March 28th, 1952
Wailuku, Maui, T.H.

Dr. Newbern Smith
Radio Division
National Bureau of Standards
Washington 25, D.C.

Dear Dr. Smith:

Enclosed is a memorandum on the "Source of Solar Radio Transients". Some time ago Virginia wrote to me soliciting a paper for the spring URSI meeting. At the time I had nothing to offer. However, if you see fit, please turn this memorandum over to her as my contribution towards the success of the meeting. She may read it if you wish.

Since writing to you in January I have had further information from the New Zealand department of Posts and Telegraph. During the life of the great spot of the spring of 1947 they observed numerous surges of solar radio waves on various direction finding apparatus. The lowest measured frequency was 6.7 megacycles where the surges lasted from a half to one minute. If a mean duration of three quarters minute is taken, this value fits very well into the empirical relationship of

$$T = \lambda$$

Thus it seems that this simple formula holds over several hundred or perhaps a thousand to one in frequency.

Unfortunately, I will not be in Washington in April but I may get to Canberra in August.

Sincerely yours,

Grote Reber

Grote Reber

SOURCE OF SOLAR RADIO TRANSIENTS

by

Grote Reber

Wailuku, Maui, T.H.

The temporary great intensities of solar radio waves known as bursts have been studied in great detail by many investigators. Their radio characteristics are quite well known. Fine structure measurements indicate the sources must be very small parts of the solar atmosphere. Considerable effort has been expended by some observers trying to correlate these bursts with visual solar phenomena. The results have been meager. About all that can be demonstrated with certainty is that solar radio bursts are most likely to occur during periods of great solar activity.

It may be recalled that the camera merely tells us what is going on in the lowest available layer of the solar atmosphere, namely the photosphere. The spectroheliograph tells us what is going on in the reversing layer which is only slightly above the photosphere. The coronagraph tells us what is going on in the chromosphere and the inner part of the corona over a very limited region at the periphery of the solar disk.

Eclipse measurements show that longer and longer solar radio waves are generated in progressively higher and higher parts of the solar corona. Even 1 cm. radiation is generated considerably above the reversing layer. Thus the poor correllation between bursts at meter waves and optical phenomena is

not surprising because these are quite incommensurate quantities. The purpose of this note is to give some publicity to a little known or understood solar phenomenon in the hope of aiding in resolving the above impasse.

On a recent visit to Mount Wilson, my attention was called to a phenomenon known as the Hydrogen Bomb. This was written about by Ellerman in the Astrophysical Journal dated October 1917, Volume 46, pages 298-300. He shows photographs and enumerates the difference in nature from a flare. If one sets the slit of the spectrograph directly on the H_α line this bomb phenomena will never be observed. It is necessary to set the slit slightly to one side of the line. Then without any disturbance of the line (quite different from a flare) there may be observed substantial broadening of the line in emission at both sides. The emission is suffisiently intense to be seen above the solar continuum out to a distance of 10 or more angstroms from the center of the H_α line. The brightening will occur only over a very short part of the line and appears as jets out both sides of the line. Perhaps a region ofthe solar disk smaller than a granulation is responsible. The phenomenon could only be found in the hydrogen lines and thus was named the hydrogen bomb. Its duration is usually from one to three minutes which is the same as that of a typical solar radio burst. Ellerman goes on further to state that sometimes several of these bombs go off in quick succession like a string of Roman Candles over a period of an hour or so. This agrees with a typical solar radio outburst.

Newall the above is going on at the sides of the H_α line without any observable effect in the line. Thus it seems highly

improbable that anything is happening in the reversing layer. Ellerman considers the bomb phenomenon to lie well below the reversing layer and might be considered in modern terminology as a kind of intense subterranean flare wherein hydrogen only participates. I was also informed that microphotometer tracings made of a bomb show that the continuum adjacent to the line is not brighter than the general photosphere. What happens is that the wings of the H_α line are reduced or eliminated so that the bomb area merely appears brighter than the continuum adjacent to the line elsewhere.

How this low level disturbance can be projected into the outer atmosphere of the sun where it might set up solar radio bursts has not been considered. Perhaps it could start a pressure wave suitable for initiating the progressive type of burst described in Science. Or it could be a very powerful source of radiation in the far ultraviolet which might leak out of a region just below the photosphere. The main features presently in favor of this phenomenon are its duration which is commensurate with a burst and its origin in a very small part of the sun, plus the fact that both bombs and bursts are usually associated with growing spots.

All in all, the various bits of evidence presently available indicate that it may be profitable to attempt correllations between solar radio bursts and solar hydrogen bombs. They nearly always occur at the edge of spots which are growing. Since the next few years will be of low solar activity the immediate future is not an auspicious time for such studies. However they seem well worth following up during the succeeding rise in solar activity during 1956-1960.