October 29th, 1953
Wailuku, Maui
Territory of Hawaii


Dr. J. L. Pawsey
Radiophysics Laboratory
C. S. I. R. O.
Chippendale, N.S.W.
Australia


Dear Pawsey:

Thank you for your letter of the 23rd.   The idea of an antenna in a cross is most interesting.  All along it has been my belief that simple schemes would be most useful in terms of results secured for the time and money expended.  Your comments about 18mc and 9mc are in general agreement with my findings here at 30mc and 20mc respectively.  Apparently trying to work down toward the F layer critical frequencies from the high end is fraught with considerable difficulties.

Since writing to you a month ago I have been studying this extraordinary ray business.  The best discussion I've been able to find here is in "Terrestrial Radio Waves" by Bremmer, page 284 and 285.

Let the absolute magnitude of the earths field be H gauss.

The gyro frequency will be $f_g = 2.8$ H megacycles.

Let the vertical incidence critical frequency of the ordinary ray be $f_0$ meagcycles.

Then the extraordinary ray will pass thru the ionosphere if $f_0 < \sqrt{2} \, f_g$

The band of frequencies which will pass thru the ionosphere will be

$$f_g > f > \left(\frac{f_g^2}{4} + f_0^2\right)^{\frac{1}{2}} - \frac{f_g}{2}$$

This relationship for various values of $f_0$ and H are plotted on enclosed sheet.  Strong fields and low criticals are needed.

Since the ray can only travel thru the ionosphere along a line of magnetic force the situation is similar to viewing a scene thru a long pipe.  As the pipe moves, glimpses of different parts of the scene will be observed. The part of the scene viewed will depend upon the length and diameter of the pipe.  No information seems to be available upon the angular deviation a ray may have from the line of force and still get thru.  However it is probably only a few degrees.  Thus the resolution will depend upon the geometry of the situation and not upon the magnificence of the antenna structures.

The celestial declination of the ray will be equal to the latitude of the observer plus the inclination of the field less 90 degrees. The center of the galaxy is at R.A. 1750 and dec. $-25°$. Inspection of maps will show that at about $44°$ south the field has an inclination of about $71°$. Thus a celestial ray from Sagittarius should get thru in New Zealand or Tasmania where the field is about 0.6 gauss.

Low values of $f_0$ are required. By peculiar chance the lowest night values of $f_0F_2$ occur around $45°$ south. I have extracted the data on Christchurch and Hobart. This is plotted up and enclosed. There is little choice. The 1953 data may be more indicative but only two months have appeared in print so far.

Nothing is available out here on the scatter of $f_0F_2$ for these stations. However I am enclosing this data on Kihei which may give some idea of how things are at 45 degrees south.

Inspection of all this leads one to believe that about 40% of the nights at $45°$ south during the months April thru July will have $f_0F_2 < 1.8$ MC from 2 to 6 am. Perhaps Christchurch is better in this regard.

At the bottom of the graphs are marked the months above the hours when Sagittarius is on the meridian. It seems that March and April might be best.

If this thing works it offers the possibility of a high resolution study of cosmic static in the frequency range 1.0 to 1.6 megacycles along a limited belt in the sky across the galactic center. Sweeps at other declinations may be made by changing the latitude of the observer provided all the other "ifs" are fullfilled.

There are two major uncertainties. First: The downcoming ray may be polarized N-S or E-W. This can be easily checked by setting up two antennas along these directions and using the best one. Second: There may be a large amount of absorption in the ionosphere even along the line of magnetic force. There is no knowledge upon this matter. Certainly D region absorption will be absent. Since the ray is not bent in the ionosphere, deviative absorption should be absent. However there may be some other brands of absorption; so this matter is a gamble.

The whole business looks like it would be worth a try. Unfortunately Hawaii is not the place as the field is too weak and too much inclined and the values of $f_0F_2$

are too high. However, I would be interested in making
some arrangement with your organization to come to
Australia next spring and assist in giving this business
a try, provided:

(a) You cannot find something obviously wrong with
the theory outlined above.

(b) You look favorably upon the idea.

(c) You can sell the scheme to someone of your
fellows to take under his wing as not much time is still
available and more than one person will be needed.

In my opinion the thing could be given a fair trial
by the middle of the summer (winter) if we are on location
getting setup sometime in February. Perhaps it will be
a good idea to go over the whole business with some
ionosphere man like Bracewell who I believe is now with
your organization. In any case, your suggestions and
comments will be awaited with interest.

Best regards,

Grote Reber

P.S. Dr. White also seemed to know a lot about the
ionosphere when he was here.

G.R.