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Author: Paul D. Rockwell, W3AFM

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STATION DESIGN FOR DX

PART IV — (a) Propagation Quirks and (b) Operating Tips

BY PAUL D. ROCKWELL,* W3AFM

Discussion of propagation will be mainly on (a) use of the long path, (b) the twilight zone, (c) use of meteor bursts for quick identification of weak local signals, and (d) use of WWV advices.

It is well known among DXers that signals frequently come in better the long way around the earth. This applies mainly to paths exceeding about 4000 miles the short way. Under some conditions, the optimum path flips from s.p. (short path) to l.p. (long path) in a few minutes, and it is difficult to choose optimum propagation. The neatest station-design to ascertain the better path is that in use at W6AM. He brings each end of each rhombic, through transmission line, into his shack. By appropriate relays, the path may be tested or operated on in less than a second simply by flipping a switch. Similar technique can be (but practically never is) applied to driven arrays and Yagis.

The question of when, in a longer term, it is desirable to search for long-path openings, is not easily answered. Recent experience gives the operator his best competence. However, some general guidance is to look along the twilight zones.

The twilight zone, globally, has an important relation to h.f. propagation. For example, on the long hauls, about 6,000 to 20,000 miles (s.p. or l.p.), phenomenally good transmission can be realized for small portions of the day, on paths nearly *parallel* with this zone. According to the relation between the maximum useable frequencies (m.u.f.) and operating frequencies, propagation may be better on the day or night side, or directly along the twilight zone. Seasonally, the zone runs due N-S at the equinoxes; mornings NW-SE in summer, NE-SW in winter; evenings NE-SW in summer, NW-SE in winter. The NE and SW directions are for northern latitudes. Long propagation paths *perpendicular* to a single intermediate twilight zone, on the other hand, tend to be poor, especially when the zone is near mid-path. This is because MUFs are usually much different in night and day zones — sometimes called the "contrast" problem. An appreciation of these phenomena is useful in estimating diurnal and seasonal openings to various parts of the world.[23]

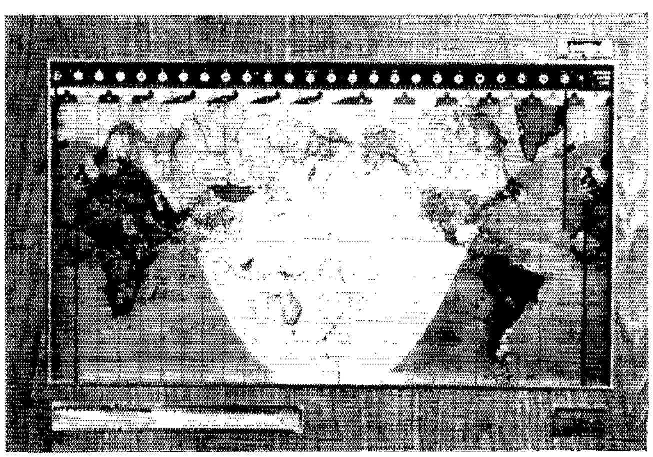
A chart, from information prepared by Frank Smith, W5VA, is presented as Table III. Frank has maintained daily schedules for several years over difficult DX paths — notably with VU2JA, plus 4S7NE as well.

Sometimes signals arrive from unexpected directions — neither s.p. or l.p. Particularly, arrivals from north and south have been reported for DX signals as much as 60° displaced in geometric azimuth. Signals reflected from the aurora zone are usually characterized by a gravelly sound. To a lesser extent, this can be observed on signals propagated through the aurora. When Europeans are heard working the Far East, it's a good sign that Far East propagation will be good, later in the day, from the United States.

Some propagation phenomena are useful for preliminary identification of signals in DX work. One of these phenomena is signal enhancement by reflection from meteor trails. The enhance-

* 5800 Hillburne Way, Chevy Chase, Md. 20015

[23] Persons interested in h.f. propagation should acquire and study an excellent value in this field: *Ionospheric Radio Propagation* (NBS CRPL), 1965, From Supt. of Documents, USGPO, Washington, D. C. 20402, $2.75. See also "Simplified CRPL DX Predictions," *QST*, July 1957, p. 28.



The Geochron Map-Clock. Hams at first stand transfixed before this—then steal occasional looks. It shows the sun and daylight zones imperceptibly moving across the Earth, with diurnal and seasonal corrections built in.

ments may be 20-to-40 db. in amplitude, and are typically about one second in duration. Unfortunately they are not always present. When they are, they serve to distinguish weak nearby (non-DX in the 20-meter skip-zone) signals from bona fide weak DX. An appreciation of this saves the time of waiting for the weak station to identify himself by sending his call letters. Another phenomenon, useful in recognition, is the well-known rounding of keying envelopes by multipath transmission. That is, keying which has passed through several propagation hops and has arrived by a combination of several paths, is likely to sound softer (in the sense of less clicky) than ground-wave or single-hop propagation signals.

It is conservative of one's time in general listening, to spend more time in good conditions than bad. WWV sends propagation advices every five minutes. While these are for the North Atlantic only, their extremes are indicative of conditions in general. A few minutes at "N7" pay off better than an hour at "W4." At W3AFM, a receiver is kept on WWV. A digital clock permits turning this receiver on a second or two before the announcement. Thus the check-up takes only about ten seconds. An automatic timer could be installed. City power runs typically ±3 seconds of accuracy.

To be guided wholly by NBS-CRPL dicta, however, can (a) subtract the fascination of the completely unexpected, and (b) cause loss of country contacts. On rare occasions, a choice DX find will turn up on an otherwise dead band. Sometimes these signals last only a few minutes, and are heard by only one or two W stations, within a hundred-mile distance of each other.

Operation and Subjective Elements

Time and keen operating practices can be traded off, to some extent, for station technical-effectiveness. Especially in this era of well-equipped DXpeditions, it is more important to be active on the right frequency at the right time, than to have the ultimate in DX e.r.p. Thus, a station at home, a home within 20 minutes drive of the place of work, and a job that doesn't require being out of town on trips, can add more to the countries total (if that's your criterion of performance) than a 200-foot tower and 50-foot boom.

A mountain-top summer-cottage, well sited and well equipped, may be the answer (a) for contest or week-end DXing, (b) if there are motivations to get the hobby out of the home, or (c) if the home location is DX-wise impossible. Remote control of the country sites is not out of the question — but is seldom put to practice, because of the costs and difficulties. W6YY u.h.f.-remotes transmitters etc. at Mt. Wilson, elevation 5710 ft., from his home at La Canada, California!

Neighborhood relations and station esthetic appearance are often problems. Even if it would fit on the home lot, a hundred-foot lattice tower and fifty-foot boom may be out of the question. In cities, the type of antenna beyond which troubles are likely to develop with neighbors is often something like a 45-foot telescoped-pipe self-supporting mast, with a 25-foot boom lightweight Yagi. Such a practical compromise, however, will not compete in contests, no matter how good the operator, against a fully equipped, well-sited station. The latter, of course, usually has a good operator along with it.

Flag-poles, if of interest for good-looking mast construction, are made by John Lingo and Son, Inc., P. O. Box 1237, Camden, New Jersey. Pneumatically telescoping masts are marketed by Andrew Corp, P. O. Box 807, Chicago, Ill. 60642. Costs of the latter range from $2,000 to $8,000 for heights of 30 to 100 feet.

TABLE III W5VA's LP/SP DX Chart

Season	*Long Path*	*Short Path*
Feb.—May	South Africa and Indian Ocean 13-15Z	Near East 22-02Z India 14 and 02Z Malaya 14Z Oceania 02-06Z
May—Aug.	(Same as above, but Malaya and Oceania better; India worse, near nil)	
Aug.—Nov.	(As above, but India strong. Malaya shifts to 22Z gradually) Oceania 22-24Z	
Nov.—Feb.	Europe and North Africa 13-15Z India, Near East and Far East from opening to 15Z Oceania from 20-22Z	Europe and North Africa 15-17Z South Africa 18-22Z Malaya (rare) 13 and 24Z Oceania (better l.p.) 13-14Z

Notes: 1. East Coast subtract 1 hour: West Coast add 1 hour to times above.
2. Months may be read February 15, etc. for W5 land; February 1, etc. for northern U. S. latitudes.
3. 4th Quarter l.p. sigs under South Pole reach W5 1 hour *earlier* than W8/1/2/3; sigs over North Pole 1 hour *later*.
4. November-February 01-02Z; India and Gus/Asia l.p.; FB8XX 589SP — Band sounds dead, actually is *not*.

Recommended Station "Library"

Callbooks, U.S. and Foreign
W9IOP's "Second Op"
ARRL Countries List (*Op Aid* 7)
ARRL Antenna Book
ARRL Radio Amateur's Handbook
ARRL Radio Amateur's Operating Manual
Radio Handbook, *Editors and Engineers*
The Radio Amateur Handbook, *R. S. G. B.*
Subscriptions to: QST, CQ, 73: *WGDXC and LIDXA DX News Bulletins*
"The DXer Magazine," Gus Browning W4BPD, RFD 1, Box 161A, Cordova, S. C. 29039
Radio Amateur World Atlas *and maps, published by Radio Amateur Callbook, Inc.*
National Geographic Atlas of the World; *also, one of their globes.*
Complete set of instruction books for equipment in use.
QSLs, SAEs, IRCs, foreign postage (see W2SAW), ARRL station log, rubber-stamp for self-addressing envelopes.
U. S. postage stamps, including 11c, 15c, 25c, etc.
Letter scale, 0–9 oz., with vernier 0–2 oz., such as the German "Bilateral" which sells for about $4.00.
Of the above, the importance of the DX News Bulletins is the item most likely to be overlooked by neophyte DXers. There are several other bulletins: Geoff Watts, VERON, LIDXA speed-postcard service, NCDXC, SCDXC monthly bulletins, etc.

Operating Tips

Much has been written on operating practices for DX effectiveness. Listening is far more productive than calling CQ. In this connection, the tradeoffs represented by Figure 6 are recommended over the more conventional ones of Figure 7. (Part II, October *QST*).

It is better to listen several times a day for short periods, than to listen for the same total time in one session. In tuning, as from 14,000 to 14,100 kc. repeatedly, it is slightly preferable to "snap back" (as is done by oscilloscope horizontal sweep circuits) than to tune uniformly back and forth. In contests, it is preferable to tune from high to low, as "the pack" predominantly moves the other way. In pile-ups, a short call precisely timed and on the right frequency, can be more effective than a longer call at higher power.

Logging, filing, and QSL procedures cannot be neglected. DX intelligence ("G-2") is *very* important. DX-alert nets are good. But when they are not available, it is sometimes possible to exchange alerting services over telephone landlines. Particularly useful are DXers who have retired from full-time employment and spend several hours a day scanning the bands. Having tools, test gear and spares close at hand can be a practical advantage in the event of breakdown at a critical time — some wrong Sunday afternoon.

Zeroing Capability

It is desirable to be capable of zeroing-in with an accuracy better than 100 c.p.s. on top of the station communicating with the desired DX station. This can be accomplished most quickly by the use of a very sharp receiving filter (say, 200 c.p.s.). It is very helpful if a second receiver can be employed to permit the zeroing operation to be performed without detuning the desired DX station, which may be very weak and fading into and out of the noise. It is especially convenient if the second-receiver v.f.o. can be cross-coupled, transceiver style, to the exciter, so that the transmit frequency automatically follows that of the zeroing receiver.

A problem that plagues some exciters is that the spotting zero is different from the key-down zero. Such a situation can seriously impair DX effectiveness.

Receiver frequency calibration should have accuracy of ± 1 kc. or better over the 14,000-14,100-kc. range. This is to permit prompt action on DX news-bulletin or other DX tips.

Break-in Capability

Full break-in is a very desirable feature. Use of even the best available t.r. electronic switches may degrade station DX performance materially. This is because the noise figure, at best, is inferior to that of a good receiver. However, these devices are sufficiently good to be useful during transmissions. A way of avoiding degradation during the most critical listening periods is to by-pass the t.r. switch automatically when the transmitter is switched off. Figure 8 (blocks 3, 4 and 5) in Part III, November *QST*, illustrates the interconnections and components. The B & W Model 381 has proved satisfactory at W3AFM; it permits full c.w. break-in by signals S6 or better. With it, one can tell while sending the approximate level of clutter on the calling frequency.

Shaping of Keying Characteristic

It is well-known that the corners of the r.f. envelopes of keyed characters should be rounded to prevent clicks. For intelligibility, the leading corner should be less rounded than the final corner. What is less well-known is that a considerable improvement (as much as 3 db. in

(Continued on page 152)

ful attention is given to the dimensions and to the matching. Complete data covering antennas of this variety is given in the *ARRL Antenna Book*, Chapter 4. An outdoor version of the Lazy-H could be fashioned by mounting the elements on 1 × 1-inch lumber support arms. It would then be possible to rotate the array, and greater efficiency should be possible since the antenna would then be out in the clear. — *W1CER*

Station Design for DX

(*Continued from page 55*)

effective output-power) may be built in the forward part of each character without loss of the rounded-corner. This is done by use of a very high value of filter capacitor in the high-voltage power supply. At W3AFM, 120 μf. are used. It should be noted that, in the case of linear amplifiers, output is not a direct function of plate voltage as in the case of Class C grid-driven amplifiers. For grounded-grid amplifiers the gain is nearly always constant (below saturation) at 10–13 db. (output power 10–20 times input power). Thus, to use this technique effectively, the driving stage and conceivably its driving stage should also be provided with high-capacitance filters. The technique should also be useful for handling modulation peaks. It has no value unless, as is usually the case, the h.v. power-supply regulation is imperfect.

Station Clock

The station clock should always run on GMT, and logs should be kept that way. Digital 24-hour types, such as the Tymeter Numechron, are preferable to round-face clocks. The map-clock, made by Geochron, is an interesting and useful guide to propagation and is a hobby in itself. It shows automatically the sun's position, daytime and nighttime zones, and corrects for seasonal changes.

Size is about 3 feet wide by 2 feet high by 4½ inches thick. A Mercator transparency moves imperceptibly, according to time of day, across a red dot at the middle of the map, representing the sun's zenith position. The red dot moves even more slowly, ±23½° in latitude and a few degrees in longitude, forming annually a thin figure of eight (the analemma). Most impressive, the precise daylight and nighttime zones are continually displayed. The clocks are made by Geochron, 2515 Palms Place, San Mateo, California, 94401

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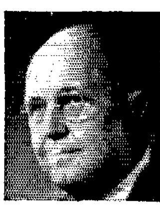

Acknowledgements

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Author's Sequel

Not all that was in my head got onto paper. Not all of what did get on paper is clear. Also, a couple of errors are worth correcting:

Transmitters should be at least be mentioned in a tract like this. Essentially all top DX stations in W/K land use kw. finals. About half these are home-built. It may help those who plan home construction of this kind, to relate a point-of-view developed from experience. This is, that it pays to buy components of first quality right from the start. For example: Westinghouse Oz-Paks, Ebert mercury power relays, B & W Type 800 chokes and Linemaster 632-S foot-switches are fine products now in use at W3AFM but each was preceded by a cheaper one. The predecessors now are in a junk box . . . a total loss. Cheaper does not mean more economical.

Referring to Part I, Sep., on antenna siting. There are three zones under consideration, namely: 1. Near-zone (I^2R losses) under the antenna, 2. The reflection zone, 3. The far-zone (horizon clearance). Take a site such as W3CRA's on Fig. 2. Frank Lucas has perhaps the strongest signals coming out of W/K land. His near-zone I^2R loss is negligible; he uses a balanced horizontal radiator and a reasonable antenna height of $\lambda/2$. His take-off lobe is formed within the first fraction of a mile, on a nearly ideal sloping forezone. This low-angle lobe is able to clear the horizon because of his high altitude in reference to surrounding terrain. If the antenna were situated back over the ledge of the hill on a level plateau, so that the antenna could not see the sloping foreground, then his take-off angle would be only that determined by the height of the antenna over the plateau.

Some questions have been raised about the curved coordinates in Fig. 2. This is 4/3 earth-radius paper. On it, radio rays passing through the refraction of standard atmosphere are straight lines. To construct such paper, draw a level straight line. From the center of this line mark off distances in miles. Then drop down for various heights according to the formula:

$$d_{mi} = 1.4\sqrt{h_{ft.}}$$

The opening remarks of Part III were mostly intended for Table I rather than Table II. Table I appears in Part I, September.

	Median Antenna Height (ft.)	*Median Boom Length (ft.)*
Table I: Contesters	74	36
Table II: DXCC	65	24

Contesters are more heavily equipped than DXCCers.

In Part III, 75A4 mod (4) refers to the r.f. stage.