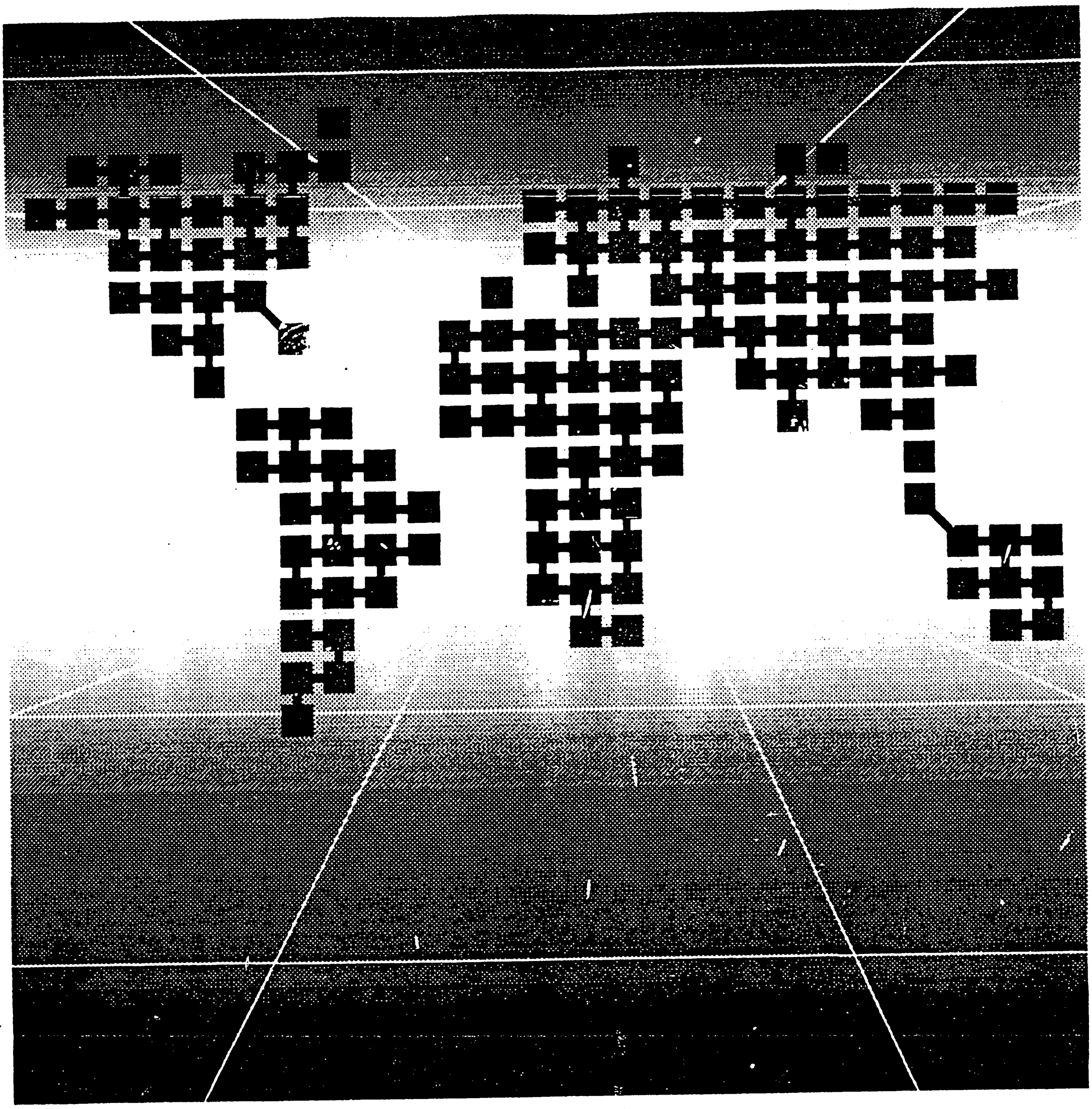

fine tuning's

PROCEEDINGS 1991

The front cover image was created by Staffer Guy Atkins and represents the melding of a map of the earth created with images reminiscent of printed circuitry. Guy created the image from scratch wholly within the DTP environment of his IBM PC compatible Avagio software. The image was output by a H-P Deskjet Plus.

International Standard Book Number application has been filed.

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introduction

Welcome to the 1991 Edition of **fine tuning's** *Proceedings*, the fourth annual volume of articles written by and for experienced shortwave broadcast DXers. When **fine tuning** first began work on this project in 1987, we hoped to establish a forum that could provide a stable intellectual and informational underpinning to the hobby of SWBC DXing. By trusting others fulfill the role of educating beginning and casual radio enthusiasts, *Proceedings* could be free to publish advanced articles of merit for those who have made a long-term commitment to the avocation of radio. We hoped that the existence of such a forum might foster advancements in the radio hobbies. Today, we feel that those goals and more are being fulfilled. Few, if any, of 1991's major articles would have been attempted if the forum of *Proceedings* did not exist. It is a great privilege for us on the Staff to feel that we are contributing to the advancement of the state-of-the-art. We hope that each article in *Proceedings* 1991 meets at least one of our three major content goals:

A) Provide a forum for "cutting edge" articles that may advance the state-of-the-art.
B) Provide material useful for experienced radio enthusiasts that is not available elsewhere.
C) Raise the level of discourse about the avocation of radio.

One of our other goals was to help break down the artificial but very real intellectual barriers between the various radio hobbies, i.e., SW DXing, MW DXing and Amateur Radio. *Proceedings*, as an institution, appears to be doing just that. The Editorial Review Board and our authors now come from among the most experienced members of all three hobbies. The readers of *Proceedings* are equally cosmopolitan in their radio-related interests with many radio amateurs and MW DXers joining SWBCers as fans of *Proceedings*.

A SPECIAL TREAT

This year we are very pleased to have two widely known and respected radio amateurs join us as authors. Bob Eldridge, like many amateurs, was an SWL DXer as a teenager. He was a registered shortwave listener (BSWL 545) in his native England, and became an amateur radio operator before WWII. Upon his immigration to Canada after the War, he received the call VE7BS which he claims to have accepted because BS is so musical in CW. We wonder.

Bob has written extensively both professionally and in the amateur radio press. His article: "The Wave ('Beverage') Antenna" will be helpful to anyone interested in this unique DX instrument. Bob's article is the badly needed *fundamental* article that everyone should read before delving further into the arcane world of Beveraging. His article will further the state of the art in SWBC DXing and we are most grateful for it.

Our other contributor who is *primarily* a radio amateur is Bill Tippett, W0ZV. Bill began his radio career as a 'Novice' class amateur in North Carolina as a teenager. He was the first amateur to work and QSL 100 countries and to Work All Zones while operating under the restrictions of the Novice license. He is a very well known DX Contester and, in recent years, has been extremely active on the 160 Meter Band. He now has over 200 countries worked and QSLed on 1.8 megahlertz; that is quite an achievement! His article on Long and Skewed Path propagation is an example of the cross-fertilization that we had hoped *Proceedings* would foster. Most SWBC DXers have always assumed that Long Path propagation was strictly a high band phenomena or that it was so rare on Tropical Band frequencies that 'Looking for Long Path' could not be considered as a useful DXing strategy. Bill's discussion of Long and Skewed Path propagation is the clearest explanation of the phenomena that we have read anywhere and should be intensely interesting to all SWBC DXers.

THE MOTHER OF ALL YEARS

The production of the first three years of *Proceedings*, in retrospect, went quite smoothly. We did suffer the usual problems with printers, articles lost in the mail, etc., but to no greater degree than any other enterprise of this type. With that track record, the Staff met in August 1990 and committed to the DeskTop Publishing approach that you see throughout *Proceedings* 1991. We knew that this new approach would mean a good deal of extra effort in the summer months for Guy Atkins, John Bryant and especially for our graphics leader Kevin Atkins. Little did we know that A) Guy and Rochelle Atkins would give birth, B) John's daughter Mary Ellen would decide to get married (The Mother of All Weddings,) C)David Clark's stepson Lenny would have a world class bar mitzvah or that D) Kevin's wife would suddenly decide to become single. All within the crucial last two months of final *Proceedings* production!! As we prepare to send these last few pages to the printer, Kevin is single, Lenny is an adult person, Mary Ellen is married and Rochelle Atkins is within hours of becoming a mother. Fritz seems to be leading a 'normal' life, but none could blame him for looking over his shoulder!

We think that it is a miracle that PROC 91 was published at all (and on time!) and ask indulgence of all to whom we owe letters, favors, etc. This was definitely The Mother of All Years!

OLD PROCEEDINGS NEVER DIE

Even though **fine tuning's** *Proceedings* was designed to be a long-term reference for radio enthusiasts, we originally planned to keep each edition of *Proceedings* "in print" only for 12 months. This was primarily a financial decision; we are a small organization and are totally without capital funds. Bluntly, printing 50 to 100 "extra" copies to keep as long term stock would tie up $1000 to $2000 that we simply do not have. Naively, we hoped that "everyone" would hear about *Proceedings* in its first year and buy a copy. We were happily mistaken; each year it seems that more radio people, both here and abroad, are continuing to discover *Proceedings*. If they find the current edition useful, and most do, many want to purchase the previous editions. Thus, a modest level of demand continues for all back editions of *Proceedings*. To respond to that, we have determined to keep all editions in print at least through 1991-92. If you are interested in one of the older editions, we have a flyer which details the contents of all past issues. To obtain a copy, please contact:

Fine Tuning's Special Publications
c/o John Bryant
Rt. 5, Box 14
Stillwater, OK 74074

IN APPRECIATION

First and foremost, we would like to thank our readers for their enthusiastic support. That support, expressed through letters, conversations at meetings and increasing numbers of readers makes all of the work worthwhile. Thank you very much for your continued support.

We would also like to thank several prominent individuals and organizations for their help and continuing support of the *Proceedings* effort: Jonathan Marks of Radio Nederland, Glenn Hauser, Rich McVicar and the other staff of HCJB, Bob Brown of NASWA and the ANARC SWL net, Goran Eriksson of Swedish DX-Kop, Arthur Ward of World Radio Club, Larry Magne, Phil Bytheway of IRCA, and of course, Gerry Dexter and Don Jensen.

Finally, although the production of *Proceedings* 1991 was rather difficult for the Staff, it continues to be a wonderful experience to work with some of the best minds in the hobby as they wrestle with the difficult task of writing. It is almost magical to watch rough ideas turn into thoroughly developed and clearly written articles. We are sure that many of these articles will be helpful to the hobby for years to come.

WELCOME TO PROCEEDINGS 1991!

John Bryant   Fritz Melberg   David Clark   Guy Atkins   Kevin Atkins

editorial review board

about fine tuning

about fine tuning

fine tuning is an organization dedicated to supporting the hobby of Shortwave Broadcast DX. Founded in 1977 by well known DXer Dan Ferguson, FT originally published a bi-weekly newsletter of rare and difficult DX heard by leading shortwave enthusiasts throughout North America. To shorten the time between reception and publication, and to keep the work load manageable, membership in fine tuning was kept small and "by invitation." After several years, Dan turned over the editing and publishing chores to Larry Yamron who continues to serve as FT's publisher.

In 1986, FT merged with the Ozark Mountain DX Club, a fully public DX newsletter founded and published by Mitch Sams. Mitch is now the Managing Editor of **fine tuning**. With the merger, FT adopted the "open organization" philosophy of OMDXC and continues today to welcome all radio enthusiasts interested in rare and difficult DX. Also in 1986, FT established its Special Publications arm led by John Bryant.

The newsletter portion of **fine tuning's** services is published weekly during the DX season and bi-weekly during the North American summer. The newsletter, also called **fine tuning**, is a journal emphasizing rare and difficult DX. The bulletins feature SWBC news but also contain news of unusual merit from the medium wave, long wave, ham, utility, or TV DX communities.

There are five people currently involved in the production of the weekly issues of **fine tuning**. Three outstanding DXers serve as editors, each being responsible for two issues before handing off to the next editor. The weekly editors are: Dave Valco, Kevin Atkins and Mitch Sams. They are supported by Back-up Editor Kirk Allen. Managing Editor Mitch Sams also maintains FT subscriptions, finances and responds to sample requests. Publication of FT is handled by Larry Yamron. Each completed issue of FT is mailed from the current editor to Larry for publication and mailing. The staff of **fine tuning's** Special Publications consists of John Bryant, Guy Atkins, David Clark, Kevin Atkins, Fritz Mellberg and Don Moore. Jon Williams serves this arm of FT as well as manager of the FT/OZDX Indonesian Database.

Cost (US) per issue of the **fine tuning** bulletin is 65 cents per issue in the US, 70 cents per issue in Canada and 80 cents US for Airmail overseas. Minimum order of 30 issues is payable to:

FINE TUNING
c/o Mitch Sams
779 Galilea Ct.
Blue Springs, MO 64014 USA

Sample copies of the **fine tuning** newsletter may be obtained from Headquarters in Blue Springs for $1.00 US.

fine tuning

propagation

ADDITIONAL NOTES ON TROPICAL BAND PROPAGATION

David Clark and John Bryant

INTRODUCTION

In fine tuning's *Proceeding's 1990*, we co-authored "Notes on Tropical Band Propagation" which many consider a milestone hobby article. In "Trop Prop," we called into question several fundamental beliefs about how HF radio waves travel over planetary distances, at least those waves in the 2-6 MHz segment of the HF spectrum known as the "Tropical Bands." Secondly, we proposed a new explanation for the well known "seasonality" of Tropical Band DX, notably from Asia and the Pacific. In addition to our own observations derived from monitoring the Tropical Band for many years, we cited numerous of works from the radio amateur community, the professional HF broadcasting community and from a variety of scholarly sources. Following that article we published four articles in the *Journal of the North American Shortwave Association* (NASWA) specifically on the enhancements of Tropical Band propagation which occur at dawn and dusk.

The following article is intended to update and expand the most important ideas in the 1990 article. It will also integrate ideas from the NASWA Dawn/Dusk series and introduce several concepts new to the SWBC DXing community.

COMMENT

The further we have pursued our studies of propagation, the more profound is our appreciation of the *irregular* nature of the ionosphere and its constituent "layers." Recognition that the ionosphere is a *non-homogeneous* medium is scattered throughout the professional literature, though most hobby publications continue to portray the ionosphere as a concave, perfectly reflecting mirror. Given the turbulent, ever-changing character of the ionosphere, we have come to feel that it is rather miraculous that there is *any* predictability at all to radio communications by ionospheric means. This continuously variable aspect of propagation prediction must be very frustrating for professionals in this field. However, that very unpredictability is one of the essential elements which keeps the radio hobby so challenging to us all.

MODES OF LONG-HAUL PROPAGATION

In the 1990 article, we put forward the idea that Tropical Band propagation over planetary distances (defined as beyond 1/4 planetary circumference or 6,250 miles) does *not* normally occur by the traditionally accepted multiple hop model. Instead, we proposed that most, if not all Tropical Band propagation over those distances takes place such that the radio waves do not take intervening ground "hops" at all. These waves stay aloft in or near the ionosphere until directed earthward by irregularities and/or "tilts" in the ionospheric structure near the receiver.

The multiple hop mode of HF propagation was first proposed about the turn of the century to explain how radio waves traveled further than was geometrically possible for a "one hop" signal. As we understand it, most of the proof of the multi-hop model was built upon two foundation points. The first was the fact that the long-haul communication was, in fact, happening. If communication out to about 1500 miles was happening by a (one-hop) refraction off of the ionosphere, then it was relatively easy to suppose that longer-haul signals would reflect off the ground (or sea) and essentially "bounce up and down" as they traveled until they reached their far-away target. When the most accurate clocks of the day were used to measure "delayed time of arrival," the time delay neatly confirmed that the signals were being delayed just long enough to account for the extra travel distance caused by the "bouncing up and down." With that confirmation, the multi-hop model was accepted as *THE* model of long-haul propagation. It is probably unfair for us to observe almost a century later that the same delayed time of arrival figures could be generated by waves bouncing from side to side or by other time delays, just as well as by the multi-hop "bounce up and down" model. Whatever the case, no one appears to have questioned the multi-hop model as the mode for *ALL* long-haul transmissions until after World War II.

After WWII a German propagation expert, H.J. Albrecht, resided for a time in and operated as a radio amateur from Australia. In both his professional and radio amateur work, Albrecht noted that signals from Europe were far stronger than he had been led to believe by the mathematical equations used to predict field strength at multi-hop distances. In fact, Albrecht's studies of the propagation paths between western Europe and Australia in the early 1950's were the foundation work that led to a later definitive study at Deutsche Welle (Voice of Germany). It was he that described "rays propagated in geometrically inscribed hops along the layer but not necessarily with all the ground reflections required by multi-hop theory." Albrecht called this mode "Chordal Hop."

In our 1990 article we cited the decade-long study by Albrecht and other German scientists associated with Deutsche Welle of daily transmissions between Germany and Australia. The study compared predicted and actual field strength values for early morning signals beamed on the short daylight path (16,000 Km to the southeast over Asia) and the long path (24,000 Km to the southwest across South America) which was crossing the darkness side of the Earth to reach Australia in the early evening. A daily index of satisfactory reception was also developed. [1]

The two principal findings of this exhaustive study were most interesting. When frequencies near the MUF appropriate for each of the paths were used, the reliability of the long path circuit was found to be twice as good as the short-path. Further, signal levels predicted by internationally accepted models (which assumed ground reflection losses associated with the multi-hop model) were found to be 12 dB too low for the short-path and an astonishing 25 dB too low for the long path. (One S-unit + 6 dB)

The study concluded that the unexpectedly high field strengths and more reliable reception of the long path signals could only have been caused by the phenomenon of ray-focusing gains in the near antipodal region (i.e. Australia) and longitudinal tilt-supported propagation without intermediate ground reflections.

We also noted that the International Radio Consultive Committee (CCIR), the scientific radio body of the International Telecommunications Union, had adopted consideration for a distance-dependent focusing gain (Spherical Convergence, as we shall discuss later) and this "no-intervening-hops" model for predicting field strengths of signals over paths longer than 10,000 Km as early as 1976. [2]

We were stunned when we found articles describing the DW work! To us, the DW study and the CCIR actions called into severe question the basic means by which most DX signals were reaching our antennas! We happened to find articles referring to the DW study at a critical juncture in our own studies of Tropical Band propagation. At that time, we had separately concluded that the conventional explanations of Dawn Enhancement just did not match what we had observed over several thousand sessions of DXing at "Max Dawn."

It did not take us too long to realize that the mechanics of Dawn Enhancement became easily understandable if one assumed that *ALL* long-haul Tropical Band signals were traveling by some sort of chordal hop or whispering gallery mode. Once making that "leap into the darkness" we began to see that most of the theoretical mechanics of Tropical Band propagation made much more sense and matched our real world experience much more closely if we visualized all long-haul Tropical Band propagation in this new fashion.

Our studies, as well as feedback from other radio hobbyists have strengthened our conviction that the "no-intervening-hop" model is the predominant, if not the only mode of long-haul HF propagation at least at Tropical Band frequencies. No one seriously questions the "one-hop" model of propagation out to approximately 1500 miles. However, no one has been able to cite for us *any* study which quotes *any* physical evidence that *multi*-hop HF propagation exists at all! All such "proof" that we have seen is based on the "time of arrival" of various signals. The fundamental assumption of all these time-of-arrival "proofs" of *multi*-hop propagation *ASSUME* that long distance signals are delayed in route by following longer paths. They are *ASSUMED* to be longer because the waves refracted/reflected up and down several times between the earth and certain layers in the ionosphere. Our response is that the only *long term* study of time-delay and time-of-arrival assumptions with *modern instrumentation* (Cesium clocks, computer-driven automated reception/logging) has called all findings based on time-delays into severe question![3] This glaring situation seems to have been rather conveniently ignored by the remainder of the professional propagation community!

FROM CHORDAL HOP TO SINGLE-SIDED DUCTING

The existence of the "Chordal Hop" mode of propagation has been known for several decades--certainly since the early 1950's. Other similar modes are referred to in professional circles as "Whispering Gallery" and "Single-sided Ducting." We have come to believe that usage of these three terms attempts to make a distinction where there is no actual difference--they all describe the same mode of propagation--radio signals refracting multiple times off the under-side of the ionosphere or its constituent layers with no intervening ground hops .(see Figure 1). We will refer to this mode as "whispering gallery" for the remainder of this article.

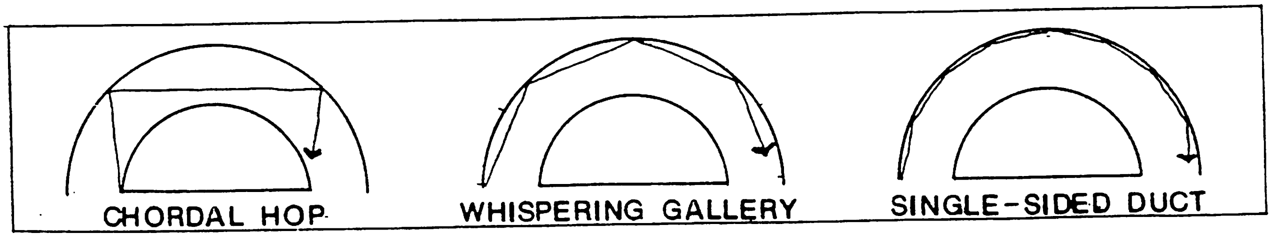


FIGURE 1: Three Terms Describing the Same Physical Phenomenon

A CASE FOR THE WHISPERING GALLERY

The professional community and conventional hobby propagation authors hold that the "whispering gallery" mode is quite rare and exceptional at HF frequencies--an "oddity." They all state that this mode's existence is absolutely dependent upon an ionospheric tilt or other anomaly near the transmitter to launch it and another near the receiver to dump the wave down to our antennas. Figure 2 is a typical representation of chordal hop mode and the ionospheric tilts believed necessary to create it.

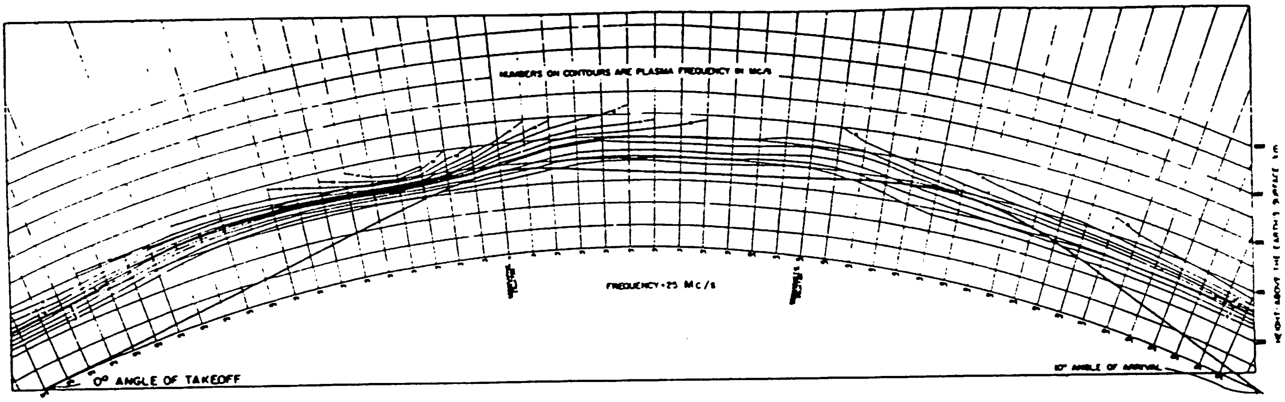


FIGURE 2. Chordal Hop

Although the dawn and dusk tilts certainly produce "non-equal angle" refracted waves and may be a source of whispering gallery signals, we have come to believe that there is another more regular source of these shallowly traveling waves... the so-called "Pedersen Rays" discussed in the next section. We do agree completely that dawn and dusk tilts are the mechanism by which these waves "skidding along the ceiling" are "dumped" down to our antennas at dawn or dusk enhancement. *However*, we contend that some significant fraction of the whispering gallery signals are also dumped down to us in the period prior to dawn and in the period after sunset. The dumping mechanisms for this form of reception may be the small random irregularities always present, even in the quietest Temperate Zone ionosphere.

We have also come to believe that some form of whispering gallery ducting is a *very common* mode of propagation at Tropical Band frequencies. We believe that the whispering gallery is a (or *THE*) normal mode of HF propagation over planetary distances and that virtually every HF transmission launches signals into this mode. In other words, there exists a strong possibility that no special tilt is required to launch a signal into the whispering gallery mode and no special tilt is required to receive these signals (at least weakly). We note the close similarity between this picture of lower HF frequency propagation and that proposed over ten years ago by well-known radio amateur DXer Uri Blanarovich in several radio amateur publications (reprinted in our 1990 article).

A final bit of evidence for the "whispering gallery" as a common mode of planetary distance propagation comes from the oil-related seismology field. John Bryant's father, Professor Glenn H. Bryant, was the seismologist on American Admiral Richard E. Byrd's Third Antarctic Expedition in the late 1930's. Prof. Bryant used the seismographic technology of the day to make the first measurements of the depth of the Antarctic ice cap. Prior to his death, he related several discussions with ionospheric specialists on the Expedition concerning the remarkable similarity between the techniques of study of ionospheric propagation and those of seismology. Both fields are concerned with the movement of wave fronts through dissimilar, non-homogeneous layers which propagate the wave front at differing speeds.

In recent private conversations between John and a mathematician/seismologist working for a major petroleum company, the same observation was made. This scientist, also a radio amateur, went further to state that in seismology there was one very common mode of propagation which cannot be analyzed or documented by normal "ray-tracing" techniques. He also said that this strange mode existed in virtually every "log" of data from field seismological soundings! Further, he stated that this mode of propagation could only be modeled or analyzed using "full wave formula" techniques which usually require the use of a super-computer. This type of work was, in fact, the main responsibility of John's friend and he used a Cray supercomputer daily. To explore the limits of his software and with understandable curiosity, this seismologist/ham input the parameters for the "international standard ionosphere" and a totally absorptive earth, both curved at the proper rate of curvature. He then propagated a spherical wave front from a point source "antenna." Apart from the expected refracted wave traveling back down to the earth, each analytical run indicated a "wave packet" propagated in what appeared to be a whispering gallery mode--parallel to the planetary surface! John has seen the "hard copy" of several of the runs. Unfortunately, the proprietary and disclosure rules of the corporation make publishing these data impossible, at present. We are hoping that hurdle can be cleared the next 12 months.

To reiterate the point so we might be crystal clear:

We all hear night-time transmissions on the Tropical Bands which have traveled more than 6,250 miles. We hear these transmissions in our local evenings and in the hours before dawn, as well. These signals are heard quite often (though sometimes weakly) when both the transmitter and the receiver are and have for some time been in total darkness. IF one accepts the idea that the "no intervening hop" or "extended hop" or "whispering gallery" mode is the primary means of propagation of these long-haul signals THEN they MUST BE LAUNCHED AND RECEIVED BY MEANS OTHER THAN THE DAWN AND DUSK TILTS!!! We would suggest that these shallowly-traveling waves are created and dumped on a regular basis by a number of mechanisms. We would also suggest that the oh-so-obvious dawn and dusk tilts are but two of several means of AMPLIFYING processes that are already occurring.

Whatever the case, we find the "whispering gallery" mode of long-haul propagation to be a very useful visualization tool as we attempt to become more effective Tropical Band DXers.

WHISPERING GALLERY SIGNAL LAUNCH

We wish to make clear that we both view terminator-related "tilts" as extremely important in Tropical Band propagation. Without doubt, the dawn tilt is the major mechanism which brings DX signals so magically to our receivers at "max. dawn." A similar effect is noticed during "sunset-at-the-receiver" enhancements. The terminator-related tilt is certainly the basic mechanism which generates "sunset-at-the-transmitter" and "sunrise-at-the-transmitter" enhancements, too. But, if whispering gallery is a (or the) common source of long-haul Tropical Band signals, there must be mechanisms other than terminator-related tilts which launch many of the signals that we hear as Tropical Band DX during the darkness hours.

Virtually all scientific work related to propagation modes involves analysis using the previously mentioned technique of "ray tracing" originally developed in the Renaissance for investigating reflection and refraction of light with mirrors and lenses. The use of this technique in studying all forms of wave propagation from light to acoustics is time-honored and accepted by all. Even using this ancient technique, it is possible to at least infer that normal HF transmissions launch a whispering gallery mode of propagation. The conventional view assumes that this mode depends on some "ray" of the signal striking the ionosphere at such a shallow angle as to be refracted at too shallow an (equal but opposite) angle to strike the earth before again striking the ever-curving ionosphere. Figures 3 and 4 are reproductions from two of the basic scientific/scholarly propagation references. They attempt to show the wide variety of angular circumstances generated by a typical omni-directional HF transmitter. All of the rays represent waves generated at the same frequency. In Figure 3, rays are generated from the very low Ray #1 to the unrefracted vertical Ray [which should be labeled #19], which is undiverted from its path escaping into space. Notice that Ray #1 is propagated at almost zero degrees of take-off and seems to travel the furthest before striking the ionosphere; it is then refracted at the same angle downward, striking the earth at the same almost zero-degree angle. Rays #2-6 are rays of ever-increasing vertical take-off angle, traveling ever-decreasing horizontal distances. The conventional view of whispering gallery mode is that an "ionospheric tilt" refracts one of these (#1 thru #6) rays at a *NOT* equal angle, but rather at a very flat angle--beginning the "whispering gallery" or "chordal hop" mode.

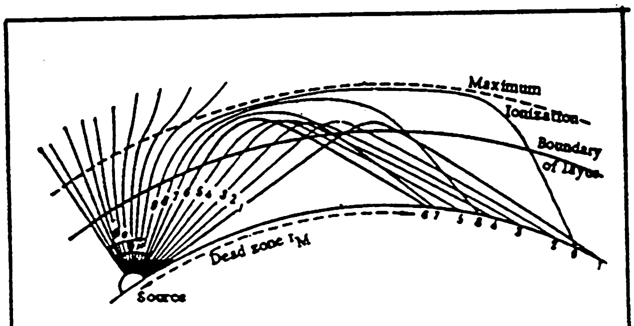


FIGURE 3.

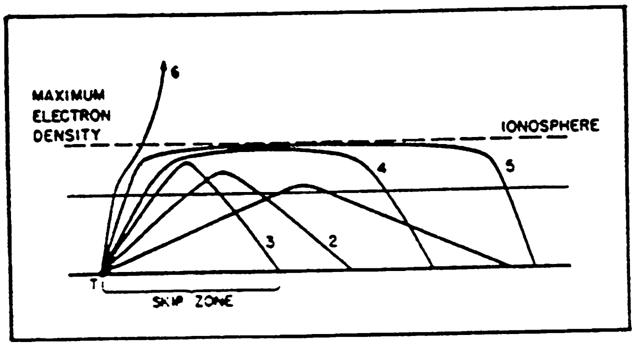


FIGURE 4.

Examine instead, Ray #8 and 9 from Figure 3, or Ray #5 from Figure 4. These are so-called "Pedersen Rays" launched at a few nearly "perfect" angles. Rays propagated at these angles are not refracted enough to return to earth (i.e. intermediate hop) but are refracted too much to escape to space. Their launch is *not* dependent on an ionospheric tilt. What happens to these rays? The answer lies almost totally in the realm of conjecture at this point, though satellite Topside Soundings and the few satellite looks *between* layers (or sub-layers) of the ionosphere may have begun to give credence to the Pedersen Ray as a potential source of long-haul HF signals.

Another argument in support of the existence of "High Transmission Angle" DX propagation view is the Australian experience with the ionospheric "Shower Service" broadcast stations which transmit on 120 Meters (2310 kHz, 2325 kHz, 2485 kHz) at night. These three widely scattered stations were built by the Australian government to provide reliable regional broadcast radio coverage to the Outback of the Northern Territory. The antennas of these three stations were designed very carefully to *eliminate* all low-angle signal radiation. The intent was to direct as much energy as possible upwards at high angles to be steeply refracted and "shower" downwards and provide strong regional coverage. Minimal energy was to be "wasted" on low-angle radiation which would travel beyond the primary coverage area. We were told that the design engineers, apparently totally absorbed by the conventional view of propagation geometry, even stated in public that the stations would likely never be heard beyond the borders of Australia, so efficient was their suppression of low-angle radiation.

There must be some very embarrassed Aussie antenna and propagation "experts" today, since reception of these three stations is regularly reported, often at quite good levels throughout the world!

We do not discount the usefulness of low "take-off" angles for the launch of long-haul signals. Several generations of radio amateurs have labored mightily to create antennas which are the reverse of the Australian Shower Service--optimizing radiation at very low take-off angles. The low angle radiators have been very successful DX transmitting antennas. It may be that very low take-off-angle waves are deviated by the normal small scale irregularities in the ionosphere into the whispering gallery mode. Since their angle of incidence with the ionosphere is very shallow, only a small refraction would be required to direct at least part of the wave's energy parallel to the layer. Thus, neither the high nor the low angle take-off of DX signals would *require* the presence of an ionospheric tilt to enter the whispering gallery mode, though both may benefit from it.

DAWN AND DUSK

We have devoted almost 40 pages to discussions of the propagational enhancements at local dawn and dusk in the *Proceedings 1990* article and the NASWA Journal articles of Spring 1991. We will summarize the main points here for the majority of *Proceedings* readers who do not belong to NASWA.

We have noted two tendencies appearing in radio hobby publications which seem to be less than useful in grappling with the complex subject of dawn and dusk propagation enhancements. First, it seems that there is a strong thrust even in professional journals to treat dawn and dusk as symmetrical propagation events. This has long been known to be untrue; it was noted decades ago that solar ionization (the build-up of the D and E layers) is a very rapid and abrupt event at dawn, while the recombination of those atmospheric ions is a much slower event continuing for some hours after local sunset. The more we read and the more we DX and observe, the stronger we feel that dawn and dusk generate *profoundly different* propagational events.

The second tendency, particularly in radio amateur writing, which we have found counter-productive is that of lumping all terminator-related propagation enhancements under the catch-all term "graylining." The two of us found our own personal thinking and discussions very confusing until we adopted specific (though cumbersome) terminology to describe the five distinct and separate propagation enhancements associated with passage of the solar terminator:

Sunrise at the Receiver (Transmitter in Darkness)
Sunset at the Receiver (Transmitter in Darkness
Sunrise at the Transmitter (Receiver in Darkness)
Sunset at the Transmitter (Receiver in Darkness)
Receiver and Transmitter Both in Twilight (True Graylining)

Having lived with these five terms for several years now, we find that we use each of these distinct propagation events very actively and productively as DXing strategies when targeting the reception of difficult DX catches. We find that our thinking and discussions are also more productive, and that we only call the last of the five events "graylining." We recognize the difficulty of developing similar nomenclature in the amateur community since there are both receivers and transmitters at each end of the circuit. Even so, some nomenclature to differentiate the various terminator-related enhancements would probably assist discussion in the amateur community as it has in ours.

TRUE GRAYLINING

If "graylining" is limited as we suggest to transmission/reception of waves which travel entirely within the twilight zone of the planet, we do not find "graylining" a very useful DX tool. We have noticed true grayline events mostly on 60 Meters at dawn, and then only very rarely. Feedback from both the radio amateur and the SWBC hobby communities indicates similar experience.There are very few cases when the well-known "seasonal" patterns of Tropical Band DX correlate well with the targets available via true graylining. In fact, this disparity which we both experienced and could not square with the conventional graylining wisdom in either the SWBC DXing or radio amateur communities was the beginning point for our joint studies in Tropical Band propagation.

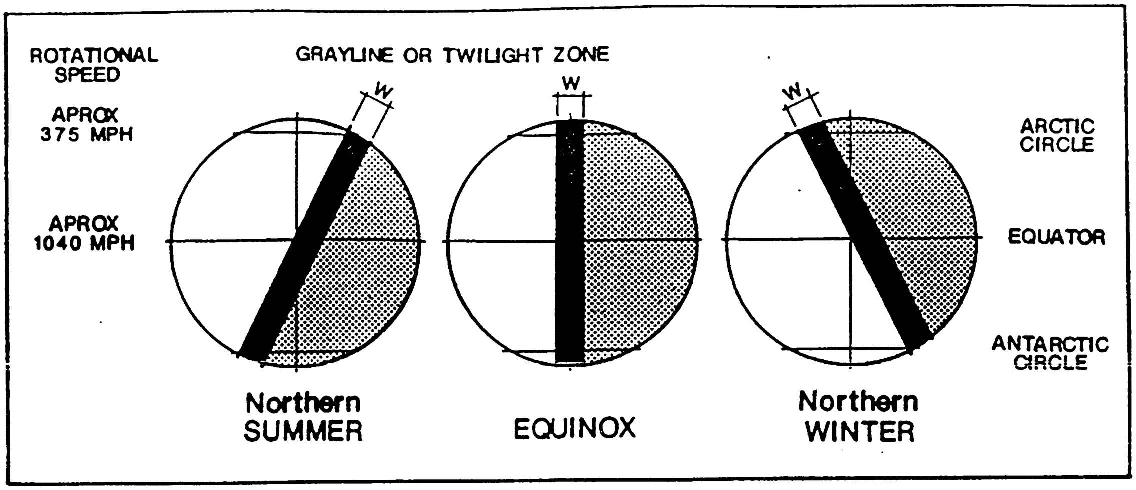


FIGURE 5.

WIDTH AND LOCATION OF THE "GRAYLINE"

Another hobby term to use cautiously is the "width of the grayline." Figure 5 is our illustration of the generic "grayline." Simple solid geometry and the laws of optics determine that the twilight zone or grayline of a planet with atmosphere is the same width at all points along its circumference. The hobby slang term "width of the grayline" refers to how much *TIME* any given point on the planet spends within the grayline or twilight zone. This time span, of course, depends on the latitude and the season of the year at any specific location.

We, like many other people in both radio amateur and SWBC DXing circles have spent a great deal of time attempting to determine the exact width (time duration) and location of the radio grayline in relation to the sunrise/sunset terminator on the ground. We now feel very strongly that this "width and location" depends on far too many factors ever to have one absolute "width and location" definition. The location and width vary widely with: the radio frequency in question, the season of the year, the current solar flux, the angular relationship between the particular propagation track in question and the terminator, along with other more subtle factors. We have found that our own DXing is more effective when we concentrate on the relative locations of the target, the receiver and local dawn or dusk on the ground.

THE MECHANISM OF DAWN ENHANCEMENT

Dawn enhancement at the receiver is the most frequently discussed terminator-related enhancement. The exact mechanics of this enhancement are open to much conjecture--most of which was summarized in our previous articles. As mentioned previously, we have never found any of the mechanisms proposed to explain dawn enhancement to be at all convincing, as long as the basic means of long-haul propagation was assumed to be the multi-hop model.

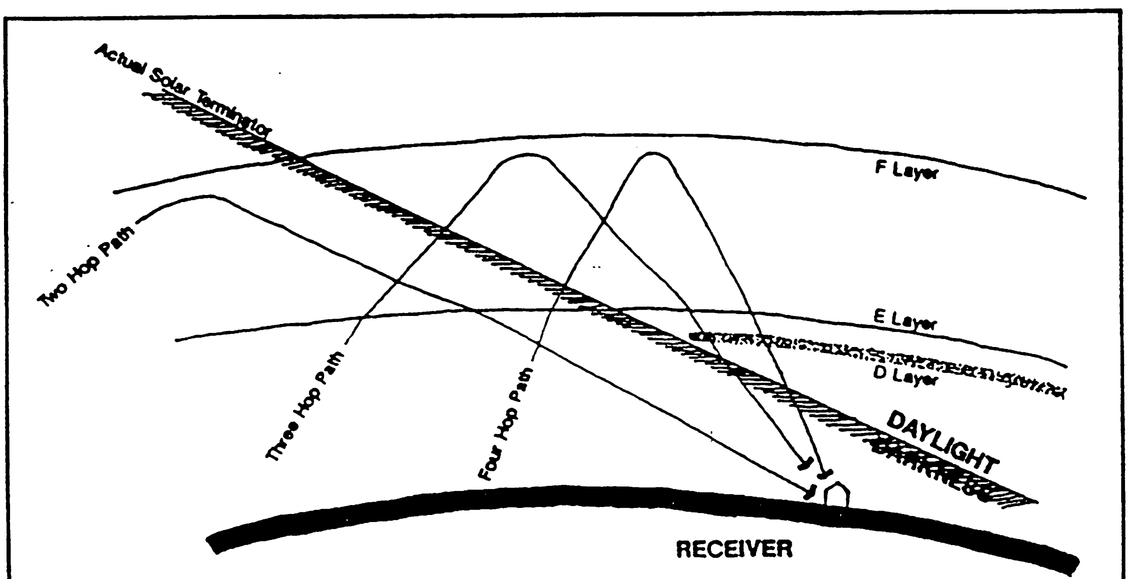


FIGURE 6. Dawn Enhancement: A Conventional Explanation

Figure 6 illustrates the most common conventional view of the mechanism of dawn enhancement. It postulates that the normal higher arrival (more hops) signals from a distant station are cut off by ionization occurring high above our heads while we listen in the pre-dawn darkness on the surface. Somehow, as these higher angle signals are cut off, the lower angle (fewer hops, therefore stronger) signals become dominant. Why these low angle, fewer hop signals weren't dominant all along is never explained. If this is the true model of dawn enhancement, we should all hear *VIOLENT* transitional multi-path destructive interference (fading and distortion) as the modes (number of hops) changed on otherwise clear and interference-free signals. We have never--not once--heard such interference under those circumstances. Rather, the signals build slowly and steadily with little or no fading as dawn enhancement begins to work its magic.

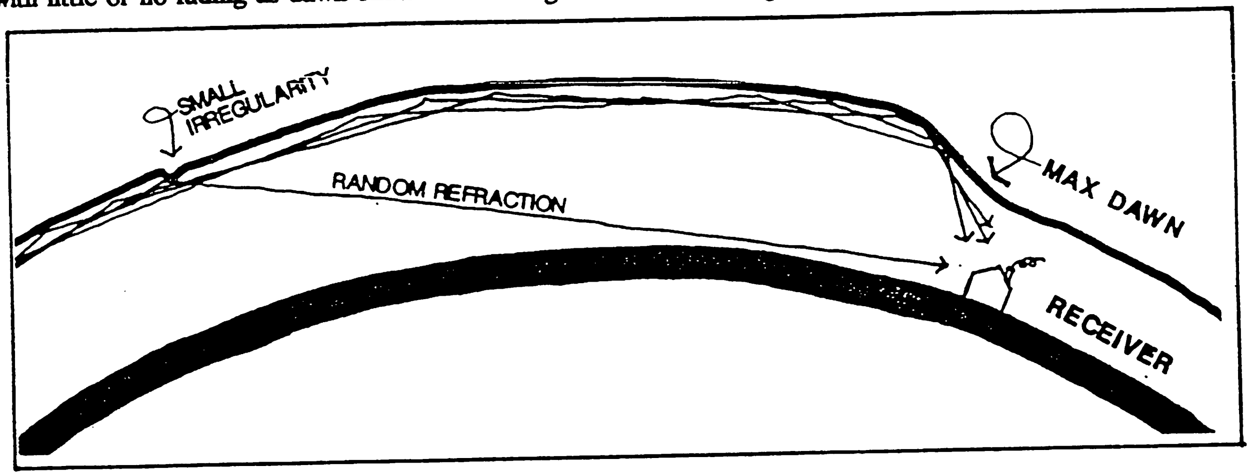


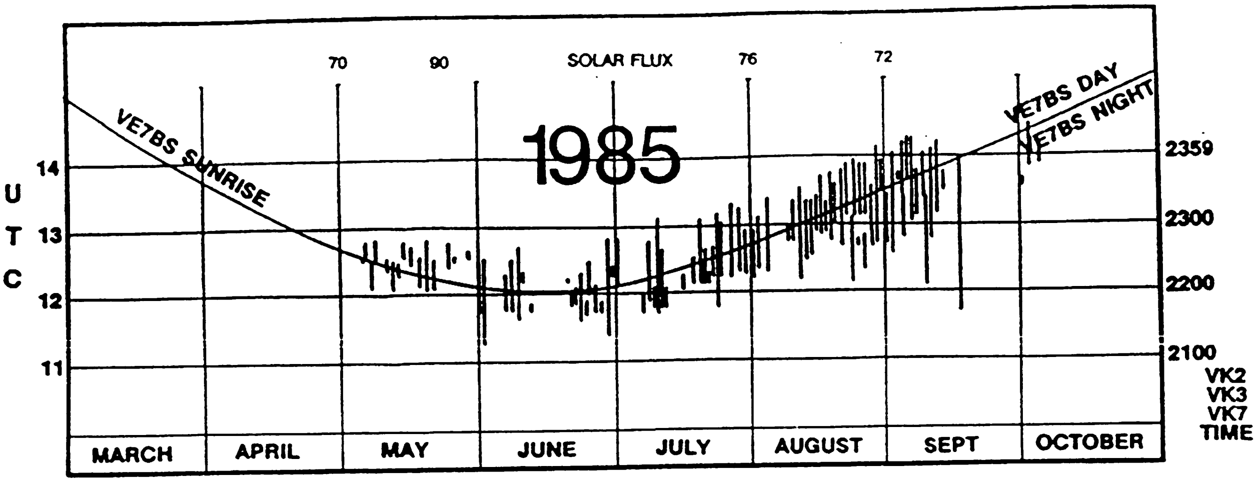
FIGURE 7. Dawn Enhancement: From The Whispering Gallery

If instead long-haul propagation is taken to be some form of the whispering gallery mode, the pattern of dawn enhancement that we *DO* experience daily and even the much lower signal levels heard from some of the same transmitters in the hours before dawn becomes very understandable. Figure 7 represents our current belief as to the mechanism of dawn enhancement of Tropical Band signals. The single arrow/ray refracted downward in the left-hand portion of the illustration has been refracted by a small random irregularity after traveling 95% of the same path length in the same trajectory. (Again, the similarity between this picture and the work of Blanarovich is noted.) One of the key pieces of evidence which would strengthen the case for the whispering gallery mode as the proper mode or geometry of events (as shown in Figure 7) is if the weak signals being heard before dawn do arrive at substantially *LOWER* angles than do those at dawn enhancement itself. This would be the exact opposite of the case put forward in the conventional "explanation" illustrated as Figure 6. Anecdotal evidence from the 160 Meter and 80 Meter amateur DXing communities indicates that high arrival angles at sunrise enhancement may well be the case. Direct experimental data (from the Farley Loop?) would be very useful in this area.

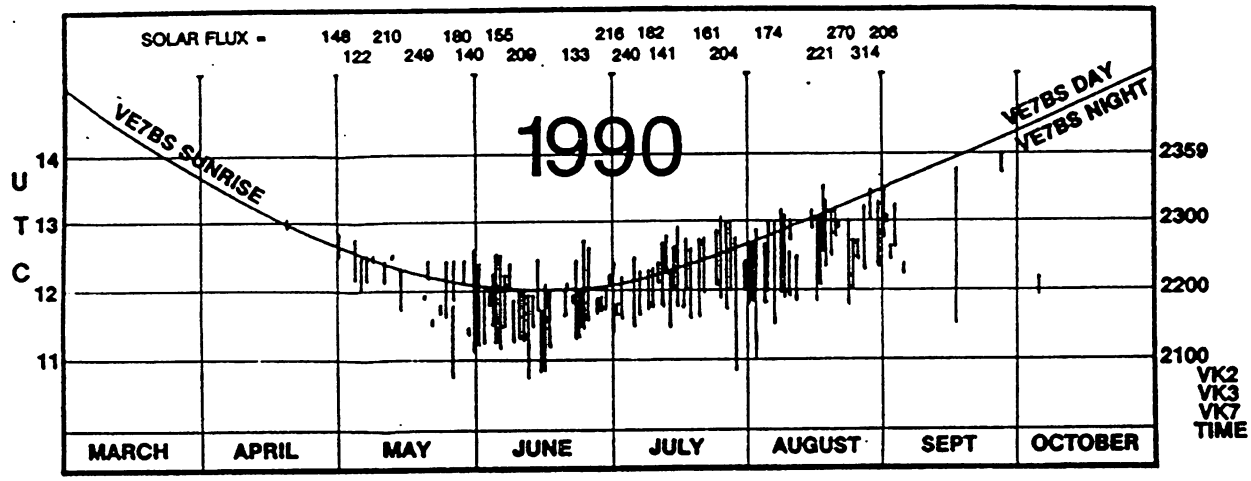
RELATIONSHIP OF DAWN ENHANCEMENT TO THE SOLAR CYCLE

Several senior NASWA DXers have mentioned to us lately that dawn enhancement doesn't seem to last as long as it used to--as long after ground sunrise, that is. We have made the same casual observation. Neither of us had seen any supporting data in either the hobby press or scholarly journals until Bob Eldridge, VE7BS, wrote and shared some of his extensive experience with us. Bob has written widely on HF matters and is a long time DXer on 160 Meters (1.8 MHz).

Figures 8 and 8A chart observed openings on 1.8 MHz between Pemberton, BC (VE7BS' location 70 mi. N of Vancouver) and Australia. Each line represents an opening on a certain day. The arcing curve from left to right indicates the time of dawn on the ground in Pemberton. When you compare the two years, you note that openings lasted far longer past dawn on almost every occasion in 1985 (solar flux generally less than 100) than they did in 1990 with solar flux running often above 200. This is particularly true during the prime three months of "the Down Under season" from late June until September. Bob's charts are the only hard data of which we are aware showing systematic study of the frequency and length of dawn enhancement and its relation to the solar cycle. Even though propagation and "openings" differ somewhat between the 160 Meter amateur band of Eldridge's study, and our favorite 90 and 60 Meter haunts, his graphs do match very well with our experience. So...since we are all again beginning a sleigh ride down the slope of the sunspot curve, there are better days ahead.



1985 160 METER OPENINGS FROM VE7 TO VK "SUMMER SEASON"



1990 160 METER OPENINGS FROM VE7 TO VK "SUMMER SEASON"

FIGURE 8 and 8A. 160 Meter Band (1.8 MHz) Openings From British Columbia to Australia. These records were kept by VE7BS. The 1985 chart represents only two-way QSO's. The 1990 chart represents both completed QSO's and reception of Australian stations where no QSO was attempted. Probably, the 1985 chart would show even a greater difference from 1985 had it also recorded reception-only openings.

THE SWEET SPOT

The final major proposal in our 1990 Trop Prop article was that there seemed to be a "Sweet Spot" of enhanced propagation trailing the sunset terminator in the Tropical Zones. We were led to the discovery of this Sweet Spot (at the transmitter) as we attempted to develop a rational explanation of the seasonality of Tropical Band DX. This Sweet Spot appeared to be about "two to three hours wide" and the "peak" appeared to be around 9 PM local time in the Tropics. The "width" and "peak" were stated to be statistical in nature, with both factors varying daily and with the presence of the Sweet Spot usually somehow linked to quiet geomagnetic conditions. We had begun to suspect such a Sweet Spot during our own DXing at our dawn enhancement. As we looked back over loggings of the weakest stations from Indonesia, Papua New Guinea and the Subcontinent, our best loggings (sometimes ONLY loggings) tended to occur when it was about 9 PM local time at the transmitter... no matter which of several time zones the station fell within!

In our extensive reading of post-war propagation/ionospheric research, we stumbled across a number of studies of Tropical Ionospheric Disturbances (TIDs.) These TIDs are also known as "field aligned irregularities" and they are sometimes known by the less precise term of "spread F." By whatever name, the TIDs themselves are gigantic cigar-shaped horizontal bubbles usually aligned with their long axes parallel to the planetary magnetic field. These bubbles rise through the tropical ionosphere on most but not all magnetically quiet evenings and have long been known to affect trans-ionospheric propagation of radio waves at all frequencies. The generation of these bubbles begins shortly after local sunset and peaks around 9 PM local time. Usually all turbulence has subsided by local midnight, although some few incidents last as late as 3 AM local time.

It is important to note that we have found no previous authors who proposed a linkage between these TID's and oblique HF propagation *below the MUF*, though Kenneth Davies and possibly others have discussed TID-supported propagation above the MUF. Our linkage of the TIDs to enhanced Tropical Band propagation, and calling the result a "Sweet Spot," is purely our own invention and has been clearly labeled as *SPECULATION*. That caution aside, the circumstantial evidence for such linkage seems almost overwhelming to any seasoned Tropical Band DXer, particularly those who listen regularly at their local dawn. Our best DX at our local "max dawn" almost always occurs in exactly the same geomagnetic conditions as those most favorable to the formation of Tropical Ionospheric Disturbances. Further, our very best reception tends to be from stations located in the center of the area behind the sunset terminator which statistically contains the greatest concentration of these bubbles. We considered our possible "discovery" of a propagational Sweet Spot to be an important contribution to the current discussions of Tropical Band propagation. We should have noted in our previous articles that this Sweet Spot is most clearly "visible" to us in and near the 90 Meter Tropical Band, though we easily note its effects in the 60 Meter and 120 Meter bands, as well.

FURTHER SWEET SPOT STUDIES

In the fall of 1990, we began what we hope will be a systematic study of the Sweet Spot by DXers throughout North America. We published projected Sweet Spot zones calculated to coincide with maximum dawn enhancement at receivers located in three parts of North America (Toronto, Stillwater, Oklahoma and Seattle.) These drawings appeared monthly in DX Ontario and in the newsletter of Fine Tuning. Dawn DXers were asked to report to us whether this alleged Sweet Spot was a useful DXer's tool. It is too early to give anything but anecdotal results. So far, however, those reporting all clearly support the Sweet Spot concept as very useful in explaining and predicting the vagaries of weak signal Tropical Band propagation.

John tracked the Sweet Spot throughout the 1990-91 season from his normal QTH in Oklahoma. He found that it tended to center around 9 PM at the transmitter in the weeks near equinox. However, the best reception spot seemed to have "scooted forward" to nearer 7:30 PM at the transmitter during the North American "Sub-continental Season" (India, Pakistan, Bangladesh, Bhutan, Nepal) of the weeks centered on December 21st. In all cases, propagation enhancements seemed markedly stronger when the transmitter was located in John's dawn Sweet Spot than when the transmitter was in its sunset terminator enhancement as John experienced "max dawn" (true graylining).

Two specific instances are worth reporting:

John watched for the normal (but previously inexplicable) winter disappearance of the PNG and Irian Jaya stations which are heard in Oklahoma at good levels throughout the summer and early fall. Sure enough, by early October all PNG and Irian Jayans had faded to nothing even though there is an "even better" all-darkness path in the winter than exists in the summer! The one anomaly noted this season in this strange annual pattern was the mornings of 20-23 October when the Spot seemed to "jump back" to New Guinea. (Refer to August through November drawings centered on Stillwater in Appendix). These drawings also accurately predicted the first and last audio from the eastern Indian regional 90 Meter transmitters (early November and mid-February) very well.

John made a brief visit to Seattle in mid-March and he and Guy Atkins were able to DX with Beverages for one night from the Pacific Coast. (Refer to 15 March drawing for Seattle). Sure enough, even the weaker Sumateran and Western Javan transmitters seemed "like locals" while even the moderately strong transmitters from central Java eastward were virtually all inaudible!

David tracked the Sweet Spot in some detail from the beginning of the 1990-91 season until the Sub-continental season pettered out, in late January at Newmarket (near Toronto, Ontario). His primary observations during this five-month period are contained in a two-page chart - Appendix 'A' at the conclusion of our article.

As the DX season matured near the Autumnal Equinox, David was watching for the *first significant seasonal opening* from various Asian transmitter sites as a basis for detecting the emergence of seasonal enhancement patterns. He also made notes of *unexpected* or *unusual* openings so that without the influence of any pre-conceived notions, we could observe and attempt to deduce how these fitted into the scheme of things.

For each selected logging judged to have met these criteria, a subjective rating has been assigned to indicate the quality of the opening *for that particular station*. You can see at a glance the UTC sunrise time at Newmarket, the sunset time at the transmitter, and the time at which reception was judged to have peaked. Most importantly for this exercise, you can see how the period of optimum reception compared with transmitter sunset, expressed in local evening times. It is instructive to compare these findings with the Appendix 'B' drawings showing the sunset terminator and the projected Sweet Spot Zone, centred on Toronto.

After the completion of our "Trop Prop" article, we began to suspect that the Sweet Spot might be centred closer to 7:30 PM at the transmitter (the mid-point of the post-sunset generation phase of spread F), rather than at the statistical maximum around 9:00 PM. Indeed, as the terminator worked its way westward and became more steeply inclined with the approach of the Winter Solstice, David found, as did John, that "max dawn" enhancement was much earlier in terms of the source transmitter's evening hour. In particular, that was the case with the Sub-continentals, many of which are situate in the geographic band between 25 degrees N (Tropic of Cancer) and 30 degrees N latitude. The chart shows a relatively consistent peak for these signals between 6 and 6:30 PM at the transmitter (sometimes 7 PM during "late" openings), typically between one and two hours after sunset.

North of the 30th parallel, considering Mongolia for example, the usual peaks were around 8 PM, but again, this tended to be centred on two hours after sunset at the transmitter. Just below the Tropic of Cancer, Vietnamese regionals would also peak two or more hours after sunset, near 7:30 PM local time.

Finally, turning to Indonesia and Papua New Guinea, lying within 10 degrees of either side of the Equator, equinoctial reception from the Island of New Guinea corresponded with our original 9 PM supposition. In the later fall, however, signals originating from sites within the middle of the three Indonesian time zones (UTC+8) exhibited a tendancy to peak
around 8 PM, yet-again about two hours following their tropical sunset.

We should bear in mind that David's survey is representative of part of only a single season just-following solar maximum. Nonetheless, there is a good deal of evidence to suggest that *the "max dawn" Sweet Spot in Eastern North America corresponds with about 8 PM at Asian transmitter sites for a substantial part of the Tropical Band season. The somewhat earlier peak of the Sub-continentals is probably accounted for by the fact that even at Winter Solstice, only the leading edge of the Sweet Spot Zone has reached the eastern extremity of India by the time "max dawn" enhancment is being experienced.*

Well known SWBC DXer Art Delibert of suburban Washington, DC reported similar experiences from his QTH and used the Sweet Spot technique to finally log Radio Manus (3315 kHz.) located in the Admiralty Islands of Papua New Guinea. Art calculated when his local dawn would coincide with 9 PM local time in the Admiralty Islands and found this to be in mid-March. Sure enough, mid-March arrived and so did Radio Manus at Art's "max dawn."

Bob Montgomery of Levittown, PA uses the vaunted R-390A receiver and has been tracking propagation enhancements at dawn. He wrote:

"I have been doing studies of propagation for some time and have come up with the same conclusions you have...the Sweet Spot is of special interest to me as I have been keeping records on Radio Australia broadcasts (referring to the 2.3 and 2.4 MHz Northern Territory "Shower Service" stations) with various graphs and have noticed this, as well. I have never found a name for it, but your terminology fits it exactly."

Bob Eldridge, VE7BS, also reports that the relative signal strengths of Aussie amateurs seem to vary in a pattern similar to that predicted by our Seattle-based Sweet Spot drawings. David recently found our most persuasive supporting data for a Sweet Spot when wandering through the dusty archives of ODXA sometime after the publication of our 1990 article. He was stunned when he found a 1970 article by the well known and respected Scandinavian DXer, Anker Petersen. It was published by the Danish Shortwave Clubs International. Mr. Petersen undertook an extensive and very precise year-long study (1969) of 60 Meter DX openings from Denmark to the rest of the world. Making thousands of loggings, he compared when each DX circuit "should be open" to the quality and length of actual openings. This is such an important work that we would like to quote a particularly important observation that Mr. Petersen made after his extensive study:

"The signal strength increases steadily from the stations' fade-in at the beginning of darkness on the path as absorption becomes lesser. ***In many cases, but not in all, a peak occurs about two hours after fade-in, followed by 3-4 hours with weaker signal strength.*** *Then the signal strength increases again and stays on a good level until the station fades out when sunrise reaches the first reflection point."*

Although this does not exactly describe our new-found Sweet Spot, it comes very close.

Figure 9 illustrates one of Anker Petersen's graphic records from that 1969 survey. Notice that the incidence of reception from Southeast Asia in his native Denmark is heavily concentrated near receiver sunset (RSS), and then again near transmitter sunrise (XSR). While it is fair to say there weren't too many "all-nighters" to be heard from Southeast Asia, note the virtual absence of signals throughout the period after RSS and before XSR when the entire signal path is in total darkness. This chart also tends to support the Tropical Band Sweet Spot proposition quite nicely! (Dusk reception in Europe equates with dawn reception here in North America, trailing transmitter sunset by several hours in each case during the DX season).

We should point out that in plotting the seasonal migration of the sunrise and sunset lines on the time scale, Mr. Petersen assigned their positions relative to the "first reflection point" which was assumed to be about 2,000 miles along the path from the transmitter and the "last reflection point," about 2,000 miles before completion of the circuit at the receiver. (He was assuming a conventional F2 multi-hop propagation mode).

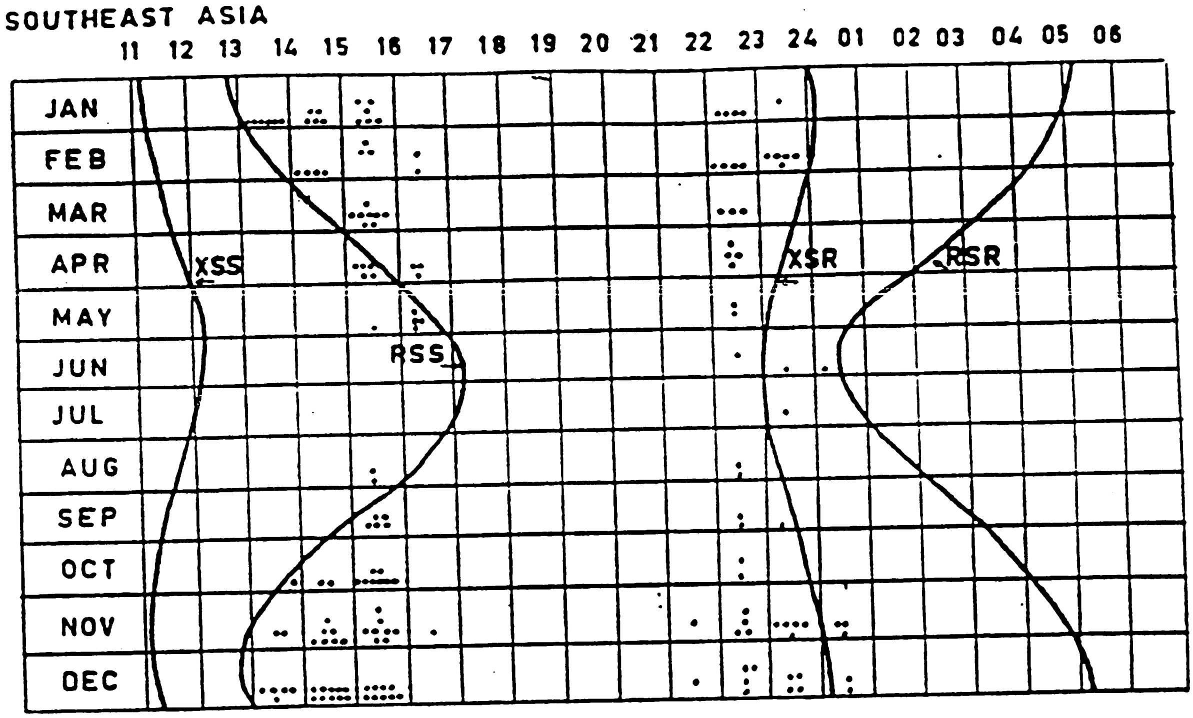


FIGURE 9. Survey of Reception Pattern of Southeast Asians on 60 Meters during 1969 near Copenhagen, Denmark. The number of stations heard during a given hour/month is shown by the number of dots within the box; the vertical position of the dots is indicative of relative signal strength.

"SEANCE" AND THE SWEET SPOT

As noted earlier, Bob Eldridge, VE7BS, is in almost daily contact "during the season" on 160 Meters (1.8 MHz) with radio amateurs in Australia. Actually, he and Bill Tippett, W0ZV, are two of the anchors of the SEANCE net (South-East Australia to North America Communications Exchange). The SEANCE net is organized to assist "first timers" across the Pacific on 160 Meters. It also is run from the Australian end to provide reliable propagation indicators for experienced North American 160 Meter operators. [More on that later].

Just as we were completing the final draft of this article, Bob forwarded the following excerpt of a letter from VK4YB, Roger Crofts, one of the main Aussie anchors of SEANCE and a widely experienced 160 Meter DXer.

"At last [people] who would be really interested in studying our log books...We of course have the raw data to support [the Sweet Spot] hypothesis:

1. **The sharply defined Season mid-May to end-August;**
2. **Peak signals at 9-9:30 local time at western end of circuit;**
3. **Sharply defined geographic region for enhanced signals** (West, Midwestern USA);
   (At times, they also work into Illinois earlier in the Australian evening);
4. **High reliability, openings on at least 90% of days.**

"I have often listened for a peak at our sunset. I have never noticed one yet. The [North American] signals don't appear until around 9 PM. At 27 degrees South Latitude, I am just outside, or rather on the edge of the enhancement zone. Of course I do sometimes work stations earlier, e.g. K6XK is often audible on 1811 CW. If I raise a reply from him it is always by transmitting on the vertical. A sure indication that another mode of propagation is in use because as we know, the horizontals at the western end of the circuit, at least, always seem to have the edge. This is one area where we are able to supply additional information to [the SWBC DXers]. I'm sure all their BC stations are using verticals–the enhancement would be more noticeable if they had dipoles."
(Roger knows though that some tropical broadcast stations use high angle antennas, like the Australian example).

"According to the [Proceedings 1990 Sweet Spot charts], we should expect an enhanced path to Japan at about 1230 UTC in mid-December. I have never noticed the JA's being anything except surprisingly weak all year."

We were riveted by Roger's letter. If we could have described what ought to be happening "under" the Sweet Spots, the SEANCE experience Down Under would be it!!! What a perfect match! Naturally, we are in contact with Roger and SEANCE and we are all interested in exploring the situation more thoroughly.

We cannot help but carry Roger's thoughts further...in our terms, he and the other VKs are *"DXing SUNRISE AT THE TRANSMITTER AT 9 PM THEIR LOCAL TIME"* (the local Sweet Spot).

We have no data on whether this reciprocal effect might work here in North America--especially north of 27 North Latitude. We do have some Asian loggings, and there are a few scholarly works which indicate that the Sweet Spot (or TIDs) may at times extend rather far above the Tropics (at least to 40 degrees N.). For us, this is a whole new thought.

IT'S 9 PM, YOUR LOCAL STANDARD TIME. DO YOU KNOW WHERE YOUR DAWN TERMINATOR IS?

For SWBC and MW DXers west of the Mississippi as well as the amateur community, there are several other items of importance in Roger's letter.

"[To facilitate propagation studies] I am most careful to synchronize my watch with WWV so that the first CQ goes out at exactly 1100Z to the second. I call CQ for exactly 90 seconds on the DIPOLE and listen for 30 seconds. If no reply I call CQ at 1102Z on the VERTICAL and listen for 30 seconds. I have had some difficulty in doing this recently because the frequency is often occupied by VKs ragchewing. I deliberately chose the then hardly used 1832 because our freq last year of 1826 was full of VK ragchewers. Now, everyone is on 1832--the problem of success!"

DXING WITH THE SWEET SPOT

Our Dawn and Dusk series in the NASWA Journal also discussed the possible impact of the Sweet Spot trailing sunset at the transmitter on African and Latin American Tropical Band DXing. This situation would occur in the North American late afternoon and evening. We have not as yet published any drawings detailing this phenomenon and suggest that you produce your own. The dawn drawings in the Appendix to this article were made by defining the Sweet Spot as extending from the Tropic of Cancer to Capricorn, from 7:30 to 9:30 PM mean solar time at the Equator. The sides of the Spot were drawn running parallel to the terminator.

To conclude this section of our discussion, we suggest that at least four relationships between the Sweet Spot and the receiver or transmitter are worthy of special interest:

A) **When the Sweet Spot is over the transmitter at your own "max dawn" enhancement--**the situation shown in the Sweet Spot drawings following this article. (These drawings apply only for the receiver locations and times/dates noted, of course.)

B) **When the Sweet Spot falls over the transmitter during local receiver sunset enhancement.** This situation would occur from some North American receiver locations to some parts of Latin America. However, it appears that this situation would be much more useful for DXers located on the Eurasian landmass.

C) **When the Sweet Spot lies between the transmitter and the receiver, especially when the long axis of the Sweet Spot is parallel to the propagation path.** This situation applies to late winter afternoon reception of African stations from North America and for enhanced evening reception of various areas of Latin America from some locations in North America.

D) **When it is 9 PM local standard time at your location (or, maybe 3 hours past sunset) try DXing sunrise-at-the-transmitter and/or sunset-at-the-transmitter.** This of course, is our possible new Sweet Spot tool found by the Australians.

Finally, we suggest that the true test of the existence of a Sweet Spot of enhanced tropical transmission/reception will be whether it becomes a tool commonly used by Tropical Band DXers around the world. If it is a chimera, it will soon sink back into the DXers' Dustbin of strange ideas hatched after too long at the dials. You decide.

SPHERICAL CONVERGENCE

"Spherical convergence" is our term for a little known and poorly understood physical phenomenon which materially effects the signal strength of every signal of whatever frequency which is propagated ionospherically and which travels more than 6,250 miles between transmitter and receiver. It effects Low, Medium and High Frequency alike. From reader feedback to the 1990 article, we are aware that spherical convergence was the most difficult concept to grasp, probably because it seems so wrong-headed. The concept accepts that signals traveling from a transmitter get weaker as they spread out. This is true for the first 6,250 miles. After that, and ignoring other losses, signals get progressively stronger each mile that they travel! This is due to the spherical nature of the planet and its more-or-less concentric ionosphere.

The only data we have found which gives actual gain figures resulting from spherical convergence is in the Deutsche-Welle study [1] which found that **this phenomenon alone, added several S-units to the strength of D-W signals received in Australia.**

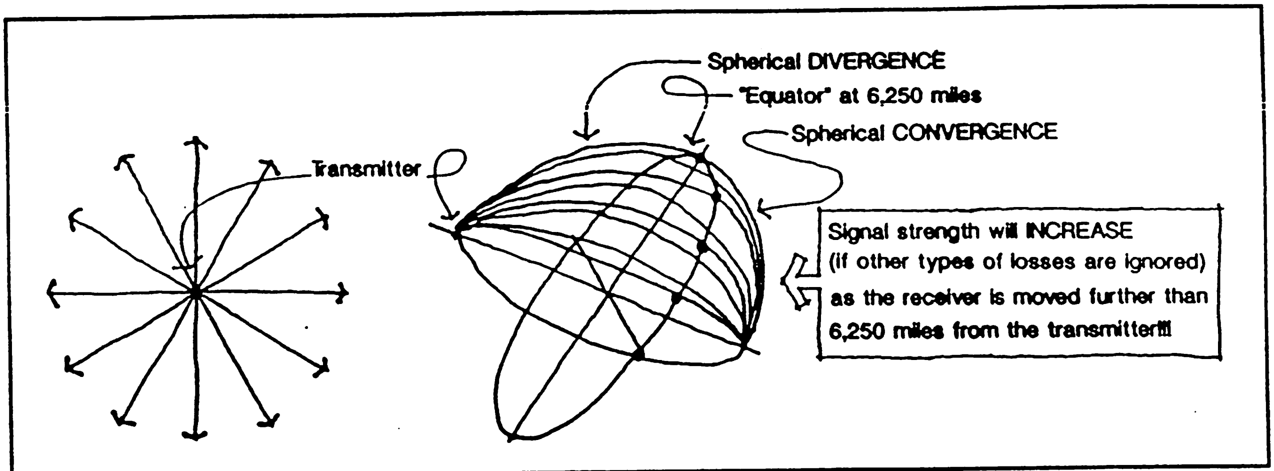


FIGURE 10. SPHERICAL CONVERGENCE
Note: Since this effect is operative at all ionospherically propagated frequencies, the effect of day/night is not shown.

Figure 10 was our attempt at explaining this phenomenon. However, many readers still had difficulty visualizing it. The following exercise helped us understand this slippery concept: We are all familiar with the "stone dropped in a still pool of water" analogy of a signal traveling outward in concentric ring-like waves from a transmitter. As the concentric waves spread to ever-larger circumference, their height decreases proportionally. So does the field strength of the analogously transmitted radio signal. We could get the same effect *in reverse* in the pool by having an adjustable metal ring in the water. If we could suddenly make the ring just a bit smaller, that movement would create an inward-traveling small circular wave. As that wave came closer to the center, it would build in height as the wave's circumference got ever smaller. (Right?? Right!!)

Now, place a "transmitter" rock at the north pole of an all-water surfaced planet, which is 25,000 miles in circumference. The ultimate receiver will be at the south pole of the same planet. Use your north polar rock transmitter to create a 6-foot high single wave at the north pole. As this tidal wave rushes outward, the wave crest will get ever-lower as the total wave circumference gets ever-larger. By the time that this tidal wave reaches the equator, it will have traveled 6,250 miles from the transmitter and that formerly 6-foot high tidal wave will be, say 1/1000 of a foot high as it simultaneously crests all points of the equator. Now, rush around to your receiving position at the south pole. You will hardly notice the 1/1000 of a foot tidal wave rushing at you, yet as the circumference of this inward-rushing wave decreases, its height builds rapidly! (So would the signal strength of an analogous radio wave after it travels 6,250 miles from the transmitter). Measured at any point past 6,250 miles, the tidal wave is getting ever-higher! Finally, it converges at your south pole location. Unless you are at least 7 feet tall, you are gonna get a mouth full of water! So, too, with the signal strengths of ionospherically propagated radio waves on a spherical planet.

This phenomenon, which we call "Spherical Convergence," is discussed briefly in some professional works using terminology such as "ray re-focusing" and/or "near antipodal focusing." We find both terms very misleading and unnecessarily obscure. Since the effect on the Germany-to-Australia circuit was 2 to 3 S-units and since this phenomenon effects *every* ionospherically propagated signal which travels more than 6,250 miles (not just from near your particular planetary antipodes) we commend Spherical Convergence to every serious DXer's consideration.

We are not aware of any propagation predicting programs which takes this mathematically simple concept into account!

THE RECIPROCITY ASSUMPTION

The Reciprocity Assumption is apparently especially dear to radio amateurs and professional propagationists. In our 1990 article, we noted that one aspect of our own observation might be a "receive only" phenomenon. No other single statement garnered such comment from our readers. We were assured by a number of folks that there was no such thing as a "receive only" phenomenon--the "reciprocity assumption" would not allow it! The reciprocity *ASSUMPTION* states that, in propagational matters, one may interchange the position of the receiver and the transmitter and not effect signal strength, propagational geometry, etc.

We are unsure why this assumption is so dear to so many and agree that it is a reasonable "most of the time" assumption. However, like all things in physical science, one should "never say never!" Our best reference documents a NATO-funded study of HF propagation in the Arctic. Scientists established matched transmitter/receiver/antenna at several sites in the sub-arctic and performed extensive propagation path testing.[4] They defined "non-reciprocity" as when there was at least 10 dB of difference between the received strength of a signal sent from Point A to Point B and that sent in the reverse direction the next instant. Since all differences of transmitter, antenna and receiver were designed out of the experiment, any instances of non-reciprocity would be due to propagation. Over 80 percent of the transmissions were non-reciprocal! Although 10 dB is less than 2 S-units of difference, the fact that such exists is very strong evidence that true "receive only" phenomena do occasionally exist.

An associated study is also worth mentioning: researchers found that the ionosphere in the Arctic was so turbulent that the strength of long distance transmissions arriving at two receivers separated by as little as 30 km varied radically. In some tests, one receiver would report a strong signal while the nearby receiver reported no signal at all! The implications of this study on weak DX signals attempting to transit either polar region must be quite profound. Similar "non-reciprocity" may or may not exist elsewhere in the ionosphere. We are not sure that anyone has ever actually tested the "reciprocity" assumption in the "more normal" temperate latitude ionosphere.

INTER and INTRA LAYER DUCTING

There is ample evidence that "true" ducting exists as a mode of radio propagation. If "layers" of higher density ionization are interspersed with layers of much less dense ionization, it is easy to visualize that wave packets traveling almost parallel to these ionospheric layers will be continuously refracted around the planet. Some speculation has appeared in scholarly journals that the regions of the ionosphere which we think of as distinct layers (D, E, F, F1, F2) may be each composed of a number of mini-layers. We understand that rocket-borne instruments have not been sensitive enough to measure such possibly very subtle vertical gradients of electron density. If this "many mini-layers" picture of the ionosphere is true, there may be *INTRA* as well as *INTER* layer ducting of radio signals.

The conventional view of "true" (that is, double-sided) ducting is that it only occurs at frequencies higher than the current Maximum Useable Frequency (MUF)--that is, generally above 25 MHz. Ducting as a mode was probably discovered because no conventional ionospheric means of propagation existed at these very high frequencies. The signals "should" have gone into free space, but did not. Why? Thus, a search and the discovery of ducting.

Since the conventional view of HF propagation (the multi-hop model) is now called into question, it is at least reasonable to speculate that ducting *MIGHT* play a significant and regular role in HF propagation over planetary distances. We have no means to determine whether the primary mode of long-haul Tropical Band propagation is whispering gallery/single-sided ducting or "true" double-sided ducting. We understand that a Canadian ionospheric research satellite will be launched via the much-delayed Space Shuttle in 1993 or 1994. It is supposed to fly at altitudes which will allow a highly detailed look at the structure of the ionosphere. We can hope that part of this project will address the behavior of the ionosphere at the lower High Frequencies.

LONG PATH/BENT PATH PROPAGATION

A major development in our own study of dawn/dusk enhancements in the past year was David's discovery that the signals of Indonesian and Southeast Asian stations sometimes audible on North American winter afternoons (primarily an East-of-the-Mississippi-only phenomenon) were coming from the South! David stumbled into this when he and DXing buddy Cedric Marshall constructed a permanent two-wire Beverage at their Ontario antenna farm. This type Beverage (refer to ARRL *Antenna Book* or Misek's *Beverage Handbook*) is switchably uni-directional off either end. Imagine David's shock when he switched the antenna pattern from north to *south* and those weak afternoon Indo's boomed in!

David was especially startled since he is one of the best known DXers of these particular DX signals and since he had spent several pages in his well-received article "DXing Asians on the Tropical Bands--The Auroral Factor" (*Proceedings 1989*) explaining how those very same winter afternoon Asians came in from the *north* through the Arctic "doughnut hole" or by "skewed" path around the northern auroral region. This northerly short path route was and is the explanation of these signals common among veteran North American Tropical Band DXers and we both fell in the same trap. Not only have we all been conditioned to "think" short path as the normal mode, but also it was assumed that Tropical Band propagation on the reciprocal (long) Great Circle path from Southeast Asia to eastern North America in mid-winter was not possible. That was because the path (from Sumatera/Singapore, for example, at 180 degrees from true North) intersects Antarctica which is bathed in twenty-four hour daylight during the southern hemispheric summer, thus implying total signal absorption or "solar blanking."

Matters only became clearer when it was recognized there is a sunset grayline from eastern North America which runs tangent to the eastern extremity of Antarctica in mid-winter and passes through the vicinity of Ujung Pandang on the Indonesian island of Sulawesi. Remembering that a grayline path is always a Great Circle path, this means that David's dusk reception of Ujung Pandang (on 4719.3 or 4753.3) is an entirely plausible example of true graylining via the long path. (January 1st Newmarket sunset = 2151; Ujung Pandang sunrise = 2153). The January 1st position of the grayline also means that most of Southeast Asia is still in pre-dawn darkness at the time of David's sunset. The Beverage antennas confirmed the conclusion that the signals from most of Jawa and all points further to the west must be adopting a bent or "deviated" long path, exhibiting as much as 30 degrees of skew from the reciprocal Great Circle path in terms of the transmitter location. The arrival of these signals from a southeasterly heading also squares with David's observation that reception of the afternoon Asians is distinguished by a total absence of characteristic polar or auroral "flutter" fading.

It is also noted that those mid-winter long path signals from Sumatera, Singapore and the Indo-China region attain their best peaks, albeit briefly, during the particular period when one-half hour past sunset at the receiver coincides with one-half hour prior to sunrise at the transmitter--the classic definition of a low-band, long path opening.

We have stated that dawn and dusk Tropical Band signal enhancements are not symmetrical propagational events. With particular reference to the Southeast Asians, dawn Sweet Spot enhancement is typically accompanied by a relatively quiet geomagnetic field, although we are finding that this is not always the case. Conversely, at dusk the initial "positive phase" after commencement of an ionospheric/geomagnetic disturbance is almost invariably the necessary criterion for a day or two of enhanced long path reception of the Asians. Given ideal conditions, certain stations can be heard at signal levels which far exceed their typical strength during dawn enhancement! We have yet to see a substantive explanation, in the hobby press or elsewhere, of this phenomenon of dusk trans-equatorial enhancement as it applies to Tropical Band frequencies.

Secondly, downward refraction of signals at dusk must be assumed to be geometrically quite different than at dawn--at least on the lower HF bands. We noted that recombination rates in the D and E layers beginning at dusk are slower that the process of rapid ionization beginning at dawn. Furthermore, the circular shape of the earth means that the F region will begin to be affected by the sun well before dawn at ground level. The opposite effect occurs at sunset. All of this implies to us that the ionospheric tilting mechanisms during dusk enhancement may result in different arrival angles and different ray-focussing of the signals than at dawn enhancement. The extent to which these suppositions might be important for the reception of long path Asians is unknown to us at this time.

In any case, we had mistakenly assumed that "long path" propagation--reasonably well known in amateur circles--was either a high frequency phenomenon (20/15/10 Meters) or was far too rare to use as a conscious DXing strategy on the lower frequencies. We feel that David's "discovery" that "long path" can be a useful Tropical Band DXing strategy is a another major contribution to our collective effort to hear ever weaker DX. We are especially grateful that Bill Tippett, W0ZV, an outstanding veteran 80 and 160 Meter DXer, has contributed his insightful article on Long Path/Skewed Path Propagation to *Proceedings 1991.*

SUMMATION AND CONCLUSIONS

As our title suggests, we view this article as a scrapbook of "Notes" and an interim report on our own maturing thoughts on Tropical Band propagation. At this point, we do not think it useful to reach conclusions beyond those contained in the text of this article. We would be less than honest, though, if we did not say that we, and probably some of you, are beginning to see an emerging picture of Tropical Band propagation which is so unconventional as to be considered heresy in many circles. Neither of us is particularly comfortable with this state of affairs and we often begin to "backslide." When this happens, we go over our reasoning carefully; we examine again the real-world experience of ourselves and others and again read the documents that we have cited. The results of this re-examination are always substantially the same, no matter how uncomfortable they seem to us and others.

We are also very conscious that our articles have not covered all major aspects of radio propagation at Tropical Band frequencies. That was very intentional.... we are still doing a great deal of "homework."

TOWARD THE FUTURE

Although we have made a start toward a clearer understanding of Tropical Band propagation, much remains to be done. We would greatly appreciate assistance from other veteran DXers who dwell mostly below 6 MHz. We would appreciate input directly to either of us or in the form of article proposals for future editions of *Proceedings*. We are sincerely interested in assistance in the following areas:

A) True Double-Sided Ducting at Tropical Band Frequencies. We feel rather strongly that this type of propagation exists at low HF frequencies. It may exist in place of or co-exist with whispering gallery/single - sided duct mode.

B) Although Bob Eldridge's work (Figure 9 and discussion) on the relationship between Dawn Enhancement and the Solar Cycle begins to clarify this issue, a whole host of other "sunspot" cycle issues remain.

The most important is determining at which points in the cycle are the best general DX conditions. Conventional wisdom has always been that high bands were at their best in high sunspot-count years, and that low bands were at their best in very low sunspot-count years. There is growing discontent with this old saw from experienced SWBC DXers, MW DXers and amateurs who haunt bands from 6 MHz downward.

C) We have also to date, steered clear of writing of our views of the very complex relationships between hourly/daily/monthly solar events and "real time" DX conditions. We are both very interested in the observations of veteran DXers concerning this aspect of Tropical Band Propagation.

D) We would appreciate hearing from anyone in the amateur or SWBC DXing community who systematically DXes over planetary distances at frequencies between 6.0 and 1.4 MHz. concerning their general impressions of our proposals and their impressions of the Sweet Spot.

E) We would appreciate any leads or citations of formal *primary* research papers which support the *MULTI-HOP* model of HF propagation at any frequency. However, we are only interested in research papers which support this model with physical data and/or findings based on anything other than tradition, secondary quotations or *DELAYED TIME OF ARRIVAL*.

We would like to thank all of those who have participated in the Sweet Spot study, so far, and also those members of our sister radio hobbies who have been so much help in furthering our understanding of propagation and who have been most helpful in clarifying our understanding of these sometimes arcane matters.

Finally, we hope that you have found reading this article half as interesting as we have found the writing of it. We also urge you to remember that no article or book on this subject is completely true and accurate. At best, all such represent the truth as the authors believe it to be at the time they write it.

Happy (Tropical Band) DXing!

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END NOTES:

We have refered to several previous articles published in other editions of *Fine Tuning's Proceedings*. These are: "Terminator Mechanics and Trans-Polar Solar Blanking" by Bryant (*Proceedings 1988*); "DXing Asians on the Tropical Bands: The Auroral Factor" by Clark (*Proceedings 1989*); "Notes on Tropical Band Propagation" by Bryant and Clark (*Proceedings 1990*). Fine Tuning's Special Publications is attempting to keep all years of *Proceedings* actively in print. Inquiries may be sent to Fine Tuning's Special Publications in care of John Bryant at the above address.

We have also made numerous references to a series of four articles which we jointly authored in the Spring of 1991 in the "DXer's Forum" of the *Journal of the North American Shortwave Association*. The first two of these articles focused on Dawn Enhancement and the latter two on Dusk Enhancements of Tropical Band propagation. Reprints of this series, Known as "Dawn and Dusk" are available at nominal cost from The NASWA Company Store, 2216 Burkey Dr., Wyomissing, PA 18702.

REFERENCES:

[1] Hortenbach, K.J. and F. Rogler. "On the Propagation of Short Waves Over Very Long Distances: Predictions and Observations". TELECOMMUNICATIONS JOURNAL, Vol. 46, June, 1979.

[2] CCIR. Second CCIR Interim Computer-Based Report Method for Estimating Sky-Wave Field Strength and Transmission Loss at Frequencies Between the Limits of 2 and 30 MHz (Supplement to Report 252-2); Kyoto, 1978. International Telecommunication Union. Geneva, Switzerland.

[3] Rose, Robt. B. "High Resolution HF Time of Arrival Measurements (1981-85)". THE EFFECT OF THE IONOSPHERE ON COMMUNICATION, NAVIGATION AND SURVEILLENCE SYSTEMS, IES'87. Office of Naval Research, 1988.

[4] Jull, G.W. "HF Spatial and Temporal Propagation Characteristics and Sounding Assisted Communications". IONOSPHERIC RADIO COMMUNICATIONS, Folkestad, K., ed.. Plenum Press, New York, 1968

APPENDIX A
TROPICAL BAND SWEET SPOT SURVEY: SEPTEMBER/90 - JANUARY/91
AT NEWMARKET, ONTARIO

DATE / QUALITY	STATION / FREQ	RCVR SR XMTR SS (UTC)	PEAK / XMTR SS (PM)	PM PEAK AT XMTR / NOTES
9/16/90 Poor	AIR-Hyderabad 4800	1100 1246	1200 6:16	*5:30* SR+1 hr, SS-45 min; Skewed Path?
9/22/90 Poor-Fair	V of Myanmar 4725	1107 1130	1200 6:00	*6:00* Heard much better near mid-winter
9/22/90 Poor-Fair	AIR-Port Blair 4760	1107 1143	1200 5:13	*5:30* 1157 s/on-1210 fade under Kunming
9/30/90 Very Good	R Enga-PNG 2410	1116 0819	1125 6:19	*9:25* Also RRI-Sorong 4874.6 good to 1230+ Late!
10/13/90 Fair-Good	R Nepal 5005	1132 1150	1200 5:55	*6:05* Best on NW Beverage; skew from Grayline?
10/14/90 Fair-Good	RPH-Melbourne 1629	1133 0835	1115 7:35	*10:15* Also RPH-Canberra 1620kHz at 1105
10/20/90 Good	Xizang BS-Tibet 4750	1141 1119	1200 7:19	*8:00* Ulaan Baator 4995 @ 1205 fair (8pm at xmtr)
10/21/90 Fair	CBS-Taipei 3335	1142 0920	1140 5:20	*7:40* 1st log; no PNG! Ulaan Baator 4828 @ 1205 (8pm)
10/21/90 Good	AIR-Delhi 4860	1142 1214	1243 5:44	*12:43* Ahead of "season" and SR+ 1 hr at s/on
10/22/90 Good	R Nepal 5005	1143 1142	1145 5:27	*5:30* Ahead of "season" but True Grayline
10/28/90 Poor-Fair	RRI-Palankaraya 3325	1151 1013	1155 6:13	*7:55* Tough catch in Ont. RRI-Ternate 3345 vy good
11/04/90 Fair	RRI-Palu 3959.8	1200 0948	1155 5:48	*7:55* New xmtr but usually just carrier
11/05/90 Fair	RPDT2-Ngada 2904.8	1202 0952	1155 5:52	*7:55* Hets from other RPDs in UTC+8 time zone
11/18/90 Good	R Bangladesh 4880	1219 1111	1230 5:11	*6:30* Subcontinental "season" kicks off
11/24/90 Very Good	AIR-Kurseong 3355	1226 1112	1230 4:42	*6:00* Dominant over PNG; best AIR "indicator" on 90m
11/25/90 Very Good	AIR-Shillong 3255	1227 1100	1230 4:30	*6:00* Also AIR outlets on 3235/3277 6-6:30 peak

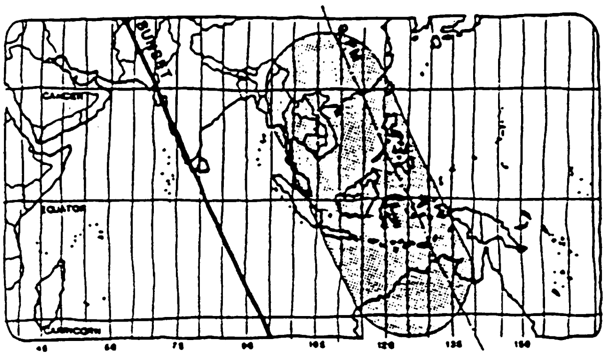
DATE / QUALITY	STATION / FREQ	RCVR SR XMTR SS (UTC)	PEAK / XMTR SS (PM)	PM PEAK AT XMTR / NOTES
12/01/90 Fair-Good	SLBC-Ekala 4870	1234 1221	1245 5:51	*6:15* New xmtr but not usually audible (presumed log)
12/08/90 Fair	Lao Cai BS-Vietnam 5597.7	1242 1019	1240 5:19	*7:40* Ha Tuyen BS 4816.5 @ same time - readable
12/09/90 Good	AIR-Gauhati 3375	1243 1100	1235 4:30	*6:05* Note Indian Regionals consistently 6-6:30pm
12/10/90 Fair	AIR-Bhopal 3315	1244 1204	1235 5:34	*6:05* Faded under PNG 1240+ AIR-Lucknow 3205 - good
12/15/90 Very Good	RRI-Dili 3306.1	1248 0950	1250 5:50	*8:50* RRI-Ternate 3345, same time - excellent (9:44pm)
12/15/90 Very Good	RRI-Nabire 5055.4	1248 0902	1305 6:02	*10:05* Audible to 1400 switch to 6127.5 - fade 1405!
12/22/90 Excellent	AIR-Kurseong 3355	1252 1118	1150 4:48	*5:20* Long Path - SW Bev! Short Path - NE Bev @1235
12/23/90 Very Good	AIR-Delhi 4860	1253 1158	1300 5:15	*6:30* Long Path-SW Bev; Major flare 12/22 at 2246
12/23/90 Very Good	R Bangladesh 4880	1253 1115	1300 5:15	*7:00* Long Path on SW Bev;
12/24/90 Excellent	R Nepal 5005	1253 1129	1315 5:14	*7:00* Skewed Path on NW Bev; Major flare 12/23 @ 0952 PCA Event 12/24 at 1200+ Audible past 1410!
12/24/90 Good	Bhutan BS 5023.1	1253 1112	1305 5:12	*7:05* Skewed Path on NW Bev; Audible past 1330!
12/25/90 Poor-Fair	AIR-Jammu 3345	1253 1159	1238 5:29	*6:08* Tentative // AIR-3355
12/30/90 Poor	AIR-Ranchi 3304.5	1255 1141	1240 5:11	*6:10* Threshold (tentative); Also AIR-Jammu 3345
12/31/90 Poor-Fair	AKR-Muzaffarabad 3662.6	1255 1204	1250 5:04	*5:50* Better than 1st (presumed log) on 12/30
01/03/91 Fair-Good	RRI-Gorontalo 3264.7	1255 1124	1215 6:24	*7:15* Sumatera can be much better at receiver SS!
01/04/91 Very Good	R Nepal 3230.1	1255 1135	1245 5:20	*6:30* Better than //5005!
01/20/91 Very Good	AIR-Kurseong 3355	1249 1137	1230 5:07	*6:00* Long Path-SW Bev; Last good Subcontinent date

APPENDIX B
DAWN ENHANCEMENT SWEET SPOT CHARTS
for
EAST COAST NORTH AMERICA

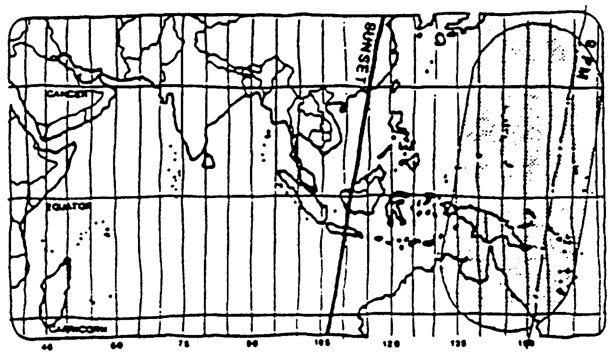
WINTER — SPRING

These charts document the statistically probable location of an area of enhanced propagation of Tropical Band signals. This enhancement may be associated in some as yet unknown fashion with Tropical Ionospheric Disturbances (TIDs) which are generated on most magnetically quiet evenings. The TID generation begins at sunset and generally peaks about 9pm mean solar time at the Equator. The chart records the statistical placement of the majority of the "creation phase" and the beginning of TID dissipation. Most TIDs dissipate by local midnight, though very unusual conditions may cause TIDs to remain active until nearly local dawn. The "Sweet Spot" on these charts is drawn from 7:30pm until 9:30pm mean solar time at the Equator. The sides are drawn parallel to the Sunset Terminator and generally extending from the Tropics of Capricorn to Cancer. The moment selected for the chart is that of:

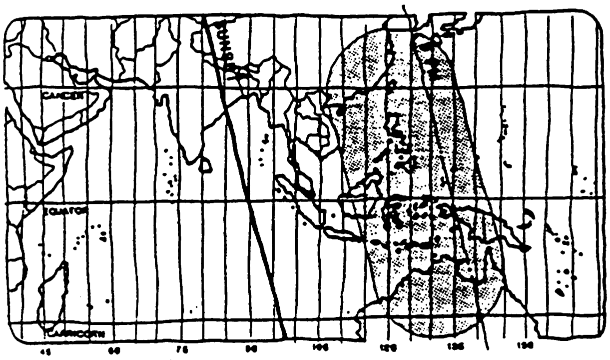
DAWN AT GROUND LEVEL in TORONTO



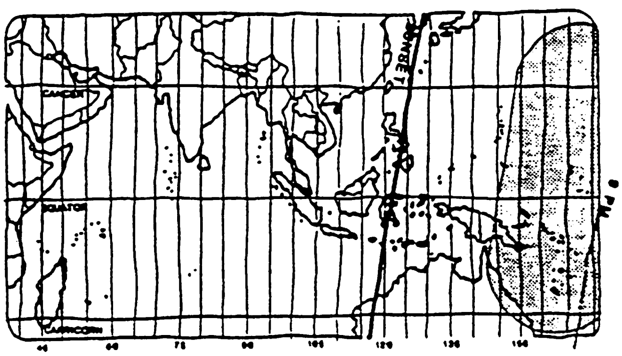
EASTERN toronto 15 JANUARY 1248 UTC



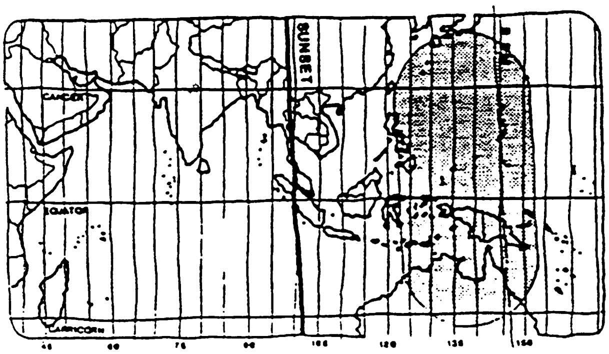
EASTERN toronto 15 APRIL 1035 UTC



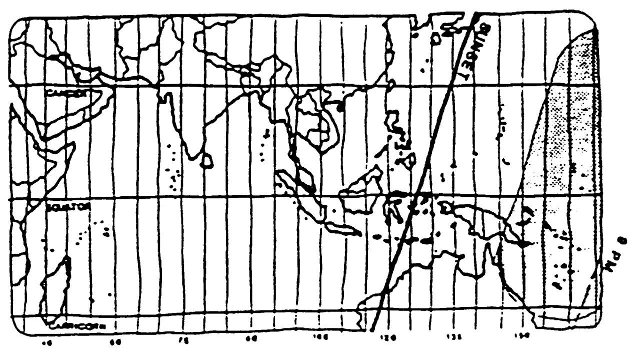
EASTERN toronto 15 FEBRUARY 1216 UTC



EASTERN toronto 15 MAY 0952 UTC



EASTERN toronto 15 MARCH 1130 UTC



EASTERN toronto 15 JUNE 0935 UTC

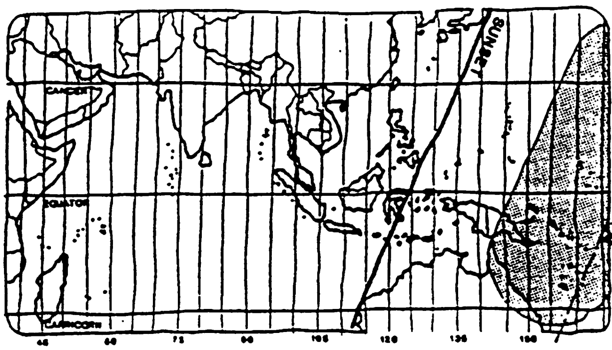
APPENDIX B
DAWN ENHANCEMENT SWEET SPOT CHARTS
for
EAST COAST NORTH AMERICA

SUMMER

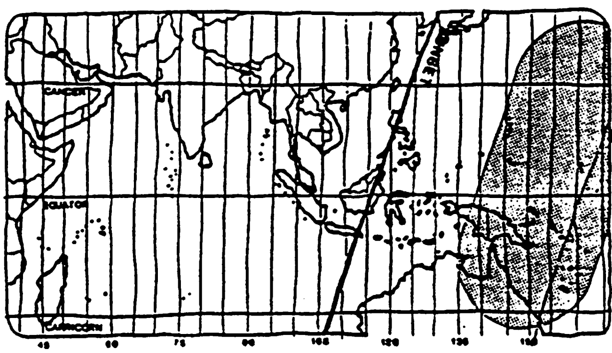
FALL

The moment selected for the chart is that of:

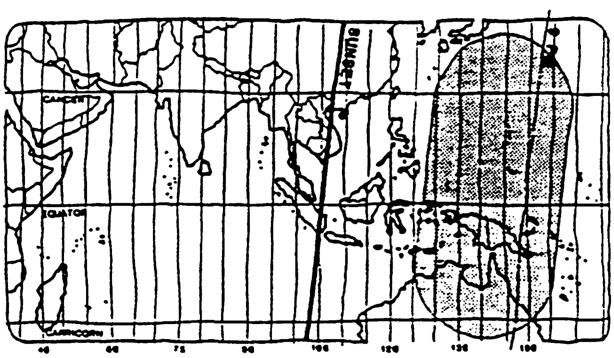
DAWN AT GROUND LEVEL in TORONTO



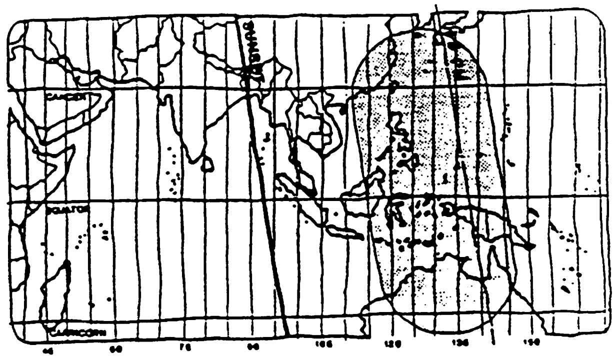
EASTERN toronto 15 JULY 0949 UTC



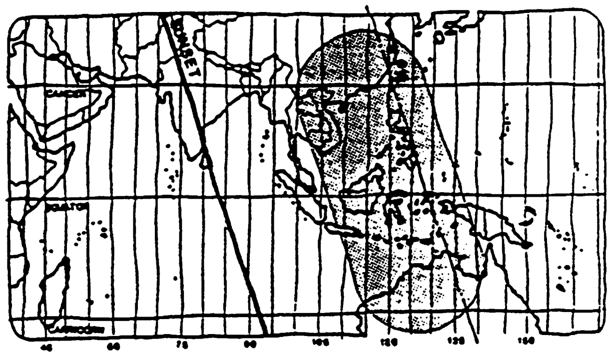
EASTERN toronto 15 AUGUST 1021 UTC



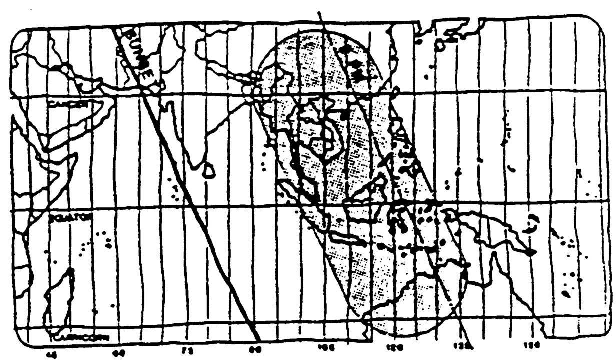
EASTERN toronto 15 SEPTEMBER 1056 UTC



EASTERN toronto 15 OCTOBER 1131 UTC



EASTERN toronto 15 NOVEMBER 1211 UTC



EASTERN toronto 15 DECEMBER 1244 UTC

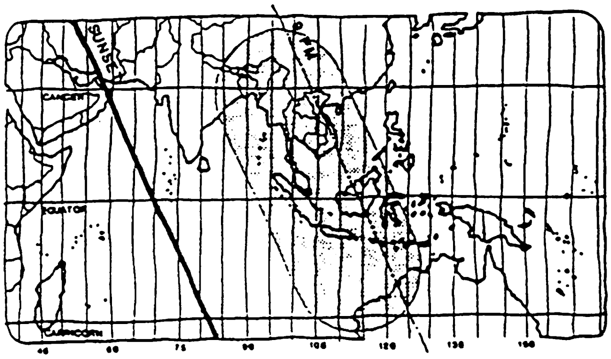
APPENDIX B
DAWN ENHANCEMENT SWEET SPOT CHARTS
for
CENTRAL NORTH AMERICA

WINTER

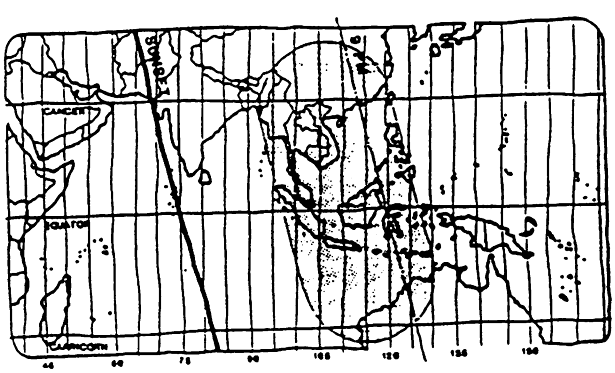
SPRING

These charts document the statistically probable location of an area of enhanced propagation of Tropical Band signals. This enhancement may be associated in some as yet unknown fashion with Tropical Ionospheric Disturbances (TIDs) which are generated on most magnetically quiet evenings. The TID generation begins at sunset and generally peaks about 9pm mean solar time at the Equator. The chart records the statistical placement of the majority of the "creation phase" and the beginning of TID dissipation. Most TIDs dissipate by local midnight, though very unusual conditions may cause TIDs to remain active until nearly local dawn. The "Sweet Spot" on these charts is drawn from 7:30pm until 9:30pm mean solar time at the Equator. The sides are drawn parallel to the Sunset Terminator and generally extending from the Tropics of Capricorn to Cancer. The moment selected for the chart is that of:

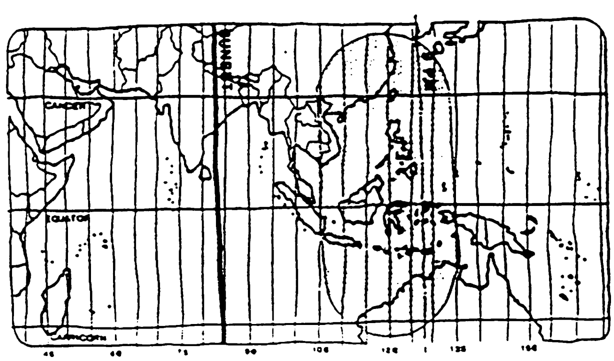
DAWN AT GROUND LEVEL in STILLWATER, OK



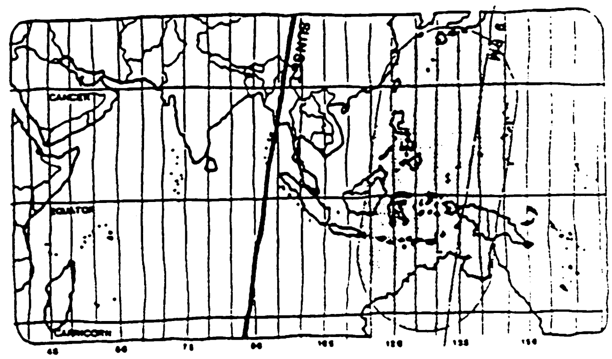
CENTRAL stillwater 15 JANUARY 1338 UTC



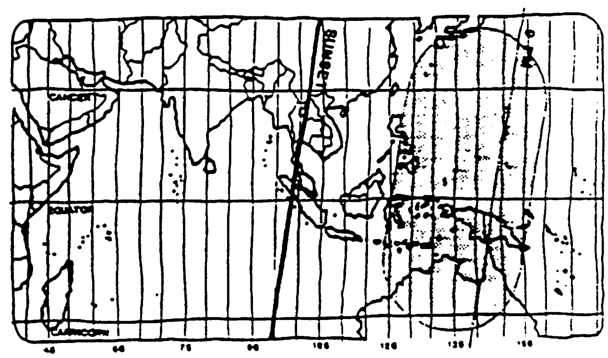
CENTRAL stillwater 15 FEBRUARY 1316 UTC



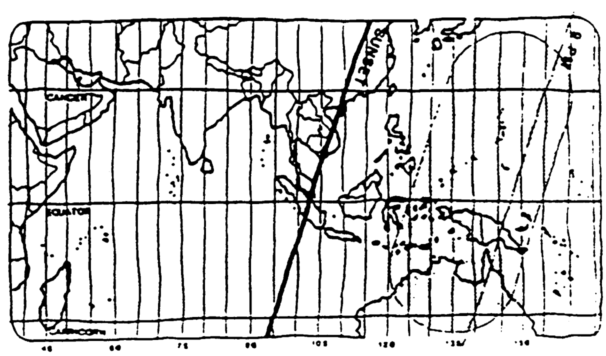
CENTRAL stillwater 15 MARCH 1239 UTC



CENTRAL stillwater 15 APRIL 1155 UTC



CENTRAL stillwater 15 MAY 1122 UTC



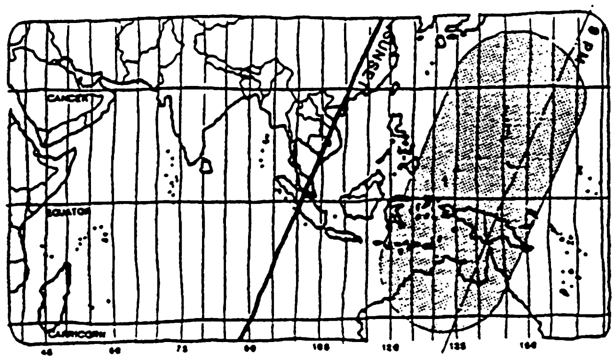
CENTRAL stillwater 15 JUNE 1110 UTC

APPENDIX B
DAWN ENHANCEMENT SWEET SPOT CHARTS
for
CENTRAL NORTH AMERICA

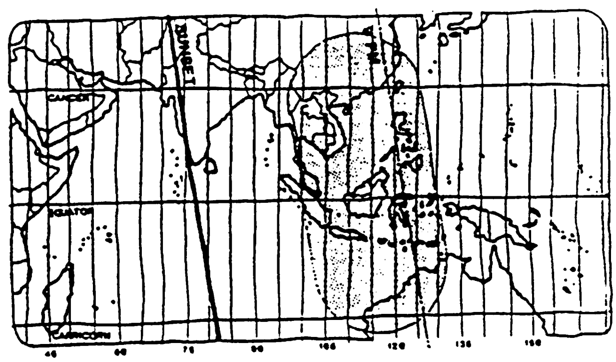
SUMMER **FALL**

The moment selected for the chart is that of:

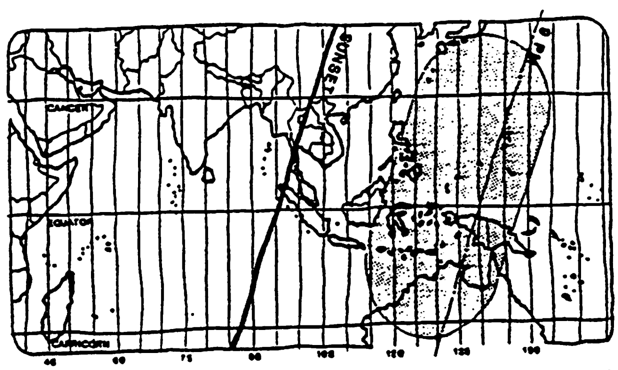
DAWN AT GROUND LEVEL in STILLWATER, OK



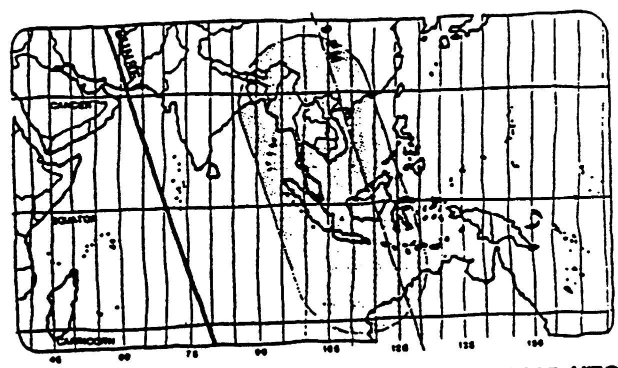
CENTRAL stillwater 15 JULY 1122 UTC



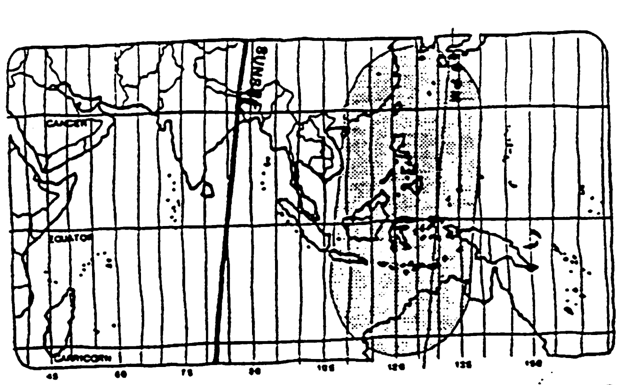
CENTRAL stillwater 15 OCTOBER 1235 UTC



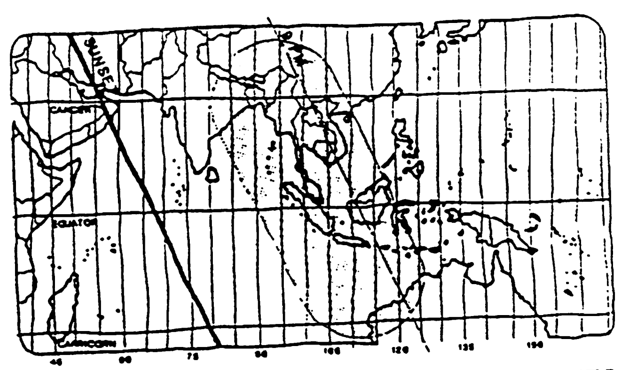
CENTRAL stillwater 15 AUGUST 1146 UTC



CENTRAL stillwater 15 NOVEMBER 1305 UTC



CENTRAL stillwater 15 SEPTEMBER 1210 UTC



CENTRAL stillwater 15 DECEMBER 1332 UTC

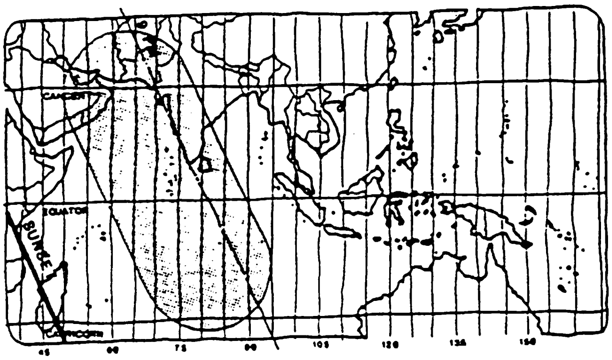
APPENDIX B
DAWN ENHANCEMENT SWEET SPOT CHARTS
for
WEST COAST NORTH AMERICA

WINTER

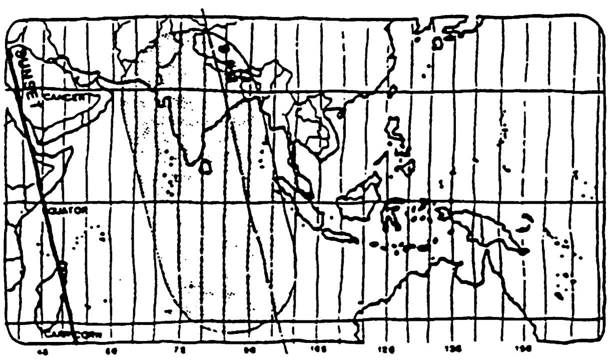
SPRING

These charts document the statistically probable location of an area of enhanced propagation of Tropical Band signals. This enhancement may be associated in some as yet unknown fashion with Tropical Ionospheric Disturbances (TIDs) which are generated on most magnetically quiet evenings. The TID generation begins at sunset and generally peaks about 9pm mean solar time at the Equator. The chart records the statistical placement of the majority of the "creation phase" and the beginning of TID dissipation. Most TIDs dissipate by local midnight, though very unusual conditions may cause TIDs to remain active until nearly local dawn. The "Sweet Spot" on these charts is drawn from 7:30pm until 9:30pm mean solar time at the Equator. The sides are drawn parallel to the SWunset Terminator and generally extending from the Tropics of Capricorn to Cancer. The moment selected for the chart is that of:

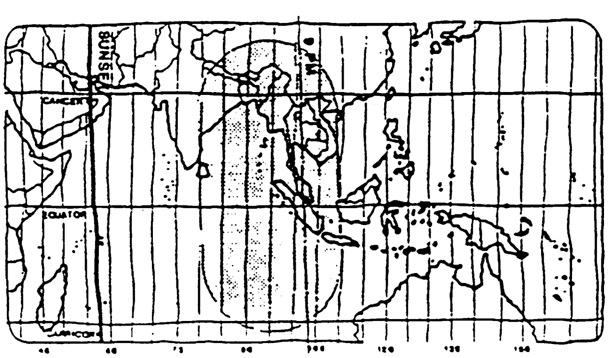
DAWN AT GROUND LEVEL in SEATTLE



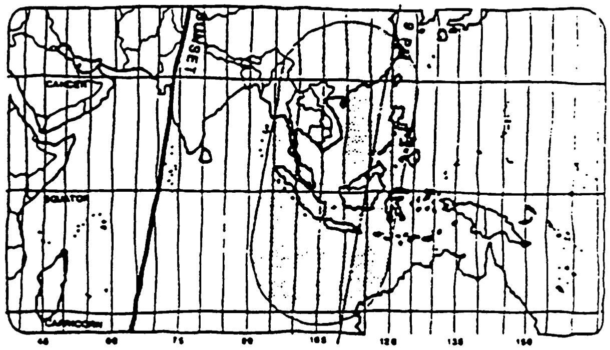
PACIFIC seattle 15 JANUARY 1553 UTC



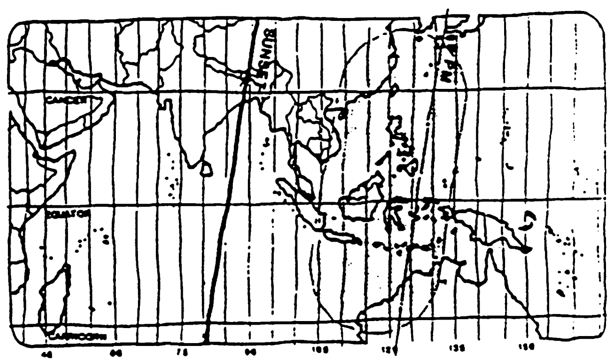
PACIFIC seattle 15 FEBRUARY 1515 UTC



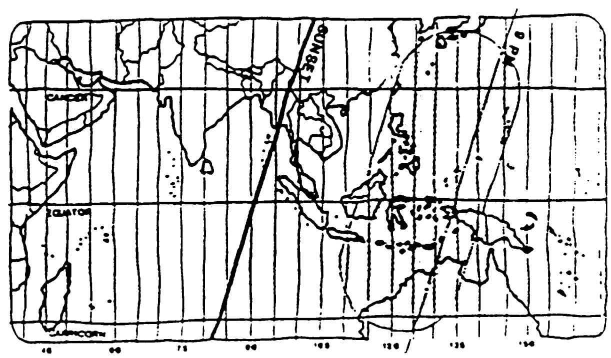
PACIFIC seattle 15 MARCH 1422 UTC



PACIFIC seattle 15 APRIL 1321 UTC



PACIFIC seattle 15 MAY 1232 UTC



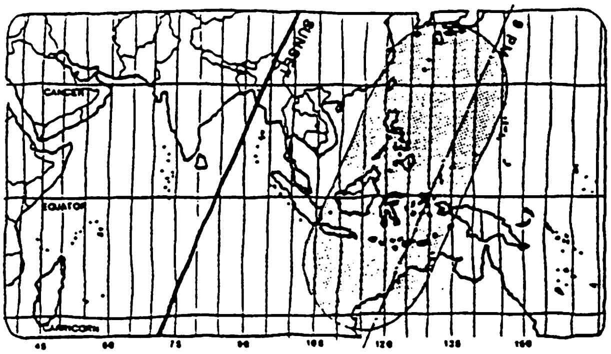
PACIFIC seattle 15 JUNE 1211 UTC

APPENDIX B
DAWN ENHANCEMENT SWEET SPOT CHARTS
for
WEST COAST NORTH AMERICA

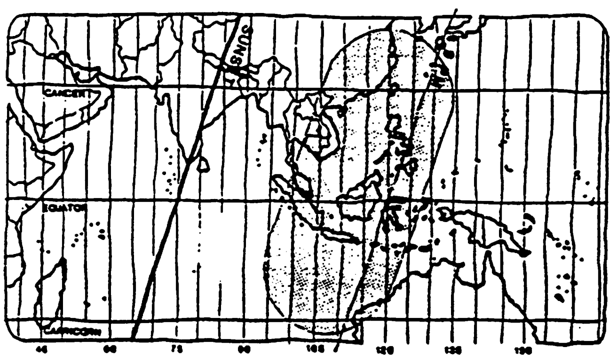
The moment selected for the chart is that of:

DAWN AT GROUND LEVEL in SEATTLE

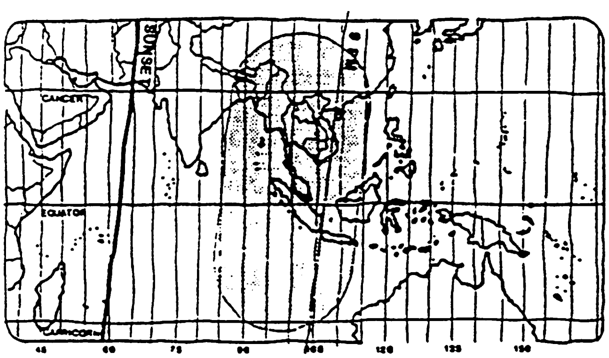
SUMMER



PACIFIC seattle 15 JULY 1227 UTC

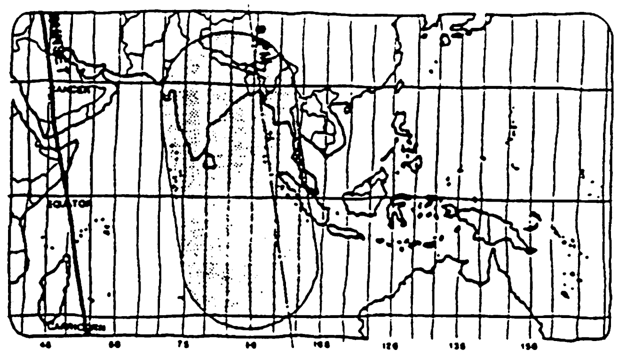


PACIFIC seattle 15 AUGUST 1305 UTC

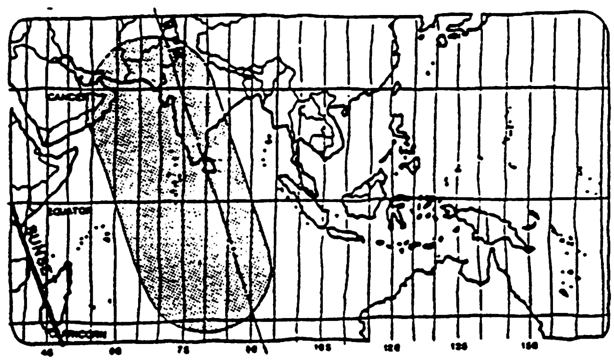


PACIFIC seattle 15 SEPTEMBER 1346 UTC

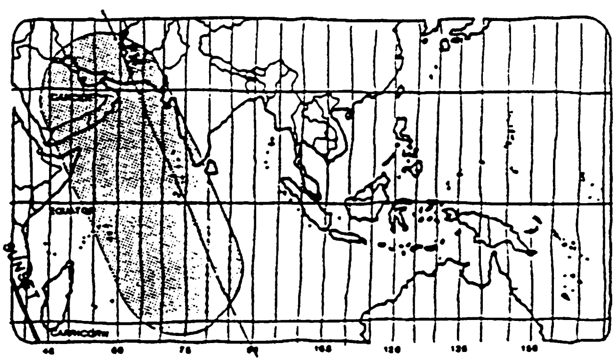
FALL



PACIFIC seattle 15 OCTOBER 1428 UTC



PACIFIC seattle 15 NOVEMBER 1514 UTC



PACIFIC seattle 15 DECEMBER 1551 UTC

LONG PATH AND SKEWED PATH PROPAGATION ON THE LOWER SHORTWAVE FREQUENCIES

Bill Tippett, WØZV

Before getting started on this article, I first would like to thank John Bryant for asking me to contribute to this issue of *Proceedings*. Since I am from the amateur radio ranks (WØZV) I was fascinated when I read a review of the 1989 *Proceedings* in our June 1990 issue of *QST*. I am mainly interested in low band DXing on the amateur bands (1.8 and 3.5 MHz) and thought I could learn from the experiences of the mediumwave and shortwave SWL communities. After reading and devouring the 1989 issue, I ordered the 1988 reprint as well as the 1990 issue, and began corresponding with John. One thing led to another and John asked me to contribute this article, which I am grateful to do in return for all the excellent articles I've read in previous *Proceedings*.

INTRODUCTION

I have been an amateur since 1957 when I first got my license at age 12. Most of my interests have been DXing on the higher amateur bands (14, 21 and 28 MHz) and I've worked all countries on our ARRL countries list except Albania. It shouldn't be long for that one the way their politics are going these days. Having worked almost everything on the higher bands, I started chasing DX on the 3.5 MHz band after I moved to a rural Colorado location in 1980. In October 1984, I put up a "temporary" antenna to operate on 1.8 MHz during a radio contest, and that was the beginning of my current love affair for what we hams call "Top Band." Currently, I have 293 ARRL countries on 3.5 MHz and 224 on 1.8 MHz, so you can see the extent of my addiction. By the way, my country totals on these frequencies equate to 204 and 140 respectively using the NASWA Countries List for reference.

Although I had been fairly successful on 3.5 MHz without using Beverages, I quickly discovered they were an absolute must to hear much of anything on 1.8 MHz. There was not much published on Beverages in those days, so I talked to anyone who had been using them to learn how to make them work. I put up my first crude one in December 1984 without a matching transformer. In August of 1985, I put up an array of seven Beverages (Figure 1) that were aimed at six population centers and one at 210 degrees for "Long Path" (more about that later). These were all properly terminated and ranged in length from approximately 600 to 800 feet. These lengths are over one wavelength on 1.8 MHz and are almost 3 wavelengths on 3.5 MHz. The directivity of these antennas (Figures 2A, 2B) really opens up a new world on the noisy low bands as anyone who has ever used one will attest. Incidentally, I have a 7 MHz rotatable Yagi up 148 feet and I find that the Beverages are at least comparable and often better than that antenna on the 7 MHz band. They are even usable up to 21 MHz, although Yagis are better on bands above 7 MHz.

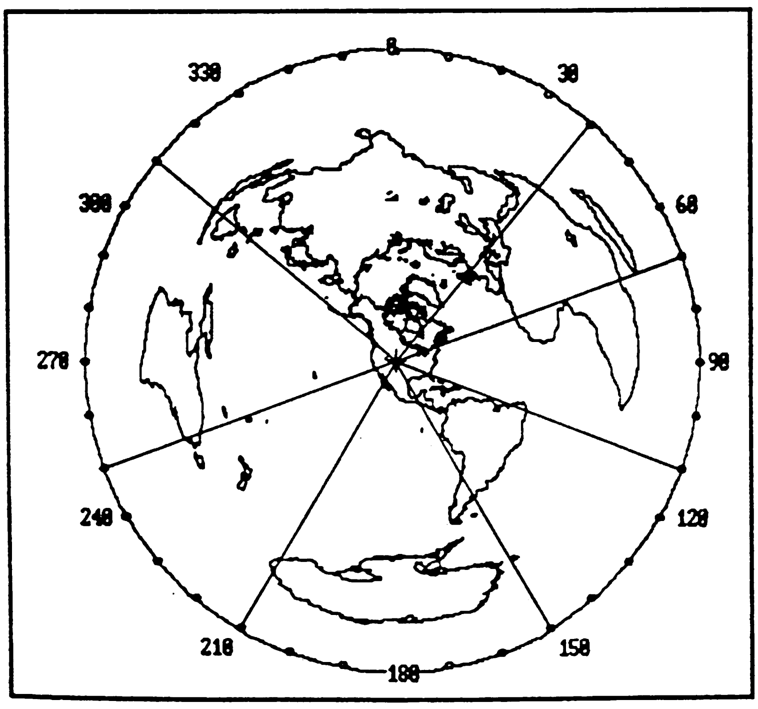


FIGURE 1. Great Circle chart showing orientation of WØZV Beverage antenna system. Map center is Berthoud, Colorado, USA. (From DX-Aid software.)

In reading the past *Proceedings* as well as a large compendium of articles on propagation which John Bryant loaned me, I was surprised to see very little mention of what we hams call "Long Path" propagation. Hence, John suggested that I write this article describing long path propagation on the low bands. Although this article is written from my perspective as a low band DXer on the amateur bands, my comments will generally apply to the 60, 90 and 120 meter shortwave bands.

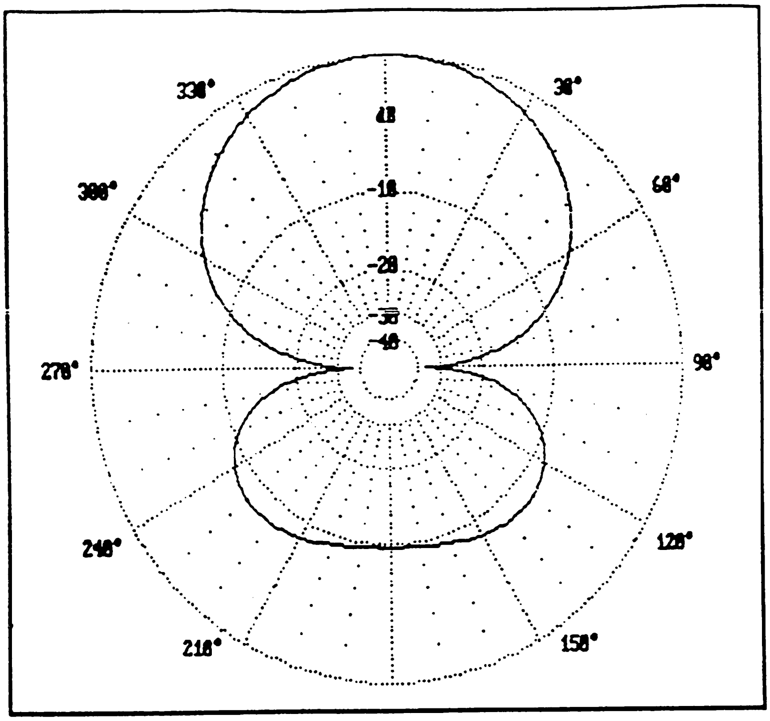


FIGURE 2A. Directive pattern of a terminated 1-wavelength Beverage antenna at 1.8 MHz. (From ELNEC Antenna Model software.)

LONG PATH PROPAGATION

Long path is a very well known phenomena on the amateur bands because most hams have rotatable Yagis on 14 MHz and higher frequencies, and can easily determine the optimum direction to receive any given signal. Given time and experience, most hams learn what direction to point their antennas at any given time of day for specific target locations. However, since many in the shortwave comunity may not have access to rotatable antennas, it may not be as well-known among shortwave circles. Simply put, there are occasions when radio signals will be propagated in a direction generally opposite to what the true Great Circle bearing is. These occasions are a function of time of day, date, and even the relative part of the sunspot cycle since all of these affect the state of the ionosphere.

Note that I said "*generally* opposite". In fact, the headings for maximum signal strength on long path are seldom exactly 180 degrees opposite to the Great Circle bearing between any two locations. Therefore, let me offer a definition of "Long Path" which is what amateurs generally mean when we use the term. *Long path is any path in which the signal is skewed by more than 90 degrees from its true Great Circle heading*. Sometimes it will be 180 degrees but often it will be less. The most common example of long path on the amateur bands is the morning path to Europe, the Middle East and Asia on 14 MHz. Both before and after local sunrise throughout North America, signals from Europe, etc. will be received by beaming approximately over New Zealand. The actual bearing is usually around 210 degrees for my location, but it's important to note that this is relatively constant whether the target area is Europe or Asia, even though the "true" 180 degree bearings for long path should be between 150 degrees and 210 degrees. For example, from my location, the direct heading for Bhutan is 346 degrees, the true (180 degree opposite) long path heading would be 166 degrees, yet the actual signal at my sunrise would be coming from about 210 degrees on the 14 MHz long path. Note that the 210 degree bearing from my location is basically oriented Southwest along my terminator during mid-winter sunrise.

This same path is also very common on 7 MHz, less so on 21 MHz and I have even seen it occasionally on 28 MHz. Thus it is not a complete surprise to us that it also exists on 3.5 MHz and even very rarely on 1.8 MHz (only one contact in my six-plus years of listening for it!)

There are also numerous other examples of long path on our higher bands. For example, working Australia by beaming east on winter afternoons on 7 and 14 MHz, Southeast Asia over South America on or after winter sunset on 7 and 14 Mhz, and even

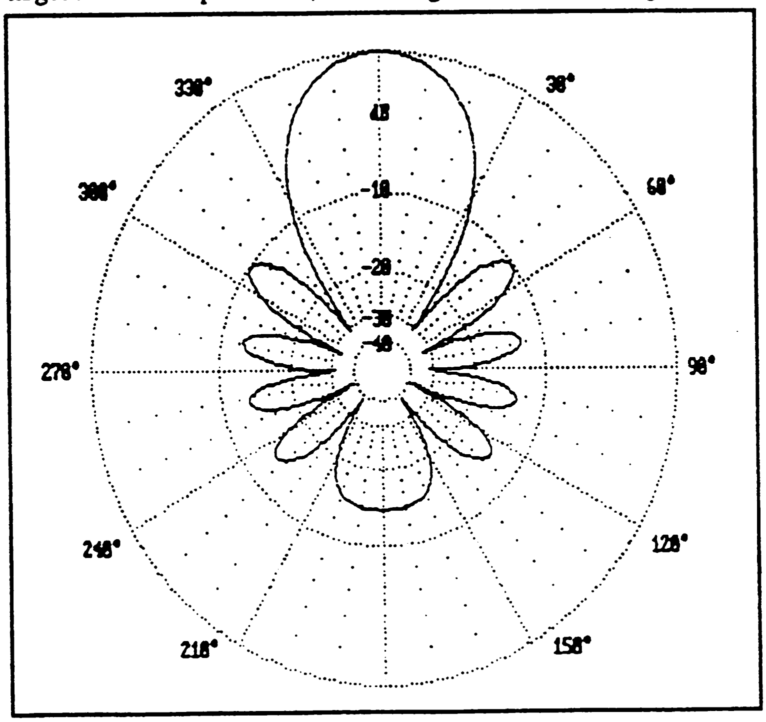


FIGURE 2B. Directive pattern of a terminated 3-wavelength Beverage antenna at 3.5 MHz. (From ELNEC Antenna Model software.)

Europe via New Zealand after local European sunrise or the Far East via South America after our local sunrise on 28 MHz. The examples mentioned for 7 MHz also exist on 3.5 MHz as we'll discuss later.

LONG PATH ON 3.5 MHZ AT USA SUNRISE

This is by far the most common long path phenomena on 3.5 MHz. It exists for stations from Boston to Seattle although it is probably most common for those of us in the western half of the USA. It also happens to be the most convenient for me because I am an early riser and am usually at home at this early hour. Such is not the case for my sunset when another long path exists, because I am usually at work long past local sunset. Incidentally, Dale Hoppe K6UA and Peter Dalton W6NLZ first described this phenomena on 3.5 MHz in their September 1975 *CQ Magazine* article titled "The Grey Line Method of DXing."

As on the higher bands, propagation is possible to Europe, the Middle East, Central and even Southeast Asia depending on the time of year. Refer to Figure 3 for a list of countries heard or worked from my location in Colorado. As observed on the higher band signals, the bearings for all target locations are relatively constant at about 210 degrees from my location. There are even a few rotary Yagis in the USA on 3.5 MHz (yes, they're huge!) and amateurs with these antennas confirm that the morning long path signals usually peak around 200 to 220 degrees, independent of the location at the target end of the long path.

The consistency of the long path signals at about 210 degrees is interesting. Although we cannot know the exact propagation path for certain, I have a premise which I will share for others to critique. As we all know, during our winter, there is an area of constant daylight over the South Pole. This area reaches a maximum at our winter solstice (December 21) covering everything from 67 degrees south latitude (the Antarctic Circle) to the South Pole. John Bryant described this area in his 1988 *Proceedings* article on Solar Blanking (Figure 4).

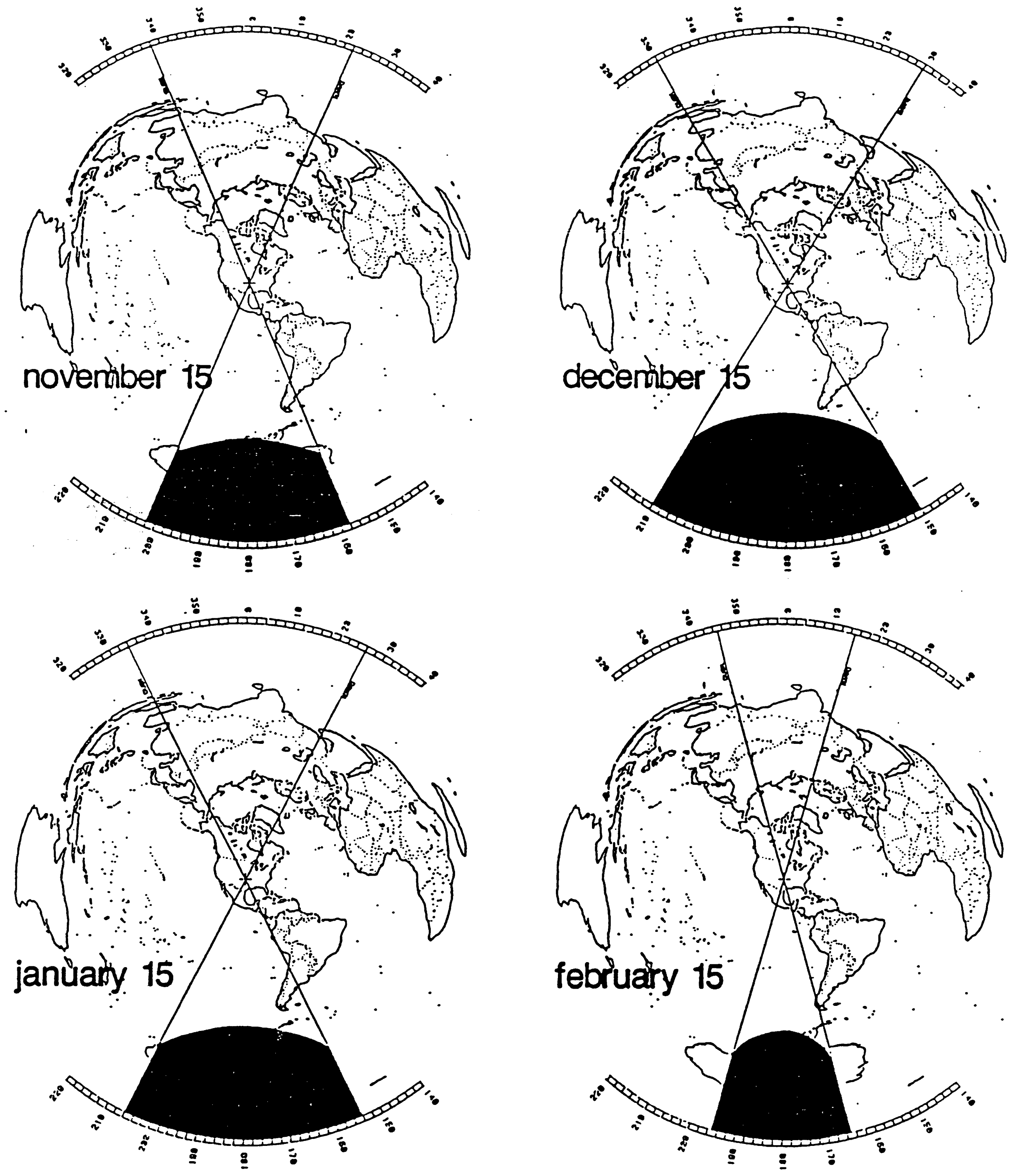
Although there is an area of continuous daylight and consequently high absorption, there is also an area of twilight or greyline tangent to its western edge at our local sunrise. My premise is that signals duct around this greyline area rather than propagating through the daylight area which signals would follow if they were following the true (180 degree) long path. I feel this explains the somewhat constant bearing of 210 degrees which is the bearing from my location to the western edge of the Antarctic Circle during midwinter. As you can see from John's great circle plots in Figure 4, this transition area is relatively constant at 195 to 210 degrees during the prime winter long path months of November through February. Although long path on 3.5 MHz exists from September to March (roughly but not exactly from the Fall to Spring Equinox period), it is most frequent from mid-November to mid-February. Also, I should mention that the resolution of a Beverage or Yagi is not enough to detect a change of a few degrees from the 210 degree bearing. My guess is that the signals actually track the greyline which is at the western edge of the solar blanking area but the change is too small for our antennas to detect.

How does one practically use this knowledge to hear rare and exotic DX? Through experience, I have found that sunrise long path propagation usually peaks about 20 minutes before local sunrise, although it also exists for more than two hours prior to and 30 minutes after local sunrise. It also seems to peak about 10-20 minutes past local sunset at the DX end of the path but can also last up to two hours past local sunset. Figure 5 illustrates several long path contacts to different target areas. The contact with RVØYF on 13 February is particularly interesting since it was almost two hours past his local sunset in Kyzyl, USSR, north of Mongolia, and more than one hour before my sunrise in Colorado. These rules of thumb are only approximate but I have found through experience that they generally apply to my location. As John Devoldere ON4UN has observed, the duration of the sunrise or sunset greyline is a function of your latitude. At the equator, openings will be much shorter than if you are at the Arctic Circle.

Let's assume I want to know the optimum time and date to hear Lahore, Pakistan on the long path. Using a sunrise/sunset table such as the one by John Devoldere shown in Figure 6, I want to determine dates which will yield approximately 30 minutes between the DX sunset time and my local sunrise

FIGURE 3. Countries heard or contacted at WØZV via sunrise long path on 3.5 MHz.

A4—Oman	UG—Armenia
A6—United Arab Emirates	UH—Turkoman
A7—Qatar	UI—Uzbek
A9—Bahrain	UJ—Tadzhik
AP—Pakistan	UL—Kazakh
BY—People's Rep. of China	UM—Kirghiz
EP—Iran	UO—Moldavia
FT8X—Kerguelen Island	UP—Lithuania
FR—Reunion Island	UQ—Latvia
HA—Hungary	UR—Estonia
HS—Thailand	VQ9—Chagos Islands, Diego Garcia
HZ—Saudi Arabia	VS6—Hong Kong
JT—Mongolia	VU—India
LA—Norway	VU4—Andaman Islands
OH—Finland	VU7—Laccadive Islands
OHØ—Aland Island	XU—Khmer Republic
OZ—Denmark	XW—Laos
SM—Sweden	3B8—Mauritius
UA—European USSR	3B9—Rodriguez Island
UA2—Kaliningrad	3W—Vietnam
UA9/Ø—Asiatic USSR	4S7—Sri Lanka
UB—Ukraine	8Q7—Maldive Islands
UC—Byelorussia	9N—Nepal
UD—Azerbaijan	
UF—Georgia	



mediumwave and tropical bands solar blanking study
centered on
stillwater, oklahoma

FIGURE 4. Mediumwave and tropical bands solar blanking study centered on Stillwater, Oklahoma. Reprinted from *Proceedings* 1988.

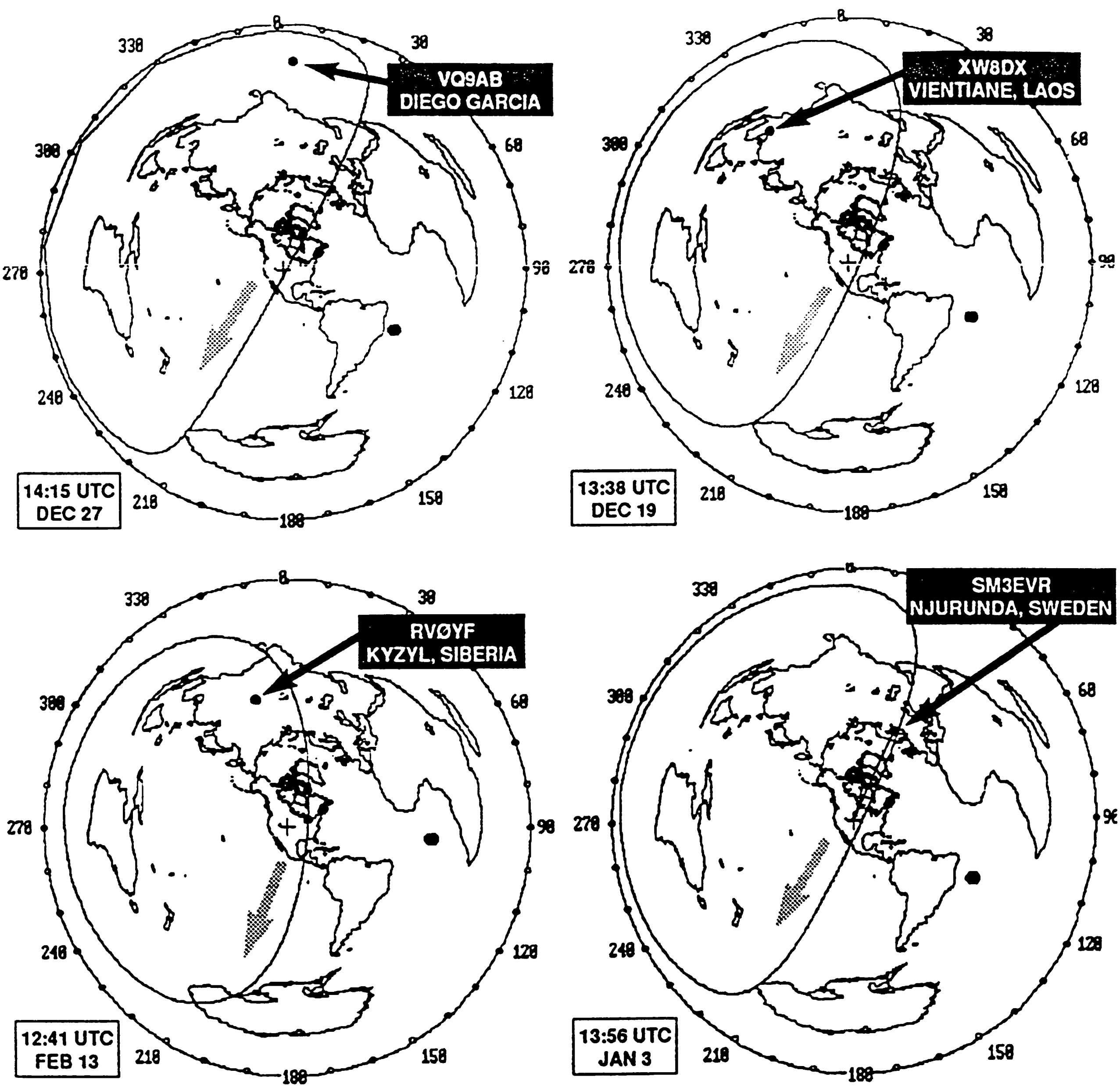


FIGURE 5. Sample Great Circle paths at WØZV sunrise. Maps are centered on Berthoud, Colorado, USA. (From DX-Aid Software.)

time. (There are also a number of software programs available which will allow you to compute these times, but be sure you check their accuracy against your own local sunrise and sunset; some are off by 15 minutes, which can be critical.) I see that on October 16, Lahore sunset is at 1231 UTC and my local sunrise is at 1311 UTC, a difference of 40 minutes. Based on this I would probably expect a peak around 1245 UTC and I would probably listen every day beginning October 1 since this propagation mode does not occur every day. Incidentally, you will notice another peak window around 1315 on March 1 when Lahore sunset is 1300 and local sunrise is 1333.

ON4UN has published a software program which computes all greyline possibilities (not just long path) for specific targets throughout the year. See Figure 7 for a sample printout. I have marked with an asterisk those paths which are typically via long path.

I have not discussed the signal strengths of these signals but they are usually fairly weak, hence the need for a good directional receiving antenna like a Beverage which is aimed in the right direction (210 degrees). It is not unusual, however, for signals to be a solid S7 during optimum conditions and I have even seen some at S9+10 dB during some exceptional openings. Keep in mind that these amateur stations are usually running less than 1 KW to simple antennas (often low dipoles, long wires, base loaded verticals, etc.)

As far as target geographies for this propagation mode, the maximum westward locations you can expect are determined by the location of the sunset terminator at the DX end at your local sunrise time on December 21. You can

-AP-			-WO-COLO-		
PAKISTAN		(LAHORE)	USA		(DENVER)
31.58 DEG.N.		-74.30 DEG.W.	39.73 DEG.N.		105.00 DEG.W.
DATE	SUNRISE	SUNSET	DATE	SUNRISE	SUNSET
JAN 1	02.02	12.10	JAN 1	14.21	23.46
JAN 16	02.03	12.22	JAN 16	14.19	00.01
FEB 1	01.56	12.37	FEB 1	14.08	00.19
FEB 16	01.44	12.50	FEB 16	13.51	00.37
MAR 1	01.31	13.00	MAR 1	13.33	00.51
MAR 16	01.12	13.11	MAR 16	13.10	01.07
APR 1	00.52	13.22	APR 1	12.44	01.24
APR 16	00.34	13.32	APR 16	12.21	01.39
MAY 1	00.18	13.42	MAY 1	12.01	01.54
MAY 16	00.06	13.52	MAY 16	11.45	02.08
JUN 1	23.59	14.02	JUN 1	11.34	02.22
JUN 16	23.57	14.09	JUN 16	11.31	02.30
JUL 1	00.01	14.12	JUL 1	11.35	02.32
JUL 16	00.08	14.09	JUL 16	11.45	02.27
AUG 1	00.18	14.00	AUG 1	11.59	02.14
AUG 16	00.27	13.47	AUG 16	12.12	01.57
SEP 1	00.38	13.28	SEP 1	12.28	01.32
SEP 16	00.47	13.09	SEP 16	12.42	01.08
OCT 1	00.56	12.49	OCT 1	12.56	00.44
OCT 16	01.06	12.31	OCT 16	13.11	00.20
NOV 1	01.18	12.15	NOV 1	13.28	23.59
NOV 16	01.31	12.04	NOV 16	13.45	23.44
DEC 1	01.44	11.59	DEC 1	14.02	23.36
DEC 16	01.56	12.02	DEC 16	14.15	23.37

FIGURE 6. Sunrise/Sunset for Denver, Colorado and Lahore, Palistan. (From ON4UN Sunrise/Sunset Tables.)

see an example of this for my location on the DX Edge shown in Figure 8. From here, Denmark, Hungary and Reunion Island are my most westerly contacts on long path. However, from Seattle, virtually all of Europe is possible. Practically speaking, the most easterly contacts are on a line approximately beginning around 330 degrees from my location.

For reasons I do not understand, approximately 330 degrees seems to be the transition between propagation by long path and direct path at sunrise in Colorado. For example Ulan Bator, Mongolia (339 degrees) Vientiane, Laos (331 degrees) Hong Kong (322 degrees) Irkutsk, USSR (342 degrees) have all been worked on both long and direct paths around local sunrise. They typically are barely audible on the direct path well before sunrise, then switch to long path peaking about 20 minutes before local sunrise, and then switch back to direct path after sunrise. There is seldom any deep fading on long path signals, even for these transition cases.

Almost 100 percent of my contacts to Central Asia and the Middle East have been via long path. From Colorado, we have very infrequent 3.5 MHz openings over the North Pole to these areas during our evening hours (sunrise at the DX end). Unfortunately long path is almost nonexistent on 1.8 MHz, and this almost exclusively accounts for the much lower country totals on that band.

I have not mentioned the incidence of long path propagation relative to the sunspot cycle. In general, it is better during sunspot maxima, although it seems to exist at varying probabilities throughout all stages of the cycle. The probability of long path is very difficult to predict based on solar activity indices, and there is just no substitute for consistent listening as all true blue low band DXers know. I suppose that is what really makes it exciting to get up and listen every morning!

As mentioned previously, the sunrise long path does exist for East Coast locations, but obviously they cannot penetrate nearly as far West because of the location of the sunset terminator at their sunrise. However, East Coast stations have another path which we will cover now.

YOUR LATITUDE IS 40.3 DEG. NORTH — YOUR LONGITUDE IS 105.15 DEG. WEST
TIME OF YEAR (MONTH/DAY) = 3 / 1
YOUR SUNRISE IS AT 13.34 UTC — YOUR SUNSET IS AT 00.52 UTC
GRAY LINE WIDTH IS 36 MINUTES. — MINIMUM TARGET DISTANCE IS 4000 KM.

PREFIX	COUNTRY	CITY	KM.	START	END	MIN/TARG
• 8Q	MALDIVE	MALE	15058	13.16	13.30	20
CE0A	EASTER ISL.		7505	13.16	13.20	20
CE9..9J	ANTARCT.	MIRNYY	16873	13.16	13.49	52
FB8Z	AMSTERDAM ISL.		19644	13.21	13.41	20
• JW	SVALBARD		6358	13.16	13.52	444
• OX	GREENLAND	THULE	4387	13.16	13.52	327
• UA	EUR. USSR	KAZAN	9055	13.44	13.52	64
• UA1	FRANZ JOSEF LAND		6469	13.16	13.52	1440
• UA9-0	AS. USSR	CELYABINSK	9317	13.16	13.52	62
• UH8	TURKOMAN	ASHKHABAD	11146	13.42	13.52	33
• UI8	UZBEK	TASHKENT	10913	13.16	13.31	37
• UJ8	TADZHIK	DUSANBE	11214	13.16	13.34	34
VK0	HEARD ISL.		18567	13.51	13.52	32
• VQ9	CHAGOS		16178	13.21	13.41	20
• VU	INDIA	BOMBAY	13412	13.16	13.24	20
• VU	INDIA	NEW DELHI	12341	13.16	13.20	24
• VU7	LACCADIVE ISL.		14408	13.16	13.28	20
• YA	AFGHANISTAN	KABUL	11669	13.16	13.33	29

FIGURE 7. Greyline table. (From ON4UN Greyline Software.) • = longpath.

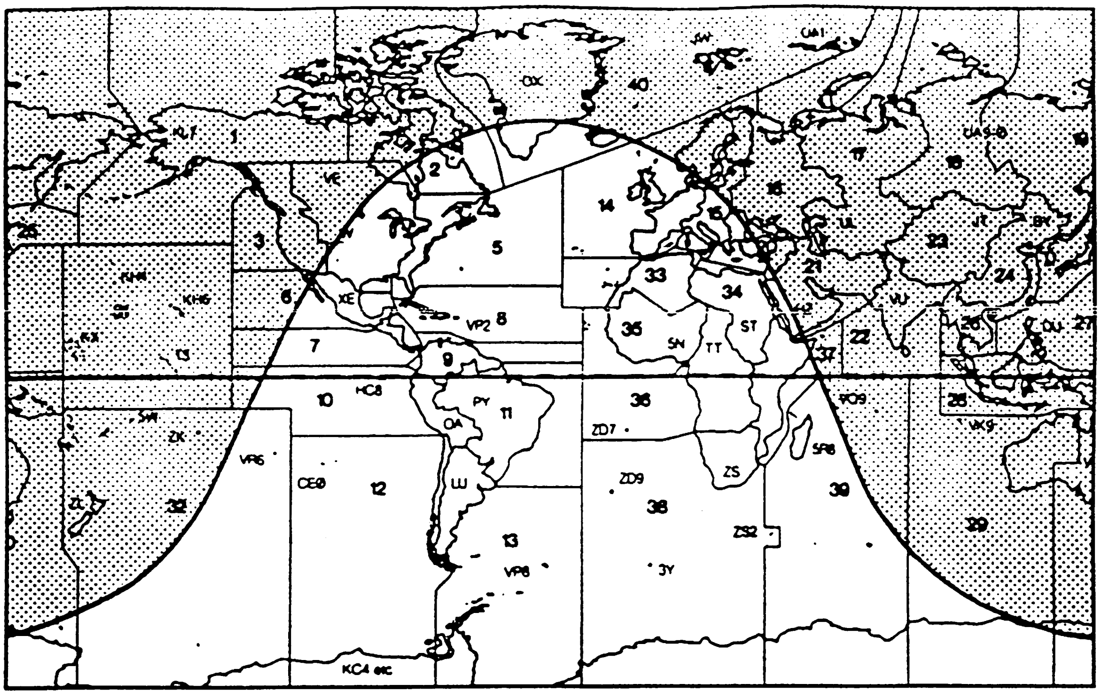


FIGURE 8.
DX Edge
Terminator on
December 15
at WØZV
sunrise.

LONG PATH ON 3.5 MHZ AT USA SUNSET

This path is one which is quite useful for stations on the East Coast. It allows propagation to the Far East, Indonesia and Southeast Asia by beaming Southeast. Although I have only made a few contacts on this path (to Diego Garcia, India and the Maldive Islands), I would speculate that the propagation path is similar to the morning path, i.e. via the eastern end of the solar blanking area at a bearing of about 150 degrees.

Bob Eshleman W4DR is the premier USA DXer on 3.5 MHz and I believe he is second worldwide only to John Devoldere ON4UN in 3.5 MHz country totals. He uses an array of four phased quarter wave verticals which he feels are comparable to Beverages in directivity. Since I am seldom at home during local sunset, Bob graciously supplied me records of his long path contacts at sunset from his location near Richmond, Virginia. See Figure 9 for samples of several long path contacts Bob made by beaming southeasterly over South America. Figure 10 illustrates the range of different countries logged by Bob.

Judging from the contacts Bob supplied me, I believe the same general rules apply as noted previously in my comments on the sunrise openings, i.e. the peak occurs after local sunset and before sunrise at the DX end. Incidentally, this path is probably what the stations in Europe and Asia experience when they are working me at my sunrise. They are beaming Southeast at their sunset.

John Kaufman W1FV, another preeminent 3.5 MHz DXer from Maynard, Massachusetts, read an earlier draft of this article and added several interesting observations. "In general, my own experiences with long/skew path propagation appear to closely parallel yours. From the Boston area, the sunrise long path is best during the peak of the cycle, with openings to Siberian USSR from the Southwest being most common. During low sunspot years, however, it is my experience that the morning long path disappears almost completely. In general, the openings last no more than 10 or 15 minutes, peaking just before sunrise. Those openings which persist after sunrise often skew fron Southwest to Northwest after the sun comes up. On the other hand, the sunset long path opens most frequently during sunspot cycle troughs, with Japan, Far Eastern USSR and Perth, Australia being most common."

John adds "I agree completely with your statement that the Beverages really open up a new world on the low bands. (He has two dual-wire switchable 450 footers aimed at NE, SE, SW and NW). Many DXers have commented on my consistently hearing and working the long path. You really ought to emphasize that the long path on the low bands is a marginal (but exciting) mode of propagation and that a low dipole or random wire simply won't hack it." I don't completely agree with John's last comment for some of the openings I've observed from Colorado, but I value his observations for the Northeast.

LONG PATH ON 1.8 MHZ

Unfortunately, this will be a very short discussion because long path is extremely rare on 1.8 MHz. I have only made one contact with UA9UCO in Prokopyevsk, Siberian USSR, in 6 years of active listening (Figure 11). I first began hearing this station on September 12-14 at my sunrise. He could not hear me then and I speculate that it was because of high thunderstorm static over Southeast Asia at that time of year. We finally made two-way contact

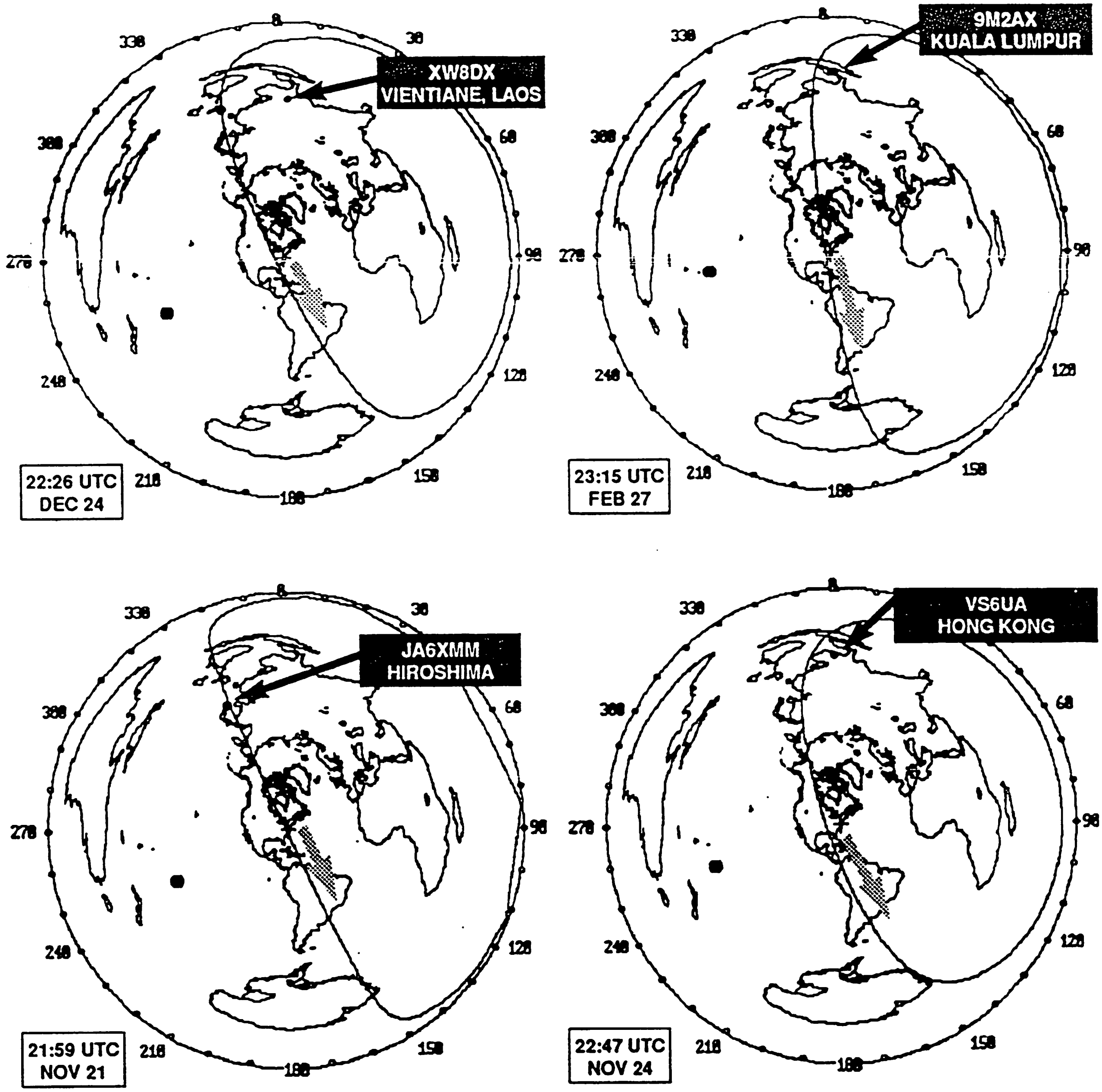


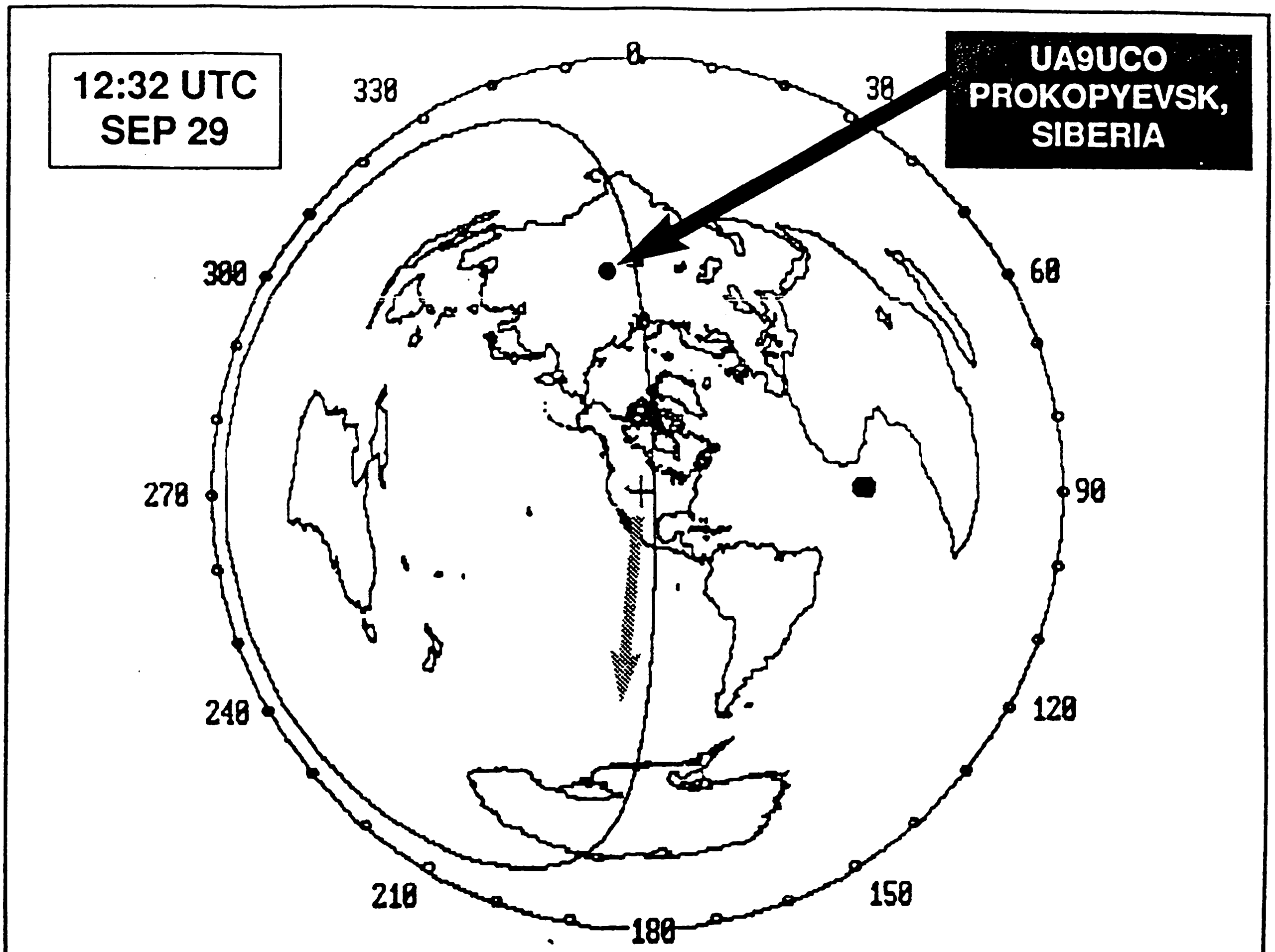
FIGURE 9. Sample Great Circle paths at W4DR Sunset. Maps are centered on Richmond, Virginia, USA. (From DX-Aid software.)

on September 29 about halfway between his sunset and my sunrise which were then almost exactly 1 hour apart. I have listened many times for long path during our winter but have never heard a whisper. I can only speculate that the ionosperic absorption over the Southern hemisphere is just too great to allow long path propagation during our winter. However, it may be that during the Equinox (when I contacted UA9UCO in Siberia) the absorption between the two hemispheres was equalized allowing a short window for long path propagation at this time of year.

John Kaufman W1FV adds, "I have heard 9M2AX (West Malaysia) long path at sunset on 1.8 MHz and he has been worked by others in the Northeast. Hong Kong has been heard long path in New England and Indonesia has been worked, I believe. Perth, Australia has been worked at sunset and there have been rumors of long path Japanese stations being heard, but I can't confirm those. I am not aware of any sunrise long path openings from the East Coast."

FIGURE 10. Countries heard or contacted at W4DR via sunset long path on 3.5 MHz.

JA—Japan
JT—Mongolia
VK—Australia
VK9X—Christmas Island
VK9Y—Cocos-Keeling Island
VS6—Hong Kong
VU4—Andaman Islands
XW—Laos
YB—Indonesia
3W—Vietnam
9M2—West Malaysia
9M6/8—East Malaysia
9V—Singapore



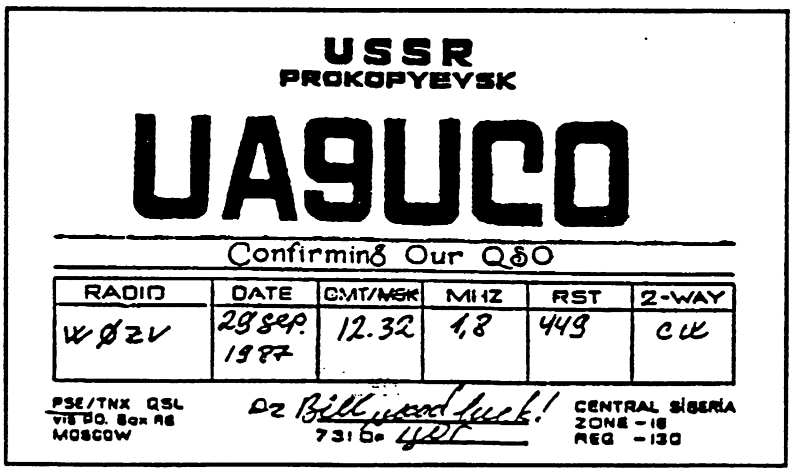


FIGURE 11. Great Circle path to UA9UCO (Prokopyevsk, USSR) for WØZV long path contact on 1.8 MHz, and resulting QSL.

SKEW PATHS ON 3.5 AND 1.8 MHZ

Let me first define what I mean by "Skew Path." *Skew path is any path in which the signal is skewed by less than 90 degrees from its true Great Circle bearing.* This is a completely different phenomena from the Long Path discussed above. I feel it is caused primarily by auroral disturbances when the signal must avoid or "skirt" the auroral zone. Typically I observe this as follows: From Colorado, my 40 degree Beverage is usually optimum for receiving Europe during our evening hours. However, when the geomagnetic field is disturbed (WWV A-index greater than 10), the European signals often peak stronger at 70 degrees than 40 degrees. East Coast stations usually observe the same effect when working Japan during their morning hours. Rather than coming via their direct heading (about 330 degrees from New England), signals are skewed south, but not as far south as long path signals. The greater the disturbance, the greater the skew. For instance, I once worked Sweden on 1.8 MHz during a severe ionospheric disturbance (A-index was 103) with signals peaking on my 110 degree Beverage even though the direct bearing from Colorado is 27

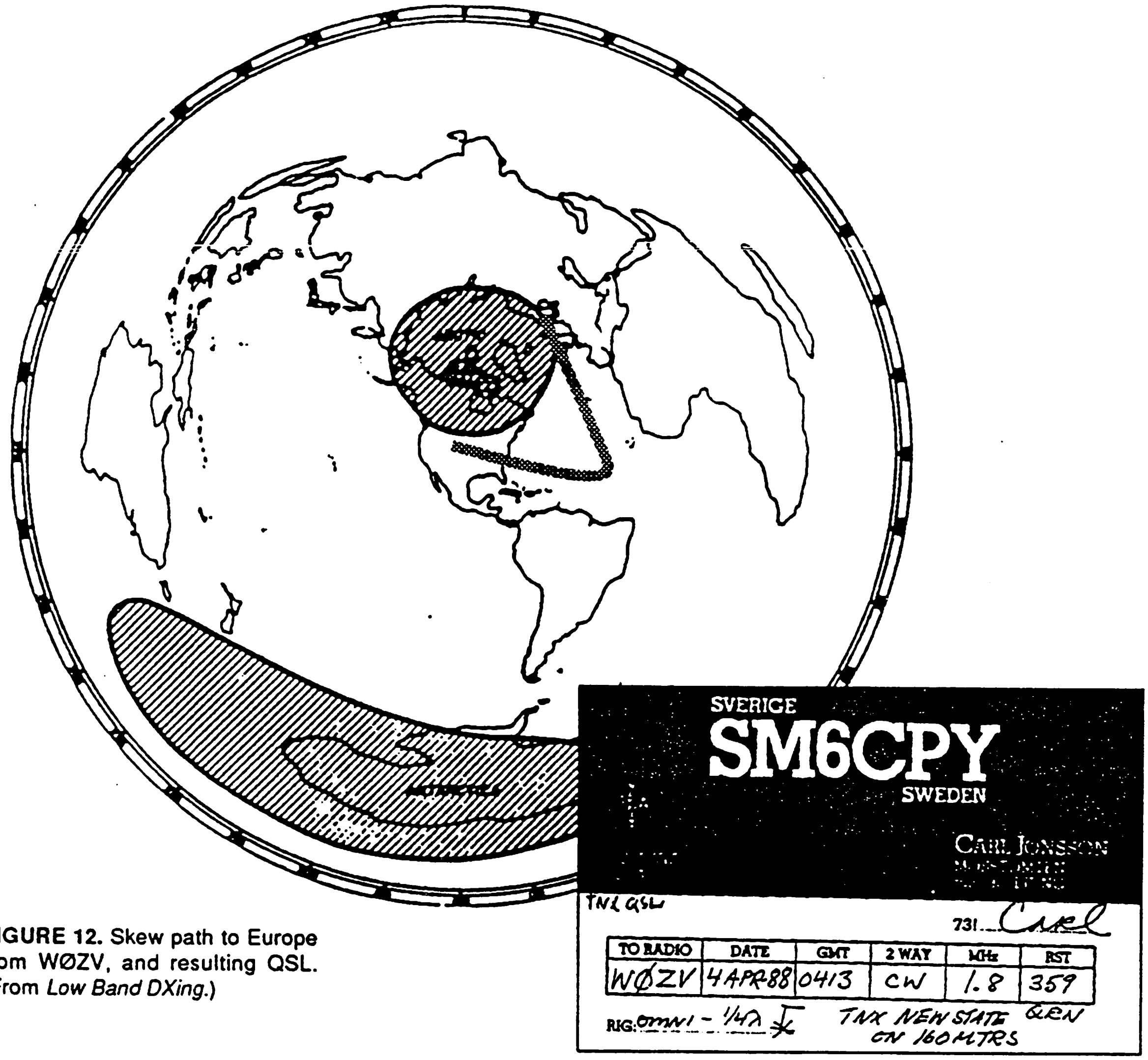


FIGURE 12. Skew path to Europe from WØZV, and resulting QSL. (From *Low Band DXing.*)

degrees! The Swedish station confirmed that he was receiving me over South America (see Figure 12).

Conversely, I have never observed signals from Japan skewed South and East Coast stations seldom observe European signals skewed South. I believe the reason for this is the relative location of the magnetic North Pole. From Colorado, it is at a bearing of 13 degrees, so the auroral zone interferes with Europe but not Japan. The converse is true for stations in New England since Magnetic North for them is about 350 degrees.

CONCLUDING REMARKS

I hope this article has been of some help to all of you whether you are from the mediumwave, shortwave or amateur communities. I feel we all have a lot of common experiences and interests which we can share with each other. Good luck on the low bands—the home of a dedicated group of radio DXers!

antennas

THE WAVE ('BEVERAGE') ANTENNA
DESIGN AND OPERATION

Bob Eldridge, VE7BS

INTRODUCTION

Much has been written about the Wave Antenna, usually called the 'Beverage' after Dr. H.H. Beverage, who developed it operationally at Riverhead, Long Island for RCA's transatlantic radiotelegraphy service and described it in *QST* in 1922 [1]. Paul Godley used one on his famous receiving DXpedition to Ardrossan, Scotland in 1921.

For those who have the space to accommodate it, the Beverage is ideal for reception of signals from the lowest frequencies used for radio, through the low and medium frequency broadcasting and the Tropical bands to about 7 MHz. Beverages have been used to 30 MHz [17] but it becomes debatable where an antenna ceases to be a Beverage and becomes a terminated longwire.

It has useful directivity, responds to signals arriving from both very low and quite high angles, is famous for a high signal-to-noise ratio, works well over poor soil, and is relatively easy to construct. Being so close to ground it is inefficient, but for reception this is no problem. The all-important factor in reception is signal-to-noise ratio, and the most useful thing about the Beverage is that it attenuates the noise more than it attenuates the signal.

Inevitably, some of the statements made about it over the years are questionable, some are just plain *wrong*,and as a result some myths have arisen (like "the longer the better"). The assignment for this article is to answer two questions:

1. How sanitary do the design and construction have to be for it to work?
2. How sanitary do they have to be for it to work *well?*

This article dwells on the fundamentals of the design and operation. It is not intended to be a stand-alone guide to the construction of broadband transformers and phasing modules. But references are given that do include such information.

I saw a Beverage for the first time about 1937 at a BBC receiving station in southern England. I still remember the awesome change in signal quality as the operator switched from antenna to antenna while receiving a Swiss MW broadcasting station. A few years later I built one for a special purpose while serving in the RAF, and it performed just as well or better on frequencies around 4 MHz. I have been a believer ever since, and specializing in 160 metre operation, have played with and used several kinds of Beverages—long, short and steerable.

Most of the information here is derived from the advice of people much more knowledgeable than I am. I have tried to keep it simple. If you want to dig into the matter, beg, borrow or steal some of the documents listed at the end of the article. But be prepared for some heavy and sometimes conflicting reading. Remember that the man with one watch thinks he knows what the time is, but the man with three watches is never quite sure. Experts sometimes differ, and the deeper you get into it, the more complex it seems. If you want just one source of theoretical and practical information on the subject, make it Vic Misek's *Beverage Antenna Handbook* [2].

WHAT THE BEVERAGE IS AND HOW IT WORKS

John Hines of Ohio State [3] described the Beverage as:

"...a long transmission line...also called the wave antenna. In its very simplest form...a single straight horizontal wire a few feet above grade level, the length being anywhere from one to several wavelengths. The characteristic impedance of this wire unbalanced to ground is roughly calculable by using the image in the ground as the second conductor in a parallel-wire system. The receiver is coupled in at one end of the line, and the other end is terminated in a resistance equal to the characteristic impedance. Stable ground systems are necessary at both ends."

His explanation of the way it works:

"The long open-wire transmission line pointed in the direction of a passing wave has a high degree of exposure to the horizontal component of the wavefront because of the wave tilt that earth losses produce in vertically polarized low-frequency waves travelling along the surface of the earth. This induces in the line a continuous series of emfs that are propagated along the wires in the form of a travelling wave. A passing wave sets up a travelling wave in the wire which starts at the distant end...and is propagated toward the end where the receiver is situated....The entire wire receives energy from the passing wave so the effects are cumulative at the receiver. Energy collected from a passing wave travelling in the opposite direction is ... dissipated in the terminating resistor so does not enter the receiver. Waves arriving from the side have comparatively little effect, hence the antenna has high directivity in the horizontal plane."

In 1986-87 VE7CRU and K7VIC tried some experiments at their respective locations (S-E British Columbia and northern Montana), with long straight wires on the ground and with some elevated a few feet. Results were difficult to analyze, so they asked Dr. Beverage for advice. He responded with some basic concepts and information [4].

Notes from Dr. Beverage:

The best length is one wavelength. A longer one may exhibit less attenuation of signal, but it will develop sidelobes and lose directivity. A shorter one will work somewhat, but will attenuate the signal more than necessary. The far end should be terminated with a resistor of about 500/600 ohms for a unidirectional pattern. A terminal ground system consisting of six 15' radials is usually sufficient. Height is not critical—5' to 10' above ground is OK. It should be as straight as possible, both horizontally and vertically. It is not imperative that it be on flat ground. It can be built up a mountainside as long as it is reasonably straight and points at the skyline.

In a letter to *QST* in December 1981, Dr. Beverage said: "With antennas more than two wavelengths long, there may be sufficient phase lag, such that the signal strength will actually decrease with an increase in the antenna length." In fact he called it the 'Wave Antenna' because it worked best when it was one wave long.

ESSENTIAL ELEMENTS

Each factor to be considered in the design of a Beverage is covered in turn. There is some repetition when there is interaction between factors, to make each discussion as complete as possible.

- **LENGTH** of the horizontal wire(s) determines the directivity, and to some extent the gain.
- **STRAIGHTNESS OF THE WIRE** affects the gain, the useful length, the stray pickup of vertically polarized signals.
- **TERMINATION** at the far end from the receiver makes the antenna unidirectional and operable on a broad band of frequencies.
- **HEIGHT** of the wire above ground affects the efficiency, the response to signals from all directions, the impedance.
- **ANTENNA LAID ON THE EARTH** is surprisingly effective, and could sometimes be the best way to do it.
- **GROUND CONDUCTIVITY** affects the gain and the stability.
- **COUPLING TO THE RECEIVER** has to include matching the antenna to the receiver and providing near-end termination to minimize back and forth reflection of signal currents.
- **LOCATION / ENVIRONMENT** includes consideration of the supports and nearby metal objects and wire fences.
- **DIRECTIVITY PATTERNS** are not so narrow and 'clean' as many believe they are.
- **THE TWO-WIRE BEVERAGE** has reversible directivity.
- **STEERING THE NULLS** in the directive pattern is possible.

We will first deal with the form shown in Figure 1, a single wire terminated at the far end with a resistor equal to the characteristic impedance of the wire. At the beginning of Hines' definition we run into a statement that needs some discussion: "length anywhere from one to several wavelengths". (In the comparisons that follow, you may wish to make a table of advantages and disadvantages, according to your own specific requirements and value judgments.)

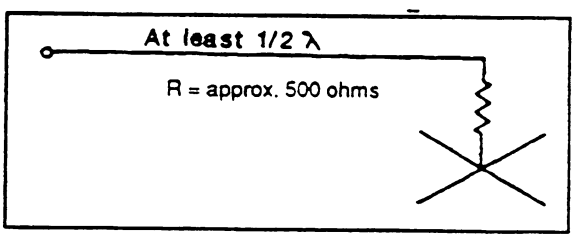


Figure 1.

LENGTH:

(1) When the antenna is terminated with a resistance equivalent to its characteristic impedance, it is aperiodic (not resonant), so no exactitude in length is necessary. An increase or decrease of 10% will not be noticeable at the receiver. But if you need an absolutely maximum front-to-back ratio, there are specific lengths that will achieve it. Misek suggests 1.6 to 1.7 wavelengths for 1.8 - 7.3 MHz and .53 to .56 wavelengths for the medium wave broadcasting band [1].

(2) For general purposes, about one wavelength long is the optimum for amateur or SWL purposes, if other essentials (straightness, wire gauge, isolation from parallel conductors for example) can be achieved.

A "one wavelength long" Beverage will be physically shorter than one wavelength calculated from the frequency of design, because the signal will travel more slowly along the wire than it does in free space. The ratio between the two speeds is termed the "velocity factor", expressed as a percentage or as a decimal fraction. 90% or .9 means the antenna thinks the wire is 100' long when it is actually 90'. The 100' may be referred to as the 'electrical length' and the 90' as the 'physical length'.

For a one wavelength Beverage, best directive properties are obtained with a velocity factor of 70-80% [5].

(3) If it is much shorter than one wavelength:

a) less signal voltage is developed at the receiver;
b) the main lobe is broader;
c) it responds to higher vertical angles of arrival;
d) there are less secondary lobes off to the side, so in this respect directivity is better;
e) Unless special measures are taken, the shortest practical length is about half a wavelength.

(4) If it is much longer than one wavelength:

a) the main (straight ahead) lobe is narrower;
b) it responds to lower angles of arrival straight ahead;
c) the longer it is, the more secondary lobes appear (vertically as well as horizontally);
d) there comes a length, depending on the velocity factor of the particular antenna, where the signals travelling along the wire and those arriving from space cease to add in phase, and signal strength at the receiver input drops in amplitude.

(5) I have seen designs aimed at optimizing a Beverage on several frequency bands, using traps and relays for selection of different lengths, but they seem very complex. It seems to me the soundest approach would be to make it about two wavelengths long at the highest frequency and settle for it being shorter than optimum at the lowest. But my personal bias shows through here. I firmly believe too short is better than too long. And I believe the simpler the better.

(6) An interesting idea for a multi-length antenna was described by WB3GCG [19]. It has the advantage that it is also reversible in direction, but there are many hundreds of feet of coaxial cable.

There is a 'grazing length' [6] defined as the length required for the induced current in the wire to reach a maximum. With a wave antenna several wavelengths long there is a broad ripple of current at half wavelength intervals. With an antenna longer than the grazing length the current settles down to a mean value somewhat less than the maximum amplitude of the ripple. The directivity pattern changes but there is no increase in gain. Knowing the grazing length helps keep the antenna length down to the length necessary to achieve maximum signal at the receiver.

At lower frequencies (say 1 MHz) the grazing length reduces by a factor of two for each 10 times decrease in ground conductivity. At higher frequencies (say 5 MHz) the grazing length tends to be proportional to the distance the wire is from the ground.

(5) If the antenna is left unterminated at the far end, avoid any length that is an odd multiple of a quarter wave. An unterminated transmission line of this length looks like a very low impedance at the near end—incidentally this applies to the random-length coaxial 'snake' antenna, and may explain why the 'snake' works for some and not for others.

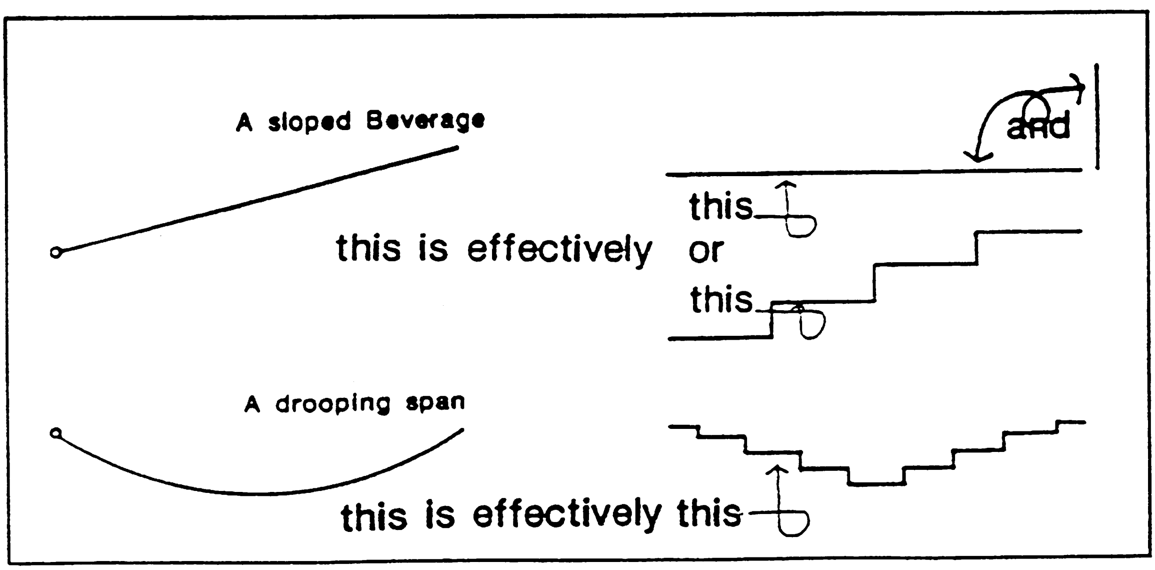


FIGURE 2.

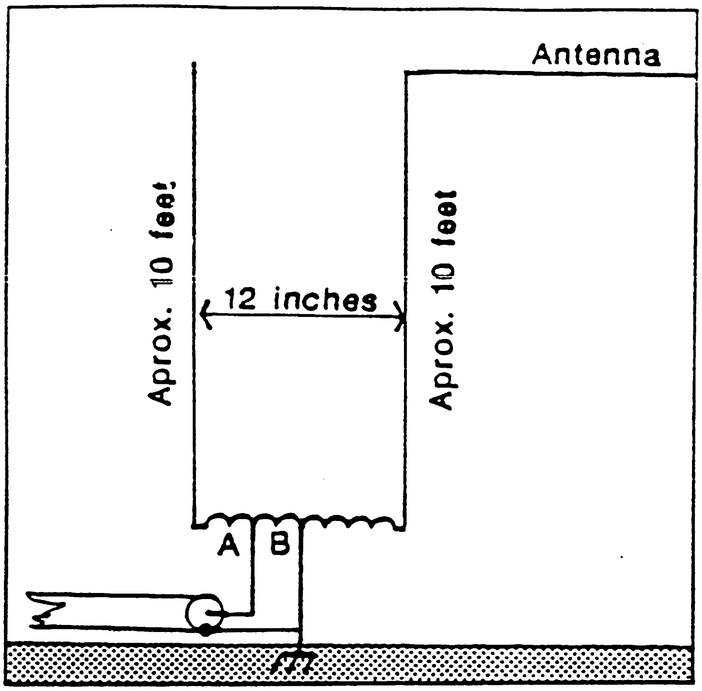


FIGURE 3. Broadband transformer suitable for frequency of interest.

STRAIGHTNESS OF THE WIRE

The wire should be as straight as possible *both horizontally and vertically*. There are several reasons for this:

(1) Current builds up best when the signal travelling along the wire keeps pace with the wavefront travelling in space. Any wiggle in the wire causes it to lag behind, because it has further to go on the wire while it travels straight in space. This is the main disadvantage of wiggle, as it also limits the length of wire usable before the signal on the wire begins to antiphase itself. As long as the wire keeps going in a constant average direction, the wiggles do not have much direct effect on the directivity;

(2) Any sag in the spans between supports not only makes the wire physically longer, it also introduces an effective vertical element. A sloping wire can be represented as two separate and shorter wires, one vertical and the other horizontal (see Figure 2). In the case of the antenna we are considering, any effectively vertical element will pick up signals from all directions, filling in nulls in the pattern. The most serious case would be strong local broadcasting stations off to the side, as they use vertical polarization, and the Beverage responds mainly to horizontally polarized signals coming in from the side. Three or four feet of total sag begins to act like the vertical whip antenna on an automobile.

(3) Don't run the wire up over bumps and down through gullies—keep it straight. A pole in a gully should be longer, and one on a bump shorter, keeping the wire straight.

(4) With the wire several feet above the ground and the terminating resistor connected to a ground system, there is bound to be an effectively vertical connection. Instead of having a vertical wire at the end of the antenna, a popular way of solving the dilemma is to taper each end of the wire with a slope of about 10 degrees from antenna level to ground level [1]. The effective vertical component is still present, but at least it is distributed over a distance. If it is not possible to slope the wire, the vertical pickup can be neutralized, as in Figure 3. It is also possible to terminate the antenna with a resistor plus an extra quarter wavelength of wire left open at the far end, thus doing away with the downlead altogether [2] [15];

(5) If you have to go round something, do it as in Figure 4, to ensure that signals induced in the diversion wires cancel out as much as possible.

For minimum sag on an elevated wire, the wire should be light and strong. For a receiving antenna, a high signal-to-noise ratio is the objective, so efficiency is not very important. Galvanized electric fence wire has been used for many Beverages and can be pulled very tight without stretching. There is no sag if you lay the wire directly on flat ground!

ANTENNA LAID ON THE EARTH

K7VIC found that a long straight insulated wire on the ground worked quite well on 1.8 MHz, and that when on the ground a wire unterminated at the far end acted almost as if it were terminated. John Bryant found that in a quiet environment, wire 'Onna Bush' had rather better gain and directivity than one laid on the ground [7]. Don Moman found that a wire on the ground had worthwhile rejection of local (15-30 km) broadcasting stations while leaving medium wave DX stations cleaner and of about the same strength as those from an elevated wire. A wire on the ground has the advantage that there is no effective vertical component, because there is no downlead to the far-end ground.

Arch Doty K8CFU [8] built two identi-

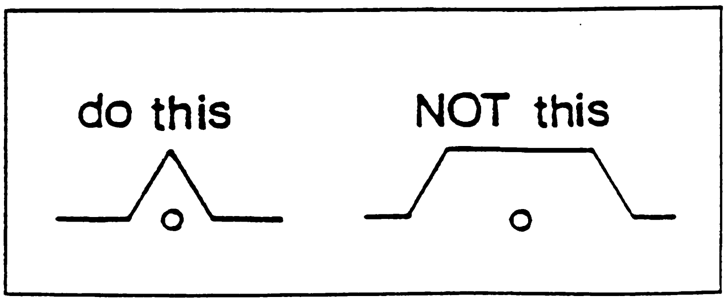


FIGURE 4.

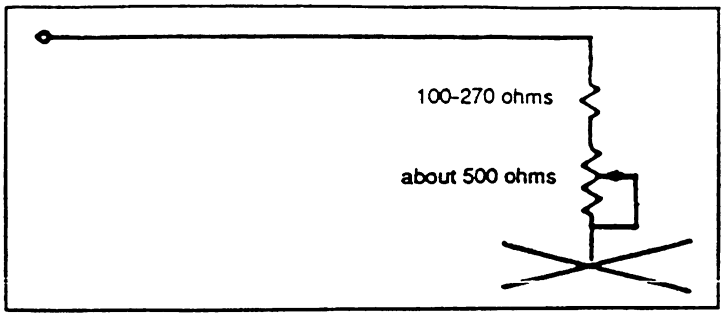


FIGURE 5.

cal 700' antennas, one 7' above the ground and the other lying on the surface (his ground conductivity is about 0.75 to 2.5 millisiemens/meter). In 500 comparisons on their performance, he could find no consistent difference between them.

Much depends on where you are and what you want to receive, but without doubt there is a lot to be said for laying the wire on the ground. And that's how Beverage started at Riverhead.

TERMINATION

The antenna should be terminated *at both ends* with something (a transformer or a resistor) equal to its characteristic impedance to prevent or at least minimize a standing wave on the wire.

(1) The termination at the receiving end is normally the transformer matching the antenna to the receiver (and of course a good match here ensures good signal transfer to the receiver input). If the match is not good, some of the signal energy will be reflected back along the wire. More about the transformer later, in the section on 'coupling to the receiver'.

(2) At the end distant from the receiver a non-inductive resistor equal to the characteristic impedance of the antenna system will dissipate most of the energy arriving from the 'back' end, an essential factor in creating a unidirectional pattern. If the far end is left open, reception from the rear will be almost as good as that from the front, and the gain in the forward direction will be as good as ever. If you are always using the antenna for signals from the west at dawn, this is quite a satisfactory arrangement.

(3) There is another benefit from termination. It ensures the antenna is not resonant at any specific frequency and makes it operate as a true travelling wave antenna. This is not the place to discuss the impedance transformation effect of a length of transmission line, but this aspect deserves some thought. The Beverage is in many respects like a transmission line.

The value of the terminating resistor is dependent upon many things. The gauge of the wire, the material and thickness of any insulating covering, the height above ground, the nature of the ground, the quality of the insulators for example. There are hundreds of Beverages with resistors of a guesstimated value between about 450 ohms for a low wire and about 600 ohms for a high wire (like 19 gauge wire 10 feet above ground). If you are not a purist these values are as good as any. Things change somewhat with a heavy shower of rain anyway. But if you want to establish the correct value, there are several ways to do so.

Remember that the terminating resistor is in series with the far end grounding system, so organize the grounding system first! If you use six or so 15' radials connected to a 2' ground rod there will probably be a few tens of ohms effectively in series with the resistor. Making the ground rod longer will not reduce the resistance of the ground connection very much. 8' and 10' rods are excellent for safety grounds, but are not necessary for r-f purposes. Also they may pick up some signal and harm the directivity, especially if the soil conductivity is poor. Underground antennas do work.

Connect a fixed composition resistor of about 100 to 270 ohms to the far end of the antenna, in series with a variable composition resistor of about 500 ohms, as shown in Figure 5. If for some reason (animals or people for example) you cannot slope the end of the antenna gradually to the termination, position the resistors at the antenna rather than at the ground, although for finding the best value it should make no difference.

The simplest method is to listen to a signal coming from the rear and adjust the variable resistor for minimum signal strength. A friend at the far end with a handie-talkie or a cordless telephone is very useful. If there is no convenient signal from the rear you can produce one. We did it once using an idling automobile with unsuppressed ignition!

MFJ Enterprises produce a very useful self-contained SWR (standing wave ratio) Analyzer (Model 207 for 10-160 metres, probably quite easily modified to cover the MW band). You could put this in place of the receiver and adjust the resistor for best SWR at the frequencies you are interested in.

Vic Misek [2] describes how to inject a signal into the antenna from a signal generator and adjust the resistor for maximum damping effect on the standing wave produced on the wire ('smoothing out' the change of signal voltage on the wire as the generator frequency is varied).

The classic article written by H.H. Beverage in 1922 [1] was reprinted with minor changes in *QST* in 1982 [10] and in its entirety in the book *Genius at Riverhead* [20]. It has a detailed description of antenna current measurements with and without terminating resistors, with plots of the change as the generator frequency is varied. It also shows a method of neutralizing the effective vertical element pickup, termed 'end effect'. This article is essential for anyone interested in the history of the antenna, and it shows how the original concept has carried through almost unchanged to the present day.

The required value of terminating resistor varies with frequency. On an antenna 360' long and 4' high the value varied between 400 and 550 ohms over a range from 2 to 10 MHz [17].

HEIGHT

There is little advantage in having the wire higher than 10 feet above the average level of the ground. Higher wire develops more signal, but not very much more. Increasing the height by 10 times increases the signal by about two times.

Increasing the height increases the effective vertical component, picking up some signal from all directions. I have not tried neutralizing this. Deep nulls make me nervous, as I think I may be missing something I want to hear! Increasing the height above 10 feet increases the characteristic impedance, but not by very much.

Decreasing the height limits the practical length, because the velocity factor becomes lower and end-to-end losses increase. Over most soils, the effective ground is well below the physical surface, which is probably the reason a wire will work well lying flat on the ground.

Misek [2] prefers to run an insulated wire or wires on the ground, grounded at each end and parallel to the antenna, providing an artificial high-conductivity ground screen below the antenna wires. This stabilizes the characteristic impedance and improves the operation at higher frequencies.

GROUND CONDUCTIVITY

For operation below about 3 MHz, a Beverage works better over lossy ground. This is because the lower end of the arriving signal wavefront is slowed by the ground, and the resulting tilt causes the antenna to respond well to signals arriving at a relatively low elevation angle (the antenna thinks they are arriving from a higher angle). Above about 3 MHz, the antenna responds to signals arriving from the sky, with a wavefront tilted in relation to the wire because of the arrival angle. Jack Belrose found that at 2 MHz gain decreases as earth conductivity increases, but at higher frequencies gain increases as earth conductivity increases [17].

At low frequencies the current induced in the antenna decreases by a factor of two for each 10 times improvement in conductivity [6]. Wire is thousands of times better than any soil, so this may be an argument against running parallel grounded wires under the antenna for MWBC and below. There are pros and cons for everything! If the ground conductivity is very poor, more radials are necessary at each end, but keep them symmetrical or they will degrade the directivity.

Ground conductivity charts are available for the U.S., parts of Canada, and several other countries. Unfortunately the ground immediately below the antenna is anyone's guess unless it has been actually measured for conductivity [11], and even the average ground in the far field is likely to differ from the map prediction.

As a rough guide to the conductivity of soil, Tom Sundstrom measured the d-c resistance of the ground return path of one Beverage as ten to fifteen thousand ohms [18].

COUPLING TO THE RECEIVER

The single wire Beverage is an unbalanced antenna, and will normally have a matching transformer designed to match the 500 ohms or so impedance of the antenna to the 50 or 75 ohms impedance of a length of coaxial cable. The coax is then plugged into the coax input connector of the receiver. The coax minimizes signal pickup on the lead-in. The transformer can be an autotransformer like the one in Figure 6 (a single winding with a tap a few turns from one end), or one with separate windings like 'R' in Figure 18. There is some useful advice on different methods of ground connection to matching transformers, and details of materials and winding procedures in *Proceedings* 1988 [14]. Vic Misek's book [2] has 80 pages of detailed information, calculations, specifications, on several variations of the Beverage, based primarily on operation at 1.8 MHz.

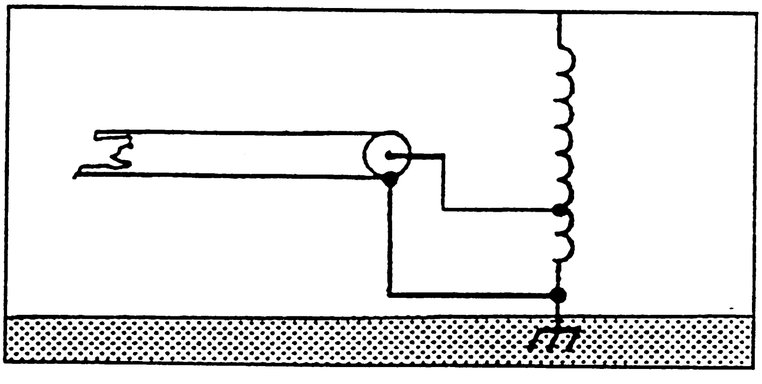


FIGURE 6.

If you want to cover several frequency bands, you need a broadband transformer, and any suitable design will serve. There are many designs in antenna and transformer handbooks. Remember that the impedance transformation is the square of the turns ratio, so for matching from 450 ohms to 50 ohms the turns ratio is 3:1. If you want to try making up your own, you had better read up on it first. For example using a core material suitable for the lowest frequency you intend to receive gives the best broadband effect, as the windings then have less and less inductance as the frequency increases.

It is advisable to mount the matching transformer in a metal box. Ferrite-cored transformers are quite effective antennas, and may pick up signals you would prefer not to hear.

A small ATU (antenna tuning unit) could be used instead of a broadband transformer to match to the receiver. It would have to be readjusted for different frequency bands, but has the advantage that it could be configured as a highpass or lowpass filter if there are problems from a powerful local station.

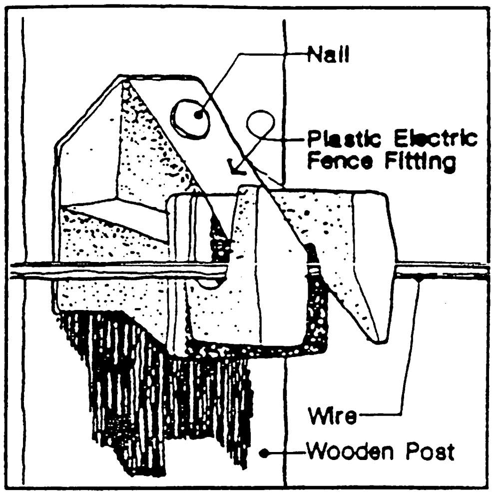


FIGURE 7.

You may need all the gain you can get if you are really serious about DXing. Many medium wave receivers are insensitive, but if you are fortunate or wise enough to have a sensitive receiver or preamplifier with high impedance front end (the antenna terminal intended for use with a random wire antenna), and the antenna ends close to the receiver, try connecting the antenna wire directly to that terminal, and you may get away without having to use a transformer.

There are many Beverages strung through woods and bushes and working well [7] [11].

A Beverage needs to be at least 200 feet from parallel antennas and other resonant structures. If there are several Beverages it is advisable to ground the ones not in use [18], although two Beverages crossing each other at 90 degrees appear to show no interaction [8].

Verticals are especially troublesome, as they reradiate vertically polarized noise and interference. Local electrical noise is not necessarily vertically polarized at its source, but the vertical component of it travels farther and is more likely to reach you. Try not to run a Beverage close and parallel to a wire fence, although some people have done so with no problems. If bare wire is used, and you don't live in an area with zero humidity and zero rainfall, insulators are necessary. I use standard electric-fence insulators like those shown in Figure 7. They are inexpensive and easily obtainable and seem to serve the purpose quite well. It is preferable to use insulators even with insulated wire, to reduce capacity to ground and as insurance in case the insulation wears through.

I use wooden posts, and for two-wire antennas, wooden crosspieces. I have a deeply rooted objection to vertical metal within the near field of an antenna, but metal posts seem to be OK [7] for people more psychologically stable. ABS plastic tubing would be ideal and the wire could be run through slots, without insulators.

DIRECTIVITY PATTERNS

The directivity of a Beverage depends on the elevation angle (the angle above the horizon from which the signal arrives). There are more and bigger sidelobes, the main lobe is wider, and the response to relatively high angle incoming signals is greater, than many people think. But this is just as well, because there are more high angle signals than many people think! A Beverage responds to vertically polarized signals from the front, and horizontally polarized signals from the side.

There are many ways to draw the pattern of any antenna. Plots are often referenced to the maximum amplitude of the main lobe. If the respective relative gains of a one wavelength and a two wavelength Beverage were not taken into account, there would not seem to be much difference except in the number of sidelobes. And if you compare one of them measured at 5 degrees elevation and the other at 30 degrees (or even the *same one* at the two different angles) you get an apparently confusing message. So check carefully before you decide there must be something wrong with the comparative directional patterns.

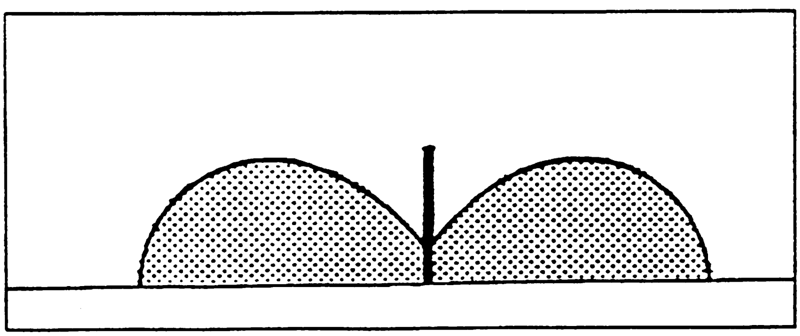


FIGURE 8.

It is not easy to draw three-dimensional patterns on a sheet of paper, and

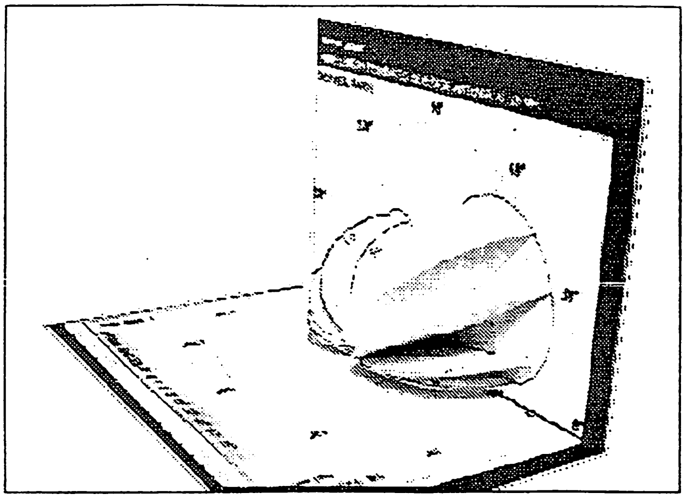


FIGURE 9.

authors often give up trying, which probably explains why many people do not have a clear idea what the true radiation envelope of an antenna looks like. Perhaps a good example is the pattern of a vertical monopole. The familiar vertical elevation pattern is that shown in Figure 8. The three-dimensional pattern looks like the top half of a doughnut with an infinitesimally small hole. Try drawing that, and then sympathize with the artist asked to portray a directional antenna with several sidelobes.

Figure 9 shows the three-dimensional pattern of a one wavelength terminated Beverage, as calculated by MN [16]. This is a photograph of a model constructed by John Bryant. A model is worth *ten* thousand words, and John's model has taught me enough about the influence of the ground on the response of an antenna to compensate for all the work of putting this article together! This image illustrates why a Beverage responds to different vertical angles and different polarizations of signal when the signals come from different horizontal directions. This means it *may respond to a particular signal better if that signal is not coming from dead ahead.* This is not unusual. A horizontal dipole responds best to high angle vertically polarized signals *off the ends*, not from a direction broadside to the wire. The familiar broadside 'figure 8' pattern of a halfwave dipole relates only to *horizontally polarized* signals at the optimum elevation. DX signals are unpredictable. They may come in from high angle, low angle or both at once. They sometimes come in from the wrong direction. The polarization is anybody's guess, and almost always there is some

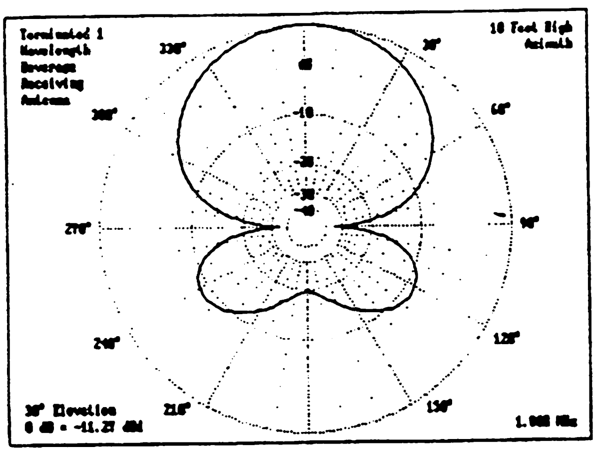


FIGURE 10.

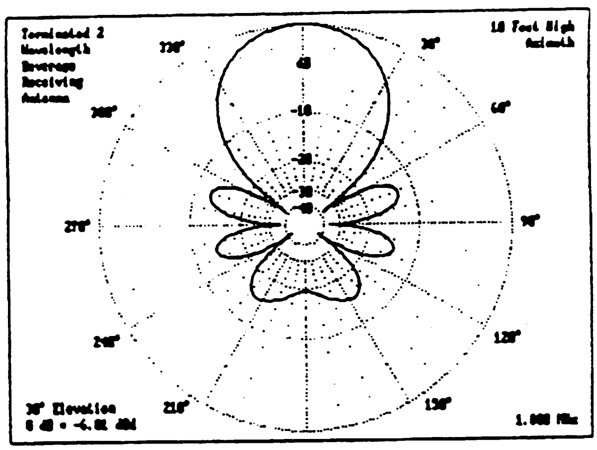


FIGURE 11.

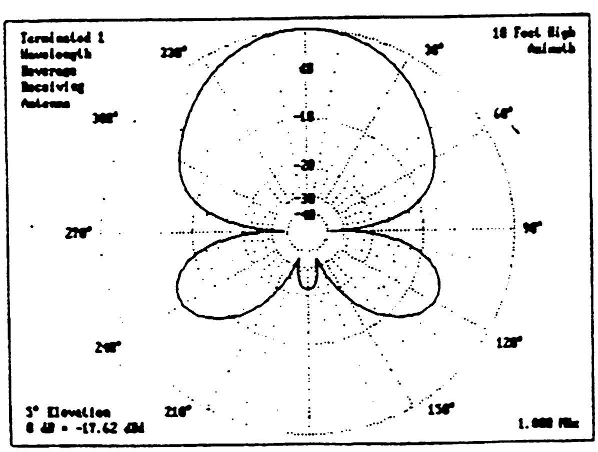


FIGURE 12.

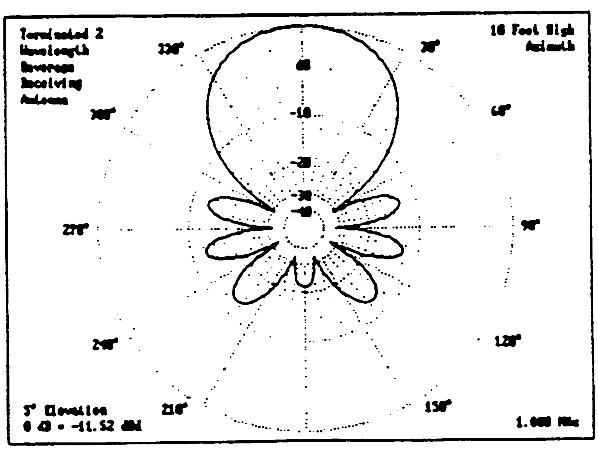


FIGURE 13.

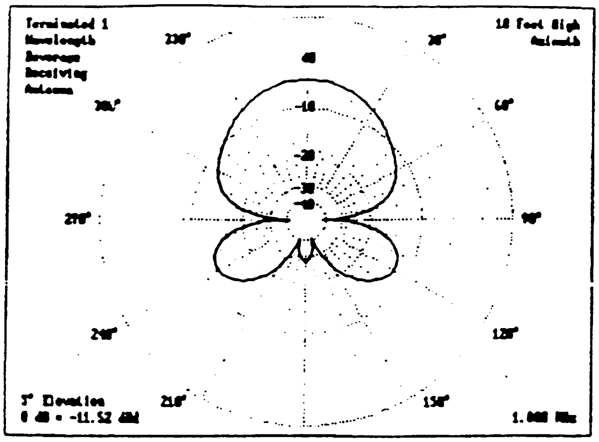


FIGURE 14A.

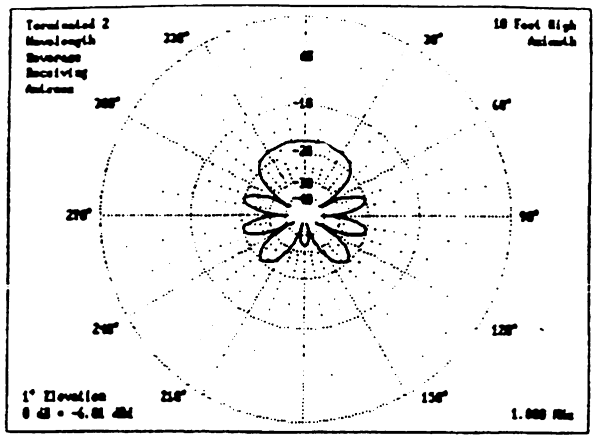


FIGURE 14B.

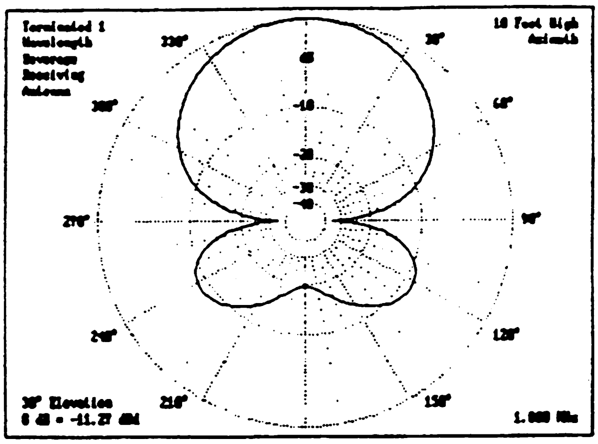


FIGURE 15.

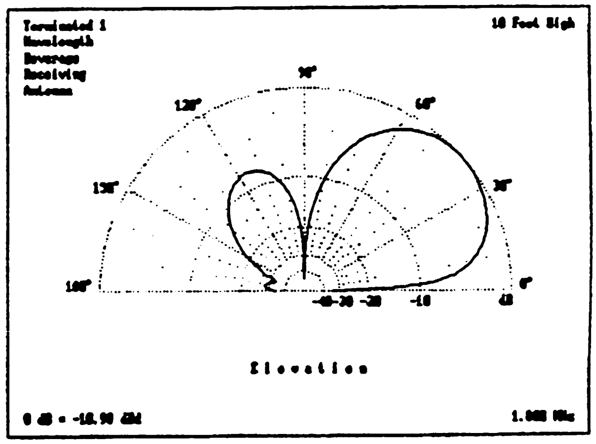


FIGURE 16.

of both. Only one thing is sure. The polarization will probably not be the same as it was when it left the transmitter.

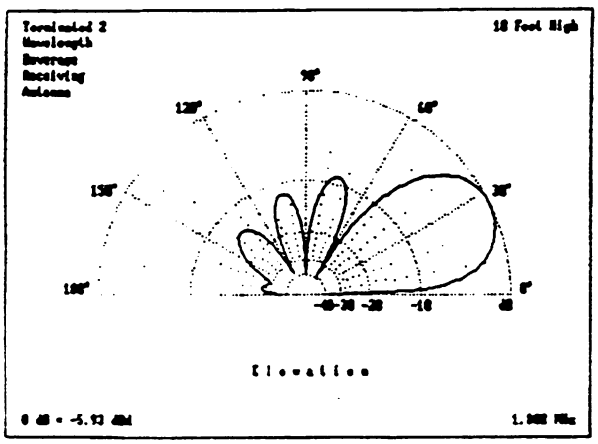


FIGURE 17.

Figures 10 to 13 show the directivity of two Beverages in the horizontal plane. For each antenna the pattern is shown at 5 degrees elevation and at 30 degrees elevation. Figure 14A shows one pattern of the one wavelength antenna 'normalized' to take account of the lower absolute gain (compare it with Figure 13, the two wavelength antenna at the same vertical angle). Figure 14B shows the pattern of the 2 wave antenna at 1 degree elevation 'normalized' to Figure 11. Normalizing gives a graphic reminder that the response in ALL directions is greatly reduced, making the unwanted lobes less fearsome. Figure 15 shows the one wavelength pattern plotted on a linear scale instead of a dB scale.

These have all been included to show the danger of comparing a pattern from one article with that from another without looking carefully at the specification of the plot.

Figures 16 and 17 show the elevation pattern of the two antennas when looking straight ahead. This is a vertical section through the lobes from 0 to 180 degrees of azimuth. These are all calculated patterns. In real life the nulls are not so sharp and deep, the lobes not so narrow.

The pattern plots were all developed using Brian Beezley's MN antenna analysis program for the IBM PC computer. Great fun to play with and extremely useful for analysis [16].

Jack Belrose measured the radiation of a 360' long and 4' high antenna at 18 MHz using airplanes and balloons, and found the measured lobes approximated those calculated [17].

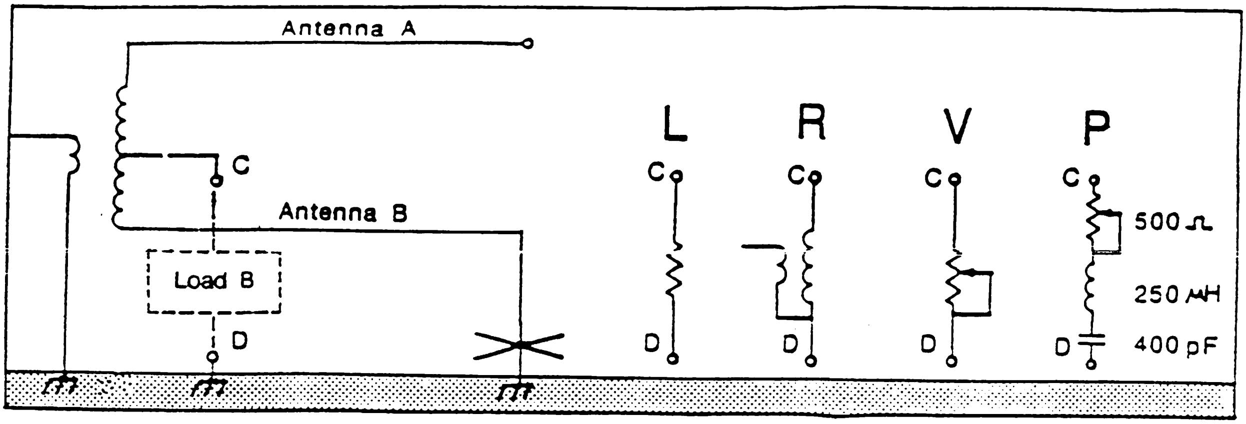


FIGURE 18.

THE TWO-WIRE BEVERAGE

There are disadvantages to the single-wire antenna. The termination is at the far end and sometimes not easy to get at. Characteristics tend to change with the seasons and the weather. A two-wire version, one variant of which [11] is shown in Figure 18, is a little more complex to build, but once in place it is more versatile and stable.

The two wires are parallel and about 12 inches apart. Length of each should be about half wave or multiples of a half wave. Height, kind of wire used, isolation from supports, are all the same as in the single-wire model. At the far end, one of the wires ends at an insulator. The other is grounded directly to a radial system WITHOUT a termination resistor.

The desired signal arrives from the left and travels along both wires, building as it goes. When it arrives at the end of the unterminated wire it has nowhere to go, so it is reflected back along the wire without a change of phase. It arrives back at the transformer A at the left end.

The signal travelling from left to right on the other wire meets a short-circuit at the far end, and is reflected with *reversal of phase*. When it arrives back at the transformer it is out of phase with the signal on the other wire. This is ideal, as they are connected to opposite ends of the transformer. +5 uV on one end at the same time as -5 uV on the other end puts 10 uV across the transformer. This in- phase addition recovers some of the loss incurred during the go and return trip the signal had to make along the wires. A signal arriving from the right travels along the two wires and arrives at the transformer. The signal is in the same phase on each wire. If you apply +5 uV to each end of a transformer winding you have no potential difference across the winding and no voltage will be induced across the secondary (the winding connected to the receiver). But this transformer has a center-tap connected through a load B to ground. Current will flow from each wire to the center of transformer A primary and from there into or through the load B.

If load B is a resistor (L in Figure 18) that matches the characteristic impedance of the antenna system it will

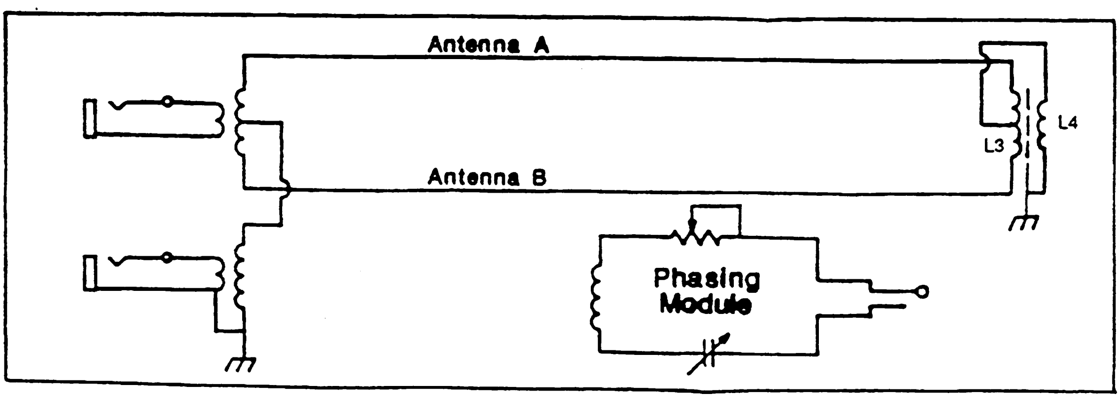


FIGURE 19.

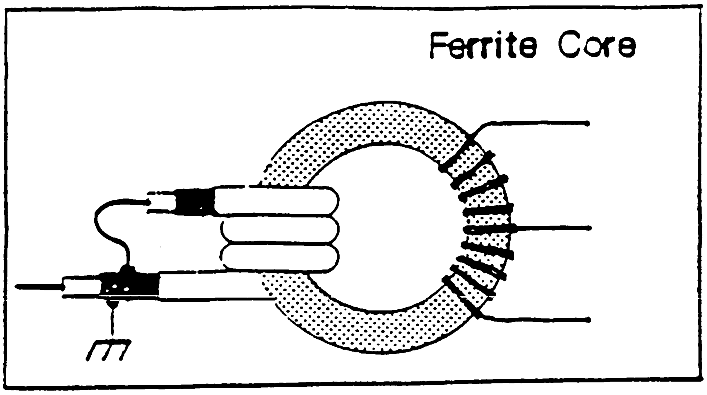


FIGURE 20.

dissipate the signal which arrived from the right, and we have a unidirectional system. If the load B is the primary of a transformer feeding a receiver (R in Figure 18) we have a system from which we can select signals from the left or from the right by plugging our receiver into the appropriate jack. To do the job properly a 50 ohms resistor should be plugged into the unused jack if there is no receiver there. It could be wired across the jack on an auxiliary contact, and automatically disconnected when a plug is in the jack.

STEERING THE NULLS

If the load B is variable (V in Figure 18) it can be custom adjusted to deepen the nulls in the pattern. If a tuning network is placed in series with the resistor (P in Figure18), the angle of the nulls can be moved [11]. The capacitor and inductor values depend on the frequency of operation. Adjustment is not easy, but if you first adjust the capacitor for a reduction in the interference (whether it be noise or undesired signal), then adjust the resistor to reduce it further, the improvement is sometimes like magic, especially if you are troubled by a ground wave signal from a local broadcasting station. Signals coming in from skywards are more difficult to null out, because the elevation angle from which they arrive is often changing quite frequently. The capacitor and inductor values shown are for 1.8 MHz. Double them both for MWBC operation (parallel the sections of a twin- gang 365 pF receiving capacitor), or try the 365 pF capacitor and ferrite loop from a portable radio.

Steerable-null antennas are best made an integral number of halfwaves long to simplify phase addition or subtraction [2].

An interesting variant of the steerable two-wire Beverage [11] is shown in Figure 19. The receiver is plugged into one jack, and the phasing circuit into the other. To reverse the directivity, the plugs are interchanged.

In this drawing, anti-phased reflection is shown as from a reflection transformer. In-phase signals arriving from the left flow from the center-tap of L3 to an unbalanced winding L4, and from there are induced into L3 again, but now the signals applied to the respective wires for sending back to the receiver are of opposite phase. A reflection transformer has to be carefully built to maintain balance, and should have a Faraday shield. It is easier to ground one wire and leave the other open instead of building a reflection transformer.

A shielded winding made from miniature coax cable is useful for the coupling to the receiver. RG58 or RG59 is better for the main run from the end of the antenna to the receiver position, unless the run is very short. Figure 20 shows how a Faraday shielded coax winding is constructed.

Detailed information on the construction of several two-wire steerable Beverages, center fed versions, a very short model, and several kinds of transformer, can be found in Vic Misek's 'Beverage Antenna Handbook' [2]. It is not practical to try to cover that kind of detail in the space available here.

CONCLUSION

How sanitary does a Beverage have to be to work? An insulated unterminated wire a few hundred feet long laid on the ground and pointed in the direction of the station to be received, connected directly to a sensitive receiver with high impedance input (like many MWBC receivers have) will have better signal to noise ratio than most antennas.

How sanitary does it have to be to work well? It depends what you want to receive and where you live. For hobby purposes you can be a bit careless and get away with it. Keep it as straight as possible and match it properly to the receiver. The rest of the answer to the editor's second question is a guide for experimental and educative fun.

REFERENCES

[1] Beverage H.H. W2BML,"A Wave Antenna For 200-Meter Reception," *QST* Nov 1922.

[2] Misek, V. *The Beverage Antenna Handbook*, 2nd Edition, 1987. (One source is CQ Bookstore, Main Street, Greenville NH 03048. Tel 800-457- 7373. Softbound $14.95 plus $4 via U.S. mail).

[3] Hines. J, Antenna section of *Radio Engineering Handbook*, edited Keith Henney, 5th Edition, 1959. McGraw Hill.

[4] Leach, R. VE7CRU, "Beverage Antennas Do Work," *West Coast 160 Meter Bulletin* Vol 2 No 1, 1984.

[5] Beverage, Rice, Kellogg, "The Wave Antenna," Midwinter Convention AIEE, New York Feb 14-17 1923

[6] Chen, K, "Time Harmonic Solutions For A Long Horizontal Wire Over The Ground With Grazing Incedence," IEEE Transactions Antennas & Propagation, March 1985.
[7] Bryant, J.H, "A DXer's Practical Guide To Beverage Antennas," Fine Tuning's *Proceedings* 1989.
[8] Doty, A. K8CFU, "Notes About Beverage Antennas," 1983 (not published).
[10] Beverage H.H. and DeMaw. D, "The Classic Beverage Antenna, Revisited," *QST* Jan 1982. (includes edited version of ref [1]).
[11] Boothe, B. W9UCW, "Weak Signal Reception On 160," *QST* June 1977.
[12] Doty, Frey, Mills, "Characteristics of the Counterpoise and the Elevated Ground Screen," Southcon/83 Atlanta Jan 18-20 1983 (also a version in *QST*, but I can't find the reference).
[14] Hall-Patch. N and Bryant J.H., "Impedance Matching a Beverage Antenna to a Receiver," Fine Tuning's *Proceedings* 1988.
[15] Devoldere, J., *Low Band DXing*, page II-121, ARRL 1987
[16] MN and MNJr for the IBM PC, available from Brian Beezley K6STI, 507-1/2 Taylor St., Vista, CA 92084.
[17] Belrose, Litva, Moss, Stevens, "Beverage Antennas For Amateur Communications," *QST* January 1983 (corrections/comment July 83, May 84]
[18] Sundstrom, T., "About The Beverage," *73 Magazine* June 1981.
[19] Orr, W., "Ham Radio Techniques," *Ham Radio Magazine* July 86.
[20] Wallen, A., *Genius at Riverhead*, North Haven Historical Society, Box 888 North Haven, Maine 04853.

EDITOR'S NOTE: **Figure 15** is *not* drawn on a linear scale as indicated in the adjacent text. Rather, it is drawn on a dB scale due to a Staff error. Sorry, Bob!

receivers

IMPROVING A WINNER:
MODIFICATIONS AND UPGRADES
FOR THE
JAPAN RADIO NRD-525

Guy Atkins

When introduced in 1986, the NRD-525 was promoted by the Japan Radio Corporation as "*The New NRD-525...You'll Find the Difference the More You Use it*". Although radically different in concept and construction from it's predecessor the NRD-515, the NRD-525 found rapid acceptance in the hobby community and became many DXers' dream receiver. Perhaps the ultimate compliment was given by reviewer Larry Magne when he stated "...It must be said that the NRD-525 is as close to the optimum shortwave listener's receiver as is in existence."[1]

Why then a compendium of improvements and modifications to the "perfect receiver"? Because nothing manmade exists that cannot be made better! DXers have had six years to discover the NRD-525's faults and blemishes and a few wrinkles have become noticeable on an otherwise pretty face.

Some serious DXers flogged their NRD-525s more than others, and pushed the receiver to the limits. In the process they developed a "true love-hate" relationship. John Bryant, writing in *Proceedings 1989* stated "...So that's about it on the 'down side'. Do I like my $1200 aluminum and plastic Bearcat? Can you read English— I hate the darn thing! But just a minute...ask me if I love it! Is the sky blue?"[2]

There are many radio hobbyists who are quite content with their bone-stock NRD-525. Its features and performance more than satisfy, and just the thought of removing the receiver's cover sends a chill up their spine. For others, however, real enjoyment of their radio begins where the factory design leaves off.

Are you in this latter category? If so, this collection of modifications and improvements for the NRD-525 should be of interest. Areas to be addressed include the IF/RF stages, selectivity, AGC, S-meter, ergonomics, and miscellaneous improvements. Some modifications are critical or at least highly desirable for serious DXing, such as the selectivity improvements. Others, like the area of ergonomics, are a matter of individual taste.

PRECAUTIONS

Anyone seeking to modify their NRD-525 should be aware that the receiver contains a vast amount of surface-mount devices (SMDs), large-scale integrated circuits (LSIs), and discrete components. The modular boards are densely packed. If you are not experienced with this type of construction and the precision soldering needed, seek qualified help. Bear in mind that many of these modifications will void your receiver's warranty. **Any modifications to your receiver are done at your own risk.**

The *NRD-525 Service Manual* is a virtual necessity for repairs or modifications. If you do not already own it, you will find the cost (approximately. $30.00 US) well worth the investment. One source for the NRD-525 manual is Universal Radio Inc.[3]

RF/IF STAGES

WIDE-BAND I.F. NOISE: The characteristic audible hiss generated in the NRD-525 has been the subject of much discussion. Larry Magne calls this the result of "selectivity distribution compromises," and it is attributed to "noticeable filter blowby" by David Newkirk in an *Enjoying Radio* article[4]. In other words, poor I.F. board component layout and minimal inter-stage isolation causes the constant background hiss of the NRD-525. It is an annoying characteristic that reduces intelligibility of weak DX signals. The problem is a complex one with no simple solutions; to eliminate the hiss at its source would require a complete redesign of the I.F. stage.

Fortunately, the wide-band noise is greatly reduced when the receiver is tuned in LSB or USB. It is generally accepted that the NRD-525's sideband mode audio quality far surpass its AM reception qualities. Many DXers find the NRD-525 more *sensitive* in AM, however.

A roll-off of the treble component of the hiss is suggested by John Tow in *DX Ontario*[5]. The addition of a 470 pf capacitor between pins 1 and 2 of IC5 on the IF/AF Amp Board (CAE-182) will reduce frequencies above 6 kHz. Similar effects can be accomplished with audio filters such as the Datong FL-2 and FL-3, or with external speakers like the Yaesu SP-102 which incorporates passive, switchable audio filters.

Find resistors R35, R36, and R37 on the CFL-205 board. These three components form a shunting circuit in the BYPASS line. Solder a jumper wire across R35 and R36 so that they are both bypassed. Cut the track in front of R37, isolating it from the rest of the circuit.

SELECTIVITY

The quality of the IF filters found in the stock NRD-525 indicate they were not high on the JRC engineers' priority list. The shape factors and ultimate rejection of the stock 2.0 and 6.0 kHz ceramic filters are surprisingly "average" for this $1200 receiver.

Two optional filters can be fitted to the NRD-525 for a total of four IF bandwidths. A number of possibilities besides the optional Japan Radio CFL-series filters are available to the NRD-525 owner. However, modification to the CFH-36 filter board is required.

Collins filters are widely known for their superior shape factors and high quality; Universal Radio sells and installs them for $169.95. George Zeller, who has the good fortune to own both a NRD-525 and an ICOM R-9000, comments: *The stock 525 filters are pedestrian at best. For this reason, I do not recommend that anybody own a stock model 525. The 2.9 kHz Collins filter turns this radio from an overpriced scanner into an outstanding DX rig. I love this filter! It is wide enough to crunch QRM way over 90% of the time. I know that the filter is expensive, but all 525 owners should install one at once if they do not have one already. Let me put this another way. Unless a DXer plans to install one of these filters, the 525 should not be purchased!*

Once the good filters are installed, the 525 actually outperforms the R-9000 in this area. Unlike the R-9000, all 525 filters can be selected in any non-FM mode. They can be operated with a tunable BFO for ECSS if desired; the R-9000 lacks this capability. I have said enough about this. The first mod to any 525 ***must*** *be the installation of some Collins filters.*

The 1.9 kHz Collins filter is also a good choice for difficult DX situations. John Bryant and I have the 1.9 kHz filter installed in our NRD-525s, and have found it to be THE choice of filters for international mediumwave DXing. It is strictly a filter for tuning in ECSS or SSB/CW mode, however. Other Collins filters available besides those mentioned above are 1.2 kHz and 3.8 kHz filters.

ICOM's excellent FL44A crystal filter (2.4 kHz) can also be installed in the NRD-525. At nearly $200 it is an expensive filter, but it requires little modification to the CFH-36 filter board. I find the FL44A filter provides more intelligible audio and better rejection characteristics than the stock 2.0 kHz ceramic filter. When installed in the AUX position (FL6), the FL44A's input and output pins are connected by very short (1/8-1/4") jumper wires to capacitors C60 and C61 respectively. Four small holes need to be drilled in the circuit board to allow the filter's pins to pass through, and the circuit trace that runs beneath resistor R65 needs to be rerouted to ground so it's not in the way of the FL44A's input pin. The filter's mounting studs are a near-perfect fit on the CFH-36 board.

Sherwood Engineering offers what appears to be an excellent series of filters at a good price for the NRD-525. Their "CN" models are 15-pole crystal filters available in 14, 8, 6, and 4.5 kHz bandwidths for $79.00 each; a 400 Hz CW filter costs $179.00 (call Sherwood to confirm current pricing). Shape factor of these filters is stated to be 1.3 to 1. Sherwood Engineering will install these filters for $20.00. In addition, for $39.00 they will perform a number of IF filter board modifications that result in a typical 15 db improvement in filter ultimate rejection.

Universal Radio sells a Murata 4.0 kHz filter for $59.95 (installed). This filter is sold as a higher quality replacement for the stock 6.0 kHz version.

David Clark has provided information on Pühler Electronic in Germany[14]. They provide a number of filter modifications for the NRD-525. This firm may be a source more suited to European DXers, since Peter Pühler of Pühler Electronic requires that all modifications be installed by his firm.

All filters mentioned so far are second IF filters for the 455 kHz IF of the NRD-525. ESKAB of Sweden offers a useful trio of IF filters for the first and second IFs. The bandwidth and ultimate rejection of the stock pair of crystal filters (FL1) and the ceramic filter (FL2) on the CFH-36 IF filter board is improved considerably by the ESKAB replacements.

The stock FL1 filters permit a 68 kHz wide (-60 db) swath of frequencies to pass through the first IF stage, while the stock FL2 filter also leaves a gaping hole of 36 kHz (-40 db). The combination of the ESKAB replacement filters results in a much better bandwidth of 6 kHz (-6 db) and 12 kHz (-40 db) at the output of FL2. John Tow states in his *DX Ontario* article that this modification alone is worth a 5 db improvement in the signal-to-noise ratio, and selectivity in all filter positions is improved. One drawback to this modification is reduced performance from the noise blanker circuit. The combination of FL1 and FL2 replacement filters is in the $85.00 price range through ESKAB.

AGC AND S-METER

AUTOMATIC GAIN CONTROL: This is another area of the NRD-525's design that has received strong criticism. Predictably, there is no consensus on exactly what *is* wrong with the AGC response; preferences in AGC are very subjective.

In the author's opinion, "hard-core" DXers tend to prefer rapid AGC attack and release times. They are willing to endure the peaks and valleys of fast AGC response in order to squeeze the last bit of intelligibility out of a weak AM signal. Fast attack and release times lessen the chance of receiver audio blanking from strong noise pulses, leaving more opportunity to catch a critical word or two during a DX station's identification.

This is the philosophy behind Craig Siegenthaler's NRD-525 AGC modification published in the "Tips And Techniques" section of *Proceedings 1989*[15]. Both the AGC attack and release times are shortened by replacing these capacitors on the CAE-182 IF/AF amp board with the following values: C75 1.0 µf; C77 0.1 µf; C80 .22 µf; and C102 µf (all polarized tantalum caps). This modification affects both slow and fast AGC constants.

Many SWBC enthusiasts will prefer a modification that accomplish the opposite effect, however. John Tow, in his *DX Ontario* article, suggests the following changes which are easy to implement: replace resistors R103 and R104 on the CAE-182 board with 10KΩ values (1/8 watt or less), and solder a 1.0 µf tantalum capacitor across pins 4 and 5 of IC9. To further slow the attack and release times, John recommends replacing C77 with a .22 µf tantalum capacitor, or a 2.2 µf value for even less speed.

ESKAB offers an AGC modification for the NRD-525, and it is a recommended option for those who install ESKAB's Phase-locked AM (PLAM) synchronous detector kit. Their modification is contained on two small circuit boards that attach piggy-back style to the CAE-182 board. ESKAB's AGC kit is available at a discount if the PLAM kit is purchased at the same time.

S-METER: No differing opinions here! All DXers agree that the NRD-525's stock bar-graph S-meter is about as jumpy as a grasshopper on an August afternoon. Most NRD-525 owners would prefer a traditional analog meter which gives useful information about relative signal strengths. The following circuits of increasing complexity describe three methods of adding an external S-meter to the NRD-525.

A NO-FRILLS S-METER: John Bryant suggests this straight-forward addition, originally developed by Dwayne Jones of Universal Radio. By tapping the AGC voltage on Test Point #3 of the CAE-182 IF/AF Amp Board, a 100ma meter can indicate relative signal strengths. John used miniature 50Ω coax cable (RG-174) for routing the signal outside of the NRD-525 to the meter, via a RCA jack on the receiver's rear panel. The shield of the coax is attached to the ground buss (wide boarder) adjacent to Test Point #3.

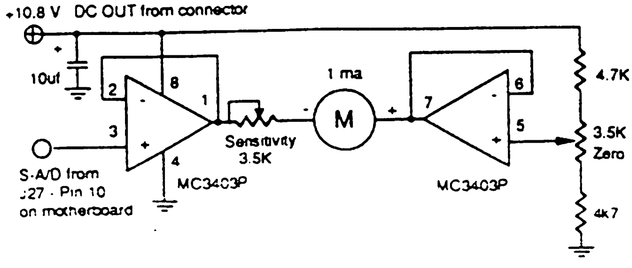
A 1K Ω trimmer potentiometer between the meter's terminals aid in zeroing the meter movement (no signal condition). Other values may work better for the meter you use. The voltage from the center conductor of the coax feeds the wiper of the trimmer, and one of the other two trimmer terminals is attached directly to the positive (+) terminal of the meter.

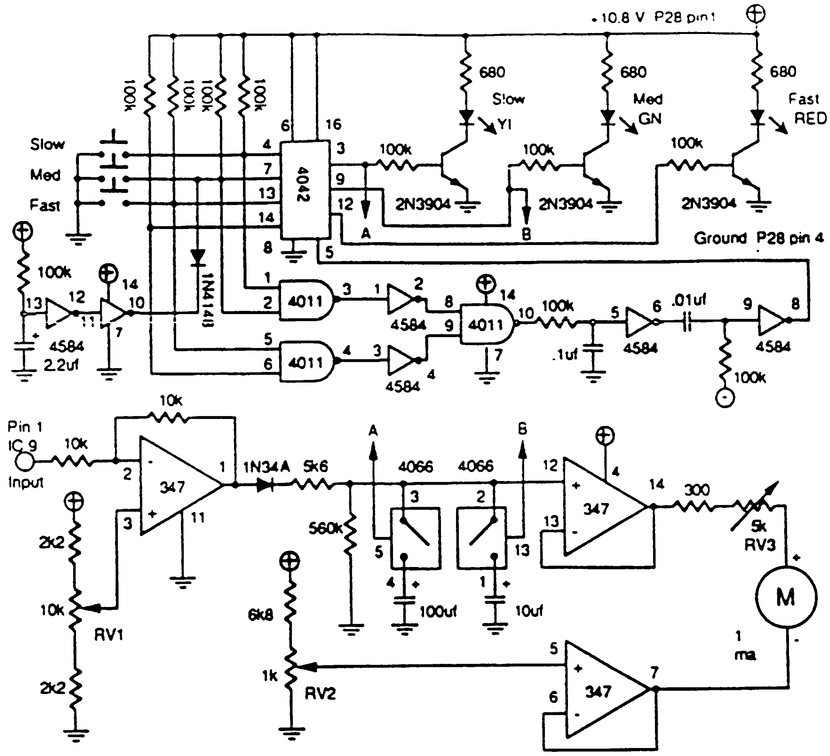
John mounted his meter upside down to show needle deflection to the right as the signal increases in strength. He recommends a large meter be chosen for the S-meter to aid readability.

A ONE CHIP S-METER: This circuit is courtesy of Paul Lannuier of JRC-New York, via Chuck Bolland. Paul states it was designed by a member of the JRC 1st Engineering Department.

The single integrated circuit (a quad op-amp) may be one of the following ICs: Fairchild U3403PC, Motorola MC3403P, National Semiconductor LM3403N, Texas Instruments MC3403N or NJM3404.

The attachment point which provides the AGC signal is pin 10 of J27 on the motherboard. This is at the base where the CAE-182 circuit slots are located. For the 10.6 volts DC power, the DC OUT jack on the rear panel of the NRD-525 can be used, or tap circuit points such as pin 1, J32 or pin 1, J34 on the motherboard. Calibration for sensitivity and meter zeroing is done with the 3.5K Ω potentiometers. If the needle goes off-scale for medium strength signals, add resistance to the line from the circuitry to the meter.





A VERSATILE S-METER FOR THE NRD-525: Craig Siegenthaler of Kiwa Electronics is the author of this flexible circuit. I have used his design for over two years and can attest to its excellent performance. Its usefulness is greatly enhanced by the selection of a large, easy-to-read meter movement and calibration to industry standard S-units.

This circuit can provide three levels of dampening to drive the analog meter. It is designed around a quad bi-fet op-amp such as a LF347 or TLO-74. Only three sections are used; the unused section should have its input pins grounded. The upper half of the schematic is the control logic to drive the CMOS FET switches which add or subtract capacitance to dampen the metering signal.

The meter used should have a 1 milliamp full-scale display. DC power is provided by the receiver with V+ connected to P28, pin #1 and ground to P28, pin #4 on the CAE-182 IF/AF Amp Board. The input to the S-meter circuit connects to IC9, pin #1 on the CAE-182 board.

To calibrate the meter, first set the RV controls to midpoint. Disconnect the antenna, and set the receiver's RF gain control to maximum. Adjust RV2 until the meter movement just begins to deflect upwards. At this point RV1 and RV3 should not require much adjustment past their midpoint settings. Adjust RV1 until it, too, just starts to deflect the meter's needle upward. Connect the antenna and tune to a strong MW station. Adjust RV3 for a similar upscale reading. Readjustment of RV1 and RV2 will be required to tune the meter so it will respond to low and high level signals.

A more accurate calibration can be performed with a RF signal generator having a precision attenuator and 50 Ω output. Terminate the generator with 50 Ω, set the frequency to mid band (example: 8 MHz), and connect it to the receiver's antenna input. The meter can now be calibrated according to the following standard signal levels adopted by the IARU (International Amateur Radio Union):

S-meter	Vrms at 50 Ω (0-30 MHz only)	S-meter	Vrms at 50 Ω (0-30 MHz only)
S9 + 40db	5 mV	S6	6.3 mV
S9 + 30db	1.6 mV	S5	3.2 µV
S9 + 20db	500 µV	S4	1.6 µV
S9 + 10db	160 µV	S3	0.8 µV
S9	50 µV	S2	0.4 µV
S8	25 µV	S1	0.21 µV
S7	12.5 µV		

Most receiver manufacturers except Japan Radio Company have adopted these signal levels as the S-meter standard. The two NRD-525 radios Craig tested show 100 μV as the S9 signal level. Also, neither receiver developed AGC voltage below S2 to S3 levels. This means it is impossible to calibrate the S-meter accurately below that point (the stock bargraph meter cannot be properly calibrated for low level signals, either).

My external S-meter, built to Craig's design, uses a surplus Hewlett-Packard meter 3-1/2" in width. After the S-meter was calibrated I created a new faceplate for it with rub-down lettering on thin white cardboard. Slipped behind the meter's needle, the faceplate markings accurately show signal levels to the industry standard.

The three selectable dampening settings of this circuit are very helpful. "Fast" gives an good indication of polar flutter conditions, or the true extent and rate of signal fading. "Medium" is the normal setting that approximates most receivers' S-meter characteristics. The "slow" setting smooths out level variations–even drastic changes–to give an average reading.

ERGONOMICS

Larry Magne, in his White Paper review, generally lauds the ergonomics of the NRD-525. However, those who have DXed with the receiver on a regular basis have found a number of faults. These become increasingly annoying after long hours in front of the receiver, such as during DXpeditions or "all nighters."

CONTROL KNOBS: In *Proceedings 1989*, John Bryant reported making numerous operator errors while DXing due to the too subtle "pointer" which indicates knob position on the NRD-525's eight small function control knobs (Volume, IF Shift, etc.). John tried painting the knob valley and pointer a bright fluorescent color, but the best fix was found at his local office supply store. Adhesive backed, 1/2" diameter round labels make excellent position indicators when cut in half. These "half moon" pieces are stuck on the front of a knob so that the straight edge is vertical *with the knob in its usual position*. Even in low light, there is no missing the fact that some control is out of its normal setting.

KEYPAD CONTROL: For those NRD-525 owners dissatisfied with the radio's stock keypad control, I described one possible solution in detail in *Proceedings 1990*[16]. This article illustrates the construction of a remote keypad controller for easier, quicker entry of frequencies, memories, bandwidths, mode, and tuning rate. Electronically, the controller is simply a collection of SPST momentary switches that parallel the action of the NRD-525's stock keypad and other pushbuttons. It is made from a "recycled" handheld calculator, and attached to the receiver via a shielded cable (similar to the NRD-515's optional keypad).

FINE TUNING THE NRD-525'S TUNING KNOB: John Bryant is quite fond of some of the old WWII receivers that had a folding or sliding bar built into the tuning knob. The could be slid or unfolded beyond the circumference of the knob, exposing a "finger hole". Because of the longer radius provided by the outboard hole, this device gave great fine tuning control and at the same time allowed very rapid dial "twirling."

Why not do the same thing for the NRD-525? After several false starts, John developed a strip of 1/16" thick by 1-1/8" wide by 2-5/8" long acrylic plastic (Plexiglas® or similar) with a 3/4" finger hole in the end. He attached the strip to the front of the knob with a couple pieces of tough hook fastener material (Radio Shack part #64-2360). This material makes for a very tight bond, but allows removal of the tuning accessory when needed. The dimensions of the plastic bar are critical as the bar must be short enough not to hit the table top on the down swing, and yet long enough to get the finger hole past the circumference of the knob.

John comments that this single, simple modification has made a great difference in the enjoyment of bandscanning with the NRD-525.

ANOTHER TUNING KNOB TRICK: If you know a competent machinist it is possible to *manufacture* an improved tuning knob for the NRD-525. The improvement comes in the form of a free-spinning finger detent in the tuning knob, which rotates separately from the knob itself. The finger detent takes the form of a "cup" that rotates easily on a ball bearing race within the new knob. Ask your machinist to create the knob from a material called black Delrin®. The stock tuning knob cannot be modified to incorporate a free-spinning detent because it is hollow (and will warp if filled with acrylic resin . . . I tried). The new knob retains the original indexed metal backplate (outer skirt).

Diagrams for the knob's exact dimensions are not given here, as the details will vary depending on the manufacturing equipment available and the skill and ingenuity of your machinist. Give him (or her!) the stock tuning knob as a guide. (Note: the knob removes from the optical encoder shaft with a *metric* Allen wrench.)

Granted, a free-spinning finger detent in a tuning knob is a small matter, but it's that kind of attention to detail that adds up to make a professional-level receiver. It *does* make a difference when bandscanning for long stretches at a time. This feature should have been built into the NRD-525 in the first place. My receiver now tunes like a dream, with no finger "drag" as the knob rotates.

MISCELLANEOUS

EXTENDER BOARD: Many adjustments to the NRD-525 modular boards are difficult or impossible without the Japan Radio CMH-365 Extender Board. This accessory plugs into the motherboard and effectively extends the circuit board under test, above and beyond the chassis and case. This provides access to trimmer capacitors, variable resistors, etc. while the receiver is powered up. Unfortunately, the CMH-365 Extender Board is expensive–nearly $170.

Terry Palmersheim[17] in Washington has located a source for the hard-to-find connectors used on the NRD-525 and the CMH-365 Extender Board. He has successfully built a substitute extender board for the receiver, at much lower cost than the JRC extender. Terry has offered to supply parts for anyone seeking to build their own extender board for their NRD-525. Contact Terry for current availability and prices.

CROSS MODULATION PROBLEMS: The designers of the NRD-525 wanted to protect their creation from static charges with a fail-safe system. To do this they used diodes in the front end on the CFL-205 board ahead of any integrated components. Unfortunately, while doing an excellent job of protecting the receiver, the diodes have a tendency to conduct when a broadbanded antenna or longwire is connected. These diodes can cause cross modulation in the NRD-525, and the problem can only be eliminated by removing the diodes. Chuck Bolland indicates that only two diodes need to be disconnected to accomplish this (desolder the "HF IN" side of diodes CD1 and CD3 on CFL-205). If you decide to sell your NRD-525 in the future, the diodes can be easily replaced. To give continued protection, Chuck recommends that a gas-discharge device such as the Transitrap be inserted into the antenna line just before the receiver.

Besides the Transitrap, another method of voltage limiting the antenna input is to connect a NE-2 neon bulb and a 10K Ω resistor between the center terminal and ground of the SO-239 connector on the NRD-525's rear panel. The bulb and the resistor are in parallel to each other. This method is suitable for 50 Ω inputs on other makes of receivers.

INTERFERENCE FROM THE RS-232 COMPUTER INTERFACE: Some NRD-525 owners have reported that the DC to DC converter on the optional CMH-532 interface causes interference to the receiver. Paul Lannuier of Japan Radio suggests the connection of a .01 µf capacitor (50wv film) between TR101 and TR102 on the CMH-532 board. It's been confirmed that the connection of the converter output common line to ground potential is effective to reduce noise, also.

AUXILIARY FILTER SWITCH: Elton Byington has discovered a simple modification for preserving the 12 kHz wide audio bandwidth even when an optional filter is fitted to the AUX slot. The only parts required are a SPDT toggle switch and some hookup wire.

Remove the CFH-36 IF filter board from the receiver. Cut three pieces of wire, each 8" long. Solder one end of each wire to point A, point B, and point C (remove jumper W1). Connect the wire from point C to the center pin of the switch. Connect the wire from point A to one of the remaining two pins, and connect the wire from point B to the other pin on the switch.

Elton notes that these are not signal carrying leads, so the arrangement of the leads is not especially critical. The wires can be routed over the top of the card cage and out the left-rear top of the receiver's case, or a bracket may be fashioned to let the paddle of the switch protrude from a ventilation slot on the cover.

Position the switch to "B" and you'll connect the accessory filter when the radio's bandwidth setting is AUX. When the switch is in the "A" position the accessory filter is bypassed, allowing the 12 kHz bandpass through to the detector.

On those occasions when a shortwave station is really in the clear, or when listening to a local broadcast station, the added bandwidth makes for very pleasant audio. The radio's LINE OUT jack also benefits from the change.

Elton has used this modification for several years without problems. It can be easily removed if the receiver is sold or returned to stock condition.

STATIC KNOCKOUT: Chuck Bolland had the unfortunate experience of an excessive static charge destroying a sensitive integrated circuit in his NRD-525. When this happens, the receiver has unique symptoms: no sensitivity between 400 kHz and 12.999 MHz. Only local stations will be heard in this range. When tuning higher than 12.999 MHz, sensitivity will be normal. If you suspect this has occurred to your receiver, Chuck advises that the following items on the CFL-205 board be replaced, one at a time: IC1 (HD74LS1450 or ECG 74LS145); TR1 (2SA1162-Y or ECG 2409); TR2 (2SK125 or Motorola U310, two each). It is likely that the problem will be corrected with just the replacement of IC1. In any case, the time and few dollars spent on these parts is considerably less than repair or replacement of the board by JRC.

THE JRC NRD-535D: At the time this edition of *Proceedings* went to press, the new Japan Radio Co. NRD-535 had been on the market for a number of months. It is worth noting briefly the major differences and similarities between the NRD-525 and the NRD-535 receivers. The NRD-535 is sold as the "NRD-535D" in North America for approximately $1690.

An ECSS mode (synchronous detection), a variable bandwidth control (BWC) and a tuning rate and resolution of 1 Hz are the most important improvements in the new receiver. However, the NRD-535D's notch and Passband Tuning controls *are not* operable in ECSS mode.

The lackluster AGC characteristics of the NRD-525 have been retained in the NRD-535D. Also present is the identical IF filter line-up as found in the NRD-525D (unfortunately!), with the addition of a 1000 Hz crystal filter.

The engineers behind the NRD-535D seem to have solved the audio hiss problem of the NRD-525, according to reports from early purchasers.

A thorough review of the NRD-535D in the July 1991 *DX Ontario* bulletin ended with the author concluding that this new receiver was more suited to the utilities DXer[18]. Time will tell whether the new NRD-535D is an improvement over the NRD-525 or merely *different*, in the eyes of SWBC DXers.

FINAL COMMENTS

For years the "three S's" have been the basic yardstick to measure receiver performance: Stability, Sensitivity, and Selectivity. Unfortunately for the serious DXer, the stock NRD-525 is lacking in the critical area of selectivity. The NRD-525 owner is strongly encouraged to consider adding one or more quality IF filters as the first step to improving his or her receiver.

In retrospect, it seems like many modifications in this compendium might be termed *personalizations*. Each DXer has a slightly different expectation of performance from his NRD-525. It is hoped that the information presented here has given you ideas on how you can "improve a winner."

This compendium would not have been possible without the assistance of the following people: David Clark, George Zeller, Chuck Bolland, Elton Byington, Terry Palmersheim, Paul Lannuier, John Bryant, and Craig Siegenthaler.

REFERENCES AND SOURCES

[1]*Radio Database International*, "RDI Evaluates The Japan Radio NRD-525U/525E/525J Receiver", Edition 2.0, June 11, 1987. International Broadcasting Services Ltd., P.O. Box 300, Penn's Park, PA 18943 USA.

[2]John Bryant, "Wastegunner On A 525", *Proceedings 1989*. Fine Tuning Special Publications, RRT #5, Box 14, Stillwater, OK 74074 USA.

[3]Universal Radio Inc., 1280 Aida Drive, Reynoldsburg, OH 43068 USA. Toll-free order line: 1-800-431-3939. Technical support line: (614) 866-4267.

[4]David Newkirk, *Enjoying Radio*, February 8, 1988. Contained within *Review of International Broadcasting*, c/o Glenn Hauser, P.O. Box 1684, Enid, OK 73702 USA.

[5]John Tow, "Modifications for the NRD-525," *DX Ontario*, August 1990. Published by the Ontario DX Association, P.O. Box 161, Station "A", Willowdale, Ont. M2N 5S8 Canada.

[6]ESKAB, Attn: Harm-Heyen Broers, P.O. Box 32001, S-200 64 Malmoe, Sweden. Phone: 040-110520. FAX: +46-40-124734. TELEX: 32967 ECOM S.

[7]Sherwood Engineering Inc., 1268 South Ogden St., Denver, CO 80210 USA. Phone: (303) 722-2257 (9am-5pm M-F). FAX: (303) 744-8876.

[8]KIWA Electronics, 612 South 14th Avenue, Yakima, WA 98902 USA. Phone: (509) 453-KIWA.

[9]Radio West, 850 Anns Way Dr., Vista, CA 92083 USA. Phone: (619) 726-3910. Price list: $1.00.

[10]"Shortwave's Best Fidelity Receiving System...for a Price," *World Radio TV Handbook*, 1984 edition. Billboard Publications Inc., 1515 Broadway, New York, NY 10036. The article reviews the SE-3 as used with a Drake R7A receiver.

[11]"Add-on Device Enriches Fidelity," *Passport To Worldband Radio*, 1990 edition. International Broadcasting Services Ltd., P.O. Box 300, Penn's Park, PA 18943 USA. The article reviews the SE-3 as used with a JRC NRD-525 receiver.

[12]Guy Atkins, "The Kiwa Electronics' Multiband AM Pickup," *Proceedings 1989*. Fine Tuning Special Publications, RRT #5, Box 14, Stillwater, OK 74074 USA.

[13]"Sorting Out Receiver Specifications," *World Radio TV Handbook*, 1988 edition. Billboard Publications Inc., 1515 Broadway, New York, NY 10036.

[14]Pühler Electronic, Almstaße 3, 8019 Steinhöring, Germany. Telephone: 08094-631.

[15]"Tips And Techniques For The Advanced DXer," edited by David Clark. *Proceedings 1989*. Fine Tuning Special Publications, RRT #5, Box 14, Stillwater, OK 74074 USA.

[16]Guy Atkins, "Improving Keypad Control For Modern Receivers," *Proceedings 1990*. Fine Tuning Special Publications, RRT #5, Box 14, Stillwater, OK 74074 USA.

[17]Terry Palmersheim, 12703 86th Avenue East, Puyallup, WA 98373. Please enclose a stamped, self-addressed envelope (SASE) when writing.

[18]James Goodwin, "The Japan Radio Company NRD-535," *DX Ontario* July 1991. Published by the Ontario DX Association, P.O. Box 161, Station "A", Willowdale, Ont. M2N 5S8 Canada.

THE RACAL RA-17 COMMUNICATIONS RECEIVER

Bruce Portzer

Tube type receivers continue to have a significant cult following in the DX hobby. The "high end" models in particular seem to have the most lasting popularity. Receivers like the Collins R-390A and Hammarlund HQ-180A were excellent performers when introduced, and still are. Another receiver in that category which was relatively unknown among DX hobbyists until a few years ago is the Racal RA-17.

The Racal Company is a well-respected British electronics manufacturer, roughly equivalent to U.S. companies like Motorola and Hewlett-Packard. Racal has been a major supplier of military and industrial communication and other electronics systems for decades. Its communications equipment has long ranked near the top in quality and reputation. Racal isn't that well known in hobby circles simply because its equipment is so expensive that few DXers can afford it. We've therefore had to wait for its gear to appear on the surplus market before many of us can try it out.

The Racal RA-17 was originally designed in the late 1950's, and continued to be built and sold through the late 1960's. When it first came out, the RA-17 represented the state of the art in receiver design. It was the first receiver to use the Wadley loop circuit. This enabled the set to provide a frequency readout with 1 kHz resolution all the way from 500 kHz to 30 MHz. This was a vast improvement over the "slide rule" accuracy of most sets of that era. The results were and still are pretty impressive. It wasn't until the mid 1970's that the Wadley loop circuit showed up in the Barlow-Wadley XCR-30, the Yaesu FRG-7 and other hobby receivers. Until then, very few other receivers provided that sort of frequency resolution. The only other major 1960's vintage receiver with 1 kHz resolution was the R-390 series receiver. The R390 had digital readout, but the mechanical tuning arrangement and readout were more cumbersome to operate and maintain.

Nowadays, frequency synthesizers and digital readouts have made the Wadley loop nearly obsolete, but in the 1960's it was a godsend for those who could pay the price. When introduced it had a price tag of about a thousand dollars. That's the equivalent of over $4000 in today's dollars. The high price, of course, placed the receiver out of reach of most hobbyists back then, but government and commercial buyers found good use for them. Mine, for example, saw 15 or 20 years service at the FCC monitoring station in Ferndale, Washington, before it was sold as government surplus in the mid 1980's. Around that time, the Canadian government unloaded a large number of RA-17s, which Don Moman bought and resold to Canadian DXers. I'm not sure how many were made, but the manual for mine says it was received 12-15-67 and has serial number 251.

There seem to be several variations of the receiver. Moman found receivers with C2/C3 suffixes to be earlier versions, and C12/C13 suffixes to be later versions. The latter had improved selectivity due to an added tuned circuit in the front end. The manual for mine says the RA-17UC is the same as the RA-17UA except for a product detector in lieu of the BFO. There are also the Racal RA-117 and RA-6117; both are similar to the RA-17 with a few internal circuit changes.

WHAT DOES IT LOOK LIKE?

The receiver is quite large. It's designed for 19" rack mounting, and is about 10" high and 18" deep. The weight is about 67 lbs. Original purchasers had the option of either getting the receiver with a cabinet or without one. The receiver is very solidly constructed; it is the only receiver I've seen with a cast aluminum chassis. The internal circuitry is very well shielded. All components are securely mounted and appear to have been top quality for their time. Best of all, the kilohertz readout is on several feet of 35 mm film, with 0.6 inches for every 10 kHz and markings every kHz. The manual claims the readout is equivalent to 145 feet for the 0.5 to 30 MHz spectrum!

Figure one is a layout of the front panel. The front panel controls include:

Power on/off: Self explanatory. The receiver can operate from either 120 or 240 volt AC, depending on how you wire the transformer.

R.f. range and r.f. tune: These controls tune the front end r.f. amplifier. You switch the range control to the band of interest and then use the tune control to peak the signal. The range switch has a position to bypass the tuned circuits.

Attenuator: A 5 position switch which reduces incoming signals from 0 to 40 db in 10 db steps.

Megahertz and kilohertz tuning knobs and displays: These controls are used to tune the receiver to the desired frequency. Their operation is discussed a little later in this article. Like many other receivers, the hairline marker for "KHz" can be moved to adjust for minor calibration and tracking errors. The "MHz" tuning control can be locked into place to prevent inadvertent movement.

Bandwidth: Selects among 0.1, 0.3, 1.2, 3.0, 6.5, and 13 kHz bandwidth in the final i.f. stage. The first two bandwidths use crystal filters, the others use L-C filters.

Mode: Selects either standby, AGC (operating with automatic gain control switched in), MGC (operation with AGC disabled), calibrate (enables the 100 kHz crystal calibrator), or BFO check.

AF gain: Adjusts the audio output to the headphone jack(s), front panel speaker, and external speaker jacks.

BFO tune: Tunes the beat frequency oscillator up to 5 kHz above or below the received frequency.

RF/IF gain: Adjusts the gain of the r.f stage and the i.f. stages. On some earlier versions, this control only adjusts the i.f. stage gain. The control works in both the AGC and MGC modes.

AGC long/short: Selects between long and short attack/decay times on the automatic gain control circuitry.

Audio level: Adjusts one of the rear panel audio outputs for driving external amplifiers, tape recorders, or other external audio devices.

Limiter: Enables/disables the noise limiter circuit. The limiter works extremely well on some types of electrical noise, as well as plain ordinary static crashes. Occasionally it provides clear copy on a station that was otherwise buried in a loud buzz. On the other hand, it can also distort received audio; this can be alleviated somewhat by adjusting the r.f./i.f. gain control.

Speaker: A 2-inch speaker which can be disabled by an adjacent toggle switch. Missing from some versions.

Headphone jack(s): Depending on the version, there are one or two headphone jacks.

Meter: The meter can function as an r.f. level, "S", or a.f. level meter, as selected by an adjacent switch.

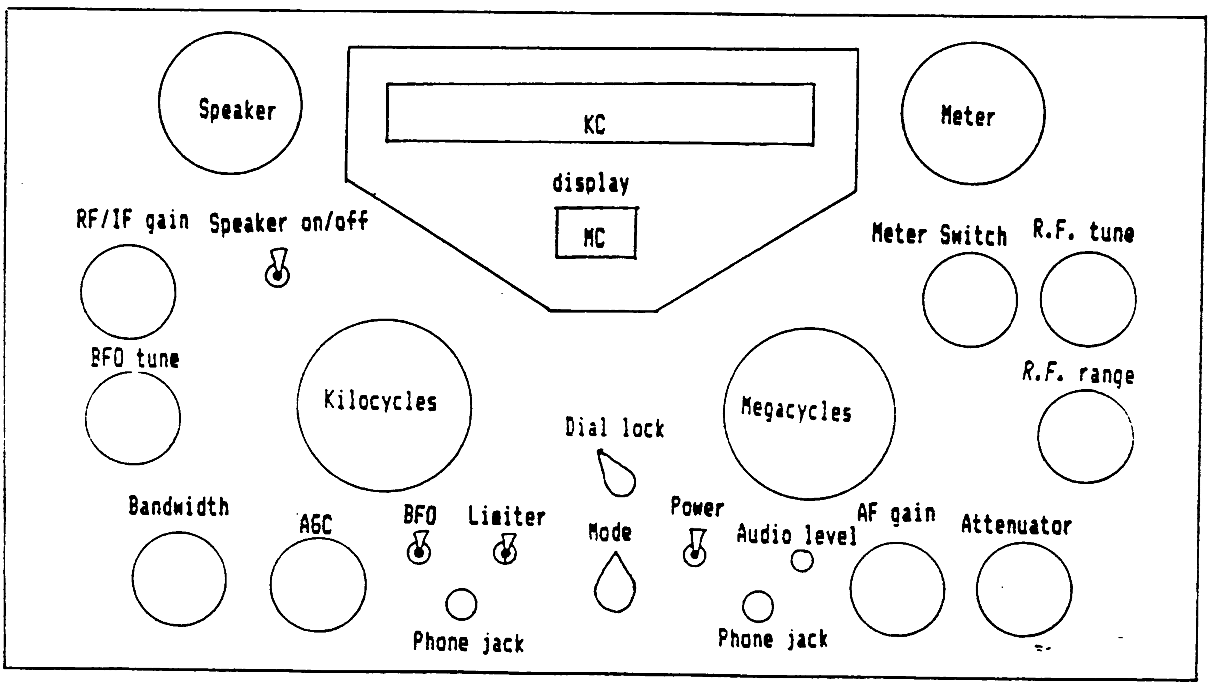
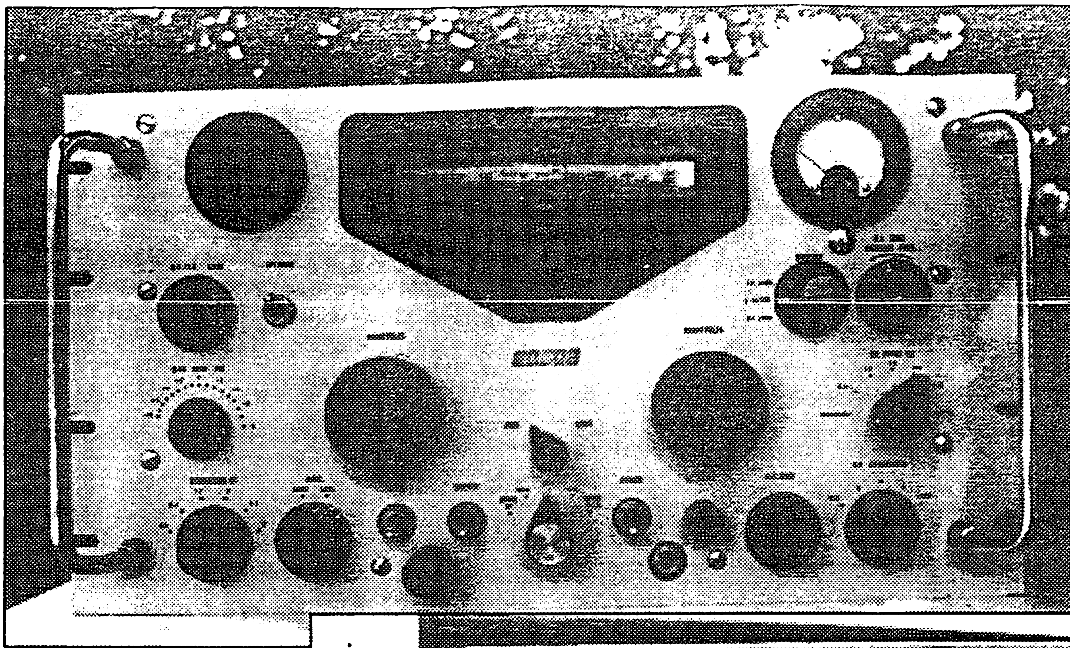
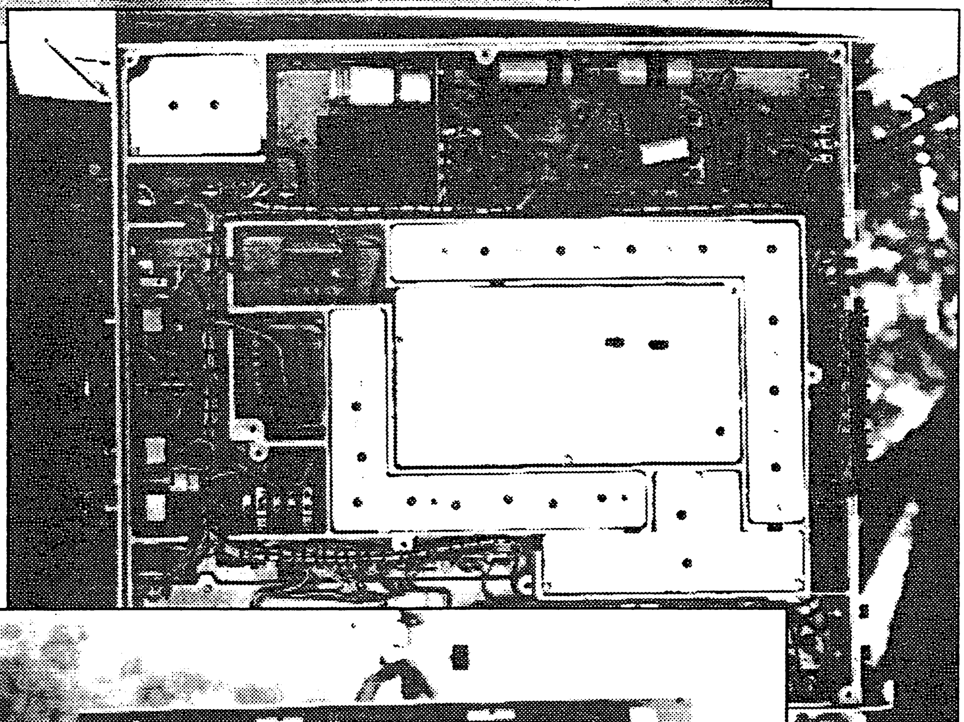


Figure 1

THE RACAL RA-17



Front Panel



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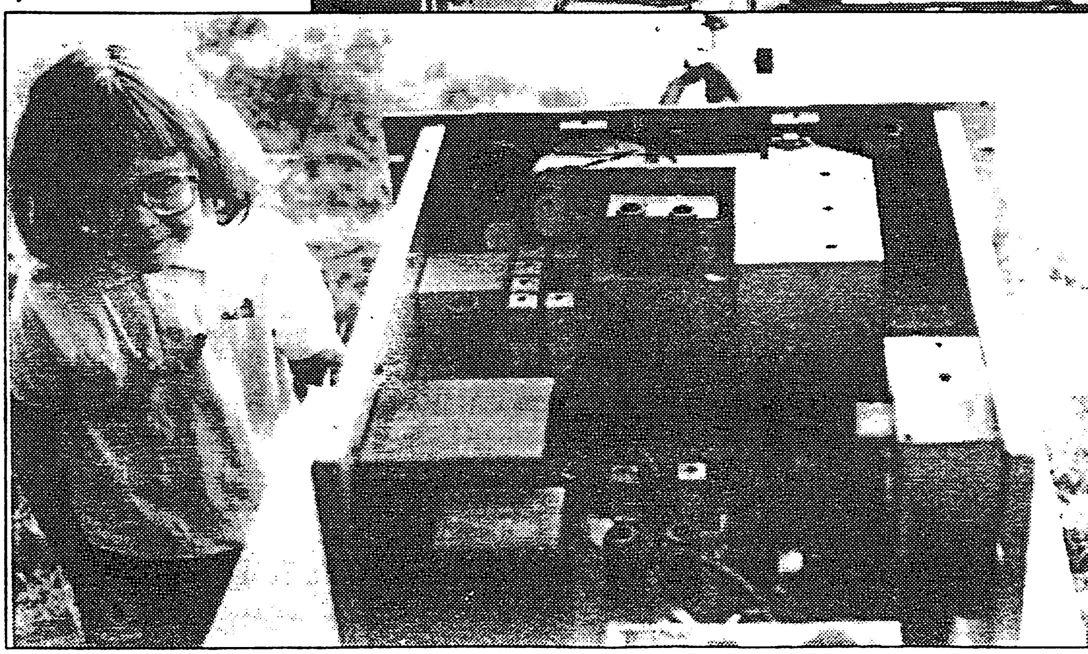
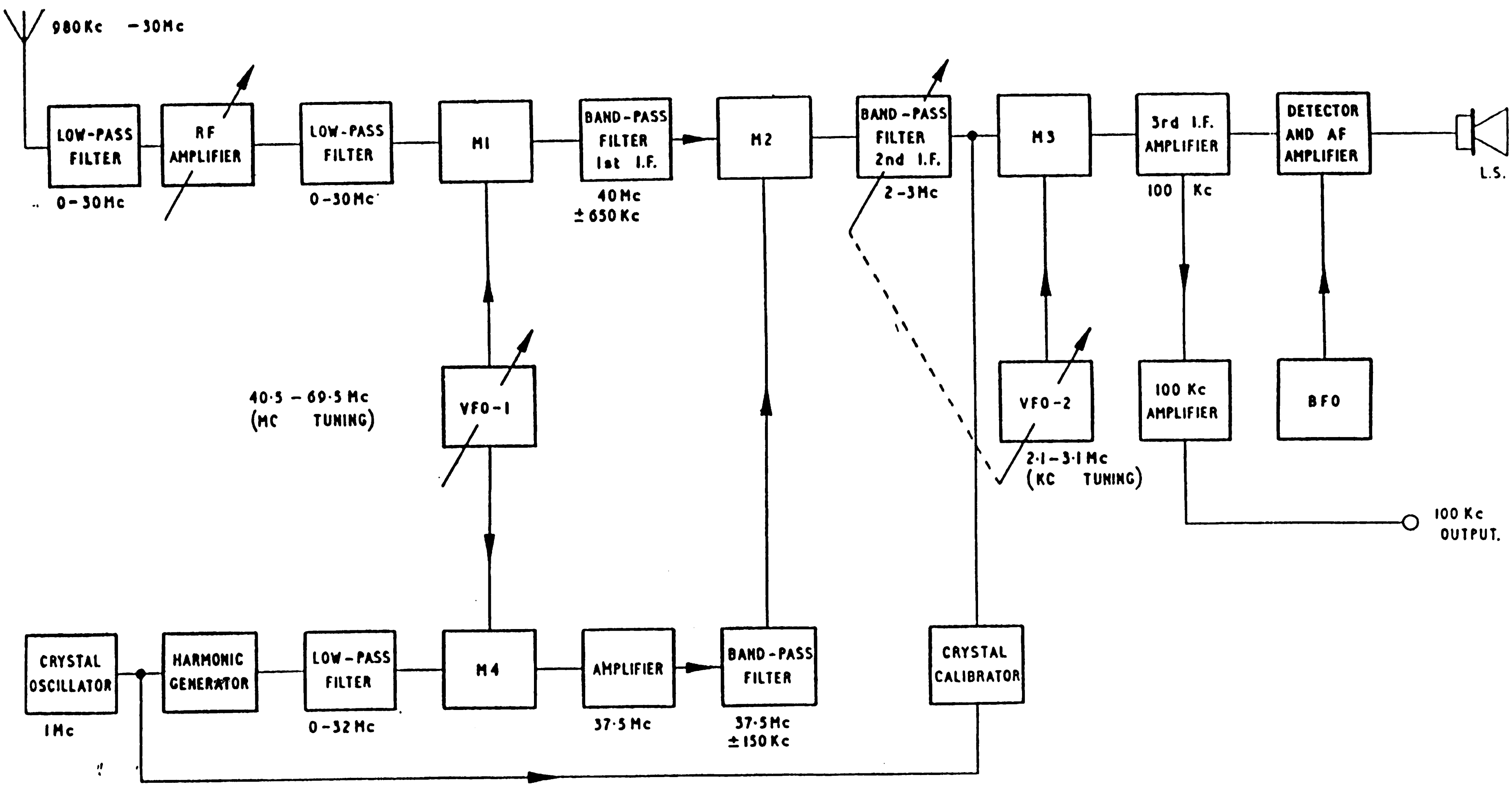
Photos and captions
by Staff



Teresa Portzer demonstrates the RA-17



BLOCK DIAGRAM OF THE RECEIVER

Figure 2

Some versions have other front panel controls, apparently for specialized user needs. Mine has a potentiometer with on-off switch in lieu of the second headphone jack. As near as I can tell, it functions as a fine tuning control (although it could conceivably be a form of passband or R-I-T tuning).

The rear of the receiver has a terminal strip with three fixed level audio outputs (3 mW, 600 ohms), one adjustable audio output (maximum level 10 mW, 600 ohms), the AGC line, and one speaker output rated for 1 watt into 3 ohms. The antenna input has an input impedance of 75 ohms. Mine had a type "N" connector, which I replaced with the more common UHF type connector. There are two BNC jacks with the output of the 100 kHz final i.f. stage. There is also an input for an external 1 MHz crystal oscillator (replacing the internal oscillator), an output for the internal 1 MHz oscillator, r.f. connections for an optional longwave converter (Racal model RA-137), and 220 volt DC output for the RA-137 or other external equipment.

The receiver takes a small amount of getting used to, but once you learn how to use it, it's easy to operate. It's ideal for those who like to tweak several knobs when tuning in a station. You won't enjoy this receiver if all you want to do is punch in the frequency and forget about it. First you set the megahertz control to the band you want to listen to, then use the kilohertz knob to select the rest of the frequency, then adjust the r.f. range and r.f. tune control. To tune in 1290 kHz, set the MHz control for "1" and the kHz control for "290". Then select the r.f. range control to "1-2 MHz", and adjust the r.f. tune control to peak the signal. It's possible to peak it on the wrong signal if there's a strong station on a nearby frequency, but with some practice and sometimes using the attenuator, you can get the hang of it. The other controls are more or less the same as you'd find on any other receiver.

Figure two is a block diagram of the receiver. Incoming signals pass through a 30 MHz low pass filter and a step attenuator. They then pass through an r.f. amplifier, which is tuned with a 7 position band switch and variable capacitor. The r.f stage uses a 6ES8 dual triode. The two halves of the tube are cascaded to form a two stage amplifier to "utilize the low noise high gain characteristics of the tube", as the manufacturer puts it. The r.f. stage output then passes through a second 30 MHz low pass filter. Racal was obviously very concerned about keeping stray VHF signals out of the receiver. The reasons will become ever more obvious in a moment.

The output from the r.f. stage is then mixed with the output of VFO-1 in a mixer stage utilizing a 6688, a tube known for its excellent intermodulation performance. The output from the mixer then passes through a 40 MHz first i.f. stage, which has a bandwidth of 1300 kHz.

In the meantime, the output from VFO-1 also mixes with harmonics of a 1 MHz crystal oscillator, which is amplified and filtered through a bandpass filter centered on 37.5 MHz. This signal then mixes with the output of the 40 MHz first i.f. in a second mixer stage, which also utilizes a 6688 type tube. The output of the second mixer is then about 1 MHz wide, centered on 2.5 MHz.

The above two paragraphs describe the process by which the receiver selects the "megahertz" tuning. The megahertz tuning knob tunes VFO-1. The output is mixed with a stable reference signal (a crystal oscillator), and in effect mixes twice with incoming signals, so the resulting output is quite reliable and stable. This is the Wadley loop.

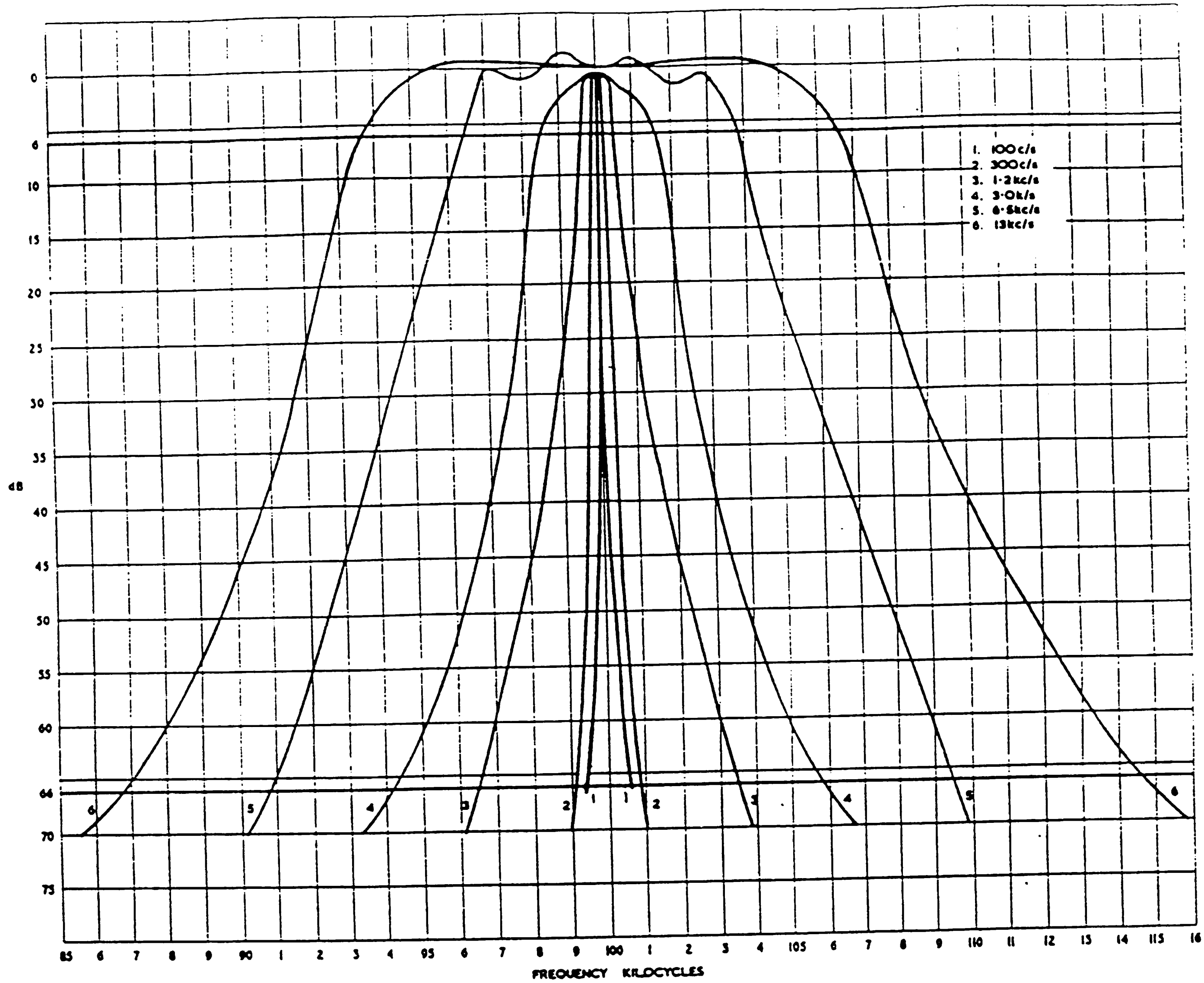
The second mixer down-converts the signals for the second i.f. stage, which is tunable from 2 to 3 MHz, and gives you the "kilohertz" portion of the tuning. The output from the second i.f. is down-converted to the 100 kHz third i.f., which in turn is followed by a diode detector for AM, and BFO or (on some versions) product detector for CW/SSB. There are also noise limiter, AGC, and audio output stages to complete the receiver. All this is done with 23 tubes. For those interested, Figure 3 is the selectivity curves from the receiver manual. It's possible to get better selectivity with mechanical, crystal, or ceramic filters, but for L-C type filtering, the bandpass is pretty good.

Because of the complexity of this circuit, Racal went to great lengths to filter and shield the heck out of everything in the receiver. A stray signal somewhere in the chain could have produced any number of spurious responses or other performance anomalies in the receiver. The receiver was, after all, built for government agencies and commercial users who had the money to spend. As a result, individual stages are physically compartmentalized in their own housing or a channel in the cast aluminum chassis. Extra band pass and low pass filter stages were included in the receiving chain. Feedthrough capacitors and ferrite beads were used extensively, particularly on power busses and wiring passing between stages.

HOW WELL DOES IT WORK?

My observations are based on published specifications, general impressions, and side by side comparisons with other receivers.

Sensitivity: The manual gives sensitivity as 1.5 uV for an 18 db signal to noise ratio, using a 30% modulated A2 (carrier modulated with a single tone) in a 3 kHz bandwidth, throughout its tuning range. By comparison, the published sensitivity for the five kilobuck Icom R-9000 is 1.0 uV for a 10 db S/N AM signal above 1.8 MHz and 6.3 uV from 0.5 to 1.8 MHz. In terms of original published specs, the edge actually goes to the Racal, especially on the medium wave broadcast frequencies. Moman found he could detect signals as low as 0.1 uV all the way down to 540 kHz. I have no reason to dispute the Racal's published sensitivity. In side-by side tests, the Racal, an FRG-7, and an HQ-180A were all able to receive the same stations on medium and shortwave. The Racal, however, had a tendency to load down a 4 foot medium wave loop, making it very difficult (and sometimes impossible) to peak signals on the AM broadcast band. The loop has since been placed in mothballs. A Radio West amplified ferrite loop works very well with it on medium wave.



TYPICAL SELECTIVITY CURVES

Figure 3

Selectivity: From a practical standpoint, I found the Racal's selectivity to be superior to that of an HQ-180A and an FRG-7 modified with a Collins 2.1 kHz mechanical filter. I thought the HQ-180A had good selectivity until I used it side-by-side with the Racal. When listening 10 kHz from strong locals on the AM broadcast band, such as KLSY-1540 and KMPS-1300, the Racal typically had listenable signals with occasional audio spikes from the locals, while the '180 had signals that were being severely trashed by the locals. This test was done by switching back and forth between the same antenna, with the HQ-180A selectivity set for 2 kHz and the Racal set at 3 kHz. Unfortunately, the next narrower selectivity setting for the Racal is 1.2 kHz, which is too narrow for useable listening. However, the 3 kHz selectivity setting is sharp enough to be more than acceptable under all but the most severe circumstances. Oddly enough, David Clark, who also owns both receivers, reached the opposite conclusion. The difference may be due to differences in performance of the individual receivers. My Racal is a later (C12A) version.

The performance compared with the FRG-7 was similar to that of the HQ-180A.

Audio Quality: Frequency response is specified as 250-6000 Hz +/- 4db, with the receiver selectivity in the 13 kHz position. Distortion is under 5 percent with 1 watt output. Overall, that's not bad for a communications receiver; the AM section of many stereo systems isn't that good. It's great for program listening with selectivity set at 6 or 13 kHz, and is still pretty good in the 3 kHz position, provided you use an external speaker. It gets even better if you run one of the external audio outputs into a stereo amplifier. The internal 2" speaker leaves something to be desired in terms of quality, but it's listenable. In side by side tests, I found the audio quality better than from the HQ-180A, but not as good as from the FRG-7. (I'm one of the seemingly few people who thinks audio from solid state receivers is better than that from tube receivers!)

Overloading, spurious signals, etc: The receiver will overload on strong local medium wave signals if you don't have the r.f. stage tuned properly. Sometimes I have to set the attenuator for 20 db or more to prevent the loop or the r.f. tuning control from peaking on the wrong signal on the medium wave band. Once the two controls are properly peaked, I don't have a problem. Overloading doesn't appear to occur at all on shortwave.

There appears to be almost no internal mixing from strong locals on the medium wave (AM) broadcast band, using a longwire or other broadbanded antenna. The short wave bands are almost clear of spurious signals from local AM or FM broadcasters. I'm relatively close to several high powered FM & TV transmitters, so nearly all of my receivers have some spots on the dial with bits of scratchy audio from one or more local FM broadcasters. The Racal isn't totally immune to this problem, but the problem is less severe than other receivers I own.

Overall, the Racal is more immune to these problems than other receivers I have used. Given all the filtering and shielding in the receiver, this is not surprising.

Readout Accuracy and Stability: Wonderful, at least for a receiver of that vintage. You have to adjust the marker on the kHz readout to maintain complete accuracy from one end of the dial to the other. But it's less of a problem than on other comparable receivers I've used. The maximum variation I've encountered in any 1 MHz band is about +/-2 kHz. Obviously, the accuracy is not as good as a synthesized receiver, but that's the way it goes. I haven't noticed any problem with drifting; not surprising since the specified stability is 50 Hz/hour after warmup.

LONGWAVE CONVERTER

An optional longwave converter, the RA-137, was designed for use with the receiver. Most R-17s available on the used/surplus market seem to have the longwave converter included with it. The converter tunes from 10 to 980 kHz, and is designed specifically for use with the RA-17 and one or two other Racal receivers. The converter requires external DC power and a local oscillator signal provided by the RA-17 or another source, plus 120 volt AC power. The output of the converter is 2-3 MHz, and feeds directly into the input of the second i.f. stage of the RA-17. For reasons I haven't figured out, my LW converter becomes insensitive with a longwire as you tune lower in frequency, unless you use a matching network or a longer longwire. Nick Hall-Patch, however, has the same model converter (minus the RA-17) and hasn't experienced this problem with it. Otherwise, the longwave converter works well with little in the way of spurious signals from local AM broadcasters.

SUMMARY

This is a receiver that was ruggedly built. Mine is still in good condition after years and years of daily use by the FCC. By contrast, the tuning knobs on my FRG-7 and HQ-180A (since sold) have required frequent tightening to keep them from falling off. I've owned the receiver for about five or six years and have had only one problem with it, a capacitor that went bad. Otherwise, it's continued to work just fine.

The receiver provides excellent performance. Sensitivity, selectivity, overload immunity, and audio quality are all equal to or better than that offered by contemporary communications receivers costing several hundred dollars. It "handles" well, if you don't mind tweaking about four knobs every time you make a major frequency change.

The going price for the receiver is about $150-200. For that amount, you get a solidly built, good performing tube-type receiver with probably the best analog readout ever made. For slightly more money, you can buy a Sony 2010 with many of the modern bells and whistles: digital readout, memory channels, synchronous detection, compact size, portability, and other niceties. But from what I can tell, the Racal provides you with better sensitivity, overload immunity, and selectivity. The tradeoffs between this vintage of receiver and more modern receivers lie in cost, performance, and convenience features (such as digital readout and memory channels). A Racal RA-17 scores well on the first two considerations, but not the third. There is also the less tangible mystique which surrounds this and other older high quality receivers like the SP-600 and R-390A. Their appeal is similar to owning a vintage automobile. After all, a '57 Chevy lacks a lot of really nice modern features, but most of us tend to say "oh wow" when we see one in good condition.

I must admit I enjoy this receiver. It's lots of fun to operate a "classic" receiver, sort of like driving a '67 Mercedes.

REFERENCES

1 "A New Receiver Tuning Principle", QST, March 1958
2. Racal RA-17UA Operating and Maintenance Manual, Racal Communications Inc., 1967
3. Portzer, Bruce, "The Racal RA-17", IRCA DX Monitor, January 7, 1989, page 2.
4. Moman, Don, "Racal RA-17 Communications Receiver", CIDX Messenger, July 1984, page 33.
5. Whitacre, Bill, "Racal RA-17: The Ultimate or Just Another Old Receiver?", NASWA FRENDX, August 1978, page 3.

THE ICOM IC-R71A RECEIVER
A 1991 APPRAISAL

David Clark

BACKGROUND

In 1979, two semi-professional receivers, the Drake R7 (later upgraded as model R7A) and the Japan Radio NRD-515 made their appearance in the SWL/Amateur Radio marketplace. While both of these rigs offered top-notch DX performance, their fully-configured $1500-2000 US price range in those days was beyond the budget of many hobbyists. About the same time, however, Japanese manufacturers, principally ICOM and Kenwood, were aggressively catering to the ham radio transceiver market with rigs that were beginning to exploit the emerging digital and microprocessor technologies. As is often the case with new technologies, they mature over time and the cost comes down. And so it was that in the fall of 1982, ICOM took the shortwave listening community by storm with the surprise introduction of the IC-R70 general coverage receiver at a "popular" price.

The design of the R70 was derived from the popular ICOM IC-720A ham transceiver and this heritage was manifest in a number of tuning idiocyncrocies. In spite of these shortcomings, the R70 introduced many shortwave listeners to several "long-forgotten" features such as a Notch Filter and a form of Passband Tuning (PBT). In addition, this innovative receiver offered modern conveniences like digital frequency readout with rock-solid stability and the convenience of dual VFO's - effectively a single channel memory. For a mid-range price of about $750, the receiver's on-air performance was in many respects like a dream come true, especially for DXers familiar with the so-called ECSS tuning technique. (Please refer to *Proceedings 1989* for a comprehensive review of the IC-R70.) [1]

ICOM clearly recognized it had struck a responsive chord in the marketplace. Less than two years later, in January, 1984, a grown-up version of their R70 brainchild was announced. First-released at a base price of $800 (and for a while retailing at less than $700, excluding options), the IC-R71A was destined to be a major factor in the "serious" tabletop shortwave receiver market into the 90's. The receiver has enjoyed an unusually long shelf life and is still being produced under the same model identification today (mid-1991). Regretably, due to a patent dispute, units manufactured after March 1989 have been devoid of the useful PBT circuit.

The original R71A continues to enjoy a favourable reputation as a high performance "DX machine". But in the face of more recent competitive offerings from Kenwood, Japan Radio, and the promising re-entry of Drake into the market, the price/performance ratio of the ICOM is *NOT* the clear winner that it was when first-introduced seven years ago as the mature follow-up to the revolutionary R70.

1984 - PERFORMANCE WITH PIZAZZ

For the most part, the R71A built upon the foundation established with the trend-setting R70 and the improved R71A software resolved most of the tuning quirks of its predecessor. Our present-day perspective is undoubtedly influenced by the capabilities of the gear that has become available in more recent times. We have seen the coming of the Kenwood R5000 and the Japan Radio NRD-525, each now of about five years' vintage (see reviews in *Proceedings 1990* and *Proceedings 1989* respectively). Now in 1991, both the new Drake R8 and the NRD-535 seem to offer great promise. But if we look back to 1984, many hobbyists found it hard to resist the temptation of ICOM's catchy advertising slogan - 'The Best Just Got Better'. I know...I bought the R71A, loaded with most of the available options!

Among the "firsts" for its time in "serious" SWL-oriented communications receivers, it sported a keypad for direct frequency entry, a dual-width Noise Blanker with a variable threshold control and 32 fully tunable memories, together with a number of scanning capabilities. Such optional niceties as infra-red remote control and synthesized voice readout of frequencies - useful for the sight-impaired - rendered a certain "sex appeal", albeit at extra cost. Provision was also made for an external computer interface. Software to control the receiver via this port never materialized from ICOM itself but was later provided in various forms by a number of third party vendors.

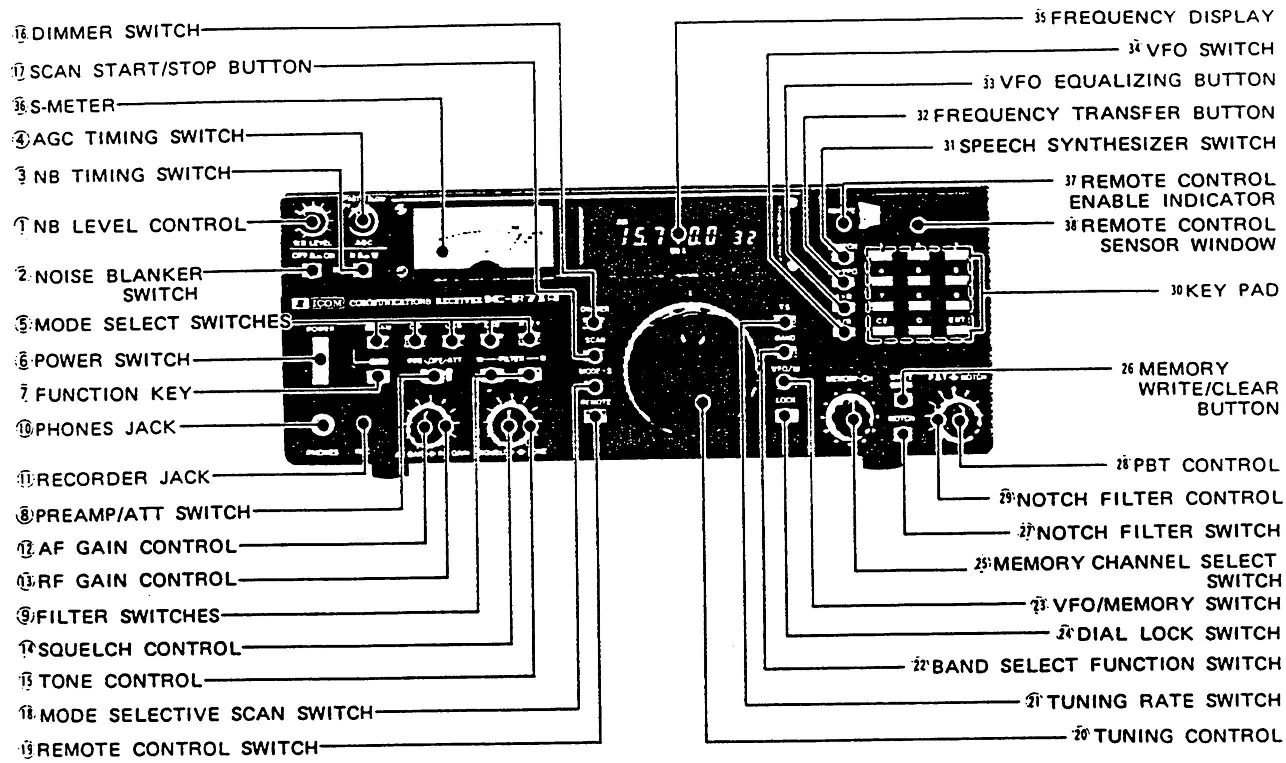


Figure 1 - FRONT PANEL LAYOUT

In terms of its all-important signal processing capabilities, several significant upgrades of interest to DXers were incorporated in the R71A. With a redesigned front-end, dynamic range was notably better. Although quality control (mostly alignment) had been a problem with some R70's, the R71A was, by most accounts, more reliably up to its rated specifications. While IF filter selection was achieved by an unnecessarily awkward arrangement involving two push-buttons, at least the filter selection was made mode-independent. The R70 offered only a single (wide) position for AM, rendering the PBT circuit of marginal use in that mode.

Traditionally, sensitivity "sells" and neither receiver was lacking in that regard, at least on the HF bands. High sensitivity with the switch-selectable preamplifier was complemented by low-noise receiver and microprocessor circuitry in the R71A. Taken together with the more flexible selectivity choices and high stability critical for ECSS, the "Three S" criteria (Sensitivity, Selectivity, Stability) combined to make the R71A the receiver of choice, especially for many DXers who were primarily interested in digging out weak shortwave broadcast and/or utility signals. The compact size and (optional) 12V DC capability made it an ideal rig for DXpeditions too.

Dual VFO's are a handy feature for checking parallels or "holding" a frequency in one VFO while bandscanning with the other. Switching between VFO 'A' and 'B' was improved in the R71A to the extent it was smooth and virtually instantaneous. Each VFO acts like the other 32 memories, storing the frequency and the operating mode.

To listen to a signal in ECSS mode, the carrier frequency can be stored in USB mode in one VFO and in LSB mode in the other VFO (or in two adjacent memory channels). It is then possible to quickly switch between VFO's (or memory channels) and to independently fine-tune the frequency of any signal if necessary. This technique circumvents the automatic 1.5 kHz (SSB) offsets that would otherwise necessitate retuning each time when switching between upper and lower sideband ECSS modes. The software "remembers" the latest frequency tuned in VFO mode. In memory mode, the stored frequency can be fine-tuned (and rewritten) as necessary.

Although user friendliness was improved, the R71A, like its predecessor, bristled with knobs and buttons. As indicated by Figure 1, the instruction manual describes thirty-eight controls and functions which are supported on the compact front panel. This provided the user with a lot of flexibility to cope with a variety of reception conditions. Even so, the well-laid-out but rather small controls were crowded onto the front panel. This hardly afforded the "sense of command" many DXers associate with a more traditional "radioman's radio" like the NRD-515 or the hollow state Hammarlund or Collins sets. When it comes to desktop operation in the shack, ease of use seems to me to far outweigh the "need" for miniaturization.

SOME SHORTCUTS AND SHORTCOMINGS

Considering that the R71A was brought to the market during a period of inflation for almost the same base price as the R70, one assumed that some shortcuts or design liberties must have been taken. Fortunately, ICOM's proven, quadruple conversion superhet design was maintained and as noted, the front-end was even improved. In addition, as we shall discuss, many of the limitations of the stock model could be overcome with relatively simple modifications.

To keep the price competitive, it would seem that the principal compromise was in the stock IF filter lineup: in the R70, good quality crystal filters were provided for AM wide (6 kHz) and CW/RTTY (500 Hz) in the 2nd IF. In the R71A, only a low-cost 6 kHz ceramic in the 3rd IF (PBT) was provided for AM wide, while the CW and RTTY positions relied upon the 2.3 kHz SSB crystal filter in the 2nd IF unless a separate CW filter ($50-60 price range) was purchased as an optional extra.

Both receivers, in their stock versions, provided only inexpensive ceramic filters in the so-called PBT circuit. This was a pity because ultimate selectivity was actually degraded when this variable bandwidth feature was invoked due to the poor shape factor of these filters. Note that the ICOM function labelled PBT is neither "passband tuning" nor "passband shift" as these terms are conventionally understood. Rather, the feature is intended to continuously vary (narrow) the bandwidth of the selected filter position by up to 500 Hz from either the upper or lower edge of the passband. "Variable bandwidth tuning" would be a more apt description.

The R70 design was one of the first to provide variable rate tuning capability down to as little as 10 Hz synthesized steps; further, a Receiver Incremental Tuning (RIT) control was also included. This permitted analog tuning resolution of a carrier frequency, necessary for "on-the-nose" (in-phase) ECSS reception. Unfortunately, the RIT control was dropped from the R71A, an inappropriate (cost-saving?) omission.

The R71A is wired to accomodate 12 volt DC operation but ICOM sure doesn't make much of it. It's not listed in the specifications and a one-liner in the manual merely refers the owner to an ICOM dealer. The DC connector must be purchased as an option: $10 bucks!! Can you believe it? At least the five minute installation job is a simple matter for any user.

Whereas the R71A no longer "dictated" USB/LSB selection according to amateur band conventions, the automatic 1.5 kHz offsets continued to be invoked when switching from AM mode to either sideband, and when toggling between upper and lower sideband. This would have been a major nuisance for DXers using ECSS mode, were it not for the availability of the second VFO and tunable memory channels as outlined above. What's more, the highly desirable IF Notch was operative only in SSB/ECSS mode. At least with the R70, the Notch was partially usable in AM mode.

Commentators have suggested the R71A was "tailor-made" for the serious SWL crowd. They must have been thinking only in terms of strong, clear channel signals which are readily tunable in AM mode on the International Bands. Even at that, wide AM performance often suffers in the face of typical 5 kHz channel spacing on the HF bands and the wide position is virtually useless on the Tropical Bands. A mid-range bandwidth (say 4 kHz) with good skirt selectivity is sorely needed. Of course, the NRD-525/535 share the same deficiency! ICOM and Japan Radio, even today, could afford to learn a lesson from Drake. The new Drake R8 utilizes L/C tuned circuits in the 50 kHz 2nd IF (instead of ceramic and/or crystal bandwidth filters). Otherwise, it continues the 1982 tradition of the expensive R7A, offering a range of five well-selected bandwidths, including 4 kHz, with better than 1:2 shape factors.

"Japanese audio" has been an irritation to many for more than a decade. Some optimists originally suggested that the audio output of the R71A was significantly improved over the R70. Indeed, the R71A Manual states that the detected AF is fed into "a high performance and low distortion AF power amplifier IC". Rubbish! In lab tests, AM distortion was found to be inordinately high, especially at the lower audio frequencies. The Tone control is of little use because it merely cuts treble response. As one reviewer wryly asserted, the Tone control, such as it is, should be permanently welded in the full clockwise (maximum treble) position. Judicious adjustment of the PBT control and the Notch Filter (in ECSS mode, or in AM mode with modification) near the carrier frequency serves to alleviate the muddy low-end response to some extent.

The front panel of the R71A is so busy that there was no room for a forward-facing speaker as provided on the R70. ICOM might as well have not bothered with the flimsy, top-firing speaker in the R71A. An external speaker is highly recommended; at least it will mask the distortion of the audio stage to some degree. The contemporary Kenwood R5000 receiver is widely acknowledged to provide much more "pleasant" audio, especially for extended periods of program listening. Early reports also indicate that audio quality *far superior* to ICOM or Japan Radio receivers is a strong suit of the Drake R8. Still, I personally don't think any solid state communications receiver that we have seen to date can hold a candle to the "intelligible", low distortion audio which is delivered by many of the older, better-grade tube-type receivers.

The R71A provided three different scanning modes and two selectable scanning speeds, with or without squelch. The problem is that the combination of the inadequate threshold level of the squelch and a pre-set scan speed that is too fast mean that it is almost impossible to spot weak DX signals in any scanning mode. There is an internal pot that can be adjusted to slow the scan speed. In any event, scanning capabilities may be of some value to utility DXers but I have not found them to be of much use as a SWBC DXer.

A year after the R71A made its appearance, there was a short-lived rhubard in the SWL press when it was learned that the lithium "back-up" battery didn't just back up the data contents stored in the memory channels. In fact, it was also required to maintain the program functions in the "volatile" Random Access Memory (RAM) when receiver power was shut off.

After some waffling on the subject, ICOM said that the battery was more likely to last fifteen or more years, not just five to seven years as originally prescribed. In the event of battery failure, ICOM said it would re-program the RAM board and supply a replacement battery for about $25. In the end, however, a technique was found so that the battery could be replaced periodically before it expired, without the inconvenience of removing the RAM board and shipping it back to the factory service centre.

1989 - THE 'BEST' IS NO LONGER BETTER!

Eliminating the PBT circuit with no change in list price (now $999) amounted to a de facto price increase early in 1989. Worse still, the marketing geniuses at ICOM chose not to change a "winning" model identification - pretty deceitful to the unsuspecting consumer!

The bottom line, however, is that the absence of a PBT circuit (including an appropriate substitute filter) *SERIOUSLY DETRACTS* from the "new" R71A's merit as a DX receiver, at least in its current $850+ retail price class. I understand that at least one supplier, Electronic Equipment Bank, is (or was) prepared to "restore" the PBT functionality but at a cost of more than $100. With that, we're well on the way towards $1,000 and we haven't even talked about options or modifications yet!

In 1991 there are plenty of "original" R71A's (often with some of the ICOM options or other modifications already incorporated) available on the used market for much less money. Look for the concentric PBT/Notch controls in the lower right-hand corner of the front panel as shown in Figure 1 - that's the one you want. I strongly advise avoiding the "new" version.

OPTIONS AND MODIFICATIONS GALORE

A glance at the 1985 catalogue of one of the major SWL suppliers reveals that a stock R71A could be had for an attractive $659. But as soon as an enthusiastic buyer started loading up on a number of the available options, it wasn't too hard to get the eventual price-tag up in the $900-1100 range. (By this time, the older but top quality Japan Radio NRD-515 had been discounted to a comparable $1,000 price level, in advance of the release of the '525'.)

The RC-11 remote control unit (about $60) was interesting in that it allowed memory channels to be called up and entered directly. Notwithstanding ICOM's somewhat misleading advertising, the keypad on the receiver could not be used to access/update memory channels directly. It is necessary to manually select a channel using the memory channel switch and to hit the memory/write button after punching up a desired frequency.

Both the R70 and the R71A exhibited excellent frequency stability. The R71A is rated as having less than 50 Hz variation after more than one hour. I found it to be virtually drift-free for extended periods of time in ECSS mode so the optional CR-64 high stability crystal oven (approximately $55) is not required, except perhaps for professional applications.

Fortunately, many of the inherent limitations of the stock R71A could be resolved with modifications. As an information source, I highly recommend the *ICOM R71A Performance Manual* which was published by Don Moman in 1985. [2] This manual is *THE* required reference for every owner or prospective owner of the R71A and the $10 price is right. It contains a useful summary of the operating features of the receiver and is a gold mine of information detailing a host of performance-enhancing modifications and upgrades.

I will not devote time describing the wiring changes and other specifics associated with modifications mentioned below. The reader should refer to the manual. Some of the modifications cited originated with other hobbyists and are acknowledged in the text. Don also provides simple, step-by-step procedures for alignment and other adjustments to bring the receiver to specification without the necessity of having an RF signal generator and a digital frequency counter. That is worth the price of the manual alone!

RF SECTION:

As noted, sensitivity on the HF bands is first-rate, especially when the low-noise preamp is switched on for weak signal reception. Below 1600 kHz however, the preamp is disabled to reduce the possibility of front-end overload and degraded dynamic range in strong signal environments. For MW DXers, a simple modification (involves cutting one wire in the bandpass filter section) is all that's required to enable the preamp to kick in, down to about 500 kHz. (A similar modification to the R70 extended the preamp range down to about 200 kHz, thus covering most of the overseas LW broadcast band as well.) The second step is to bypass a fixed attenuator in the MW bandpass filter circuit. These changes are especially desirable for MW DXers using loop antennas. The sensitivity improvement in both receivers is quite significant: 15-20 db additional gain!

This is an opportune time to mention that the owner of the R71A (or any other solid state receiver) ought to take precautions to provide some kind of RF protection from static buildup. The front-end of the R71A tends to be more immune to high static levels than some other receivers but it is unprotected nonetheless. Some receivers like NRD-515/525/535 employ back-to-back or series diodes to limit RF voltage at the antenna input but they cause rectification problems with strong signals.

A trick that Don describes in his manual overcomes this problem but still provides a worthwhile degree of protection. The simple procedure is to install a small neon bulb (the NE-2 available from Radio Shack has a firing voltage of about 70 volts) and a small resistor (10K ohms at 1/4 watt) in parallel with the antenna input and the chassis ground. The resistor acts to "bleed" off static charges before they reach the 70 volt level but if that point is reached, the neon bulb will then conduct heavily, thus limiting the voltage potential at the antenna input. Don tells me "I have never blown a front end on any set that had the neon bulb modification, even though I've seen in flashing merrily away with large thunderstorms in the area".

Of course, neither this arrangement nor any of the commercially available "protection" devices will be of much use in the case of a direct lightening hit. The only safe recourse with the approach of an electrical storm is to physically disconnect the antenna *AND* the AC power source.

IF SECTION:

The one "must-have" option for the serious DXer was the FL44A, a high quality 2.4 kHz eight-pole crystal lattice filter which replaced the 2.8 kHz ceramic in the PBT circuit. This filter was not cheap at $150 but it provided far superior ultimate selectivity for narrow (ICOM called it "normal") AM and SSB/ECSS. Alternatively, some DXers opted for a Collins mechanical filter in one of several available bandwidths which could be optionally installed by some dealers, including Universal Radio.

The subject of IF selectivity merits further discussion because the manner in which the various filter combinations (including the PBT circuit) were invoked, depending on mode and position selected, was quite complex. ICOM did not make matters any easier to understand: the published specifications were incomplete and the manual contained misleading information in this critical area.

To assist owners and prospective owners of the R71A, Figure 2 shows the mode/filter combinations for both the stock version and as altered when the optional 2.4 kHz PBT and CW (2nd IF) crystal filters were incorporated. [2]

MODE	SELECTED> POSITION	WIDE	NORMAL	OPTIONAL NORMAL	OPTIONAL NARROW
AM	- 6db -60db	6.1 11.0	2.8 4.7	2.4 3.1	(Same as Normal)
	2nd IF 3rd IF (PBT)	-- 6 kHz Ceramic	2.8 kHz Crystal 2.8 kHz Ceramic	2.8 kHz Crystal 2.4 kHz Crystal	(Same as Normal)
SSB/ ECSS	- 6db -60db	2.8 4.7	2.2 3.3	2.2 3.3	(Same as Normal)
	2nd IF 3rd IF (PBT)	2.8 kHz Crystal 6 kHz Ceramic	2.3 kHz Crystal 2.8 kHz Ceramic	2.3 kHz Crystal 2.4 kHz Crystal	(Same as Normal)
CW	- 6db -60db	(Same as SSB)	(Same as SSB)	(Same as SSB)	0.25 0.90
	2nd IF 3rd IF (PBT)	(Same as SSB)	(Same as SSB)	(Same as SSB)	250 Hz Crystal 2.4 kHz Crystal

Figure 2 - IF FILTER CONFIGURATIONS / MEASUREMENTS: STOCK AND OPTIONAL

Other selectivity modifications (not reflected in Figure 2) were also possible and are outlined in Don's manual. For example, unless you were a utility DXer requiring a narrow CW filter, the unused 2nd IF slot could be wired to incorporate the better 6 kHz crystal as found in the R70 for improved AM wide performance. The FL-33 filter (costing about $40) yielded selectivity measurements of 5.8 kHz at -6db and 9.6 kHz at -60db.

Taking matters a step further, a tighter ceramic (such as the 5 kHz filter which Sony uses for narrow selectivity in the ICF-2010) could be substituted for the stock 6 kHz PBT ceramic. Don told me about this particular filter although it is not mentioned in his manual. The pin-for-pin replacement makes substitution a simple matter. This filter does significantly improve the performance of the PBT in wide AM and to some extent in wide SSB/ECSS mode. Don says that he has also used it to good effect in other rigs which he has owned, including the ICOM IC-735 and the Kenwood TS-440. The Sony part number is 1-527-569-00.

Don cites other ceramic filters that can be used for this substitution, although some mechanical and electrical expertise is required to perform the installation. For example, the Vernitron VTD-3-I, a better-grade 4 kHz ceramic, yields selectivity of 4.3 kHz at -6db and only 6.6 kHz at -60db when used in combination with the FL-33. Terrific!

Now that we've invested the effort to improve AM selectivity, wouldn't it be nice if the Notch Filter could be made to operate in AM mode? Well, as Don describes, this very worthwhile enhancement can be accomplished quite simply: all that's involved is splicing in one resistor in the IF section. The notch will now cover the range of +1200 Hz to -1500 Hz in AM mode - quite adequate for most close-in hets, especially when one considers that the notch depth is superb, measuring close to 100db reduction!

Modifications in the IF section are rounded out by adding a jumper wire between two diodes near the filter switch which must also be set to the "on" position. The effect of this change is to enable true PBT with the R71A, a capability which Drake made famous with the R4 Series and the R7/R7A. Thus, the PBT filter (3rd IF in the R71A) can be positioned anywhere in the passband, making it possible to move between the upper and lower sidebands without retuning. Rotating the PBT control is a neat trick for tailoring the audio response to the individual's liking too, even if there is not a problem with an interferring signal.

IMPROVED SYNCHRONOUS DETECTION:

Since I am a fan of ECSS, I bemoan the lack of RIT. One cannot fine-tune within the minimum 10 Hz synthesizer tuning steps. Don provides a solution for this that I have never seen elsewhere. The modification involves moving the MASTER CAL trimmer to the tone control (no loss since since it should be left in maximum treble position anyway). The result is plenty of RIT range on either side of the tuned frequency. With a good ear you can now get perfect phase-match in ECSS mode when reception conditions warrant using that tuning technique.

One other problem in SSB/ECSS mode is the greatly reduced audio output as compared with AM mode. Installation of one resistor in parallel with another in the audio section serves to provide a modest increase in the audio output from the product detector IC while leaving the AM mode output undisturbed.

Moman's manual does not address internal or external add-on synchronous detection devices which can used to reduce the effects of selective fading. They are worth considering because they also provide much better audio quality than can be obtained by operating the R71A "barefoot" in ECSS mode. Units which employ either the phase lock loop (PLL) or the non-phase lock loop (non-PLL) principle can be used. The various means by which synchronous detection can be achieved and the advantages of each are clearly explained in an article by Craig Siegenthaler in *Proceedings 1990.* [3]

For those prepared to invest an additional $200 or so, perhaps the "ultimate" in PLL synchronous ECSS reception was available by purchasing the ESKAB/EDVIS 'Phase Locked AM [PLAM] Board'. Early editions of this add-on unit were manufactured for the R70 and well as the NRD-515 but they are quite rare. The PLAM board for the R71A was more widely distributed. Mine was purchased from and installed by Don Moman. The installation procedure is rather beyond the capabilities of an electronics neophyte like me!

Briefly, the PLAM board enables the user to obtain phase-locked AM reception using the product detector of the R71A in USB or LSB mode. Once installed, it is activated by placing the noise blanker 'Width' control in the "wide" position. The lock range is in the order of 50 to 70 Hz relative to the carrier frequency of the intended signal. PLAM lock is indicated by a steady glow from the 'Function' LED on the front panel of the receiver. The PLAM works well with moderate level signals, provided there is not another interferring carrier in the passband. ESKAB therefore recommended (and supplied) an optional 4 kHz crystal filter that could be fitted in the available 2nd IF slot (instead of ICOM's 6 kHz FL-33 as discussed previously). This filter provided an ideal bandwidth for effective performance in phase-locked, as well as normal AM mode on the SWBC bands.

As with other PLL synchronous detectors, it tends to exhault background noise as well as the desired signal, thus rendering it less useful for weak signals, except under very quiet conditions. I have found on occasion that the circuit helped pull a very weak signal up out of the mud. The absence of an RIT does make the PLL device somewhat "touchy" to operate. A similar PLAM board is presently available from ESKAB for the NRD-525 but the R71A version may not be available now, except where already installed in a used receiver.

Other R71A owners or prospective owners might consider the MultiBand AM Pickup (MAP) unit currently available from Kiwa Electronics as an appropriate alternative. ECSS reception is not possible when the MAP is used with the R71A (or the R70) because the receiver's product detector follows the 4th IF which functions at 9 MHz - the MAP operates at the more conventional 455 kHz. However, the MAP offers the capability of (non-PLL) synchronous detection in AM mode, additional stages of IF filtering and *vastly improved* audio. A full review of this high quality add-on unit can also be found in *Proceedings 1989.* [4]

OTHER:

One other audio-related modification is worthy of note. The fixed record output level in the stock R71A is limited to about 100mv, as compared with the standard "line" level of .775v at 600 ohms. This is inadequate, especially for very simple portable recorders. A modification whereby one offending resistor is shorted out serves to triple the signal level. Why risk having an unnecessarily poor recording of those once-in-a-season DX catches?

Finally, Bob Grove describes a solution for the potential expiration of the lithium battery. [5] To paraphrase his explanation: With bottom plate cover removed, locate the backup battery near the centre, plug in power to the receiver and turn in on normally so that the RAM circuit will remain powered up, even when the original battery is removed. Unsolder the old battery, ensuring that a soldering iron having a non-grounded tip is used (so as not to short out the grounded power supply in the process). Remove and replace the battery with a fresh one. Performing this surgery about every five years should ensure that the receiver functions will not die due to loss of the operating software. I've had my R71A for seven years now and it still holds the original battery. I wonder if I'm living on borrowed time?

THE LAST WORD - A 1991 APPRAISAL

In my opinion, there is no doubt that the "original" ICOM IC-R71A continues to be a *very capable DX receiver*, even by today's standards. A clean, used R71A (ie. a unit manufactured before March, 1989) which has been fitted with the FL-44A filter, or an appropriate substitute Collins mechanical filter, in the PBT circuit is a worthwhile buy for $750 U.S. or less (as is the venerable NRD-515).
I would not advise paying more than $600 for an "original" R71A if the PBT filter has not been upgraded. Alternatively, if one's hobby budget is a constraint, the predecessor R70 remains a relative "bargain" in the $350-400 price range. Of course for that money, or even less, this writer would be looking first for a well-preserved Hammarlund SP-600, HQ-180 series or Collins R-390A...and I already have all three of these boat anchors. Old habits die hard!

I reiterate my belief that the "new" R71A should *NOT* be purchased at the current $850 retail. For about the same outlay, the Kenwood R5000 would be the better buy, brand new, for all 'round DX and program listening purposes. Moving up the pricing ladder to somewhat more than $1100, the NRD-525 has been the serious DXer's "receiver of choice" for the past five years. The '525' is not without its "blemishes" either, but Guy Atkins describes many worthwhile modifications and upgrades elsewhere in this edition of *Proceedings*.

If the price is right and you are inclined to tinker,invest ten bucks for Don Moman's Performance Manual and have fun with the R71A. You will certainly hear lots of DX with it. But I'll conclude this appraisal by hedging my bets. Earlier this year, Japan Radio purported to "re-write the standard" by which other receivers are judged with the release of the new NRD-535D in North America. It contains several interesting built-in enhancements over the '525': a PLL synchronous detector and a variable bandwidth control. It is also reported that the aggravating IF "white noise" inherent in the '525' has been cleaned up. It remains to be determined, however, if the NRD-535 "delivers" on its stock $1600 price-tag, especially since the stock IF filter lineup remains unchanged. Regardless, human nature being what it is, many '525' owners will probably jump on the bandwagon and "upgrade" to the '535'. Do we detect some emerging bargains in used '525' receivers?

At the April/91 Dayton Hamfest, a pre-production model of the new Drake R8 was showcased and garnered a lot of attention. The R8 also features a PLL synchronous detector and on paper appears to carry over many of its *very impressive* specifications from the vintage R7A. The proof of the pudding will be in the performance and an encouraging picture was beginning to emerge as this article was being completed in July, 1991.

Guy Atkins was one of the early R8 purchasers. He expresses some concerns with the ergonomics and operating software. But he does report that when it comes to tough-signal DX performance, "this radio really cooks", the equal of a Drake R7 and an NRD-515 in side-by-side comparisons, with vastly superior audio quality to boot!. While hunting trans-Pacific "splits" on medium wave, sometimes separated from powerful domestics by only one or two kilohertz, Guy found the Drake's 1.8 kHz selectivity was not quite the equal of a 1.9 kHz Collins mechanical fitted in a '525' but that's a mighty demanding test!

I think it's a pretty good bet that the Drake R8, at an indicated retail price of $960, will emerge as the "hot" item of the year among SWBC DXers and perhaps will remain-so for some years to come, just as the R71A did in its heyday. I'm sure you'll be able to read all about these recent offerings from Japan Radio and R.L. Drake in *Proceedings 1992*.

REFERENCES

[1] Atkins, Kevin; Strawman, Jerry; and Tow, John. "The ICOM IC-R70 - A DXers Review, Technical Description and Modifications". *Proceedings 1989*. Fine Tuning Special Publications, 1989

[2] Moman, Donald. "ICOM R71 Performance Manual". Shortwave Horizons, 1985

[3] Siegenthaler, Craig. "Synchronous Detection". *Proceedings 1990*

[4] Atkins, Guy. "The Kiwa Electronics' Multiband AM Pickup". *Proceedings 1989.*

[5] Grove, Bob. "Ask Bob" column in Monitoring Times, June, 1990

SELECTED BIBLIOGRAPHY

Lichte, Rainer. *Radio Receiver - Chance or Choice*. Gilfer Shortwave, 1985

Magne, Lawrence. "WRTH Tests Full-Size Receivers". *World Radio TV Handbook, 1985*. Billboard Publications, Inc., 1984

Magne, Lawrence. "RDI Evaluates The ICOM IC-R71 Receiver - A Radio Database International White Paper" (Edition 1.2 and Addendum). International Broadcasting Services, Ltd., 1988

McCoy, Lew. "The ICOM R71A General Coverage Receiver" in CQ Magazine, August, 1984

Moman, Donald. "ICOM IC-R71A: The Best Just Got Better - Or Did It?" in The Messenger (Canadian International DX Club), July, 1984

Moman, Donald. "Receiver Comparison Guide" in The Messenger (CIDX), November, 1984

Tow, John. "A Critical Review of The ICOM R-71A" in FRENDX (North American Shortwave Association), July, 1984

THE PHILIPS DC-777

SHORTWAVE LISTENING IN THE CAR IS NOW A REALISTIC CHOICE

Terry Palmersheim and John Grimley

Shortwave radio in the car is not a new concept. Since the end of the second world war, a number of radios have been produced for the European market with shortwave capability. Often such coverage was restricted to the 49 metre band and little else, mainly because Europe used this band (and still does) for short-range broadcasting to its own and to neighboring countries.

In the sixties, John had such a radio in the U.K., a Sony 7F-74DL, a rare model, which consisted of a metal housing case, mounted below the dash, in which was slotted an analog receiver, with all controls on the front face, looking very like a conventional two-knob car radio. It could be removed from the housing and, using its internal batteries and its own antennae, doubled as a portable "transistor", as they were called then. It had long wave, medium wave, VHF (our FM band), and one shortwave band which covered 5 MHz to 18 MHz! Sensitivity tailed off towards the band limits and there was no fine tuning control, either. Needless to say, tuning shortwave stations was an adventure and as the band was tuned, stations would appear at the speaker with a distinct "plop" sound. But, once tuned, the thing delivered very solid-sounding audio into the car.

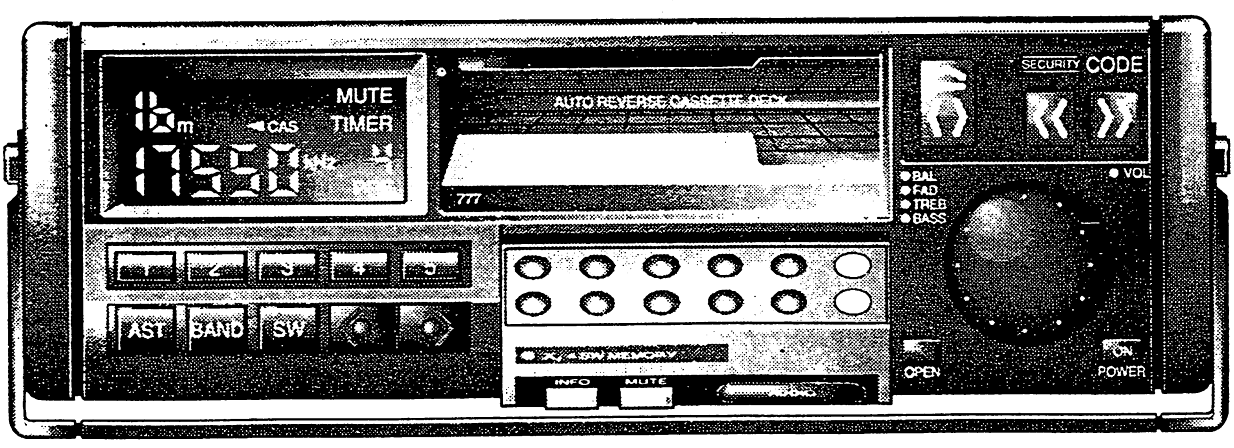
THE DC-777

Add digital tuning, miniaturization and most of the other trappings, improvements and performance of today's typical shortwave portable by Sony or Panasonic; take away the duplicate antennae and the batteries and you'd have something close to the Philips DC-777—the first breakthrough in affordable, credible shortwave radio for the car; certainly, at least, in North America (with apologies to Blaupunkt!).

The fact that the DC-777 is marketed in North America at all started as somewhat of a sideline. It is clearly manufactured for the European market, with its long wave, "medium" wave and "VHF" coverage. The original model had 9 kHz channel spacing on the AM band and the unit had the capability to tune in European FM sub-carriers, which are used there to carry road traffic reports and the like.

VERSION I

The first version available here was publicized by Philips and by other pre-release sources as being the same as the European version. When it hit the streets here, in the Spring of 1990, it had no long wave (just as well), the channel spacing was 10 kHz on AM (just right) and there was no FM subcarrier capabilty (very little used to date in North America). It was just what was needed. And with a price, including the housing unit, of US$399 at Universal Shortwave it was steal. All this and an auto-reverse audio cassette deck included as well. John owns version I. Towards the end of 1990 Philips pulled this model from the North American market, replacing it with a second version.



VERSION II

Terry owns version II. It is essentially the same as the European model. The mounting housing is no longer supplied by Philips and Universal accordingly dropped their price by twenty bucks. Very fair. Because of fairly wide selectivity and single kiloHertz tuning increments, 9 kHz channel spacing is not really a problem. Memories can hold frequencies to an accuracy of 1 kHz, too. (Thoughtfully, Philips designers have provided 10 memories each for AM and FM and 20, in 4 banks of 5, for shortwave.)

ENTER VERSION III

In response to a letter by Harold Sellers of the ODXA, requesting literature on the product, Mrs. Imme Giomb (Philips Car Stereo International, Box 1440, D-6330 Wetzlar 1, Germany) writes, "We would like to inform you that a DC-777 specifically designed for US reception circumstances will be available from July 1991 onwards." On that basis, version three should be available in North America by the time this article is published and, hopefully, Philips will have got it right this time.

APPROACH

Installation of the radio will be discussed first, since most will be user-installed. Discussion will then centre on the important features and aspects of the receiver, followed by an evaluation of its performance.

Much of the text reflects the authors' common viewpoint and experience, but individual preferences and experiences are also included, where appropriate. The intention is to provide a balanced perspective for those who are considering shortwave radio for the car.

INSTALLATION

The DC-777 is no more difficult to install than other modern digital auto receivers. Note that there are two power leads; one from the ignition switch and one connected directly to the battery, used to maintain memory, time and security system data. As the DC-777 is a standard DIN-sized deck, installation in many North American cars which do not conform to DIN may pose problems and may entail the purchase of an aftermarket mounting bracket. European and Oriental cars usually conform to this DIN standard.

All of the necessary electrical connectors are supplied with the radio, with most having about six inches of wire attached. The power and ground leads are, necessarily, longer. Two four-wire and two two-wire terminal blocks are supplied, with screw type fasteners. They are not required but their use eliminates soldering. All speaker leads (two or four speaker system) are of the two-wire variety, plus and minus, and do not use a common ground. It is recommended that the existing connecting block(s) on the car's speaker leads not be removed and that, if necessary, an adapter be inserted between them and the DC-777's connector block. This makes it very easy to reconnect the original radio if the car is to be sold.

The DC-777 is protected by a 7.5 amp blade type fuse, mounted in the connector block, instead of the usual in-line fuse found on many other auto receivers. All plugs and sockets are keyed to ensure correct connection. The antenna connector is a standard Motorola fitting. There are two other sockets on the connector block. These are not referred to in the manual. Only the wiring labels suggest their intended use. One is labelled 'remote control' and is used to operate a remote antenna motor and the other provides line level outputs (e.g. to an external amp and/or equalizer).

If the car does not have a standard DIN aperture, Radio Shack and some automotive stores market conversion kits; but they do not, of necessity, cover all makes of North American cars. You may need to resort to some minor surgery on the dash board, as John did, or incur the expense of a professional installation job.

Note that the radio's pull-out handle may be mounted to be recessed over either the top or the bottom front edges of the radio. Be sure to mount it along the top edge; mounting along the bottom can impede the operation of some of the controls on the lower front face.

SCAN TUNING

There are five memory presets each for LW, MW and FM. Twenty memories are available on SW. These are accessed through a row of five buttons under the digital display. The display indicates which memory is being used. There are, in fact, ten memories each for MW and FM. The extra five per band are accessed via the 'AST' button. AST stands for Auto Store and functions only on MW and FM. Pressing this button causes the DC-777 to mute and search the selected band. AST flashes and, if there are sufficient stations of reasonable signal strength, the radio loads into memory the strongest five stations found during the search. These five are now accessible through the memory buttons. Pressing the 'Band' button returns normal MW and FM memory operation. The AST thus effectively provides a memory expansion and is especially useful for those who travel widely by car, in areas where the local stations may not be known.

Philips mentions that 'Search' tuning (up and down arrow buttons) is accomplished at three different sensitivity levels (LW, MW and FM only). The DC-777 searches for high signal strength stations first. If none are found, the receiver increases its sensitivity and tries again. And so on. On SW, searching is done only within the pre-programmed SW broadcast bands (but direct access tuning will reach frequencies outside these bands). It mutes during the search process on all bands. The search function is a useful aid to finding stations whilst driving.

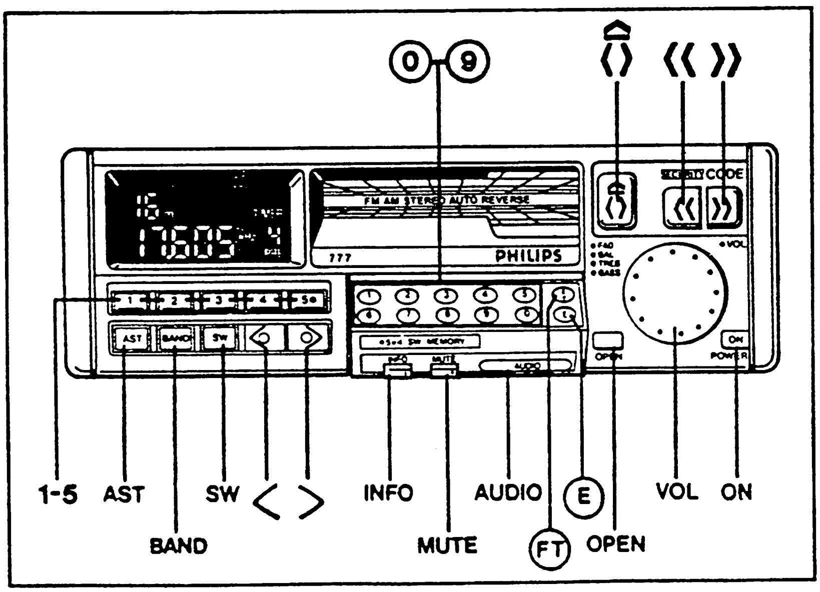
The manual tuning mode is accessed by holding down both the up and down slew buttons together, until a chirp sound is heard. (This chirp is heard when many controls are operated and is useful feedback that the control has functioned, without having to take one's eyes off the road to check it. But the sound is too loud, compared with the audio volume.) The tuning speed in this mode is rather rapid and frequency overshoot is quite likely, especially on MW. Philips did not provide a tuning knob; manual tuning is performed by holding down either the up or the down slew buttons. The radio mutes on LW, MW and FM while manually tuning. This is unfortunate and should be changed. Fortunately, it does not mute when tuning SW frequencies, which assists station location and identification.

The DC-777 has a remarkable knack, while auto-searching or in manual tuning mode, of distinguishing between bona fide signals and interference. Also, it stops right on the correct frquency, even if the signal is very strong. For example, the BBC WS on 6175 kHz will not fool it into thinking it is on 6174 kHz. All this suggests that it it programmed to detect carriers, rather than skirts. What's more, such tuning is done in no more than 1 kHz increments, since split channel stations are also found, e.g. WYFR on 17612 kHz will not escape the scan.

Changing bands, except for SW, is achieved by pressing the 'Band' button. The minor annoyance here is that it is necessary to carousel through each band (LW, MW and FM) to reach the desired band. Press only the 'SW' button to enter the SW bands. The frequency displayed will be that of the currently active memory number, not the previously active SW frequency. This can be irritating at times.

MEMORY TUNING

The twenty memories allocated to SW are accessed in an intriguing way. The first four presets each cover a bank of five memories; these are recalled by hitting the fifth memory button (which does not act as a memory on SW) to carousel through the five frequencies stored. For example, Terry's preset 1 holds 5975, 6060, 6160, 7355 and 7520 kHz. Each time the fifth button is hit a chirp is heard and it proceeds to the next stored frequency. Only one direction is used; to move from 6060 to 5975 requires 4 hits of button five. This is a little cumbersome, but is nonetheless an efficient way of getting twenty memories into five buttons. In theory, presumably, the number of memories per button could be increased. However, for SW listening in the car, twenty memories seems to be quite adequate.



SUMMARY OF CONTROLS

1-5	Preset buttons (button 5 acts as a preset location switch on SW)
AST	Auto-Store button.(FM & MW only)
BAND	Waveband selector (FM, LW, MW)
SW	Shortwave band selector
<	Search/manual tuning downwards button
>	Search/manual tuning upwards button
INFO	INFO button for traffic information
MUTE	Mute button for muting the radio/ cassette player (apart from traffic information if INFO is activated)
AUDIO	Audio mode (Fader/Balance/Treble/ Bass) selector
OPEN*	Door open button
VOL	Volume control; also to adjust the Fader, Balance, Treble & Bass
ON	On/off switch
⏏	Eject cassette/Reverse tape direction button
« »	Fast wind buttons

**Press OPEN button to access the following controls on the keyboard:*

0-9	Digit buttons—for direct entry of frequency, time and Security Code. Buttons 1-3 are also used for timer.
FT	Frequency/Time selector
E	Enter button

DIRECT ENTRY TUNING

The addition of a numerical keypad in a car radio, for direct frequency entry, is perhaps unique to the DC-777. Icom's IC-R100 and Kenwood's RZ-1 also use keypads but neither is considered to be a de facto car radio. The DC-777 is definitely a car radio. It looks, acts and behaves as one and Philips is certainly marketing it as such. The IC-100 and the RZ-1 are mobile scanners. Also, both can be used outside of an automobile. It is an understatement to say that the addition of a keypad to a SW car radio is a good idea. It is almost a must for successfully accessing shortwave frequencies that are not preset in memories. Imagine tuning SW using only slewing buttons in a moving car!

The DC-777 keypad is accessed by pressing a small button marked 'Open'; the keypad hinges outwards to a 45 degree angle and has two rows of six buttons. 1 - 5 plus 'FT' (for time set) on top and 6 - 0 with 'E' (for enter) along the bottom. The buttons are small with a rubber-like feel and take some getting used to. When first installed, the buttons required some pressure to function. They have loosened up somewhat over time. They chirp when hit.

The Philips designers have done their software homework on this receiver. There are no decimal points or leading zeros to enter. When the first digit is entered the radio mutes and the digit appears in the frequency display. Entering 1-5-4-2-5 and 'E' produces Radio Moscow, booming in at 2000 UTC. The software could be a little more intelligent; if a SW frequncy is entered while in the FM mode, for example, the radio beeps and the entry is rejected. On the FM band a trailing 0 or a 5 is required to complete the entry—for example, 93.3 MHz must be entered 9-3-3-0. Presumably this is necessary in some parts of the world.

Once familiar with the various tuning methods, moving around in the spectrum is fast and easy. In respect of this area, and others, it is highly recommended that the manual be read very carefully, and more than once, in order to get the most out of the DC-777. This is particularly true of users who may not be familiar with digital radio or scanner-type operations. Generally, the owner's manual and the installation instructions are well written (in ten languages, but not in Japanese!), including useful graphics, but some useful features are either glossed over or omitted completely.

AUDIO

The DC-777 will deliver 20 watts per channel into two speakers or 7 watts per channel into four speakers. Including a separate on/off button (usually the on-off switch of a car radio is integrated into the volume control knob), there are only four controls affecting audio functions—the main rotary control knob, an oblong button marked 'Audio' and another marked 'Mute'. Mute can be activated in all modes, including tape cassette, whereupon 'Mute' is indicated on the display panel. The rotary knob has detents and controls volume as its default setting. Pressing the 'Audio' button lets you carousel through the other audio functions of Fade, Balance, Treble and Bass, again using the rotary knob to adjust these functions. Fade does not operate and shows 'Off' if only two speakers are used.

The main control knob uses a photo-encoder circuit, similar to that used by tuning knobs on some digital portable radios. It is not linear in response and careful adjustment is required to obtain the desired settings.

All audio settings, except volume, can be pre-programmed independently for each band, including the presets for that band. This gives needed flexibilty, because of the differing audio characteristics of each band; but distict settings for each preset would have been a welcome addition.

At switch-on, the volume level is always at a relatively low, preset level, regardless of the volume setting when the radio was last switched off. This is also a useful feature, avoiding that blast of sound from having the audio up too high the night before!

Terry's DC-777 is installed in a 1980 Pontiac Phoenix hatchback and John's is in a 1984 Chevrolet Caprice Classic, both with originally fitted speakers and speaker wires. Audio power is more than enough and the sound is quite clean, particularly on FM. But for those who insist on entertaining their fellow road users, as well as themselves, while driving and listening, an additional amp and matching speakers will be needed!

MW AND FM PERFORMANCE

Both Medium Wave (AM) and VHF (FM) sensitivity and overall quality are at least on a par with other car radios experienced. As with SW, much depends on the antenna used; FM performance on fringe signals is much improved by using both a horizontally mounted windshield antenna and an external vertical. The ability to be able to tune between the AM band channels allows local, boomy signals to be tailored to a more pleasing audio tone by detuning a couple of kiloHertz. This feature is also available on FM and allows clearer reception of weak signals which are adjacent to strong signals. For example, at John's location, 93.1 has a strong signal and 92.9 is weak. By tuning to 92.85 the strong signal is avoided and the weak signal is heard in the clear.

As a testament to the AM section's performance, Terry, located in Washington State, has heard HLAZ from South Korea on 1566 kHz using 250 kw with very good signals in the early morning hours, around 1230 UTC.

SIGNAL PROCESSING

The DC-777 has its own way of dealing with what it perceives as weak FM signals; it automatically switches from stereo to mono. This can have a disconcerting affect while driving; multipath reception of strong signals will also produce the same effect. It is rather annoying at first, but it does solve what has been an inherent problem with FM reception while on the move, especially in built up areas, where multipath is more likely. 'Picket fence' noise is eliminated with this feature. The ability to switch this control in or out, according to taste, would have been desirable.

Universal Radio's 91-02 catalogue provides more insight, on page 12: Philips has designed several FM signal processing circuits into the DC-777: SDS/SDR (signal dependent stereo/response), MDS/MDR (multipath dependent stereo/response) and IAC (interference absorption circuitry). None of these features is mentioned in the manual.

PANEL ILLUMINATION

Panel lighting is good but could be improved. At night, most controls are lit and visible, as is the keypad, when opened. Buttons not illuminated are AST, BAND, SW, INFO, MUTE and ON. Based on ergonomics, Philips would do well to consider lighting for the ON, BAND and SW buttons.

The main display panel is very informative compared with other car radio displays, and use is made of colour—orange, yellow and green—to distinguish different pieces of information, both by day and by night. It is easily read, except in direct sunlight.

TIMERS

Another feature is the incorporation of three separate switch-on timers. They are activated via the keypad's 'FT' button and are easily programmed. Philips has chosen to adopt the twenty-four hour format for their clock and timers, so UTC can be properly used for shortwave listening. All that is required for the DC-777 to turn itself on at the programmed time is that the 'On' button be depressed. It will automatically switch to the desired frequency at the programmed time. It even controls the cassette deck! This is a welcome feature on a car radio capable of shortwave reception.

SECURITY

The DC-777 has its own security system, the principles of which are now beginning to appear in conventional car radios in North America. Each radio has its own 4 digit security code. When the permanent 12 volt supply from the battery is diconnected (e.g. by a thief removing the radio), it will not function again unless and until the security code is re-entered properly via the keypad. Small window stickers are provided which advise the prospective thief of this. Whether or not this is an effective deterrent is debatable. The thief may have a useless radio, but the owner is still minus one radio. And the chances of the culprit returning the thing when it is discovered that it will not work seem rather slim.

The security code system did not function correctly in Version I, one reason why Version II was introduced so quickly. If you purchase Version I (there should be very few on the market now), it is recommended that the security system not be activated in the first place, whereupon it will not fail. In any event, the car's door locks (and trunk) provide the best deterrent.

ANTENNA EXPERIENCES

Terry had replaced his original windshield antenna with a Radio Shack 31" cowl mounted antenna (catalogue #12-1322) to improve reception of MW stereo on his previous radio. The DC-777 exhibited quite a bit of ignition noise with this antenna. Expect some ignition noise when listening to weaker SW stations (see below). Terry installed RJ-14 resistor spark plugs, by Champion, and noise suppressor type spark plug wires at his next tune-up. A Harada model ST-19 replaced the Radio Shack antenna at the same time. This antenna is a 45" three section whip with a base loaded 'booster coil', cost US$13.00. EUREKA! Shortwave reception became better than was ever imagined in the car, with no ignition noise apparent.

As mentioned above, John has kept the windscreen antenna and combined it with a mag-mount whip. This provides at least adequate signal levels on all bands, but engine noise (airborne, via the antenna, not via the 12 volt supply) can still be a problem on weaker SW signals.

It should be stated clearly that practicalities dictate that shortwave radio in a moving car is very much a question of Shortwave Listening, rather than DXing. Therefore these noise problems tend to limit themselves, because it is the higher strength SW signals that are most often tuned in and listened to.

To help in minimizing noise pick-up at the antenna, it cannot be emphasized enough that a good ground connection be installed, and maintained, between the underside base of the antenna and the metal body of the car. Use a short, braided grounding strap to optimize the shielding properties of the coax line. This is not always possible with a mag-mount, however. Use a silicone-based caulking compound to keep out air and water at all exposed points, to avoid poor contacts due to future corrosion; also ensure first rate electrical contacts in all areas, to avoid disconnection due to vibration.

AUTO NOISE

The DC-777 has excellent DC filtering and provides a virtually noiseless DC current to the radio, which itself is well shielded. Any auto noise experienced will be airborne RF noise, picked up by the antenna and/or the lead-in. It may be radiated by the offending component, by connecting wires or by the whole car chassis and body metal—perhaps by all of the above. It may come from sources beyond the car.

Terry and John have compared notes concerning listening experiences. Antenna type and location are critical for both optimizing signal pickup and minimizing RF noise interference. Our own experience, and that of others, suggests that expensive antennas with their own pre-amps may prove to be a costly mistake, rather like active antennas in a downtown environment. Try to eliminate the source of noise rather than to excessively boost the signal input.

The other major variable is the car itself. RF noise generation varies from model to model and even from car to car of the same model. At the risk of generalizing, it seems that Japanese cars fare better in this area, and they also use that DIN size aperture a lot more than North American cars.

Guy Atkins has a DC-777, installed in his Laser XE Turbo. The car's three on-board computers issue a fair amount of RF noise, especially on the 90, 75, 60 and 41 meter bands. Guy believes that most of the noise comes from the interconnect wires, rather than the components themselves. His experimentation with noise supressors (e.g. LC filters, coaxial feedthrough capacitors and ferrite beads) yielded no perceptable improvement. His present setup uses a Radio Shack 102" CB antenna, cut down to 72" for aesthetics and manageability. Guy says this works well.

Before embarking into SW for the car, use your portable SW receiver and its whip antenna to assess RF noise coming from your car. Try different parts of the car, including under the hood, at different frequencies. Compare the results with other cars.

It's worth repeating that, in its intended mobile environment, the DC-777 is not a DXing machine. Even if it was, the vulnerability of your insurance premiums, and possibly your life, should preclude any temptation to dial-twiddle whilst driving! Eyes on the road and hands on the wheel, please!

SHORTWAVE LISTENING

What shortwave broadcasters do we listen to on the DC-777? John listens to the BBC World Service mainly, out of personal choice. Fortunately they beam transmissions to North America during both of the East Coast rush hour periods, usually with more than one acceptable signal at those times. Typically, Radio Australia and TWR in the morning and Radio Netherlands, Ecos del Torbes, WCBS, Deutche Welle, etc. in the evenings; with WCSN, Radio Sweden and even All India Radio in between. One set of John's memories carry WWV and CHU for accurate time checks and current propogation reports. Sadly, the memories which contain Radio Canada International frequencies have received little use since March of 1991....

Driving to work around 1430 UTC, Terry has no problems hearing R.Australia on 6060 and 9580 kHz. The BBC rolls in on 9740 and 11750 kHz. Terry has had good reception of R. Thailand on 9655 kHz. Letting the DC-777 search through the 60 metre band nets many Chinese regionals and it will lock onto RTM Kuching on 4950 kHz, with its English programming. It finds Taiwan's BCC station on 6087 kHz and WYFR on 17612 kHz.

CKZU from Vancouver on 6160 kHz. can be heard all day and, on occassion, CKFX 6080 and CFVP 6030 have been heard.

Travelling from work, Terry also tunes in the BBC, on 9590, 9915 or 15260 kHz. Lunchtime driving on the west coast yields R. Moscow on 15425 and 17605 kHz and the VOA transmits good signals for the DC-777 on 17800 and 21485 kHz. Radio Netherlands, from Bonaire, on 21685 provides an early version of Media Network, on Thursdays, during the 2030 - 2125 period, which Terry hears quite well in the car on the North West Coast.

The DC-777 is a single conversion receiver and the occassional image has been noted—an example is R Moscow appearing on 5100 kHz, being 900 kHz away from 6000 kHz; the DC-777 uses a 450 kHz intermediate frequency. Images are hard to find in this model, but experimentation with a longwire antenna produced, perhaps not surprisingly, MW images and excessive overloading. If DXing is desired at a static location, limit the longwire to no more than 25 metres.

By way of comparison to existing equipment, John considers the front end of the DC-777 to be close to or on a par with the paperback-size portables from Panasonic and Sony, using their telescopic whips (but the Philips has no SSB capabilities). Because of the power output and the car's own speakers the audio quality is considerably better than any small shortwave portable can deliver and most table tops too. One of the big pluses of the DC-777 is its sound quality on shortwave. Terry compares it favourably with his Grundig Satellit 500, when the car engine is turned off.

In terms of comparison with alternative methods of listening to shortwave in the car, there's no contest. The DC-777 far outperforms any SW converter and is much more convenient to operate and provides the audio power and dynamic range necessary in the car that, say, a portable radio strapped against the car window just cannot deliver. True, there is no headphone socket on the DC-777. But it is neither desirable, nor necessary to listen on headphones.

Philips' choice of bandwidth, 6 kHz, proves to be a good compromise between the fidelity that it produces and the avoidance of splatter from adjacent channels. The DC-777's audio controls and 1 kHz tuning increments are often enough to get rid of all but the most stubborn hets and whistles. The AGC is very well adjusted; signal fading is conspicuous by its absence in the DC-777.

CONCLUSION

On long, non-routine drives, as well as during the daily commute, the variety afforded by international shortwave broadcasters seems to make the journey pass more quickly and enjoyably, compared with home-spun, ho-hum radio. And somehow, being cooped up in that metal shell on wheels doesn't seem such a bad thing after all. In fact, we confess we quite look forward to getting behind the wheel these days.

The DC-777 is the first and, so far, the only radio that has successfully brought acceptable shortwave listening into the car in North America. It has certainly exceeded our expectations of such a radio in such an environment. For a price tag that can be less than US$400, Philips are to congratulated on their thoughtful design of a product that fills a need that has existed for many years. And they've done it in a professional way and at a price that represents excellent value. Neither of us would now relish being without a DC-777 in the car.

Until now, there have been two main categories of shortwave radios—portables and table tops. Now we can add a third.

A FIRST LOOK AT THE FULLY AUTOMATED
McKAY-DYMEK DR-333

John Bryant

INTRODUCTION

We did not realize it in the late '70s, but the arrival of receivers using purely solid state frequency control opened the door to an ever-expanding world of receiver automation. The first strides in this direction were "memory channels" offered on SONY's ground-breaking ICF-2001 portable. This was followed rapidly by similar "frequency only" memory capability offered as an accessory on several communications receivers. We all thought that a plateau was reached when JRC introduced the NRD-515 with an accessory offering a whopping 96 memory channels! That record was shattered by JRC itself with the introduction of the NRD-525 ($1300 in the US) sporting a full microprocessor and 200 memory channels. For the first time, those memory channels "remembered" not only frequency but also filter choice, AGC settings and reception mode. Since, thanks to a sophisticated on-board microprocessor, the receiver is completely tuneable from each memory channel, the 525 offered 200 parallel VFO's along with scanning capabilities. The NRD-525 and the more recently introduced Kenwood R-5000 took automation one step further by offering computer accessory interface boards. These allow PC computer owners to achieve almost fully automated control of the receiver.

As the 1990s approached, ICOM introduced the R-9000, surely the ultimate "hobby" receiver at close to US$5000! The R-9000's highly sophisticated automation scheme will be left to George Zeller's review in this edition of *Proceedings*.

This brief history of receiver automation is offered to make several points. First, the drive toward automation has been very rapid. Secondly, we now have radio receivers that also contain moderately capable microprocessor/computers. Thirdly, since most of us now own a home computer, the development of a radio with a built-in computer to operate it is forcing us to buy one computer more than many of us really want. If we pay $400 for an interface board and software to control our R-5000 or NRD-525 with our own PC, then the computer in the radio (for which we paid several hundred dollars) is truly redundant!

DEVELOPMENT OF THE McKAY-DYMEK DR-333

I was stunned when I first heard the "Black Box" concept applied to a consumer receiver by Wes Olson of Inline Components, Inc., a small California-based electronics firm. Wes simply asked me why I would want to buy a fairly dumb computer inside a new communications receiver when I already owned a very smart one (my IBM PC clone). That level of creative thinking led ICI to gather a design team from the Southern California military and aerospace communications community to tackle the design of what was to become the McKay-Dymek DR-333. Interestingly, the design team was lead by a superb designer/engineer originally from the famous Plessey team in Great Britain. The third element of the team was the McKay-Dymek Division of the well-known West Coast electronics manufacturer Stoner Communications.

Figure 1. THE McKAY-DYMEK DR-333

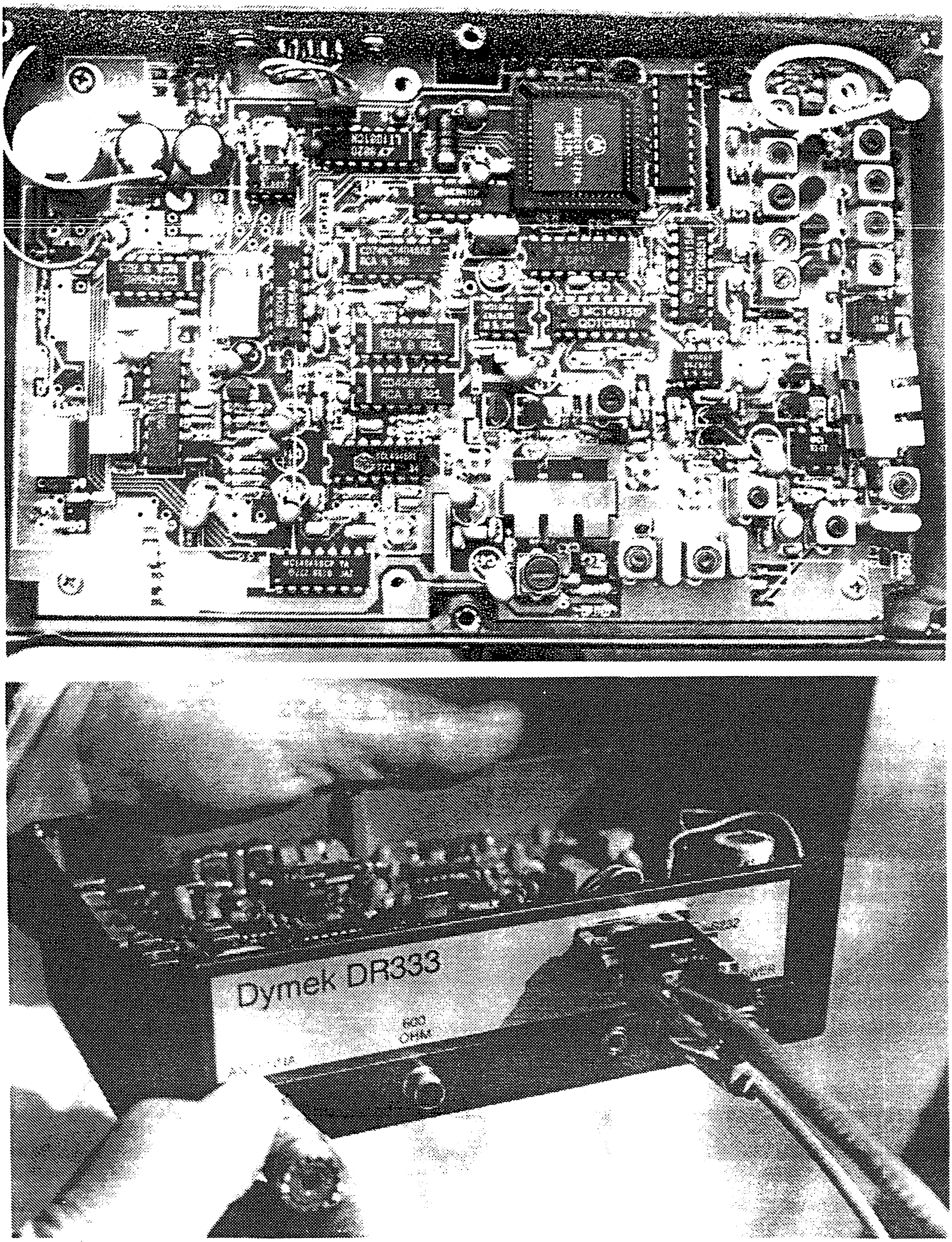


Figure 2. DR-333, a Look under the Hood.

The team's operating concept was that there was a significant market that would welcome the efforts of designers who concentrated on designing RADIO circuits and sophisticated control software and who left it to the user to supply the control hardware (your home computer). This idea is similar to the "Black Box" module approach developed in the design of military avionics some years ago. Since the Black Box concept separates the control and read-out package from the device itself (the Black Box), there are several advantages. As you upgrade your computer for other reasons, you are upgrading your radio as well; as more sophisticated operating environments become available (multi-tasking with Windows 3?) the capabilities of the radio are enhanced. Also, since a Black Box comes with no problem-prone buttons, knobs, switches, pots or lights, there is less likelihood of the radio having mechanical or electrical breakdowns.

As you can see, the DR-333 is truly a black box (matte black, in fact). It measures 7.375" w x 4.75" d x 2.25" h and weighs 2 lbs. The only connections to the receiver are an RS-232 connection to your PC clone computer, the 11 to 16 volt DC power connection, a female BNC Antenna input port, a 4 to 8 ohm audio output RCA jack for a speaker, a mini-jack for low impedance earphones and a 600 ohm audio output for recording, etc. That is it...power, control, antenna input, and three audio outputs.

Before going further, I should note that Wes Olson asked me if I would like to be involved in the latter stages of development of one of the two control software packages that come with the DR-333. I jumped at the chance and essentially acted as one of several "normal user" Beta testers. Over the past 18 months, I have used three different generations of the pre-production DR-333 with developing generations of the two separate software control packages. My regrettably brief use of a near-production version of the DR-333 coincided with the last days of the Final Drafting phase of *Proceedings 1991.*

The receiver's specifications are very impressive and in Figure 3, are compared with those of the new NRD 535 and the R-9000. You should be aware that these are specifications as published by the manufacturers and may not always have been measured in the same ways. I must say though, that I know of some bench tests which show that the DR-333 is even more sensitive that its 1 microvolt spec for AM reception.

The professional monitoring and surveillance applications of this receiver seem obvious and its success in those venues seems assured. In the world of hobby radio, the DR-333 is a complete conceptual departure from any previous receiver. Beyond being an electronic novelty, the DR-333's success in the hobby world will hinge on three crucial questions:

1) How TRADITION-BOUND are radio hobbyists? Will they accept any radio, no matter how good, that has NO knobs to twist or buttons to punch?

2) How good a RADIO is it, anyway? Putting a 286 or better computer and some memory behind anything can make a good <u>scanner</u>, but how good a general-use listening and DXing radio is it?

3) How good is the SOFTWARE? Is it easy to learn and to remember how to operate? Will it do things for us that a "normal" radio won't do...things that will help us hear more DX? Most of all, is the damn thing fun to play with???

THE SOFTWARE: OVERVIEW

The two software operating programs that come with the DR-333 are so different from each other that, from a user's point of view, you really get two different radios when you purchase the DR-333. The software that most radio people will first find attractive and reassuring is the graphically-oriented Special Purpose Program (SPP). You operate the 333 with this software from a main computer screen that looks like a radio (See Fig. 4). This program may be run using the arrow keys, but using a mouse is much easier. The Special Purpose Program software, being more graphic, requires a CGA or better color monitor. I use the DR-333 with the SPP software on a laptop with a "CGA compatible" monochrome screen, and it looks great!

Please note though, that the software that I find by far the most effective is the OTHER one: the Standard Operating Program (SOP). The SOP is a menu-driven alpha-numeric text-based program which really allows you to get the most out of the receiver. However, the SOP software gives you no reassuring drawings of knobs, buttons, etc. on the screen.

The Standard Operation Program software was carefully designed to require the most modest of PC clone hardware: 256k RAM and DOS 2.0 or higher. My XT clone laptop computer operates the SOP driven DR-333 very satisfactorily. This combination offers the possibilities of very portable operation since both units operate from 12 or 13 VDC power. The SOP software does look better with a color monitor and does operate more quickly with a 286 or 386 machine. However, careful design of the SOP software has given even the owner of very modest (and now, very affordable) computers an amazing array of DX tools.

Since these two programs operate so differently and offer the user such different capabilities, it makes the most sense to continue this discussion on twin tracks. Since the graphically-oriented SPP software is the package people will tend to use first with the receiver, we will deal with it first.

SPECIFICATIONS	R-9000	NRD-535	DR-333
FREQUENCY COVERAGE	.15 kHz to 1999.8 MHz	90 kHz to 30,000 kHz	10 kHz to 29.999995 MHz
TUNING RESOLUTION: **ACTUAL**	10 Hz	1 Hz	1 Hz
TUNING RESOLUTION: **DISPLAYED**	10 Hz	10 Hz	1 Hz
PASS BAND TUNING	IF Shift	+ or - 1 kHz	+ or - 1 kHz
NOTCH FILTER	YES	YES	NO
MODES	AM, SSB, CW, FSK, FMN, FMW, TV	AM, SSB, CW, RTTY,FAX,NFM	AM, SSB, CW, RTTY, FAX, FSK
IF FILTERS	12, 8, 2.6	12,6, 2.0, 1.0, + variable + options	2.7 and 6.0 + many options
SENSITIVITY	AM 1.μV (HF) SSB .16μV CW .16μV FSK .16μV	AM ? SSB .5μV CW .5μV FSK?	AM 1.μVolt SSB .5μVolt CW .25μVolt FSK 2.μVolt
IMAGE REJECTION	>90 dB	>70 dB	>90 dB
1st IF REJECTION	>100 dB	>70 dB	>70 dB
2nd IF REJECTION	?	?	>100
3rd ORDER INTERCEPT	33 dBm	?	30 dBm
MEMORY CHANNELS	1000 w/comment	200	9,999 w/comment
BAND SCAN MEMORY	?	1	999 w/comment
SPECTRUM OCCUPANCY DISPLAY	YES	NO	YES
EVENT TIMERS	6 EVENTS	1 EVENT	NONE, BUT PROGRAMMABLE
TONE CONTROL	BASS and TREBLE	"TONE"	NONE
CONTROL REQUIREMENTS	DIN port only. PC control not easy.	May connect a PC. No software provided. RS-232	Must have IBM PC compatible, 256K, Mono or Color
DIMENSIONS	16.7"x5.9"x14.4"	13" x 5.5" x 11.25"	7.4" x 2.25" x 4.75"
WEIGHT	44.1 lbs.	20 lbs.	2 lbs.
POWER REQUIREMENTS	Power supply internal AC ONLY	Power supply internal. All normal AC voltages plus 12 V DC	Must have 11-16 V DC supplied externally. (normal ops. 320 ma)
APROX. RETAIL	$4700.00	$1600.00	$1500.00

Figure 3. PARTIAL SPECIFICATIONS As published by the manufacturers

THE SOFTWARE: SPECIAL PURPOSE PROGRAM

The Special Purpose Program (SPP) is graphically oriented and optionally, uses a mouse as the major control device. Figure 3 is a print of the main screen. The SPP driven DR-333 offers a radio that, like the R-9000, includes a "spectrum analyzer."

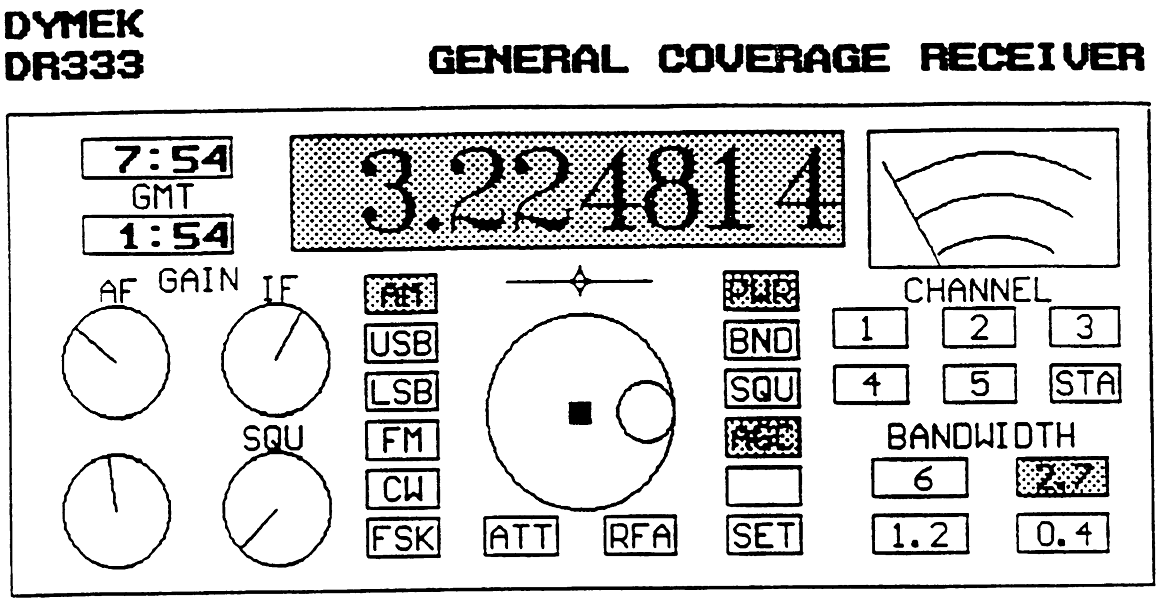


Figure 4. Computer Monitor Representation of The DR-333 as Driven By the Special Purpose Program. The cursor is in the middle of the tuning knob.

If you are at all familiar with mouse use, operating the DR-333 with the SPP software is similar to operating a conventional 525 or R-5000. From the main control panel, you just point and shoot to change the volume, the IF level, etc.

With the Special Purpose Program, the DR-333 offers Pass Band Tuning in 10 Hz steps, plus or minus 600 Hz. (The Passband Control is the horizontal line and diamond below the frequency indications). It also offers dual on-screen clocks and 100 memory channels. There are other operator conveniences not quite as apparent from the front panel. First, there is absolute tuning in one (1) Hz increments. That is, you can specify 3.224814 megahertz and the receiver responds! To my knowledge, this is the first "commercial grade" receiver to allow such fine control and readout of frequency. Actual tuning can be accomplished in several ways. Continuing the tradition of McKay-Dymek, you may "click" on the tuning knob and then once the cursor is on the proper numeric position in the readout, scroll that numeric position up or down.

EXAMPLE:
You want to listen to 5975.000 in the evening for BBC and you left the DR-333 parked on Australia's 9580.000. To get to the BBC, you put the cursor on the megahertz position and scroll from 9 down to 5 (radio dial then reads 5580); move the cursor to the hundreds of kilohertz position, scroll the 5 up to 9 (it then reads 5980); move the cursor to the 8 and scroll down to 7 (it then reads 5970); then move the cursor to the 0 and scroll to 5. The receiver now reads 5975.000 and you are listening to the BBC. This particular operation is much less cumbersome than it sounds, but still leaves something to be desired.

This tuning concept does continue the tuning tradition of the famous DR-22 and DR-33 of a decade or more ago. Those receivers were tuned by a set of rotary switches, with digital indicators above each switch. To tune 5975 kHz, you rotated the "ten's of megahertz" switch to '0', the megahertz switch to '5', the hundreds of kilohertz switch to '9', the tens of kilohertz to '7' and the kilohertz switch to '5'. The front of the receiver then read 05975.

A second means of tuning using the SPP software is to access the 100 memory channels that each remember frequency, mode and filter setting. The third means of tuning with this software is to click on the

BND button on the front panel. This kicks up a menu set in a window in the upper left-hand corner of the screen giving you instant access to various MW, SWBC, amateur and user-defined bands. You highlight the desired band and hit 'ENTER'. In all, there are 5 other menu windows which allow you to change the default settings of the receiver and do other housekeeping chores.

The 100 memory channels offered with the Special Purpose software does make SWLing much easier. You just use the channels like push-buttons on your car radio. However, after a decent amount of experience with this software, I find that I only use the SPP software when I what to use the "Spectrum Analysis" package. For any other purpose, the Standard Operating Software is far superior.

SPECTRUM ANALYZER

The Special Purpose Program (SPP) software also offers a Spectrum Analyzer, as shown in Figure 5. Initially, I had expected an oscilloscope-like animated display of the characteristics of the 20 kHz or so of spectrum that I was monitoring...I have always wanted to "see" the QRM "live." However, I believe that the term for that kind of gear is a "panoramic display." The DR-333's Spectrum Analyzer is identical in type to most professional monitor spectrum analyzers that are also known as spectrum occupancy monitors or analyzers. This function is similar to that offered on the R-9000. In operation, the Spectrum Analyzer rapidly divides the user-defined spectrum to be analyzed into 400 "stops." It then makes a single minute-long sweep, measuring and displaying the signal level present at each of the 400 stops. A moveable "marker" finds the specific frequency of each stop and an overlay grid may be imposed when needed. The narrowest band of frequencies that the Analyzer will display is 50 kHz and the maximum is the full limit range of the receiver.

I was concerned that static bursts in the spring and summer would render this tool useless. That has not been the case, mostly due to the "Average" function. When that function is invoked before a sweep, the display is 'calmed' considerably and signals do stand out from noise quite nicely in most cases.

When used close in, looking at 50 to 100 kHz at a time (refer to Fig. 6), the display often paints with enough detail to see the side bands of each signal as separate elements. This works best if the narrower IF filters are invoked before the sweep.

After an analysis sweep has been completed, it is possible to go back and investigate various signals while the chart is still on the screen. It is possible to use the "Find" function to move the graphic marker and the tuned frequency of the radio left and right across the screen in steps. You hear each signal as you go. It is also possible to investigate specific frequencies within the analyzed spectrum by invoking the "Mark" function and typing in the frequency of interest.

It is wonderful to see what I have been hearing all these years! However, I am not sure of the practical application of this professional function to our hobby use. I have been pleasantly surprised however, at the clarity with which I can see all but the weakest inaudible signals under all but the noisiest band conditions.

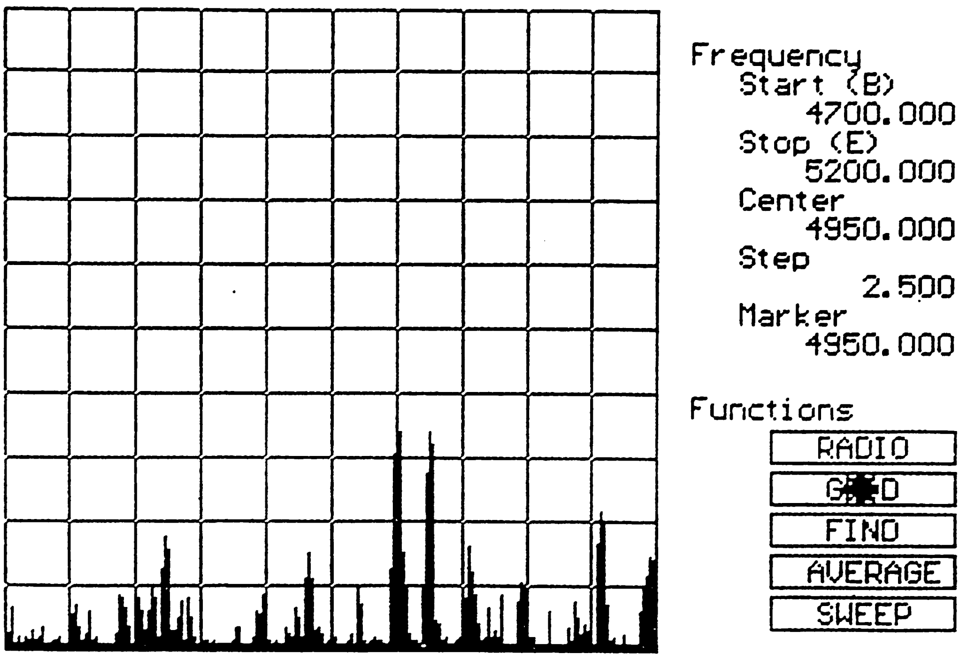
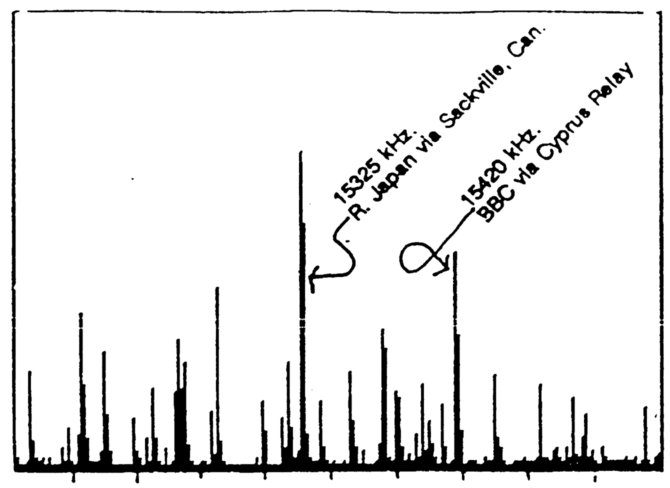


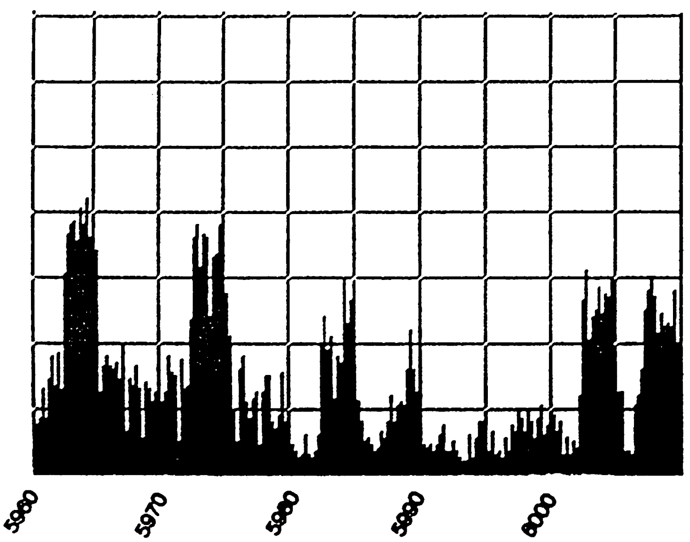
Figure 5. DR-333 (SPP Software) Configured as a Spectrum Analyzer
As you may note from the information on the right of the screen, the spectrum width was from 4700 kHz. to 5200 kHz. The horizontal divisions each represent 30 kHz. The time was 0330 (mid-evening.) The two strongest signals are to the right center are WWV on 5000 kHz. and Cuba's Rebelde on 5025 kHz.



FREQUENCY: 15100 kHz. to 15600 kHz.
TIME: 0402 UTC
STEP: 2.5 kHz.
BANDWIDTH: 6 kHz.

COMMENTS: Since the Analyzer automatically segments the operator determined frequency band into 400 divisions, the scan "step" is determined internally. When the frequency width is this wide (500 kHz.) or wider, I obtain much better results with the receiver bandwidth set at 6 kHz. The Analyzer will then "see" stronger signals as more than one vertical bar.

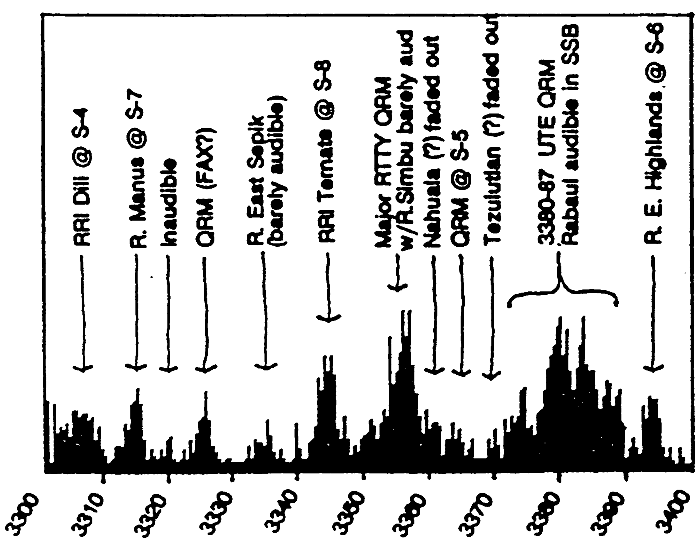
The tick marks, added by the author, at the bottom bar each represent 50 kHz. The station identifications were added manually.



FREQUENCY: 5960 kHz. to 6010 kHz.
TIME: 0320 UTC
STEP: .200 kHz.
BANDWIDTH: 2.7 kHz.

COMMENTS: With an analysis of only 50 kHz., the narrow bandwidth of 2.7 obtains the most useful results. The horizontal divisions of the grid each represent 5 kHz. Note that all signals appear to be shifted about 1.3 kHz to the left. This is a glitch in the pre-production software, both SPP and SOP, which is only present when the 2.7 kHz. filter is invoked.

The signal to the far left is Havana on 5965 kHz. The next major signal, on 5975 kHz. is the evening service of BBC via Sackville.



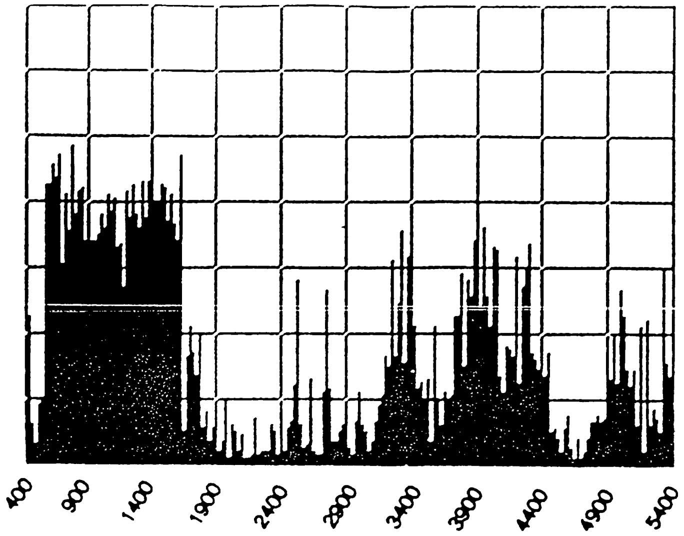
FREQUENCY: 3300 kHz. to 3400 kHz.
TIME: 1200 UTC (max dawn enhancement)
STEP: .500 kHz.
BANDWIDTH: 2.7 kHz.

COMMENTS: This is a run at exactly maximum dawn enhancement on a typical early September morning. There is a good deal of thunderstorm static present. Propagation conditions are markedly sub-par.

This analysis does give a good indication of every signal climbing above the band noise floor. However, it is possible for a good DXer to at least partially copy voice signals which are at or slightly below the band noise, thanks to our personal built-in "speech recognition" talents. That kind of signal will be missed by the Analyzer, of course.

Figure 6. Three Analysis runs, illustrating very typical results from Shortwave

This Figure illustrates three partial Analyzer screens, truncated for convenience, as displayed during Spectrum Analyzer use. These are dot matrix prints of a CGA resolution screen. The square Analyzer frame is about 4.5 inches square on a 14 inch color monitor. The images are considerably enhances in color, with the optional grid and Mark indicator being a different color from the signal strength bars. With the exception of the lower illustration in this Figure, All analysis runs shown in Fig. 5 and Fig. 6 & 6A were done on a single evening between 0300 - 0400 UTC (mid-evening) with active thunderstorm cells about 50 miles away. See notes beneath Fig. 6A for techniques used in obtaining hard copies of these analysis screens.

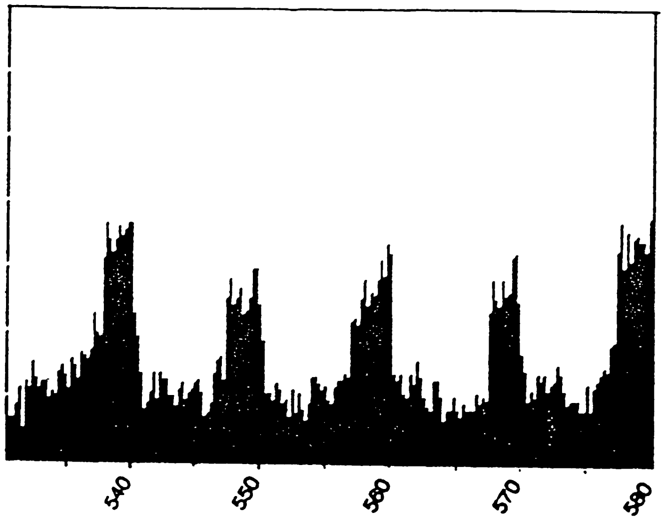


FREQUENCY: 400 kHz. to 5400 kHz.
TIME: 1100 UTC
STEP: 10.0 kHz.
BANDWIDTH: 6.0 kHz.

COMMENTS: This scan is a more or less panoramic analysis of the Medium Wave and Tropical Band spectra. The horizontal grid divisions each represent 500 kHz.

The Medium Wave Band is easily noticeable. Little activity is present on 120 Meters (around 2400 kHz.) The 90 Meter broadcast band, just to the left of 3400 kHz, is quite active, as is the 80 Meter Amateur band centered around 3900 kHz. The lower portion of 60 Meters is strangely quiet (to the left of 4900 kHz., while WWV, 5000 and Rebelde, 5025 are quite obvious.

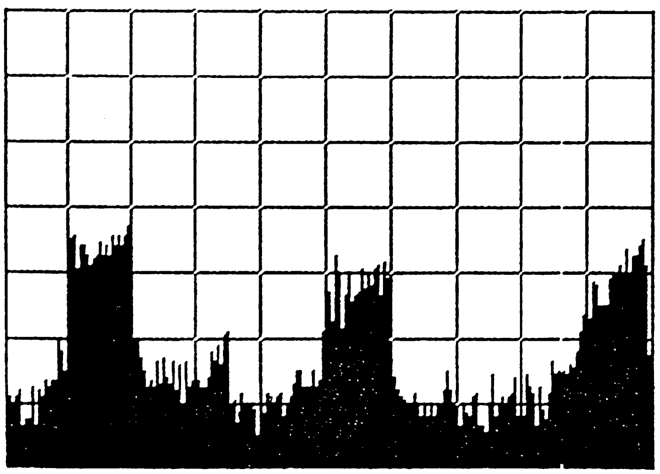
Frequency notations added by author.



FREQUENCY: 530 kHz. to 580 kHz.
TIME: 0330 UTC
STEP: 0.2 kHz.
BANDWIDTH: 2.7 kHz.

COMMENTS: This scan covers 50 kHz. and horizontal division is 5 kHz. With the previously mentioned pre-production software glitch, all signals are shifted about 1.3 kHz. to the left of the proper grid point. The MW channels are clearly visible. The space between them is slightly exaggerated by the "averaging" function. However, the real space between these channels is almost this wide, thanks to the superb IF filtering.

The analysis scans tends to emphasize the upper sideband, graphically, most of the time. I am unsure why this is the case, but I have not found it objectionable.



FREQUENCY: 535 kHz. to 560 kHz.
TIME: 0335 UTC
STEP: 0.1 kHz.
BANDWIDTH: 2.7 kHz.

COMMENTS: This scan covers 25 kHz. and is about as "close in" as the current software will go. The horizontal divisions represent 2.5 kHz. Again, the mistaken 1.3 kHz signal offset (to the left) is apparent. The left hand signal is XEWA on 540 kHz. at about S-7. The signal on 560 is actually a mixture of an American and a Latin station. There was a significant sub-audible hetrodyne on the channel, indicating that one of that stations was off frequency. This may be the cause of the smeared look of the right hand signal. The small blip at 545 kHz was present thru several sweeps. This was not detectable as a het in SSB mode with the DR-333 or my 525.

Figure 6A. Typical Spectrum Analyzer results at Medium Wave frequencies.

This and other partial Spectrum Analyzer displays were printed from a CGA screen using the graphics screen print utility GRAFPLUS produced by Jewel Technologies of Seattle, WA. The images were taken from a CGA screen and printed out on a 9 pin dot matrix printer. They were then reduced 50% in size by photocopy methods. The images in Figure 6. are truncated to fit three per sheet and represent the only the lower 80% of the normally square graphic display.

THE SOFTWARE: THE STANDARD OPERATING PROGRAM

At first glance the numeric/text version of the software, known as The Standard Operating Program (SOP) is somewhat alien to "a real radio man." There isn't even an animated drawing of a friendly knob, dial or switch on the screen! The two main screens should be familiar to almost any casual user of general computer software: menu-driven. After using this SOP version software for some time, I am convinced that it, or user-modified versions of it, will be the software of choice for most serious DXers and SWLs. This version of the control software allows you to combine and maximize the power of your computer and combine it with excellent state-of-the-art radio gear.

With the SOP software, the DR-333 offers 9,999(!!!) memory channels filed at the operator's discretion in any of several formats. Each channel records all main receiver settings and, thankfully, includes a 15 character comment line. The channels may be quite easily accessed manually (my preferred method) or you may automatically scan as many adjacent channels as desired. The receiver also provides up to 999 separate user-defined band scans.

It is the SOP version software, of course, which allows remote as well as highly automated operation of the DR-333. The remote operation may be via hardwire, modem or RF link.

HANDS ON OPERATION

With all of its power, I am still amazed that the SOP software is so easy to use. I feel obligated to take you through just a bit of the operation. From either main screen, Fig. 7 or Fig. 8, you may control the receiver manually. To control frequency, you may simply type **'f'** followed by the number, followed by **'k'** for kilohertz or **'m'** for megahertz, and you are instantly on that frequency. Also, you may type in the full frequency in hertz followed by **'enter.'** I have always thought in kilohertz, so to tune in BBC in the evening, I type **'f5975k'** and when I hit the **'k'**, I'm there. Similarly to tuning the DR-333 with the first (SPP) software, you may tune the receiver using the Standard Operating Software just like the famous DR-33. In this case, each Function key controls one decimal place of frequency in hertz. That is, you punch the **F1** key to control the 10's of megahertz, with each tap of the key adding or subtracting **(Shift + F1)** 10 megahertz from the tuned frequency. The **F2** key controls the single megahertz; the next Function key controls the hundreds of kilohertz, etc. In addition to direct entry tuning, the other controls may be adjusted manually from any screen. The prompts necessary to adjust the other controls manually are located in the upper right of the screen and along the bottom bar.

The use of "hot keys" to adjust audio, IF, mode, band width and the other controls is easy and intuitive. The on-screen prompts virtually eliminate the need to refer to any notes or manual.

Manual operation of the DR-333 is much easier and faster with the Standard Operating Software than with the SPP software discussed earlier. I will admit however, that I shall always miss having a few knobs to focus on when straining to catch some audio from weak Indonesian stations at 4 AM.

```
MEMORY AVAIL:  42494                                              DYMEK DR333
                          2309.600 kHz USB   CHAN1000       SIG  0
                             0     PBT                      =
   UTC     01:00:25                                         -= VOL        30
   DAY     04-03-91                                         [] IF        ???
   LOC     07:00:25                 VLBA ALICE SPR          m  MUTE       ON
                                                            a  AGC      SLOW
   RADIO   ON                                               b  BW        6.0

CHANNEL MENU                                                     57 CHANNELS
   R-Read           O-Outout         N-New       E-Edit    D-Delete
-Scroll-up     -Scroll-down     P-Pick      T-Scan      Z-Exit
    CHAN    FREQUENCY AUDIO  MODE     BW   IF    COMMENT
  ->1000      2309600    22   USB    6.0   30    VLBA ALICE SPR
    1001      2324600    26   USB    6.0   25    VLBT TENNANT C
    1002      2349600    30   USB    6.0   25    RRI YOG+KOREAN
    1003      2359700    18   USB    6.0   20    MAYA DE BARILL
    1004      2376400    30   USB    6.0   30    RRI SURABAYA??
    1005      2389600    30   USB    6.0   30    RRI CIREB+HUAY
    1006      2409600    28   USB    6.0   30    R. ENGA PNG
    1007      2454600    30   USB    6.0   30    KARISMATIKA JK
    1008      2472800    30   USB    6.0   30    RRI PURWOKERTO
    1009      2484600    20   USB    6.0   25    VLBK KAT NOOSL

n-LSB  ;-AM  k-USB  l-CW  c-CHANNELS  f-FREQ  u-UTC  s-SCANS  w-WWV
```

Figure 7. SOP Channel Screen

MEMORY CHANNEL OPERATION

The memory channel section of the SOP software offers an incredibly powerful and useful tool to DXers and SWLs. Note the channel screen above. The current time and date information is in the upper left. Current tuning information (the "dial") is in the upper center and the other control settings are in the upper right. The individual hot key prompts are to the left of each control, its current setting to the right. For instance, the **"b BW 2.6"** line tells you that tapping the **'b'** key will cycle the DR-333 through various IF bandwidths and that the current BW is 2.6 kilohertz.

The center of the screen contains a bar of prompt information particular to Channel Operation. Below that, any 10 of the current memory channels are displayed. A scroll feature allows a good look at the entire channel file.

Many may wonder if 9,999 memory channels is not over-kill. My experience with the 200 memory channels of the 525 indicates that 10,000 channels is about what I can use effectively. In my brief use of the latest version of this receiver, I have not completely set up the memory banks. However, these are my plans: I have already dedicated the first 100 to "active memory" channels to use while I'm DXing--to check parallels, temporarily save signals found during a rapid manual band scan, etc. The second 100 channels will soon be used to automate listening to various frequencies of the top 20 or so of my favorite program listening stations.

A 24 hour "hit list" of 10 channel per hour of DX tips already occupies another 240 adjacent channels--this is really a semi or fully automated hit list! Long term, about 1000 channels will be taken up with banks of 100 or 200 channels allocated on a regional basis (100 channels of Brazilian targets, 200 Indonesians, etc.) All of this automation is a practical reality for the DXer for two reasons. First, each channel, as you see, displays a 15 character memo note located under "the main dial" when that channel is invoked. Since it is impossible to remember the content of 10,000 channels, the memo feature is an essential element of the DR-333. The second feature that makes all of this possible for us is the remarkable ease of data entry and editing with the SOP software. The designers were quite ingenious in this area, using format boxes, prompts, etc. so that even the least adept typist (me!) finds putting in 100 channels easier than in-putting 10 channels to the 525!

There are two methods of using the channels, once they are in the memory. The first, and my favorite for DXing, is manual-mode exploration. I scroll through the channels "picking" the ones of interest and listening briefly. If I've got a hot one, I can instantly store all the radio settings in a channel in my "active memory" (those first 100 channels). Once I've finished my fast manual run through the channels, I drop down to the "active memory" channels and DX to my heart's content.

Automated scanning of any group of adjacent channels is built in to the software, of course. You can control the amount of time spent monitoring any one channel and you can set a minimum signal level. In channel scanning mode, the receiver stops at every channel that has an above minimum level signal for the specified time period and then moves on the next occupied channel. Unlike UHF scanning, it does <u>not</u> stay on an occupied channel until it becomes unoccupied. The operator is able to stop the scan instantly, however.

I have used the channel scanning in a semi-automated fashion by setting the 'dwell' time at about 2 seconds. In the San Juan Islands, I often monitor 6 or 8 HF Coast Guard frequencies this way. If there is interesting chatter on a channel, I stop the scan and then restart it when the chatter ends. I also have set up my favorite Indo frequencies so that I can scan them with about 1 second stops. I have the frequency offset and the receiver in side band. I just listen for the whistles and note down which channels look interesting. I can check 100 Indo frequencies in less than 2 minutes and then return to spend time with the best. Try that strategy with a R-390A sometime!

It is also possible to create an automated "log" that only notes those channels with signals above the user-set minimum level and records the signal strength present. (Similar to Fig. 9). This totally automated function is probably a very useful capability in professional monitoring and surveillance, but I have not found it useful in my own DXing.

BAND SCANNING OPERATION

Figure 8 is the second main screen of the SOP software configured DR-333. As you will note, the upper half of the screen and the lower prompt bar of the Band Scan Screen are identical to the Channel Screen (Fig. 7) previously discussed. The lower half of the screen displays 10 of the up to 999 user-defined band scans. Essentially, it is possible to declare segments of the spectrum "Bands" and then scan them. Since the bands are scanned individually, the declared bands may overlap, need not be sequential, etc. Besides setting the start and end frequency, the operator determines the "Scan Step" that's the increment of tuning (from 1 Hz) and "Scan Delay" that's the time spent at each frequency that has a signal stronger than a user-determined minimum strength. The operator also determines Audio, and IF Gain, Mode and Band Width. The settings are constant for that particular band scan.

As with Memory Channel Operation, it is VERY easy to edit existing Band Scans and create new ones. Also, as with the Channel scanning operation, one can stop and then restart the scan at any moment. Again, as with the Channel Operation, the operator may create a text file "log" of the Band Scan that records the frequency and signal strength of each active step in the Band Scan. An example of a log of a band scan is shown as Figure 9.

Frankly, this capability has been of less interest to me than the other segments of the two software programs. I think that I will much prefer to use "screen grabbing" software to grab a graphic representation of a band scan from the Spectrum Analyzer. The graphics output is easier for me to grasp than the alpha-numeric output of these logs. However, this Band scanning capability and its ability to create a text log file would be a powerful DX tool if coupled with a timing device to allow you to Band Scan while you sleep.

```
                                                                      DYMEK DR33C
                           9850.000     USB    CHAN            SIG  6
                                                               =
    UTC     02:30:31                                            -= AUDIO     17
    DAY     03-23-91                                            [] IF        30
    LOC     20:30:31                                            m  MUTE     OFF
                                                                a  AGC     FAST
    RADIO   ON                                                  b  BW       2.7

 BAND SCAN MENU                                                     12 BANDSCANS
    R-Read           O-Output          N-New       E-Edit      D-Delete
 -Scroll-up     -Scroll-down    P-Pick      T-Restart    Z-Exit
    SCAN START-FREQ    END-FREQ     STEP DELAY  SS AUD MOD  BW IF LO COMMENT
 -,   1     500000     1610000    10000  2000  80  18  AM 6.0 60  Y am
      2   14950000    20100000     1000  2000  20  17  AM 6.0 30  Y swl
      3   21150000    21500000     1000  2000  60  18 USB 2.7 60  Y 15 meters
      4    7150000     7300000     1000  2000  20  18 LSB 2.7 30  Y 40 meters
      5     500000     1700000     1000  2000  20  17  AM 6.0  1  Y short wave sca
      6   14900000    20100000     1000  2000  30  18  AM 6.0 30  Y SW scan
      7   14150000    14500000     1000  2000  30  18 USB 2.7 60  Y 20 meters
      8   28150000    29222000     1000  5000  50  18 USB 2.7 60  Y 10 meters
      9    3220000     5850000     1000  2000  20  19  AM 6.0 30  Y low end SWL
     10    9000000    10000000     1000  2000  20  18  AM 6.0 30  N 9-10 MHz scan

 h-LSB  j-AM  k-USB  l-CW  c-CHANNELS  f-FREQ  u-UTC  s-SCANS  w-WWV
```

Figure 8. SOP Band Scanning Screen

```
BAND SCAN MODE
START FREQ =     3199000
END   FREQ =     3300000
FREQ STEP  =        1000
TIME DELAY =        2000
MIN SS     =          55
LOG WANTED =         YES
stp 3199000 SS=152        stp 3223000 SS=254     stp 3248000 SS=254     stp 3271000 SS=120
stp 3200000 SS=102        stp 3224000 SS=152     stp 3249000 SS=152     stp 3272000 SS=230
stp 3202000 SS=230        stp 3227000 SS=230     stp 3250000 SS=102     stp 3273000 SS=96
stp 3203000 SS=254        stp 3228000 SS=96      stp 3251000 SS=120     stp 3274000 SS=152
stp 3204000 SS=152        stp 3229000 SS=224     stp 3252000 SS=230     stp 3275000 SS=102
stp 3207000 SS=230        stp 3232000 SS=230     stp 3253000 SS=96      stp 3277000 SS=230
stp 3208000 SS=96         stp 3233000 SS=254     stp 3254000 SS=224     stp 3278000 SS=254
stp 3209000 SS=152        stp 3234000 SS=224     stp 3257000 SS=230     stp 3279000 SS=224
stp 3210000 SS=102        stp 3235000 SS=102     stp 3258000 SS=96      stp 3280000 SS=102
stp 3212000 SS=230        stp 3236000 SS=120     stp 3259000 SS=224     stp 3281000 SS=120
stp 3213000 SS=96         stp 3237000 SS=230     stp 3260000 SS=102     stp 3282000 SS=230
stp 3214000 SS=152        stp 3238000 SS=254     stp 3262000 SS=230     stp 3283000 SS=254
stp 3216000 SS=120        stp 3239000 SS=224     stp 3263000 SS=96      stp 3284000 SS=152
stp 3217000 SS=230        stp 3241000 SS=120     stp 3264000 SS=224     stp 3285000 SS=102
stp 3218000 SS=254        stp 3242000 SS=230     stp 3266000 SS=120     stp 3287000 SS=230
stp 3219000 SS=224        stp 3243000 SS=96      stp 3267000 SS=230     stp 3288000 SS=96
stp 3220000 SS=102        stp 3244000 SS=224     stp 3268000 SS=254     stp 3289000 SS=224
stp 3221000 SS=120        stp 3246000 SS=120     stp 3269000 SS=224     stp 3290000 SS=102
stp 3222000 SS=230        stp 3247000 SS=230     stp 3270000 SS=102     stp 3291000 SS=120
```

Figure 9. SOP Band Scan Log

Conceptually, the SOP software combines the best automation ideas from scanner design with a real understanding of how "we" use radios, whether DXing or program listening. Further, this software allows you to operate the radio over a full range of degrees of automation, that is, from "hands on" to stand-alone totally automated monitoring or remote monitoring via modem from half a world away.

OTHER USES: UTILITY DXING

I don't have much experience in the world of HF utility DXing. However, I understand that most UTE's are fixed frequency operations that shift periodically between a fairly limited number of fixed frequencies and I believe that most UTE DXing occurs outside the unstable and static-ridden Tropical Bands. That being the case, Utility DXers should be able to make maximum use of the automation of SOP software. For non-voice modes, the McKay-Dymek people are planning on-boaard demodulation of many other modes.

Frankly, I wish that I'd had this radio during the Gulf War. It would have been super to input 100 or so Military Airlift and SAC frequencies and let this Black Box do its thing. From what little I know about this segment of the hobby, the DR-333 should be a UTE DXer's dream.

OTHER USES: SPECTRUM MANAGEMENT & MONITORING

I also know very little about the professional field of spectrum management and rule enforcement. This is the area of law enforcement and planning undertaken by the FCC and similar telecommunications agencies throughout the world. I have it on very good authority that a number of national telecomm agencies are quite interested in the DR-333. I believe that the only other receivers in the world that offer similar capabilities in automation, remote operation and quality of hardware are the receivers from the German manufacturer Rohde-Swartz. The prices of these receivers begin an around $4000!

With a good event timer added to the software package, this receiver also seems a natural for use by major broadcasters for monitoring their own broadcasts and those of their competitors. The ability to operate the receiver remotely via either RF or telephone links and the ability to operate the same receiver hands-on, like any other receiver seems to offer a great deal to major broadcasters, as well as those less automated and less well funded. Military and law enforcement uses for this gear seem a natural, as well.

HOW GOOD A RADIO IS IT?

If your tastes and radio operating pattern relate to the McKay-Dymek tuning scheme (if you can give up analog tuning), *you are going to love this radio*. PERIOD. If you think that you can't give up having at least some semblance of analog tuning, or if you absolutely cannot survive without turning at least one knob, *you may miss owning a truly superb radio.*

Unfortunately, production runs of the DR-333 were delayed longer than I expected when I volunteered to do this article. I understand that much of the delay was related to Desert Storm. Most of my experience with the DR-333 is with a receiver from the last pre-production factory run. The following remarks are based on this 'almost' production run.

Audio: There was a persistent background hiss in some of the prototypes. That problem appears to be solved. Even with the hiss, the audio was super--without it, I am hearing things that I've never heard before, even when using the MAP Unit. Syllables are more distinct and intelligibility is improved markedly over any SW receiver that I have ever used. The audio obviously has been fine tuned for the speech spectrum. This may be one of the few (only?) solid state receivers with a chance to have better audio than the best of the tube gear. *Audio Magazine* has a DR-333 undergoing their rigorous tests as this article is being written. That should say a lot! I believe that the last SW receiver that *Audio* reviewed was the DR-33.

Sensitivity; The receiver is at least as sensitive as my 525 on SW and more so on MW. Unlike most solid state SW radios, the DR-333 does not reduce sensitivity in the MW band. This "wide open" approach may make the receiver overload in some locations. I have never experienced that, however, except with one receiver which had a defective component (not M-D's fault). I have been told that some 333's bench test at less than .5 microvolt sensitivity on AM--a fabulous figure. Given that this sensitivity is available throughout the spectrum, I look forward to using the 333 on MW this winter.

Selectivity: Each of the DR-333 receivers that I have used has sported Collins mechanical filters. With the 333, I think that I am experiencing the full potential of the Collins filters for the very first time. I have Collins mechanical IF filters in my 525 and they improved the poor selectivity of the 525 quite a bit. I now know that the 525's selectivity is still being degraded by the leakage and cross-coupling that Larry Magne complained of when he reviewed the 525. The useable selectivity of the Collins filters in the 333 seems VERY much better than that I experience with essentially those same filters in my 525. The designers of the DR-333 must have been very astute in both circuit design and board layout, because the skirts of the filters seem almost vertical! I have limited experience with this receiver and I lack test bench type equipment. However, I must say that the DR-333 exhibits better usable selectivity than any receiver that I have ever operated.

Since I lack test bench equipment, I cannot judge the more sophisticated parameters of receiver evaluation--ultimate rejection, various measures of image rejection, intermodulation, etc. I can only say that DR-333 pre-production-run receivers that I have used had superb audio and exhibited better selectivity than I have previously experienced. They were quite sensitive and seemed to hear everything that was there; I did not notice any signals that weren't supposed to be there. Within the approach to receiver design taken by the Stoner/McKay Dymek team, the DR-333 is a superb receiver.

HARDWARE OPTIONS

The manufacturer has recently announced that they will be offering fully operating packages of a portable computer packaged with the DR-333. Although this is primarily a service to commercial and governmental purchasers, it may be of interest to some in the hobby. Initially, one of the better known laptop computers will be offered as a fully operating computer and DR-333 controller. The McKay-Dymek Division is also planning to offer the current rage of the "palm-top" computer market, the HP-95LX as an option with the DR-333. The 95LX is a hand calculator-sized powerful computer which uses a memory card rather than disks. When the DR-333 and the HP-95LX are purchased together, the 95LX's memory card would already contain the 333's software. This latter package should retail for just over $2000. Not bad for an excellent palm-top computer and a world class receiver.

FOR THE FUTURE

I miss analog tuning! Although the time that I spend SWLing far exceeds my time DXing, what I *really* care about is DXing during those precious minutes every day during dawn enhancement. After a quick semi-automated sweep of my favorite Indo frequencies (which the DR-333 does magnificently) I like to wander around 120, 90 and 75 meters looking almost randomly for pleasant surprises. Totally digital tuning does not allow me to do this as well as I want to.

I understand from the Stoner/McKay-Dymek people that it may be possible to use Track Ball or Mouse movement to emulate a normal old-fashioned tuning knob. However, this welcome event may await incorporating a fiber optics link between the computer and the receiver. The fiber optics link will likely await a whole new generation of the receiver.

SWLs using the receiver for its fine audio will not miss the tuning knob. The many utility DXers who should really benefit from the DR-333's automation will probably not miss the "Big Knob," either....I will.

OTHER IDEAS AND COMMENTS:

Software

It would be helpful to have timed "event programming" control of the receiver to at least the level of sophistication of a VCR. This capability should be very useful in professional monitoring or spectrum surveillance and in the listening hobbies. I am sure that any astute programmer could, (and probably will) develop routines to accomplish this as well as other software upgrades. To facilitate this kind of third party development, McKay-Dymek is offering a disk of programming files as an option with the receiver ($40 extra). McKay-Dymek has focused on keeping the SOP program slim so that modest machines can operate the DR-333. Possibly they can be persuaded to market two versions of each control program: Basic and Enhanced.

Hardware

From the hobby perspective several improvements could be made in an already awesome package:

First, this innovative receiver would be even more welcome if it came with at least three and preferably five electronically switched antenna input ports. Frankly, I cannot imagine any DXer who does not regularly employ more than one antenna. Professional remote and automated monitoring and surveillance would be particularly enhanced by this capability, as well.

Second, an IF notch filter is a very popular device and is found on most major receivers offered since the mid-1980's. The DR-333's Pass Band Tuning is very useful, but sometimes I would like another QRM-defeating weapon. I will admit, however, that the DR-333's superbly effective Collins IF filters may replace the a notch filter for my needs.

Finally, I find that I miss the Tone control available on some major communications receivers. Granted, I almost never use that control on my "normal" receivers, but it would still be welcome.

FINAL IMPRESSIONS

I've been trying to think of an analogy that could illustrate how it feels to DX with the Standard Operating Program configured DR-333. I am the proud owner of a museum quality Hallicrafters SX-28A produced in 1945, undoubtedly one of the finest receivers to come out of WWII. It is everything that a major tube receiver ought to be and it weighs about 75 pounds. It also had such superb audio that it was sold as a console model and as an early HiFi! Its front panel is stunningly beautiful and the case was designed by the most famous industrial designer of the WWII era, Raymond Loewy. I love this radio! I love looking at it, listening to it and even casually DXing with it. Being a war plane buff too, when I radio with the SX-28A, I sometimes feel that I'm flying the finest WW II fighter plane--the P-51 Mustang. The P-51 looks, sounds, and flies like an airplane ought to look, sound and fly. If the SX-28A is a P-51 Mustang, the R-390A is an F-86 Sabre jet, and maybe, the NRD-525 is a F-15 Eagle. My fighter plane analogy for the SOP-configured DR-333 is the X-wing fighter from the movie Star Wars! DXing with this piece of the 21st Century is an absolutely fantastic feeling. Using it on a semi-automated basis combines the best of my brain, my experience and my ear as a DXer with cutting edge automation and state-of-the-art radio circuitry. It feels and sounds wonderful!

The McKay-Dymek DR-333 will sell for $1495 and should be available as Proceedings 1991 goes to the printer. For further information contact: McKay-Dymek Division, Stoner Communications, 9119 Milliken Ave., Rancho Cucamonga, CA 91730 (714-987-4624)

THE ICOM R-9000:
THE ROLLS ROYCE OF RECEIVERS, OR A PENTAGON TOILET SEAT?

George Zeller

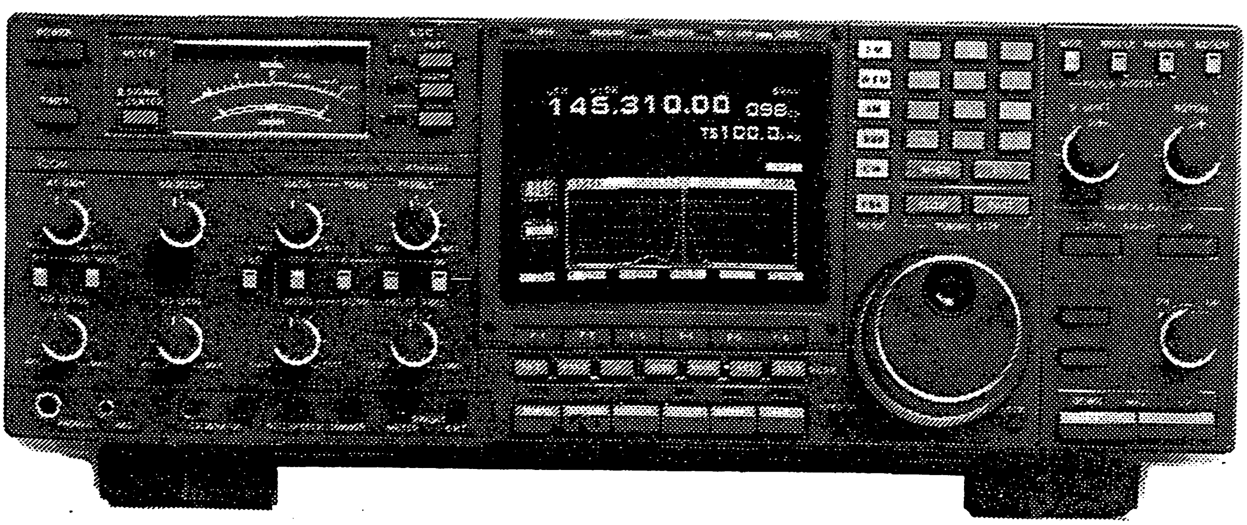
The ICOM IC-R-9000 receiver defines the current state of the art in consumer grade communications receiver technology. It provides exceptionally flexible performance over an enormous frequency range, and it contains the most complete complement of memories, knobs, functions, and gizmos that is now available in a shortwave receiver marketed to the general public. In his White Paper series and in the 1991 *Passport to World Band Radio*, Larry Magne rates the IC-R-9000 as the best receiver that he has ever tested. Universal Shortwave maintains a working display model of the receiver in their Reynoldsburg, OH store, and I have watched several dozen avid DXers drool while fiddling with this radio in the showroom. Virtually every serious DXer would very much like to have an R-9000 in the shack.

Despite the literally fantastic capabilities of this receiver, only a tiny handful of active DXers own an R-9000. Why? Its list price is $5,459.00 US! Even after a normal retail discount is deducted, the unmodified stock version of this radio costs at least $4,500.00 US. The *sales tax* on the R-9000 approaches the price of a new Sony 2010 portable. New *automobiles* with lower sticker prices are currently for sale in Cleveland. Clearly, the R-9000 is too expensive, and the overwhelming majority of DXers simply cannot afford to buy one. This is apparently not the case as far as the United States government is concerned. Several ICOM dealers reported that their retail inventory of the receiver was exhausted in early 1991 because of large orders by government agencies and the military.

However, during 1990 my bank account was unexpectedly (and temporarily) in a healthy condition. I swallowed hard, traded in an ICOM R-7000, chiseled an additional discount from the dealer, administered a full scale anesthetic to my wallet, considered that my single marital status guaranteed that I would not have to dodge flying objects launched by an irate XYL when I got home, and I bought one of these big black boxes with a CRT display on the front panel. During the 1990-1991 DX season, I operated it A-B with my old Japan Radio Corporation NRD-525, which has been modified by the addition of superb 1.9 and 2.9 kHz Collins bandwidth filters. I own no test equipment, but I now have a good idea of the comparative practical DX performance of these two receivers.

Let's get straight to the bottom line. Is the R-9000 worth all that money? The United States military was embarrassed in the late 1980's by press accounts of its $500 hammers and $1,000 toilet seats. After all, even though the Pentagon spent a lot of money on these items when they were procured, the government received goods that really were nothing but hammers and toilet seats. How about the R-9000? Is it a deluxe state-of-the-art receiver, or is it just an overpriced "toilet seat?"

After about a year of heavy use, I still have mixed feelings about this. Despite a few small flaws, the R-9000



is unquestionably a superb HF receiver that somewhat outperforms the NRD-525 in a number of significant DX areas. Its VHF-UHF-GHz scanner is noticeably better than the ICOM R-7000 that I traded in. Its CRT and CPU perform functions that ordinarily require the purchase of an expensive outboard personal computer with DX software. It has a very useful spectrum display that is hard to duplicate, even in the peripheral device market. It also contains a black and white (actually black and amber) TV set with tuner specifications that are unparalleled in the consumer television marketplace.

If you want and need all of these functions, and if you have negotiated consent agreements with your conscience, accountant, and spouse, the R-9000 may actually be worth $4,500.00. But, if you don't want or need all of these capabilities, or if you don't have ironclad agreements with your significant others, then the R-9000 is drastically overpriced. Other modified communications receivers deliver HF DX performance that approaches the level of the R-9000, and these alternatives are sold for about one third as much money. Consequently, the R-9000 cannot be properly evaluated without simultaneous consideration of its excellent performance, the astonishingly broad array of its applications, and its astronomical price tag.

Most serious DXers are by now familiar with the performance characteristics of JRC's NRD-525 (see John Bryant's excellent "Wastegunner on a 525" in *Proceedings* 1989). Larry Magne's White Paper series provides a fine technical review of both the 525 and the 9000. Going beyond lab test specifications, is the R-9000 worth all of that extra cash? After an A-B DX season using both receivers, my unequivocal answer is, "It depends."

WHAT DO YOU GET FOR YOUR INVESTMENT?

The IC-R-9000 is a quadruple conversion receiver that continuously tunes frequencies between 30 kHz and 2000 MHz. (The owner's manual lists official limits of 100 kHz and 1999.8 MHz). Seven modes (AM, CW, USB, LSB, FSK, and at least two FM bandwidths) are useable on *all* frequencies. The receiver's frequency synthesizer tunes in nine different selectable increments, the smallest of which is 10 Hz. The 10 Hz digit reads out accurately on large frequency indication numbers that are clearly visible at the top of the CRT display. A typo in Magne's R-9000 White Paper incorrectly suggests that the receiver frequency readout is to 1 Hz. Actually, both the frequency synthesizer and the display operate on a 10 Hz standard, unfortunately with no RIT for 1 Hz tuning.

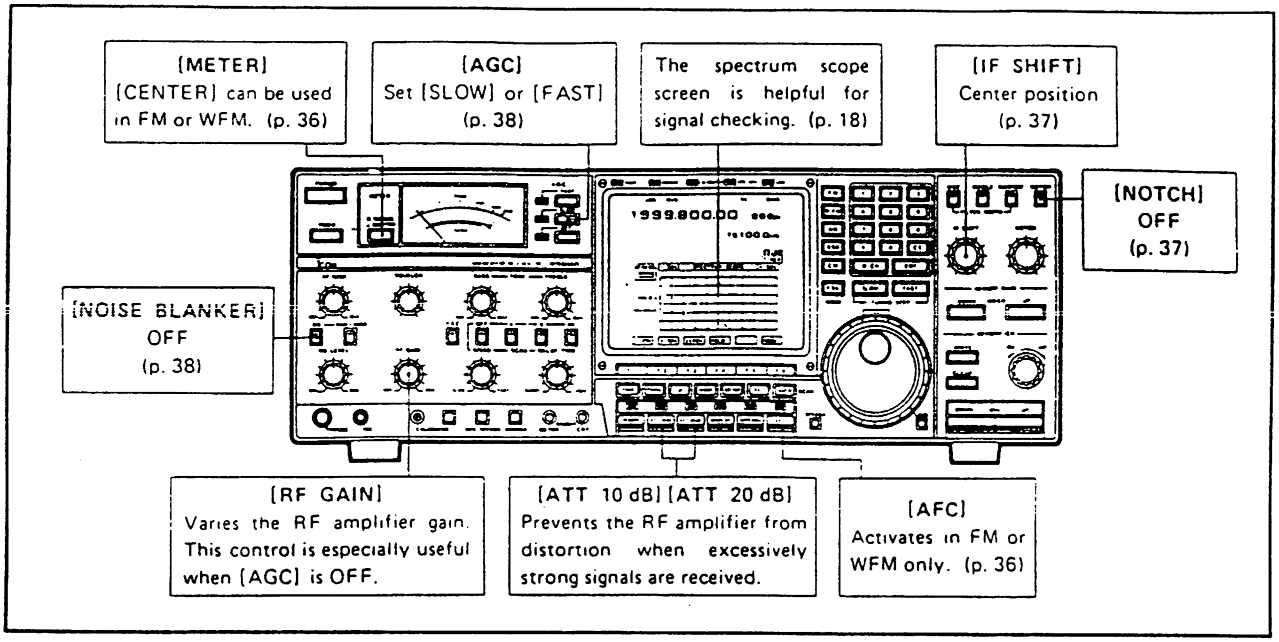
There are 53 knobs, buttons, lights, and jacks on the front panel, including a unique built-in 5"x3" CRT display. The CRT supports twenty display screen menus that are controlled by six buttons beneath the screen. Within the 20 screen display modes, the 6 buttons collectively control 88 functions. Thus, 135 different functions (53+88, minus 6 for an unduplicated count) are user-selectable from the front panel. No other shortwave receiver gives this level of operating flexibility to the listener. An additional 23 jacks, sockets, and connectors are on the back panel, including four antenna inputs (two for HF, one for VHF/UHF, and one for GHz). The HF antennas are user switchable by a front panel button. A couple of additional switches and a clock battery are reached under an ICOM-style trap door. My USA version runs off either 110 volt mains AC current or a "regulated 13.8 volt DC power supply." The owners manual specifically warns that an auto battery is not a regulated DC power source, but except for Hulk Hogan, few people would be muscular and/or crazy enough to take this rig on a DXpedition.

The CRT display is the central feature of the R-9000. It lists frequency and operating modes, functions as a TV set, prints RTTY data from external demodulators, displays memory contents, and indicates settings for literally dozens of control options. In one display mode, the CRT generates a frequency spectrum display of received signals within adjustable bandwidths of ± 25, 50, and 100 kHz around the tuned center frequency. This spectrum display is *extremely useful* for DX purposes.

A description of all functions supported by the R-9000 would require a book, and is therefore beyond the scope of this article. Fortunately, the book is available. The attractively bound R-9000 owners manual is 68 pages long. Universal Shortwave sells the manual (minus the receiver) for $11.50. It makes for interesting reading. Even though this is a complex receiver, the clear manual and the rig's well designed logical software lead to a relatively short user learning curve. In his White Paper review, Larry Magne complains that the R-9000 comes without a schematic diagram. This is no longer the case—I received a full detailed schematic printed on both sides of five large 42½" x 11" sheets of paper.

Compared to the modified NRD-525, how does the R-9000 perform? This is a complex question that does not have a simple answer. The R-9000 supports scores of applications that are beyond the capabilites of the NRD-525, so the question is an apples-to-oranges comparison. Above 34 MHz, the unmodified NRD-525 does not function, so the R-9000 wins by forfeit. Below 34 MHz, the R-9000 wins most (but not all) key A-B battles.

There are a lot of similarities between the 525 and the 9000. Both have battleship front ends, unlike the ICOM R-70 and the Kenwood R-5000. In an urban environment like my home in Cleveland, where local medium wave powerhouses blast away on a 24 hour basis, this is a very important consideration. Both receivers are incredibly stable, sensitive, and selective. They are loaded with features that provide considerable operator flexibility. But, a detailed



look at their *differences* is more useful to the serious DXer.

VHF-UHF-GHz: THE R-9000 AS A SCANNER AND TELEVISION SET

Unlike the unmodified NRD-525, the R-9000 contains a state-of-the-art scanner that has complete frequency coverage between the HF bands and 1999.8 MHz. The quality of this scanner is outstanding on dimensions like sensitivity, selectivity, image rejection, audio quality, freedom from synthesizer birdies, stability, etc. HF DXers who have no interest in VHF/UHF will certainly want to ignore the R-9000, since this capability is built into the receiver's gigantic purchase price. I have found that the R-9000 scanner is substantially better than the one in my old ICOM R-7000. The R-9000 has 1,000 (sic) memories, 100 of which can be used to automatically scan and store active frequencies, including an indication of the time and date that a signal was initially heard on a particular frequency during a scan. (The R-7000 has 100 memories, only 20 of which support a less comprehensive auto-write function).

The R-9000 scanning speed is both significantly faster and more adjustable than the R-7000. It supports just about every scanning scheme and mode that is known to man. The R-9000 demodulates television video, which can be displayed either on the front panel CRT or on an external black-and-white monitor. (The stock R-7000 does not demodulate TV video.) The TV bandwidth filter skirts are better than any that I have ever seen on commercial television sets. I can watch weak TV-DX signals on channel 2 while the local powerhouse WKYC-TV blasts forth on adjacent channel 3 with zillions of watts from a transmitter less than five miles from my house. I can also watch the Indians game on channel 43 from my DX shack. If the Indians give up another three run homer as usual, I can instantly switch back to 60 meter HF DX with one push of a button.

All of this is impossible on the NRD-525. A detailed review of the R-9000's scanner performance is beyond the scope of this article. But, the R-9000 outperforms the R-7000, which retails for more than $1,000.00. As far as I know, it beats *all* other hobby scanners in receiver quality and overall performance. It also is substantially better than any commercial black and white television set tuner that is on the market; this feature is probably worth in excess of $250.00. So, about one-third of the cost of an R-9000 is tied up in its VHF/UHF/GHz capabilities. The HF part of the radio, which does *not* come separately, costs less than $3,000.00. This narrows the 525/9000 price gap considerably.

HF: THE GOOD NEWS

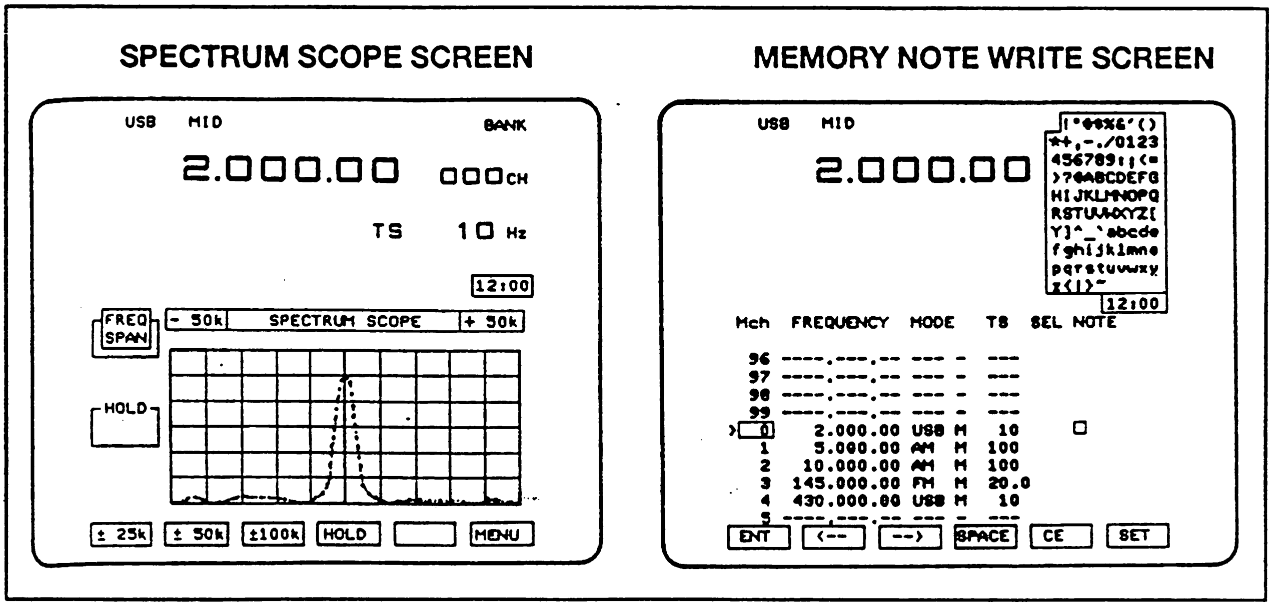
In quite a number of key areas, the R-9000 noticeably outperforms the NRD-525 as a DX receiver. For some functions, this improvement is small. In other areas, the difference is dramatic. The R-9000 exceeds the 525's capabilities in all of the following respects:

1. AUDIO. The NRD-525 generates frustratingly inadequate audio. Cheap $30 walkman radios produce better audio than the muffled junk that comes out of the 525. Even when run through external speakers, the 525 is too bassy. Even worse, it is notorious for a constant high pitched audio hiss that is not unlike the white noise you get on an FM tuner when no station is on frequency. In contrast, the R-9000 generates a quite pleasant wideband audio frequency response. This audio is very quiet, contains no hiss noise, and is adjustable by effective treble and bass con-

trols. The R-9000 audio can be favorably compared to the sound that comes out of old boat anchor tube rigs. This outstanding audio obviates the need for external graphic equalizers, MAP units, etc. that are designed to clean up the mess put out by radios like the 525. The top-mounted internal R-9000 speaker produces acceptable sound, but the audio is much more impressive through a decent outboard speaker. DXers should not minimize the importance of this. Good audio is useful for comfortable program listening, but it also is a great help for fishing the weak DX ID out of the mud. As a very substantial bonus for DXers, a combination of the R-9000's AGC constants and adjustable audio very noticeably minimizes the damage caused by QRN noise, particularly in comparison to the 525. (NOTE: I originally was delighted with my 525, because its audio was much better than the sound from my ICOM R-70, particularly in ECSS with the 2.9 kHz Collins filter in the circuit. Hence, the R-9000's audio is *startlingly* better than that of other ICOM equipment).

2. S METER. The R-9000 has an analog S meter. The NRD-525 does not. Enough said. The S meter in my old ICOM R-70 tended to significantly underread, particularly in SSB. While on a St. Helena DXpedition with Kevin Atkins, I noted that his R-70 has the identical malady. ICOM solved this problem in the R-9000. The S meter reads robustly (and pretty accurately) *in all modes*. It also functions as a center-tune indicator on FM, if desired.

3. MEMORIES. One of the great breakthroughs in the 525 is its 200 tunable memories. The R-9000 raises this ante significantly with 1,000 tunable memories. This huge memory capacity is actually necessary, particularly if a user does much VHF listening in a metropolitan area. On both receivers, the memories store frequency, mode, and bandwidth filter. Unlike the 525, the R-9000 memories also store tuning step settings. This feature is even more valuable when you consider the fact that the 9000 has nine different tuning step settings; the 525 has only two. The 9000 does not store attenuator and AGC settings like the 525 does, but this is not a big deal. The 9000 does, however, display any ten of the stored memories on the CRT, along with a useful eight character note that identifies the station (e.g. TACHIRA, RELOJ, TRISTAN, etc.) These notes are easily entered with a CRT function button and the tuning knob within a user friendly display screen that is illustrated below. This very useful feature is not available on the 525. Both receivers access memories through the keypad, but the R-9000's memory tuning knob is *considerably* more convenient for quick tunes through adjacent memories than the 525's awkward memory slewing buttons. The R-9000 supports convenient internal memory editing functions (such as copy, move, and delete) that are missing on the 525. In the memories battle, the R-9000 wins hands down.



4. NOTCH FILTER. The 525 has an excellent 40db notch filter, which is a major improvement over its notchless predecessor, the Japan Radio NRD-515. The R-9000 has a better one that is rated at over 60db. Magne says that the R-9000's notch filter is the deepest one that he has ever tested. He is right. This filter kills hets, period, in ECSS. However, its range is somewhat limited in AM, so it does not work on AM mode heterodynes at audio frequencies above 1500-2000 Hz or so. The notch is unbelievably deep and effective on the R-9000, but its audio width sometimes seems a little too broad for me. The filter has a slight tendency to notch out some useful audio along with the hets.

5. IF SHIFT. The R-9000's version of passband tuning is labeled as an "IF SHIFT" control. It works in all non-FM modes, and is enormously effective. QRM is eliminated as the IF passband shifts away from the tuned frequency, but the signal retains decent audio after this shift. The NRD-525's "Pass Band Tuning" control is often a little too vigorous for my taste. It does effectively narrow the passband, but it simultaneously squeezes the audio down

to "tin can" levels. I have never used the famous passband tuning circuit on the Drake R-7A, but I have to assume that the R-9000 IF Shift compares very favorably.

6. NOISE BLANKER. The 525 has a decent noise blanker that is somewhat adjustable. But, the R-9000 has an outstanding noise blanker that has a greater adjustment range. In my experience, most noise blankers seem to work about 30% of the time. They can be effective on spark plugs, vacuum cleaners, power line noise, woodpeckers, etc. However, they can be annoyingly ineffective in an urban environment like Cleveland, where noise is a big factor in serious DXing. I find that the R-9000 noise blanker will completely attenuate noise at least half the time. This is way above average for blankers on communications receivers. Furthermore, the noise remains visible on the CRT spectrum display, so it is psychologically uplifting to hear its disappearance. Hallelujah, the wicked noise is gone! This property is not unique to the R-9000; the ICOM R-70 also has an effective (though less adjustable) noise blanker. I conclude that ICOM noise blanker circuits are better than JRC noise blanker circuits. On the R-9000, the noise blanking effect is even more pronounced on longwave than it is on HF. This is really impressive!

7. NOISE FLOOR. The R-9000 is much quieter than the 525. I am not sure why this is true, but it probably is a combination of quiet RF, IF, and AF circuits. Thunderstorm static and other sources of noise are noticeably less bothersome on the R-9000. This is a *major plus*. The advantage can be enhanced by effective manipulation of the notch filter, IF shift, and noise blanker. Under some conditions, static can be drastically attenuated. It is amazing! Unlike the noisy frequency display on the 525 that puts out RF interference to adjacent radios, the R-9000 CRT is well-shielded and quiet. A Sony 2010 lying on top of my 525 is useless because of the loud buzz, but a 2010 lying on top of my 9000 is completely functional. Although I have not tried it, MW DXers could use indoor loop antennas for the 9000 without fear of receiver-generated QRM.

8. TUNING FLEXIBILITY. Again, the R-9000 beats the 525 in this category. The 525 tunes in 10 Hz or 100 Hz increments with a comfortable main knob. The R-9000 has an equally comfortable knob that tunes the same 10 and 100 Hz increments, but it can also be set for 5, 9, 10, 12.5, 20, 25, and 100 kHz steps. A very nice optional "click" function (both audible and palpable with the fingers) adds to the tuning "feel" of the 5+ kHz steps. Slewing buttons and keypad tuning supplement the knob on both rigs, although I personally have little use for slewing buttons. (The R-9000 slewing increments are limited to 1 MHz steps.) Overall, the R-9000 has considerably greater tuning flexibility. The 5 and 10 kHz increments are convenient for bandscanning of HF and MW, respectively.

9. FM DEMODULATION. FM signals are not common on the HF bands, but there are exceptions to this. Many 10 meter hams, some pirates, and a handful of utility stations regularly use FM. In addition, some poorly modulated SWBC stations transmit fundamental frequencies and spurs that have partial or full FM'ing signal components. The FM mode on the NRD-525 is lousy. This receiver's FM detector is pretty flimsy, and its bandwidth is way too wide for effective use on HF. On frequencies below 30 MHz, the R-9000 has two excellent FM bandwidths. (A third wideband FM mode kicks in on higher frequencies for reception of broadcast FM and television audio.) In the FM category, the 9000 beats the 525 by an overwhelming landslide.

10. SPECTRUM DISPLAY. The R-9000 spectrum display is obviously not present in the 525, or in any other quality consumer receiver (with the exception of the vastly inferior offering on the SONY V21 "portable"). Some DXers have speculated that this spectrum scope is a gizmo and frill that does not have significant DX applications. *These people are wrong!* The R-9000 spectrum scope is quite valuable in many DX situations. It must be used to be fully appreciated. The invention of windshield wipers was a big improvement to the level of visibility through automobile windshields. The R-9000 has a similar effect on the mental relationship between a DXer and a receiver. You can *see* a signal's constantly changing strength and bandwidth while listening to it. You can also see the same properties of other signals that are ± 25, 50 or 100 kHz away from the signal that is currently tuned in.

This capability is useful in several situations. First, QRM and QRN are visible on the screen. Adjustments to filter, notch, noise blanker, and other controls have audible effects through the speaker *and* some visible effects on the screen. The process of ear-finger-brain coordination is significantly enhanced by the scope. Second, as signals come and go on adjacent frequencies, they are immediately visible on the screen. This is an exceptionally valuable feature. Multiple pirates who operate simultaneously can be noted and heard; some would probably be missed without a scope. Clandestines (and jammers) that jump frequencies can be instantly followed to their new spot without a lot of tuning guesswork. As a band opens up, new carriers can be visually spotted before a bandscan starts, particularly on relatively quiet bands.

After using the R-9000, I am convinced that built-in spectrum scopes are the best new DX idea since the invention of the digital frequency display. Most DXers should want one. Until they become routine in HF receivers, there should be a reinvigorated market for peripheral spectrum displays. The plusses and minuses of the R-9000 should guide the development of future products. On the positive side, the ± 25 and 50 kHz bandwidths are good choices; the ± 100 kHz range is usually too cramped on HF, but is useful on VHF. The R-9000 display is visually attractive, and is easy to learn effectively. On the negative side, the R-9000 display response is slightly behind real time, and its "pixie-dot" non-analog image "feels" sluggish during tuning. It could use an additional narrow bandwidth (± 5 kHz?) to make it more useful as a tuning scope for things like FDM RTTY signals, and another wider bandwidth (± 500 kHz or 1 MHz?) for use in some VHF/UHF frequency ranges. But, until more built-in scopes are available in the commercial receiver market, the R-9000 spectrum display is the *only* existing alternative, and is *very* valuable. You should go buy one at once!

11. MODE AND FILTER BUTTONS. On the 525, tuning modes and filters are selected (or lost and confused) by four up-down slewing buttons that cascade through the various available alternatives. AM/FM/USB/LSB/FSK modes and all bandwidth filters are selectable on the R-9000 with individual buttons. This may seem to be a minor point, but it enhances ease of operation on the R-9000. Three cheers for ICOM, and four boos for JRC.

12. MISCELLANEOUS FEATURES. The R-9000 is loaded with capabilities and features that are not present on the 525. Some of these are nice for DXers, and should be noted. The CRT displays a clock at all times. On some screens, this clock shows seconds, day, date, month, and year. The CRT also displays the tuning step setting at all times. Four FSK offsets are user selectable. (The 525 has only two, RTTY and FAX). Although scanning functions have limited utility on HF, the 9000 scanner is much more sophisticated than the one in the 525. Among the extra capabilites is a circuit that stops scanning only when voice signals are detected. The *feel* of the two rigs is also different. The R-9000 weighs 44 pounds, and just looks very solid. The 525 weighs less than half that, and its plastic cabinet does not make you feel like you have a major appliance on your shelf. My experience suggests that the R-9000's complexity does not hinder the ease of routine DXing. The overall receiver design is ergonomically sound, and the extra features need only be used when necessary or appropriate.

HF: THE BAD NEWS

Alas, everything is not rosy on the R-9000. In a few performance areas, the 525 is marginally superior, despite the enormous price differential between the rigs.

1. FILTERING. The stock bandwidth filters in the NRD-525 leave a lot to be desired, but my 525 has been modified by the installation of absolutely superb 1.9 and 2.9 kHz Collins filters. In some respects, the 2.9 kHz Collins outperforms the stock R-9000 filters. In AM, the R-9000 engineers screwed up. Magne measures the three AM filters at 11.3, 7.8, and 2.6 kHz. The wide one is way too wide, except on local MW stations or for HF blockbusters like WWCR on 7520 kHz. The medium AM filter is also too wide, especially on bands like 49 and 41 meters at night. The narrow AM filter is excellent, but it is narrow, and thus has limited audio fidelity. (Fortunately, the audio quality of the narrow filter can be enhanced by detuning about 1 kHz up or down from the center frequency of a station.) Both the wide and medium AM filters should be narrowed by about 3 or 4 kHz apiece. Suprisingly and inexcusably, the R-9000 filters cannot be selected independent of mode! On SSB/RTTY/CW, three different and narrower filters kick in, including an FL-44A and an FL-52A. The SSB/RTTY filters rate at 2.8 and 2.5 kHz, and the CW filter seems at least as tight as its nominal 500 Hz value. All of these filters are superb, and are nearly up to the Collins standard. (The skirt selectivity of the 9000 SSB filters is slightly worse than that of the Collins filters, sometimes necessitating the use of the attenuator to eliminate slop from loud adjacent signals.) Overall, the R-9000 is an *extraordinarily good* receiver in ECSS. However, if a 4 or 5 kHz filter were available, useable in both AM and SSB, things would be much better. My modified 525 has this multimode filter capability. Remember, the R-9000 costs several kilobucks, so it should not be necessary to add bandwidth filters after you already shelled out a fortune for the stock rig. But, firms like EEB will add a board and a couple of Collins filters for an additional charge of several hundred dollars. Ugh.

2. HEAT. The R-9000 runs thermally HOT. It is a *lot* hotter than the 525. A heat sink in the back right hand corner of the receiver absorbs quite a bit of thermal energy. It's not warm enough to brew coffee, but it might give you a rare steak if you left the meat on there long enough. The heat also generates an audible mechanical "pop" at strange intervals, much like a car engine does if you look under the hood with the engine off after a long ride on a hot day. This heat cooks the top of the cabinet to about 110 degrees, and it makes me nervous. So far, it does not seem to have created any ill effects. But, if this heat creates receiver unreliability down the road, I am going to be furious when I show up at the repair shop with my warranty that expired after one year.

3. PUZZLING ECSS BFO OFFSETS. My 525 can easily and accurately measure AM carrier frequencies down to 10 Hz in ECSS mode by a simple technique that only requires use of the tuning knob and my ears. Using automatic BFO offsets in either LSB or USB mode, I match the pitch of hets about ± 200 Hz or so on both sides of the center frequency of a station, add half of the frequency difference in Hz between the two matched tones to the frequency display reading for the lowest tone, and BINGO. The frequency is precisely measured, and the receiver is tuned on the nose to a station's carrier frequency. This procedure can be tried on the R-9000, but it is usually more complicated. The R-9000 SSB BFO offsets generally produce a loud audible het around off-tuned ECSS signals on only one side of an AM carrier. I am a technical numbskull, so I am not sure why this is true. But, to generate two offset ECSS tones on the R-9000, you often have to take two readings in both LSB and USB after pushing a button to change modes. The 525 will do this in either USB or LSB without the need to fiddle with any mode change controls. While a minor

point, this is a minus for me. I do a lot of frequency measurement, particularly while DXing for pirates.

4. STABILITY. Both the 525 and the R-9000 are absolutely rock stable. It is amazing what they can do in Japan nowadays. When the dial says 5047.13, it means precisely 5047.13. The 525 is instantaneously stable from the moment when the power is switched on. From a cold start, the R-9000 often needs several seconds of warmup before it drifts down to a precisely stable frequency. The spectrum display warms up even more slowly, and takes at least 10 seconds to drift down to an accurate frequency range after a cold start. Hence, when the receivers are turned on, the 525 is more stable than the R-9000 for about 2-10 seconds. This is curious, but it is only a minor inconvenience. On the other hand, both my 9000 and my 525 show a constant frequency variation of about 20-30 Hz that is frequency dependent. On my 525, WWV on 5 MHz accurately reads at 5000.00 KHz on the frequency display. But on 15 MHz, the WWV frequency reads out as 15000.03 kHz. The synthesizer error is about 30 Hz over a 10 MHz range. My R-9000 seems to have a similar 20 Hz error range, but it is adjustable. A tuning callibrator screw on the front panel can set WWV to 15 MHz on the nose, but then it is 20 Hz low on 5 MHz. If I reverse the process, I can set WWV to 5000.00 on 60 meters, but then the synthesizer will be 20 Hz too high on 19 meters. The error seems to be linear on both rigs, and it is quite stable. At least the small synthesizer error is externally adjustable on the R-9000. With the 525, I just have to live with it.

5. AGC. Both fast and slow AGC decay constants are too slow on the R-9000. They can be instantly defeated by hitting the AGC "off" button momentarily, but this situation is a nuisance when the radio is tuned past a powerhouse S9+40db signal toward a weak S3 signal. On the tropical bands, the AGC settings rarely cause any problems. In contrast, I think that the NRD-525 AGC decay settings are more appropriate. On both radios, the AGC attack constants are both rapid and well chosen. (Some DXers think that they are *too* rapid.) On the brighter side, the 9000 has separate buttons for fast, slow, and off AGC settings. The 525 has only one inferior button that cascades through these AGC positions.

6. KEYPADS. The 525 has taken some deserved criticism for its oddly shaped vertical keypad buttons. In *Proceedings* 1989, John Bryant sarcastically called them "dull knives." But, the buttons on the R-9000 are *worse*. They are dinky, flat, slippery, and too squeezed together. This frequently leads to input errors. Give me widely spaced dull knives any day; I'll take them. There is more bad news. The software for keypad frequency input on the R-9000 requires the input of a MHz dot. You cannot enter 7415 kHz or 760 kHz. Instead, it must be 7 dot 4 1 5, and 0 dot 7 6. The 525, which will take either MHz or kHz input on its frequency entry keypad, is considerably more convenient. The R-9000 loses the keypad ergonomic battle to the 525 by a wide margin. On the R-9000, I also find that the six dinky CRT control buttons are located too close to the dinky scan function buttons. My big fingers sometimes start a scan by mistake when I actually wanted to change function settings on the CRT.

7. DIAL-TO-MEMORY FUNCTION. On the 525, a dial frequency can be conveniently stored into any memory channel by pushing a couple of buttons (or actually a few buttons, but the process is logical and easy, and it is easier to do than it is to describe). In stark contrast, *the R-9000 has no dial-to-memory function*, and it lacks a dual VFO capability. You can store the contents of the single VFO into one pretuned memory channel, but you cannot enter another memory channel without losing the frequency being tuned by the VFO. This R-9000 quirk is a serious drawback. It hinders efficient storage of frequencies into memories during bandscans. In addition, blank R-9000 memories default to the FM mode with a 20 kHz tuning step. This further complicates the ease of memory storage on HF frequencies. Here is another area where the ICOM engineers made a significant mistake.

8. BFO NOT TUNABLE. The R-9000 provides seven different fixed BFO offsets in SSB/CW/FSK modes. Aside from this, the frequency of the BFO is not manually tunable by the listener, and the automatic LSB/USB offsets cannot be defeated. The situation is puzzling in a top-of-the-line receiver. The 525 has a tunable BFO frequency knob, its automatic SSB offsets can be turned off, and its bandwidth filters are selectable in all modes. These features, none of which are present in the 9000, permit ECSS reception on frequencies within AM station sidebands that are not restricted to automatic BFO offset settings (see "Getting the Most Out of ECSS" by Gene Pearson in *Proceedings* 1990). The 9000's lack of 1 Hz tuning might create additional anguish for some ECSS purists, but my ears do not detect a problem here.

9. LINE OUT LEVEL. Various "line out" audio levels are unusually low on the R-9000. They certainly are lower than comparable outputs from the 525. The situation complicates A-B input from the two receivers into my audio amplifier, my M-7000 RTTY demodulator, my tape deck, etc. Constant adjustment of the AF gain and audio input levels is necessary when receivers are switched. This is not a serious problem, but it is a nuisance.

THE JURY IS OUT: USABLE SENSITIVITY

After several months of A-B use, one key question is still unresolved in my mind. Between the R-9000 and the NRD-525, which receiver has more usable sensitivity? The official sensitivity specifications of the R-9000 are slightly better than those for the 525. This, plus the exceptionally quiet noise floor and the excellent audio of the

R-9000, suggests that the R-9000 performs somewhat better on really weak DX than the 525 does. But, this has not always been the case in my actual experience. The *really marginal* het seems to produce more useful audio on the R-9000 about 85% of the time, but I sometimes get a more intelligible signal on the 525. There are two factors that I suspect here. First, the 525 has a function that can disable the RF filters in the front end. In some cases with the AGC off, this can increase the apparent audible gain of a signal by a slight amount. The R-9000 does not support this feature. Second, my old ICOM R-70 seemed to be sensitive to the impedance of my antenna. The 525 has automatic preselection circuits, and this greatly minimizes the suspicion in my mind that I might be losing signal from an impedance mismatch. It is possible that my R-9000 might have a slight "dead spot" or two from impedance mismatch with my antenna, particularly on 90 and 120 meters. I have not experimented with an antenna tuner, so I am not yet sure if my suspicions are justified. Astonishingly, I very occasionally get a more usable signal on my Sony 2010 portable with its whip antenna than I find on either the 9000 or the 525 with an outdoor antenna! This certainly is a result of the 2010's phase-locked loop synchronous detector, which is absent on both of the high priced receivers.

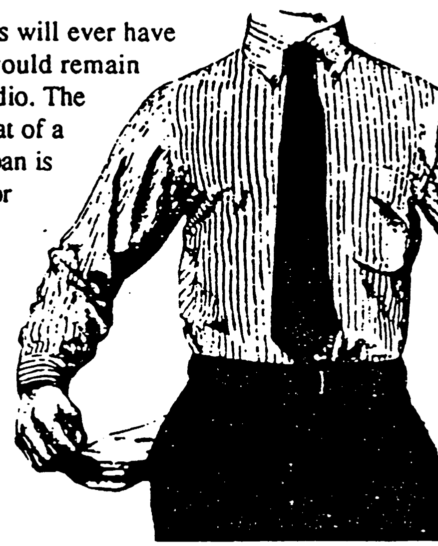
IS THE ICOM IC-R-9000 WORTH THE BIG BUCKS?

This is a hard question to answer. It depends on the applications that a listener has for the receiver. The R-9000 is an HF receiver that performs significantly (but not overwhelmingly) better than my modified NRD-525 on an overall basis. It is also a VHF/UHF scanner that outperforms the ICOM R-7000. It is a black and white television tuner and monitor that considerably outperforms my regular TV as a DX rig. It is also a spectrum scope; this property is not available in any similar receiver. It is also a small PC that supports memory lists and edits, automatic station logging, and similar DX computer applications.

Let's attempt to tabulate the value-added from all these features, using comparative prices from the current Universal Shortwave catalog. The NRD-525 (with two Collins filters installed) retails for $1,470. The ICOM R-7000 costs $1,030. A new black and white TV with a super tuner is hard to find, but if you could get one, it probably would cost at least $250. So far, the total cost of the equipment exceeds $2,750, which remains about $1,700 below the cost of a new R-9000. For this additional $1,700, the receiver provides a useful spectrum display, which is not available at any price in other stock receivers. It does things that normally would require a PC/software combination that certainly would cost at least $1,000. Most important of all, it outperforms the alternative receivers. All in all, a case can be made that the R-9000 is reasonably priced, *if* you want and need all of these capabilities.

I have found that there are some situations where the 525 outperforms the 9000. So, the best solution is to buy both the 525 *and* the 9000. This can be done for about $6,100.00 US. Obviously, this suggestion moves us into the realm of the absurd. Most DXers have trouble scraping up the $900 for a used 525. Hence, it must be concluded that the list price of a new R-9000 is clearly prohibitive. Because of this enormous cost, the receiver will never have much of an impact in the DX hobby. But, despite a few inadequacies discussed in this article, the R-9000 does provide good value for the money. If a DXer intends to use the R-9000 for serious HF *and* UHF/VHF purposes, and if a large amount of cash is available in the household budget, the extreme cost *can be justified.*

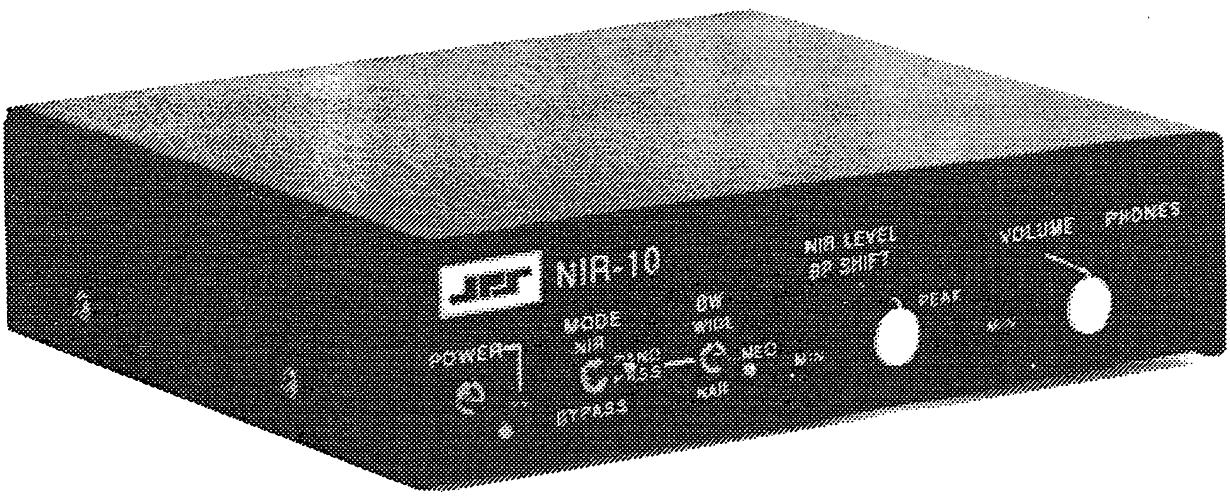
On the other hand, let's be realistic. Very few DXers will ever have 4 or 5 big ones to spend on a receiver. Very few spouses would remain married to DXers who even *tried* to spend that much for a radio. The R-9000's performance is not really dramatically better than that of a JRC NRD-525 or a Kenwood R-5000. So, the challenge to Japan is still there. We need an R-9000 (without the warts) that sells for about $2,500. The new NRD-535 and Drake R-8 receivers have not been thoroughly reviewed in time to meet *Proceedings* 1991 deadlines, but when they are replaced, receiver engineers and manufacturers should shoot for this goal.



peripheral equipment

THE DIGITAL JPS NIR-10 NOISE AND INTERFERENCE REDUCTION UNIT

Guy Atkins



When significant advances in electronics technology occur, a predictable progression takes place. The military is among the first to get equipment incorporating the new technique, process, or hardware. Next in line is industry and finally the new development becomes available to the consumer market, often finding its way into a wide variety of products.

Such is the case with Digital Signal Processing (DSP). After years of refinement, the benefits of DSP reached the consumer in the mid-1980s with the release of the compact disc (CD) player. As the technology progresses, other products using DSP are being introduced.

The NIR-10, a Noise and Interference Reduction unit from JPS Communications of Raleigh, North Carolina, is a new receiver accessory that is the first to offer the benefits of DSP to the DXer. It effectively reduces broadband noise, repetitive impulse noise and other interference encountered while monitoring AM, SSB, CW, packet, and RTTY modes. In addition, a recent upgrade to the NIR-10's software provides automatic, multiple hetrodyne removal.

The NIR-10 is JPS Communication's first product for the ham radio/SWBC DXer market. They are a supplier of advanced DSP-based communications equipment for government and industry, and the NIR-10 is a spin-off from their commercial product line. All their products are manufactured in their Raleigh plant.

In phone conversations and correspondence with JPS, they have proven to be a friendly, responsive company, interested in user-feedback on the NIR-10. They periodically send out helpful service bulletins, with details and schematics of upgrades and improvements the user can install. The upgrade and modification notices presumably reflect the fact that I was an early purchaser of the unit which initially came on the market in the Spring of 1991. Current models incorporate all previous upgrades.

DIGITAL SIGNAL PROCESSING– WHAT IS IT?

A digital signal is a group of pulses that are either "on" or "off". In digital terms, opposite conditions or amplitudes are indicated by the numerals 1 and 0. This results in a binary system with only two bits of information for each pulse, and variations for the digital signal are represented by changes in the 1 and 0 levels. Analog audio signals can be encoded in a digital form by sampling the signal at a very rapid rate.

Digital signals have a distinct advantage over analog signals in terms of less noise; it is relatively easy for a digital circuit to recognize just the two specific amplitude levels of a digital signal. The conversion from one

I've found that the NIR mode performs best in the area of white noise reduction, but it also reduces ignition noise, powerline noise and CW/RTTY interference. Any form of interference that is of a repetitive nature or constant tone can be reduced to some extent by the NIR- 10. Static crashes, which are random impulses, are affected very little by the NIR-10.

The use of NIR mode reduces operator fatigue when attempting to interpret noisy, interference-plagued signals for a prolonged time. I've found lengthy DX sessions definitely less tiring when using the NIR-10. However, the constant adjustment of its various controls makes bandscanning difficult; the slight time delay of the DSP circuitry causes the NIR-10's audio to lag behind the receiver tuning. It is much easier to tune in BYPASS and then go into the NIR or BANDPASS mode when an interesting signal is found.

Surprisingly, the NIR-10 can reduce noise and interference while instrumental music is being received (unless the NIR level is set at an excessive level which breaks up the audio). I can only conclude that the speech recognition software in the unit is not sophisticated enough to differentiate music FROM speech, but can separate music AND speech from noise.

The NIR-10 works well in an audio processing "loop" with the Multi-band AM Pickup (MAP) unit from Kiwa Electronics. The result is better intelligibility than with the NIR-10 alone. The MAP works off the receiver's 455 kHz I.F. frequency and improves AM or ECSS reception before the signal is demodulated and passed along to the NIR-10 for audio processing.

Because the NIR-10's input is audio, it can work with other sources such as a cassette tape recording. I often record DX signals "raw" without any audio processing, for later playback through the unit, experimenting with various NIR LEVEL and BP SHIFT settings.

The NIR-10 has no record output jack, but it is possible to use the two outside lugs of the volume control potentiometer as a constant level audio output. Tapping this point in the circuit, I've recorded processed signals for playback again through the NIR-10. Only occasionally has this second pass of digital processing yielded further improvement, but it is a technique worth trying.

BANDPASS mode in the NIR-10 offers three fixed audio filter bandwidths: narrow (200 Hz), medium (600 Hz), and wide (1800 Hz). The center frequency of each is continuously variable from 300 Hz to 3400 Hz. BANDPASS is a utility DXers delight; it is easy to use and works extremely well. It is intended to enhance CW, RTTY, SSTV, and packet at the narrow and medium settings, and voice transmissions in the wide position. Because the NIR-10 operates in the digital realm, the resulting bandpass has steep skirts and superb ultimate rejection (>60 db) that equal or surpass those of the best switched-capacitor or active analog filters (according to the manufacturer).

Any narrow, steep-skirted filter-- digital or analog-- is subject to "ringing". The NIR-10's narrow bandwidth is the equivalent of a resonant high-Q circuit, and can display a rasping sound when a signal is placed on the band edge. This rasping is the digital equivalent of ringing. However, the NIR-10's digital filtering in BANDPASS mode surpasses that of analog filters in that no ringing or other irregularities occur with the signal placed in the passband.

The first release of the NIR-10 provided a wide bandwidth of 1500 Hz, not completely suitable for voice modes. JPS Communications later changed this setting to 1800 Hz wide in Version 4.2 of the software, and it is now very useful for DXing SWBC stations. The setting of the BP SHIFT control is critical and a small adjustment of the center frequency makes a large difference in intelligibility (a geared vernier control would be helpful here!). BANDPASS mode in the wide setting offers another way to reduce effects of noise and interference on voice signals, but NIR and BANDPASS cannot be used simultaneously.

The medium and narrow positions are very effective for isolating individual RTTY and CW signals. I've had astounding results pulling single CW signals out of horrendous pile-ups, splatter, and other interference. DXers who tune RTTY, packet, fax, and SSTV will find the NIR-10 very useful in both NIR and BANDPASS modes.

The Automatic Het Removal mode operates well and will even remove multiple tones (i.e., RTTY interference is reduced to a pattern of soft clicks, leaving a much more intellible signal). This mode removes tones (hetrodynes) from tune-ups, broadcast stations, CW, RTTY, or any tone which last longer than 3 milliseconds. It is a curious experience to bandscan in ECSS with the Automatic Het Removal activated; all hetrodynes are silenced and the audio simply comes and goes as you tune across a station.

Automatic Hetrodyne Removal mode is controlled by the Bandwidth (BW) switch. This mode is activated by placing the BW switch in the WIDE position (all the way up) in either NIR or BYPASS modes. Automatic het removal is not possible in the BANDPASS mode. Here the controls all work normally, where the BW switch controls the bandwidth of the tuneable passband filter.

This mode has a curious effect on music and it will totally remove many sustained notes. A rousing rendition of *Amazing Grace* on radio station KVOH was nearly turned into *The Sound Of Silence*.

This feature performs best when tuning SSB voice signals in medium and narrow receiver bandwidths. I've noticed that voice signals may suffer distortion as the NIR-10 seeks out tones and hets to remove if the receiver is in AM mode with a wide filter.

PRICE AND ORDERING INFORMATION

The NIR-10 Noise and Interference Reduction Unit costs $395.00 (US), which includes surface shipping. If you do not possess an appropriate AC adapter (12vdc at 1 amp.), JPS can supply one for $12 when ordered with the unit. The NIR-10 is covered by a 90 day warranty.

To order the NIR-10, contact: JPS Communications, Inc., P.O. Box 97757, Raleigh, NC 27624-7757 USA. Phone: (919) 790-1011. FAX phone number: (919) 790-1456.

THE BOTTOM LINE

Is the NIR-10 worth nearly $400? This amount is definitely a significant outlay for most DXers. However, since the NIR-10 is currently a one-of-a-kind product–the first of its type–there is no other similar device to compare it to. New technologies cost a premium, yet if you're willing to wait there will certainly be less expensive, even better performing noise and interference reducing digital accessories available in the future.

If you monitor various utility transmissions as well as broadcast stations you will find the NIR-10 a valuable accessory, and will use all its capabilities on a regular basis. Only one of the unit's three BANDPASS filters will be of value to DXers who stick to voice modes. They will find it harder to justify (as I do) the NIR-10's cost.

At this early stage in the evolution of DSP, any evaluation of the cost/performance equation must ultimately be left to the individual. The reviewer of the *73 Amateur Radio Today* article mentioned earlier concluded that the unit is definitely worth having if your listening or DXing frequently involves extended periods in front of the receiver.

JPS Communications is an established company which has impressed me with their customer service and dedication to improving their product. It's steep price aside, the NIR-10 is a state-of-the-art performer that has given us a glimpse into the future of audio processing for the DX hobbyist.

A DXER'S LOOK AT THE NEW
DYMEK FC-11 FOG CUTTER

John Bryant

AUDIO FIDELITY

Audio fidelity should be every DXer and SWL's obsession. Whether we are focusing every neuron to hear a station at threshold level audio or simply relaxing with the BBC, we all need to hear what is coming our way as clearly as possible.

Unfortunately, neither receiver manufacturers nor the hobby press seem to focus on audio fidelity as a serious issue in shortwave receiver design. Manufacturers seem to leave design of the audio stage to a last minute low budget afterthought. Particularly in AM mode, we are faced with audio that is usually too bassy, often strangely muffled and distorted and often accompanied with some level of circuit hiss. The NRD 525 is notorious for the latter, while the former is most noticeable from ICOM and some Kenwood products. I thought that my NRD 525 had "reasonably good" audio until I put it side-by-side with a good tube receiver. The amount of hiss to which my 525-trained ears had become accustomed was unbelievable! Even though my brain wasn't hearing it, the hiss was masking useful audio information. If you think that your solid state receiver has "reasonably good" audio, put it next to a good tube receiver and find out how much audio you have been missing.. You will probably be as shocked as I.

ACTIVE DEVICES

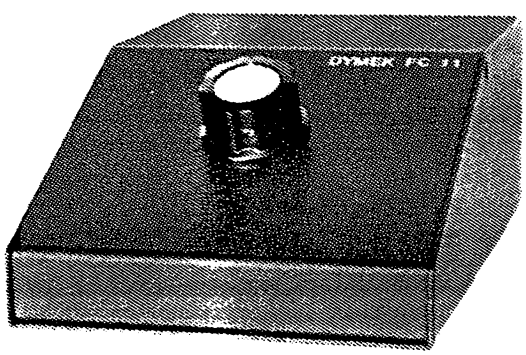
There are several active devices that will improve the audio performance of communications receivers. Many of us have tried the so-called stereo "graphic equalizer" that allows control of about plus or minus 12 dB of change in 6-10 audio frequency ranges. Since 12 dB is too little to affect hets and splatter much, few DXers remain satisfied with this device for long.

A second family of devices to improve audio fidelity is active audio filters. The best of these devices are excellent het removers and have some effect against hash and other repetitive noises. They are especially useful with receivers lacking effective IF Notch and/or Pass Band Tuning. Even though some of these devices allow some shaping of the audio spectrum, I have never used one that noticeably "clarified" or made the speech audio more intelligible. The other negative aspect to top-of-the-line active filters is their $300-$400 price!

A third type of device available to improve the audio of communications receivers is the MAP Unit by Kiwa Electronics. The MAP is a unique device that allows the user to "clip in" to any receiver with 455 kHz IF. When clipped in, the MAP temporarily replaces most or all of the receiver's IF section, detector and audio amplifiers. This device improves audio fidelity and intelligibility of speech remarkably. It has done so on every receiver that I have coupled to it. Unfortunately, this highly sophisticated device also sells for nearly $400 US.

THE DYMEK FC-11 FOG CUTTER

The Dymek FC-11 Fog Cutter is a ***passive*** audio filter or processor working in-line between a receiver's headphone jack and/or external speaker and your headphones or external speaker. It is powered only by the radio's audio circuit and requires no batteries or other external power source. The FC-11 has been in development by Inline Components and Stoner Communications (the Dymek people) for about two years. I was fortunate enough to be loaned a pre-production prototype to test.



The FC-11 is a deceptively simple device about the size of a thick paper-back book and has but a single six-position knob on top. The rear panel sports two RCA-type jacks. One is for input from the receiver, and the other for output to an external speaker. There is also a headphone mini-jack.

My version of the operating instructions is also simple: "Place this device in-line between the receiver and your low impedance speaker or headphones. Turn the radio on and adjust the volume to a comfortable level. Twist the knob a few times to discover that of the six knob positions provides the best audio. Enjoy!" That's it. Utter simplicity! Several DXers have tested the FC-11 using (very unusual) NRD high impedance headphones. Because of the nature of the L-C circuits, the device MUST be used with (normal) low impedance phones or speakers.

A LOOK INSIDE

Inside, the Fog Cutter is very simple. Electrically, it is a collection of various sized inductance-capacitance (L-C) circuits each selected in turn by the six position switch. As I understand it, these circuits work much like the L-C traps on a "trapped dipole" antenna, passing through certain audio frequencies and blocking/attenuating most others. Each circuit has different capacitance and each has a different coil selected from a collection wound around a gigantic (3"dia.) ferrite toroid core. The secret of this remarkable device is the selection of the exact values of L and C!

Five of the six switch positions each engages a different combination of coils and capacitors. (The 1st position is Bypass). The values of these switch-selected combinations of L and C are chosen to pass through a carefully selected but somewhat different range of those audio frequencies most important to speech intelligibility. Most good active audio filters give you the choice "High Pass" or "Low Pass" audio filtering as well as an "Audio Notch." I think that the secret of the FC-11's success is that it is a "Middle Pass" device, attenuating both high and low frequency audio to varying degrees.

In general, the most audio processing is found in the central positions of the switch (positions 3 and 4); however, each position yields a unique audio profile. I find that one of the "maximum" settings usually yields the most intelligible speech on very weak signal DX. When listening to strong signals, one of the lesser settings (positions 5 and 6) eliminates the 525's hiss and produces much improved audio. It is likely that different receiver designs (the R-71A, the R-5000, etc.) could find slightly different switch settings may be more effective.

JUST HOW GOOD IS IT?

For both testing and normal use, I hooked the FC-11 in-line between the External Speaker port on the 525 and the Receiver Audio input on the MAP Unit (Version 1.0). The MAP has an "A/B" switch that allows you to hear the MAP operating (A position) through its internal speaker and (B position) simply to use the MAP's speaker as an external speaker for the receiver. Hooking the FC-11 up this way allowed me to make quick comparisons of "barefoot" 525 audio, FC-11-modified audio and MAP-supplied audio, with each choice driving the MAP's internal speaker. I have made many comparisons over the past six months using this setup.

Surprisingly, the differences between the MAP audio and the FC-11 audio with the NRD-525 were usually relatively minor. Either unit rendered vastly superior intelligibility as compared with the lamentable audio of the barefoot 525. In a few cases (usually muffled languages at threshold levels) the much more sophisticated and expensive MAP Unit won hands down.

One other aspect of the FC-11/NRD 525 combination is worth noting. Like most other SWBC DXers using 525's, I have found that the receiver is noticeably "more sensitive" in AM mode than when operated in either LSB or USB. This is partly due to the really fine AM synchronous detector in the 525. I now know it is also partly due to the 525's really awful sideband audio when tuning weak AM signals (ECSS). I am not exactly sure how, but the Fog Cutter improves the VERY mushy audio in weak signal ECSS tremendously and makes that mode of DXing with the 525 MUCH more effective.

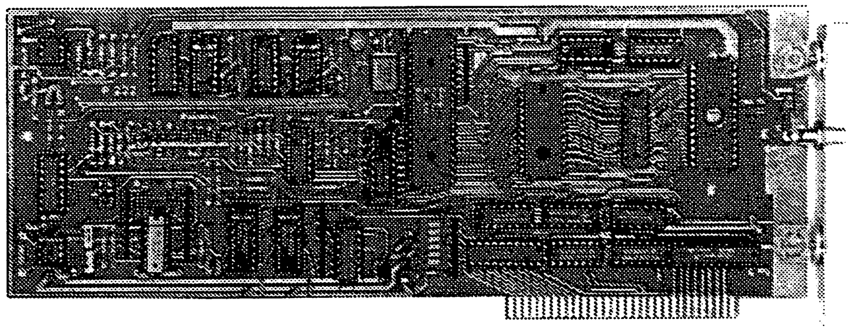
SHOULD YOU BUY ONE?

If you are using a 525 barefoot, or one of the several ICOM or Kenwood products that are notorious for poor audio, I recommend the Fog Cutter very highly. After having compared several audio processing schemes for the past couple of years, I have decided that I will never again listen to a Japanese designed solid state communication receiver's audio "barefoot." They all have poor audio! The modestly priced and small FC-11 is ***not*** as good as the MAP Unit, which sports 23 IC's to replace the entire back half your receiver. The Fog Cutter is, I believe, better than any active filter that I have tried. The Fog Cutter is not designed to perform het or "hash" removal to the levels of the JPS NIR-10. However, direct comparisons between the FC-11 and the MAP or the NIR-10 are very unfair to the Fog Cutter. Projected to sell for $79.95, it costs about one-fifth of the other major audio processing devices. I have found the FC-11 to be extremely useful in both DXing and program listening. I intend it to be a permanent part of my array of DXing hardware. I will not DX without one.

More information on the Dymek FC-11 Fog Cutter can be obtained from Stoner Communications, 9119 Milliken Ave., Rancho Cucamonga, CA 91730 Phone: 714-987-4624

DX-ING QRM: A USER REVIEW OF THE UNIVERSAL M-1000

Chuck Yarbrough



In a recent batch of loggings for my monthly utility column SPEEDX Utility World, one of my reporters submited voice aeronautical loggings and apologized for "calling this stuff QRM and now reporting it." He went on to complain, "Voice and SSB are okay, its the CW and FAX that are QRM!"

Most SWLs and DXers would agree with my reporter's definition of QRM. There is nothing more annoying than having that 'once-in-a-decade' DX catch from Outer Slobovia interrupted by radioteletype!

For a minority of shortwave listeners, however, the SW broadcast station would be the QRM. Armed with the appropriate technology it is possible to DX beyond the usual broadcast signals.

This article reviews the newest addition to the line of Universal multi-mode decoders, the M-1000. It will also tell you what you might expect to 'hear' on your IBM-compatible personal computer if you decided to lay out the dollars for the '1000. You might say this is a primer for utility listening.

AN INTRODUCTION TO UTILITY LISTENING

I assume that most readers of Proceedings are not avid digital mode utility listeners, so lets get a basic definition out of the way. First, there are two broad classes of utility listening. My reporter showed us this difference when he defined QRM in the introduction. Voice (SSB) transmissions can be deciphered by anyone with that capability in their receiver. Typical transmissions in this class would be aeronautical communications, amateur radio broadcasts, ship-to-shore broadcasts, and radio broadcaster feeder transmissions. Most of the loggings which come to me each month are of this variety, because they are more accessible to the average radio listener.

The second class of utility transmissions are non-voice, or digital transmissions. These typically include radioteletype, facsimile, non-directional beacons, and morse code. I will discuss what you are likely to hear on each of these types of digital transmissions later in this review, but for now it is important to realize that these stations are assigned approximately 78 percent of the entire shortwave radio spectrum.

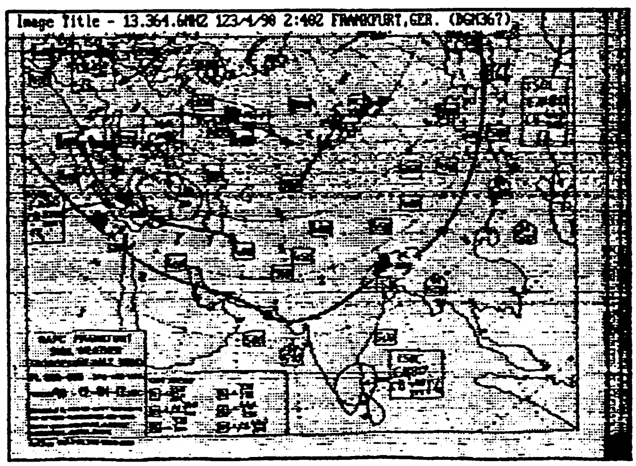
Listening to this 78 percent of the high frequency spectrum is different than listening to your favorite SW broadcasting station or even DXing Radio Nibi-Nibi. Sure, you might know the 'hot spots' on the dial, but that does not guarantee your success. When listening to the digital communication modes tuning in the signal is only half (or less) of the battle. You also must know what protocol the transmission is using. Is it a radioteletype station or is it a facsimile station? When you listen to a shortwave radio broadcast from, say the BBC, you can usually count on a regular schedule because you are the Beeb's intended audience. This is not the case when you listen to utility stations. Utility stations are there in order to provide two stations with the capability to communicate with each other. These two stations can be two embassies, or a ship and a shore station, or an airplane and an airport, or any number of other combinations.

There are, however, several major functions which might allow you some listening pleasure in the digital utility category. One of my favorite types of stations is a radioteletype press service. In the past both the Associated Press and United Press International were on shortwave, but with the exception of some radio facsimile pictures coming out of Buenos Aires, Argentina, these services have moved to satellite. In fact, these Argentinian AP Photo stations have not been logged in almost a year, so press photos may be a thing of the past on SW as well. What you will hear will be many of the 'third world' news agencies and some Soviet and ex-Soviet bloc news agencies. Examples of these are TASS and NOVOSTI from the Soviet Union, TANJUG from Yugoslavia, Middle East News Agency (MENA) from Cairo, Egypt, the Pan African News Agency out of Dakar, Senegal, and the Islamic Republic News Agency out of Teheran, Iran. News agencies based in the People's Republic of China (XINHUA) and on the island of Taiwan (Central News Agency) can also be heard, although these are more easily "caught" in the areas surrounding the Pacific Ocean. These are sources of information which are not ordinarily available to people in North America, but they provide useful perspectives on world events. All of these news sources broadcast in English either to Europe or to North America. In either case you usually can tune them in and understand what they are saying.

Don't feel left out if you listen to SW in order to improve your foreign language skills. There are also many stations which broadcast in French (ie. MENA), German (ie. Informationsfunk der Bundsregierung Fuer Europa), and Spanish (ie. Prensa Latina). Arabic staions can also be decoded, but the nature of the Arabic alphabet makes decoding much more difficult. In fact, since most people learn to read a second language before they can speak it, radioteletype can be a very useful learning tool. I know that my French has improved immeasurably since I started "reading" MENA. They broadcast stories in both English and French in the same transmission, so you can compare the translations.

Another type of digital station you will probably pick up will be maritime stations. These stations communicate with ships at sea for a number of reasons. I have received Associated Press news summaries, ship docking instructions, weather reports, various communications between shipping companies and their ships at sea, as well as the contents and delivery dates for a particular ship. Many people would ask, why would I want to listen to this? Simple, bunky. Many times political events in the world will influence whether ships put into port or not. There were not many ships being advised to pass through the Panama Canal during the Panamanian Invasion of 1989. Indeed, maritime stations were issuing advisories against visiting Panama during that time.

If any of you enjoy listening to voice aeronautical communications of either miliary or commercial flights, then you would probably enjoy decoding meteorological information found on shortwave in digital form. These data generally take two forms. The first type is radioteletype transmissions from airports around the world. These transmissions are intended primarily for other airports, but planes can also receive the data. The second form of meteorological information comes in the form of radio facsimile transmissions. These transmissions provide many of the weather maps and satellite photos of the earth that you see on the evening news on television. These FAX transmissions are also a great help to boaters, yachtsmen, and commercial shipping all over the world. With the M-1000 satellite photos and facsimile images usually take on a three-dimensional aspect, especially when displayed on a VGA monitor. The artwork to the right shows what one of these weather facsimile images looks like as decoded on the M-1000. During the Persian Gulf War in early 1991, when CNN was not broadcasting weather maps and forecasts from the Arabian Peninsula for 'security' reasons, these data were readily available every evening on radio facsimile. The ironic thing about this was that most of these images were provided by the U.S. Navy!



A final area of interest for many people on shortwave radio is what Harry Helms has called, "The Secret Shortwave Spectrum". Spy stations, embassy broadcasts, and many other mysterious transmissions can all be found in the world of digital utility stations. Much diplomatic traffic is encoded or uses exotic modes of transmission, but occasionally uncoded messages can be received. If you are a voice numbers station fan, then you will love radioteletype and morse code. With either the M-7000 or M-1000 you can decode either mode and print out the number combinations for analysis later on. Law enforcement agencies also frequent the digital utility scene as well. INTERPOL, the FBI, the CIA, the GRU, as well as other less well known agencies all use digital modes to communicate with each other.

One advantage of monitoring radioteletype or CW over monitoring SSB "numbers stations" is that you do not have to be present to get your results. If you are seeking a station identification on a numbers station you simply set your receiver on the frequency you wish to monitor then turn the printer control on automatic and then check back in a few hours. If anything has come across on that frequency then you have a "hard copy" and you can then sit down at your leisure and attempt to decode the number or letter groups. You do not have to sit for hours listening to CW. The machine does it for you! In case you were wondering, there are numerous numbers stations which use the digital modes. If spy transmissions are your bag, then you will love the digital modes.

In conclusion, these are just a few of the major things you can find each day when tuning digital utility stations. There are many other types of stations which I did not mention. There is always something going on in the utilities. Personally, I enjoy listening to shortwave broadcasts during the morning and evening, but during the day when the broadcast traffic dies down, the utility stations are at their peak, since they are conducting business rather than trying to get you when you are home after work. Also, if you are a 'country counter', you will be able to log many countries which do not broadcast programming on shortwave. Most utility stations will verify reception reports as well.

UNIVERSAL'S NEWEST DECODER

The Universal M-1000 decoder card for IBM-compatible personal computers was introduced in October 1990 as a low-end alternative to its pricey M-7000 stand-alone decoder unit. When I bought my M-1000 I thought I was taking a big risk. At $399.00 I only prayed that it would be a good second decoder, since I already owned the M-7000 ($1200.00). After using the M-1000 alongside the M-7000 for almost a year, I now prefer the M-1000! It is important to note that both machines are "receive only", so you cannot transmit in RTTY with them.

Why the price difference between the two models? With the M-7000 you are buying the computer to go along with the decoder. Since many shortwave radio buffs have access to a personal computer, this purchase seems a bit redundant. With the M-1000, you are purchasing only the decoder.

There are a few limitations to the M-1000, however. First, your computer must be an IBM-PC compatible. As of this writing there is no Apple version. Second, while the decoder will work on a monochrome, bare-bones PC, you will not be able to display facsimile intercepts on that type of machine. EGA or VGA adapters are necessary for high quality fax displays. Third, you will need at least 512Kb of RAM in your computer, but 640Kb is recommended. Finally, the interface programs which enable you to interact with the decoder run more smoothly and quickly off of a hard disk. You do not have to use a hard disk, but it is recommended.

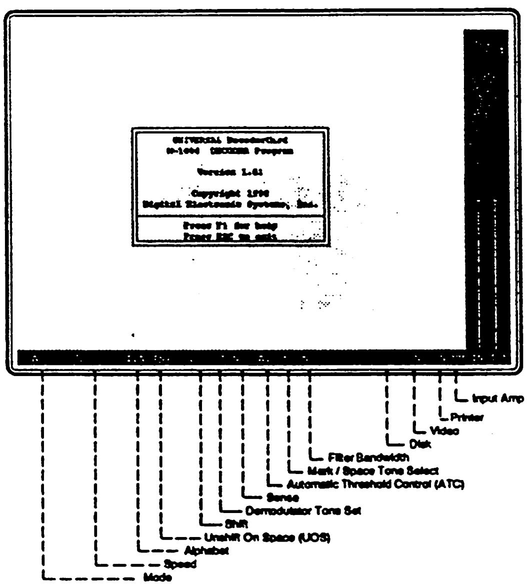
As for the actual performance of the M-1000 versus the M-7000, I have found the '1000 to be more sensitive and flexible than the higher priced machine. One problem anyone who has ever used a computer within 50 feet of a shortwave radio is that of QRM from the computer. The M-7000 is an exceptionally noisy beast. In my application, the M-1000 plugged into my Tandy 1000TX computer, I have not experienced much noise at all. In fact, I can be decoding with the '1000 and then turn on the '7000 and the signal that I was getting flawless copy from suddenly turns to hash. If you can't hear it, you can't decode it!

Many of you are probably asking, what about Radio Frequency Interference (RFI)? Obviously any machine you turn on while attempting to listen to the radio will introduce RFI. It is also true that every monitoring station will exhibit unique RFI "problems". Obviously I cannot tell you how much RFI will be introduced into your particular station if you use a decoder. If you are concerned, see how much RFI is introduced when you turn your computer on. I have found that the M-1000 does not introduce any additional RFI into my shack since my Tandy is fairly well shielded. All of my equipment is also well grounded. Both of these factors are critical in reducing RFI. On the other hand, I can hear my M-7000's microprocessor buzzing and humming from 10 MHz on up. Yes, you will have increased RFI, but of all the options the M-1000 seems to be the quietest serious demodulator on the market. One quick bit of advice, choose a computer with a slower clock (CPU) speed. The faster the speed, the more RFI it will produce. Its no accident that they measure clock speed in MHz!

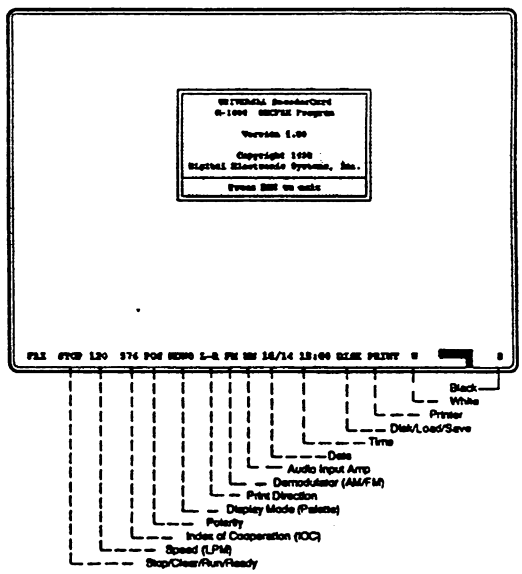
Let me describe the '1000. The M-1000 is an internal PC card which fits a long (10 1/2 inch) 8-bit slot. The only interface on the board is an RCA female jack on the back of the board. This is for the audio input. On the board itself there are three separate decoders: one for CW or morse code; one for Radioteletype; and another for facsimile reception. This is nice because the different decoders do not electrically interfere with each other since they are completely different circuits. Another nice feature is that the chips are socketed so that you can upgrade by replacing the microprocessor chip.

I have already replaced the microprocessor on my board. Universal sent a free upgrade from version 1.01 to 1.02 in May 1991. This upgrade "fixed" many of my original criticisms of the FAX program on the '1000. Replacing the chip in the '1000 was much easier than the same chore in the '7000 since I could pull the entire decoder and have more complete access to the chip. It is nice to know that my board will not be left behind as the software changes (as those of you who have purchased a "RTTY reader" know!).

The decoder package is almost idiot proof when it comes to installation. All you do is plug the board into any available slot inside the computer, put the program disk in, and type "INSTALL". The program does the rest and in a minute or so you are up and running with your new decoder. I have found the graphic interface of the DECODER and DECFAX programs to be much more "user-friendly" than the M-7000 with its cumbersome key arrangement and complex command structure. The screens for both programs look like this



M-1000 RTTY/CW Decoder Screen



M-1000 DECFAX Decoder Screen

Both programs are menu-driven, although at present there is no mouse support for these menus. In future versions computer rodents probably will be supported. In the first version of the decoder the cursor arrow keys step you through the options. Another way of navigating through the software is through macros (called "Expert Mode Commands" by Universal) which allow the user to move directly to another mode by pressing a single key. One disadvantage of this structure is that these macros are preprogrammed, so you cannot modify them. Perhaps in a future version Universal will provide an editor through which the software interface may be individualized by the customer.

The manual for the M-1000 is fairly good, although one consistent frustration most digital utility DXers find is that much is left unsaid in ALL manuals. One of the biggest challenges to the budding utility DXer is to learn what the different digital emission modes "sound like". There are commercially available cassette tapes which provide this information, but they are not included with any of the decoders being sold today. For more information, see the bibliography at the end of this review.

THE M-1000 VS. THE M-7000

What are the biggest differences between the M-1000 and the M-7000? For a complete listing of the features found on all of the different Universal machines, see the most recent Universal Radio catalogue. For a direct comparison between the '1000 and the '7000, I include a list of features:

M-7000/M-1000 Model Comparison Chart

Reception Modes	M-7000(v.7)	M-1000(v.1.02)
Morse Code (CW) 5-120 wpm	X	X
RTTY Baudot Standard 45,50,57,75,100 baud	X	X
RTTY Non-Standard Variable 40-250 Baud	X	X
RTTY Bit-Inversion	X	
RTTY ASCII Low Speed Standard 75,110 baud	X	X
RTTY ASCII High Speed Standard 150,300,600,1200 baud	X	X
RTTY ASCII High Speed Non-Standard 1050,1800 baud	X	
Sitor A (ARQ) & Sitor B (FEC), Autor (selective & synchronous)	X	X
ARQ-Moore (TDM) 2 channel 86,96,100 baud	X	X
ARQ-Moore (TDM) 4 channel 172, 192, 200 baud	X	X
ARQ-E 48, 64, 72, 86, 96, 144, 192 baud	X	X
ARQ-E3 48, 64, 72, 86, 96, 100, 192, 200 baud	X	X
Packet 300 and 1200 baud (AX.25)	X	X
Facsimile AM/FM 60, 90, 120, 240 LPM 288, 440, 576 IOC	X	X
VFT (FDM) 8, 12, 16, 24 channel	X	
FEC-A	X	
FEC-S	X	
ARQ-S (4,5,6,7 character groups)	X	
SWED-ARQ	X	
Reception Shifts		
Standard Baudot Shifts 170, 425, 850, Variable	X	X
Extended Baudot Shifts 85, 1200 Hz	X	
Microprocessor Controlled Shifts	X	X
Auto. Shift Select and Display	X	X
Auto. Shift Select w/ Automatic baud/polarity	X	X
Standard ASCII High Speed Shift (BEL)	X	
Expanded ASCII Shifts (103A, 103o, 202, CCITT v21 O/A, CCITT v.23 mode 1 & 2)	X	
Selectable Low and High Tone Pairs	X	X
Morse Code Dual Tones 750 and 1000 Hz	X	
Printer Control		
Serial RS-232, MIL288, Loop Driver-7 baud rates	X	N/A
Digital Auto-Start Output	X	X
Parallel (Centronics) Printer Port	X	N/A
Screen Print (Retro)	X	X
User Programmable Selcals	X	X*
Serial ASCII 7th Bit Selectable	X	N/A
Parallel ASCII 8th Databit Selectable	X	N/A

Additional Features		
Microprocessor Controlled Switch Capacitor Filters	X	X
Unshift-On-Space	X	X
Multiple Scroll Inhibit	X	X
Status Line	X	X
Speed Readout to Nearest Standard Baud	X	X
Speed Readout to Nearest Baud (+/-2 baud)	X	
Ten User Programmable Memories	X	X
Status Line Dump to Printer	X	X
High Resolution Facsimile Display		X
Automatic Gain Control (AGC)	X	X
Automatic Threshold Control (ATC)	X	X
On-Screen Graph Tuning Indication	X	X
Scope Output	X	N/A**
Facsimile Video Zoom Function		X
Facsimile Reception in 5 Palettes (color)		X
Storage of Data on hard or floppy disk		X
3 User Selectable TTY Alphabets (ITA2,MIL,TELEX)	X	X
Russian 3rd Shift Cyrillic Alphabet	X	
Literal Display Mode	X	X
Databit Code Analysis	X	X
Video Squelch	X	X
Tuning, Tuning Error, Data, Data Error, Idle, and Squelch Indicators	X	X
Diversity Reception	X	
Parity Select on ASCII Receive	X	X
Datascope		X
Built-In Diagnostics	X	X
Video Scrolling	X	X
Intelligent Peripheral Port (IPI)	X	
Audio Input Gain Control	X	
Direct Keyboard Input of Baud Rate	X	X
Help Screens	X	X
Real Time 24 Hour Clock on Status Line	Opt.	X
Video Fax Screen Editor Function		X

*The M-7000 contains 4 User Programmable Selcals (String Search on incoming text), while the M-1000 contains 5.
**The M-1000 needs no scope output since a Datascope (simulated multi-trace oscilloscope display of demodulated RTTY signal) is included as a standard function of the program.

For our purposes here, there are several key differences which are not evident upon first glance. First, the M-1000 provides a much better video display of all modes. The M-7000 only provides low-resolution graphics, especially in FAX mode, while the M-1000 is only limited by the resolution of your computer. However, the M-7000 is far superior to the M-1000 when it comes to printing out your data. It almost seems that the two models flip-flop the video and print quality. Since I do not really like to "burn" a lot of paper, nor do I like the noise printers introduce into the monitoring environment, I still prefer the '1000 over the '7000.

A second major difference between the two models is that with the '1000 you can save everything to either floppy or harddisk. This is nice if you want to import say, a fax image, into a desktop publishing package. With WordPerfect 5.0 or higher, fax images can be directly imported into your document just like any clip art with an extension of .PCX. Text files you receive over the radio can also be saved in the standard DOS .TXT format and then be imported into whatever program you wish. If you are wanting to archive your intercepts, be prepared to use some memory. The typical facsimile image will require 150Kb of memory and the text files will require however much text you recorded.

A third difference which can be quite useful is the datascope function on the '1000. This is a simulated display of a multi-trace oscilloscope provided on your computer screen. With the '7000 you have to provide an external oscilloscope to tune tricky radioteletype signals. The datascope allows you to more accurately tune signals in various modes in real time. It also allows you to identify what type of signal you are listening to by showing you the "signature" of that particular mode.

A fourth difference is in the amount of deskspace each unit requires. The '7000 requires as much deskspace as my personal computer. If you already have a personal computer, then the '1000 will not require ANY additional space in your shack. If your wife, husband, or significant other does not like the Starship Enterprise control panel look in the family room, then the internal decoder card can be quite convenient! My dream setup is to have a laptop personal computer with VGA display and the M-1000 mounted internally so that I can go on DXpeditions with only my radio and my laptop. Just think of the freedom! I cannot imagine lugging around the M-7000 and its external monitor as well.

A fifth and most telling difference between the two units is ease of use. I have been quite impressed with the user friendliness of the '1000. Despite the fact that I have owned an M-7000 for over three years, I was never able to tune in an ARQ-E3 signal. ARQ-E3 signals are primarily used by the French Military and quite often are broadcast "in the clear". On the '7000 I attempted to master this mode for over a year, with no results. Only two months after installing my '1000, I logged my first ARQ-E3 station primarily because of the simpler interface. This difference could be only in my head. Since everyone reacts differently to things, your results may not be like mine, but I consider myself a rather ordinary shortwave listener.

THE DOWNSIDE OF THE M-1000

Desipte all of the excellent features and abilities the M-1000 has, there are a few "warts" which any prospective buyer should know about. I will focus on three major problems. First, the printing function within the DECFAX program is abysmal. Despite the fact that the version 1.02 was supposed to enhance the laser printer functions, how many of us can spring for a $1500 printer? There are only two print options with this board--"DOT" (dot matrix) and "LASER". Since I use a HP Deskjet Plus printer, I cannot use the laser option. However, the dot matrix function does not work with the DJ Plus either. Even on my old EPSON RX-80 dot matrix printer, the fax image output is at best "low-res". Universal really needs to go back to the drawing board on their printer function. The only way that I can get any resolution at all while printing is to import my FAX images into WordPerfect and then print them. You can judge the results for yourself since the image several pages ago was manipulated in this manner.

A second "wart" is that the AUTOTUNE, SPEED READOUT, and TUNE functions in the RTTY decoder mode sometimes will not work. Usually this happens after the machine has been on for a while. Perhaps it gets tired, but it should work ALL of the time. The only fix I have found for this is to exit the DECODER program and then reenter it. This has always cleared up the problem. Perhaps this is my machine's way of telling me that I have been DXing too long! This is only a minor inconvenience, but it is something that needs to be fixed.

A third problem which I have found with the '1000 is not in its performance as such, but rather in the way the computer interface programs are programmed and marketed. There is no way to modify or customize either the DECODER or the DECFAX programs. Granted Universal has the right to keep its codes secret, but it would be nice to be able to create my own macros and to customize the default settings within the programs. If Universal would make their codes known, then perhaps third-party software developers could create a "complete" SWL computer package. This package could include greyline indicators, a mapmaking utility, integrated database for loggings, a forms package for multi-lingual reception reports, and many other functions. After all, personal computers are very good at doing a wide variety of tasks, why limit the user?

IN CONCLUSION

Despite the doom and gloom of the previous section, the M-1000 is a quality peripheral device. If you are interested in giving the digital utility stations a try I would heartily recommend that you start with the Universal M-1000 decoder card. If you do not own an IBM compatible computer, I would invest in a low-end PC clone and the M-1000 instead of buying the expensive stand alone units like the M-7000. This may sound a bit ridiculous at first, but consider that when you upgrade to another computer you can switch the M-1000 board as well as your EGA/VGA monitor to your new computer. However, if you have a computer already, then you are ahead of the game. If you already have a decoder, I would consider giving the '1000 a try as a second decoder. If you are like me, you will not regret it.

I have a feeling that the shortwave hobby is on the verge of a "utility revolution". Until the past five years, digital modes of emission were out of the financial grasp of the vast majority of shortwave listeners. With the M-1000 even many of the most exotic digital modes are readily available for the average shortwave listener. Armed with a good shortwave receiver and the M-1000, anyone can receive and decode information which previously has been available only to governments and professional news agencies. Gone is the day of noisy, oily, heavy mechanical teletype machines. With the dawning of the utility revolution, I look forward to the day when there will be no distinction between Utility DXer and Broadcast DXer. EVERYONE will listen to ALL modes! Pipe dream? Maybe. But with these new technologies the barriers keeping people away from "exotic" modes have evaporated.

Who knows, maybe one day you will suddenly realize that you are chasing signals you used to call QRM. I know I am. With the M-1000 you can start out with a decoder which will enable you to do almost everything you can do with the high-end commercial products, with the exception of displaying Russian Cyrillic characters on your screen and decoding a few of the specialty modes! As the boundaries of shortwave listening move, maybe even my skeptical SPEEDX reporter will eventually even consider CW and FAX as desirable DX--Well, perhaps we can't expect miracles!

The Universal M-1000 decoder board may be purchased for $399.95 (plus $5.00 shipping) from Universal Radio, 1280 Aida Drive, Reynoldsburg, Ohio 43068, USA. They can be reached by telephone at (614)866-4267.

A SELECTIVE UTILITARIAN BIBLIOGRAPHY

The following references will provide you with much of the information you will need to tune and identify utility signals.

Bob Evans, Aeronautical Communications Handbook (HF Edition), Universal Radio Research, 1989.
Gary Gorka, The Soviet Maritime Radioteletype Dictionary, Universal Radio Research, 1988.
Bob Grove, Shortwave Directory, Grove Publications, Brasstown, NC.
Geoff Halligey, Confidential Frequency List, revised 7th edition, Gilfer Publications, Gilfer Radio.
Joerg Klingenfuss, Guide to Utility Stations--1991, Klingenfuss Publications, Universal Radio.
______________, Guide to Facsimile Stations, Eleventh edition, Klingenfuss Publications, Universal Radio.
______________, Radioteletype Code Manual, Eleventh edition, Klingenfuss Publications, Universal Radio.
______________, Compact Cassette Recording of Modulation Types, 5th edition, Klingenfuss Publications.
The RTTY Listener, Universal Radio, Quarterly. (Free with purchase of any Universal decoder.)
Michiel Schaay, Radioteletype Press Broadcasts, 2nd edition, Universal Electronics Inc., 1988.
______________, Embassy Radio Communications Handbook, Universal Electronics Inc., 1988.
SPEEDX, The SPEEDX Utility Station List, SPEEDX Special Publications, See SPEEDX address below.
Daryll Symington and John Henault, Utility QSL Address Guide, Volumes 1 & 2, Radio InfoSystems, 1987.

In addition to these bibliographical sources, there are several North American SWL clubs and publications which provide timely news and loggings of utlity stations. These include:

Monitoring Times, Grove Publications, P.O. Box 98, Brasstown, NC, 28902 (monthly, several columns)
Popular Communications, 76 N. Broadway, Hicksville, NY 11801. (monthly, RTTY column)
Shortwave Magazine, PW Publishing Ltd., Enefco House, The Quay, Poole Dorset BH15 1PP England (monthly, Decode column)
SPEEDX, P.O. Box 196, DuBois, PA., 15801-0196 (monthly, Utility World column)
DX Ontario, Ontario DX Assoc., P.O. Box 161, Station A, Willowdale, Ont. M2N 5S8, Canada (monthly, Monitoring Services column)
North American Shortwave Assoc., 45 Wildflower Road, Levittown, PA. 19057(monthly)
Association of DX Reporters, 7008 Plymouth Road, Baltimore, MD 21208. (monthly, Utilidits column)

features

SHORTWAVE BROADCASTING IN BOLIVIA
A GEOPOLITICAL PERSPECTIVE

Kevin Atkins

Andean South America has fascinated DXers for decades. Drawn by the haunting huayño, the legends of the Incas, or just the challenge presented by a number of low-powered DX targets, we forfeit sleep to be at the dials in the pre-dawn hours, or hurry home from work and have dinner in the shack to catch a few moments of sunset signal enhancement. Perú, owing to its sheer number of stations, gets most of the press in DX publications, and typifies "Andean" in the minds of many. But Bolivia offers equally challenging and colorful targets, and for those who care to dig a little deeper, a glimpse at an unusual culture and the unique role radio has played, and continues to play, in this Andean nation.

GEOGRAPHY

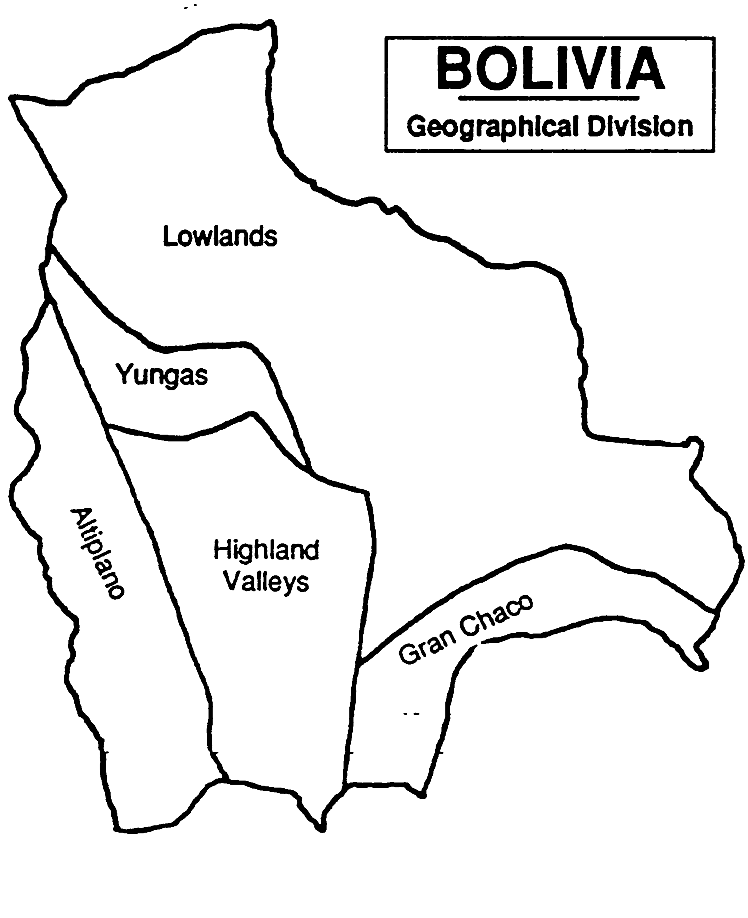
Bolivia's geography (or more specifically, its topography) has profoundly influenced the development of its society, by restricting the movement of people and material. Even today, overland travel between many parts of the country is impractical.

Modern Bolivia encompasses 1,098,000 square kilometers. There are five principle geographic regions: the Altiplano, the highland valleys, the Yungas, the Gran Chaco, and the jungle lowlands. With elevation ranging from the Andean heights to sea level in the jungle, climate is more a function of altitude than of latitude.

The Altiplano. The word "altiplano" means "high plain". This is the lofty platform between two ranges of the Andes, with an average altitude of 3500-4000 meters. The Andean peaks on either side rise as high as 6500 meters. The romantic images of Bolivia—an Indian boy tending a herd of llamas against a backdrop of impossibly beautiful mountains, for example—are rooted here. The Altiplano was home to the Aymara Indian civilization, and later to their Inca conquerors. But for all its overwhelming magnificence, it can be an inhospitable place. The winds are often bitter cold, and the rarified air at this altitude is not exactly conducive to good health and long life. Modern Indians continue to scratch out a physically demanding subsistence lifestyle, farming and tending domestic animals, while visitors from the lowlands have difficulty climbing a flight of stairs. The defacto capital city, La Paz, is located here, as well as the mining city of Oruro.

The Highland Valleys. The most pleasant climatic conditions in Bolivia are found in these hills and valleys at the base of the Andes. The temperate climate makes agriculture a less tortuous affair, and many crops flourish here. Cities in this region include Cochabamba, Sucre, Tarabuco, Potosí, Tupiza and Tarija.

The Yungas. North of the highland valleys lies this transitional zone between the Andes and the jungle. The area is an agricultural breadbasket. The principle town in the region is Coroico.



POLITICS IN MODERN BOLIVIA

One does not embark on a study of Bolivian politics lightly. The subject is a murky and confusing one, and any attempt to write a 'brief sketch' inevitably leads to oversimplification. But radio broadcasting in Bolivia is linked, for better or worse, to politics, and an understanding of what has transpired in the political arena in recent years is a necessary prelude to discussion of certain aspects of broadcasting.

The current government is the 189th since independence in 1825. Some governments have lasted only days. In the history of Bolivian politics, the *golpe de estado* (literally, 'blow against the state') has been as common a means of attaining power as the electoral process. Thus Bolivia has earned the reputation as being the most politically unstable country in Latin America.

Many of the governments have at least been colorful in their ineptitude. For example, General Mariano Melgarejo, the president in 1870, was a great admirer of Napoleon. He was also an avid consumer of alcohol, and while in an impaired condition, he sent his army to the aid of France in the Franco-Prussian war—*marching overland.* He sobered before having to deal with marching across the Atlantic Ocean, and ordered his troops back to Oruro, saying "The Emperor will know we have done our best."

The 1952 Revolution. The most significant political event in Bolivia's recent history was the popular revolution of 1952. It provides a starting point for the historical background necessary to understand Bolivian politics today.

The left-of-center party *Movimiento Nacionalista Revolucionario* (MNR) and its presidential candidate, Víctor Paz Estenssoro, won the election of 1951 with a straight majority. In a bid to prevent the MNR from coming to power, the military illegally accepted the resignation of the outgoing president and appointed General Hugo Ballivián president. Ballivián anulled the elections and outlawed the MNR as a communist organization.

In response to the military's power play, the MNR moved to take control of the government by force. On April 9, 1952, the armed struggle began. The growing labor movement, lead by the tin miners' union, was armed, as were the Indian peasant masses. In three days, the army was defeated.

The MNR Era: 1952-1964. The MNR assumed power, but in reality it was labor and the peasants who made the difference between a "routine" golpe and a sweeping national revolution. The MNR and now-president Victor Paz Estenssoro were reformers, but not hard-core revolutionaries. But the forces set in motion by the arming of the vast underclass could not be easily controlled. Literacy requirements which had denied political participation to the majority of the population were swept aside with the declaration of universal sufferage. The army was reduced in size and influence. The largest tin mines were nationalized and placed under the control of the newly-founded *Corporación Minera de Bolivia* (COMIBOL). (Notably, certain U.S.-owned mines were excepted; the U.S. intervention then underway in Guatemala was duly noted.) Finally, land reform gave land titles to the Indian peasants who had worked the land for generations under the hacienda system.

Victor Paz Estenssoro and other MNR leaders, notably Hernán Siles Zuazo, took turns at the presidency for the next twelve years. But the financial costs of the revolution, paid by simply speeding up the printing presses, began to erode support for the MNR in some sectors of society. The government turned to the United States for aid, but the politically-unpopular strings attached to that aid divided the leadership of the MNR. The U.S. insisted on a harsh International Monetary Fund plan designed to balance the government's budget and cut the inflation rate. Paz, in the fourth year of his second presidential term in 1964, embraced the plan and leaned to the right, while centerist Siles and left-leaning Juan Lechín split with the MNR entirely. Paz had been strengthening the military (purportedly to prevent communist subversion), and he picked his vice-presidential candidate for the 1964 elections, General René Barrientos, from its ranks. Stripped of the support of the left and center and dependent on the army, Paz was overthrown a few months after his re-election and Barrientos became president. Thus ended the twelve-year Revolution—the army once again dominated politics. But the miners and Indian peasants awakened during the Revolution would remain a powerful political force. [3, 4]

Military Rule: 1964-1982. Bolivia was governed by "the generals" for the next eighteen years. Barrientos set the tone by attacking his most potent opposition—the tin miners—almost immediately. Government troops and rebellious miners battled often; the most notable instance was a massacre of miners by government forces at the Catavi-Siglo XX mining center.

Barrientos died in a helicopter crash in 1969. Several golpes later, in 1971, Colonel Hugo Banzer Suárez began a presidency that lasted until 1978. Like Barrientos before him, Banzer attempted to curry favor among the peasants while grinding the miners' union under his bootheel. In this he was largely successful. The support of the Indian majority was ensured by the continuation of the agrarian reform and granting of land titles begun after the 1952 revolution.

Banzer may be the only Latin American dictator ever to stage a *golpe* against his own government. He had allowed various rival parties (notably the MNR) token participation in his government. But in 1974 he announced a sweeping restructuring of the government in which *all* parties—even conservative ones—were banned. Banzer thus sought to emulate Pinochet in Chile, achieving 'stability' through the total suppression of dissent. He overestimated his support, though, as he was deserted by first one camp, then another. Finally he lost the support of his own military, and in 1978 he was forced to step down. [3]

Towards Civilian Rule. There were sputtering attempts at both civilian and military rule over the next four years, including a *golpe* or two. General García Meza presided over a particularly brutal period when the tin miners endured repeated military assaults. Hernan Siles Zuazo re-established civilian rule and took the presidency in 1982, but his main contribution was hyperinflation, peaking at 24,000% in 1985.

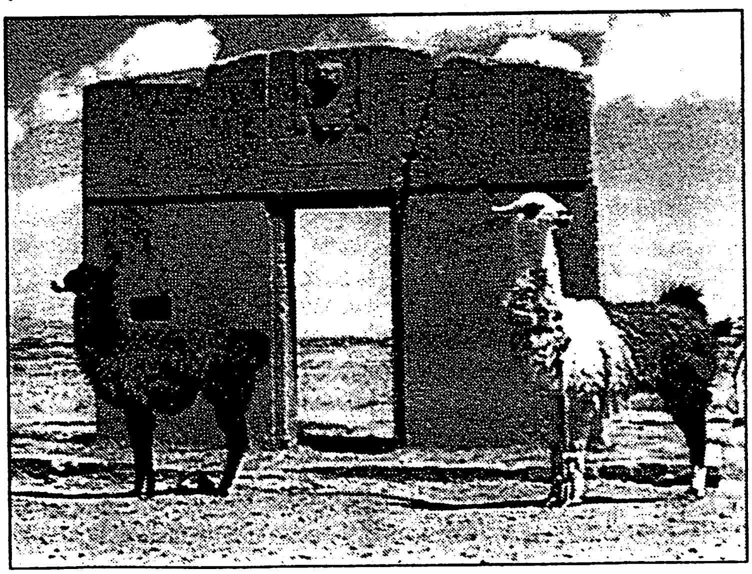
Victor Paz Entessoro regained the presidency in 1985 and inherited the basket case that was the economy, which he placed in the hands of his Minister of Economy, Gonzalo Sanchez de Lozada. Through a program of economic shock therapy, Sanchez engineered an economic recovery that brought the inflation rate down to 10%. It was thus no surprise when the MNR chose Sanchez as its presidential candidate in 1989 after Victor Paz Estenssoro, at age 80, announced his retirement from politics.

The Last Shall Be First. Sanchez, by virtue of his reputation, was the early favorite to win the election. His two main opponents were Jaime Paz Zamora of the *Movimiento de la Izquierda Revolucionaria* (MIR, the Movement of the Revolutionary Left) and Hugo Banzer, the military strongman from the seventies—proof that old dictators don't die easily. It might seem incredible to those accustomed to a democratic tradition that a dictator with a good deal of blood on his hands could present a viable challenge in a free election. But the economic turnaround engineered by Sanchez had not been without political cost. While it looked good on the balance sheets and made the International Monetary Fund and various bankers happy, the draconian measures it required hit labor and the peasant masses especially hard, and the benefits of the turnaround were slow to reach the bottom of the economic ladder. Many people longed for 'the good old days' under strongmen like Banzer, who gave out land titles with one hand while crushing dissent with the other. When the votes were counted, Sanchez and Banzer were virtually dead-even, each with 27% of the vote. Jaime Paz Zamora had 22%, with the rest divided among several also-rans.

Bolivian law mandates that a presidential candidate must win a straight majority in an election. If no candidate does, the congress chooses the president. In fact, Banzer had won the 1985 presidential elections, but lacked the necessary majority, allowing the MNR to win the congressional vote on the strength of an alliance with the MIR. Fearing he would again be denied his chance to govern, Banzer instructed his party (the ADN, *Acción Democratica Nacional*) to vote for Jaime Paz Zamora, forming his own alliance with the MIR. In return, Paz Zamora accepted a member of Banzer's party as his vice president, and Banzer himself was given the presidency of a powerful commission that wields much of the real power behind the scenes. Thus the leftist Paz Zamora, who was actually jailed by Banzer in the seventies, became president, with Banzer, the former right-wing dictator, pulling his strings. Both have pledged to continue the economic policies of Sanchez, whose candidacy they derailed. [9]

THE PAST AND PRESENT OF SHORTWAVE RADIO IN BOLIVIA

The Bolivian government established Radio Illimani in the 1930s. The station is in La Paz, and is named for the Andean peak that towers over the city. There are stations in Bolivia with the official-sounding phrase *Radio Nacional* in their names, but none of these have any government connection; Illimani is the sole government voice on shortwave. The station's history includes a takeover by rebel forces during the 1952 revolution. It was the only station on the air from La Paz on April 9th and 10th of that year, and thus played a critical propaganda role in the success of the revolution.



The Bolivian military has in the past operated at least two stations on shortwave—Radio Batallon Topater and Radio Batallon Colorados. As we have seen, sometimes the military supports the government in Bolivia; sometimes, it *becomes* the government. Thus it would not be precisely correct to call these stations government broadcasters, although the transmitters could be easily appropriated if themilitary sought to assume direct control of the country. They are essentially commercial stations in their day-to-day operations. Unfortunately, both seem to be inactive at this writing.

Aside from Radio Illimani and the military stations, shortwave stations in Bolivia fall into one of three general categories—commercial, religious, or the unique network operated by the tin miners' union. Stations in all three categories have been profoundly affected by the activities, antics, and atrocities of the various governments.

Commercial stations like Radio Panamericana and Radio El Mundo are run much like commercial operations in the rest of Latin America. Contemporary and traditional music, news, sports and drama are normal programming fare. The more established stations in the larger cities derive income from conventional advertising, while the smaller stations (particularly those in isolated areas) fill a niche much like that of the rural Peruvian broadcasters. *Comunicados* and song dedications are a principal means of income, along with commercials for local businesses.

While not political by definition, commercial stations have run afoul of the government in the past. Stations have been shut down, and in some cases have pulled the plug themselves rather than abide by whatever conditions the government sought to impose. Other stations have succumbed to the indirect sort of government interference that has long plagued Latin America—economic fiascos that force struggling businesses of all sorts into ruin, for example, or the lack of government commitment to provide a transportation infrastructure for moving goods (such as transmitter tubes!).

Religious stations in Bolivia bear little resemblance to those in North America. A number of Catholic and Protestant organizations fund broadcasting missions in Bolivia, but while the 'religious' designation may indicate affiliation with such a group, it does not necessarily mean that programming is restricted to sermons. Educational and health programs are equally common; the Catholic church, in particular, is very much a force for social change in Bolivia and the rest of Latin America. Radio Juan XXIII opens its broadcast day with a program of Bolivian folk music for its campesino audience—recognizing, perhaps, that they must catch the ear before saving the soul.

This mixture is not at all incongruous, given the overall context of Christianity in the Indian world. Campesinos who accept the 'new' religion generally do not abandon their previous beliefs; they merely graft the new onto the old. A miner may attend Mass regularly, but he would not go into the mines without making an offering to one of the gods his ancestors have worshipped for centuries. Many campesinos celebrate the Fair of Abundance, dedicated to the Inca god Ekeko, as fervently as the *Festividad de Nuestro Señor Jesús del Grán Poder* [1].

Radio Pio XII is unique among Bolivia's religious stations. The station was established at the Siglo XX mining camp in 1960 by the Catholic Oblate Fathers. It was originally intended to compete with La Voz del Minero for the hearts and minds of the miners. It took an anti-communist stand that was none too popular with the leadership of the miners' union, and competition between the stations was more intense than anyone had bargained for. But Pio XII sided with the miners after witnessing the military's atrocities under General Barrientos in 1964. Barrientos had the station destroyed, but it later returned to the air, and has since been considered a part of the miners' network. Ownership remains in the hands of the Catholic Oblate Fathers, who also champion the cause of the campesinos. [6]

The tin miners' network is the most fascinating part of the Bolivian radio story. It has no real parallel in Latin America, and perhaps not in the entire world. To call the miners' stations a 'network' is actually a liberal use of the term, as there has never been any attempt at nationwide conformity or coordination in the formal sense. On the contrary, the localized individuality of the stations is really part of the phenomenon. The stations are, for the most part, owned and operated by the miners themselves at the various mining centers, with programming designed to serve their own needs as a community. They become a 'network' only when the union is threatened by outside forces—i.e., the government.

Communications scholars Fernando Lozada and Gridvia Kunar, cited in [6], identify three roles for these stations:

> "In 'normal' times of democracy the radios link the miners' union and its members, and the everyday culture of the miners and campesinos. In times of emergency, when the country and the workers face a military coup, the stations form a network of resistance against the approaching armed forces, broadcast decisions made at public and organizational meetings, and allow union leaders and members, women, and students to offer advice, encouragement, or criticism. Finally, in times of military control, when the stations are closed, they are a focus of underground organizing, and the people demand their return to the airwaves."

The first record of a miners' union station in Bolivia is La Voz del Minero at Llallagua/Siglo XX. Several versions of its founding have been published, placing its beginning sometime between 1945 and 1952. Generally, though, the 1952 Revolution may be thought of as the beginning of the miners' network, because the reforms that resulted from the revolution made the spread of miners' radio possible. The number of stations peaked at around 24 in the 1960s. The stations have been forced off the air for long periods of time while various military regimes held power, notably those of Generals Barrientos, Banzer and Meza.

Programming emphasizes local culture, with folk music, poetry, drama, sports, and community and social news. Since financing comes from union dues, there are almost no advertisements. But during the aforementioned 'times of emergency', the programming changes dramatically, as shown by the following translated excerpts from broadcasts in July, 1980, during the coup of General García Meza:

> "The troops are approximately five kilometers from Siete Suyos and very near Santa Ana... therefore we are preparing to defend ourselves... This is *Radio Animas* for all the south of the county." [And from *Radio Nacional Huanuni:*] "...at any moment our miners' radios may be closed down, but the Bolivian people and especially the mine workers continue the indefinite general strike with the aim of obtaining the democratization of the country." [6]

These are not alarmist ravings or empty words. Force has been employed against miners' union stations no less than 70 times, and hundreds of miners, and the wives and children of miners, have been killed defending their stations and, by extension, their way of life. Stations have been besieged and attacked by the army and bombed by the air force. While the miners comprise only a fraction of a percent of Bolivia's population, they constitute the militant backbone of the labor movement. The government's practice of using force against the miners actually predates the miners' first station: December 21 is celebrated as the Day of the Miner, commemorating a massacre of miners at the Siglo XX mining center in 1942. The military has always felt threatened by them and, perhaps most of all, their radio stations, which they recognize as communications centers for mobilizing opposition.

Since Bolivia is currently enjoying a relatively long period (since 1982) of civilian rule, one would think the tin miners' stations would be flourishing. Actually, they are facing what may be the most serious challenge ever to their existence. The 'enemy' is once again the government, but economics has replaced guns and bombs. Part of Gonzales Sanchez de Lozada's economic shock therapy was the selling or closing of many of the unprofitable tin mines, and scaling back operations at others. Estimates vary, but certainly fewer than 25% of the miners nationwide have retained their jobs. The remainder have been forced to accept the government's offer of a one-time unemployment payment of approximately $1,000 and relocation to another part of the country. A financial correspondent in La Paz reported:

> "At Huanuni, 150 miles south of La Paz, half the miners have lost their jobs. Many of those without regular work have built themselves mud shacks near the river, where they pan for left-over tin trickling down from the mine. If they are lucky they may make $40 a month, stooping in contaminated water, seven days a week. Other former miners have moved to Bolivia's tropical lowlands, making sure the country remains the number-two grower of coca leaf." [9]

Huanuni is, of course, the home of Radio Nacional Huanuni, the largest and best-equipped of the miners' stations. Since the mines at Huanuni are still operating at a reduced capacity, the station remains on the air. But where mines have been completely shut down, the stations are sure to follow. The government is not exactly enthusiastic about saving the stations, either. Many have had their licenses revoked by the government for non-payment of licensing and frequency-use fees. In 1989, the miners' union negotiated a package deal with the government to reduce the total amount of fees due from the stations from $100,000 to $64,000. In addition, some stations which never had licenses were ordered to make a deposit of 10% of their declared capital. With fewer than one-fourth of the miners still working and thus financially supporting the union, the future of the stations does not look promising. Even stations at some of the active mining centers don't have enough money to maintain their equipment. [7]

THE FUTURE OF SHORTWAVE BROADCASTING IN BOLIVIA

There are some reasons for optimism about the future. In the long term, the very forces that currently threaten the miners' stations may help ensure the survival of commercial broadcasters. While far from complete, the economic turnaround in Bolivia stands in marked contrast to the nightmare of Perú, and foreign investment in the country is on the increase. There is no reason that the economic growth to come should not affect broadcasting in as positive a fashion as it does business in general. The government has also relaxed the tariff on imports to 10%, making studio equipment and replacement parts more affordable.

The great exodus from shortwave to mediumwave in Latin America has not so far reached epidemic proportions in Bolivia, due in part to the need to reach an often remote listenership. The resettlement of miners and campesinos in the jungle lowlands may actually increase the need for shortwave, and the former tin miners in particular should bring an appreciation for radio to the jungle. They probably won't be bringing any transmitters, of course, but some of them might have the desire to acquire one and the knowledge to get it on the air. The desire to spread ministries to the new frontier might even lure more religious broadcasters to the lowlands. In any case, further development of the lowlands is inevitable as the government seeks to deemphasize mining, long the mainstay of Bolivian exports, and encourage oil and natural gas production and agribusiness. With that development will come new population centers, and the potential for new broadcasters.

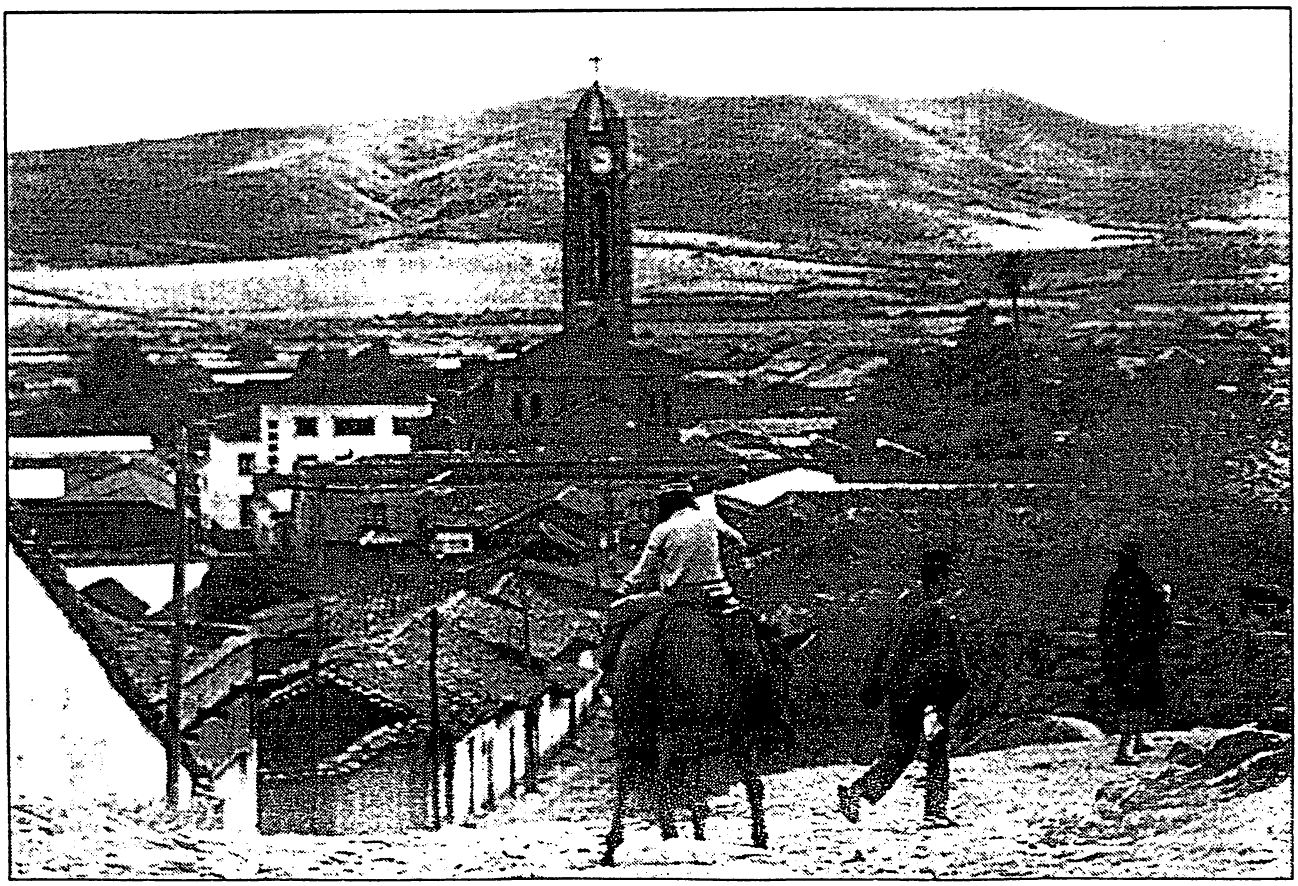
The miners' network has survived formidable challenges in the past, but the enemy they now face is one that cannot be beaten by force or persistance. While tin has declined in importance in Bolivia's economy, it is still possible to operate some mines profitably. The mines will survive, but the long-term survival of the miners' union is not a forgone conclusion. As long as it does hold on, their will likely be at least some broadcasting activity, but only a handful of the stations are currently active. The prognosis, unfortunately, is "get 'em while you can."

Still, there is hope that some of the miners' stations might survive, albeit not in their present form. Many of the stations operating as commercial ventures in Bolivia today were started and are still owned by various non-mining unions. Some of the miners' stations with profit potential might be able follow this route to survival, forfeiting—at least temporarily—their activist social agenda.

If General Banzer is indeed the behind-the-scenes president in Bolivia today, *all* Bolivian broadcasters would do well to watch their flanks. Banzer is no friend of the media. His military government in the 1970s was quite repressive, even by Bolivian standards:

> "What radio stations were permitted to broadcast were directed largely by government officials. The transmitters of the Church were destroyed. Radio Pio XII, which was one of the few stations broadcasting news of the repression of miners throughout General Barrientos's presidency from 1964-1969, no longer could operate." [5]

This is the same gentleman who thought Pinochet had the ultimate solution to government, and proceeded to ban all political parties in Bolivia. One must also question motives when the far right and the far left join forces. Banzer and Jaimie Paz Zamora seem about as idealistically alike as Jesse Helms and Ted Kennedy. Hopefully a continuation of the economic recovery will prevent either man from unleashing his true nature.



LOGGING AND VERIFYING BOLIVIAN BROADCASTERS

Persistance is the key to successful Latin American DXing, and Bolivia is no exception. A number of stations can be logged easily, and a few are fairly good verifiers. But the rare catches still require a good opening, or finding a normally dominant station off the air, or both.

The Auroral Factor. The effect of disturbed geomagnetic conditions on Latin American DX is well-documented. One of the best examples of this effect can be observed by DXing low-powered Bolivian and Peruvian stations. Many of them operate with transmitter powers well under 500 watts, and (sometimes uninentionally) use frequencies well outside the standard broadcasting bands. Tuning across 5505.4 most evenings might yield a weak het, or more likely, nothing at all. But during auroral conditions, don't be surprised to find Radio Dos de Febrero on the frequency with surprisingly good signals.

Seasonality. North American DXers are accustomed to thinking about 'seasons' as they affect reception from Indonesia, the Indian Subcontinent, and the like, but enhanced seasonal propagation from our southern continental neightbor does not seem to be as well-known. David M. Clark in Newmarket, Ontario notes, "I have found October through about mid-November to be an optimum period for early evening [Andean] DXing." I have noted some exceptional early evening Bolivian openings from my Alabama QTH during the late spring and early summer months each of the last three years, corresponding to the time of year when Bolivian sunset occurs approximately two hours before my local sunset (refer to the propagation section of *Proceedings 1990* for more on this 'sweet spot' phenomenon). I usually note an obvious signal peak at receiver sunset, with steadily declining signals for the remainder of the evening and the weaker stations disappearing entirely.

I have not personally observed any period of significant enhancement that affects pre-sun*rise* reception of Bolivians in North America. But another factor that often determines whether a rare station can be heard is often in evidence in the mornings—the highly variable sign-on times of Latin American stations. About a month before the Bolivian presidential elections in 1989, I noted an obviously Andean station signing on anywhere from 0930-1000 UTC, weakly audible until it was covered by the sign-on of Radio Táchira, also 9030-1000v. The Bolivian station Radio Grigota was one possibility, listed here with a 1000 sign-on—that's certainly what I *wanted* it to be—but I never managed an ID, and after the elections, the early sign-ons ceased. Earlier this year, though, the ever-vigilant Kirk Allen in Ponca City, Oklahoma began hearing the Andean station again signing on before Táchira, and finally managed to ID it as Radio Grigota.

It is worth noting that evening and morning Bolivian DXing each net a whole different crop of stations. In the mornings, stations broadcasting to campesino audiences sign in the 0900-1000 UTC range with the folk music programs so popular in the countryside. Stations heard in the evenings are more likely to play contemporary music, romantic ballads, and the like.

One particularly challenging aspect of DXing Bolivia is that much of the programming for the campesinos will be in either the Quechua or Aymara language. Use of the Indian languages on the air seems more common in Bolivia than in any other South American nation, including Perú. While the average DXer can't hope to understand a great deal of either (or distinguish between them, for that matter), it is worthwhile to spend some time listening to Quechua broadcasts on HCJB to get a feel for how identifications and time checks might sound. Be aware that both Aymara and Quechua broadcasts will include some Spanish lexicon, which could be confusing.

Verifying Bolivian stations can be an exercise in frustration. The situation is not nearly as bad as that in Perú, where reports are routinely ignored in favor of more pressing concerns (like staying alive). But postal service in Bolivia—or rather, the lack of it—prevents many reports from ever reaching the stations. Mail service to La Paz is reliable, and Santa Cruz is quite 'connected' these days, but letters to jungle outposts or remote mining centers stand only a slight chance of reaching the addressee. Outside of La Paz, the best method is to use registered mail and use 'Correo Central' for any nonexistant street address. If anyone from the station decides to visit the post office, he might get your report. My own Bolivian verification rate over the last three years is about 50%—about four times my Peruvian rate. Remove the miners' stations, and the Bolivian rate soars—I have yet to get a single miners' station to verify, but they obviously have other concerns.

Return postage in the form of Bolivian mint stamps or U.S. $1.00 bills is a must. U.S. currency is not quite as easy to exchange now as it was when the inflation rate was 24,000%, but there are still moneychangers in most population centers. For remote stations, mint Bolivian stamps (among the most expensive country available, currently about $1.50 per unit) will save the prospective verification signer some trouble and perhaps improve the odds. As with most Latins, a post card, some photographs or a sticker or two will enhance the chances of getting a pennant along with a QSL. And please, call the Bolivian Indians *campesinos* in your reception reports—it is considered an insult to refer to them as *indios*.

THE FIRST FIVE...

While the face of the Bolivian radio dial is subject to rapid and remarkable change, a few stations are fairly consistent in terms of frequency, operating hours, and audibility. Logging these stations should provide the newcomer to Andean DXing with a foundation on which to build.

Radio Panamericana. This La Paz commercial station is probably the easiest of the lot to hear, subject to what international broadcaster is using 6105 kHz at the time. Panamericana is normally a bit high in frequency, around 6105.5, and is best heard at their morning sign-on (1000v). The station management is quite friendly to DXers, and verifies with an attractive multi-colored QSL card.

Radio Santa Cruz. This commercial station in the relatively new boom-town of Santa Cruz puts a good signal into North America in the pre-dawn hours on the low side of 6135 kHz, normally around 6134.8. It is also a good verifier [although the card is fairly primitive compared to that of Panamericana, the latter being the exception rather than the rule], and some DXers have received pennants as well.

La Cruz del Sur. This is a religious station (operated by Bolivian Baptists) that is fairly consistent on 4875 kHz during the predawn hours. Programming may be in Spanish, Indian languages, or even German, and an occasional English ID has been reported. Look for sign-on anywhere between 0900-1000, with interference from a Brazilian or two. The station seems to respond well to reception reports which include prepared QSL cards, which they sign and stamp; reports lacking such are likely to be answered with nothing more than a program schedule.

Radio Santa Ana. This commercial station, located in Santa Ana de Yacuma, has typical evening programming of Latin ballads and ads. It is no powerhouse, but falls into the "weak but clear" category most evenings on its out-of-band frequency of 4649 kHz. It is a useful propagation beacon for more difficult Bolivians, too. Unfortunately, the verification track record is not very good.

Radio San Miguel. Less reliable than the previously-cited offerings, Radio San Miguel nonetheless is often reported in North America with fairly good signals on 3310.3 kHz. The station is operated by the Catholic church from the town of Riberalta in the jungle lowland department of Dení. Look for sign-on anytime after 0900. The station verifies consistently, usually by letter.

BIBLIOGRAPHY

1. Anstee, Margaret Joan, *Bolivia: Gate Of The Sun*. New York, Paul S. Eriksson, Inc., 1970.
2. Gwyn, Robert J., "Rural Radio in Bolivia: A Case Study," *Journal of Communication*, Spring 1983, pp. 79-87.
3. Klein, Herbert S., *Bolivia. The Evolution of a Multi-Ethnic Society*. New York, Oxford University Press, 1982.
4. Malloy, James M., *Bolivia. The Uncompleted Revolition*. University of Pittsburgh Press, 1970.
5. Nash, June C., *We Eat the Mines and the Mines Eat Us: Dependency and Exploitation in Bolivian Tin Mines*. New York, Columbia University Press, 1979.
6. O'Connor, Alan, "The Miners' Radio Stations in Bolivia: A Culture of Resistance," *Journal of Communication*, Winter 1990, pp. 102-110.
7. Slaughter, Jane, "Tin Miners' Radio on the Ropes," *The Progressive*, Volume 53, No. 2, February, 1989, p.11.
8. Swaney, Deanna, *Bolivia. A Travel Survival Kit*. Victoria, Australia, Lonely Planet Publications, 1988.
9. Various correspondent reports in *The Economist*, 1988-1990. The quotation used herein is from the October 20, 1990 edition, pp. 48.

ACKNOWLEDGMENT

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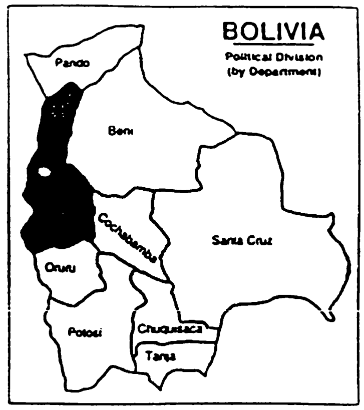
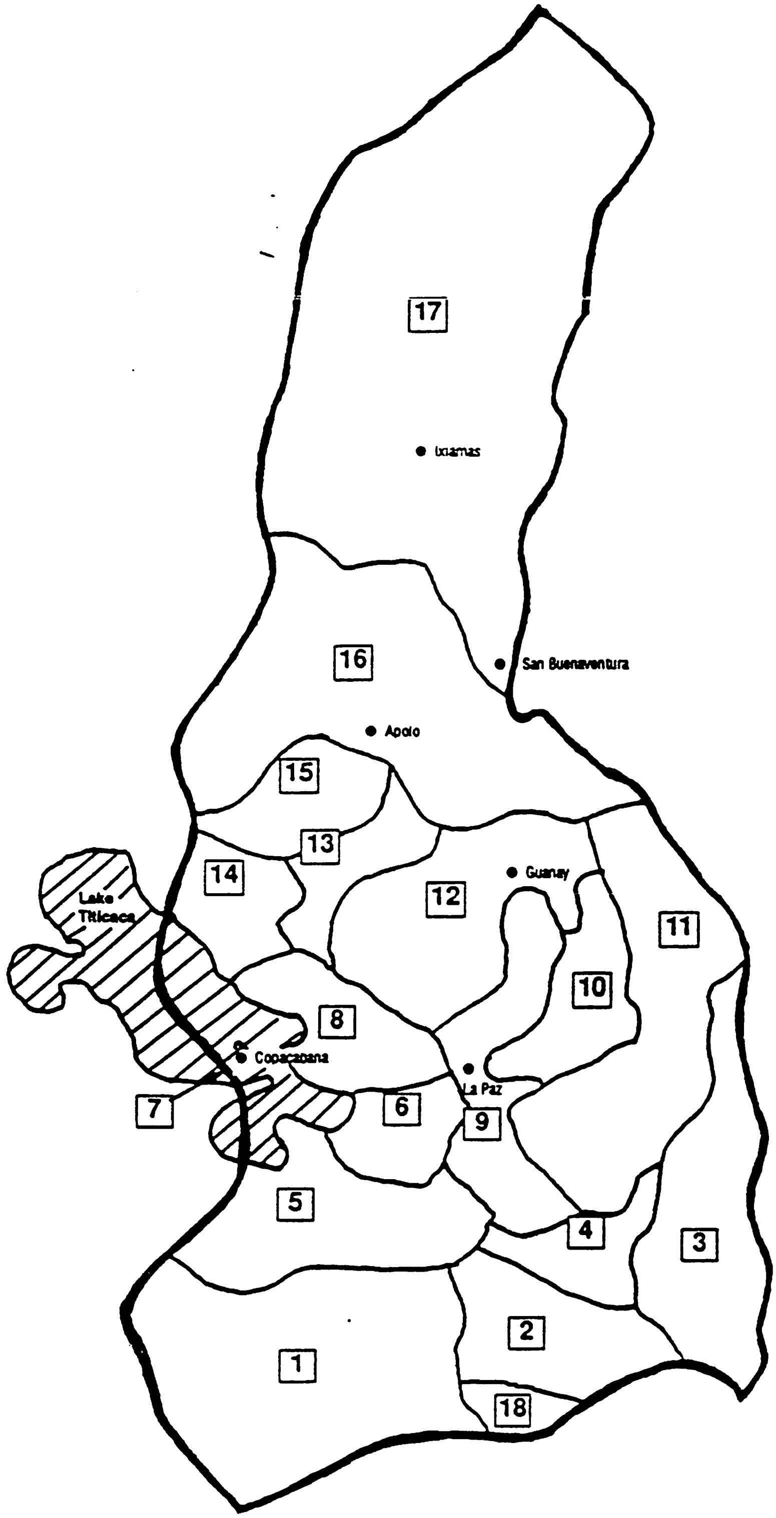
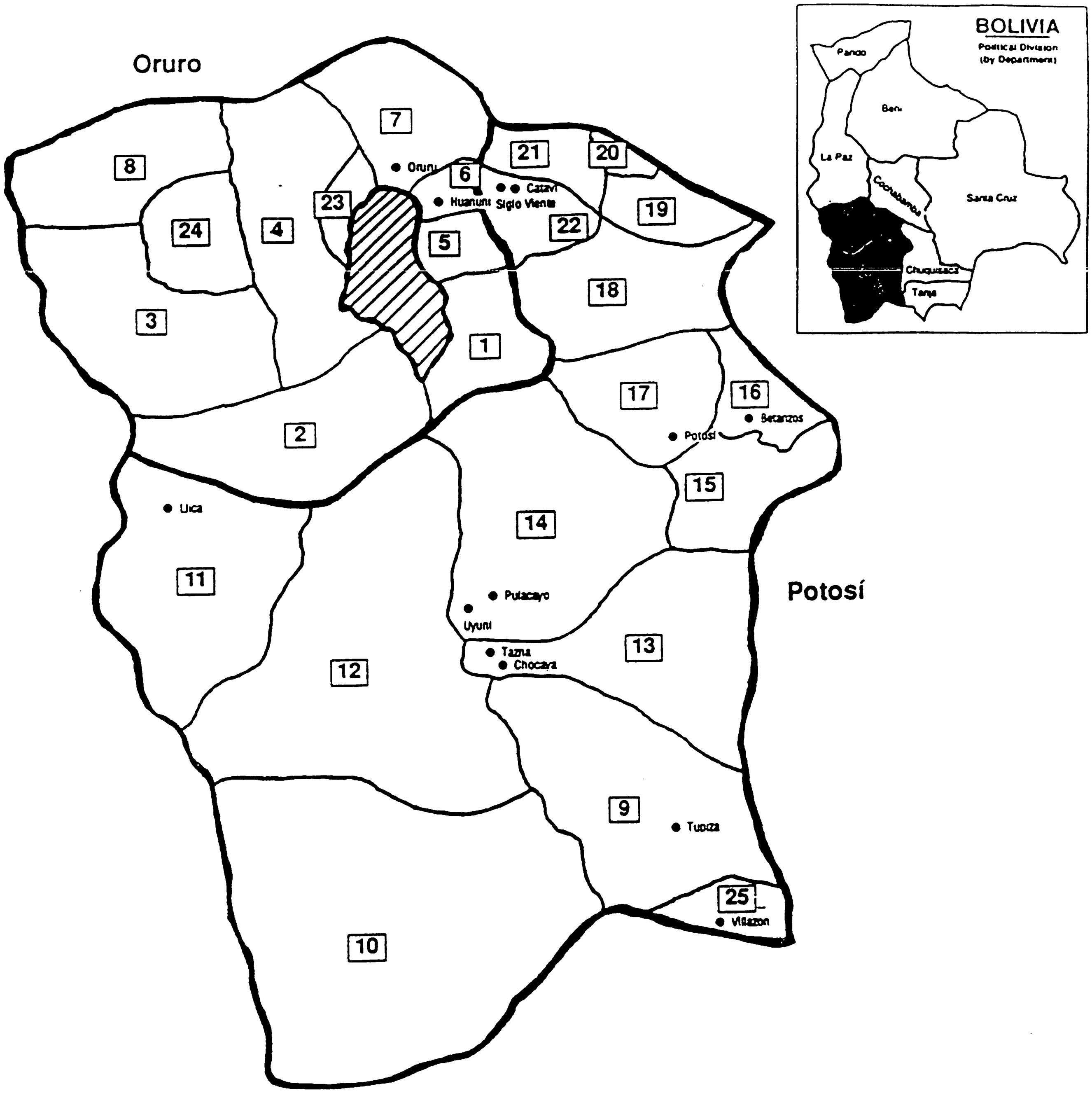
Pennant images from <u>Station Pennants of the World</u> by Barto





1 Pacajes
2 Aroma
3 Inquisivi
4 Loaiza
5 Ingavi
6 Los Andes
7 Manco Kapaj
8 Omasuyos
9 Murillo
10 Nor Yungas
11 Sud Yungas
12 Larecaja
13 Muñecas
14 Camacho
15 Saavedra
16 Franz Tamayo
17 Iturralde
18 G. Villaroel

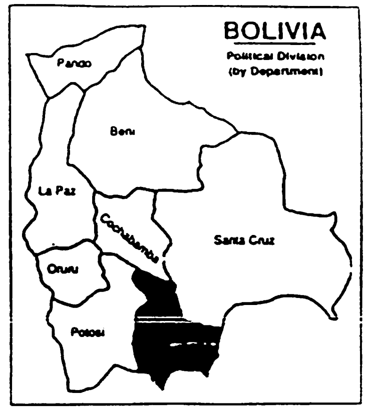
Department of
La Paz

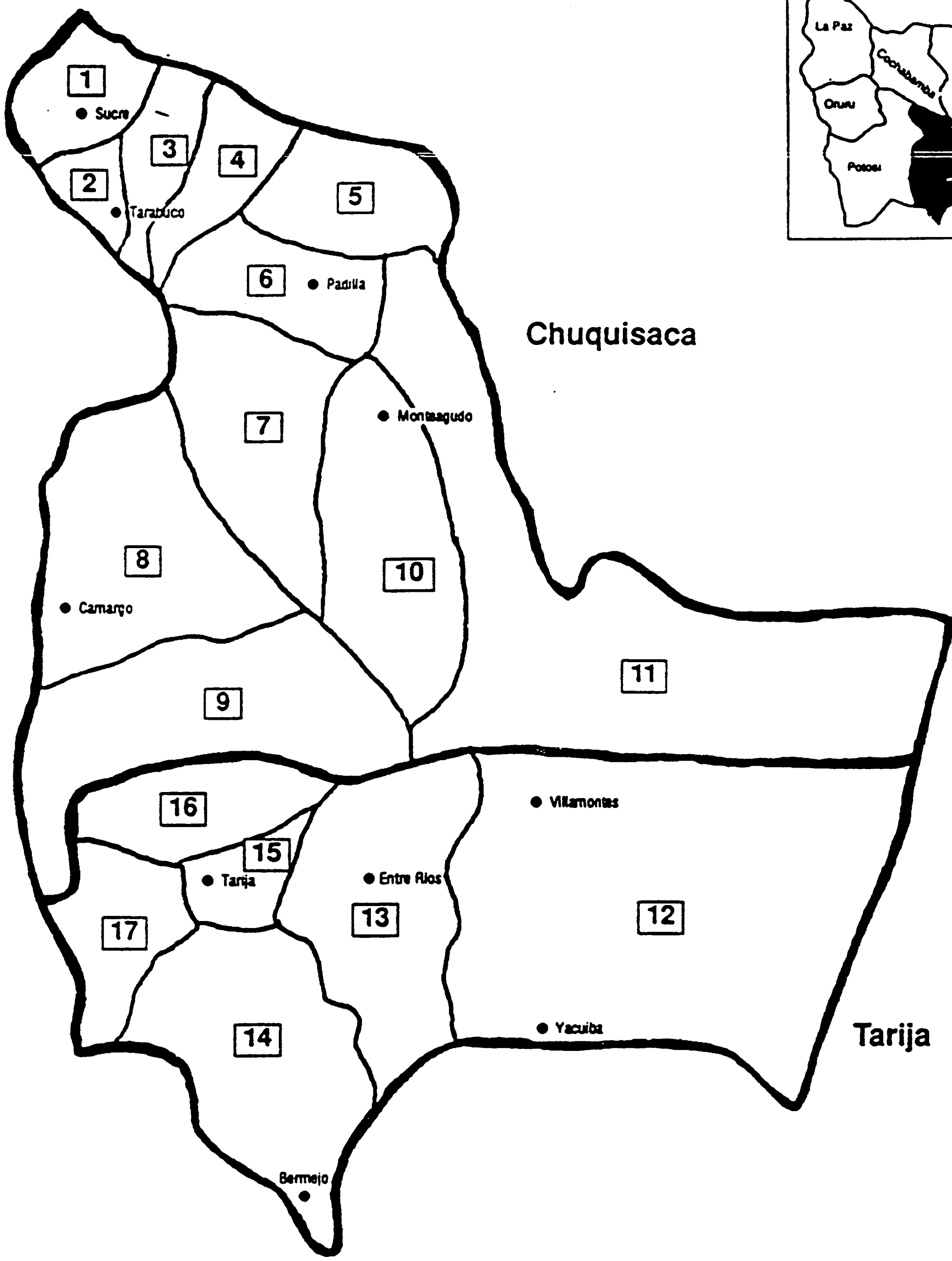


1 Abaroa
2 Cabrera
3 Atahuallpa
4 Carangas
5 Poopó
6 Dalence
7 Cercado
8 Sajama
9 Sud Chichas
10 Sud Lipez
11 Daniel Campos
12 Nor Lipez
13 Nor Chicas
14 Quijarro
15 Linares
16 Cornelio Saavedra
17 Frías
18 Chayanta
19 Charcas
20 General Bilbao
21 Alonzo de Ibañez
22 Bustillos
23 Saucari
24 Litoral
25 Modesto Omiste

Departments of Oruro and Potosí

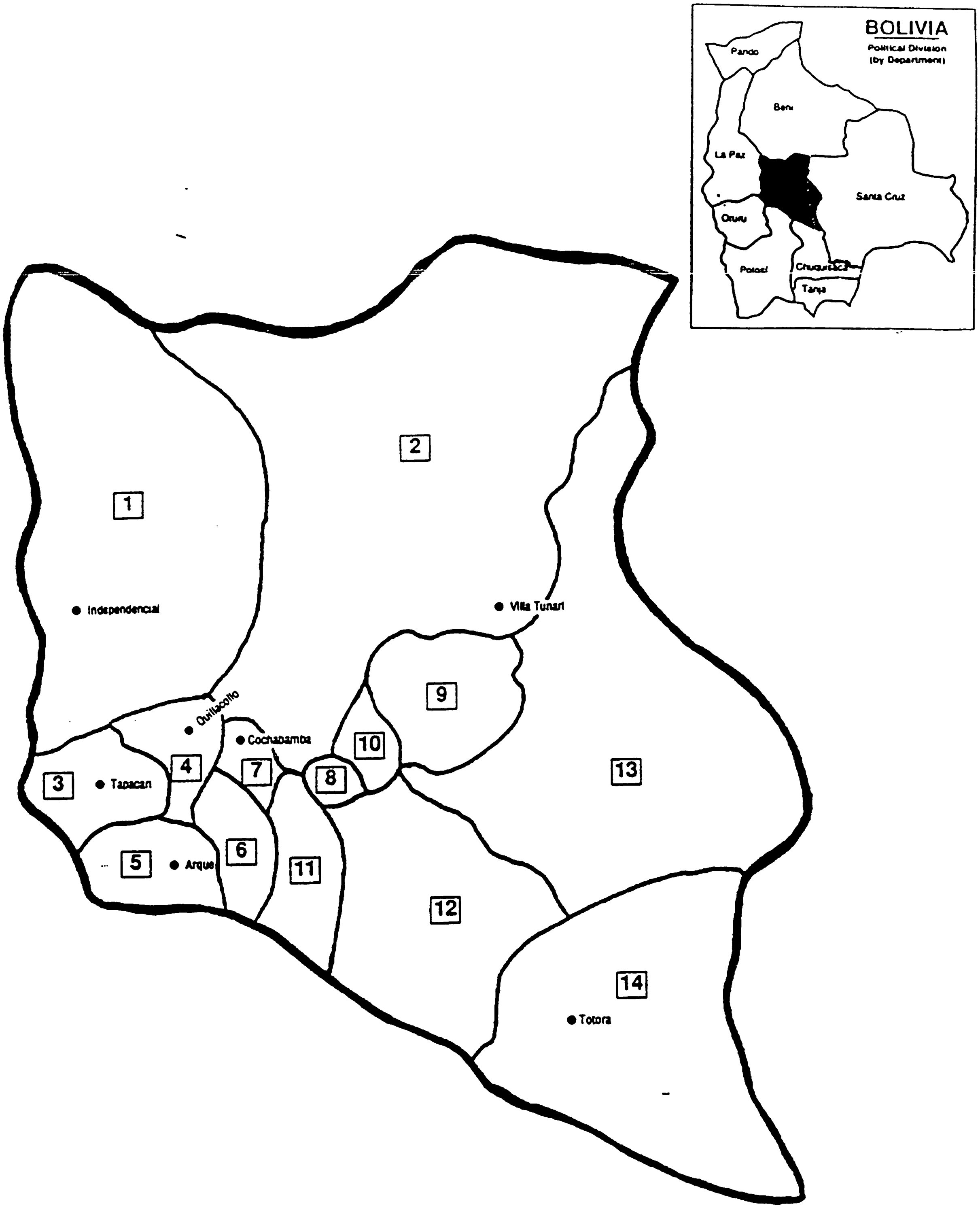
F21.12





1 Oropeza
2 Siles
3 Yamparáez
4 Zudañez
5 Boeto
6 Tomina
7 Azurduy
8 Nor Cinti
9 Sud Cinti
10 Azero
11 Calvo
12 Gran Chaco
13 O'Conor
14 Arce
15 Cercado
16 Mendez
17 Avilez

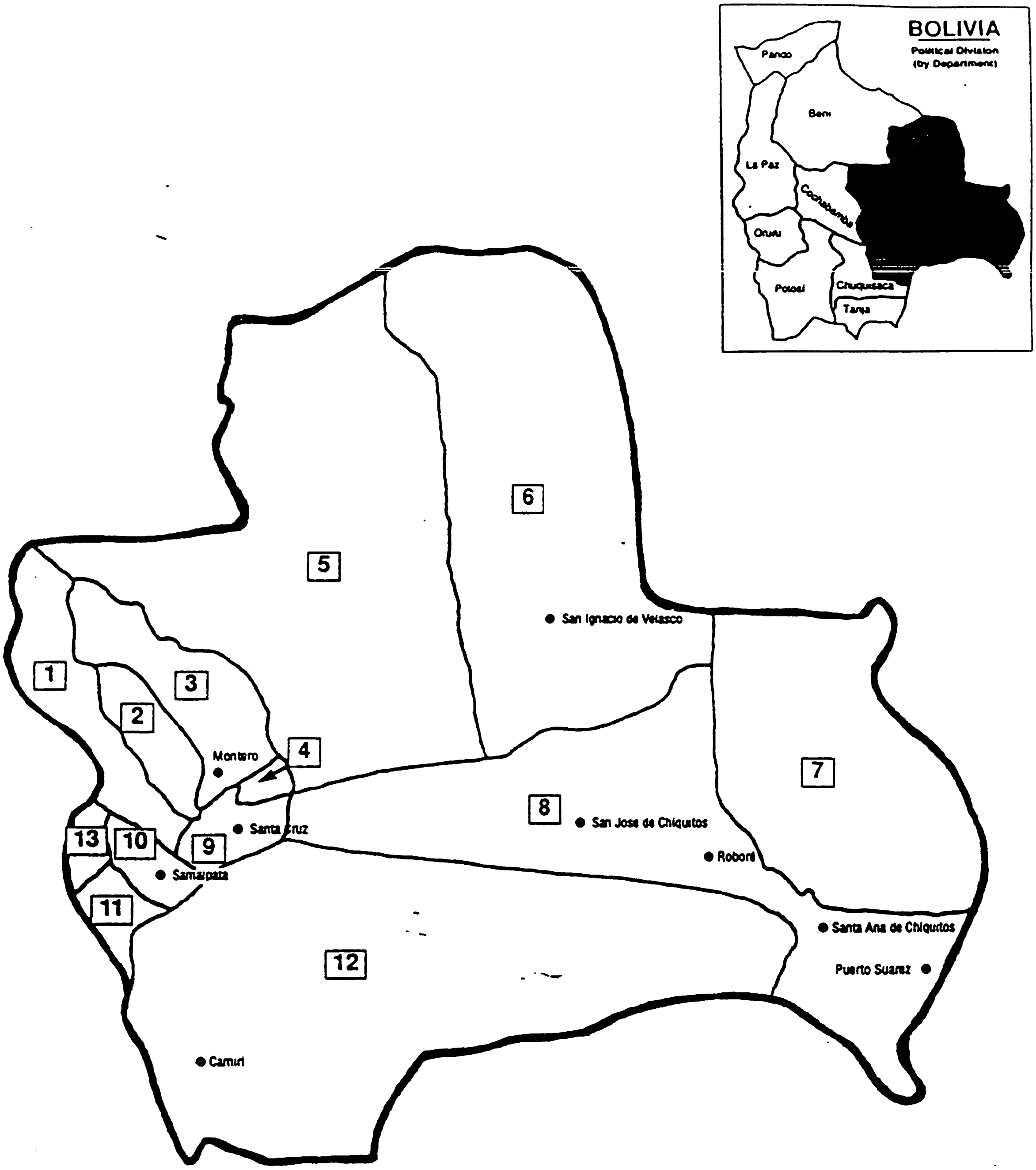
Departments of
Chuquisaca and Tarija



1 Ayopaya
2 Chapare
3 Tapacarí
4 Quillacollo
5 Arque
6 Capinota
7 Cercado
8 Jordan (Cliza)
9 Arani
10 Punata
11 Arce
12 Mizque
13 Carrasco
14 Campero

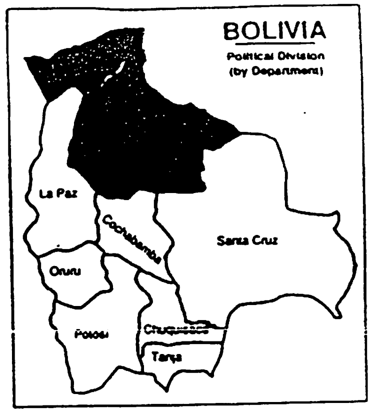
Department of
Cochabamba

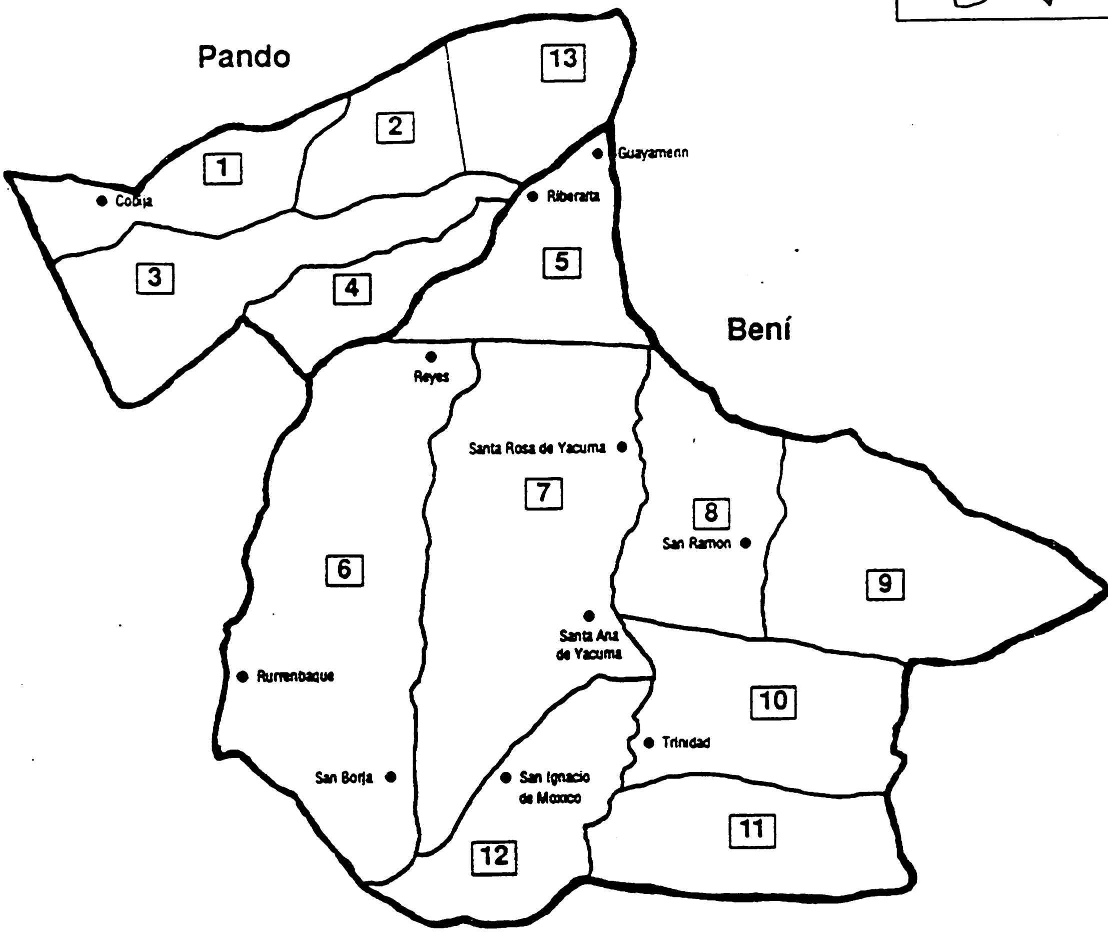
F21.14



1	Ichilo	7	Sandoval
2	Gutierrez	8	Chiquitos
3	Santiesteban	9	Ibañez
4	Warnes	10	Florida
5	Nuflo de Chávez	11	Vallegrande
6	Velasco	12	Charcas
		13	Caballero

Department of
Santa Cruz





1 Nicolas Suarez
2 Abuna
3 Manuripi
4 Madre de Dios
5 Vaca Diez
6 Ballivián
7 Yacuma
8 Mamoré
9 Iténez
10 Cercado
11 Marban
12 Moxos
13 Gral. Federico Roman

Departments of
Pando and Bení

INTERNATIONAL MEDIUM WAVE DXING FROM EAST COAST NORTH AMERICA

Jim Renfrew

When I began DXing in the late 1960s, the great challenge to Medium Wave (MW) DXers was the increasing number of No Silent Period (NSP) stations on the air. Many commented how DXing was far more difficult than it had been "in the good old days." When I returned to the National Radio Club after college in the late 1970s the new obstacle was increased channel congestion, with most of the once clear-channel frequencies becoming filled by lower power regional stations. In 1969 the only stations on 1200 kHz were WOAI in Texas and a low power station in Frobisher Bay, NWT. Today there are more than thirty US and Canadian stations tearing up the frequency! Hearing international stations on 1200 and other similar frequencies is more challenging than ever before.

Bruce Portzer, in *Proceedings 1990*, speculated that international MW DXing may be more difficult for reasons other than channel congestion. A decline in long distance signal strength and audio quality may be related to some aspect of solar cycles that is not yet fully understood. It may be that the degree of electro-magnetic noise in our local environment is greater than ever before. Another negative factor is a greater amount of "slop" from local stations bleeding well beyond the 10 kHz spacing. Even so, a close look at international DX loggings in NRC's *DX News*, IRCA's *DX Monitor* and ODXA's *DXOntario* reveal that east coast DXers are continuing to hear good catches, *but* it takes a great deal of planning, patience, and plain old luck.

In the pages that follow, possibilities for Trans-Atlantic (TA), Caribbean and Latin American (LA) DX from East Coast North America (ECNA) will be outlined. Unusual North American targets and rare Trans-Pacific (TP) DX will also be considered. Before offering the list, some general comments are in order concerning factors critical to the success of international DXing. All times are UTC.

LOCATION

There is no question that DXing from inland locations is tougher. A site at the high tide line on the beach is the ideal, with diminishing possibilities as one travels inland. A coastal transmitter site will also enhance reception. Northeastern locations favor high latitude TA reception. Southeastern locations should favor low-latitude TAs, but, in fact, these are very difficult. The southeast, however, is far more ideal for Caribbean and Latin American receptions. Rural is better than urban, because there may be less locally-produced noise. Or, put another way, the further you are from your neighbors' fluorescent lighting, dimmer switches, and television the better. Ground conductivity is also be a factor. Try to live where there's lots of iron in the ground or where the ground retains moisture! Terrain (hills, mountains, and buildings) may reduce the chances of good reception in certain directions. Given these factors, it is not suprising that the best ECNA loggings are either from rural or coastal locations, and that many urban DXers have gotten into the habit of DXpeditioning to remote rural locations to enhance their chances.

One additional observation: DXers to the north and west of the Great Lakes have noted enhanced reception to the Caribbean and points south. So if you can't afford Atlantic beachfront real estate, try looking for a big lake!

EQUIPMENT

Your receiver must be able to tune split frequencies. Most Eastern hemisphere broadcasters follow the 9 kHz channel plan (531, 540, 549 etc.), and not the 10 kHz standard used in the Western hemisphere (540, 550, 560 etc.). If you plan to drive your car to the beach for DXing, you will need an analog car radio tuner, or a radio that allows you to choose 9 or 10 kHz channel separation. "Splits" are also a factor in LA DXing, where some stations are found on frequencies ending in "5." Other stations will periodically drift 1 or 2 kHz off frequency.

The ability to tune a little above or below the actual frequency is an important way to dredge up the weak audio of a DX signal under a more powerful co-channel or adjacent station. Not all receivers that can tune splits actually bring in distant stations due to poor selectivity. Unfortunately, many of the newest DX machines which perform so brilliantly on SW often prove disappointing on MW. A choice of several bandwidths employing filters are highly desirable in a receiver. MW club newsletters give instructions for modifications or tips on where to get the job done. Highly regarded receivers, as seen in logging reports to NRC's DX News, are older tube radios like the Hammarlund

HQ-180A (I have the HQ-150) and SP-600 or the Collins R-390A. Modern communications receivers like the ICOM R70 and R71, Kenwood R-1000, 2000 and 5000, NRD 515 and 525, and Yaseu FRG-7 are also used. The Sony ICF-2010, usually slightly modified, appears to be growing in popularity among MW DXers. The inexpensive GE Super-Radio, still available in some markets, has proven to be an adequate receiver for those with low DX budgets.

The antenna is critical. Some of the newer receivers tend to overload on MW when any outboard antenna system is attached, especially when in the vicinity of local MW transmitters, so a manual RF gain control is an important plus. Beverage antennas give the best results, the only draw-back being the need for considerable space. Those who construct 500 meter beverage antennas need to carefully consider the terrain and weather, as others have had to deal with deep snow, desert wildlife, swamps, off-road vehicles, and curious police officers!

In the absence of a beverage, a loop antenna is a necessity. A ferrite rod or a wire-wound "air-core" loop is used inside your shack, can be tuned and has the ability to "null" dominant signals as the user rotates (and tilts) the antenna. The beverage is the most directional of the two, but the loop can be easily rotated at will. I have had good success with a ferrite rod loop less than 2 miles from my local stations. Many portables have a built in ferrite rod so at the very least try turning your radio in different directions for nulling. Your whip antenna will probably not give you good DXing results.

A regular random-wire antenna is less effective than a beverage or loop, but go for it if that's the best you can manage. Some DXers have built phasing units to combine properties of a loop and a long-wire, or multiple long-wires, to obtain especially sharp nulls. You are advised to read the various NRC/IRCA reprints on phasing units, loops, and other aspects of antenna design.

While good equipment is critical, there are enough stories about amazing receptions on the car radio during rush hour to give encouragement to the owner of any receiver!

TIMING

The daily "window" for TA receptions begins at local sunset and continues up until Europe/Africa sunrise. There are cases of TA reception well before local sunset and after transmitter sunrise, but the best time for TA DX is generally during the hour after local sunset when potentially interfering domestic stations to the west are still in daylight. As is the case on the Tropical Bands, peak TA reception is often enhanced at receiver sunset (2100-2300 or transmitter sunrise (0400-0600). Caribbean and Eastern South American catches are possible at local sunset as well. Central America, the Caribbean and Venezuela/Colombia are heard throughout the evening, but also after local sunrise when during certain months of the year (April to September), the transmitter may still be in darkness. African stations fade out later than Europeans in Spring/Summer mornings. Sunset/Sunrise charts or equivalent computer software are essential in understanding these phenomenon.

Some domestic stations are off the air between 0500 and 1200, which means that DXers will find distant receptions possible on these frequencies during this time. Even stations that are normally on the air 24 hours will occasionally sign-off in the middle of the night for maintenance and testing. While this could happen on any night, the best time to look for temporarily open frequencies is 0500-1200 on Mondays. Sundays and Saturdays are also possibilities. Until the Gulf War began, CBC English stations on clear-channel frequencies (740, 940, 1550) would leave the air every morning between 1:15 and 5:00 AM local time, and it is possible that CBC will return to this schedule in the face of tightened budgets.

MW DXers generally expect international DX to appear in September and last through April. Even so, most nights show little TA activity, so prepare to be very patient. The reception of stations south of the equator (Chile, Brazil, New Zealand) should theoretically be possible in summer (their winter), but ECNA receptions of these are quite rare.

The A-index has always been considered the most useful predictor of DX conditions. A high A value (10 plus) announced on time station WWV (2.5/5/10/15/20 mHz) at 18 minutes past every hour, generally indicates that reception to the south is more likely. Low values, particularly if they have been reported for several days in a row, may favor TA receptions. At my location, if CBJ-1580 (or any other Eastern Quebec or Maritime station) is coming in well before my sunset, good high-latitude conditions toward Europe are indicated. If CBJ is inaudible, and I'm hearing daytimers on 1580 to the south, I figure that TA prospects are limited. Some DXers note the early arrival of eastern Caribbean stations on 640, 780, 1100 as evidence that conditions will favor the south through the course of the evening. Those with propagational insights from tropical band listening and 160 and 80 meter amateur operations should find their knowledge generally applicable to medium wave.

To visualize the significance of the A-index for DXing, simply think of the auroral "northern lights" as a "blanket" in the upper atmosphere spreading south. The skywave signals of stations immediately under this blanket get absorbed by it, and lose their ability to propagate over distance. Meanwhile stations to the south slip in under the leading edge of the aurora at a low-angle, sometimes resulting in a normally powerful clear-channel station all but disappearing under a distant Caribbean or LA station. Many DXers believe that the actual south-to-north propagation of signals originating at equatorial latitudes is enhanced during auroral conditions. Auroral conditions are often observed during October and March. If you ever see the northern lights, head for your receiver! The shortest path between ECNA and Europe actually crosses the ocean at a high latitude, so northern European stations are especially susceptible to auroral absorbtion, and southern European/African stations less so. If you are located to the north you may hear northern Europeans best, but Southern Europeans and Africans are still possible under auroral conditions.

MW DXers often comment that a great Latin American DX night often begins with what appears to be a dead band, with normally dominant stations sounding watery, dull or weak, and ends with the suprise of LA stations booming in.

In addition to low A-index values, another tip-off for TA conditions involves checking for "hets" on reliable indicator channels such as 1521 (Saudi Arabia) and 891 (Algeria) kHz. Since good TA openings are often frequency-selective, check for hets at the low end and high end of the band. If a strong whistle is heard on the high side of WWKB-1520 or WLS-890, chances are that other splits are trying to get through. TAs at the high end are more common. The Saudi station is quite powerful, and can be heard in the vicinity of Buffalo's WWKB-1520. Be careful, however, for interference from a nearby TV produces a light "buzz" on splits. With experience you will learn to tell the difference.

The eleven year solar cycle has a bearing on international DX. The quieter the better for TAs, the more auroral the better for LAs. But broad generalizations are suspect, for 1978 was my best year for TAs, but 1989 and 1990 have been disappointing. Most of us only DX at odd intervals, so we often "discover" good conditions for TA or auroral DX by pure chance. On any given night, something unusual may be happening, and the best way to find it is by checking out the band!

TOOLS

As a multi-band DXer, I find it hard to memorize station schedules, path of darkness or grey-line windows, so I try to have the information I need close at hand. The World Radio TV Handbook provides MW frequencies, schedules, identification announcements and interval signals, powers, SW parallels, addresses, and verifications signers. NRC's *DX News* or IRCA's *DX Monitor*, each published about 30 times per year, are filled with hot tips and strategies (see addresses at end of article). The *NRC AM Log* contains domestic schedules, networks, program and language notes. NRC's *Canadian-American Night Pattern Book* shows directional antenna patterns of North American and selected Mexican/Caribbean stations, but is sadly dated. The *IRCA Mexican Log* is a very detailed list of stations, networks, and schedules. *IRCA Foreign DX Reference* is a summary of ECNA and WCNA receptions of international stations during the past year(s). *IRCA AM-FM Almanac* (5th Edition), is a recently published compendium of just about anything related to MW DXing, including a section on MW foreign DXing. Sunrise/Sunset Charts or the DX Edge (or equivalent computer software) are essential for determining the sunset/sunrise terminator and specific sunrise/sunset times at target stations for any calendar date. Other tools include: Spanish-English, French-English, and Portuguese-English dictionaries, a good atlas, and a world almanac (for name of currency, current political leaders, national holidays, etc.). Reprinted articles concerning a variety of subjects related to MW DXing are available from the NRC Publication Center and the IRCA Reprint Center. Try to obtain a recording of national anthems from your library or music store. These are usually played at s/on and s/off times. An excellent reference is *National Anthems of the World* (edited by Martin Shaw, Henry Coleman and T.M. Cartledge) which can be found at better public libraries. It also pays to be current with different world pop musical styles, like High Life, Salsa, Ranchera, Reggae, etc. I also find it very helpful to have a digital shortwave receiver next to my old Hammarlund so that SW frequencies can be checked for MW parallels. A tape recorder is indispensible for later interpretations of identifications in unknown foreign languages. SW DXers will be interested to learn that NRC and IRCA accept recordings as an alternative form of verification.

GENERAL COMMENTS CONCERNING VERIFICATIONS

In recent years I've noticed fewer mentions of verifications of foreign broadcasters in the pages of NRC's *DX News*. This may mean that the veterans have already gotten all the QSLs they need, that newcomers are less interested, that taping is preferred, or that the response rate is way down. In any event, all of the lessons you've learned concerning shortwave QSLing strategies hold true and more so for MW DXing. Except for the admonition to write in the station's local language, I will not review QSLing stategies here. Even so, Scandinavian DX clubs report a great deal of correspondence is being received from Central and South America by those who keep at it.

MW DXers can expect a quick QSL response from governmental broadcasters in Europe. Most Caribbean stations are generally good responders, though a follow-up may be needed. Central American, South American, and African stations take the greatest persistance of all.

TARGETS

Most of the international DX targets that are listed below reflect the actual reports of hard-core ECNA MW DXers during the last two years, as reported in *DX News* (NRC) and *DX Monitor* (IRCA), and from *DX Ontario* (ODXA). Please note, however, that the following information may change without notice, due to political turmoil, hurricanes, or equipment break-down.

Abbreviations: HS = Home Service; ES = External Service; SW = shortwave; IS = Interval Signal; // = parallel; DT = Dutch; EN = English; FR = French; SP = Spanish; PT = Portuguese.

Synchro = several or more stations with high or low powers on the same frequency with the same program. If you notice an odd pattern of fades on a signal, it may be two synchros with separate fade patterns.

EUROPE

In addition to their shortwave operations, many of the governmental broadcasters in Europe transmit their international service on powerful MW transmitters. This means that a DXer can look for shortwave parallels as an aid in identifying a particular mystery station. But it also means that a station with a program in French, for example, may not be from France.

ALBANIA Radio Tirana is one of the easiest targets from Eastern Europe, because of high power with good punch and ideal split frequencies. The ES is on 1395 (1000 kW, 0500-2400), and 1215 (500 kW, 0400-2200). Also heard on 1458 (500 kW, 0400-2300). Different languages, check WRTH for likely SW parallels, and listen for RT's well-known trumpet IS.

ANDORRA A commercial station once active on 701 that could be heard in North America is now dismantled. Recent reports are that a new operation may soon begin on 819.

AUSTRIA There are several good splits to work on: 1476 (600 kW), 1026 (100 kW), and 585 (240/600 kW). 1476 is most often reported; all are 0500-2310.

AZORES While its outlets are low-power, some of them get through to ECNA. 693, 837 and 1566 have been reported in ECNA.

BELGIUM The ES on 1521 (600 kW, 0500-2230) is the best bet, but the DT HS on 927 (300 kW, 0430-2245, 0530 Su), and the FR HS on 621 (300 kW, 0430-2240, 0530 Sa/Su) are also possible.

BULGARIA High power HS outlets are 576 (500 kW), 594 (250 kW), 747 (500 kW), 828 (500 kW, 2nd HS program), 1161 (500 kW), 1224 (500 kW, sometimes parallel with SW ES), and 1296 (150 kW). All 24 hrs. It may be possible to hear parallels to the HS on 7670 and 11660 kHz, although these operate less than 24 hrs.

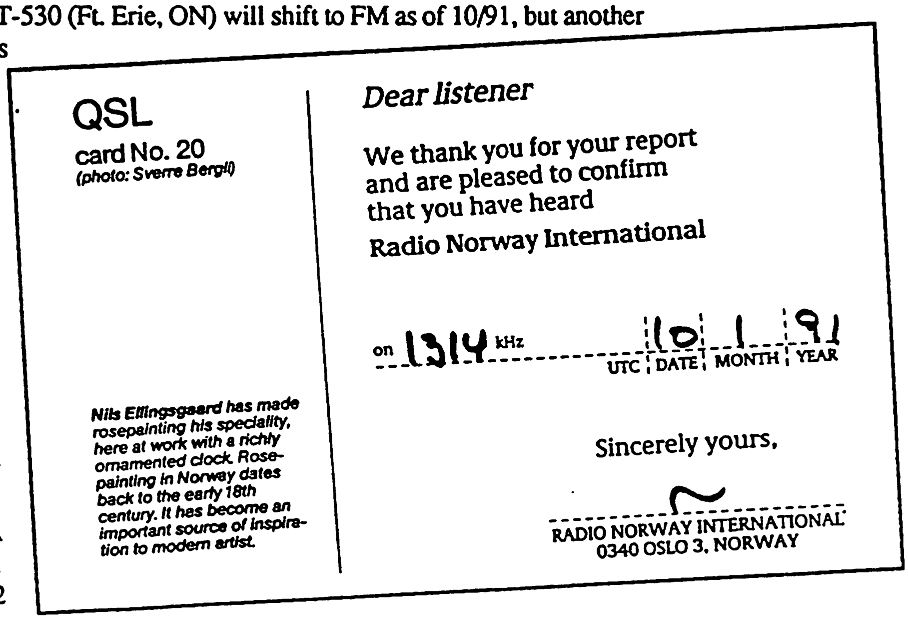
CZECHOSLOVAKIA 1521 (600 kW, HS, 24 hrs) is sometimes reported here, instead of Saudi Arabia. Also heard on 1098 (750 kW, 0300- 2300 0500 Su) and 1287 (300/400 kW, 0400-0640 0600-0640 Su, 1400-2310 Radio Free Europe; and 1300-1400 ES)

DENMARK There is one medium wave outlet of Danmarks Radio Kanal Tre (channel 3) on 1062 (250 kW, 0355-2310).

FAROE ISLANDS Utvarp Foroya 531 (200 kW) is in Danish. The schedule is as follows: 0715-1400, 1700-2100 M-F, 0715-1600, 1830-2205 Sa, 1000-1900 Su. The station has been heard in Canada, and is said to have an EN weather report at 0800. CJFT-530 (Ft. Erie, ON) will shift to FM as of 10/91, but another Ontario station may take its place, so look for this one now!

FINLAND 963 (600 kW, 0300-2200 M-Th, 2300 F/Sa, 0400-2200 Su). Not often reported.

FRANCE Stations are regulary heard from France on Network B: 1557 (300 kW), 1377 (300 kW), 1206 (100 kW), 837 (200 kW), and 711 (300 kW) (0530-2200 0558 Su, including programs for foreign workers 0530-0600, 2100-2200); and Network A on 675 (600 kW), 1161 (100/200 kW) and 162 (2



Mw) (24 hrs except 0005-0358 Tu). 162 is one of the most reliable LW TA signals.

GERMANY Stations on 783, 1044, 1323 and 1575 are from the former GDR. 1593 (WDR is one of the easiest TAs, 24 hrs with 800/400 kW), 1539, 1422, 1269, 1197 (EN language US Armed Forces Network reportedly leaving the air soon), 1107, 1017, 936, 828, and 756 are from the Federal Republic. With the consolidation of media services following reunification, the operations are going through identification, network, and schedule changes.

> RDP
>
> A Radiodifusão Portuguesa agradece e verifica o relato de escuta referente à emissão transmitida no dia 31 / 1 / 88 entre as 0435 e as 0500 TMG, na frequência de 666 kHz banda de 450 metros, enviado por Jim Renfrew
>
> 100 KW.
>
> GABINETE DE RELAÇÕES PÚBLICAS – Av. Engº. Duarte Pacheco, 5 – 1000 Lisboa – Telex 64774

GREECE 1044 (150 kW) in Macedonia has been reported, though rarely. Also rare is VOA on 792 (500 kW, approx. 1700-0700).

HUNGARY The following have been reported: Magyar Radio, Program II, 0330-2315 (0500 Su), on 1251 (500 kW) and 1341 (300 kW). Also check 1188 (135 kW).

IRELAND Listen for EN on 567, (500 kW, 0630-0048), 612 (100 kW, 24 hrs). Atlantic 252 (500 kW, 24 hrs) is a new longwave target with EN pop music.

ITALY WRTH shows Radio Uno (0500-2230) and Notturno Italiano (0500-2230) on 846 (540 kW). 1116 (150 kW) and 1332 (300 kW) have also been reported.

LUXEMBOURG: RTL 1440 with 1.2 Mw is a possible "even" TA (1900-0300 EN). The s/on time in other languages not clear in WRTH. LW 234 is 24 hrs in FR.

MALTA Two stations share the same 600 kW 1557 transmitter, but 1991 WRTH shows conflicting use: Radio Monte Carlo (0600-0800, // 9765); Deutsch Welle (0400-0550, 0700-0750, 1200-1800, and 1900-2120, with many SW parallels).

MONACO Two stations share the same 1 Mw 1467 transmitter, but 1991 WRTH shows conflicting use: Transworld Radio (0430-0515, 1945-2350); Radio Monte Carlo (0500-1830 with Arabic). RMC also uses 702 (300 kW, 0530-1830 in Italian).

NETHERLANDS All are possible: 675 (120 kW, 0600 - 2300, 0700 Su). 747 (400 kW, 24 hrs). 1008 (400 kW, 0800-2130 Tu-Fr (2200 Sa, 2140 Su, 2100 Mo).

NORWAY Easily the best high-latitude TA on a good split. Many DXers use this as a beacon. Norsk Rikskring-kasting (NRK) 1314 (1.2 Mw, 24 hrs in Norwegian) can be heard on the coast before local sunset and through the early evening well inland.

POLAND Most often reported is 1503 (300 kW). 1206 (200 kW) is also possible. Schedule in 1991 WRTH is not clear.

PORTUGAL Also an easy low-latitude TA, with various targets, but note that Spain and Portugal often have stations on the same frequencies, so be sure that you can identify the language in use. Antena 1 666 (135 kW and synchros, 24 hrs) has also been heard by some on the "even" TA frequency of 720! Rádio Comercial is also a good prospect on 1035 (135 kW) and 1062 (100 kW), both 24 hrs, and 783 with 50 kW (0600-2400). Look for Rádio Renascença, of SW fame, on 594 (100 kW, 24 hrs). Others heard include 567, 693, 756, 1562, and 1575.

ROMANIA 756 (400 kW, 0500-2200 includes some ES programs); 855 (1.5 Mw, 0500-2100); 1152 (950 kW, 0500-2100) have been reported. Also possible are 558 (200 kW, 0400-0600, 1400-2200, 0600-1100 Su); 1053 (1 Mw, 0400-0600, 1400-2200, 0600-1100 Su); and 1179 (200 kW, 24 hrs).

SPAIN An easy low-latitude TA country, with a range of high power targets, and occasional low power stations making it across. The best has been Radio Uno 774 (60 kW the

10 BEST TA BETS		10 BEST LA BETS	
(see listings for schedules)			
1. NORWAY	1314	1. CUBA	710
2. SPAIN	774	2. MEXICO	730
3. PORTUGAL	666	3. NETH. ANTILLES	800
4. ALGERIA	891	4. ANGUILLA	1610
5. GERMANY	1593	5. BAHAMAS	810
6. SENEGAL	765	6. CAYMAN ISLANDS	1555
7. ALBANIA	1395	7. VENEZUELA	670
8. YUGOSLAVIA	1134	8. COLOMBIA	770
9. SAUDI ARABIA	1521	9. ST. KITTS	825
10. MONACO	1467	10. TURKS AND CAICOS	1570

highest power among multiple "synchro" sites). Radio Uno is also on 585 (500 kW), 684 (500 kW), 738 (500 kW), 855 (125 kW the highest power synchro). In past years SER synchros, with low power on 1584 and 1602, have been heard. Other reported frequencies: 612, 621, 727, 837, 918, 999, 1107, 1134, 1179, 1224, 1413, 1476, 1485, 1503, 1521 and 1539. Local and regional programming can be heard 0655-0659, a good time to seek site IDs.

SWEDEN Your only chance is 1179 (600 kW, HS 0450-1600 and ES 1600-0130) during high-latitude TA conditions.

SWITZERLAND German 1566 (300 kW) is most often reported (0500-0700, 1600-2400). Look for FR on 765 (600 kW, 24 hrs). Senegal's Afro-pop mx is very distinctive, if you are worried about confusing the two. Also Italian on 558 (300 kW, 24 hrs).

U.S.S.R. Difficult, but stations have been heard on 1089, 1143, 1215, 1386, and 1548. Listen for the distinctive Mayak IS of SW fame, but be aware that various republican services are now carving out separate slogans and Interval Signals.

UNITED KINGDOM The BBC has several services, each with high and low power synchronized transmitters: Radio One on 1053 and 1089 (150 kW, 0500-2300); Radio Three 1215 (100 kW, 0655-0035, 0005 Sa/Su); and Radio Five 693 and 909 (150/200 kW, 0600-2400). Some of these networks are expected to go commercial in the near future. BBC WALES can be heard on 882 (100 kW, 24 hrs). BBC Ulster NORTHERN IRELAND is on 1341 (100 kW, 24 hrs).

VATICAN CITY Vatican Radio is well heard with a wide array of languages on 1530 (300/600 kW, 0250-1100, 1400-0100) and 1611 (15 kW, 0310-1000, 1700-2100), with SW parallels shown in the WRTH. These may actually be 24 hrs. 1530 gets out very well.

YUGOSLAVIA Another easy shot at Eastern Europe is RTV Zagreb, frequently heard with western pop music on 1134 (1.2 Mw) // to the weaker signal on 1125 (300 kW). WRTH says schedule is 0400-2305, 24 hrs on Saturdays, although monitors report 24 hrs every day. These two transmissions are from Croatia, so keep an ear out for "Hrvatska" the Serbo-Croat word for "Croatia." 882 Titograd was reported in 1988.

INTERNATIONAL WATERS/EURO-PIRATES The famous Radio Caroline 819 is now off the air, probably for good. Low-power Western European pirates can be found above 1600 kHz, but none have been reported by ECNA DXers. According to recent reports, pirates are now on the rise in the USSR, probably with lower powers.

AFRICA

If you get any TAs at all, you should get at least one from Africa. Several outlets get out very well. Only the most likely countries are listed here.

ALGERIA One of the easiest TAs of all is 891, (300/600 kW, 24 hrs, and frequently audible as a het against WLS. 531 (300/600 kW, 24 hrs) is heard also. Listen for Koranic recitations.

CANARY ISLANDS COPE 882 (20 kW, 0700-2400) often produces a het against WCBS, but other outlets can be heard in spite of low power once Spain is in daylight, such as RNE-1 621 (100 kW, 24 hrs) RNE-5 747 (20 kW, 24 hrs), COPE 837 (10 kW, 0500-0100) and RNE-5 1098 (2 kW, 0800-2300). These are Spanish networks, so you will really have to dig for a local ID.

EGYPT 864 and 1107 are occasionally reported. Schedules were in flux during the Gulf War.

GUINEA Conakry 1404 (200 kW, 0600-0800, 1200-2400, 0800-2400 Su) was once very easy, but seems to have lost much of its "punch."

LIBYA 1251 and 1125 and // SW, listed as 1745-0430.

MAURITANIA 1349 (50 kW, 0630-0100, FR, AR and local languages).

MOROCCO RTM 1044 (300 kW, 24 hrs) is most frequently reported, along with "Medi Un" 612 (300 kW, 0600-0100 // 9575 0800-2100); also look for 594 (100 kW, 24 hrs), RTM 999 (10 kW, 24 hrs), 1053 (600 kW, 24 hrs) and 1197 (20 kW, 0600-0100, FR, EN, SP).

SENEGAL Dakar 765 (200 kW, 0600-2400 0700 Su) is a strong low-latitude split for those outside of Detroit and New York, heard this past season by DXers in Manitoba. FR language, with Afro-pop music. By the way, this is one of the best WCNA TA bets.

SIERRA LEONE SLBS 1206 (10/50 kW, 0558-2315 // (at times) 5980 and 3316 SW). Less frequently reported in recent years.

TUNISIA Sfax 1566 (1.2 Mw, 1600-2330) check // 7475. Arabic programming.

ASIA

Yes, a TA from this continent is very possible because of—

SAUDI ARABIA on 1521 (2 Mw, listed 0300-2300, but reportedly with extended hours during the recent Gulf conflict). The het against 1520 is quite strong through most of the winter months. Listen for recitations from the Koran and Arabic prayers (which should never be referred to as "chanting" or "wailing"). 1512 (1 Mw) has also been heard.

ISRAEL 738 (1.2 Mw, 0300-2215), TURKEY 1017 (1.2 Mw, 24 hrs), and the BBC OMAN relay 1413 (750 kW, see latest BBC sked) are also long-shot possibilities. Special Note Concerning Long-Wave TA Receptions:

CARIBBEAN

There are lots of countries here that you'll never hear on SW, with EN, FR, DT, SP, and Creole. Some are easy; some will take years of patient effort.

ANGUILLA By far and away, one of the easiest Caribbean stations is the Caribbean Beacon on out-of-band 1610 (50 kW), with EN religious programs. If it's coming in well, try for // 690 (15 kW). A good verifier. Tele-evangelist Gene Scott has reportedly purchased the Beacon and is simulcasting his TV audio on the Beacon and // KVOH 9785 SW. R. Anguilla 1505 (1 kW, 0930-1800, 2100-0210) is reported during auroral conditions.

ANTIGUA VOA 1580 (50 kW, 0000-0200, 1000-1200). Watch for its open carrier around 2350, followed by VOA EN programming. Noted in parallel with 5995. Commercial ZDK 1100 (10 kW, 0900-0504, 0956 Sa, 1426-0204 Su) and the religious Caribbean Radio Lighthouse 1165 (10 kW, 0925-0230) are good possibilities.

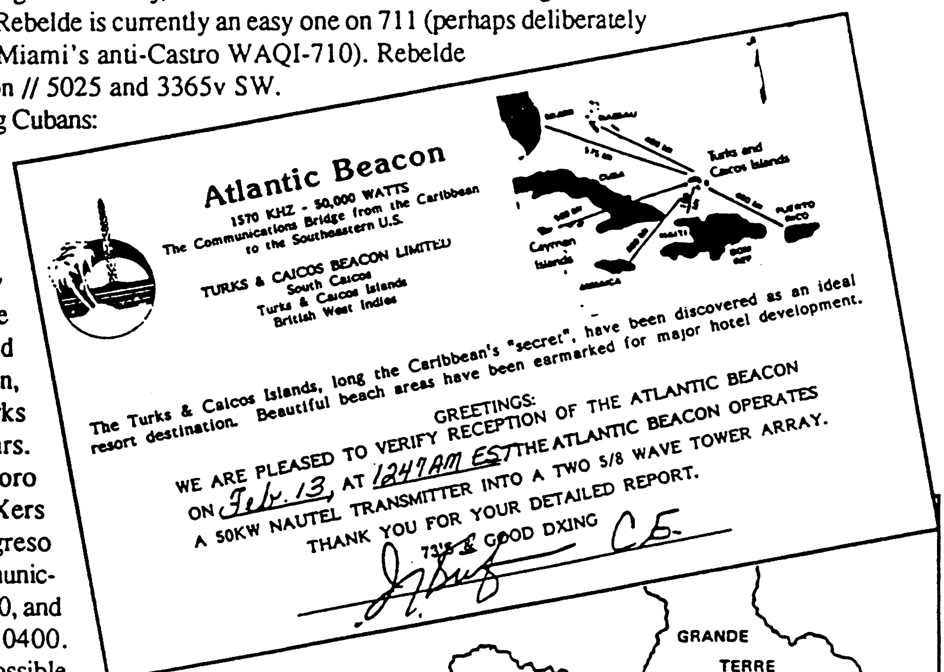
ARUBA Stations listed on 960, 1270, 1320 and 1440 are rarely reported outside of Florida. 1320 IDs as "Canal Noventa".

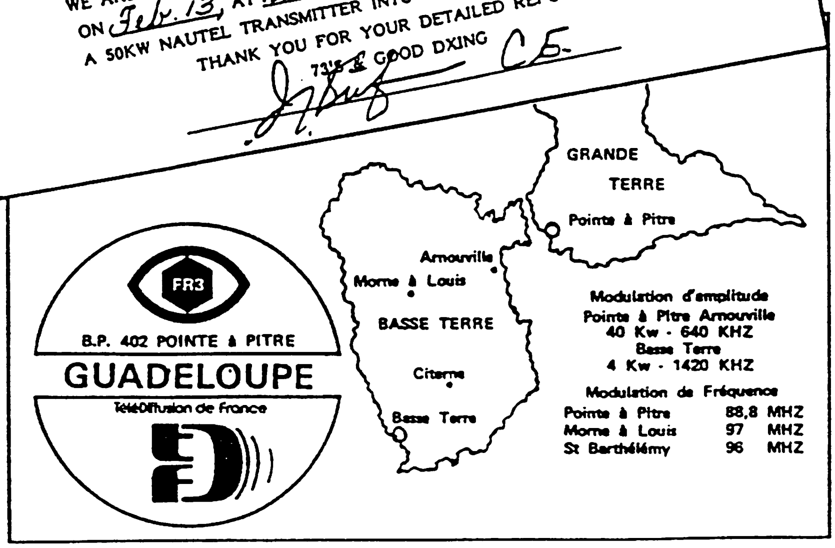
BAHAMAS ZNS-1 is widely heard on 1540 (20 kW, 24 hrs), especially during auroral conditions. ZNS-3 on 810 (1 kW, 24 hrs) can be heard with WGY nulled. The station has not been responding to verification requests in recent years. ZNS-2 1240 (1 kW) is a tough target. ZLS, a morse code beacon, is now on 526 and being widely heard.

BARBADOS CBC 900 (10 kW, 0855-0500) and VO Barbados 790 (20 kW, 0900-0500). Both tough due to domestics, Cuba and Mexico.

CAYMAN ISLANDS Radio Cayman is fairly easy to hear on 1555 (10 kW) and 1205 (1 kW). WRTH schedule is 1100-0400, but it is often on later than this. Caribbean accented EN with pop music. A good verifier.

CUBA For most DXers, Cuba is more obstacle than target. Radio Taino 1180 (also check 830, 1040, 1100) is easily heard with programming in EN and SP. Most other Cuban stations come in bunches, an easy one being Radio Reloj 760 whose programming consists of continuous news over the sound of tick-tick and "RR" IDs every minute in morse code. When you get one Reloj, look around for others. Radio Progreso can be heard on 640, 660, 740 and 880. Radio Rebelde is currently an easy one on 711 (perhaps deliberately drifted to interfere with Miami's anti-Castro WAQI-710). Rebelde programs can be heard on // 5025 and 3365v SW. The big hint for identifying Cubans: no advertising, but great music! Call letters are rarely heard, except on 840 "Dobleve" ("W"). Cuban networks are now in a state of flux, with some stations reducing power and limiting hours of operation, or carrying other networks during midnight hours. According to Arnie Coro (Radio Habana's "DXers Unlimited"), Radio Progreso stations sign off at 0500, municipal (local) stations at 0100, and provincial stations at 0400. Cuban verifications are possible, but are often non-specific and may take many months. Arnie has offered to be a conduit for MW QSL requests, and according to Harold Sellers of ODXA, he is trying to encourage site identifications at sign-off time. GUANTANAMO AFRTS 1340 (250 W, 24 hrs), a challenge!





DOMINICA DBS 595 10 kW (0930-0230, 0955 Su) can be heard during auroral conditions.

DOMINICAN REPUBLIC There are several opportunities to hear the DR. R. Amanecer 1565 (5 kW, 1000-0300) is a religious station with SW // 6025. This one verifies. Also look for R. Clarin 860 (50 kW, last reported SW // 9950), R. Central 1040 (10 kW, 24 hrs), R. Mil 1180 (10 kW, 0930-0500), R. Continental 890 (5 kW, 0930-0600), and R. Universal 650 (20 kW, 24 hrs).

GRENADA R. Grenada 535 (20 kW, 0957-0400/0200Su) is on a good split, if your receiver tunes this low!

GUADALOUPE RFO 640 (40 kW, 24 hrs) can be heard during auroral conditions. Listen for FR under Cuba and Venezuela. Difficult, but possible, if you keep looking for it.

HAITI La Voix Evangelique is on two channels: 1030 (10 kW, 0900-1000 & 1900-2200 SP, 1000-1300 2200-2300 EN) and 840 (10 kW, 0900-0200 Creole and FR), with religious programs. A recent QSL letter explains that these stations are currently operating with earlier s/off times due to high cost of generator fuel. 840 was heard with Christmas music, and "Amazing Grace" IS during evenings in December, 1990. St. Lucia also has FR on this frequency, so listen carefully for IDs.

JAMAICA There are two networks, both easily heard. JBC's Radio One is on 700 and 750 (10 kW, 24 hrs), heard well at night and at sunrise with Caribbean accented EN, reggae and other pop music, ads, talk shows, etc. RJR, with similar programming, is heard on 720 (10 kW), and 770 (5 kW). It also gets out quite well on 580 (10 kW, 24 hrs). JBC doesn't seem to verify, but QSL cards have been received from RJR.

MARTINIQUE R. Caraibes 1090 (20 kW, 24 hrs) has been heard on rare occasions, in FR.

MONTSERRAT Stations on 740, 885, and 930 were hard hit by a hurricane a few years ago and are off the air. Reports indicate that R. Antilles 930 is under construction with 80 kW, and will transmit BBC, VOA, RCI, and Deutsche Welle programs.

NETHERLANDS ANTILLES A real powerhouse is Transworld Radio 800 (500 kW), with religion in SP, PT and EN. Daily schedule is 2159-0430, 0659-1258 (later on Sa and Su). Excellent verifier. PJZ, Radio Z-86 860 (10 kW) has not been reported in some time, but programs are in Papiamento, a Caribbean form of DT/SP.

PUERTO RICO A glance at the NRC night pattern book shows why Puerto Rico is so hard to hear: most station patterns are directional away from the continental US. Scandanavian DXers hear more PR stations than we do. A good prospect is WIAC 740 (10 kW), which since the big hurricane has been apparently less directional. WRTH says 0859-0400, til 0600 Fr and Sa. WKAQ "Radio Reloj" is a good target on 580 (10 kW) and WQBS (5 kW) is worth checking for on 630.

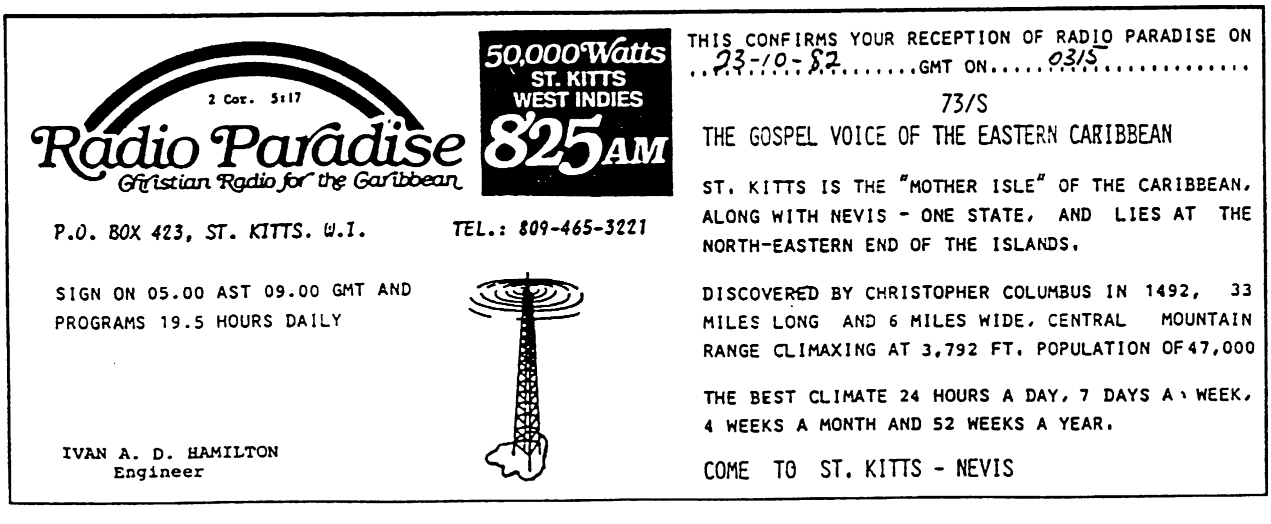
ST. KITTS A good country for splits. Radio Paradise 825 is widely heard in EN (50 kW, 0900-0400, Sa 0500). Voice of Nevis (or VON) 895 (10 kW) is a new station on the island of Nevis, but not often reported. ZIZ 555 (20 kW, 1000-0400) is another split, not reported lately.

ST. LUCIA SLBS 660 (10 kW, 0925-0300) in EN and Creole is sometimes reported. There is a 1 kW relay on 625. R. Caribbean International 840 (20 kW, 0500-1900) in EN and Creole with pop music is only possible at sunrise, due to limited schedule, but it may resume late night operations in Patois/EN quite soon.

ST. VINCENT NBC 705 (10 kW, (0930/1000Su-0300/0400FrSa/0200Su) is a split that sometimes gets through under auroral conditions.

TRINIDAD AND TOBAGO Sometimes heard on 730 (20 kW, 24 hrs). Less likely on 610 with 50 kW (0845-0600) —reported by Medium Wave News (UK) to have shifted to 620 as of 3/91.

TURKS AND CAICOS There are two chances to hear this island group, one fairly easy, the other much more difficult. The Atlantic Beacon 1570 (50 kW, 24 hrs) has been heard in WCNA with US-based religious programs from


2 Cor. 5:17
Radio Paradise
Christian Radio for the Caribbean
50,000 Watts
ST. KITTS
WEST INDIES
825 AM
P.O. BOX 423, ST. KITTS. W.I.
TEL.: 809-465-3221
SIGN ON 05.00 AST 09.00 GMT AND PROGRAMS 19.5 HOURS DAILY
IVAN A. D. HAMILTON
Engineer
THIS CONFIRMS YOUR RECEPTION OF RADIO PARADISE ON 23-10-82 GMT ON 03.15
73/S
THE GOSPEL VOICE OF THE EASTERN CARIBBEAN
ST. KITTS IS THE "MOTHER ISLE" OF THE CARIBBEAN, ALONG WITH NEVIS - ONE STATE, AND LIES AT THE NORTH-EASTERN END OF THE ISLANDS.
DISCOVERED BY CHRISTOPHER COLUMBUS IN 1492, 33 MILES LONG AND 6 MILES WIDE, CENTRAL MOUNTAIN RANGE CLIMAXING AT 3,792 FT. POPULATION OF 47,000
THE BEST CLIMATE 24 HOURS A DAY, 7 DAYS A WEEK, 4 WEEKS A MONTH AND 52 WEEKS A YEAR.
COME TO ST. KITTS - NEVIS

RADIO JAMAICA
RJR-AM (The Supreme Sound)
NAGGO HEAD (Kingston and environs) 720 KHZ (10,000w)
MONTEGO BAY 550 KHZ (5,000w)
SPUR TREE (Near Mandeville) 770 KHZ (5,000w)
GALINA (Near Port Maria) 580 KHZ (10,000 w)

CAPITAL STEREO (FM)
KINGSTON 92.7 MHZ AND 95.7 MHZ

RJR

Radio Jamaica Ltd.,
32 Lyndhurst Road,
P.O. Box 23,
Kingston 5, Jamaica
Telephone: 926-1100 Cables: Broadco

11th December 1983

Dear Mr. Renfrew,

This is to confirm your report of reception of Radio Jamaica on a frequency of 580Khz on 13th December 1982 as being correct and that the programme was broadcast by us.

Yours truly,

Chief Engineer,
RADIO JAMAICA LTD.

its transmitter on South Caicos Island. It verifies from a US address. Radio Turks and Caicos 1460 (2.5 kW, 1100-0400 0315 Su) has been heard as far north as New England along the coast, but rarely inland.

VIRGIN ISLANDS (US) Very tough. Best chance is WVWI on 1000 (5/1 kW, 24 hrs, 1000-0400 SaSu), heard in Florida in 1991.

VIRGIN ISLANDS (British) ZBVI 780 (10 kW, 1000-0200, 1100-0100 Su) is often heard in early evening hours, before WBBM comes in. Recently reported in DX Ontario to be signing off at 0400, with a new 5 kW transmitter, hoping to go to 10 kW soon.

CENTRAL AMERICA

BELIZE Once an easy split on 834, Radio Belize is now much harder on 830 (10 kW, 1100-0600). A good verifier. VOA has relays on 1530 and 1580 (50 kW, 0030-0400, 1200-1430), according to a recent VOA schedule, with likely SW parallels (but note that VOA Antigua is also on 1580).

COSTA RICA A variety of commercial outlets are audible on 530, 670, 730 (R. Reloj is also 4832 and 6006 shortwave), 760, 980 (the old R. Impacto), and 1120 (as high as 1127).

EL SALVADOR YSS, Radio Nacional, on 655 (10 kW) is widely heard between and WSM and WFAN with music and time checks, although not as frequently as in past years. I heard their full data network s/off at 0400 in 11/89.

GUATEMALA TGW 640 (50 kW, 1055-0600) used to be commonly reported. Its signal was extremely over-modulated when I last heard it 8 years ago. Radio Cultural is sometimes reported on 730 (10 kW (0955-0730 // 3300 and 5955 SW) with SP and EN.

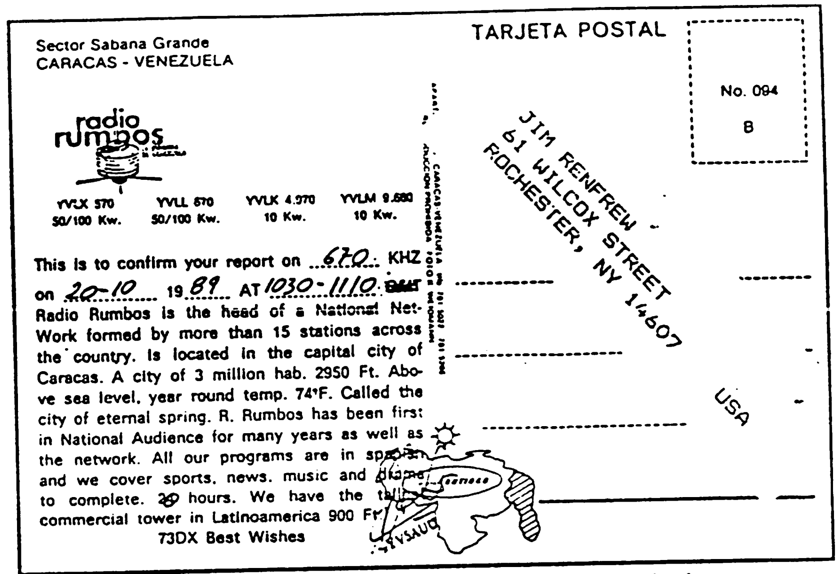
HONDURAS A country with many drifting stations, so unlisted splits that you may discover might be Honduran. LV de Honduras, HRN, 670 (1 kW) is the one most often reported. Stations on 880 (10 kW) and 890 (10 kW) are also reported. Recent splits include: R. Paraíso 1162, R. Latina 1255 and R, Danlí 1372.

MEXICO Mexico is, of course, fairly easy to hear on some channels, but also provides a great challenge on others. XEX 730 (100 kW) is heard regularly, in spite of Canadian interference. XEW 900 (250 kW), XEQ 940 (50 kW), and XEWA 540 (150 kW) are also regulars in many US locations. XERF 1570 (250 kW) is a high power "border blaster" with programming in EN for US listeners. At least one SW parallel comes into play, as XEEP 1060 (6185 kHz) is frequently heard under KYW (also a great music program in morning hours). IRCA has produced an incredibly detailed Mexican log, based upon observations from border areas, correspondence with Mexican networks, as well as travel loggings. The log indicates call letters, networks, hours of operation, and transmitter powers. There is a major shift in frequencies taking place in Mexico, with many stations now switching to US clear channels. XESFT 780 is one such station not far from the Texas border that is now heard under WBBM. What additional challenges after hearing a few from Mexico? See what you can hear from the various Mexican states, such as XEDM 1580 in Sonora and XED 1050 in Nuevo Leon.

NICARAGUA Since the change of government in late 1990, the broadcasting scene has been in a state of flux. R. 19 de Julio 555 (10 kW, 1100-0400) was heard for many years on this split, but less so recently. R. Ya was well heard this past season on 601 (10 kW, 1000-0600), but has now settled on 600. Jeff White in DX Ontario reports that out of power Sandanistas are using equipment removed from R. Nicaragua SW for R. Ya. Other stations reported include R. Católica 720 (10 kW, 1200-0400) and R. Sandino 750 (50 kW, 1000-0600).

PANAMA The only one I've heard in the northeast is R. Nacional on 770 (10 kW, 24 hrs). R. Nacional 1015 (3 kW) is a split that is heard on occasion.

CANAL ZONE US forces' Southern Command Network 790 (10 kW, 24 hrs) is obviously quite a challenge.



SOUTH AMERICA

ARGENTINA Perhaps your last, best chance for the Southern Hemisphere. Several DXers, in recent years, have heard Radio Nacional on 870 (100 kW, 24 hrs) with distinctive time pips on the hour under WWL/WHCU.

BRAZIL In order to hear Brazil, it is necessary to give careful study to Sunrise/Sunset charts and operating schedules, where known. DXers from New England or Long Island occasionally report Brazilians. The only one I have seen in the last two years was R. Record 1000 (200 kW). The best time to listen is at Brazilian morning s/on.

COLOMBIA The full range of possibilities is extensive, but the best bets are CARACOL 810 and 700 (24 hrs, 250 kW // CARACOL SW outlets). A station that seems to have the best punch toward the NA interior is RCN 770. Stations on 650, 760, 780, 850, 870, 890, 1040, and 1100 are frequently heard, most 24 hrs. The WRTH list of network affiliates is very helpful to have on hand. Stations on the northern Caribbean coast get out quite well. High-powered CARACOL 700, in Cali, is tantalizingly close to Ecuador. Also try for MER morse code beacon on 1685 (1 kW) before the domestic band extends to 1700 kHz.

ECUADOR Very difficult. The best bets occur when an Ecuadorian drifts off-frequency. None were reported to IRCA and NRC in the last two years, though WCNA DXers have occasionally heard R. Superior 890. Werner Funkenhauser reports reception of Radio Católica Nacional 880 in January 1987 at s/off. I heard my only Ecuadorian, Ondas Orenses, on 915 at 0430 in October, 1983. It may be easier to try for the LAG beacon on 1665 (1kW).

FRENCH GUIANA RFO 1070, (10 kW), is rarely heard. WRTH says it carries Radio France's "Inter" program 24 hrs, and is not parallel to 3385/5055/6170 SW.

GUYANA Very tough. GBC broadcasts on 560 (0730-0300 irr. 24 hrs) and 760 (0800-0200), both 10 kW, // 5950 (if on the air).

SURINAM Radio Nickerie 914 (3 kW, 0930-1700, 1930-0100), is a possibility as a split frequency. Mainly Samami Hindi, with some DT and Javanese.

VENEZUELA A country where it is possible to hear a fair number of stations, even on nights when conditions are otherwise poor. Best bet is R. Rumbos 570/670 (100 kW, 0900-0600) from two transmitter sites // 4970/9660 SW. Distinct door bell tones between songs. It gets in well, even if Cuba is strong on 670. Other targets: 540 R. Mundial Perijá (0900-0400), 550 R. Mundial (24 hrs), 640 Ondas Porteñas (24 hrs), 700 R. Popular, 720 R. Visión Oriente (0900-0500), 740 R. Maracaibo (0900-0400), 740 R, Caroní (tantalizingly close to Brazil!), 750 R. Caracas (24 hrs, 100 kW), 780 Ecos del Torbes // 4980 (0900-0400/0600SaSu), 780 R. Coro (new, and quite strong, with many TCs between songs, 24 hrs), 830 R. Sensación (0900-0500), 1020 R. Mundial Margarita (quite easy under KDKA, 0955-0500), 1080 R. Barcelona, 1120 Ondas del Lago (1000-0400, 24 hrs SaSu) and 1200 R. Tiempo (24 hrs). The NA is frequently heard at s/on, s/off and at AST midnight. Watch for AST s/ons on open frequencies in the morning. R. Nacional is testing on 1240 (1 Mw) during limited hours, but may be off the air now due to complaints of interference.

BOLIVIA, CHILE, FALKLAND ISLANDS, PARAGUAY, PERU, and URUGUAY are extremely rare. Peru and Bolivia are only likely on drifting or split frequencies, and even when audible are usually too weak to identify. 985 Peru was heard in 1989.

NORTH AMERICA

ALASKA To my knowledge, no stations from Alaska have been heard in ECNA in many years.

BERMUDA The best bet is VSB-3 1160 (1 kW, 24 hrs), with BBC relay programming some of the time. The frequency is getting more and more congested, but this station is being heard. Also on 1280 and 1450.

GREENLAND Rarely heard outside of Canada and Scandanavia, and no longer on SW. Stations on 650 and 720 are the best bets, scheduled 1000-0300 (1100-0205 Su).

NEWFOUNDLAND A good target for this "country" is CHCM 740, on the air 24 hrs since a commercial station picked up this former CBC frequency. The oldies program punches through quite nicely. As the bombs began falling on Baghdad, CBL 740 in Toronto has gone 24 hrs, but I heard it in CBL's null one night at 0600, so it continues to be a potential target. The station is a relay of 590 and IDs as VOCM. A good verifier.

ST. PIERRE ET MIQUELON Two small islands off the coast of Newfoundland are French territory, with their own RFO outlet on 1375, with 20 kW. Schedule is 0930-0230 local programming, 0230- 0930 with Radio France's "Inter" program. When this station is in, it is a good indicator of TA conditions, but don't confuse it with France on 1377!

TRANS-PACIFIC

These are only likely at ECNA sunrise, and are quite rare. I have always heard that best reception possibilities are at the equinoxes, but, alas, have no personal experience of this!

AUSTRALIA 738 and 774 have been reported. Use ABC domestic SW parallels to help in identifying these (see WRTH). Great challenges are Radio for the Print Handicapped (RPH) outlets on interference-free 1620 and 1629, which have been heard in Ontario (D. Clark), Massachusetts (R. Moore), and Alabama (K. Atkins), but which are leaving these frequencies for FM or other mid-band MW frequencies. Fall, 1991 might be your last chance!

JAPAN There have been hints of carriers from Japan in ECNA, but not recently. Look for NHK 500 kW outlets on 747, 774 or 873.

KIRIBATI 846 Tarawa (10 kW, 1825-2000, 2355-1030, 0555-0930 Mo-Fr, 1825-0130, 0555-0930 Sa, 2355-0130, 0555-1100 Su // 14917.7 SW), is occasionally reported, but usually only the het.

TAHITI 738 (20 kW, 24 hrs) with FR and Tahitian sometimes gives a tantalizing het.

Ray Moore heard TP hets in October, 1990 on 747 and high-end 1548, 1566, 1575, and 1593 ten to twenty minutes after local sunrise.

LONGWAVE

There is not enough space to detail international Long-Wave DX, but I will simply note that some countries are only likely on LW: ICELAND 207 (off the air at date of writing for antenna repairs, expected to return with 500 kW) and LUXEMBOURG 234 (unless you can get it on the "even" TA of 1440 kHz). LW stations are good MW TA beacons, and MW clubs encourage the submission of longwave loggings. LW is more likely to suffer from local noise, and there is frequently interference from one of the many non-directional aeronautical and marine beacons using this band.

MW CLUB ADDRESSES

The best way to keep up with the International MW hobby is to become a member of one of the following North American clubs, and/or make use of their extensive reprints services.

International Radio Club of America (IRCA), c/o Ralph Sanserino, 11300 Magnolia #43, Riverside CA 92505 USA. IRCA Reprint service is c/o Steve Ratzlaff, 295 Pettis Avenue, Mountain View CA 94041 USA. Exclusively dedicated to Medium Wave DXing.

National Radio Club (NRC), P.O. Box 118, Poquonock, CT 06064 USA (subscriptions); P.O. Box 164, Mannsville, NY 13661-0164 USA (publications/reprints—Catalogue $1.00). Exclusively dedicated to Medium Wave DXing.

Ontario DX Association (ODXA), P.O. Box 161, Station 'A', Willowdale, Ontario M2N 5S8 Canada. Monthly column on International Medium Wave DXing, loggings from Ontario only.

THANK YOU!

This article would not have been possible, except for the relatively small group of avid MW DXers who continually report all of their loggings to their respective clubs. Thanks to all, and keep those reports coming! Also my appreciation goes out to Werner Funkenhauser, Harold Cones, David Clark, Nick Hall-Patch, Kevin Atkins, Fritz Mellberg and John Bryant for their helpful suggestions regarding the presentation and content.

"TUNING THE SHORT-WAVE BANDS" REVISITED: A 1991 INTERVIEW WITH HANK BENNETT

Harold Cones

I expect there are similarities in our shortwave stories. I was raised in the country, my family had little money and my wordly experiences were minimal. It was in the pre-Sputnik days and although my dad was an electrical engineer, the government had not yet learned to appreciate the discipline. Through my dad, I became interested in the mystery of electronics. To foster this interest, he presented me with an old military surplus receiver, a BC-312 M. It was big and it was ugly, but it tuned the shortwave broadcasters, and my life has never been the same. It only took a few minutes of shortwave and overnight my big bedroom closet was cleaned out to became a "radio shack." Only those that have ever experienced the thrill could understand the feeling that ran up my spine when I heard the chimes of Big Ben and realized that I was actually listening to London! That evening I left the farm and toured the world from my bedroom closet. Later, I discovered I could write letters to such exotic places as Peking, Moscow, Prague and Colombo; and, they would write back, sending letters covered with beautiful stamps and filled with pictures to stimulate my imagination. Through a new magazine, *Popular Electronics*, I found there were actually other people involved in "my" hobby. And when I received my WPE400 callsign, I felt part of a large fraternity that elevated me out of my rural setting and made me a part of the world.

I did not do this all alone. I had a wonderful teacher who came to my house once a month to visit me and explain such things as QSLing and receiver operation. Occasionally my teacher would tell me about a new shortwave station or other people in the hobby. Of great importance to me were the monthly loggings he brought, which allowed me, in my isolation, to learn what was being heard and on what frequencies. My teacher was Hank Bennett and he wrote "Tuning the Short-Wave Bands" (later to be called "Short-Wave Report") in *Popular Electronics*.

Hank Bennett wrote his first PE column in May 1955 and continued to instruct both the new and the experienced shortwave listener for 15 years, publishing his last column in August 1970. A number of recent surveys indicate that the average shortwave hobbyist is in his mid- to late 40s. This would suggest that a majority of us look to Hank Bennett as the man who started us and nursed us through the early days of our hobby.

Because I still use tube gear and have remained philosophically a 50's DXer, I was asked by *Proceedings* to investigate the possibility of an interview with Hank Bennett. I asked for an interview and my request was granted. The interview was conducted in February 1991.

I had the personal thrill of meeting Hank and his wife Amelia at the Fourth Annual Winter SWL Fest in Kulpsville, PA on 23 March 1991. The Bennetts had driven 45 minutes in the rain for this brief meeting and they were as bright and cheerful as Hank's old columns were. I found that the Bennetts work as a team—for example, Mea would get up at 1:30 AM, make coffee and hot chocolate, and she and Hank would listen to the Belgian Congo together (yes, you have my permission to show this sentence to your spouse!). Her answers to my questions convinced me that a Hank Bennett interview would not be complete without a few questions directed to Mea, and her answers are included here also.

I hope you enjoy this interview as much as I have enjoyed compiling it.

PROCEEDINGS: Would you please share a personal biography with us? Where are you from, what is (was) your profession? Wife? Children? Etc.?

MR. BENNETT: Both my wife, Amelia, and I are now rated as senior citizens, both of us being 66. She will be mentioned from time to time since she has been in this hobby with me since the day of our marriage in 1948. She is from Wyoming, Michigan; I am from Collingswood, New Jersey. We met through the good efforts of her brother with whom I worked in the middle of a cabbage patch in various areas of France as operators of a field radio station for the 250th Signal Operation Company, on detached service with the 13th Air Photo Group. We have two kids—Marion and her family live nearby; Jim and his family live in Terrytown, Louisiana. We have eight grandkids in all.

I left World War II service with qualifications as 776 (low speed operator), 766 (high speed operator) and 738 (intercept operator). I went in as a PVT, came out as a PFC. I went in at 140 pounds, came out at 144. Both weight and age have increased...

Well anyhow, upon leaving the service, I took a job as stock boy with the world renowned Franklin Institute in Philadelphia, who had considerable US Navy Research and Development contracts. I stayed as stock boy for one day. After that I became an electronic technician, as a result of being a licensed amateur radio operator (since 1941, as W2PNA and for a period later on, also as K8AVT). The job included constructing chassis per engineering orders and schematics. I stayed there for several years until I got fed up with the Philadelphia wage tax imposed on non-Philly residents, and took a job over here in New Jersey at Schaevitz Engineering, making and testing Linear Variable Differential Transformers and gradually working up to a supervisor that was too high to be in the union and too low in management to be in management. So in 1962 I dumped that and went to work as a letter carrier for the USPS, a job that I was to hold until my recent retirement after 28 years.

Amelia and I spent our honeymoon at a secluded little lake in the New York Adirondacks (we had intended to go on to Montreal but Caroga Lake proved to be too inviting); returned home, and shortly thereafter, Amelia went with me to Schaevitz where she became an AI coil winder and she kept on with this until kids started showing up. Meanwhile, we were in SWL and ham radio together. She never obtained her ham ticket but when it came to sitting up all night working the rig or tuning the dials she's right in there with me.

Gee. All of that for the first question. Hmmmm.

PROCEEDINGS: Now, could we hear about your hobby biography? How did Hank Bennett become a shortwave listener? How long have you been in the hobby? Who inspired you? Do you specialize in a specific geographic area? Do you collect QSL cards? Do you keep track of countries heard and verified (if you do, what are your current numbers?)? What do you consider your absolute best "catch?" What is your favorite QSL? How did you become involved in hobby journalism?

MR. BENNETT: How did I become an SWL? It might have made my parents mad at times but when I was a kid, my Dad used to listen to WJZ in New York, on 760 kcs. We were 90 miles from New York and 99 miles or so from Baltimore. WBAL was also on 760 and immediately following the WJZ station announcement, one could easily hear WBAL with their announcement. You understand that they were actually both in the same network so the station breaks were the only thing different in their programming, at least during prime evening hours.

So, if I could hear WBAL without any effort, what else could I hear somewhere other than on 760? I tried many other frequencies between station breaks and often found distant stations. One evening I nailed KOMO, Seattle, in the minute between Lowell Thomas and Amos 'n' Andy. Another goodie was "CJCB, Sydney". My Mom flipped over that one. I HAD AUSTRALIA!!! (Yeah, right.)

I must have been all of 8 or 9 years of age in that time period. Sooner or later I received a 5-tube Emerson receiver in a plastic case and I was off! That was actually my second receiver—I'll tell you about my FIRST one later.

Going back to WWII, during slack overnight periods or when weather prevented the Air boys from flying, we'd switch the BC342 (or whichever one we had at the time) to the BCB and pick up WINS, New York, and other stateside stations; the best catch in mid-France being KMOX, St. Louis, which was verified along with several others. I also received a QSL while in France from TAP, Ankara, Turkey, which caused a considerable number of raised eyebrows from those concerned who did nothing but censor mail.

As I have mentioned, I became licensed as a ham operator in 1942 when callsigns were being held up due to the war. Next year will be a half century for me as a ham. I suppose if you consider my earlier escapades on the BCB, I guess my total years as an SWL, in one way or another, would now total about 60 years.

Actually, no one person actually inspired me. As I've described a few paragraphs above, I inspired myself. This stuff of hearing distant stations was GREAT!

I have never specialized in any certain geographical area. And yes I did collect QSL cards for a long time until I became more heavily involved in writing and at that time, there just wasn't enough time to tend to QSLing. I still have all of my veries in scrapbooks, carefully stored. I cannot honestly tell you of my correct country totals heard or verified. As for my best catch (and veri) I would claim that to be W8XO, 700 kcs., Cincinnati; WLW's superpowered station (after midnight). Why? Here's where my FIRST receiver comes into being. This logging was done on a 1901 Westinghouse cats-whisker crystal set—no tubes, no batteries, no AC or DC; simply the cats whisker, a galena, a coil, an antenna, ground and a set of "cans" (earphones).

In modern times, or with more modern equipment, my best BCB catch would be KULA, in Hawaii. My best shortwave catch...*which is still yet to happen!* ...would be Radio Tahiti. I have also logged and veried a number of European BCB stations. As a shortwave editor for more years than I care to remember, my first love was—and is—BCB. One of my favorite QSLs was from XERA, Villa Acuna, Mexico, when they were running 250,000 watts, which was denied by many people, but I do have the QSL to prove it and one can still find a copy of that QSL in an old, old copy of RADEX. XERA was so strong that evenings it would block out local (15 miles) 50,000 watt KYW. My most interesting catch would have to be Radio Ceylon with their late evening (sunrise, their time) sitting up exercises with an announcer that often appeared to be three sheets in the wind. Or crocked. Use your own adjective. Hi!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Certified by:

Oliver P. Ferrell WPE2XZ
Editor, Popular Electronics

Hank Bennett, WPE2FT
Director of Monitor Station Registration

Another of our favorites for many years was the International Goodwill Station in Leopoldville, Belgian Congo, with their fabulous dark hours (our time) musical programs of waltzes and the like. We lost many sleeping hours to ORU!

I'm not sure that you asked but here's another answer anyhow and this is where I may be tooting my own whistle. Back in the late 30's and very early 40's, before I had my own ham ticket, I would listen to various hams locally on the 160 meter band, which would come in all over my little Emerson set on the BCB. I think I probably visited just about every one of the 40-odd hams in our town bothering heck out of them. One in particular, W3BWI, took me under his wing and helped me for hours and hours AND HOURS with the code. He taught me code, he taught me technical points, he even taught me the facts of life when my Dad suggested that I was staying at W3BEI's more than I was at home. W3BEI and I would work (and set up and take down) the public address system at our local high school football games. At one point, after I had flunked the FCC code exam for the fourth time, W3BEI took me in hand and crammed morse code at me until neither of us could see straight. I went the next day and passed.

Anyhow, I had received so much help from so many hams in our town, and so many spare parts and just general radio stuff, that I swore to myself that if I could ever get my license and get on the air, that I would spend the rest of life trying to help others who were new to the hobby. I have tried to do just that.

PROCEEDINGS: Do (did) your hobby activities have a positive influence on the other aspects of your career and life?

MR. BENNETT: Really, the only way that my hobby helped me while I was in electronics was one day when engineers at Schaevitz Engineering had something on their low frequency 'scope, and they asked me to try and identify it. It was a British CW station on 16 kcs but I cannot recall the callsign (GBY, GBZ, or something similar). They were transmitting a morse running marker at about 8 words per minute. This may not sound like much speed but for copying CW on a scope or by lights, 8 wpm is high speed.

PROCEEDINGS: It is said that through an editorial in the *Newark News Radio Club Bulletin* you were the spark that led to the start of the Association of North American Radio Clubs (ANARC). What events guided you to the concept of a cooperative club organization?

MR. BENNETT: Despite anything that has ever been printed in the past, the idea for ANARC was mine. I had been following for some time the activities of a combined union of European radio and SWL clubs and I was so impressed by what they were doing that it seemed like a good idea for North American clubs to try, since there was so much bickering and dissention among the clubs. After I had editorialized it in the NNRC, I asked Don Jensen if he would take on the chores of organizing what was to become ANARC. I was not a key member in it in any sense, nor was I asked to be, but it was my idea and my offer to Don to consider taking it over. He accepted and for a long time it seemed like it was working.

PROCEEDINGS: The Newark News Radio Club was one of the oldest clubs. When and how did you become involved with the club? What jobs did you hold? What led to the demise of the organization? Do you still see any of the "old gang" from the NNRC?

MR. BENNETT: The NNRC was one of the oldest clubs. Correction: it was THE oldest club; it was the pioneer of all radio and SWL clubs. Unfortunately, I do not have a copy of the club's history but it goes way back to one day when a group of hobbyists gathered in—I believe—the offices of the *Newark News* newspaper and opened operations. I became involved just after the WWII years (in fact I may have been a member before 1943 but I can't remember for sure). I began sending in reports and in 1948 I was asked to take over editorship of the shortwave column from James Hart, who wanted to retire from the writing chores but remain active in the operation of the club. I took it over on the condition that I could pick my own editorial assistant and as it turned out, Amelia and I became co-editors. She would handle the reports and a lot of the other administrative work and I would do the actual work of putting the reports onto stencils. In later years when the North Jersey group became too small to get the bulletin run off and mailed out each month, we offered to take it over. Amelia resigned as co-editor and was immediately appointed Vice President and Publisher, a job she was to hold until the club folded due to lack of funds and dwindling membership, as all clubs were then experiencing. We very rarely see any of the old gang anymore. Truth is, most of the old gang has passed on. Dick Labate, Irv Potts, Walt Townley, Les Kraemer, Bill Fallender, John Tweedie, Carl Lord, Harold Robinson, Dick Deneker, John Sanderson—I could go on and on. Still around are charter members Gene Bataille and Bob Koppelon, and subsequent member and officer Murray Buitekant, but there aren't many left otherwise, and certainly no one here in South Jersey other than Tom Sundstrom.

PROCEEDINGS: A mythical country, Nibi Nibi, was reported in your NNRC column in late 1958 or early 1959 (and, in fact, you published a disclaimer in your March 1959 Popular Electronics column). The whole thing became quite famous. What was your involvement with the great Nibi Nibi hoax?

MR. BENNETT: Nibi-Nibi. Ah yes. I was 'tooken in' with that one much like certain others. It didn't take long, however, to find the culprit and we immediately barred him from any further published DX activity. There isn't much else that I can tell you on that subject.

PROCEEDINGS: In your NNRC column, you always lamented that others were hearing Radio Tahiti but you had not heard it. Have you now heard it?

MR. BENNETT: Radio Tahiti. Yeh, right. No, I still haven't heard it. You'd think that if my 25 watt W2PNA could be heard and worked by LA7Y in Norway, I'd be able to hear Tahiti. Hasn't happened yet. Yet...

PROCEEDINGS: You had a dedicated core of reporters both at Newark News and at *Popular Electronics*—folks like Grady Ferguson and George Cox. Did you ever meet any of your more faithful reporters? Do you still correspond with any of them?

MR. BENNETT: I surely did have a good bunch of dependable reporters with me at NNRC (and at PE, too, for that matter, with most of them contributing to both columns). George Cox got married and forever dropped out of sight. Grady Ferguson is gone as are most of the others. John Beaver dropped me stone cold and I have never received any answer from him as to why. He was one of my best reporters but to this day he has never replied to any of my follow-up letters. While I rarely correspond with any of the remaining old-timers, I will surely answer them should they write in. I do, however, hear, increasingly, from old time WPE people that are returning to the hobby.

PROCEEDINGS: The hub of shortwave activity in the '50s was generally considered to be in Europe. What was going on in European clubs in the '50s that was special?

MR. BENNETT: I'm not really sure of anything special that was going on in clubs in that part of the world other than the fact they had a good bit more inter-club cooperation and friendship than was prevalent in North America.

PROCEEDINGS: What was happening with American club activity? Were most clubs national or were there lots of "local" clubs? Were you involved in other clubs, or the beginnings of other clubs?

MR. BENNETT: Yes, there were quite a number of North American clubs at one time. Let's see if I can recall—National Radio Club—BCB only. Far as I know, still in existence. United 49's DX Society—didn't last long. Grand National SWL Club—I believe Lavoyd Kuney, Detroit, was in that one. R9LL Listeners League—another quick one to start up and die out. Universal Radio DX Club, on the West Coast; for years one of our main competitors but operated by a one-man board who did a great job until he passed away. International Radio Monitors was one of the great ones but I can't really remember much about it or who operated it. Seems to me it may have been based in Utah. One other club, which is probably still in business, formed out of NNRC members in the Baltimore area and was headed by Reuben Dagold. I wrote for them until Dagold and lifelong friend Carroll Weyrich, and a few others, violently disapproved of my editorials defending one Glenn Hauser who was being verbally abused by his own club. I was thrown out and that probably put the lid on any further editorial work on my part.

PROCEEDINGS: When *Popular Electronics* started in October 1954, Ken Boord of *Radio-TV News* was the shortwave editor. In May 1955, the column was split, with you taking the shortwave broadcasting side of the hobby ("Tuning the Shortwave Bands") and Roger Legge taking the amateur side ("Touring with Roger Legge"). How did you come to replace Ken Boord? Did you continue your column in the Newark News Bulletin while you wrote for *Popular Electronics?* Did Ken Boord return to *Radio-TV News?*

MR. BENNETT: It was rumored that Ken Boord left *Popular Electronics* over a pay dispute. I was contacted probably because the Editor of PE was O. Perry Ferrell, who, in turn, was a NNRC member.

Yes, I continued writing for both NNRC and PE at the same time, using information interchangeably but in a different format. NNRC was by frequency and PE was by country. Later on, Wayne Green started up his own magazine in New Hampshire and he wanted me to write similar columns for him. That lasted only a very short time, however, and my work with him was just sort of terminated by agreement and in cordial form.

I almost forgot to mention that I have also written a number of columns for *Monitoring Times*.

PROCEEDINGS: Even though Newark News Radio Club's membership was international, there was a tradition of local meetings on the East Coast. Who were the usual attendees at these meetings and what went on at a typical meeting? Did the Newark News Radio Club take an active role in "shaping" the future of the hobby? How many people belonged to NNRC at its peak? Were most of them active?

MR. BENNETT: I began attending local NNRC meetings in 1948. They were held at homes of various officers, directors and, at times, members. We've been to meetings from central Connecticut to Eastern Pennsylvania, and several times to our home but for the most part the meetings were held within a few miles of the greater Newark, N.J. area. In later years we had a few meetings in Newark at one of the *Newark News* offices. There were also yearly conventions at various places.

Attendance was usually limited to officers and directors plus a scattering of appointed members but guests were cordially invited to attend any meeting. When the meetings were held in various homes, each person was asked to donate a couple of bucks each to help the host and hostess with refreshments and dinner. A typical Board meeting dinner consisted of ham, roast beef, turkey, salads, hot veggies, dessert, and literally no limit on drinks although NO ONE was ever known to drink to excess. We had Jews, Catholics, Protestants, a Quaker, and who knows what else and all in all it was the most cordial bunch of people that I've ever known. Events at a typical meeting generally pretty closely followed regular Parliamentary procedure. General attendance was from 15 to 25. How many people at its peak? Tough question—400-500 perhaps, maybe more. Surely seemed like many more when Amelia and I were running bulletins off, collating, folding, stuffing, sealing, and stamping! Several of the board members were active at the dials; some were not but had been in the past. Poor old Ben Feinstein, our secretary for many years, bought a brand new Super XXX receiver of some sort and it wasn't until a few months later when we met at his home that he learned—from us—where the AC on-off switch was.

PROCEEDINGS: The first offer of a WPE registration certificate appeared in the March 1959 *Popular Electronics*. Where did the idea for the WPE callsign/registration program come from? Who administered the program? How long did it last and how many certificates were issued? Why did the program stop? When did the WDX program start and who started it? How many WDX certificates were issued? I understand there was an earlier registration program than the WPE program. What do you know about this program?

MR. BENNETT: WPE-WDX. This first began by Joe P. Morris in Cleveland sometime before 1959; I can't come up with the date. His format was WRO (as opposed to WPE and WDX), I believe; anyhow he found that it became too much to handle and PE took it over (I do not know what was involved in the changeover) and they made it WPE for obvious reasons. They began publicizing it in the magazine and soon found out that they had a real hot one on their hands to the extent of having several members of the office staff in on overtime just to handle certificate requests. This overtime did not set well with the people that controlled the money and when I found out that it was to be dropped, I asked for and received permission to take it over. (Make that WE asked—Amelia and I). Since then (1970) we have issued *thousands* of certificates. Our main reasoning for continuing WDX was to make available to all hobbyists the opportunity to have their own individual radio identification, which would be similar to actual callsigns but still different enough to cause no conflict. Our program and identification was approved by FCC (although no one at FCC would probably admit it) and the only complaint that we've ever received was from several Canadian recipients who claimed their government was making inquiries about those illegal (?) callsigns appearing on our certificate envelope to them. We dropped our procedure of showing their identification on the outside envelope and nothing further has ever been heard on it.

PROCEEDINGS: In all your years in the hobby, other than being on the ham bands, and now, on CB, were you ever actually on the air from a broadcast station?

MR. BENNETT: Yes, I was. Once. At one time I was able to con one of the operators at local WKDN, 800 kcs, Camden, New Jersey, to put on a dark-hours test program for NNRC and anyone else listening. The name of the operator shall remain nameless because of his later heavy involvement with Radio Swan. We went on the air somewhere around 2:50 AM, and stayed on until 4 AM and encouraged listeners from the world over to call in and tell us that WKDN was being heard loud and clear.

We received one telephone call. The guy lived about two miles away in the shadow of the Camden-Philadelphia bridge. He was also irate, to put it mildly. His clock activator was set for WKDN's morning sign-on and we woke the poor guy up in the middle of the night. At least we succeeded. We received one phone call! That was my only experience in an actual on-the-air situation.

PROCEEDINGS: What do you see for the SWL/DX hobby in the future? What aspects of the hobby are in Hank Bennett's future?

MR. BENNETT: As for the future of the SWL/DX hobby, I wonder. Over the past years it has dropped down to the point where the clubs have really been hurting. More recently it shows, from where I stand, a slight increase. But for the most part I just don't see any real big interest such as there was 20 years ago. Sending reports and getting verifications is becoming a lost phase of the hobby. Simply exchanging SWL cards among others—a practice that was widespread years ago—is now virtually extinct. I personally feel that in the coming years there will be far less international broadcasting and virtually no reporting/verifying.

As for my future—I had and gave my best shot. I was on top of the editorial heap for far longer than I ever should have been (with total journalism training of zero), I wrote and had a book published, and I'm content to sit and watch the up and coming people have their turn. Glenn Hauser is probably top man in the hobby right now, but there is still plenty of room for people that want to get active and to operate clubs and to write articles and they should be given every chance to show their stuff, just as I was given the chance. For us, we're happy in continuing the WDX program.

PROCEEDINGS: Thank you, Hank. And now for Mea. You were much more than an "understanding spouse" when it came to Hank's hobby involvement. What was your personal involvement in the shortwave listening hobby? What are your views of the hobby, past, present and future?

MRS. BENNETT: I became interested in the hobby of Shortwave Listening and Ham Radio when Hank and I were going together in 1947-1948. I came east to visit him and his family and sit with him at his radio while he talked to other hams; we also listened to broadcasts from stations in many countries. It was very interesting. After we were married and settled in our home, we'd spend evenings spinning dials and Hank would tell me who we were hearing. Often times we would go to bed early, then get up in the middle of the night to listen to the very enjoyable dark-hours programs of music from ORU, the International Goodwill Station, in Leopoldville, Belgian Congo.

When the Newark News Radio Club asked Hank to have a go at the shortwave column to replace Jimmy Hart (who had his hands full with his own weekly shortwave column in the Sunday *Newark News*), he agreed on the condition that he could have me as his co-editor. We had a lot of fun putting the columns together each month. And we would be in frequent attendance at the monthly Board of Directors meetings which were usually held in the homes of the various officers and directors. I soon found out that radio families contained some of the nicest people that I have ever known. It was fun hearing about verifications, QSL cards, kilocycles, morse code, and the million other things that go into shortwave listening. Once a year we would host a Board meeting and we would have officers and directors in from Connecticut to Maryland. One year was most memorable—our home, at the time, was one block from our local firehouse. On the day of our meeting, our town hosted a humungous firemen's parade and there were fire trucks in from Podunk to Lower Japip. The poor guys (and ladies, too) who came to our meeting had to walk upwards of eight blocks to get around the fire trucks that were everywhere. We were also one block from a local church that played church music on their outdoor public address system every Saturday at 6 PM for a quarter hour. Our meeting was in the side yard of our home. Need I say more? The yearly meetings at our home did require a lot of advance preparation but this was greatly overcome by the many friendships that were resulted.

Then, when we took over the bulletin, much more time was involved in mimeographing, collating, folding, stuffing, sealing, weighing, and stamping, and, finally, mailing. I would spend a couple of days doing all the mimeographing and then we would all get together (daughter, son, scattered friends of the kids) and we could finish the job in one evening.

On the much more recent scene, we've just added two-way radio to our car in the form of CB radio. Oh, we've listened to the CB'ers many times but to be actually handed the mike and told to talk is an entirely new dimension of the hobby as far as I'm concerned. Our first contact was with a prospective ham operator in Runnemede, New Jersey who was obviously at the same point in the hobby as Hank was in 1939—just about ready to take the FCC ham radio examination. We wished him a lot of luck and he was most appreciative. This was, for me, virtually an entirely new experience, since it had been many years since Hank and I built a two-meter rig and yakked with the local guys—until the rig blew up. But to talk to someone while going up the highway is still a brand new experience for me—for both of us—and, well, you guessed it, we like it! If you should happen to hear someone with a handle of MAMA MEA or HANK THE CRANK it just might be us. (P.S.—we do encourage reception reports and we will QSL!)

Right at present it seems to be my opinion that many of the shortwave stations do not actually encourage reports from listeners to the extent that was the case in the past. A lot of stations have so-called "mailbag" programs and this enables them to get a good idea where their listeners are, and where their signal is going. Letters are answered on the air and this eliminates any need for sending out QSL cards. It would further seem to me that many stations have their own (paid?) monitors in various parts of the world, thus making reception reporting and QSLing a matter of courtesy rather than of necessity.

Nevertheless, there will probably always be stations that will continue to be interested in listener reports and keep a pile of QSL cards on hand for replies.

In closing, Hank reminded me that there was one form of verifying that became extinct many, many years ago. Back in the dark ages, probably the 1920's and perhaps into the early 30's, many stations verified with EKKO stamps. These were metallic stamps, about the size of postage stamps, that had the station call on it. These were, indeed, prized, and the only ones available today are those that may be in the hands of collectors. They were unique, indeed.

PROCEEDINGS: Thank you very much, Hank and Mea, for sharing your hobby and personal lives with us.

SHORTWAVE RADIO AS A TEACHING TOOL

Chuck Yarbrough

How many of us in the SWL/DXing hobby have dreamed of gaining official sanction for spreading the virtues and benefits of shortwave radio? How about getting paid to do it? Over the past several years I have been fortunate enough to do just this at Wingate College in Wingate, North Carolina, just southeast of Charlotte.

The following is my account of the trials, tribulations, and triumphs of teaching International Radio Broadcasting on the college level. I will also give you some suggestions on building your own shortwave radio course in a variety of educational environments.

COURSE DEVELOPMENT

Despite my academic training as a speech teacher, I do not apologize for my lack of 'official' schooling in the area of international broadcasting--many times the school of hard knocks is the best university anyway! I have never had any institutionally sanctioned courses in the area. However, I made International Broadcasting my research area since I am currently writing my dissertation on the uses of audience targeting in shortwave programming. Naturally when I came to Wingate College, I wanted to teach a course in my area of research, so I petitioned the administration. They approve a two credit seminar in International Broadcasting. This was quite a risk for the college, as we could not at that time find any officially sanctioned college level course on shortwave broadcasting upon which we could model our effort.

John Bryant, the well-known DXer and shortwave enthusiast, confirmed the results of my survey in my conversations with him before the beginning of the course. Sheldon Harvey did a 'not for credit' course in conjunction with the Canadian International DX Club and Radio Canada International, but his was the only syllabus from which I could draw. Since that first fall I have found that Professor Donald Browne at the University of Minnesota teaches several courses in International Broadcasting and Media. I will give some of his ideas later in the article. Stephen Canney also teaches some Shortwave Broadcasting courses in the evening in conjunction with Centennial College in Scarborough, Ontario.

I had read <u>Shortwave Radio Listening With the Experts</u>, edited by Gerry Dexter, and decided to break the semester roughly along the lines of the chapters in that book. The class met only one night a week for two hours, so the chapters gave me basic information on the major aspects of SWLing for each week. I had to do much outside research on each area in order to satisfy the standards which I set for the class.

I decided to use two books as texts, Harry Helms' <u>Shortwave Listening Handbook</u>, which is no longer in print, and Larry Magne's <u>Passport to World Band Radio: 1990</u>. If I were teaching the class now I would use Helms' new <u>Shortwave Listening Guidebook</u> instead of his earlier title. Both books provided much of the introductory material needed by the students, 97 percent of whom had never heard a shortwave radio broadcast. My classes were truly representative of the American public in that less than three percent listen to shortwave on a regular basis. As a longtime listener, this was one of the most difficult issues I had to confront. Not everyone is destined to become a 'dyed-in-the-wool' SWL/DXer. However, I am probably a great disappointment to my elementary school piano teacher as well!

The most difficult problem I had to solve before I could proceed with course development was, you guessed it, getting radios into the classroom. Our school had no shortwave receivers so I tried to get federal funding. Despite writing numerous governmental agencies and public officials, my pleas fell on deaf ears.

TIME LINE

The following is a listing of events, year by year.

NEW/DEPARTING STATIONS	STATION ACTIVITY	MISC.
1980:		
Africa #1	HCJB on 26020	Sony ICF-2001
R. Southwest Africa	Cape Verde 3930 introduced.	
Capital Radio, Transkei	Guinea Buissau 5474	Ozark Mt. DX Club
Antigua relay	Andorra 6215, 15045 starts	
UAE Radio	Maldives 4754	DX South Florida
WRNO	El Salvador 9553 starts	
hi-power for Lesotho	R. Lebanon 15170	
	Franceville, Gabon 4830	
	Sao Tome 4807	
	Polish Pathfinders 6195	
	Paraguay new on 9735	Vanuatu = New Hebrides
	Guinea with English on 15308	
	Afghanistan with English on 15077	
	Mexico & Tahiti have English	
1981:		
Swazi Music 6155	Not. del Cont. 9615	Rudy Espinal
Israel Defense 18128	Zanzibar 3339	Beijing=Peking
Luz y Vida, 3250	Pt.Noire, Congo 4843	Last Com World
Lebanon 6215	Mauritius 9709	NRD-515
Venceremos	Saudi Arabia with English on 11855	
LV de Mosquitia 4910	Falklands 2370	
R. Truro, South Africa 6155	Cook Islands on 11760	
Rumbo, Costa Rica 6078		
R. Triunfo, Ecuador 3252		
Pat. Chilena 6080		
BBC Lesotho		
Kiribati 16432		
Andorra gone		
R. Nat. del Continente, Costa Rica gone		
English svc from Chile gone		
1982:		
"Liberty"	Nac. Guat. EE 6180	Icom R-70
Atlantico del Sur	Somalia 6790	Pop Comm
KYOI	Lux, Honduras 4890	Loudenboomer
hi-power for Botswana	Comores 3331	USDXA
Consentida, Mex 18395	Citadelle, Haiti 6155	Falkland war
Maldives gone	Variedades, Hond. 6000	New 22 mb
	Valles del Tuy, Ven	Satellite feeds for BBC
	VOFC via WYFR	ACE is new
	Libya in English	
	Nacional Guatemala 9760, 6180	
	R. Nacional, Peru bombed off the air	
	New Caledonia English 7170, 11710	
	Bassacongo, Angola 4885	
1983:		
Miskut 6920	Sudan 11938	White's R. Log
Parakou, Benin 5025	Nac. Ven. 11695	Grenada war
Moundou, Chad 5290	Falklands 3958	R-2000

future of international radio in the "developed world??" Many think so...

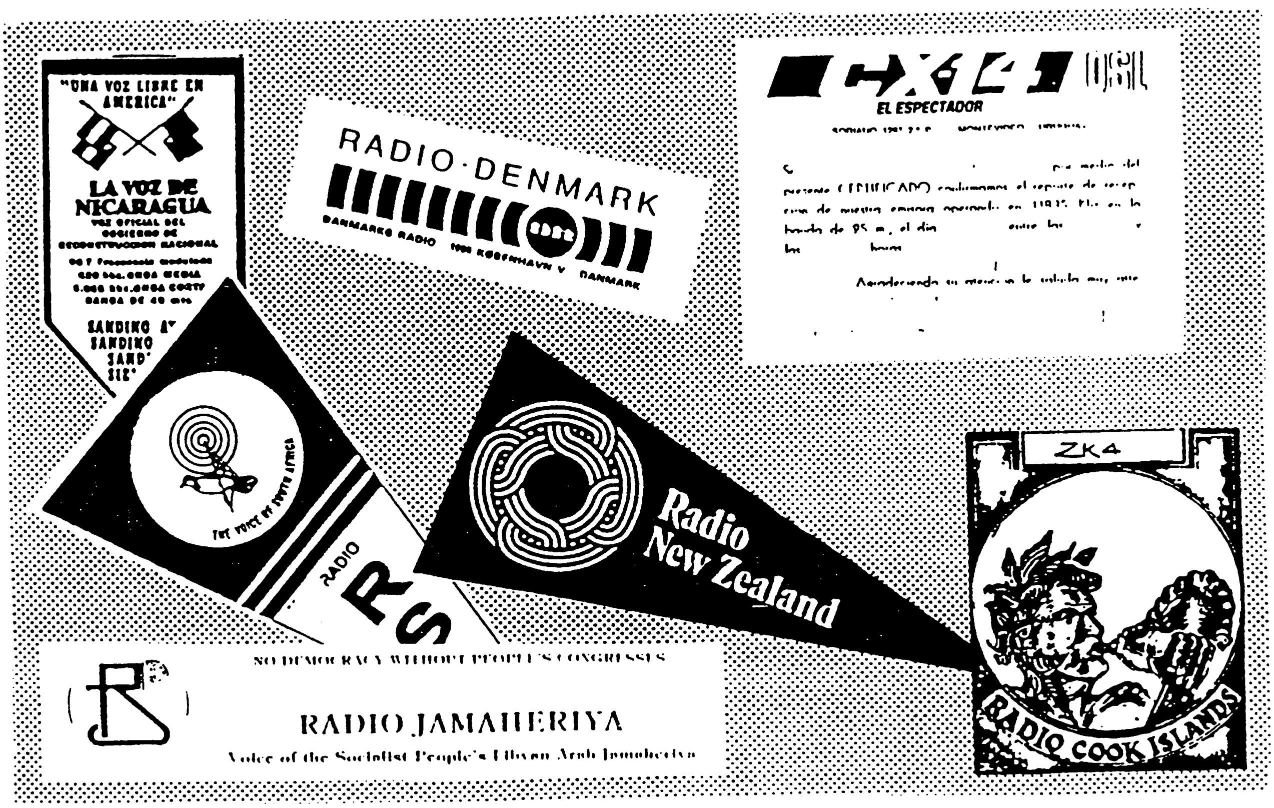
What of international broadcasting directed to the large populations of the emerging world? Some predict direct radio broadcasting from satellites to inexpensive PORTABLE radios. Others predict a shift of the majors to single side band transmission. Many in the hobby expect neither of these, but do see more satellite-based transmitters swapping and satellite feeds to local AM and FM broadcasters in target countries. No one really knows the answers, but the 1990s WILL be different.

And finally, whether receiving technology? At the end of the decade, it seemed that the industry had thoroughly refined the PLL, synchronous detection, selectable SSB and digital read out technologies introduced at the start of the 1980's. Three areas seem to shine brightly in our crystal ball: A) Receivers designed to process normal analogue signals in a totally digital domain B) Receivers or peripheral equipment which uses speech recognition and other sophisticated signal processing software to finally eliminate all natural and man made noise from weak signal reception C) Total receiver automation. Will these technologies create the next 2010 or 525? Or can we dare think that they might be in the next Drake or Collins??

For those of us actively monitoring shortwave broadcast radio, throughout the 1980's, one thing is crystal clear: Shortwave broadcasting, as seen by hobbyists, is an amazingly accurate reflection of life as it is being lived in its countries of origin. SWBC programming is an excellent mirror of its producers whether they be local commercial stations in the Andes or strident and heavily controlled propaganda broadcasters from the remaining totalitarian regimes in the world. To the experienced listener, the technical quality and extent of service of shortwave broadcasting from a country is also an indicator of quality of life of the citizens of that area. Whether it be the deteriorating poorly modulated signals from an area struggling to deal with the difficulties for modern life or the wall-to-wall local strength signal sent our way via satellite by prosperous "developed" countries, each speaks clearly of its origins. The difference between the two signals speaks to us each, as well.

If the tumultuous years of 1988 and 1989 in Asia, Eastern Europe, Africa and Latin America are Precursors, the 1990s are almost sure to be an era of rapid change. Events in Eastern Europe, Africa and Asia in 1989 called into question the fundamental organization of whole societies. In Latin America and the Pacific borders and the definition of nationhood are not in question but systems of government and economic life continue to be a source of strife and change.

Those of us privileged to enjoy SWBC, a truly unique window on the world, will most surely find the 1990s fascinating!



rienced hobbyists who often made the news that they then edited.

John Bryant of Stillwater, OK, was a member of OMDC who joined the newly formed FT staff in 1986, heading up the Special Publications department. Special Publications produced DXers maps, Latin DXing guides, and a very comprehensive Indonesian list and guide book. However, Special Pubs real accomplishment was *Proceedings*. First published in 1988, FT's *Proceedings* has become a hobby institution. Proceedings is a collection of in-depth articles published annually written by and for experienced DXers. The book has become established thanks to the hard work of Bryant and the Proceedings staff—Dave Clark, Kevin Atkins and Guy Atkins to name a few.

John Bryant was the perfect person for the job of Chief Editor of Proceedings. His background both professionally and in the hobby prepared him well for the task. His approach to the hobby was much like his professional life as an Architecture Professor at OSU—scholarly. John set about to learn as much as he could about his DX targets, such as China and Indonesia, and about antennas and propagation. By 1987 when *Proceedings* kicked off, he was like a well seasoned Chief Editor ready to tackle a big project.

The newsletter Numero Uno, passed an incredible milestone during the 1980s, one unmatched in hobby history. Don Jensen completed 20 years and 1000 continuous issues of NU as editor/publisher. During those 20 years NU always provided the latest news. Don is probably the most experienced hobbyist of the time. Besides NU, his other projects included a monthly segment on Radio Canada International named "Don Jensen's Journal," and a shortwave column in Popular Electronics. Don was also primary editor for Communications World and wrote an excellent shortwave column in Elementary Electronics. Don handed the reigns of NU over to John Herkimer soon after the 20th anniversary issue.

Other newsletters that were active internationally in the '80s were PLAY-DX, published by Dario Monferini of Italy, QTH Africa, Union of Asian Dxers from Sri Lanka, and SW Bulletin from Sweden.

PEOPLE

Beginning in the mid 80's, the Committee to Preserve Radio Verifications (CPRV), with Jerry Berg as Chairperson, offered a vital service to the hobby: preserving QSL collections. These collections represent the history of the hobby and of broadcasting itself. They also represent a lifetime of work for the individuals who collected them. CPRV preserved thousands of cards that can now be enjoyed by others. Finding these collections involved much detective work, especially when some of the collections dated from the 1920s and 1930s. CPRV also provides a service that helps hobbyists informally will their collections to the organization.

Lovers of Latin American DX were delighted by the highly detailed and comprehensive reports submitted by Juan Carlos Codina. He was an embassy official living in Lima, Peru and operated an NRD-515. As might be expected, his native tongue was Spanish. Fortunately for many of us, he was also very fluent in English. With the ever increasing number of new Peruvians and Bolivians coming on the air, Codina kept the hobby world up to date on that confusing situation. The familiar "JCC" credit graced many a bulletin in the early and mid 1980s. In the latter '80s, he left Lima for an embassy assignment in Switzerland and then disappeared from the hobby limelight. Other notable sources for news from Latin America were Emilio Pedro Povrzenic and Gabriel Ivan Barrera of Argentina and Rogildo Fontenelle Aragao, from Bolivia.

Two North American shortwave listeners moved to overseas listening posts and provided a considerable amount of information from their respective regions. Gerry Bishop, who was in the military, moved to the Philippines. From this location Gerry provided newsbreaking information on Asian stations. While there, he even managed to log and QSL Bhutan.

Don Moore spent time in Honduras as a Peace Corps volunteer and traveled Central and South America extensively, all the while sending reports faithfully to hobby bulletins. His reports picked up where Codina left off. While visiting hundreds of stations throughout Latin America, Don coaxed rare QSLs out of some shortwave stations for other Norte Americano DXers. Were it not for Don's generous efforts, these beauties would probably still be in the bottom of a drawer at some remote station in Peru or Bolivia. Don's approach to the station visit was courteous and he became the hobby's good-will ambassador to Latin America.

In Germany a young enthusiastic DXer named Bernhard Gruendl became prominent in the Danish Shortwave Clubs International (DSWCI). Bernhard was a confirmed Tropical Band enthusiast and soon began editing the club's famous Tropical Band Survey, or "TBS," as well as the loggings section of the DSWCI bulletin. Bernhard filled hobby bulletins worldwide with many useful reports for several years. He died tragically in a car accident in the summer of 1991.

Other very active Europeans: German DXer, Roland Schulze, was quite active throughout most of the decade and sent reports to several clubs and Finn Krone of Denmark and several other Scandinavians did likewise.

Gordon Darling, a former BBC Monitoring Service employee, moved from the UK to the exotic country of

Communications World—ceased publication. This was a real loss for the hobby and a noticeable journalistic void existed for sometime afterwards. Both magazines featured articles and columns by hobbyists such as Don Jensen, Gerry Dexter, Ralph Perry and C.M. Stanbury II.

In 1982, *Popular Communications* hit the magazine racks to fill this void. It, too, presented several hobbyists as writers. Pop Comm was a true "slick" magazine with many photos and a professional format. At first it concentrated mostly on shortwave but later included scanners, satellite and para-military themes.

Two existing publications, one owned by Larry Miller and the other by Bob Grove, merged in 1986 into what was then called *Monitoring Times*. MT gradually gained in popularity and appearance, moving from a newspaper style to a true magazine format. The magazine was a success and the dominant commercial publication at the close of the decade. Many hobbyists were happy to see the return of the famous *Popular Electronics* in 1989, especially with Don Jensen as editor of a shortwave column. Shortwave now had even more representation at the public magazine racks.

Gerry Dexter launched Tiare a unique commercial venture, in the mid '80s. Tiare Publications developed and marketed books specifically targeted to the SWL. Some of Tiare's releases are now part of the backbone of any serious listeners's library. The Language Lab series, written in Spanish, French, Portuguese and Indonesian was a revolutionary new aid for the shortwave QSLer. This series of books allowed the DXer to create and write personal letters to stations in four different languages. Also for the QSLer, was the "bible" of QSLing—*Secrets to Successful QSLing*, drawing on Gerry's many years of experience. The largest undertaking for people involved in Tiare was actually published by Sams books. This was the huge indepth handbook *Shortwave Radio Listening with the Experts*.

The shortwave mail-order business really flourished during the 1980s. The big three in the US were Gilfer Shortwave, Park Ridge, NJ, Universal Shortwave, Reynoldsburg, OH, and Electronic Equipment Bank, Vienna, Va. Their catalogs got fatter and fatter with more receivers, books and peripheral equipment offered each year. Gilfer was the old-timer in the business, but Universal and EEB became large businesses rather quickly. Universal had Fred Osterman, a hobbyist himself, who did a good job of catering to the shortwave clubs and individuals. Universal's catalog became "must" reading in the SWBC and utility DXing hobbies.

THE CLUBS

MONTHLY BULLETINS

Almost as dramatic as the change in receiver technology was the change in the hobby clubs during the 1980's. Many clubs and organizations declined in membership and several experienced hobbyists "retired" in the early '80s, leaving a void. Many who had been active in the '60s and '70s just dropped away and became inactive.

The hobby demographics also "grayed" rapidly. In the '80's there was no large pool of young, enthusiastic DXers to shoulder the load as editor's or in club management. It became more likely that a new member in a club may be 35-45 years old and quietly returning to a hobby he knew when in high school. This "new" member more than likely would have a Sony portable and many would not be interested in intense hobby activity. Many pundits have surmised that kids turned to computers and video games rather than radios in the 80's. Whether or not that is true, one thing was evident: the number of young members dwindled considerably. This trend was evident not only in North America, but also in Europe and Japan.

The new shortwave listener members were often a different breed, falling somewhere between serious DXers and program listeners. They were less interested than the old guard in the weak, noisy Tropical Band stations but they did enjoy the DX up on the International Bands when conditions were good. These new people often weren't interested in day-in and day-out program listening either, but were attracted by the news and commentary available on shortwave bands. This interest often seemed to focus on the current news hotspot in the world.

With this new makeup, fewer members seemed interested in club formalities. The motivation to send in pages of written loggings to bulletins, or to understand the cryptic jargon printed in bulletins was not strong. The downturn in club participation was widespread. Many clubs saw hundreds of members drop, and the oldest club in North America—the Newark News Radio Club—went out of business entirely in the early 80s.

One club, however, very skillfully weathered the downturn and actually managed to prosper. The Ontario DX Association (ODXA) of Canada was well led by Harold Sellers, Ron Hopkins and Dave Clark, ODXA saw the need for change early-on and reacted accordingly, concentrating ODXA services on the personal side of the hobby. Many local or regional events held that strengthened the spirit of comradery. ODXAns were also good business managers, raising money for the club and investing it in club equipment and other improvements. ODXA was the first major club to adopt total desktop publishing, which produced a professional graphic look. The ODXA's membership increased while virtually others decreased.

World DX Club, of England, also was a club emphasizing a personal and friendly approach to the hobby. They were cooperative with other organizations, and survived the '80s nicely. Arthur Ward was an excellent repremarket.

The first real competition for the main Sony Portables didn't come until 1984 when Radio Shack introduced the DX-400 (also sold by Uniden as the CR-2021). Its performance was respectable, but it was priced too close to the Sony to achieve a significant market share.

The last round of the shortwave portable war took place in 1986. As Sony updated to the 2010, a newcomer to the market, Sangean of Taiwan, came out with the ATS-803. Radio Shack marketed the same receiver under the name DX-440. For about $200 one could obtain very good performance, small size and many features. With the advent of the Sangean 803, many people asked—"do I really want a 2010 so bad that I'm willing to pay $150-$200 more for it than for the Sangean or DX-440. This receiver was the first real "hit" for Radio Shack since the DX-160 back in the '70s. Sangean continued to introduce new portables with an astounding 9 models offered simultaneously by 1989.

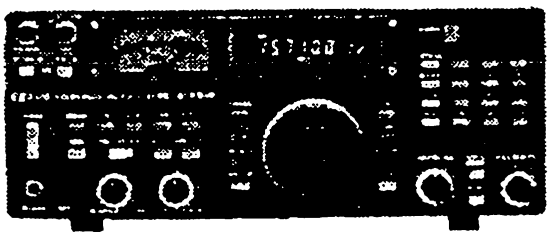
TABLE-TOPS

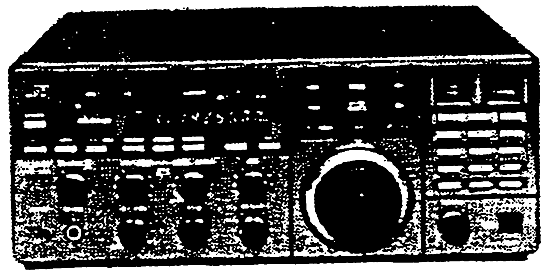
In 1980, the Drake R-7A dominated the upper end of the table-top receiver market. The R-7A is still considered one of the best general coverage receivers ever produced and it offered most of the latest advances in receiver technology desired by the discriminating listener DXer. It was the first of the "under $2000" super radios. Although the R-7A was popular, and is now one of the best buys on the used market, The almost $2000 price was steep enough to keep it from widespread use. Along came the Japanese. They were able to design and market a receiver with performance characteristics similar to the R-7A, for about half the price.

During the '80s three major Japanese shortwave manufacturers dominated the table-top market—Icom, Kenwood and Japan Radio Company (JRC). Icom's first entry into the general coverage market was a home run. The new IC-R70, which borrowed from the receiver section of one of Icom's transceivers, was one of the most popular major receivers of the decade. It offered high performance and sold for as little as $575 in 1983. The R-70 was the ICF-2001 of the table-top market, and soon was the most often mentioned radio in the contributors' pages of club bulletins around the world. The R-70 boasted good sensitivity, good stock selectivity, microprocessor control feature, and other useful extras like a notch filter and passband tuning. One measure of a receiver's popularity, strangely, is the amount of interest shown in modifying it. Many articles and tips were written on all sorts of mods to the R-70.

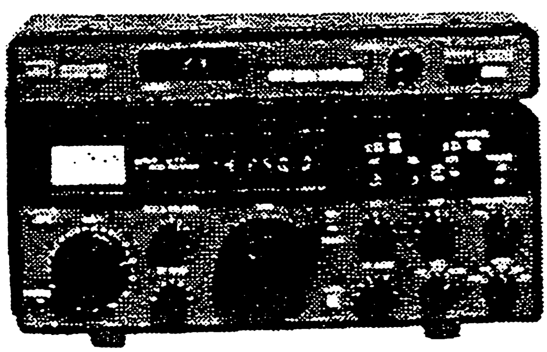
Kenwood's R-1000 was popular in 1980, but lacked the latest gadgets such as keypad entry and memory channels. Soon after the R-70 was released, Kenwood responded with the R-2000. It was a nice looking receiver with many of the new features DXers had now come to expect.

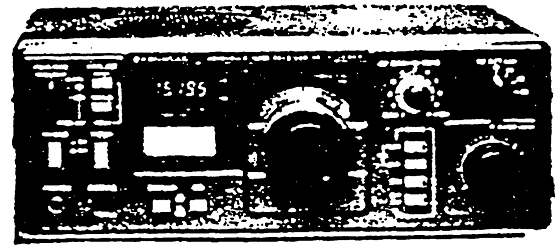
Japan Radio Company has long been known for producing high quality, high performance receivers and continued to do just that in '80s. In 1981 they brought out the NRD-515, a ruggedly built and reliable 'top of the market' receiver. It came out too early to take advantage of microprocessor keypad features, but had all of the other performance features that a serious listener needed. Its operation was smooth as silk and each control had the feel of quality. The 'top of the market' price tag coupled with now outdated technology caused the 519 to give way to Icom and Kenwood by 1983 or so.





Clockwise from upper left: Icom R71-A, JRC NRD525, Kenwood R1000, JRC NRD515 (with memory unit).





event, arranged by John Ekwall of Sweden, allowed SWBC listeners to hear the country of Gambia on shortwave again. Gambia had left shortwave several years earlier. British and US government funding provided shortwave upgrade's for Lesotho and Botswana, making these two countries much easier to hear on the air. French and other foreign aid also allowed the governments of several countries to upgrade their national SWBC stations. These included Chad, Burkina Faso, Senegal and Niger. The BBC established a new relay station on the Seychelles in the Indian Ocean and a US foreign aid grant funded the Liberian Rural Communications Network, which included several low-powered shortwave broadcast stations.

SATELLITES AND RELAYS

Since the early 1960s many broadcasting experts have predicted that satellites would soon reduce the need for traditional forms of shortwave radio broadcasting. This reduced reliance on the SWBC medium would most likely come about as international broadcasters employed satellites as a point-to-point relays to ground based medium wave or FM networks in the target countries. Some experts also foresaw direct broadcasting from satellites to relatively unsophisticated portable radio receivers. This rather futuristic view did not appear to come any closer to real as the 1980s unfolded. However, the 80's did witness greatly increased reliance on satellites as feeders for the major broadcasters. During the 80s, satellites were used more often to accomplish that task, although shortwave feeders from the VOA and BBC were still easy to find at the close of the decade. Also, the AFRTS left shortwave in favor of satellite feeds to their overseas stations. Satellite TV dish owners and cable TV subscribers could, at times, find BBC and DW shortwave audio on sub carrier cable audio channels. This programming was being picked off the satellite by astute cable companies with the same equipment that they used to receive HBO and other cable TV services. Swapping transmitters and transmitter time between major broadcasters was also greatly facilitated by the use of satellite feeds.

Shortwave, however, still remained an extremely cost effective way to broadcast over great distances to large audiences. This was true throughout the 1980's. Many developing nations could not afford satellite technology and continued to be served by shortwave. It is yet to be seen how fully direct satellite broadcasting will be integrated into international radio broadcasting services.

PIRATES

Shortwave pirate activity varied widely during the 80's, especially in the US. In general, the level of pirate broadcasting tracked directly with the sunspot activity. At the sunspot peak, the pirate bands were very active every Saturday night. Many of these broadcasters simply ran an unrehearsed format of rock music and chatter and were, at best, unprofessional. However, a few pirates did offer well produced and entertaining programs. Some of these were Syncom 48, Voice of the Voyageur, Voice of Laryngitis and Jolly Roger Radio. One pirate, Radio New York International, made national headlines when it was busted live on TV aboard its rusty ship just off the East Coast of the US.

Three European pirates made regular showings in North America. They were Radio Dublin, Ireland, Weekend Music Radio, Scotland and Radio Caroline based on a ship off the coast of England.

All of this pirate activity spawned a specialized monthly bulletin published in the US which was dedicated to pirate and clandestine stations. The Association of Clandestine Enthusiasts (ACE) had several hundred members at peak of pirate activity.

QSLING

The art and science of QSLing became increasingly more difficult and expensive in the 1980's. This was due in large part to a worsening economic situation in the Third World. The area where this trend was most evident was Latin America. Economies there suffered greatly, throughout the 80's with soaring inflation rates in many countries. This great difficulty put answering reception reports low on the list of local broadcasting station priorities. To complicate things further, a number of stations received more rude and demanding reports from listeners than in the past.

Again, due to inflation, Mint stamps, long enclosed with reception reports as return postage became practically useless in Latin America. The high rate of inflation the stamps would devalue the stamps even as they were being mailed to the station. The US $1 became the most popular form of return postage for stations in Latin America, especially.

Some ever more cost conscious major broadcasters also became less reliable QSLers. Radio Canada and several european stations virtually eliminated this traditional element of the listener—station relationship.

Beyond Latin America and some of the majors, the picture was much brighter. The large number of stations in Papua New Guinea and Indonesia were not only exotic DX targets, but they most often provided exotic QSLs as well. This reasonably reliable pattern extended almost uniformly across the Pacific and Asia as well as most of Europe.

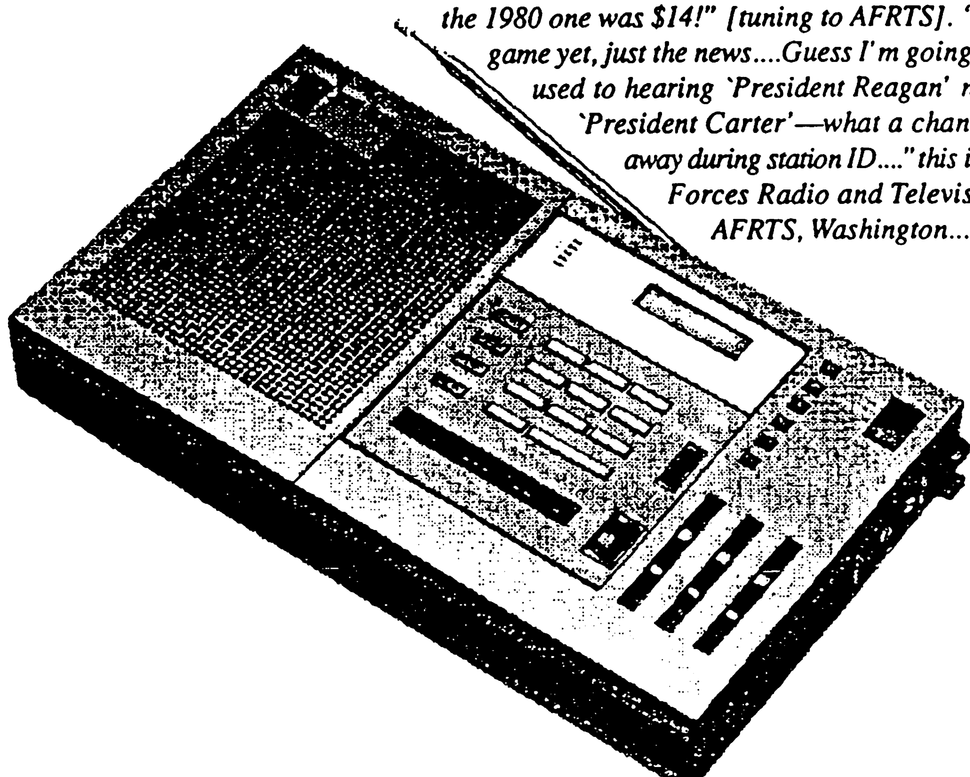
Flashback to November, 1980:

*A shortwave listener at the dials of a brand new Sony ICF-2001. His or her thoughts while tuning the bands—"I still can't get used to just watching the digits zip by as I tune around; I miss seeing the dial pointer tremendously. On the other hand, I don't have to fool around any more with those *!#@ charts or guessing at the frequency. Talk about easy! Lets see, I think I'll start at the top end of 19 meters." [the radio is tuned by the 'slewing' buttons]. "What a mess! Those Soviet jammers are everywhere, blocking every Radio Free Europe and Radio Liberty outlet up here." [more tuning]*

"Hey, what's this? Rough accented English....oops, there's Brezhnev in Russian fading up in the background; I should of guessed! So, it's Radio Moscow or an Eastern European presenting the propaganda of the day." [more tuning]. "There's the Radio Peking interval signal, not news but it's always interesting to realize what a long haul from China that broadcast makes...It's 2100 GMT, guess I could check for AWR—Andorra on 15045, I sure need to finally send a reception report to Andorra." [more tuning] "Oh, wait! I can catch the obituaries on Radio Free Grenada after the 2100 news! I think that's 15050 kHz. I can get the Andorra reception report another day." [more tuning]

[30 minutes later]. "Think I'll check for the new United Arab Emirates Station mentioned on DX Jukebox the other nite." [more tuning] "Well, no luck, they must still be testing. I can check the experimental HCJB transmitter on 26020 to see how propagation is doing. That may be part of the problem."

[A few minutes later]. "Things are pretty slow, guess I'll park on AFRTS, listen to a ballgame and finish reading my Communications World." [Rummaging around the desk while tuning]. "Oh, there's my order from for the 1981 WRTH. Wonder how much more it'll cost me this year—the 1980 one was $14!" [tuning to AFRTS]. "Well, no ballgame yet, just the news....Guess I'm going to have to get used to hearing 'President Reagan' now instead of 'President Carter'—what a change." [we fade away during station ID...." this is the American Forces Radio and Television Service—AFRTS, Washington....]



SHORTWAVE BROADCASTING IN THE 1980s
A HOBBY PERSPECTIVE

Mitch Sams

EDITOR'S FOREWORD

As the editorial team began to finalize plans for Proceedings 1990, one of us had the wonderful idea to publish a record of shortwave broadcasting in the '80s as seen from the perspective of the hobby listener/DXer. As we cast about for a suitable author, Mitch Sams' name kept coming up. Mitch was one of the most active SWBC DXers throughout the '80s, was one of the founders of Ozark Mountain DX Club, and was a guiding hand in the modern incarnation of our own parent organization, fine tuning.

We approached Mitch with our idea of publishing a record of the 1980s. He agreed with alacrity and went right to work. In retrospect, none of us realized how difficult a task we had set for him. Writing the history of the immediate past must surely be one of the most arduous writing challenges of all—every reader is an expert in the subject, and the events being discussed are often still unfolding.

Mitch did a tremendous amount of research in the next 6 months and submitted his article for the 1990 edition. Unfortunately, neither we nor Mitch felt it to be the mix of scholarship, romance and factual record that we all wished to create. We all agreed to postpone publication until 1991. Mitch very willingly cast his net wider, sought input from a number of leading DXers in North America and abroad and virtually started over.

The history that you are about to read is the result of an unbelievable amount of work by Mitch with help from many others. We hope that you will agree that this article is an excellent record of the 1980s and a real contribution to the documentation of this avocation we all love. Thank you very much, Mitch.

John H. Bryant for the Proceedings '91 Staff

INTRODUCTION

Technological advances in shortwave receiver design introduced during the 1980s had a profound impact on the media and the hobby itself. Affordable, high performance, easy to operate, portable digital readout receivers changed listening habits and put shortwave at the fingertips of casual DXers and listeners alike. People who never had an interest in racks of gear and hours of tuning the noisy bands became involved in shortwave listening during the 1980's. For hobby clubs, the arrival of high quality photo-reduction copy machines and early versions of desk top publishing software fostered major improvements in the graphic design and in the legibility of most club bulletins. In some clubs, editors and contributors communicated via computer modem or Fax, radically shortening reporting lag time and accelerating the flow of information.

With the arrival of home computers, hobby software was used by many to make serious listening a bit more organized and efficient. Graphically oriented grayline and propagation predictors became popular with listeners. Radio schedule databases became available that contained hundreds of station schedules which could be easily and quickly updated. By the late 1980's several major receivers offered computer interfaces. This innovation made it possible for listeners to download schedules directly into the radio's memory. Home computer-based word processing also served to reduce the time required to produce reception reports and follow ups.

The decade of the 1980's produced many exciting moments for listeners. Political upheaval was monitored first hand on shortwave from Nicaragua and El Salvador, whose civil wars played out over the airwaves during most of the decade. Iran and Iraq fought each other not only with guns, rockets, and bombs but also with shortwave jamming and propaganda. At the close of the decade, the science of jamming suffered an almost fatal setback as a strange silence fell over the bands when the Soviet Union shutdown it's huge arsenal of jammers. Simultaneously, Eastern Block countries freed themselves from Moscow's control one by one, their stations changed format, sometimes their names and interval signals and even began to criticize the former communist leaders. On three separate occasions shortwave listeners were the first to know that a Soviet president had died. When Brezhnev, Andropov and Chernenko each died while in office, Radio Moscow played uninterrupted somber music and then finally made the announcement make this unprecedented statement on international shortwave radio. He was quickly replaced at Radio Beijing, although his recorded statement was mysteriously repeated during the 0400 broadcast.

The hardline Chinese leaders did not back down from their new/old strategy of suppression in spite of almost world-wide condemnation of their behavior. The denunciation of the leadership on Radio Beijing was the first and last effective public defiance heard from the inside China to protest the massacre. A clandestine station called Radio Democracy developed from this event.

DEMOCRATIZATION OF EASTERN EUROPE

At the beginning of 1989, a very historic process began. The collapse of Soviet influence in Eastern Europe in early 1989 and the thawing of the Cold War had immediate impact on shortwave broadcasting from Central and Eastern Europe. When Soviet jamming, long a major presence on the bands, stopped, listeners were very surprised. The Soviets possessed the largest network of shortwave jammers in history. As the decade closed, USSR officials were dismantling or converting the entire jamming network to peace time uses. Optimism for peace ran so high in Europe at the close of the decade that some political leaders questioned the continued need for US-funded operations like Radio Free Europe and Radio Liberty. By 1990, it looked as if their days were numbered.

As the Berlin wall fell at the end of the year and the rest of Eastern Europe broke from the Soviet grip, shortwave broadcasters in the region quickly reacted. Programming, station titles, and even the interval signals were changed. Programming was much more open now, with a wide variety of viewpoints replacing the numbing saneness of 'the Party Line.' Most stations even began to criticize the communist governments and openly call for withdrawal of Soviet troops. Radio Prague reverted to the interval signal used before World War II.

CIVIL STRIFE IN CENTRAL AMERICA

In Nicaragua and El Salvador, bloody guerilla wars continued. These conflicts were very prominent on shortwave, with several long-lived clandestine broadcasters operating throughout the '80s. It was an interesting time; it was fairly common to find two or three of these stations every night on out-of-band frequencies in the 5, 6 or 7 MHz regions.

Radio Venceremos was one of the most widely heard El Salvadoran clandestines, and happily for country counting listeners, it did broadcast from inside El Salvador. For most of the decade, this was the only way for SWBC DXers to hear El Salvador. Radio Farabundo Marti was another El Salvadoran clandestine that was widely reported.

Radio Quince de Septembre and La Voz de Sandino were clandestine shortwave broadcasters that were directed against the Nicaraguan government. LV de Sandino sounded like a rag-tag operation while Quince seemed much more "professional." Later when Nicuaraguan president Ortega was voted out of office, most of these clandestine operations went silent.

Also there were several anti-Castro stations on the air during the 1980's: R. Libertad Cubana, La Voz de Alpha 66, La Voz del CID, and La Voz de la Junta Patriotica Cubana. Most were run by expatriot organizations based in Miami. "Commandante David" was often heard on these stations, and sometimes even appeared on national TV network news in the US. At one time, La Voz del CID was openly relayed by Radio Clarin a long time licensed station in the Dominican Republic.

The US Reagan administration managed to push through the funding for an anti-Castro shortwave broadcaster based in south Florida. Radio Marti came on the air with programming intended to catch the attention of the average Cuban and to provide them with the US viewpoint on matters affecting Cuba. The station was named after one of Cuba's most celebrated national heroes. However, the initial response from listener's was not good and much of the programming was not well produced. After correcting some of these problems, the station remained on the air despite continuing criticism.

with a slick Rock and Roll format and numerous commercials. The programming was produced in Los Angeles and was in Japanese. A third US shortwave broadcaster tried commercial rock and roll as well; they were issued the call letters KUSW and were located in Salt Lake City, Utah. It looked as if the commercialization of US shortwave had finally succeeded. At one point, WRNO even sold shortwave converters for the car.

Reality soon intervened, however. All three stations found trans-national marketing and audience verification almost impossibly difficult. Thus, they each had great difficulty attracting substantial sponsors. Both KYOI and KUSW experienced financial difficulties and were eventually sold to religious broadcasters. WRNO produced fewer and fewer shortwave segments, relying more on the simulcast of their FM station. They also sold airtime to religious organizations to help pay bills.

It seemed that the only groups that had the money and the motivation to use privately owned US-based shortwave were the religious broadcaster. The list of new religious stations is long: WMLK, KCBI, WWCR, KVOH and WHRI to name just a few. Two new religious shortwavers located on the US Territory of Guam—one a FEBC station, the other an Adventist World Radio station. Another bright spot for listeners was KNLS which was established in Anchor Point, Alaska and produced another new radio country for SWBC DXer types.

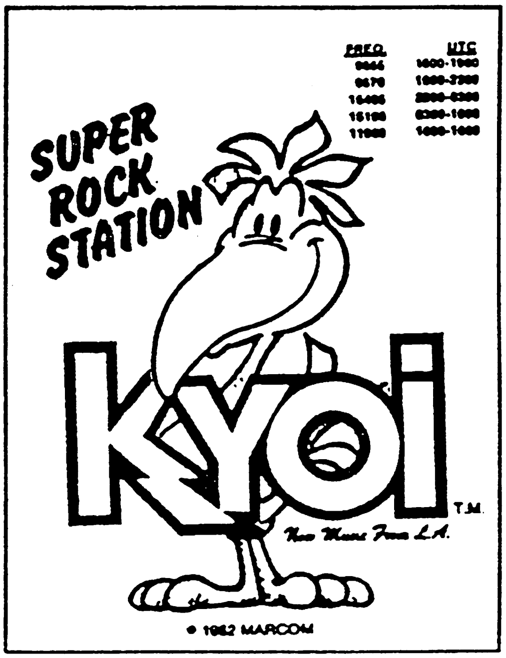
There was one new religious broadcaster that gained widespread listenership. It was the new Christian Science Monitor station, WCSN, from Scott's Corner, Maine. In keeping with the Christian Science tradition of excellent news coverage, WCSN soon rivaled the VOA for comprehensive, quality news of world affairs.

The strangest new US broadcaster, though, was the one that never was. NDXE, of Opelika, Alabama promised many spectacular new firsts for shortwave, including stereo shortwave broadcasts! The ever-hopeful owner managed to market license plates, t-shirts, and other memorabilia and even placed a full page ad in the WRTH. The enterprising Alabamian accomplished all of this without ever going on the air, or even owning a transmitter. Apparently things had never been completely in place for the station to become licensed and for construction to begin; NDXE quietly disappeared at mid-decade.

VOICES FROM THE PACIFIC

The economic growth and increased development of the Pacific countries fostered several new shortwave stations and new radio countries during the 1980's. Shortwave was well suited for the region since great broadcast distances and widely scattered audiences were the norm. Somewhat like Africa in the '60s, the 1980's saw some island groups gain nationhood, with some even developing to the point of sponsoring shortwave outlets. Kiribati made use of a point-to-point feeder as a shortwave broadcast station. At first there was some controversy in the hobby as to whether general broadcasting was really what the station intended. This was a vital point for those hobbyists following the NASWA Country List; NASWA only recognizes reception from SW broadcasters. To the relief of all concerned, Radio Kiribati later confirmed that the station was serving dually as a point-to-point utility relaying programs to a remote AM station while simultaneously serving outlying island listeners directly as a broadcaster.

Radio Cook Islands became a bit easier for DXers to hear when they moved up to the 25 meter band and with increased power. After being flooded by QSL requests, they nearly quit QSLing all together. The Marshall Islands surprised everybody by suddenly appearing on 60 meters one night. WSZO had local flavor and was enjoyed by all who heard their unique programs. Equipment problems and leadership changes at the station later lead to erratic operation and virtual closure of the shortwave service by decade end. Yet another exotic new radio country was established for SWBCers when Radio Tonga took to the airwaves on 5030 kHz.



Papua New Guinea is a country, like Indonesia, India, China and Peru, which makes extensive use of shortwave radio networking to blanket the country. Most of Papua New Guinea's twenty-odd provincial stations moved from the 120 meter band up to 90 meters during the decade. By 1990, more than half of the stations received new Japanese NEC 10 kilowatt transmitters as part of the growing Japanese foreign aid program in the Pacific. These new units upgraded the worn out and poorly maintained mostly 4 kilowatt units left behind by the Australian administration at the time of national independence in the early 1970s. Only Radio Enga remained behind on the 120 meter band.

Many thought that Fiji had returned to the SWBC ranks when the University of the South Pacific began broadcasting law classes over an out-of-band transmitter. After a very hopeful investigation by

COURSE EVALUATION

Overall the first course was a success. I now had a firmly established set of activities and procedures which aided in operating the listening post. The students also began to interest other students in shortwave radio and in the opinions carried in the broadcasts. An example of this newfound tolerance and willingness to listen to other views is easily seen in the student's attitudes toward Radio South Africa. In January 1990, when students came across the Radio RSA broadcasts, they were almost angry at the station. Their only reaction, besides a startled facial expression, was to turn to the next available frequency--anywhere except Johannesburg. Neither I nor the college endorse the views of the South African government, but the students learned how to listen and appreciate views with which they fundamentally disagreed. Students now voluntarily tune to controversial radio stations. In the case of Radio RSA, during Nelson Mandela's release several students came in especially to tune into the station for its live account of the event. This change took place in less than two months time.

There were several indications that this first course was successful. First, the level of geographical knowledge the students gained during was greatly enhanced by the radio class and listening. I tested the students on the first night of class as to their geographical knowledge and the results were quite startling. Ten percent of the students did not know where Canada was--now they beg to get into the post to listen to "As It Happens", broadcast over Radio Canada International. Thirty-five percent did not know where Australia was--now they seek out Radio Australia as well as Radio New Zealand. Radio Havana is a favorite for the jazz programs, but the jazz and latin rhythms of RadioBras was a real treat for them, propagation conditions permitting. My students are not significantly different than other students of the same age group, so I think that any group of students could gain increased geographical knowledge from using shortwave radio. It is important to provide a world map for student use while they are listening to the radio. My classroom had a map located on the wall directly above the radios.

Secondly, the number of students who bought their own shortwave radios indicates that the course had some effect on them. College student budgets are notoriously small, and the expense involved in buying even the least expensive models represents a major expense. However, in that first seminar I had no less than eight students who told me they bought their own radios! Lets see, how many nights 'on the town' would that buy....?! In the semesters since that first course, our local Radio Shack has not been able to keep shortwave radios in stock. In the two months following the course, figures from the local store manager showed that 15 DX-440s were sold. Until that time, he said that the same radios had been on the shelf for about nine months. Obviously this may not be directly attributable to the class, but it is quite a coincidence.

Harlan Seyfer, who teaches English at Tsinghua University in Beijing, China says that students in his classes usually find no problem in getting access to a SW radio. Most of them have access to receivers. The hardware store on campus even stocks radios for the students. His experiences with students buying their own radios parallels my own in that many do get them, thereby reducing the load on the radios which the school provides. Let's face facts, most schools will not provide SW radios for students.

There is a mass media theory called "The Two-Step Flow of Communication". Most SW broadcasters use this as a determinant of their success. The theory states that when communicating any information, there are two distinct groups you should aim for. First, the people who actually receive the information are called "Opinion Leaders". These people are in turn looked to as information sources by the second group, the "masses". The importance of this theory is that it emphasizes that as a broadcaster you do not have to be heard by everyone. Perhaps if you are heard by 10 percent, that is as effective as trying to get total penetration of a media market. This is a traditional definition of success for international broadcasters. By the same token, when you are teaching it is important to realize that whatever course you teach in shortwave, you actually are teaching many times that many people through your students.

This phenomenon was evident at Wingate as the course was declared a success by the college administration due to the good enrollment the following semester. Through a clerical error in the registrar's office the International Radio course which was to be offered the following semester was inadvertently left off the course offerings sheet. Despite this fact, the class again filled to capacity! In this second class I only had two students who had attended my first class, so there were a total of 58 students who had been exposed to shortwave in the first two semesters. This would not be uncommon at a large, state-supported university, but Wingate has a student population of 1300.

Week Eight: Utilities; VHF/UHF Monitoring.

Helms Chpt. 8

--As a utility buff, I like to expose my students to the non-broadcast stations. I bring in decoding equipment and the bulk of the evening is spent with them attempting to learn what the different utility modes sound like and how to tune the simple ones.

Week Nine: Amateur Radio.

Helms Chpt. 9

--I usually have a local amateur radio operator in as a guest lecturer for this class. Morse Code, license classes, MARS, emergency services, and other ham specialties are covered in the session.

Week Ten: Clandestine and Pirate Monitoring.

Helms Chpt. 10

--I open the session with a brief history of clandestine broadcasting, its purposes, its results, what types there are, and what clandestine stations they may be able to hear. I then explain the differences between clandestine stations and pirate stations. I then show the video, Inside Pirate Radio, and conclude with a brief talk on the ethics of radio broadcasting.

Week Eleven: Medium Wave Monitoring.

Helms Chpt. 9

--The intricacies of monitoring mediumwave (AM) broadcast band radio stations are discussed. The differences between shortwave, longwave, FM, and mediumwave stations are discussed and clear channel stations are tuned and logged.

Week Twelve: Regulatory Organizations and Their Laws.

--Various national and international regulatory agencies are examined. The effects of ITU and FCC laws on international broadcasters are the central focus of this lecture.

Week Thirteen: Legal Aspects of Monitoring Radio Communications.

--United States communication laws which affect the radio listener are examined. Issues discussed include: what can I report to a club bulletin?; what can I tell my friends?; why can't I start my own press service with information I hear on the radio? Potential penalties for breaking disclosure laws are also outlined.

Week Fourteen: **TEST TWO**

--The final exam for the class.

Week Fifteen: **The Competition.**

--A high pressure, station count activity which tests the students' ability to tune, listen, identify, and log as many stations as they can in a 15 minute period.

PATTERN FOR EACH CLASS:

The class sessions are divided into a first and second half. During the first half lectures and group discussions are held, tests will be taken, and other activities which are appropriate to the 'traditional' classroom are held as well. The second half of each class consists of actual 'hands on' radio monitoring. The student is responsible for working with a team to accomplish the task for that particular monitoring session. While the majority of my students were able to have access to a shortwave receiver, there were not enough to go around. My solution to this problem was to provide cassette tapes of stations within their particular region for them to listen to. After a period of time the groups switched between the radios and the tapes, so everyone had a chance to listen to SW. Actually I find that taping specific radio broadcasts provides several advantages to listening to SW. First, not all SW broadcast stations within a particular geographical region are available during classtime, so "tape delaying" the broadcasts works very well. Second, having tapes available also helps reduce the number of students surrounding each radio.

minimum of 35 stations logged. A special Wingate College Monitoring Post monitoring form is used to log the stations. After these sheets are returned to the students, they can be mailed to the station as reception reports.

TERM PROJECT

The term project is a 5-10 page paper, as described in the "Requirements for the Class" in the syllabus. This paper is a summary statement of each student's experiences as a shortwave radio monitor during the semester. Also, the student is expected to act as an international relations analyst. To do this he or she must draw upon their knowledge of the events of the past semester as they recall them from previous research as well as their monitoring activities during the semester.

'THE COMPETITION'

On the final night of class, every monitoring group competes in a stressful and extremely fun competition. Each group is ranked, based on the total number of stations logged for each individual in each group throughout the semester. (ie. Jane has 17 loggings, Paul has 40, and Jeanne has 75--the total for the group would be 132.) All groups are then "seeded" in order of group logging totals. (ie. Group One has 198 stations logged, Group Seven has 180, Group Three has 175, etc.)

Each group would then compete against another group in a round-robin tournament to see which group can log the most stations in a 15-minute period. If you have nine different groups, like I did, then you might give the top ranked group a "bye" in the first round. If there is a tie between the two groups at the end of the period, the total number of countries logged (rather than stations) is used to determine the winner.

There are four rounds, each involving a 15-minute contest, or until all groups except one are eliminated. Prizes are given to each member of the winning monitoring team. Those people will also be entered into the "DX Hall of Fame" so that other would-be DXers can stand in awe in future classes! Believe it or not I usually finish a complete tournament within the confines of a two-hour class period.

HOW CAN YOU GET INVOLVED?

I provide these excerpts from my course to give you some ideas in course development for your special courses you may teach. There are many opportunities to teach shortwave radio to an eager audience. Your local community college, radio clubs, civic groups, scout groups, as well as simply placing an ad in the paper for a special seminar are all ways that you can get in the shortwave education business as well. All it takes is a little 'boning up' on some of those topics you may not be familiar with.

There is one maxim of education that I have found to be absolutely true--YOU DON'T TRULY LEARN A SUBJECT UNTIL YOU HAVE TO TEACH IT! So don't let the "I don't know enough..." idea get in your way.

So far in this article I have been concentrating on shortwave as a teaching tool on the collegiate level. You probably are not a college professor. How can radio be used in primary and secondary schools? Miles Mustoe has written an excellent workbook for using shortwave in the primary school classroom. Not only does he explain the process of shortwave broadcasting, but he provides almost 50 different exercises which are appropriate for elementary and junior high school students. If you are a teacher, or if you are thinking about conducting a seminar on the subject, get Miles' book.

What if you are a high school teacher? Are there any resources out there for you? I haven't been able to find any specifically targeted at the high school audience, but there are a few applications that I have either done for local high schools or could do if I were asked. First, if you are a foreign language teacher, there is probably a shortwave station broadcasting in your language. Make a tape recording of an interesting program in the language and then get your students to attempt to translate it. You will probably have to give them quite a bit of help, but many language teachers have found that a radio broadcast provides more student motivation than a packaged educational tape. Record music in your language and have the student try and translate the song.

Probably the most common educational use of SW in the classroom is in foreign language laboratories both on the high school and college levels. In fact, some national governments mandate that school of "what I like to do in my spare time" type stuff. Make the most of these opportunities. Let's face it, most people have never even heard a SW broadcast. ANYTHING you tell them, no matter how basic, will be new to them. Whats even more important, you are EXCITED about your topic. As a speech teacher I often tell my classes, "There are no boring topics only boring TREATMENTS of those topics!" Your excitement will make your audience want to know more! Go ahead, be a resource person.

Other examples of these one-shot deals are speaking to various civic or church groups, working with the local Scout Troop in helping the boys and girls get their "Communications" merit badge, your local Parks and Recreation Department often will offer "Saturday morning college" where a one or two hour presentation would be appropriate, and many more. Don't stop there! Try offering a course at your local VO-TECH or community college in SW radio. Conduct a class in the nearest Elderhostel program. Offer your services to schools (both high school and university) as someone who would be willing to speak to groups on campus in their student development lecture series. It is important to remember that volunteers are always welcome. Anyone who has ever tried to set up a meeting knows the difficulty in getting speaker!

Perhaps we are focusing too much on the "formal" definition of education. The oldest form of education is that of the mentor and student. Go down to your local Radio Shack or electronics store and give them your name as a "local radio expert", a person to whom they can send customers with questions about the big bad world of SW radio. Volunteer to assemble a display case in your local town hall or high school on SW radio. The important thing is to make yourself visible to as many people as possible. You will find that your "students" will come to you. Granted this may be a bit of a bother, but just remember how you felt when that that old "Elmer" told you the secrets of the radio universe!

OTHER APPROACHES TO SHORTWAVE IN THE CLASSROOM

While my first attempt at teaching international broadcasting was a fairly simple one, there are other ways of teaching international broadcasting on a more advanced level. I have also taught a course in Comparative Media Systems in which I used shortwave as a "lab" to illustrate the different types of broadcasting systems which can be found in different nations.

I have also used shortwave radio in my Intercultural Communication classes when I talk about 'national cultures' and how they differ. In this case I let the class listen to about 15 minutes of a Radio Moscow broadcast and have each student list everything that sounds strange or unusual to them. We then go over these in class and try to see how United States culture differs from Soviet culture.

Several other universities use shortwave in their courses. Professor John Buckley, a teacher of Speech Communication at the University of Tennessee, uses shortwave broadcast content as examples of propaganda in his Theories of Persuasion courses. Dr. Donald Browne, professor and chairman of the Department of Speech Communication at the University of Minnesota, teaches three different courses in international broadcasting. His courses include, 'International Broadcasting', 'Comparative Broadcast Systems', and 'Broadcasting and National Development'. From his latest syllabi, Browne's courses look quite rigorous but quite interesting as well. There are other courses which explore the world of shortwave radio I am sure, but these are the ones of which I have personal knowledge.

The question will no doubt already be ringing in your head, 'This is great that you have radios in your class, but I don't have access to them for my classes'. No problem! Both Professors Buckley and Browne use audio tapes of broadcasts for their class listening projects. In fact, in Browne's International Broadcasting class he requires his students to complete a listening exercise. His students use a tape of a VOA broadcast and a Radio Moscow broadcast to compare the two broadcasters in the areas of program production and broadcast content. His students then write a paper comparing and contrasting the two broadcast styles. So, you don't need a radio for everyone in your class. Your receiver at home and a tape recorder will do!

Don Moore, who in addition to writing for Monitoring Times and NASWA teaches English as a Second Language at Ferris State University in Michigan, uses audio tapes extensively in his classes. He writes,

> "An option for those using tapes would be to put them in the school's cassette language lab. I direct the lab here at Ferris State which is used by International students studying English and Americans studying foreign languages. Adding tapes....of non-dated general SW programs to be used

Wingate College
Radio Monitoring

Wingate, North Carolina 28174
(704) 233-8189

Monitor: ____________________

Station: ____________________

Freq.: ____________________

Page ________ Of ________

Time UTC	Counter Number	SINPO	Program Details	Comments

1988:

KUSW
VO Pujiang, China 3990
Or Sor, Thailand 6148
LV del Rio Arauca, Col. 4895
BBC Seychelles
VO Mediterranean,
MaltaContinental, Ven. 4939
Kossuth R., Hungary 6025
R. Kekchi, Guatemala 4845
Italian R. Relay Svc 7160
Hargeisa, Falklands, AFRTS,
FEN Japan gone.

Nat. Unity, Sudan 9435
Ngia Binh, S. Viet 4797
RTV Hong Kong 7290
Togo 7265
Chad 7121
Burkina Faso 7230
2 MHz N. Koreans move to 3 MHz
Switzerland via Gabon
U. of S. Pacific 9070
Canada via Japan

1st Winter Fest
PROCEEDINGS

1989:

Mundial, Ven. 5049
Tonga 5030
Andaman Isls, India 4760
AIR-Shillong, India 3255
WSHB, WWCR, KHBI
KJES Vado, New Mexico
Clube do Angra, Azores 13585
R. Caroline, KYOI gone

Bukavu, Zaire 4846
Sierra Leone 3316
WMR, Scotland 15045
Bhutan on new 5023
Jordan gets high power
Mauritania 7244.8
R. Norte, Dom. Rep. 4800
Em. Meridiano 70, Colombia 4925
Ecos del Atrato, Colombia 5025
Garoua, Cameroon 7240 ex-5010

Pop Electronics
Soviet jamming ceases
Zeller's "Pirate R. Directory'

CREDITS:

In addition to the Proceedings review panel I would like to thank the following individuals for their inputs: Joe Farley, Sheryl Paszkiewicz, Jerry Berg, Peter Bunn, Aurthur Ward, George Zeller, Don Jensen, Bill Matthews, John Bryant, Guy Atkins and Don Moore.

Thanks to Kevin Atkins and John Bryant for providing finishing touches and seeing this project through to the end.

In Memory

Oliver Perry Ferrel. Head of Gilfer shortwave, and a hobbyist himself. He died in an Easter morning car accident in 1984. His wife Jeanne carried on the Gilfer business.

Alan Roth. A well liked DXer who was active during the '70s died in 1986.

Ron Schatz. Of Florida. Well known Cuban broadcast expert, died in 1988.

Mac Leonhardt. Former executive director of NASWA. Died March 2nd, 1988.

Larry Brookwell. President of the San Diego Dxers Club and an excellent equipment reviewer.

C. M. Stanbury II. An accomplished author and tropical band DXer. Some of his work appeared in "Elementary Electronics".

Marge Witte. Accomplished Asian DXer, from California. Active in SPEEDX died in 1989.

SWBC TRANSMITTER SITE LOCATIONS
AFRICA, ASIA, EUROPE, OCEANIA

FT Staff

The exact geographic location of shortwave broadcast transmitter sites is becoming increasingly important to radio hobbyists. One main driving factor for this change is the proliferation of PC compatible software now available that will find To/From Azimuthal Bearings, Sunrise/Sunset Times and Grayline Targets. Other sophisticated mapping programs such as Geoclock, DX Aid and DX Edge also require this information. Unfortunately, each of these programs also seems to require the geographical coordinants in a slightly different format. Our database is set up with the following conventions:

East Longitude is Plus
North Latitude is Plus
West Longitude is Minus
South Latitude is Minus
Fractions of a degree are in **DECIMAL**, not minutes and seconds

The other major reasons to compile and publish this database relate to the differing way of counting radio countries. Country counting is an arcane science with many differing points of view and is far too complex to explore here. There are at least four different listings of 'radio countries' in use by radio listening hobbyists throughout the world. We understand that the most widely used list is that of the North American Shortwave Association (NASWA). Since most of our readers are familiar with that list, the NASWA approach to radio country organization has guided our work.

We have sorted the databases printed here ALPHABETICALLY BY NASWA COUNTRY and by SITE NAME within each NASWA country. The NASWA country list is based on country names as they existed in 1945, although newer names are present in some cases. Because NASWA is a club that specializes only in shortwave *broadcast* radio, the NASWA Country List only recognizes countries from which shortwave *broadcasting* has taken place.

The other radio country list included in the database is that of the European DX Council. The EDXC is an umbrella organization encompassing many different forms of the radio listening hobby. Therefore, the EDXC list contains a few countries not recognized by the NASWA list. These countries are in the database at the end of the lists of each continent. The fact that there is no corresponding NASWA country is acknowledged by placing asterisks (****) in the NASWA column.

You will also note that NASWA fragments some 'real' countries into several radio countries while the EDXC listing does not often do so. The classic example of the policy is Indonesia. EXDC recognizes only one country, congruent to the modern political entity of Indonesia. NASWA recognizes the major islands and groupings as eight separate radio countries: Sumatra, Java, Bali, Lesser Sunda Islands (Nusa Tenggara), Borneo (Kalimantan), Celebese Is. (Sulawesi), Molucca Is. (Maluku), Netherlands New Guinea (Irian Jaya). Each of these approaches is reflected in databases.

We hope that users will find these databases a useful guide as to which transmitter sites are located in which radio country. We also hope that the listings will serve as a useful conversion table between the two most widely used radio country lists, those of NASWA and EDXC. If you are unfamiliar with the NASWA Country List, you may find that accessing the list from the right hand side (via the EDXC name) is easier.

The remainder of the databases, North and South America, are currently being developed by FT Staff. As any DXer of Latin Station knows, that is an arduous task. Those two remaining databases will be published in Fine Tuning's Proceedings 1992.

We have worked very hard to make these lists as complete and error-free as possible. However, this is a very complex endeavor, prone to human error and the SWBC scene changes almost daily. We are sure that a few errors, both of omission and commission exist in these databases. If you note significant errors, we would really appreciate it if you could drop us a note so that we may publish an accurate correction sheet in Proceeding 1992. Please drop us a note in care of John Bryant, Rt. 5, Box 14, Stillwater, OK, USA 74074.

Copies of the NASWA Country List and Awards Program are available for $2.00 from Bill Oliver, Publisher, 45 Wildflower Road, Levittown, PA, 19057, USA

Copies of the EDXC Country list are available from EDXC along with a number of other publications. Send 2 IRC's for more information to EDXC, P.O. Box 4, St. Ives, Huntingdon, PE17 4FE, England

fine tuning's

SHORTWAVE BROADCAST STATION TRANSMITER SITES

A*F*R*I*C*A

NASWA COUNTRY	SITE NAME	LAT.	LON.	EDXC COUNTRY	STATE/PROV
A-E Sudan(Sudan)	Omdurman	15.63	32.50	Sudan	
Algeria	Algiers	37.00	6.00	Algeria	
Angola	Benguela	-12.58	13.42	Angola	Benguela
Angola	Cabinda	-5.55	12.20	Cabinda	Cabinda
Angola	Huambo	-12.72	15.78	Angola	Huambo
Angola	Kuito	-12.50	17.25	Angola	Bie
Angola	Lobito	-12.33	13.56	Angola	Benguela
Angola	Luanda	-9.00	14.00	Angola	Luanda
Angola	Lubango	-14.92	13.50	Angola	Huila
Angola	M'BanzaKongo	-6.27	14.25	Angola	Zaire
Angola	Menongue	-14.60	17.80	Angola	Kuando-Kuang
Angola	Moxico	-13.00	20.50	Angola	Moxico
Angola	N'Dalatando	-9.23	14.90	Angola	Kuanza-Norte
Angola	Saurimo	-9.64	20.40	Angola	Lunda-Sul
Angola	Uige	-7.50	15.10	Angola	Uige
Ascension Is.	Ascension Is	-7.95	-14.35	Ascension Is	
Azores	Azores	28.00	-38.50	Azores(Euro)	
Basutoland(Leso)	Maseru	-29.38	27.50	Lesotho	
Bechuanaland(Bo)	Gaborone	-23.00	25.50	Botswana	
Bel.Co.(Katanga)	Lubumbashi	-11.66	27.47	Zaire	Katanga
BelgianCongo(Za)	Bukavu	-2.50	28.87	Zaire	Bukavu
BelgianCongo(Za)	Bunia	1.56	30.25	Zaire	Haut
BelgianCongo(Za)	Kananga	-5.90	22.42	Zaire	Kasia Occidente
BelgianCongo(Za)	Kinshasa	-5.50	15.50	Zaire	Kinshasa
BelgianCongo(Za)	Mbandaka	0.07	18.27	Zaire	Equateur
BelgianCongo(Za)	Mbuji-Mayi	-6.15	23.64	Zaire	Kasai Oriente
Br. Somaliland	Hargeisa	9.55	44.05	Somalia	
Canary Is.	Tenerife	28.31	-16.56	Canary Is.	
Cape Verde	Cape Verde	16.00	-24.00	Cape Verde	
Comoros (F.I.R.)	Moroni	-11.68	43.27	Comoros Repu	
Comoros(Mayotte)	Dzaoudzi	-12.69	45.27	Mayotte	
Egypt	Cairo	30.00	32.00	Egypt	
Ethiopia	Addis Ababa	9.00	38.00	Ethiopia	
F.E.A.(CentAfRe)	Bangui	4.00	18.00	Cent.African	
F.E.A.(Chad)	Moundou	8.58	16.27	Chad	
F.E.A.(Chad)	N'djamena	12.11	15.05	Chad	
F.E.A.(Gabon)	Libreville	5.00	9.50	Gabon	
F.E.A.(PRCongo)	Brazzaville	-5.00	15.00	Congo	
F.E.A.(PRCongo)	Pointe Noire	-4.80	11.86	Congo	
F.Morocco(Moroc)	Rabat	34.00	-7.00	Morocco	
F.W.A.(Benin)	Cotonu	6.35	2.58	Benin	
F.W.A.(Benin)	Parakou	9.33	2.63	Benin	
F.W.A.(Burkina)	Ouagadougu	12.50	-2.00	Burkina Faso	
F.W.A.(Guinea)	Conakry	9.50	-13.50	Guinea	
F.W.A.(Ivory Co)	Abidjan	6.00	-4.50	Ivory Coast	
F.W.A.(Mali)	Bamako	13.00	-8.00	Mali	
F.W.A.(Mauritan)	Nouakchott	18.00	-16.00	Mauritania	
F.W.A.(Niger)	Naimey	14.00	3.00	Niger	
F.W.A.(Senegal)	Dakar	14.50	-17.00	Senegal	
F.W.A.(Senegal)	Tambacounda	13.78	-13.66	Senegal	
F.W.A.(Senegal)	Ziguinchor	12.58	-16.27	Senegal	
FSomaliland (Dj)	Djibouti	11.50	43.00	Djibouti	

fine tuning's

SHORTWAVE BROADCAST STATION TRANSMITER SITES

A*S*I*A

NASWA COUNTRY	SITE NAME	LAT.	LON.	EDXC COUNTRY	STATE/PROV
Abu Dhabi (UAE)	Abu Dhabi	24.40	54.28	U.A.E.	
Aden (YeminiRep)	Aden	12.83	45.05	Southern Yem	
Afganistan	Kabul	34.50	69.17	Afganistan	
Andaman&Nicobar	Port Blair	12.00	92.50	Andaman & Ni	
Armenian SSR	Yerevan	40.18	44.50	Soviet Union	
Asiatic RSFSR	Anadyr	64.75	177.50	Soviet Union	Magadan Oblast
Asiatic RSFSR	Birobidzhan	48.80	132.95	Soviet Union	Khabarovsk K.
Asiatic RSFSR	Blagoveshcen	50.33	127.60	Soviet Union	Amur Oblast
Asiatic RSFSR	Chanty-Mansi	61.00	69.10	Soviet Union	Tyumen Oblast
Asiatic RSFSR	Chita	52.05	113.50	Soviet Union	Chita Oblast
Asiatic RSFSR	Irkutsk	52.30	104.25	Soviet Union	Irkutsk Oblast
Asiatic RSFSR	Khabarovsk	48.00	140.00	Soviet Union	Khabarovsk K.
Asiatic RSFSR	Komsomolsk	50.00	138.00	Soviet Union	Khabarovsk K.
Asiatic RSFSR	Krasnojarsk	56.02	92.83	Soviet Union	Krasnojarsk
Asiatic RSFSR	Kyzyl	51.73	97.48	Soviet Union	Tuva ASSR
Asiatic RSFSR	Magadan	60.00	152.00	Soviet Union	Magadan Oblast
Asiatic RSFSR	Novosibirsk	55.07	83.08	Soviet Union	Novosibirsk
Asiatic RSFSR	Palana	59.12	159.96	Soviet Union	Kamchatka Obl
Asiatic RSFSR	Petropavlovs	52.00	158.00	Soviet Union	Kamchatka Obl
Asiatic RSFSR	T'umen'	57.15	65.55	Soviet Union	T'umen' Oblast
Asiatic RSFSR	Ufa	54.73	55.93	Soviet Union	Bashkir ASSR
Asiatic RSFSR	Ulan-Ude	51.85	107.61	Soviet Union	Buryat ASSR
Asiatic RSFSR	Vladivostok	43.15	131.88	Soviet Union	Primor Krai
Asiatic RSFSR	Yakutsk	62.00	129.66	Soviet Union	Yakut ASSR
Asiatic RSFSR	Yuzhno-Sakha	47.00	143.00	Soviet Union	Sakhalin Obl
Azerbakian SSR	Baku	40.37	49.88	Soviet Union	
Bahrain	Bahrain	26.00	50.50	Bahrain	
Bali (Bali,Indo)	Denpasar	-8.75	115.20	Indonesia	Bali
Bhutan	Thimphu	27.50	89.66	Bhutan	
Borneo(Kal,Indo)	Banjarmasin	-3.33	114.58	Indonesia	Kal. Selatan
Borneo(Kal,Indo)	Ketapang	-1.87	109.98	Indonesia	Kal. Barat
Borneo(Kal,Indo)	Palangkaraya	-2.27	113.93	Indonesia	Kal. Tengah
Borneo(Kal,Indo)	Pontianak	-0.03	109.33	Indonesia	Kal. Barat
Borneo(Kal,Indo)	Samarinda	-0.50	117.15	Indonesia	Kal. Timur
Borneo(Kal,Indo)	TanjungSelor	2.85	117.37	Indonesia	Kal. Timur
Borneo(Kal,Indo)	Tenggarong	-0.20	116.97	Indonesia	Kal. Timur
Br. North Borneo	KotaKinabalu	5.92	116.08	MalaysiaEast	
Brunei	Brunei	4.93	114.97	Brunei	
Burma (Myanmar)	Rangoon	16.43	96.15	Burma	
Burma (Myanmar)	Taunggyi	20.90	97.00	Burma	
Celebese Is(Sul)	Gorontalo	0.55	123.05	Indonesia	Sula. Utara
Celebese Is(Sul)	Kendari	-3.95	122.58	Indonesia	Sula. Tenggara
Celebese Is(Sul)	Kotamobagu	0.77	124.32	Indonesia	Sula. Utara
Celebese Is(Sul)	Manado	1.48	124.85	Indonesia	Sula. Utara
Celebese Is(Sul)	Palopo	-3.00	120.20	Indonesia	Sula. Selatan
Celebese Is(Sul)	Palu	-0.88	119.88	Indonesia	Sula. Tengah
Celebese Is(Sul)	UjungPandang	-5.12	119.40	Indonesia	Sula. Selatan
Ceylon(SriLanka)	Colombo	7.10	79.95	Sri Lanka	
Ceylon(SriLanka)	Ekala	7.10	79.95	Sri Lanka	
Ceylon(SriLanka)	Trincomalee	8.73	81.17	Sri Lanka	

NASWA COUNTRY	SITE NAME	LAT.	LON.	EDXC COUNTRY	STATE/PROV
India	Aizwl	23.70	92.72	India	Mizoram
India	Aligar	28.00	78.10	India	Uttar Pradesh
India	Bangalore	13.00	77.67	India	Karnataka
India	Bhopal	23.50	77.50	India	Madhya Pradesh
India	Bombay	18.93	72.85	India	Maharashtra
India	Calcutta	22.58	88.35	India	West Bengal
India	Delhi	28.62	77.22	India	Delhi
India	Gorakhpur	26.75	83.35	India	Uttar Pradesh
India	Guwahati	26.00	92.00	India	Assam
India	Hyderabad	17.35	78.49	India	Andhra Pradesh
India	Kohima	25.60	94.10	India	Nagaland
India	Kurseong	26.97	88.33	India	West Bengal
India	Lucknow	26.85	80.90	India	Uttar Pradesh
India	Madras	13.08	80.30	India	Tamil Nadu
India	Nagpur	21.15	79.19	India	Maharashtra
India	New Delhi	28.60	77.25	India	Delhi
India	Ranchi	23.30	85.30	India	Bihar
India	Shillong	25.55	91.90	India	Meghalaya
India	Shimla	31.12	77.15	India	Himachal Pradesh
India (Pakistan)	Islamabad	33.67	73.13	Pakistan	
India (Pakistan)	Karachi	24.85	67.03	Pakistan	
India (Pakistan)	Peshawar	34.00	34.50	Pakistan	
India (Pakistan)	Quetta	30.25	67.00	Pakistan	
India(Banglades)	Dhaka	23.70	90.37	Bangladesh	
Iran	Tehran	35.75	51.50	Iran	
Iraq	Baghdad	33.23	44.37	Iraq	
Japan	Fukuoaka	33.75	130.50	Japan	
Japan	Hiroshima	34.38	132.45	Japan	
Japan	Kagoshima	31.60	130.55	Japan	
Japan	Kumamoto	32.80	130.72	Japan	
Japan	Matsuyama	33.83	132.75	Japan	
Japan	Nagoya	35.17	136.91	Japan	
Japan	Osaka	34.67	135.50	Japan	
Japan	Sapporo	43.08	141.38	Japan	
Japan	Tokyo/Chiba	35.67	139.75	Japan	
Japan	Yamata	36.15	139.85	Japan	
Java (Jawa,Indo)	Bandung	-6.85	107.40	Indonesia	Jawa Barat
Java (Jawa,Indo)	Blitar	-8.25	112.15	Indonesia	Jawa Timur
Java (Jawa,Indo)	Blora	-6.60	111.42	Indonesia	Jawa Tengah
Java (Jawa,Indo)	Bogor	-6.32	106.78	Indonesia	Jawa Barat
Java (Jawa,Indo)	Cirebon	-6.53	108.40	Indonesia	Jawa Barat
Java (Jawa,Indo)	Jakarta	-5.97	106.80	Indonesia	D.K. Jakarta
Java (Jawa,Indo)	Jember	-8.37	113.70	Indonesia	Jawa Timur
Java (Jawa,Indo)	Lumajang	-8.00	113.22	Indonesia	Jawa Timur
Java (Jawa,Indo)	Madiun	-7.58	111.52	Indonesia	Jawa Timur
Java (Jawa,Indo)	Malang	-7.98	112.62	Indonesia	Jawa Timur
Java (Jawa,Indo)	Ngawi	-7.42	111.43	Indonesia	Jawa Timur
Java (Jawa,Indo)	Purwokerto	-7.69	109.10	Indonesia	Jawa Tengah
Java (Jawa,Indo)	Semarang	-6.90	110.52	Indonesia	Jawa Tengah
Java (Jawa,Indo)	Serang	5.82	106.15	Indonesia	Jawa Barat
Java (Jawa,Indo)	Sukabumi	-7.18	106.93	Indonesia	Jawa Barat
Java (Jawa,Indo)	Sumenep	-7.02	113.87	Indonesia	Jawa Timur
Java (Jawa,Indo)	Surabaya	-7.25	112.75	Indonesia	Jawa Timur
Java (Jawa,Indo)	Surakarta	-7.75	110.98	Indonesia	Jawa Tengah
Java (Jawa,Indo)	Yogyakarta	-8.22	110.72	Indonesia	D.I. Yogyakarta

NASWA COUNTRY	SITE NAME	LAT.	LON.	EDXC COUNTRY	STATE/PROV
Saudi Arabia	Riyadh	24.52	46.78	Saudi Arabia	
Sharjah	Sharjah	24.40	54.45	U.A.E.	
Singapore	Singapore	1.30	103.87	Singapore	
Sumatra(Sumatera)	Banda Aceh	5.57	95.33	Indonesia	D.I. Aceh
Sumatra(Sumatera)	Bangkinang	0.35	101.03	Indonesia	Riau
Sumatra(Sumatera)	Bengkulu	-3.80	102.27	Indonesia	Bengkulu
Sumatra(Sumatera)	Bukittinggi	-0.32	100.37	Indonesia	Sum. Barat
Sumatra(Sumatera)	Jambi	-1.50	103.00	Indonesia	Jambi
Sumatra(Sumatera)	Kisaran	3.18	99.30	Indonesia	Sum. Utara
Sumatra(Sumatera)	Kotabumi	-4.83	104.90	Indonesia	Lampung
Sumatra(Sumatera)	Medan	3.75	98.67	Indonesia	Sum. Utara
Sumatra(Sumatera)	Padang	-0.95	100.35	Indonesia	Sum. Barat
Sumatra(Sumatera)	Palembang	-2.90	104.75	Indonesia	Sum. Selatan
Sumatra(Sumatera)	Pangkalpinan	-2.13	106.13	Indonesia	Riau
Sumatra(Sumatera)	Pekanbaru	0.75	101.45	Indonesia	Riau
Sumatra(Sumatera)	Pematangsian	2.75	99.00	Indonesia	Sum. Utara
Sumatra(Sumatera)	Rantauprapat	2.10	99.83	Indonesia	Sum. Utara
Sumatra(Sumatera)	Sibolga	1.75	98.80	Indonesia	Sum. Utara
Sumatra(Sumatera)	Tanjung Pand	-2.75	107.65	Indonesia	Sum. Selatan
Sumatra(Sumatera)	Tanjung Pina	0.92	104.45	Indonesia	Riau
Sumatra(Sumatera)	Tanjungkaran	-5.32	105.27	Indonesia	Lampung
Sumatra(Sumatera)	Tembilahan	-0.32	103.15	Indonesia	Riau
Syria	Damascus	33.52	36.30	Syria	
Tadzhik SSR	Dusanbe	38.58	68.80	Soviet Union	
Thailand	Bangkok	13.83	100.48	Thailand	
Tibet (P.R.C.)	Lhasa	29.66	91.15	China	
Trans-Jordan(Jord)	Amman	31.95	35.95	Jordan	
Turkey	Ankara	39.92	32.83	Turkey	
Turkmen SSR	Ashkhabad	37.95	58.38	Soviet Union	
Uzbek SSR	Fergana	40.40	71.76	Soviet Union	
Uzbek SSR	Tashkent	41.27	69.22	Soviet Union	
Yemen(Yemini Rep)	San'a	15.35	44.20	Yemen	
****	Bahrain	26.00	50.50	Bahrain	
****	Chagos Arch.	-6.00	72.00	Chagos	
****	Christmas Is	-10.50	105.66	Christmas Is	
****	Cocos Is	-12.15	96.96	Cocos Is	
****	Iraq/Saudiln	29.33	45.50	Iraq/Saudiln	
****	Macau	22.15	113.55	Macau	
****	Spratly Is.	8.60	111.95	Spratly Is.	

fine tuning's
SHORTWAVE BROADCAST STATION TRANSMITER SITES
O*C*E*A*N*I*A

NASWA COUNTRY	SITE NAME	LAT.	LON.	EDXC COUNTRY	STATE/PROV
AdmiraltyIs(PNG)	Lorengau	-1.80	147.20	Papua New Gu	Manus
Australia	Alice Spring	-23.77	133.93	Australia	NorthernTerr
Australia	Brandon	-19.50	147.33	Australia	Queensland
Australia	Brisbane	-27.50	153.17	Australia	Queensland
Australia	Carnarvon	-24.90	113.72	Australia	Western Aust
Australia	Darwin	-12.42	131.00	Australia	NorthernTerr
Australia	Katherine	-14.47	132.27	Australia	NorthernTerr
Australia	Shepparton	-36.33	144.40	Australia	Victoria
Australia	Tennant Cree	-19.66	134.15	Australia	NorthernTerr
Bougainv'le(PNG)	Kerema	-7.80	145.75	Papua New Gu	NorthSolomon
Co.of N.Marianas	Saipan	13.00	146.00	Marianas	
Cook Islands	Rarotonga	-21.11	-159.48	Cook Is.	
Fiji	Suva	-18.00	178.00	Fiji	
GilbertIs.(Kirbati)	Bairiki	1.00	173.00	Kiribati	
Guam	Agana	13.51	144.75	Mariana Is	
Hawaii	Honolulu	21.00	-158.00	Hawaii	
Marshall Islands	Majuro	7.06	171.23	Marshall Is.	
Neth. New Guinea	Biak	-1.00	136.00	Indonesia	Irian Jaya
Neth. New Guinea	Fak Fak	-2.90	132.30	Indonesia	Irian Jaya
Neth. New Guinea	Jayapura	-2.53	140.70	Indonesia	Irian Jaya
Neth. New Guinea	Manokwari	-0.87	134.08	Indonesia	Irian Jaya
Neth. New Guinea	Merauke	-8.47	140.33	Indonesia	Irian Jaya
Neth. New Guinea	Nabire	-3.37	135.48	Indonesia	Irian Jaya
Neth. New Guinea	Serui	-1.88	136.23	Indonesia	Irian Jaya
Neth. New Guinea	Sorong	-0.88	131.25	Indonesia	Irian Jaya
Neth. New Guinea	Wamena	-4.10	138.50	Indonesia	Irian Jaya
New Britian(PNG)	Kimbe	-5.35	150.00	Papua New Gu	West NewBrit
New Britian(PNG)	Rabaul	-4.00	152.00	Papua New Gu	East NewBrit
New Caledonia	Noumea	-22.16	166.26	NewCaledonia	
New Guinea Terr.	Goroka	-6.05	145.25	Papua New Gu	Eastern High
New Guinea Terr.	Kundiawa	-6.20	144.50	Papua New Gu	Chimbu
New Guinea Terr.	Lae	-6.60	147.00	Papua New Gu	Morobe
New Guinea Terr.	Madang	-4.90	145.80	Papua New Gu	Madang
New Guinea Terr.	Mt. Hagen	-5.50	143.85	Papua New Gu	Western High
New Guinea Terr.	Vanimo	-2.60	141.40	Papua New Gu	West Sepik
New Guinea Terr.	Wabag	-5.10	143.40	Papua New Gu	Western High
New Guinea Terr.	Wewak	-3.35	143.40	Papua New Gu	East Sepik
New Hebrides(Van	Port Vila	-17.44	168.33	Vanuatu	
New Ireland(PNG)	Kavieng	-2.60	150.90	Papua New Gu	New Ireland
New Zealand	Wellington	-41.28	174.78	New Zealand	
Papua Terr.(PNG)	Alotau	-10.20	151.00	Papua New Gu	Milne Bay
Papua Terr.(PNG)	Boroko	-9.40	147.35	Papua New Gu	Central
Papua Terr.(PNG)	Daru	-9.00	143.20	Papua New Gu	Western
Papua Terr.(PNG)	Mendi	-6.10	143.40	Papua New Gu	SouthernHigh
Papua Terr.(PNG)	Popondetta	-8.46	148.14	Papua New Gu	Northern
Papua Terr.(PNG)	Port Moresby	-9.60	147.30	Papua New Gu	Central
Solomon Islands	Gizo	-7.95	156.75	Solomon Is.	
Solomon Islands	Honiara	-9.25	160.03	Solomon Is.	
Tahiti	Papeete	-17.00	-149.00	Society Is.	

fine tuning's

SHORTWAVE BROADCAST STATION TRANSMITER SITES

E*U*R*O*P*E

NASWA COUNTRY	SITE NAME	LAT.	LON.	EDXC COUNTRY	STATE/PROV
Albania	Gjirokaster	40.10	20.10	Albania	
Albania	Kruje	41.60	19.60	Albania	
Albania	Lushnje	40.95	19.66	Albania	
Albania	Tirana	41.30	19.83	Albania	
Andorra	Andorra	42.50	1.51	Andorra	
Austria	Vienna(Moos)	48.22	16.37	Austria	
BalearicIs(Spain)	Balearic Is.	39.60	2.70	Spain	
Belgium	Brussels	51.22	3.23	Belgium	
Bulgaria	Kostinbrod	42.85	23.62	Bulgaria	
Bulgaria	Plovdiv	42.15	24.68	Bulgaria	
Bulgaria	Sofia	42.67	23.30	Bulgaria	
Bulgaria	Stolnik	42.68	23.63	Bulgaria	
Byelorussian SSR	Minsk	53.90	27.56	Soviet Union	
Byelorussian SSR	Mogil'ov	53.90	30.34	Soviet Union	
Channel Islands	Jersey	49.20	-2.00	Great Britian	
Czechoslovakia	Kostolany	48.52	16.15	Czechoslovakia	
Czechoslovakia	Litomysl	49.80	16.15	Czechoslovakia	
Czechoslovakia	Prague	50.08	14.50	Czechoslovakia	
Czechoslovakia	Rimovska Sob	48.40	20.00	Czechoslovakia	
Denmark	Copenhagen	55.72	12.68	Denmark	
England	Daventry	52.25	-1.12	Great Britian	
England	London	51.50	0.00	Great Britian	
Estonian SSR	Tallin	59.41	24.75	Soviet Union	
European RSFSR	Archangel'sk	64.53	40.67	Soviet Union	Archangel'sk
European RSFSR	Krasnodar	45.04	39.00	Soviet Union	Kransnodar
European RSFSR	Leningrad	59.92	30.42	Soviet Union	Leningrad Obla
European RSFSR	Moscow	55.75	37.70	Soviet Union	Moskva Oblast
European RSFSR	Murmansk	68.98	33.13	Soviet Union	Murmansk Obla
European RSFSR	Tula	54.20	37.65	Soviet Union	Tula Oblast
European RSFSR	Uljanovsk	54.33	48.40	Soviet Union	Uljanovsk Obla
Finland	Helsinki	60.17	24.88	Finland	
Finland	Pori	61.45	21.90	Finland	
France	Allouis	47.20	2.00	France	
France	Issoudun	47.15	2.22	France	
France	Paris	48.85	2.33	France	
Ger (FRG)	Biblis	49.68	8.48	Ger (FRG)	Hessen
Ger (FRG)	Bremen	53.10	8.78	Ger (FRG)	Lower Saxony
Ger (FRG)	Holzkirchen	47.85	11.72	Ger (FRG)	Bavaria
Ger (FRG)	Julich	50.95	6.35	Ger (FRG)	Wesphalia
Ger (FRG)	Lampertheim	49.50	8.52	Ger (FRG)	Hessen
Ger (FRG)	Munich	48.13	11.58	Ger (FRG)	Bavaria
Ger (FRG)	Werachtal	48.10	10.68	Ger (FRG)	Bavaria
Ger (GDR)	Konigswuster	52.30	13.60	Ger (GDR)	Brandenburg
Ger (GDR)	Leipzig	51.16	12.28	Ger (GDR)	Saxony
Ger (GDR)	Nauen	52.62	12.90	Ger (GDR)	Brandenburg
Ger (W. Berlin)	Berlin	52.52	13.33	Ger (W.Ber.)	Berlin
Greece	Alvis	38.35	23.60	Greece	
Greece	Athens	38.00	23.73	Greece	
Greece	Kavala	40.90	24.86	Greece	
Hungary	Budapest	47.50	19.08	Hungary	
Iceland	Reykjavik	64.15	-21.65	Iceland	
Ireland (Eire)	Dublin	53.33	-6.25	Ireland	

authors and editors

ABOUT THE AUTHORS AND EDITORS

GUY ATKINS — ISSAQUAH, WA

Guy is 35 and married to Rochelle. The Atkins are expecting their first child to arrive just in time for the autumn DX season. Guy is a Quality Assurance inspector of equipment manufactured by Zetec Inc., a leader in nuclear power safety inspection systems used worldwide. Previous to Zetec, he spent nine years in graphic arts and advertising.

A battered Sears Silvertone portable was responsible for Guy's first enthusiasm in radio at age 13. His DXing interests began in 1982 when he met other SWBC hobbyists in the Seattle area. Guy enjoys combining DXing and graphic arts; in the late 1980's he promoted the hobby in the Pacific NW through publication of the Cascade Mountain DX Club newsletter and DX-Northwest's Grayline Report. He has also hosted social activities for DXers and organized DXpeditions. Guy currently is on staff with Fine Tuning, Proceedings. His primary receiving equipment includes a JRC NRD 525 and various audio-improving accessories. His favorite DX targets are the South Pacific and Africa. Both Guy and his wife are big fans of Afro-pop music, an interest that grew out of the challenge of DXing Africa from the Pacific Northwest.

KEVIN ATKINS — PINSON, AL

Kevin is 32 years old, and being recently divorced, is now married only to his Icom and his Macintosh. He manages Communication Arts, Inc., a typography and computer graphics studio and Postscript service bureau serving the Birmingham, Alabama advertising community. He majored in journalism at Auburn Univ and the Univ of Ala at Birmingham.

Kevin serves the fine tuning organization as co-editor of the newsletter, and is a member of the Proceedings editorial staff. He is a NASWA member and edits the DXer's Forum column in the NASWA JOURNAL. Other club affiliations include the Ontario DX Association, OZDX and DX South Florida.

Kevin's first DX-love is Indonesia, with Andean South America (particularly Bolivia) running a close second. He is an avid DXpeditioner, and if he finds out where you live, he may show up on your doorstep with a sleeping bag and a BIG roll of wire one day. He also enjoys reliving his childhood at the dials of his son's Lafayette HE-10. His current NASWA country totals are 208 HIC, 189 VIC.

JOHN H. BRYANT — STILLWATER, OK

John is 50 and has been married to Linda for 27 years. Although John's home town is Stillwater, OK (their current QTH), John and Linda lived in Arizona, Illinois and Alabama before returning home a decade ago. John is Professor and former Head of the School of Architecture at Okla. State Univ. John is widely known as an expert on the traditional architecture of East and Southeast Asia. In the mid-1970's, the Bryants spent a year in Japan where John was a Senior Fulbright Research Scholar. John has traveled extensively in China, both as a member of official US delegations and as a lecturer at a number of Chinese universities.

John has had 2 careers in the DX hobby. The first was as a teenager in 50's. John began in 1952 as a SW DXer but spent most of that era as a "medium waver." His best catch was 1YZ, Rotorua, New Zealand on 800 KHz in the winter of 1959. His second career, mostly SW this time, began in 1979-80 with the purchase of a Sony 2001. He currently operates a highly modified NRD-525 coupled with a semipermanent 1200' Beverage pointed at the China coast and Sumatera. Although he is enthusiastic about DX from anywhere, John couples his "real world" interests with his DX interests by being absolutely obsessed by DX from East and Southeast Asia. His other radio interest include antenna and propagation experiments. His current total are 205 countries heard/186 countries verified from the "modern era." John is the Editor of Special Publications for Fine Tuning.

DAVID M. CLARK — NEWMARKET, ON

David is 45 years old, a graduate in history and geography and works as a Director of Systems Development for a major trust company in Toronto. He and his wife Elena have 4 children and reside on a 10 acre wooded property in the country, site of Clark's infamous "DX Barn" and antenna farm.

After a variety of listening interests spanning more than thirty years, David now concentrates on Tropical Band Pacific and Asian DX, focussing primarily on Indonesians and signals from the Indian sub-continent. He is especially interested in studying seasonal reception phenomena and their relationship with trans-polar and longpath Tropical

BOB ELDRIDGE — PEMBERTON, BC

Bob is 70, and was born and educated in England. He met Claire in Belgium in 1944 and married her in 1947. They have two children and a 17-year-old granddaughter. Bob served in RAF Signals from 1940-50, and the rest of his working life in communications until retirement in 1982 to a property with lots of room for big antennas in a mountain valley 70 miles north of Vancouver BC. He represented Canada at many CCIR conferences and at WARC-79. He was awarded the Diploma of Honor for outstanding contributions to the work of CCIR.

Bob helped his father build a Lissen Hi-Q Five about 1930, joined the British Short Wave League and built an 'Artificial Aerial" transmitter. From 1946, he operated as D2GQ at Luebeck and G3AGQ in England. He came to British Columbia in 1953 and was licenses as VE7BS before collecting his checked baggage from the railway station! He operates on all HF Amateur bands, mainly on CW, but is dedicated to 160 meters. His main interest is propagation across the Pacific, but dabbles in writing, chess, music and the computer.

WERNER FUNKENHAUSER — GUELPH, ON

Werner is 49 years old and is a college Professor of Computer Applications. He has been DXing since 1956 when a neighbor gave him a 1938 General Electric "All-Wave" receiver. Later he graduated to a Knight-Kit "Ocean Hopper" regenerative radio. Since then, he has been in and out of the hobby and returned most recently in 1985.

Werner is a dyed-in-the-wool MW DXer and rarely listens on other bands. He is editor of "Medium Wave International," ODXA's Foreign Medium Wave column. When not DXing, he spends some of his hobby time building and modifying air-core loop antennas. A few years ago he acquired a Connelly longwire/loop antenna phasing unit and is especially interested in the effects of phasing with longwire/loop antenna combinations.

JOHN GRIMLEY — TORONTO, ONT

John is 42 and emigrated to Canada from the U.K. in 1975. Married with a son aged 9, he is an accountant by profession and is controller of an importer and exporter of engineering components.

He has listened to shortwave, on and off, since childhood. Most of his present listening is as an SWL, but delights in intensive periods of DXing at DX camps, competitions and the like. His main equipment comprises a NRD-525, a 25 metre inverted L antenna and the QF-1 audio filter by Autek Research. A Panasonic RF-B65 and the Philips DC-777 are used outside the shack.

He is presently a director of the Ontario DX Association and holds the office of Treasurer. He has co-managed the club's annual convention and is a frequent contributor to DX Ontario. John developed and manages the club's phone-in information system, the DX-Change. He may be reached at the ODXA mailing address. His voice/fax phone number is 416-299-4281.

NICK HALL-PATCH — VICTORIA, BC

Nick is in his early 40's and is married to Susan, a piano teacher. They have two daughters. Clare, at 9 years old can still be convinced that a Beverage expedition is a camping trip, but 12 year old Lucy is starting to agree with her mother that lemonade is preferable to one of the good doctor's antennas as a beverage while camping.

An ongoing interest in improving MW DX reception has marked Nick's DX career since the mid-60's, when he first started to experiment with receivers and antennas. He has been technical editor of the International Radio Club of America since 1978, and was editor of IRCA's "A DXer's Technical Guide," published in 1980 and 1983, and in German translation in 1987. He is also a member of CIDX and LWCA, and is a radio amateur, VE7DXR. Mongolia and Bulgaria are among the better MW catches from his QTH, but most good DX is now heard using Beverage antennas on expeditions to the Pacific coast. He prides himself on never having seriously DX'd with a stock receiver, and presently uses a receiver of his own design and construction.

After some years of self-employment as a gardener in Victoria, Nick is now re-discovering the delights of mental exhaustion by pursuing an electronics engineering technologist diploma at a local college.

DON JENSEN — KENOSHA, WI

Don has been an active DXer since 1947, when, at the age of 11, he was introduced to radio by his father, a sometimes bootleg "ham." Even at that tender age he was intrigued by geography and far-away places. He found it a marvelous adventure to sit at home and tune in places like Quito, Ecuador, and Bern, Switzerland, his first two DX catches. While he dabbled in different aspects of the listening hobby over the years, his primary interest has remained SWBC. He has been active in the hobby in numerous ways. In 1964, he founded and was the first executive secretary of the Association of North American Radio Clubs (ANARC). He has held editorial and administrative posts in a number of radio clubs, including NASWA for the past 26 years. From 1969 through 1989, he published and co-edited the Numero Uno DX travels, he has visited over 100 radio stations. He enjoys QSL collecting from both big and small stations, and is especially proud of his collection of over 120 different HCJB QSLs. He has over 1000 SWBC stations heard and over 500 verified. Other interests include folk music of all types, history, science-fiction, gardening and camping.

TERRY PALMERSHEIM — PUYALLUP, WA

Terry is 36 years old and is employed at Carlyle, Inc., a manufacturer of voice/data cables and fibre optic assemblies, as a Quality Assurance Technician.

As an 'Air Force Brat' with its associated travelling, Terry's discovery of the world of shortwave was inevitable. His first experiences were with his father's Hallicrafters S-38D in 1967, while stationed at Eglin AFB in Florida. Interest in the hobby all but disappeared from 1974 to 1980, when he 'rejoined' with avengence. Purchasing a used Hammarlund HQ-145, the aspect of QSLing was, and still is, his primary 'vice'. Since 1980, he has heard 221 NASWA countries and has verfied 205. His principal line of attack is an NRD-525 with a KIWA MAP unit, a Grundig Satellit 500, a Sony ICF-2002 and the Philips DC-777. Antennas are an Alpha Delta Sloper and a home-brew T2FD. Favourite target areas are Central and South America, Indonesia, India and Africa.

Terry is a member of NASWA, MDXC, ODXA, FT and ACE.

BRUCE PORTZER — SEATTLE, WA

Bruce has been DXing since 1964. His primary interest is MW DX, but he has dabbled in almost every part of the spectrum at one time or another. He was editor-in-chief of "DX Monitor," the weekly bulletin of the International Radio Club of America, and has logged about 2200 MW stations from 45 states and 70 countries. He also has an advanced class ham license and has worked about 100 countries during the past year and a half.

Bruce's receiving set-up currently includes the Racal RA-17 described in this issue of Proceedings, plus a Yaesu FRG-7 and various portables. An electronics engineer, he works for a consulting firm that designs security and communications systems for major architectural projects, ;especially jails and prisons (one of America's biggest growth industries). He and his wife Evelyn have been married 16 years and have two children, Theresa, age 4, and Steven, born January 1991.

JIM RENFREW — ROCHESTER, NY

Jim was first exposed to DXing by his father (who's still at it), and got serious about it around 1967, when at the age of 13 he got his first Heathkit for Christmas. After brief involvement with SW, he gravitated to MW. He first joined the National Radio Club in the late 1060's when he lived in Connecticut. DXing was left behind when he went off to college, but his interest revived in 1977 when he moved to Rochester. He has heard about 1325 MW stations from Rochester from 43 states and 45 countries, most recently with a Hammarlund HQ-150 receiver and a "Space Magnet" ferrite bar loop. In the early 1980's, he went back to SW (now using the Sony ICF-2010) and has branched out to FM and TV DX as well, but his favorite is still international DX on MW. He has about 275 MW and 350 SW verifications. Jim began editing the International DX Digest column of NRC's DX News in Sept. 1990. He is also a member of NASWA, WTFDA, and ODXA (associate).

Jim is 37 and is married to Melissa Marquez. He has been a Presbyterian minister for nine years, ;and is now combining work at Grace Presbyterian Church, Rochester, and Stone Church Presbyterian Church, Bergen. He began at Stone Church in early 1991 and quickly noticed a BIG cornfield in back of the church, so he is giving serious thought to erecting a beverage antenna there next winter!

R. CHARLES RIPPEL — VIRGINIA BEACH, VA

Chuck is 37 years old and is married to Beth and has one 8 year-old daughter, Ashley. After a period of employment with Northrup-Page Communications Engineers, Inc. assigned to the Saudi Naval Expansion Project, Chuck became and currently holds the position of CEO for Great Atlantic Information Systems, Inc. in Virginia Beach, VA. He also consults to the commercial broadcasting industry and is a member of the Society of Broadcast Engineers, a professional society.

Chuck began DXing in 1972 with a Realistic DX-150 and was introduced to NASWA by Edward Shaw. He is one of the founding members of ODDX, the Old Dominion DXer's Association based in Tidewater, VA. In 1974, he edited the CIDX column "At Random" and in 1987, he created DXer's Forum for NASWA. Chuck was Chairman of the NASWA Editorial Committee till Sept. 1988, until his appointment as Executive Director of NASWA which he held until Feb, 1990. Over the years, he has contributed several articles to FRENDX including papers on Antenna Noise Bridges and Delta Loop Antenna theory and construction techniques. This is Chuck's third effort with PROCEEDINGS, the prior years contributing to the Papua New Guinea articles and writing the engineering review of the Marantz tape recorder. This is also Chuck's third year serving on the Proceedings Editorial Review Committee where course of his research, he has spent time at the VOA, USIA, RFE/RL, as well as nearly a dozen other international broadcasting organizations. Chuck currently serves as the Utility World column editor for SPEEDX and is also a member of NASWA, ODXA, and the Association of DX Reporters. He is currently working on several special publication projects for SPEEDX including a revision of the SPEEDX Guide to the Utilities, and a collection of reviews of publications in the area of HF Utility reception.

GEORGE ZELLER — CLEVELAND, OH

George is 41, and he reports that his single status since 1984 has greatly reduced in-house QRM. He holds a Sociology BA from Wittenberg University, and did his graduate work at Ohio State University. After 12 years as a sociology professor, he switched to full-time research. George is currently the Senior Researcher at the Council for Economic Opportunities in Greater Cleveland, where he writes detailed annual poverty reports covering greater Cleveland and the state of Ohio. Among his other flaws, he is a diehard Cleveland Indians fan, and a member of the Society for American Baseball Research.

George started DXing in 1963, but was inactive 1968-78 while in college. An avid pirate and clandestine DXer, George has heard more than 200 different pirates, with over 100 stations verified. He wrote the 1989, 1990, and 1991 editions of "The Pirate Radio Directory" for Tiare Publications, and he also writes a monthly "Clandestine Profile" column for the Association of Clandestine Radio Enthusiasts. He currently is active in ACE, NASWA, ODXA, and NU. George also regularly tunes his rigs (see article!) to SWBC and utility DX, and is an active contributor to the weekly ANARC 7240 Shortwave Listeners Net.