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AIRMAIL

17 October, 1963

Mr. Grote Reber,
Tasmanian Regional Laboratory,
C.S.I.R.O.,
Stowell Avenue,
Hobart, Tasmania,
Australia.

Dear Mr. Reber:

Thank you for your letter of September 30th. Unfortunately, I do not have available any copies of my report on the satellite cosmic noise experiment, but I shall try to summarize the results in this letter.

This Establishment built the "Alouette" satellite and it was placed in orbit by the American National Aeronautics and Space Administration. The satellite was intended to be a top-side ionosonde, but as planning progressed it was found convenient to include three other experiments: a VLF receiver, energetic particle counters, and the facility for the measurement of cosmic radio noise. After more than a year of operations all the experiments are still performing reliably and many data have been and continue to be accumulated, only a small fraction of which has been analyzed.

The cosmic noise experiment uses the sweep frequency receiver of the sounding experiment, but takes the output from the AGC line. An integration of 20 ms in the AGC circuit eliminates any significant contribution from the ionosonde echo pulses so the two experiments can operate at the same time. Cosmic noise measurements are obtained, then, over the frequency range 0.5 to 12.0 Mc/s, but the reduced sensitivity at the extremities of this range set the practical limits at about 1.5 and 11.0 Mc/s. There is a further complication because of antenna interaction so that our calibration of the 4 to 11 Mc/s band is uncertain: so far only relative measurements have been made in this upper portion of the sweep range.

The frequency range 1.5 to 4 Mc/s gives reliable and reproducable data and so far my main interest has been in this band. The effects of the ionization in the vicinity of the satellite can be seen in the records but do not affect the data except at frequencies very close to the resonances of the local medium. Apparent galactic temperatures and spectral indices have been obtained, and some effort has been devoted to a mapping of the galaxy: the interpretation of the results of this latter project are still uncertain because of the broad antenna beam that was used.

In Figure 1 you can see the kind of results that I am getting. The upper frame is obtained by scaling one frame of the AGC recording (this represents about 12 seconds in time: the equipment then recycles, so it repeats the measurement every 18 seconds). The middle frame is the computed response for the antenna network: the free space approximation is found to be a good one except in the vicinity of the local resonances. In this particular case, the departure sets in at about 1.8 Mc/s and values below this frequency are unreliable.

Also above 4 Mc/s the computed response is found to be unreliable due, we believe, to antenna interaction. The lower frame in the figure is obtained by comparing the two upper ~~waves~~ curves and represents the variation of apparent galactic temperature with frequency. The straight line approximation in the region 2 to 4 Mc/s is found to be quite reproducible, is independent of local electron density, and has a mean slope of -1.9 with extreme values of about -1.8 and -2.1. This means that temperature is proportional to $(\text{frequency})^{-1.9}$, or that flux density is proportional to $(\text{frequency})^{+0.1}$ in this range of the spectrum. These results cannot be reconciled with those obtained from ground-based measurements at Hobart.

My spectral index values are independent of location in the galaxy --- bearing in mind that the Alouette effective antenna beam is quite broad and cannot resolve individual galactic features. Accordingly, I would like to enquire how ionospheric absorption, that is D-region absorption mainly, has been evaluated and allowed for in the measurements reported by Ellis and his co-workers. While there can be little doubt but that regions exist for which the F-layer critical frequency at night is extremely low, and Tasmania is at about the right latitude for this, this does not necessarily mean that absorption at frequencies of 1 or 2 Mc/s can be neglected. The spectral index for galactic radio noise obtained from ground-based equipment would seem to be entirely dependent on the correct evaluation of ionospheric absorption. Can you tell me how this was measured?

Incidentally, the surprisingly high electron density reported by Hoyle and Ellis for the galaxy would be considerably reduced if my spectral index were used. This would be consistent with the interpretation that only a portion of the absorption occurred in the galactic gas and the rest in the ionosphere.

I am pursuing these studies further, but my main interest is in the solar noise enhancements at these low frequencies. Accordingly, much of the potential value of the records for galactic studies will not be realised, at least not in the near future.

Your query regarding low critical frequencies can be answered in part. Figure 2 shows a profile of electron densities as a function of height. The contours are identified by their plasma frequency. This diagram was prepared in this Establishment by Dr. G.L. Nelms and his co-workers and to my knowledge has not yet been published. Among other significant features of the top-side ionosphere, the "trough" at about 45°N geographic latitude stands out well. This particular record was obtained for a day of mild geomagnetic disturbance and may not be entirely representative. However, other studies show that the trough is a consistent feature of the night-time ionosphere, although it does not always last all night. Its width varies and its location in latitude changes slightly from day to day, being dependent on magnetic indices. In the southern hemisphere a corresponding trough is found at about the same distance from the magnetic equator. These results are somewhat preliminary as the studies on this feature are not completed.

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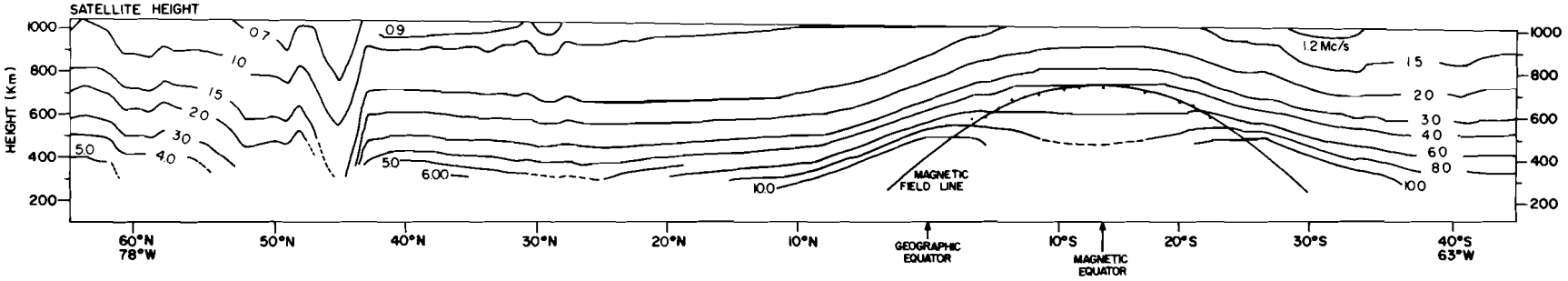
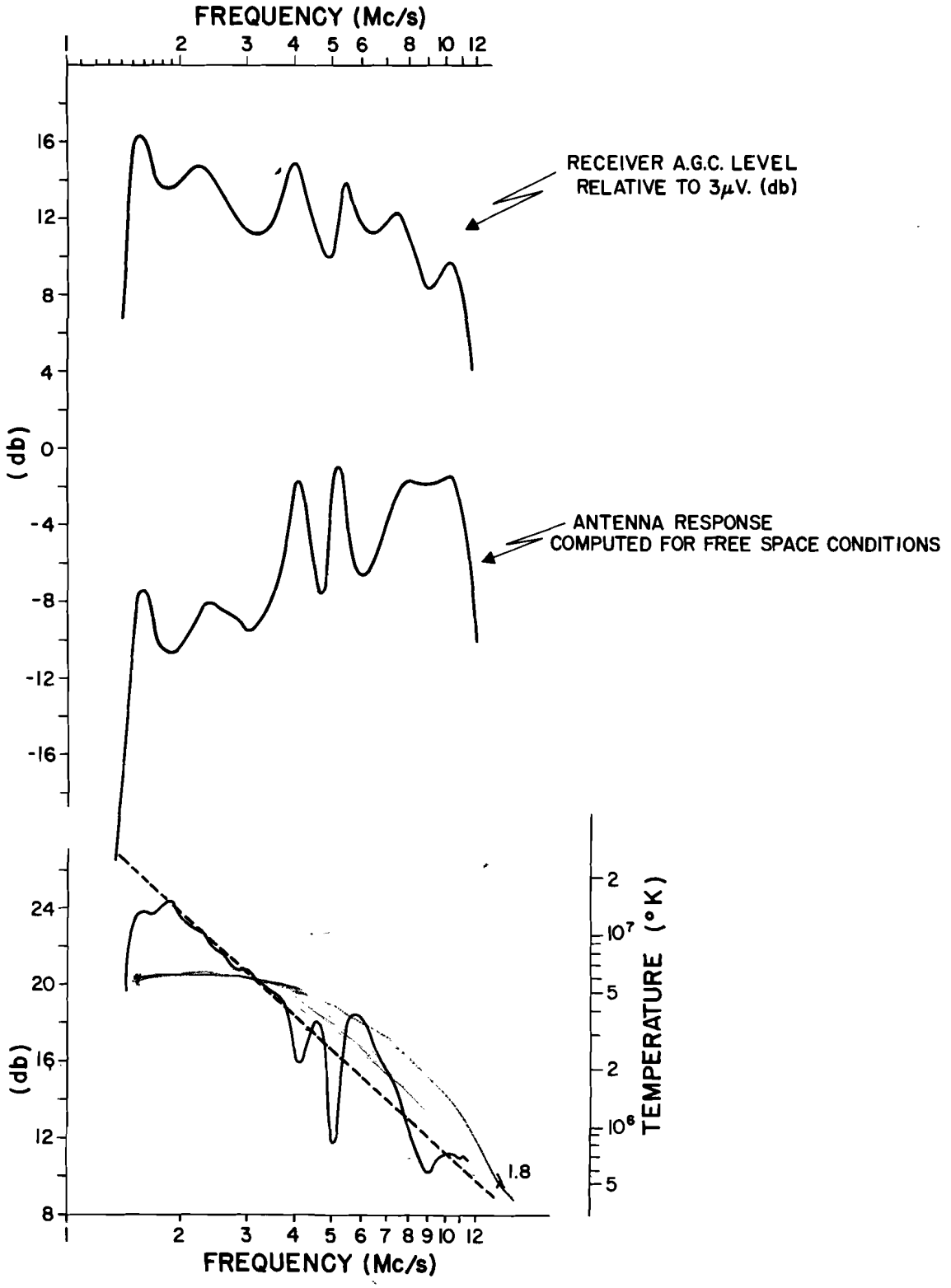
If you would like more information on these projects, we will do our best to satisfy your questions. Unfortunately, the publication of results is not up to date with the analysis. If you should find yourself in this part of the world in the near future, we would be pleased to have you visit us.

Sincerely yours,

T.R. Hartz.

Encls.


SATELLITE HEIGHT
HEIGHT (Km)
1000
800
600
400
200
0.7
0.9
1.0
1.5
2.0
3.0
4.0
5.0
5.0
6.00
10.0
1.2 Mc/s
1.5
2.0
3.0
4.0
6.0
8.0
10.0
MAGNETIC FIELD LINE
60°N 78°W
50°N
40°N
30°N
20°N
10°N
GEOGRAPHIC EQUATOR
10°S
MAGNETIC EQUATOR
20°S
30°S
40°S 63°W
GEOGRAPHIC LATITUDE
24 OCTOBER 1962 2318 HRS. GMT.


FREQUENCY (Mc/s)
1 2 3 4 5 6 8 10 12
16 12 8 4 0 -4 -8 -12 -16
(db)
RECEIVER A.G.C. LEVEL
RELATIVE TO 3μV. (db)
ANTENNA RESPONSE
COMPUTED FOR FREE SPACE CONDITIONS
24 20 16 12 8
(db)
1.8
2 10⁷ 5 2 10⁶ 5
TEMPERATURE (°K)
1 2 3 4 5 6 7 8 9 10 12
FREQUENCY (Mc/s)