



**CENTRE FOR RESEARCH COLLECTIONS
EDINBURGH UNIVERSITY LIBRARY
GEORGE SQUARE
EDINBURGH
EH8 9LJ**

TEL: +44 (0)131 650 8379

FAX: +44 (0)131 650 2922

BOOK-SCANNED 2018

SHELF MARK: Coll-37 MS2300.C344 (part)

TITLE: Papers of Sir Edward Victor Appleton

AUTHOR: Alexander, F.E.S.

N.B.

Scanned as single pages.

Blank pages have been omitted.

Due to variations in the density of the text some words are illegible.

The binding frequently obscures text in the guttering.

Ink in Original is badly smudged, some text is illegible.

Original pages are creased, some text is illegible.

The text contains some pagination errors.

THIS IS THE BEST COPY AVAILABLE.

The University of Edinburgh Library



This PDF is supplied under a Creative Commons CCBY License:

you may share and adapt for any purpose as long as attribution is given to the University of Edinburgh. Further information is available at <http://creativecommons.org/licenses/by/4.0/>

Please address all enquiries to Centre for Research Collections.

The Library wishes to be informed of work based on this Pdf copy, and would welcome a copy of any publication that makes use of it.

The University of Edinburgh is a charitable body, registered in Scotland, with registration number SC005336

R.D. 1/518
RADIO DEVELOPMENT LABORATORY,
DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH,
WELLINGTON, N.Z.

TITLE: REPORT ON THE INVESTIGATION OF THE "NORFOLK
ISLAND EFFECT".

By F.E.S. ALEXANDER

DATE: 1.8.1945.

COPY NO.....6..... FOR S.I.O., London.....
(For T.R.E.)

30°S.

35°S.

40°S.

RADIO DEVELOPMENT LABORATORY,
DEPT. OF SCIENTIFIC & INDUSTRIAL RESEARCH, WELLINGTON, N.Z.

REPORT ON THE INVESTIGATION OF THE "NORFOLK ISLAND EFFECT".

1. INTRODUCTION.

On April 1st, 1945, the officer Commanding Unit 51 (Norfolk Island) reported to R.N.Z.A.F. headquarters that since March 27th, 1945, an increase in noise had been observed on the C.O.L. range tube each morning and evening. The set, turning gear, aerial connections etc. had been checked and it was shown that this noise increase came from outside the set. The effect was observed only as the sun was rising or setting and lasted for about half an hour. The maximum increase of noise was on the bearing of the sun and rotation of the aerial showed noise fluctuations corresponding fairly closely to the radiation diagram of the aerial. At its maximum the noise reached saturation on the azimuth of the sun and peaks of noise were also observed on azimuths corresponding to the first and second pair of side lobes. Switching off the Transmitter had no effect on the noise and the increase was not observed on the B.L.4.

2. PRELIMINARY ACTION TAKEN.

The report from Unit 51 was referred to the Radio Development Laboratory of the Department of Scientific and Industrial Research and was discussed between officers of the R.N.Z.A.F. and R.D.L. It was decided that the phenomenon should be further investigated, firstly to ascertain the reality of the effect (which had not been reported before) and secondly to give some idea as to what further action should be taken.

Unit 51, which is on twenty-four hour watch, was instructed to record the increase in noise and the azimuth of maximum increase every few minutes and the time observations were taken daily so long as the taking of these observations did not interfere with operational requirements. A general description of the weather at the time of taking the observations was also asked for.

Units 4, 5, 6, and seven operating C.O.L.'s in North Auckland are on daylight watch only except for special periods when aircraft have to be tracked at other times. These Units were instructed to set special watches of an hour centred about sunrise and an hour centred about sunset and to take observations as detailed for Unit 51.

Enquiries were also made as to whether any sets on other frequencies had observed the effect.

No evidence of solar radiation on 200 Mc/s having been detected was found in the literature and calculations on black body theory indicated that the amount of energy available would scarcely be detectable on a fully efficient C.O.L. receiver. Southworth's work in the centimetre region indicated a general agreement with black body theory at these frequencies and it was felt that if the Norfolk Island effect were established an interesting field of enquiry would be opened up.

30°S.

35°S.

40°S.

3. RESULTS OF PRELIMINARY INVESTIGATION.

The results of the observations taken at the five C.O.L. stations are given individually below, together with notes on the various sites. The significance of the results will be discussed in paragraph 4.

3.1 Unit 51.

The C.O.L. stands at a height of 1,000 feet near the north western corner of Norfolk Island. There is an unobstructed view all round and the sun rises and sets over a sea horizon. The station is and has been on continuous watch but the phenomenon under discussion was not observed until March 27th, 1945. It is unlikely that it was developed to any noticeable degree before this date.

In the period March 27th to April 1st the weather was fine, the preceding week having been wet and foggy. The noise increase was very striking the grass reaching saturation on the azimuth of the sun and sometimes on azimuths corresponding to the first pair of side lobes.

During the period April 12th to April 23rd, the weather was variable and there was much rain and fog. The noise increase was observed only on the 12th, 14th, 20th, 21st and 23rd. On the first four days the effect was observed at sunset and on the fifth at sunrise. In every case there was more or less broken cloud along the horizon. On the 20th and 21st the azimuth of maximum noise was reported to be not that of sun, which was obscured from the station by cloud, but was about eight degrees to the north. In each of these cases the azimuth of maximum noise appeared to correspond with that of a brightly illuminated patch of sea. At no time was there any increase in noise observed on the B.L.4 or G.L.II.

3.2 Unit 6.

The C.O.L. stands at a height of 1,000 feet near North Cape, New Zealand. There is much high land in the vicinity, most of the hills being of nearly the same height as the station and the only really clear outlook is to the north. To the east and west the horizon is much broken and while the sun rises over a sea horizon for most of the year and can be observed always at a low angle to the west it sets behind hills and for most of the year is lost at a comparatively high angle. Also irregularities in the site are known to distort the vertical radiation pattern seriously and it is not at all clear where the lobes are on most azimuths.

The station is now on daylight watch only. Previously it was on continuous watch and never reported the "Norfolk effect". Special watches were kept from April 11th till April 17th. The weather was generally fine, though on four occasions there was either fog or an overcast sky.

No change was noticed in the noise level at any of the sunset periods. During two of the sunrise periods a very slight increase of noise was observed. On the first occasion (April 11th) the weather was fine, on the second (April 13th) there was heavy fog.

30°S.

35°S.

40°S.

3.3 Unit 7.

The C.O.L. stands at a height of 730 feet near Whangaroa on the East coast of North Auckland. The sun sets behind land but rises over a sea horizon. The station is now on daylight watch only. During the period in which it was on continuous watch the "Norfolk effect" was never reported. Special watches for the Norfolk effect were kept from April 12th to April 18th. No increase was noticed on the first two days. The Officer Commanding the Unit then decided that the effect might be too slight to be readily observed on the range tube and a microammeter was installed between the receiver output and the diode limiter. The procedure now adopted at this Unit was to record the meter readings for normal noise. The aerial was then swept slowly across the azimuth of the sun, the meter readings and azimuth being recorded every two degrees. The sweep was taken from normal noise on one side of the sun to normal noise on the other side of the sun. From one to five sweeps were completed in any one period of noise increase. On each of the days from April 14th to April 18th some increase of noise was observed at both sunrise and sunset. Where more than one complete sweep was taken the azimuth of the noise peaks could be seen to have drifted in the same direction as the changing azimuth of the sun. However, a comparison of the actual azimuth of any peak with the calculated azimuth of the sun at the same time seemed to indicate that at both sunrise and sunset the azimuth of maximum noise always lay about 3° to the north of the calculated azimuth of the sun. The timing of the radio observations was not very accurate as the time was taken at the beginning of the sweep and not at peak meter reading. Also the azimuth of peak meter reading may be out by about 1° . The difference in azimuth may not be significant. However, all four sets of observations in which this effect could be investigated showed it and it merits further investigation. The maximum increase in current on the different dates varied from about 10% to about 50% on the normal "noise current". For one set of observations the weather is reported as showery, for the rest the weather was fine with various degrees of cloud. There did not seem to be any correlation between local weather and the magnitude of the effect.

3.4 Units.

The C.O.L. stands at a height of 1580 feet near Maunganui Bluff on the West Coast of North Auckland. As observed from the C.O.L. the sun rises over land and sets over a sea horizon. The station is now on daylight watch but no sunrise and sunset effect was reported during the time when it was on continuous watch.

Special observations were taken from April 11th to April 17th. No increase of noise was observed at any of the sunrise periods. On the evenings of the 12th, 14th, 15th, 16th and 17th a slight increase in noise (from $1/16''$ to $1/8''$ on different occasions) was observed just before sunset. The noise increase was spread over from 8° to 16° in azimuth. On the last four occasions the maximum noise was approximately on the azimuth of the sun. On April 12th, however, there seems to have been a slight increase ($1/16''$ increasing to $1/8''$) at an azimuth some 60° higher than that of the sun. The sky

30°S.

35°S.

40°S.

was overcast and there was local rain at the time and this increase may not have been the effect sought.

3.5 Unit 4.

The C.O.L. stands at 840 feet on a cliff top on the west coast across the isthmus from Auckland city. The sun rises over land and sets over a sea horizon as observed from the station. The station keeps daylight watches and is also 'on the air' whenever aircraft are expected at other hours. During the time when the station was on continuous watch the 'Norfolk Island effect' was never reported. Special observations were made from April 10th to April 19th but during four sunrise periods and one sunset period full observations could not be made as the set was required to track aircraft. On three occasions an increase in noise was observed. On April 13th there was an increase of 0.5 cm. in the noise level for about 15 minutes after sun rise. The effect was spread over 5° to 8° in azimuth and there was no drift of central bearing. On April 18th there was an increase of noise for 15 minutes before sunset. The maximum increase was 1.0 cm. in the middle of the period. The width of the disturbance was from 4° to 10° in azimuth and there was no drift of azimuth. A similar effect was observed at sunset on April 19th but the maximum noise increase was only 0.5 cm.

4. DISCUSSION OF RESULTS OF PRELIMINARY INVESTIGATION.

Observations of noise level in C.O.L. receivers in the New Zealand area indicate that at sunrise and sunset a detectable amount of noise over and above normal noise is received from a direction roughly that of the sun. The observations outlined above are admittedly crude but they do seem to indicate that more energy is sometimes radiated from the sun on 200 Mc/s than would be expected on black body theory. It appears that there has been an increase in this energy recently though too much stress should not be laid on this increase. In the New Zealand stations the increase over normal noise was so small that it might in the past have been missed. At Norfolk Island, however, the increase was quite striking. The officer who was in charge of the station when the effect was first noticed had been there for a year and is convinced that had there been any increase before it would not have passed unnoticed.

Comparison between the results obtained by the different units cannot be exact. In table I where ever figures have been given for normal noise and noise increase the increase has been expressed as a % increase on the normal noise. The figures suggest that the effect is stronger at Norfolk Island than at the southern stations.

30°S.

35°S.

40°S.

TABLE I.

Date & time	Unit	51	6	7	2	4
April 11th	sunrise	Nil. Rain & fog	Very slight	Nil.	Nil.	Operational
"	"set	" " " "	Nil.	"	"	Nil.
April 12th	"rise	" " " "	"	"	"	"
"	"set	100%	"	"	slight 60° off azimuth	"
April 13th	"rise	Nil. Rain & fog.	Very slight	"	Nil	Operational
"	"set	" " " "	Nil	Meter installed	"	17%
April 14th	"rise	" " " "	"	20%	"	Nil
"	"set	100%	"	48%	slight	"
April 15th	"rise	Nil. Rain & fog	"	7%	Nil	"
"	"set	" " " "	"	23%	slight	"
April 16th	"rise	" " " "	"	40%	Nil	Operational
"	"set	" " " "	"	30%	slight	Nil
April 17th	"rise	" " " "	"	50%	Nil	"
"	"set	" " " "	"	22%	slight	Operational
April 18th	"rise	" " " "	No obser- vations	24%	No obser- vations	"
"	"set	" " " "	"	40%	"	33%
April 19th	"rise	" " " "	"	No obser- vations	"	Nil
"	"set	" " " "	"	"	"	17%
April 20th	"rise	" " " "	"	"	"	No obser- vations
"	"set	100%	"	"	"	"

Results of noise level observations on five C.O.L. stations in the New Zealand area.

It is apparent that this effect merits systematic investigation and action has been taken as shown in paragraph 5 below.

5. FURTHER INVESTIGATION OF THE NORFOLK ISLAND EFFECT.

As soon as it had been established that the Norfolk Island effect was significant and was connected with radiation from the sun, enquiries were made in the United Kingdom, Australia and U.S.A. through the New Zealand Scientific Liaison Officers, as to whether similar effects had been observed elsewhere. As far as is known the effect has not been observed in Australia. In America solar radiation is under investigation in the centimetre region and cosmic noise at lower frequencies but no reference has been found to solar radiation on 200 Mc/s. Southworth⁽¹⁾ quotes Reber as stating that he had not detected any solar radiation on the frequencies at which he was working. However, the description of Reber's experiment⁽²⁾ indicates that owing to terrestrial interference the effect would be difficult to detect at the site employed. In England long wave solar radiation is under investigation and Sir Edward Appleton states that work done in New Zealand on this problem would be of interest.

A more detailed investigation of the effect was put under way and observations are about to start. Each of the five C.O.L. units and any Army and Navy stations that can take the observations are being supplied with specially designed vacuum tube voltmeters and signal generators. The V.T.V.M.'s are to be inserted just after the second detection of the radar receivers to measure noise voltage. The signal generators are to be used to supply standard signals for calibration purposes. The signal generators have all been

30°S.

35°S.

40°S.

calibrated against laboratory equipment and will be recalibrated on return from the field. With reasonable care the signal generators should hold their calibration. As the station sites are very varied and the terrain is usually hilly it is not possible to feed the signal in to the aerial at the various stations with any hope of obtaining comparable conditions. Therefore the signal is to be fed into the feeder lines to the aerial, with suitable precautions for uniformity. The procedure proposed is to switch off the transmitter, turn the aerial about 90° from the sun where the noise is normal, connect in the vacuum tube voltmeter and record the meter reading. The signal generator is then connected in and the attenuator adjusted until the vacuum tube voltmeter meter reading is a little above the normal noise reading. These meter readings and the attenuator reading are recorded. The signal generator is disconnected and the set is ready for noise observations.

When an increase in noise voltage is observed, either of two procedures is adopted. Either the aerial is swept backwards and forwards across the sun's azimuth from normal noise through maximum to normal noise again and meter reading, azimuth and time is recorded every two degrees. Or the aerial is swung just sufficiently to determine the azimuth of maximum noise and meter reading, azimuth and time is recorded every one or two minutes. These observations are to be carried out over the sun rise and sunset period daily operational requirements permitting. Weather observations, with particular reference to amount and position of cloud cover, are to be made for each set of measurements.

Results outlined in paragraph 3 above indicate that there may be some deviation of the angle of arrival of the radiation from the azimuth of the sun. As all the observations have been taken on the lowest lobe of the radiation diagram this may be an atmospheric effect or a local site effect. A suggestion has been made that the effect is only observed when the sun is rising or setting behind broken cloud and that the noise comes not directly from the sun but from brightly illuminated patches of sea. The experiment outlined above was designed to clear up these points as far as possible with the equipment available.

6. CONCLUSION.

The results so far obtained are too few and insufficiently accurate for a foundation for any kind of theory. There is a strong suggestion, however, that there was an increase in solar radiation on 200 Mc/s observable in the New Zealand area at the end of March and during April of 1945. There is some suggestion of a concentration or focussing of this radiation when the sun is at low altitude as the effect has not been observed at a sun's altitude of greater than 8° above the horizon.

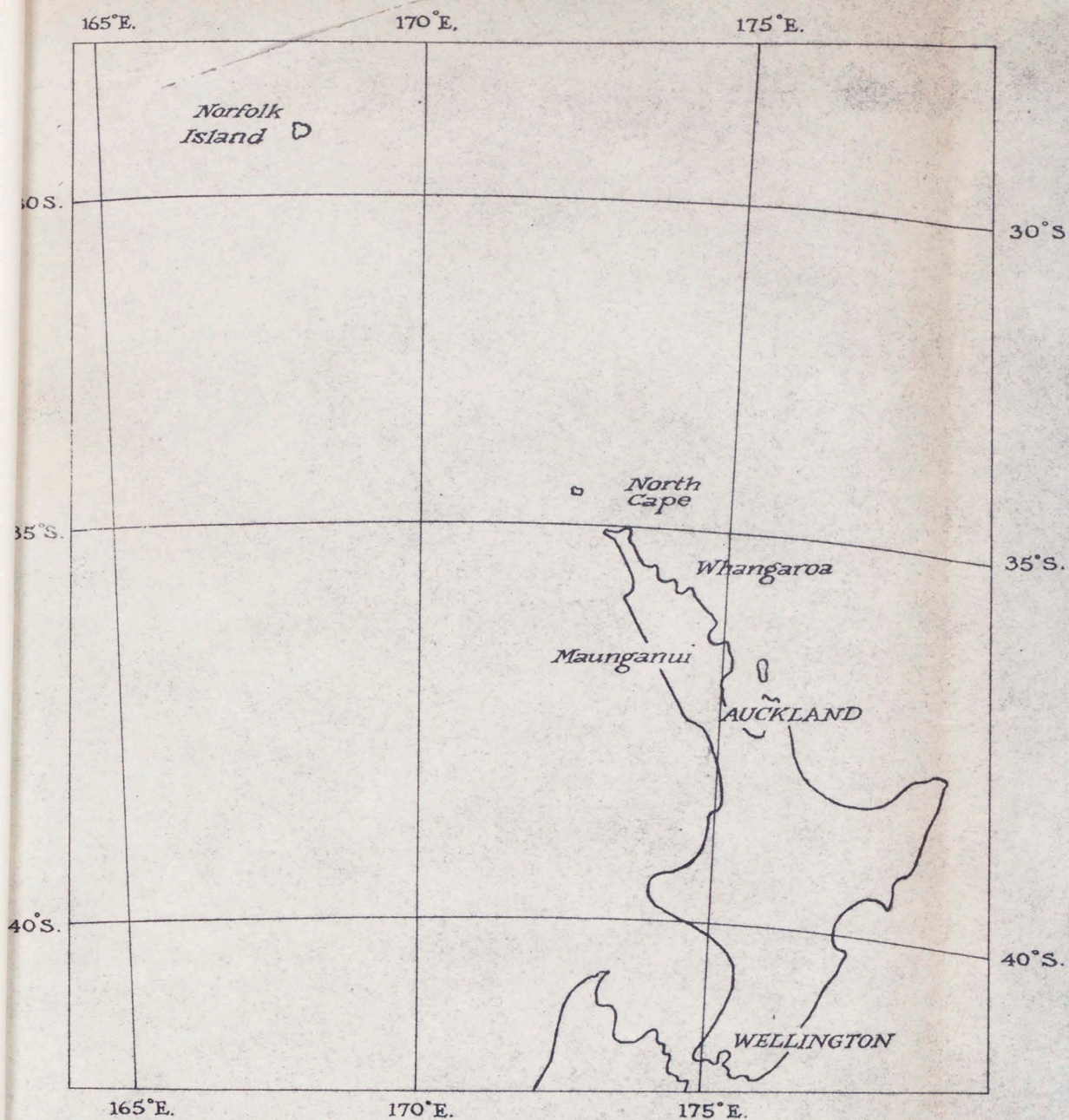
REFERENCES.

- (1) Southworth, G.C. "Microwave Radiation from the Sun". June 1st, 1944.
Bell: Tel: MM-44-160-30. (See also Journal of the Franklin Institute for April, 1945.)
- (2) Reber, Grote. Cosmic Static Prox. I.R.E., Vol. 30, No. 8. August, 1942.

30°S.

35°S.

40°S.



R. D. 1/518

*Rough Map shewing Location of Sites at which 200 Mc/s.
Radiation from the Sun, is being investigated.*

FIG. 1