CQ

January 1976
$1.00

Will you love 20 meters tomorrow as you love it today? .... see page 18

- 160 Meter Broadband QRP Amplifier
- All About Light
- 2 Meter Repeater Survey
- Interlaced HF Beam Elements
- CQ Reviews KLM Multi-2000
- WPX Contest Rules

QRP DXCC No. 2 Trophy to W2GRR...see page 43 for story

The Radio Amateur's Journal

Three new money-saving Heathkit

NEW HEATHKIT HW-2026 — transmit & receive on any 2-M channel with no crystals to buy!

A true 5 kHz per step synthesizer opens every 2M channel from 144 to 147.995 MHz. The lever switches on the front panel are much easier to use than thumbwheels and a 0/5 kHz toggle switch permits split channel operation.

Ten watts minimum output and frequency modulation put real punch into your signal. And the transmitter is fully protected — even operates into an infinite VSWR without failure!

The receiver is tops in features and performance. "Hot 0.5 μV sensitivity for 12 dB SINAD, Schmitt-trigger squelch with a threshold of 0.3 μV or less, a diode-protected dual-gate MOSFET front-end, IC IF, dual conversion and an 8-pole crystal filter for superior IF shape and excellent adjacent channel rejection. Linear audio response and a built-in 2" x 6" speaker may make you think the op you're working is in the room with you and there's even an external speaker jack.

There's also much more. LEDs indicate that the synthesizer is locked on-frequency and warn if the channel is already in use. A mode switch selects simplex, −600 kHz offset or an "aux" crystal with a different offset frequency. A built-in continuous/burst encoder accesses most closed repeaters.

The HW-2026 is one of the smallest synthesized rigs you can buy, but it's not difficult to build — just 5 circuit boards to wire. Alignment requires only a VTVM, although a frequency counter would be helpful.

Kit HW-2026, Synthesized Transceiver 289.95
(plus 2.52 postage)
Kit HWA-202-1, AC Power Supply 32.95
(plus 1.72 postage)

NEW HEATHKIT HW-104 CW/SSB TRANSCEIVER — now the latest broadband technology costs less

The reviewers and hundreds of customers have fallen in love with our SB-104's instant QSY. It's easy to understand why — you just pick the mode and band, then dial the frequency. It's that easy. Advanced broadband circuitry keeps you in tune — without preselector, load or tune controls.

Now Heath offers the same basic circuitry in our lower-priced HW-series. Like the SB-104, the new HW-104 is 100% solid state — cool and quiet — with an output you can instantly switch from 100 watts to 1 watt. Its coverage extends from 3.5 to 29.0 MHz. And, if you need the top end of 10 meters, add the optional HWA-104-1 accessory. Its coils and filters fit onto the "104's" existing circuit boards and take you up to 29.7 MHz.

The HW-104's performance is superlative. Transmissions are clean and crisp — at 100 watts third-order distortion is 30 dB down and unwanted sideband suppression is 55 dB. In the receiver, broadband design virtually eliminates adjacent signal overload, yet sensitivity is less than 1 μV. And because cross-modulation and intermodulation have been dramatically reduced, signals seem to "pop out" of a quiet background.

The HW-104 also has the convenience you want — a 15 MHz WWV position on the bandswitch, a 15 MHz per turn spinner, 5 kHz markings on the circular dial, and a built-in 100 kHz/25 kHz calibrator for accuracy to 2 kHz. Since it's 12 VDC powered, the "104" is an ideal mobile rig and the optional noise blanker provides up to 50 dB of effective blanking. For base station use, buy the optional HP-1144 AC Power Supply.

Plug-in phenolic circuit boards and two wiring harnesses simplify construction. Alignment requires only a VTVM, mike and dummy load.

Kit HW-104, Transceiver .....539.95 (plus 5.56 postage)
Kit HWA-104-1, 10-M Accessory .....16.95 (plus .76 postage)
Kit HP-1144, AC Power Supply .....89.95 (plus 5.08 postage)
Kit HS-1661, Matching Speaker .....19.95 (plus 1.40 postage)
Kit SBA-104-1, Noise Blanker .....26.95 (plus .76 postage)
Kit SBA-104-2, Mobile Mount .....36.95 (plus 1.56 postage)
Kit SBA-104-3, 400 Hz CW Crystal Filter 39.95
(plus .76 postage)

reasons to build a Transceiver

NEW HEATHKIT HW-2021 HANDHELD TWO-METER TRANSCEIVER—a great value in personal and emergency communication gear

Compare the HW-2021 with any other handheld two-meter transceiver. In value and performance, we think you'll agree it's unsurpassed.

A top-mounted knob selects any of five crystal-controlled channels — we even include a crystal for 146.94 to get you on the air fast. And, to save money, a single crystal controls both transmit and receive! A simplex/offset switch and −600 kHz crystal actually give two transmit frequencies for every crystal you buy — just like having a 10-channel transmitter!

The transmitter output is one watt minimum with 0.005% (or better) stability. Frequency modulation and a separate built-in mike provide a better signal. The receiver features 0.5 μV sensitivity for 12 dB SINAD and a squelch threshold of 0.3 μV or less. The HW-2021 comes with built-in nickel-cadmium batteries and a separate AC charger. The battery-saver circuit uses a pulsing technique to extend the battery life by 75% in the standby/receive mode.

For personal and emergency communication, the optional HWA-2021-3 Auto-Patch Encoder accesses telephone lines through repeaters with touch-tone input. The 12-digit keyboard and keying light mount directly on the front of the transceiver. You can add the encoder when you build the transceiver or later.

Finally, the HW-2021 is both compact and lightweight — it weighs just two pounds, including batteries! The HW-2021 and HWA-2021-3 are not difficult to build, but, due to compactness, some soldering experience would be helpful. Alignment requires only a VOM or VTVM. To make the HW-2021 an even better value, we've included accessories worth up to $60—a crystal for 146.94 MHz, a −600 kHz offset crystal, a flexible "rubber duckie" antenna plus an output for an external antenna, a built-in nickel-cadmium battery pack and a separate AC charger. And you get them all at no extra cost when you buy the HW-2021. That's the kind of value that has made Heath a leader in two-meter equipment!

Kit HW-2021, Handheld Transceiver, 169.95 (plus 1.40 postage)
Kit HWA-2021-3, Auto-Patch Encoder, 39.95 (plus .92 postage)
HWA-2021-2, Carrying Case .....12.95 (plus .76 postage)

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- ☐ HWA-104-1 10-M Accessory
- ☐ HS-1661 Station Speaker
- ☐ HP-1144 AC Power Supply
- ☐ SBA-104-1 Noise Blanker
- ☐ SBA-104-2 Mobile Mount
- ☐ SBA-104-3 400 Hz CW Filter
- ☐ HW-2026 Synthesized 2-M Transceiver
- ☐ HWA-202-1 AC Power Supply
- ☐ HW-2021 Handheld 2-M Transceiver
- ☐ HWA-2021-2 Carrying Case & Strap
- ☐ HWA-2021-3 Auto-Patch Encoder
- ☐ HWA-2021-4 Crystal Certificates

Please add the above items and postage to my Heath Revolving Charge Account # _____.

Signature _____
(necessary to send merchandise)

for the experimenter!

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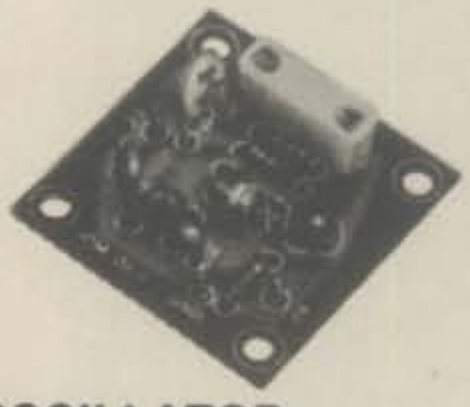
Price $3.95 ea.



OF-1 OSCILLATOR
Crystal controlled transistor type. 3 to 20 MHz, OF-1, Lo, Cat. No. 035108. 20 to 60 MHz, OF-1, Hi, Cat. No. 035109
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MXX-1
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A single tuned circuit intended for signal conversion in the 30 to 170 MHz range. Harmonics of the OX or OF-1 oscillator are used for injection in the 60 to 179 MHz range. 3 to 20 MHz, Lo Kit, Cat. No. 035105. 20 to 170 MHz, Hi Kit, Cat. No. 035106
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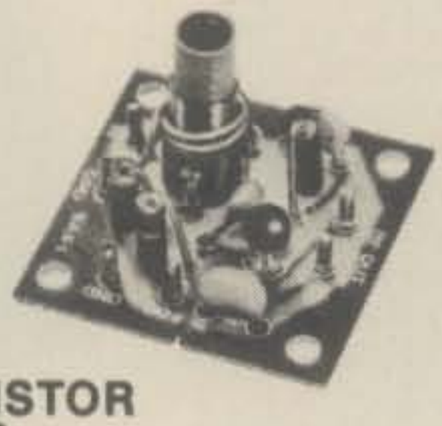
Price. $4.50 ea.



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JANUARY, 1976 VOL. 32, NO. 1

CQ

The Radio Amateur's Journal

FEATURES

DEPARTMENTS

Offices: 14 Vanderventer Avenue, Port Washington, L.I., N.Y. 11050. Telephone: 516-883-6200

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KENWOOD

TS-520

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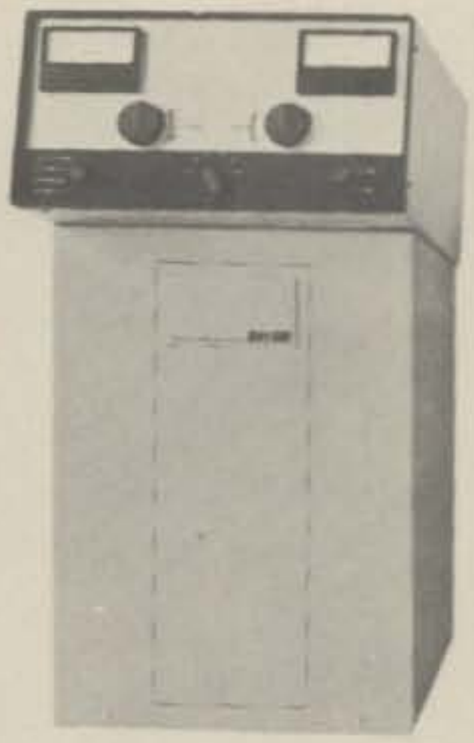
Henry Radio's
2K-4



The 2K-4 linear amplifier embodies all of the famous features of the 2K-3...rugged construction, reliable performance and heavy duty components, plus unique modern styling. The tilted RF deck faces up for easy visibility and convenient operation. If you are one of the more than 3000 happy 2K owners, trade up to the new 2K-4. If you are not one of the group, now is the time to join.

The 2K-4 (console or desk model).....$995.00

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The Tempo "ONE" SSB transceiver represents the culminating achievement of many years of experience in the amateur radio field. Modern design, superb performance, sturdy construction, outstanding reliability...at a surprisingly low price makes the Tempo "ONE" the best buy in transceivers today. Please come in or write for complete specifications.

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Zero Bias

This issue marks the beginning of what will be a new era for *CQ*, The Radio Amateur's Journal. After 31 years of being published in the nominal 6" X 9" size, *CQ* now joins the vast majority of consumer and technical publications in the 8¼" X 11¼" format. But rather than just "putting the old magazine under the magnifying glass" and simply giving the same design only a little larger, we have labored to produce a magazine which is totally new in appearance, and which will, over the next few months take a totally different approach to this hobby of Amateur Radio.

The new approach will include such techniques as the "Real Time Review." For decades the Amateur has been subject to various quality editorial reports on new Amateur equipment, but usually the reports have come too late to help the eager buyer. The gear is a year old before the first word of comment hits the Amateur press. We're changing that. Already underway are "Real Time Reviews" on two major manufacturer's products which will not be released for several months. You'll read evaluation's of these products in the issues of *CQ* following the manufacturer's own product introductions.

There are several other "new twists" we'll be breaking over the next few months but only after we've ironed the mechanics of each one will we release them to the pages of *CQ*.

CQ is not the largest of the Amateur magazines, but we believe it's the best for the active, intelligent Amateur. *CQ* has always been independent and progressive, sometimes controversial, and unfortunately, often late. As we change so many of our characteristics we will strive to retain our progressiveness, independence and controversiality, and most importantly, shake off the pernicious problem of lateness once and for all. This issue should arrive somewhat earlier than the dreadfully late November and December issues, and February will show still further improvement.

Despite groundless rumors to the contrary, we're in the Amateur Radio publishing business "for the duration" and we intend to remain a factor in this highly unpredictable hobby/service. Those who would count us out would do well to tend to their own business. *CQ* was around before *73* or *Ham Radio* were gleams in their publisher's eyes, and we'll still be around when other Johnny-come-lately's crop up, but we'll still be around, of *that* you can be sure. Onward and upward!

K2MGA

On The Cover

The young lady balancing the DXCC QRPp no. 2 Trophy is South Dakota born Diana Wetzler, friend and former student of K8EEG.

A Guest Editorial by Dr. Theodore J. Cohen, W4UMF

The Fall of the Amateur Service?

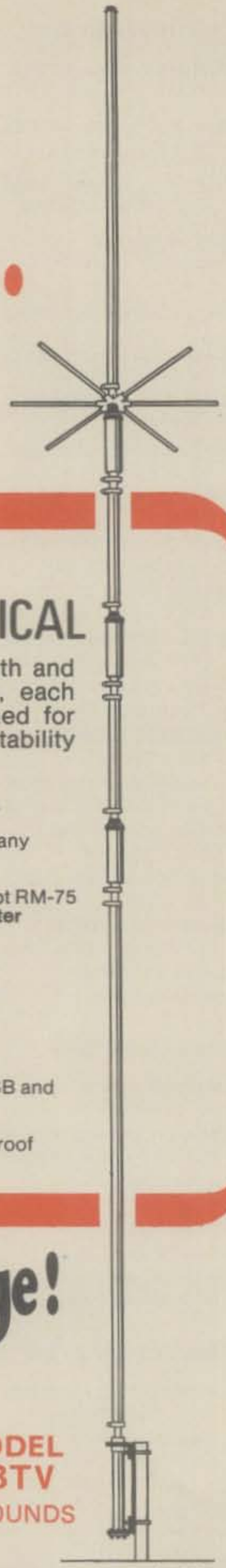
An apparent emergency on Christmas day, 1975, involving a small boat on Lake Erie, and the resultant communications between Amateurs and the Coast Guard on 3804 kHz, raises many questions about our value in emergency situations, and about the general conduct of Amateurs today. For an incident which involved many Coast Guard districts, a Coast Guard cutter, and a number of helicopters, one certainly would not have expected to hear the following from Amateurs on the emergency frequency: monologues by operators supposedly trying to assist with the rescue efforts, swearing, backbiting, belching, tuning up and other forms of intentional interference, calling CQ without checking to see if the frequency was in use, and calling in on the frequency by operators who only wanted to say they were standing by. Then too, some Amateurs even attempted to tell the Coast Guard how to handle the search effort, further complicating a situation already made difficult by the poor weather conditions prevailing at the time. So chaotic were the "emergency communications" at one point that the pilot of Helicopter 1441, in an erroneous but not unwarranted comment, lamented the fact that the CB'ers on the channel were not keeping the frequency open! Even after 3804 kHz was declared an emergency frequency by the Coast Guard, the disruptive activities of many misguided individuals demonstrated a lack of self-restraint and and respect for authority which pervades so much of our Society today.

Procedures for operator conduct during emergency are well documented in the Amateur literature. Suffice to say here that if any operator has assumed control, do not transmit on the emergency frequency unless directed to do so.

As for those individuals who lack the maturity to conduct themselves in an acceptable manner, and who hide their adolescent behavior behind the anonymity of unsigned transmissions, ignore them! Responding to their transmissions just worsens an already deteriorating situation. Remember . . . Amateur Radio exists for the services it provides. And if we ever hope to maintain the Amateur Service as a viable communications medium in the years ahead, each of us must pursue our on-the-air activities in such a manner as to reflect credit upon the Service, and upon ourselves as well.

— W4UMF

if the 4-BTV weighs 39% more... what do others leave out?



HUSTLER FIXED STATION FOUR BAND VERTICAL

The 4-BTV is longer for greater aperature, larger in diameter for strength and bandwidth, heavier traps for precision and safety factor. Individually, each subassembly weighs more to collectively give you an antenna designed for convenience of assembly and installation, a wide margin in mechanical stability and far superior electrical performance.

- **Lowest SWR**—PLUS!
- Bandwidth at its **broadest!** SWR 1.6 to 1 or better at band edges.
- Hustler exclusive trap covers **"Spritz" extruded** to otherwise unattainable close tolerances assuring accurate and permanent trap resonance.
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- Extra heavy duty aluminum mounting bracket with **low loss—high strength** insulators.
- All sections **1¼" heavy wall,** high strength aluminum. Length 21'5".
- **Stainless steel clamps** permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be **easiest assembly** of any multi-band vertical.
- Antenna has ⅜"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for **75 meter operation** when desired.
- Top loading on 75 meters for broader bandwidth and **higher radiation efficiency!**
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- Ground mount with or without radials; roof mount with radials.

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Our Readers Say

Russian Boycott

Editor, *CQ*:

Regarding The Sasa Story I have to make a comment. Describing the "Russian boycott" of the Israeli amateur radio contacts the author states, "This is basically because the Russians are very careless, and in some cases very stupid operators."

I understand the frustration in seeing valuable points wasted in a contest because of such a "boycott" but I cannot approve calling the Russian amateurs very stupid, for several reasons.

First of all, the Soviet Amateurs, (not only the Russians, as the author calls all the U hams, even the Kazakhs), are excellent operators and very knowledgeable technicians. I was in the Soviet Union and personally met many U hams. Most of them have learned enough English to handle a light conversation and that's more than the majority of the world's hams can do, at least those who cannot speak a second language.

Secondly, no matter how biased or upset a ham is, he should not call another ham names. This kind of talk is far from the spirit and mentality of amateur radio. Ham radio means friendship and there is no place for name calling in our hobby.

Thirdly, the author does not understand life in the Soviet Union. He blames the Soviet amateurs for the rules set up for them by their political leaders. This is like blaming the average Soviet citizen for not spending his winter vacation in sunny Miami. Why? Is it up to him? What can he do when he is ordered not to work with a certain country?

About 20 years ago, when I was YO2BO in Romania, we were ordered, for pure political reasons, not to work Yugoslav amateurs. What could we do? Defy the order and get us and our families in trouble? Here and there, for the sake of a new country we tried to make a forbidden QSO, not emphasizing the prefix or the name of the country, just barely mumbling the forbidden letters YU.

About in the same time, Spanish amateurs were not allowed to work us. When one called CQ and we answered, or he replied not mentioning our prefix (but asking QSL through a neutral Swedish ham) or he told us honestly: this QSO is prohibited. Could he be called very stupid? I don't think so. And we should not forget that there have been a few countries which we the hams in these good, old, U.S. of A., could not contact at various times, this is still so and with the Canadian hams.

Otherwise, "The Sasa Story" is an excellent article, informative and entertaining, with many good photos.

George Pataki, WB2AQC
New York, N.Y.

Trigger Electronics

Editor, *CQ*:

I read about Mr. Veen's experience with Trigger Electronics in your October, 1975, issue ("Our Readers Say" Column).

I sent Trigger Electronics a check for $79.40 on August 29, 1974. Of course, they have not sent the merchandise and it has been over a year, although they were very fast to cash the check. I have written them several letters to no avail, including copies of the cancelled check. They claim to have lost these copies and are unable to find the order.

I would suggest that there ia a strong possibility they are making fraudulent use of the U.S. mail.

M.C. Gilliland, WBØNHG
Denver, CO

Editor, *CQ*:

Concerning the letter in the recent issue of CQ about Trigger Electronics located in a suburb of Chicago.

Trigger has had a bad reputation for at least the past 10 years. This has been a known fact to Chicago area hams. Unfortunatally he makes his money through mail order and it takes a first experience with this store to know what is going on.

There is a rumor that Trigger is switching over to CB and is getting out of the amateur radio market.

If your readers have any complaints they could write to the manufactuerer of the item they ordered from Trigger. Tell them the complaint and perhaps they will go to bat for you. After all they gave Trigger permission to sell their products and they have a reputation at stake too.

Instead of writing the B.B.B. contact the States Attorney office in Chicago.

Larry Cotariu, WA9MZS
Skokie, IL

We would like to hear of other experiences —both good and bad— which readers have had with the people who sell to Amateurs. As space allows, we will publish your letters, and where warranted, the dealer or manufacturer will be given an opportunity to reply in print. — *K2MGA*

Repeater Woes

Editor, *CQ*:

Steve Cole's, WB8BGQ, article "Don't Build A Repeater" could not be more accurate, and I'm sure there are hundreds of other trustees that agree.

Manny Marcel, WB2BON
Trustee: WR2ADZ, WB2AEB
Uniondale, NY

K3AZ's Firecracker

Editor *CQ*:

Two items, Dick:

1. Dial-A-Prop is great. Makes one feel someone is personally interested in readers.

2. K3AZ's (The AZ - Special) article much appreciated. Brewed up same - the antenna is an absolute firecracker! One problem - no one believes me anymore when I c.w. the info that I'm running QRP at 650 mw. I mean: 579 in Spearfish, South Dakota on less than 1 watt?

Makes one want to take out a lifetime subscription to *CQ*!

C. Rozycki, WN2BXH
Patchoque, NY

To Each His Own

Editor, *CQ*:

I think it's great that progress is being made towards aiding the handi-

(continued on page 15)

A Replacement is an Improvement with Amperex RF Communications Components

RF Power Tubes,
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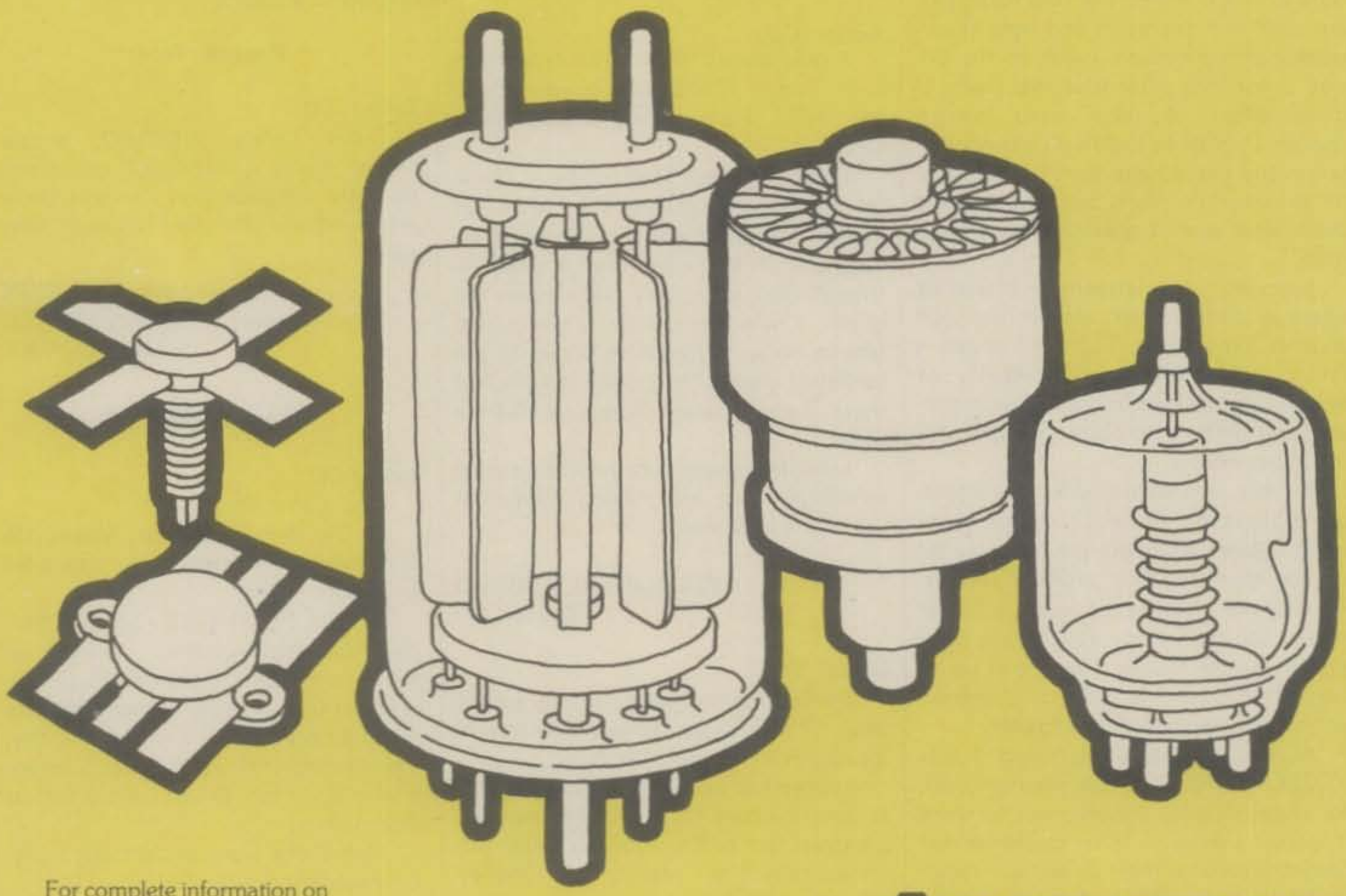

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No other multi-mode 2m transceiver has this.

And now the "Multi-" can be yours at a $116 savings.

See your KLM dealer and take one home today.

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● **Wheaton, Illinois** — The Wheaton Community Radio Amateurs midwinter hamfest is Sunday, February 8, at the DuPage County Fairgrounds, Wheaton, Illinois (Manchester Road, near County Farm Foad), 8 a.m. to 5 p.m. Tickets $1.50 advance, $2.00 at the door. For advance tickets send $1.50 each and a self-addressed stamped envelope to L.O. Shaw, W9OKI, 433 S. Villa Avenue, Villa Park, Illinois 60181. Advance tickets postmarked no later than Feb. 1.

● **Southfield, Michigan** — The Southfield Amateur Radio Club's 10th Annual Swap and Shop will be held on January 18, 1975 at Southfield High School, Ten Mile and Lahser Rds., Southfield, Michigan, Tickets $1.50. For more information about tickets and tables write to Mr. Robert Younkders, 24675 Lahser Rd., Southfield, Michigan 48075.

● **Traverse City, Michigan** — The Cherryland Amateur Radio Club will hold its third annual Swap 'N Shop on Saturday, 14 February 1976, from 9:00 a.m. to 4:00 p.m. at the Northwestern Michigan College campus in Traverse City. Door prizes will be given away. for more information contact Bill Mader, WA8WWM, Box 2, Empire A.F.S., Mi. 49630. Donation is $1.00.

● **Griffith, Indiana** — The Lake County Amateur Radio Club, Inc., announces its 23rd Annual Radio Club Banquet scheduled for February 23, 1976 at the Griffith Knights of Columbus Hall, 1400 South Broad Street, Griffith, Indiana. The banquet will start promptly at 6:30 p.m., CST. Enjoy a delicious home-cooked meal - - all you can eat - - entertainment, special awards, speeches, gifts, and an evening of companionship with your fellow amateurs. Tickets $7.50 each, availabel from Herbert S. Brier, W9EGQ, 409 South 14th St., Chesterton, Indiana 46304, or from other club members. Positively no tickets sold at the door!

● **Cuyahoga Falls, Ohio** — The 1976 Cuyahoga Falls Amateur Radio Club Annual Auction and Flea Market will be held February 27, 1976 at the Bolich Jr. High School, Cuyahoga Falls, Ohio. The admission is $1.50 advanced registration (Deadline Feb. 1, 1976) and $2.00 at the door (night of auction) Talk in W8VPV 84/24-04/64-52/52. For info contact K8VAK 216-644-1213.

● **Mansfield, Ohio** —Mansfield Mid-Winter Hamfest/Auction will be held Sunday February 1, 1976 at the Richland County Fairgrounds. Forums, indoor flea market (tables $1.00) displays, prizes, auction. Easy access from I-71 and US 30. Registration $1.50 advance, $2.00 at door, starts 9 a.m., auction 2 p.m. No commision. Talk in on 3,972.5, 146.52 and 146.34/94. Additional info from K8JPF. (419) 529-2801 home (419) 524-1441 work.

● **Davenport, Iowa** — The Davenport Radio Amateur Club Hamfest is February 22, 1976 at the Masonic Temple, Davenport, Iowa. Admission is $1.50 advance, $2.00 at door. Tables available at a small fee. Talk in on 28/88 and 52 simplex. For tickets and info. write: WAØGXC, Dick Lane, 116 Park Ave. So. Eldridge, Ia. 52748.

● **Stuart, Florida** — The second Stuart Half-A-Buck Hamfest will be held 9 a.m. to 5 p.m. Feb. 28 at the Tri-County Rehabilitation Center, 4461 S. Federal Hwy., Stuart, FL. Exhibits and Swap Shop covered and air conditioned. Swap Shop opens 8 a.m.; set up Friday. Talk-in .46/.06, .94/.94.

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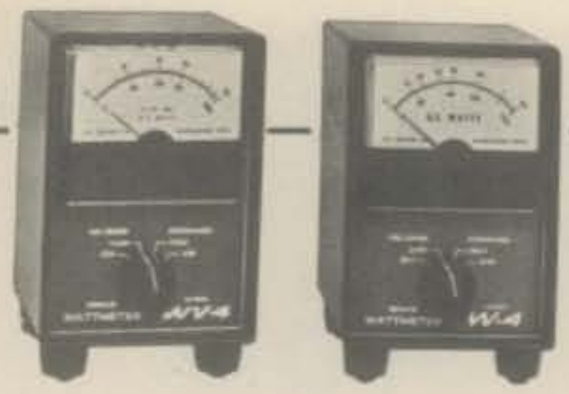

Memo from Drake

One of our observers wrote the other day that we do some rather curious things from time to time here at Drake. For example, he said, we seem to have a penchant for putting wattmeters in almost everything.

On thinking that over, it is true that the W-4 is a fine device for up to 2 kW from 1.8 thru 54 MHz. The WV-4 covers 20 to 200 MHz and we do have W-4 type units in the MN-4 and MN-2000 antenna matching units. We also have one in the C-4 Station Console, and a 3 kW meter in the L-4B Amplifier.

Our friend went on to say since we have put so many wattmeters in various things, we had probably even put one in the coffee pot here at the plant. Now obviously that carried the whole thing a bit too far -- after all, we had enough trouble getting one into the water cooler!

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Our Readers Say

. . . Continued

capped (The Optacon, Oct. '75), but would rather read about it somewhere other than my *CQ* Magazine "The Radio Amateur's Journal."

Steve Gillispie, WB8CGC
Hurricane, WV

As the title above says, "To Each His Own." But it seems to us that one of the most elementary concerns of Amateurs is the welfare of their fellow human beings. What we attempted to do occasionally during 1975 was to introduce Amateurs to some of the techniques and devices which are becoming available to blind or deaf and blind persons to enable them to function in a seeing society. All told, very little page space was devoted to the subject, but Mr. Gillespie apparently would withhold even that small amount of coverage from *CQ*. Sorry, Steve, but the vast majority of our readers feel differently, and so do we. — *K2MGA*

Fair Shake

Editor, *CQ*:

I am writing in response to the statement made by Mr. Richard Ross, K2MGA, in his review of the Heath SB-104 (*CQ*, August 1957). In particular please refer to page 73 column 2 sentence no. 1. "Amateur Radio operation hasn't been this simple before." Evidently K2MGA himself wasn't "in tune" with amateur radio, as I've been using a Triton II by Ten-Tec for a good year before the SB-104 was introduced and Triton II does not need tuning (I will give you the benefit that you do need to "resonate" the receiver but it is broadband tuned.) I feel an apology if forthcoming to Ten-Tec — by the way when did you test the Triton. I've only been subscribing to *CQ* since June 1974?

I realize that Heath is a "biggy" and you will not offend them but please give us Triton/Argonant owners a fair shake. I'm pleased with both.

Jake Meyer, KZ5JA/WBØNUL
Fort Clayton, Canal Zone

Most certainly, broadband transmitter output circuits have been with us for many years. In the late 1950's, 1959 to be exact, Central Electronics introduced the 100V, a broadband-tuned linear amplifier. So the simple presence of broadband-tuned output circuits in a transmitter does not by itself, indicate the "ultimate" in simplicity or operating ease. It was and is my opinion that the *total* ease of operation of the SB-104 in all respects warranted the observation, "Amateur Radio operation hasn't been this simple before." Operating preferences vary from one operator to the next, and while our aim is to remain impartial in our equipment reviews, it is impossible to distill out all personal opinion. The Ten-Tec, Atlas, Signal One and Swan broadband transceivers are all fine quality gear, and all had their own distinct design objectives. The fact that another transceiver strikes the fancy of a reviewer at a particular moment, in no way reflects his opinion of another transceiver. We can only review one at a time! — *K2MGA*

The Editors of CQ welcome your letters, cards, comments and observations about Amateur Radio in all its varieties. To improve your chances of seeing your letter in print, please type, print neatly or use your most legible longhand. Sorry, but we can't print a letter which we can't read.

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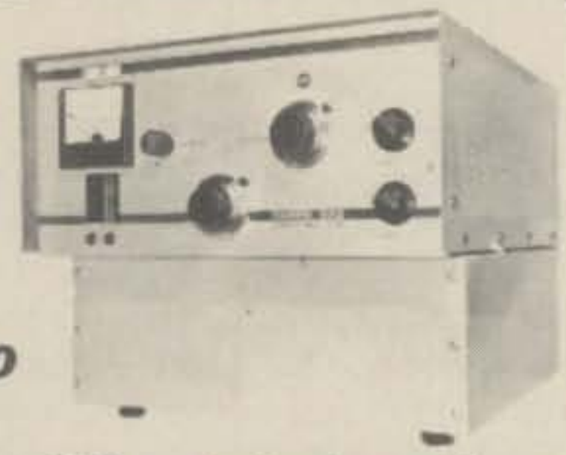

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UHF (400 to 512 MHz) Drive Power	Output	Model No.	Price
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10W	70W	70D10	$250
30W	70W	70D30	$210
2W	40W	40D02	$180
10W	40W	40D10	$145
2W	10W	10D02	$125

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"What's happening to the solar cycle?" "When will it bottom out?" "What sort of DX conditions can we expect over the next few years?"

Solar Activity Update: The Transition Years

BY DR. THEODORE J. COHEN, W4UMF AND GEORGE JACOBS, W3ASK

CQ has commissioned two well-known experts in the field of Radio Propagation to look into the crystal ball to see if they can come up with the answers. Dr. Theodore J. Cohen, W4UMF, and George Jacobs, W3ASK, *CQ*'s Propagation columnist, have pooled their experience and talent in the following exclusive *CQ* report. You may *not* like their conclusions!

SUNSPOT Cycle 20 is now in its declining years, and with spots already observed from Cycle 21, it should not be long before the 12-month smoothed sunspot numbers start to increase, officially signifying the start of the new cycle. In the meantime, the point at which the forthcoming minimum will be reached is the subject of much debate. Speculation abounds, with some analysts misinterpreting the lull in solar activity during May, 1975, and the subsequent, but temporary, increase in activity in June through August, 1975, as indicating that Cycle 20 has "bottomed out".

When can we expect the low for Cycle 20 to occur? What will the high-frequency spectrum be like during the low? And what level of solar activity can we expect during Cycle 21? These are the questions on everyone's mind. But before attempting to answer them, a review of previous solar activity is given so as to define the phenomenon known as the sunspot cycle.

The Sunspot Cycle

Sunspots are known to have been observed by the Chinese over 2000 years ago. It was not until 1611, however, following the invention of the telescope, that sunspot activity was recorded for scientific purposes. During the middle of the 18th Century, and early in the 19th Century, European astronomers began keeping independent records of solar activity on a regular basis. One, an amateur astronomer from Dessau, Germany, named Hendrick S. Schwabe, studied data he had collected over a 20-year period, and in 1843, concluded that the interval between sunspot maxima was on the order of 10 year's duration. To Schwabe, then, goes the credit for the discovery of the sunspot cycle.

In 1849, Rudolf Wolf, Director of the Zurich Observatory in Switzerland, devised a means to describe solar activity in terms of a "sunspot number." This number is obtained from daily observations of sunspots and sunspot groups, with greater weight being given to the large, active groups.

Since a record of daily sunspot observations exhibits wide fluctuations, it is necessary to smooth the data in order that trends may be observed. The first smoothing is done by averaging the daily numbers over a one month's period; the result is the *monthly mean relative sunspot number*, R_m. The monthly means are then smoothed by taking a 12-month running average. These *12-month running smoothed sunspot numbers*, R_s, define the so-called sunspot cycle, and are derived from the following equation:

$$R_s = \frac{\frac{1}{2}R_{m1} + R_{m2} + R_{m3} + \ldots + R_{m12} + \frac{1}{2}R_{m13}}{12} \quad (1)$$

where: R_s is the 12-month running smoothed sunspot number centered on R_{m7},

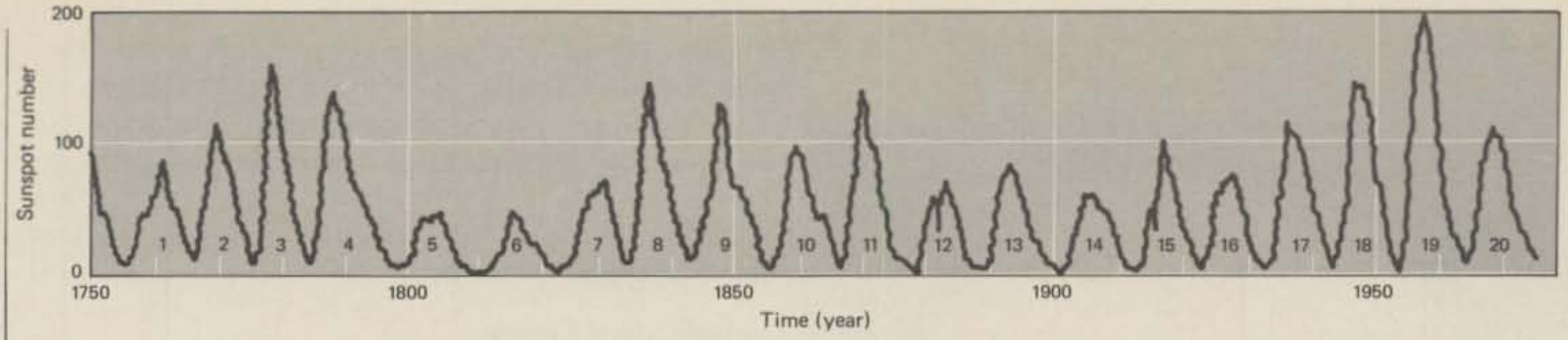


Fig. 1—Solar activity from 1749 to the present.

and R_{m1} through R_{m13} are monthly mean relative sunspot numbers for 13 consecutive months.

While the preparation of daily relative sunspot numbers was begun at Zurich in 1849, Wolf, using the sunspot records of earlier observers, was able to extend the data on mean monthly sunspot numbers back to 1749. The first accurately reported sunspot cycle, then, began in 1755, and since that year, 19 complete cycles have been observed, with the 20th now nearing its end (fig. 1).

From fig. 1, solar activity is seen to vary in a periodic manner. The number of years between consecutive minima varies from cycle to cycle, but averages 11 years. For this reason, the variation in sunspot activity is called the 11-year sunspot cycle. No two cycles have been observed to be identical, however; some have lasted only nine years, while others have been as long as 14 years in duration. The average cycle determined from data for the first 19 recorded cycles is summarized in Table I and fig. 2, and will serve to orient the reader on general sunspot cycle behavior (see, also, Jacobs and Leinwoll[1]).

Table I

The "Average" Sunspot Cycle (Cycles 1-19, incl.).

Characteristic	Average
Sunspot minimum	*New cycle begins with 12-month running smoothed sunspot number between 0 and 11; 5 is average.*
Ascending period to maximum value	*Varies between 2.6 and 6.9 years, with 4.1 years as average.*
Maximum values	*Ranges between 49 and 201, with 109 average.*
Descending period from maximum to minimum	*Varies between 4 and 10.2 years, with 6.7 years as average.*
Period from minimum to maximum to minimum	*Average of 10.8 years.*
Interval between the maxima of two adjacent cycles	*Ranges from 7.3 to 17.1 years, with an average of 10.9 years.*

It should be noted, in passing, that at the start of a new cycle, sunspots first appear in two areas, 25 to 40 degrees north and south of the Sun's equator (fig. 3). As the cycle matures, spots occur progressively closer to the equator until at the end of a cycle, the spots appear almost on the equator. Spots from a new cycle will be observed near the end of the old cycle, and the two sets of spots may be observed together for a period of two or more years. For convenience, it is the minimum in the 12-month running smoothed sunspot numbers (computed with no distinction made between "old" and "new" spots) which is used to define the end of the old cycle and the beginning of a new cycle. This point generally occurs when the spots associated with old and new cycle activity are equally numerous.

Cycle 20—The Past

The current sunspot cycle, Cycle 20, began in October 1964, with a smoothed sunspot number of 9.6. Though starting at a level somewhat higher than average, this cycle rose to a peak of 111 (12-month

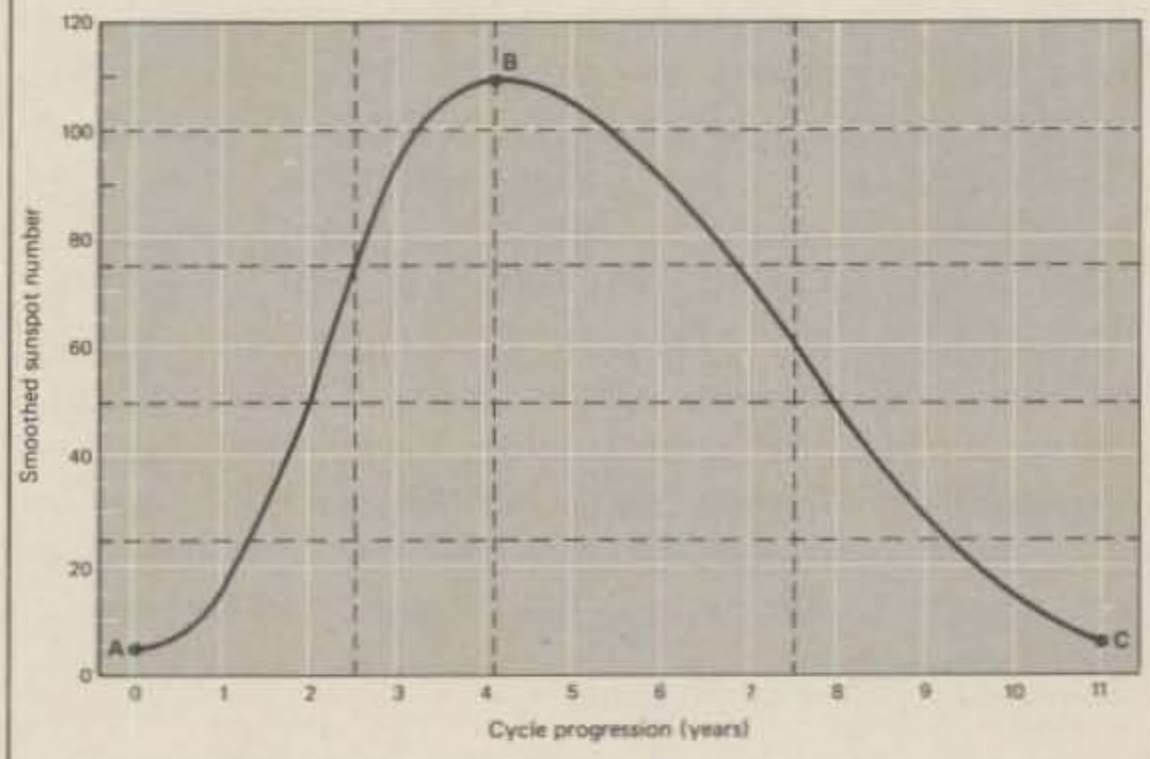


Fig. 2—The average sunspot cycle, based on the characteristics of the 19 cycles which have taken place since 1750. At A, the average minimum value is 5; at B, the average minimum value is 109, and C marks the end of the cycle 10.8 years after its beginning. The average time interval for the rising portion AB is 4.1 years, while the average descending period is 6.7 years.

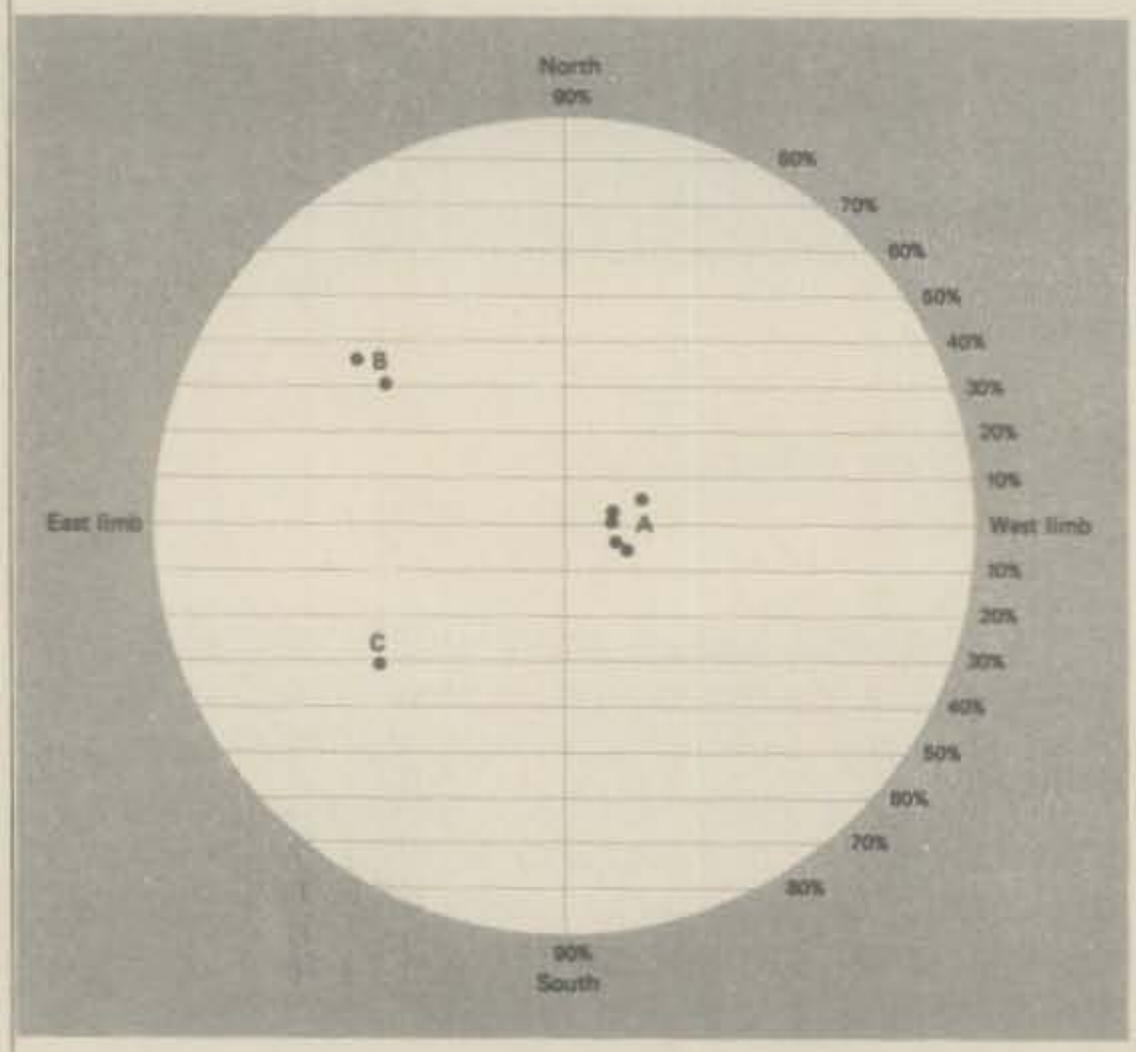


Fig. 3—Positions of sunspots associated with the start of a new solar cycle (B and C) and with the old cycle (A).

running smoothed sunspot number) centered on November, 1968. Thus, during the ascending portion of the cycle, Cycle 20 followed the average cycle more closely than did any previous cycle. Based on this behavior, one would have predicted in 1969 that Cycle 20 would end 10.8 years after it began or in mid-1975, with a minimum 12-month smoothed sunspot number of 5. That the 12-month running smoothed sunspot number centered on April, 1975, is 18.6, and given the recent solar activity of July through September, 1975, most of which was related to sunspots near the Sun's equator (hence, related to Cycle 20), it appears that Cycle 20 will not end before mid-1976. What has happened, of course, is that significant periods of high solar activity (for example, the sunspot activity observed in late 1974) have punctuated the decline of Cycle 20, thereby elevating the smoothed sunspot numbers to levels higher than would be expected from an examination of the average cycle.

Given the vagaries of Cycle 20, what can one now say about its decline, and the transition to Cycle 21?

Sunspot Cycle Predictions

Methods for predicting the future course of sunspot-cycle activity are as numerous as the number of investigators who have attempted such predictions. Unfortunately, no satisfactory theory exists for the origin of sunspots, and so, methods for predicting the behavior of future sunspot activity are almost totally based on data observed for previous cycles. These methods, called empirical predictions methods, fall in two categories; those that consider each solar cycle as an independent event, and those that assume solar activity to be a periodic phenomenon. Some attempts have also been made to predict solar behavior on the assumption that planetary tides on the Sun trigger solar activity.

Independent Events

One family of solar prediction methods is based on the premise that each 11-year (approximate) solar cycle is a relatively independent event. No assumptions are made as to the existance of long-term periodicities, but rather, each rise and subsequent fall is considered an independent outburst. In this method, extensive studies on the behavior of previous cycles are used to derive empirical relationships between the various solar-cycle parameters. For example, the following empirical law derived by Waldmeier,[2] relates the time, θ, in years between the maximum and minimum of a given cycle, to the maximum smoothed sunspot number, R_x, for the cycle:

$$\theta = 3 + 0.03R_x \text{ years.} \qquad (2)$$

For Cycle 20, the maximum 12-month running smoothed number, 111, was reached in November, 1968. Using this value in Equation 2 yields a decay time of roughly 6.3 years. As such, this method predicts that the minimum for Cycle 20 should have occurred early in 1975.

Another empirical method developed by Jacobs (unpublished) is interesting to consider. In using this method, one first selects about five or six cycles that more or less are similar to the cycle under study. Moving three years forward in time from the peak of each cycle, the *monthly* sunspot numbers are averaged over the cycles selected. This yields an average level of monthly mean sunspot activity which can be projected into the current cycle. Using these projected numbers, one then calculates the predicted 12-month running smoothed sunspot numbers for the remainder of the current cycle.

For Cycle 20, application of this technique in 1972 suggested that the minimum would be reached in late 1975, with the expected minimum 12-month smoothed sunspot number being on the order of 7. Re-analysis of the data using the latest monthly figures available for Cycle 20 now indicates that the minimum may occur in August 1976, with a smoothed sunspot number of 5.

Empirical methods such as those developed by Waldmeier and Jacobs may be used only for predicting the course of a cycle once it has begun. It is desirable, however, to predict not only the trends for the current cycle, but also to predict the behavior for future cycles. To do this, consideration must be given to those methods which assume that solar activity is a periodic phenomenon.

Table II—Predicted Solar Activity (Lincoln-McNish Method—NOAA).

Year and Month		Predicted Sunspot Number (12-month)
1975	September	17
	October	16
	November	15
	December	15
1976	January	15
	February	14
	March	14
	April	14
	May	13
	June	13
	July	13
	August	13

Table III—Predicted Solar Activity (Boykin and Richards Method—NASA).

Year and Month		Predicted Sunspot Number (12-month)
1975	April	20
	July	16
	October	15
1976	January	15
	April	14
	July	13
	October	12
1977	January	13
	April	15
	July	18
	October	21

Periodic Phenomenon

Empirical methods for predicting solar activity which are based on the periodic behavior of the solar cycle seek to describe the short and long-period recurrence behavior of previous cycles, and to extrapolate these results to portions of the current cycle and to future cycles.

One method for predicting solar activity which assumes that the sunspot cycle is periodic was developed by McNish and Lincoln.[3] This method takes, as a first approximation to the prediction of a future value for a particular period in the current cycle, the mean of the values observed during similar periods of the ten previous cycles. The values associated with this mean cycle are then modified by adding correction factors which are based on the amount of deviation observed between earlier values of the present cycle and the mean cycle. These correction factors are computed by the method of least squares.

The Lincoln-McNish prediction method is recommended only for use in predicting 12-month running smoothed sunspot numbers up to one year in advance. It is possible, using this method, to predict two and three years into the future, but by the fourth year, activity in future years is best predicted using the mean of the previous ten cycles.

For Cycle 20, the Lincoln-McNish method yields the predicted smoothed sunspot numbers shown in Table II.[4]

That no cycle has "bottomed out" above a 12-month smoothed sunspot number of 11, and given the predicted slow decay for Cycle 20 shown in Table II, these data are interpreted here to suggest that the minimum may not be reached until early 1977.

Another solar-prediction method which is currently used is one developed by Boykin and Richards.[5] These investigators modified the Lincoln-McNish technique so that the smoothed sunspot numbers could be predicted up to 15 years in advance. A good background in matrix algebra is required to understand Boykin and Richard's work, so no attempt will be made here to elucidate the statistical technique employed.

Applying the method of Boykin and Richards yields the result shown in Table III.[6] As seen, the data indicate that Cycle 20 is expected to end late in 1976 with a predicted minimum smoothed sunspot number on the order of 12.

A new approach to predicting long-range solar activity was devised by Cohen and Lintz [7,8] in 1974. Using the Maximum Entropy Spectral Analysis (MESA) technique, these investigators found that the spectrum for the sunspot cycle was quite complicated, with significant signatures observed at 8.1, 9.9, 11.2, 57.1 and 89.6 years. These results suggest that the repetition period for a waveform produced by the super-position of sinusoids having these periods is about 179 years ($2 \times 89.6 = 179.2$; $3 \times 57.1 = 171.3$; $16 \times 11.2 = 179.2$; $18 \times 9.9 = 178.2$; $22 \times 8.1 = 178.2$). This 179-year recurrence in solar activity can be seen by comparing Cycles 1 and 17, 2 and 18, 3 and 19, and 4 and 20 in fig. 1. Note, however, that the period of 179 years is not an intrinsic periodicity of the solar cycle.

If the major characteristics of the sunspot cycle repeat every 179 years, then, by definition, the data are periodic outside an interval of this length. That is, to a first approximation, the level of solar activity observed 179 years ago should again be observed today. Thus, sunspot activity can be predicted by taking the spectral components corresponding to the data for any 179-year interval, and reconstruct the smoothed sunspot numbers in that interval. By repeating the waveform outside the interval, smoothed sunspot numbers can be extrapolated forward in time.

Table IV—Predicted Solar Activity (Cohen and Lintz Method).

Year and Month		Predicted Sunspot Number (12-month)
1975	*April*	*18*
	July	*15*
	October	*13*
1976	*January*	*11*
	April	*9*
	July	*7*
	October	*5*
1977	*January*	*4*
	April	*3*
	July	*3*
	October	*3*
1978	*January*	*4*
	April	*5*
	July	*7*
	October	*9*

Table V—Summary of Predictions for the Date of the Cycle 20 Minimum.

Source or Method	Date of Minimum	*Smoothed Sunspot Number at Minimum (12-month)*
Average cycle characteristics	*Mid-1975*	*5*
Waldmeier	*Early 1975*	*—*
Jacobs	*Late 1976*	*5*
Lincoln-McNish (NOAA)	*Early 1977**	*—*
Boykin-Richards (NASA)	*Late 1976*	*12*
Cohen & Lintz	*Mid-1977*	*3*
Jose	*1977*	*—*
Wood	*Early 1977*	*—*

**Extrapolated from data published in September, 1975.*

Using the technique described above, Cohen and Lintz computed the 12-month running smoothed sunspot numbers shown in Table IV. As seen, the minimum for Cycle 20 is predicted to occur in mid-1977, with an expected smoothed sunspot count of 3.

Planetary Theory of Sunspots

No discussion on sunspot predictions would be complete without some reference to the planetary theory of sunspot causation. Basically, this theory holds that sunspot activity is affected by planetary positions, and that planetary tides on the Sun vary in the same manner as do sunspot variations. Jose,[9] for example, observed that the variations in the motion of the Sun about the center of mass of the solar system has a periodicity of 178.7 years, and by visual inspection of sunspot data, he asserted that the sunspot cycle is found to have the same period. Based on this analysis, Jose predicted that the minimum for Cycle 20 would occur in 1977.

Wood,[10] in his analysis of solar tides, found a similarity between the solar tidal height fluctuations and sunspot numbers. He postulated that the minimum for Cycle 20 would occur in early 1977.

Similarities in solar-tide effects and sunspot numbers notwithstanding, the planetary theory of sunspot causation has recently come under renewed criticism. Writing in *Nature*, Okal and Anderson [11] stated that the apparent agreement of the sunspot cycle with planetary tidal effects is an artifact of the calculations. By analyzing 1,800 years of solar-tide data based on planetary positions, Okal and Anderson showed that the spectrum of these data exhibited only a single long-period peak at 11.86 years (the orbital period of Jupiter). No planetary peaks were found at 8.1, 9.9, 57.1, or 89.6 years, as were observed by Cohen and Lintz; further, no peak was found at about 179 years, again indicating that this peak is not an intrinsic periodicity of the solar cycle.

At the least, the planetary theory of sunspot causation is considered speculative. For that matter, any of the methods used for sunspot prediction must be considered speculative, for the period on which the predictions are based (225 years) represent only the smallest fraction of the Sun's life to date.

Speculative as they are, the methods outlined here for predicting solar behavior must, for the present, suffice. Using them, the investigators cited, and others, have produced numerous predictions for the date of the Cycle 20 minimum.

The data of Table V summarize the predictions reviewed here. As seen, the data suggest that the minimum is not expected to occur before late 1976, and possibly as late as the middle of 1977. The 12-month smoothed sunspot number at the minimum will almost certainly be less than 11, and may be as low as 3.

The Transition Years

In all likelihood, the minimum for Cycle 20, and the transition to Cycle 21, will be marked by a period of two years or so in length, during which time the 12-month smoothed sunspot numbers will probably lie in the range 3 to 10. What this means in terms of ionospheric propagation on the high-frequency bands is best described by Jacobs,[12] Jacobs and Leinwoll,[13] and Jacobs and Martin.[14] Briefly, during the sunspot minimum, the total number of hours that all Amateur bands on a particular circuit remain open will drop sharply (see "Total Usable" columns in

Table VI—The number of hours each amateur band is usable daily (falls between the MUF and the LUF) during the four seasons of the year: a comparison between high and low sunspot activity for the eastern USA—western Europe path.

	High Solar Activity (SSN = 100) Band (Meters)							Total Usable	Black-out
Season	*160*	*80*	*40*	*20*	*15*	*10*	*6*		
Winter	1	3	8	9	7	4	0		6
Spring	0	2	6	12	7	4	0		5
Summer	0	0	2	10	5	1	0		10
Fall	*0*	*2*	*6*	*12*	*7*	*4*	*0*		*5*
Total	1	7	22	43	26	13	0	112	26

	Low Solar Activity (SSN = 10) Band (Meters)							
Season	*160*	*80*	*40*	*20*	*15*	*10*	*6*	
Winter	2	6	5	6	3	0	0	9
Spring	1	3	7	11	0	0	0	7
Summer	0	1	3	6	0	0	0	14
Fall	*1*	*3*	*7*	*11*	*0*	*0*	*0*	*7*
Total	4	13	22	34	3	0	0	76	37

The average daily number of hours an amateur band is expected to open on a particular circuit serves as an index for a particular season. For example, in Table VI, the 40 meter band is expected to open for 5 hours a day during the winter season of low solar activity. This index, taken for each of the four seasons and totaled, becomes the "Total" column in Table VI. The "Total" is significant only as a convenient index for making comparisons. In Tables VI and VII the "Total Hours Usable" for each band is totalled to give an overall "Total Usable" index.

Table VII—The total amount of time (average daily totals for the four seasons) that each amateur band is usable: a comparison between high and low sunspot activity for paths between the USA and nine areas of the world.

(Sunspot)	160	80	40	20	15	10	6		
1. Eastern USA—Australasia									
(High)	1	4	10	21	18	19	0	73	52
(Low)	3	5	15	9	7	0	0	39	72
2. Eastern USA—South and Central Africa									
(High)	1	3	11	21	19	27	0	82	40
(Low)	3	9	14	12	13	2	0	53	59
3. Eastern USA—Central Asia									
(High)	0	0	1	9	9	1	0	20	77
(Low)	0	0	2	6	0	0	0	8	88
4. Central USA—Central Asia									
(High)	0	0	1	11	9	1	0	22	84
(Low)	0	0	2	8	9	0	0	10	87
5. Central USA—South America									
(High)	2	16	24	37	54	35	3	171	14
(Low)	6	20	26	22	30	9	0	113	21
6. Western USA—Australasia									
(High)	1	6	9	19	21	21	1	78	39
(Low)	4	9	16	9	15	3	0	56	55
7. Western USA—Western Europe									
(High)	0	0	2	10	14	2	0	28	70
(Low)	0	1	3	8	1	0	0	13	84
8. Western USA—Far East									
(High)	0	6	14	24	33	15	1	93	35
(Low)	1	7	19	17	13	0	0	57	51
9. Western USA—South and Central Asia									
(High)	0	1	5	14	26	20	1	67	43
(Low)	0	3	9	10	13	1	0	36	63

Tables VI and VII), with the overall average reduction being 43%. Thus, the amount of high-frequency spectrum which will be usable for long-distance communications during the period of low sunspot activity (the next two to three years) will be less than two thirds of the amount usable during a period of relatively high sunspot activity. Further, for the ten representative circuits considered, the amount of time that communications cannot be maintained is 25% greater at sunspot minimum than during periods of high sunspot activity. Finally, as the solar cycle declines towards a minimum, there is a shift in emphasis from the higher to the lower frequency bands, with the 20, 40, 80 and 160 meter bands opening most frequently.

For a detailed band-by-band (160 through 6 meters) summary of conditions as they are expected to exist during the summers, winters, and equinox periods of the sunspot minimum, the reader is referred to the portion of this month's *CQ* Propagation column entitled "Outlook 1976" and to the work of Jacobs and Leinwoll.[13] Then, too, because openings will be fewer and of shorter duration, short term propagation forecast methods which give the operator indications of current or expected band conditions should be employed to maximize one's communication capability (see, for example, Cohen,[15] Jacobs and Cohen,[16] and Tilton[17]). Propagation forecasts such as those provided by WWV,[18] DIAL-A-PROP,[19] MAIL-A-PROP,[20] and *CQ*,[21] as well as those included in such publications as the West Coast DX Bulletin,[22] The Long Island DX Association Bulletin,[23] and Geoff Watts' News-Sheet,[24] also serve to assist the operator in effectively planning his activities on the high-frequency bands.

Cycle 21—What Can We Expect?

The first sunspot associated with Cycle 21 was observed on 15 November 1974.[25] Since that time, sunspots from Cycles 20 and 21 have been observed together, with Cycle 20 sunspots considerably more in evidence, even at this writing. Given that the minimum for Cycle 20 is expected to occur sometime between late 1976 and mid-1977, what can be said about the expected activity for Cycle 21?

Figure 4 summarizes some of the predictions made for Cycle 21. In addition to work previously referenced, the data of Gleissberg[26] have been included here. As seen, the data show that the maximum 12-month running smoothed sunspot number

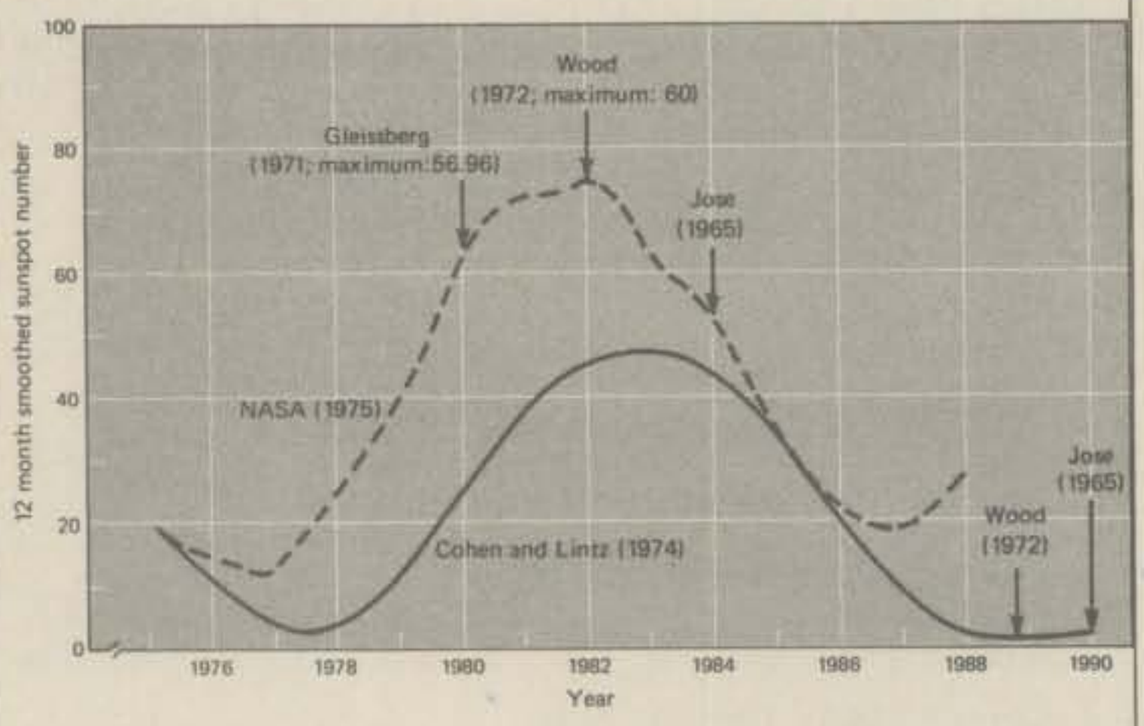


Fig. 4—Predictions for cycle 21.

for Cycle 21 is expected to be in the range from 48 to 96 counts, with the maximum expected to occur between 1980 and 1984 (1982 is favored). Thus, these predictions suggest that the activity of Cycle 21 will be lower than that associated with the average cycle (Table I and fig. 2). Should these predictions come true, conditions on the high-frequency bands during the next maximum will be similar to those experienced in the period 1971-72. Even during this period, however, consistent worldwide openings were observed on the 10 and 15 meter bands, and the 20 meter band was open around the clock on some circuits for several days at a time.

Finally, the minimum following Cycle 21 is predicted to occur between 1986 and 1990. If this minimum corresponds to the minimum following Cycle 5, as is postulated by Cohen and Lintz,[7,8] the minimum following Cycle 21 will exhibit the lowest 12-month running smoothed sunspot numbers observed since 1810.

Conclusions

The current sunspot cycle, Cycle 20, is slowly declining towards a minimum which is expected to occur between late 1976 and mid-1977. Cycle 21, from which sunspots have already been observed, may peak around 1982 with a maximum 12-month running smoothed sunspot count in the range 48 to 96. The next two to three years, then, are best described as "the transition years." During this period, solar activity will be very low, and as a result, the usable high-frequency spectrum will shrink to about half of that available during periods of high solar activity. Emphasis will shift to the lower-frequency bands (80 through 20 meters, inclusive), and even the 160 meter band will exhibit openings to many areas of the world during the hours of darkness, especially during the equinox and winter months.

There is no question that ionospheric propagation during the transition years will pose a challenge to Amateurs. However, though the Sun will be in a quiet state, occasional bursts of solar activity will drive the Maximum Usable Frequency (MUF) to 20 MHz or more. During these periods, only those operators with the foresight to monitor WWV and to use the currently-available propagation forecasts will optimize the time they spend in maintaining communications on the high-frequency bands.

Acknowledgements

The authors thank Mr. Harold C. Euler, Jr., NASA, Marshall Space Flight Center, Alabama, for forwarding information on the method used by NASA to prepare sunspot cycle predictions. The critical comments of Messrs. Mort Cohen, K3EH, Steve Jarrett, K4CFB, and Bill Shephard, W3ZSR, were sincerely appreciated, and were of considerable help in preparing the final manuscript. ■

References and Notes

[1] Jacobs, G., and S. Leinwoll, "A Sunspot Story—Cycle 20: The Declining Years," *CQ*, November, 1969, p. 44.
[2] Waldmeier, M., "A Prediction of the Next Maximum of Solar Activity," *Terrestrial Magnetism & Atmospheric Electricity*, Vol. 51, 1946.
[3] McNish, A. G., and J. V. Lincoln, "Prediction of Sunspot Numbers," *Transactions of the American Geophysical Union*, V. 30, 1949.
[4] Anon., "Weekly Radio Telecommunications Forecast," Telecommunication Services Center, U.S. Department of Commerce (NOAA; Weekly publication).
[5] Boykin, E. P., and T. J. Richards, "Application of the Lincoln-McNish Technique to the Prediction of the Remainder of the Twentieth Sunspot Cycle," Lockheed Missiles and Space Company, Technical Memorandum 54/30-89, Huntsville, Alabama, March, 1966.
[6] Smith, R. E., "Solar Activity Indices," George C. Marshall Space Flight Center, National Aeronautics and Space Administration (NASA; Monthly publication).
[7] Cohen, T. J., and P. R. Lintz, "The Sunspot Cycle, Analysis and Prediction," *CQ*, March, 1974, p. 24.
[8] Cohen, T. J., and P. R. Lintz, "Long-Term Periodicities in the Sunspot Cycle," *Nature*, V. 250, August 2, 1974.
[9] Jose, P. D., "Sun's Motion and Sunspots," *The Astronomical Journal*, Vol. 70, No. 3, April, 1965.
[10] Wood, K. D., "Sunspots and Planets," *Nature*, V. 240, November 10, 1972.
[11] Okal, E., and D. L. Anderson, "On the Planetary Theory of Sunspots," *Nature*, V. 253, February 13, 1975.
[12] Jacobs, G., "Sunspots, and the Solar Influence Upon High-Frequency Radio Communications," Masters Thesis, University of Maryland, 1960 (205 pages + appendices).
[13] Jacobs, G., and S. Leinwoll, "A Seven Year Propagation Forecast for the Amateur DX Bands," *CQ*, November, 1969, p. 52.
[14] Jacobs, G., and E. T. Martin, "The Dwindling High-Frequency Spectrum," *IRE Transactions of the Professional Group on Communications Systems*, V. CS-9, No. 4, December, 1961.
[15] Cohen, T. J., "Short-Term Predictions for Ionospheric Propagation," *CQ*, September, 1974, p. 27.
[16] Jacobs, G., and T. J. Cohen, "A Breakthrough In Simplifying Ionospheric Propagation Forecasts," *CQ*, March, 1975, p. 16.
[17] Tilton, E. P., "The DXer's Crystal Ball," *QST*, June, August, September, 1975.

(Continued on page 75)

A Solid State 13 Watt R.F. Amplifier for 1.8 MHz

BY ADRIAN WEISS, K8EEG
QRP Editor, CQ

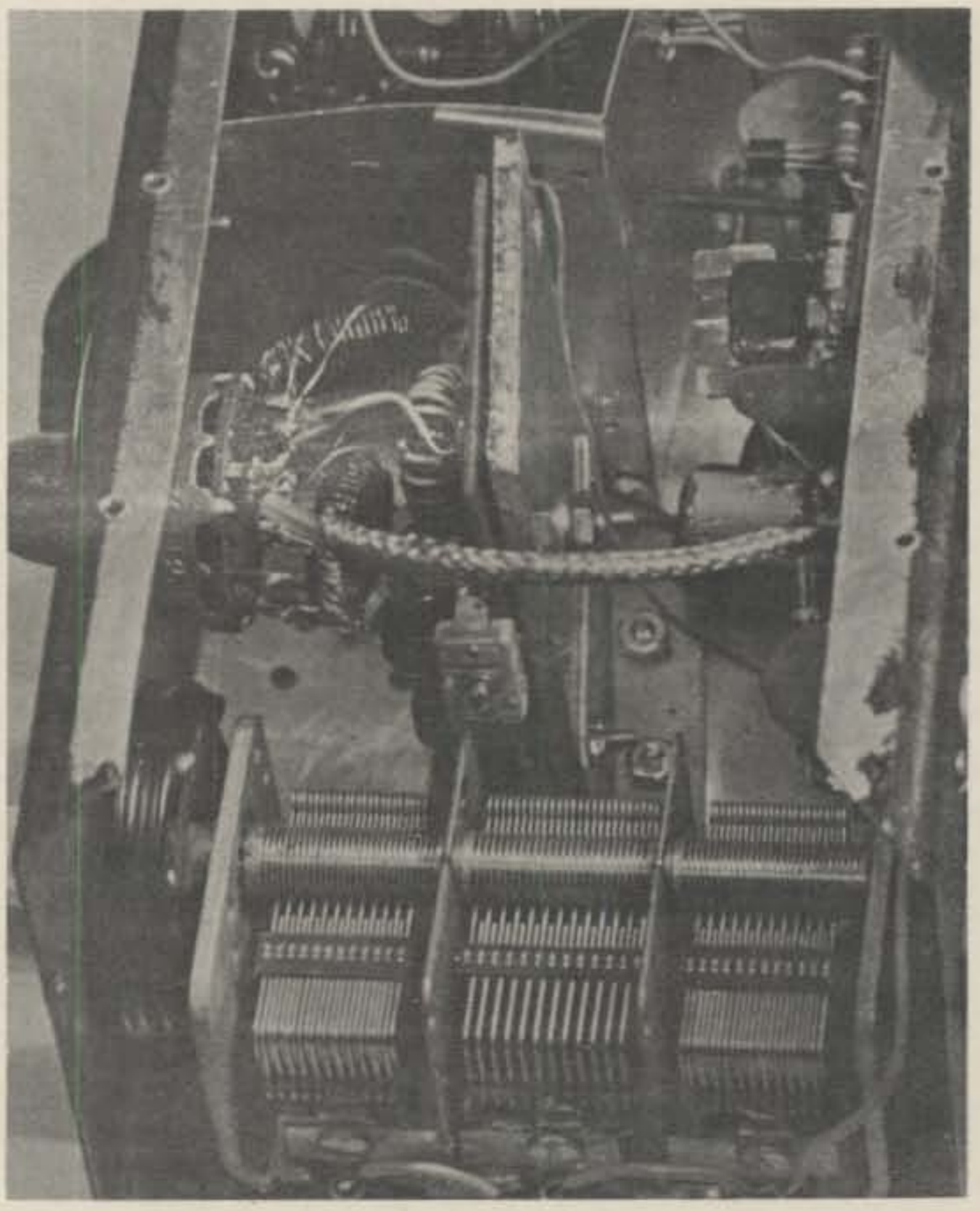
In an earlier paper,[1] I described a moderate power solid state transmitter for 160 meters, and outlined the difficulties encountered in its design and construction. The only major difficulty occurred with respect to the final transistors that were tried in the final amplifier stage. Although the 2N3632 and TI487 could be made to work efficiently in the circuit, both were very prone to instability under high-gain conditions, and very precise tuning of circuit components was essential to proper, stable operation. In spite of these difficulties, the transmitter has performed flawlessly on the air, especially during two grueling *CQ* WW 160 Contests.

Balanced Emitter R.F. Power Transistors

My prediction that the new modern breed of "balanced emitter" transistors would become available to the ordinary amateur experimenter in five years or so was wide of the mark, and happily so, now that I have had an opportunity to use the balanced emitter devices in a number of circuits. And price is remarkably reasonable too. Reference 2 lists some sources of the 2N5590 featured in the amplifier described below.

The advantages of this new breed of r.f. power transistor are numerous. While the construction of the device, which places numerous individual transistors, each with its individual emitter resistor, on a single chip, results in nearly destruction-proof operation under direct short conditions, the balanced emitter approach provides another very important advance over earlier devices in terms of operational stability. Emitter degeneration is no problem. Likewise, input impedance appears more constant over a wider range of operating conditions than with earlier devices. And finally, power gain under normal conditions is fantastic. Manufacturer's specs rate the 2N5590 at 10 watts output in the v.h.f. region, but all of the devices I have used easily provide in excess of 13 watts output at 13.6 Vcc! One application in a transmitter for 20 meters holds the record at present—240 mw drive produces a clean 9.2 watts output! That is a considerable degree of gain, to say the least. Likewise, efficiencies on the order of 60% are easily achieved with proper attention to tuning conditions.

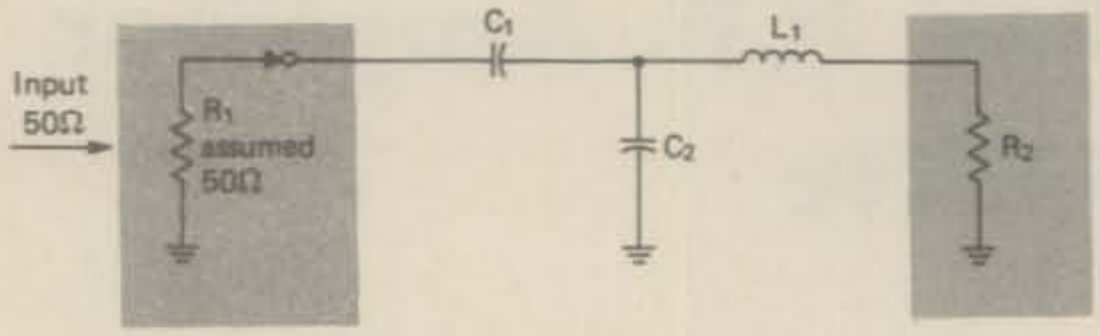
In short, if you've been "turned off" by the tendency of older devices to break into self-oscillation at the slightest provocation, or to vaporize at the least mismatch encountered, you have to try one of



Amplifier p.c. board and 3/32 inch aluminum heatsink at center of cabinet, C_{3A} trimmer at lower edge of board. Angle bracket mounting for amplifier visible to the right bottom of board. Rotary switch and L network antenna coupler switch front panel, C_4 lower edge. Coax lead to antenna jack.

[1] Weiss, A., K8EEG, "Design Notes on A Moderate Power Solid State Transmitter for 1.8 MHz," *CQ* Nov. 1972, p. 18. Check for construction details, photos, circuits.

[2] The following firms presently offer the 2N5590 and other balanced emitter power transistors: Semiconductors Unlimited, 1095 East Indian School Rd., Suite 400, Phoenix, AZ 85014, $5.00; Nurmi Electronic Supply, 1727 Donna Rd., W. Palm Beach, FL 33401, $6.00; Tri-Tek Inc., PO Box 14206, Phoenix, AZ 85031, $5.00. SPECIFY "MARKED" TRANSISTORS ONLY! If a transistor is unmarked, that means that the manufacturer rejected it, and it will not perform adequately!



$X_{L_1} = Q_L R_2$ (loaded Q, R_2 = Input impedance of final transistor) (1)

$$X_{C_2} = R_1 \sqrt{\frac{R_2(Q_L^2 + 1)}{R_1}} - 1 \quad (2)$$

$$X_{C_1} = \frac{R_2(Q_L^2 + 1)}{Q_L} \cdot \frac{1}{\left[1 - \frac{X_{C_2}}{Q_L R_1}\right]} \quad (3)$$

Fig. 1—Design of interstage matching network for the 160 meter solid state amplifier.

these new breed devices before quitting solid state entirely!

Design Objectives

The design objectives outlined in the earlier paper were still in effect for the new final amplifier. However, the 2N5590 was selected to allow operation at the standard 13.6 volt (nominal 12 volts) level. Secondly, since the triple section variable output capacitor would not be necessary in the new amplifier circuit (it had peaked the double-pi net in the old amplifier), it was decided to make it functional as part of a self-contained "L" network antenna coupler.

Previous experience had shown that when one uses a random wire on 160 meters (as is often the case), it should be as high and as long as possible. Inevitably an external antenna coupler was required. Space was available for a single pole, eleven position rotary switch, and so the transmitter is now a completely self-contained unit from v.f.o. to antenna coupler. The antenna coupler, incidentally, has proven very useful in maximizing amplifier matching to 50 ohm coax feedline.

Design and Testing

Since the driver board already in the transmitter was capable of producing in the vicinity of 1 watt of clean drive, it was decided that a tuned input matching network would make for easy incorporation of the new final into the existing transmitter and provide another stage of harmonic rejection. Standard formulas for component values of the interstage matching network were followed and produced workable values (see fig. 1 formulae). The circuit was breadboarded first to optimize component values. C_1 and C_2 were variable capacitors of approximately 500 pf each.

A few simple instruments were required for tuning and checking output purity: an absorption wavemeter, general coverage receiver, and the boob-tube. The procedure for optimizing the values of C_1, C_2 and L_1 is simple, and can be applied to great effectiveness when using other balanced emitter transistors in amplifiers in the h.f. region.

Once all components are selected and mounted, the absorption wavemeter is coupled tightly to the 2N5590 collector inductance (L_2), the coupling being determined by the sensitivity of the meter. The objective is to determine at what settings or combinations of L_1-C_1-C_2 the maximum amount of r.f. "feedthrough" appears on the final collector. Next, adjustment can begin. **The B+ is disconnected from the final collector!** R.f. drive is applied, and C_1-C_2 tuned for an indication of r.f. feed-through

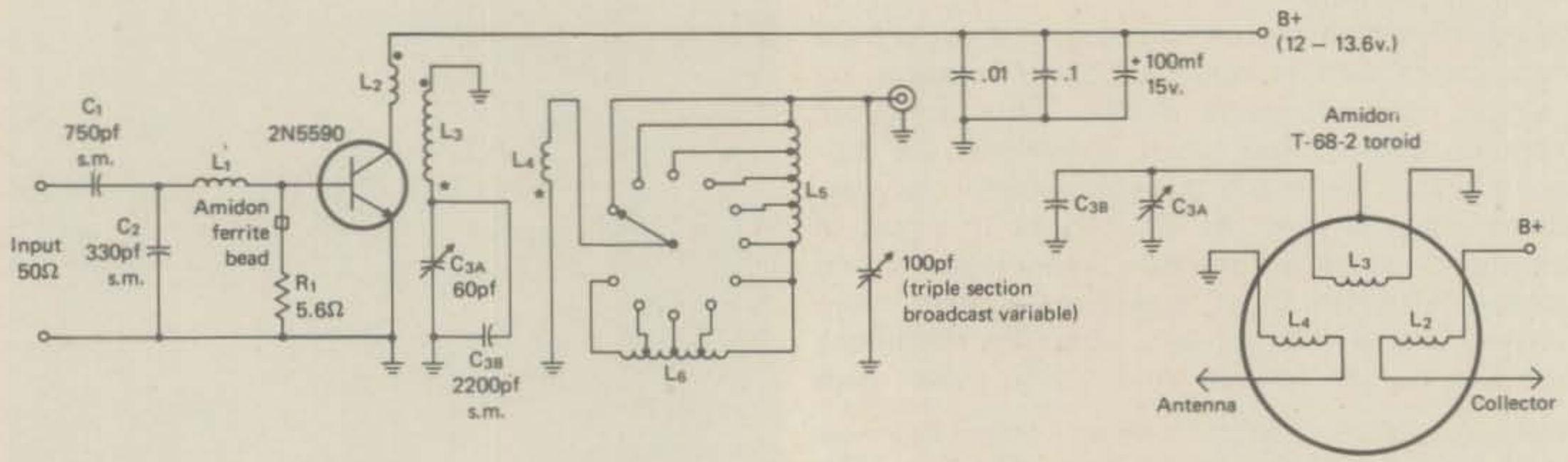
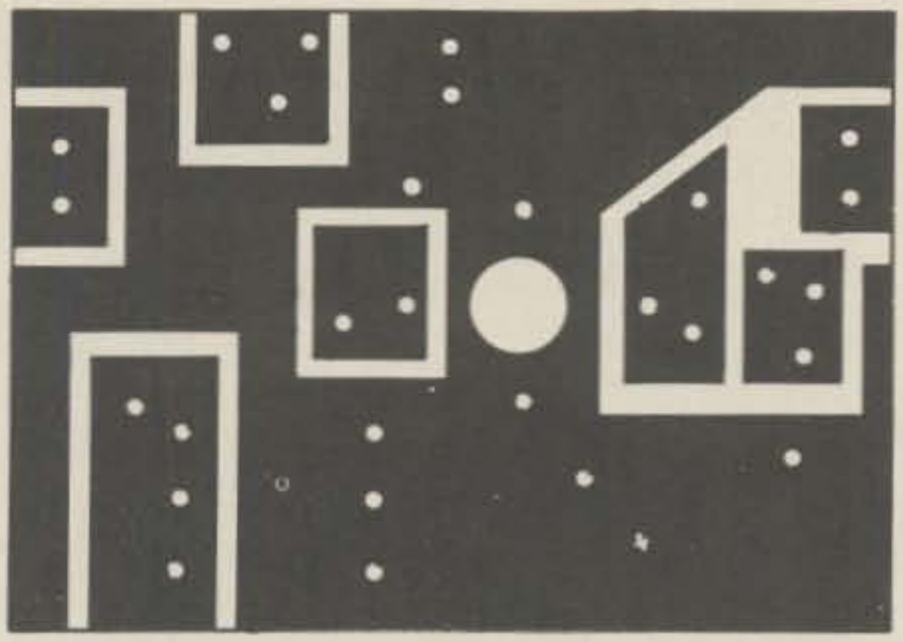
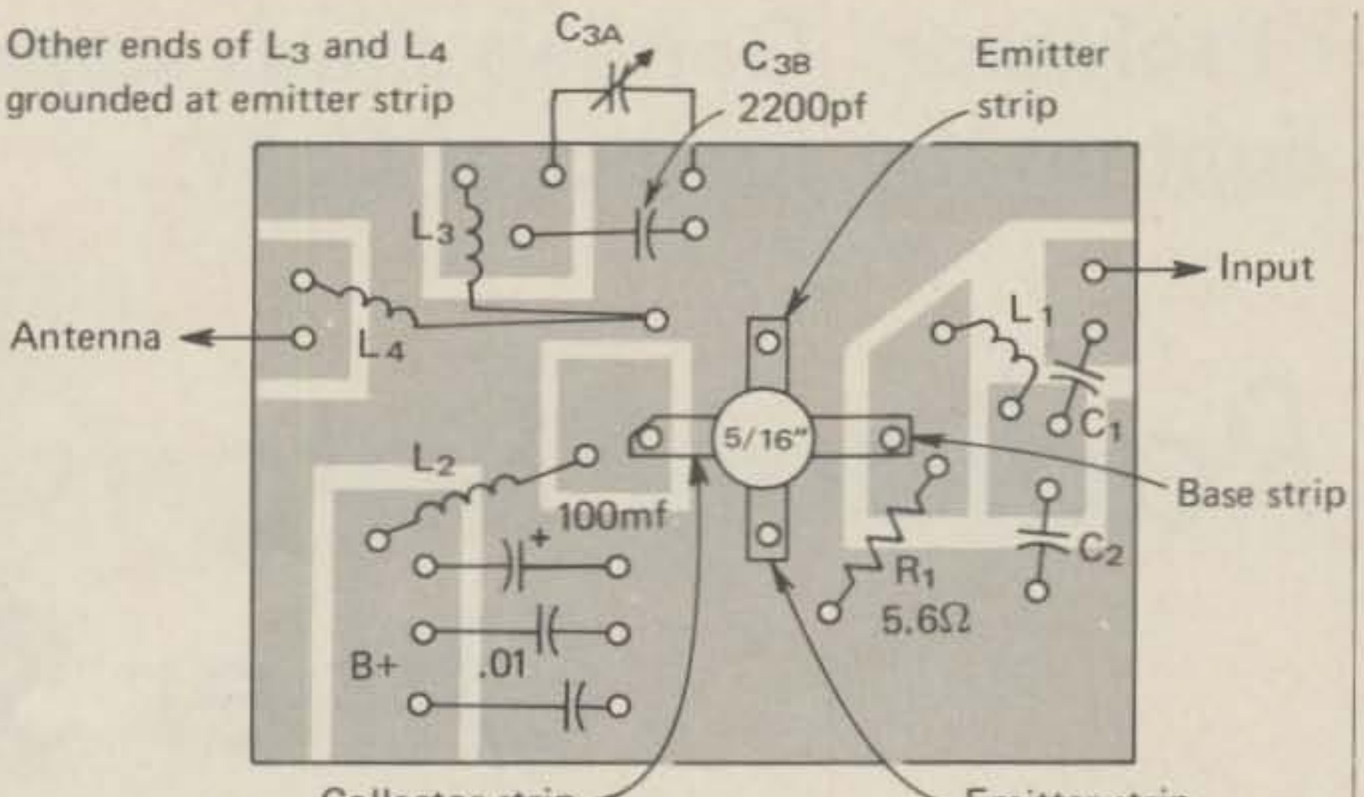


Fig. 2—Circuit of the solid state 13 watt amplifier for 160 meters. All grounds should be connected directly to the emitter strips of the 2N5590.

L_1—38 t. #24 e. on Amidon T-50-2 toroid.
L_2—4 t. #22 plastic covered, same direction of twist as L_3, beginning at dotted end of L_3.
L_3—25 t. #22 plastic covered, full circumference of Amidon T-68-2 toroid.
L_4—7 t. #22 plastic covered, same direction twist, begin at starred end of L_3.
L_5—44 t. #24 e. on Amidon T-68-2 toroid core, tapped at 15, 20, 25, 33 and 38 t.
L_6—44 t. #24 e. on Amidon T-68-2 toroid core, tapped at 15, 27 and 36 t.



(A)



(B)

Fig. 3—(A) Actual size printed circuit board layout for the 13 watt 160 meter amplifier, shown from the foil side. Parts placement is shown at (B).

to the final collector. If no indication can be obtained, increase coupling, or simply connect the input side of the wavemeter directly to the collector coil. Once indication is achieved, the input network is adjusted for maximum feedthrough, and then the collector tank (L_3-C_3) tuned for a peak.

Next, check for second and third harmonic energy with the wavemeter—if none is present, fine. If harmonics are present, try different settings for C_1-C_2-L_1 until the harmonics are nulled. Once these procedures are completed, B+ can be applied. The amplifier should "take off" immediately. All components should be repeaked for maximum output. The wavemeter should then be used to check for harmonics, and the general coverage receiver tuned a couple MHz both sides of amplifier frequency to insure that no "hash" is being generated.

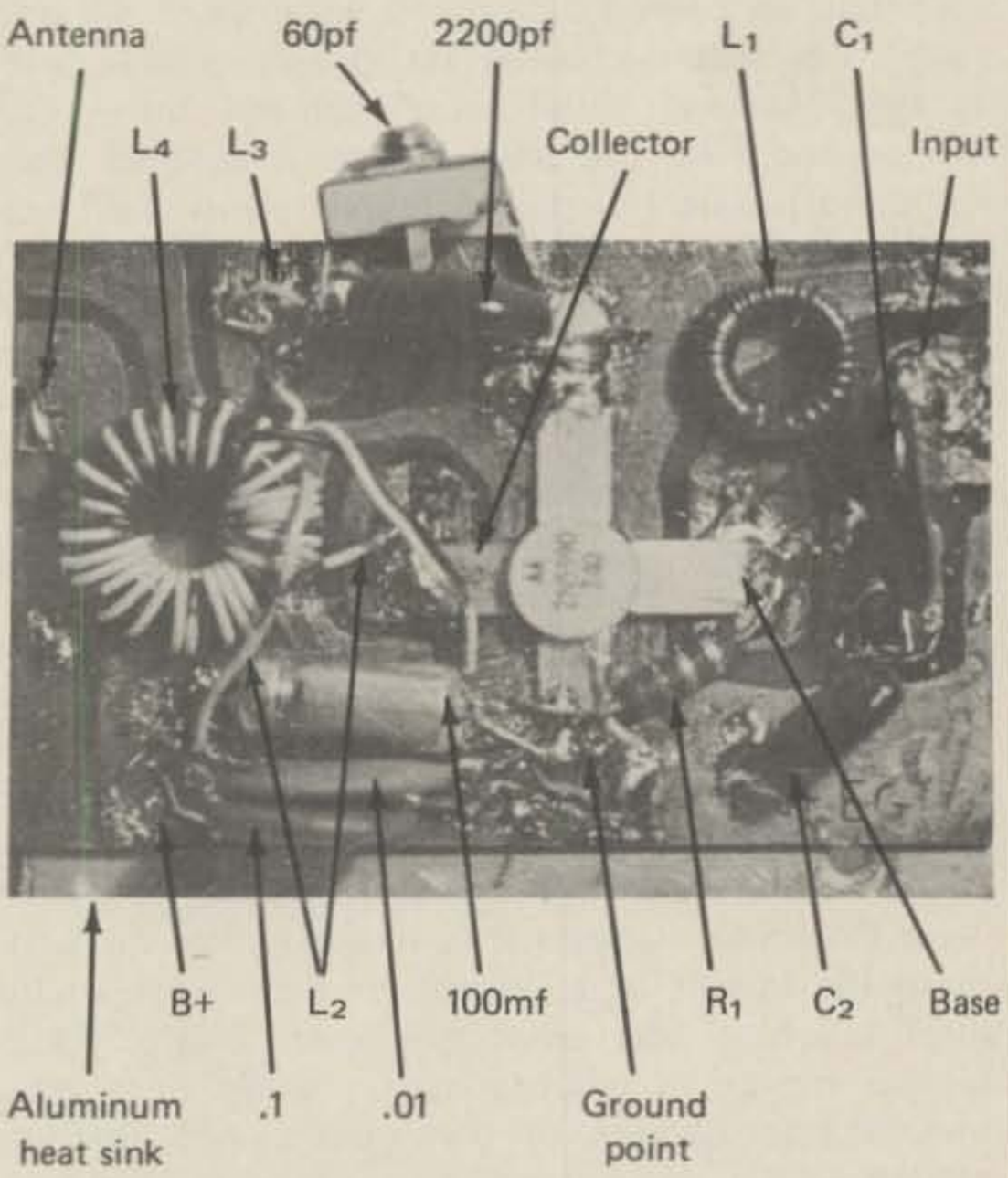
The variable capacitors for C_1 and C_2 can then be replaced by fixed silver mica capacitors until the proper capacitance values are reached. It may be necessary to make the final adjustment of the input network by compressing or spreading apart the turns of L_1. The amplifier is ready for installation and use.

Construction

Figure 3 shows an "isolated pad" p.c. board that will be useful for this and other power amplifiers. The heat sink consists simply of a piece of 3/32 inch or larger aluminum stock. Several thinner plates the size of the p.c. boards will serve equally well, so long as good thermal contact is achieved.

Since the 13 watt output was far in excess of my usual QRPp level of five watts, the s.p.d.t. B+ switch shown in the original transmitter was used to insert and remove a 62 ohm 2 watt series dropping resistor which carries the B+ to the driver collector. The v.f.o. draws its B+ directly from the B+ input post. The 62 ohm value was achieved by hacksawing into the carbon center of a standard two watt 47 ohm resistor until the reistance was

(Continued on page 74)



P.C. board layout showing C_3, mounting detail and method of taking all grounds to either upper or lower emitter strip.

"Professor" Gottlieb sheds some light on the subject of Light...

Radiant Photons and Other Scintillations

BY IRVING M. GOTTLIEB, W6HDM

Notwithstanding some suggestive evidence to the contrary, this author has long contended that hams are normal people—or at least, most of us tend towards normalcy *most of the time.* In any event, the nightmare which intruded upon my peaceful somnolence the other night probably was induced in much the same way that ordinary ilk (non-hams) fall prey to these disturbing experiences. Although I am not now able to recall whether I partook of such classical provocation of nocturnal scenarios as peanut-butter and sardines, I did engage in a rather fruitless DX quest, all the time guzzling several varieties of spirited brew. No sooner had I hit the sack, or so it seemed, this mundane hassle faded into oblivion and, lo! I occupied a ringside seat to the following flick:

Two slow-scan TV hams were QSOing via their video equipment and simultaneously over a voice-channel also. One was saying, "The **radiant intensity** of your picture is pretty good, OM, but it wouldn't hurt to **brighten** up the **irradiancy** a bit. And if you could get more **Lumens** on those large areas, the **hue** on the overall **contrast** would probably perk up some. Why don't you try for higher **luminous exitance** from your light source . . . but don't get too many **candelas** in the gray areas or your **illuminance** will be leaking all over the place."

At this point, I abruptly awoke in a cold sweat. Without resort to pun, the picture was only too clear—no Freudian analysis was needed, nor did I require the talents of a Joseph or Daniel for an interpretation. I had obviously been treated to a typical replay of what goes on when ham-radio invades the domain of ham-optics. And this includes LED's, solid state and gaseous readouts, electro-optics, lasers, and light-beam communication links, as well as SSTV! Let's face it gentlemen, our grasp of optical parlance is often limited to our

ABERRATION	**LUMINOUS FLUX**
APOSTILB	**LUMINOUS INTENSITY**
BRIGHTNESS	**LAMBERT**
BRILLIANCE	**NIT**
CANDELA	**OPAQUE**
CANDELA/UNIT AREA	**PHOSPHORESCENCE**
CANDLE/UNIT AREA	**PHOT**
CANDLEPOWER	**PHOTOMETRIC**
CHROMA	**PHOTON**
CHROMINANCE	**POWER**
COHERENCE	**PURKINJE EFFECT**
COLOR	**QUANTITY**
DIFFRACTION	**QUALITY**
DIFFUSE	**RADIANCE**
DISPERSION	**RADIOMETRIC**
EMITTANCE	**RADIANT EXCITANCE**
ENERGY	**RADIATION**
FLUORESCENCE	**REFLECTION**
FLUX	**REFRACTION**
FOOTCANDLE	**SATURATION**
FOOTLAMBERT	**SHADE**
HUE	**SOURCE INTENSITY**
ILLUMINANCE	**STERADIAN**
ILLUMINATION	**SURFACE INTENSITY**
INTENSITY	**SURFACE LUMINESCENCE**
IRRADIANCE	**TALBOT**
LASING	**TINT**
LUMEN	**TRANSLUSCENT**
LUX	**TRANSPARENT**
LUMEN HOUR	
LUMINESCENCE	

Fig. 1—Words found in spec-sheets on electro-optical devices. Devices include LED's, solid-state displays, solar cells, photo-diodes, photo-transistors, photo-FET's, semiconductor lasers, oscilloscopes, photo-multiplier tubes, image-converter tubes, image intensifiers, and gas lasers.

BEAUTIFUL . . . An oft-used adjective which neatly sums up good optical-technology and pleasing esthetics. (As with "nice," often beautifully mis-applied.)

BRILLIANT . . . Generally used in the same sense as "bright," or "intense." Also denotes a sparkling or glittering quality. This word fails to communicate rigorous meaning because "brightness" and "intensity" are different concepts in optics.

CHROMA . . . The quality of light perception which includes *color* and its *purity*. The purity of a color varies inversely with the amount of "noise," that is, *white light* mixed with it. Thus, pink, red, and deep-red describe chromas for the visible wavelength in the vicinity of 650 nanometers. In parlance more relevant to optics, chroma pertains to the response of the eye to the combined effects of *hue* and *saturation*.

CHROMINANCE . . . Pertaining to chroma, that is, to the "mix" of color and white light. Note that *brightness* is not involved. Thus, pale-pink may be either more or less bright than its "pure" constituent, *red*. An example of this is seen in a TV receiver wherein the color signal is processed in the *chrominance channel,* but the brightness information is handled separately in the *luminance channel*.

COLOR . . . The everyday term for *hue*. One of the two constituents of the quality, *chroma* (the other, being white light). The mind-eye sensation produced by different wavelengths within the visible spectrum produce the colors, some of which are simply identifiable by such names as violent, blue, green, yellow, orange, and red. (Black, white, and gray are not properly described as colors, but this is a difficult rule to abide by in the everyday experience.)

DIFFUSE . . . Light which has been either inadvertently, or purposely *scattered.* Such diffused light propagates in many directions and is not intensely polarized when it illuminates surfaces. With diffused light, a high brightness-level may be achieved with minimal glare.

HUE . . . A more inclusive and more precise identification of the optical wavelengths than the commonly-used word, "color." Rather than argue whether the maximum daylight sensitivity of the eye is to green-yellow or yellow-green, it is technically more rigorous to state that it occurs at a *hue* of 555 nanometers.

OPAQUE . . . The optical quality of a substance whereby light cannot pass through it. The meaning is directly opposite to that of *transparent*. Thus, steel is opaque to visible light.

SHADE . . . A mixture of a color with black.

TINT . . . A mixture of a color with white light.

TRANSLUCENT . . . Partially transparent by some dictionary definitions, but in optics the notion of imperfect, or diffused, light transmission is generally implied. Thus, a translucent material may conduct light, but not clear images.

TRANSPARENT . . . Implying clear and unimpeded transit of light. Window-glass is common example.

Fig. 2—Words which may be used to describe various aspects of light behavior. With the exception of "beautiful," these words have been extracted from the list of fig. 1.

ability to describe the dancing frivolities on the screen of the color boob-tube. (Some of us have not even read the labled adjustment-knobs!) Surely, an overview of this semantic debacle is very much in order. Nor is it far-fetched that even some of you peddlers of optodevices may profit from a little pedantic intimacy with relevant words! Indeed, if observation is a teacher, the ensuing discussion is properly dedicated to *all* of us (at least, *most of the time!).*

The underlying reason for such lingoistic confusion is that we are dealing with a deceptively complex subject. And if it is not inherently complex, it certainly has been made so by an abundance of units, non-standardization, and by somewhat differing philosophical approaches to the subject. Nor are we helped by the fact that there are three ways of "looking at radiation." The physicist often deals with the **photon system,** whereas applied technology is best served by the **radiometric system.** Finally, those who design and experiment with *optical* apparatus are more concerned with the **photometric** system of light quantities. Rather than attempt to squeeze a condensed course in radiation and optics into the few pages allotted for such an article, we will content ourselves to peruse a portion of the vocabulary attending these extensive subjects and try to capture a qualitative and dimensional feeling for many terms which are often misconstrued or misused.

ABERRATION . . . When incoming rays of light pass through a lens, they should converge at one point. Because of lens geometry, and because of the difference in the bending (refraction) imparted to different light frequencies (colors), this ideal may not be satisfactorily approximated. The focusing of the image is then blurred by such aberration.

DIFFRACTION . . . When light encounters an obstruction, it *spreads* somewhat around its edges. Thus, light emerging from a tiny hole will display a larger diameter than that of the hole. Similarly, light passing through a lens tends to focus into a small disk, rather than a point. Such spreading, or diffraction, reduces the resolution of the image.

FLUORESCENCE . . . Many substances emit light when excited by energy manifestations such as x-rays, ultra violet light, electrons, or visible light. The emitted light generally is of a longer wavelength than the impinging radiation. (Such fluorescence may persist for a *short* time after the excitation is turned off.) Example: Fluorescent Lamps.

ILLUMINATION . . . When objects are rendered visible by light reflected from their surfaces to the eye, the objects are said to be illuminated. In illumination, much interest usually centers on the source of the original light.

LASING . . . A unique mode of light production by stimulated emission from excited atoms. The uniqueness of the lasing process is that the light thereby generated tends to be a single frequency, coherent in time and space.

LUMINESCENCE . . . A generalized term for light generation other than that from incandescence. Luminescence includes both fluorescence and phosphorescence. Not to be confused with luminance (brightness).

PHOSPHORESCENCE . . . The light production by many substances for a *long* period of time after excitation from another energy source is turned off. Essentially, it is time of persistence that distinguishes phosphorescence from fluorescence. Example: Clocks with hands coated with radium salts. The hands glow after exposure to ordinary light.

PURKINJE EFFECT . . . As ambient lighting is dimmed, the response of the eye shifts away from the red region and towards the blue region of the color spectrum. Maximum response then tends toward a blue-green, rather than the yellow green mexima of bright daylight.

RADIATION . . . The emission of electromagnetic energy into space regardless of the frequency. Thus, radiation includes thermal, radio, visual, and x-ray energy. The propagation of energy by radiation does not require a medium to support transmission.

REFLECTION . . . The change in direction imparted to light rays which impinge upon a surface but do not penetrate therein. (Those rays which penetrate are either absorbed as heat energy, or refracted within the material.) Equally applicable to other radiation.

REFRACTION . . . Light rays which impinge upon a surface and thereafter continue *through* the material or substance, generally have their direction of travel altered. This *bending* constitutes refraction. Example: Light entering water from the air.

SATURATION . . . A term applied to a color which is "pure" to the extent that it is not mixed with white light. The less white light, the more *saturated* the color is said to be. This is suggestive of "signal to noise" ratio, where the "noise" in this case is white light.

Fig. 3—Words which denote various manifestations of light or other radiation. These words have been extracted from the list of fig. 1 because they represent important behaviorisms of light under different circumstances.

Figure 1 is just a list of words taken more-or-less randomly from literature on optical and electro-optical devices. It is by no means comprehensive —but it will prove sufficiently inclusive to serve our purpose in educating against gross mis-applications of descriptive and identifying words. If you can round up some spec sheets on LED's, displays, CRT's, photo-multiplier tubes, solar cells, photo-transistors, etc., you will surely find some of these terms. Our mission will be to cast some light upon these words, some, if not many of which may presently produce fuzzy mental images. The best way to undertake this task is by classification — we will endeavor to cut this long list down to size by dealing with groups of words which have things in common. For example, there are words which identify basic radiation phenomena. There are others which tend to be more descriptive in nature and are more often used as adjectives. And then, there are the names of units. It will be found that this systematic breakdown will alleviate any feelings of being "snowed" by the contents of fig. 1.

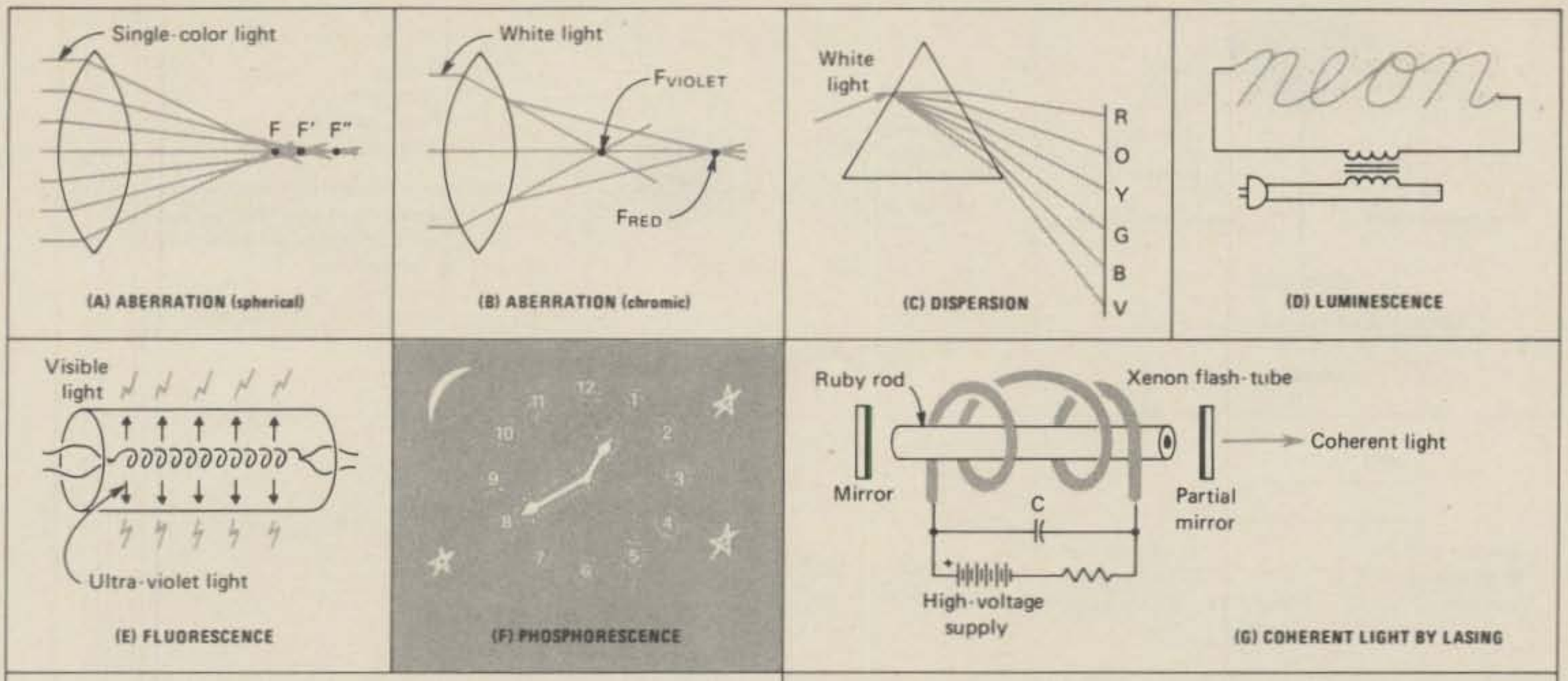
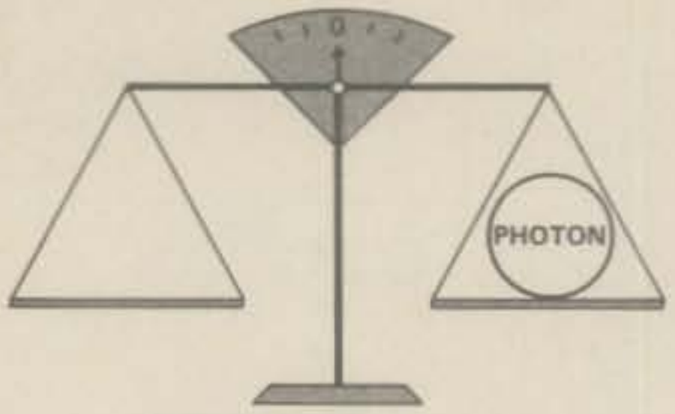


Fig. 4—Some common manifestations of light and their key words. (A) *Aberration,* from lense geometry (spherical aberration). (B) Aberation from selective bending of colors (chromatic aberration). Note the difference in the focal points of red and violet light. (C) Separation and spreading of the colors. This type of aberration is known as *dispersion*. (D) The production of visible light in a neon sign is a phenomenon of *luminescence*. (E) In the fluorescent lamp, ultra violet is generated by luminescence, but visible light is generated by fluorescence. (F) The hands of a clock glow in the dark because of *phosphorescence*. (G) The lasing process generates single-frequency coherent light. (H) The Purkinje Effect: Night (scotopic) vision is displaced toward the blue region from the day (photopic) vision. (I) *Reflection* is the return of light from a surface. *Refraction* is the bending of light rays which, having penetrated a surface, continue on their path through the new media.

In fig. 2 we concern ourselves with those words which describe, or which invoke description of various aspects of radiation and light. Everyday words like "brilliant" do serve mundane purposes without getting us into too much trouble. However, its loose usage can lead to the inference that it is an apropos substitute for *both* intensity and brightness. Such is not the case, inasmuch as brightness denotes intensity per unit area, or per unit solid-angle. This may sound like nit-picking, but such distinctions separate science from esthetics, and often, the men from the boys!

The list of words depicted in fig. 3 name important *behaviourisms* of light and other radiation. There is a greater tendency for these words to be used as nouns than most of those listed in fig. 2, and there is less likelihood of these terms cropping up in general conversation, especially involving those who are not technically-oriented. Allowing for some overlap, or gray area, the words listed in fig. 3 are a "lesson-ahead" of those in fig. 2. Further insight into the meanings and implications of these manifestations may be gleaned from the sketches in fig. 4. Note that the emphasis is on optical phenomena, and more precisely, on the visible portion of the radiation spectrum. (In radiation technology, "optical" manifestations embrace the cause-effect relationships which include the ultra-violet and the infra-red spectral regions.) Fluorescence and phosphorescence are *special* kinds of luminescence. And the difference between fluorescence and phosphorescence is in the duration of the "afterglow," (light emission after the source has been turned-off). Generally, phosphorescent substances



The rest-mass of the photon is zero.

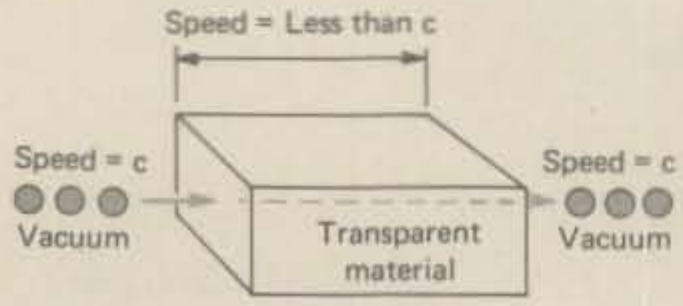
(A) MASS

$E = f \times h \times c$

E = Energy
f = Frequency
h = Plank's constant
c = speed of protons

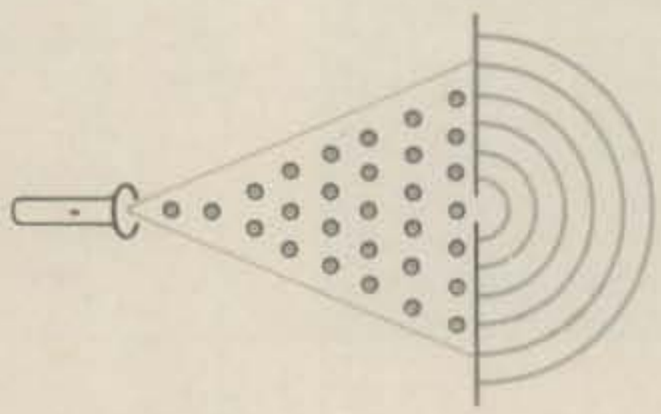
The energy content of the photon governs the frequency of its light manifestation.
Thus, "violet" photons are more energetic than "red" photons.

(B) ENERGY



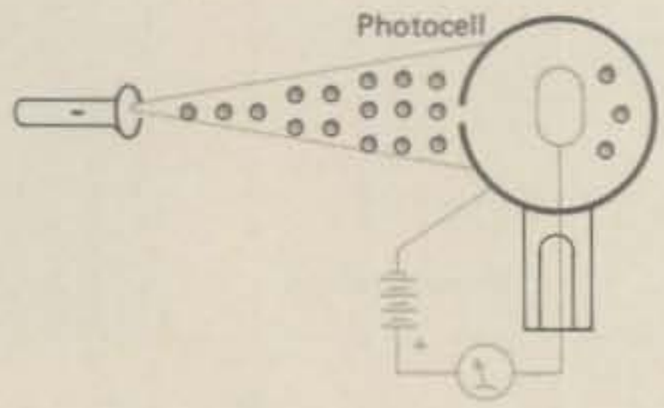
The speed of light photons in a vacuum is a constant of nature and is approximately 300,000 kilometers per second. Speed in gases, liquids, or solids is always *less*.

(C) SPEED



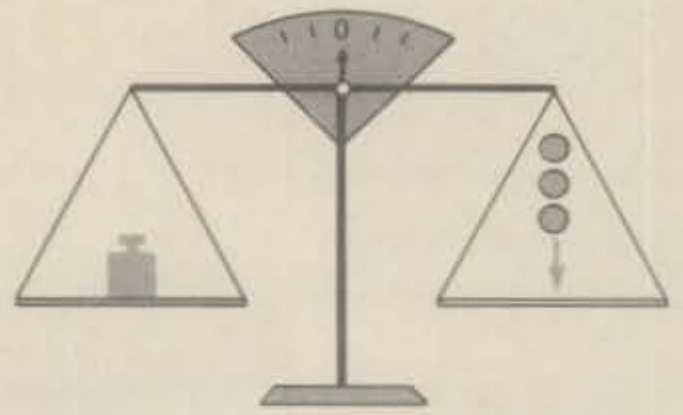
Diffraction pattern is a *wave* phenomenon.

(D) WAVE NATURE



Bombardment of photo-emissive material by "particles" produces electrons.

(E) PARTICLE NATURE



(F) PRESSURE

QUANTITY	PHOTON UNITS
Energy	Photon
Flux	Photon per second
Source intensity	Photon per second per steradian
Irradiance	Photon per second per square meter
Emittance	Photon per second per square meter
Radiance	Photon per second per steradian per square meter

(G)

Fig. 5—Some Properties of the photon, the "building block" of radiation and light. (A) The photon additionally has zero electric charge and zero magnetic field. (B) The energy of the photon is directly proportional to the frequency of its wave manifestation. (C) The speed of the photon in vacua cannot be exceeded by any other type of energy-transport. (D) "Pure" particles could not produce the circular pattern observed when the light beam is passed through a narrow slit or tiny hole. (E) Although the photo-electric effect is a particle-impact phenomenon, no electrons are released (not withstanding the number of impacts per second) unless *the photons have a certain minimum frequency, or threshold energy. (F) Extremely delicate torsion-balances have been constructed which actually measure the pressure exerted by a light beam. The drawing is only intended to convey the basic concept that photon energy manifests itself as a "push" when it impacts a surface. (G) Various radiation quantities can be measured or described in terms of photon units.*

are those which glow for seconds, minutes, or hours after being excited. Fluorescent substances ideally cease their light emission following excitation. Actually, most fluorescent substances require some time to decay to zero light output. If this short time is, nevertheless, important to the optical application, it is well to describe the substance as being *phosphorescent*. A case in point is the "*phosphor*" coating used in oscilloscope screens. Here, the afterglow, or persistence has importance. Conversely, the phosphor used in "fluorescent" lamps serves no useful purpose by virtue of whatever afterglow it may have.

Note, also, that aberration, dispersion, reflection, and refraction all deal with the intentional, or inadvertent change in direction of light rays. And, finally, it may come as a surprise to many that the color response of the eye changes with the brightness of ambient light. A more realistic rendition of color is had from the TV when some ambient brightness-level exists in the room, *providing* that the glow of the red phospors are bright enough.

(With earlier color TV tubes, this was not the case)

It is inescapable that we should have to delve somewhat into the physics of radiation. Paradoxically, the language becomes *simpler*. Behind and underneath all of the myriad phenomena and diverse manifestations is the simple *photon*. At least, the basic concept of the photon is a simple one. The main features of the photon are shown in fig. 5. In radiation and optics, one can become proficient with the relevant hardware sans much knowledge about the photon, just as skill with electronic circuitry is not necessarily predicated upon an intimate acquaintance with the electron. Yet, insight is enhanced in both disciplines if some rapport with the fundamental particle, or basic "building-block" has been established. In particular, it will prove rewarding to become acquainted with the table of radiation quantities shown in (g) of Fig. 5.

Quantity	Dimensional Concept	Description	Symbol	Unit(s)
Radiant Energy	Energy	This energy resides in the space surrounding a **source** which emits photons (or generates electromagnetic waves).	U	Joule, Erg, Watt-hour, Watt-second
Radiant Power or Radian Flux	Power	The rate of energy expediture from a **source** of photons (or electromagnetic waves).	P	Watt, Kilowatt, Milliwatt, etc.
Radiant Intensity	Power per unit solid angle	Defines the power contained in a unit solid angle or "beam" eminating from a **point-source** of radiant energy.	J	Watts per steradian.
Irradiance	Power per unit area	Measures the power density impinging upon a **surface.**	H	Watts per sq. meter, Watts per sq. foot, etc.
Radiant Exitance or Radiant Emittance (Sometimes)	Power per unit area	Measures the power density leaving a **surface** by reflection, transmission, or in some cases, by emission.	W	Watts per sq. meter, Watts per sq. foot, etc.
Radiance	Power per unit area per unit solid angle	Essentially a power-intensity concept in which each unit area of a **surface** is treated as an equivalent point-source of radiation.	N	Watts per sq. meter per steradian

Fig. 6—Radiometric quantities. An ideal radiometric detector or "eye" would have flat response encompassing the ultra-violet, visible, and infra-red regions of the spectrum, at the least. In principle, *the flat response of such a detector could extend to the X-ray region and to the microwave region, although the practical realization of such a wide-band device would incur formidable difficulties.)*

Note that all of the depicted quantities are expressed in terms of the photon. **Source intensity,** also called **radiant intensity** applies to **sources** of radiation, ideally "point" sources. What is measured here is the **flux** or **power** contained in a unit solid angle or "steradian." Dwell on this a moment: imagine a flashlight beam. The beam diverges or spreads, thereby forming a "solid angle." The radiant **flux,** or **power** contained in this beam, or in a known portion of it, is proportional to the source intensity of the tiny lamp.

The concept of **irradiance** is simple, too. The flux or power **impinging** on a unit area of a **surface** is the **irradiance.** It has the dimensional concept of **power density.** (If the impinging radiation is in the visible spectrum, the term irradiance would be replaced by **illumination,** or **illuminance.**)

Quantity	Corresponding Radiometric Quantity	Symbol	Unit(s)
Luminous Energy or Quantity of Light	**Radiant Energy**	Q	Lumen-hour, Lumen-sec., Talbot.
Luminous Power or Luminous Flux	**Radiant Power or Radiant Flux**	F	Lumen.
Luminous Intensity	**Radiant Intensity**	I	Candela, Candle, Candlepower, Hefner candle, International-candle.
Illuminance or Illumination	**Irradiance**	E	Lux, Lumen per sq. meter, Phot, Footcandle.
Luminous Exitance	**Radiant Exitance**	L	Same as above
Luminance or "Photometric Brightness"	**Radiance**	B	Candle per sq. meter, Candle per sq. foot, etc. Nit, Stilb, Apostilb, Lambert, Footlambert.

Fig. 7—Photometric quantities. The radiation detector required is the photopic (daylight responding) human eye, or a device displaying the same response.

Emittance, otherwise known as **radiant emittance,** or **radiant exitance,** is dimensionally the same measurement as irradiance. However, now we are dealing with the power density of the radiation *leaving* the surface. Obviously, the nature of the surface, its texture, "color," transparency, etc. comes into play here.

Finally, **radiance** is another way of measuring or describing the radiation *leaving* a surface. Here,

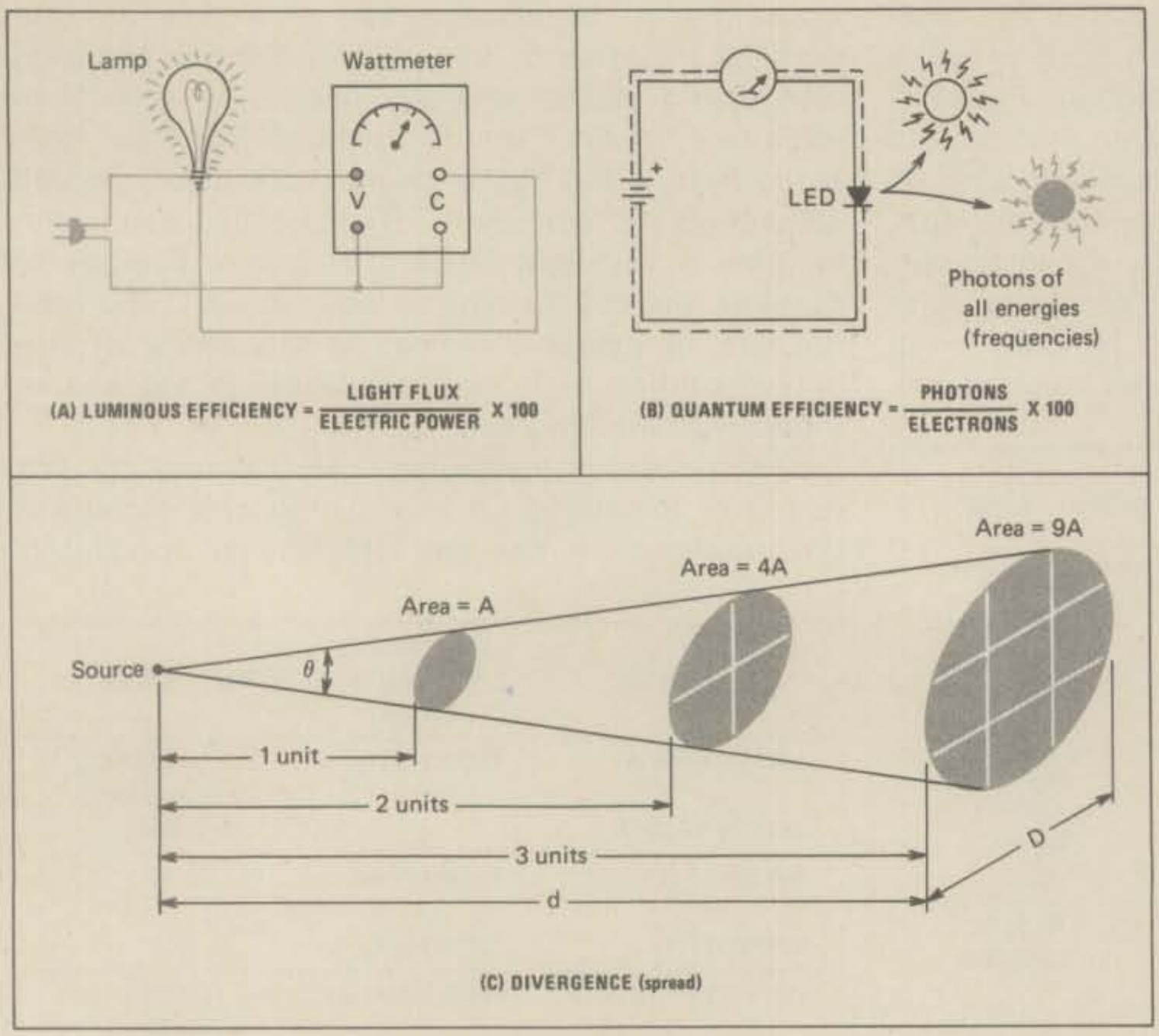


Fig. 8—Additional concepts pertinent to light and radiation. (A) The luminous efficiency of a light source compares the power (flux) residing in the visible radiation with the electrical input power. Instead of expressing this figure of merit as a percentage, it is often stated simply as so many Lumens per Watt. Thus, a 100 watt incandescent lamp (tungsten) may have a luminous efficiency on the order of 17 Lumens per Watt. Conversely, LED's may have luminous efficiencies ranging from less than one, to several-percent. It is also true that the frequency (color) selectivity curve for the eye depicts its luminous efficiency. (B) There are two quantum efficiencies for LED's. The internal quantum efficiency relates to the radiation generated in the junction itself and can range as high as 50%. The external quantum efficiency relates to the radiation actually available from the exterior of the device and is generally considerably lower because of transmission losses. (C) The divergence, or spread, of light is directly proportional to the square of the distance from the source. If the angle of divergence, θ, is small, and is expressed in radians, the diameter, D, of the light circle is equal to the distance, d, from the source times θ. (D and d must be expressed in identical units.)

each unit area of the surface is treated as a point source of radiation. Thus, *both* **areas** and **solid angles** are needed to produce the unit of radiance.

Inasmuch as most of these quantities involve radiant flux or radiant power (photon-per-second units), the various concepts depend on how the flux is geometrically *distributed* and/or whether a source or surface is involved. There should be no confusion thus far. But be patient! Opportunity for confusion will not be lacking as we penetrate further into what will become a veritable tug-of-war between physicists and illumination engineers, as well as between British and metric units. As hinted earlier, we are not going to resolve the battle of units in this article, but will try to clarify the implication of the basic radiation quantities. The surprisingly large number of units encountered in the visible region of the radiation spectrum can be connected by conversion factors which can be ferreted out of engineering handbooks.

So much for our brief encounter with photons. In applied technology, we are more likely to be involved with the units which appear in fig. 6. Note that the same radiation quantities are under consideration. However, now the units which describe the origin and distribution of radiant flux (power) are old familiar friends—watts, milliwatts, kilowatts, etc. Be sure to study the *Description* column of this table. Doing so will tie things together and will pave the way for ready comprehension of the quantities shown in fig. 7. This is the real objective of this article.

Actually, the quantities in fig. 7 repeat those listed in fig. 6, despite the different nomenclature. The name-changes stem from the fact that we are now restricting consideration to radiation which is *visible to the eye, i.e.,* approximately from 400 to 700 nanometers. Such spectral selectivity is implied by the term, "photometric." The only real difficulty in transferring thought from fig. 6 to fig. 7 involves the matter of the numerous photometric units. With regard to the intent of this article, it should suffice to realize that this situation is analagous to using miles, kilometers, yards, and other linear units to depict distance. (In both cases, there exist appropriate conversion units connecting the various units). It is relevant to note, however, that extreme caution must be employed when computing problems in photometric radiation—it is, oh so easy, to foul up!

A typical light problem might give the required or measured illumination, "*E*," impinging upon a surface. This will be so many foot-candles, or lumens-per-square-foot. (the two units are numerically identical). If the distance in feet, "*d*," between source and surface is known, what is the luminous intensity, "*I*," of the source? The basic equation connecting these quantities is $I = d^2 \times E$. "*I*," in this case, is given in candlepower, candela, candles, or in lumens-per-steradian. (All, numerically identical.) It so happens that illumination measurements are conveniently made by placing an instrument known as an illuminometer on the illum-

(Continued on page 74)

Output frequencies (MHz)

Input frequencies (MHz)	145.58	146.28	146.34	146.46	146.64	146.70	146.76	146.79	146.80	146.82	146.85	146.88	146.91	146.94	146.97	146.987	147.06	147.12	147.30	147.39	147.42	147.45	Total
145.20													1										1
145.62												1											1
146.01					1																		1
146.04					1																		1
146.10						1						1			1								3
146.16						1	13						1		1								16
146.19															1								1
146.20							1	1	4														6
146.22											13		1		1						1	1	17
146.25							1					3	1		1								6
146.28							2	1					16		1		1						21
146.31							1					2	1	1	1								6
146.34	1		1				35				1	1	1		84			1					125
146.37							1									3							4
147.38															1								1
146.46				1	1								6		3		2						13
146.76							1																1
146.83						1													1				2
146.94		1		1			1								1								4
147.45																						2	2
147.50																						2	2
147.80																	1						1
Total	1	1	1	2	3	3	56	2	4	14	8	28	1	96	3	1	3	1	1	1	1	4	235

Table I—Input and output frequencies used by 2 meter repeaters—1972.

A Survey:

Two Meter Repeater Growth 1972—1975

BY ALEX. F. BURR, W5QNQ

Most Amateurs recognize that two meter f.m. is currently the fastest growing segment of our hobby; but few realize just how fast that growth has been. There is one aspect of this growth which is quite unusual. The increase in repeaters from about 250 in 1972 to over 1100 in 1975, just 4 years later, is an obvious factor in this growth. While the growth is obvious, it is not so evident that the growth has been extraordinarily orderly. It is to the great credit of Amateurs, repeater groups, and regional organizations of repeater groups that the f.m. scene today is less chaotic than it was in 1972.

All the data on which the statistics in this article are based have been taken from the 1972 and 1975-1976 repeater directories compiled by the ARRL. These directories do not, of course, list every repeater, and Amateurs being the incurable experimenters that they are, it is impossible to keep any list of repeaters up to date. However, these directories are the best readily available and provide a homogeneous data base which permit trends to be accurately identified. In compiling the following tables only those two meter repeaters which were listed as open or available to all Amateurs were considered.

In 1972 the ARRL issued its first repeater directory. Several other lists were already circulating and 2 meter f.m. was well into its period of exceptional growth. Frequencies used by repeaters were scattered all over the upper part of the 2 meter band.

Table I shows all the various frequencies which were used in 1972 by two or more open repeaters. In this table the input frequencies are listed on the left and the output frequencies are listed at the top. The number at the intersection of any two lines repre-

(Continued on page 75)

Table II—Unique 2 Meter Repeater Pairs—1972.

Input Frequency (MHz)	*Output Frequency (MHz)*
145.155	146.90
145.25	146.75
145.66	145.30
146.11	146.61
146.52	146.19
146.58	147.03
146.61	147.33
147.12	147.68
147.18	147.84
147.21	147.21
147.40	147.81

CQ WORLD WIDE WPX/SSB CONTEST

0000 GMT MARCH 27-2400 GMT MARCH 28, 1976

SPECIAL BICENTENNIAL PREFIXES FEATURED

I Contest Period: Starts 0000 GMT Saturday. Ends: 2400 GMT Sunday. Only 30 hours of the 48 hour contest period permitted for Single Operator stations. The 18 hours of non-operating time may be taken in up to 5 periods anytime during the contest, and must be clearly indicated on the log. Multi-operator stations may operate the full 48 hours.

II Objective: Object of the contest is for amateurs around the world to contact as many amateurs in other parts of the world as possible during the contest period.

III Bands: All bands, 1.8 thru 28 MHz may be used, but operation is confined to two-way single side band *only*.

IV Type of Competition: 1. Single Operator (a) All Band, (b) Single Band. 2. Multi-operator, All Band, *only*. (a) Single Transmitter, (only one signal permitted), (b) Multi-Transmitter, (one signal per band permitted).

V Exchange: Five figure serial number, RS report plus a progressive three digit contact number starting with 001 for the first contact. (Continue to four digits if past 1000) Multi-Transmitter stations use separate numbers for each band.

VI Points: 1. Contacts between stations on different continents; count 3 points on the 14, 21, and 28 MHz bands, and 6 points on the 7, 3.5 and 1.8 MHz bands.

2. Contacts between stations in the same continent but not in the same country; count 1 point on 14, 21 and 28 MHz, and 2 points on 7, 3.5 and 1.8 MHz. (Exception: Contacts between different North American countries count 2 points on 14, 21 and 28 MHz, and 4 points on 7, 3.5 and 1.8 MHz. This applies to North American countries *only).*

3. Contacts are permitted between stations in the same country for the purpose of obtaining a Prefix multiplier, but have no QSO point value.

VII Multiplier: The multiplier is determined by the number of different prefixes worked.

A "prefix" is considered to be the two or three letter/number combinations which forms the first part of an amateur call. (W1, W2, WA2, DL1, DJ, 4X4, 5A1 etc. See WPX rules.)

Each prefix may be counted only *once* during the contest.

Exception: During the *1976 WPX Contest* a double multiplier (2) may be counted *once* for *each different special prefix* as authorized by the FCC. (Example: AA1, AB2, AC8, AD0, AH6, AJ3, etc.) for use by United States amateurs to celebrate the USA Bicentennial. (These contest QSO's may also count toward the *CQ* Special Bicentennial Achievement Award, "USA-WPX-76." See rules in Oct. 1975 *CQ*, p. 27.)

Note: USA amateurs may submit log entries for utilizing the special Bicentennial call prefix, or the regular call, or both, at the same station location. Separate logs are required when submitted for both prefixes. Each such log received will be judged as a separate station entry. Each must be in compliance with these rules.

VIII Scoring: 1. Single Operator (a) All Band score, total QSO points from all bands multiplied by the number of different Prefixes worked. (b) Single Band score, QSO points on that band multiplied by the number of different Prefixes worked. See VII.

2. Multi-Operated stations. Scoring in both these categories is the same as the All Band scoring for Single Operator.

3. A station may be worked once on each band for QSO point credit. However, prefix credit can be taken only *once* regardless of the band.

IX Awards: Certificates will be awarded to the highest scoring station in each category listed under Sec. IV.

1. In every participating country.

2. In each call area of the United States, Canada and Australia.

All scores will be published. However, to be elegible for an award, a Single Operator station must show a minimum of 12 hours of operation. Multi-operator stations must show a minimum of 24 hours.

A single band log is eligible for a single award *only*. If a log contains more than one band it will be judged as an all band entry, unless specified otherwise. However, a 12 hour minimum is required on the single band.

In countries or sections where the returns justify, 2nd and 3rd place awards will be made.

X Trophy & Plaques: *(Donors)*

1. WORLD—Single Operator, Single Band. *(Jack Reichert, W3ZKH)*

2. WORLD—Single Operator, All Band. *(Don Murray, K4FMA)*

3. WORLD—Multi-operator, Single transmitter. The Ted Thorpe, ZL2AWJ Memorial. *(Don Miller, W9WNV)*

4. WORLD—Multi-operator, Multi-transmitter. The Chuck Swain, K7LMU Memorial. *(Don Miller, W9WNV)*

5. USA—Single Operator, Single Band. The Joe Johnson, W5QBM Memorial, *(Richardson Wireless Klub)*

6. USA — Single Operator, All Band. The Joe Hiller, W40PM Memorial. *(Jerry Hagen, WA6GLD)*

7. *CANADA*—Single Operator, Single Band. *(Gene Krehbiel, VE7KB)*

8. CANADA — Single Operator, All Band. *(Garth Hamilton, VE3EUP)*

9. WORLD — Contest Manager's Plaque. To the DXpedition especially organized and operated in the WPX Contest, that the Committee considers the most worthy. (A minimum of three logs must be received. *Bernie Welch, W8IMZ)*

XI Club Competition: A club award is being considered, provided interest continues to increase, and additional logs are received indicating the fact.

XII Log Instructions: 1. All times must be in GMT. The 18 hour non-operating periods must be clearly shown.

2. Prefix multipliers should be entered *only* the FIRST TIME they are contacted.

3. Logs must be checked for duplicate contacts and prefix multipliers. Recopied logs must be in their original form, with corrections clearly indicated.

4. A prefix check list is not only desirable but a *must* for proper contest operation. (It is recommended that you also send it along with your contest log.)

5. Each entry must be accompanied by a Summary Sheet listing all scoring information, the category of competition and the contestant's name and mailing address in BLOCK LETTERS.

Also a signed declaration that all contest rules and regulations for amateur radio in the country of the contestant, have been observed.

6. Official log and summary sheets are available from *CQ*. A large self-addressed envelope with sufficient postage or IRCs must accompany your request.

If official forms are not available you can make your own with 40 contacts to the page.

XIV Deadline: All entries must be postmarked no later than May 10, 1976. From rare isolated areas the deadline will be made more flexible. Your support is appreciated.

Logs go to: *CQ* WPX SSB Contest Committee, 14 Vanderventer Avenue, Port Washington, NY 11050 USA.

Year 1976

CQ World Wide WPX SSB Contest CQ

Last Full Weekend of March

Call Sign AC8IMZ | Country U.S.A.

☒ Single Operator: ☒ All Band ☐ Single Band

☐ Multi-Operator (All Band Only): ☐ Single Transmitter ☐ Multi-Transmitter

	QSO's (minus duplicates)		QSO Points		Prefix		Score		Rest Periods (Single Operator Stations Only)
1.8 mc	12	→	24	×	4	=		1.8 mc	0200 to 0400
3.5 mc	21	→	42	×	18	=		3.5 mc	0630 to 1100
7.0 mc	—	→	—	×	—	=		7.0 mc	2130 to 0430
14 mc	142	→	332	×	93	=		14 mc	0700 to 1000
21 mc	66	→	173	×	34	=		21 mc	2230 to 2400
28 mc	39	→	130	×	29	=	↓	28 mc	
All Bands	280	→	701	×	178	=	124,778	All Bands	Total: 18 Hrs.

Realtime = FINAL SCORE

Remarks (Biggest thrill in Contest, funniest story, comments, etc.): SEE SEPARATE LOG ENCLOSED FOR MY CONTEST OPERATION, SINGLE BAND, SINGLE OP, ON 7 MHz AS W8IMZ, AT THE SAME STATION LOCATION.

This is to certify that in this contest I have operated my transmitter within the limitations of my license and have observed fully the rules and regulations of the contest.

(Signature) Bernie Welch

Type or Print

Name BERNIE WELCH Call AC8IMZ

Address 7735 REDBANK LANE

City DAYTON,

State or Country OHIO - USA Zip 45424

Logs must be postmarked no later than May 10 75

Note: Duplicate QSO's can mean disqualification.

Mail to: CQ Contest Committee
14 Vanderventer Ave.
Port Washington, N.Y., U.S.A. 11050

CQ Form 1076 - 1972

1976

WORLD-WIDE WPX SSB CONTEST

CALL LX1BW Log For 21 Mc Band COUNTRY LUXEMBOURG

Page 5 of 10 Pages

DATE / Time GMT	STATION	SERIAL NUMBER Sent	SERIAL NUMBER Received	Fill in only when QSO is mult. PREFIX = MULT.		Points
1613	EA6BJ	59 152	59188	EA6	1	1
32	XX60Z	59 153	59422	XX6	1	3
36	EA8CR	59 154	59422	EA8	1	
44	TR8DG	59 155	59234	TR8	1	
1702	VP5B	59 156	59512	VP5	1	
13	AD1DWQ	55 157	56049	AD1	2	
16	AD1YXK	59 158	58189			
30	AC1WY	57 159	57063	AC1	2	
31	AC1GYE	59 160	59101			
49	AB2SQN	59 161	59233	AB2	2	
1801	AJ4AST	59 162	59401	AJ4	2	
05	XE1LLS	57 163	57201	XE1	1	
10	AJ3AA	57 164	56063	AJ3	2	
13	AC8IMZ	56 165	59083	AC8	2	
15	AB8IAY	58 166	57100	AB8	2	
17	AA8ZAN	58 167	57100	AA8	2	
20	AB8VLG	54 168	57031			
28	W8BI	59 169	59071	W8	1	
41	AC4SYL/5	58 170	45091	AC5	2	
59	K6SSS	[illegible] 171	59068	[illegible]		
1900						

27 MARCH

35	WA8ULI/4	[illegible]	376	4XØ		
OFF — 2040		0640	= 10 Hours			—
0641	LX2HH	59183	59118	LX2	1	0
53	HV3SJ	59184	59122	HV3	1	1
0710	AD1DWQ	185	084			DUP.
15	VE3EUP	59186	59402	VE3	1	3
20	AD4IIF	59187	58199	AD4	2	
21	AC4WSF	59188	59301	AC4	2	
22	W4WSF	59189	59101	W4	1	
31	AD4KZZ	59190	59299			

28 MAR.

TOTAL POINTS THIS SHEET 51 107

CQ Form 1069 eff. Feb. 1968

CQ Reviews: The KLM Multi-2000 2-Meter FM/SSB/CW Transceiver

BY HUGH R. PAUL, W6POK

The Multi 2000 is a recent entry into the US amateur market, one which has created considerable interest among two meter operators. The unit is currently being imported and distributed by KLM. Until recently International Telecommunications Corporation was the importer and was the source of the unit tested.

The Multi 2000 has a number of interesting features. A phase locked loop frequency synthesizer covers the entire 144 MHz to 148 MHz region in 10 kHz steps. Ten watts of wide or narrow band f.m., c.w. or 15 watts PEP on s.s.b. Mars and CAP frequencies above 148 MHz can be covered with crystal control from a three-position auxiliary oscillator. For repeater operation, a 600 kHz transmit offset, either above or below the receive frequency, is switch selectable.

A receiver incremental tuning control allows you to shift the receive frequency, plus or minus 5 kHz. With the RIT control in the off position, you can shift both the transmit and receive frequency, plus or minus 7 kHz, by means of the variable crystal oscillator control.

There is also a switch marked "test," which when pressed, keys the push-to-talk line and an 800 cycle audio oscillator to modulate the rig in any mode.

Add a high-low power switch, a noise blanker, an r.f. gain control and you end up with a crowded, but functional front panel.

Construction

The rig is housed in a heavy gauge, two piece steel cabinet. Remove nine screws and the top lifts off. Remove three more and the entire unit can be lifted out of the bottom half of the cabinet.

The majority of components have been mounted on eleven main etched circuit boards, mounted above, below and within a sturdy steel frame, chassis combination. The circuit boards are constructed of a heavy phenolic material. I prefer glass epoxy. The additional manufacturing cost is so slight, that I can't understand why they would use anything else. I don't want to mislead anyone. These are good quality boards with heavy foil, laid deep into the board. They are better quality than some of the thinner glass boards currently being used by a number of manufacturers. It's just that I have this thing about Mil Spec boards.

Most component identification is clearly silk screened on the top of the boards and in addition they have silk screened the outline of the foil on the top sides. This can be a big help in troubleshooting. I wish I could say the same for the instruction book. It is terrible. Not only is the English difficult to understand, but it fails to mention things like the location of the deviation control. Even the block diagram has a number of errors. The schematic is so small, that anyone with less than 20-20 vision will find it impossible. It too, has errors in labeling of wiring, etc.

There was a note attached to the instruction book stating that the importer (ITC) was preparing a new one, which would be mailed to all registered owners as soon as received from the printers. Perhaps now that KLM is marketing the unit, this will be rectified.

The power supply is built on the chassis, at the back of the unit. The regulator transistors are heavily heat sinked, as are the r.f. power transistors and the audio IC package.

Synthesizer

The heart of the transceiver is, of course the frequency synthesizer. Employing 13 IC's and a number of transistors, in a phase-lock loop system, this one displays extremely high accuracy and stability.

The location oscillator is crystal controlled in the region of 13.9 MHz. It is this oscillator, which is shifted by the RIT and VXO controls, thus providing for transmitting and receiving on frequencies between the switch-selected 10 kHz points.

The 13.9 MHz LCO output is multiplied nine times to the 125 MHz region and is, in turn, injected into a high level mixer with the 130-MHz-region signal from the voltage control oscillator. The resulting 4 MHz mixer signal is amplified and passed through buffer stages to the *1/N* frequency divider, where it is divided by ratios of 200 to 399. The result is a 10 kHz signal, which will be phase compared

with the channel oscillator signal.

The channel oscillator is crystal controlled at 10 MHz. After the 10 MHz is processed through three 1/10 dividers, the resulting 10 kHz is applied to the phase comparator. The phase comparator produces an output proportional to the difference between the two 10 kHz signals. This output is amplified and a control voltage is applied to the Varicap diode of the voltage control oscillator. The change in capacity of the Varicap, shifts the frequency of the VCO until the comparator no longer detects any phase difference between the two 10 kHz signals.

The KLM Multi-2000 2-meter FM/SSB/CW transceiver.

Receiver

The receiver section employs double conversion in the f.m. mode and single conversion for s.s.b. The first i.f., which is common to both modes, is 16.9 MHz. The second i.f. is 455 kHz.

A dual gate MOSFET is used as an r.f. amplifier, followed by a JFET in combination with a three section helical resonator, which acts as a band pass filter. The first mixer is another MOSFET where the incoming signal mixes with the 127 MHz to 131 MHz output from the synthesizer to produce 16.9 MHz. The design of the first three stages, in my opinion, is excellent.

Following the first mixer is a single-section crystal filter and then the first of the 16.9 MHz i.f. stages. The noise blanking process takes place in this stage. Noise pulses are sampled from the i.f. transformer primary, amplified by an IC network, rectified and the resulting d.c. pulses applied to the gate of an FET. The FET provides some amplification and squaring of the pulses, prior to their being applied to the junction of a pair of blanking diodes. The pulses cause the diodes to conduct, thus cutting off the i.f. signal during the time duration of the pulses.

There is no provision for adjustment of input level to the blanker circuit and in my opinion, the level in my unit is a bit too high, resulting in a degradation of the desired i.f. signal. The noise blanker circuit is not as effective as some of the more complex ones being used in other imported transceivers, but is still worthwhile in the s.s.b. mode.

After the noise blanker has done it's job, the i.f. signal enters another transformer. In the secondary of this transformer, the s.s.b. and f.m. signals are separated for further processing.

The f.m. signal is applied to the second mixer and converted to 455 kHz, then passed through a ceramic filter, two i.f. amplifier stages, a limiter and is finally detected at the discriminator.

The s.s.b. signal continues at 16.9 MHz through another i.f. amplifier, then by means of a diode switch, is routed through the crystal filter and i.f. amplifier shared with the transmitter section. From there the signal passes through two more i.f. stages, finally being detected in a diode ring demodulator.

AGC is derived from the last 455 kHz i.f. stage for f.m. and the last 16.9 MHz i.f. stage, for s.s.b. AGC is then applied to the r.f. amplifier and the first 16.9 MHz i.f. amplifier. AGC action is not sufficient to prevent overload when receiving a couple of the stronger local repeater signals. The r.f. gain control is a necessity for these stations.

Sensitivity of the receiver in the f.m. mode is excellent. Over most of the band, squelch opened with 0.1 microvolt and 20 db of quieting was achieved with 0.2 microvolt. At the very low end of the band, squelch opened with 0.15 microvolt and 0.3 microvolt was required for 20 db of quieting. SSB sensitivity averaged 0.15 microvolt for 10 db signal-plus-noise-to-noise.

Manufacturer's selectivity specifications are 15 kHz at −6 db, shape factor 2.5:1 on f.m. and 2.4 kHz at −6 db, shape factor of 2:1 on s.s.b. Tests verified these specifications. An attempt was made to operate on one of the new split channel repeater assignments. It is very difficult with the receiver's 15 kHz bandwidth.

Split channeling is developing rapidly in some of the larger metropolitan areas. The manufacturer will no doubt be required to provide, either switchable crystal filters or forego the wideband capability of the receiver if the full market potential for the transceiver is to be realized.

The squelch circuit is unique. The threshold is

distinct and yet, as you advance it beyond the threshold it tightens up very slowly. At the full on position, it can still be opened by the stronger stations.

In addition to the S meter, the transceiver has a zero center meter to indicate off frequency tuning of the receiver. Tests revealed that each division was equal to about 1.1 kHz and is linear in readout either side of zero. On my transceiver, I found that the meter was indicating in reverse. Stations higher in meter reading were in fact lower in frequency. A simple reversing of the leads from the d.c. meter amplifier to the meter should solve that problem.

Two watts of audio at less than 10% distortion is available from an IC amplifier package, rated at 5 watts. An external speaker jack is provided, but is unnecessary. The built in 3" one does a fine job.

Transmitter

In the transmitter section we find modulation accomplished by two stages of audio amplification followed by a diode limiter and another stage of audio amplification. There are two outputs available, one for wide band f.m. and s.s.b., the other for narrow band f.m. In the former, audio is taken directly from the output of the third audio stage and either applied to a Varicap diode at the input of the synthesizer's voltage control oscillator for f.m., or to the modulator for s.s.b.

In the narrow band f.m. position, audio is taken from the third audio stage thru a 5 K pot. This allows adjustment of the deviation from zero to about 12 kHz, which is the fixed deviation realized when the wide band f.m. position is selected. Remember that the selection of the wide band or narrow band position with the transceiver's mode switch determines only the amount of deviation to be realized. It in no way affects the receiver selectivity.

C.w. is accomplished by plugging a key into the jack on the back of the unit and keying the push to talk line and the 800 cycle test oscillator mentioned earlier in the article. The 800 cycle audio is applied to the audio limiter stage through a buffer amplifier. It is also used to provide a tone for monitoring your keying. You will soon notice that you are also keying the transmit-receive relays. This is a situation to which they will no doubt react adversely, if you are an ardent c.w. man. A better way is available: The accessory plug on the back, gives you access to the push to talk line. Grounding this line turns the transmitter on and you can then key the oscillator without the relay clatter.

A word of caution: You are actually keying an audio oscillator in the s.s.b. mode. This means that you must unplug the microphone or stray audio will also be present on the signal. Perhaps the manufacturer will consider installing a switch on the front panel which will ground the push to talk line and at the same time, open the microphone audio line.

144 MHz r.f. output is achieved by mixing the130 MHz signal from the synthesizer with 16.9 MHz from a crystal oscillator for f.m. or with the 16.9 MHz upper side band signal for s.s.b. Following this mixer are three lower level r.f. amplifier stages, a driver stage and finally, a single NPN transistor, designated 2SC1177 does the job of delivering the r.f.

An outstanding job has been accomplished in the design of the driver and final amplifier section. From board layout to heat sinking and shielding, it's top notch. In the past couple of months, I have evaluated two solid state 10 watt f.m. broadcast exciters. None were any better in the design and contruction techniques used in the amplifier sections. Both fell behind the Multi 2000, when it came to shielding.

Following the transmitter final is another shielded assembly containing a harmonic filter, the protective circuitry for the final amplifier and the a.l.c. circuit. The protective circuit samples a high standing wave ratio. The rectified r.f. supplies d.c. to a silicon controlled rectifier, which when it fires, in turn lowers the collector voltage on the first low level r.f. amplifier, thus reducing the drive to the following amplifier stages. The a.l.c. circuit is conventional and seems to work well.

Transmitter power output was measured through the band and found to be a minimum of 12 watts and a maximum of 12.4 watts S.s.b. produced a minimum of 12.7 watts PEP and a maximum of 14 watts PEP. Power measurement while operating with 13.9 v.d.c. was almost identical to that obtained with operation on 117 v.a.c.

Spectrum analysis in the high power f.m. mode revealed a spur about 4 MHz above the carrier frequency, which was only 18 db below the power output at the desired frequency. In checking rigs owned by others, it was learned that some also exhibited this spur and/or one at 16.9 MHz. Further investigation resulted in a cure for this problem.

Careful re-alignment of the transmitter convertor and driver stages while observing the transmitter output on a spectrum analyzer dropped the level of the spurs to a more acceptable figure. In the case of my Multi 2000 the spur dropped to a –46 db. All other spurious signals were better than a –50 db. Since the average amateur does not have access to a spectrum analyzer, it would be wise for the importer to measure the spurious from each unit, prior to delivery.[1]

On s.s.b., spectrum analysis revealed third order products to be 29 db below a single tone of a two tone test. Suppression of unwanted sideband was 49 db and carrier suppression was 4 db.

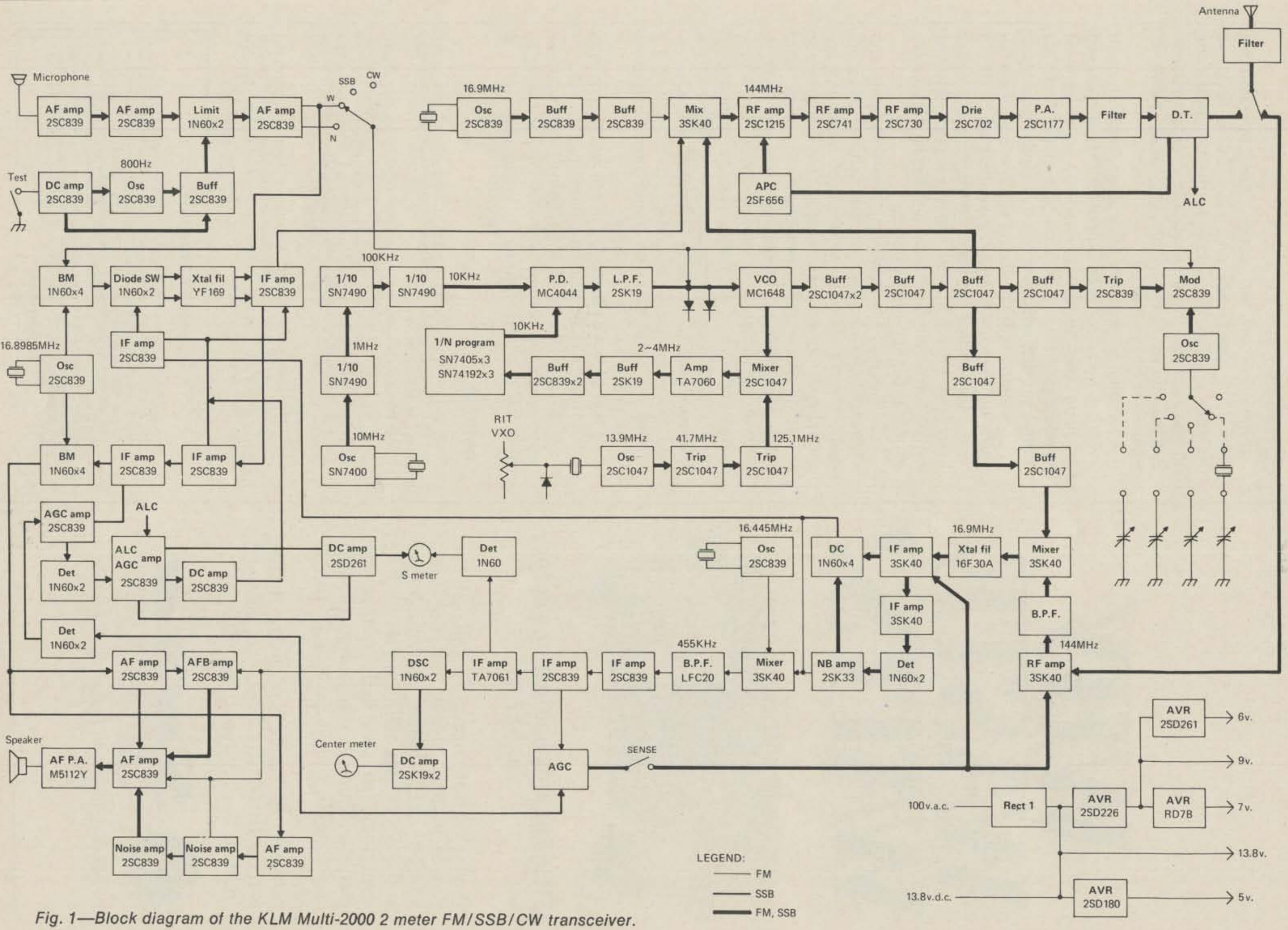


Fig. 1—Block diagram of the KLM Multi-2000 2 meter FM/SSB/CW transceiver.

Operation

During the past few weeks I have operated the Multi 2000 extensively and have found it to be versatile and fun to operate. In the f.m. mode the rig has received more unsolicited compliments regarding audio quality than any other piece of equipment I have owned.

A number of contacts have been made through Oscars 6 and 7. Power output of the unit proved adequate when used with a ground plane on most passes nearer than one thousand miles. The VXO control proved adequate for frequency excursions while working through Oscar, but the lack of a v.f.o. was a bit frustrating when looking for s.s.b. QSO's on the low end of the band. If your main 2 meter interest is f.m. than you will appreciate the fine synthesizer in the Multi 2000 and the lack of a v.f.o. will not prove a negative factor.

Extensive effort to measure crossmodulation and intermodulation products in the receiver, was not made. I don't know at what signal levels the importer made these measurements. They claim figures of −80 db and −70 db respectively. However, what I did was inject r.f. signals of sufficient level to achieve full quieting of the receiver. No crossmodulation was discernable and no evidence of intermodulation products appeared on the spectrum analyzer display. At higher injection levels, intermodulation products, of course, developed, but I believe the receiver to be better than most units on the market, in this respect.

All test data was compiled in the electronics labs of the University of Southern California

My special thanks to Gary Sprong, WB6IOJ, for taking time from his two way radio service work to verify the sensitivity figures for the receiver. ■

Footnote

[1] Since submission of the evaluation to the publisher, the author has had the opportunity of discussing the Multi-2000 with Mel Farrer of KLM Electronics.

Mel has assured me that since they have taken over distribution, all units are being checked on a spectrum analyzer. If required, the units are being re-aligned to insure that all spurious is below the published specification. In addition, a new operator's manual, correcting the deficiencies mentioned in the article, has been prepared. A copy will be mailed to every registered owner.

For those of you who may wish to put some shoes on the Multi-2000, KLM will soon have available a power amplifier that matches the cabinet design of the transceiver. We will report on the unit as soon as it becomes available.

Forecast of Things to Come

Want the finest in long-range forecasts of radio propagation conditions? Want to set a sked to any place in the world? *CQ*'s propagation Column can give you all the answers with hard-to-beat accuracy. It'll even tell you what sort of signal strenght to expect! Months in advance!

But if you're looking for super-accurate short term forcasts, you can get them for the price of a phone call to *CQ*'s Exclusive Dial-A-Prop service. Just dial 516 883-6223 any time day or night for a 2-minute pre-recorded forecast covering the eight-day period from Tuesday through Tuesday, revised every Tuesday . . . more often if necessary. Remember: 516 883-6223. Available only through *CQ*.

The "Impossible" Challenge: DXCC QRPp

BY ADRIAN WEISS, K8EEG
QRP Editor, *CQ*

THERE must be somewhere in the vicinity of a thousand "awards" available to competition and service oriented radio amateurs these days. But only a few—a very few in fact—really stick out as "impossible challenges. 160 Meter DXCC is one such challenge. Working 100 countries with less than five watts output seems equally ridiculous. Or so it seemed back in the latter half of 1970 when I, as Editor of *The Milliwatt: National Journal of QRPp,* toyed with the idea of offering two new awards for DXCC at the five watt and one watt levels. At the time, only a few fellows had managed to work WAS QRPp!

Responses from seasoned DX'rs and veteran QRPp'rs were almost unanimous: "Can't be done, so why bother," "Ya gotta be kidding," "Better get a check-up OM." The whole idea sounded crazy, but I went ahead with the official announcement of *DXCC QRPp* (five watts output) and *DXCC MILLIWATT* (one watt output) in the April, 1971, issue of *The Milliwatt.* John Attaway, K4IIF, obligingly carried the announcement in his DX Column in *CQ.* It wasn't long until K4OCE snapped up the first *DXCC QRPp* Trophy with an enviable stack of QSL's. Four years later, Sandy Sadowsky, W2GRR, becomes the second operator to meet the seemingly impossible challenge—QSL's from 100 ARRL countries verifying contacts made while he was running five watts output or less. What does such an achievement involve? Let's let W2GRR tell his own story.

What could possibly motivate an avid DXer/contester/certificate hunter to give up his kilowatt and speech processor for a transceiver capable of running a mere five watts input? In this time of low sun spots and overcrowded bands, one might answer that the aforemenioned DXer must have suffered a severe blow to the head or a prolonged loss of oxygen to his brain. Well, I'm the guy that did it, and this is my story.

I was undergoing one of my yearly ebbs in enthusiasm for Amateur Radio. With high power and a four element 20 meter yagi situated in the backyard of my hilltop QTH the challenge had all but vanished from my hobby. If some unwary DX station dared show his head on Kilowatt alley (14.200-14.225 MHz), my processed audio would be one of the first to be heard. One day after working an AP2 I sat back lazily thumbing through a copy of *CQ* as I listened to 100 hungry stations attempting to work the station with whom I had just chatted. I suddenly came across something even more impressive than the AP2. It was a photograph of a lovely bikini-clad lady who, I discovered about 60 seconds later, was holding aloft a couple of trophies. The picture was located in Adrian Weiss' QRPp column, a column which I had not previously read. After all, what interest could a man who runs a kilowatt have in a QRPp column? Some time later, after I had thoroughly studied the photograph, I read the caption and discovered that one of the trophies was offered by the *Milliwatt Magazine* to any ham who could offer QSL confirmations for contacts with 100 countries while never running more than 5 watts output. I laughed to myself thinking that Ade Weiss and his *Milliwatt Magazine* would certainly never go broke buying trophies offered for an impossible task. Sure, I'd worked well over DXCC in one contest weekend, but with my station that was no great task. "How

The antenna at W2GRR—four elements on 20 meters at about 40 ft. It isn't much, considering some of the aluminum the big-gun KW's push to 100 ft. or more! Like the Old Man said: "it's the man at the key that counts!"

W2GRR at the operating position which netted him DXCC QRPp no. 2. Sandy's occupation (airline pilot) aided his quest for the trophy by enabling him to "be there" when a rare one "popped up." But nothing can overshadow his enthusiasm, patience, and determination in his successful achievement of the almost impossible task! More recently, Sandy has branched out into long-distance running and tries to get in at least ten miles a day on the track. He's in some condition for a DX-hound: a local MD had him on the treadmill for a heart check-up and gave up after a couple hours work wouldn't push Sandy's pulse rate above 160 or turn up any heart function abnormalities! Not bad for a guy who sits at the Argo tuning for "new ones" for hours-on-end!

could one hope to even get out of his backyard with five watts?" I wondered to myself as the pileup on the AP2 became more frantic. My appetite was certainly whetted, and with thoughts of trophies and bikinis (not necessarily in that order), I quickly tuned my rig to the 20 c.w. band, and carefully loaded up my rig to just under five watts output: I would see for myself if one could possibly contact another Amateur more than two blocks away with 5 watts. I found myself on a frequency on which SM6AOU was in QSO with a station. I patiently (never before could I use that adjective to describe my Ham activities, but it was a virtue I was soon to develop) awaited the end of the QSO, and then called the Swedish station, *certainly not* expecting a reply. Wow! The guy actually came back to me, and gave me a signal report of 559! I was stunned, excited and at that moment hopelessly bitten by the QRPp bug. I felt the same as I did some twenty years previous, when as a new Novice operator, a station finally answered my 158th CQ.

I purchased a TenTec Argonaut, a nifty little QRPp transceiver, and put my main rig up for sale. My first hours of operation with my Argonaut were during the last 3 hours of the ARRL DX contest in March of 1974. To my amazement I discovered that I was making DX contacts quite easily, and in three hours worked numerous countries in 5 continents! My first month of operation was spent strictly on c.w. By now I had learned the true meaning of the word "patience," and I think I developed more operating skills in that month than in my previous 20 years combined. My many hours spent in daily tuning, listening, waiting, pleading, and calling netted me fifty countries worked that first month.

I had not yet tried my little Argonaut on s.s.b., because in spite of my unbelievable success on c.w., I was convinced that five watts p.e.p. would work nothing. One day I ventured up to my old home (Kilowatt Alley) just to listen around. I was startled to hear JW1SO calling CQ, and I was terribly disappointed that I had sold my "big" rig a week previously, because I needed Svalbard Island for my non-QRPp country total. He finished calling, and in desperation I shouted into my microphone, "DOUBLE-YOU TWOO GERMANNY RADIOO RADIOO, DOUBLE-YOU TWOO GERMANNY RADIOO RADIOO." He came back to me! As it turns out I was the only station calling, but I had netted a new country, and a rather rare one at that, with my first QRPp s.s.b. contact. I was soon to have my most exciting moment of my ham career on QRPp s.s.b.

One morning about 0030 local time, I came across a gigantic pile-up on 14210 kHz. The object of the commotion was 5W1AU in Western Samoa. I listened for about ½ hour as he gave one W6 after another 59 signal reports, and needless to say I didn't waste my breath trying to break through the "RF Curtain" on the West Coast with my 5 watts. I heard no East coast stations calling, but being a weekday I suppose most were in bed. (As an airline pilot with lots of time off, I have the advantage of being able to work DX at "unusual" times.) Finally 5W1AU answered a W9, and gave him a 57 report. I was suddenly inspired, and knowing that there was no chance for my signal to travel 7,000 miles plus through the West Coast pile-up, I picked up my microphone, and yelled my call twice. 5W1AU's next words were, W2GRR you are 59, over." I was so shook up I could hardly answer, and with the gang patiently (maybe not so patiently) waiting, I said, "wait a minute, I'm only running 5 watts, do you really mean that I'm actually 59?" His reply was that when the skip is right you can work them on a wet noodle. That contact left me high for two weeks, but my biggest surprise was still to come. One night at 2000 local time I had a solid ten minute QSO in Kilowatt Alley with VK4ZQ—longpath! I don't know what the distance is long path, but from New Jersey the short path to Australia is some 10,000 miles. My signal report was 53!

With just under three months of QRPp operation, and 88 countries worked, I discovered the YL International Single Side Band System. This friendly service oriented group of hams meets daily from 1600Z until sometime in the evening on 14332 kHz. Their primary purpose is the handling of emergency traffic, and they have check-ins from all over the United States and the world to facilitate the timely handling of any emergency traffic that might arise. When no emergencies exist members are able to work one another. They are very helpful to QRP operators, and frequently stand by for QRP check-ins. My first two days of operation on this wonderful system netted me contacts with the following goodies: 7X2BK, 5T5LO, SV1BV, ZB2CF and 5U7BB. I frankly could never have had the QRPp results that I experienced without the help of the YL ISSB, and I certainly thank them. Appropriately enough on June 26, 1974, just 3 months and 13 days after my first QRPp QSO, I worked my 100th country on the YL ISSB—TG9EP. Anyone who has set themselves a difficult goal, and finally achieves it, can appreciate my elation upon achieving QRPp DXCC. Although three months and 13 days sounds like a short

(Continued on page 74)

WILLIAM I. ORR, W6SAI, ON

Antennas

"Nothing enrages a vulture as much as biting into a glass eye," remarked Pendergast.

"Why do you say that?" I inquired.

Pendergast did not reply, but the copy of the *Appliance Operator* magazine he was reading was tossed into a graceful arc, landing in the waste basket.

"It is the end of DX," replied my friend in an angry voice. "Can you imagine making two pee-wee islands in Canada into two new 'countries'? It boggles the mind! What next?"

"This opens up a world of possibilities," I replied. "Think big. Why, all the National Parks in the U.S. can become separate 'countries'. Take Yellowstone Park, for instance. It's run by the National Park Service, has its own Police Force, and has a different color on the map than the surrounding states! It is a natural for a new 'country'. Or how about Treasure Island in San Francisco bay? It's under Navy jurisdiction, not the state of California. It has its own Fleet Post Office address and the autos on the island have Navy license plates, not California plates. And how about Manhattan island? If it were a new 'country' and the Manhattan hams charged a dollar a QSL card, they could bail New York city out of all its financial difficulties . . ."

"Stop!" commanded Pendergast, holding up his hand in mock protest. "I have my own private means of compensation. Goodbye to false 'countries' and hello to v.h.f. DX! I'm thinking of going up to 2 meters and I'm getting interested in moonbounce work!"

"Have you seen the latest issue of *CQ-Ham Radio* from Japan? It has a feature article on moonbounce communication and a lot of information on the 144 MHz contact between JA6DR and W6PO. And plenty of good pictures of moonbounce antennas and v.h.f. stations in JA-land."

My friend brightened up. "Well, maybe it isn't the end of DX after all. Just because the 20 meter DXers are fooling around doesn't mean that DX is really dead."

"Right," I exclaimed. "There's a lot of DX activity on 144 MHz, 220 MHz and 432 MHz. Take 2 meters. My friend W6PO is up to 33 states via moonbounce and meteor scatter, 4 continents, and has worked over 40 stations via moonbounce. And there are others who have higher totals than his."

Pendergast took out his black notebook, with a serious expression on his face. "Tell me all about it," he commanded. "Especially the antenna problem."

E-M-E path loss	Distance miles (kM)	50MHz (db)	144MHz (db)	432MHz (db)	1296MHz (db)	2400MHz (db)
Perigee	221,463 (356,334)	177.89	187.08	196.62	206.17	211.43
Apogee	252,710 (406,610)	179.03	188.21	197.76	207.21	212.56

Fig. 1—Free space path loss for earth-moon-earth circuit when the moon is at perigee (221,463 miles) and apogee (252,710 miles). The nominal 1.4 decibel difference in signal loss between perigee and apogee becomes 2.28 decibels for the round trip to the moon and back. For a marginal circuit, the additional loss may make the difference between success and failure. The chart is based upon a transmitter power output of one miliwatt.

"The *first* problem to solve is which band to use," I said. "An error of choice at the beginning of the game could turn out to be very expensive and time consuming. As you know, radio signals traveling through space are attenuated as the square of the ratio of the frequency. Consequently, the path loss to the moon and back is 8.3 times (9 db) greater on 144 MHz than on 50 MHz, and a similar increase in path loss occurs between 144 MHz and 420 MHz and between 420 MHz and 1250 MHz. Figure 1 shows the loss, based upon 1 milliwatt of radiated power.

"In addition, transmitter efficiency tends to decrease and receiver noise

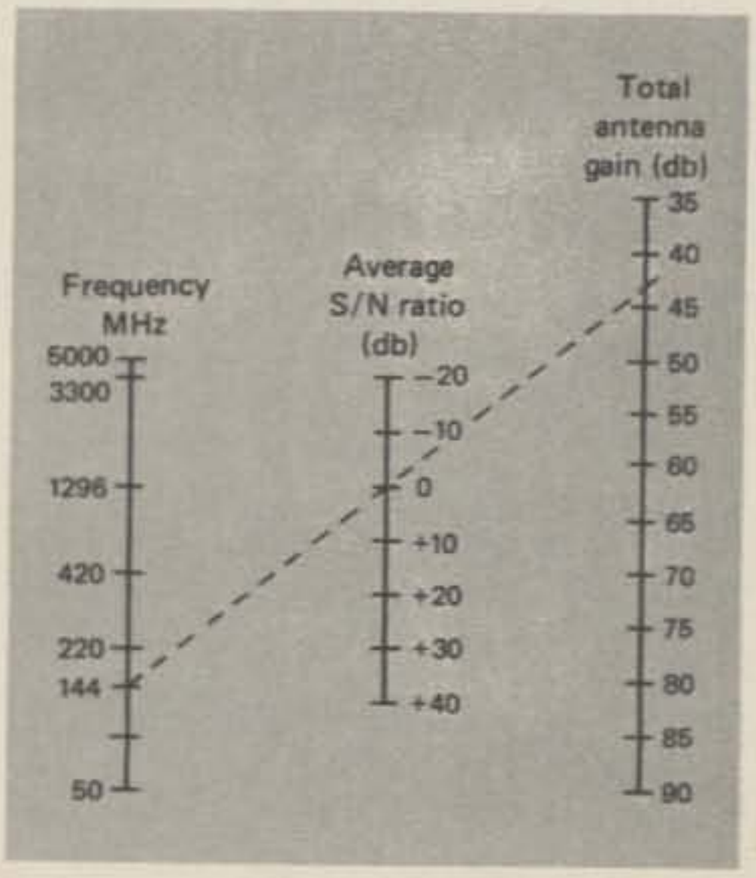
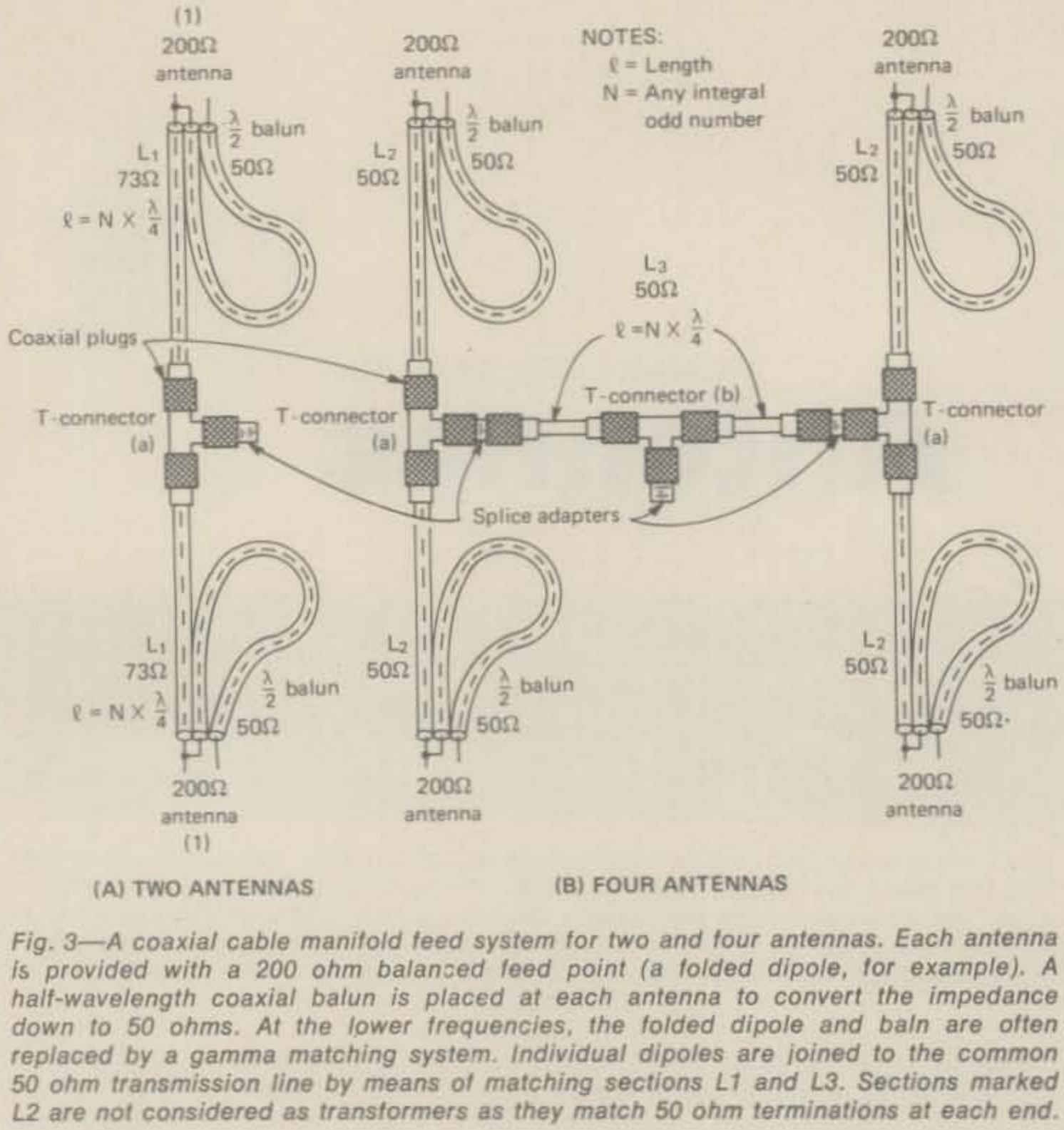


Fig. 2—Moonbounce nomograph provides guideline to successful EME contact. The graph is based upon 590 watts output, zero decibel receiver noise and 100 Hz bandwidth. Lay a straight edge across any two columns and read the desired unknown in the third column. The antenna gain figures represent a compromise between calculated gain required based upon free space losses and the experience of successful moon bounce experimenters. At 144 MHz, for example, for an average signal-to-noise ratio of two decibels, a total antenna gain (for both ends of the path) is about 44 decibels. The graph shows an example for a zero decibel signal-to-noise ratio, but this is impractical at 144 MHz because of sky temperature noise. The zero decibel figure, however, is quite practical at 432 MHz, where the sky noise is lower.



(A) TWO ANTENNAS (B) FOUR ANTENNAS

Fig. 3—A coaxial cable manifold feed system for two and four antennas. Each antenna is provided with a 200 ohm balanced feed point (a folded dipole, for example). A half-wavelength coaxial balun is placed at each antenna to convert the impedance down to 50 ohms. At the lower frequencies, the folded dipole and baln are often replaced by a gamma matching system. Individual dipoles are joined to the common 50 ohm transmission line by means of matching sections L1 and L3. Sections marked L2 are not considered as transformers as they match 50 ohm terminations at each end.

and transmission line loss increase with increasing frequency. So there are compelling reasons to use as low an operating frequency as necessary."

"It sounds as if 50 MHz is the band to use," muttered Pendergast.

"On the other hand," I continued, "the power gain of a directive antenna of a given size increases by the same ratio that the path loss increases and, because the antenna gain is realized in both transmission and reception at each end of the circuit, there is a net signal gain with increase in frequency, even after deducting the increased circuit path losses."

"Well, then, 420 MHz is the band to use," said Pendergast.

Which Band to Use for Moonbounce?

"I would think that at the present state of v.h.f. technology, the various gain and loss factors seem to combine most favorably on the 420 MHz band. Conventional tubes work well and you can generate the necessary power at this frequency. Good, low noise receivers are easy to make. In addition, conventional stacked, multi-element Yagi and collinear antennas of reasonable size are relatively easy to assemble and provide sufficient gain for successful EME (earth-moon-earth) communication. And there are operational 420 moonbounce stations in many parts of the world."

I took a big breath and continued. "The 220 MHz band is a difficult one because it is not an international assignment and it has a lot of QRM from channel 13 TV 'spill-over' in many areas. And a lot of fellows are reluctant to make the substantial investment in time and money if the band is going to be split up for the Citizens Radio Service."

"You sound as if 144 MHz may be *the* band for EME work," observed my friend.

"It is a personal opinion," I replied. "To date, most amateur moonbounce contacts have taken place on the 2 meter band. That's where the action seems to be, as of right now."

"How much power is needed? What about antenna gain?" asked Pendergast.

"Well, look at the chart of fig. 2," I replied. "The right-hand scale is total antenna gain for the EME circuit. The example shows that if a 144 MHz station at one end of a moonbounce circuit is equipped with an antenna having a gain of 26 db over a dipole, the station at the other end will need only a 17 db antenna to provide an average signal-to-noise ratio of zero db. This graph is based upon a transmitter power output of 590 watts, zero db receiver noise figure and 100 Hz receiver bandwidth."

"And two stations using 22 db beam antennas can do the job," said Pendergast.

"This is the average situation," I replied. "Don't forget that at 220 MHz and below, sky temperature changes make a zero db noise figure impractical. About the best you can achieve is 2 db noise figure. Anything much better than that will just 'hear' more noise."

"Any other problems?" asked Pendergast.

"The free space path loss varies about 2.28 db on the round trip, because the orbit of the moon is not a perfect circle, the distance to the moon varying between 221,463 miles and 252,710 miles. And you also have to take Faraday Rotation and Doppler Shift into account."

Faraday Rotation and Doppler Shift

"This sounds more complicated than 20 meters," groaned Pendergast. "What are these problems? What do they mean to the newcomer on EME?"

"Take Faraday rotation. When a radio signal travels to the moon, it may be rotated in polarization several times before it strikes the moon. When the signal is reflected back to the earth, any rotation present is enhanced on the return journey. Faraday rotation is produced by the effects of the earth's magnetic field and the resulting polarization change produces a cyclic fade in the moon-reflected signal because the path length is continually changing. On 144 Mhz the fade is quite slow, and most moonbouncers merely work around it.

"Doppler shift is the change in frequency of the received signal due to the relative motions of the moon and the earth. At the equator, the shift in Hertz is 2.966 times the frequency in MegaHertz. When the moon is rising, the received frequency is increased; when it is setting, the frequency is decreased."

"Wow," said Pendergast, shaking his head in amazement. "It sounds as if moonbounce communication is really pushing the state-of-the-art, as far as amateur radio is concerned."

"That's right," I agreed. "The moon only reflects 7 percent of the signal that strikes it, and that portion of the

signal is re-radiated and diffused all over space. The fraction of the echo signal that returns to earth is spread over an area of about 98,470,000 square miles. Compare this vast area to that of even the largest 144 MHz antenna! Obviously only a small fraction of the transmitted power ever reaches the receiving antenna after the round trip to the moon. Yet, amateurs are having QSO's regularly by moon reflected signals on both sideband and c.w. So you see why moonbounce has challenged the best talents of many of the world's most skilled v.h.f. amateurs. No wonder they don't get excited when a new 'country' is invented by over-eager DXers!"

Active Moonbounce Antennas

"Leaving aside the problems of locating and tracking the moon, let's look at the moonbounce antenna for 144 MHz. The *ante* to get into EME is an antenna, steerable in both azimuth and elevation, that provides about 20 db gain over a dipole. Practical moonbounce antennas often consist of an array of beam antennas. Stacking two or more antennas to obtain additional power gain or directivity requires that each antenna in the array be fed an equal amount of power in the proper phase. The power to the array, therefore, must be divided evenly between the antennas. The secret of success is the use of a completely symmetrical feed system which applies power to the driven element of each array in equal fashion. A *manifold feed system,* such as shown in fig. 3 is one way of doing the job. This illustrates the method of feeding two, or four, Yagi antennas from a single coaxial line. The driven element of each Yagi has a balun and matching device so the antenna presents a 50 ohm termination. Typically, this may be done with a folded dipole driven element having the proper impedance transformation, and a half-wavelength balun. There are several other ways of accomplishing this, including the gamma match, and the omega match."

I paused as Pendergast continued to write in his notebook. "The individual dipoles are then joined to the main transmission line via quarter-wavelength matching transformers. In fig. 3A each dipole and balun combination is adjusted to 50 ohms at point (1) and the impedance is then stepped up to 112 ohms by virtue of the 75 ohm coaxial transformer section. At point (a) the two 112 ohm terminals are placed in parallel to provide a nominal impedance of about 56 ohms, which closely matches the impedance of the main transmission line. Adjustments are made by monitoring the s.w.r. in the main line.

"Figure 3B shows how four antennas may be matched and fed with a 50 ohm line. Again, each driven element is a folded dipole having a 200 ohm termination that is transformed to 50 ohms with the aid of a half-wave coaxial balun. The remainder of the harness is made up of 50 ohm coaxial line. The section designated as L2 is not considered as a transformer and the length is unimportant, as long as all L2 sections have equal length. At points (a) on each side of the harness, the two sections are connected in parallel to provide a nominal impedance of 25 ohms. Sections L3 are 50 ohm transformer sections which provide a step-up transformation to 100 ohms in each instance. Parallel the two terminals at point (b) to provide a nominal 50 ohm terminal to match the transmission line."

"How do you mount such a monster in the air?" asked my friend, as he looked at the illustration.

"Obviously you need a very rugged framework to keep all that antenna and harness in the air. Figure 4 shows you the general idea. This frame is designed to support four long 144 MHz Yagi beam antennas. The cross-bracing is important to counteract wind forces.

"Some amateurs having even larger arrays than this use tower sections for the horizontal portion of the boom structure. Some very impressive designs are shown in the photographs."

"Well, how many individual antennas do you need to get the job done?" demanded Pendergast. "It looks to me that it's almost an impossible task."

"It is possible to make a good estimate," I replied. "One of the most popular arrays is made up of 8 Yagi beams, stacked four over four, as shown in fig. 5. A widely-used Yagi is the 7-element job shown in the *ARRL VHF Manual.* A conservative estimate of gain for this antenna is 11 db. Two antennas, properly stacked one above the other should give you twice the field strength, or

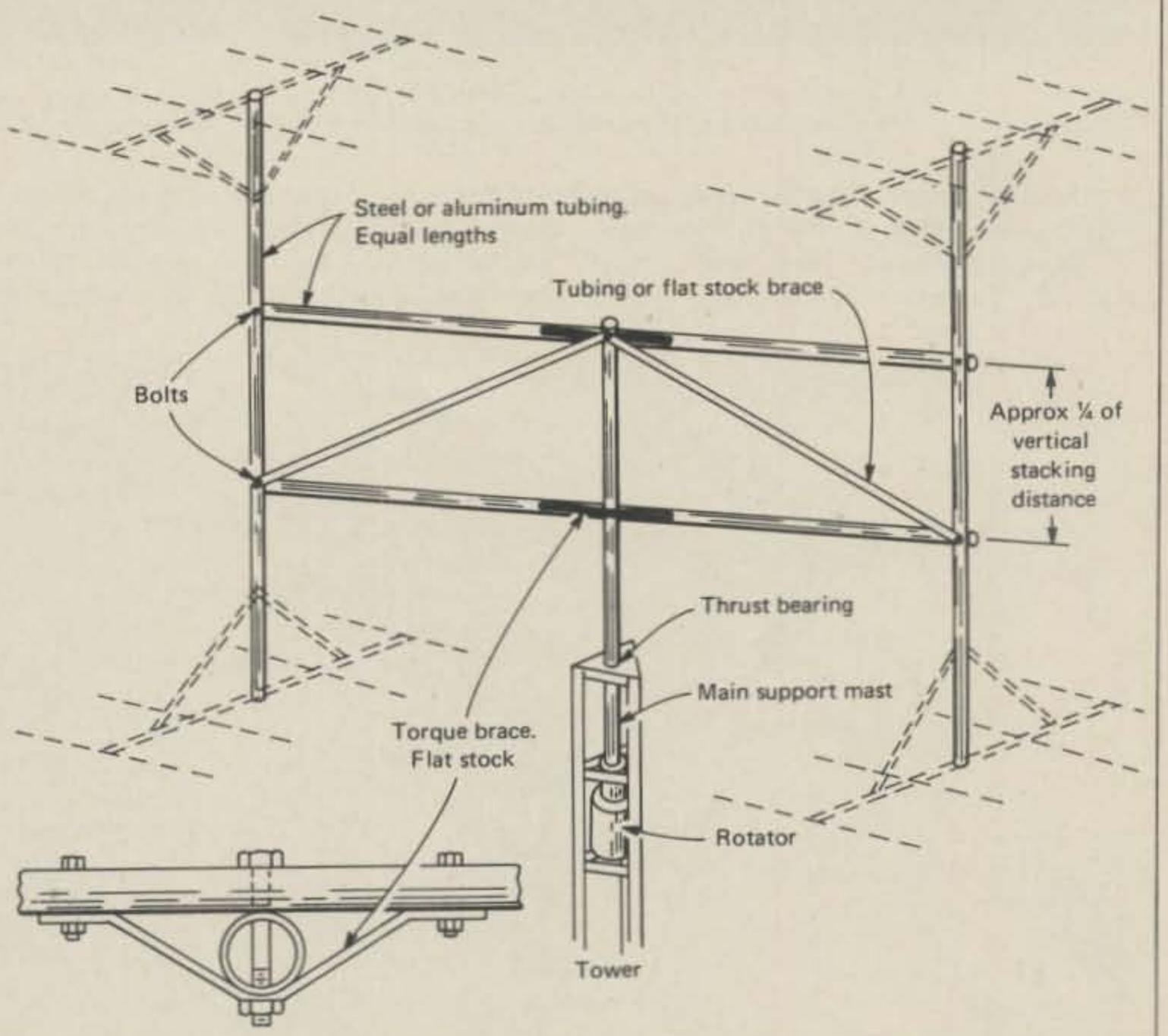


Fig. 4—Representative stacking framework to support four long Yagi antennas. The cross-bracing is important to counteract wind forces. Lateral stresses on the framework are a function of the frontal area facing the wind and its distance from the support mast. The same style of assembly can be used for vertically polarized arrays but the framework members in the same plane as the elements should be made of nonconducting material. The stacking distance is a function of the capture areas of the individual antennas and increases with the gain of each antenna. Stacking distance must be carefully chosen if maximum front-to-back and minimum side lobes are desired. Rule-of-thumb indicates a stacking distance equal to boom length of one antenna.

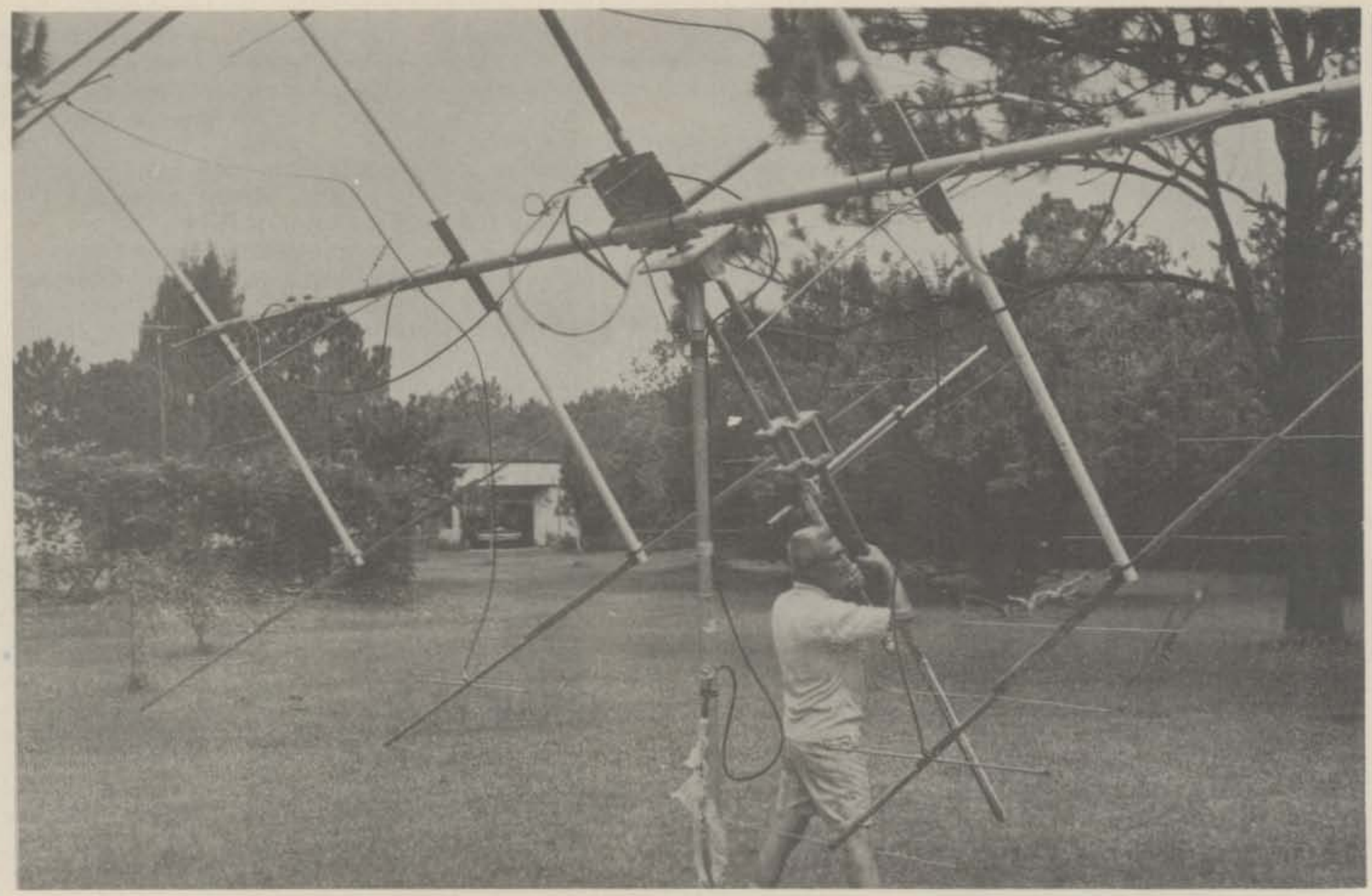


Fig. 5—The "four over four" array of K4IXC. John's antenna is made up of eight, 7-element Yagis. The assembly is low enough for easy aiming and maintenance. The antennas are fed with a coaxial harness. John's final amplifier uses a pair of 4CX250B tubes.

3 db more power. So that adds up to 14 db over a dipole. An arrangement of four antennas (two over two) should provide twice the field strength, or a power gain of 17 db. Now, if you double the size, to include eight Yagis (four over four) you add another 3 db, to achieve a power gain of 20 db."

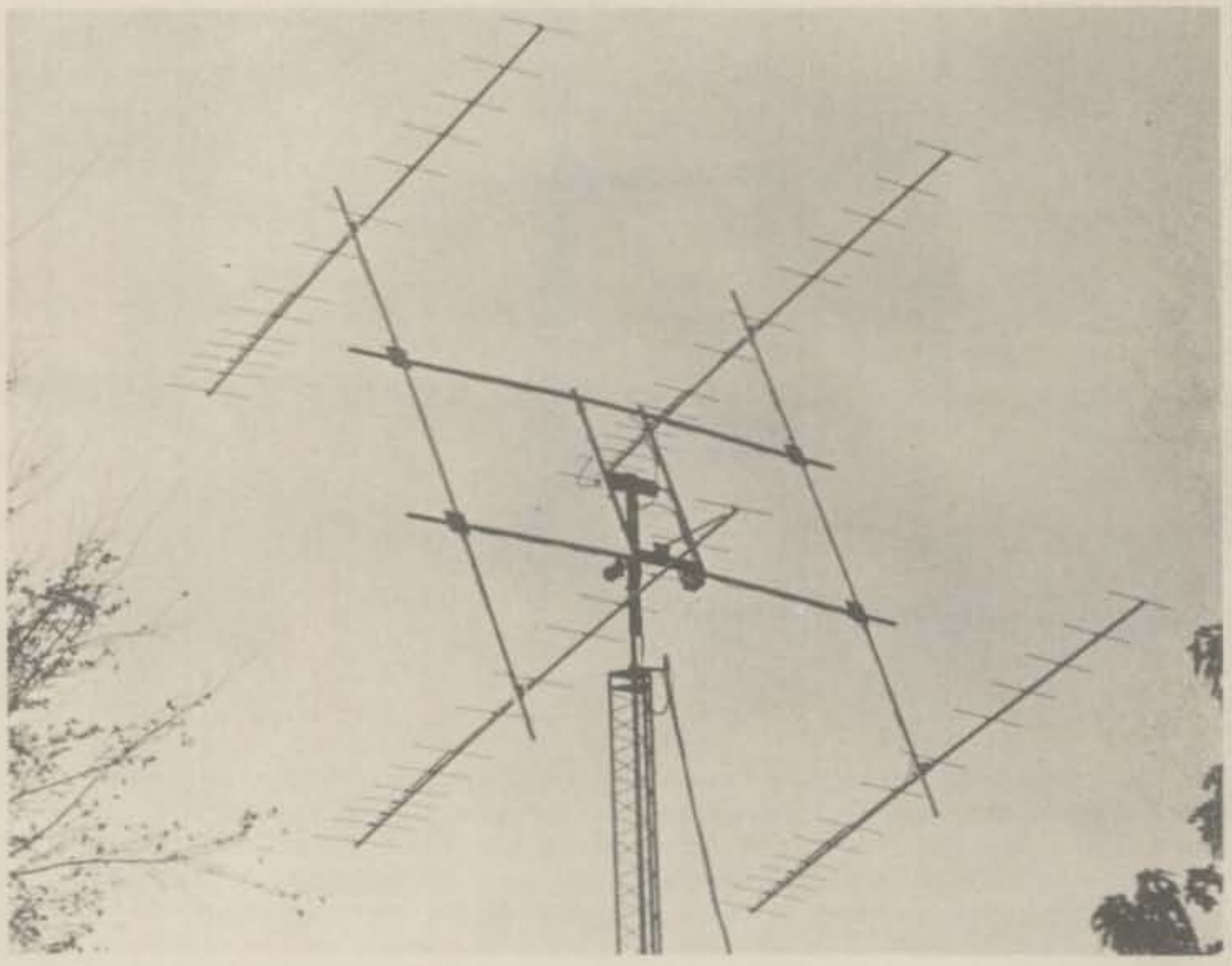


Fig. 6—Orville, K5VWW did an excellent job on this array of four 14-element, 144 MHz KLM log-periodic Yagis to provide an easy way to change the elevation of an "H-frame" mounted array. Both K4IXC and K5VWW are prominent "moonbouncers."

"That's barely enough," objected Pendergast. "You were speaking of a power gain of about 20 db, *or better.*"

"Right," I agreed "But this antenna will work for EME, even though it might be considered marginal. Other experimenters have antennas that have more than average 20 db power gain, and make up the difference. K4IXC, one of the more popular moonbouncers, uses an antenna of this type and has made many contacts. In order to actually achieve an overall power gain of 20 db, you have to use eight Yagis at minimum, each with a power gain of 11 db, or better. And I'm not talking about inflated, DX-type decibels! These are the *real thing*. Of course, the problem is that as the gain of the individual antenna is increased, the spacing between the antennas in an array must be increased too, or full power gain will not be achieved. Each antenna has an *effective aperture*, or zone about it, that must not be invaded by the adjacent antennas. By spacing the individual beam antennas so their effective apertures just 'touch', power gain will increase

(Continued on page 74)

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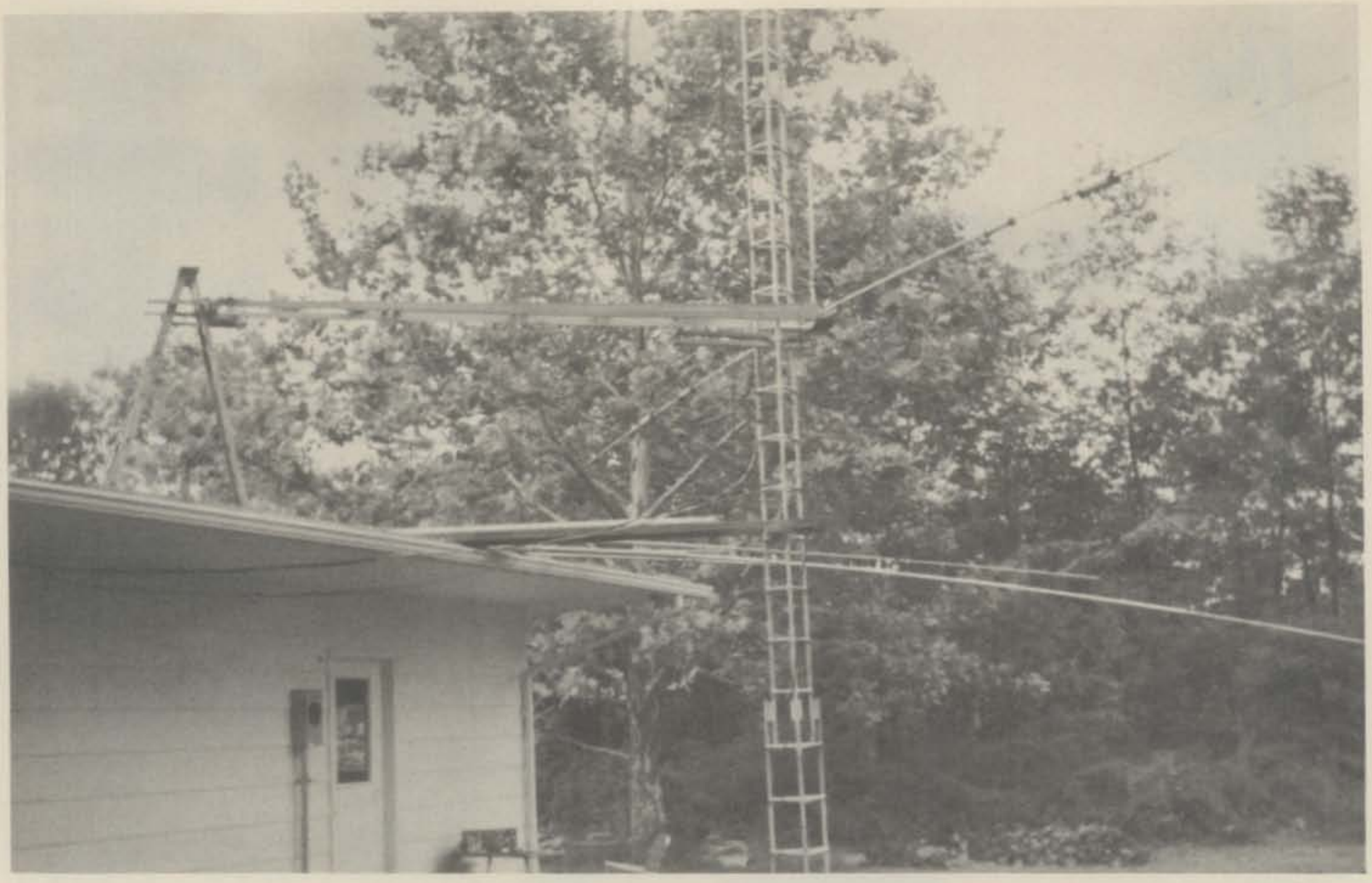

The experimental transmitting antenna setup used at W9LT. Elements for the various bands were placed atop the trellis section extending between the tower and the house. The receiving antenna was a dipole located 750 feet away.

Interlaced Elements for Yagi Antennas

BY LAMAR RAY, W9LT

FOR many years I have tried the interlacing of elements for several bands on Yagi type antennas. The first seat-of-the-pants experiment almost 25 years ago gave excellent results on a 10 and 20 meter combination. Seven or eight other versions since haven't been that successful. Yet, the lack of traps continued to make the thought of big inerlaced arrays intriguing.

The result was that two years ago I set out to find just what seemed to affect what. With the able assistance of WB9LHI and planning of WA9GFR, a makeshift antenna range, consisting of a path length between stations of about 750 feet, was set up. Unfortunately, one low-profile residence was roughly in the middle of the path. And, metal flashing, gutters, etc. on my home were directly below the transmitting (experimental antenna.

The experimental antenna shown in the photo consisted of a Mosley TA-31-40KR driven element trapped to operate on 40, 20, 15, and 10 meters mounted at 14½ feet on my tower. A wooden trellis (used as a boom) was laid between the tower and a step ladder on my flat-roofed house. The parasitic elements were added on the trellis with only one in use at a time and without providing any readjustment to the Heath SB-401 once it was loaded into the bare dipole on a particular band.

Table I—Parasitic Elements

Element	Length
40 Reflector	Hy Gain 402B Reflector (c.w. setting)
40 Driven el.	65 feet, 9 inches
20 Reflector	35 feet, 3½ inches
20 Director	31 feet, 11 inches
15 Reflector	23 feet, 8 inches
15 Director	21 feet, 1½ inches
10 Reflector	17 feet, 8 inches
10 Director	15 feet, 10½ inches

The receiving set-up consisted of a well-calibrated Bruel and Kjaer type 2006 Tunable Voltmeter and an 8 foot high, 20 foot long doublet fed with a resistive pad network, as shown in fig. 1. A Texscan model SA-50 adjustable attenuator was included to provide a cross check of the voltmeter calibration. Communication was maintained, with much difficulty, through a set of the junior operator's CB handitalkies.

It was decided that a practical interlaced beam might employ minimum spacings of 2½ feet between 10 meter elements and those of a lower frequency band, 3 feet for 15 meter ones, and 5 feet for 20 meter ones. Further, 5, 7, and 10 feet were selected for typical element spacings for 10, 15, and 20 meters respectively.

Most of the elements used were those removed from previous unsuccessful antenna projects. No attempt was made to optimize the element lengths. Table I lists the self-supporting aluminum elements used.

With much climbing up and down the tower between readings, the re-

Table II—Frequency = 28.5 MHz

Parasitic Element	Spacing in Feet	db Relative to Dipole
40 Reflector	2.5	−5.3
40 Driven Element	2.5	−2.2
20 Reflector	2.5	−3.0
20 Director	2.5	−1.0
15 Reflector	2.5	−1.5
15 Director	5	−2.7
15 Director	2.5	−2.0
10 Reflector	5	−6.2
10 Director	5	+1.5

sults of Tables II, III, and IV were obtained. Based on repeated double checks, the data was repeatable to at least ±0.3 db. The low gain figures measured with the directors were undoubtedly due to the need for re-loading of the transmitter. The low front-to-back ratios were attributed to effects from the house, guy lines for the tower, etc. However, since we were only looking for trends, we felt that repeatable readings, not absolute ones, were adequate.

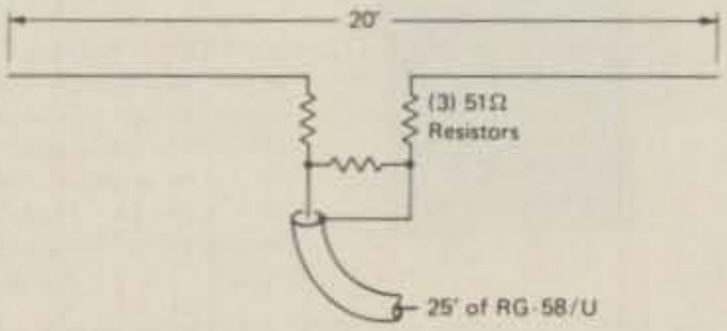

Fig. 1—Receiving antenna and pad used for evaluating interlaced beam antenna performance.

Conclusions

I was satisfied that the data trends (not the actual forward gain or front-to-back ratios) were accurate and should be useful to the "roll-your-

(Continued on page 73)

Table III—Frequency = 21.25MHz

Parasitic Element	Spacing in Feet	db Relative to Dipole
40 Reflector	3	−4.8
40 Reflector	7	−3.5
40 Driven Element	3	−0.1
40 Driven Element	7	−0.5
20 Reflector	3	−1.5
20 Director	3	−1.2
20 Director	7	−1.3
15 Reflector	7	−5.8
15 Director	7	+1.9
10 Reflector	7	+1.1
10 Reflector	2.5	+1.1
10 Director	2.5	+0.9

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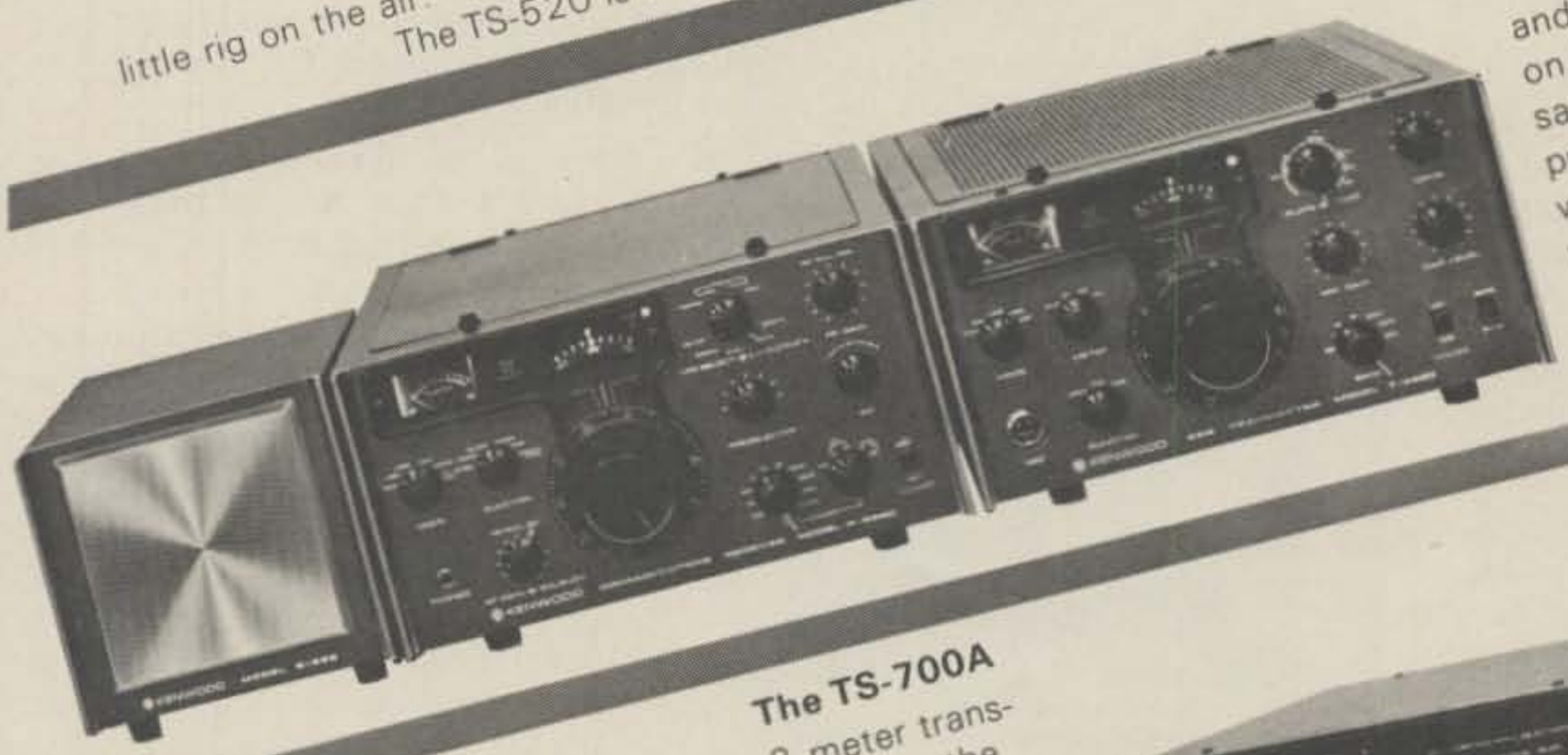

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In Focus

BY BILL DEWITT, W2DD

ROBOT Research has disclosed the fact that several possibilities for the control and use of stored images are being explored in preparation for supplying an Add-On unit to go with their versatile Model 300 Scan Converter.

Because of the numerous possibilities that are being considered, no announcement of specific capabilities will be made until trade-offs between cost and function are fully evaluated. Of interest to Model 300 owners however is the fact that whatever emerges will be plug-compatible with the Accessory socket (already installed) and will not require any modification of their units.

It appears that Robot Research has put the enormous capacity of the storage tube system to work. It can be said that storage tubes are expensive, but so is any other storage system of equal capacity.

The transmission and reception of color images is the most exciting potential feature of the proposed Add-On unit. Other possible features include "Zoom" and stereo.

The reason that Robot can accomplish these functions without adding another storage tube or other memory devices is because so much information can be stored in each quadrant of the storage tube target. (This fact has certainly not been well understood by many potential users of storage tubes.)

By storing brightness and control information representing a color picture in the four quadrants of the target and then programming the readout to sequentially control the three guns of a color tube, a color display on a broadcast color TV set is possible.

There are all sorts of other "special effects" possible. Pictures can be written small and read large so that several successive SSTV frames are displayed either simultaneously or in succession. This gives rise to multiple-picture stunts ranging from visually-merged effects (rapid successive display as mentioned to produce color or stereo), to slow sequences as in displaying several previously received SSTV pictures simultaneously.

It's going to be very interesting to see how the evolution of Robot's new system proceeds. Whatever the final choice of features, it appears that the Model 300 plus its Add-On will offer a challenge to the imaginative user.

A Pre-Slow Scan proposal.

Looking Backward And Forward

If you look younger with your hat on, you will undoubtedly remember the famed Hugo Gernsback, longtime Editor and Publisher of *Radio News*. He was indeed one of the most prolific authors of electrical/radio/electronic articles and texts. Gernsback's visionary and creative genius brought literally thousands of ideas into his editorial writings. Gernsback died many years ago but his predictions of things to come in the field of radio and television applications would make a good "order list" for the major portion of today's industrial, military, commercial, and amateur equipment. (We'll have more about Gernsback in a future issue.)

In 1915 and 1918, Gernsback wrote a series of articles on what we now know as television. The May 1926 issue of *Radio News* carried Gernsback's two page editorial on "The Next Great Development In Radio". It was Gernsback's opinion that television represented the wave of the future. He predicted the use of attachments to the broadcast receiver that would permit simultaneous viewing and listening. He also predicted similar attachments for use with the telephone.

Does all of this begin to remind you just a little bit of what Cop MacDonald started back in the late fifties?

The timing of Gernsback's predictions wasn't perfect, but he did predict the amateur use of television in conjunction with phone operation. His optimistic estimate was that hams might have something going by 1928. (If you know of any hams who were operating television gear at that time, let's hear from you. I'm referring to TV transmissions.)

As a bit of frosting on the cake, the May 1926 issue of *Radio News* cover portrayed a love-lorn ham proposing to his girl via television. See accompanying photo.

Lacking Gernsback's visionary talent, and recognizing only the realities of today, I ask myself what response did the YL make to her devoted suitor? Encoding the story and picture into my PHOTOENCEPHLOGRAPHICTIMETHIZER, pushing the UPDATE button, I get an immediate three-frame update and playback. You may not believe it, but the YL flipped off her mike and camera, turned on her keyboard, and typed out "K PSE."

A Plea For More Pictures!

The real value of SSTV is its Picture Transmission capability. Picture transmission combined with voice commentary offers a means of information exchange not possible by the use of graphics (printed words) no matter how they are generated. The extent to which SSTV is currently used as an inefficient teletype system has reached the almost unbelieveable stage.

I recently demonstrated my slow scan gear to a non-ham visitor who was intrigued by my description of how still pictures could be sent around the World. After seeing several minutes worth of "Rig here — Name is — Ur sigs — K PSE", my visitor said, "Why don't they just tell you what their names are by speaking into the microphone? Why do they take so much time to spell out all these words that they could SAY much faster?"

Since I didn't have any good answer, I kept looking for a picture transmission. It took a while, but soon we were watching a sequence of pictures that included a bullfight, kids playing in the snow, ye op's wife, daughter, son, and finally, YE op himself. A sequence from another station included views of his home and his car. Now my visitor was fascinated. He said, "This is terrific! Imagine being able to see the home of a ham in England without using a few million dollars worth of satellite and fancy NASA-level equipment! But who would want to sit around looking at all those printed messages by the hour?" I decided that his question was a good one.

Time For Helpful Hints?

It's true that the resolution of our SSTV system limits the detail that we can receive and transmit, but don't be inhibited by that restriction.

Use Close-Ups. If your camera lens won't focus below say 46cm or about 18 inches, try to pick up one that will focus to onethird that distance, or, get a close-up auxiliary lens and use it! Let's face it, in slow scan, you just can't hold the detail in a "long" or "medium" shot that we're accustomed to in snapshots, flat copy, or on "TV". So, if detail is needed, use a Close-Up to show it.

Lighting In One Easy Lesson

Avoid extreme brightness ranges. How do you do that? Use two lamps with reflectors. If you use one lamp, you'll probably have a hot spot surrounded by a sea of ink. And just remember that it's best to use reasonably flat lighting, avoid sharp shadows. Whether the subject is "live" or plain old flat copy, it helps to use one lamp on each side of the camera as shown in the accompanying photo. You can get by with one lamp if the "copy" is small, but people will look a lot better on your screen if you use two lamps, and add an overhead lamp when you can.

Pictures—Pictures—Pictures

It hardly seems necessary to talk about how to generate a collection of pictures for an interesting tape. On the other hand, it IS easy to overlook some sources.

Direct SSTV camera "shots" around the shack are not difficult to get. However, since there is a lot of similarity in gray and black boxes around the world, why not tape some views of your home? Sometime I'd like to see what F6BDJ's front door looks like. How about a view of your kitchen, your car, your pets? If you are a collector of antiques, paintings, coins, clocks, stamps, old ham gear —or what have you—make a series of pictures showing off your collection.

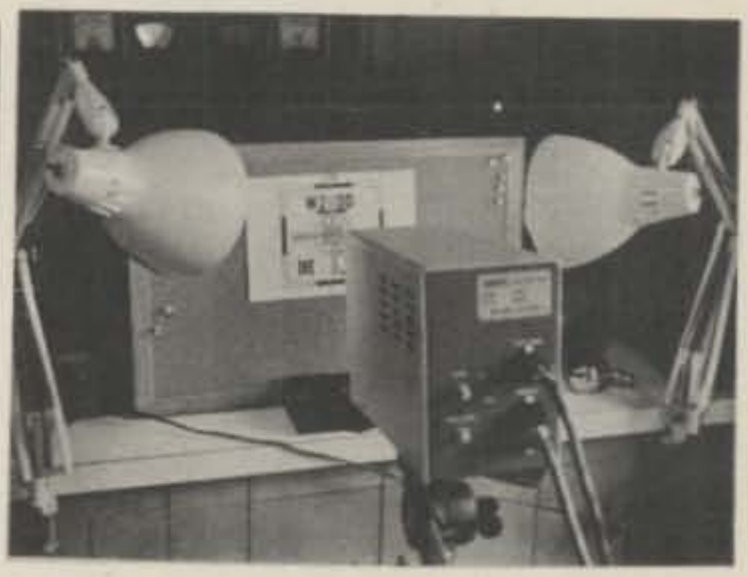
Have you or your family won any awards? What does a French ham license look like? What does your local newspaper look like? Do you grow flowers or vegtables? Let some of your SSTV friends see them.

Do you have a family album? Get it out and let the boys on 20 see how you looked WITH hair. (Speak for yourself, Bill!)

How about those slides or snapshots of your trip to Europe, North America, etc.?

Do you have a picture of the company plant or office where you work? Pictures of the products you help produce? Have you EVER sent any part of a circuit diagram to anyone?

And what about sports? Own a camper? How about boats—do you have a canoe or a cruiser? Did you ever catch a really big fish? You must have pictures of that occasion! Maybe you even have a picture of a deer trophy or game fish right on the wall of your shack.



Use two lamps for even illumination.

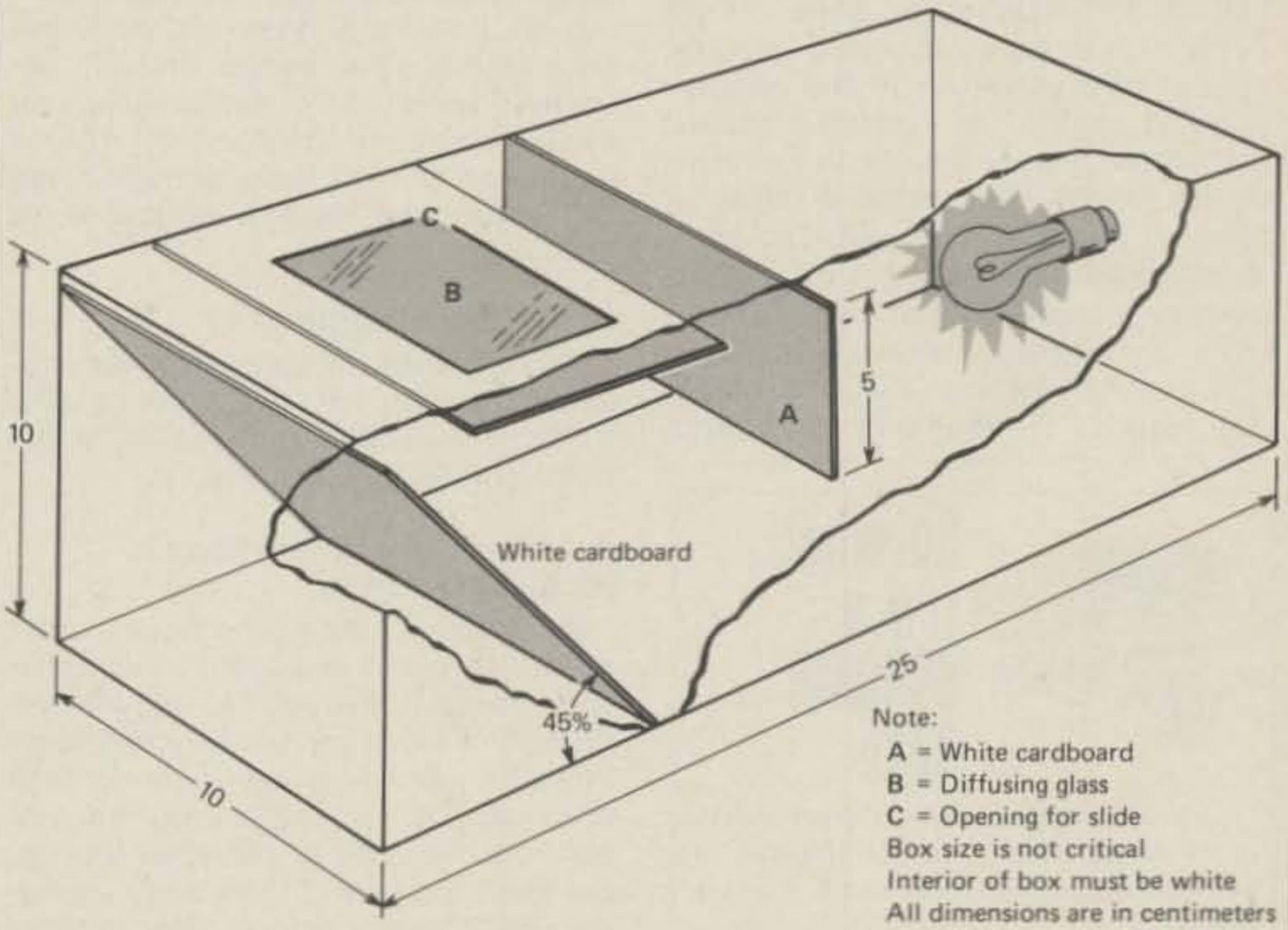


Fig. 1—Simple illuminator for slides.

What About Slides? . .

It's a cinch to put your slides on slow scan. Suddenly close-ups are

F6BDJ's optical system for slides.

A very tired GD3IAD.

no problem. Use your slide projector to get the image size you want, point your SSTV camera at the screen, and you've got it made.

If you don't darken the room, ambient light will probably ruin the Contrast of the projected picture and you'll get "washed out" quality.

You might say that Jean Nicolas, F6BDJ, of Grenoble goes "First Class". Jean uses the very elegant optical device shown in the accompanying photo to transmit/record his slides. A light source (not shown in the photo) illuminates a diffusing glass in back of the silde. The slide is imaged on the vidicon by a combination of lenses that I hesitate to label a "close-up attachment".

After Jim Young, K4TGC, of St. Petersburg, Florida told me about his simple "box illuminator" for slides, I built one myself. Jim said that his illuminator is simply a "frosted" light bulb in a box with an opening in the top.

My slide illuminator was "designed, engineered, and constructed" in about fifteen minutes. Maybe it looks it, it works, see fig. 1. This technological gem was made out of a discarded box. I used staples, glue, and masking tape to hold it together. The toughest thing to find for an illuminator is a piece of diffusing glass or plastic to even out the illumination. Check your local photo dealer or Woolworth's plastic items.

To put your vacation pictures on television, just locate the slide over the opening on the illuminator, locate your camera directly over the slide and zoom in until the slide fills the monitor screen. Mask off the opening so that light does not spill out around the slide image. (It will adversely affect any automatic level control device in the camera.) All you need is a 15 watt lamp, so don't use 200 watts and start a housefire or burn up your slides!

What About Negatives?

K4TGC says he just flips the "reverse" switch on his camera and Voila — beautiful pictures from his color and B&W negatives.

Now That You Have Those Pictures On Tape

Sometimes the conditions won't permit it, but it is possible on occasion to run through a picture sequence with quick verbal comments interrupting the video—and no loss of synch. I'm not suggesting that you tell your life history between frames, but you could say, "Here's my youngest etc." just before the vertical synch pulse occurs. Try it sometime. YV1AQE used to do this as he transmitted some of his excellent pictures.

News And Pictures From Around The World

A letter from Neville Jackson, G3IAD, of Nottingham, reports that his August expedition to the Isle of Man almost lasted longer than expected. Neville had his entire station loaded into his car for the trip home —and with one hour to departure time, the car wouldn't start! Jim Parnell, GD3YUM used a Landrover to tow Neville's car five miles to the docks. Two minutes before departure time, Neville got the car started and on the boat. Expeditions can be fun even if they do "age" you a bit!

Neville says that the dazed look on his face in the accompanying photo is the result of staring at the green-eyed square box for eight days whilst working 43 countries, 530 SSTV contacts, and WAC from GD3-land. At his home station, Neville has finally achieved his goal of WAS-SSTV. That's the first outside of the USA. Congratulations!

Just to wind up our coverage of GD3IAD, take a look at the photo of GD3IAD's station ID. That picture, taken in a moment of great excitement was made by Eddie Collins, W4MS. is contact with GD3IAD gave him his 100th country on SSTV and Eddie snapped the picture as proof-positive. (But Eddie, how do we know he was working YOU at the time?)

Ever hear of the Texoma Hamarama? It's a biggie in hamfests, and a good one too. Warren Weldon, W5DFU, of Tulsa, Oklahoma walked off with First Prize for homebrew construction at Lake Texoma in the

Proof-positive of W4MS' 100th SSTV country worked.

Fall. Warren's prizewinner was a slow scan monitor using a Direct View Hughes Tonotron Storage Tube. Received pictures can be stored on the screen for extended viewing. Warren gets a good gray scale with this monitor, a feature not always easy to come by with Tonotrons. In addition to slow scan, Warren is interested in monitoring weather conditions with a TV camera. I hope that we can get some pictures and a complete story on this unusual accomplishment from Warren for inclusion in an early issue.

Bob Arrowsmith, W4JNN, of Annandale, Va. is looking for SSTV contacts via the Oscars. Anyone interested?

John VandenBerg, VE3DVV, located near Hamilton, Ontario, seems to have a very special technique for adding titles to the pictures he transmits. John throws in an upside-down title now and then just to see if you are really "copying" him!

73, Bill, W2DD

Math's Notes

BY IRWIN MATH, WA2NDM

I'D like to start the new year with an item of interest to all of the bargain hunters that read this column. As we have been saying one of the best ways to build up a good amateur radio station is to obtain and modify older equipment. This equipment is often available at a very small fraction of its original cost and can easily be the basis of a really good piece of equipment once "modernized".

With this thought in mind, I'd like to acquaint you with a new company called "Buyers and Sellers" located in Boston, Massachusetts. These people operate a vast clearing house for anyone trying to buy or sell any type of amateur radio gear. If you are a buyer all you do is call them at 617-536-8777, weekdays from 9-5, and Wednesdays and Sundays from 7 p.m.-midnight eastern local time and tell them what you want. They will then provide you with the name or names of fellow amateurs selling the item and the price. Other than the phone call to Boston, there is no other charge.

If you are a seller, a phone call will put your gear on their giant list and you must then agree to pay a 10% commission when you sell the equipment. At the time this is being written, Steve Kirshner, WB2MZU/1 tells me that they will shortly offer a monthly subscription to the list for a nominal fee—however the free (to buyers) 10% commission to sellers service will continue and you are free to use the service whether you subscribe or not.

In the past year we have received many letters expressing extreme interest in the modifications we have indicated for older equipment—particularly receivers. As a result, we would like to present some more tips in this area.

As you well know, the mode of operation on all of the lower bands these days is s.s.b. Most older receivers will receive s.s.b. signals, after a fashion, with the use of the b.f.o. but the a.v.c. and S-meter suffer due to overload from the b.f.o. signal. Also, strong signals are distorted and tuning become a pain in the neck.

The solution of course is to add a product detector and the following circuit, tried, tested and installed in our receiver should fit the bill perfectly. As can be seen from fig. 1 the detector employs a 6BY6 (in keeping with the fact that the balance of all

(Continued on page 72)

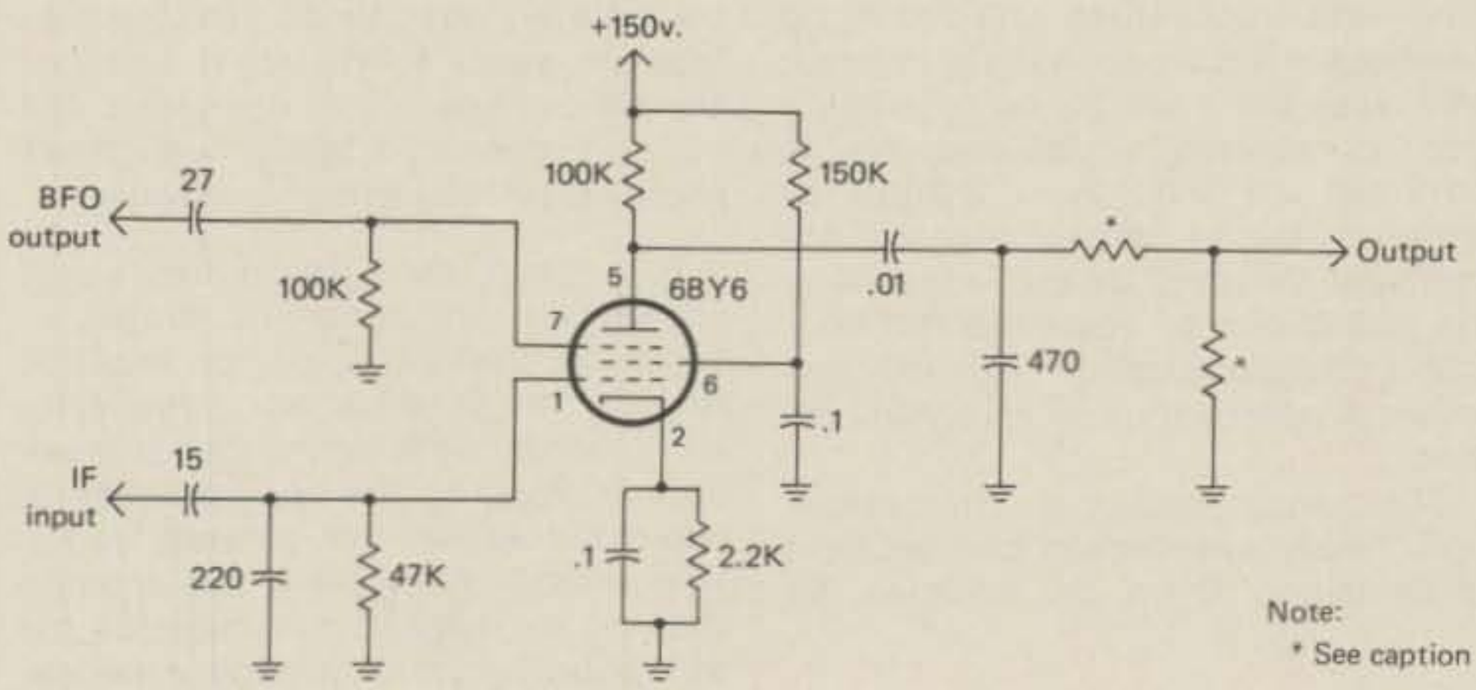


Fig. 1—A product detector for s.s.b. reception. The starred components may be added to allow the output of this detector to match the output of the a.m. detector to prevent blasting when switching beween a.m. and c.w./s.s.b.

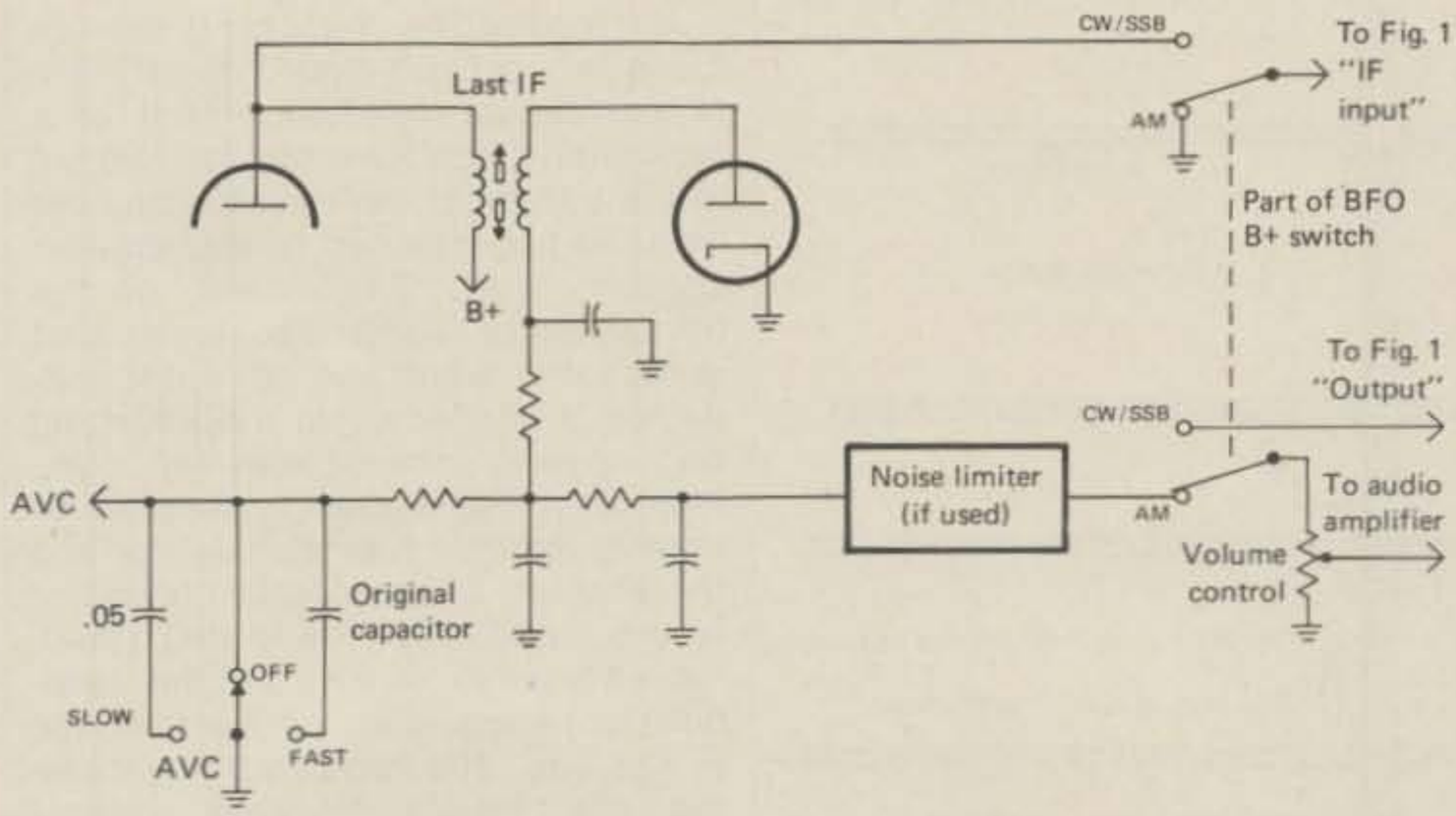


Fig. 2—The hookup of a product detector with an optional fast-off-slow a.v.c. switch. Be sure to keep the connection on the fast i.f. transformer short.

Novice

BY HERBERT S. BRIER, W9EGQ

TRUE to our promise to include material of interest to prospective Communicator licensees, let's discuss v.h.f. antennas. Actually, antenna principles are the same on 146 MHz or 220 MHz as they are on 4 MHz. However, v.h.f. antenna dimensions are small enough to allow erecting an efficient v.h.f. antenna in locations too cramped to erect even a mediocre h.f. antenna. For example, a ½-wave, 146-MHz antenna is approximately a meter (38.5 inches) long, compared to 37 meters (125 feet) for a ½-wave, 3.75-MHz antenna. These lengths are calculated with the aid of the following equations: Length in feet = 468/Frequency in MHz. Length in inches = 5616/Frequency in MHz, and Length in meters = 142.5/Frequency in MHz. Length of ¼-wave antennas are cut in half.

Verticals or Horizontals

One of the first things the v.h.f. operator has to decide when erecting an antenna is whether to use horizontal or vertical polarization. When radio communications between two points are by direct rays without any intervening reflections—as v.h.f. communications are virtually all the time—the transmitting and receiving antennas must be similarly polarized; otherwise there will be up to a 20-db loss in received signal strength. In contrast on the lower frequency amateur bands where signals are normally reflected by the *ionosphere,* the reflections so scramble the original signal polarization that matched antenna polarization is rarely important.

The omni-directional characteristics of vertical antennas and the ease of installing them on vehicles for mobile operation make verticals the overwhelming choice of v.h.f. f.m. operators, who are usually interested in effortless, short-distance communications. On the other hand, v.h.f., a.m., c.w., and s.s.b. operators generally prefer horizontal polarization, primarily because horizontal receiving antennas pick up less man-made noises than verticals do, and the horizontals seem to result in stronger signals over extended distances. Not all v.h.f. operators agree with these polarization conventions, however.

A ½-wave, centerfed dipole works equally well mounted horizontally or vertically. Vertical operation requires running the feedline horizontally for a ½ wavelength from the antenna before dropping the line vertically to avoid disrupting the antenna radiation pattern. Alternately, the antenna may be an unbroken conductor fed at the bottom end through a matching device that transforms the 50-ohm line impedance to the estimated nominal 1200-ohm end impedance of the dipole.

An ingenious matching device (used in the Cush-Craft "ringo") is a ¼-wavelength conductor bent in a horizontal circle. One end is clamped to the bottom of the radiator, and the other end is clamped to the antenna support mast. The shield of the transmission line is also terminated at the latter point, and its center conductor is connected to the matching ring several inches from the common point. The system is adjusted by varying the length of the radiator and the position of the center conductor of the feedline for the lowest standing-wave ratio (s.w.r.) on the feedline, as indicated on an s.w.r. bridge in the line. The problems in mounting and feeding ½-wave vertical antennas are not too serious in fixed-station installations, but generate more trouble in mobile installations.

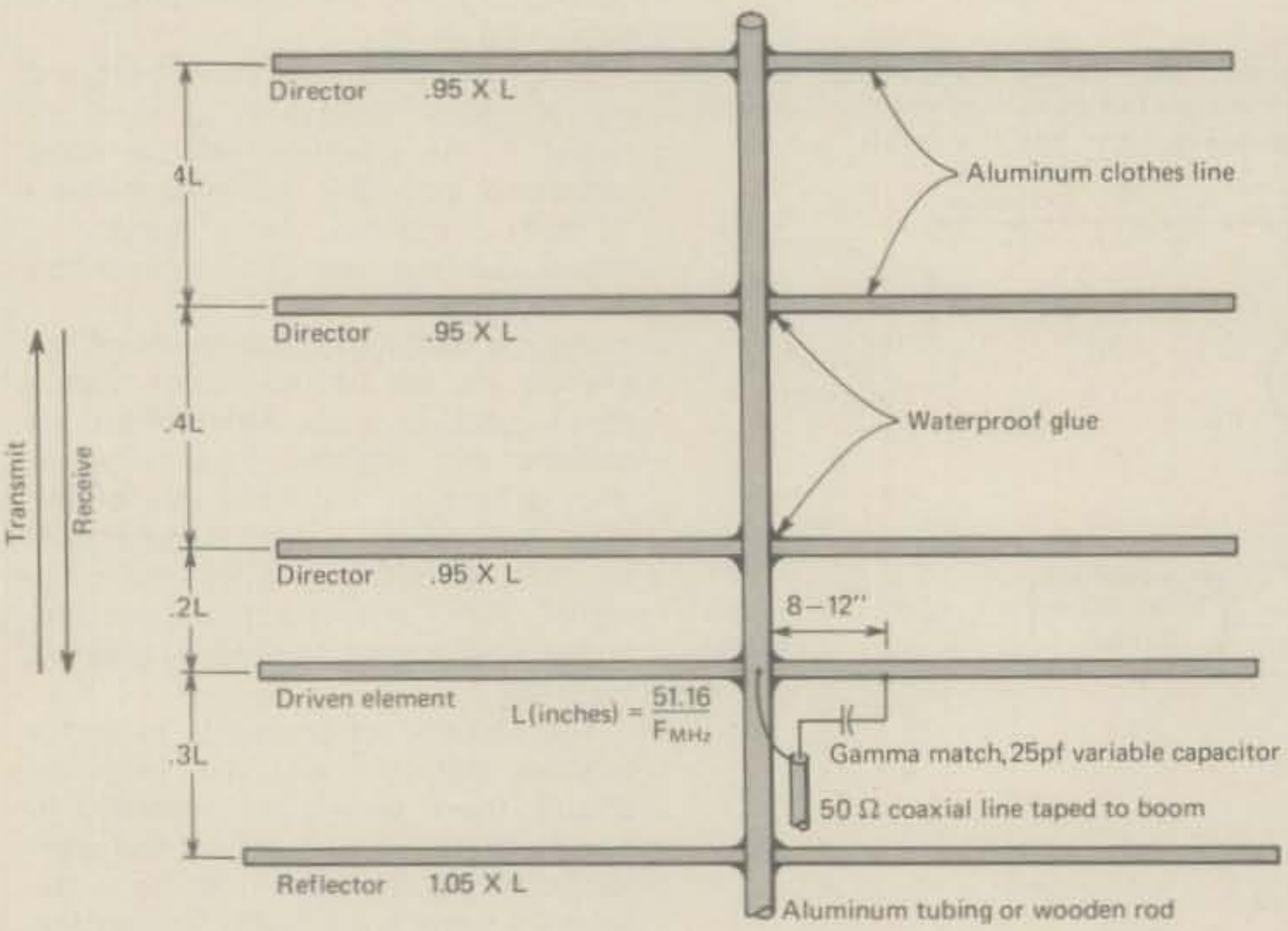


Fig. 1—A medium gain, minimum adjustment v.h.f. array. If operated vertically bring the feedline along the boom behind the reflector.

The ¼-Wave V.H.F. Antenna

By cutting a ½-wave antenna in half and mounting it in the middle of the car roof (the preferred position) or the center of the trunk lid with an insulating fitting a ¼-wave vertical, mobile antenna is formed. Connect the center conductor of the coaxial feedline to the base of the rod and its shield braid to the car top or trunk lid through a terminal lug under the insulated bushing. Connect the other end of the feedline to the transmitter/receiver via a coaxial connector. Considering its simplicity, such a ¼-wave vertical antenna works well, and one can be purchased for a few dollars, if you do not want to build your own. Some commercial units use a stainless steel whip for the radiator for strength and flexibility. However, the stainless steel has much higher resistance than copper or aluminum; therefore, for lowest losses, try to get one with a copper or aluminum radiator.

By substituting four ¼-wavelength conductors (radials) running out from the four corners of the base insulator for the car roof top or trunk lid, a "ground-plane" antenna that can be hoisted high in the air for fixed-station operation is formed. The radials are often slanted down from the center 30 to 45 degrees to increase the antenna base impedance from approximately 35 ohms to 50 ohms for a good match between the transmission line and the antenna. Also, by replacing the ¼-wavelength radiator with a ⅝ wavelength rod and a small coil between the rod and the inner conductor of the feedline, the antenna will concentrate its radiated power closer to the ground, resulting in a 3-db increase in effective radiated power (ERP) over the ¼-wavelength rod. The loading coil, approximately 5 turns of #12 or #14 wire, ⅜ inches in diameter, is adjusted for minimum standing wave ratio on the transmission line with the aid of an s.w.r. bridge connected in the line. No changes are made in the radials (if used).

Parasitic-Element (Yagi) Arrays

By placing a "director" five per cent shorter than a ½-wave radiator 0.1-wavelength ahead of the latter, a 2-element array with a forward gain of 5.6 dbd (**dbd** = db gain compared to a dipole) is formed. Adding a "reflector" five percent longer than the radiator 0.15 wavelength behind the radiator brings the gain up to 6.5-7 dbd. Additional directors, each 0.2-wavelengths ahead of the previous one, will further increase the power gain but at a slower rate. A 5-element array has a nominal gain of 10 dbd, a gain of 20 dbd may require over 100 elements in an array of arrays. Such monsters are not recommended as first antenna projects, but a roll of aluminum clothes-line wire for elements, and a 5-foot aluminum tube or broom handle for a support boom are the major components for a 4- or 5-element Yagi. Center and glue the elements in holes drilled in the boom with epoxy glue. Consult a v.h.f. handbook for simple matching systems to feed power into the radiator.

News And Views

After attending a Novice study course taught by **John Kienzle, WA2-UON,** a teacher at Maple Rock High School, 1216 Maple Hill Road, Castleton-on-Hudson, New York 12033, **Richard, WN2CPD, Tom, WN2CPE, Peter, WN2CQL,** and **David, WN2-CQM,** received their licenses in November. That's what I call a successful amateur course! The boys join Ann, WN2WXT, and Jim, WN2-ZFF, who got their licenses last winter, as the licensed members of the school radio club (A couple graduated in the spring.) . . . **Larry Noyes, WN6MCV,** 211 S. Verdugo Rd., Glendale, Calif. 91205, takes us to task for calling him W6MCV in the October column. But that is what he said his call letters were, honest, boss! He thanks us again for steering him to choose a horizontal antenna in the July, 1974, NOVICE SHACK, after hearing how much more local noise vertical antennas pick up . . . We don't suppose many Novices have spare power amplifiers laying around, but you never know. **U. Hla Oung, WA6SNC, ex-VU2AC, AI2AC, XZ2AD,** Rangoon, Burma, is looking for one "dirt cheap." When the Burmese Military Government took over recently, all of his radio equipment, including antenna and mast, was confiscated and he is starting over again in San Francisco, a stranger in a foreign country. If you have anything for his junk box, his address is 210 Richardson Ave., San Francisco, CA. 94123. . . . **Jay Johanson, WNØPZW,** Bridgeton, Mo. 63044, age 15, works 15 meters in daylight and 80 and 40 meters at night. His tools are a Heathkit DX-60B transmitter driven by HG-10B v.f.o. and the matching HR-10B receiver and a Mosely RV-8-C 10-through-80 meter vertical antenna. In a couple of months of operation, he has worked 28 states, Canada, Curacao, Brazil and England. So vertical antennas do work. Look for Jay on 15 meters between 3:30 and 4:30 P.M., his time, if you need Missouri. Don't be surprised if he is signing WBØPZW, though.

Evelyn Fox, WN9QZA, Merrimac, Wisc. 53561, a 78-year old graduate of Jim, K9PKQ's Novice Class, sponsored by the "Yellow Thunder Amateur Radio Club," Baraboo, Wisc., operating her Heathkit HW-101. Evelyn is active on 40 meters and enjoys correspondence and getting QSL cards. We are sending her a 1-year subscription for CQ Magazine for this winner in our Monthly Photo Contest. If you would like to enter the contest, send a clear picture (preferably black and white) of you operating your amateur station and some details about your radio career to: Photo Contest, c/o Herbert S. Brier, W9EGQ, 409 S. 14th St., Chesterton, IN 46304. Even if you don't win, suitable pictures will be published as space permits.

Ruddy Ellis, W4LNG, 2936 Arden Rd., N.W., Atlanta, Georgia 30305, a

(Continued on page 72)

HUGH CASSIDY, WA6AUD, ON

DX

THE memory of a DXpedition if often short-lived and with the years there often is difficulty in establishing the facts of a past DX effort.

There is adventure in DXing and a major DXpedition to a rare location is often a high point in the memory of many. This is true not only of those who were on the effort but also for those who worked the DX action. But it does seem that the recording of these great efforts is often sketchy and incomplete. Soon many of the salient details are blurred by the passage of the months and years and the effort is forgotten by many and unknown to those DXers who came on the scene late.

One of the few significant efforts to record the experiences and the background adventures of DXing has been HC2YL, Darleen Magen's story of her operations from many DX areas around the world. With part of the story involving a sudden, personal tragedy, the recounting of her trips and experiences in her book *Globe Trotting Via Amateur Radio* has few recent equals in recalling the adventures of DXing and getting them into a permanent form.

Getting the facts and experiences of a DXpedition is not always the easiest matter. An approach a few years back to one major DXpedition that a running log should be maintained and the feel, the action and the day-to-day color of an DXpedition be put into permanent form brought the obviously sincere reply that every single minute of the trip was absolutely taken up with absolutely something and there was not and had not been the slight possible time available to record or log any of the events.

When one goes back fifteen or twenty years in the world of DXing, there is often considerable difficulty in locating information on a DXeffort. While some may feel that the event itself should enshrine them forever in the memories of DXers, those of the present and all those DXers to come in the future, this is not so and the great days are soon forgotten.

More of the adventures of DXing should be preserved. DXpeditions are unique events and there will be many in future years who will wish to know of them. Even the minor ones would benefit from a record and notations, the major ones should be completely chronicled.

There seems to be a void possibly existing in the history of DXing. The long-term rewards of more attention to chronicling the great days would be worth the effort.

Ken Miller, K6IR, with S.S.B. WAZ No. 1234 proudly mounted behind the rig. Ken has been licensed since 1940 and operates 10, 15 and 20. He is in the electronic equipment business, specializing in digital communications and test instruments.

The CQ DX Award Program

SSB	C.W.
411...VE7CE	185...G3AHE
412...SP5DZI	186...UB5SG
413...G4DDS	187...UA4AY

Endorsements

WA2ZHR 150; WA2ZHR 200; 3.5-7 MHz W8SET.

Complete rules and application forms for the *CQ* DX Award Program may be obtained by sending a business size #10 envelope, self-addressed and stamped, to *CQ* DX/WPA Awards, Box 3388, San Rafael, Calif. 94902.

New Countries

There have been changes during the last few months of 1975 with Papua-New Guinea going independent on September 15th and the P29-Papua-New Guinea will be accepted for DXCC starting January 1st. Sable Island and St. Paul Island, VX9A and VY0A suddenly came on the scene in late October and November when VE-amateurs put Sable Island, VX9A, on the air for the *CQ* Test. Then in November Saint Paul, VY0A, was put on the air racking up over 5000 QSOs under difficult condtions. Lloyd and Iris Colvin were expected to open the first of January from the new country of Tuvalu signing VR8C, this being a renewed activity sponsored by the YASME Foundation.

Angola became independent in early November and was slated to sign D2D instead of the familiar CR6. With the departure of the Portugese administrators the situation within Angola was fluid and some have expressed a feeling that three, possibly four, new countries may evolve from the former CR6 area.

Transkei Republic will be a new one later this year when that homeland in South Africa establishes itself as an independent nation. Preparations for this separation from South Africa has been proceeding for some years, the Transkei area having been largely self-governing for a long period. In October 1976 the homeland will be completely independent and from then on will be known as the Republic of Transkei.

WB6RJP at the DU1JMG rig during his visit to the Philippines last summer (Photo by DU1BOS)

Glorioso

Guy P. de la Rhodiere, FR7ZL, was due to arrive on Glorioso on November 20th and should be there through this month. In spite of having been on the air a number of times in recent years, this was still a very rare one, being No. 11 in the Most Wanted List compiled by the WCDXB in November. Much of the demand for Glorioso, and much of the frustration, stems from the failure of a previous operator to QSL. Guy, FR7ZL, has an excellent record in his QSLing for past activity on these French islands in the Indian Ocean and Glorioso should drop down in demand. In the poll made by the WCDXB, Glorioso was needed by 48.5% of those responding.

Travelers

Northern California amateurs were moving in various directions during last Fall, some of their actions aimed at producing some DX activity.

Lloyd and Iris Colvin departed in December for the start of another of their DX efforts under the auspices of the YASME Foundation. Their first objective was Funafuti in the Ellice Islands where they were ready to put the new country on the air when it became independent on January 1st. Almost a decade back W6KG and W6DOD had visited the group while on a Pacific DXpedition and had had the callsigns of VR1V and VR1Y previously assigned to them. From Tuvalu the Colvins are aiming for more action in the Pacific area and their future plans should be interesting.

The Northern California DX Foundation planned to send two operators to Macao in early December to activate CR9AK and clean up some of the demand for that one. K6AHV, Bob Ferrero, who was on the KP6-Kingman effort, and Don Schliesser, W6MAV, were aiming to open from CR9AK the first week in December. CR9AJ, Horacio Torres, has been active from Macao on 15 meters but during the early Fall very few W/Ks had been able to work him.

Harry MacLaren, W5FGO, is another recent WAZ winner. Harry's fine Heath station has qualified for most major DX awards.

The WPX Program

Mixed

501...G4BVH
502...JA1QXY
503...YZ1NPF
504...G3XYP
505...XE2MX
506...I6ANZ
507...DK6FT
508...DJ8MU

C.W.

1419...K4DAS
1420...UB5CI
1421...UT5YF
1422...UA9CAC
1423...UK2FAM
1424...UP2BAV
1425...UK5QBE
1426...UL7NAF
1427...I2DMK
1428...W5MCO
1429...W3EAI
1430...W2RPZ

SSB

871...UO5BZ
872...G3XYP
873...G4AHJ
874...DK1IU
875...WA6CCP
876...WA7OBH

Endorsements

Mixed: F9RM 1350; WA2EAH 1000, WA2EAH, WA5-VDH 950; WB4SIJ 900; K6ZDL 850; WA6TAX 750; G3XYP, DK6FT 650; G3XYP 600; G3XYP 550; G3XPY 500; G3XYP 450.

C.W.: W2HO 1100; WB2FMK 1000; WA6JVD, VO1AW 850; K6ZDL, VO1KE, W5MCO 700; W5MCO 650; W5MCO 600; W5MCO 550; DL1LD, UB5C1, W5MCO 500; DL1LD, UB5CI, W5MCO 450; UB5CI, W5MCO 400; UB5CI, W5MCO 350.

SSB. HP1JC, I8AA 1000; I8AA 950; WA2EAH, WB4-SIJ, I6SF 800; G3XYP, F5JA, UB5WE, WB2FMK 650; G3XYP 600; G3XYP 550; G3XYP UO5BZ 500; G3XYP, UO5BZ 450; G3XYP, UO5BZ 400; G3XYP, JA3AEV, UO5BZ 350; G3XYP 300; G3XPY 250.

80 Meters: UY5QQ, UB5CI

20 Meters: UY5OQ, UB5CI

Africa: G3XYP

Asia: G3XYP, UB5CI, UY5OQ

Europe: G3XYP, DK6FT, I2DMK, UQ2AN, UB5CI, UY5OQ

Complete WPX Rules may be found on page 67 of February 1972 issue of *CQ*. Application forms and prints of the rules may be issued by sending a business sized, #10 envelope, self-addressed and stamped to *CQ* DX/WPX Awards, Box 3388, San Rafael, Calif. 94902.

Clyde Schoenfeld, W6KNH, departed in October for an extended trip which would take him to BV/9V1/9M2/9N1/VU/4S7/VQ9/5Z4/ZE and PY before returning home. Those who were looking for QSLs from Clyde for his efforts, for any of the stations that Clyde would normally be handling, will have to wait until his return to California.

China/Iraq/South Sandwich

Last Fall Geoff Watts in his *DX News Sheet* gave the result of his poll for the "Most Wanted Countries." South Sandwich was No. 3; China was No. 4 and Iraq was No. 5. Then the WCDXB polled the W/VE amateurs and Iraq was No. 1; South Sandwich was No. 2 and China was No. 6. Thus, it is rather definite that from whatever angle you look at them, these countries are high on most of the needed lists. And a lot of DXers would be interested in hearing them on the air.

Back before Thanksgiving there was a number of recurrent rumors. One W7 amateur had hopes of putting Iraq on the air when he was there in November at the invitation of the Iraqi government. However, this did not work out. Then there was another possibility being guardedly mentioned and this involved a large number of 'maybes'. The line-up did look good and it may have already come off. If not, there are some who are a bit optimistic on Iraq because of the changes in the political situation there in recent years.

Iraq has swung its political inclination toward the Western nations in the last year or two and a good number of western corporations are doing business in Baghdad but things are not completely relaxed as yet. At the W9DXCC meeting last Fall, Hank Meyer, W3ACE, and who once signed YI2AM, reported that he had some talks last summer with the top man in the radio field there in Baghdad and Hank had gotten the feeling that the time might be favorable for some YI-operations. W3ACE applied for a license, this going all the way to the top echelons of the government before coming back with the 'Reject' stamp on it. However, there still remains some cautious optimism on this one and it is considered possible that a YI-station may be heard on the air before many months pass, if one has not been heard already.

On China there are recurrent rumors. A year back LA1SH/BY was heard for a brief operation, working only c.w. and saying that he was from a Norwegian merchant ship docked at Dairen. A number of stations worked this one but with some bit of caution. However, QSLs were reported coming through from this operation some months back, these being marked "Dairen (Peoples Republic of China)". It might also be noted that last Fall the FCC announced that there was no longer any objection to communication with BY-amateur operators.

There are other reports of stations ready to go at a moments notice. The JA operators have used a number of diplomatic and business avenues to make inquiries and while the answers have all been to reject the inquiries, there is a feeling that there is a continued look going on and something will come one of these days. While the official position is that there are no amateurs in BY-China, there

Just call this photo "Nostalgiasville." Left to right are Jack Astley, Skipper of the "Edward Bear," Larry Page, WB2DHF/VQ8CH, Don Miller, W9WNV/VQ8CB, and Bill Rindone, WA6SBO, just before their departure for St. Brandon from Mauritius.

WPX HONOR ROLL

The WPX Honor Roll is based on confirmed *current* prefixes, which are submitted by separate application in strict conformance with the CQ Master Prefix List. Scores are based on the current prefix total, regardless of an operators all-time prefix count.

Mixed

W4LRN	1475	YU1BCD	1066	WA5VDM	910	W9WMM	811	WA1JMP	727
WA6MWG	1276	WA6GLD	1055	YU2OB	881	IØJX	803	K7NMG	719
VE3GCO	1210	W3GJY	1052	W4WSF	877	SM6DMU	803	WA6EPQ	713
W6TCQ	1209	W9FD	1035	DL1CF	872	K6ZDL	802	PAØVB	706
F9RM	1187	PAØSNG	1017	K2AAC	863	IT9AGA	791	W9ZTD	700
W2NUT	1183	YU2DX	995	W4BYU	859	K2ZRO	782	WAØCPX	693
W8LY	1165	WB4KZG	980	WB4SIJ	853	K4KQB	769	WA6TAX	655
W3PVZ	1155	YU1AG	957	G3DO	849	JA1AG	765		
W4CRW	1140	WA2EAM	950	W6ISQ	847	K8UDJ	750		
W8ROC	1111	W4IC	950	WA6JVD	836	WØSFU	750		
DJ7CX	1102	I6SF	946	WAØKDJ	824	OT1LN	749		
W4BQY	1102	DL1MD	940	SM7TV	822	WA5LOB	749		
WB2FMK	1100	WØAUB	929	W3YMR	818	PY4AP	735		
ON4QX	1088	K6SDR	914	W6NJU	811	KØBLT	733		

C.W.

W8LY	1150	ON4QX	920	W6TCQ	811	K2AAC	736	WA5VDH	685
K8KPL	1064	W2MO	885	VK3AMQ	809	WA2HZR	732	W6ISQ	685
DL1QT	1030	YU1BCD	993	WA6JVD	803	I6SF	726	K2ZRO	649
W2AIW	972	VO1AW	873	W3ARK	800	SM5BNX	706	K1LWI	629
WB2FMK	960	DJ7CX	841	W4BYU	768	VO1KE	700	VE4OX	600
WA6MWG	946	G2GM	840	YU1AG	760	K6ZDL	699	OK2QX	600
W9FD	944	K7ABV	812	W4IC	754	OK2DB	693		

2 × SSB

W4NJF	1200	I8KDB	985	PA0SNG	908	DL1MD	858	PY3BXW	808
IØAMU	1156	IØZV	982	F2MO	904	DK2BI	856	WB2NYM	806
F9RM	1135	DL9OH	954	I8YRK	900	IT9JT	833	W4IC	800
W6TCQ	1013	HP1JC	954	WØYDB	884	YU1BCD	824	W3YMR	793
WA6MWG	1008	CT1PK	923	K2POA	883	W6RKP	822	OE2EGL	780
W9DWQ	987	I4ZSQ	922	ZL3NS	874	W3DJZ	818	G3DO	765
OK1MP	763	W2EHB	750	YU1AG	727	WA6TAX	705	WA5VDH	691
WB4SIJ	763	WA2EAM	750	W6YMV	720	CX2CN	702	CR7IK	613
DJ7CX	752	WA5LOB	747	WB6DXU	708	WB4KZG	700	I4LCK	608

seems to be some of this type of action in the Technical Schools and those close to the border of China have reported hearing them working each other, and diving for cover if someone tries to break them.

One of the U.S. personnel with the U.S. Liason office there in Peking a year or two back tried but could not get operating permission. This DXer was there during the time of the LA1SH/BY activity but could get no information about this station and whether or not it was authorized or legitimate. When this amateur with the Liaison Office wished to bring his rig to Peking, there was no problems and for many months he sat there, ready to go with a complete station, but only a BY/s.w.l. as the hoped for operating permission did not come.

The changing political climate may bring something in the future to help the patient DXers. While it is not expected to come this next week, it might come with little warning. Those close to the scene feel that the possibility of an outsider putting a station on the air is a bit remote and any activity most likely will be by a Chinese national and operating a strictly BY-Chinese station.

South Sandwich is always going to be a difficult one because of the location on the edge of the Antarctic and because of certain natural activities going on in the group itself. This one does seem to be the most remotest possibility of these three countries.

There are at least two active volcanos in he South Sandwich group and these are violently active at times. The fumes from the volcanic eruptions can be dangerous to humans should there be a wind shift. However, on this point the wind is usually easily predicted because it is usually howling at gale force out of the west except for the times it is howling at gale force out of the east.

LU2DX who operated with the Argentine DXpedition there in 1955, the party operating from the South Sandwich island of Thule, says it is not only difficult to get to the islands but it is also difficult to stay once you have made it.

The 1955 Argentine effort signed LU2ZY, LU3ZY and LU4ZY and the group had to be evacuated in a bit of a hurry when one of the volcanos on the island started pouring molten lava into the ocean nearby their operating site. The island itself is pretty much of a spire sticking up out of the sea and while but three miles long, it has a peak that reaches over six thousand feet high.

VP8HF/VP8 operated from the South Sandwich in March 1964 and this was apparently the most recent operation there. In a recent conversation with LU2DX, he indicated that the Argentine Navy has no plans for any operations in that area in their summer which is now on in the southern hemisphere, so any possible operations are a year or more off. Probably several years if one reads the signs right. LU2DX noted that the seas in the general area of the South Sandwich group are often high and rough and a vessel with good sea-keeping qualities plus a helicopter are almost essential to any effort to get on the island and stay there.

If you want an educated guess as to the possibility of hearing a legitimate operation from any of these countries, it would seem that the placement would be (1) Iraq, (2) China and (3) South Sandwich. All this is speculation but eventually these will be heard again but, in the meanwhile, you probably will add some new ones you have not yet even heard of.

Vern Dameron, K1DRN, receiving his FPØXX license from the Telecommunications office at St. Pierre. XYL Janet and daughters Lauree, WN1VUM, age 10! and Susan, age 6, also made the trip this time. The Dameron's are becoming the number one tourist family of FP8-land.

Awards

The National Capitol DX Association is offering a Bi-Centennial Award for all those strange prefixes that came with the new year. If you work ten of the NCDXA stations using the special Bicentennial call signs, they will supply you with the Bicentennial Award.

All you have to do is send a certified list to W4QAW, Raymond Spence, 10013 Coach Road, Vienna, Virginia. U.S. Stations send 50¢, DX Stations get the award free. Any band or mode may be used.

The Santa Clara County Amateur Radio Assn. (SCCARA) is also offering a Bicentennial Award for contacts with amateurs in Santa Clara County. The rules are a bit more complex but you can get all the information by sending a note to the club at Box 6, San Jose, Calif. 95103.

There are a number of awards being offered during this 1976 year of celebration but one of the problems has been to figure out who is what behind those unfamiliar prefixes. As the year neared its end there were also some rumors that the FCC was ready to make some changes in the availability of the 1×3 and 1×2 callsigns.

Some DX Notes

DXers are reminded that the old style IRCs will be no good after the end of this 1976. Actually, there are two old-style IRCs still in circulation and while still valid during 1976, will not be acceptable after the end of this year. The new style IRC, with the spaces along the bottom and no country designation, and with all the printing in French language, will continue to be acceptable. As the IRC is the creature of the Universal Postal Union, this change applies everywhere.

The Northern California DX Foundation air-freighted a s.s.b. rig to Alex Mootoo on Rodriguez last Fall for his 3B9DA operations. Alex initially opened with only a c.w. rig and the rush shipment kept him active on Rodriguez for an extra month and with a multitude of s.s.b. contacts.

John Allaway, G3FKM, who has handled the DX Column in *RSGB's Bulletin*, was elected President of the RSGB last September. G3FKM has been long known to many DXers for his monthly column "This Month on the Air".

VK5XK arrived on ZK2-Niue early in November to put ZK2AP on the air for a month. Just before Arch arrived ZK2AO opened up, all of this causing a bit of a puzzle. It was finally easy to sort them out with ZK2AP mostly on c.w. and QSLing to W0JRN while ZK2AO was on SSB and QSLs to Box 36, Niue. The c.w. transmitter ZK2AP took to the island with him was built in 1944. As it had worked well from VK9-Norfolk in a recent operation, Arch saw no reason why it would not perform just as well from Niue.

The *CQ* WW Test in October found good conditions for the s.s.b. portion but rather poor conditions for the c.w. effort. The conditions as forecast through the *CQ* articles of W4UMF and W3ASK proved to help many DXers in figuring out what is going on. These predictions and the Solar Flux and A Index from WWV at 18 minutes after the hour are proving a valuable help.

Ed De Young was aiming for some possible action late last year with Willis being mentioned as a possibility. Sd is now signing VK4LX and says that he is still waiting for the word from the ARRL and the ITU on country status of the Hutt River Principality in western Australia. This one came into being when a rancher in Western Australia had a run-in with the Australian tax authorities and declared himself and his lands the "Hutt River Principality". Ed also says that any action directed towards Mellish Reef will have to wait a few months until the cyclone season abates.

The Vanik Bill, H.R. 7052, will be facing some critical points in this second session of the 94th Congress and help in the form of letters to your Congressman may help get this legislation enacted.

KT4MP was on from the Dry Tortugas during the time of the *CQ* WW SSB Test in October, this one being submitted for New Country Status because of its separate administration from the State of Florida. However, the Awards Committee turned it down. There will be more of these turning up, his being the "Kingman Rule" and springs from Rule 1 of the DXCC Country criteria.

QSL Information

CT7BER to CT1DW
FB8ZG to F8US
FGØMM to WA1JKJ
JA8AQN/JD1 to JARL
KE2AN to K6SE/2
KD5OME to W5UK or WA5TRX
PJ8YFQ to WA4BTC
W5TES/KJ6 to W2GHK
VP2LL to W2MIG
VP2GMB to W5MYA
VP2MIR to W7FCD
VP2M to VE7SV
VP2A to K2IGW
VP5WW to WB4EYX
VX9A to VE3GMT
VYØA to VE3MJ
VR8B to YASME
VR8C to YASME
9G5AC to W1YRC
9J2MH to VE3AUM
JY9CS to U.S. Embassy, APO New York 09892
KQ4ST to Box 599, Sterling, Virginia 22170
KY6NWC to Naval Weapons Ctr., China Lake, Ca. 93555
T75AA to Box 115, Guatemala City, Guatemala
WW9WWW to Box 1, Plymouth, Wisc. 53075
YASME to Box 2025, Castro Valley, Calif. 94546

73, Hugh, WA6AUD

GEORGE JACOBS, W3ASK, ON

Propagation

Nineteen hundred seventy-five was a year of low and still declining solar activity. In all probability, the minimum of the present cycle and the beginning of a new cycle will occur during the New Year.

The old year began with a smoothed sunspot number of 23, and by the end of 1975 the cycle had dropped to an estimated level of 11.

The new year is expected to begin with a smoothed sunspot count of 10, and reach a minimum level of around 5 by mid year, although it could occur somewhat later.

During 1975, low and still declining solar activity resulted in a considerable reduction in DX openings on the *10* and *15* meter bands, although some good *15* meter openings were still possible, mainly towards southern and tropical areas during the daytime hours. *Twenty* meters continued to be the best all around DX band during 1975, with openings possible to most areas of the world from just past sunrise to shortly before sunset, and to as late as Midnight during the late spring and summer months. It was the optimum band for DX during the daylight hours of 1975.

Overall, there seems to be a slight improvement in *40* meter DX conditions during 1975, especially from an hour or two before until and hour or two after sunset and again from about an hour or two before until an hour or so after sunrise. During the late spring, summer and early fall months the band often remained open for DX to most areas of the world throughout the hours of darkness, but during the winter months it often dropped out for several hours, especially towards Europe and Asia.

Conditions on *80* and *160* meters usually improve as solar activity declines, and this was very evident during the past year. *Eighty* meters opened for DX from sunset to sunrise throughout most of the year, including the short nights of the summer months. W1BB reports 1975 as one of the best years he has observed on *160* meters. During 1975, *80* shared honors with *40* meters as the best DX band during the hours of darkness.

LAST MINUTE FORECAST

Day-to-Day Conditions Expected For Jan. 1976

Propagation Index	*Expected Signal Quality* (4)	(3)	(2)	(1)
Date				
Above Normal: 9, 11, 17	A	A	B	C
High Normal: 7-8, 10, 13-14, 16	B	B	C	D
Low Normal: 1, 4-6, 12, 15, 18-21, 28, 31	B	C	D	E
Below Normal: 2-3, 22, 25-27, 29-30	C	D	E	E
Disturbed: 23-24	D-E	E	E	E

Where *expected signal quality is:*

A—Excellent opening, exceptionally strong, steady signals greater than S9+30 dB.

B—Good opening, moderately strong signals varying between S9 and S9+30 dB, with little fading or noise.

C—Fair opening, signals between moderately strong and weak, varying between S3 and S9, with some fading and noise.

D—Poor opening, with weak signals varying between S1 and S3, and with considerable fading and noise.

E—No opening expected.

HOW TO USE THIS FORECAST

1. Find *propagation index* associated with particular band opening from Propagation Charts appearing on the following pages.
2. With the *propagation index*, use the above table to find the expected signal quality associated with the band opening for any day of the month. For example, an opening shown in the charts with a *propagation index* of (3) will be *fair* (C) on Jan. 1, *poor* (D) on the 2 & 3rd and *fair* (C) again on the 4th through the 6th, etc.

For updated information dial Area Code 516-883-6223 for DIAL-A-PROP, subscribe to bi-weekly MAIL-A-PROP, P.O. Box 86, Northport, NY 11768, or check WWV at 14 minutes past each hour.

Outlook 1976

Very few DX openings are expected on *10* meters during 1976, during the daylight hours.

Somewhat fewer DX openings are expected on *15* meters this year, as compared to last year, but fairly regular openings should continue to be possible during much of the daylight hours, especially towards southern and tropical regions. The band may open occasionally towards Europe and Asia during the spring, fall and winter months.

Twenty meters will continue to be the best band for *daytime* DX during 1976. The band should continue to peak for DX during a two-to-three hour "window" just after sunrise, and again during the late afternoon, although DX should be possible during most of the daylight hours. During the spring and summer months, the band will often remain open until Midnight, especially towards southern and tropical regions.

On *40* meters, expect good DX openings from about an hour before, to an hour or two after sunset, and again from about an hour or two before, to an hour or so after sunrise. During the late spring, summer and early fall months, the band often should remain open throughout most of the hours of darkness. During the winter months, expect the band to close for DX from an hour or two after sunset until an hour or so before sunrise, except towards the more favorable southern and tropical areas.

Look for a continued improvement in DX conditions on *80* meters during the New Year. The band should open for DX shortly before sunset and remain open to one area of the world or another throughout most of the hours of darkness, and until shortly after sunrise. During the fall, winter and spring months, *80* meters should be the best band for nighttime DX. During the summer months, when DX openings should be possible despite a seasonal increase in static levels, it should share this honor with *40* meters.

Expect improved conditions on *160* meters as well. There should be fairly good DX conditions on this band throughout the hours of darkness, especially during the late fall, winter

HOW TO USE THE SHORT-SKIP CHARTS

1. In the Short-Skip Chart, the predicted times of openings can be found under the appropriate distance column of a particular Meter band (10 through 160 Meters), as shown in the left hand column of the Chart. For the Alaska and Hawaii Charts the predicted times of openings are found under the appropriate Meter band column (15 through 80 Meters) for a particular geographical region of the continental USA, as shown in the left hand column of the Charts. A ** indicates the best time to listen for 10 meter openings; * best times for 160 meter openings.

2. The *propagation index* is the number that appears in ( ) after the time of each predicted opening. On the Short-Skip Chart, where two numerals are shown within a single set of parenthesis, the first applies to the shorter distance for which the forecast is made, and the second to the greater distance. The index indicates the number of *days* during the month on which the opening is expected to take place, as follows:

(4) Opening should occur on more than 22 days
(3) " " " between 14 and 22 days
(2) " " " between 7 and 13 days
(1) " " " on less than 7 days

Refer to the "Last Minute Forecast" at the beginning of this column for the actual *dates* on which an opening with a specific propagation index is likely to occur, and the signal quality that can be expected.

3. Times shown in the Charts are in the 24-hour system, where 00 is midnight; 12 is noon; 01 is 1 A.M.; 13 is 1 P.M., etc. On the Short-Skip Chart appropriate *daylight* time is used at the *path midpoint*. For example, on a circuit between Maine and Florida, the time shown would be EDT; on a circuit between N.Y. and Texas, the time at the midpoint would be CDT, etc. Times shown in the Hawaii Chart are in HST. To convert to daylight time in other USA time zones, *add* 3 hours in the PDT zone; 4 hours in MST zone; 5 hours in CDT zone; and 6 hours in EDT zone. *Add* 10 hours to convert from HST to GMT. For example, when it is 12 noon in Honolulu, it is 15 or 3 P.M. in Los Angeles; 18 or 6 P.M. in Washington D.C.; and 22 GMT. Time shown in the Alaska Chart is given in GMT. To convert to daylight in other areas of the USA, *subtract* 7 hours in the PDT zone, 6 hours in MDT zone, 5 hours in CDT zone and 4 hours in EDT zone. For example, at 20 GMT it is 16 or 4 P.M. in N.Y.C.

4. The Short-Skip Chart is based upon a transmitted power of 75 watts c.w. or 300 watts p.e.p. on sideband; The Alaska and Hawaii Charts are based upon a transmitter power of 250 watts cw or 1 kw p.e.p. on sideband. A dipole antenna a quarter-wavelength above ground is assumed for 160 and 80 meters, a half-wave above ground on 40 and 20 meters, and a wavelength above ground on 15 and 10 meters. For each 10 db gain above these reference levels, the *propagation index* will increase by one level; for each 10db loss, it will lower by one level.

5. Propagation data contained in the Charts has been prepared from basic data published by the Institute For Telecommunication Sciences of the U.S. Dept. of Commerce, Boulder, Colorado, 80302.

and early spring months. Best time to check for *160* meter DX is from an hour or so before sunrise to just after sunrise, at the *eastern* end of a DX path.

During January, *20* meters should be the best band for DX propagation during most of the daylight hours, with some openings also possible on *15* meters, especially when conditions are High Normal or better. During the hours of darkness, *80* meters should be the optimum DX band, with good openings on *40* meters when conditions are High Normal or better. Be sure to also check *160* meters for interesting DX openings during the hours of darkness, especially during the 43rd Annual Trans-Atlantic *160* Meter Test which will be conducted between *0500 and 0730 GMT* on January 11 and February 8. W1BB points out that during the test periods W and VEs should operate between 1800 and 1807 kHz and DX stations between 1825 and 1830 kHz. W and VE stations should call "CQ FT DX" during the *first* three minutes of each fifteen minute period, starting on the hour, then listen for or work DX stations during the remaining twelve minute periods.

Short-Skip Charts

This month's column contains a Short-Skip Propagation Chart for use between distances of approximately 50 and 2300 miles. Special Charts for use between the mainland and Alaska and Hawaii are also included. Instructions for use of these Charts are given elsewhere in this column. DX Charts for January appeared in last month's column.

V.H.F. Ionospheric Openings

There is a fairly good chance for some meteor-scatter type openings during the first week of January when the *Quadrantids* meteor shower is expected to take place. This is usually a major shower, and it should peak on the 2nd and 3rd with about 30 to 40 meteors entering the earth's atmosphere each hour.

January is generally a poor month for v.h.f. ionospheric propagation. Auroral activity is usually at a low seasonal level, and there is little sporadic-E activity expected. Best bet for ionospheric openings are on those days when h.f. conditions are expected to be Below Normal or Disturbed. These appear in the "Last Minute Forecast" at the beginning of this column.

Latest Sunspot Number

The Swiss Federal Observatory at Zurich reports a mean sunspot number of 9 for October, 1975. The highest level recorded during the month occurred on the 14th with a daily count of 30. There were nine days during the month when the sun was completely devoid of spots, and the daily number was zero.

The monthly mean for October results in a smoother sunspot number of 19 centered on April, 1975. A smoothed sunspot number of 9 is forecast for January, 1976.

73, George, W3ASK

CQ Short-Skip Propagation Chart
January & February, 1976
Local Standard Time At
Path Mid-Point (24-Hour Time)

Band (Meters)	Distance Between Stations (Miles)			
	50-250	250-750	750-1300	1300-2300
10	Nil	Nil	10-15 (0-1)	10-15 (1) 15-16 (0-1)
15	Nil	10-16 (0-1)	08-10 (0-1) 10-15 (1-2) 15-16 (1) 16-18 (0-1)	08-09 (1) 09-10 (1-2) 10-15 (2-3) 15-16 (1-2) 16-18 (1) 18-19 (0-1)
20	Nil	08-10 (0-1) 10-12 (0-2) 12-14 (0-3) 14-16 (0-2) 16-22 (0-1)	06-07 (0-1) 07-08 (0-2) 08-10 (1-4) 10-12 (2-4) 12-14 (3-4) 14-16 (2-4) 16-17 (1-3) 17-18 (1-2) 18-22 (1)	06-07 (1) 07-08 (2) 08-10 (4) 10-14 (4-3) 14-16 (4) 16-17 (3-4) 17-18 (2-3) 18-19 (1-2) 19-20 (1)
40	07-09 (0-1) 09-10 (1-3) 10-11 (3) 11-15 (3-4) 15-16 (3) 16-18 (1-2) 18-20 (0-1)	07-08 (1-2) 08-09 (1-3) 09-11 (3-4) 11-15 (4-3) 15-16 (3-4) 16-18 (2-3) 18-20 (1-2) 20-02 (0-2) 02-07 (0-1)	07-08 (2) 08-09 (3-1) 09-11 (4-1) 11-15 (3-1) 15-16 (4-2) 16-18 (3-4) 18-20 (2-4) 20-02 (2-3) 02-07 (1-2)	07-08 (2-1) 08-15 (1-0) 15-16 (2) 16-18 (4-3) 18-20 (4) 20-02 (3-4) 02-04 (2-3) 04-07 (2)
80	07-08 (1-2) 08-09 (3-4) 09-18 (4) 18-21 (2-3) 21-23 (1-2) 23-03 (1) 03-07 (0-1)	07-08 (2) 08-10 (4-2) 10-16 (4-1) 16-18 (4-2) 18-21 (3-4) 21-23 (2-3) 23-03 (1-3) 03-07 (1-2)	07-08 (2-1) 08-10 (2-0) 10-16 (1-0) 16-18 (2-1) 20-21 (4) 21-23 (3-4) 23-03 (3) 03-07 (2) 18-20 (4-3)	07-08 (0-1) 08-16 (0) 16-18 (1-0) 18-20 (3-2) 20-23 (4) 23-03 (3) 03-06 (2) 06-07 (2-1)
160	09-17 (1-0) 17-19 (3-2) 19-05 (4) 05-07 (3) 07-09 (2-1)	17-18 (2-1) 18-19 (2) 19-21 (4-3) 21-05 (4) 05-06 (3) 06-07 (3-1) 07-09 (1-0)	17-18 (1-0) 18-19 (2-1) 19-21 (3-1) 21-03 (4-3) 03-05 (4) 05-06 (3-2) 06-07 (1) 07-08 (1-0)	18-19 (1-0) 19-21 (2-1) 21-03 (3) 03-05 (4-2) 05-06 (2) 06-07 (1-0)

#See explanation in "How To Use Short-Skip Charts" in box at the beginning of this column.

*Indicates best times for 160 Meter openings.
†Indicates best times for 10 Meter openings.

Note: The Alaska and Hawaii Propagation Charts are intended for distances *greater* than 1300 miles. For shorter distances, use the preceding Short-Skip Propagation Chart.

ALASKA
Opening Given In GMT#

To:	15 Meters	20 Meters	40 Meters	80 Meters
Eastern USA	21-23 (1)	18-22 (1) 22-00 (2) 00-02 (1)	03-10 (1) 10-12 (2) 12-13 (1)	07-12 (1)
Central USA	20-23 (1)	18-22 (1) 22-00 (2) 00-02 (1)	03-11 (1) 11-13 (2) 13-14 (1)	07-12 (1)
Western USA	20-00 (1)	17-18 (1) 18-22 (2) 22-00 (3) 00-01 (2) 01-03 (1)	04-05 (1) 05-12 (2) 12-15 (1) 15-16 (2) 16-17 (1)	05-12 (1) 12-15 (2) 15-17 (1) 12-15 (1)*

HAWAII
Openings Given In HST#

To:	15 Meters	20 Meters	40 Meters	80 Meters
Eastern USA	06-07 (1) 07-08 (2) 08-11 (1) 11-13 (2) 13-14 (3) 14-15 (2) 15-16 (1)	06-07 (1) 07-09 (2) 09-12 (1) 12-14 (2) 14-15 (3) 15-16 (2) 16-17 (1)	17-19 (1) 19-21 (2) 21-00 (3) 00-03 (2) 03-04 (1)	19-21 (1)* 21-01 (2) 01-03 (1) 23-02 (1)*
Central	06-07 (1) 07-12 (2) 12-14 (3) 14-16 (2) 16-17 (1)	06-07 (1) 07-10 (2) 10-13 (1) 13-14 (2) 14-16 (3) 16-17 (2) 17-18 (1)	17-19 (1) 19-20 (2) 20-03 (3) 03-04 (2) 04-06 (1)	19-20 (1) 20-22 (2) 22-01 (3) 01-03 (2) 03-05 (1) 23-03 (1)*
Western USA	12-15 (1)† 06-07 (1) 07-08 (2) 08-12 (3) 12-14 (4) 14-15 (3) 15-16 (2) 16-18 (1)	06-07 (1) 07-08 (2) 08-10 (4) 10-14 (3) 14-16 (4) 16-18 (3) 18-19 (2) 19-20 (1)	16-18 (1) 18-19 (2) 19-22 (4) 22-02 (3) 02-04 (2) 04-09 (1)	19-20 (1) 20-22 (2) 22-04 (3) 04-05 (2) 05-07 (1) 22-05 (1)*

A. EDWARD HOPPER, W2GT, ON

Awards

The January "Story of The Month", passed along by John, is:

John P. Nelson, W6JHV
All Counties #51, 2-24-71

"I was born in Albany, California, August 1, 1933, and got interested in amateur radio at the age of 12. I did not get my ticket until I was 17 and then I went on the air with my 12 watt 2 meter rig. Five years later, as I recall, I had 400 watts to a pair of 4-65s with 811-A modulators, still on 2 meters.

"It was around 1954 that I rebuilt the rig for 40 meters and I got interested in DX. I stayed on 20 and 40 until I got up to 265 countries, WAZ, and WPX. In 1968 I moved to Montana and continued DXing as W6JHV/7.

"I tuned across the 20 meter Independent County Hunters Net one day, and started working Counties. My first QSO was with WAØWOB and Skip, WAØWOB later gave me my last County, Searcy, Arkansas.

"I was married in 1956, worked at making missiles and am now with a recreational land development company.

"May I thank all the County Hunters for all the help and kind cooperation, and of course thanks to Skip for my first and last one—Hi. When I can find time, I'll be doing some more mobiling and get active to try to complete them All 20, All S.S.B.".

Awards Issued

Bea Dietz, WA2GPT made them *all*, 9-18-75 (Thanks to Bea for her many fone calls with valuable information, her FB Net Controlling and all her help to others).

Les Jeffrey, W8WT added All Mobiles to his *All Counties Award* #92, dated 1-3-73. He already has endorsements of All S.S.B., All 14.

Bill Grew, W9GBI was issued USA-CA-500 through USA-CA-2500 endorsed All S.S.B., All Mobiles.

LeRoy Ullrich, WA0LMK acquired USA-CA-2500.

Special Honor Roll
(All Counties)
#137—Beatrice A. Dietz, WA2GPT 9-18-75.

Gordy Baker, WA5KQD added USA-CA-1500 and 2000 to his collection, both endorsed All A-1.

Doctor Hugh Unger, WB4UHN claimed USA-CA-500, endorsed All 14, All S.S.B.

Kate Saul, WA2MIO, with the help of Bea, WA2GPT, got her paper work finished to receive USA-CA-500.

Hans Schleifenbaum, DL1YA qualified for USA-CA-500.

Awards

Achievement Certificate: Issued by the North Jersey DX Association under the following rules: To non-USA stations for working 5 NJDXA Members via **OSCAR** 6 or 7; to non USA-Stations for working 15 NJDXA Members; and to USA Stations for working 25 NJDXA Members. Send data and at least postage to: Hayden Evans, K2BZT, 11 Holly Tree La., Little Silver, N.J. 07739, U.S.A. Membership includes: W2AGW, 2AIW, 2BHM, 2BOK, 2BXA, K2BZT, W2CWK, K2DCA, W2DEO, WA2DIG, W2DXX/K2KL-silent key, WA2ELS, 2FQG, W2FZY, W2GHK/4, W2GK, 2GT, 2GUM, 2GZZ, 2HTI, 2HZY, 2JB,. K2-JGG, W2JLH, 2JVU, K2KER, W2LNB, 2LV, 2MIG, 2MJ, 2MS, 2MZV, 2NHV, 2ODO/6, 2OEH, K2OJD, W2OKM, 2OST, K2QBW, K2QHL, W2QM, W2-QT/7, 2TP, 2TQC, WB2UKP, K2VJE, W2YD, 2YT, 2YY, 2ZZ, W3CWG/W2-RGV, K4JRI/W2DEW, W5VQ and W8-RT. May I mention that the officers for 1975 were: Pres. Joe, W2BHM; V.P. Lou, W2ZZ; Tres. Bob, W2JLH and Sec., Bro. Pat, W2GK ex W2ZTV.

1976 Summer Olympics Award: This Certificate sponsored by the Westminster Amateur Radio School, to honor the 1976 Summer Olympics, will be awarded to licensed amateurs (with provisions for s.w.ls, on a heard basis) who comply with the following requirements.

1. Canadian Amateurs must work 10 Montreal *Island* stations (Montreal *Island* amateurs must work 20 Montreal Island stations—v.h.f./u.h.f. repeater contacts disallowed).

2. Foreign amateurs must work 5 Montreal *Island* stations.

3. Contacts must be made between August 1, 1975 and July 31, 1976. *Any Mode.*

4. Send $1.00 or 5 IRCs and a copy of your log containing: date, time, station worked and operator, mode, frequency, signal report received and

MARAC Award Worked All Counties USA Second Time.

1976 Summer Olympics Award

report sent. No QSLs required—send to: Secretary, Westminster Amateur Radio School, Box 323, Montreal Int'l Airport, A.M.F., P.Q. Canada.

MARAC Award—Worked All Counties USA Second Time: This special Plaque is available to all licensed amateurs anywhere in the world and is issued to them as individuals regardless of calls held or operating QTHs. All County contacts must be dated after the completion date of first time worked. Also available to s.w.ls on heard basis. All contacts must be confirmed by QSL and QSLs must be in your possession. Any QSLs altered in any way will disqualify the applicant. Independent Cities, parks or reservations not acceptable for adjoining counties. There is no basic certificate, different classes, special seals or special endorsements. The walnut Plaque measuring 9 × 12 inches will have the MARAC Mobile Car mounted on the bottom portion of the Plaque. The plate on the mobile car will have the wording (In silk screen process) "Worked All Counties Second Time." A special engraved plate mounted top center of Plaque will display the number of the award, operators full name, call letters at time of application and the date of the achievement.

USA-CA HONOR ROLL

2500		1500		500	
W9GBI	201	W9GBI	378	W9GBI	1073
WAØLMK	202	WA5KQD	283	WB4UHN	1074
2000				WA2MIO	1075
W9GBI	236	**1000**		PL1YA	1076
WA5KQD	237	W9GBI	282		

Applications must be submitted in organized book form showing states alphabetically and counties alphabetically under each state. Each county worked shall show call letters of station that was worked and date station was worked. Completed applications, certified by two amateurs (General Class or higher) or an official of your Radio Club, should be submitted to MARAC Awards Chairman with a fee of $15.00 to cover cost. MARAC Awards Chairman is: Jack Scroggin, W0SJE, 602 Jefferson, Lee's Summit, MO. 64063. For *any* additional information on MARAC membership, Awards Program, County Hunting, CH special QSLs, frequencies, etc. . . . send large envelope with 3 first class mail stamps (will be more than 10¢ × 3 by the time you read this) and oh yes, have your address on it—Bertha Eggert, WA4BMC, P.O. Box 6811, Southboro Station, West Palm Beach, Florida 33405.

Notes

The price now for POD 26 (Directory of Post Offices, Publication 26) is $5.05. It is sold by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Hurrah for a New Year, let us hope and pray that radio and other conditions will improve.

Perhaps some of those who tune up on Net frequencies and some of those who intentionally cause QRM to Net frequencies, will make New Years Resolutions to cease!

May I wish *you* and *yours* all the best in 1976. Write and tell me, How was your month (year)?

73, Ed., W2GT.

North Jersey DX Association Achievement Award

Contest Calendar

BY FRANK ANZALONE, W1WY

We had another good one for the Phone Contest last October. George Jacobs was right on target with his prediction of above normal conditions.

Trust you all got your logs mailed before the December 1st deadline. This may have been a problem for our Canadian friends. The mail embargo was in full progress just about that time. Don't worry fellows, just put them in the mail whenever the Postal authorities give you the green light, we'll accept your entry.

And don't forget, the 15th of this month (January) is the deadline for your c.w. effort.

I strongly recommend that you study the WPX Contest rules on page 00 of this issue. Especially the Exception to the Multiplier in Par. VII. We are going to have an exciting contest this Bi-Centennial year. An excellent opportunity to fatten up your total for the special "USA WPX 76" Achievement Award. (See Oct. *CQ*).

CQ WW 160 DX Contest

Starts: 2200 GMT Friday, January 23
Ends: 1600 GMT Sunday, January 25

Rules are the same as previous years and were fully covered in last month's Calendar.

For those not familiar with 160 operation, most of the state-side and VE activity, especially on the East Coast, will be found between 1800 and 1825, and 1830 and 1850 kHz. The section between 1825 and 1830, the "DX Window" by a gentlemen's agreement, is reserved for over-seas DX stations. West Coast and KH6 stations will be found below the 2000 kHz edge. (See the U.S. Regulations for 160).

The DX stations, W6 and W7 and KH6's usually indicate where they will be listening. Usually 1800—1805 but not on frequency. It will be a split frequency operation. *(If operating transceive be careful spotting your frequency switch, it could be embarrasing. Hi!)*

Last year the phone boys were most cooperative and stayed out of the "DX Window," some joined us or took the week-end off. Thanks fellows. its only a once a year request.

Contest stations should also cooperate and not work too close to 1825 and 1830 edges. Some of you have real potent signals that will spill over into the DX portion of the band.

Still time to obtain log forms and U.S. Regulation sheet from *CQ*. A large s.a.s.e. with your request please.

Mailing deadline for your logs is February 28th to: CQ 160 Contest, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.

ARRL DX Contest

Phone: February 7-8 and March 6-7
C.W.: February 21-22 & March 20-21
Starts: 0001 GMT Saturday
Ends: 2359 GMT Sunday

This will be the 42nd year for this contest. DX stations will be working the W/K and VE/VO's who in turn will be digging for the DX.

The modified rules used in last year's contest worked out so well that the same format will be used in this year's competition.

Single operator stations will now be able to compete in one of three categories: All Band, High-band (10, 15 & 20) and Low-band (40, 80 & 160) Multi-operator stations, All Band only. Phone and c.w. are separate contests.

Exchange: RS(T) plus state or province for W/K and VE/VO's. RS(T) plus 3 figures indicating power input for DX stations. (1KW if 1000 watts).

Scoring: Three points for each completed QSO on each band. W/VE multiply total by the number of DX countries worked on each band for their final score. DX stations use the 48 continental states plus VO and VE1-VE8, a possible 57 per band for their multiplier. The same station may be worked on each band for QSO and multiplier credit. (KH6 & KL7 considered DX)

Awards: Certificates to the highest scoring single operator station in each category, in each country and each U.S. and Canadian ARRL section. Awards to multi-operator stations, single and multi, will be made in each W/VE call area and DX country. In addition DX stations making 1000 or more QSOs will also receive a certificate. Plaques to the Top single operator in each continent.

There is also Club competition with detailed regulations and a disqualification clause. Better check *QST*.

Log forms and check sheets are available from ARRL, include postage if you wish them sent 1st Class.

Mailing deadline is April 15th to: ARRL Communications Dept. Newington, Conn. 06111.

QCWA QSO Party

Starts: 2300 GMT Friday, February 13
Ends: 2300 GMT Sunday, February 15

The 19th annual QXWA Party is

Calendar of Events

*Jan.	3	Pacific Net Party
Jan.	3-4	ARRL VHF Sweepstakes
*Jan.	3-4	Nostalgia Radio Exchange
*Jan.	10-11	YU 80 Meter C.W. Contest
*Jan.	14-15	YLRL DX C.W. Contest
***Jan.**	**23-25**	**CQ WW 160 C.W. Contest**
*Jan.	28-29	YLRL DX Phone Contest
*Jan.	31-	
Feb.	-1	French C.W. Contest
Feb.	7-8	ARRL DX Phone Contest
Feb.	13-15	QCWA QSO Party
Feb.	14-15	10-10 Net QSO Party
Feb.	21-22	ARRL DX C.W. Contest
Feb.	21-22	YL-OM Phone Contest
Feb.	28-29	French Phone Contest
Mar.	6-7	ARRL DX Phone Contest
Mar.	6-7	YL-OM C.W. Contest
Mar.	14-15	South Dakota QSO Party
Mar.	20-21	ARRL DX C.W. Contest
Mar.	**27-28**	**CQ WW WPX SSB Contest**
Apr.	24-25	Bermuda Phone Contest
May	1-2	Helvetia 22 Contest
May	8-9	Bermuda C.W. Contest

*Covered last month's Calendar

sponsored by the Gator Chapter of Florida this year. Rules and format have again been changed with a rather interesting but complicated scoring system in effect this year. *(Better have your calculator handy when you figure your final score.)*

Exchange: QSO no., your name and your chapter. Members not affiliated with a chapter use "none." "Distinguished Members" holding a 50 year certificate add the suffix "D" after their QSO number.

Scoring: Only contacts between members count.

1. One point if between members in same or adjacent countries.

2. Two points if in a nearby country or state separated by ocean or another country.

3. Five points if in a different continent.

4. Two points if you contact QCWA Memorial Station W2MM/4.

5. Add an additional point if station worked is a 50 year member. ("D" after QSO no.)

The same station may be worked once on c.w. and again on phone, but not on different bands.

Multiplier: One for each different Chapter.

Final Score: Total QSO points from 1, 2, 3, 4 plus "D" members worked multiplied by total of different chapters worked.

Frequencies: Phone — 1805-1825, 3940-3960, 7240-7260, 14240-14260, 14280-14300, 21340-21360, 28640-28660. C.W. — 1805-1825, 3540-3560, 7040-7060, 14040-14060, 21040-21060, 28040-28060.

It is suggested that when calling CQ you use a frequency in which the last digit is the same number as your call area. (i.e.—W1 would use 7241 or 7251, W4 would use 14284 or 14294). Keep your activity within above limits and avoid operation on Net frequencies.

Awards: The Annual Plaque award goes to the "Top Banana" in the Party. The Plaque is presently held by W3IN. Appropriate certificates will be presented to the three top chapters with the highest aggregate scores. (No mention was made of certificates for members, like working 100 members or more and etc.)

Include a summary sheet showing the scoring, indicate your Chapter, number of your 50 year certificate if you hold one, and your name, call and address. Comments are invited.

Mail your log as soon as possible to: Dave Davis, W4GQ, 6971 Grand Vista Way, South, St. Petersburg, FL 33707

(Continued on page 72)

CQ United States Regulations CQ

For 160 Meter Operation

Area	Maximum D.C. Plate Input Power in Watts															
	1800 to 1825 kc		1825 to 1850 kc		1850 to 1875 kc		1875 to 1900 kc		1900 to 1925 kc		1925 to 1950 kc		1950 to 1975 kc		1975 to 2000 kc	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Alabama	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Alaska	200	50	0	0	0	0	200	50	0	0	0	0	0	0	0	0
Arizona	0	0	0	0	0	0	0	0	0	0	200	50	500	100	1000	200
Arkansas	1000	200	200	50	100	25	0	0	0	0	100	25	100	25	500	100
California	0	0	0	0	0	0	0	0	100	25	200	50	200	50	500	100
Colorado	200	50	0	0	0	0	0	0	0	0	200	50	200	50	1000	200
Connecticut	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Delaware	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
District of Columbia	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
Florida	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Georgia	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Hawaii	0	0	0	0	0	0	0	0	200	50	100	25	100	25	500	100
Idaho	100	25	0	0	0	0	100	25	100	25	100	25	100	25	500	100
Illinois	1000	200	200	50	100	25	0	0	0	0	0	0	0	0	200	50
Indiana	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	200	50
Iowa	1000	200	200	50	200	50	0	0	0	0	100	25	100	25	500	100
Kansas	500	100	100	25	100	25	0	0	0	0	100	25	200	50	1000	200
Kentucky	1000	200	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Louisiana	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Maine	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
Massachusetts	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Michigan	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	100	25
Minnesota	500	100	100	25	100	25	100	25	100	25	100	25	100	25	500	100
Mississippi	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Missouri	1000	200	200	50	100	25	0	0	0	0	100	25	100	25	500	100
Montana	100	25	0	0	0	0	100	25	100	25	100	25	100	25	500	100
Nebraska	500	100	100	25	100	25	0	0	0	0	200	50	200	50	1000	200
Nevada	0	0	0	0	0	0	0	0	100	25	200	50	200	50	1000	200
New Hampshire	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
New Jersey	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
New Mexico	100	25	0	0	0	0	0	0	0	0	100	25	500	100	1000	200
New York	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
North Carolina	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
North Dakota	500	100	100	25	100	25	100	25	100	25	200	50	200	50	1000	200
Ohio	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	100	25
Oklahoma	500	100	100	25	100	25	0	0	0	0	100	25	200	50	1000	200
Oregon	0	0	0	0	0	0	0	0	200	50	100	25	100	25	500	100
Pennsylvania	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Rhode Island	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
South Carolina	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
South Dakota	500	100	100	25	100	25	100	25	100	25	200	50	200	50	1000	200
Tennessee	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	200	50
Texas	200	50	0	0	0	0	0	0	0	0	0	0	100	25	500	100
Utah	100	25	0	0	0	0	100	25	100	25	200	50	200	50	1000	200
Vermont	500	100	100	25	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	500	100	100	25	0	0	0	0	0	0	0	0	0	0	100	25
Washington	0	0	0	0	0	0	0	0	200	50	0	0	0	0	500	100
West Virginia	1000	200	500	100	100	25	0	0	0	0	0	0	0	0	100	25
Wisconsin	1000	200	200	50	200	50	0	0	0	0	0	0	0	0	200	50
Wyoming	200	50	0	0	0	0	100	25	100	25	200	50	200	50	1000	200
Puerto Rico	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Virgin Islands	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Swan Island	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Serrana Bank	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Roncador Key	500	100	100	25	0	0	0	0	0	0	0	0	100	25	500	100
Navassa Island	500	100	100	25	0	0	0	0	0	0	0	0	0	0	200	50
Baker, Canton, Enderbury, Howland	100	25	0	0	0	0	100	25	100	25	0	0	0	0	100	25
Guam, Hohnston Midway	0	0	0	0	0	0	0	0	100	25	0	0	0	0	100	25
American Samoa	200	50	0	0	0	0	200	50	200	50	0	0	0	0	200	50
Wake	100	25	0	0	0	0	100	25	0	0	0	0	0	0	0	0
Palmyra, Jarvis	0	0	0	0	0	0	0	0	200	50	0	0	0	0	200	50

(Cut Out And Save)

Surplus Sidelights

BY GORDON ELIOT WHITE

THIS new year—1976—is an anniversary of sorts. It is the 30th year since World War II surplus came on the market in 1946. It is hard for me to admit that 30 years ago I was poking in piles of olive drab, looking for shoulder patches. I must have had the best collection of Army patches in my junior high school. A little later I moved over into the electronics bins, and I still cannot resist the urge to scrounge a bit in a well-stocked surplus store.

It must be harded still for those who actually used those RBAs and TBXs and ART-13s in combat, to realize how long ago it was. I still get mail from old brass-pounders who go back to the 1930's, looking for a lead on a surplus receiver capable of tuning down into the 500-meter bands, as if the spark signals and c.w. from that long-ago time were still bouncing around in the ether, waiting to be heard again.

Surplus, by its nature, tends to be a bit historical. Some things hit the surplus market almost as soon as they are manufactured. Some dribble out for years, as equipment in use is slowly replaced by newer items. My belief is that the good stuff lasts longest—the lemons are dumped first. The obvious example is the Command Receiver design, now 40 years old but still in a lot of military aircraft. Its production lifetime (1939-1965) was eight years longer than Ford's Model T, a fantastic statistic in the present era of instant obsolescence.

Receivers seem to remain popular a lot longer than transmitters, naturally enough, I suppose, because the state of the art has given us single-sideband, unknown during World War II. Stability figures have tightened up a great deal, and television has a demanded sanitary signals not really required during the big war.

Receivers, however, have progressed more slowly. Even relatively old units have proven adaptable to modern conditions, with product detectors added, and dynamotors readily replaced by transformer-diode power suplies. In the very longest wavelengths, there has been very little equipment built to replace the old sets.

The BC-348, and its cousins, BC-189, BC-312, and BC-342, are still popular, at least from my mail. K2-KWK writes, for example, that he had a BC-348 "in my early hamming days. It produced much fun, and a good companionship developed between this equipment and me.

"In 1970 a bit of nostalgia developed strong enough to make me seek out another BC-348 and I later ended up with another for parts due to its being flooded by Hurricane Agnes. Interestingly enough, the flooded one works fine after getting dried off."

Ed Cafferey, (Spark 5 PK) writes that he finally junked his BC-344 (150-1,500 kHZ) receiver because the MFP (anti-fungus varnish) had so hardened that defective parts were impossible to replace. Ed recalled that MFP was necessary in the jungles of the China-Burma-India theatre because the "bugs" would eat any organic material, and even etch the lenses of photo-optical equipment.

Unfortunately, I don't have a good file on the BC-348 and its design history.

The receiver was built as a "liaison" set for use in large Army Air Corp planes—large enough to carry a radio operator. There was no pilot's remote control, a factor which has made conversion simple, since all control functions are locally operated.

A "liaison" set, as opposed to a "command" unit, was designed to communicate with ground-based stations, for weather and military instructions. "command" sets were for plane-to-plane communications, and

for contact with control towers on landing and takeoff, thus "Command" sets had to have pilot operated controls and were designed for short-range work.

The BC-348 in the B-17, for example, was located in a radio compartment just behind the cockpit. The radio operator doubled either as the top turret gunner or used a single .50 cal gun overhead at the rear of the radio compartment.

Of course the set was operated by a 28 volt d.c. dynamotor. For those too young to recall, a dynamotor was a small electric motor-generator. You put in 28 volts and took out 250 volts, or whatever B+ your set was designed for. The efficiency of such devices was incredibly low—about 20 percent, at best.

The BC-224 was a 12-volt version. The BC-312 was a slightly different 12-volt set, of the same general design, while the BC-342 was a 115 volt, a.c. powered model of the BC-312. The BC-312/342 had an intermediate frequency of 470 kHz, while the BC-348/224 had a 915 kHz i.f. A low-frequency set, BC-314/344 covered 150-1500 kHz, with a 92.5 kHz i.f.

The BC-348 and 342 receivers both covered 1,500 kHz—18 MHz, but the 348 series had a 200-500 kHz band as well.

Of course, none of these had any sort of provision for sideband reception, though all of them had beat-frequency oscillators. The only reference I can offer to a sideband adaptation was written by W4EPL in *QST* in March, 1966.

There are numerous conversion pieces on the set which deal with power supplies and bandspreading (see *CQ* Feb., March, 1959, April 1948, Sept. 1956, *QST* Nov. 1947.) One of the best ideas was the use of a command receiver such as the R-24/ARC-5 as an outboard i.f. strip (Q-5er) by tuning the ARC-5 to the 915 kHz i.f. of the BC-348. For the other sets, a BC-453 or R-23/ARC-5 will tune to 470 kHz and do an even better job of sharpening up the passband.

After the war a lot of these receivers were stripped out of scrap aircraft and sold, but a lot of them stayed in military and government service, and have dribbled out onto the market for these 30 years. I do not know just where to recommend nostalgia buffs to look for them, but almost any electronic surplus dealer is likely to have one or more on his shelves, somewhere.

Parts for these units may be in short supply, unless you can find a second receiver from which to

scrounge. The same problem afflicts the other good surplus receivers—the Hammarlund SP-600 and super-pro, and the Collins R-388, R-389, R-390, 390-A, 391, 51J, etc. I am advised that D & R Electronics, Route 1, Box 56, Milton, Pa., 17847, does stock these parts. D & R's phone is 717-742-4604.

For manuals, I find the best sources are Sam Consalvo, 7218 Roanne Dr., Oxon Hill, Md. 20021, and Quaker Electronics, Hunlock Creek, Pa. 18621.

There was a product detector for the R-390 written up in *CQ* in the January, 1968 issue, p. 55, also September 1970 p. 77 and August 1973 p. 43.

The original manufacturers, of course, are long out of the business of building this type of receiver, or parts. Collins has been sold, and has not made R-390's for many years. Hammarlund gave up amateur equipment in 1967 and abandoned commercial general coverage receivers in 1973.

Sic Transit Gloria. We now live on Citizens Bands, and f.m. First-class general coverage receivers are no longer commercially viable. If you want to listen around on all the bands, you have to go to surplus, or to super-costly laboratory-grade equipment.

In this economic and technical environment, they don't build 'em like they used to, and probably never will, again. Up nostalgia! Up the BC-348!

Novice *(from page 59)*

member of the "Stone Mountain Repeater" on 146.16-146.76 MHz, disagrees that you should avoid the use of "CQ" when operating through a repeater. "If you are making a General Call and will answer anyone who replies, 'CQ 76. This is W4---,' is the correct call. The fact that your transmitter might be crystal controlled has nothing to do with it. 'CQ' is the shortest thing you can say and means exactly what you are trying to say with '. . . monitoring the frequency,' 'Is anyone around,' and so forth. Also, 'QRZ?' is entirely incorrect as a substitute for 'CQ.'

"The widespread use of scanners and synthesizers today makes adding the frequency on which you are going to listen after the 'CQ' advisable. A mobile operator with a scanner/synthesized receiver has to take his eyes off the road for an instant to see which channel is active when he hears the call, unless the caller tells him. I agree that a *long* CQ is unnecessary on the first call. But if you get no answer, or if you are operating marginal simplex, you should use the same type of CQ that you would on h.f. Thanks for listening to the 2-meter old timer." We hope Ruddy forgives us for condensing his remarks somewhat.

At this point, we always remind you that the NOVICE SHACK is your column. Whatever your class of license, your "News and Views," suggestions, and pictures are what make the column possible. Address all mail to the address on the first page of the column.

73, Herb, W9EGQ.

Contest Calendar *(from page 69)*

Ten-Ten Net QSO Party

Starts: 0001 GMT Saturday, Feb. 14
Ends: 2400 GMT Sunday, Feb. 15

This is the winter QSO Party of the Ten-Ten International Net of Southern California. It's open to all amateurs but non-members are not eligible for awards. However they are encouraged to submit a log and apply for membership. Details can be had from K5MRU.

Activity is on 10 Meters only, using any mode, but one contact only with same station.

Exchange: Name, QTH and 10-10 membership number if a member of the Net.

Scoring: For members, 1 point for each QSO, add another point if it's with a 10-10 member, and an additional point if QSO is with a out-of-state, province or DX station. Possible 3 points for one contact. That's your score.

Awards: 1st and 2nd place certificates in each U.S. call area, KH6 & KL7, and each VE province. And to 11 continental and sub-continental areas over the world.

Complete results will be published in the 10-10 Net Bulletin.

Logs go to: Grace Dunlap, K5MRU, Box 445, La Feria, TX 78559

YL-OM Contest

Phone: Feb. 21-22 C.W.: Mar. 6-7
Starts: 1800 GMT Saturday
Ends: 1800 GMT Sunday

Its the YL's working the OM's in this one. All bands may be used but cross-band or Net contacts do not count.

Exchange: QSO no., RS(T) and A.R.R.L. section or country. (See *QST* for section list)

Scoring: One point per QSO. Multiply total by number of A.R.R.L. sections and countries worked for final score. The same station may be worked once only regardless of band.

There is also a power multiplier of 1.25 for stations running 150 watts or less input. (300 watts p.e.p. if on s.s.b.) Multiply your final score by above factor.

Phone and c.w. are separate contests and require separate logs.

Awards: Certificates to the highest scoring YL and OM in each U.S. and VE call area and in each country. There are also 4 Trophies for the Top YL and Top OM in each contest. And 2nd and 3rd place certificates for the runner-ups.

Logs must be mailed by March 24th and received no later than April 18th. This year they go to: Beth Newlin, WA7FFG, 826 W. Prince Rd. -06, Tuscon, Ariz. 85705

(Since the dates are on the same week-end as the A.R.R.L. contests but on opposite modes, it will be interesting to see if there will be any loss in participation. At least QRM should be down. Ed.)

73 for now, Frank, W1WY

Math's Notes *(from page 57)*

older sets use vacuum tubes) in a common product detector circuit. S.s.b. signals at the i.f. frequency are mixed with the b.f.o. signal in the tube and the resulting audio is fed to the regular audio stages in the receiver. There is no path for the b.f.o. energy to back into the i.f. stage or a.v.c. stage where it would overload things. As a result, the S-meter will indicate correctly and the a.v.c. may be left on. Because of the nature of the s.s.b. signal however, the speed of response of the a.v.c. line may not be suitable and a fast as well as slow a.v.c. response time will be required.

In fig. 2 we have indicated the proper way to hook up the detector of fig. 1 as well as provide a fast/slow a.v.c. switch. The detector shown in this example is one of the most common and, with minor variations, was the one used in probably 90-95% of the 1960's vintage receivers.

Installation consists of simply punching a hole for a 9 pin miniature tube socket in a convenient location near the a.m. detector and b.f.o. tube and wiring the circuit. The existing a.m./c.w. switch may be changed to a similar one with the proper number of poles and then the only addition would be the a.v.c. fast/slow switch. If one is adventurous, a 3 position switch could be used instead of the commonly supplied a.v.c. on-off switch, making this control an a.v.c. fast-slow-off control. Then, no front panel drilling would be necessary at all.

Adjustment of the circuit is quite

simple. All one has to do is tune to a carrier (on a.m.—or if you can't find one, WWV, CHU on 7.3333 etc.) being certain that you are getting the maximum reading on the S-meter. Now switch to s.s.b., adjust the b.f.o. pitch control for zero-beat, and start receiving s.s.b. the proper way. To receive c.w., it is only necessary to slightly detune the receiver to get a desirable beat note or, in a very critical case, adjust the pitch control for a desirable tone.

At this point you might find that the tuning rate of your receiver when receiving s.s.b. is too rapid. The only direct solution we know of for this problem is to purchase some sort of gear-reduction knob or unit and somehow couple it to the band spread control of the receiver to help alleviate the problem.

In conclusion, I would like to thank the hundreds of readers who have written to me with their comments and suggestions this past year and apologize to those I could not answer due to lack of time. I would also like to request a stamped self-addressed envelope from those readers who would like an answer to a question as the volume of mail has—at times gotten a little out of hand—and the easier it is for me to answer, the quicker I will.

73, Irv, WA2NDM

Interlaced Elements *(from page 51)*

own" antenna man. The resulting conclusions were:

10 Meters

a. Interlacing 10 meter elements with any 15, 20, or 40 meter elements will degrade 10 meter performance.

b. Possibly 10 meter elements could be placed in a multi-element 20 meter beam with acceptably low 10 meter degradation (the further forward, the less the degradation, but also the less the boom length).

15 Meters

a. All 10 meter elements on a 15 meter beam boom will act as somewhat inefficient 15 meter directors.

b. All 20 meter elements on a 15 meter beam boom will act as somewhat inefficient 15 meter reflectors.

c. 40 meter elements on a 15 meter beam boom probably act, more or less, as directors or reflectors in accordance with the design for 40 meters.

20 Meters

a. 10 and 15 meter elements on the boom of a 20 meter beam have essentially no effect on the 20 meter beam.

b. 40 meter elements on the boom of a 20 meter beam probably react very much like 20 meter elements on a 10 meter beam.

Results

The conclusions reached have been used as the design premise for three different types of antennas involving various combinations of bands from 40 through 10 meters. The use of some traps was even worked into one of these. All have been quite successful and each has proven competitive with comparable mono-band Yagi antennas throughout the 1974-75 DX contest season as attested to by the WB9LHI and W9LT scores. I hope to be able to describe these in a future article. ■

Table IV—Frequency = 14.2 MHz

Parasitic Element	Spacing in Feet	db Relative to Dipole
40 Reflector	5	+0.1
40 Driven Element	5	−7.6
20 Reflector	10	−5.2
20 Director	10	+2.4
15 Reflector	10	−0.3
15 Reflector	3	0
15 Director	3	0
10 Reflector	2.5	−0.1
10 Director	2.5	0

Antennas *(from page 48)*

directly as the number of antennas is used. And a rough approximation of the aperture is the boom length of the antenna itself."

"So as the individual beam antenna grows longer to achieve more gain, the effective aperture increases and more stacking distance is required," mused Pendergast, as he contemplated the photographs.

"That's right," I replied. "There's no free lunch, and the bigger the antenna, the greater the difficulty in supporting it and in making a rugged array that is still light enough to be supported in the air by a reasonable framework."

Pendergast sighed. "It all sounds fascinating and a real challenge. I would like to learn more about moonbounce. It seems as if it is one of the last resorts of the true, amateur experimenter."

"The v.h.f. region is where the real action is, contrary to what you might hear on the DX bands," I replied. "But you have only scratched the surface. When you have a few more moments, we'll go into moonbounce a little deeper.

"Don't forget, I am still looking for photographs and descriptions of interesting antenna installations, high frequency, or v.h.f., it matters not, and I'll send one of my antenna handbooks in response to any such material that I use in this column."

"Right," said Pendergast as he got ready to leave. "And may you prosper in 1976."

"The same to you," I replied. "That's very Centennial of you and I appreciate your good wishes." ■

QRP Challenge *(from page 44)*

time, if the time was given in hours of operation time, and days of listening for hours without hearing a needed country, it would not sound too short.

There was only one problem now. It's true that I had worked the hundred, but I was still short 65 QSL cards to qualify for the trophy. To make my waiting for the cards almost unbearable, it took me over two months to go from 99 to 100 confirmed. Finally, just a few days short of one year from the time I worked my 100th country, a shipment came from the W2 QSL bureau containing four new ones bringing me up to 103 confirmed (I had 119 worked at this time, including all continents on s.s.b. phone). I would like to thank Adrian Weiss for his dedication to QRPp and his sponsorship of the fine QRPp awards program, the YL ISSB for their friendliness and help. My DX associates who occasionally allowed me to ride "piggyback" on a DX contact, and last but not least the Ten Tec Company for designing the oustanding little Argonaut.

If any of you are contemplating QRPp operation be prepared for one thing—to have the time of your ham-life.—*W2GRR*

The big question is: who will be next, and how long till he claims DXCC QRPp #3? An even more tantalizing question is: will anyone ever qualify for *DXCC MILLIWATT?* Several of us have passed the 100 countries-worked mark with five watts, but those cards are ever so slow in coming. Sandy resorted to all known tricks short of transoceanic telephone calls—but that is a story in itself. We'll be waiting for the next qualifier nonetheless. W2-GRR's achievement is considered sufficiently noteworthy by *CQ* so as to warrant the coverage we're giving it! And plans are in the works for a separate QRPp section in the annual *CQ* WW DX Test coming up later this year. QRPp is where a real challenge is in ham radio—give it a try if you have a taste for competition! 73, Ade, K8EEG

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160 Meter Amplifier *(from page 27)*

raised the proper amount. When switched in, the transmitter (with decreased drive to the final) puts out about 5-6 watts. Power output with full drive at 13.6 Vcc is 13.2 watts; at 12 Vcc about 12.5 watts, and about 9.5 watts with 11 Vcc.

The circuit of the "L" network antenna coupler is shown along with the final amplifier circuit in fig. 2. Two Amidon T-68-2 toroid cores are wound full circumference (53 turns) with #24. The first tap position connects the output link L_4 directly to the coax output receptacle, and the remaining ten tap positions allow insertion of up to about 24 μh in roughly even steps for the first six taps, and larger amounts for the remaining steps. A two terminal strip used in the original amplifier was on the rear panel, and pressed into service as a junction point for adding external capacitance to C_4.

Results

The new final amplifier has really improved the performance of the transmitter in terms of stability, ease of tuning, and efficiency of operation. Contacts have been made throughout the U.S. using a 60 foot top-loaded vertical with a very inefficient ground system (ever try burying radials in frozen dirt?). I'm sure that this rig will provide much satisfaction for a long time to come. While I didn't end my earlier paper with any exhortations or promises of ease of construction and operation, I am inclined to put thet full stamp of approval on the entire rig now that the new final amplifier is in operation. 13 watts will go a long way on 160 meters with a decent antenna. And the application of the new balanced emitter 2N5590 has removed any difficulties that were present in the original transmitter. ■

Radiant Photons *(from page 34)*

inated surface. This instrument is essentially a photo-diode and a calibrated micro-ammeter. Another useful relationship is, $F = E \times A$. Here, F is the flux or power which resides in the light impinging upon a surface of area, "*A*". Additional concepts appear "post-script" fashion in fig. 8.

You should now be in a more favorable position to acquire skill in working out light problems, but as the textbooks often state, "that is left as an exercise for the student." Good luck, OM, and remember that in an opto-coupler you can express the input and output in *electrical* quantities without concern over the radiation path in the middle of the gadget! ■

Solar Activity Update *(from page 24)*

[18] Radio propagation forecast information is broadcast by Radio Station WWV at 14 minutes past each hour, and includes updated readings on solar flux, and geomagnetic activity. Solar and geomagnetic activity reports for previous-day activity are broadcast at 18 minutes past each hour.

[19] A two-to-three minute propagation forecast summary can be obtained by calling DIAL-A-PROP at (516) 883-6223. The forecast is changed every Tuesday, and contains a day-by-day forecast for a complete week (telephone number is *not* toll free).

[20] MAIL-A-PROP provides forecasts for a two-week period on a day-to-day basis. This newsletter also contains timely items on radio propagation, solar and geomagnetic activity, progress of the solar cycle, v.h.f. ionospheric information, and schedules of meteor showers. A sample copy may be obtained by sending a SASE to MAIL-A-PROP, P.O. Box 86, Northport, NY 11768.

[21] Jacobs, G., "Propagation," *CQ* (Monthly column).

[22] West Coast DX Bulletin, 77 Coleman Drive, San Rafael, CA 94901.

[23] Long Island DX Association Bulletin, 416 Victory Drive, Lake Ronkonkoma, NY 11779.

[24] Geoff Watts News-Sheet, 62, Belmore Road, Norwich NR7 OPU, England.

[25] Waldmeier, M., "The Beginning of a New Cycle of Solar Activity," *Nature,* V. 253, February 6, 1975.

[26] Gleissberg, W., "The Probable Behavior of Sunspot Cycle 21," *Solar Physics,* V. 21, 1971.

Two Meter Repeater Growth *(from page 35)*

sents the number of repeaters using that particular combination of frequencies. The numbers on the right give the total number of repeaters using that input frequency and the numbers on the bottom do the same for the output frequencies. Eleven repeaters used frequencies which were not used by any other repeater. The frequencies are given in Table II.

It is clear from Table I that some, but not much, thought had been given to the frequency allocation problem. The concentration of repeaters along the diagonal of the table reveals the tendency to use an input-output separation of 600 kHz and the concentration of repeaters on a few pairs shows the tendency to use the pairs used by successful pioneering repeater stations.

Repeaters were scattered all over the frequency map. Nevertheless, with only nine crystals you could get on all frequencies which were occupied by ten or more repeaters. With these crystals you could use 159 of the repeaters or about 65%. However you would have to use independent transmit-receive switching. For example only 84 of the 125 repeater using 146.34 MHz as an input frequency used 146.94 MHz (600 kHz higher) as the output frequency. Thus 33% used non-standard spacing. Once you covered these 159 repeaters, it was pretty hopeless to get a significant number of the rest because they were scattered all over the 2 meter spectrum. Of course, the average Ham could use only one or at most two repeaters because good repeaters were relatively rare and far apart.

By 1975 the picture had changed considerably. The number of open repeaters had increased to 1132, an increase of over 360%. But strenuous efforts by those most interested in the development of repeaters had obtained the acceptance of an organized but voluntary frequency allocation along with a separation of 600 kHz. Thus, it would be a waste of space to present an updated Table I. Instead a list as given in Table III will give the best overall picture of the current frequencies being used. In Table III the input and output frequencies are followed by the number of repeaters using that frequency pair. The most popular pairs are indicated in the last column.

It should be noted that there is no frequency pair anywhere near as popular as any of the first four. With only eight crystals one can use almost half of the available two meter repeaters. As a traveling ham

(Concluded on page 78)

Table III—Currently Used Standard 2 Meter Pairs.

Input Frequency (MHz)	*Output Frequency (MHz)*	*No. of Repeaters*	*Rank*
146.01	146.61	40	
146.04	146.64	49	
146.07	146.67	49	
146.10	146.70	33	
146.13	146.73	48	
146.16	146.76	143	2nd
146.19	146.79	59	
146.22	146.82	113	3rd
146.25	146.85	59	
146.28	146.88	98	4th
146.31	146.91	45	
146.34	146.94	188	1st
146.37	146.97	47	
146.40	147.00	22	
146.43	147.03	6	
146.46	147.06	17	
147.60	147.00	11	
147.63	147.03	14	
147.66	147.06	9	
147.69	147.09	22	
147.72	147.12	21	
147.75	147.15	17	
147.78	147.18	16	
147.81	147.21	13	
147.84	147.24	13	
147.87	147.27	7	
147.90	147.30	10	
147.93	147.33	13	
147.96	147.36	10	
147.99	147.39	8	

Table IV—Summary of Number of Repeaters Using Non-Standard Frequencies—1975.

Repeaters using split channels for both input and output frequencies	31
Repeaters using a split channel for either input or output frequencies	6
Repeaters using 1 MHz separation	6
Repeaters using a separation other than 600 kHz	48
Total number of open repeaters using a non-standard frequency	102

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ADVERTISER'S INDEX

2 Meters *(from page 75)*

with only a limited crystal budget, I can only applaud this development. However, as areas with large ham populations get more repeaters, it is inevitable that more different frequency pairs be used. In fact, if you were to cover all pairs occupied by twenty or more repeaters, you would need 11 more pairs of crystals costing over $100.

There are a large number of repeaters using various unusual combinations of frequencies. These combinations are summarized in Table IV. Most of these unusual combinations are used because of congestion, intermodulation problems, or accidents of local development. It is of course a great service to visiting amateurs if the most active repeaters of a given area can be placed in one of the most popular slots.

There are a number of interesting observations which can be made based on a study of the latest repeater directory and comparison with the previous directory. The most striking area of growth has been in those high frequency repeaters where the input frequency is above 147 MHz and 600 kHz above the output frequency. In 1974 there were 67 repeaters in this category; in 1975 there were 184—an increase of almost 300%. This spectacular growth is due to the rapid filling of the more conventional channels in the large metropolitan regions. The past year also saw a 40% growth in .16–.76 and .22–.82 occupancy.

A few geographical observations can also be made. San Francisco and the surrounding area really has a shortage of unoccupied standard frequency pairs. Southern California has the greatest concentration of closed repeaters. It is interesting, and unfortunate if really true in practice, to note that New Orleans lists both the popular .16–.76 and .34–.94 pairs as closed. Texas appears to have made the best attempt to concentrate their repeaters on the most popular channels, thereby alleviating the crystal buying problems of the hams in that area. Canada has a particularly large number of 146.46-147.06 MHz repeaters.

The study of repeater directories is interesting from an historical and practical point of view. The growth, in particular the orderly growth, of the repeater usage is easily seen. The channel analysis of Table III will easily show which crystals will access the most repeaters for somebody traveling outside their local area. Get another set or so and have more fun when you travel. ■

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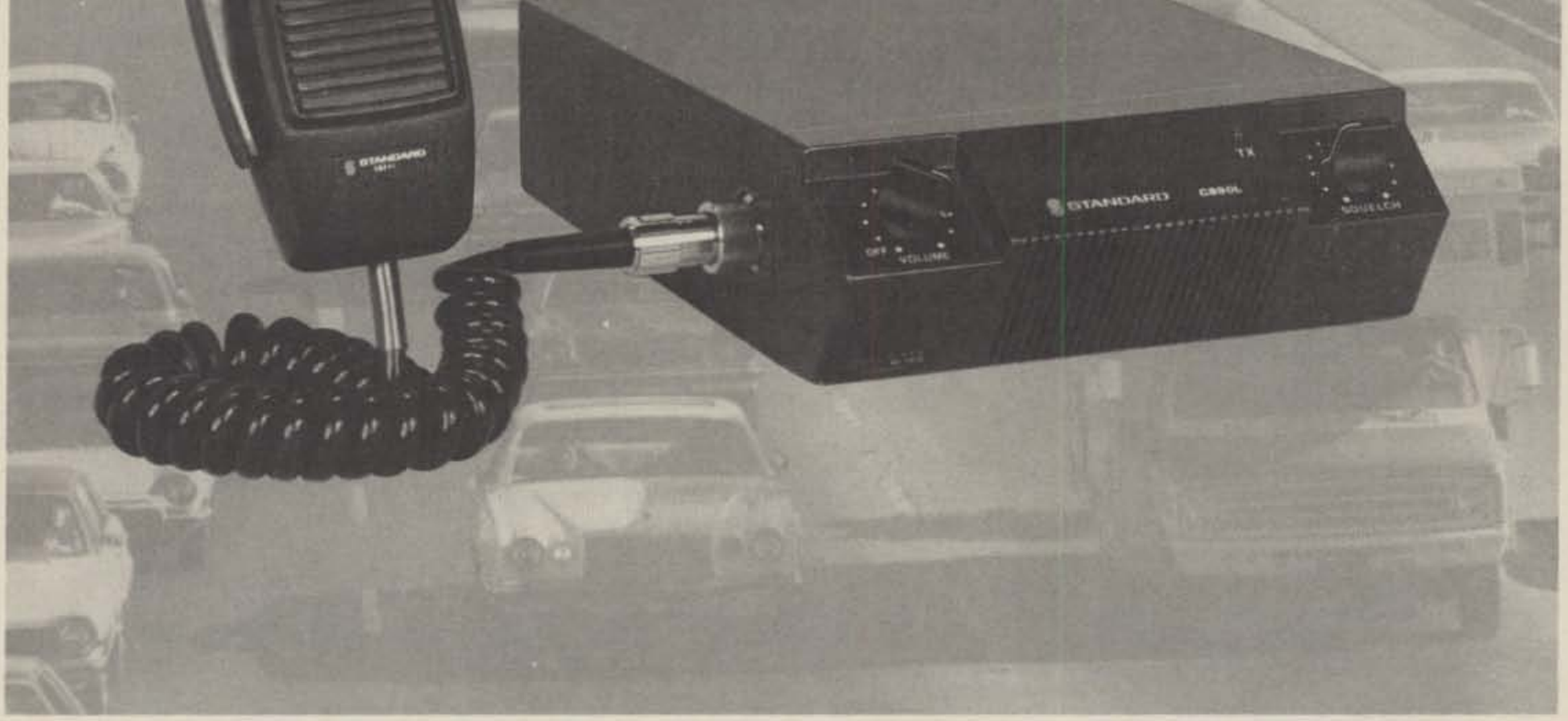

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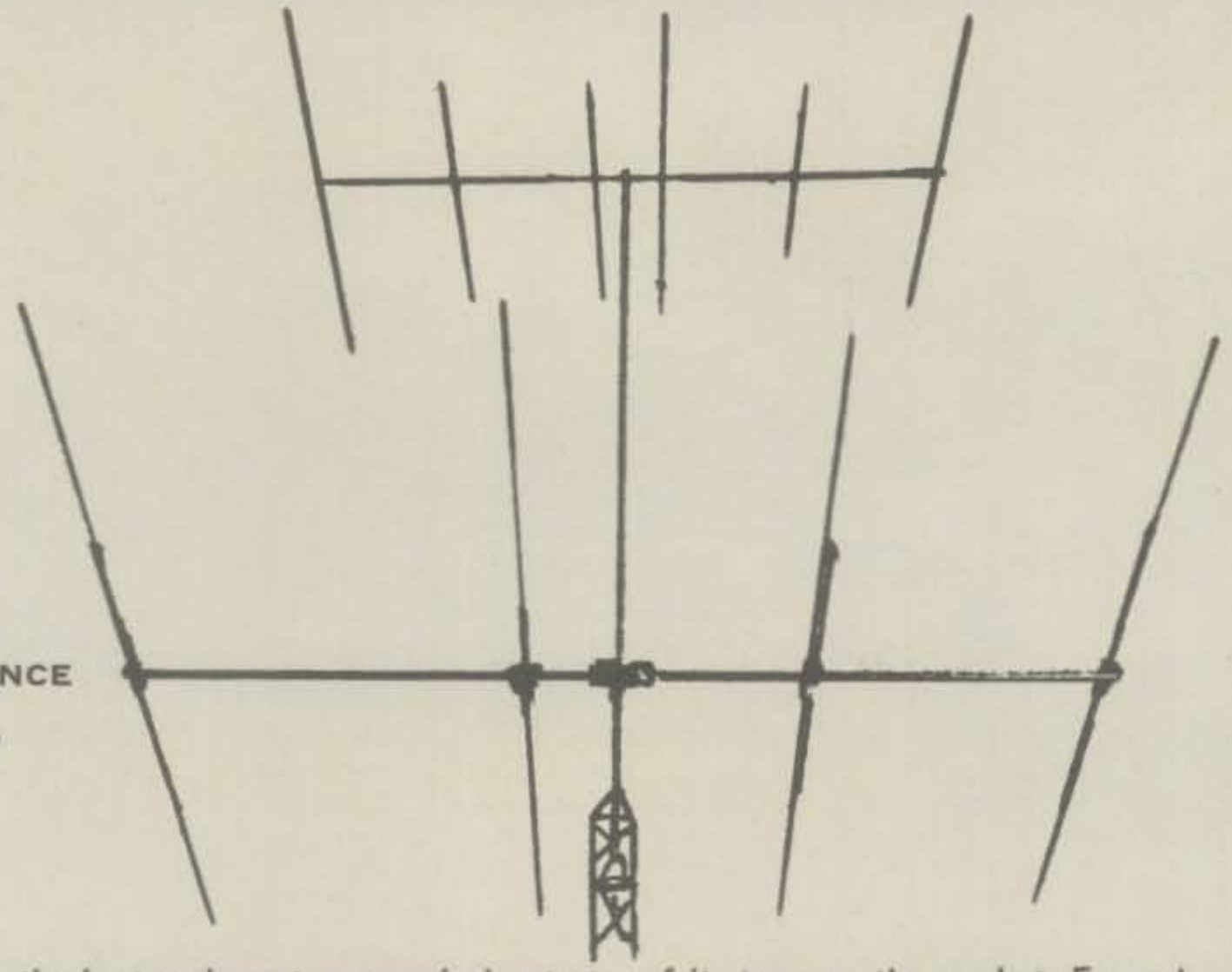

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M520	12.0	26	30	40	5	36'4"	27'0"	5.0	125	90	96	269.00
M204	10.0	25	30	26	4	36'4"	22'6"	3.9	100	46	49	139.00
M155	12.0	26	30	26	5	24'3"	18'0"	3.7	93	41	44	139.00
M154	10.0	25	30	20	4	24'3"	15'9"	3.0	75	30	32	89.00
M106	13.0	26	30	31	6	19'0"	16'1"	2.9	73	34	36	99.00
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