Sunday Noon

4 Dec 1938

Dear Grote:

Friday Afternoon I want over to MIT to see Barrows with whom you had some correspondence in 1937 and he was interested in what you were doing. I showed him the pictures of your machine and also the last letter you wrote to me explaining the theory of the source of the waves. He said he knew little about that sort of thing andthat your letter was Greek to him. I asked him about Sloat's thesis and he said it would likely be of small assitance to you in what you were doing. However, I told him I felt incompetent to judge on his explaination, andthat I would like to see it.

They are plenty cagey about letting outsiders see these theses and I had to sign my name about 10 times before they would give it to me. Even then I had to use it in the Library there and there is absolutely no chance of my taking it out. Consequently, I took down in long hand (with abbreviations) the Introdudtion which tells what he proposes to do, andthe Conclusion which tells what he found out by his efforts. Likewise, I looked throughit to get the organization of the paper and it is given in brief on the attached paper. If the material I took down appears to be what you are looking for and you wish to get the method of procedure, I can turn on the charm andtry to take a typewriter into the library over there and perh aps take off the whole damn thing---they should have some side rooms where I could work---on a machine it would be only a matter of a couple of hours to get it in toto. Likewise, if you want to know about the diagrams I can copy those, and I can arrange to have photostats made of the charts if you think that they are important; I checked on that when I was there Friday. From my own experience---aside from the technical aspect---I didn't think the paper was too well written; I could have done better myself. Also, there was an appearance of trying to pad the things with too many photographs ofthe equipment---pretty but of no consequency.

In talking with Barrow I tried to explain the method of your attack on the problem. He could understand your procedure until we got to the antenna in the drum and the receiving mechanism attached to the top of the drum. I could give him the dope up to the antenna in the drum and beyond that I couldn't be any more than vague about your procedure with the hollow copper tubes and the little radio tubes etc etc. Whereupon, he suggested some articles which might be helpful to you, in his opinion. They are as follows:

1. "Radiation from Rectangular Hollow Metal Pipes". I. R.E. for December,1938

2. Hansen " Atype of Electrical Resonator" Journal of Applied Physics, October 1938.

3. Paper on the designs of metal horns for directional antenna to be published in one of the early 1939 issues of the Electrical Engineer.

I tried to get an appointment with Prof. Whipple, but he wouldn't be back at school until Monday so I shall call for another appointment then. If there is anything else you want me to check on before I come home, let me know because it will be much easier to explain my findings than to write them.

Take it easy,

Schuyler

Intboduction:

Directive Wireless Communication had its beginning in 1888 when Hertz by use of parabolic metal reflectors definitely established the existence of free electromagnetic waves in space. There are several possible advantages of direbtive systems over the general broadcast method.

1. Concentration of Radiated energy.
2. Application of methods of visual surveying to wireless
3. To overcome severe atmospheric disturbance.

Hertz used parabolic metal reflectors for short electromagnetic waves when he established the existence of such waves in 1888. Much research done since then by R. C. A., the Bell Laboratories, etc.

However, it appears that no work has been done on cylindrical metal reflectors for short waves. The use of cylindrical feflectors suggests the possiblity of producing a type of space resonance effect which will materially alter the impedance of the antenna placed alongthe axis ofthe cylinder. This may result in the production of a directional field pattern for the radiation field. Problems that this thesis proposes to attack are:

1. The investigation of field pattern around the cylindrical reflector system for various angles of opening ($\phi$) and for various radii ( r ).

2. Possibility of measuring the complex impedance of the antenna by means of a transmission line.

3. The possibility of determining the diffraction around a cylindrical edge and the impedance ofthe antenna by analytical means.

4. The most important consideration---and to which themost attention will be given in this thesis---the measurement of radiation field patterns.

The diagram attached below was copied out of the text; Z apparently goes to the apparatus---the oscillator.

Theory ---A few formulas and diagrams

Experimental Apparatus--- Four circuit diagrams of oscillator and receiver and numerous photographs of the apparatus.

Experimental Procedure--- Much text, one diagram, and one formula.

Data --- 32 pages of chartings on polar coordinate paper

Conclusion ---

The results show that a cylindrical reflector gives directional field patterns, the amount and direction of the field depending on the angle of the reflector's opening. For angles of opening less than 60 degrees the central beam is not very well defined and is less intese than the two lobes which appear at 90 degrees to each side of the opening.

As the angle of reflector opening was increased from 60 degrees, there seems to be a critical angle between 60 and 80 degrees where radiation from the system assumed a wide central beam with diffraction lobes at the sides becoming smaller. For angles above 80 degrees the field patterns show radiation gradually assumes the shape of one main lobe with small lobes at side decreasing in intensity. This was true for all various radii used, and especially for a radius equivalent to $\frac{1}{4}$ wave length.

Tests were made with 3 different radii for reflector: 1/8, $\frac{1}{4}$, and 3/8 wave length. For each of these the angle of opening was varied from 30 degrees to 180 degrees. Field patterns show effect of different radii on shape of field is not very great; that is, the shape of field patterns are in general th same for all radii tried. The most satisfactory results were obtained for a radius of $\frac{1}{4}$ wave length.

Extensive tests show that concentric conductors are very satisfactory for transmission lines. This type of transmission lin e very satisfactory in eliminating radiation from the reflector itself---much superior to results obtained from parallel wire feeder systems through solid metal reflectors. Whenever there is a differ nce in potential between the transmission line and the reflector itself there must necessarily be energy taken from the transmission line with resulting distortion and radiation from the reflector. The only way to eliminate this distortion is to eliminate the field between the reflector and the feeder line. If the line is fed through the rear of reflector, some sort of concentric conductor must be used. This thesis show that a brass tube with a bare copper wire down the center makes an excellent concentric conductor, with the tube as one conductor and the wire as the other. If a split dipole is used as an antenna, this system may be used to great advantage with solid metal reflectors.

The rest of conclusion consisted of a statement as to the consistency of the results obtained---very consistent---and because this was so the author apparently was convinced that the method was proper. Then followed a re-dapitulation in a few words of the experiment which gave absolutely no infor mation so I ommitted it.

From talking with Barrows and from reading the thesis with my untechnical training I gathered the following situation about the experiment. This reflector was a piece of galvanized (iron) metal about five feet high supported on a framework about three or four feet off the ground. This reflector was the center of a circle some fifty or 75 feet in diameter. This circle was marked off into arcs of 10 degrees forthe full 360 degrees and stakes driven into the ground at these points The wave length was held constant at 2.1 meters while the angle of openingwas varied. The receiver was a very small gadget which was worn around the experimenter's neck as he walked around the perimeter of the circle. How the chartings were made I don't know.