Editor's note: The following is a transcript of a speech given by William T. Slayton to the Arcturus Men's Club of Key West in 1980, three years after his retirement from the National Aeronautics and Space Administration. Mr. Slayton's handwritten notes have been incorporated into the transcript.

Speech to Arcturus Club
Key West, Florida – Oct. 10, 1980
By Bill Slayton

My Experiences at the Naval Research Lab

I first want to thank Bill Seeker for supplying this View-graph from the Florida Keys Community College.

I'm one of a very limited number of people in this world who have not only seen a Black Hole, but actually entered it, explored its secrets, and lived to tell the tale. What's more, I can prove it.

May I have the first picture, please. Thank you very much.

(Fig. 3, p. 3 of NRL Report)

I guess I should explain that this Black Hole was an anechoic chamber in Building 52 at the Naval Research Laboratory in Washington. The term anechoic chamber, of course, means an anti-echo chamber – in this case, a microwave dark room.

I was in the Antenna Research Branch, and my project was to develop a set of microwave antenna gain standards. Hence, the Black Hole – a room designed to prevent reflection of microwaves from the walls, floor, and ceiling. [Mention absorbent material (hair flex)]

[Show cover page & explain will get back to this report]

(Turn off or remove picture.) (Fig. 3)

The term Black Hole is applied in retrospect, for this effort took place in 1952, 1953 and 1954, when astronomy was still in the Dark Ages, relatively speaking, (or should I say relativity

speaking?) The Big Bang theory was only speculative in those days. It's hard to realize that that was a quarter of a century before Penzias and Wilson received the Nobel Prize, for proving that the Big Bang was what began it all.

I know that several of you gentlemen have either visited the Naval Research Lab or have had occasion to deal with the Lab in your military careers. In fact, Roy Anderson recently gave us a talk on his experiences while working at NRL.

I spent five of the best years of my life at that beautiful spot on the banks of the Potomac. The buildings (there were 52 of them) weren't all that beautiful by today's standards, but it was a beautiful place to work. Those functional white concrete buildings were beehives of scientific activity.

Much of the development of radar took place there. I should mention that I was sent to radar school there during World War II. I remember seeing a captured German radio antenna and waveguide assembly laid out on a flatbed railroad car – it was that large. The Germans were still operating at comparatively long wavelengths (or low frequencies, if you prefer), at what we called L-Band, in the region of 30 centimeters, which is 1000 megahertz. The result was that they were stuck with large, cumbersome waveguides which resembled air conditioning ducts. Thanks to the development of the magnetron, we were operating at S-Band, where the waveguide was about the size of a 2x4 inch cross-section, and X-Band, where the waveguide cross-section was (and is) about ½ inch by 1 inch. So we had a tremendous advantage in size and weight over the Germans.

Among other types of research at NRL were Sonar, Radio Astronomy, and Sounding Rockets for upper atmosphere research. I remember in particular that Fred Whipple was very active in developing Radio Astronomy. Some of you may know him, or know of him.

By far the most dramatic and exciting day in my experiences at NRL occurred one day in 1954. My boss, Dr. John Bohnert, gathered together a group of us in a hush-hush atmosphere and told us that President Eisenhower had ordered the development of a device to be called a satellite, which would orbit the earth continuously for an indefinite period. This was to be ready for launching during the International Geophysical Year (the IGY) in 1957-1958. The name of the project was Vanguard. Our job was to design a suitable antenna for it. The prime responsibility fell on Al Simmons, a good friend of mine. It's hard to realize now what an earth-shaking effect that had on us at the time. Of course, today, most satellite launches are barely mentioned in the news, but then it was a big deal indeed.

Many of my cohorts at NRL moved on to NASA when it was formed. The Goddard Space Flight Center at Greenbelt, Maryland, right outside of Washington, relied heavily on former NRL personnel, as well as on a large contingent from White Sands, New Mexico.

Getting back to my antenna gain standards project, this report of mine is the fruit of my long hours of observations in the Black Hole.

(Show cover)

Very simply put, the gain of an antenna is its capability of concentrating a transmitted signal in one direction. I could talk about isotropic radiators as point sources, etc., but I don't want to lose half my audience. Here is a simple analogy that illustrates the point – a flashlight bulb and reflector. Without the reflector the bulb would emit light equally in all directions, but the light would be very weak. Put the bulb in its reflector and you have a tremendous increase of light in one direction. This is the gain due to the reflector. The reflector collects and radiates light waves in the same way that these horns collect and radiate the microwaves being fed into them.

The purpose of these gain standard horns was to provide an accurate standard at each waveband in the microwave region.

We dealt in terms of centimeters for convenience, but for the benefit of megahertz lovers, the range was from 950 to 39,000 mhz. This is from 31.5 cm down to 0.77 cm.

These horns were designed to be easily duplicated. They had a useful, practical gain figure, and they were very carefully calibrated. It took many months of painstaking, experimental measurements to verify their accuracy. I'll spare you the details, but a few illustrations should give you some idea of the work involved.

1. Show pp. 15, 18 and 22 of NRL report.
2. In those days there were no computers available, and I spent many, many hours using a Frieden or Marchant calculator.
3. Show p. 8. The arrow here points to Schelkunoff's gain formula, which was used in the calculations.

I also wrote an article for Electronics Magazine on the same subject.

(Show cover of Electronics Magazine and pass around reprint.)

These horns were adopted as standards by the Inter-Service Antenna Group.

After this work was published, a number of commercial companies in the microwave field built standard gain horns from the data supplied in my NRL report. Among them were Scientific Atlanta, Waveline, Inc., F-R Machine Works, Stavid Engineering, and Carl W. Schutter Manufacturing Company. [Show companies' sheets] They are still in use today in the microwave industry.

I never received any financial reward from this, except for my salary, because this work was done on government time. I understand that today it is standard practice for a government

employee to receive one-half of the rights or royalties if his work results in a commercial product.

Perhaps I was born twenty-five years too soon.

Thank you.

If you have any questions, I'll try to answer them.

References:

Slayton, William T. *Design and calibration of microwave antenna gain standards.* NRL Report 4433, Microwave Antennas and Components Branch, Electronics Division, Naval Research Laboratory, Washington, DC, November 9, 1954.

Slayton, William T. *Design of microwave gain-standard horns.* Electronics, pp. 150-154, July, 1955.

A brief biography of the author:

William T. Slayton, Jr. was born on February 1, 1914, in Morrisville, VT, the son of a doctor and grandson of a Civil War captain. Mr. Slayton studied electrical engineering at the University of Florida in Gainesville, FL, and at the George Washington University in Washington, D.C. During World War II, Mr. Slayton served as a Radio Technician First Class in the United States Navy, receiving training at the U.S. Naval Training School, Theodore Herzl, Chicago, IL; College of the Ozarks, Clarksville, AR; and the Naval Research Laboratory (NRL) in Washington, D.C. After the War, Mr. Slayton continued his Navy service as a civilian employee at the NRL, during which time he invented a design for microwave gain-standard horns that is still used today. Following a brief employment with The Martin Company in Baltimore, MD,

Mr. Slayton returned to the service of the U.S. Navy as a civilian employee at the Westinghouse Air Arm, in Baltimore, MD. In 1961, Mr. Slayton, along with many fellow engineers from the NRL, moved to the National Aeronautics and Space Administration, Goddard Space Flight Center, in Greenbelt, MD. Mr. Slayton continued his service as a senior engineer in the unmanned space flight program at NASA until his retirement in 1977. After enjoying many years of retirement in Florida and North Carolina, Mr. Slayton died on December 1, 2000.