QP

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Mr. Ralph Williamson
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Dear Ralph:

Thank you for your very inquisitive letter of the 18th. From time to time I have described orally how I became interested in the subject of radio astronomy and now may be a good time to have these remarks put down on paper.

From about 1927 until 1934 I was a radio amateur W9GFZ and a DX addict of a rabid sort. These people take great pride in obtaining QSL cards (which verify 2-way communication) from far distant places, and then nailing these upon the wall. After a time this indoor sport began to pall and furthermore domestic difficulties were being encountered due to the plaster on the walls coming down. Also, cards from 60 countries and all six continents had been secured. Thus I began to look about for other interesting things to do. About this time Jansky published his series of papers which dated from 1932 to 1935 and I was greatly impressed. It appeared that he had made a phenomonal discovery and that information upon the exact direction of arrival of these radio waves would be of great interest. Having recently graduated from school and having learned something of physical optics and theoretical physics I deduced that experiments should be made at short wavelengths. First, because the resolving power of any optical devices is proportional to the size of the device in wavelengths and consequently for any given device more wavelengths can be crowded into its aperture when the wavelength is small. Second, Planck's radiation formula predicts that a blackbody radiator will have an intensity per unit band width proportionnal to the square of the frequency when the frequency and temperature are low. Also, about this time Southworth described his series of experiments upon waveguides and I was able to secure a small magnetron from RCA for use as a signal generator. Armed with this information and equipment I decided to build the 32 foot mirror which is now located at Sterling, Virginia. This mirror was constructed during the summer of 1937. During the following winter a receiver was built having a frequency of 3,300 Mc/s. It used a home-made adjustable crystal detector and

a battery powered audio amplifier of 120 db gain. The crystal detector was mounted in a cavity resonator of my own design (see Communications of Dec. 1938). The cavity resonator and audio amplifier were installed at the focal point of the 32 foot mirror. The ratio of my operating frequency to Jansky's operating frequency of 20 Mc/s was 165. This factor squared is approximately 27,000 times. Thus if these newly discovered radiations were from a black-body, exceedingly crude equipment would suffice for their measurement. Since the above 3,300 Mc/s equipment was incapable of detecting any radiation it was immediately obvious that the source was not operating in the manner of a black body.

About this time RCA brought out the triode type acorn tube. Two of these were connected to a push-pull oscillator at a frequency of 910 Mc/s. This regenerative detector and a new cavity replaced the previous crystal detector input circuit. Again this equipment failed to detect any celestial radiation at 910 Mc/s.

By this time I had gained some experience in the radio industry and began to realize the problem of internal noise in a receiver. Experience indicated that a simple superheterodyne receiver was far inferior to a tuned radio frequency receiver in relation to internal noise for reasons now well understood. About this time (summer 1938) RCA brought out tetrode acorn tubes. Several of these were constructed into a multi-stage radio frequency amplifier at a frequency of 160 Mc/s. Considerable of the inspiration for this receiver was obtained from Research Paper RP-856 published by the National Bureau of Standards dated October 1935. The frequency of 160 Mc/s was chosen for two reasons. The first was that acorn tubes would operate very well at this frequency. The second was that large sheets of aluminum came in lengths of 12 feet long. When designing the focal point cavity for use with this receiver the largest possible drum made with one weld turned out to be about 46 inches in diameter. The lowest frequency at which this drum would function was about 160 Mc/s. Thus, these mundane matters determined the frequency choice. With this apparatus useful results began to be secured in the month of March 1939. The rest of the story is reasonably well told in the literature.

During the summer of 1937 I had correspondence with R. M. Langer of CIT and he informed me that he had made some experiments in the desert which roughly verified Jansky's discoveries. This winter at New Haven, Jessie Greenstein showed me some pictures of this early equipment which Langer had given him. Apparently Langer had set up twin loops on top of one of the buildings in the city and had been unsuccessful because of large amounts of local man-made noise. Then Langer put all of the equipment into a small car and drove out in the desert. He set up a piece of pipe for a mast about 15 feet high. He connected one end of his dipole to the mast and the other end to his car. His equipment (located in the car) was battery operated and he could determine the general direction of arrival of the waves by driving his car in a circle about the mast.

During 1937 I had some correspondence with Jansky wherein I questioned him more closely about his apparatus and results. He could add little to what was already published and suggested that a more profitable endeavor would be to make new measurements instead of attempting to extract more dubious information out of old data. This outlook I am now well able to appreciate.

I am having some photographs made as you requested and will send them to you at Ithaca if possible or if not, I will send them directly to you at Richmond Hill.

Very truly yours,

Grote Reber
Experimental Microwave Research
Central Radio Propagation Laboratory

GR:FMT