Antennas: Special Issue

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HAM RADIO HORIZONS

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BUILD A MINI RECEIVING ANTENNA

WØROF's SECRET ANTENNA

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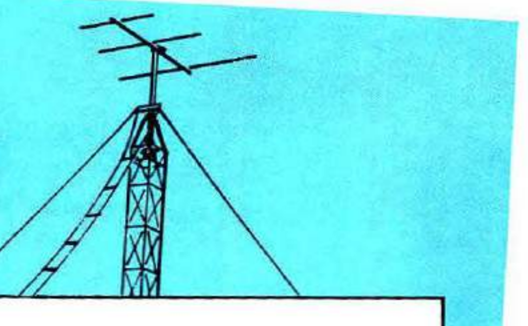

Memo from Drake

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Consider a typical all-band antenna set-up — a 135 foot doublet, center-fed with 60 to 70 feet of balanced line at a height of 45 to 60 feet. The Drake MN-2700/B-1000 will match this as a true balanced system on 80 thru 10 meters.

But what about 160 meters? Many amateurs recommend tying the feeders together and using the antenna as a vertical with a "top-hat". In fact, we suggest this ourselves in our manual.

However, the use of this or any vertical assumes you have a good ground or radial system for efficient operation. If you do not have enough room or do not wish to install such a radial system, performance may suffer. And if you do have radials, you still have to change the feeder connections each time you operate on 160 meters.

On the other hand, when you use the MN-2700/B-1000, simply leave the feeders in the balanced connection as you would for 80 thru 10, and move the special antenna selector switch to Position No. 4. This automatically converts half of the antenna and feedline to an inverted "L", fed through a 4:1 impedance transformer, with the other half operating as a counterpoise.

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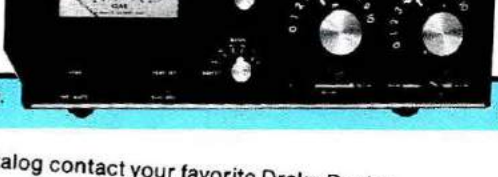
The Drake MN-7 offers the same special switching design, and is rated for 250 watts output.



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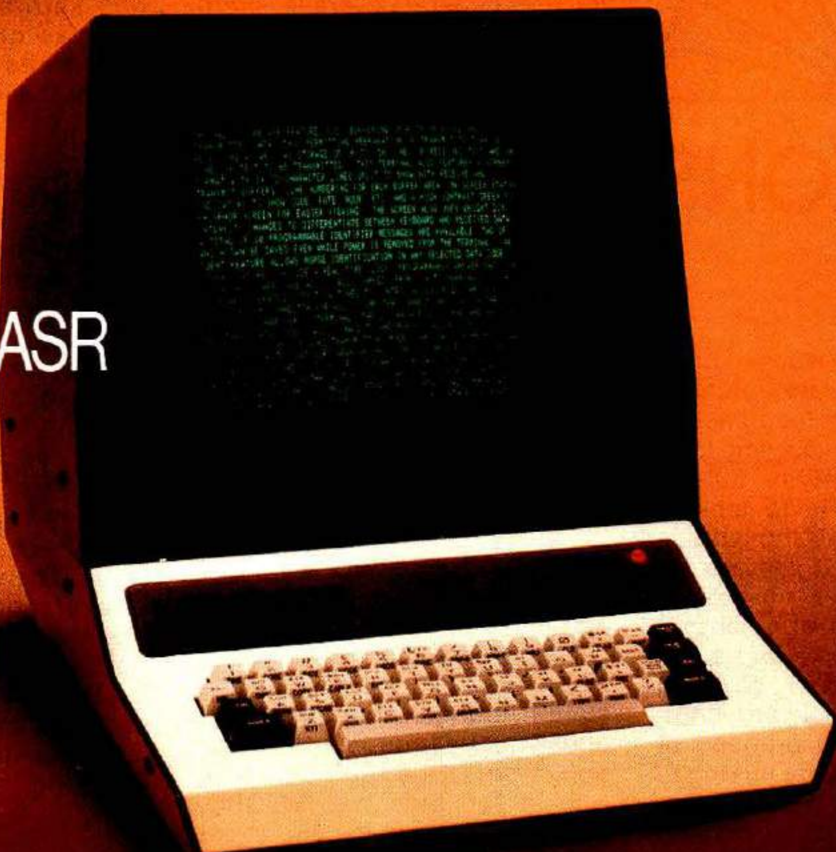

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THIS MONTHS HORIZONS

Antenna Hints and Hardware

There are as many ways to build antennas as there are antennas to build, and every ham has his own pet tricks for putting it all together. One sure-fire trait of the experimenter is to look at anything and everything with an eye toward what it can do for that new beam — no matter what the gadget's original purpose. W1SL passes along a few tips from his notebook, covering many years of backyard engineering. You'll be surprised at what antenna parts are lurking in your nearby auto-parts store, plumber's supply house, or hardware emporium.

Midnight Antenna Party

Apartments and condominiums are a modern solution to the housing problem, but the lease usually spells doom for an antenna enthusiast. The urge to create (and to work DX) can be driven underground, but it smolders in the dark, searching for the way out. WØROF tells how he won, and his tale is required — and delightful — reading for all you cramped-space captives.

Short Receiving Antenna

It's difficult to make a shortened antenna perform in a conventional manner when it must be bent, twisted, or hidden in the confines of a small house or apartment. However, if you forget about the way an antenna *should* work and make it behave like a probe, sampling the voltages around it, then things begin to happen. Author Blakeslee tells you about a compact unit that can be assembled in a few evenings; it will do wonders for that general-coverage shortwave receiver, and for listening on the ham bands as well.

Antenna Switch

It is a rare Amateur who does not need or desire several antennas — even a beginner tries to be the first on his block with more than one. However, a look at the cost and bulk of several coaxial feedlines can give pause to almost anyone. Here's a scheme that will really put a single coaxial cable to work for you, with a couple of safety features thrown in.

Logbook Commentary

A look at the logbook of many Amateur stations usually reveals the bare essentials of contacts made. To the operator of the station, entries can trigger memories which far outlast the duration of the QSOs. Author Jablin, who at the time was W2QPQ, gives you a little insight about reading between the lines. Not world-shaking DX, but contacts memorable in their own right, proving that Amateur Radio is a wonderful medium for relaxing and getting to know your fellow man.

More Delta-Loop Details

Antennas are always a popular subject, and response to the delta-loop article in our June, 1978, issue was very gratifying. The author of that article, G3LLL, couldn't leave well-enough alone, and has added two more bands to his array. It's not a difficult task and the results are well worth the effort. See how it's done on page 42.

More Tales Of The Early Days Of Radio

You've surely heard of Plymouth, Massachusetts, and Plymouth Rock. It marked the beginning of America in 1620. Now you can read about another beginning — tales of what happened in Plymouth around the turn of the century in the world of early radio, or wireless, as it was known then. Author Alan Douglas gives some amusing anecdotes about the period before today's Amateur bands.

The Cover

William LeBaron, WØMTK, sent us this photograph of his beautiful location and antenna installation. It appears that Bill is into several facets of Amateur Radio — that beam covers several bands, and there's an inverted-V hanging off the tower too. A sharp eye will notice a vertical antenna for vhf work as well. The message is that this is *Ham Radio Horizons'* annual antenna issue. The station shown in the inset is not Bill's, but rather is one we added to show a slice of Amateur Radio indoors — meaning that something must be connected to both ends of the coaxial cable to enjoy the fun of hamming.

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Run 1.5 KW PEP. Match any feedline from 1.8 to 30 MHz: coax, balanced line, random wire.

Gives maximum power transfer. Harmonic attenuation reduces TVI, out of band emissions.

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June, 1979
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CONTENTS

THE VIEW FROM HERE

When the band conditions are hot, as they have been for the past few months, in the late afternoon and evening you'll probably hear me prowling around the low end of the bands, looking for new countries for my DXCC. When conditions are just so-so, no doubt you'll hear me working one of the WAS or county-hunters' nets, but when a solar flare or some other disturbance completely destroys propagation, I usually spend my time in the shop working on one of the many projects I never seem to have time to finish.

More often than not when I'm in the shop I turn on the stereo and listen to some relaxing music, but once in awhile I flick on the receiver and tune around the upper end of 75 meters for an interesting round table — I can invariably find an interesting conversation, whether it's about the pros and cons of nuclear power, the fine fishing in the Colorado Rockies, or a technical discussion on the merits of quads versus Yagis. Whatever my mood, there's always something on 75 that piques my curiousity, and occasionally, something that starts the old adrenalin flowing.

Not too long ago, for example, two characters with two-letter calls were holding forth on the low end of 75 phone just inside the Extra class segment. The technical topic of the evening was transmission lines, and to hear these guys talk, they were the *original* experts. In reality all they had to offer was a barge full of baloney. Now I'll readily admit that, of all the subjects in Amateur Radio, transmission lines are among the most difficult to understand, but that isn't a license to run off at the mouth. And to be perfectly blunt, some amateur publications suffer from the same foot-in-mouth disease when it comes to transmission lines and antennas.

I don't know where all the feedline myths started, but I suspect it had something to do with the do-it-yourself SWR bridges which first became popular back in the early 1950s. Up until then most amateurs didn't even know about standing waves, and if they did, they didn't seem to care. SWR bridges soon caught on, however, and it wasn't too long before these handy little gadgets were more popular than peanuts at a beer party. One wag even suggested that the Q-signal QSW be used with a scale of 1 to 10 to report your latest SWR reading as you moved around the band; fortunately nobody took the idea very seriously.

Some amateurs got interested enough in the subject of standing-wave ratios to dig into the books, but when they discovered that SWR is a result of power reflected from a mismatched antenna, it only served to reinforce the myth. If a mismatched antenna causes power to be reflected back down the line, they reasoned, this power obviously wasn't radiated by the antenna. Some even suggested that the reflected power got back into the transmitter tank circuit and was dissipated in heat; others apparently thought that reflected power was lost forever to some great SWR heaven in the sky. A few well-informed amateurs tried to nip these absurdities in the bud, but it was hopeless — the disease spread faster than the cure.

The whole subject of transmission lines is much too complex to be covered in this short space, but it's time to bury some of the myths. First of all, reflected power is not lost nor does it heat up the tank circuit of your transmitter. Secondly, if your feedline has low loss, as is usually the case on 80 through 10 meters, increased loss due to SWR is so small you can forget about it. Since a 10:1 SWR on 100 feet of RG-8/U at 4.0 MHz increases loss by *less than 1 dB*, don't worry about the fact that SWR rises above 2:1 at the band edges — the station at the other end won't be able to tell the difference. If your transmitter doesn't like to load into a mismatch greater than 2:1, buy or build an antenna tuner and save yourself a lot of grief by forgetting the SWR on the line to the antenna if it's within reasonable limits, say 10:1. And finally, if you don't understand transmission lines and SWR, don't make wild statements before you have your facts straight.

Jim Fisk, W1HR
editor-in-chief

Imagine All The Places You Can Tuck ICOM's Remotable IC-280. (Think small.)

The **IC-280** 2 meter mobile comes as one radio to be mounted in the normal manner: but, as an option, the diminutive front one third of the radio detaches and mounts by its optional bracket, while the main body tucks neatly away out of sight. Now you can mount your 2 meter radio in pint-sized places that seemed far too cramped before.

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With the microprocessor in the detachable control head, your **IC-280** can store three frequencies of your choice plus the dial, which allows you to select from four frequencies with the front panel switch without taking your eyes off the road. These frequencies are retained in the **IC-280's** memory for as long as power is applied to the radio, even when power is turned off at the front panel switch. And if power is completely removed from the radio the ±600 KHz splits are still maintained!

The **IC-280** works frequencies in excess of the 2 meter band with ICOM's outstanding single-knob tuning, so you can listen around the entire band without fooling with three tuning knobs. With steps of 15 KC or 5 KC, the **IC-280** puts rapid and easy frequency change at your single fingertip and instantly displays bright, easy to read LED's.

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IC-280 Specifications: ☐ Frequency Coverage: 143.90—148.11 MHz ☐ Operating Conditions: Temperature: −10°C to 60°C (14°F to 140°F), Duty Factor: continuous ☐ Frequency Stability: ±1.5 KHz ☐ Modulation Type: FM (F3) ☐ Antenna Impedance: 50 ohms unbalanced ☐ Power Requirement: DC 13.8V ±15% (negative ground) ☐ Current Drain: Transmitting: 2.5A Hi (10W), 1.2A Lo (1W), Receiving: 0.630A at max audio output, 0.450 at SQL ON with no signal ☐ Size: 58mm(h) x 156mm(w) x 228mm(d) ☐ Weight: approx. 2.2 Kg ☐ Power Output: 10W Hi, 1W Lo ☐ Modulation System: Phase ☐ Max. Frequency Deviation: ±5 KHz ☐ Spurious Output: more than 60 dB below carrier ☐ Microphone Impedance: 600 ohms dynamic or electret condenser type, such as the SM-2 ☐ Receiving System: Double superheterdyne ☐ Intermediate Frequency: 1st: 10.695 MHz, 2nd: 455 KHz ☐ Sensitivity: 1 uv at S+N/N at 30 dB or better, Noise suppression sensitivity 20 dB, 0.6 uv or less ☐ Selectivity: less than ±7.5 KHz at −6 dB, less than ±15 KHz at −60 dB ☐ Audio Output: More than 1.5W ☐ Audio Output Impedance: 8 ohms

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FOCUS & COMMENT

I've just noticed a couple of sure signs that Spring has arrived — the latest list of flea-markets and auctions has every weekend for the next four months crammed full of events, and, this is our annual antenna issue of *Ham Radio Horizons*.

If your antenna survived the winter, you were either very fortunate, lived in a very mild climate, or did a well-planned job of building in the first place. Parts of the country that never before had more than a few chilly days suddenly got clobbered with ice storms and winds — sure death to large arrays of most kinds, especially quad antennas. However, as the weather warms, and the thought of those terrific openings on the higher bands invigorates Amateurs everywhere, I'm sure the antennas will go back up, perhaps bigger and better than ever.

Now, to a more serious note. There's a slow, creeping threat to our antennas and stations that will bear watching, or, perhaps a better way of expressing it is to say, we should take an active, informed, and aggressive stance against it. The threat is easy to identify but difficult to name, and the effects are likely to be longer-lived than whatever damage a winter storm can do. Simply stated, it is the threat posed by many well-meaning groups of people who see electromagnetic radiation of any type to be a threat to the health and well-being of you and me and them.

A case in point: Senate Bill 423, in Oregon. It is a bill that proposes to sharply restrict all electromagnetic emissions in residential areas. (Since most hams live in residential areas, that hits all of us.) The bill is practically all-encompassing, even down to naming electric power lines and transformers, as well as TV and Radio transmissions, as possible dangers to man and beast.

Another case in point: a few years ago, largely as a result of some *industrial* accidents wherein people suffered rf burns from high-powered uhf transmitters, Radio Amateurs (and all users of radio equipment) in Texas faced some bills in the legislature which would severely restrict power output from their transmitters — on any frequency.

I'm not going to try to argue about the extent of the danger, or even if any such danger exists or does not exist. In truth, nobody *really* knows the whole story about radio waves and their effects. Radio has not been around long enough to assess its danger to several generations of people living in fields of electromagnetism. Certainly, a rat or gerbil, placed in a restricted environment and subjected to strong radio fields, is not truly representative of real life; neither is a technician unwary enough to be working on a multikilowatt uhf transmitter with no shields in place! Animals, and, I suspect, humans too, usually sense when something is bothering them and take steps to get away from the source of irritation. If the source of irritation is a probe or antenna only a few centimeters from the captive animal, the fact that he cannot get away from it could be as emotionally disturbing as the radiation itself. You or I or your neighbor would feel just as disturbed if we had to spend our lives a few feet from the business end of a 10 meter beam, with the doors locked!

Fortunately, the bulk of radiation is directly in front of a beam antenna, which keeps it far above the usual habitat of people (another good argument against *tower* restrictions). As to incidental radiation — it is at a very low level (or should be, if your antenna is working right), and there is just no evidence to prove (or disprove) that such low-level energy has any effect on human behavior.

There is, of course, the possibility that scientific studies will eventually reveal harmful effects from low-level electromagnetic radiation, but such studies are not done overnight. If so, and we have to meet some new standards of safe radiation levels, so be it. But, let's make sure the restrictions are the result of scientific studies, not the aftermath of uninformed hysteria fed by someone with an axe to grind because he sees funny bars and sparklies on his TV screen, or because he always feels grumpy in the morning.

Incidently, we hams are not alone in facing threats to our hobby. Almost any hobby group or special interest group has another special interest group trying to shoot them down; that's one of the prices you pay for living in a free society.

As has been said over and over, the price of freedom is eternal vigilance. I'll modify that to read: be vigilant, be well-informed, be rational, and be involved.

Thomas McMullen, W1SL
Managing Editor

NEW!

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$199.95 LIST — The Best Value in Amateur Antennas on the Market Today!

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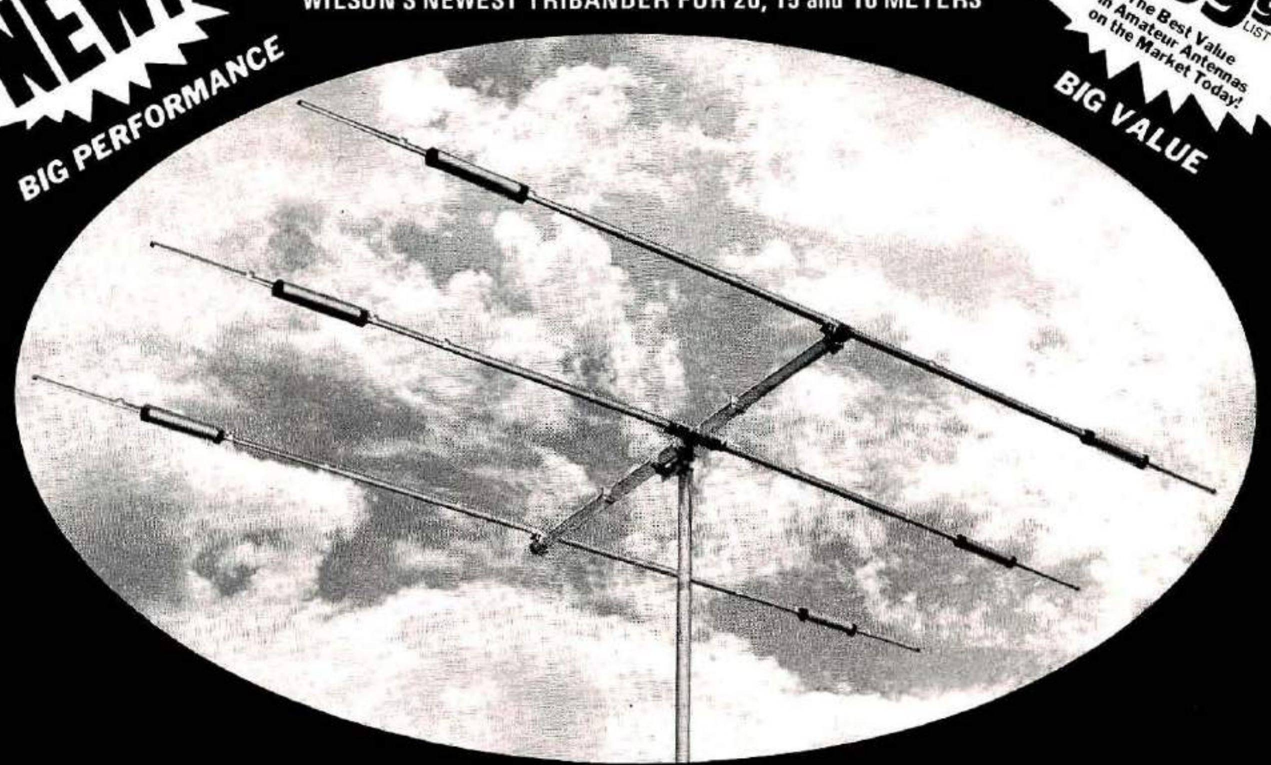

Capable of handling 2,000 watts, the "SYSTEM THREE" is the newest tri-bander available to the amateur.

Designed and produced by one of the world's largest antenna manufacturers, the traditional quality of workmanship and materials continues on with the "SYSTEM THREE".

The special heavy-duty vise-like extruded aluminum clamps on the reflector and director are a key point in the design of strength and durability.

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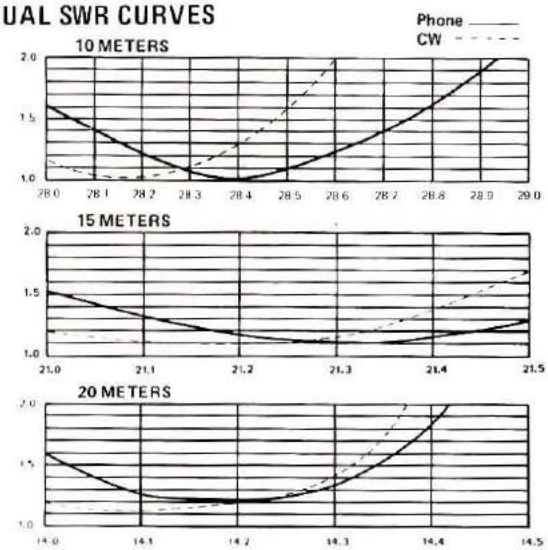
ACTUAL SWR CURVES



SPECIFICATIONS

Band MHz	14-21-28
Maximum power input	Legal limit
Gain (dbd)	8 db
VSWR at resonance	1.3:1
Impedance	50 ohms
F/B ratio	20 db
Boom (O.D. x length)	2" x 14'4"
No. elements	3
Longest element	27'4"
Turning radius	15'9"
Maximum mast diameter	2" O.D.
Surface area	5.7 sq. ft.
Wind loading at 80 mph	114 lbs.
Assembled weight (approx.)	37 lbs.
Shipping weight (approx.)	42 lbs.
Direct 52 ohm feed or balun maximum wind survival	100 mph

Prices and specifications subject to change without notice.

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NEWSLINE

"WHISKEY CLUB" AND "HF" operation cost a Baltimore Amateur his license in an FCC Administrative Law Judge's decision released in late March. In their well-prepared case, FCC engineers established that they'd monitored Tom Kaufman, WA3VWC, operating on various non-CB 27-MHz frequencies and, on one evening had even heard Kaufman on 11 meters as "7Whiskey353," and a few minutes later on 28.782 MHz as WA3VWC. They also recorded operation by him as "HF 8644" on various 27-MHz frequencies.

Kaufman Had Earlier Pleaded guilty to the criminal charge of operating his Amateur station on frequencies not assigned to the Amateur Service, and was fined $50. He also forfeited the gear that had been confiscated when his home was raided. The gear had an estimated value of $1270. In view of his youth and his cooperation with the FCC after his arrest, the judge revoked his station license but suspended his operator's license for only one year, after which he can reapply for a new station authorization.

TWO BILLS TO AMEND the Communications Act of 1934 rather than replace it have been introduced into the U.S. Senate. The majority bill, S-611, is sponsored by Senate Communications Sub-Committee Chairman Senator Hollings and Senators Cannon and Stevens. The other, S-622, was introduced by Senator Goldwater with Senators Schmidt and Pressler as co-sponsors. Both were offered in response to the House proposal to rewrite the Communications Act, but both propose amending the existing act rather than starting over as the House bill had. Neither of the two bills addresses the growing RFI issue, and Amateur Radio rates only passing mention. S-611 does propose permitting the FCC to issue an Amateur license good for ten years, and both would exempt non-commercial stations serving the public interest from any user fees.

Neither Bill, as introduced, goes into much detail, with the understanding that they'd be considerably expanded during the course of extensive public hearings.

431-433 MHZ WILL REMAIN "off-limits" to ATV repeaters, the FCC decided at its March 15 meeting. Responding to two Petitions for Reconsideration on Docket 21033, the Commissioners noted that protection for weak signal and satellite operation was appropriate, but ATV repeater operators would always have the option of requesting a waiver. If the operator could establish a need for repeater operation in the protected segment, while showing his operation would not interfere with weak signal work there, such a request for waiver would be granted.

AMATEUR TRANSMISSIONS of emergency information cannot be rebroadcast by commercial broadcast stations, the Commissioners decided. Acting on a petition (RM-2830) filed by the National Association of Broadcasters, the Commissioners agreed to further consider whether CB emergency transmissions should be rebroadcast for public use.

A BRAND NEW EDITION of FCC's Amateur Radio rules, updated to January, 1979, has just gone on sale at the Government Printing Office. The revised Part 97 is stock number 004-000-00357-8, and price postpaid is $1.40. Write Superintendent of Documents, Government Printing Office, Washington, D.C. 20402, or check at a GPO bookstore in larger cities.

"LEGAL ASPECTS OF PERSONAL COMMUNICATIONS" is the subject of a papers competition just announced by the Personal Communications Foundation. The competition, open to any law student in a recognized law school, will offer a $500 first prize, $250 for second place, and $100 for third. Purpose of the competition is to stir interest in the field of personal communications law, and papers will be due October 1. For complete details on submissions, write Personal Communications Foundation, 10960 Wilshire Boulevard, Suite 1504, Los Angeles, California 90024.

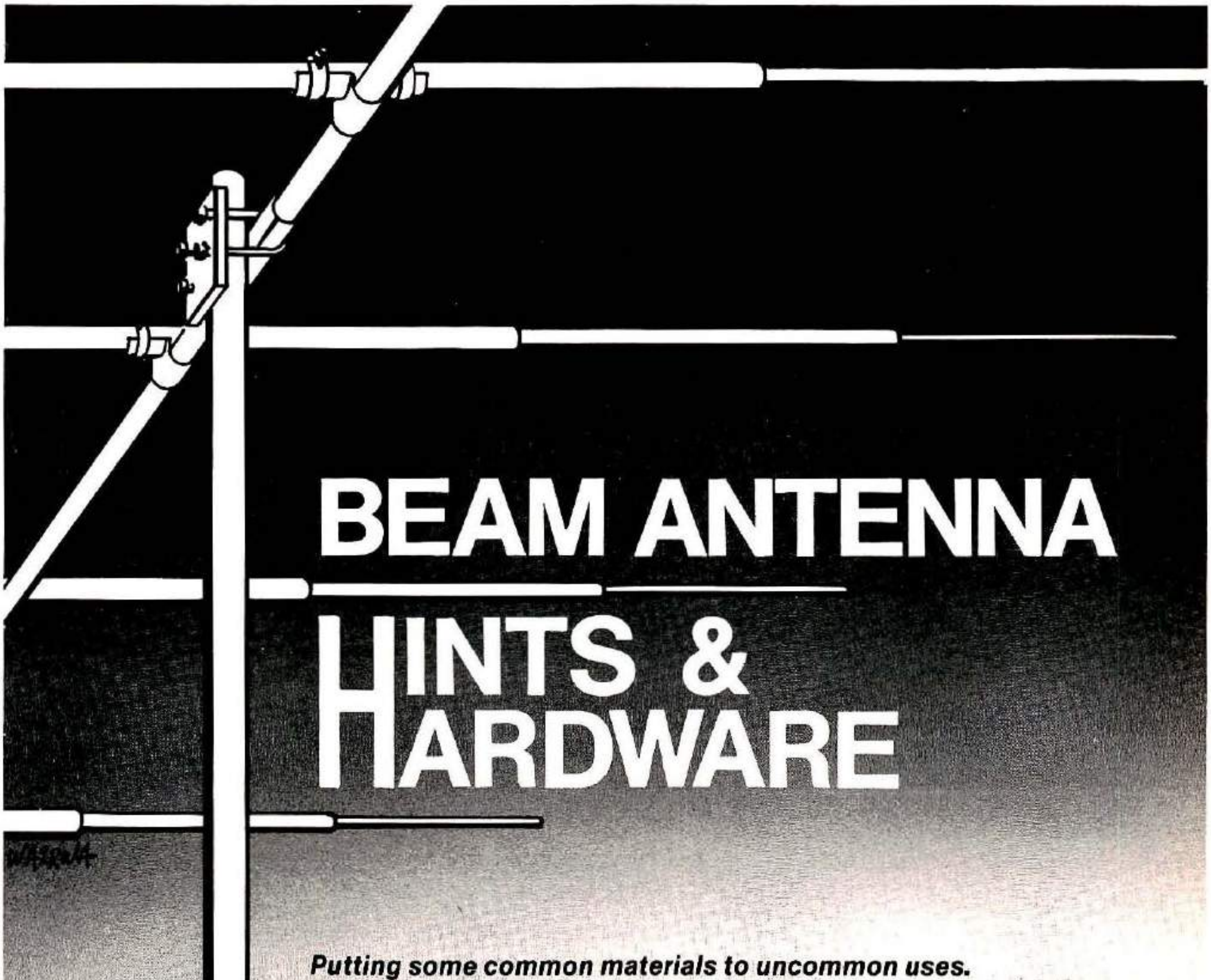
FIELD DAY THIS YEAR (June 23-24) will find OSCAR 8 operating on both modes simultaneously, the ARRL has announced. Dual mode tests conducted during the satellite's birthday weekend showed the satellite to be capable of dual mode operation, and greater Field Day use of the satellite is expected as a result.

"UOSAT" — The University Of Surrey Satellite — will include a voice synthesizer to provide telemetry transmissions in plain English, include a 4,000 character datastore capability and a slow-scan TV camera for live cloud-cover pictures. Educators who've heard about the sophisticated bird are reported very enthused about its classroom possibilities.

AMSAT's 1979 Annual Meeting has been set for October 6 (a long weekend) at the Goddard Spaceflight Center.

CIGARETTE LIGHTER PLUGS can prove disastrous in some new cars, VE2BMQ warns in the VE2RM Bulletin. Some new autos with insulated dashes are wired in reverse, so check before plugging in.

A 29.705 MHZ "BEACON" for 10-meter FMers is offered by the Israeli Broadcasting Administration's recently introduced service on that frequency, operating weekdays 1400-1645Z in Yiddish and Russian. It's potent — over 100 kW ERP!



BEAM ANTENNA HINTS & HARDWARE

Putting some common materials to uncommon uses.

BY THOMAS McMULLEN, W1SL

You've decided to build a beam antenna, but you are so new at this Amateur Radio game that your hardware "junk box" is still empty, right? Or, you've read dozens of construction articles and picked the "Super-Signal-Snagger" as your dream antenna — then you find that the special clamps and brackets are made only by the author, who moved out of the country three years ago. At this point, the whole idea is beginning to become less and less attractive, and you're beginning to doubt that this "do-it-yourself" craze is all they say it is.

Well, before you grab the hammer and start making threatening motions toward your piggy bank, take the time to read a bit more. Perhaps I can show you a way to build your beam and save the bank for a rainy day (or a new rig).

Once you have gotten past the theory part of an antenna, all that remains is some hardware of various types, and you'd be surprised how much leeway there is for substitution and inventiveness here. An antenna can be divided into just a few parts — conductors, insulators, supports, and nuts and bolts to hold it together. There are very few cases where you cannot make a well-thought-out substitution, and you will be able to find most of what you need at your nearby hardware, automotive, and home-supply stores. Let's take a look at some of the possibilities.

Elements

These are the active parts of an antenna, and can be classified as conductors. There are several ways to make elements, and the most popular is to use aluminum tubing of various sizes. The ideal system is to find one size of tubing that fits inside another. The problem comes when you try to find a size that fits loosely enough that one will slide easily into the other, but not so loosely that it requires several pounds of hardware to keep the assembly from rattling in the breeze.

There are many variables to watch for when you start shopping for aluminum tubing, so plan to do a bit of searching before you find the right combination. There are different wall thicknesses, different hardnesses, different lengths, and even different tolerances for a given size of tubing. **Table 1** will give you an idea of what sizes will fit inside another, but note that it applies only to certain wall thicknesses. The important thing to watch for is that the smaller tube will slide smoothly inside the larger one, without the use of undue force. A very tight fit will jam, usually before you have enough overlap for support, and you'll have to resort to the hacksaw to get it apart again.

One of the easiest ways to join two pieces of tubing is to split the end of the larger one with a hacksaw — make a cut which is equal in length to approximately two times the diameter of the tubing. Then, slide the smaller tube inside the larger, and clamp the two together with a hose clamp. There's no need to make a lot of cuts in the outer tubing; too many will weaken it beyond usefulness. In most cases, one pass with the saw, cutting through both walls, will do very well. There is seldom any need for more than two cuts (four slits) at the most. Hint for easier assembly: When you make the slits with a hacksaw, don't place the tubing in a vise and wind it up tight — you'll crimp it enough that the inside piece will jam. Hand-pressure to hold the tubing against a V-notch in a bench, or against some other support, should be used, and cut slowly and evenly with a fine-tooth hacksaw blade. Remove any inside burrs before assembly — you have only a few thousandths of an inch clearance in properly telescoping sizes.

If you have no luck finding tubing that fits properly for a neat telescoping assembly, you can still make the element you need by simply placing a bushing between the sizes, see **Fig. 1**.

The thickness of the bushing will depend upon how big the gap is, of course. I've often used a split piece of aluminum tubing as a go-between — this is one of the reasons I never throw out scrap ends of tubing, especially those with thin walls. Sheet-metal strips can be rolled around the inner piece to form a good sleeve or shim. Just remember that you will be taking up twice the thickness of the material — a piece 1.5 mm (1/16 inch) thick will fill a gap of 3 mm (1/8 inch) between tubing sizes.

As an alternative to using hose clamps, you can run three or four sheet-metal screws, or even pop-rivets, through the walls to fasten the joint together, as in **Fig. 1**.

Table 1. These sizes of aluminum tubing are stocked by many warehouses in the United States and Canada. Note that each size listed will telescope into the next size, assuming that each has a wall thickness of 0.058 inch, which leaves a clearance of 0.009 inch. Don't try to work with less clearance or the pieces will jam. Because of its strength and ease of working, 6061-T6 (61S-T6) round aluminum tubing is recommended. It usually comes in 12-foot lengths, and is sold by the pound. Aluminum in your local do-it-yourself hardware store may or may not have these dimensions — check the fit before you buy.

Outside Diameter, Inches		Wall Thickness	Fits Into	Weight in pounds, 12-foot length
1/4	(.250)	.058	3/8	.492
3/8	(.375)	.058	1/2	.816
1/2	(.500)	.058	5/8	1.040
5/8	(.625)	.058	3/4	1.452
3/4	(.750)	.058	7/8	1.776
7/8	(.825)	.058	1	2.100
1	(1.00)	.058	1 1/8	2.424
1 1/8	(1.125)	.058	1 1/4	2.736
1 1/4	(1.250)	.058	1 3/8	3.072
1 3/8	(1.375)	.058	1 1/2	3.384
1 1/2	(1.500)	.058	1 5/8	3.708
1 5/8	(1.625)	.058	1 3/4	4.032
1 3/4	(1.750)	.058	1 7/8	4.356
1 7/8	(1.825)	.058	2*	4.668
2	(2.00)	.049	2 1/4**	4.200
2 1/4	(2.25)	.083		7.920

* 0.049 wall thickness
** 0.083 wall thickness

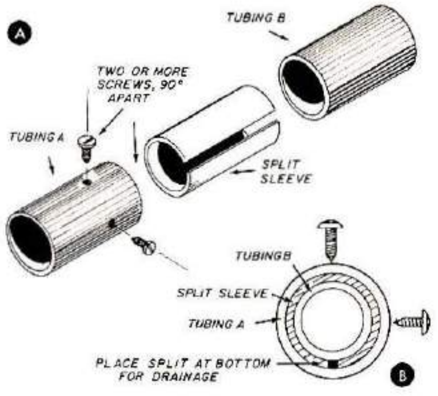


Fig. 1. A method of joining two pieces of tubing that do not fit closely enough for good telescoping action is to place a split sleeve between them, **A**. The assembly can be fastened together by means of two or more sheet-metal screws, **B**. Place the screws at right angles to each other for maximum holding effect.

Insulation

Beam antennas of the early days were generally made of wire, supported on a wooden or metal framework. As aluminum tubing became available, and less expensive, the framework persisted for a time, but the elements still were supported on ceramic pillar insulators. That is a good method of building beams, but large ceramic insulators are becoming increasingly difficult to find.

Fortunately for us, the center of a half-wave element is the "coldest," as far as rf voltage is concerned, which means that mounting it to another piece of metal at that point should have no effect on its operation. This is generally true, and the only elements that need be isolated from the metal support are those that are "fed," or driven, with energy from the coaxial cable. There are exceptions here: a noninsulated element can be fed by means of a gamma match, but not all antenna designs you'll read about make use of that system.

Equally fortunate is the fact that where the voltage is so low, we can use almost any insulation that will not absorb moisture. Many early beam antennas and television DX arrays (in the 1950s) used hard-rubber blocks as insulators. Bakelite was common, as was a very hard substance called Micalex. These are still good insulators, if you can find them. A more readily available material, however, is PVC tubing or pipe. You can obtain enough to insulate a lifetime supply of beams by going to your nearby plumber and asking him for some short pieces which were cut off when they were "plumbing" a new house or apartment.

Simply split a short length of plastic pipe and wrap it around the element you want to insulate, place it under the U-bolts, and you have an insulated element! What could be easier?

Strengthening

Just as a rope is weakened by a knot, a piece of tubing becomes weakened where it joins another part of the antenna. Any stress or vibration has its most severe effect at the U-bolt or clamp that holds an element in place, at the boom-to-mast clamp, or wherever there is an abrupt change in size or thickness of the material. If you want your creation to stay in the air, you must take steps to relieve that stress.

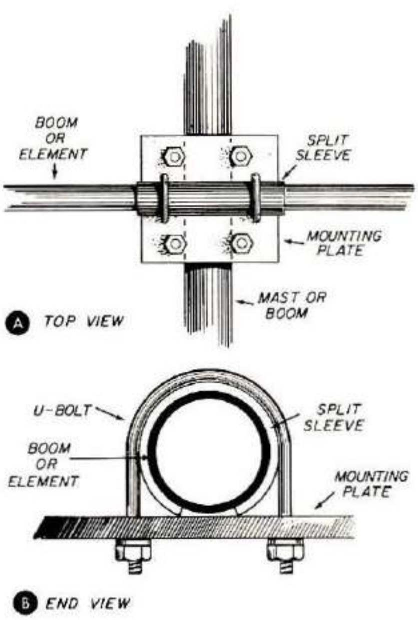


Fig. 2. U-bolts will crush tubing when tightened. A cure for that is to place a split sleeve over the tube to reinforce it. Note the thick aluminum mounting plate used to keep two pieces of tubing at right angles to each other — a good source of material for these plates is scrap aluminum panels of 3 to 6 mm (1/8 to 1/4 inch).

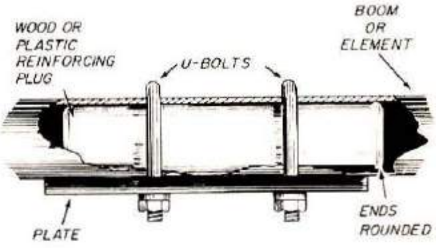


Fig. 3. You can also strengthen a boom or element by placing a wood or plastic plug inside it. The plug should be a sliding fit inside the tube, and long enough to extend beyond the U-bolts on both sides. Round the ends, or give them a slight taper to prevent metal fatigue at a sharp corner.

A handy method of providing extra strength where U-bolts are used is to place a split sleeve on the outside of the element or boom, as shown in **Fig. 2**. The sleeve spreads the pressure of the clamp over a greater surface area than the contact points of the U-bolt alone, thus adding to your beam's strength and longevity.

In cases where it is not practical to place a sleeve on the outside, you can put a wooden dowel on the inside for much the same effect, **Fig. 3**. Hardwood dowels are best, but almost any snug-fitting piece of wood or plastic will be better than none at all (snug fitting but not tight — you'll have trouble forcing a tight plug to the midpoint of a long piece of tubing). Here's a tip — round the ends of the plug slightly, or even give the last inch or so a *slight* taper. This allows a gradual contact which will help dampen vibration. Make the plug long enough to extend 5 to 7 cm (2 to 3 inches) beyond the last clamp.

In areas subject to high winds or heavy ice accumulation in the winter, some builders have had good results by placing another piece of tubing, or even steel conduit, inside the main boom of their beam. This keeps the clamps from crushing the boom, and provides added strength over a good portion of the boom's length. Here, again, it is important to round the ends of the interior pipe to allow any stress to dissipate without fracturing the tubing at a sharp edge.

The rf path

One very important thing to keep in mind when building any antenna is the path that the rf must take through the elements. It is not unusual to build a beam with elements made up of several pieces of tubing fastened together to make the right length. Each joint must be a good one, electrically and mechanically. They'll be just fine when new, and all the shiny surfaces fit together well. However, moisture and gases will corrode the metal, causing intermittent contact, or none at all. At best, this will cause noise in your receiver, create harmonics or other forms of interference when you transmit; at worst, it can cause the antenna to refuse to accept power at all.

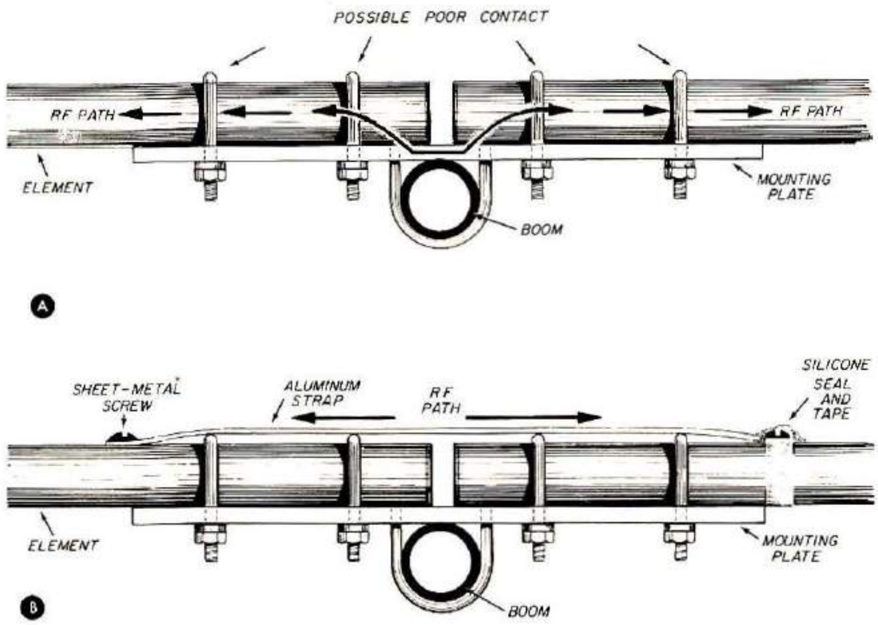


Fig. 4. Be sure that the rf path through the elements is as smooth and continuous as possible. An aluminum strap should be placed across any discontinuity, and any critical joints should be sealed and taped for weatherproofing.

The secret is to protect the rf path from the effects of moisture and gases. After your tubing has been telescoped together, spray the joints with a clear sealant — there are several types available in pressure cans. In severe cases, you may need to apply a silicone caulking compound, tape over that, and then spray the entire area with acrylic lacquer.

One trouble spot that is often overlooked is the joint at the center of a long element — where two pieces of tubing meet at the boom, see **Fig. 4**. The usual method of construction here is to use four or more U-bolts to hold the tubing to the mounting plate. The rf path, in going from one end of the element to the other, must go through the U-bolts, into the plate, then through the other U-bolts to the other half of the element. The point at which the U-bolts bear on the element is not very large, and is one of the first places to corrode. This, too, can cause noise and poor operation. You can cure this problem by placing an aluminum strap across the whole assembly, thus providing a direct path for the rf. The strap can be fastened in place with sheet-metal screws, and the screw heads and strap ends

Here is an assortment of hardware you'll find handy when putting beam antennas together. It's easy to recognize the hose clamps, lower left, and they're available at almost any hardware, plumbing, or auto-parts store. The small U-bolts at upper left are hardware-store items. Two types of muffler clamps are shown here — use the type shown disassembled at the upper right. Note that the pressure plate is formed so that there are two edges to bear upon the tubing being clamped, instead of the single edge of the one near the center. The pair of U-bolts at the lower right are common TV-antenna installation hardware, available almost anywhere TV sets are sold and installed.

sealed with caulking compound and tape for weatherproofing.

Beam antenna elements that vibrate in the wind not only create noise than can be disturbing in the still of the night, but they also break. The stress of the vibration creates metal fatigue at the point where the element is connected to a heavier piece of metal (usually at the element-to-boom clamp), and this leads to a cracked or weakened element. It will usually break in a high wind just before (or during) a contest weekend, or when some hapless bird decides that your beam is the best place from which to survey his kingdom.

One very successful method of dampening vibration is to place a length of plastic rope inside the tubing. It doesn't have to be tight, just run it the full length and let it lie there. The rope's inertia will be "out of phase" with the vibration of the element, and it will tend to soak up energy, thus dampening the vibration. For small elements, the light, braided-plastic ropes of 3/16 to 1/4-inch size will do well; larger sizes will work for the larger-diameter elements, up to rope of 1/2-inch or so. Use the plastic stuff — braided cotton or natural fiber will soak up moisture and decay, causing the element to deteriorate from inside. Also, be sure the rope is small enough to freely flop around inside the tubing; the tendency to absorb energy when it moves in one direction, and meets the tubing moving in the other, is what makes it work.

Some constructors have reported good results by filling elements and booms with plastic "peanuts" such as those used for packing delicate equipment for shipment. Again, these must fill the element to the ends, but not be packed so tight that they cannot move and "jostle" around when the tubing vibrates. The "peanuts" can be kept inside by either crimping the ends of the elements or by placing a tight-fitting plastic cap on the ends.

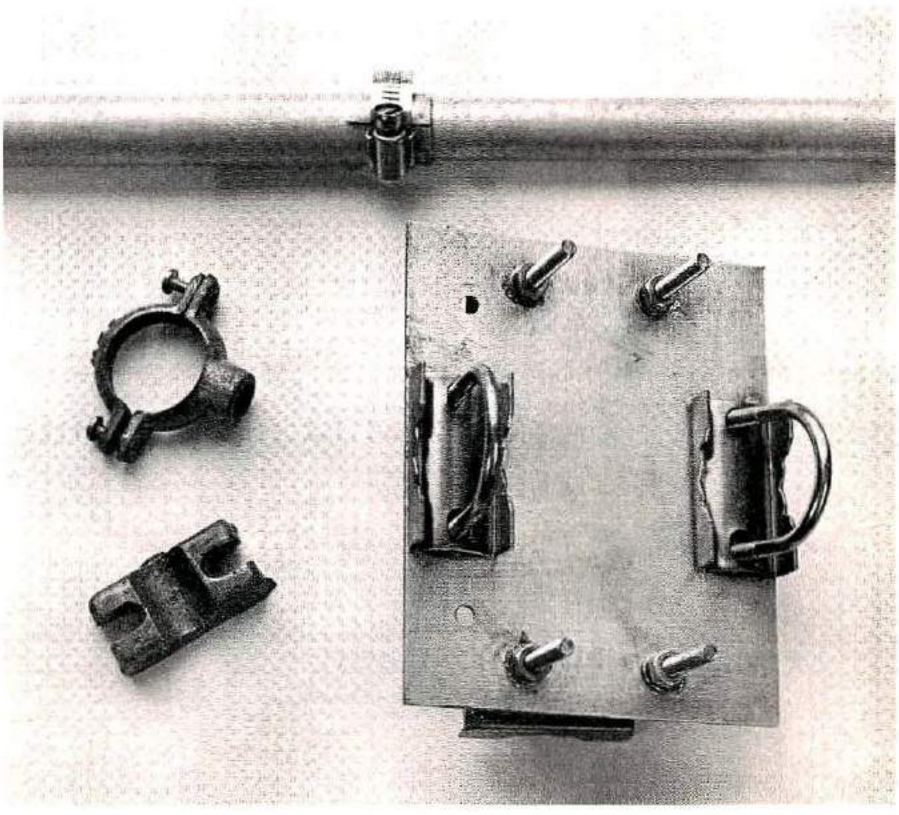
Putting it all together

Here's where you can really practice being ingenious, and devious. Any time that my travels take me to a different part of the country, I try to find a few minutes to check out the nearby hardware stores. You just never know when you'll find some clamp or gadget that will be "ideal" for putting together a new beam. The security agents at the X-ray counter at airports must hear some incredible stories, but none more "far-out" than my explanations for that assortment of weird clamps and stuff in my luggage. I've also developed a set of answers for the store clerk who wants to know if this stuff is for drinking-water plumbing, waste-water, new construction, or old.

For instance, there is a marvelous assortment of pipe-hangers available at the better-equipped hardware stores and at most plumbing supply houses. Try several houses — everyone has his idea of how a pipe should be fastened in place, and the style and shape of hardware reflects these differences. One of my favorite types is shown in an accompanying photograph. These clamps can be used in many ways to fasten a variety of tubing sizes together. Hint: Take along a small sample of the element and boom tubing — try the clamps for fit, even if the clerk argues loudly that "it's not made for that use!"

Another favorite source of

Two pieces of tubing joined by clamping with a hose clamp, at top. Hint for added strength: don't cut a long piece of tubing just to allow it to protrude a short distance inside the outer one. The extra length inside will strengthen the assembly, and, if you ever need to change the element or boom size, you have plenty of material to work with. The plate with U-bolts, lower right, is a common way of joining a boom and mast. The plate can be made of a scrap aluminum panel or other material of 3 to 6 mm (1/8 to 1/4 inch) thickness. The block at lower left is a boom-to-mast casting salvaged from a defunct TV antenna. Just above it is a cast pipe-hanger clamp. They're available in many sizes, and with a variety of threaded holes for mounting.



hardware is the automotive parts store. One of the photographs shows muffler clamps. They come in a wide range of sizes, so there again, take along a sample piece of tubing. The largest clamp I've seen so far is 10 cm (4 inches) inside diameter. (I'll never build a beam with a boom that size, but it's nice to know the hardware is available, just the same).

To use the clamps, you'll need a plate of some sort to act as a go-between. A square piece of aluminum will work fine for joining two large pieces of tubing, such as fastening the boom to the mast. A piece of aluminum angle stock, or a flat plate, makes it possible to mount elements to the boom by means of a muffler-clamp.

Most muffler clamps are plain, untreated steel, and they usually have a coating of oil when you buy them. The oil is messy when you are trying to build an antenna and will not stay there long in any case, so you might as well clean it off right away. This, however, leaves the clamp and its hardware very susceptible to rusting. The easy way to take care of that is to spray the clamp with some type of rust-preventative primer and paint. I've found that some of these work fairly well for a year or two, but eventually the moisture gets inside and does its dirty work. A better solution is to have the clamp and all its hardware (washers, pressure plate, nuts) plated. Many job shops will take a handful of clamps and run them through a cadmium-plating bath for a modest fee, and it's well worth it to have clamps that will last a while (and they look quite "professional" too).

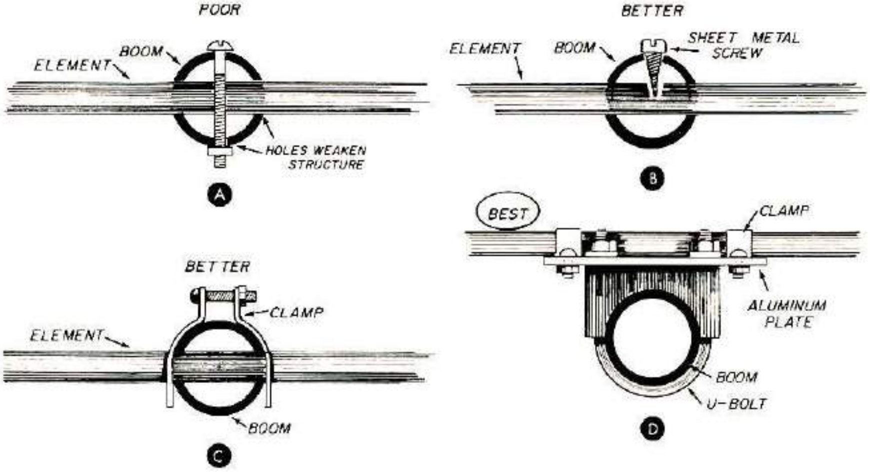


Fig. 5. There are many ways to mount elements to booms, and some are invitations to disaster, as in **A**. The multiple holes weaken the boom. The best system is in **D**, with no holes in the boom needed.

Single-screw mounting

Elements that are comparatively light, such as those for use on the vhf bands, can be fastened to the boom in a much simpler manner than by using U-bolts and plates. A long-time favorite of many builders is to drill a hole in the boom, then place a bolt or sheet-metal screw through both the element and boom to hold things in place. I always shudder when I see an otherwise well-designed antenna built that way. Any hole through the boom weakens it, and the larger the hole, the weaker the assembly will be. Drilling two holes at right angles at the same place on the boom is inviting disaster, see **Fig. 5**. I'm always looking for ways to avoid drilling holes in the boom.

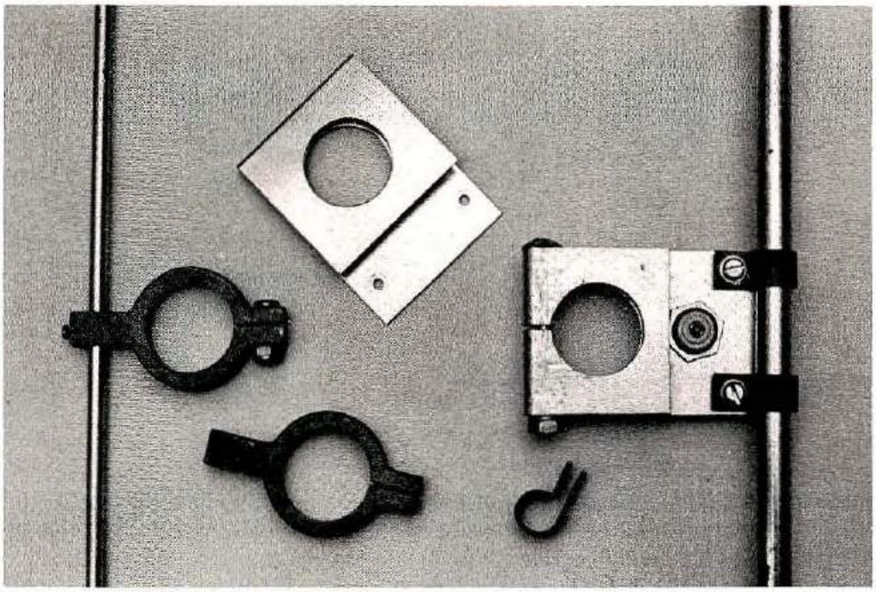
One solution is the cast, split-ring clamp available from Kirk Electronics.* However they come in sizes to fit only a few boom diameters. They usually have a pilot-hole drilled which you can enlarge to fit several sizes of element, up to approximately 9.5 mm (3/8 inch).

My experimenting led me to develop my own version of a "split-ring" clamp, shown in the photograph. It is made from aluminum sheet, and you can make it fit almost any boom and element combination you want. An added benefit is that you can modify the design a bit and — presto! — you have a place to mount the coax connector, at no extra cost. I've used aluminum salvaged from old chassis, stuff found in the scrap yard, and strips left over from large sheets of aluminum that were being trimmed for another purpose. Thickness is not overly critical — it must be strong enough to hold the element yet thin enough that you can bend it back on itself around a 6.5-mm (1/4-inch) or larger bolt. The aluminum must be hard enough that the pressure of the bolt will not deform it, yet soft enough that it will not crack when you bend it. Try a scrap piece, bent around a bolt or rod, and look for cracks.

Bar stock

No, not the bottled kind — the solid-aluminum kind. Element-to-boom hardware made by drilling holes in bars of aluminum stock is rugged, looks great, and is not too expensive. However, if you're going to build more than an 8- or 10-element yagi, be prepared for a lot of drilling! Aluminum-supply houses have square and rectangular bars in stock, usually sold by the pound. Try to buy it with a larger order (include it with your tubing order, or with a friend's order) to keep the cost down. I limit my use of clamps made this way to booms of 12

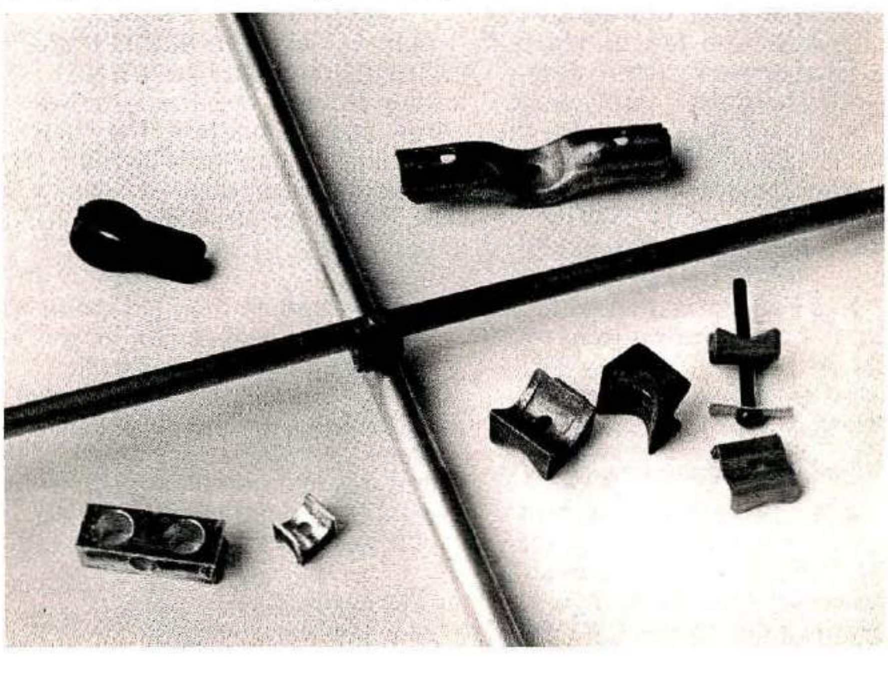
*Kirk Electronics, 75 Ferry Rd., Chester, Connecticut 06412.



A commercially made clamp, left, by Kirk (see text for address). My home-made version (top center and right) is simply a piece of sheet aluminum with holes (made by a Greenlee chassis punch), folded back upon itself so the holes will align. The folded part is split with a hacksaw, and a bolt run through for tightening. The completed version at right was made a bit longer to allow room for a coaxial connector. Element is held in place by two clamps of strip aluminum, formed as shown just below the assembly. Holes in these boom clamps will fit standard 1-1/8 inch TV-mast tubing.

to 16 mm (1/2 or 5/8 inch) or less because of the difficulty in obtaining drills for larger sizes, and because the weight of the blocks adds appreciably to the weight of the beam. The bar should be just slightly larger than the boom diameter, because it is difficult to drill a smooth hole if the bit extends beyond the edge of the stock. *Caution*! Use good clamps to hold the stock in place on the drill table, and run large drills at a low speed. To make the clamps, simply drill a series of holes at right-angles to each other, one hole the size of the element, the other the size of the boom. Then, use a hacksaw to separate each "clamp" right across the middle of each hole, see photograph. The form-fitting walls of the "half-hole" will prevent the element and boom from being crushed when you tighten the single bolt through the whole assembly. I must admit, however, that the idea for this one came to me when I found some crude castings on an old TV antenna at the town dump. I didn't have a means of making castings, but I did have a drill press — hence, my improved, but more costly, version.

An element and boom, center, joined by a block of aluminum shaped to fit the contour of both pieces of tubing. The block was made by drilling holes (at right angle to each other) in a piece of bar stock, then separating the pieces by a hacksaw, lower left. The castings at the lower right serve the same purpose, and were salvaged from a discarded antenna — as were the spacers and bolt just to their right. The two pieces in the upper right and left are also salvage from scrap antennas.



Another piece of element-mounting hardware which I often make, rather than buy, is a small clamp somewhat like the old-fashioned hose clamp with a tail on it, see photograph. It is simply a strip of aluminum with a hole drilled in each end, bent around the element, and the "tail" squeezed shut in a vise, or with pliers. A bolt can be passed through the hole to fasten the assembly to whatever support is necessary. The length of the strip, and the distance between the holes, should be such that there is still a small gap between the tabs after the bolt is tightened up, thus maintaining tension to hold the element in place.

Again, a scrap chassis is a good source of metal to make these clamps, and the aluminum must be soft enough to bend without cracking.

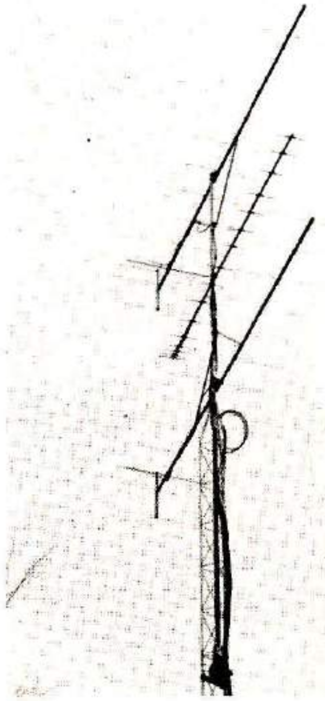
Salvage

If you truly aspire to be a hard-core antenna experimenter, never pass up a chance to collect scrap antennas. Cruise your neighborhood after every severe windstorm in the summer, and after ice storms in the winter. Visit your town dump, if they'll let you pick it over (some towns are very fussy about this), or keep in touch with all your nearby TV sales and installation houses. A little friendly persuasion, a cigar, a can of soda or beer, will ensure that on your next visit there will be a pile of mangled aluminum tubing waiting for you. Most of the tubing will be worthless, and you can collect and sell it by the pound.

The real gravy is the hardware you can accumulate! Most element-to-boom hardware will be fastened in place by rivets, but a few minutes work with a sharp drill will remove those. I'll give you fair warning though — the number of any given type of clamp you have on hand will always be one less than you need to put together a pet beam. If you're going to make a 10-element Yagi, you'll have nine of one style clamp, and one each of a dozen others! That's one of the hidden laws that haunt antenna-building enthusiasts. That's also the reason I schemed and pondered until I found a way to duplicate the function, if not the appearance, of many pieces of hardware.

Wire elements

I've been talking about beam antenna elements made of aluminum tubing, but there's no reason to forget that you can make some very neat arrangements by using wire for the elements, as some *Horizons* articles have pointed out.[1,2] The advantage of such an arrangement is low cost. The disadvantage is that you must provide a support for the wire, and providing a rugged support for a very large beam can be difficult. Such supportes are usually nonmetallic, which means that they are heavy, subject to moisture absorption, and break easily. Nonetheless, wire-element beams for the 20-, 10-, and 6-meter bands are small and inexpensive enough to be worth considering, and if properly constructed, they will last many years.



Antennas are fun to build, and you can take real pride in your work when they perform well and have a well-engineered appearance. This pair of home-made two-meter Yagis has done a great job for two years and withstood some severe ice and wind at my New Hampshire QTH. The small antenna in the center is for 432 MHz, and was made by KLM.

Tower tip

In these days of small building-lots and crowded neighborhoods, hams often place a tower at the side of the house — either to keep it as far from the edge of the lot as possible, or to gain added support by fastening a bracket to the eaves of the house. This is fine, but towers tend to hum, creak, and thump in even the slightest of breezes, all of which can be very disturbing to a light sleeper. A friend (WA1NXP) found a way to quiet things down a bit. He obtained a pair of motor-mounts from a defunct Volkswagen and placed them between the tower legs and the eaves bracket. The rubber cushions tend to damp out most of the noise, yet provide adequate support for the tower. It'll take some planning, and most likely some welding too, to fit whatever motor-mounts you have to your tower and bracket, but the improvement is well worthwhile.

Welding, brazing, soldering

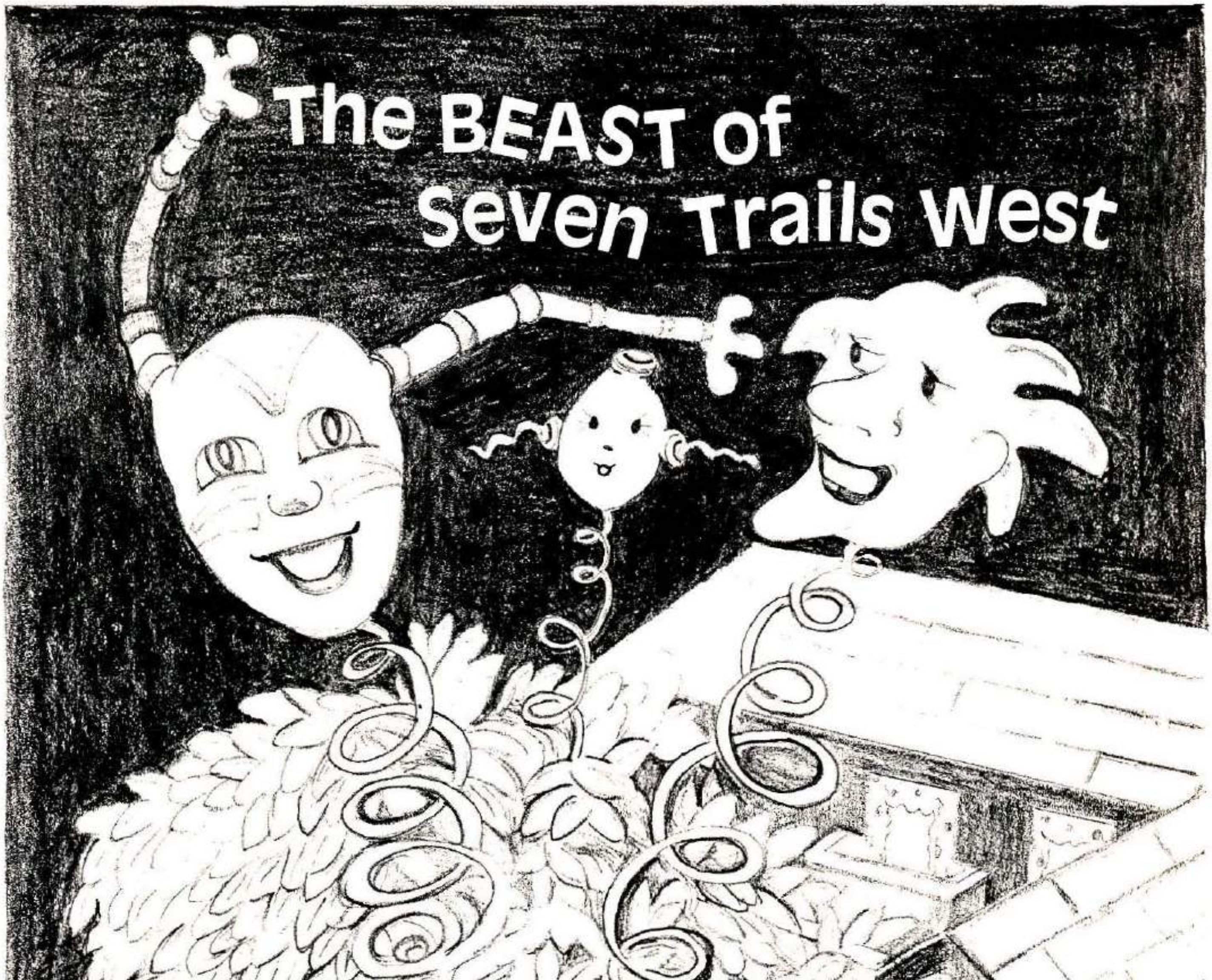
Sooner or later some of you will see an advertisement for some "miracle" aluminum solder or an aluminum-welding process, and you'll look upon this as the answer to an antenna-builder's dream. I know, because it has happened to me — several times — and I hate to think of how much aluminum tubing I transformed into scrap each time a new product was advertised.

The stuff works, there's no denying that. However, there are two major drawbacks as far as an experimenter is concerned. First, it's permanent. If you want to change something, or replace a broken element, lots-of-luck. Second, the inevitable heating required to make a proper bond between an element and the boom will seriously weaken both of them. I once built a pair of two-meter Yagis, each element nicely "brazed" in place. It was a masterpiece, each element secure from weather-induced corrosion and sporting a smooth fillet of metal where it joined the boom. I was really proud of it until the first ice storm, which left it looking like the most mistreated umbrella in the world. The softened aluminum had all the strength of damp spaghetti. My conclusion is that I'll stick to nuts and bolts to build Amateur antennas.

References

1. John Tyskewicz, W1HXU, "Triband Wire Yagi Antenna," *Ham Radio Horizons*, December, 1977, page 26.
2. John Tyskewicz, W1HXU, "Simplex 3-Band Wire Beam," *Ham Radio Horizons*, November, 1978, page 56.

HRH


The BEAST of
Seven Trails West
S. GRAY

BY TROY WEIDENHEIMER, W0ROF

They say a monster lives in the park behind our apartment complex. Invisible during the day, it looms up in the moonlight, swinging and swaying in the night wind. And its voice is an eerie metallic rattle. And they say that sometimes it puts funny lines on your TV screen. It's a creature with three great necks stretching skyward. And it's mine.

I remember the terrible day I arrived at Seven Trails West Apartments. One look at the "No Antenna" clause in the rental contract would engulf even a repeater jockey in waves of dismal depression. For me, a QRP_p (low, low power) DXer who relies on lots of antenna to make up for lack of power, it spelled doom . . . the certain end to all I cared about in life.

I became morose, quit eating. My eyes grew dull and my body temperature fell to the low sixties (not uncommon among DXers during sunspot minima). For nearly a month nothing remained of my usual bountiful spirit but a pilot light flickering weakly. I'd gone dormant.

But, in the dark recesses of my inner mind, there was a flurry of activity. I sensed that soon the dilemma would surface.

On Thursday, July 24, while enjoying a quiet dinner with my family, my mind exploded. I sprang from my chair, eyes flaming. Wisely, my family found shelter in the kitchen and peered out at me through a crack in the door. In seconds I was in the hall closet attacking the man-sized stack of ham magazines.

"It's here . . . It's here SOMEPLACE," I screeched.

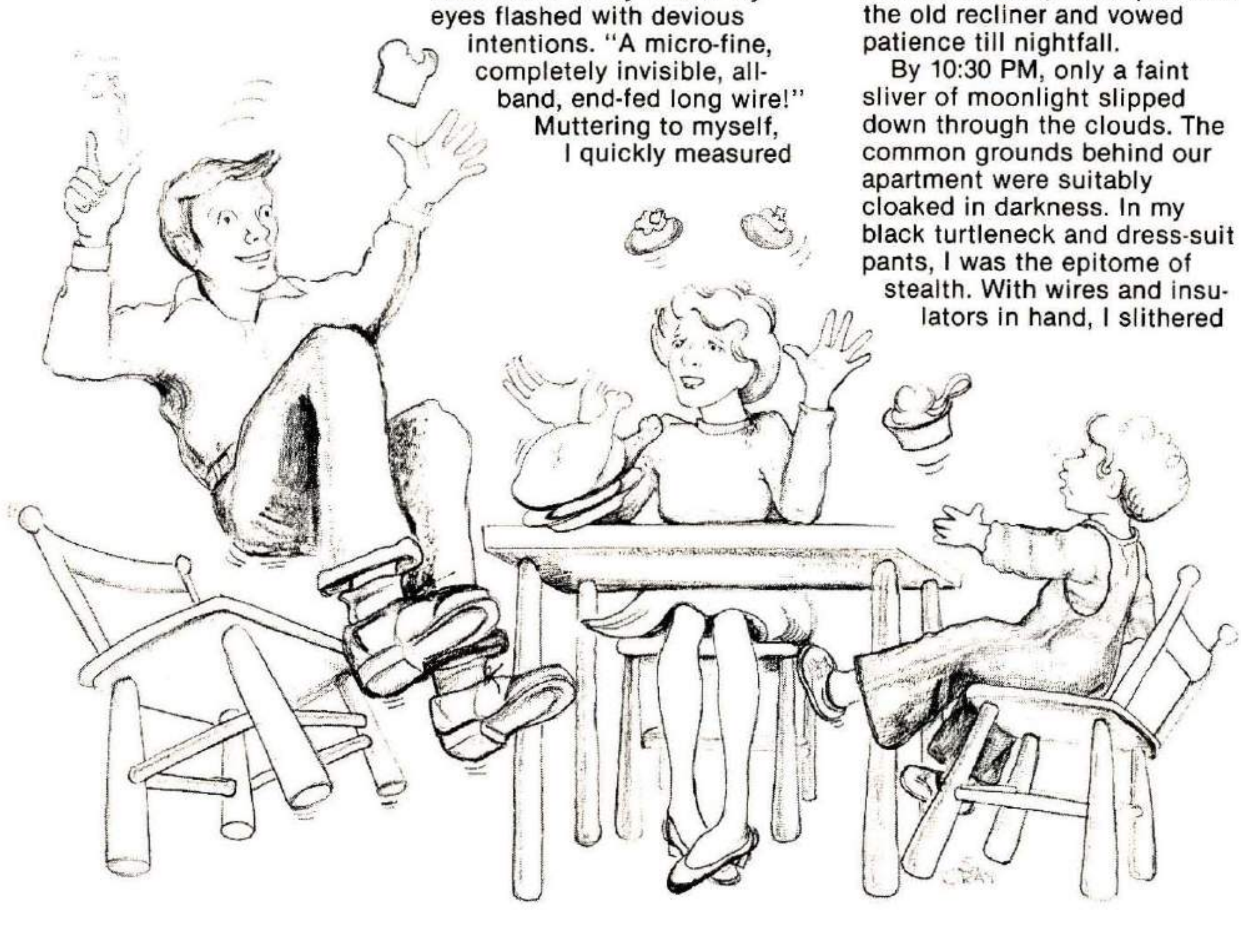
"W . . . W . . . what's there?" ventured my XYL.

"Article . . . invisible antennas . . . how to make 'em . . . AH . . . AH, I have it!"

Down the basement steps I bounded. Snatching up a huge roll of No. 28 magnet wire, I clutched it to my chest. My eyes flashed with devious intentions. "A micro-fine, completely invisible, all-band, end-fed long wire!" Muttering to myself, I quickly measured the length of the basement room, drove tiny nails in opposing walls, then began spooling off wire. Skipping back and forth across the room with my wire, I might have been a great spider awkwardly weaving a web.

I rolled the measured wire back onto the spool, pounced up into the living room, and made for the glass patio door. Without caution, I threw back the curtains covering the door and immediately recoiled in terror. "Ohhhhhh," I moaned, like a vampire caught in the open at dawn. The light poured in. Starkly revealed, I stood clutching three hundred feet of wire and a dozen ceramic insulators. And there were the neighbors, barbecuing something dreadful, just beyond our patio. Had they seen me? And how could I explain what I was preparing to do? Fortunately, they were so engrossed in their smoky toil that they remained oblivious to my sudden appearance and equally sudden retreat. Shaken, I slumped into the old recliner and vowed patience till nightfall.

By 10:30 PM, only a faint sliver of moonlight slipped down through the clouds. The common grounds behind our apartment were suitably cloaked in darkness. In my black turtleneck and dress-suit pants, I was the epitome of stealth. With wires and insulators in hand, I slithered



into the yard, crept along the side wall of the townhouse, knelt, and fed one end of the wire into our basement window. That left only 295 feet to string through the trees and buildings without being detected. My confidence dwindled.

A large, park-like area of common ground lay directly behind our townhouse. But fifty apartments which looked out on this setting sent an equal number of probing shafts of light out over my prospective antenna farm.

Like Red Ridinghood's wolf, I started out streaking from tree to tree. My heart pounded both in anticipation and trepidation. Clinging with one arm to the trunk of a towering cottonwood, I dug into my bulging pocket and withdrew the pair of C cells I had taped together to provide weight for my "throwing string." Cautiously backing into the tree's shadow, I began to swing the weighted string around my head, aiming for a branch high in the tree.

Round and round, faster and faster the weights whirred through the air and . . .

"TWANK!" At approximately Mach 4, the batteries parted company with the string and whizzed off on a flight path which I quickly calculated would pass directly through the great picture window of apartment No. 313.

SURPRISE! The window did not disintegrate. Instead, the batteries altered their course magically, and whanged against a massive, forty-foot-high dowspout by the window. Instantly, one hundred glowing eyes glued themselves to the glass rectangles which looked out on my hiding place. Few things go "CLANK!" in the night at Seven Trails West. And that one had hit with the impact of a crazed condor.

Heart pounding, I pressed still closer to the tree and waited. As the last reverberations died in the downspout, the eyes drifted back into the depths of the dimly lit TV rooms and I went nervously back to work.

This time, I tied a large rock to the end of my throwing line and succeeded in heaving it over a fine branch high in the

Down the basement steps I bounded.

In seconds I was in the hall closet attacking a man-sized stack of ham magazines.

cottonwood. Then I tied the free end to my antenna and threaded it up through the branches and back to the ground on the far side of the tree.

By about 3:30 AM all the wire was out . . . zigzagging around the common area, ending up tied securely to a sapling in front of the complex.

The next night, after dinner, I hurried down to the basement to give the new antenna a try. Flip on the rig. Bandswitch to 40 CW. Tune past the nets, through the RTTY boys, around the keyboard "QRQ heads," and zero-in on 7040 kHz to try to stir up a low-power ragchew. The tiny changeover relay in the Argonaut "snipped" away happily as I buzzed off my "CQ."

But before I could sign, I heard a distinct "PING," and then another. Signal strength fell markedly . . . and so did my mood as I pondered the cause. PIGEONS! Rammed! 28 gauge wire is no match for a determined pigeon's strafing run. Now what? Permanent QRT?

Two weeks later, a new and

fiendishly creative plan rose into my mind. There was a way to build a completely people- and pigeon-proof, multi-band antenna . . . one so cunningly installed that no one could trace it to the "strange-eyed fellow" in No. 103.

Once again I waited anxiously for darkness, this time with two-hundred feet of small-gauge coax and a big butcher knife. Sundown came with a good cloud cover.

I began beneath the basement window, carving a thin trench with the knife. The grass was high and wet. Mosquitos, chiggers, and gnats were abundant, and the ground was luxuriant with granite boulders. Combine those problems with the 95-degree heat and drenching humidity, and I faced a task that makes laying a transatlantic cable child's play.

The first night I buried only 80 feet of transmission line; the next night, another 80. By the weekend, the line extended across the common ground, under the big hedge on the property line, along a narrow footpath, and out into the city park.

Saturday morning I picked up several Slinky toys at the hardware store. By measuring the length of wire in each loop and multiplying that by the number of turns, I was able to arrive at the number of turns required to approximate a half wavelength on each of my favorite bands: 40, 20, and 10 meters. When you extend a coiled-up half wavelength of wire to about one eighth wave in stretched-out length, it acts like an electrical quarter-wave; perfect for a vertical antenna. I cut three Slinkys to size and wired them together at the base so they could be fed simultaneously with the center conductor of the coax.

The next step was to cut a number of radial wires to about 33 feet in length. I ran out of energy after twenty four of them and concluded that I had reached the optimum number. I placed the radials and the Slinky verticals in my black bag, and, by 11 PM, was creeping from tree to tree, across the common ground, through the hedge, and into the park. After some searching, I located the stub of coax which projected from the end of my laboriously carved transmission-line trench. So carefully had I replanted the grass and weeds in the slot after inserting the coax that there was no sign of my work.

The moon was dimmed by the fat, fuzzy clouds which marched lethargically across the sky. Working furiously, I cut the slits and placed the radials in the traditional fan-like arrangement. I attached the center conductor of the coax to the conjunction of the three Slinkys, and fastened the shield to the point where the radials joined. I then smeared the entire feed point with silicone glue, let it dry, wrapped the connections with tape, and applied another layer of the rubber-like glue. I wasn't about to let any moisture ruin the product of all that drudgery.

Stepping back to admire the job, I looked down on the three small coils which were just detectable in the tall grass below the big tree. Next, I tossed a roll of 15-pound-test monofilament line up and over a strong branch that stood out horizontally from the trunk of a nearby tree. Twice more I threw the roll, then cut each length of mono and attached the end of each to the top turn on each of the three Slinkys. A small screw-eye twisted into the tree trunk served as the tie-down point for the elevating lines.

"At last," I thought, "my antenna farm is about to spring into action." I drew each coil up to its full operating height with the raising line, and tied it temporarily in position. The verticals, joined at their bases, stretched up and outward like a huge candelabra. My work done, I slithered through the dewy grass back to my townhouse and my station, which now beckoned.

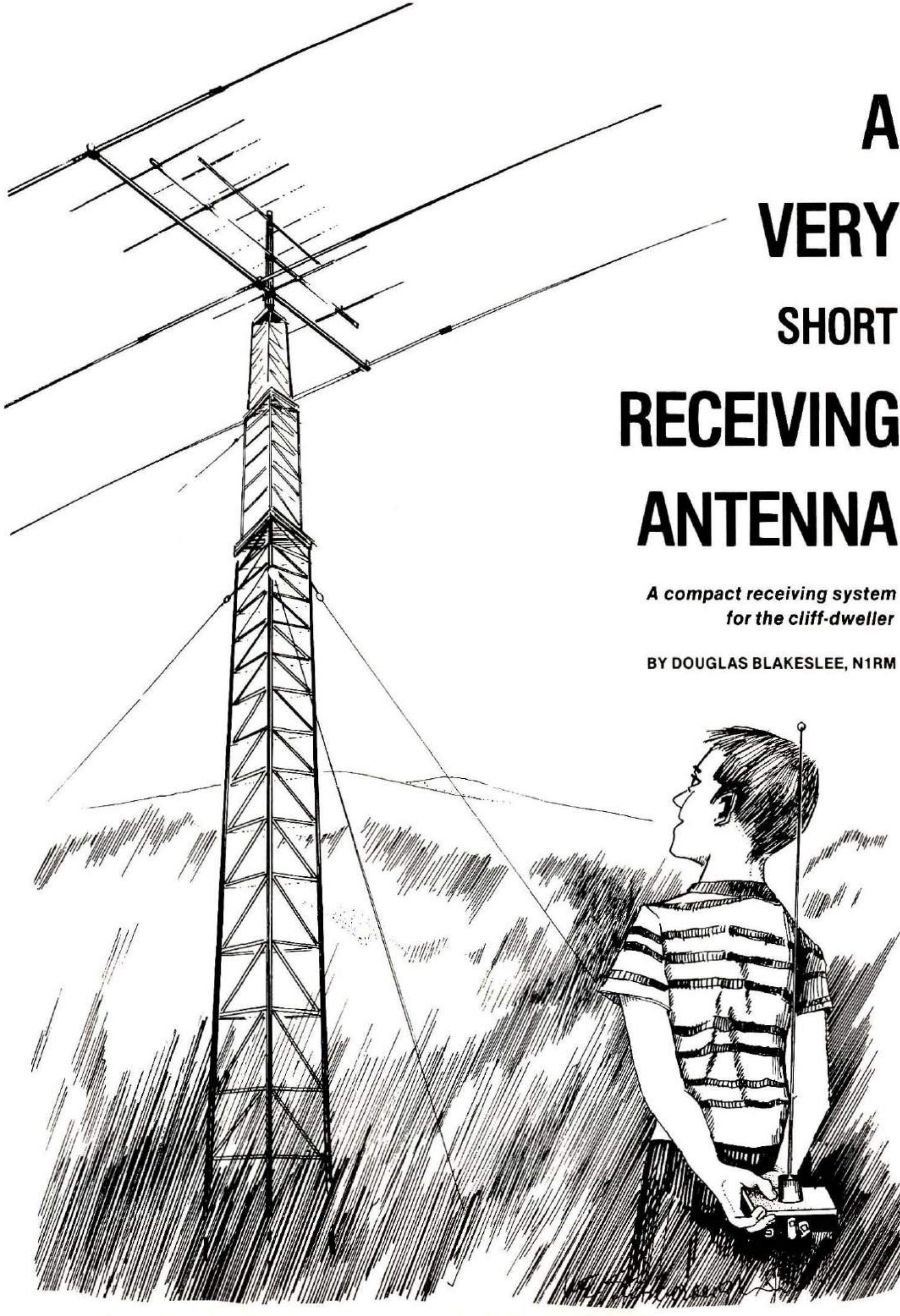
Some say, on dark nights, something rises up in the park behind Seven Trails West. It's a beast with three long necks that quivers and gleams in the moonlight; a creature that roams at night and hides by day. I listen to the stories and smile. A monster lives just 200 feet from my ham shack desk. And it's mine. **HRH**

Glowing eyes looked out upon my hiding place.

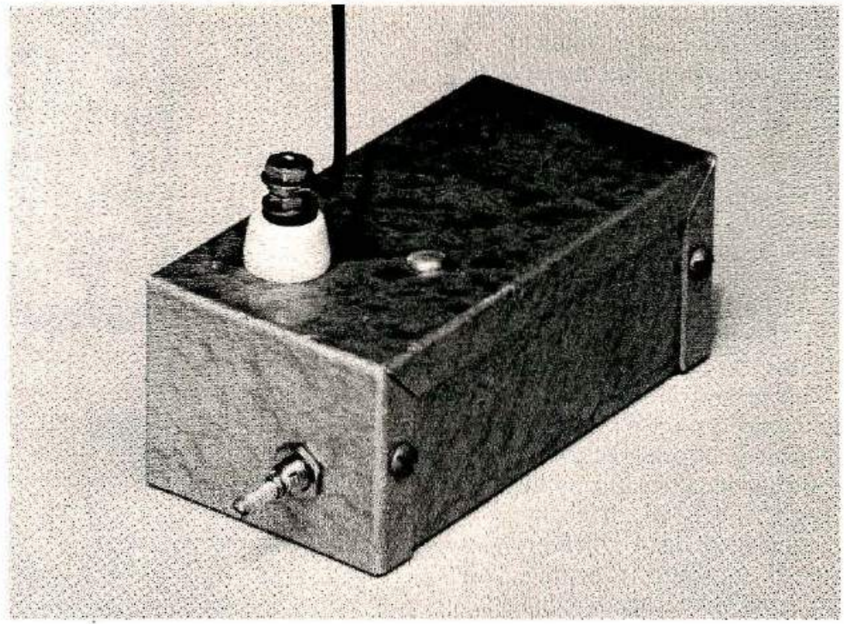
A VERY SHORT RECEIVING ANTENNA

A compact receiving system for the cliff-dweller

BY DOUGLAS BLAKESLEE, N1RM



An advertisement for a commercial antenna currently appearing in electronics publications is headlined "Good Listeners Keep A Low Profile." It's true, especially if you inhabit an apartment. Hams with very limited — or no — space for antennas are at a severe disadvantage. Not too long ago *Ham Radio Horizons* outlined some tricks for limited-space antennas.[1] For both transmission and reception, such antennas are definitely second-class cousins to even simple arrays erected by those who have the acres and poles needed for profitable antenna "farming." For transmitting, the *Horizons* article outlined many of the solutions available. For receiving, however, the apartment dweller need not suffer with second-class performance.

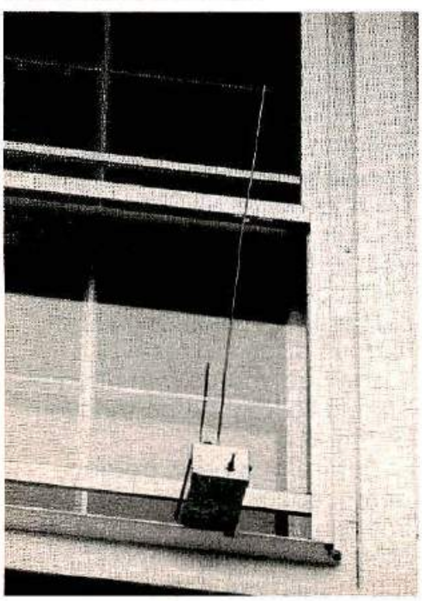


The preamp assembly is mounted in a Minibox. The screw adjustment is for the broadcast-band trap.

Evolution of an idea

It seems that every time I have a good idea, I find that someone else has thought of it first. When I read Jim Fisk's piece about the voltage probe antenna in *ham radio*[2] some years ago, I was intrigued with the concept and I stored the idea away for future reference. At the time I didn't know how appropriate coupling and gain circuits might be designed.

The unobtrusive voltage-probe antenna mounted on a window sill.



During my conversation with John Kraus, W8JK, for an interview article,[3] he said that short transmitting antennas could be very inefficient if losses weren't controlled, but small receiving antennas could work very well, as evidenced by the loop-stick antenna in a-m broadcast radios. A light came on in the back of my head. Of course! A voltage-probe antenna could be made quite simply with today's solid-state components. Performance should be good, especially at low frequencies. All that was needed was to combine the high-impedance input circuits used in frequency counters with the broadband rf-amplifier designs being used in test equipment and some solid-state transmitters.

Circuit design

Most electronic projects do not work the first time — at least not mine! The circuit that evolved for the cliff dweller antenna is the result of some cut-and-try experiments. The configuration and circuit are a starting point for those who like to experiment. The antenna is shown in block-diagram form in **Fig. 1**. (Block diagrams are often used to simplify electronic circuits so that they may be readily understood.) The antenna is a short, 30-cm (12-inch) wire connected to the circuit ground by means of a high-value resistor. Voltages developed across the resistor by incoming signals are sampled by a preamplifier that provides moderate power gain and an appropriate output impedance level for connection to a transmission line.

Impedance matching in the classic sense of the term is not used at the input to the preamp. Full-sized transmitting and receiving antennas usually have a low or moderate impedance at the feed point, typically 70 ohms for a dipole and 300 ohms for a folded dipole. Impedance matching is employed to ensure maximum power trans-

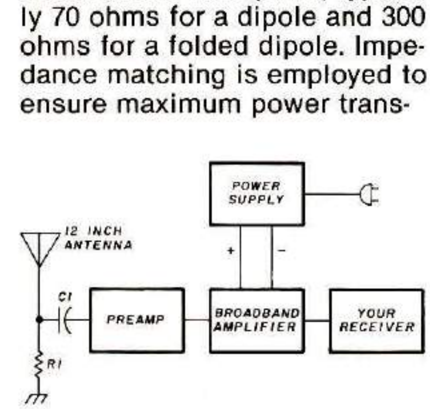


Fig. 1. Block diagram of the voltage-probe antenna system.

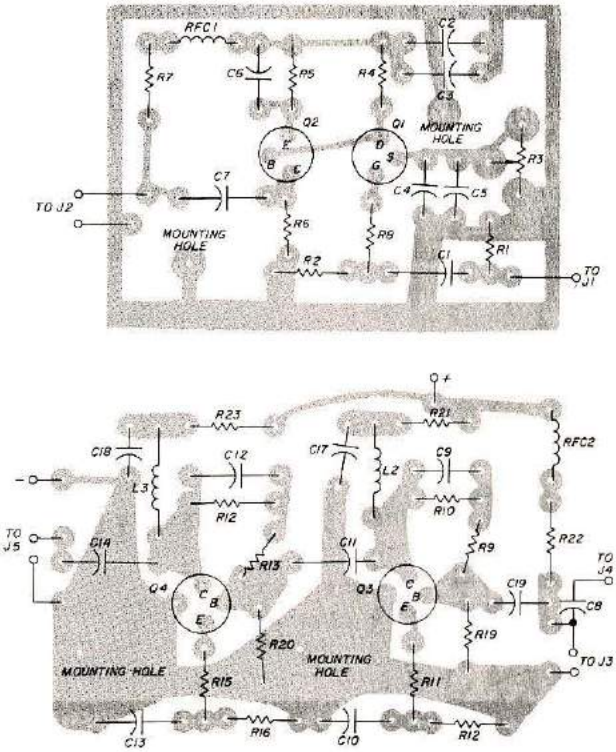


Fig. 6. Parts-placement guide for the preamplifier, above, and the amplifier, below, from the component side.

swing without distortion. The follower, Q2, is a bipolar transistor whose purpose is to provide an output impedance near 50 ohms. Power to the preamp is provided through the signal cable. An rf choke, RFC1, passes dc voltage while blocking rf energy. Thus, the output cable simultaneously carries the radio frequency signals from the preamp while conducting dc power to the unit.

The preamplifier feeds a combination wide-band amplifier/power supply, **Fig. 3**. The amplifier is a design by Wes Hayward, W7ZOI, first described in private correspondence[4] and later in print.[5]. The two amplifier stages, Q3 and Q4, use heavy feedback. Feedback, coupling energy from the output of a circuit to its input, is used in many ways (and to good advantage) in radio circuitry. In an oscillator, it is feedback that produces continuous oscillation. In audio and rf amplifiers, feedback helps to reduce distortion, to eliminate gain variations between amplifying devices, and to establish desired impedance levels.

The amplifier stages use 2N5179 transistors, high gain, wide-bandwidth devices designed for service in CATV amplifiers. The combination of circuit components, including emitter degeneration provided by R11 and R15 plus the collector-emitter feedback networks of C9/R9 for Q3 — and C12/R13 for Q4 — stabilize the gain at 9 to 10 dB per stage. The input and output impedance is 50 ohms. An auxiliary input is provided, J4, so the amplifier can be used for other purposes — as a preamp for a frequency counter, for example. Hayward's original design was a four-stage unit producing nearly 40 dB of gain. It has wide dynamic range, so it can handle strong signals before overloading. But, as with any amplifier, it can be overloaded. More about that later.

The power supply is a simple full-wave-bridge affair. Such circuits have been previously described in *Ham Radio Horizons*.[6] The transformer can be any unit providing a 12-volt output. I used a diode-bridge package as a rectifier, but four silicon diodes can be used as a substitute, as shown in **Fig. 4**. The power-supply output filter is a simple RC (resistance/capacitance) arrangement because voltage regulation and ripple are not important in the rf circuits used for the voltage-probe antenna.

Construction

Two assembly methods are suggested for the preamplifier and amplifier. You can make your boards from the patterns given in **Fig. 5**, or you can purchase ready-made boards from Whitehouse.[7] Another technique is to make a board yourself, using the isolated-pad technique. Special drill bits are available for making pads of various sizes.[8] Whatever technique you use, the boards should follow the parts layout of **Fig. 6**.

Before mounting components, check the printed circuit boards for tarnish and dirt. If they are not bright and shiny, touch them up with fine steel

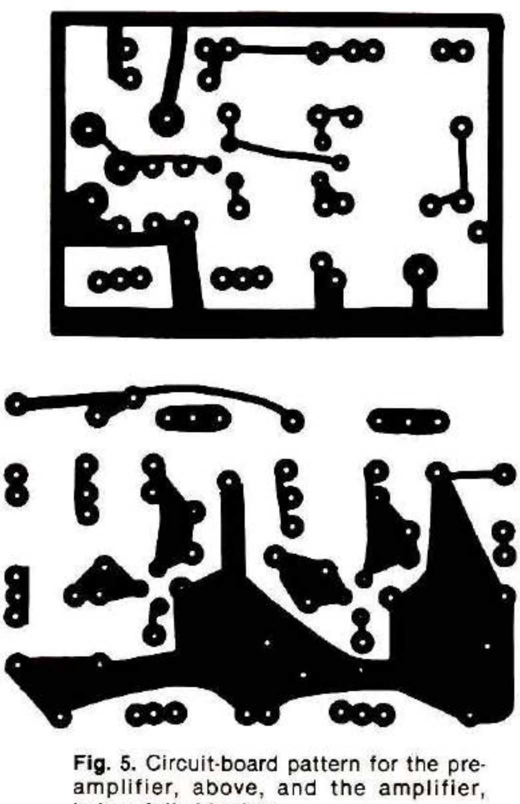


Fig. 5. Circuit-board pattern for the preamplifier, above, and the amplifier, below, foil-side view.

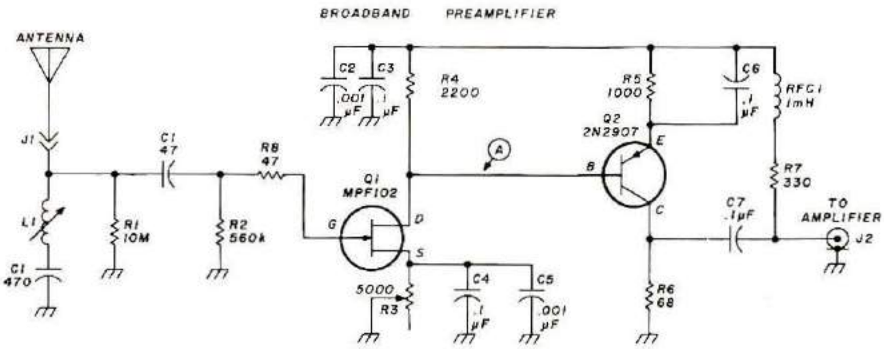


Fig. 2. Schematic diagram of the preamplifier. Point **A** is a voltage-test point, as described in the text. Resistors are 1/4-watt sizes.

fer from a transmitter and to a receiver. In this voltage-probe antenna, power transfer is ignored. The voltages developed across the resistor are coupled via a capacitor to the input of the preamp, which has a very high input-impedance. Because capacitive coupling is used, the unit is essentially independent of frequency across the high frequency spectrum. Or, to say it another way, it's very broadband.

Of course, a very short antenna does not extract as much energy from a passing radio wave as does a full-size antenna. Thus, it is necessary to provide some amplification of the incoming signals if this short wire is to approach the performance of its larger counterparts. A broadband preamplifier, with a gain of approximately 20 dB, is used for this purpose. The choice of an appropriate gain level posed a design problem which is still not fully resolved. The shorter the antenna, the higher the gain that is needed. But the amount of energy extracted by the antenna varies with frequency, with low frequencies providing the lowest signal levels. Thus, the preamplifier gain needs to be a tradeoff between the frequency range and the length of the antenna. Too little gain will degrade signal strength while too much gain can cause distortion in the preamp or amplifier from

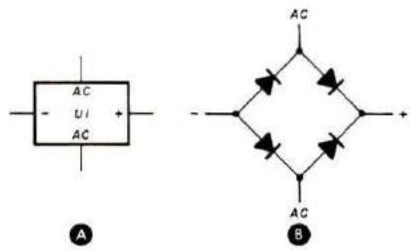


Fig. 4. A bridge rectifier for the power supply can be an assembly such as U1, (at **A**) or, you can make your own by wiring four diodes (RS 276-1102) as shown at **B**.

strong signals, generating spurious signals and causing overload of your receiver front end.

Circuit components

The circuit diagram for the preamplifier is shown in **Fig. 2**. Any voltage developed across R1 is coupled to the input of Q1 through a capacitor, C1, with which R2 forms an RC (resistance-capacitance) network to attenuate energy in the low-frequency range. Signals in the broadcast band can be particularly troublesome if you live within a mile or two of a transmitter. Signal strengths can be more than enough to limit the effectiveness of a voltage-probe antenna. This was a problem in my case, so a series trap consisting of L1 and C2 was added to null out a broadcaster on 910 kHz. If you have no broadcast stations for neighbors, L1 and C2 can be eliminated.

The fet input stage is directly coupled to an emitter follower, Q2. R3 is used in the source lead from Q1 to adjust the drain current through the FET to provide maximum signal

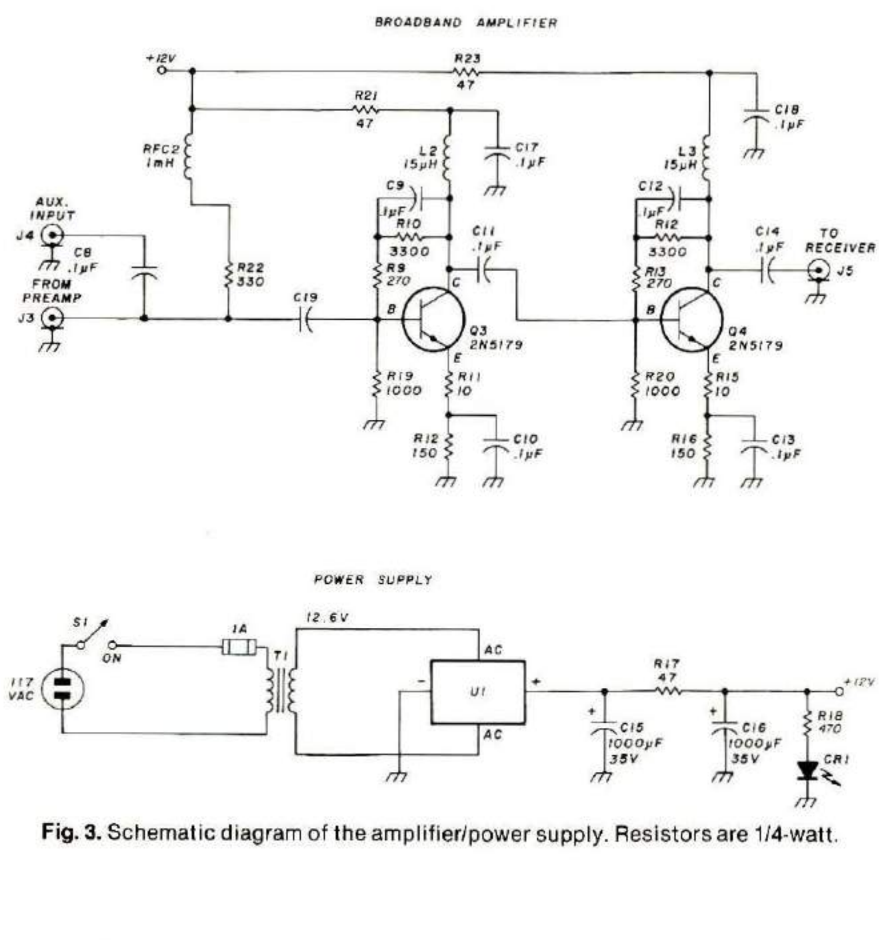


Fig. 3. Schematic diagram of the amplifier/power supply. Resistors are 1/4-watt.

wool. Then mount the components a few at a time. Bend the leads slightly to hold the parts in place. Then, touch the soldering iron to the component lead and the copper of the circuit board simultaneously.

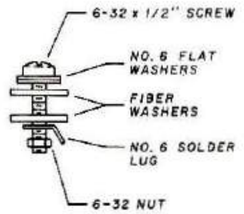


Fig. 7. A homemade feed-through insulator.

After a second or so, apply a small dab of rosin-core solder. As soon as the solder has melted, remove the iron. Inspect the solder joint. If it has a smooth, shiny appearance, all is well. But if it looks lumpy or dull, it is probably a "cold" joint which may fail electrically or mechanically. Reheat any cold joints until the solder flows freely. After soldering each group of components, check to be sure that no bridges of solder have splashed between adjacent leads on the circuit board.

The preamplifier was housed in a 41 × 50 × 101 mm (1-5/8 × 2 × 4 inch) (Radio Shack 270-239) Minibox. Any enclosure of similar size is suitable. I used a small ceramic feed-through insulator from my junk box to mount the antenna. Such components are rapidly gaining dinosaur status. A suitable mount can be made using two fiber washers, as shown in **Fig. 7**. Keep the lead from the antenna input to the preamp circuit board as short as possible.

A 127 × 177 × 50 mm (5 × 7 × 2 inch) aluminum chassis (Bud AC-402 or Radio Shack 270-246) was used to house the power supply and broad-band amplifier. Any chassis or Minibox of similar size is suitable. In fact, the unit could be made somewhat more compact if desired. After the mounting holes are drilled, the chassis can be given a coat of paint in your favorite color. All wiring in the unit, other than the circuit board, is made point-to-point, using tie strips for connection points. Be sure to observe the proper polarity when mounting the rectifier assembly and filter capacitors. Do not connect the lead from C16 to the broadband-amplifier circuit board until you start the adjustment procedure. The leads from the circuit board to the phono connectors should be kept short. Otherwise, lead lengths are not critical.

Adjustment

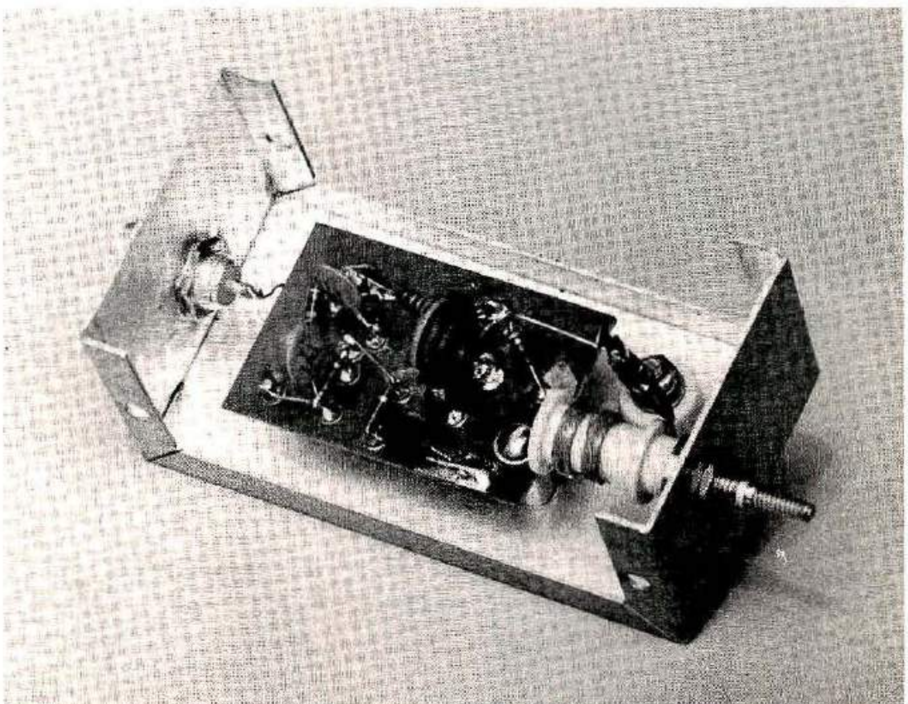
When all wiring of the preamp and amplifier/power supply is complete, recheck all connections. Connect a volt-ohmmeter (VOM) — set to measure resistance on the highest scale — between the plus terminal of C16 and the chassis. The ohmmeter should kick to a low resistance reading and then slowly return to an indication of more than 10,000 ohms. (This action is caused by the battery in the ohmmeter charging C16.) If the reading is low, you have a defective component or short-circuit connection.

If the resistance reading is high enough, set the VOM to read a voltage of approximately 20 volts. Turn on the power switch; the voltage across C16 should be between 18 and 22. If this check is successful, turn off the power and connect the lead from C16 to the amplifier circuit board. Connect the cable from the amplifier/power supply to the preamplifier. Turn the power on again, and check the voltage at the junction of RFC1 and R5 in the preamp. It should be approximately 12 volts. Make a note of the actual reading. Move the voltmeter lead to the junction of the drain lead of Q1 and the base lead of Q2, point **A** in **Fig. 2**. Adjust R1 until the VOM indicates half of the voltage reading noted above. This completes the adjustment procedure.

Results and improvements

In some 20 years of hamming, my first try with the voltage-probe antenna was perhaps the biggest shock. Direct comparison with a full-size, ground-mounted vertical

This prototype version of the preamp uses the isolated-pad construction technique.



with thirty-two radials showed 40-meter signals originating 3000 or more miles away were often of equal strength on the voltage-probe unit. On 80, they were down some 10 to 15 dB.

Listening to 80-meter ssb signals from Japan, one of the most difficult paths from Connecticut, I found signal strength down somewhat but the signal-to-noise ratio was always better than from the full-size antenna. Ground-mounted verticals can be rather noisy, but they're great for transmitting. Long Beverage antennas of 1000 feet or more will produce better receiving results on long paths. I don't have a Beverage for comparison; the results with a few inches of wire will probably prevent lazy me from tacking several thousand feet of copper out through the trees!

Also, the short antenna didn't seem to follow the rules of antennas as I know them. Placing the short antenna in a horizontal or vertical position made little or no change in incoming signal strength. Some simple experiments with ground planes (not connected directly to the preamplifier assembly) showed no change in signal strength, whether they were in place or not. Also, the short antenna did not show signs of detuning even when brought within two inches of a large metal structure. The results obtained with the short antenna inside a wooden-frame house were not observably different from those obtained outdoors. In a cement apartment house with metal supports, the system performed better when the antenna was set out on a window sill.

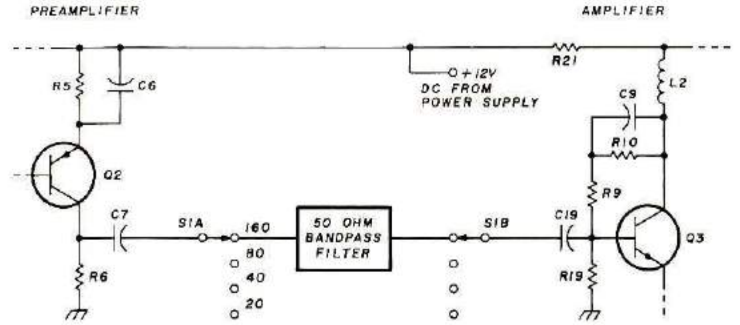


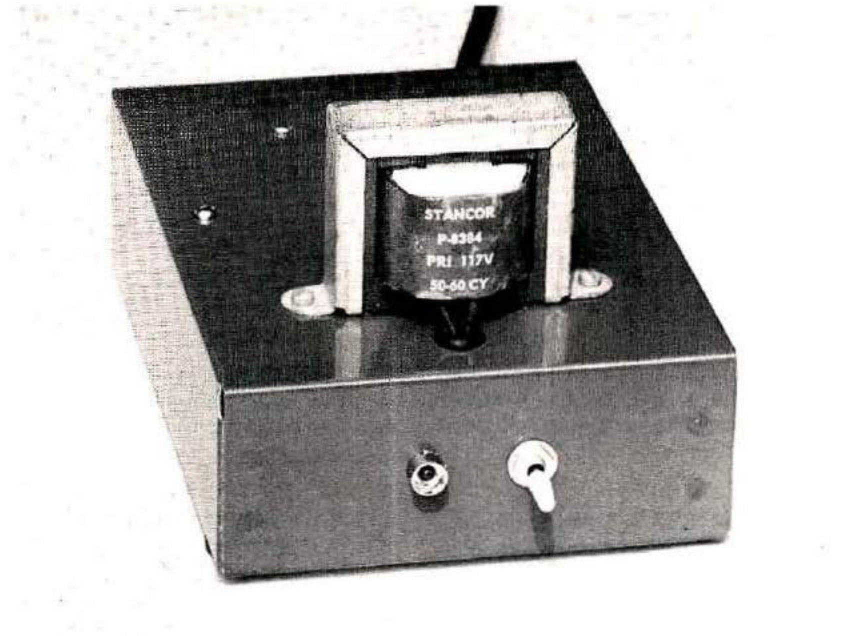
Fig. 8. Circuit changes needed to insert bandpass filters between the preamp and amplifier to improve performance. All components are those used in **Figs. 2** and **3** except for S1, which is a two-pole, four-position, rotary type (RS 275-016).

Above 20 meters, a few feet of wire thrown out the window will suffice. This is fortunate because the performance of the voltage-probe antenna deteriorates as the frequency goes up. Very strong low-frequency signals produce distortion in the amplifying system. This distortion creates harmonics (multiples of the basic frequency) and distortion products (multiples of the basic frequency which mix, adding and subtracting to produce many new frequencies). The basic design is "wide open;" that is, it contains no selectivity, other than input-circuit components selected to reduce the strength of signals below 1.5 MHz.

Active antennas are in their infancy. It's an exciting new field which takes only a few hours in the workshop to enter. *ham radio* magazine has published articles about using short antennas in arrays for directivity.[9] Clearly, the major problem is to build an amplifier which will handle strong signals without overload, while retaining sufficient sensitivity.

Table 1. A parts list for the preamplifier/amplifier/power supply. RS numbers given are Radio Shack part numbers.

C1-C14, C17-19, incl.	0.1 μF, low-voltage disk ceramic capacitor (RS 272-120 series)
C15,C16	1000 μF, 35V electrolytic capacitors (RS 272-1019)
CR1	Light emitting diode (RS 276-041)
J1	Ceramic feedthrough insulator or homemade equivalent (see **Fig. 7**)
J2-J5, incl.	Phone connector (RS 274-346)
L1	Adjustable inductor, 45 to 100 μH (J. W. Miller 42A825CBI)
L2,L3	16 μH inductor, 5 turns No. 26 (0.4 mm) enamel wire on 250 μ jumbo ferrite bead (G. R. Whitehouse, 15 Newbury Drive, Amherst, New Hampshire 03031)
Q1	JFET (RS 2036)
Q2	PNP (RS 2022)
Q3,Q4	NPN, 2N5179
R1,R2, R4-R23, incl.	Carbon resistors, ¼ or ½ watt (RS 271-000 or 271-1300). If ½-watt resistors are used, they must be mounted vertically on the circuit board.
R3	Linear taper control, PC mount (RS 271-217)
S1	SPST (RS 275-612)
T1	117V primary, 12V secondary (RS 273-1385, 273-1505, or Stancor 8384)
U1	Bridge rectifier, 100V, 1 A (RS 276-1152)

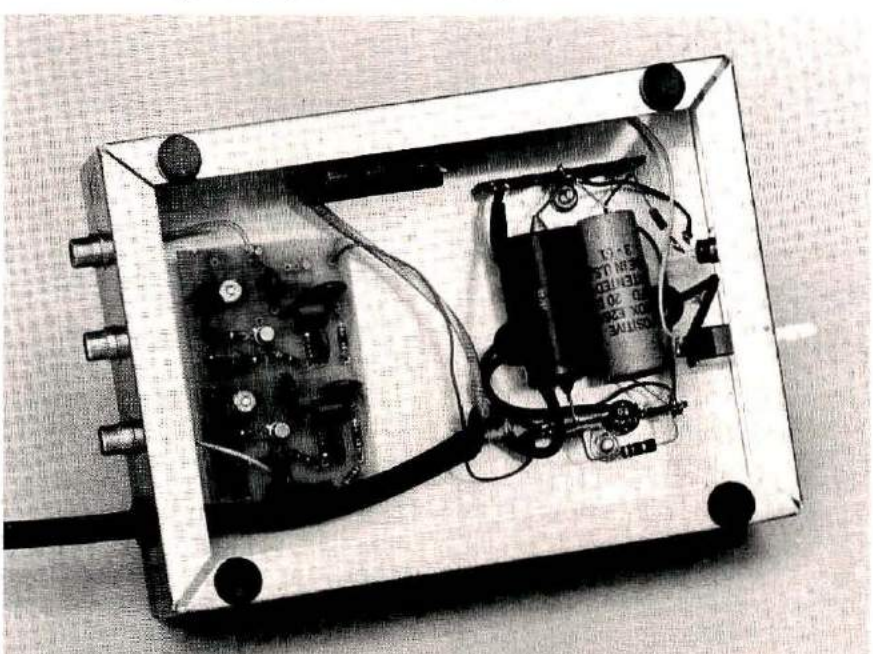


Front view of the power supply/broadband amplifier. An LED lamp is included to indicate when the power is on.

This is an area of development which has occupied communications-receiver designers for the last 15 years. Many of the amplifier-circuit developments for receiver design are directly applicable to active antennas.

My simple unit can be improved by placing selectivity between the preamp and the amplifier. Bandpass filters for the ham bands of interest are a worthwhile improvement for those who wish to use a short antenna for serious hamming. Suitable filters can be chosen from the ARRL *Data Book*.[10] The use of such filters introduces new complexity into the receiving system because a bandswitch is now required. Also, a separate conductor is needed to pass dc power to the preamp, as the signal cable cannot be used, see **Fig. 8**.

The broadband amplifier is the circuit board to the left. The power supply components are mounted using tie strips (Radio Shack 274-688).



For those with an experimental bent, the field of active receiving antennas will be an exciting subject. Radio theory as it is now understood would seem to preclude similar developments of efficient short transmitting antennas, but, who knows. Meantime, it's fun to say, during an 80-meter QSO, "my receiving antenna here is only 12 inches long, OM."

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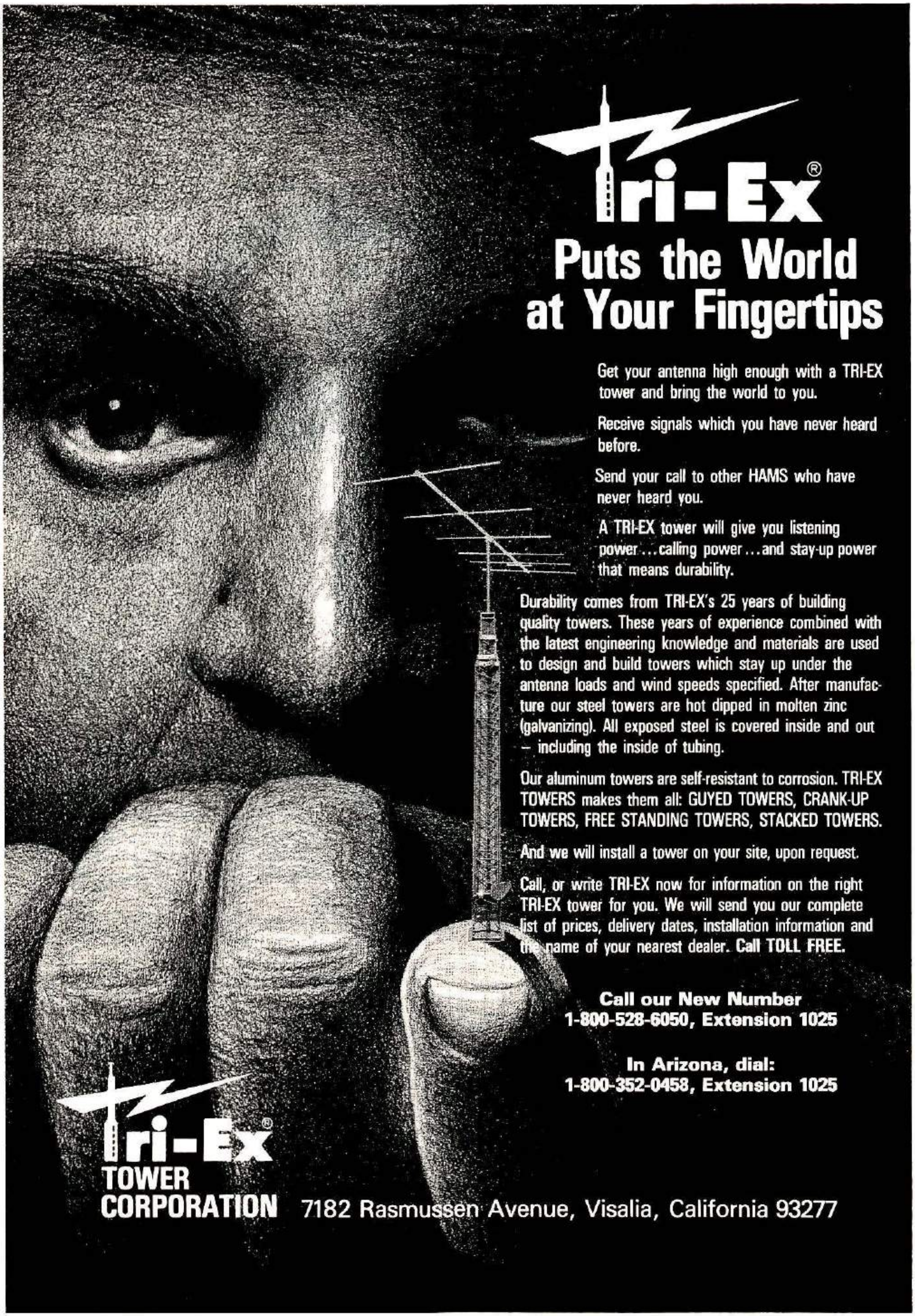
HRH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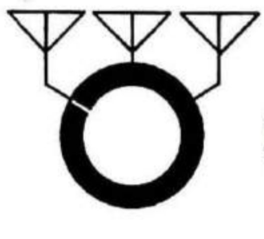


BY DAVID MALLEY, K1NYK

It is fairly common for hams to have multiple antenna systems in order to obtain coverage of several Amateur bands. This applies to both the old-timer and newcomer alike, since the Novice might have an 80-meter inverted vee, and dipoles or beams for the 15- and 10-meter bands. After nearly twenty years in the hobby, I finally acquired a tower which now supports a triband beam (20, 15, and 10 meters), a 2-meter beam, and the old standby 80-meter vee. With such a variety of antennas, three transmission lines coming into my somewhat small basement shack would present a problem. The three hundred feet of coax required to do the job also taxed the ham budget more than I liked. The answer to the problem seemed to be to use a remotely controlled antenna switch located near the top of the tower. The existing run of coax would be fed into the switch while short coax lines would be connected to each antenna. The desired antenna could then be selected by a control box in the hamshack.

While there are commercially available switches that would do a good job and prevent the maze of feedlines, their high price tags made me think in terms of a homemade device. The circuitry that was selected

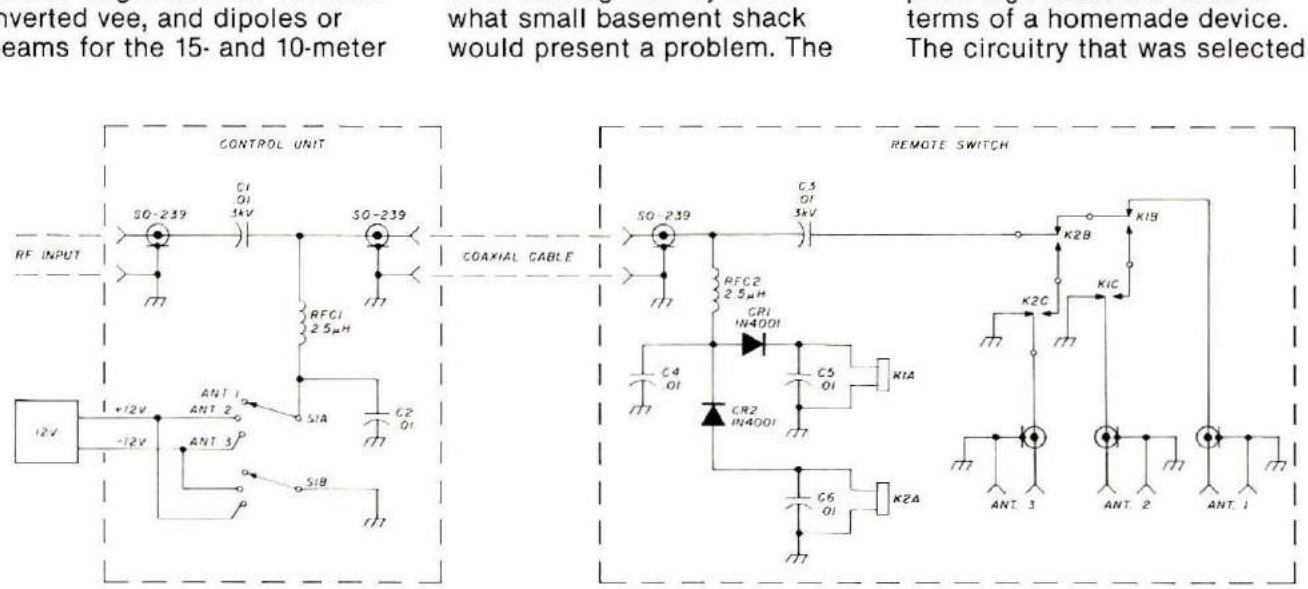


Fig. 1. Schematic diagram of the remote antenna-switching system. The relays are Radio Shack 275-208 with 12-volt dc coils. The power supply must have both the positive and negative terminals above ground.

is relatively simple to understand and can be easily built by the newcomer. Another attractive feature is that all of the parts are readily available. Information on where to obtain the necessary components is presented later in the article. I make no claim as to the originality of the circuit used: it can be found in the *ARRL Radio Amateur's Handbook*. However, a few modifications have been made to improve operation and add an extra element of safety.

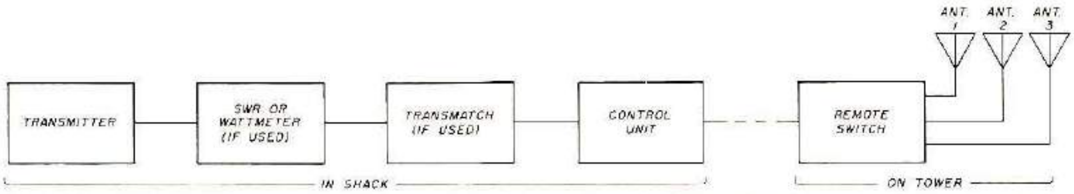


Fig. 2. Suggested equipment connections when the remote switching system is used with a wattmeter (or SWR bridge) and a matching network.

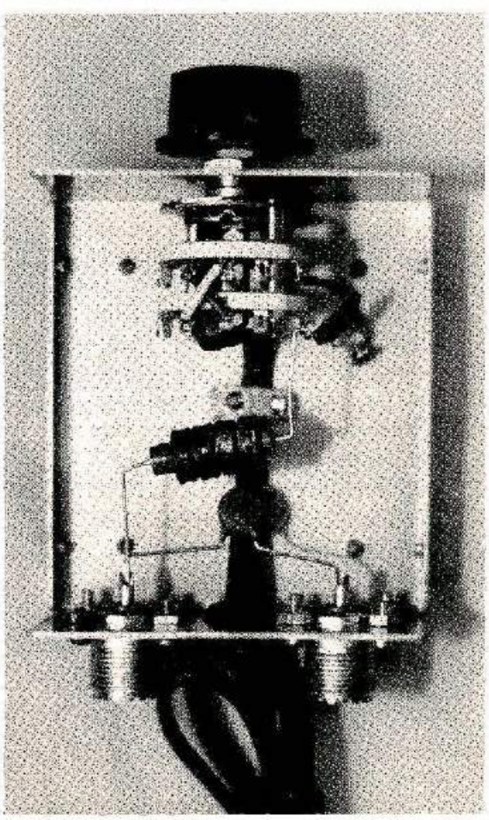
How it works

The circuitry for both the control unit and the remote switch is shown in **Fig. 1**. The 12-volt power supply was already on hand. However, many circuits have appeared in the literature. Whether you buy or build the power supply, a one-ampere rating is more than adequate. *Caution*: Both the positive and negative output terminals must be ungrounded to prevent shorting out the supply when it is connected to the coaxial cable.

The two-pole, three-position, antenna-selector switch applies zero, plus 12 volts, or minus 12 volts to the center conductor of the coax cable going to the remote switching box. **Fig. 1** shows the selector switch in the zero-voltage position. By studying the wiring, you will see that the other positions determine the voltage polarity. By using the coax to carry this voltage, you save the need for a separate wire going up to the remote switch itself. C1 serves as a blocking capacitor to prevent the supply voltage from entering the transmitter and possibly being shorted to ground in the final tank circuit. RFC1 and C2 are used to prevent the transmitter's rf energy from floating around inside the control unit.

Now for the remote switch itself. When there is no dc voltage present, the normally closed relay contacts provide a straight-through connection to antenna 1. In my case, that was chosen to be the tribander, as it would be the most frequently used. Positive voltage passes through diode CR1 to the K1 relay coil and activates antenna 2. This voltage is prevented from reaching K2 by the reverse-polarized diode, CR2.

The selector switch, rf choke, and capacitors fit into a small aluminum box with plenty of room to spare. A single-wafer switch can be used as long as it has two circuits and three positions.



The opposite effect occurs when minus 12 volts is applied and K2 energizes antenna 3.

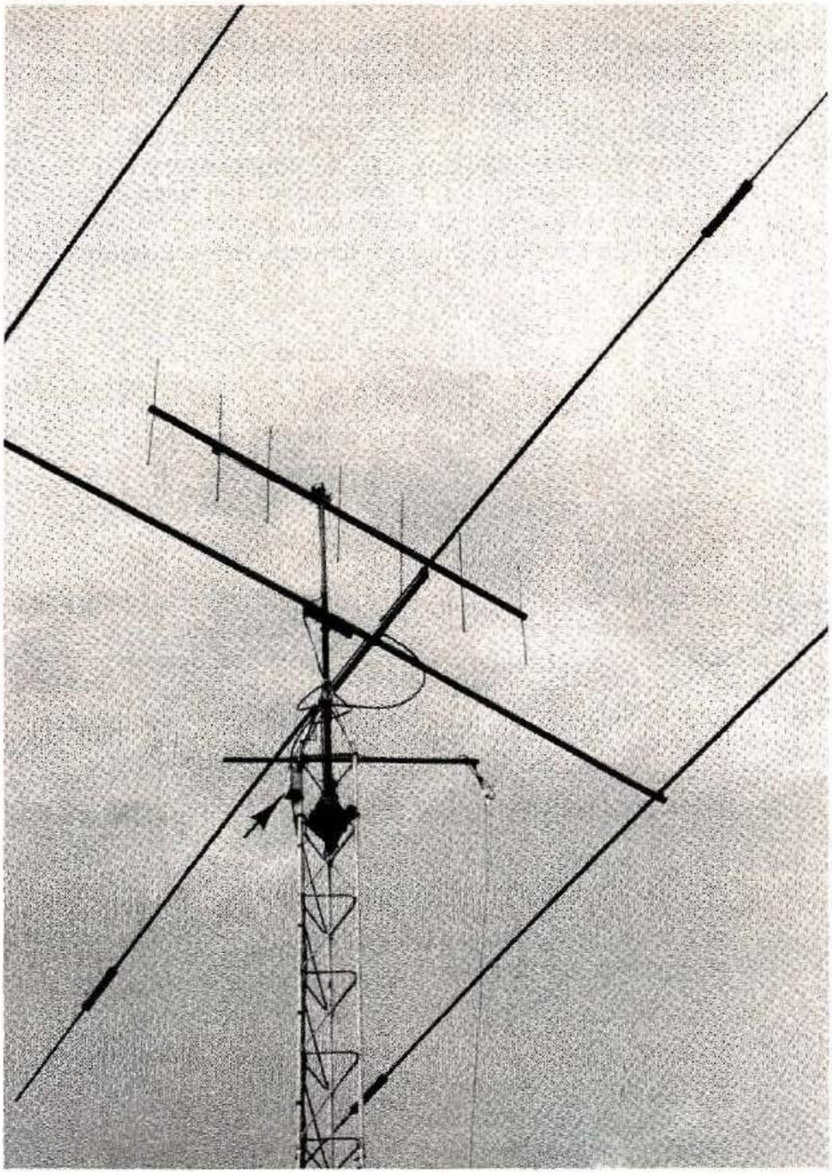
Note that antennas 2 and 3 are grounded when not in use to avoid static charge build-up and thus reduce the possibility of damage to your equipment. This capability is a result of using dpdt relays, and is one of the modifications made to the original design. In my case, only one-half of the triband driven element is always above ground. A Blitzbug* is inserted in the transmission line at ground level to discharge excessive static from that element.

Blocking capacitor C3 stops the dc voltage from going up to the antennas while RFC2 and C4 keep rf away from the relay coils. The values of both C1 and C3 were increased from their *Handbook* values of 0.001 μF. This reduces the reactance of the combined series capacitance and eliminates the initially high standing wave ratio (SWR) on 80 meters. Typically, the SWR increases from about 1.3:1 to 1.5:1 as a result of putting the switch in the line. This is a minor increase and is not considered important. Either 52 or 75 ohm coax is suitable for connecting the control unit to the remote switch. A voltage drop of only 0.3-0.4 volt was measured over a 31 meter (100 foot) length of RG8/U.

Construction hints

The control unit is enclosed in a 10 × 8 × 6 cm (4 × 3¼ × 2¼ inch) aluminum box

*Blitzbug is the registered trade name of a lightning arrester manufactured by Cushcraft Corporation.



The remote antenna selector box is mounted atop the tower, near the antennas it feeds (arrow). The seams in the box, and the coaxial cable connectors, should be weatherproofed with sealant to prolong the life of the relays.

(Radio Shack 270-251). This is a convenient size because it has enough room to assemble the components required. SO-239 chassis connectors are used for the input and output. A six-position ceramic rotary switch was on hand, but any two-circuit, three-position switch would be fine. The junkbox also provided the rf chokes, but they can be purchased from electronic supply houses. Both C1 and C3 are 3 kV-rated capacitors and are available at supply houses. This voltage rating is necessary, because a high SWR or high transmitter power can create very high voltages at certain points along the transmission line. Placement of components in the box is not critical, and the photograph shows the parts layout I used. The application of dry transfer labels completed the assembly.

The aluminum box for the remote switch (Radio Shack 270-238) measured 13 × 8 × 5 cm (5¼ × 3 × 2 inches). A slightly larger enclosure, however, would have made construction simpler. Again, parts placement is not critical. The use of 10-ampere relay contacts allows running 2 kW PEP without arcing problems. Of course, a lower current rating is satisfactory if high power is not contemplated. The relays that I selected (Radio Shack 275-208) have 95-ohm coils and draw 0.125 amp when 12 volts is applied.

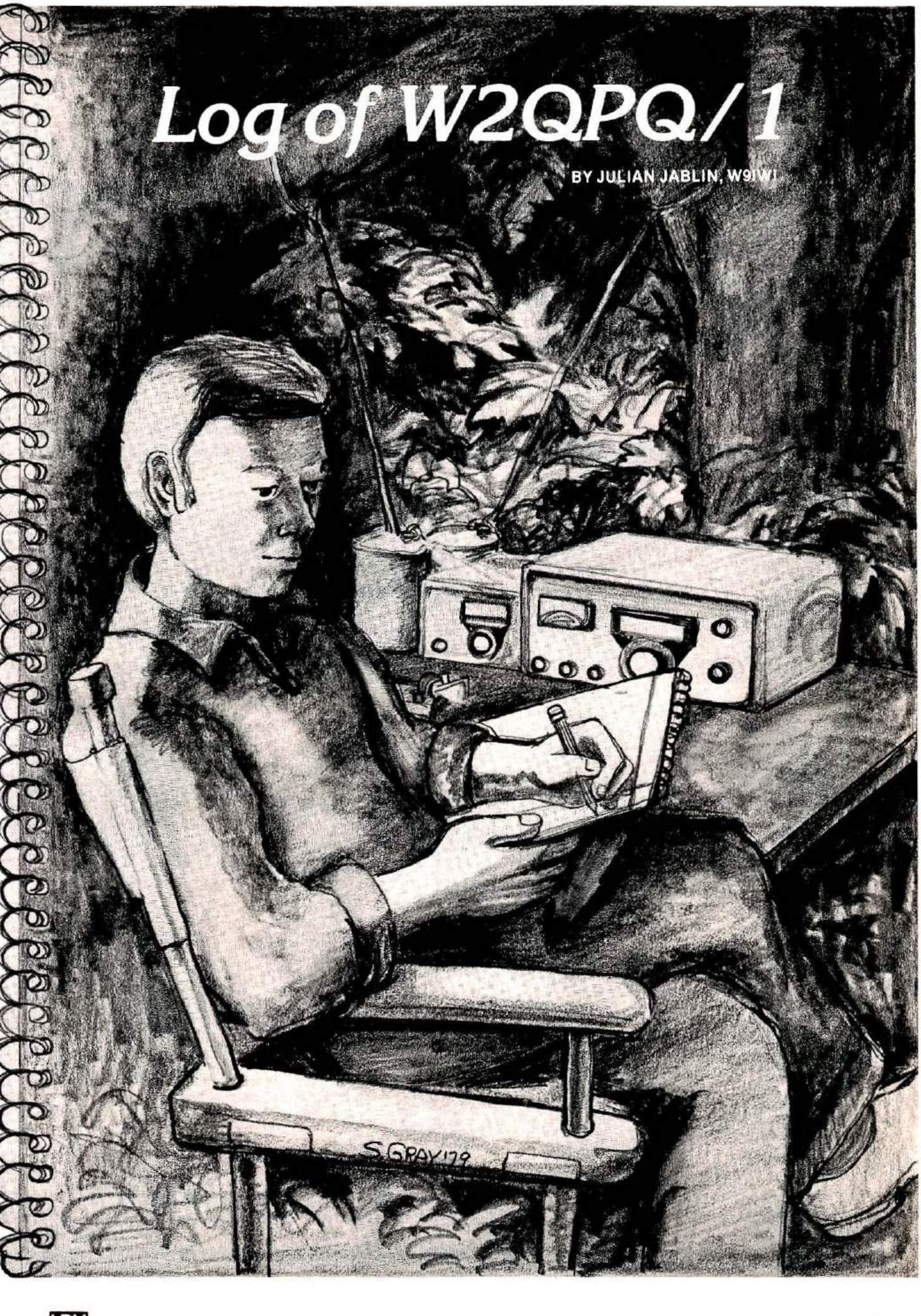
When the wiring has been completed and checked, connect the two units with a length of coax and make sure that the relay contacts energize the proper antenna coax connectors. This can be done by listening for the relay clicks as the selector switch is rotated, or by using an ohmmeter to determine if the antenna connectors are disconnected from ground when activated. Occasionally, the relay contacts may be sticky and not close properly. If this should happen, disconnect the control unit and apply 12-18 Vac from a transformer secondary directly across the input coax (or terminal) on the remote switch for a few seconds. Normal contact-cleaning procedures can be used if the relays are not sealed.

If you plan to use a Transmatch or Matchbox, it should be located before the control unit. Many matching circuits do not have dc continuity between their input and output terminals and would prevent the control voltage from reaching the remote switch. Experience indicates that for an SWR bridge or wattmeter to function properly, it should be placed before the control unit (refer to **Fig. 2**). Before mounting the switch outdoors, the enclosure should be well sealed along mating edges and corners to keep moisture out. Silicone sealant, such as used for bathtub caulking, seems to be ideal for this application and is available in small tubes from hardware and discount houses.

Finally, I should point out that the remote switch allows some amount of convenience in disconnecting the rigs from the transmission line that enters the house, since only one is present. This also implies that only one Blitzbug (or equivalent) need be purchased. **HRH**

Log of W2QPQ/1

BY JULIAN JABLIN, W9IWI



July 6, 0100Z — W2QPQ/1 set up at Pine Mountain State Park, Vermont. Transmitter final input, 2 watts; receiver, direct conversion; antenna, long wire; frequency, 40-meter band.

What kind of vacation can it be when you take along a child not yet two-years old — even to a cabin in the woods? Just as she does at home, Helen will be cooking and making beds, and we will take along enough disposable diapers to fill the back of the station wagon. You can't imagine all the things that she thought were necessary. But when she saw my little ham rig she objected. Helen: "You're not taking an Amateur Radio, are you?" Me: Stony silence, meaning that I darned well am. Helen: "When will you get a chance to use it?" Me: "I'll have plenty of time. Gary takes a nap every afternoon, so we'll be tied down to the cabin then. What about after supper . . . where can we go in the evening? And how much reading can you do?" Final compromise: I will operate only during his nap and an hour after supper.

July 6, 0230Z — No contacts.

We did not see the cabin before we signed up for it. "Pine Mountain" sounded good. I visualized a place miles from any source of QRM, and Vermont is pretty. The cabin had all the conveniences — outside! No electricity. That gave me the idea of taking along a low-powered rig. Some quick arithmetic convinced me that a couple of lantern batteries would last the whole two weeks if I did not transmit too much. The transmitter-receiver, plus an electronic keyer, a hundred feet of No. 18 wire, and a spool of 22-pound-test nylon fishing line, an antenna tuner, plus phones, and there was my station. After we arrived at the cabin (it *was* pretty) I found a couple of trees about 75 feet apart, heaved the fishing line into them, tied on the antenna wire, and I was in business. But, no contacts. Strange — there should be a lot of guys looking for Vermont!

July 7, 1900Z — Still no contacts. July 8, 0238Z — W3SPA — Baltimore — Jerry — my RST 559, his RST 599.

First contact. So I am getting out, anyway. Jerry is running 200 watts to a pair of 6146s (good luck!) in a rig he built himself. I guess if you want a real CW-only rig these days you have to homebrew it. We were having a good QSO when someone with a gallon* opened up on top of me and wiped me out. That's what happens with a low-powered rig, and you learn to accept it.

July 10, 1945Z — VE2AAV — Ontario — Ted — my RST 589, his RST 599.

Ted is a radio maintenance man at an RCAF base somewhere in Ontario. We had a long rag-chew, mostly without QRM, about vacations and fishing. He is planning to go on leave next month. Maybe I ought to investigate the fishing while I'm here. Ted says that I could learn to fly-cast without much trouble, and he's really enthusiastic about it. I told him about open-party-boat fishing on Long Island Sound; they don't have anything like that where he is. We signed when his lunch hour was over — that's when he operates. Wonder how he handles a key and a sandwich at the same time! We made a sked for tomorrow . . . same time, same frequency.

July 12, 0200Z — WB8SDD — Oberon, Ohio — Peter — my RST 599, his RST 569.

Today I helped a Boy Scout show off his ham station. Peter is at Scout camp near Cleveland, and he is running about the same kind of operation that I am here, except that today he had a bunch of would-be hams watching him make contacts, and I had to say hello to Tommy, and Lou, and Harry, and all the rest, all of which Peter translated from Morse into English. He built his rig from a kit — part of his Radio Merit Badge requirement — and it sounded pretty good. We both wondered why his 35-watt signal was weaker than my two watts — must be conditions. Food at camp is awful; he did a three-day hike with only the bare necessities to get along in the woods; his parents cannot understand why he does not write longer letters; they have something called "Middle School" before Junior High where he comes from. You learn all sorts of things on the Novice portion of the band!

July 14, 1935Z — No contacts. July 15, 0200Z — No contacts.

It pays to check things out every once in a while. And, like Peter, my Boy Scout contact of the other day, I should learn to be prepared. The reason for all those "no contacts" was no antenna. Coming out of the cabin this morning, I happened to look up and noticed that the antenna wire had broken off

*Gallon = big signal; a kilowatt transmitter.

just where it was tied to the nylon line. The feeder portion had stuck in the tree, and I was putting power into about 25 feet of wire slanting up into the branches. I got everything down and — of course — had not brought a soldering iron along. A trip to the Park Superintendent's maintenance shop took care of that. When the antenna went up again, it was cut a little closer to a half-wave at 40 meters. It was all completed in time for my regular schedule with Ted. He suggested a lightweight rechargeable soldering iron, plus a few simple tools, if I ever do this kind of trip again.

July 16, 2040Z WD4GHY — Ft. Lauderdale, Florida — Bob — my RST 569, his RST 589.

Sometimes CW can lead to a little mix-up, or maybe people hear what they want to, not what you say. Bob is retired, used to live in Bay City, Michigan. Some retirement! He's busier than ever before, working on his boat, his house, and his rig. Then he asked me how old I am and what I do for a living. Maybe he got the figures all mixed up, or maybe my keying is not all that perfect. Anyway, he somehow got the idea that I am well along toward retirement myself, and began boosting Florida. "Give it some thought, Steve . . . you'll be down here with us having a ball in a few years!" Just then, Gary woke up, squalling to be changed, and I had to QRT — Helen tells me a father should have a hand in *every* aspect of child-rearing. So I told Bob that I had to go, but did not tell him why. It would have involved too many explanations!

July 17, 1950Z — VE1PB — Halifax, Nova Scotia — Burt — my RST 559, his RST 589.

Right after signing with Ted I worked another Canadian. When we had gone through the opening amenities, Burt asked me what I do, and I told him. Seems that he sells the same kind of stuff in the area around Halifax, and he kept asking questions about the specific lines I handle, and what's good about them. It sounded as though he might want to change manufacturers, and was looking for some unbiased information. I was a little worried about the trend the QSO was taking — where's the line between social conversation and business in a situation like this? So I suggested that we continue by mail after I got back home. I just wonder if — along with the other QSLs I expect to find when I return — there will be one from the Friendly Candy Company.*

July 17, 2350Z — KZ5HC — Canal zone — Frank — my RST 339, his RST 599.

Wow! This is a record, for me, for miles per watt! I'll have to check in an atlas just how long a haul it was. It was a very brief contact; Frank had a phone-patch sked on for 2400Z and was spending a few moments in the CW portion of the band, just listening, when he heard my CQ. That was lucky — with low power you do not usually call CQ. It pays off better to listen and answer someone who's calling. We used most of the time just to get the calls, RST and QTH information exchanged. My signal must have been very bad down there, and he had a lot of patience. That's what makes a good operator. I'll have to add a special "thank you" on my QSL to him.

July 18, 1830Z — W1LRP — Stacey, New Hampshire — Dan — RST 599 both ways.

*The FCC, Federal Communications Commission.

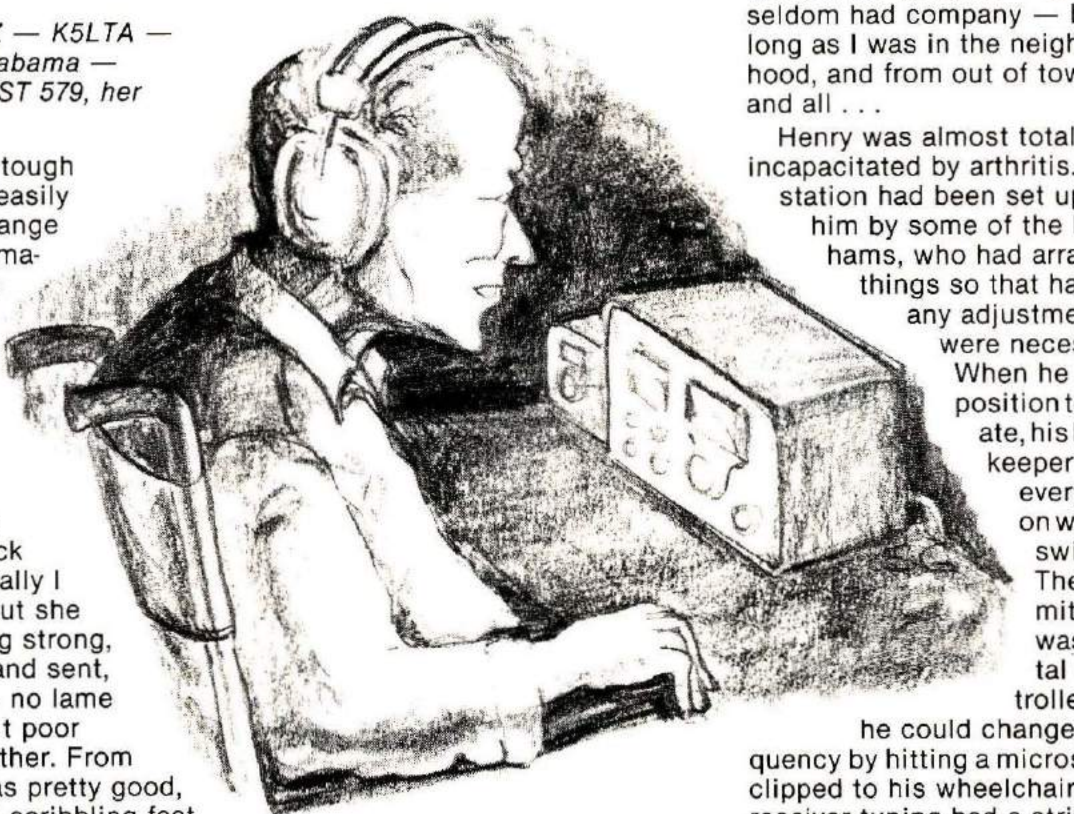
Real DX. There cannot have been more than 120 km (75 miles) between us. But it was a fun contact; you take the locals with the exotic ones and enjoy them all. When Dan told me that he is a farmer, I joked and asked, "Antenna farmer?" Well, whatever else he grows, he sure grows antennas! I'd like to see his 40-meter rhombic — three wavelengths on a leg!

July 18, 1910Z — K5LTA — Huntsville, Alabama — Ruth — my RST 579, her RST 599.

That was a tough QSO. Started easily enough, exchange of basic information, then she began to warm up the key. Well, I stuck with it for a while, and we were really moving the Morse back and forth. Finally I peaked out, but she was still going strong, so I gave up and sent, "Pse QRS" — no lame excuses about poor readability, either. From there on it was pretty good, but I was still scribbling fast. She did say that she was rag-chewing only as a break from handling traffic. Somewhere along the line Helen heard me muttering, and looked over my shoulder at the scratch pad on which I was making notes. Then she said nastily, "What's the matter, honey, a woman too much for you?"

July 19, 2100Z — W1CAF — Altonville, Vermont — Henry — my RST 599, his RST 599.

I figured that this would be the last contact. We were to leave for home tomorrow, and there would be a lot of packing to do. Helen has been very good about the fact that my one-hour hamming periods have stretched well beyond our agreed time, and I wanted to give her as much help as possible in getting ready for the trip back. At any rate, I tuned around and there was a terrifically loud signal, a good note, but the worst CW I'd ever heard — slow, with uneven dots and dashes and some long pauses. I called him and after a bit he came back to me. He was in Altonville, about



five miles down into the valley. It's a big town (or a small city) where we had done some shopping and one night saw an outdoor movie while Gary was asleep in the back seat. Henry said that he'd heard me on but had not called me before this.

After some talk, I invited Henry up to the park to see our cabin and my rig, but he said that he couldn't. Then I told him that I had to go to Altonville to buy some disposable diapers for the trip home, and that I could stop in to say hello to him in person. A long pause, then he said okay, and gave me his address.

It was a big old frame house, and I could see the 40-meter dipole strung from the eaves to a tree in the back yard. A woman let me in and said that Henry was in back. I went to an enclosed back porch and saw a little old man in a wheel chair, hunched up in front of a rig. The rear was arranged in a semi-circle so that he could reach almost everything without moving very much. After inviting me to sit down, he told me that he had not really wanted me to come — he seldom had company — but as long as I was in the neighborhood, and from out of town and all . . .

Henry was almost totally incapacitated by arthritis. His station had been set up for him by some of the local hams, who had arranged things so that hardly any adjustments were necessary. When he was in position to operate, his housekeeper turned everything on with one switch. The transmitter was crystal controlled, and he could change frequency by hitting a microswitch clipped to his wheelchair. The receiver tuning had a string drive which came out to a big wheel near his less-crippled hand. He keyed the transmitter by *blowing* on the cone of a little speaker which was in a sort of VOX circuit, which his buddies had also worked out and installed. No wonder his CW was slow and uneven!

We talked for a while, then I remembered Helen waiting for me in the cabin, so I said so long and left. When I got back to Pine Mountain, before I unplugged everything, I gave Henry a call and sent "73" several times. No answer, but perhaps he was listening.

July 19, 2350Z — W2QPQ/1, Pine Mountain State Park, Vermont, closed station.

HRH

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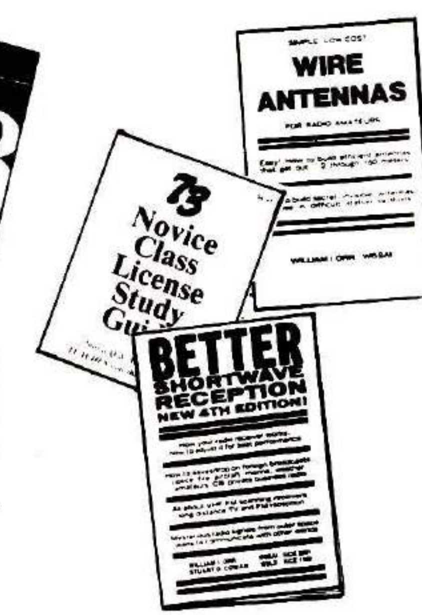

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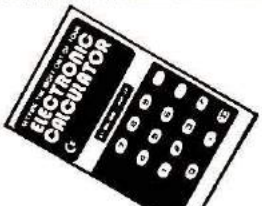

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The Delta-Loop Antenna Rides Again

BY HARRY LEEMING, G3LLL

After I moved to a new location in November, 1976, my thoughts turned to antennas. At that time the only band offering a chance of trans-atlantic QSOs was 20 meters. A beam was considered essential if contacts were to be at all pleasurable.

After much thought and consideration I decided to try a delta-loop beam, and after some trial and error this resulted in the inverted-V, two-element delta loop described in *Ham Radio Horizons* for June, 1978.

The delta loop is really an out-of-shape quad and seems to retain the quad's qualities. Like the quad, it is famed for good results when mounted at modest heights, and this is usually attributed to a low angle of radiation. Perhaps this is true, but vhf tests do not seem particularly convincing. There may be other reasons. Perhaps the loop construction results in a "contained field" with less signal lost in nearby objects. Loops are certainly quiet on receive, and it would seem sensible that an antenna which picks up less interference from local electrical wiring in the receive mode also wastes less rf on transmit by not pumping it into the same wiring. Certainly loop antennas do seem to produce fewer RFI problems and more DX, and, after all, that is what most of us want. Theoretical arguments aside, to me even a one-element delta loop seems to be at least an S-unit ahead of the most carefully trimmed and oriented multi-band dipole.

To return to the story — after having used the 20-meter, two-element delta loop for a few months, the sun broke out in spots, and 15 meters opened. I temporarily interlaced a 15-meter driven element inside the 20-meter-element. This made a very satisfactory antenna, but, like Oliver Twist, I still wanted more. Next, a reflector was put in place. This gave me some gain toward the U.S. By this time winter was approaching and antenna activity for the next few months was confined to putting things back every time they blew down!

The new loop

With the advent of spring 1978, the delta loop was long overdue for rebuilding, and to ensure future reliability I decided to completely dismantle it and start again. Previous rough measurements had seemed to indicate that the length of wire required was somewhat more than that normally used for quad loops. Therefore, I decided to make more accurate measurements so as to help anyone who wished to duplicate the antenna. The previous construction was of No. 22 AWG (0.6-mm) wire for the loops, but this could not withstand storms. I selected copper/nylon braid for the new antenna because of its strength. This brought a bonus in that it proved to have much less tendency to "whistle" in strong winds.

I then decided to make the antenna cover the three main long-distance bands, and first of all the driven elements were installed and experimentally altered in length until they were resonant in the center of the three bands. The required length of copper/nylon braid varied, depending upon the shape of the antenna, but the eventual shapes and lengths that proved satisfactory are indicated in **Fig. 1**. No measurements of impedance were made, but various handbooks would lead one to expect that the impedance of the driven element operated on its own would be somewhere in the region of 100-150 ohms. This seems to be the case, as feeding the driven element directly with 75-ohm coaxial cable results in an SWR of between 1.5 and 2 to 1.

At the time that I was rebuilding the antenna, a friend, G4GCT, was experimenting with various designs of balun transformer, and measurements of their loss were made. Some samples showed a slight loss, and this loss increased when they were encapsulated. For comparison purposes an expensive commercial balun was obtained and was found to be surprisingly inferior to most of the home-brewed samples, giving a loss of almost 1 dB. This may not seem like much, but losses add up, and even 1 dB brings the output of a 200-watt transmitter down by 30 watts or so. Give the same inattention to two other lossy points and you are down to half power.

Being in the hi-fi trade, I have long since proven the extreme efficiency of ferrite cores in stopping rf from flowing on the surface of leads entering hi-fi amplifiers. A quick check with a dummy load fed with a length of coaxial cable wrapped round a ferrite core showed no loss of power or increase of SWR, and so, while good results had been obtained without a balun of any kind, I decided to install a ferrite-core, choke-type balun. The coaxial cable was disconnected from the antenna, wrapped six times round two 38-mm (1½-inch) stacked cores, and reconnected to the antenna. It works! Previously, I had been able to hear a distorted version of my voice in the headphones while transmitting on my FT-101. The balun cured this, so it obviously has stopped rf from coming down the outside of the coaxial feeder. It seems, therefore, that a couple of 50-cent cores will do all that a $20 balun will, except give a 1 dB loss!

Being eager to get back on the air, I used the antenna in its one-element form (firing east/west) for some weeks. Very good results were obtained, and I wondered how I could retain this feature, and yet have a good front-to-back ratio and gain toward the U.S. when I wanted it. A note in the Radio Society of Great Britain's booklet *Amateur Radio Techniques* referred to a solution advocated by W6AJZ. Why not bring the reflector adjustment into the shack? W6AJZ's method is shown in **Fig. 2**. A

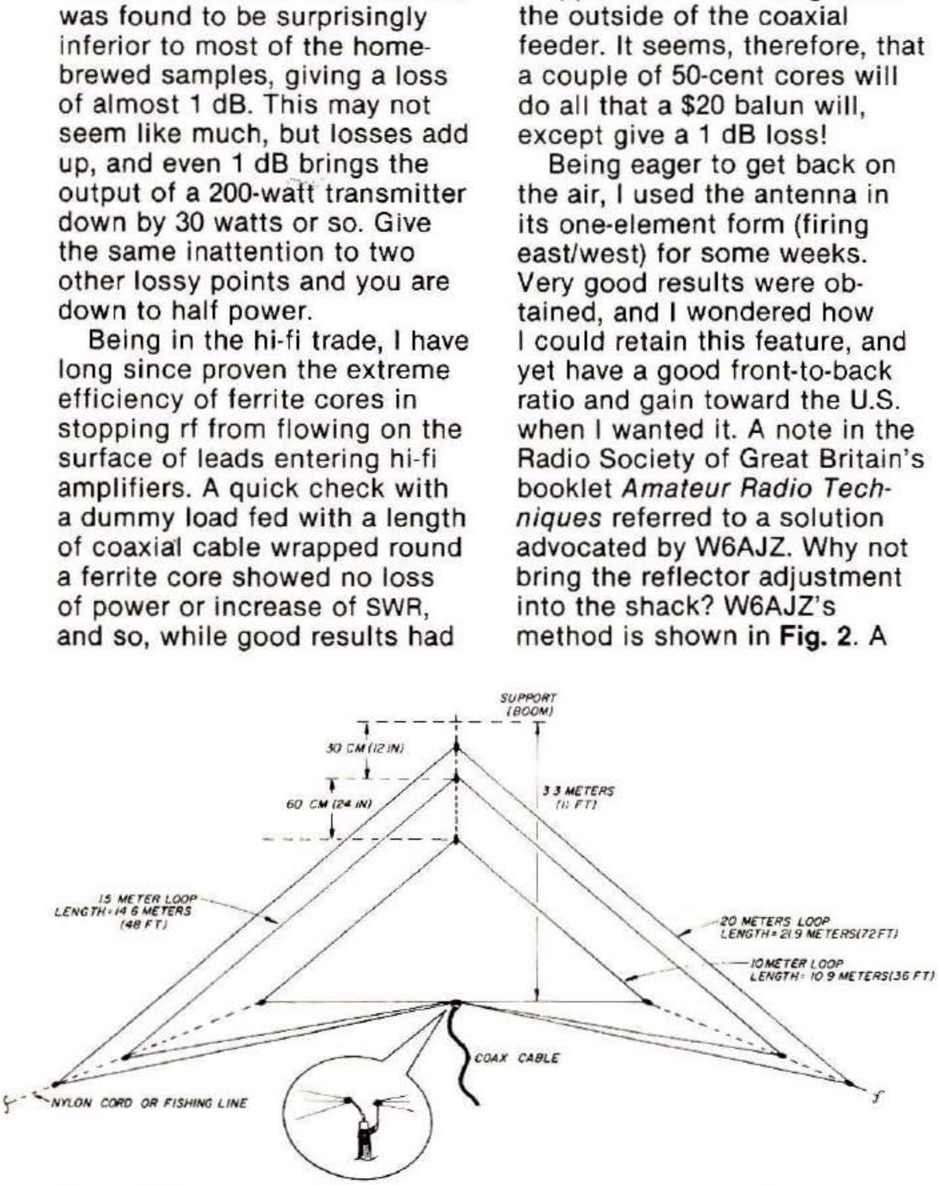


Fig. 1. Dimensions and mounting details for the driven elements of the delta-loop antenna. Loops of the same size can be used for reflector or detector if fed with twin-lead transmission line as described in the text. Nylon cord or fishing line is used to support the tops of the loops and to pull the bottom corners out to position. Lengths given for the loops are total length of wire around the loop.

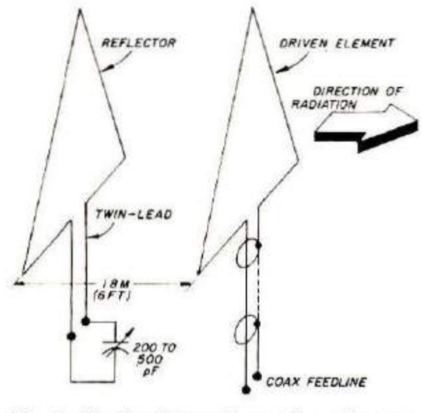


Fig. 2. The basic configuration of a two-element delta-loop beam. The tuning capacitor adjusts the reflector to resonance for best gain and directivity of the beam. It can be located in the shack at the end of twin-lead feeder which is a multiple of a half-wavelength, as discussed in the text.

length of transmission line runs from the center of the reflector to the operating position. If this line is electrically an exact number of half wavelength long, it effectively brings the center of the reflector into the shack so that adjustments can be carried out in comfort.

A second 20-meter element was slung from the fm broadcast antenna which is mounted on top of the mast. It was positioned so that at the bottom it was around 3 meters (10 feet) from the driven element. One electrical wavelength (approximately 17 meters, or 58 feet, allowing for the velocity factor) of 300-ohm ribbon feeder was connected to this element at the center, the other end being brought down to the operating position. A one-turn loop was connected to the end of the 300-ohm feeder to allow checking with a grid-dip meter. The element proved to be resonant at 14.2 MHz. Short extra lengths of 300-ohm feeder were added until resonance fell to 13.8 MHz, and a 500-pF variable capacitor was then connected in place of the loop as shown in **Fig. 2**. This allowed the resonant frequency to be altered.

This was it — would it work? Well, yes and no! A gain toward the U.S. of about one element. The SWR was found to be almost completely unaffected by the tuning of the reflector, and so my conclusion was that the delta loops were spacings of around 2.4 to 3.6 meters (8 to 12 feet) and it is not clear just why such close spacing is needed for the best results with my delta loop.

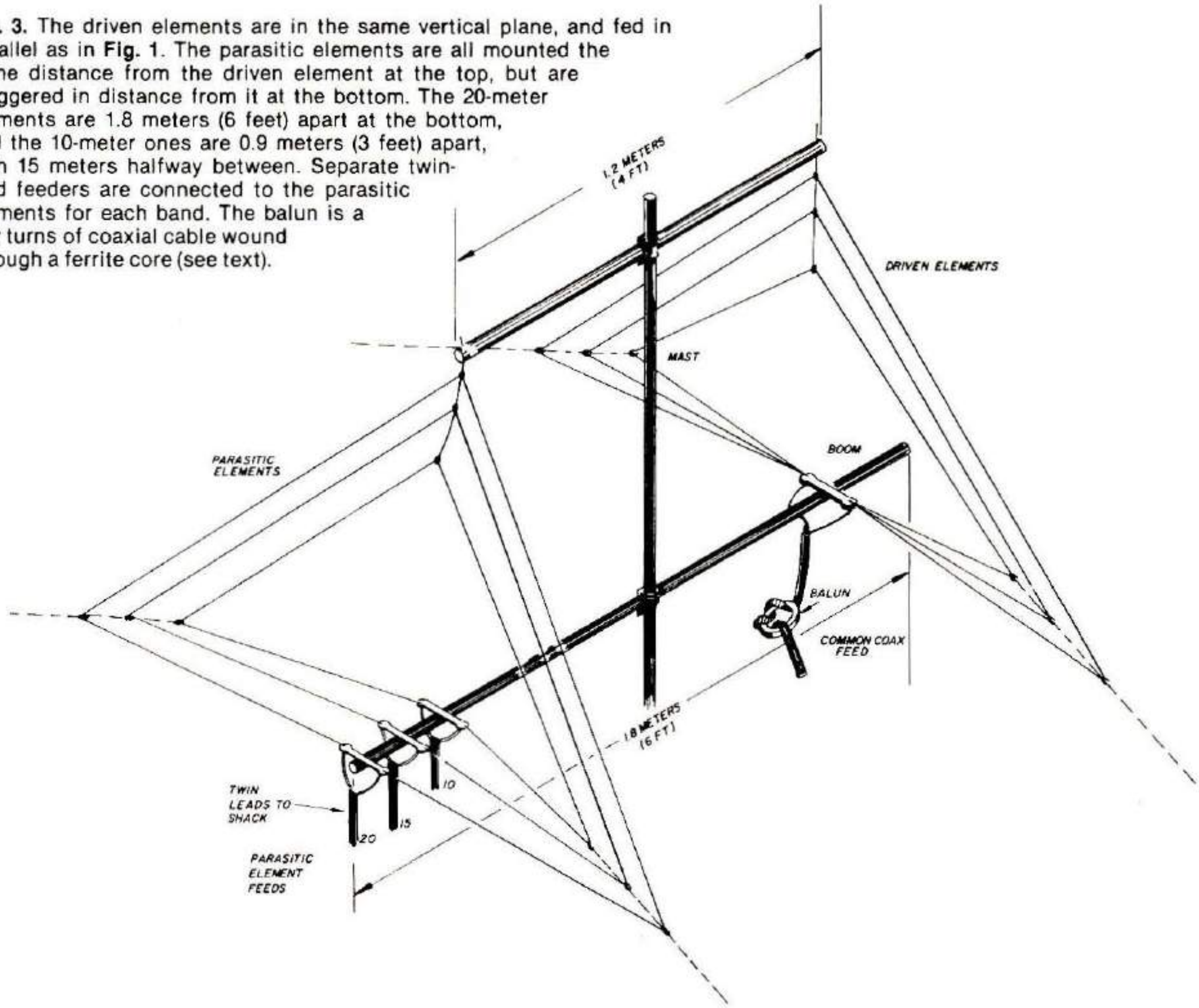


Fig. 3. The driven elements are in the same vertical plane, and fed in parallel as in **Fig. 1**. The parasitic elements are all mounted the same distance from the driven element at the top, but are staggered in distance from it at the bottom. The 20-meter elements are 1.8 meters (6 feet) apart at the bottom, and the 10-meter ones are 0.9 meters (3 feet) apart, with 15 meters halfway between. Separate twin-lead feeders are connected to the parasitic elements for each band. The balun is a few turns of coaxial cable wound through a ferrite core (see text).

S-unit (over the delta loop on its own) occurred when the capacitor was set at anything above about 50 pF or so. The front-to-back ratio was very poor, adjustment of the capacitor was very broad, and the tuning very flat. Attempts to tune the reflector to act as a director were disappointing and produced no gain or front-to-back ratio at all.

At this point I decided to recheck the standing wave ratio, because adjustment of a parasitic element should normally have quite an effect on the impedance of the driven element...

too widely spaced. This was indeed the case, and, upon reducing the spacing to 1.8 meters (6 feet), things really started working. The front-to-back ratio increased dramatically. By altering the length of the feeder cable slightly and tuning the variable capacitor, I was able to fire the beam east or west, although with somewhat less gain when the reflector was tuned as a director. The SWR was also quite sensitive to the tuning and could be brought down to around 1 to 1.

Normal quads and delta loops for 20 meters use

Perhaps the following points are worth thinking about, however:

1. Most measurements of quads and delta loops are made on vhf scale models which are mounted several wavelengths in the clear; the presence of the roof could be affecting results.
2. The thickness-to-length ratio of the vhf antenna elements is likely to be very much different from that of a high-frequency antenna even if wire, rather than tubular elements, is used.

3. Having the tuning control in the shack enables instant reversals to be made, and hence the merits or faults of the antenna are more readily noticed. A spacing of 1.8 meters (6 feet) gave the best results, so whatever the textbooks say, and whatever the reason, this it remains!

Next, a 15-meter reflector was added and connected to the same 300-ohm feeder, which, on 15 meters, was 1½ wavelengths long. This was not a success, and while slight gain and front-to-back ratio resulted, the tuning was poor and indecisive. Also, 20-meter operation suffered. Hence, it was found necessary to use a separate 300-ohm feed for each band.

The final design

Ideally, the elements should be spaced at 0.9, 1.3, and 1.8 meters (3, 4, 5, and 6 feet) respectively, at the top as well as the bottom, but the arrangement shown in **Fig. 3** is mechanically convenient and works well. The feeder from the driven element can be any good quality 75- or 50-ohm twin or coaxial feeder. The feeder from the reflector should be open wire or TV-type ladder feeder, but 300-ohm ribbon works quite well unless you reside in a very damp climate. Be sure that the parasitic-elements feeder is kept well away from any metal objects, and, if possible, mount it on stand-off insulators. The electrical length of a half wavelength is approximately 5½, 7, and 11 meters (18, 24, and 36 feet) on the three bands, and open wire or ladder feeder should be cut to a multiple of this: for instance, 21.9 meters (72 feet), which equals 2 × 36, 3 × 24, and 4 × 18 feet. This is a suitable length for all bands. 300-ohm ribbon feeder has a velocity factor of around 0.8, and so a length of about 17.6 meters (58 feet) is suitable. When you have decided on the length of parasitic feeder, add about 1.2 meters (4 feet) to the 20-meter feeder, 0.9 meter (3-feet) to the 15-meter feeder, and 0.6 meter (2 feet) to the 10-meter feeder, so as to bring the element and feeder resonant as a reflector when the tuning capacitor is set at maximum.

Trying it out

First of all, test the driven element by measuring the SWR. If the elements have previously been trimmed and adjusted by a grid-dip meter the SWR should measure around 2 to 1.* The SWR will vary somewhat as you tune across the band, but if it goes above 3 to 1 and is much worse at one end of the band than the other, it will be necessary to adjust the length of the driven element to even out the response.

Once you have the driven elements working, install the parasitic elements. For convenience of construction, parasitic elements can be made the same size as the driven element, there being no need to adjust it exactly to frequency, as this will be done later from the operating position.

Next, bring all the feeders into the shack, and put one-turn loops on the end of the tuned feeders going to the three parasitic elements. Check, with a grid-dip meter, the resonant frequencies of the parasitic elements plus tuned feeders. There will be quite a number of resonant points, but main resonances should occur approximately 100-200 kHz below the lower end of each of the bands. If necessary, adjust the length of the open wire feeder until this occurs. Note that grid-dip meters are not usually accurately calibrated, and so the frequency should be checked against a frequency meter, or monitored on an accurately calibrated receiver.

*Connect a one-turn coil instead of the feeder to measure resonant frequency. You can only do this on the roof; you cannot grid-dip the driven element frequency at the end of the feeder.

Having done all this you are in business. Leave the coils in place and you have a three-band beam which will give good results in your favored direction. Disconnect the loops and wire in a variable capacitor of approximately 500 pF maxivum, and the beam becomes reversible. If you measure the SWR you should find that maximum forward gain and front-to-back ratio, with the parasitic element acting as a reflector, occurs with the variable capacitor set very slightly toward the maximum capacitance side from that which gives minimum SWR. Maximum forward gain in the opposite direction occurs with the capacitor near minimum, and in my case results in an SWR of about 1.75 to 1.

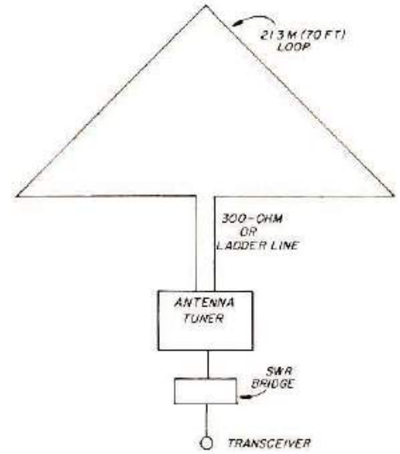


Fig. 4. A single loop can be made to work on three bands and fed with one feedline if you use a tuner and open wire line. It also works to some extent on 40 meters. It's a good substitute for a trap dipole.

Front-to-back ratio is about 3 or 4 S-units on local groundwave stations, and on stations several thousand miles away. The gain under these conditions is 1½ to 2 S-units when operating a director. Directivity on stations less than a thousand miles away varies greatly with conditions, and can be as good as that indicated above or almost non-existent if reception is by high angle radiation. This fact of life applies to all beams.

A simple version

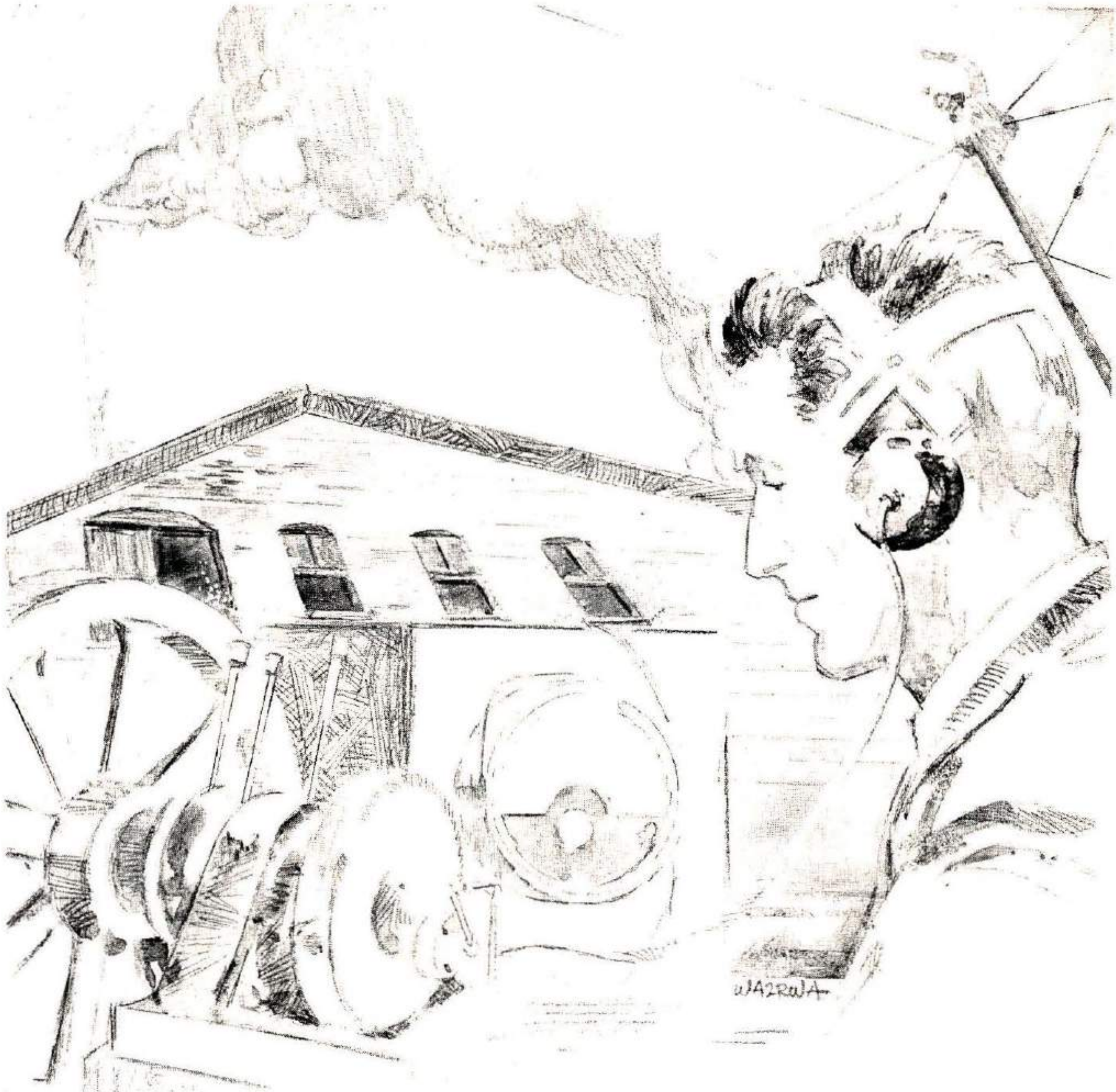
During construction and testing of this antenna, the effect of using one 20-meter element as a multiband delta loop on 10, 15, and 20 meters was tried; it proved most effective. Directivity on 20 and 15 meters is the typical figure-eight pattern while as far as could be ascertained, good results on 10-meters short skip in all directions occurred. This arrangement is shown in **Fig. 4**, and can be highly recommended to anyone wanting good results for minimum effort.

Final notes

Signal fading makes it almost impossible to evaluate antennas over long paths by the usual method of making contact and asking for reports. If you doubt this, ask any station for comparative reports between "my old antenna" and "my new antenna," giving them two transmissions on the same antenna. Most stations will tell you that "the new antenna" is better — if you don't believe me, try it!

Resonant antennas should perform exactly the same whether receiving or transmitting, and should give the same gain in either mode. Comparative tests with antennas should be done in the receive mode, as this enables the test to be repeated and comparisons made with many stations. Tests carried out with only one or two stations can produce misleading results, as it is the average results that really matter and not what happens with a particular station under a particular set of conditions. Only after months of operations do the full merits of an antenna become clear — I can only say that I am delighted with the low-cost, reversible delta loop. If you hear me, give me a shout. **HRH**

More details? Ad Check page 78.



Tales of Old Wireless

BY ALAN S. DOUGLAS

Author's preface: This is really Harold Mansfield's story. I've known Harold Mansfield about eight years, just a fraction of the time he's been involved in radio. Harold has a wealth of stories to tell, and I decided to set down on paper a few of them — stories that have historical interest and capture the flavor of days when hams roamed the airwaves unlicensed.

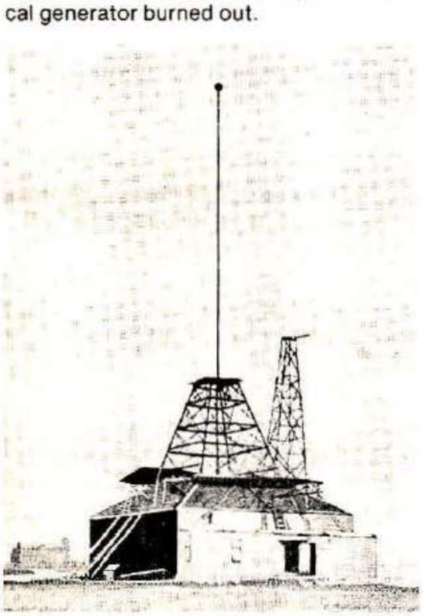
Harold Mansfield's Story

Many have heard the account of Nikola Tesla causing the Colorado power station to be shut down by drawing too much power for his experiments.* On a smaller scale, I once did nearly the same thing in Plymouth, Massachusetts. After 1910 I worked for the Plymouth Electric Light Company, whose plant was on Leyden Street on the waterfront (the buildings were removed in 1920 for the Tercentenary celebration to "improve the atmosphere" of Plymouth's oldest and most historic street). I was in high school and worked from 2 to 9 PM testing meters in a room above the stock room, across the street from the main plant. After the regular repairmen went home for the evening, I was also on call to repair street lamps and such.

An early ham station

A friend akd I had often snooped around the Brant Rock wireless station a few miles away, where the most advanced work was going on in those days. By watching through an open door with a telescope, we had discovered the rotary spark gap responsible for the high-pitched tone characteristic of this station.

Nikola Tesla's electrical observatory in Colorado in 1899. The setup was used to test a huge Tesla coil. Power drain on local facilities was too much; the electrical generator burned out.



The Plymouth, Massachusetts, power station as it appeared between 1910 and 1920.

I had my own wireless station above the electric company's stockroom. Through friendship with Spink Donlavy, the Brant Rock tower man, I obtained a 2-kW General Electric open-core high-voltage transformer when the Plymouth test station was dismantled and the equipment was returned to Brant Rock in 1911. This monster stood two feet high and was enclosed in red fiber with insulators on top. I built a 20-tooth rotary spark gap, copied from a Clapp-Eastham design. The condenser† was made with ¼-inch glass plates salvaged from the base of the Brant Rock tower. These plates were two feet square. I cut them in half and cemented tinfoil to them with collodion, then I painted the outer edges with asphaltum to inhibit corona discharge.

*On July 3, 1899 the first full-power test of a gigantic Tesla coil, capable of throwing 100-foot lightning bolts, drew so much current that the generator at the power station burned out.

†For newcomers, a capacitor was called a "condenser" in the old days. Same horse with a different name. That's progress. **Editor**

The stockroom building was long and narrow, ideal for a six-wire flattop antenna above the roof. Energy for the stockroom lights was supplied by a husky pole transformer across the street in front of the power plant, so I had no fears of an inadequate power source for my 2-kW rig. (What I didn't know was that the same transformer supplied the Tirrill regulator that controlled the output voltage of the whole plant.) This regulator, beautifully built into a glass case, controlled the field current of two 360-kW alternators.

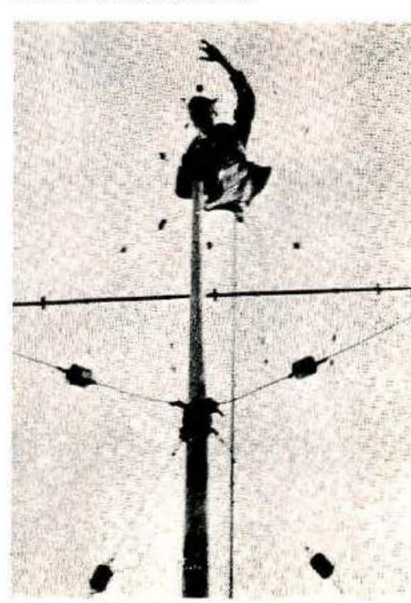
The moment of truth

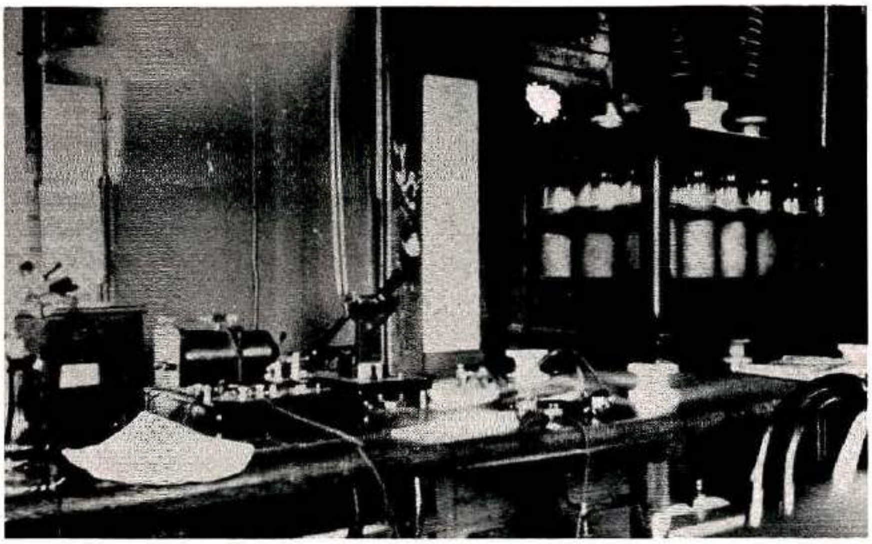
At 4 PM I made the last connection, turned on the rotary gap motor, and pressed the Massie key just once. When the lights nearly went out, I knew something was wrong. Moments later the downstairs door flew open and in burst the manager, Mr. Eugene Perry Rowell.

"What are you doin' up there? You almost shut down the town!"

A kickback (rf in the power line) had fused the Tirrill regulator contacts, and the

Rigger Donlavy atop one of the pipe masts supporting the flat-top portion of the Brant Rock antenna.





Mansfield's wireless station (*ca.* 1912). Equipment was constantly changing. At this point a bank of Leyden jars was used for rectifiers, which had been obtained from Walter Massie.

men said they'd never heard such a growling noise come from the alternators. It scared the daylights out of them.

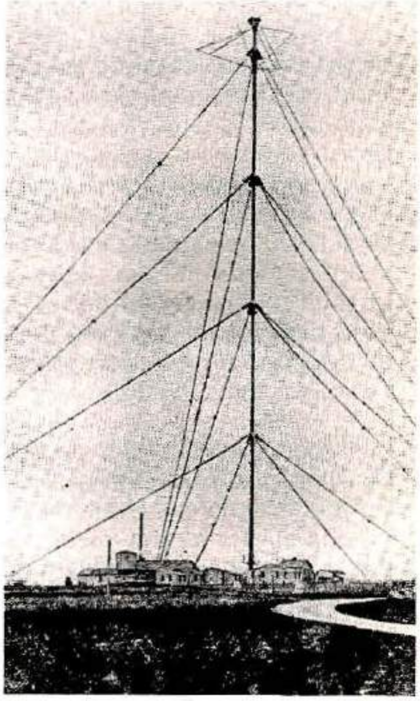
Said Mr. Rowell, "You clean this place out. There'll be no more wireless around here!" It's a good thing I'd been teaching his son electrical theory or I'd have been fired on the spot.

About that time (1912) a new radio law had been passed, which required licenses, and imposed limits on wavelength and power. The whole idea of licensing went against my grain, and I just let the matter drop.

A visit to an early manufacturer

The Massie Wireless Telegraph Company of Providence, Rhode Island, was active from 1905 to 1912, equipping the Fall River line and other passenger ships as well as Navy stations on the east and west coasts.

About 1911 I saw a Massie advertisement. Not knowing anything about them, but thinking it would be a fine place to buy a 25-cent resistor or some other part I needed, I took a train there one Saturday morning. I located the shop, on Market Square near the State House, on the second floor. I walked in and oh boy —



View of the antenna at the Fessenden wireless station at Brant Rock, near Plymouth, Massachusetts.

A 1906 Massie Oscillaphone detector, which was reconstructed from a few original parts in 1978. The actual detector is a sewing needle laid across two carbon knife edges. It was crude but workable, better than a coherer detector, and free from patent infringements. Crystal detectors had not yet been invented. Compare this with one of your solid-state diodes in your junkbox.

second heaven! Machine tools everywhere. Men working busily turning out Massie wireless sets. The whole room hummed with activity.

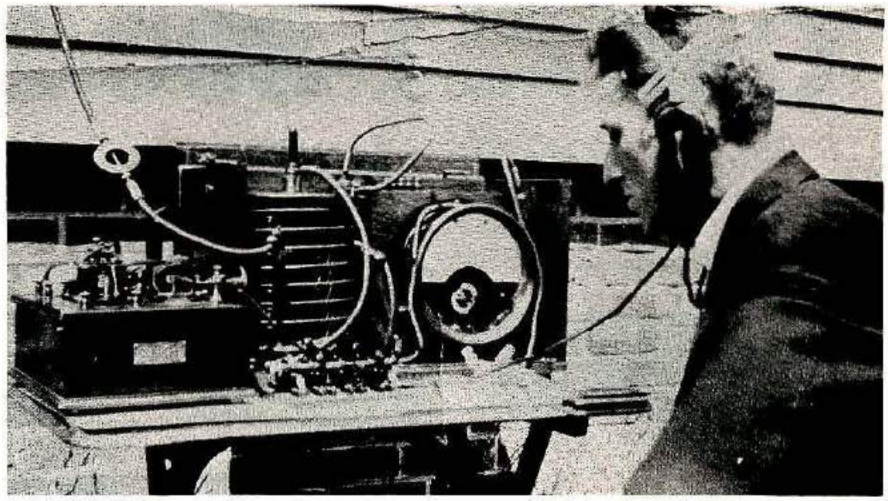
A nearby man looked up from his machine to see what had come in the door, then came over to find out what I wanted. I told him I came to buy a resistor (or whatever it was). He laughed and asked me what I wanted it for. We started talking about electricity and wireless. As we stood there I could see his eyes shifting, as if someone were behind me. I turned around and another man took over with more questions:

"Where did you learn all this wireless stuff?"

I told him there was a big station near me, the Fessenden station at Brant Rock, and I hung around the place. His eyes really lit up then and he began asking me more and more details about the Brant Rock operation for over an hour.

I thought this was an odd electrical store — *he* was asking *me* all the questions — and I still didn't have my resistor!

Come to find out, it was Walter W. Massie himself, and he was pumping me for information on his competitor! Well, from that time on the shop was mine — "Come in any time, stay as long as you want." Every Saturday for an entire summer I took the train to Providence.



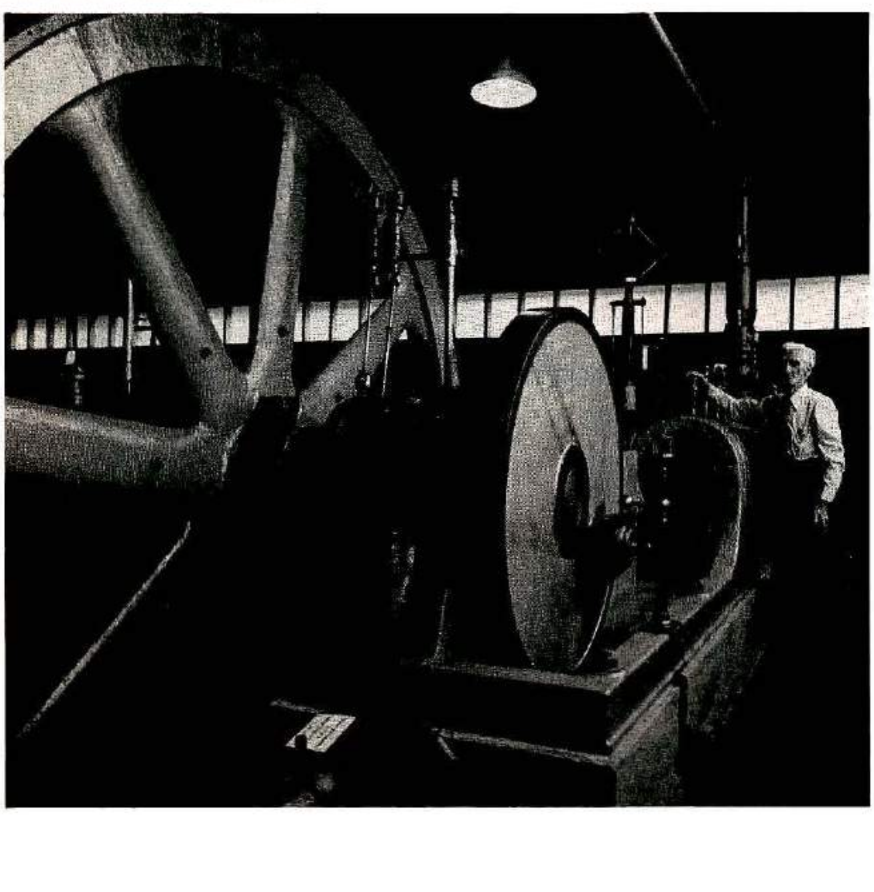
A Massie portable wireless set designed for the U.S. Army Signal Corps in the early 1900s.

One way to obtain equipment

Several months later I received a letter from Massie. He was selling out to the American Marconi Company, and if I wanted anything at all from the shop, he would give me a good price. I brought back a big truckload of stuff: keys, meters, Oscillaphone detector boxes and receivers, a Fleming Cymometer wavemeter, complete transmitters — even a box of Massie and Underhill wireless textbooks.

Most of this gear was later scrapped; some was resold through the years. One key, an antenna changeover switch, and a reconstructed detector box survive today. The ivory scale of the Fleming wavemeter went to the Smithsonian Institute in 1932, where, the last I heard, it rests under glass.

The Harris-Corliss steam engine, which powered electrical alternators, is located in the New England Wireless and Steam Museum, East Greenwich, Rhode Island. It is almost identical to the steam engines installed at Plymouth, Massachusetts, at the Brant Rock station around 1910.



The view from here

Climbing the Brant Rock tower was quite an experience. The tower was made of steel tubing with a ladder inside. It consisted of four 100-foot sections plus 20 feet at the top. A platform was installed every 100 feet where the guys attached.

The view from the top was spectacular, but no one was allowed near the place. Even after the station was abandoned in 1912, the grounds were patrolled by a watchman.

However, a friend and I sneaked in one Sunday when the watchman was elsewhere and made our way to the top. That was fine. But the watchman returned and we couldn't get down! We had to wait until dark. By then, the streetcars had stopped running and I had to walk 10 miles back to Plymouth. And it rained. And I got home at half past two in the morning. But what an experience!

HRH

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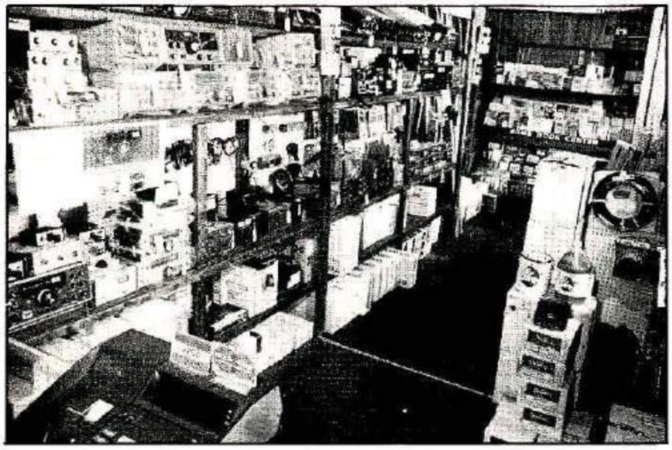

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POST BOX

Dear Horizons:

While thumbing through some back issues of *Ham Radio Horizons*, I decided to build up the one-transistor rig for 40 meters described in the April, 1978, issue.

After completing the breadboard arrangement, my first CQ raised a response from W4BFQ in Merritt Island (across the bay from Cape Canaveral). He reported RST 589! Next morning, out with the dawn patrol, I called W7LO and received a RST 549 from Phoenix, Arizona. That's my best DX. Other stations in south Florida are worked with ease. Instead of the 2N3553, I used the Motorola MPS-U05, which can be obtained from Heathkit. It is used in the Heathkit QRP rig, HW-7. Keep those little projects coming — they are what we "weekend engineers" need.

Phil Partee, W4ABI
Miami, Florida

Dear Horizons:

I'm pleased to advise you that three weeks ago I passed the Canadian ham radio operator exam, and my new call sign is VE7CSX.

Your magazine helped me a great deal in my studies — keep up the good work. I like *Ham Radio Horizons* because it is designed for us beginners.

G. Horvath, VE7CSX
Port Coquitlam, British Columbia

Dear Horizons:

I am writing this note to tell you just how great your Publishing Group is. I have been fighting for two years to get books for ham classes . . . this last six months I struck gold with you. Fast, prompt, and efficient service. Thank you.

Next, I want to thank you for running the ad for the Oak Hill Academy Radio session. I flew back there this summer, and returned to Germany in time to help four Novices upgrade in September. Mr. Carl Peters puts into two weeks what most clubs take two years to cover!

John C. Kaskell, DA1UY/KA1CZ

Dear Horizons:

I greatly enjoyed your article on how to be a lid; but unfortunately you missed two of my favorite lidisms.

How about the big-time experimenter who ties up some good DX station for 15 minutes while he twitches the switches on his speech processor and says "ah."

Also, how about the two yoyos, who, after finding that they each have 20-dB-over-9 signals when running barefoot, (low power), go right back to their 2 kWs.

I disagree with the author's premise that *all* "Q" signals belong on CW alone, since many of them have been there as long as "DX." It does, however, give me the dry heaves to hear some guy on ssb talking about warm "WX." 73rds.

Bill Robinson, W5QAR
Rockport, Texas

Thanks for your comments, Bill. We've received several letters about the "lidisms," some applauding us, some giving us the raspberry, but all interesting. From the tone of the letters it is obvious that ***A****, the authors only scratched the surface of lidisms,* ***B****, some people whose toes were stepped on have no sense of humor, and* ***C****, there are as many opinions about operating procedure as there are amateurs. Keep the Alka-Seltzer handy.* **Editor**

Dear Horizons:

To add to the article in October, 1978, *Ham Radio Horizons*, by K4QF about visiting hams, I would like to give some information for hams visiting Europe. In Europe we have ten repeater channels on two meters; R0 — R9 with input frequencies from 145.0 to 145.225 and output frequencies 145.6 to 145.825 MHz. Most European repeaters can be opened with a 1750 Hz audio tone. There are no private or closed repeaters in Europe, and there are no autopatches. In addition to repeaters, there is also much activity on simplex channels near 145.5. These are, (especially in Holland) 145.250, 145.275, 145.325, 145.350, 145.375, and 145.400 MHz. These are the channels where stations with a PD0 prefix are allowed to operate.

I hope this will be of some help to hams who wish to visit Europe.

Gabri Hoek, PE1CHF

Dear Horizons:

More thanks than there are frequencies go to a true ham, Jay Malay, WD8MET, who took a mixed group of people interested in radio and produced eight Novices. When the high school closed for summer vacation, before our educational session was over, Jay took this group of eight people into his home once a week. He also gave individual assistance at all times — his door was always open, which was the reason all got their licenses. Jay, true to his amateur status, would take no compensation as our instructor. He wanted us all to pass as his only reward, and we did!

Paul McFarland, KA8BXW
Allegan, Michigan

Dear Horizons:

I enjoy your magazine and without it I don't think I ever would have passed my test for my Novice license. I would like to get my father interested in ham radio. Would you please send me your information on becoming a ham for my father.

Also, if possible, would you please print an article on the construction of a 40-meter receiver. I'm building the 40-meter transmitter in your April 1978 issue. Keep up the good work.

Fred German IV, WA2OJU
Woodville, Alabama

We're glad to help your father become interested in Amateur Radio, Fred. Perhaps you have seen the 80/40-meter receiver in our February and March, 1979, issues, and the converter for higher bands in April. It was being designed when your letter arrived. Because of the variety of circuits involved in a receiver, there is no way to make one as simple (and effective) as the one-transistor transmitter, but I think author/designer Wildenhein did a great job in keeping it as plain as possible, yet obtaining great performance from it. Thanks for writing. **Editor**

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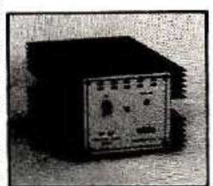

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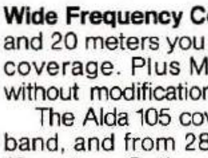

The PS-115 delivers 18 amps unregulated and requires 117v or 220v, 50/60 Hz input.

Mobile Power. The transceiver requires a nominal 13.8 volts dc input at 20 amps. When you operate mobile, just connect the transceiver directly to the battery.

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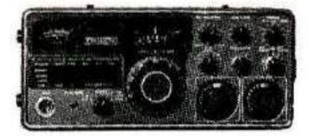

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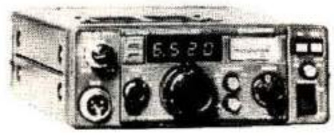

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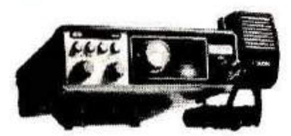

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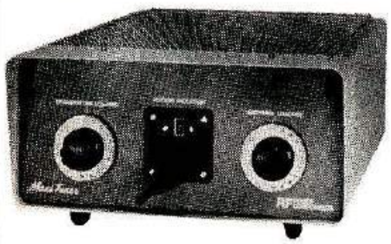

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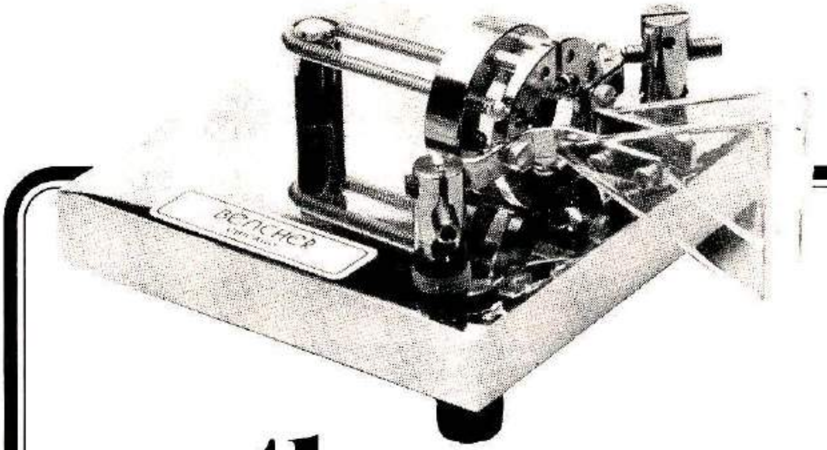

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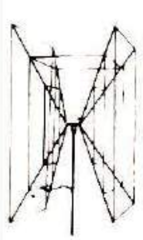

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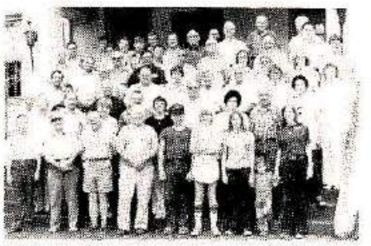

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MASSACHUSETTS: NoBARC Hamfest July 21, 22 at Cummington Fairgrounds. Tech talks, demonstrations and dealers. Flea market, $1.00; advance registration $3.00 single, with spouse $5.00 to Tom Hamilton, WA1VPX, 206 California Avenue, Pittsfield, Massachusetts 01201 or $4.00/$6.00 at gate. Mobile talk-in on 146.31/91. Gates open at 5:00 P.M. on Friday for free camping.

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WISCONSIN: CWRA Swapfest Picnic, June 3, 1979, Stevens Point. For info write W9BCC, Frank Guth, 1632 Ellis Street, Stevens Point, WI 54481.

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PENNSYLVANIA: Milton A.R.C. Hamfest, June 3, 1979 at the Allenwood Firemen's Fairgrounds, U.S. Route 15, four miles north of Interstate 80. Doors open 8 A.M. $2.50 advanced, $3 gate; children and spouses FREE. Flea market, auction, contests, portable/mobile FM clinic, prizes, food & beverages. Talk-in on 146.37/.97; 146.34/.94 repeaters and 146.52 simplex. Details from Kenneth Hering, WA3IJU, R.D.#1, Box 381, Allenwood, Pennsylvania 17810; Telephone (717) 538-9168.

MOBILE IGNITION SHIELDING provides more range with no noise. Bonding strap sale less than 50¢ each. Literature. Estes Engineering, 930 Marine Drive, Port Angeles, Wash. 98362.

ILLINOIS: Six Meter Club of Chicago presents the 22nd Annual ABC Hamfest, Sunday, June 10, 1979 at Santa Fe Park, 91st & Wolf Road, Willow Springs, Illinois. Registration $1.50 advance, $2 at gate. Features large swappers row, picnic grounds, plenty of parking, refreshments, pavillion displays, AFMARS meeting, color TV, etc. Advance tickets from Val Hellwig, K9ZWV, 3420 South 60th Court, Cicero, Illinois 60650. Talk-in on 146.94 or WR9ABC on 146.37/.97 (PL2A).

WANT UP-TO-DATE INFORMATION? "Radio-Hobbyist Newsletter" issued every two weeks. Only $5.00 per year! Guaranteed! ARC; Box 1171-G; Garland, Texas 75040.

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HAMFEST — Official ARRL 5th Annual Hall of Fame Hamfest, Stark County Fairgrounds, Canton, Ohio, Sunday, July 15. Mobile check in on 19-79 or 52-52. $2.50 advanced; $3.00 at gate. Contact WA8SHP, 10877 Hazelview Ave., Alliance, Ohio 44601.

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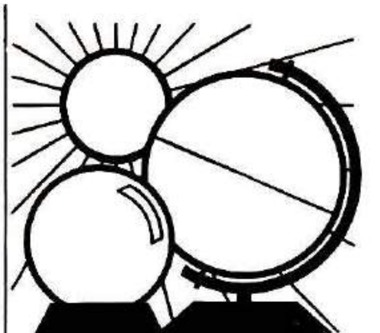

DX FORECASTER

The DX word this month is GOOD, with a mixed bag of opportunities in which DX activity is likely to be as prevalent on vhf as it is on hf!

The seven-day period between June 6th and 13th is likely to be disturbed, with maximum effects most likely to be felt on the 7th or 8th. Such disturbances could produce aurora in the ionosphere, and atmospheric storms, giving rise to auroral as well as tropospheric propagation. Sporadic E activity is likely on many days of the month, making *ten*, *six* and even *two* meters likely candidates for skip contacts.

For the best current information about changing conditions as they affect DX, tune in WWV at eighteeen minutes after each hour for up-to-date reports of ionospheric and geomagnetic-field conditions.

Band-by-band predictions

Twenty meters will be open to one part of the world or another during each day, except for occasional disturbed days, with an early morning spate of activity followed by late afternoon and evening DXing. Short skip to about 1600 kilometers (1000 miles) will occur during midday on most days.

Fifteen meters should be the best overall DX band in June, with openings occurring during early morning and late afternoon hours. Hours surrounding midday will be best for short skip out to about 1900 kilometers (1200 miles) while extended north-south path DX is expected during the afternoon and evening.

Ten meters will be excellent on many days of the month, offering an incredible variety of propagation conditions from which to choose. Expect long and short skip, long and short path DX, and an occasional disturbance to keep your days full of interesting happenings. Considering the low power required for good signal strengths, you can have as much or more fun on *ten* than on any other band. Midday is short-skip time with regular openings out to about 2000 kilometers (1200 miles).

Six meters is likely to open more frequently than in any previous year of the past decade. Not only short skip of 2000 to 2500 kilometers (1200 to 1500 miles) on many days, but the added bonus of long-haul DX between the USA and South and Central America — possibly even to Hawaii and Africa on a super day — will cheer the hearts of the avid DX-chasers.

Eighty, *forty*, and *one-sixty* meters are not considered to be summertime DX bands. Occasional openings on *forty* in the late evenings will bring happiness, particularly on north-south paths. High static levels, plus high signal absorption levels, render *eighty* and *one-sixty* practically useless, but — if you're willing to try — check them out on that rare cold and clear evening when QRN slacks off to bearable levels. Early morning or late, late evening attempts on these bands are best for DXers. Short skip of 500 to 1200 kilometers (300 to 800 miles) on 80, and 1100 to 1600 kilometers (700 to 1000 miles) on 40 can be expected up to mid-morning, and following mid-afternoon hours.

HRH

JUNE

WESTERN USA

GMT	PDT	N ↑ Asia / Far East	NE ↗ Europe	E → S. Africa	SE ↘ S. America	S ↓ Antarctica	SW ↙ New Zealand	W ← Oceania / Australia	NW ↖ Japan
0000	5:00	15	15	20	10	—	10	10	10
0100	6:00	15	15	20	10	—	10	10	10
0200	7:00	15	10	—	10	—	10	10	10
0300	8:00	15	10	—	10	—	10	10	10
0400	9:00	15	10	20	15	—	10	10	10
0500	10:00	20	10	15	15	—	10	10	10
0600	11:00	20	10	10	15	—	15*	15	10
0700	12:00	20	10	10	15	—	15	15	10
0800	1:00	20	—	10	20	—	15	15	10
0900	2:00	20	—	10	—	—	20	15	10
1000	3:00	20	—	10	—	—	20	15	10
1100	4:00	—	—	10	—	—	20	15	—
1200	5:00	—	—	15	20	—	20	15	—
1300	6:00	20	10	20	20*	20	20	15	—
1400	7:00	20	10	20	15	20	20	15	15*
1500	8:00	20	10	20*	15	20	20	15	10
1600	9:00	15	10	15	15	20	—	15	15*
1700	10:00	15	10	15	15	20	—	15	15
1800	11:00	15	10	15	10	20	—	15	15
1900	12:00	15	10	15	10	20	—	15	15*
2000	1:00	15	10	15	10	20	—	10	10
2100	2:00	15	10	15	10	20	10	10	10
2200	3:00	15	10	15	10	20	10	10	10
2300	4:00	15	10	15	10	—	10	10	10

MID USA

GMT	MDT	N ↑ Asia / Far East	NE ↗ Europe	E → S. Africa	SE ↘ S. America	S ↓ Antarctica	SW ↙ New Zealand	W ← Oceania / Australia	NW ↖ Japan	CDT
0000	6:00	15	15	20	15	—	10	15*	15	7:00
0100	7:00	15	15	20	15	—	10	15*	15	8:00
0200	8:00	10	15	20	15	—	10	15	15	9:00
0300	9:00	10	—	—	15	—	15*	15	15	10:00
0400	10:00	10	—	—	15	—	15	15	20	11:00
0500	11:00	10	15	—	15	—	15	15	20	12:00
0600	12:00	10	15	20	15	—	15	15	20	1:00
0700	1:00	—	10	—	—	—	15	15	20	2:00
0800	2:00	—	15*	—	—	—	15	15	—	3:00
0900	3:00	—	—	—	—	—	20	15	—	4:00
1000	4:00	—	—	20	—	15	20	20	—	5:00
1100	5:00	—	15	20	—	15	20	20	—	6:00
1200	6:00	20	15	20	15	15	20	20	—	7:00
1300	7:00	10	10	15	10	15	20	15	20	8:00
1400	8:00	10	10	15	10	20	20	15	20	9:00
1500	9:00	10	10	15	10	20	20	15	20	10:00
1600	10:00	10	10	15	10	20	—	20	20*	11:00
1700	11:00	10	10	15	10	20	—	20	15	12:00
1800	12:00	10	10	15	10	20	—	20*	15	1:00
1900	1:00	15	10	15	10	20	—	15	15	2:00
2000	2:00	15	10	15	10	—	20	15*	15	3:00
2100	3:00	15	10	15*	10	—	15	15*	15	4:00
2200	4:00	20*	15	10	15	—	10	15*	15	5:00
2300	5:00	20	15	15*	15	—	10	15*	15	6:00

EASTERN USA

GMT	EDT	N ↑ Asia / Far East	NE ↗ Europe	E → S. Africa	SE ↘ Caribbean / S. America	S ↓ Antarctica	SW ↙ New Zealand	W ← Oceania / Australia	NW ↖ Japan
0000	8:00	15	15	20	20	—	10	15	15
0100	9:00	15	15	—	20	—	10	15	15
0200	10:00	20	15	—	15	—	10	15	20*
0300	11:00	20	15	—	15	—	15	15	20
0400	12:00	20	15	—	15	—	15	20	20
0500	1:00	—	—	20	15	—	15	20	20
0600	2:00	—	—	20*	15	—	15	20	20
0700	3:00	—	—	15	—	—	20	20	—
0800	4:00	—	—	15	—	—	20	—	—
0900	5:00	—	—	20*	—	—	20	—	—
1000	6:00	20	15	20	—	—	20	—	—
1100	7:00	20	15	15	20*	20	20	—	—
1200	8:00	20	15	15	15*	20	20	—	—
1300	9:00	20	15	15	10	20	20	20	—
1400	10:00	20	10	15	10	20	20	20*	20
1500	11:00	15	10	15	10	20	20	15	20
1600	12:00	15	10	10	10	20	—	15	20
1700	1:00	15	10	10	10	20	—	15	20
1800	2:00	15	10	10	10	20	—	15	20
1900	3:00	15	10	10	10	20	—	15	20
2000	4:00	15	10	10	10	—	20	15	15
2100	5:00	15	10	15	10	—	15	15	15
2200	6:00	15	15	15	15	—	10	15	15
2300	7:00	15	15	20	15	—	10	15	15

HAM CALENDAR

June 1979

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
*All international events such as contests are shown on the GMT days on which they take place even though they may actually begin on the evening of the preceding day in North America	ISLE OF MAN MILLENIUM DXPEDITION — The Liverpool and District Amateur Radio Society are mounting a DXpedition to the Isle of Man during the period of the special GT prefix to celebrate one thousand years of the Island s Parliament, Tynwald The Club s call sign GT3AHD/Portable, will be used during this period (2300Z 6/29 to 2300Z 7/8) and operation will be on all HF bands Suggested frequencies plus or minus QRM are as follows CW — 1 820-835, 3 505, 7 005, 14 080, 21 080, 28 080 SSB — 1 820-835, 3 695/780, 7 092, 14 195/275, 21 245/275, 28 495/550 144 290, 432 290		Club members operating will include G3 s XSN, YBH G4 s AHS AMX, CVZ, EST, FPB, GEB, BHS, GHT, GKF, HGT, HSF G8 s AVJ, CFM, FHD, NNX, NRD Participation in the RSGB VHF national field day is intended QSLing will be 100% either via the bureau to G3AHD or direct (including the appropriate IRCs) to G. H. Cohen G4GHS, 41 South Station Road, Gateacre, LIVERPOOL Merseyside L25 3QE England		New Zealand Association of Radio Transmitters Annual Conference — Upper Hutt, New Zealand — 1-4 **1**	AMATEUR FAIR 79 Swapfest/Exposition — Minnesota State Fairgrounds — St. Paul MN Bridge City ARC Convention — Red Carpet Inn — Beaumont TX — 2-3 Minnesota QSO Party — 1800Z 6/2 - 2359Z 6/3 Nebraska QSO Party — 2-3 **2**
Central Wisconsin RA Swapfest/Picnic — Stevens Point WI L-MARC Hamfair 79 — Islip Speedway NY — WB2ALW N2AOI KA2CAD Milton ARC Hamfest — info Kenneth Hering WA3IJU RD #1 Box 381 Allenwood PA 17810 Ole Virginia Hams ARC Hamfest — Prince William County Fairgrounds — ½ mile S of Manassas VA on Route 234 South Shore ARC Fleamarket/Auction — Viking Club — 410 Quincy Avenue — Braintree MA Starved Rock RC Hamfest — Bureau County Fairgrounds — Princeton IL Tri-State ARA Hamfest — Camden Park — Huntington WV **3**	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146 31-91 at 7 30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222 66/224 26 MHz via WR2APG and 21 400 MHz USB WEST COAST BULLETIN Edited & Transmitted by W6ZF 9PM PDST 3540 kHz, A-1, 22 WPM **4**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) **5**	SOWP QSO Party — CW — 0000Z 6/6 - 2359Z 6/7* **6**	**7**	**8**	ARRL VHF QSO Party — 9-10 Bemidji Hamfest — Fairgrounds — Bemidji MN — WB0MSH — 9-10 Central Ontario Amateur Radio Fleamarket — Centennial Arena — College Avenue W — Guelph Ontario Canada Crawford ARS Hamfest — Crawford County Fairgrounds — Meadville PA Tri-State Hamfest — Coliseum of Northwest Junior College — Senatobia MS — 9-10 **9**
Monroe County Radio Communications Association Hamfest/Swap N Shop — Info Fred Lux WD8ITZ, P.O. Box 982 Monroe MI 48161 Shore Points ARC Hamfest — Stockton State College Campus — Pomona NJ Six Meter Club of Chicago inc Hamfest — Santa Fe Park 91st Street and Wolf Road — Willow Springs IL **10**	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146:31-91 at 7 30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222 66/224 26 MHz via WR2APG and 21 400 MHz USB **11**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) **12**	**13**	**14**	ARRL Central Division Convention — Milwaukee WI — 15-16 **15**	All Asian Contest — Phone — 16-17 ARRL Georgia State Convention — Atlanta GA — 16-17 Central Michigan Repeater Association Hamfest — Midland County Fairgrounds — Midland MI Raritan Valley RC Hamfest/Fleamarket — Columbia Park — Dunellen NJ VK/ZL/Oceania DX Contest — 1000Z 6/16 - 1000Z 6/17 West Virginia QSO Party — 2300Z 6/16 - 2300Z 6/17 **16**
CQ Radio Club Fleamarket — Fish and Game Association Grounds — Just off Route 4 at Weed Road between Torrington and Goshen CT — W1JSU Eastern Montana Hamfest — Glendive MT Frederick ARC Central Maryland Hamfest — Frederick Fairgrounds — Frederick MD Satellite ARC Swapfest/Barbeque — Info Satellite Amateur Radio Club Inc P.O. Box 1615 Vandenberg Air Force Base CA 93437 Schuylkill Amateur Repeater Association Hamfest — Lakewood Park — Barnesville PA **17**	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146 31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222 66/224 26 MHz via WR2APG and 21 400 MHz USB WEST COAST BULLETIN Edited & Transmitted by W6ZF 9PM PDST 3540 kHz, A-1, 22 WPM **18**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) **19**	**20**	**21**	**22**	ARRL FIELD DAY — 23-24  **23**
 See June 2, 5, 6, 16, 19, 23, 30 **24**	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146 31-91 at 7 30 PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222 66/224 26 MHz via WR2APG and 21 400 MHz USB **25**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) **26**	**27**	Louisville Area Computer Club Computerfest — Bluegrass Convention Center — Louisville, KY — 6/29 - 7/1 Young Ladies Radio League, Inc International Convention — Holiday Inn 4th and Arch — Philadelphia PA — WB2JCE 6/29 - 7/1 **28**	**29**	ARRL West Virginia State Convention — Jackson s Mill WV — 6/30 - 7/1 Seven-Land QSO Party — 6/30 - 7/1 **30**

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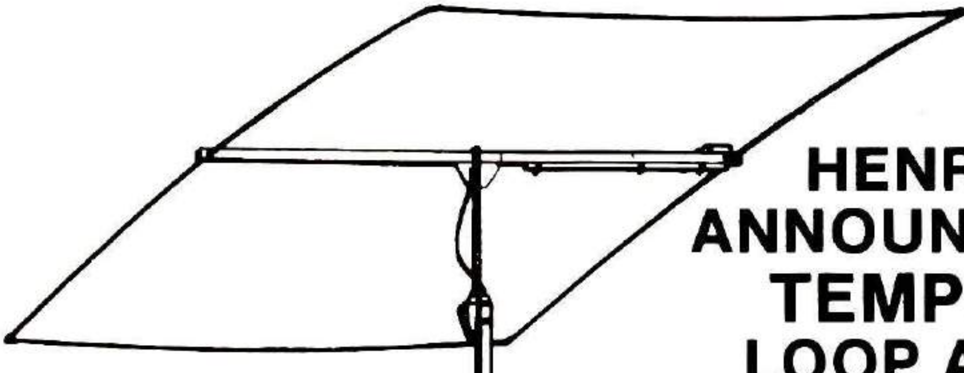

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NEW!

Digital Frequency Control*
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