might consider making several of each project at the same time, assembly-line fashion—one for your kitchen and extras for your friends.

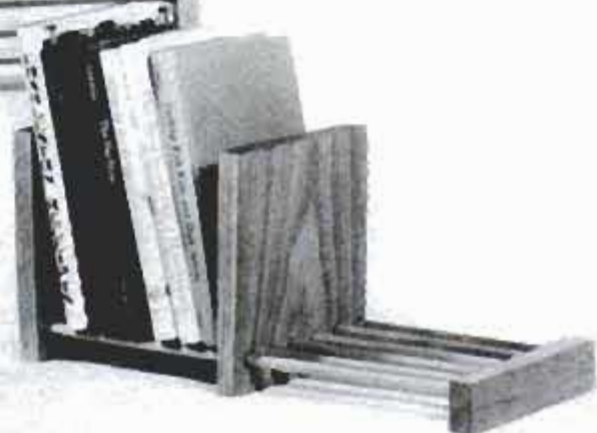
1 UTENSIL RACK

Mounted on the wall close to countertop range, this rack with S-hooks provides handy access and storage of cooking paraphernalia.



2 CASSEROLE CRADLE

You can use this handsome wooden cradle to transfer a hot casserole from the oven directly to the table.



3 BOOKRACK

This contemporary bookrack boasts fixed end panels and a sliding divider that adjusts to suit the cookbooks you own.

1. UTENSIL RACK

Handier than the old-fashioned washboard it resembles, this wall rack corrals cooking utensils in one convenient place. You can buy the hanging S-hooks or shape your own out of No. 12 copper wire.

Begin by cutting the two vertical sidepieces. Then cut the 27 hardwood dowels to size using a backsaw and miterbox to ensure that the ends are square.

Lay out for the dowel holes in the sides with a combination square set to create a centerline down both vertical parts. Mark a hole location $\frac{1}{2}$ in. from one end and on $\frac{1}{8}$ -in. centers for the rest of the dowels. Use an awl to make starting holes for the drill.

To help bore holes perpendicular to the wood surface, use a drill guide. You can construct a guide from two pieces of scrap wood, each about $\frac{3}{4} \times 2 \times 5$ in. Cut one 2-in. side of each piece at a 45° angle, then glue the blocks together so these edges form a V-guide for the drill bit.

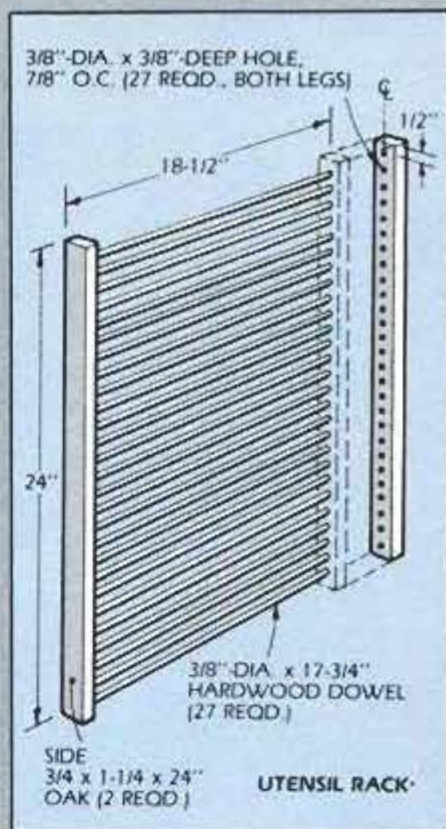
Apply tape to a $\frac{1}{8}$ -in.-dia. bit at the

$\frac{1}{8}$ -in. mark for use as a depth gauge. Bore $\frac{3}{8} \times \frac{3}{8}$ -in.-deep holes in the sides for the dowels. Bore a hole angled upward in the back of each side 1 in. from the top for nails to hang the rack.

Round the wood edges with a plane or file. Sand all surfaces with 150-grit sandpaper.

To assemble the rack, apply a small amount of carpenter's glue to the dowel holes of one side. Insert the dowels and tap them until they're fully seated in the holes. Apply glue to the holes in the other side and insert the free dowel ends. When the glue is dry, give the rack several coats of polyurethane varnish. Use more than two coats if you plan to hang it close to the stove.

The S-shaped utensil hooks are available in hardware and home center stores. Or you can make them of No. 12 copper wire. Strip off the insulation and cut the wire to 3-in. lengths. Bend the wire into an S-shape using needle-nose pliers. You can make variations in hook shapes to suit your utensils.



2. CASSEROLE CRADLE

This cradle is an attractive and safe way to serve food baked in a glass casserole dish directly from the oven. Designed to accommodate a standard 2-qt. dish, the holder has sturdy oak handles with hardwood dowels running

its length. Begin work by drawing a 1-in. grid on a piece of heavy paper or cardboard. Transfer the outline of the cradle ends to the cardboard. Next, cut out the pattern and then use it as a template to draw on the stock. Use a sabre

saw for cutting the top contour.

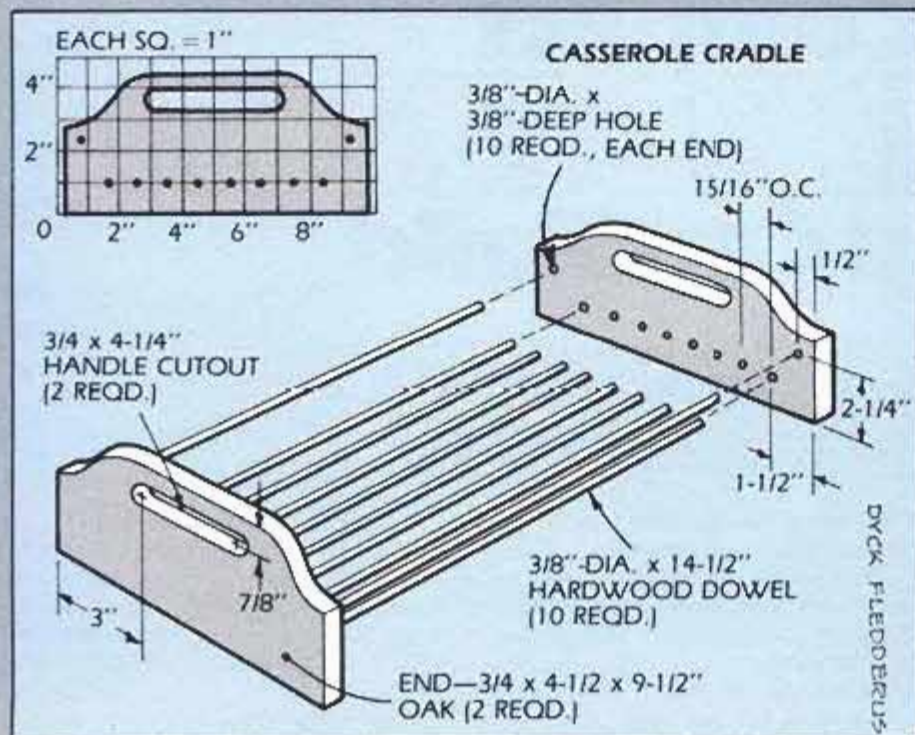
Lay out the dowel and handle-hole locations using a combination square. Locate the eight bottom dowel holes on a line 1 in. from the bottom, $1\frac{1}{2}$ in. from each side on $1\frac{1}{8}$ -in. centers. The upper dowel holes are located $\frac{1}{2}$ in. from the edge, $2\frac{1}{4}$ in. from the bottom. Mark the center of the handle holes $2\frac{1}{4}$ in. from the sides and $3\frac{1}{4}$ in. from the bottom. Provide starter holes using an awl.

Use a V-block drill guide (see the utensil rack project above for tips on making the guide) and use tape on the drill bit at $\frac{1}{8}$ -in. as a depth gauge. Bore $\frac{3}{8} \times \frac{3}{8}$ -in.-deep holes through the dowel marks.

To cut out each handle, bore a $\frac{3}{4}$ -in.-dia. hole at both ends of the handle. Remove the center waste with a sabre saw. Cut the dowels to a 14-in. length with a backsaw and miterbox. Then round all the edges slightly with a block plane or sandpaper. Sand all surfaces smooth with 150-grit sandpaper.

Assemble the holder by applying a small amount of carpenter's glue to the dowel holes on one side and inserting the dowels. Then apply glue to the holes of the other end and insert the free ends of the dowels. Tap the sides to seat the dowels. After the glue sets, you can apply several coats of a satin polyurethane varnish.

(Please turn to page 149)





Compact WORKBENCH You Can Build

This sturdy bench gives you your money's worth—and a chance to customize.

BY DAVID WARREN AND RAY PETERSON

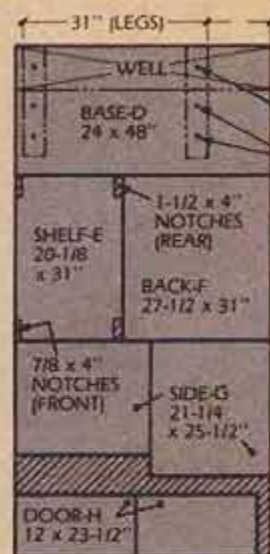
The main activity in any ongoing workshop usually centers around the workbench. It should provide a rigid, durable surface for a variety of operations from sanding to assembling parts. The version above not only fulfills this requirement, but provides storage space for tools and supplies, costs a

fraction of comparable commercial units and can be customized to suit.

This bench is an improved version of our classic bench (see *Workbench Fit For A Pro*, page 162, Oct. '70). We added a heavy-duty, dual-action back vise, a bench hold-fast clamp and a sturdy 1½-in.-thick butcher block top.

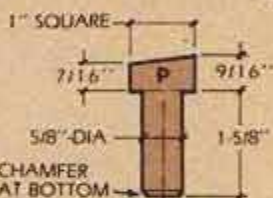
A steel stop (also called a dog) on the vise combines with a wooden bench stop inserted into a hole in the bench-top to hold a workpiece up to 52 in. long. The 1½-in.-deep well at the rear keeps small tools and parts from rolling off the top.

After you've rounded up all needed

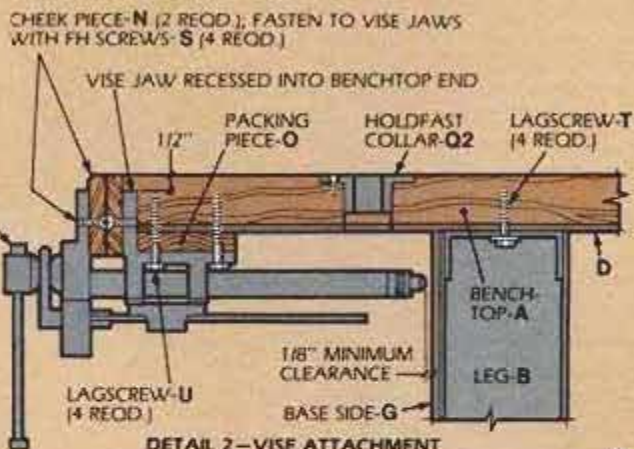


CUTTING DIAGRAM

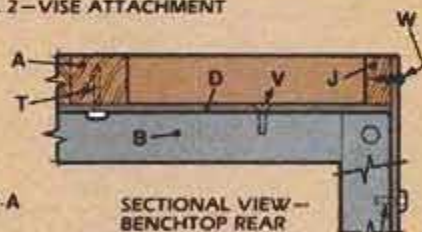
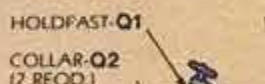
X DETERMINED BY DEPTH OF VISE GUIDES (SEE DETAIL 2)
 FASTEN FROM ABOVE
 FASTEN FROM BELOW (SEE DETAIL 2)



DETAIL 1—STOP



DETAIL 2—VISE ATTACHMENT



SECTIONAL VIEW—BENCHTOP REAR

STOP-P (SEE DETAIL 1)

5/8" DIA. HOLES, SPACED 4" APART TO CLEAR LEGS

X

G

B

H

5-1/2"

HOLDFAST-Q1
 COLLAR-Q2 (2 REOD.)
 WELL SIDE-I (2 REOD.)

WELL BACK-J
 BACK-F
 BASE-D

BUTCHER-BLOCK TOP-A

ELECTRICAL OUTLET

Y

SLIDING DOOR TRACK-M

SHELF-E
 SHELF SUPPORT-K

SHELF SUPPORT-L (2 REOD.)

SLIDING DOOR-H (2 REOD.)

10-1/2"

7/8"

3/4" DIA. HOLE

LEG FRAME-B (2 REOD.)

VISE-C (SEE DETAIL 2)

SIDE-G (2 REOD.)

X

W

MATERIALS LIST—WORKBENCH

Key No.	Size and Description (use)
A	1 1 1/2 x 16 x 48" butcher block (top)
B	Pr. Pridcraft steel legs
C	1 Dual-action back vise
D	1 1/4 x 24 x 48" hardboard (base)
E	1 1/4 x 20 1/8 x 31" hardboard (shelf)
F	1 1/4 x 27 1/2 x 31" hardboard (back)
G	2 1/4 x 21 1/4 x 25 1/2" hardboard (side)
H	2 1/4 x 12 x 23 1/2" hardboard (door)
I	2 3/4 x 1 1/2 x 7 1/2" pine (well side)

J	1 3/4 x 1 1/2 x 48" pine (well back)
K	1 3/4 x 1 1/2 x 18 1/2" pine (shelf support)
L	2 3/4 x 1 1/2 x 28" pine (shelf support)
M	Set 1/4" sliding door tracks
N	2 3/4 x 4 x 8" maple (vise cheeks)
O	1 Pine packing piece (to keep vise jaws 1/2 in. below benchtop)
P	1 1 x 1 x 6" maple (stop)
Q1	1 Bench holdfast
Q2	2 Bench holdfast collars
R	1 Duplex outlet (grounded) and receptacle box

S	4 1/2-18 fh machine screws countersunk
T	4 1/4 x 1 1/2" lagscrews (for butcher block)
U	4 Lagscrews to suit (secure vise)
V	6 1/4-20 x 1" fh machine screws (secure base to leg frame, shelf to leg)
W	4 3/4" No. 10 rh screws (secure back to well)
X	20 1/4-20 x 1" hexhead machine screw (secure sides and back)
Y	8 1" finishing nails

Misc.: Carpenter's glue; Illinois Bronze No. 321 spray paint

materials (see list, page 115), assemble the legs (B). Pridecraft legs are widely available at lumberyards; or see the source list on this page. Before tightening the leg bolts, check the entire assembly with a framing square. Install the electrical box (R).

Next, you can cut the base (D), sides (G), back (F), shelf (E) and sliding doors (H) to size. Bore $\frac{1}{4}$ -in.-dia. finger holes in the doors and chamfer the door edges with a plane or router.

Attaching the sides

Secure the sides to the legs in this manner: Remove the upper bolt from the outside of the leg. With the smooth side of the hardboard facing outward, place the top and front edges of each side flush with the leg; the rear edge will extend about $\frac{1}{4}$ in. Mark the location of the bolt hole on the side. Bore a $\frac{1}{4}$ -in.-dia. hole and replace the bolt with a longer 1-in. machine screw. Mark the location of the other fasteners, bore holes and fasten both sides.

To secure the back, remove both bolts on the back of each leg. Hold the back between the overlapped sides. Temporarily fasten the back so it extends $1\frac{1}{2}$ in. above the legs. Mark and bore holes on each side of the back and bolt it to the legs.

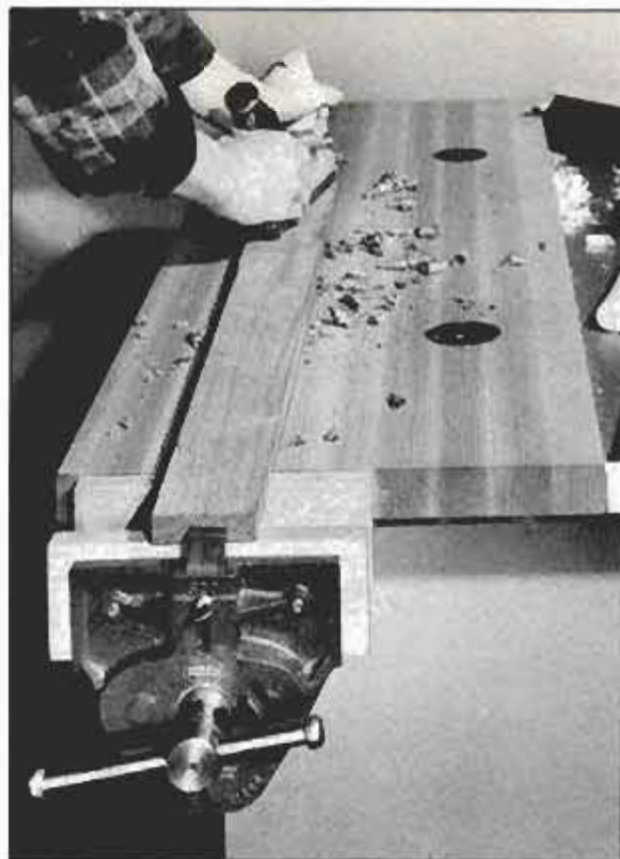
Cut the 1×2 shelf supports (K and L). Nail and glue them as shown in the drawing. Bore and fasten the shelf to the metal leg stretchers with $\frac{1}{4}$ -20 \times 1-in. flathead machine screws. Nail and glue the shallower grooved door track (M) to the shelf. Position it so that half of the rear channel intercepts the rear edge of the legs.

Next, secure the butcher block top (A) to its base. Lay the hardboard base on a flat surface. Apply Titebond or other carpenter's glue along the bottom edges of the butcher block and position it on the base. Use several 3d nails and weights to assure a good bond.

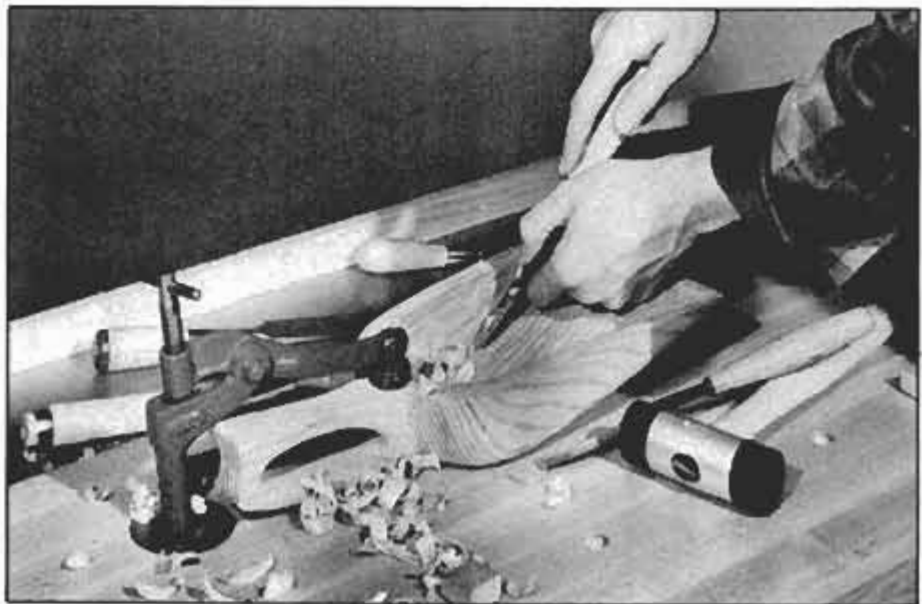
Install the vise before fastening the top to the leg assembly (see drawing detail 2). Set the top edge of the vise's stationary jaw approximately $\frac{1}{2}$ in. lower than the benchtop. Preferably, the jaw should be let in so its face is flush with the bench edge.

Fit a packing piece (O) under the benchtop and secure the vise firmly through the piece to the top by lagscrews (U). Fit wooden cheeks (N) onto the vise, grain running vertically. Make top edges level with the benchtop.

With the vise closed and the top resting upside down, turn the cabinet over and position it on the top. Allow a $\frac{1}{8}$ -in. gap between the end of the vise guides and the side of the cabinet. Mark four attachment holes in the butcher block and two holes in the well area of the hardboard base. Bore holes partway through the butcher block and screw



Planing a long board such as the one shown at left is a great deal easier when it is held between the back vise and a bench stop (also called a dog). The holding method also works well for sanding operations. The phantom photo (below) shows the bench stop (background) as it retains the workpiece.



Classic holdfast supplements back vise by securing unusually shaped workpieces.

the top to the legs just finger tight. Glue the upper door channel in place. When the glue has set, loosen the lagscrews, place the doors in the channels and screw the legs down tight. Turn the bench upright and secure the well sides (I), well back (J) and back panel.

Mark off the row of stop holes in line with the stop in the vise. Lay out the $\frac{1}{8}$ -in.-dia. holes so they clear the steel cross members. Turn the wooden stop (P) on a lathe (see detail 1). Position the bench holdfast collars (Q2) to suit your needs. Sand or plane all edges flush. Apply paste wax to the butcher block, door channels and vise cheeks. Mask

parts as needed and spray paint. For rigidity, bolt the bench to the floor. **PM**

SOURCES

- Legs—Pridecraft steel home workbench legs, \$32.95 postpaid; Pridecraft, 5908 Northwest Hwy., Chicago, Ill. 60630.
- Butcher block top— $1\frac{1}{2} \times 16 \times 48$ -in. electronically glued top with protective oil coating, \$69.95 postpaid, Butcher Block and More, 1600 South Clinton St., Chicago, Ill. 60616.
- Dual-action vise and bench holdfast—Constantine, 2050 Eastchester Rd., Bronx, N.Y. 10461.
- Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013.
- Silvo Hardware Co., 107 Walnut St., Philadelphia, Pa. 19106.
- Wood Carvers Supply Co., 3056 Excelsior Blvd., Minneapolis, Minn. 55416.
- Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801.

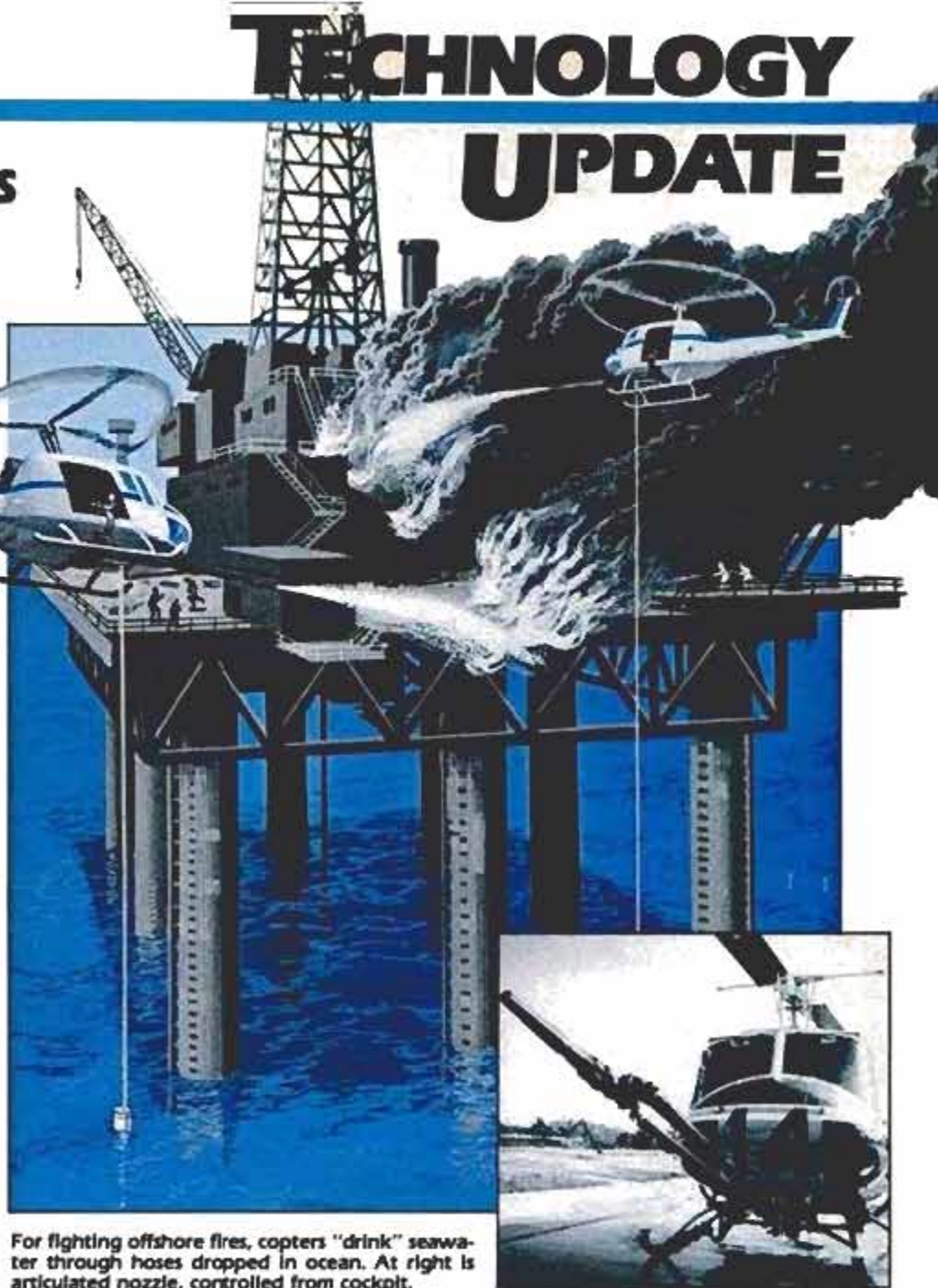
INVENTIONS

Flying fire engine

Hitch a fire hose to a helicopter and you have a flying fire engine able to get quickly to trouble spots that would be difficult or impossible for ground equipment to reach. The unit can save lives and property at ship or oil-rig fires at sea, forest fires, and fires in high-rise structures or at crash sites away from roads. The system, under test by the Los Angeles County Fire Dept., consists of a boom-mounted nozzle, pump and chemical reservoir tank in a self-contained add-on unit that can be fitted to a copter in minutes when an emergency arises. When not needed, the add-on unit is easily removed, freeing the chopper for other duties.

The most ingenious part is a submersible pump and hose that can be lowered into the water when fighting fires off shore or along a waterfront. Seawater, drawn up the hose like soda through a straw, gives the copter a steady, endless supply without its having to rely only on what could be carried in an onboard tank. A similar umbilical can also be used on land where a pond, cistern or hydrant is available.

The FireMaster system throws a stream more than 100 feet and can be adjusted to deliver from 90 to 180 gallons a minute. It's made by Chadwick Inc., 11969 Southwest Herman Rd., Sherwood, Ore. 97140.



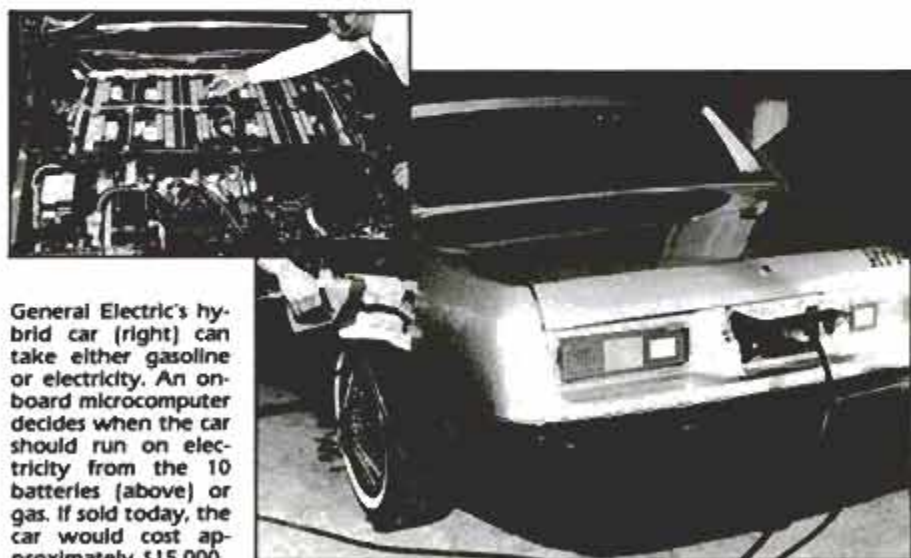
For fighting offshore fires, copters "drink" seawater through hoses dropped in ocean. At right is articulated nozzle, controlled from cockpit.

AUTOMOTIVE

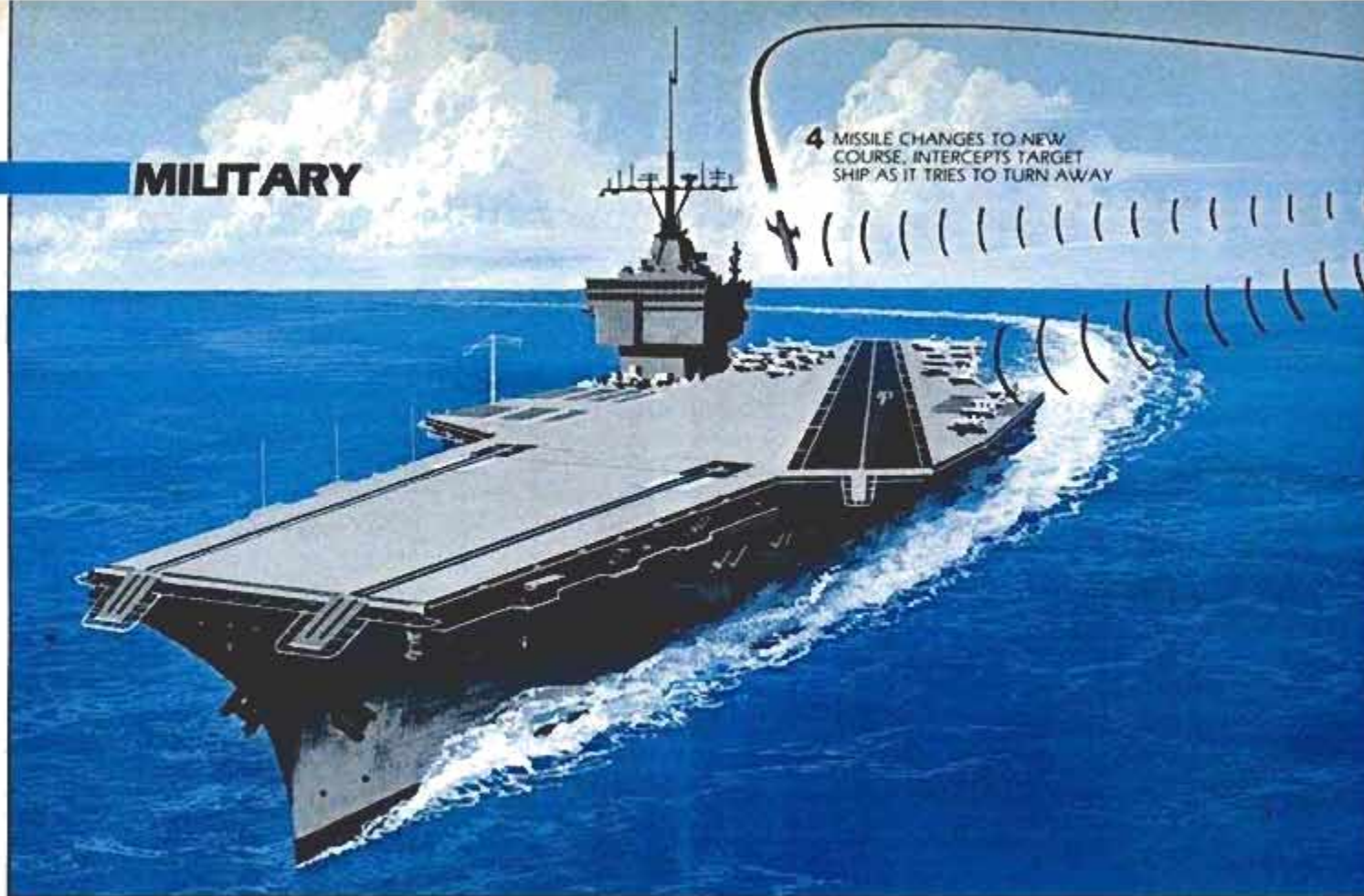
Electric horses

General Electric is testing a car with a 1980 Buick Century body that runs on either gasoline or electricity. The hybrid auto—developed under a federal grant—has an onboard microcomputer that decides when to switch from one power source to another. The decision would be made based on the amount of charge in the car's ten 12-volt lead-acid batteries compared with the amount of gasoline in its tank.

But the same old problem is holding back marketing: Lead-acid batteries don't hold a charge long enough, and longer-charge models are still to be developed. If placed on the market today, the car would sell for \$15,000.



General Electric's hybrid car (right) can take either gasoline or electricity. An onboard microcomputer decides when the car should run on electricity from the 10 batteries (above) or gas. If sold today, the car would cost approximately \$15,000.



Libya's new threat: The missile we fear most in the Middle East

The good news is that it's a very smart missile, so smart it can seek and destroy enemy ships normally hidden beyond the horizon. The bad news is that the wrong side has it.

It's the Otomat, a deadly new French-Italian export weapon now being sold to just about anybody who wants to buy it, including some anti-U.S. troublemakers in the Third World. What worries the Pentagon most is that Libya's saber-rattling Col. Muammar Khaddafi already has ship-based Otomats tracking the U.S. fleet in the Mediterranean. Among their chief targets: our nuclear supercarrier, the mighty USS *Nimitz*.

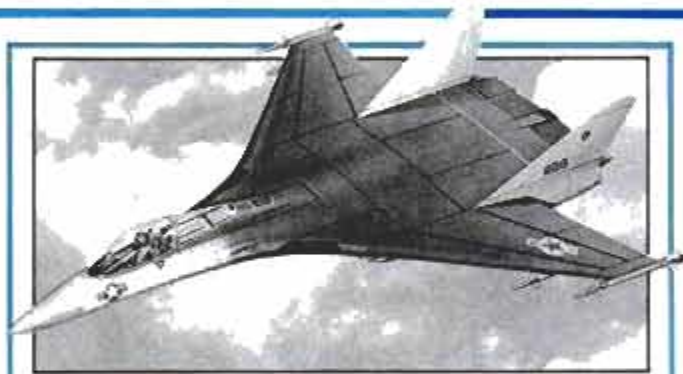
The missile, jointly developed by Italy's Oto Melara and France's Matra (hence the name Otomat), is used in conjunction with an airborne radar platform, such as a helicopter. Since radar waves do not bend with the Earth's curvature, shipborne tracking radar is useless beyond the horizon (about 21 miles). Another problem is that a fast-moving enemy vessel can be out of range by the time a conventional fixed-course missile reaches its original point of aim.

By contrast, the Otomat keeps changing course until it finds its target. The high-flying helicopter serves as the mother ship's radar eyes, enabling it to "see" a target over the horizon. After the missile is launched, the helicopter



SKI PLANE FOR DESERT SPYING

Most ski-equipped aircraft operate on snow, but not this one. A highly modified Air Force O-2 observation plane, it's designed to function in deep sand—the kind of terrain most likely to be encountered in the currently volatile Middle East. Its broad skis, plus fat tires, give it high flotation. The shrouded pusher prop keeps clouds of sand from being kicked up. Intended for covert surveillance patrol in desert regions, the craft is rumored to be of interest to Saudi Arabia and—not surprisingly—our own CIA.



FIGHTER FOR THE FUTURE

What the Air Force's next-generation fighter may look like is shown in the artist's impression above. The design is Rockwell's entry in the sweepstakes to pick the much-heralded ATF (Advanced Tactical Fighter). It uses stealth technology in a broad, flat, airfoil-shaped fuselage for maximum lift and minimal radar signature. Vectorable thrust nozzles tilt to provide enhanced directional control and to permit short-field landings and takeoffs. The ATF, when chosen, will replace the current F-15 Eagle in the 1990s.

1 HELICOPTER SPOTS TARGET VESSEL, RELAYS POSITION TO MOTHER SHIP OVER THE HORIZON

2 MOTHER SHIP (HIDDEN FROM VIEW) LAUNCHES MISSILE TOWARD APPROXIMATE TARGET LOCATION

3 HELICOPTER SENDS MIDCOURSE CORRECTION TO RE-AIM MISSILE



In test firings from an Italian frigate (above), Otomats scored hits at incredible ranges of 84 and 95 miles. The versatile missile also can be launched from mobile shore batteries to provide long-range coastal defense.

keeps tabs on both its course and the position of the enemy vessel. It then issues midcourse guidance corrections, causing the projectile to change direction as needed to follow the target ship as it moves. In the final phase, the missile can sneak in low at waveltop level, making it hard to detect, or climb and dive, striking from above.

The current Otomat has near-sonic speed (Mach 0.9) and a lethal range, with midcourse updates, of 100 miles. And if this isn't enough, a supersonic version is already in the works that will have twice the present range. While the U.S. Navy has no plans to adopt the Otomat itself (it has its own highly regarded Harpoon missile), the weapon is awesome enough to cause serious concern. Rattling sabers is one thing; rattling Otomats could be quite a different matter.



NEW HARRIER TAKES OFF

The U.S. Marines have begun a yearlong test of the latest Harrier jet—the McDonnell Douglas AV-8B. The Harrier II, as it's also known, takes off and lands vertically, like its predecessor, the AV-8A. But the new craft, seen in the foreground of the photo above, has 15 percent more ferrying range than the model it replaces. The Harrier II flies 2,000 miles with minimum payload and carries 9,000 pounds of payload, 4,000 more than the original. The jet in the background is an F/A-18, also built by McDonnell Douglas.

TECHNOLOGY UPDATE



Raining fire

The enemy is launching strafing attacks from land-based airfields. From a safe distance, you consider using scores of guided missiles to knock out the runways. This scenario prompted the U.S. Defense Department to look for a specialized missile system. Martin Marietta is working with the Air Force on its new counter-air missile (CAM).

Still on the drawing board, the device will sit in the rear end of a Pershing missile. As the missile points earthward and hurtles down, its fins open, creating a wobbly spin. As it twists, the missile body breaks apart, leaving just the CAM section with an elongated spear-like nose designed to keep the CAM headed downward. When the spin hits maximum, spring mechanisms are loosened and scores of projectiles are thrown away from the CAM body. Kinetic energy keeps them headed at high speed toward the airfield, where they explode. If the technology works, the system will limit the use of non-V/STOL jets in combat.

Editor: Dennis Eskow
Contributors: Sheldon M. Gallager, Jack Hammond,
Howard Levy, John Dornberg, Yvonne Michele Horn

INVENTIONS

Thor's broom sweeps the sea

The tool most associated with the Norse god Thor is a hammer. But the Thor we found patrolling the North Sea off the coast of Germany is an odd-looking split-hull ship that sweeps up after oil spills. The 250-ton, 114-foot-long vessel looks like two halves of a freighter joined together at the stern by a hinge. In fact, Thor is an acronym for Twin-Hull-Oil-Recovery ship.

Before Thor, oil slicks were cleaned up by using two tugs, spaced several hundred feet apart, to drag booms attached to a single catamaran. As the group moved forward, it would embrace the oil slick, letting the oil flow back toward the catamaran. The thick glob would then be sucked into a cleaning system and pumped into a tanker. The trouble with the boom system is the hulls of the catamaran remain high until the ship fills up. With the vessel riding high in the sea, the oil tends to escape under the catamaran. But Thor sits lower in the water. Twin 59-hp engines in the stern push the two sides apart. The oil is then sucked into heated tanks in which the water evaporates, leaving a thick fluid for recovery.



Thor's hull splits (above) to surround an oil slick and suck in the floating oil. The vessel travels as a normal freighter (left inset) until twin jet propeller engines in the stern (right inset) drive the two halves for cleanup operations.



New wings for flying businessmen

They may look a bit odd, but there's nothing fluky about the way they fly. The Omac 1 (top) and the Avtek 400 (bottom) are the first business aircraft to adopt the radical canard, or tail-first, configuration previously seen only on a few fighter jets and experimental sports planes. Both are small, sleek, high-speed turboprops designed to combine corporate luxury with fuel-efficient economy.

The canard, a forward-mounted stabilizer with elevators, is intended to increase lift and reduce drag by eliminating the negative, power-robbing

download imposed on conventional tail surfaces. Vertical wingtip fins, called winglets, help to convert drag-producing tip vortices into useful lift. The rear, pusher-prop installation provides a smooth airflow over the wings and minimizes noise.

The single-engine Omac 1 carries six passengers, does 300 mph and can climb at 2,000 feet per minute. The twin-engined Avtek 400 seats six to nine, climbs at a phenomenal 5,400 f.p.m. and has a top speed of 425 mph, making it the fastest corporate turboprop ever designed.



PORTABLE MONORAIL

It looks a little like a roller coaster, but the new monorail from Von Roll Habegger is quite tame. It can be built to any length, according to the company. For the smallest do-it-yourself system, you'd have to pay about \$2,500.



LIGHT CLEANING

Using a high intensity Xenon light, California physicist John Asmus (above) removes grime from old and delicate works of art. The light pulses vaporize surface material. But they don't remove the original detail from the art.

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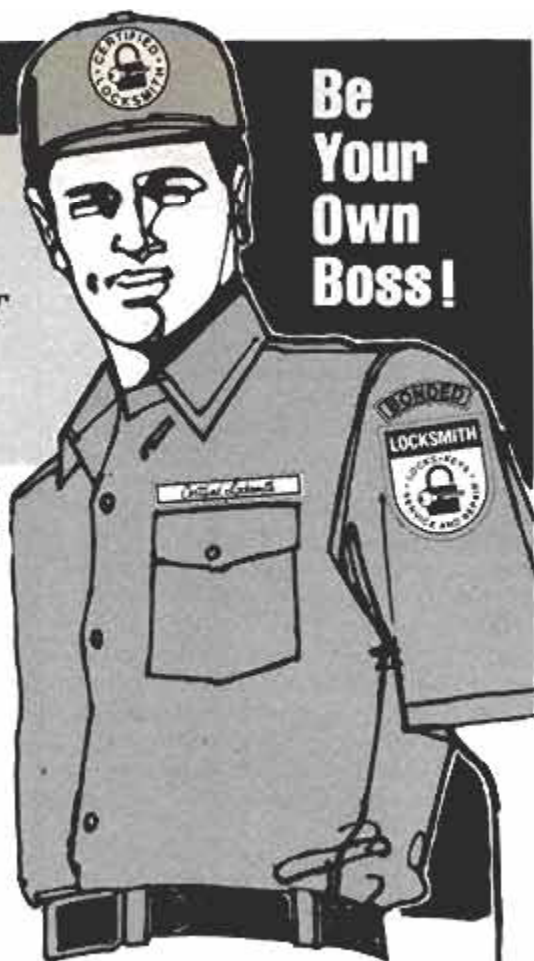
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David Fairbrother—Dave's Locksmith Service Milwaukee, Wisconsin 53209



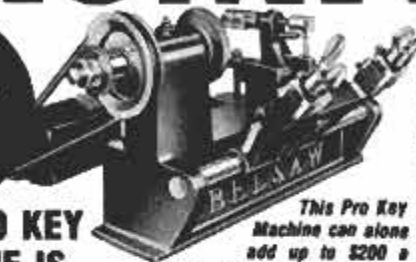
"I opened my own business, spare time, seven months after I enrolled and made a profit of \$329 for the first week."
B. A. Deberry Littleton, Colorado

"No more hard, nasty work for me. Now I have my own business and with hardly any effort I average around \$50 a day. Thanks for my new start in life."
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CORVETTE

(Continued from page 91)

engineers should have worried less about the digital instrument console and more about the too-quick steering, the too-stiff suspension and the too-long shift throws."

With the Z-51 suspension, the Corvette is virtually uncontrollable at high speeds anywhere but on a very smooth road or track. There's an intimidating amount of cowl shake. Suspension travel was sacrificed in order to minimize body roll.

As Auto Editor Wade Hoyt said, "I don't care about skidpad numbers; it's all over a rough road. Are you sure this is the handling suspension?"

After years of fielding complaints about too-slow steering, the engineers obviously decided to speed things up. Sam Posey complained that it was too quick even for the track: "It takes many laps to adapt to its suddenness . . . it's like a bobsled! Rough, sudden, heavy . . . a real plunger."

The whole interior design came in for especially harsh criticism. The Corvette seemed to have been styled by someone who'd never heard of ergonomics, or the human factors of engineering. Just about every control is in a willfully inconvenient spot, from the windshield wiper switch hidden in the door handle to the unlabelled power seat control buried in the center console. The removable glass hardtop takes four bolts to undo, rattles constantly and was labelled a "solar-powered passenger heater" on even a partially sunny day. As someone summed it up, "This is the most uncomfortable car I've ever been in."

Porsche 928S

If there is an overall winner of this comparison, it's Porsche's superb 928S.



Track test crew inspecting inner workings of the Corvette include (from left) writer Rich Taylor, racing drivers Skip Barber and Sam Posey, Auto Editor Wade Hoyt.

PM's Test Crew At Lime Rock Park

To bring years of high-speed driving experience to bear on our road test, we called on the two professional racing drivers who can be said to "own" Lime Rock Park. Sam Posey, from nearby Sharon, Conn., has been racing at Lime Rock for 25 years. He's raced just about every type of car there is, and today ranks as one of the premier endurance racers in the world. Sam is also a highly regarded development driver, valued by many racing teams for his ability to diagnose a car's behavior on the track. The day before our test, he was evaluating Paul Newman's Datsun race car at Lime Rock.

Skip Barber is equally at home at Lime Rock. His Skip Barber Racing School, headquartered in nearby Canaan, Conn., uses Lime Rock as its principal classroom. Skip is a multitime Sports Car Club of America (SCCA) National Champion and one of the few Americans to ever compete successfully in Formula One grand prix racing.

Rich Taylor is a frequent contributor to PM who organizes and executes many of our instrumented road tests. Rich is a former motorcycle and sports car racer. Wade Hoyt is our Auto Editor, and has 20 years of road test experience.

It was ranked first on the street portion of our test by a considerable margin, yet was only a tick behind the Corvette at the track. The 928S is the ultimate combination of performance and usefulness, awesomely good in every way.

The 928S is a cinch to drive fast. As

Skip Barber said, "Lovely. Smooth and powerful, with great response." Said Sam, "Gentle understeer in the fast bends and controllable oversteer in the slower ones make this a nearly perfect driver's car. Terrific brakes, clean aerodynamics and the highest top speed on

(Please turn to page 126)

SPECIFICATIONS AND DIMENSIONS

Car	Price (As Tested)	Vehicle Type*	Engine**	Transmission	Wheelbase (in.)	Overall Length (in.)	Curb Weight (lbs.)
Aston Martin Volante	\$115,000	4-pass. conv.	F.I. dohc 5.3 V8	3-speed auto	102.8	183.8	4,100
BMW 633CSI	\$39,374	4-pass. coupe	F.I. sohc 3.2 in-line 6	5-speed manual	103.4	192.7	3,300
Camaro Z-28	\$14,038	4-pass. coupe	Ohv 5.0 V8	5-speed manual	101.0	187.8	3,400
Corvette	\$25,609	2-pass. Targa	F.I. ohv 5.7 V8	4-speed manual	96.0	176.5	3,300
Ferrari 308-GTS	\$60,345	2-pass. Targa	F.I. dohc 2.9 V8	5-speed manual	92.1	174.2	3,300
Jaguar XJ-S HE	\$34,700	4-pass. coupe	F.I. sohc 5.3 V12	3-speed auto	102.0	191.3	4,000
Mercedes-Benz 380SL	\$43,820	2-pass. conv.	F.I. sohc 3.8 V8	4-speed auto	96.9	182.3	3,650
Mustang GT	\$9,871	4-pass. coupe	Ohv 5.0 V8	4-speed manual	100.4	179.1	3,000
Mustang SVO	\$15,970	4-pass. coupe	Turbo sohc 2.3 in-line 4	5-speed manual	100.4	179.1	2,800
Porsche 928	\$45,080	4-pass. coupe	F.I. sohc 4.7 V8	5-speed manual	98.4	175.1	3,300
Porsche 944	\$21,950	4-pass. coupe	F.I. sohc 2.5 in-line 4	5-speed manual	94.5	170.0	2,800

* All front engine, rear drive except Ferrari, which is mid-engine, rear drive.

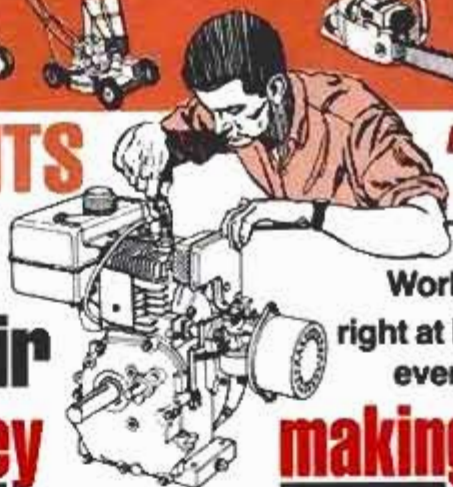
** Displacement is listed in liters; F.I. = fuel injected; sohc = single overhead cam; dohc = double overhead cam; ohv = pushrod overhead valves.

All vehicles have independent front and rear suspensions, with exception of Aston Martin, Camaro, Mustang GT and Mustang SVO; they have independent front and rigid axle rear.

All vehicles have vented disc brakes front and rear with these exceptions: BMW, Jaguar and Mercedes have vented disc front, solid disc rear; Mustang GT has vented disc front, drum rear.



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CORVETTE

(Continued from page 122)

the straight." Our testers were equally dazzled by the Porsche after they took it out for test drives on the street. "A great car," said one. "Very close to perfect."

Porsche 944

The littlest Porsche purred its way into our testers' hearts. It ranked high on everyone's list, and garnered second overall in our voting. You certainly couldn't predict that from the track numbers. The 944 was seventh around Lime Rock, third in braking and ninth or tenth in everything else.

What the 944 has that other cars don't is balance. It's not inexpensive, but it is \$3,659 cheaper than the Corvette. It's small on the outside, yet spacious and comfortable for two plus an occasional two more. It has lots of luggage space, terrific visibility and all the ergonomic thoughtfulness for which the Germans are famous. And it has just the right combination of characteristics to make it fun to drive. Said Sam, "You always have a sense of supreme control. In addition to good handling, you get controllable power . . . and the brakes are 100 percent."

Rich was just as impressed. "Excellent driving position, neutral handling, smooth engine, terrific shifter. I'd purchase this car and live happily ever after."

Skip was much more succinct. "MOST FUN," he wrote.

BMW 633CSi

"Smooth and precise, balanced and flexible . . . a real thoroughbred." "No vices." "The best all-rounder . . . practically perfect on road and track . . . does everything well." "Absolutely sensational."

Comments like these are typical of our testers' response to the 633. When all the votes were tallied, they'd put it third, behind the two Porsches, but ahead of the Ferrari and Jaguar. That's pretty heady company for what is essentially a rebodied BMW sedan with a few concessions to racetrack performance.

The BMW has all the finesse and balance of the Porsche 928, but not its overwhelming power. It's also far more livable and handier than the Ferrari or Jaguar. The 633 is sensational transportation for the real world of potholes, off-camber corners and rain-slick tarmac.

Racing a 633CSi is a dumb thing to do, though the car behaves impeccably. You can get in this car and drive all day with three passengers and a mountain of luggage at double the speed limit and arrive no more fatigued than if

you'd stayed at home. This is the very definition of a Grand Touring car.

Ferrari 308 GTSi/4

There really is something special about a Ferrari, something refined and memorable and good. We had the new quattrvalvole—which simply means the 2.9-liter V8 has four valves per cylinder instead of two—and it was just as quick as the much larger and more powerful Corvette and 928S.

The Ferrari is not only easy to drive fast, but fun. The exhaust note should be bottled and sold as a pick-me-up. The steering is heavy but accurate, and the handling is out of this world. Sam enthused: "Wonderfully smooth and tractable, approximates the easy feel of a good racing car."

Sam also brought up an interesting point about the contrasting philosophies of Ferrari and Chevrolet. "These two cars are both dream machines," he said, "but the Ferrari is all content, while the Corvette is more concerned with external appearances."

Alas, all is not serendipity with the 308 GTSi/4.

The interior is very close, the seats narrow, the seating position more like lying in bed. Ferrari drivers have to be as slim and athletic as the car, just to get inside.

Jaguar XJ-S HE

What a pleasant car the XJ-S has become. It's smooth and powerful, comfortable and quick, with enough luggage space for a well-heeled couple to set out on a summer-long tour. Of the cars in this group, the Jaguar XJ-S made the fewest demands on the driver.

According to Skip, "This is what a great American car would be like—fabulous ride, big lazy engine, comfortable interior. The Jaguar XJ-S is the best highway cruiser in this group." Said Wade, "Smooth performance. A very civilized car."

Everyone agreed that "the racetrack is no place for a car like this." On the other hand, this fish out of water was a remarkable fifth fastest around Lime Rock—just two seconds behind the 928S.

Our testers voted the Jaguar into fifth place for street driving, mostly because it feels a bit awesome around town. But it was the only car in this group about which there were no major complaints.

Camaro Z-28

Let's talk value. For \$14,000 you can buy an aerodynamic 2+2 GT that is only half-a-mile-per-hour and seven-tenths of a second slower than the winning Corvette in acceleration, second around the Lime Rock Big Bend, fourth

through the slalom and sixth around the road course.

Said Sam, "It's fun, fun, fun to drive this car. It's very well balanced in terms of oversteer/understeer, has good throttle response, excellent vision and even good lateral support in the seat."

There were only two weaknesses on the track: The shifter is very vague, with long throws, which Sam said "makes every shift an adventure." And the steering, like the Corvette's, is actually too fast even on a racetrack. Explains Sam: "This car has much more performance than its shifter and steering will let you use."

As a passenger car, the Camaro is far ahead of the Corvette in usefulness and creature comforts.

It has doors big enough to get in and out, headroom for an adult and seats in which you can sit. Its controls are designed for real people, not video game crazies. Compared to something like a Ferrari or Porsche, it'll be a lot cheaper and easier to maintain. The worst part of the Camaro is the plastic interior trim, which cheapens the whole car. It may not be the best production sports car in the world, but it's the best value for the money (\$14,038), hands down.

Mercedes-Benz 380SL

The 380SL is a dog at the track . . . slow and unimpressive, except for its excellent brakes. But drive it on the street and you'll be a believer. Said one tester, "The more I drive it, the better I like it."

As Sam explained: "It doesn't deliver the sensation of being a fast car, yet it's remarkably confidence-inspiring. I expect this would be an excellent car for long trips in bad weather."

Our other testers responded to the Mercedes in similar terms. "Classically Germanic . . . like my old Grundig radio . . . excellent ergonomics and fabulous craftsmanship."

Said Skip: "Extremely solid and safe. Wonderful on rough surfaces and, honestly, much nicer than I expected for a design that has been in production for over a decade." Wade got in the final word on its dated styling: "If the Corvette is Bo Derek," he said, "this is Shelley Winters."

Mustang SVO

The SVO is the familiar Mustang with a turbocharged, 2.3-liter Four and five-speed transmission, a spruced-up interior, revised grille and tail, "bi-plane" rear spoiler and extensive suspension work. This is a kind of modern-day Shelby Mustang GT-350.

The SVO may be just a hot-rod Mustang, yet it was only one-tenth of a second slower around Lime Rock than the

(Please turn to page 128)

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CORVETTE

(Continued from page 127)

Porsche 928S, which costs three times as much.

The SVO was also first in the slalom and fourth in acceleration, even though it had the smallest engine in this group. The one place where its plebeian origins showed was in braking, where it tied for last.

Of all the cars in this group, the SVO was the easiest to drive flat out, due largely to the shaved racing tires that Ford put onto the car they provided. These "cheater" tires, purposely worn nearly treadless, are illegal for street use, but can reduce lap times at Lime Rock by about 1/2 second, according to our experts.

As Sam pointed out, "Terrific adhesion from the tires and excellent suspension . . . the car is just *biting* the road like Velcro!"

Our testers weren't so sanguine towards the SVO for street driving. Their biggest complaint concerned the engine.

Instead of keeping the torquey five-liter V8 that's in the Mustang GT, Ford's Special Vehicle Operations has spent an immense amount of time and energy perfecting an intercooled, high-output, 2.3-liter Four that delivers acceleration identical to the V8, 20 percent worse fuel economy and absolutely no low-speed torque.

The SVO's other problems are inherited from the Mustang. The rear end is very light and loses traction easily on rough roads, the brakes aren't up to the performance of the car and the steering is so vague that Skip complained, "I don't think the steering wheel is connected to the tires." Said Wade, "Same problems as the Mustang GT, only to a lesser extent . . . still wanders over the road, still has axle hop on rough surfaces."

We all agreed that this is a terrific racing car, but one that's unsuitable and dangerous on the street because the turbo power comes on so suddenly.

Aston Martin Volante

We never came to grips with the Aston Martin. At \$115,000, it costs twice as much as a Ferrari, five times as much as a Corvette and ten times as much as a Camaro. And yet it was not only the worst performer at the track, but our least favorite car except for the Mustang GT.

Sam Posey was as perplexed as the rest of us. "What's going on here? Who buys these cars? This is the world's fastest truck."

Said another wit: "Not much of a machine considering the price. Antiquated in design and performance.

Very heavy in both feel and appearance. If I were Englebert Humperdinck, I suppose I'd love it."

Mustang GT

Ford wanted us to try only the SVO version of the Mustang. We wanted to see how it compares with the V8. While our other vehicles were supplied by the manufacturers, we borrowed our Mustang GT from Bill Kolb at Faulkner Ford in Blauvelt, N.Y.

The two Mustangs made for an illuminating comparison. The V8 was as fast as the SVO at the dragstrip, much more economical, noticeably better in braking and a substantial \$6,000 cheaper. It'll also be a lot less trouble to maintain, and is *much* more effective in street use. Since our test, Ford has introduced the GT with a four-shock rear axle and a more powerful version of the V8, which should make the GT markedly faster than the SVO.

Still, the Mustang GT was way out of its league in this group of cars, and our testers resoundingly voted it into last place. The problems are primarily suspension-related.

In a nutshell, the video game steering is much too light, with no road feel, and it wanders badly. The front suspension has too much compliance, not enough travel and improper geometries, so that rough roads induce almost uncontrollable bump steer. The rear end is very light and undershocked; thus, gross slides and axle tramp are a way of life.

The V8 makes more power than the chassis or brakes can handle, and on Lime Rock's smooth front straight it was literally impossible to keep your foot on the throttle as the car bounced up and down and darted from side to side. Our testers' comments included "This car is life-threatening," "dangerous in the hands of an inexperienced driver" and "a real kid-killer."

Our unanimous advice to the Ford Motor Company: Put the excellent SVO suspension under the GT V8 and forget about the 2.3 Turbo. Ford could sell that car for \$12,000, and have a worthy competitor for the Z-28.

The best sports car

It's not the new Corvette. If you have \$10,000 to \$15,000 to spend, we'd say buy a Z-28 Camaro. If you can swing \$20,000 to \$25,000, put your name on the waiting list for Porsche's superb 944. If your accountant is writing the whole thing off anyway, get the Ferrari 308 GTSi/4. If your wife is going to use it, too, see if she doesn't think the BMW 633 CSi or Jaguar XJ-S isn't the most wonderful car she's ever driven. And if you want to own "the best production sports car in the world," there is only one best—the Porsche 928S. **FM**

ULTRALIGHTS

(Continued from page 98)

today, but it was the first WWI fighter to mount a forward-firing machine gun synchronized with the propeller and proved so deadly that it became known to Allied pilots as the dreaded "Fokker Scourge." It was also the plane in which German ace Max Immelman developed the celebrated Immelman Turn—a deceptive half loop with a roll to upright at the top that enabled a pilot both to gain altitude and reverse direction in a single, swift maneuver.

The Eindexer and Jenny replicas are both historically accurate with only minor concessions to modern amenities. The original Eindexer used antiquated wing warping for roll control, whereas the reproduction employs spoilers operating as ailerons for added maneuverability. The Jenny uses spoilers in place of the original's ailerons because they're more effective at low ultralight speeds and produce no adverse yaw (negative turning force).

Both replicas will be available as kits, the Jenny for \$6,500 and the Eindexer for about \$5,500. Both are also the first in a planned series of authentic reproductions that will include other historic warplanes in ultralight form. We may even get to see the Red Baron's Triplane mixing it up with a Sopwith Camel or Spad.

The ultimate ultralight?

To see just how far ultralights have come, you have only to look at the NAC Dream, a startlingly realistic tri-gear cabin plane that, from a distance, might be mistaken for a \$40,000 Cessna. Its 32-foot wingspan is, in fact, only inches shorter than that of a real Cessna 150 or 152.

The Dream is the work of Jim Bede, noted designer of the famous though financially troubled BD-5 sports plane of the early '70s. Now Bede is back with what he's convinced could be the ultimate ultralight—an affordable plane that anyone can fly, much like the legendary Piper Cub was intended to be half a century ago.

Like past Bede creations, the Dream is crammed with sophisticated engineering. Slots in the leading edge of the wing channel airflow up and over the top, providing increased lift at high angles of attack and delaying wingtip stall. This keeps the ailerons effective even when the inboard wing sections stall out—a safeguard sure to be appreciated by untrained pilots who may not recognize when a stall is coming. The slots do generate some drag, but who cares in an ultralight that can't be legally flown faster than 63 mph anyway?

The ailerons have a 2-to-1 differential, moving up twice as far as down, to

minimize adverse yaw. There are also spoilers for killing lift when you don't want it. Their control lever is positioned so it can be reached only by the same hand that works the throttle. Thus, you can't accidentally operate both spoilers and throttle at the same time—a clever idea. The gas tank is located right on the center of gravity so there's no trim change as fuel weight is burned off—another thoughtful touch. For power-off soaring, the prop can be disengaged so it windmills freely to reduce drag. The NAC Dream will be sold ready to fly for about \$7,200.

Stallproof biplane

Another new ultralight that could easily pass for a real airplane is the spectacular Sorrell Hiperlight, a fully enclosed, negative-stagger biplane that recently won the Experimental Aircraft Assn.'s Best New Ultralight Design Award. The negative-stagger arrangement—lower wing set ahead of the upper wing—provides superb forward and upward visibility, especially welcome in steeply banked turns. It also permits one wing to remain flying after the other stalls out, reducing the danger of a full-stall condition in much the same way as does a forward-mounted canard.

The Sorrell Hiperlight has full-span flaperons in the lower wing, is powered by a 28-hp engine, and will be sold completely prefabricated for \$8,500 or as a kit for \$6,500.

In fairness to others in the ultralight movement, it should be noted that not everyone agrees with the new wave of realism that's sweeping the scene. Some argue that ultralights are *not* airplanes and shouldn't try to look like them—that their charm lies in their quaintly graceful, gossamer quality, and never mind all those wires that hold them together. In any case, whichever way your sentiments may lean, there's plenty of room for all tastes in this, the biggest-booming phenomenon in sport aviation history.

Now along come ARVs

Meanwhile, another new class of sports plane is also emerging—the so-called Air Recreational Vehicle, or ARV. Viewed as the next step up from ultralights, ARVs are true airplanes, subject to FAA regulation, but restricted to a maximum weight of 350 pounds. Within this limit, they can be as fast and wild as your engineering ingenuity can make them.

The idea behind the ARV formula is to combine the low operating cost and structural simplicity of an ultralight with the higher performance of a real airplane. ARVs use essentially the same small, light, economical engines

(Please turn to page 130)

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ULTRALIGHTS

(Continued from page 129)

as ultralights, burning less than two gallons of fuel an hour. Yet they're more stable in rough air, can perform aerobic maneuvers that would be considered unsafe in most ultralights and, in some cases, boast speeds in excess of 100 mph.

Groups support ARVs

While ARVs lack official status (they're not governed by any formal body), they do have the support of such prestigious organizations as the Experimental Aircraft Assn., the Aircraft Owners and Pilots Assn. and the Kevlar Div. of DuPont. Some of the new designs the concept has stimulated are shown on page 98 (see *New ARVs: Half Ultralight, Half Airplane*).

One example of just how far you can go with an ARV when you put your mind to it is the award-winning Star-Lite, a smart-looking, low-wing single seater that does a sizzling 110 mph on a tiny 20-hp engine. Its weight: a scant 195 pounds, less than that of most ultralights. It not only took top honors in a recent ARV competition, but also received the Experimental Aircraft Assn.'s Outstanding New Design Award.

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ULTRALIGHT/ARV SOURCES

- **Acro-X:** Light Aircraft Design Inc., Box 474, San Andreas, Calif. 95249 (info pack \$7).
- **Aerodique Parasol:** Yesteryear Aviation, Box 12151, Wichita, Kan. 67277 (info pack \$8).
- **Avid Flyer:** Light Aero Inc., 615 East 44th, Bldg. No. 8, Box 45177, Boise, Idaho 83711 (info pack \$6).
- **Fisher Koala:** Fisher Flying Products Inc., Rt. 2, Box 282, South Webster, Ohio 45682 (info pack \$5).
- **Fokker Eindecker:** The Airplane Factory Inc., 7111 Brandtville Ave., Dayton, Ohio 45424 (info pack \$2).
- **Hovey Delta Hawk:** Aircraft Specialties, Box 1074, Canyon Country, Calif. 91351 (info pack \$6).
- **Jenny:** Cloud Dancer Aeroplane Works, Box 14202, Columbus, Ohio 43214 (info pack \$5).
- **NAC Dream:** National Aircraft Corp., 1060 Valley Forge Plaza, King of Prussia, Pa. 19406.
- **Questor:** Omni Weld, 10700 South Freeway, Fort Worth, Tex. 76140 (info pack \$10).
- **Sadler Vampire:** American Microflight Inc., 7654 East Acorn Dr., Scottsdale Airport, Scottsdale, Ariz. 85260 (info pack \$5).
- **Sirocco:** Atlantic Business Organizations Inc., 845 3rd Ave., New York, N.Y. 10022 (info pack \$2).
- **Sky Pup:** Sport Flight Engineering Inc., Box 2164, Grand Junction, Colo. 81502 (info pack \$5).
- **Somethin' Else:** Ultralite Soaring Inc., 3411 Northeast 8th Terrace, Pompano Beach, Fla. 33064.
- **Sorrell Hiperlight:** Sorrell Aircraft Co., 16525 Tilley Rd. S., Tenino, Wash. 98589 (info pack \$10).
- **Star-Lite:** Star-Lite Aircraft Co., 2219 Orange Blossom, San Antonio, Tex. 78247 (info pack \$5).
- **Sun Ray:** Sun Ray Aerospace Corp., Box 317, Napanee, Ind. 46550.
- **Topo Scout:** Topo Aircraft Co., 1401 Offshore, Oxnard, Calif. 93033 (info pack \$6).
- **Zipper CL-1:** Cleary Aircraft Corp., Suite 100, 6600 North Harvey, Oklahoma City, Okla. 73116.
- **Zippy Sport:** Fishercraft Inc., 4356 Narrows Rd., Perry, Ohio 44081 (info pack \$6).

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TECHNOLOGICAL INNOVATIONS

Aerodynamic, structural and propulsion systems innovations have led to the design and production of over 60 different STOL (Short Take Off and Landing) aircraft. These revolutionary machines, called ultralight air vehicles, are controlled by three-axis aerodynamic systems. NASA and university developed airfoils, as well as new materials -graphite/fiberglass/epoxy composites and



Amphibious "SunRay" uses advanced composite construction, along with unique aerodynamics.

DuPont Kevlar - made the new technology possible. Refined rotary, 2-cycle and 4-cycle engines have been built for the airframes.

The successful development of these vehicles, together with engineering analyses, load tests, computer aided design studies, wind tunnel tests, and actual flight testing... has led to the creation and optimization of lightweight, compact air vehicles for consumer use.

BREAKTHROUGH IN PERSONAL TRANSPORTATION

Most importantly, ultralights need not be registered, nor do you need a license to fly them. These vehicles are not only very low in cost, but also the easiest to fly. Many can takeoff and land in less than 100 feet on land

and water. Instead of wasting time in traffic jams, you simply fly over them - a real breakthrough in personal transportation.

With foldable wings, the garage becomes your hangar. Many owners actually fly from their backyards. Furthermore, these vehicles are very inexpensive to operate, and burn regular automotive gasoline at miserly rates.

The various designs available will suit any aesthetic appeal and performance requirements. You can either build them from kits, or simply buy them factory-built. They can be purchased and flown by anyone. Personal flight is no longer just for the rich.

TYPICAL SPECIFICATIONS

Cruise Speed	30 - 63 MPH
Rate of Climb	600 - 1200 FPM
Takeoff Distance	100 FT
Landing Speed	25 MPH
Ceiling	10,000 - 21,000 FT
Range	100 - 300 MI
Empty Weight	254 LBS
Payload	250 LBS

MORE DETAILED INFORMATION

Those wishing further information on these revolutionary vehicles are urged to contact Ultralight Publications, Inc. In cooperation with the industry and M.A. Markowski, AE (Ultralight Consultant), the corporation has produced three authoritative, heavily illustrated books. Learn about the dramatic impact the new vehicles will have on travel.



Mitchell "B-10" flying wing was tested by the Navy. It's fast and very fuel efficient.

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FREE CATALOG

ULTIMATE TELEPHONE

(Continued from page 102)

tion. Their range can vary from 100 to 1,500 feet, depending on the antenna system used and weather and atmospheric conditions.

A typical portable is the Uniden EX-2600. It has such features as last-number redial, which allows the phone to keep dialing a number if it was busy the first time; high and low volume, so you can hear conversations in noisy environments; rechargeable batteries; and tone paging. It also allows you to cancel a call at the push of a button.

These features are common to most portable phones, although some have other bells and whistles, such as frequently dialed number storage and intercom capability. Another common feature is a battery-save option, which places the phone into low-power mode when it is deactivated.

Portables do offer a great deal of convenience, but have two primary drawbacks—limited frequency space and the potential for piracy of your telephone service. Although the Federal Communications Commission is acting to expand the number of frequencies, portables are still limited to five chan-

nels between 1.6 and 1.8 MHz and five channels in the 49 MHz bands.

With so few channels available and with hundreds of thousands of portables in the hands of the public already, these frequencies are overcrowded to the point of bursting. This can create an interference problem if you live in a neighborhood where there are many portables. You may hear conversations you weren't expecting when you activate the phone. Although the new frequencies should help alleviate this problem, the manufacturers are also taking steps against it by providing alternate channels to which you can switch at the touch of a button if interference is present.

Further, in the 1.6 to 1.8 MHz band, electric motor noise, power line noise, AM radio station and other forms of interference can raise havoc with reception and transmission. The new frequencies should help alleviate this problem.

Of more importance to you and your phone bill is piracy. In some cities, people drive up and down the street with a portable phone handset activated, waiting for it to find a waiting base station. When they hear the dial tone, these

(Please turn to page 142)

Ma Sets The Kids Free

January 1, 1984, will be a momentous day. Bigger than New Year's, the Super Bowl or the Rose Parade. It's the day Ma Bell breaks up and passes into history, with AT&T and seven independent telephone operating companies to take her place.

Although it may strike you as something that's brand-new, it isn't. It really began in the late 1960s as the Justice Department looked into Ma's dominant position in the marketplace. This action began a long, drawn out court case that was settled two years ago. That settlement initiated the breakup of the phone system into competitive units.

It wasn't really noticeable during much of 1981 and 1982 because the phone companies, AT&T and the courts were involved in working out the problems of the settlement. However, about the beginning of last year it started to become more noticeable, especially in the consumer market.

Instead of just urging people to "reach out and touch someone," AT&T began competitively pushing telephones. It wanted you to "own your own phone." We were also given the option of purchasing the phones already installed in our homes. (We have had the right to tie our own phones into the phone system since the Carterphone decision of 1977.)

But this advertising is just the tip of the iceberg. For starters, the way we do business with the phone system will change. We have long taken service on the phone system for granted, but now we will be

facing large charges for service calls (some have speculated as much as \$35 to \$50). And, instead of having a friendly serviceman appear to help with a problem, we will probably be advised to A) bring the phone to a service center or B) call AT&T.

The settlement splits the responsibility for phone service. AT&T controls renting and service of phones and access to long-distance service, while the local system retains control over the phone lines. This creates an added layer through which the customer must wade.

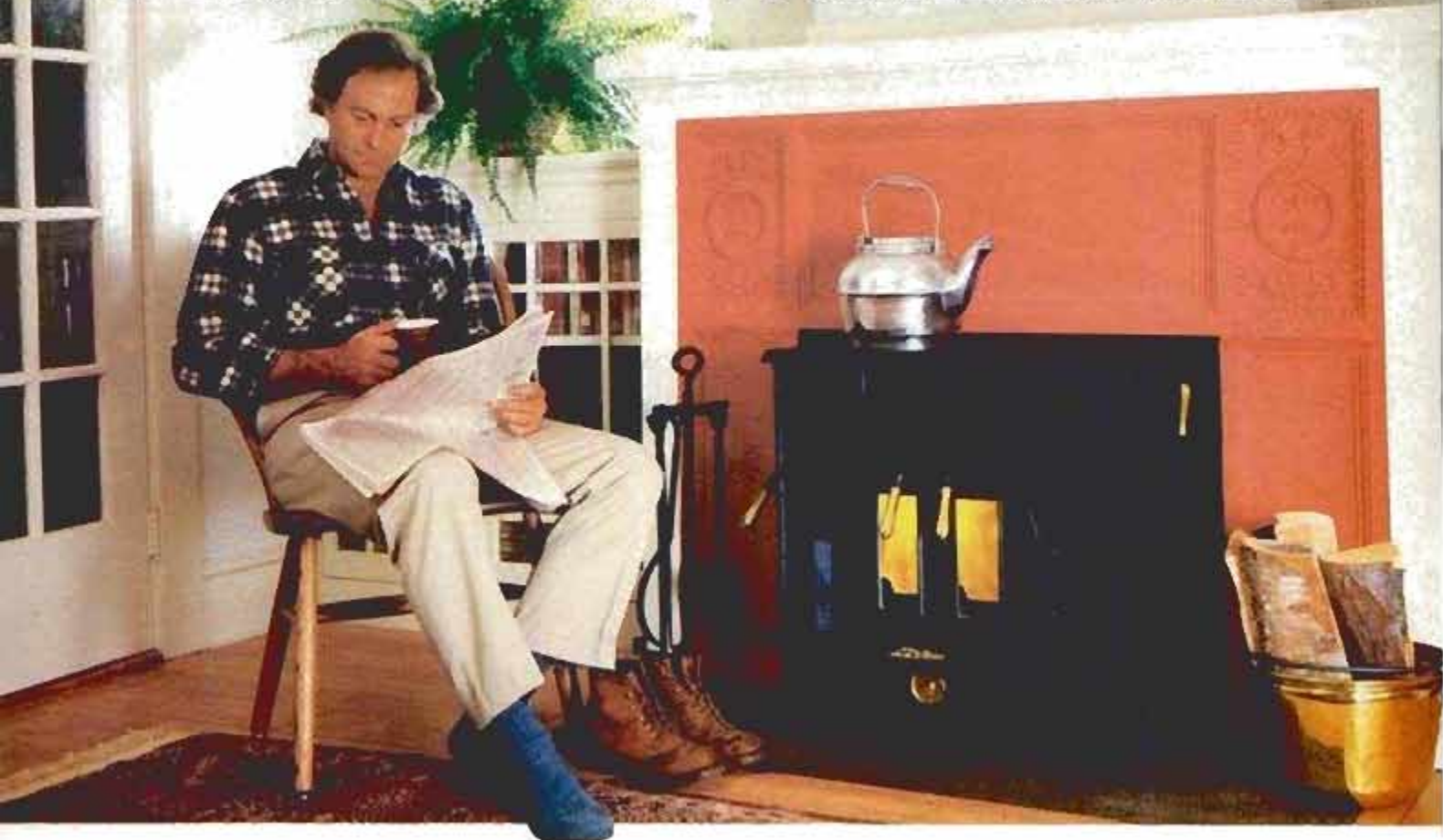
Further changes will come in our monthly phone bills. When AT&T controlled the whole show, long-distance service subsidized a great deal of local service. However, with the changes, the local phone companies are deprived of this source of revenue, resulting in an increase in local service charges. Businesses will face a monthly access charge.

Also, since there are now sharp dividing lines in service coverage, some services we have taken for granted such as unlimited intrastate calling may be drastically curtailed, as will special cross-area code plans. Further, the phone company may raise the cost of the 10 cent call and may eliminate service in unprofitable areas.

As you can see, there are some changes ahead.

On the brighter side, though, we can probably expect a decrease in long-distance phone rates and easier access to long-distance services such as Sprint and MCI—M.S.

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More and more Americans are turning to wood and coal to reduce their heating bills. In homes from Maine to Montana, thousands of Consolidated Dutchwest stove and fireplace owners are saving 50% to 70% and even 90% on their heating bills. Comfort? The kind you used to take for granted. Start saving *this* year. Send for your FREE catalog of our complete line of *cast-iron* stoves and fireplace inserts today!



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UNHEARD WORDS

I would like to say at this time I'm at a loss for words where my monster maul is concerned. One of your customers described it well, "Find me a place to stand and I'll split the world." One thing I never expect to read in the Sotz News is someone ordering another maul because he wore his out! I haven't had a chance to fire up my stove yet but by following your directions it was a piece of cake. In this competitive world today it's indeed a pleasure to deal with a company such as yours. Your products are exactly as stated and your prices very reasonable. As for the guarantees, they are almost unheard of elsewhere. I'm really looking forward to my new cart. There's still a lot of firewood to be moved to the pile. Keep up the good work.

Charles Abbott, Absecon, NJ

SPLITTING MACHINE

I have used your Monster Maul for two years with outstanding results. I know of nothing that can compete with this device in curly or difficult wood-except possibly dynamite! Wood cutting would be much more burdensome if I weren't able to split the big stuff in the woods so I can get it out much easier. This is a real wood splitting machine. I think I could out-split a mechanical splitter especially if the wood was curly or knotty. I see you now have a lady maul for splitting clear wood and small stuff. . . So we are going to order one. I feel if I can't split it, I'll bash it into kindling! Jackie E. Allen, Warsaw, Oh.

CLEAN SPLIT

I compliment you on manufacturing a splitting maul that exceeded my strongest hopes. It works like nothing else I've ever used. I used it on oak logs 20" long and ranging up to 24" in diameter, and it split them cleanly with one swing. It out-performed wedges so much that I no longer even bring wedges along when splitting wood. You have an excellent product. Your idea of incorporating a steel handle, instead of the usual ash, makes it a tool that I'm sure will last for my lifetime and my children's.

George L. Voss, Portland, Ore.

HYDRAULIC CHALLENGE

I have easily split several cords of firewood consisting of white oak, cherry, poplar, and maple, all with amazing speed and with minimal physical exertion. I've even participated in a "Sportsman's Challenge" against a hydraulic splitter, against which my...maul proved much faster. My only regret is I have now sold the maul to the owner of the gas powered hydraulic splitter, who was completely amazed by its performance. During these times of phony advertising and cheap workmanship, I am truly thankful to find a firm who is honest and sincere and provides quality products.

David A. Hojnacki, Monroe, Mi.

EQUALLY SMART

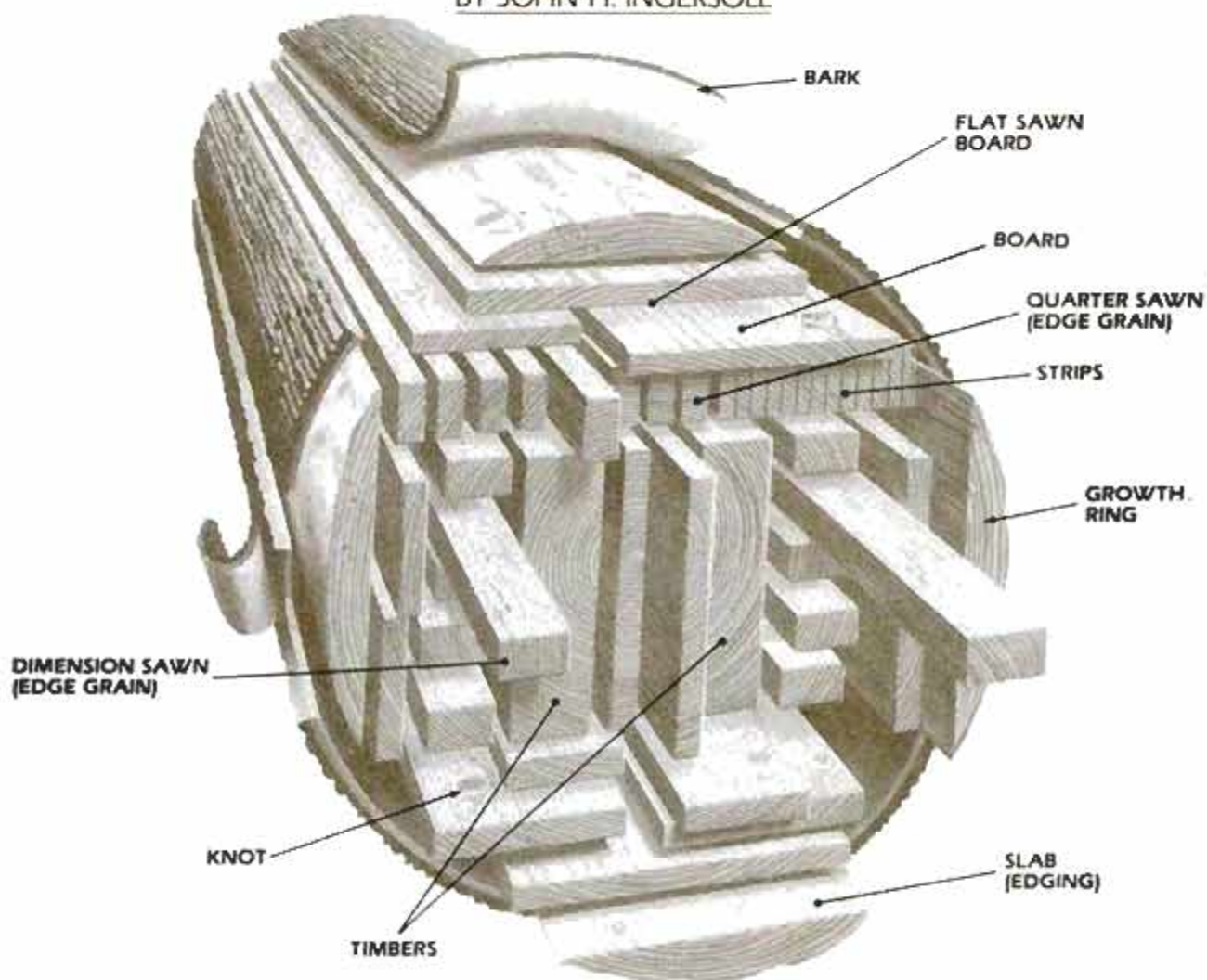
I am pleased to order one of your famous Monster Mauls. I have used one in the past and found it to be unequalled in strength, durability and ease of use. Your ad says there is no need to be a strong man; that's for sure, because I'm a woman!

Cynthia Smith, Bristol, Vt.

PICKING THE BEST LUMBER

The wood you work determines the results you get—
buying wrong can ruin the best craftsmanship.

BY JOHN H. INGERSOLL



Do you judge lumber by looks? Walk up to a bin of 1x8s and pick out the two or three that please your eye? If you do, you're in the majority.

When I built my first coffee table, I checked out boards by surface appearance, grain and color. I didn't know or care whether it was B&H, Sterling or Clear. It didn't matter to me whether it was western pine, eastern hemlock or cedar. Appearance should be important in any lumber-buying decision. Yet, knowing how wood is graded, how different species perform, what's commonly stocked in what sizes, and the way lumberyards will or won't serve you could save money—and still get you great wood for your project.

Rough lumber is wood as it comes out of the saw. It has loose fibers and saw-tooth marks. Rough wood costs a little less than lumber that is dressed.

Dressed wood is the rough lumber that's been run

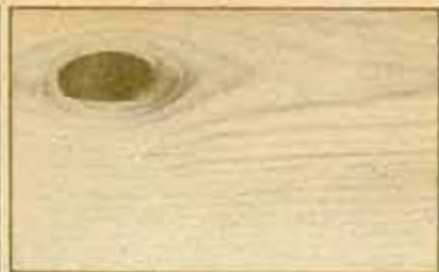
through a planer. All four of the long sides are smooth.

Worked lumber is any wood shaped for a specific purpose. Tongue-and-groove floorboards are examples, as are grooved paneling and ogee base moldings.

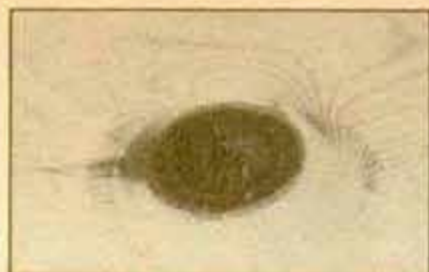
There are only two basic kinds of wood: softwood and hardwood. Easily 90 percent of the wood sold is softwood. Cut from conifers (pine, spruce, hemlock and so on), it's the backbone of construction, most projects, home repairs and improvements.

Hardwoods cut from deciduous (leaf-dropping) trees like oak, maple and walnut go into fine furniture, knife handles and cabinetry. As more craftsmen take on these kinds of projects, more yards stock hardwoods. There are also many wood specialty mail-order sources, such as Albert Constantine, 2050 Eastchester Rd., Bronx, N.Y. 10461.

Actual softwood sizes refer to the dimensions of



Intergrown knot, also called tight or red, was a branch that grew into trunk.



Checked knot shrank unevenly as wood dried, creating cracks along its grain.



Spike knot was cut nearly parallel to the grain of the branch, weakening board.



Unsound knot has surface damage, but it's tight and weakens timbers very little.



Encased knot is not firmly fixed. It's formed by an embedded branch stub.



Sloughed knot was outer section of spike knot that separated near the edge.

dressed lumber. A nominal 2x4 is very close to 2 in. thick and 4 in. wide when cut from the log. Planed smooth, the numbers come down to 1½ x 3½ in. When you plan a specific project, always work with the actual dimensions of the lumber you'll be using. At that stage, it doesn't matter what the standard sizes are, you care about what you've got.

Measurements for redwood are different, but not by much. Clear, All-Heart and B grades are planed to the same dimensions as other softwoods, but there are two exceptions: A ¾-in.-thick redwood board is surfaced to 11/16 in. and an 8-in. wide board measures 7½ in. instead of 7¼ in. A garden-grade redwood 2x4 actually mea-

sures 1⅞ x 3⅞ in. because it's shaped green and shrinks as it dries.

Hardwood usually is not stocked in easily identifiable sizes at the yards, but check the mail-order houses. If local yards stocked ½-in. boards, two buyers a year might ask for them. A standard 1-in. board can be planed to satisfy many customers requiring differing thicknesses.

Lumber is offered in even-numbered widths and lengths. If you want a 1x7, the yard will rip a 1x8, charge you for the 1x8, add a cutting charge and give you the sliced-off strip—or you can take home the 1x8 and rip it yourself.

Charges for cutting or planing are not consistent. Some

WOOD SELECTION CHART

A = High

B = Medium

C = Low

Species	Ease Of Working	Freedom From Warp	Heartwood Resists Decay	Bending Strength	Stiffness	Strength As A Post	No. Of Knots	No. Of Other Defects
White Ash	C	B	C	A	A	A	C	B
Western Red Cedar	A	A	A	C	C	B	C	C
Eastern Red Cedar	B	A	A	B	C	A	A	C
Cherry	C	A	A	A	A	A	C	'
Cypress	B	B	A	B	B	B	C	B
Douglas Fir	C	B	B	A	A	A	B	B
Eastern Hemlock	B	B	C	B	B	B	B	A
Western Hemlock	B	B	C	B	B	B	B	B
Hickory	C	B	C	A	A	A	B	B
Western Larch	C	B	B	A	A	A	A	A
Hard Maple	C	B	C	A	A	A	B	B
Soft Maple	C	B	C	C	C	C	C	C
Red Oak	C	B	C	A	A	B	C	B
White Oak	C	B	A	A	A	B	C	B
Ponderosa Pine	A	A	C	C	C	C	B	B
Southern Yellow Pine	C	B	C	A	A	A	C	B
Northern White Pine	A	A	C	C	C	C	A	B
Sugar Pine	A	A	C	C	C	C	A	B
Idaho White Pine	A	A	C	B	B	B	A	A
Redwood	B	A	A	B	B	A	C	C
Eastern Spruce	B	A	C	B	B	B	A	B
Sitka Spruce	B	A	C	B	A	B	B	B
Engelmann Spruce	B	A	C	C	C	C	A	B
Walnut	B	A	A	A	A	A	C	C

*Depends on use.



Machine burn leaves a black, charred mark that can usually be sanded out.



Pitch pocket is a seam or streak that holds or once held solid or liquid resin.



Wane is bark or missing wood along the edge of a board cut too near log surface.



Grub holes bored by insects while tree was alive weaken and mar finished board.



Peck are pockets of dry rot in living trees. They are mostly in cedar and cypress.



Compressed wood is on low side of leaning softwood tree. It can be brittle.

yards tack on a small charge for each pass through the saw or planer. Others give you the first few cuts free, and some may cut to length free. Suburban and rural yards rarely cut lumber to project specs. City yards, catering to apartment-dwellers who often have no space for power tools, saw to a fraction of an inch.

Lumber language

A *board* describes any lumber less than 2 in. thick and 1 in. or more wide. A board less than 6 in. wide is called a *strip*. *Dimension lumber*, the backbone of house construction, includes pieces from 2 in. thick up to but not including 5 in. thick, and 2 in. wide or more. *Timbers* are heavy

If the size you want isn't priced by the piece, it's probably sold by the linear foot. A typical recent price for No. 2 Idaho white pine 1×10s was 80 cents per linear foot or \$9.60 for a 12-ft. board.

If you find a yard that does sell by the board foot, here are two ways to figure it: 1. Multiply thickness in inches by width in inches by length in feet and divide by 12. 2. Multiply thickness, width and length in inches, then multiply the result by .007. Example: A 10-foot 2×4 by method No. 1: $2 \times 4 \times 10 = 80 \div 12 = 6.7$ board feet. Or, by method No. 2: $2 \times 4 \times 120 = 960 \times .007 = 6.72$ —close enough.

Reduced to essentials, a good-looking piece of wood grades high, a scruffy one, low. Top grades are clear, showing few tiny knots or none at all. High grades have no checks, splits or blemishes. As boards come lower on the grade scale, allowable knots become progressively larger, and other imperfections increase in size, number and importance.

Construction lumber is graded on strength as well as appearance. It's guaranteed to perform as span and stress tables indicate. A 2×4 graded stud may look like a throw-away, but, if it's officially graded, it will bear the weight specified for its size and species.

When grain is important

Graining counts if you're buying wood for a fancy project. Boards for an edge-glued tabletop must be perfect. First, you want good looks. Second, you need a *straight-grained* board cut at right angles to the growth rings in the log. These *quarter-sawn* boards are more dimensionally stable as humidity changes. A *face-grain* board, displaying long loops of grain on the widest wood surface, is *plain sawn*, cut near the edge of the log on a tangent with the growth rings. It may show pretty grain patterns, but it's more apt to warp or change size as humidity changes.

Grade marks are stamped on most dimensional lumber and many boards. No particular spot has been standardized and it's often missing from top grades of finished lumber. You can easily sand it off if it will show on your finished project.

As with anything else, when buying wood, shoot for the best quality at the lowest price. If a lower grade is suitable, there's no reason to pay more for a better grade. You don't need clear pine at \$2.90 per linear ft. for a toy chest

SOFTWOOD LUMBER SIZES*

Thickness (in.)		Width (in.)	
Nominal Size	Actual Size	Nominal Size	Actual Size
3/4	3/8	2	1 1/2
1/2	7/16	3	2 1/2
5/8	3/8	4	3 1/2
3/4	5/8	5	4 1/2
1	3/4	6	5 1/2
1 1/4	1	7	6 1/2
1 1/2	1 1/4	8	7 1/4
1 3/4	1 3/8	10	9 1/4
2	1 1/2	12	11 1/4
2 1/2	2	Even numbers over 12	3/4 off nominal
3	2 1/2		
3 1/2	3		
4	3 1/2		
5 and over	1/2 off nominal		

*Kiln-dried or air-dried lumber. Moisture-laden green lumber sizes are from 1/4 in. to 1/2 in. larger.

structural members. Their smallest dimension in any direction is 5 in.

Yards order lumber by the board foot. There was a time when you had to do the same, but now, especially in the big cash-and-carry yards and home centers, lumber is sold by the piece. Grossman's, a large New England lumber chain, recently put 8-ft. 2×4s on sale at \$1.53 each. These were Stud Grade—you pick the straightest.

you plan to paint when you can get No. 2 pine for 99 cents or even No. 3 for 75 cents. Just seal the knots with a pigmented shellac and paint over them. No one but you will know the difference.

For small projects, check the pieces in the bargain bin. It will be filled with shorts cut from longer pieces. You may find everything you need at prices reduced from 30 to 50 percent from full-size boards. Compare prices. If you have a good table saw capable of ripping a 1x12 into three 1x4s, you might be able to save.

Use longer boards. Say you need two 1x8s 7 ft. long. Two 8-ft. lengths of No. 2 pine might be \$10.24 while a single 14-ft. length lists for \$8.96. Given the right equip-

ment, you'd be better off gluing up narrow boards to make a wide piece.

Be a little flexible. If you have your mind set on Douglas fir to frame a garage, you might be able to get it easily at one yard, but not at another. Settling for spruce, also plenty strong for the job, could save you a long haul to get the fir.

Spend a little spare time in a lumberyard. Get to know what they have before you draw up plans for a project. That way, you can avoid disappointment. Besides, I have to admit, I get almost as big a boot out of wandering around a lumberyard as I do from poking through the merchandise in a hardware store. You may, too. **PM**

How To Convert A Materials List To A Buying List

Most project materials lists are not lumber shopping lists. You've got to translate the materials list into a certain number of 1x10s by so many feet long, and so on.

Converting the materials list taken directly from the plans into a lumber-buying list serves two purposes. It produces your shopping list and allows you to figure out exactly how you're going to cut and assemble the project.

Keeping in mind that wood is sold in even-numbered lengths and widths, start making your list by writing the materials required for each part in one column and the standard stock measurements closest to these numbers in the second column. Leave room for a third column for your actual order.

Using the in-the-wall workshop (*Build PM's In-The-Wall Workshop*, page 126,



Apr. '83) as an example, you see that the first item calls for four boards 3/4 x 11 1/2 x 76 in. The closest standard yard size is 3/4 x 12 x 96 in. (8 ft. long). This goes in the second column.

The third column becomes your actual order. The first two items are for 3/4 x 12-in. boards. You could order four 8-ft. lengths for the first entry and three more for the second. Or, you could cover both with four 12-ft. lengths. Compare prices. At one yard, seven 8-ft. 3/4 x 12s cost \$81.20 in clear, all-heart redwood KD (kiln-dried). Four 12-footers are \$75.20.

In all cases, group smaller boards for your order, remembering that it may pay to rip a wider board to make two or more narrower ones. For example, 3/4 x 2-in. stock appears in five entries. Few yards stock it. Combine these into 3/4 x 4-in. stock and rip the boards in your shop or have the lumberyard do it.—J.H.I.

MATERIALS LIST—IN-THE-WALL-WORKSHOP

Key	No.	Size and description (use)	Key	No.	Size and description (use)
CABINETS (2)					
A	4	3/4 x 11 1/2 x 76" redwood (cabinet side)	K	4	3/4 x 5 1/2 x 76" redwood (door side)
B	11	3/4 x 11 1/2 x 22 1/4" redwood (top, bottom, shelves)	L	13	3/4 x 5 1/2 x 22 1/4" redwood (top, bottom, shelves)
B1	1	3/4 x 8 x 22 1/4" redwood (hinge shelf)	M	2	3/4 x 23 1/4 x 76" redwood, edge-joined (door front)
C	1	1/2 x 3 x 21 1/2" hardwood (hinge cleat)	N	2	3/4 x 1 1/4 x 21 1/2" redwood (rail)
D	2	3/4 x 23 1/4 x 76" redwood, edge-joined (back panel)	O	2	3/4 x 21 1/2 x 28 1/2" Peg-Board
E	1	1 1/2 x 3 x 45" redwood (base front)	P	6	3/4 x 1 1/2 x 27 1/2" furring strip (Peg-Board frame)
E1	2	1 1/2 x 3 x 8" redwood (base sides)	P1	4	3/4 x 1 1/4 x 21 1/2" furring strip (Peg-Board frame)
F	2	3/4 x 1 1/4 x 21 1/2" redwood (rail)	Q	2	3/4 x 1 x 2 1/2" redwood (catch plate block)
G	2	3/4 x 20 x 37" oak plywood (tabletop veneer)	Q1	2	Heavy-duty magnetic catches
G1	1	3/4 x 20 x 37" fir plywood (tabletop core)	R	2	Brass door handles, Amerock No. B9 302BB
G2	2	1 1/2 x 1 1/4 x 37 1/2" redwood (edging)	Misc.: Carpenter's glue, 8d common nails (to attach cabinet backs), 1 1/2" No. 8 fh screws (to attach shelves), 1" No. 6 fh brass screws (to attach table hinge to shelf B1), 2" No. 14 fh screws (4, to secure unit), 3/8 x 1 1/2"-dia. wood plugs, 3/8 x 1/2 x 76" plywood splines, 1 standard electrical outlet box, 3/4 x 3 1/4" capscrew with washer and nut (for installing lamp bracket).		
G3	1	1 1/2 x 1 1/4 x 20" redwood (edging)	Note: Use nominal 3/4" clear all-heart KD redwood (actual dimension: 1 1/8"). Other lumber as noted.		
H	2	3/4 x 3 1/2 x 32 1/2" redwood (legs)			
H1	4	3/4 x 3 1/2 x 21" redwood (braces)			
I	1	3/4 x 3"-dia. redwood (gravity stay top)			
11	1	3/8"-dia. x 3" hardwood dowel (gravity stay pin)			
J	2	1 1/2 (open) x 72 1/2" continuous hinge (for doors)			
J1	1	1 1/2 (open) x 21" continuous hinge (for tabletop)			

No.	Materials List (in.)	Stock Lumber Nearest In Size	Lumber Order
4	3/4 x 11 1/2 x 76	3/4 x 12' x 8'	(4) 3/4 x 12' x 12'
11	3/4 x 11 1/2 x 22 1/4	3/4 x 12' x 2'	
1	3/4 x 8 x 22 1/4	3/4 x 10' x 2'	(1) 3/4 x 10' x 2'
1	1/2 x 3 x 21 1/2 (hardwood)	1/2 x 4' x 2'	(1) 1/2 x 4' x 2' (hardwood)
2	3/4 x 23 1/4 x 76	3/4 x 10' x 8' 3/4 x 10' x 8' 3/4 x 6' x 8' (edge-glued)	(See order A below) (See order B below)
1	1 1/2 x 3 x 45	1 1/2 x 4' x 4'	(1) 1 1/2 x 4' x 6'
2	1 1/2 x 3 x 8	1 1/2 x 4' x 1'	
2	3/4 x 1 1/4 x 21 1/2	3/4 x 2' x 2'	(1) 3/4 x 4' x 12' (C) (1) 3/4 x 4' x 10' (B) (Rip in half after 3/4 x 4' lengths are taken)
2	1 1/2 x 1 1/4 x 37 1/2	3/4 x 2' x 4'	
1	1 1/2 x 1 1/4 x 20	3/4 x 2' x 2'	
2	3/4 x 3 1/4 x 32 1/2	3/4 x 4' x 3'	
4	3/4 x 3 1/2 x 21	3/4 x 4' x 2'	
1	3/4 x 3 dia	Cut from scrap	
1	3/8"-dia. x 3 dowel (hardwood)	3/8" dia. x 3'	(1) 3/8"-dia. x 3' dowel (hardwood)
4	3/4 x 5 1/2 x 76	3/4 x 6' x 8'	(See order B below)
13	3/4 x 5 1/2 x 22 1/4	3/4 x 6' x 2'	
2	3/4 x 23 1/4 x 76	3/4 x 10' x 8' 3/4 x 10' x 8' 3/4 x 6' x 8' (edge-glued)	(4) 3/4 x 10' x 14' (A) (6) 3/4 x 6' x 14' (B)
2	3/4 x 1 1/4 x 21 1/2	3/4 x 2' x 2'	(See order C above)
6	3/4 x 1 1/2 x 27 1/2 (furring strip)	1/2 x 2' x 3'	(1) 1/2 x 2' x 12' (to be ripped)
4	3/4 x 1 1/2 x 21 1/2 (furring strip)	1/2 x 2' x 2'	
2	3/4 x 1 x 2 1/2	Cut from scrap	

PM'S TIME MACHINE

75 YEARS AGO: January 1909



Device kills 3 tons of moths.

An Electric Trap For Moths

The authorities in Saxony are waging a successful war against the caterpillar plague by means of a trap which consists of two large electric searchlights or reflectors and a number of power suction fans.

Oil Well Fire

The great oil well fire in the San Geronimo district of New Mexico burned continuously for two months before it could be extinguished. The oil was ignited on July 4, and a gas blow-out caused the opening in the earth to be widened.



Japan's Great Passenger Ship

The Pacific turbine "Tenyo Maru," recently placed in commission by the Japanese, is the most modern as well as the swiftest vessel of all the steamers operating on the Pacific.

The Piano-Harp

The Dolcette, which is probably one of the newest musical instruments placed on the market, is a harp played

on a keyboard similar to that of a piano. The lower half of the instrument contains the piano portion.

50 YEARS AGO: January 1934



Seek a sunken treasure in 1934.

Salvaging Lutine's Gold

In the folklore of the little village of Terschelling (Holland), the story of how the pride of the British navy, "La Lutine," sank during a storm in 1799 has been kept alive, not only by the knowledge that the frigate carried \$12,000,000 in gold and silver, but also by the grumbling of salvage crews who have made the village their base of operations. A new attempt to bring the rich cargo to the surface is underway. If this latest venture is successful, the salvagers stand to reap a rich reward.



Number Recorder For Phone Shows Calls Made

All telephone calls are counted and the numbers recorded on a roll of paper by a number recorder which is used in Germany with a dial-type of instrument. A disc on the recorder fits over the dial of the telephone.

Calculator For The Chemist Gives Molecular Weights

Serving the chemist in the same way that an adding machine aids the book-keeper, a sliderule calculator quickly shows molecular weights.

Robot Prints Calling Cards

After inserting the coin, the operator turns dials to spell out his name and turns a crank. The machine deposits the printed cards in a drawer automatically in just one minute.

25 YEARS AGO: January 1959



New cars and Seaway make news.

Stairway To The Sea

In early spring, when the last of the mud has settled in the miles of canyonlike channels they have carved, and the last raw earth embankment has healed under a new hide of turf, the St. Lawrence Seaway will have become a Gargantuan \$1,090,000,000 reality.

TV Watches Tots

Television is the baby-sitter at a Florida motel. A camera suspended from the wall is trained on the sleeping child. A nurse sitting in a central control room can tend five children at one time.

"Hurricaneproof" House

Designed to withstand hurricane winds and tidal waves is a house on nine-foot-high stilts at North Dartmouth, Mass. The stilts actually are part of a V-strut foundation intended to hold the house in place against the impact of rushing water.

Helicopter Navigation

In front of the pilot is a pictorial map of the regular route. A stylus moves across the map, constantly showing the path he has flown. The system automatically measures radio transmissions from a chain of stations along the route.



Retractable Dome Will Cover Arena

Both indoor and outdoor events can be staged in a new civic arena planned for downtown Pittsburgh.

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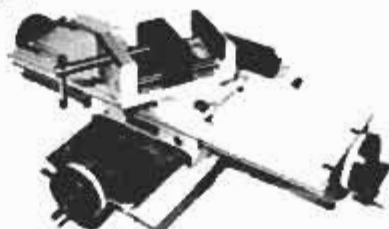
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ULTIMATE TELEPHONE

(Continued from page 132)

people make many untraceable long-distance calls and run up your bill.

The portable manufacturers have taken steps to alleviate this problem. Many new models, such as the Uniden or Electra, feature digital or subaudible tone transmission techniques which prevent unauthorized access to a base unit. Unless the handset of the portable issues the right digital code or the right tone, the base station won't activate.

By now, the Ultimate System is nearly complete, but it wouldn't really be the ultimate if it didn't let you send pictures of the new baby or your new car to your friends. And—with the Robot 450C color transmitter, a color monitor and a color camera, with the necessary phone line coupler—you can do it.

Sending pictures across phone lines is nothing new. In fact, the news wire services and many businesses have been doing it for years. But the 450C now allows you to do it, too. You'll also need a well-lighted room and a good portable color television camera, such as those found with many home videotape recording systems. Focus the camera on the subject of the picture, start the Robot and take a look at the monitor to make sure it's what you want.

Then, dial the number you want and let the computer-controlled Robot system take over. It turns the electrical signals from the camera into digital signals, representing not only the image of the object, but its colors. It then stores the subject matter in its memory for retransmission. When the connection has been made, the Robot turns the digital data into tones which are compatible with the phone system, and the picture is on its way.

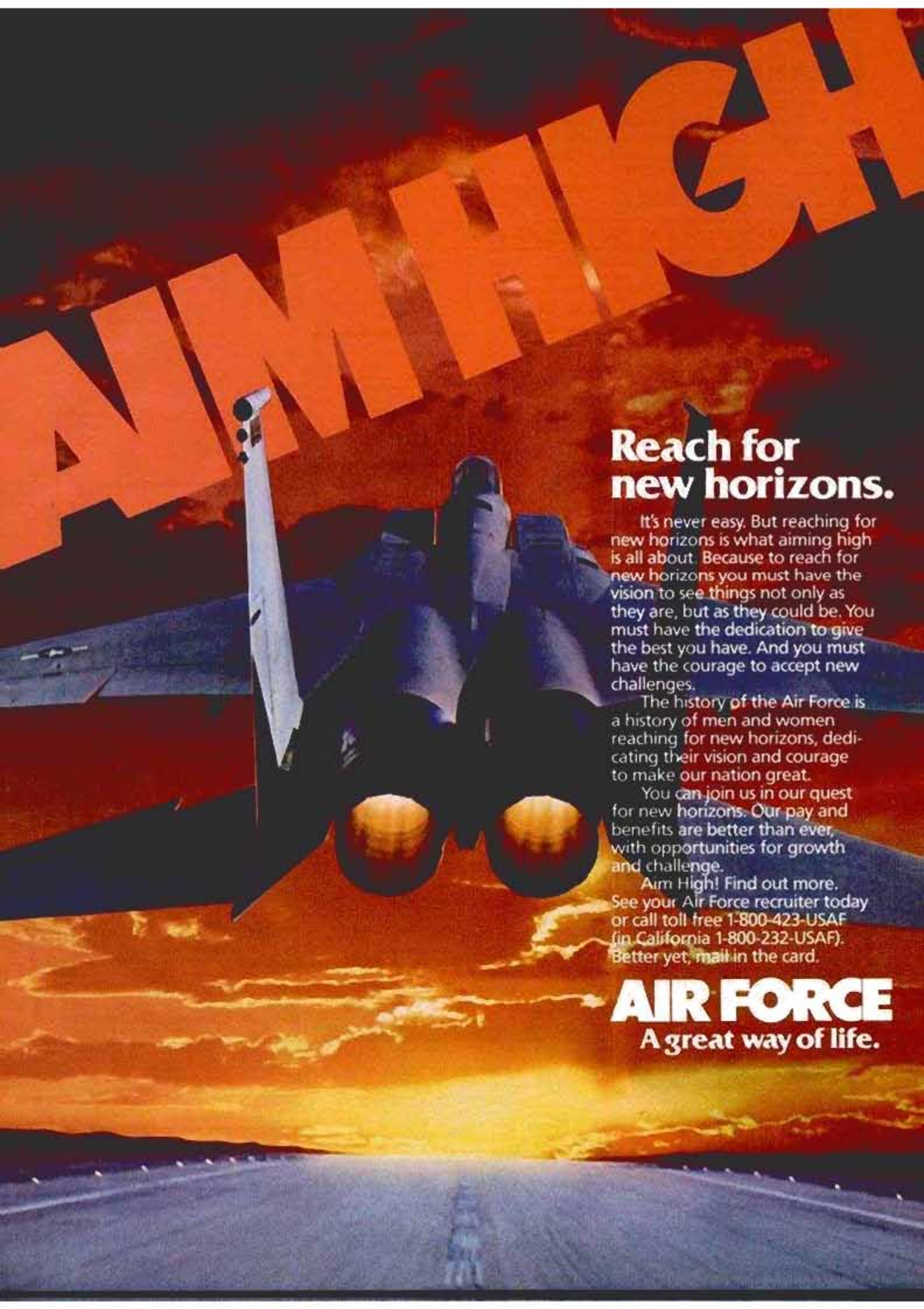
If your friend has the correct Robot receiver and a color monitor, he will begin to see the picture materialize on the screen. It takes about 16 1/2 seconds to send one picture.

To be sure you don't miss any important calls while you are out of town, our Ultimate System has a telephone answering machine. And Radio Shack's Duofone TAD-150A is no ordinary unit. It provides for unlimited messages of unlimited length because it is voice-actuated. The machine also has a digital readout which shows the date, time and message number of each call. Actually a sophisticated cassette tape player, it uses separate message and answer tapes. It also allows you to make one or more messages. And, when it isn't serving as an answerer, it can double as a dictation machine and record calls as you make them.

With all of this equipment in your home, it's really not a wise idea to leave it unguarded. And if you have a Sensaphone, you won't. A Sensaphone, made by Gulf + Western, looks like a large telephone dialing pad. However, it has one big speaker and a microphone. This allows you to listen in on your home while you are away. All you do is dial your number and the Sensaphone answers and you hear what's going on. The Sensaphone will even alert you to any problems in a synthesized voice when you call in.

We could go on and on with our Ultimate System because the world of items available to tie into your home phone lines is increasing every day, thanks to more competition. Suffice it to say, though, that our system could also allow you to call people without lifting a handset, via a memory auto-dialer, which contains frequently called numbers; put people on hold with hold modules; and allow you to use pocket touch dialers. Or, you could add electronic phones which also act as calculators, autodialers, memory phones and elapsed-time counters, as well as telling you the time, date and number called.

As you can see from our Ultimate System, times are changing in the world of telephones. **PM**



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OWNERS REPORT: PULSAR

(Continued from page 103)

and VW buffs—me among them—used to describe their beloved Beetles in the same terms that Pulsar owners use today: "sporty," "cute" and "different."

Whatever you and I think of the Pul-

sar's styling, one thing's certain: It's among the most glitch-free automobiles PM has surveyed recently. It's in a league with such monuments to reliability as the Starlet, Celica, GLC and the new Thunderbird. It surpasses the Cimarron, the Maxima and even the semihandmade Chrysler Imperial.

Over 67 percent of all Pulsar owners

told us they'd had no mechanical problems at all. They couldn't evaluate their dealers' service departments because they'd never needed service.

And the problems they did mention were the sort that owners of other makes usually pray for. Example: The worst mechanical "illness" that Pulsar purchasers could point to was that they

SUMMARY OF 1984 NISSAN PULSAR NX OWNERS REPORTS*

Total miles driven 1,403,757	No complaints 11.6	Rear seats	Two cars 28.0
Average miles per gallon:	Cramped rear seats 9.9	Excellent 15.3	Three cars 20.6
Automatic transmission	Surges when automatic shifts 9.4	Good 42.6	Four or more cars 13.3
In town 28.7	Paint chips too easily 8.3	Average 33.0	
On the highway 35.8		Poor 8.8	
Manual transmission	What changes would you like?	Had any mechanical trouble?	Makes of other cars owned:
In town 33.5	No changes 21.8%	No 67.3%	Ford 30.4%
On the highway 41.8	More horsepower 17.6	Yes 32.7	Chevrolet 28.1
Transmission choices:	Less cramped rear seating 8.3	What type of trouble?	Nissan 25.9
Manual five-speed 81.7%	Chip-resistant finish 4.7	Air conditioner 23.6%	Pontiac 13.3
Three-speed automatic 18.3	Smoother-shifting automatic 4.7	Headlamp aiming 15.3	Toyota 12.6
Why did you choose this car?	How much did you pay?	Surging automatic transmission 12.5	Would you buy another Pulsar NX?
Styling 85.9%	Average \$8,417	Steering column lock 6.9	Yes 57.4%
Economy 56.3	Range \$7,200-\$10,750	Fuel induction 5.6	No 5.1
Price 41.3	Workmanship opinion:	Dealer repairs satisfactory?	Maybe 37.5
Handling 9.9	Excellent 54.7%	Yes 64.4%	Would you buy another Nissan?
Performance 7.5	Good 43.0	No 35.6	Yes 83.2%
Specific likes:	Average 2.3	Dealer service opinion:	No 1.9
Styling 77.5%	Poor 0.0	Excellent 28.2%	Maybe 15.0
Economy 63.2	Comfort opinion:	Good 48.3	Age distribution of owners:
Handling 38.7	Front seats	Average 15.5	15-29 years 52.4%
Ride 19.1	Excellent 68.3%	Poor 8.0	30-49 years 38.2%
Sunroof 18.1	Good 26.7	Number of vehicles owned:	50-plus 8.3
Specific dislikes:	Average 4.5	This car only 38.1%	
Not enough power 27.6%	Poor 0.5		

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

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POPULAR MECHANICS • JANUARY 1984

felt the engine slowing down and speeding up as the air conditioner compressor kicked in and out. Now isn't that awful?

The next worst problem had to do with headlamp angle. The factory, it appears, aimed the Pulsar's pop-up headlights too high in 15.3 percent of the cases. That meant a quick trip to the dealer.

More horsepower

At the time of our survey the Pulsar was still relatively new to these shores. None of our respondents owned a turbocharged Pulsar. Why? Simply because the turbo didn't become available until after we'd sent out our questionnaires. That's especially noteworthy because 17.6 percent of the owners we queried told us they'd appreciate a little more horsepower.

Well, they can get it today, thanks to the Pulsar NX's optional Garrett AiResearch turbocharger and Bosch L-Jetronic fuel injection. These combine to add 31 hp and 20 lbs.-ft. of torque from a slightly smaller displacement version of the Pulsar/Sentra engine.

The Pulsar uses the same powerplant, fwd drive train, floorpan and suspension system as the Nissan Sentra. Its standard engine is Nissan's E-series—a 1.6-liter, carbureted ohc Four that's rated at 69 hp.

Last summer, though, Nissan introduced an optional, turbocharged, 1.5-liter version of this same engine. The \$950 turbo package boosts horses to an even 100. The turbocharged car also gets a recalibrated suspension system, a boost gauge, altered graphics and about two to five seconds lopped off its 0 to 60 time, depending on which gearbox you choose. Both engine sizes are available with either the five-speed manual transaxle or a three-speed automatic with converter lock-up.

There's more, too, to the Pulsar line than just the NX coupe. For 1983, you could have bought a five-door Pulsar sedan or a three-door hatchback coupe, both with more conventional styling than the NX coupe. For '84, the hatchback and sedan have been dropped.

The NX comes in only one trim level, Deluxe, which means you get such standard equipment as sunroof, AM/FM stereo, adjustable steering column, reclining front buckets, a fold-down rear seat, halogen headlamps, intermittent wipers and power steering (with the carbureted 1.6 engine only).

Pulsar owners found few faults with the NX and plenty of virtues to praise. On the minus side, the paint chips easily. Flying stones take their toll. However, 98 percent rated overall workmanship good to excellent.

Nissan rates the Pulsar NX a five-
(Please turn to page 148)

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OWNERS REPORT: PULSAR
(Continued from page 147)

passenger automobile, but the owners we surveyed dispute this. "The rear seat is too cramped and has too little legroom for even two adults to sit comfortably," said a Michigan teacher. "You definitely can't put three people back there."

A related problem involves the "memory" front seats, which rear riders can release and push forward out of the way. "That's an excellent feature for getting out," said a Maryland social director, "but it's terrible if rear passengers are getting into the car. The only way to lock the seat in place again is to push it to the rear of its track."

Many owners raved about the unexpected amount of trunk space. A New Hampshire educator said, "One great feature is the folding back seat, which opens into the trunk to make a modified hatchback. It's every skier's dream."

Good ride and handling

Ride and handling were judged good—ride on a par with larger, heavier cars and handling up to the expectations of normal driving. Owners didn't expect sports car cornering, although one man mentioned that a rear sway bar would make a welcome addition.

As for fuel economy, we've finally found a car whose owners don't feel cheated by the EPA's figures. Interestingly, drivers of manual-transmission Pulsars logged 5 to 6 mpg more than those with automatics.

That's a wider gap than usual and comes as a particular surprise when we consider that the automatic transmission incorporates a lock-up torque converter. Owners did report a fair amount of hunt-and-peck around the lock-up speed—something common to a number of cars with this feature. Even so, the automatic ought to come closer in mileage to the manual transmission.

Interior appointments and controls again received good marks. We heard a few grumbles about ashtray location, but this was countered by a Missouri air conditioner wholesaler who said, "The Pulsar's air conditioner did a beautiful job of keeping up with our 100° heat this summer."

The Pulsar, then, offers a good combination of styling, price, practicality, workmanship and economy.

As a Florida insurance underwriter said—and this is fairly typical: "I owned a 1980 Datsun 210 before and loved that car, too. I was thinking about buying something different when I saw a TV commercial for the Pulsar NX. The next day I went to the showroom to see the car live, found I liked it as much in person as on TV, and ordered mine right on the spot. I'm truly happy." **PPM**

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3 EASY KITCHEN PIECES

(Continued from page 113)

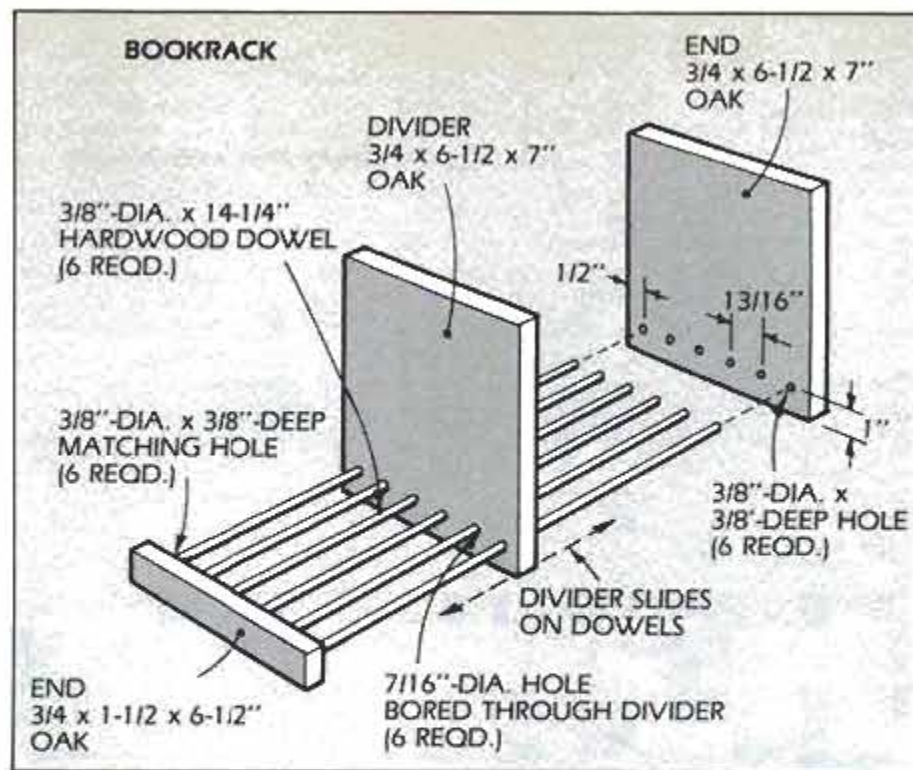
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Cut the two ends and the divider to size. Using a combination square, lay out the dowel holes. Set the blade of the square to 1 in. and use it as a marking gauge to draw a line along each bottom. Starting $\frac{1}{2}$ in. from the side, mark the location of the six dowel holes $\frac{1}{16}$ in. on center. Use an awl to make a centering hole at these intersections.

Bore the dowel holes in the divider and the larger end at the same time. To bore them at the proper depth in the end piece, wrap a piece of tape around the drill $1\frac{1}{2}$ in. from the tip of the bit for use as a depth gauge. Place the divider on top, bore completely through it and $\frac{1}{8}$ in. into the larger end. Lay out and bore the smaller end after taping $\frac{1}{8}$ in. from the drill tip. Enlarge the dowel holes in the divider to $\frac{7}{16}$ -in. diameters for easy sliding.

Cut the dowels to size with a backsaw and a miterbox. Then round the edges of the pieces with a block plane



or sanding block fitted with 100-grit paper. Finish-sand all pieces with 150-grit abrasive paper.

Apply a scant amount of carpenter's glue to the dowel holes of the larger end and insert the dowels. Tap them

into the bottom of the holes. Using a wood block between the hammer and the workpiece protects the surfaces. Slide the divider on and glue the dowels to the end. We finished the original with DEPT's Danish oil finish. **PM**

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DASHBOARDS

(Continued from page 95)

tral carriage sense disappeared. A wooden panel behind the engine took its place—the rear wall, so to speak, of the engine compartment.

So, today's interior designers refer to what we still call the "dashboard" as the *instrument panel*, or i.p. for short.

The automotive instrument panel has evolved from a relatively plain and unadorned slab of wood or, sometimes, aluminum, into one of the most complex and highly developed pieces of equipment inside the modern motorcar.

You can see from these pages that the past 80 years have taken us from no gauges to an overkill of technological gadgetry mixed with useful information. Today's instruments tell us so much via analog light displays and voice synthesizers that some drivers consider them downright annoying.

In America's earliest automobiles, though, you bought gauges as accessories if you wanted them at all. As speed limits came into being, speedometers arrived through necessity. Early ones bore such names as Stewart, Johns-Manville, Warner, Sears Cross and Jones. Most ran off large gears inside

the right front wheel, and displays were the drum type, where only the speed you were driving showed. You properly called them *digital*.

Other gauges weren't necessarily on the i.p. at all—temperature "motometers" stood atop the radiator cap, and fuel gauges were often on the tank. Or you simply poked a stick down the neck to see how much gas was left.

The Model T Ford and other cars came into the 1920s totally without instruments. Those Model Ts of the '20s that used generators also had ammeters, but Fords sold without a starter or electric lamps carried merely a punch-out blank where the driver could mount a dial. Even that era's more expensive cars had relatively small factory instruments that seemed almost like incidental add-ons.

By the '30s, carmakers began to feel a need to supply gauges, and in the mid-1930s, larger round dials came into vogue, with needles replacing drums for the speedometer. Nearly every car then made had the five basic gauges: speedometer, fuel, ammeter, oil pressure and engine temperature.

Birth of the idiot light

But in the mid-1930s, Hudson began tampering with this formula by introducing what we've come to call the *idiot light*. The 1936 Hudson Terraplane, for example, had a big Dali-esque plastic instrument cluster adorned with a shooter-sized red glass jewel that lit up when there wasn't enough current flowing through the car's electrical arteries.

By the early 1940s, most new automobiles used plastic in their i.p., and too often these early plastic bezels and backgrounds tended to warp and crack.

During the '50s, the general trend turned to the nearly universal adoption of warning lights and the elimination of as many working gauges as feasible. Chrysler Corp. was the only major U.S. auto manufacturer who stayed with full working gauges from the 1940s through the 1970s. But the majority of American cars from those years came with only a speedometer and fuel gauge as standard equipment. Printed circuits also became the norm.

With the dawning of the 1980s, and spurred by Japanese electronics development, automotive instrument panels are again blossoming out to include the five basic gauges, but this time with warning lights in reserve. We've gone to more and more gauges as we supplement the basic five with tachometers, turbo boost meters, trip computers, graphic displays and voice monitors. By the end of this decade, the average U.S. automotive instrument panel will likely be totally electronic.

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SLINGSHOTS

(Continued from page 93)

bands, and even a cul-de-sac latex power chamber. They're mounted on steel or aluminum frames, with handgrips of wood or plastic that look like something from another planet. Each is the result of a continuing process of gradual design evolution that masks a high degree of sophistication with apparent simplicity.

Even the way you hold a slingshot has changed radically from the straight-up form we used as kids, and the ammo is no longer rocks.

Serious competitors shoot precision ball bearings in matches, and use marbles for plinking fun; white marbles can be seen like tracers, making them more fun to shoot. Steel shot that you buy is usually rejected ball bearings, or the partially finished balls that come out of the ball-bearing machinery before the expensive final sizing and finishing. Lead balls, available in sporting goods stores catering to the muzzleloading crowd, serve small game hunters most effectively.

Each kind of ammo has its advantages and disadvantages. Steel shot doesn't deform on impact and can be

picked up with a magnet, but it costs more. Marbles are cheap but lighter, and so they have a shorter range. Lead hits harder but flattens out. Stones, while free for the picking up, tend to slice or hook because few are round.

Serious slingshooters wouldn't consider shooting gravel or rocks. The rough edges might nick the latex drive bands and cause them to break. Anyone who has experienced snap-back from a broken drive band won't use rough-edged ammo again. You can even get little fold-up paper boxes to shoot BBs or birdshot in your catapult. The boxes open up when fired, with the hope that you'll better your chances of nailing targets on the wing.

Arrows with hooked heads can be shot and are supplied with the Com-Bow sling, which also accepts bands with a conventional pouch to shoot standard ammo. Its strange form was devised by NonFireArms Inc. so longer bands to give higher missile speeds would fit in a compact slingshot. By doubling the bands over a roller, they can have a longer pull than would otherwise be possible.

S/R Industries' Marksman Maxima achieves the same result by a forward extension between the handle and the fork.

Saunders Falcon, often used in competition, sports stabilizers. These damp the vibration as the shot is released and are claimed to improve accuracy.

Trumark's Mark Ellenberg, who's been designing sophisticated slingshots for 30 years, pointed out some of the niceties that have been developed.

He uses aluminum fork frames because the ends can be smoothly rounded to reduce fraying that can cause the bands to break. Steel forks can rust where the bands grip and become rough enough to cut the rubber. Aluminum also eliminates any need for plastic pads to keep the tubing from slipping off the frame. It holds on by the same principle as the Chinese finger trap, made of woven material, so it opens only when pushed together. Molded plastic pouch-holders also plug into the open ends of the drive bands to save weight, simplify production and reduce band breakage.

The wrist brace, patented in 1954, and surgical tubing bands started the slingshot renaissance. By supporting the fork on your arm against the pull of the driving bands, you can draw stronger bands more steadily. By hooking your hand through the brace, effort is further reduced. It's easier to grab a slingshot with the brace mounted at the top of the handle rather than the bottom, but the leverage works against you so you have to grip the handle firmly. With your arm through the brace,

(Please turn to page 156)

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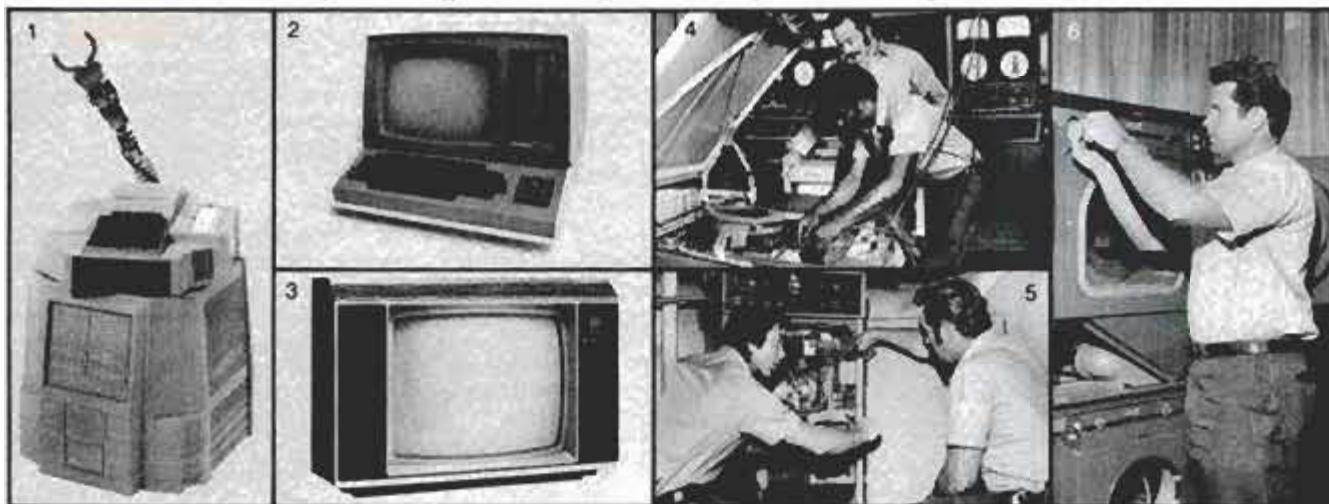
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SLINGSHOTS

(Continued from page 152)

you can open your hand without risking having the slingshot come back and bop you on the head when the bands are at full stretch.

In a modern slingshot, pulling back the pouch holding the shot is more like drawing a bow than snapping off a quick shot the way you did as a kid. You hold the fork—braced or unbraced—in your left hand as always, but you don't hold it vertically as of yore. Extend your arm naturally and you find the fork wants to lie on its side. And, that's the way you shoot it. You can even use the top arm of the fork as a sight.

Pull back to the ear

Unlike the ancient bowman who drew to the breastbone, you haul back on a modern slingshot the way the English longbowman drew his bow. You pull back to the ear. Actually, for consistency, you nestle the knuckle of your thumb into the hollow of your cheek with your left arm extended.

Pulls average 20 to 25 pounds and a 120-grain, half-inch steel ball bearing takes off at 200-plus feet per second (f.p.s.). That's about the same velocity achieved by a compound bow or cross-bow firing an arrow or bolt of 500 grains. (One ounce is 437.5 grains).

Using the modern laid-over-on-its-side stance, competition catapulters working with special competition ammo and slingshots regularly put 10 shots into a 3-inch circle at 10 meters (32.8 feet). That's about the level of accuracy good handgunners and black-powder riflemen achieve at 50 yards, and better than most archers can do at 10 meters.

Competitors admire Gary Hunsicker's 1982 World Record. He put 48 out of 50 shots into a 3-inch bull's-eye. They also bow to Kent Shepard's speed shooting record of 1,000 pellets in 32 minutes, 1 second—a sustained rate of about two seconds per shot. No hand-gunner or rifleman could come close because his gun would melt.

Adult slingshots, like adult air guns, can be pricey as well as sophisticated. But the range is more reasonable. Unlike match air rifles which can cost \$500 or more, about \$50 is tops for catapults. Most cost from about \$5 to \$15. So, if you get hooked on slingshots, you can afford to try several that appeal to you without the risk of going broke.

You can even play with some of the gimmicks like the Marksman Repeater, which holds ammo in its handle. Pushing a button lays one in the pouch—in theory. I found it often produced more than one at a time. Trumark also has one with a neat little trapdoor that works like a butterfly valve in a carbu-

retor. This ammo-carrier slingshot also has a wrist brace. Barnett offers a holster to carry its various models. For hunting, it can be a useful accessory.

Why carry a slingshot when out hunting? Because, where legal, it means you can take small game for the pot without firing a noisy shot that would drive your big game away.

Another big game hunter's trick applies the silence of the slingshot to bring his game to him. Sometimes, you can hear a buck moving through the woods ahead of you and he can hear you behind him. Chances are, he'll out-walk or outrun you if you continue to play this game. A number of successful hunters have solved this problem by first moving to a good stand, and then catapulting shots into the woods beyond the buck. Deer have been known to circle around, offering a clear shot with the rifle.

All the safety shooting rules for slingshots are similar to those for guns or bows. Never aim at anything you do not intend to shoot. Wear shooting glasses to protect your eyes if a band breaks. Know your target and your backstop.

Watch the ricochets

One special rule for slingshoters: Watch out for ricochets. The steel shot bounce back from any hard surface, so experienced target shooters make a point of facing the target at a slight angle to minimize the risk.

Maintenance is a minor problem. The bands may last for hundreds of shots, but should be kept out of direct sunlight and away from oil. Oil rots the latex. Time and use deteriorate the bands. Check for nicks where a tear could start, especially near the forks and pouch. Spare bands are available and worth keeping on hand. A dab of rubbing alcohol makes it easy to slip them over the ends of the fork. Let the alcohol evaporate for 12 hours or overnight to make certain the bands won't slip off when stretched.

For more information about catapults and slingshots, we suggest that you write to nationally organized clubs and the makers of different models.

SOURCES—SLINGSHOTS

- Barnett International Inc., Box 934, Odessa, Fla. 33556.
- M&M Enterprises, Box 445, Island Lake, Ill. 60042.
- Marksman Products Div., S/R Industries Inc., Box 2983, Torrance, Calif. 90509.
- National Catapult Assn. of America (NCA), Route 1, Box 63A, Amherst Junction, Wis. 54407.
- National Slingshot Assn., 8112 East Carey, Las Vegas, Nev. 89110.
- NonFireArms Inc., 687 Calabasas Rd., Watsonville, Calif. 95076.
- Hank Roberts Inc., 410 South Sunset St., Longmont, Colo. 80501.
- Trumark Mfg. Inc., 2040 28th St., Boulder, Colo. 80306.
- Weber International, 1039 Ellis St., Box 47, Stevens Point, Wis. 54481.

BUILD THE NAME CALLER

(Continued from page 77)

entrance delay timer formed by C10, R12 and gates A and B of IC1. After the delay, a pulse goes through C4, starting the two-minute horn-honking timer composed of C5, R6 and gates C and D of IC1. The two-minute timer doesn't directly honk the horn in code, it only causes Q1 and Q2 to generate a regular pulse every 1/2 second. These pulses are fed into decade counter IC2.

The 4017 is an interesting IC. The 10 output lines, where the encoding diodes are connected, each take a turn putting out 12 v. to trigger the horn relay circuit. But note that we can connect only nine diodes. This is because the IC's line 0 (which is pin 12) would always be firing when the alarm is unarmed. A diode there would result in an endlessly honking horn.

Instead, the IC's gates 1 through 9 are what we connect to. It would be easier to follow if gate 1 was connected to pin 1, but unfortunately, the pin numbers do not match the gate numbers. Note that D1 is connected to pin 2, D2 to pin 4 and so on. Connected in this way, the diodes will be firing sequentially from D1 to D9. *The key to getting the code is to put the diodes in only some of the lines.*

For example, if you wanted two short beeps followed by a long one, you would insert diodes D1, D3, D5, D6 and D7. If you wanted two long beeps followed by a short, you would put diodes D1, D2, D4, D5 and D7 in position. You can set up any code you want.

If you use a circuit board, all you have to do is solder the parts on the board as indicated on the layout pattern. When soldering, don't heat the transistors, diodes or ICs any more than you have to. You can also use point-to-point wiring. Once the parts are soldered on the circuit board, fit everything in the case. Now, you're ready to install the Name Caller in your car.

What the connections do

The first connection is a ground. All you need to do is find any screw or bolt that goes into the metal frame of the car. Make a lug terminal connection to it.

The three car wires you need for the Name Caller are the positive 12-v., ignition and horn relay. They are usually very easy to locate at the car's fuse box. However, if you have any trouble or aren't sure, look at the shop manual for the car. The positive 12-v. line should always be "hot." It supplies the Name Caller with power and is also where the alarm system looks for voltage spikes in the car wiring.

The ignition line tells the Name Caller whether you are driving the car. This is how it knows to stay disarmed for the entire time you are on the road, and then rearm a few minutes after you leave the car.

If you want the ignition line to act as the disarmer, then you tie the cutoff line to it. If you wanted the headlights to act as the disarmer, then you would connect the cutoff to the headlight wire. Finally, if you wanted a hidden switch, you would connect the cutoff to a switch that goes to 12 v. In short, bringing the cutoff line to 12 v. disarms the Name Caller.

The line that goes to the horn relay supplies the coded on-off pulses to the horn relay, which honks the car horn.

To test the Name Caller, open the car door. After 12 seconds, regardless of whether the door is open or closed, the horn should start honking in the code you selected. Two minutes later, it should shut off. Reopening the door after the honking stops should restart the alarm cycle. Make sure your interior light switch is in the position for the light to come on when a door is opened. While the horn is honking, you should check to see that the disarm method you used cuts off the alarm.

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The early synthesizers looked like something from outer space, with their dozens of black patch-cords, banks of dials and sliders, and large cabinets full of oscillators. They also cost tens of thousands of dollars, even though they were of limited versatility. Chords and choruses of musical voices had to be built up, note by note, and stored on tape.

Synthesized sound moves into the home with these affordable keyboards. We used them and our feet are still tapping.

BY CHRISTOPHER GREENLEAF

Yamaha's MP-1 (below at top) features an astonishing little printer which plots notes on a musical measure as you play them. Its little brother, the PS-300 (middle), has a smaller keyboard, but with rhythm and autochord controls (no printer). Casio MT-70 (bottom) can read music via bar code.

The keyboard is the oldest and probably the best way to play not just notes but whole chords and harmonies. It's logically set up, can give even a complete beginner some idea of the relation of one note to another, and is just right for putting electronics through its paces to make music.

Not too surprisingly then, nearly all of the instruments PM looked at in checking out what's available are played from keyboards. They range in price from Yamaha's under \$200 machine to somewhere under \$10,000 for the impressive and beautifully engineered Kurzweil 250.

Yamaha's PortaSound PS-300 costs



\$199, which is about the price at which useful musical features become available. It has a 37-note minikkeyboard (F1 to F4) that calls on 10 adjustable rhythms and eight preset instrumental sounds. Unlike some of the early synthesizers, it can play up to eight notes at once. If you feel on shaky ground with harmonies, but you still want to accompany melodies with chords, the Auto Bass Chord section provides harmony based on the fundamental, or bass, note you press. Fingering variations can even give you a selection of major, minor, seventh and minor seventh chords, which is harmony enough for nearly any melody.

If you tire of simple chords, there's an automatic arpeggio effect to ripple the notes up the scale as you use the autochord part of the keyboard. It used to be that someone used to playing in one key couldn't accompany someone who wanted to sing or play another instrument in another key. A transposer knob that adjusts the pitch over a full octave solves that problem! If you use it subtly, you can even change keys in the middle of a song—à la Peter Nero—by turning this transposing knob. There are handy little features to teach you the right notes to play for melodies and a small metronome light—tied in to the rhythm section—to keep you at the tempo you want.

Another minikkeyboard, with slightly smaller keys than a normal piano or

organ, is the Casiotone MT-70. It has most of the features of the PS-300 and adds a few of its own. The most striking and innovative of these is the bar-code memory play section. A handheld wand on an extension cord reads music from printed codes very similar to supermarket check-out pricing codes. These lines of bar code feed the melody into the MT-70's memory, where it comes out at the speed and tempo you want, with whatever instrumental voice you choose from among the 20 on hand. There are 49 keys (C₁-C₅), just as in the old parlor reed organs at the turn of the century. You can transpose over a full octave, fine-tune the pitch, play automatic chords as accompaniment and choose from 20 rhythms. There are even flashing red LEDs to tell you which notes of a memory-stored melody are being played back. Normal and delayed vibrato, a sustain effect for reverberant note decay and a switch to play the melody an octave lower are further features.

There are controls to edit what has gone into the memory. They are labeled delete, repeat, back, forward, reset, return, rest and end of music (double bars). There's a convenient readout to speed up this editing. An excellent manual shows how to use the instrument and explains how to make connections to headphones or an external amplifier. It's \$399.50.

Another Yamaha model is the MP-1.

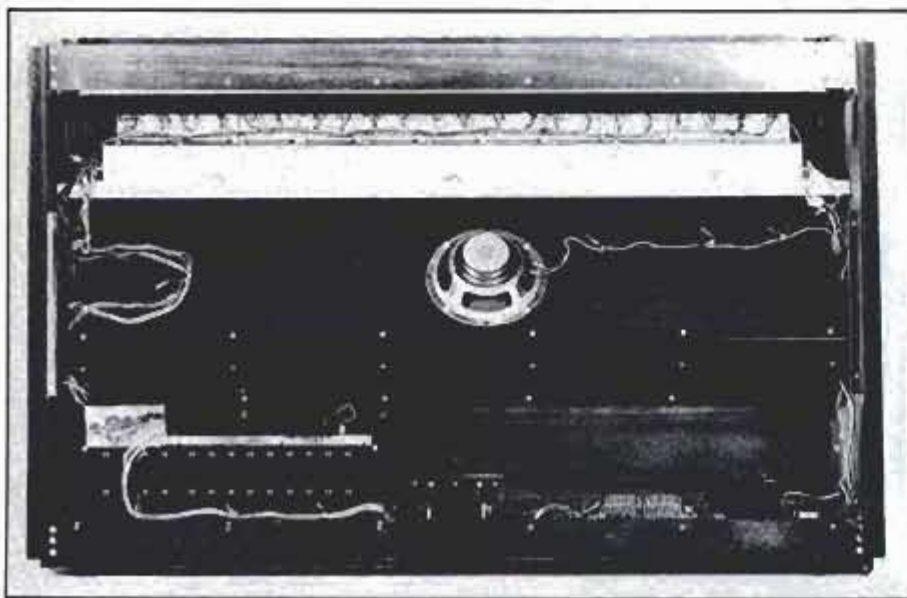
with 10 instrumental voices, a rather elaborate rhythm section, a number of auto bass chord possibilities, a means of automatically harmonizing melodies and the same external inputs and outputs as the two previous units. The 44 keys (F₁-C₄) feed into a memory that's large enough to store melodies and chord sequences and even perform some simplification of overcomplicated melodies. There are both fine-tuning and full-octave transposing controls.

The real news about the MP-1, though, is its music printer. It uses an easily replaced ball-point element to print out melodies, sharps, flats, rests, bar lines, staff lines and accompaniment chord names on a 2¼-inch roll of paper. The paper can be used as is or glued onto any paper to make sheet music. At \$795, this is more than just a musical sketch pad: It opens up new and exciting possibilities for the creative music lover.

Super piano

When someone mentions the Baldwin Piano Co., most of us think of sleek grands and popular uprights. Now, the company has made an addition to its line of keyboard instruments that has 88 keys, the feel and touch of a standard piano keyboard, and a walnut case and music rack. It looks just like a piano. But it doesn't have hammers, strings, or a heavy cast-metal frame.

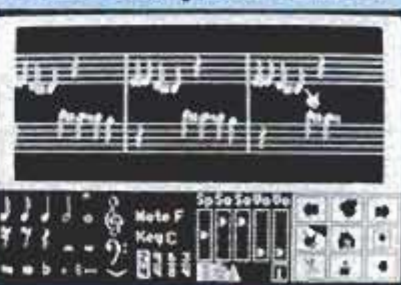
(Please turn to page 160)



The Baldwin PianoPro certainly does look like a piano (right), but when you pop its hood (above) you won't find any strings, hammers or other such technology. Instead, the PianoPro makes its music electronically. Even though it is electronic chip technology rather than strings making the sounds, the musician will feel right at home with a true piano-style instrument which maintains all the "feel" of that type of playing.



Home Computer Sounds



Electronic Arts has a new program called *The Electronic Music Construction Set* that will allow anyone with an Apple, Atari or Commodore computer to get in on the fun of synthesized sound. Instead of using a keyboard, your game control or joystick is used to design your melodies. Notes are literally picked up onscreen (above) and moved, via the joystick, onto the proper spot on the musical clef. Chords, rests, just about every musical detail may be quickly programmed in this pictorial manner. The sounds are very good on Atari and Commodore computers, while the Apple needs an add-on called *The Mocking-board* (from Sweet Micro Systems) to sound properly. This program is not only a capable musical instrument, but is a great way to learn music.—N.S.

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ELECTRONIC MUSIC

(Continued from page 159)

Instead, there are a sophisticated set of logic and tone-generation circuits controlled by a microprocessor, a 50-watt amplifier, a large loudspeaker in front (behind a grille), and, of course, a cord to plug it all in. Called the PianoPro, it is essentially two instruments: a standard piano with normal piano-key touch and realistic dynamic range, and an instrument for teaching and playing. It's got more than a dozen simple and complex rhythms; a memory; and such functions as single-finger chords and automatic rhythm variations.

There's even a means of adding automatic professional ornamentation to the melody or playing the melody notes with the classy-sounding reinforcement of the same pitches two octaves higher. The PianoPro transposes from one key (played) to another key (heard) and even gives numerically correct beat counts for each bar of music, via a panel called the Conductor. The same panel has a visible metronome that can also click in time with the tempo. Combining the accompaniment styles—such as ragtime and polka, for example—creates new and variable rhythms to suit each song (\$3,000).

Cadillac dreaming

As good as these instruments are, we can't help mentioning that for a paltry \$10,000 you can always buy a Kurzweil 250 keyboard. At that price, it is really not meant to be competitive with the home units we have looked at, but if you want the ultimate, this is it. The Kurzweil features an extremely accurate and realistic duplication—via external amplifiers and loudspeakers—of a grand piano. With a computer and other add-ons, the Kurzweil can copy just about any sound as well as invent new ones.

Even if you can't afford a Kurzweil for home entertainment, the revolution it has touched off will be bringing consumers some flexible, well-engineered keyboard instruments that talk to computers, don't sound thin and "synthetic" and put orchestral resources in a single keyboard.

I think it'd be nice to be able to do at home what it used to take tens of thousands of dollars worth of equipment weeks to do. The Yamaha, Casio and Baldwin instruments are among the first musical instruments to bridge the gap between the traditional and the futuristic. At prices that make them comparable with the stereo components they can interface with, they promise to accomplish something that is an old musicians' dream—the return of musicmaking to the living room, where it all started.



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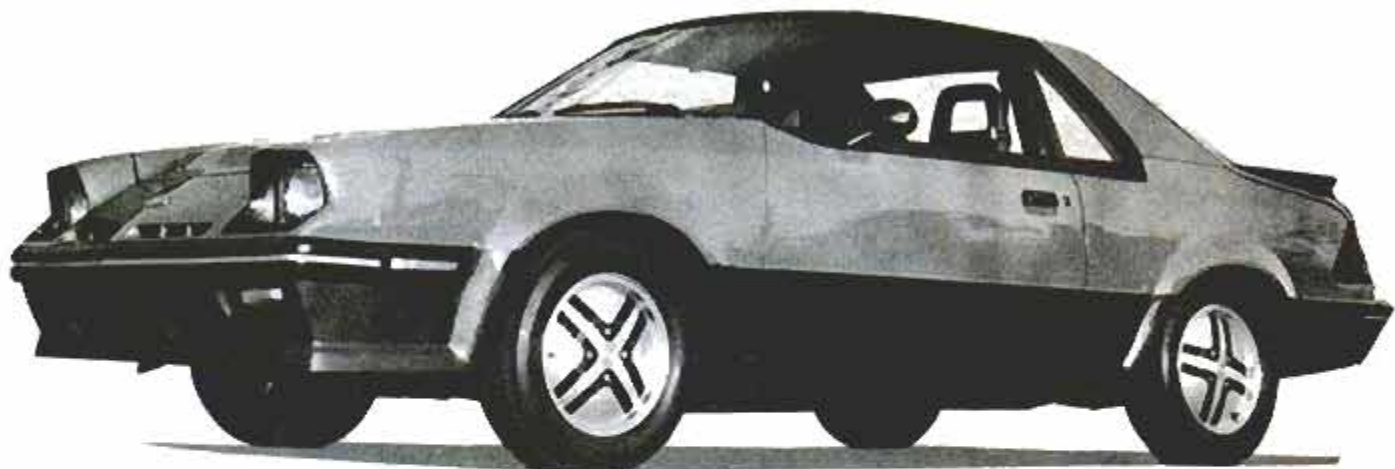
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Ford EXP Turbo

Ford's two-seat commuter gets a little boost—good for 40 extra horses.

BY DANIEL CHARLES ROSS DETROIT EDITOR

A lot of stones have been thrown at the Ford EXP since its introduction. Not every observer has agreed that this was a good car to compare to the mid-'50s Thunderbird, Ford's previous two-seater. Not long after the EXP debuted, potential buyers discovered what Ford insiders had hoped would be overlooked: that the EXP was an Escort without the back seat.

The EXP interior groaned for relief from its commonplace appearance. Its engine cried out for more power. The little Escort knock-off, which was to have become Ford's two-seat "sporty car" of the '80s, had failed to deliver on the promises made by its sheet metal.

The EXP Turbo, new for the 1984 model year, is the car that ought to have been the very first EXP out of the factory chutes. We didn't need another Escort. But a small, fuel-efficient two-seater, with turbo power and a passenger compartment designed for the driving enthusiast, is definitely most welcome.

It took the Special Vehicle Operations (SVO) crew to get the EXP turbo on the road. They started with the standard-issue, 1.6-liter CVH engine and replaced the basic two-barrel carburetor with EEC computer-controlled, electronic fuel injection. The turbocharger chosen was a jewel-like IHI unit whose small size allows rapid boost accumulation up to about 8 p.s.i. Aluminum alloy pistons were replaced by forged aluminum, with a compression ratio of 8.0:1. An oil cooler was

mounted to the block. Radiator cooling is taken care of by two pancake pusher-type electric fans.

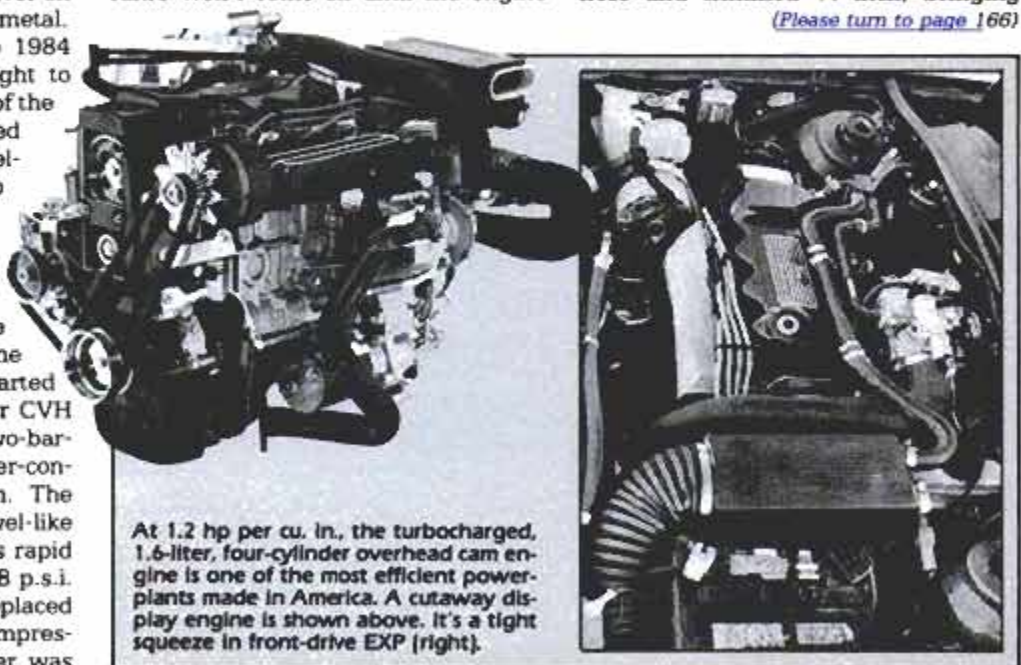
The EXP Turbo gets 40 more ponies than the 1.6-liter HO engine, which now becomes the base motor. For an estimated \$9,942, you get 120 hp at 5,200 rpm, and 120 lbs.-ft. of torque at 3,400 rpm. This is good for mid- to high 8-second runs from 0 to 60 mph.

Getting to 60, however, is the fun part. In city traffic—where the EPA claims the EXP Turbo might get as much as 26 mpg—the fuel economy side of this equation holds court. The turbo won't come on until the engine

winds up to around 2,800 or 2,900 rpm, so all the benefits of Ford's gas-sipping Four are yours until you get aboard the freeway on-ramp. Putting your foot to the floor causes those 120 horses, dormant beneath the hood, to rise up in screaming indignity. The turbo motor exhibits little of the buzzing normally associated with this engine. It accelerates quickly to its 6,000-rpm redline time after time.

Handling had to be improved to accommodate the extra horsepower. This was a compromise move. The front springs were increased in stiffness and trimmed $\frac{3}{4}$ inch, bringing

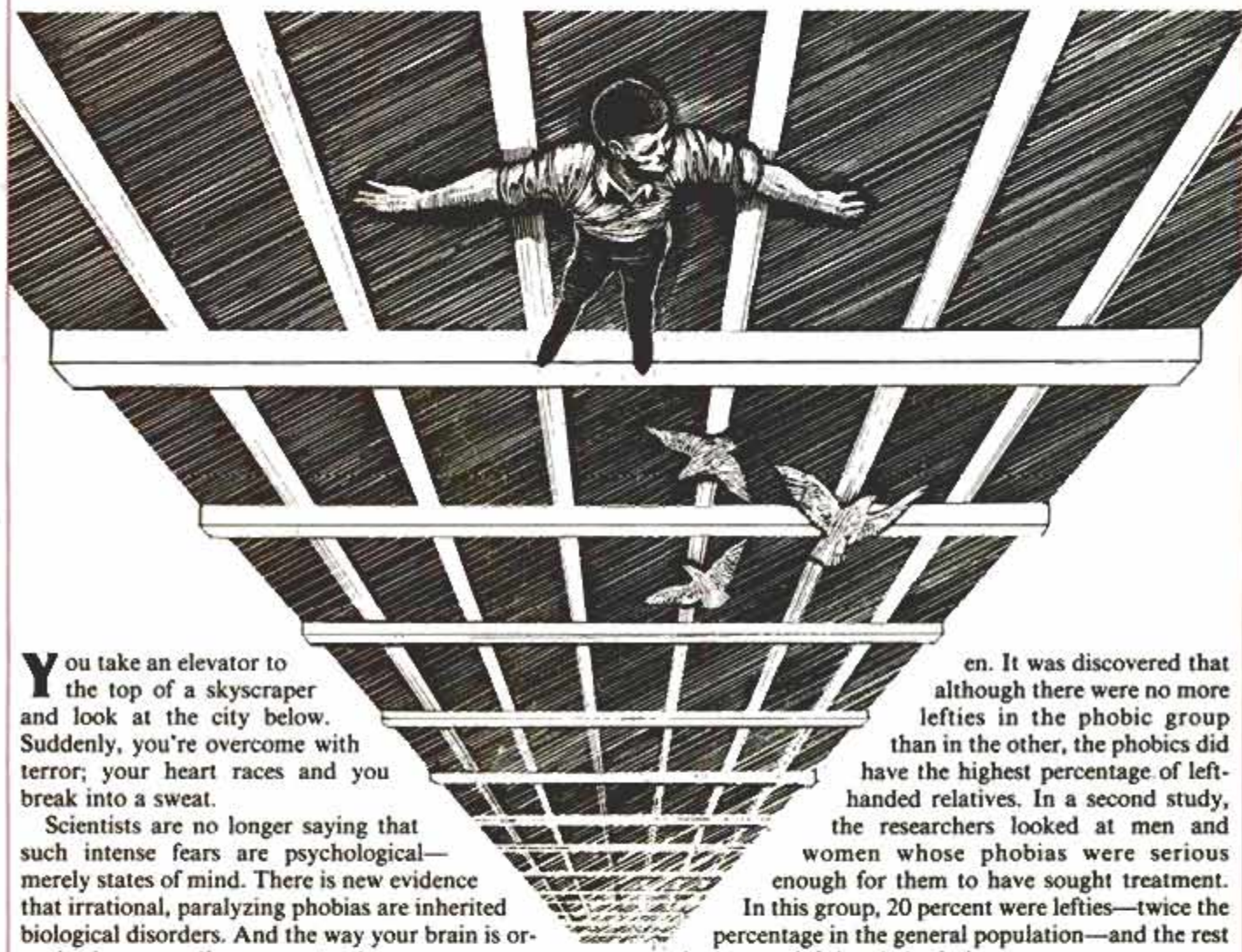
(Please turn to page 166)



At 1.2 hp per cu. in., the turbocharged, 1.6-liter, four-cylinder overhead cam engine is one of the most efficient powerplants made in America. A cutaway display engine is shown above. It's a tight squeeze in front-drive EXP (right).

PHOBIAS: THE BATTLE IN THE BRAIN

Deep-rooted fears are often biological—the result of one side of the brain losing control.



You take an elevator to the top of a skyscraper and look at the city below. Suddenly, you're overcome with terror; your heart races and you break into a sweat.

Scientists are no longer saying that such intense fears are psychological—merely states of mind. There is new evidence that irrational, paralyzing phobias are inherited biological disorders. And the way your brain is organized may predispose you to them.

The brain has two hemispheres that, although physically connected, generally have different functions. For example, the left half is in charge of rational thought and verbal concepts; the right handles nonverbal ideas and emotions. In most men and in right-handed people, the division of labor is pronounced; the two hemispheres are said to be "lateralized." In women and lefties, however, the brain's halves share many duties; the hemispheres are less lateralized. Noting that about 95 percent of people with animal phobias are women, psychologist Claude Chemtob, of the Veterans Administration Hospital in Honolulu, recently speculated that there may be a connection between phobias and incomplete lateralization.

Chemtob and colleagues decided to check the extent of brain lateralization in phobics by looking at the frequency of left-handedness. Two groups of women were recruited through a newspaper ad. One group met the diagnostic criteria for having a phobia—for example, a fear of snakes or spiders. The other had similar fears but were not phobic. Both groups were then compared to "normal" wom-

en. It was discovered that although there were no more lefties in the phobic group than in the other, the phobics did have the highest percentage of left-handed relatives. In a second study, the researchers looked at men and women whose phobias were serious enough for them to have sought treatment. In this group, 20 percent were lefties—twice the percentage in the general population—and the rest had many left-handed relatives.

The results, say Chemtob, "clearly indicate that incomplete lateralization and phobias are somehow related." But how can it foster phobias? Chemtob believes that the "rational" left hemisphere inhibits emotional arousal in the right. In highly lateralized brains, the left side has more control. But in brains where the two sides share functions, the right can wreak havoc.

Robert DuPont, a Georgetown University psychiatrist and president of the Phobia Society of America, says that Chemtob's results are noteworthy: "They are part of a trend to understand the biological basis of phobias, and this is an important area of research."

While scientists continue to look for the cause of phobias, they have made significant advances in treating them. Psychoanalysis used to be the only treatment available, but now clinics around the country are using a therapy in which patients are gradually exposed to the thing they fear. With the help of a therapist, they learn how to master their feelings. Drugs, such as antidepressants, are also proving effective.

"FEMININE" MEN ARE FINE MATES

Men in happy marriages tend to have an unexpected quality in common with their wives: femininity.

John Antill, a psychologist at Macquarie University in Sydney, Australia, interviewed 108 married couples about their relationships. The survey included an evaluation of the "femininity" and

"masculinity" of each spouse. (Femininity was characterized by compassion, gentleness, sensitivity and loyalty; masculinity by assertiveness, dominance, ambition and leadership ability.)

This was compared with each couple's rating of their marital happiness. In most marriages deemed successful, both partners tended to be more feminine.

Antill was surprised. He had expected to confirm the results of two previous studies, one of which had concluded that

"masculine" men and "feminine" women were psychologically happier as individuals, and another that suggested that psychological androgyny—the presence of equal amounts of masculine and feminine characteristics—contributed to a person's well-being.

"Instead," says Antill, "it appears that not only are feminine characteristics most beneficial to a relationship, but masculine characteristics have no bearing on its success."

SCALPEL MAKES STITCHLESS CUTS

A scalpel that seals its cuts with microwave heat may soon help surgeons save fragile, quick-to-bleed organs.

The new instrument will enable doctors to perform some operations in just a few minutes' time, with minimal blood loss and no stitches.

It was designed by electrical engineer Leonard Taylor of the University of Maryland at College Park, along with surgeons Frederick Toy and William Reed, of the University's hospital.

They have tested the tool on laboratory animals, mostly removing sections of the spleen—an organ that, when damaged, is often completely removed because its spongy, porous texture defies stitching. While it is possible to live without the spleen, its absence greatly increases susceptibility to infection, especially in young children. "So whenever we can,"

says Toy, "we like to leave at least part of it intact. The microwave scalpel will allow us to do that."

The instrument looks like an ordinary scalpel with the blade's center cut out. The blade is wired to a microwave generator and works like an antenna. As an incision is made, the microwave heat raises the temperature of the adjacent tissue until its blood coagulates.

So far, the animal tests have been very successful, says Toy. Follow-up exams have shown that the spleen remnant still works, and the animals have had none of the problems—bleeding and infections, for example—that often plague patients after such surgery.

The surgeons have also used the scalpel on the liver and hope to try it on the kidney. It should be ready for human application in about a year.

WIFE'S JOB HARMS HUSBAND'S HEART

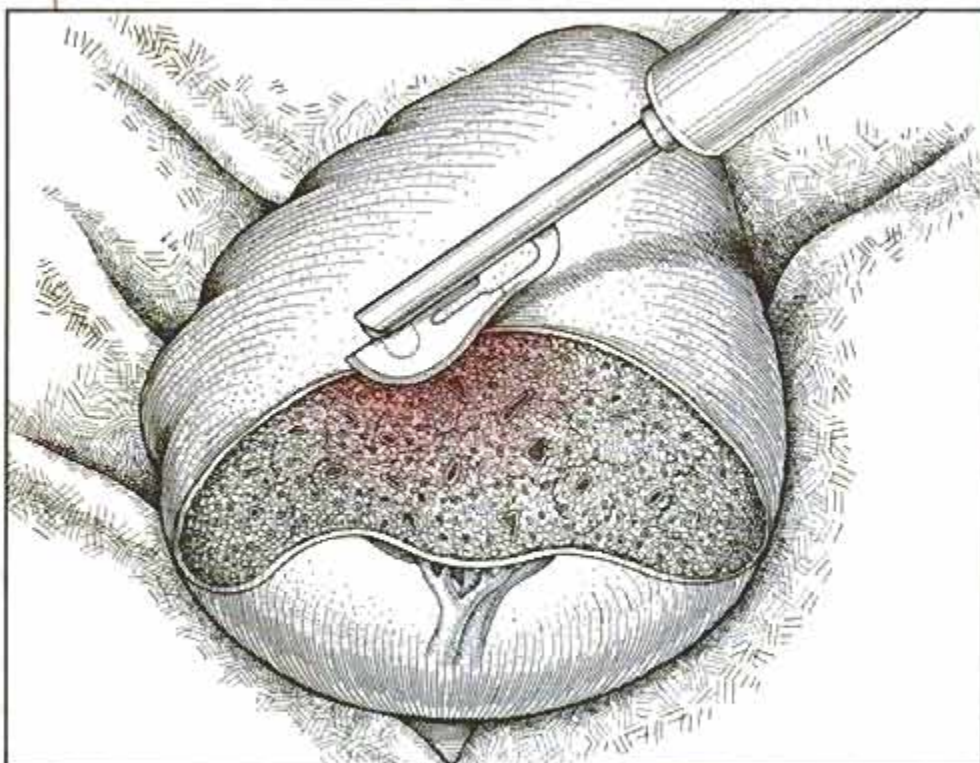
The advent of the two-career family has brought with it an unforeseen health problem: Two recent studies have shown that men married to highly successful women are much more likely to develop heart disease than other men their age.

Carlton Hornung, an associate professor of preventive medicine at the University of South Carolina, Columbia, studied over 1,000 couples to see how husbands are affected by their wives' occupational success. For underachieving men between the ages of 40 and 50 married to overachieving women, the death rate from heart disease was 11 times higher than the norm. And the greater the wife's success, the higher the risk.

"Of course," says Hornung, "underachievement all by itself causes stress for men"; the mortality rate for all male underachievers is double the norm. It seems that a major contributing factor in this particular situation is psychological abuse. Hornung found in an earlier study that about 80 percent of these husbands had been ignored, threatened, insulted or otherwise abused by their wives.

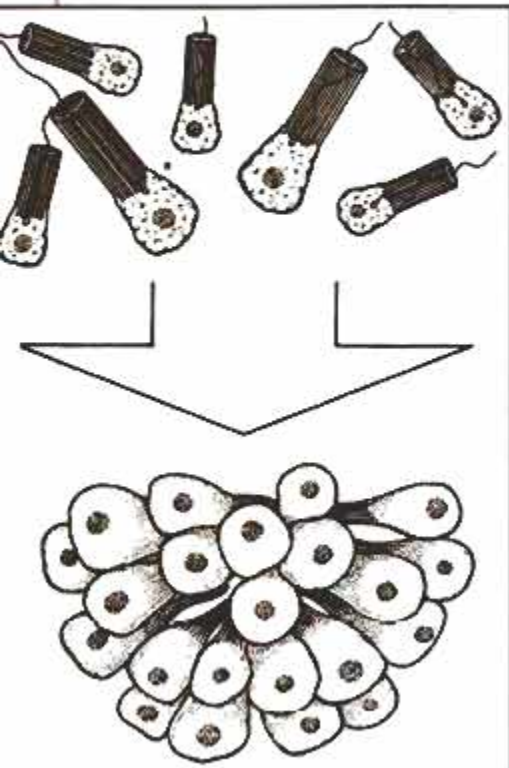
More recently, Suzanne Haynes, of the University of North Carolina, Chapel Hill, and two colleagues reported in the *American Journal of Epidemiology* that men whose wives have stressful jobs, unsupportive bosses and few promotions were seven times more likely to develop heart trouble, regardless of the status of their own careers. In such cases, the husband shares his wife's frustrations and feels powerless to help her. The result: stress-induced heart disease.

IT'S WELL KNOWN that many female insects eat their mates. But a cousin of the praying mantis has an even more masochistic courtship ritual: Only after the female has bitten off her mate's head is he capable of copulating.



The spleen is so fragile, normal surgical methods do more harm than good. A new scalpel that generates microwave heat could make such surgery simple, fast and safe.

SPONGES TEST HUMAN DRUGS



Clumping of sponge cells in response to injury matches that of human blood cells in fighting infection; sponges can thus be used to test anti-inflammatory drugs.

When you test a drug intended for humans, ideally you should give it to a species that's closely related to man—chimpanzees, perhaps. Now, however, after scouring distant rungs of the evolutionary ladder, a doctor has discovered that valu-

able anti-inflammatory drugs can be tested perfectly well on sponges.

What do sponges have in common with humans? "Sponge cells tend to clump back together when separated," says Gerald Weissmann, of New York University Medical School. This enables the animal to reassemble itself if damaged. "They aggregate the same way that human white blood cells cluster at the site of an injury or infection during healing."

In humans, though, the clumping can sometimes do more harm than good, causing fever and inflammation. Drugs designed to reduce inflammation—those used to treat arthritis, for example—do so by inhibiting cell clumping; they block the cell-to-cell movement of calcium that triggers this response. "Because sponge-cell aggregation is also triggered by calcium," explains Weissmann, "it made sense to assume that sponges would react to these drugs the same way."

So far, Weissmann has tested more than 40 anti-inflammatory drugs on *Microcrocina prolifera*, a cousin of the common bath sponge. In each instance, the drug stopped the sponge cells from clumping.

The value of the sponge-cell test isn't clear yet, but anti-inflammatory drugs are certainly big business: About 31 million prescriptions were written in the first half of the past year alone. Weissmann says his test will fit in well in the initial steps of drug testing. Researchers will no longer have to rely on expensive, perishable human cells. All a scientist will have to do is throw in the sponge. ■

SODA CAN LESSEN LEAD POISONING

Despite soda's junk-food reputation, a chemist has shown that it may help diminish the effects of lead poisoning.

Paint on the walls in many older, run-down houses often contains lead. Unfortunately, it also has a sweet taste that can tempt toddlers. Once children taste the paint, says Ho-Leung Fung, head of the pharmaceuticals department at the State University of New York, Buffalo, "it's difficult to stop them."

Salts containing phosphorus stop lead from dissolving easily in fluids—including stomach acid—so Fung checked household products that contained these chemicals, hoping to find one that could help reduce lead absorption in children.

Hundreds of foods and beverages are treated with preservatives containing phosphorus. Fung chose soda (sodas were called "phosphates" early in this century). He fed rats lead paint followed by small amounts of cola. "They absorbed significantly less lead than rats who were given lead but no soda," he says.

Fung hasn't tried the test on humans yet. Even so, he suggests that parents who find their children eating paint would do well to give them some soda—and get them to a doctor at once. ■

SKUNKS HAVE MORE than smell to protect themselves. They can withstand five times the snake venom that would kill a rabbit.

TIGHT BRAIDS CAN CAUSE BALDNESS

A popular hairstyle among blacks may be causing early baldness, says a physician at the Albert Einstein College of Medicine, in New York City.

Reporting in the *American Journal of Diseases of Children*, Gary Brauner says that tightly pulled braids "done in a multitufted style" put too much tension on hairs, especially around the edge of each tuft. "The tufts become progressively narrower," he says, "surrounded by increasing areas of [baldness]."

Cornrow braiding, perhaps most widely known from Bo Derek's role in the film *10*, can hurt the scalp as well, by promoting bacterial growth.

Brauner also cautions that some commercial products that "relax" curly hair tend to weaken it, compounding the baldness problem. ■

LAUGHING GAS APHRODISIAC

Nitrous oxide—the "laughing gas" some dentists use as an anesthetic—has a potentially troublesome side effect: It can arouse women sexually.

The danger is to the dentist, according to Theodore Jastak, an oral surgeon at the University of Oregon Health Sciences Center. Sexual fantasies experienced by partially conscious patients can be mistaken for actual abuse.

"That doesn't mean that dentists never harass female patients," he says. "I know of cases where this has unquestionably happened. But I'm also aware of situations where it's pretty clear that it didn't happen." Jastak documents several instances in an article in the *Journal of the American Dental Association*.

A recent South African study, published in *The Journal of Sex Research*, confirms Jastak's anecdotal evidence.

Tests on female volunteers showed that the gas indeed promotes both sexual fantasy and physical arousal. The mechanism may involve the brain's natural opiate secretions, say the authors, who suggest that their findings could lead to the use of nitrous oxide in sex therapy.

Does arousal happen in men too? "Frankly, we don't know," says Jastak. "There haven't been complaints to spur us to find out." He says, though, that dentists can easily avoid trouble: "Never give gas without a third party there." ■

THE COMMON SPONGE was used in ancient Greece as a gas mask, a compress, a contraceptive—and, of course, for bathing.

MEN'S NEW ROLE IN PREGNANCY PREVENTION

Within a few years, men could be practicing birth control by rubbing salve on their stomachs once a day.

The prospect of a chemical contraceptive for men comes from 12 years of research by Larry Ewing, a reproductive biologist at Johns Hopkins University. His formula has successfully sterilized rats and rhesus monkeys without producing unpleasant or dangerous side effects. "We've never had a single failure or health hazard," he reports.

Best of all, the process can be reversed, and it doesn't interfere with sexual activity. Both problems have surfaced with other male contraceptives.

The compound is a mixture of the male sex hormone testosterone and estradiol, a synthetic version of the female hormone estrogen. Implanted beneath the skin, it seeps at low doses into the bloodstream at a slow, steady rate. The drug blocks chemical signals from the pituitary gland that trigger sperm production. When the implant is removed, the animal returns to full fertility.

There is no proof so far that the contraceptive will turn out to be safe and effective in humans, but Ewing has applied to the Food and Drug Administration for permission to find out. Permission to test can take from several months to several years. After that, says Ewing, the actual testing on humans might take several years more. "That's even assuming we overcome all the stumbling blocks we'll inevitably run into," he says. "Men shouldn't give up on the condom quite yet."

If the formula ever makes it to the marketplace, Ewing thinks it will have to be in a more convenient form than an implant. The idea of an ointment that would be absorbed directly through the skin is speculative but not unreasonable, he says.

BLOOD TYPE IS RELATED to life expectancy. Caucasian men with type O tend to live longest; those with type B, shortest. Just the opposite, however, is true of women. Blood type is also associated with specific diseases: People with type O get more duodenal ulcers; those with type A are prone to pernicious anemia and stomach cancer (from *Invitation to Biology*, Worth Publishers, 1981).

NOXIOUS NURSING NIPPLES

The more scientists look for cancer hazards, the more they seem to find. The latest culprit is the rubber used in baby-bottle nipples.

The degree of danger to babies, if any, hasn't been established yet, according to Donald Lisk, head of the Toxic Chemicals Laboratory at Cornell University. But traces of four known or suspected carcinogens were leached from sample nipples into water—and could presumably show up in a baby's saliva as well.

Lisk and a team of Cornell scientists tested four U.S. brands of nipple by chopping them up and soaking them for three hours in water that was constantly agitated. To simulate in-use conditions, the water was maintained at a constant 98 degrees Fahrenheit.

The result: Three varieties of nitrosamine, a carcinogen that also occurs in cured meat and beer, were found in min-

ute concentrations. A fourth chemical, diphenylamine (DPA), whose cancer-causing potential is still being studied, was also found. DPA is used in manufacturing as a rubber preservative. The researchers determined that the water with dissolved chemicals was mutagenic—it caused genetic changes—in bacteria.

For now, the FDA is not suggesting that parents stop using the nipples. But they have urged producers to look into alternative technologies that already exist for making rubber without potentially dangerous chemicals.

PRAIRIE DOGS GREET in a manner unusual among animals: They kiss. Scientists think it's a way of telling friend from foe.

NERVE SPLICING MADE EASY

The success rate for reconnecting peripheral nerves has soared from 15 percent to nearly 100 percent, thanks to a procedure developed at the National Institute of Mental Health (NIMH).

If it works in humans as well as it does in rats, doctors should be able to restore function when limbs are severed or nerves torn.

Peripheral nerves carry messages to and from the spinal cord, relaying sensations to the brain and sending commands to the muscles. When they are cut, numbness and local paralysis result. The problem until now, says Luis de Medinaceli, head of the NIMH team, has been that the tens of thousands of fibers that make up each nerve are too small and too numerous to reconnect surgically. If the ends of the nerve itself are sutured, the fibers, which must cross a large gap, grow back together haphazardly.

The new technique combines elements that have proved individually unsuccessful. First, the nerves are frozen so that the surgeon's vibrating scalpel won't mash the ends of the delicate fibers. The ragged nerve ends are then trimmed so they'll fit together; nerves rejoin poorly when there's intervening dead tissue.

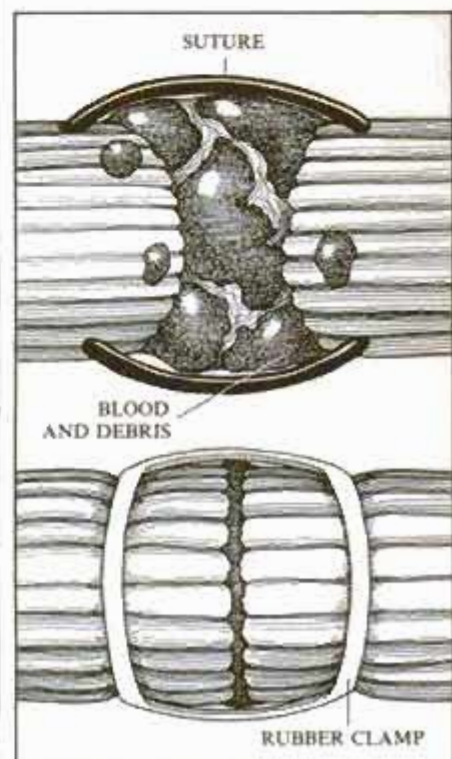
At the same time, the fibers are soaked in a solution that matches the chemical makeup inside the nerves. Otherwise, says de Medinaceli, the chemical environment of the wound kills the nerve tip.

Finally, the nerve ends are gently held together with a rubber clamp, not sewed, so pressure won't distort them.

The next step is to try the procedure on

monkeys. If it is successful, human tests will follow.

Can the central nervous system benefit as well? It is a much more complicated situation, says de Medinaceli, but it's not impossible.



Traditional nerve repair involves sewing the ends together (top). But blood and tissue keep them apart. A new procedure cleans the ends and clamps them closer.

Illustration by Michael Reingold

ANTICIPATING PAIN MAKES PAIN WORSE

Most of us start to hurt the minute a dentist walks toward us with anything that whirs. Now an experiment has confirmed that we feel much of our pain because pain is exactly what we expect to feel.

Working at the University of Washington, Seattle, researchers explained to a group of 66 nurses that their teeth would be tested for sensitivity to electrical stimulation. The nurses were asked to signal the instant they felt any sensation and again when they felt pain. Furthermore, they could stop the stimulus when it became too uncomfortable. Samuel Dworkin, a dentist and clinical psychologist, reports in the *Journal of Dental Research* that this preliminary test provided threshold and tolerance levels that could be compared with further tests.

A week later, the nurses repeated the test—half in the same laboratory, the rest in a dentist's office, where a "dentist" told them their teeth were to be checked for health. The nurses in the laboratory actually felt less pain the second time around. But those in the dentist's office experienced a 17-percent decrease in threshold for sensation, a 26-percent drop in pain threshold and 35-percent lower pain tolerance.

When asked, 70 percent of the nurses in the dentist's chair responded that they'd felt more anxious the second time, as opposed to only 17 percent of those at the lab. ■

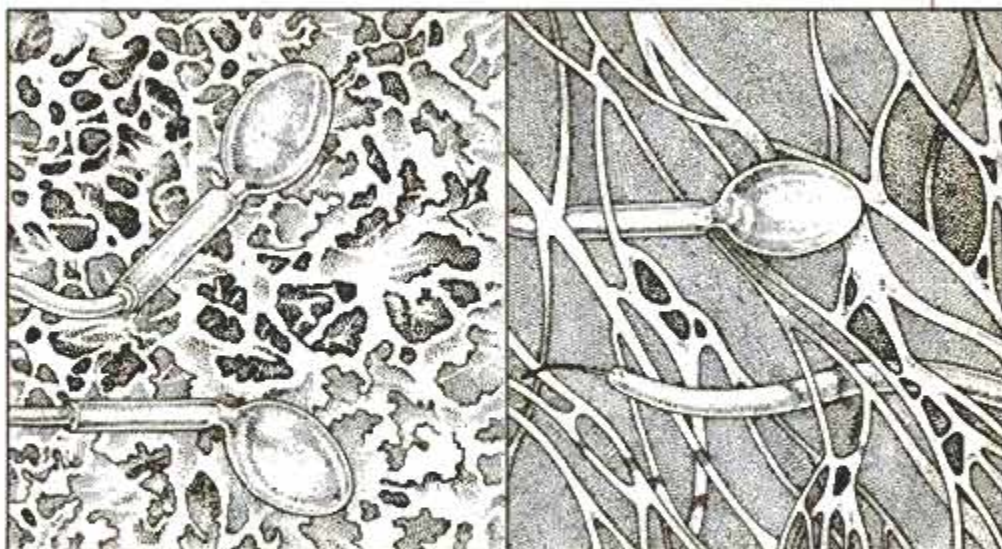
BIRDS CAN BREATHE through their bones. A British anatomist proved it in 1758 by blocking the windpipe of a fowl and cutting through a wing bone. Air flowed freely in and out of the hollow bone.

"OLD" SMOKE IS STILL BAD SMOKE

Can inhaling the smoke from other people's cigarettes be hazardous to your health? According to one recent study, nonsmokers who spend time in smoke-filled rooms may run a greatly increased risk of stroke and heart attack.

Helmut Sinzinger and a research team at the University of Vienna Medical School put nine nonsmokers in a room filled with smoke from 30 cigarettes. After 15 minutes they tested the subjects' platelets—clot-forming particles in the

BAKING SODA BOOSTS FERTILITY



Some women are infertile because dense mucus blocks the passage of sperm to egg. A simple baking-soda solution can expand the spongelike pores and restore fertility.

Can the yellow box of baking soda in your kitchen cure infertility? "Sometimes yes," claims reproductive biologist Kenneth Gould of the Yerkes Primate Center of Emory University in Atlanta.

About one percent of American women aren't able to conceive because of abnormal mucus in the cervix, the necklike opening connecting the uterus with the vagina. Under an electron microscope, cervical mucus appears weblike and porous, and at certain times during the menstrual cycle, the pores in the mucus normally expand, allowing sperm to pass through.

But in some infertile women, the pores remain closed, forming a shield that keeps the sperm out. Gould has found that certain ions (electrically charged atoms) introduced into the mucus can change its structure. Ions with more than one negative charge, such as those found in baking soda, cause the pores to expand. Gould suspects that the ions alter the way the proteins making up the mucus bond

with one another.

To test the theory, Gould instructed about 90 infertile women to douche with baking soda before intercourse, after which a third of them conceived. The douche appears to be entirely safe, and if Gould is right, baking soda may someday become a common home remedy for childless couples.

Another potentially valuable spinoff of the research may be a contraceptive. Because positively charged ions make the mucus pores contract, they might be useful by themselves, or in combination with conventional birth control methods, as an effective blockage against sperm. ■

IT'S NOT THE AMOUNT of DNA in a gene that counts; it's the way that code is arranged. A lily's genes, for example, contain 10 times as much DNA as a man's.

blood—for sensitivity to prostaglandins, blood-borne chemicals that keep platelets from sticking together. Tests have demonstrated a strong link between this sensitivity and heart attack and stroke.

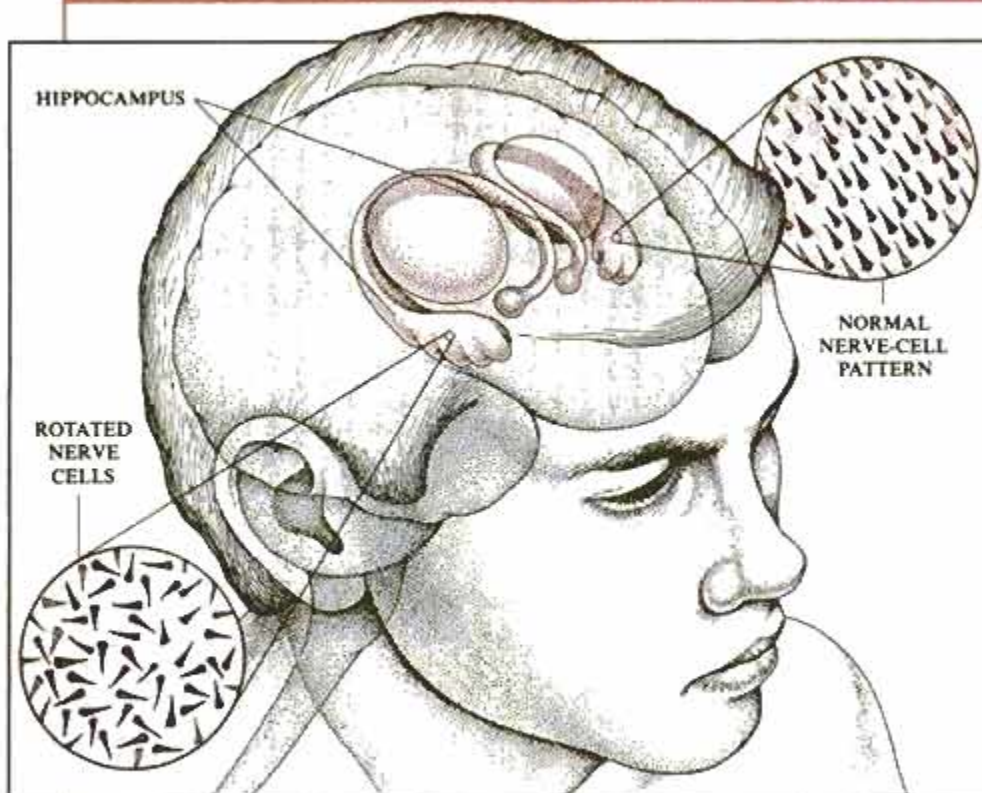
The platelets were found to be 75 percent less sensitive than usual; in other words, the prostaglandins were largely blocked from doing their job, greatly increasing the nonsmokers' risk of developing life-threatening blood clots. Even an hour after leaving the smoky room, sensitivity was still substantially lowered.

Although smokers exposed to the same conditions had no significant response, regular smoking had permanently cut

their platelet sensitivity in half.

Sinzinger says that nonsmokers in smoky atmospheres may run about the same risk of stroke and heart attack as those who regularly smoke up to a pack a day. And, given their lower tolerance to smoke, even an occasional puff may be dangerous to those who don't smoke. ■

ALTHOUGH A BLOOD CLOT is jellylike and filled with fibers and platelets, it is actually 99 percent water.



Disordered nerve cells deep in the brain seem linked to schizophrenia. A virus may be responsible, but a scientist trying to repeat the research is not yet convinced.

IS SCHIZOPHRENIA CONTAGIOUS?

Some people may "catch" schizophrenia while in the womb, two California researchers contend. But a psychiatrist who failed to duplicate their findings says he isn't convinced.

Schizophrenia is a mental disorder that causes the personality to disintegrate. UCLA psychiatrist Arnold Scheibel proposes that aberrations in the hippocampus—the brain's emotional center—may be responsible. Indeed, he and graduate student Joyce Kovelman found that, in severe schizophrenics, many hippocampal nerve cells faced the wrong way. Some were as much as 180 degrees askew.

They also discovered that brain cells in mild cases were rotated up to 90 degrees, with the amount of twist matching the degree of mental illness. But some normal subjects also had disorganized brain cells. "The deviations were smaller," says Scheibel. "Some may simply be borderline individuals."

Scheibel believes schizophrenia arises during the mother's first trimester of pregnancy, due to a genetic defect or, perhaps, a viral infection. The embryonic cells rotate while gluing themselves to the forming hippocampus; the "glue" dissolves and the cells shift.

But researchers at the National Institute of Mental Health report that many normal brains have these abnormal cell twists. Says NIMH psychiatrist Daniel

Weinberger, "One reason why Scheibel's virus idea is attractive is that we know there are certain viruses associated with the limbic system, which includes the hippocampus."

Why can the syndrome take decades to appear? Says Weinberger, "Children may be schizophrenic, too, but we just don't recognize it." Or, notes Scheibel, stress or hormonal changes may trigger a dormant virus.

DANGER IN CATARACT CURE

The way we treat cataracts, a doctor claims, can cause blindness.

As the lenses in our eyes age, cloudy spots, called cataracts, often develop. These prevent light from reaching the retina and thus impede vision. The most common cure is to remove the lens.

But the lens does more than focus light. Humans and other animals active in daylight have a yellow pigment in their lenses that acts as a filter. "This pigment cuts down on glare and light levels," explains ophthalmologist Seymour Zigman, of the University of Rochester Medical Center. It also absorbs short wavelengths of light—blue and near-ultraviolet—that can seriously damage the retina if not filtered out.

The lens pigment in gray squirrels is

LASER ATTACKS TOOTH DECAY

Are you cavity-prone? If so, smoothing your teeth with a laser may stop those destructive bacteria from taking hold and digging in.

Scientists at Canada's University of Alberta have found that a laser can fuse a tooth's fissures, where the decay process first occurs. "These fissures, mainly on the biting surfaces of the back teeth, are like faults," says pediatric scientist John Hargreaves. "Some are badly formed and too deep."

The procedure, which has so far been tried only on extracted teeth, involves passing a laser, via fiber optics, over the tooth surface. According to Hargreaves, it takes far less than a second per tooth, so the heat created never reaches the central nerve. Thus, it's unlikely that the laser treatment, when tried on patients, will be painful.

The researchers are now developing a hair-thin fiber that can pass between the tooth and gum into the root-canal system. Root-canal work today involves filling these channels to keep out contaminants. With a few pulses of the laser, dentists would be able to both sterilize the affected area and permanently bond the sealant to the tooth.

Clinical trials of the technique, says Hargreaves, are at least two to three years away.

IF THE SUN goes behind a cloud, the momentary drop in temperature can slow a buzzing fly down to a casual stroll.

nearly identical with the pigment in human lenses. And when a squirrel's lens is removed, near-ultraviolet light—even from indoor sources—can destroy the retina's light-sensitive cells.

The same may be true in humans, especially if natural lenses are replaced with artificial intraocular lenses (IOLs). Not only do IOLs lack the real lens's filtering pigment, says Zigman, "but if short-wavelength light enters the eye through an IOL, it's focused just like sunlight through a magnifying glass. It's not hot enough to burn the retina, but it can damage cells."

Researchers have yet to document such damage in humans. But at least one optical-supply company is now developing yellow-tinted IOLs just in case.

WHAT ARE CLOUDS?

From mackerel skies to thunderheads, all clouds are shaped by fundamental laws of physics.

Like ghosts, clouds seem to rise mysteriously from nowhere. In fact, they are the visible part of a continuous cycle in which water evaporates into the air, condenses and returns to Earth.

This cycle starts when the sun warms the Earth. The Earth, in turn, warms pockets of moist air. When an air pocket heats up, its molecules bounce around more actively and begin to take up more space. As a result, the air expands and becomes less dense. The surrounding, heavier air then pushes its way underneath the warm pocket, which rises like a hot-air balloon.

As the warm, moist air climbs through layers of the atmosphere at decreasing pressures, it expands more. Since heat in gases is generated by the jostling of all the molecules in a given volume, the air cools as the molecules spread out.

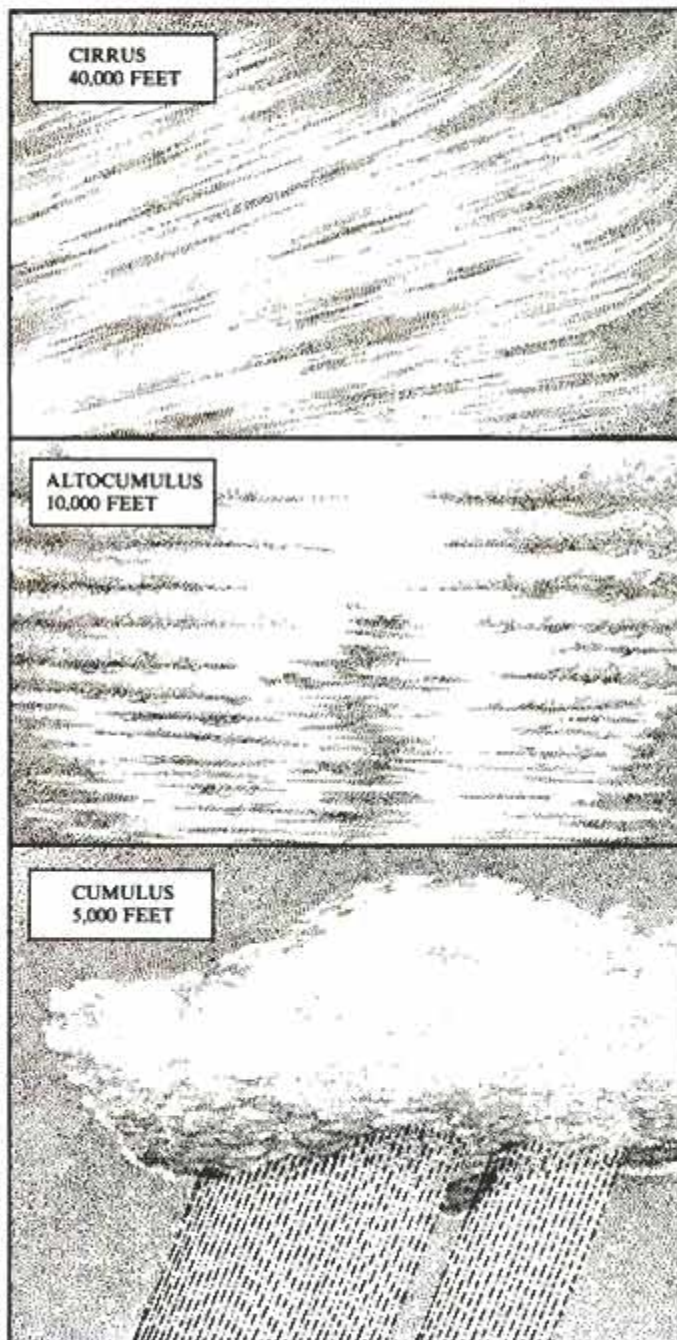
At lower temperatures, air can hold less moisture in the form of invisible water vapor. At a temperature called the dew point, it becomes supersaturated. Water vapor condenses into a fine mist of droplets. Just as early morning dew condenses on grass, water vapor high in the atmosphere condenses on tiny particles of ash (from fires and volcanoes), salt (from air bubbles bursting in seething ocean waves) and fine sand (from dust storms). There are about 80,000 such particles suspended in a cubic inch of air over land, about 10,000 over the ocean.

Only when the water condenses does it become visible, and when enough droplets condense, they form a cloud. Clouds can completely cover the sky when warm, moist air is rising over a broad area.

When they look like scattered puffs of cotton, they've been caused by localized updrafts. Clouds can grow to vast proportions if enough air is heated: A thunderhead can tower eight miles high, and half a million tons of water can be released in a single downpour. Sometimes, updrafts can hold rain in a cloud until so much accumulates that a deluge results. One cloudburst in the Caribbean in 1970 produced 1.5 inches of rain in one minute.

Clouds stay aloft because the droplets are so tiny that they remain suspended on air currents. Each mist particle is minuscule—only one-millionth the mass of a raindrop. Sometimes the particles drop out of the cloud, only to evaporate and be swept up again. At other times, they leave the sides of the cloud, to be replaced by water vapor from below. Thus, the visible boundary of a cloud is really just a division between water in vapor form (invisible) and water in droplet form (visible). Says William Rossow of NASA, "It looks as if it is stable, but the cloud is constantly renewing and destroying itself."

The droplets in a cloud continually collide and fuse, forming larger droplets. These drops can grow to be a hundred or a thousand times larger. If the cloud is at least a mile thick, so many collisions can occur that the drops eventually become heavy enough to fall as rain. When the air is cold enough, the droplets crystallize and become snowflakes. Even in summer, rain can start as snow, since the temperature is often below freezing in the upper atmosphere. But the snowflakes melt as they fall into warmer air.



Clouds are formed by heat and cold and are sculpted by the wind. Most types (these are just a few) occur at specific heights.

CAFFEINE QUIZ

Most people know caffeine's kick. Here's more on the popular stimulant.

Where does it come from? Dozens of plant sources, the best known being coffee, tea, cocoa and cola nuts.

What does it do for plants? U.S. Department of Agriculture researcher Robert Buchanan says it may help them neutralize poisons made by molds. If so,

caffeine could become a valuable agent in commercial food preservation.

Is it harmful? Caffeine has been shown to cause irregular heartbeat, and some studies point to birth defects in rats fed large amounts. But Manfred Kroger, a University of Pennsylvania food scientist, says up to 10 cups of coffee a day is quite harmless.

What about quitting? Go slowly; withdrawal symptoms include headaches, nausea, irritability and drowsiness. ■

HOW DO BARNACLES GET BY?

A barnacle's success in life depends on a single decision: where to live. Once it glues itself to a rock, ship's bottom or turtle shell, it can never move. If the ship is drydocked or the rock exposed too long to air, the barnacle dies.

"It's a rough life," says Mark Denny, a Stanford marine biologist who has studied these cousins of the lobster for five years. Baby barnacles, swimming a feeble six inches an hour, are at the mercy of any fish that happens to come along. "At a rough estimate," Denny says, "only one in every ten thousand barnacles grows to adulthood."

When currents bring the survivors into contact with a solid surface, they attach themselves with temporary glue while they test the location for adequate supplies of plankton, their food source. If the site is poor, the still-mobile barnacles let go and try again.

When a satisfactory habitat is found,

the barnacles secrete permanent cement. In two weeks, this protein-based glue is nearly indestructible. Its secret would be valuable to learn: The glue sets underwater, defies corrosion and is so hard that it's easier to break the rock than it is to pry the barnacle off.

Once attached, the barnacle forms a shell around itself and begins waving its fan-shaped feet to catch plankton. It also starts to mate. Barnacles are hermaphroditic, having both male and female sex organs, but they can't mate with themselves. Fixed in place, they have no choice of partner; the next-door neighbor must do. To bridge the gap and impregnate a mate, the barnacle has evolved the longest male sex organ relative to body size of any animal in existence.

What causes the tightly packed colonies of shells that mar ships' shapes? Some larvae settle down right after birth to live with mom and dad. ■

MALES: WHO NEEDS THEM?

Could men become sexually obsolete? The distressing answer is: possibly. Many species have acquired the capacity to reproduce without mating—roughly one in 10,000—and in most cases, the species is now exclusively female.

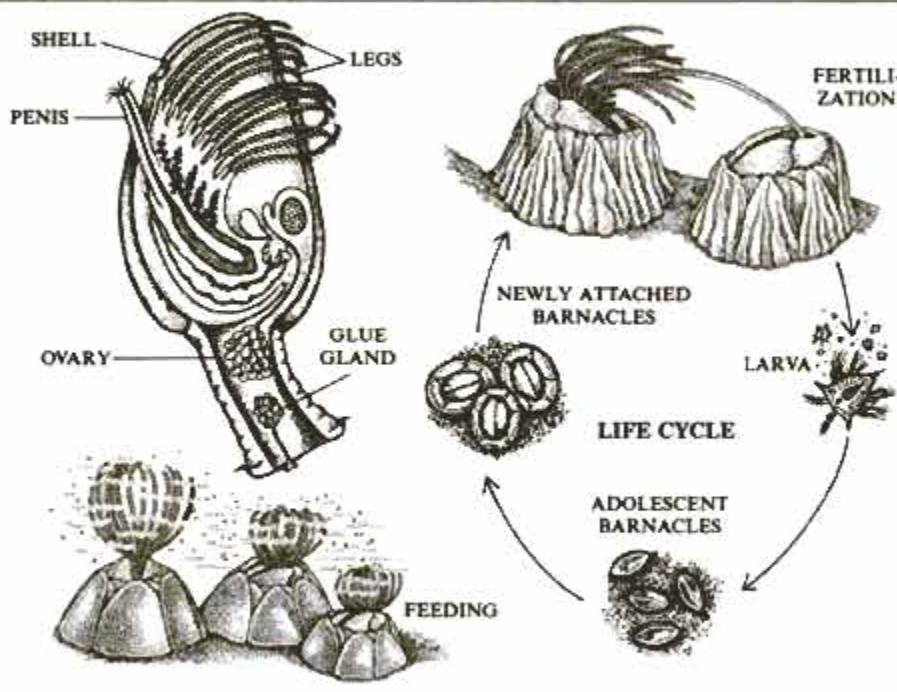
When an unfertilized egg develops into a mature offspring, the phenomenon is called parthenogenesis. It is most common in invertebrates but also occurs in fish and lizards—and, says University of Illinois ecologist Michael Lynch, "The potential is present in all species."

Traditional evolutionary theory maintains that sexual reproduction is always superior to parthenogenesis, since the mingling of male and female genes can produce improved offspring. But in certain conditions parthenogenesis can do just as well—if not better. Explains Lynch, "If you have an ideally developed species in a stable environment, parthenogenesis will give you ideal offspring. Plus, you double the number, because each organism can reproduce individually."

Further, says Lynch, asexual species do acquire genetic variation. For example, a tiny crustacean called *Daphnia* is found in both sexual and parthenogenetic varieties. Lynch has tracked 75 generations (there's a new one every week) of the parthenogenetic form, and, he reports, "Genetic variation has definitely increased because of mutations." In the wild, sexual and parthenogenetic *Daphnia* have roughly similar genetic diversity.

"The potential exists in humans, too," says Lynch. "Ovarian cysts are caused by unfertilized eggs that embed in the uterine wall and start to develop." ■

THE HUMAN BODY can lose heat up to 23 times faster in water than in air the same temperature.



Growing to nearly a foot across, the acorn barnacle (at right) is a delicacy in some countries. The anatomy of its cousin, the goose barnacle, is at the upper left.

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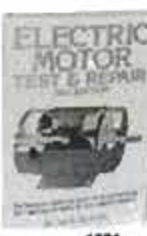
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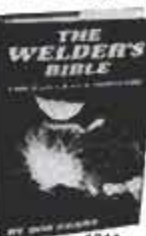
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FORD EXP TURBO

(Continued from page 162)

down the half-shaft angles in a successful attempt to reduce torque steer. Koni shocks were installed at each corner. Rear springs, taken from the Escort, were chosen to improve what some early drivers felt was too firm a ride.

Suspension improvements can still be made, primarily in the area of ride. We would happily have traded a bit more tar-strip harshness for a little more hard-cornering ability. The suspension tuning works very well in tame environments. At speed, a few fast laps through your favorite sweepers will teach you how to get through them safely. It may mean sacrificing some



EXP interior benefits from a new dash, seats and door panels in '84. Turbocharged version gets sports seats and SVO wheel.

speed to promote directional stability, but after all, this is not a race car. Ford may not have made a silk purse out of the old EXP, but it has at least made a Dacron one.

Driving the EXP Turbo at greater than city speeds is when you discover the improvements made by SVO. The car feels much more confident while accelerating. In high-speed turns, the oversteer we associate with front-wheel drive can be modulated very easily by judicious use of the throttle. Steering is very light, unfortunately, because power steering is required with the turbo package. This power steering works too well, effectively masking any meaningful conversation between the driver and the road.

The EXP dashboard has been redesigned, as have the door panels and standard seats. The turbo car, however, gets even better sport seats. They do not have the supportive characteristics of the seats in the SVO Mustang, but they are big improvements over previous fare and hold up well under hard acceleration and cornering. The only

flaw with the thick, three-oval sport wheel is that it completely obstructs a driver's view of the right turn signal light in the upper part of the instrument panel.

One improvement Ford could make is to the transaxle. It was designed for the 80-hp HO Four, with gear ratios intended to suck every last mile from each commuter gallon of gasoline. The turbocharged car gets the same MTX III five-speed manual transaxle that goes into the unboosted cars, with a final drive of 3.73. Its wide ratios fail to take full advantage of high-rpm boosted power.

Third gear acceleration is adequate, but it's third gear one must use in order to pass, sometimes a tricky maneuver if the driver goes to it directly from fifth. Downshifting to fourth to pass just won't do the job.

Little is lacking

Automotive journalists generally are an unsatisfied bunch. They always think each improvement could have been done better, or differently. But the EXP Turbo lacks very little to become one of the hottest in a hot new breed of performance car. Better gear ratios are the most obvious need.

The exterior of the turbo version has received some attention, too. Since the Mercury LN7 has been discontinued for 1984, Ford installed its dark taillamps and bubblelike backlight on the EXP. For the turbo, the rear also gets a low spoiler and a red Turbo decal on the lower body's matte black paint.

Little has changed up front in the boosted version, except for the obvious and tasteful addition of a chin air dam. While the only interior color is charcoal, exterior colors for cars with the turbo option are white, black, silver or red.

Also quite obvious from the outside are the addition of tires and wheels from the Tempo. Our test vehicle has 13 x 5.5 cast aluminum wheels with P185/65R-365 Michelin TRX steel-belted radials. Ford experimented with tires as large as 210s, but found there were clearance problems with the bigger rubber. Other tire makers, including Goodyear, are being evaluated for the Turbo package, so a wide range of tire choices may soon be available.

The EXP Turbo is going to surprise a lot of people not used to taking this car seriously. It now does what it was designed to do in the first place—provide two people with transportation that accomplishes more than just the commute to the office. Driving, after all, was meant from the start to be fun.

Where the EXP Turbo does its best work is in showing us that, finally, it is no longer a car standing in the Escort's shadow. It has a much-needed identity of its own.

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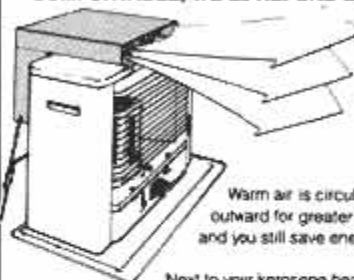


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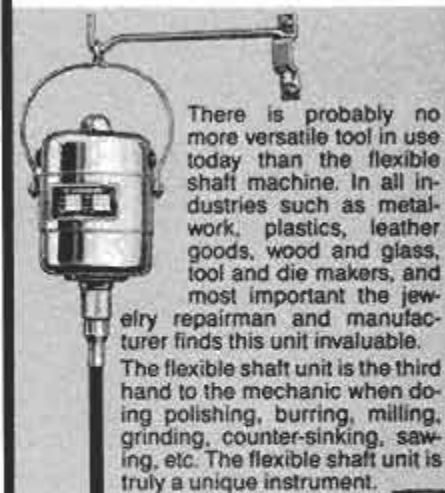
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12" Wedge, 5" Bore x 24" Stroke cylinder, 7 gal Tank, 15 gal 2 Stage pump, 10 Hp. Motor, Auto detent valve.

On Sale #1142 **\$1319**
Will Ship 48 States \$80.

(Must include Frt at time of order or we will ship Frt Collect.)

LOG SPLITTER PARTS



11 gal 2 Stage pump
Use with 5 Hp Motor #1011 **\$98**

13 gal pump
Use with 5 + Hp. Motor #1013 **\$129**

16 gal 2 Stage pump
use with 8 Hp or Larger Motor #1015 **\$147**

22 gal pump
use with 10 Hp. or Larger Motor #1016 **\$239**

Standard Control Valve
Built in Relief Valve, #2010 **\$42**

Detent Valve,
Pressure Sensitive detent.
You don't have to Hold Handle
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8" High 6" Deep Wedge
#3060 **\$19.25**



Hydraulic Filter
to 20 gal/min #4020 **\$10.75**

4 x 24 x 2" Cylinder
(Can go UPS) #902424 **\$109**

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type Ship wt. 100 lbs. #909524 **\$204**



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We have the largest stock of trailer parts to repair or build your own at discount prices including Hubs, fenders, wheels and tires, Axles, Brakes, Hitches, Winches etc.

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1216	480x12 (4 Hole)	\$34.00
12131	570x8	\$31.00

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Save up to 50% 3 ply Belted Construction (U.S. Made)

21 x 12 x 8 Knobby	\$39.95
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Quiet and reliable. Static noise suppresser for reduced TV and Radio interference. Oil Alert system automatically shuts off engine if oil level below safe limit. Chrome plated frame for protection. Ideal for camping accessories, small tools and appliances or emergency Power.

ITEM #1660	EM-500	500 Watts	\$299.
1662	EM-600	600 Watts	\$327.
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8 Hp. Tecumseh cast iron sleeve #6081
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3-20 Hp. Horiz.Vert. Engines at discount prices

\$137
\$132
\$149
\$179
\$183
\$214

2. Infrared Heaters

11,000 BTU Infrared Heater
No fumes, instant heat, lights in seconds. Economical and Versatile, use in emergency heat situations, camping, farm, garages, cabins etc. For use with disposable propane cylinders. Item #17201 Sale Price **\$38.78**

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Clings to any magnetic iron or steel surface. Energy efficient. Thermostatically controlled. Provides heat for pipes, pumps, engine oil pans and countless other uses. Item #17101 Sale **\$17.50**

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Get it together—Buckle up.

The new '84 Ford Tempo. Technology never felt so comfortable.

The inside story.

Tempo's interior is a computer-refined compartment for five. Computer-designed placement of seats, door, roof and window areas afford maximum space efficiency.

Even Tempo's front-wheel-drive configuration was designed to provide more interior room. Since there is no drive shaft, there is no large hump to rob valuable floor space. In fact, Tempo actually has more rear room than a Mercedes 300D.*

For driver's convenience, controls are all placed

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Technology that works for you.

Outside, a unique aerodynamic shape channels the wind over and around Tempo to help increase fuel efficiency. It also directs the airflow, reducing overall lift for improved stability and directional control.

Its front-wheel drive delivers all-weather

traction, while its four-wheel independent suspension provides a smooth ride.

Plus, Tempo has the world's most advanced automotive computer, the EEC-IV. It processes up to 250,000 commands per second. Coupled with Tempo's 2300 HSC (High Swirl Combustion) engine, you get quick power response from a standing start and at cruising speed.

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*Based on EPA Interior Volume Index.

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