THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA

FOR THE PROMOTION OF THE MECHANIC ARTS

Hall of the Institute,
Philadelphia, October 17, 1962.

Report No. 3385.

Investigating the Work of

Grote Reber

in Radio Astronomy.

THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA

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Committee on Science and

the Arts Case No. 3385.

The Franklin Institute of the State of Pennsylvania, acting through its Committee on Science and the Arts, investigating the Work of Grote Reber in Radio Astronomy, reports as follows:

It is well authenticated that Grote Reber was the first to follow-up experimentally on the discovery by Carl Jansky in 1932 of extra-terrestrial radio noise. Jansky had made his discovery in the course of a study of atmospheric static.

During the period of 1936 to the early Forties, Mr. Reber was the only radio astronomer in the world. During this period, he constructed the world's first radio telescope, made numerous measurements of gallactic and solar signals and steadily improved the techniques. This work was done in Mr. Reber's spare time.

The concept of the Universe has been appreciably enlarged by radio observations in recent years. Radio waves are emitted from the Moon, Venus, Mars,

Jupiter, and Saturn, from the Sun's gaseous atmosphere, from the debris of exploded stars, from neighboring galaxies of stars, from clusters of distant galaxies, from clouds of gas in the spiral arms of our Milky Way galaxy, from very distant Island Universes in collision, and from hundreds of invisible and unsuspected heavenly objects, popularly called radio stars. Radio studies have now taken the lead in mapping the structure of our own galaxy, and have revealed the fact that the Milky Way is a rather tightly wound spiral galaxy. Many astronomers believe that some of the fainter radio sources are at distances beyond the range of present optical telescopes and that with the recent attainment of Doppler shift measurements on the radio hydrogen-line radiation from distant galaxies, cosmologists may soon be given a fresh and penetrating view into the depths of time and space. It is expected that with the proposed seven-acre antenna the attainable distance for radio astronomy will exceed by tenfold that achieved with the largest optical telescope.

It is expected that the radio telescope will have an important role in tracking the scientific probes that will be sent into interplanetary space in coming years.

Astronomers are searching for new radio sources in space in the hope that information will be gained, allowing them to settle the question of the origin of the Universe. As of now, they cannot decide between the theories of an explosive beginning and a continuing expansion, or of an alternatively exploding and contracting Universe.

Most of our knowledge of the Universe has been gained from electromagnetic light waves, falling on the earth through a window in the atmosphere about five octaves wide. Radio astronomy is now exploiting the existence of a second

window through the atmosphere 12 octaves wide. Radio waves shorter than a few millimeters are absorbed by atmospheric oxygen and water vapor; whereas the ionospheric layers turn back radio waves longer than several decameters. Thus radio astronomy observations are made at frequencies used in television, frequency modulation radio, microwave relay links, rocket and satellite telemetering and control, and radar.

Large regions of the Universe are forever inaccessible to optical study because of heavy obscuration by interstellar dust which, however, is transparent to radio waves. On the other hand, tenuous ionized gas-regions such as exist around the Sun as its corona, and surrounding super-giant blue stars as bright gaseous nebulas, and even enveloping all the stars in spiral galaxies, are transparent to light waves, but reflect, absorb, or emit radio waves. Thus radio methods offer new and powerful means of studying these gaseous regions and, at the same time, penetrating the obscuration due to cosmic dust without the least detectable effect.

Reber measured the angular distribution of this cosmic emission at the frequency of 160 megacycles with a sharp antenna beam (3^{o}). (Plate I) He found several subsidiary maxima, one in the constellation Cygnus. The intensity at this higher frequency was much less than Jansky found at 20 megacycles. In his 1940 paper Reber suggested that the radiation was generated thermally by collision between electrons and positive ions (called free-free transitions) in interstellar matter ionized by starlight. The theory for this type radiation was first given by Kramer to explain continuous X-ray spectra, and is physically equivalent to the Lorentz absorption theory used in ionosphere propagation.

Reber was the first (in 1943) to publish evidence of radiation at

160 megacycles from the Sun. Hey, in England, and Southworth had independently discovered such radiation a year earlier, but war restrictions prevented publication.

Details of his amplifier design and illustrations of the equipment used were presented in one of his early papers. Originality was demonstrated in his introduction of a noise cancellation scheme for the detector and in his dish design (the first with a solid surface), the principles of which are incorporated in the many much-larger dishes erected since. He achieved sensitivity as high as 10^{-23} watt/sqcm/ circular degree/megacycle bandwidth.

An officer of the National Radio Observatory states that "Grote Reber's contributions to radio astronomy, in the late 30's and early 40's, were very great. It was through his early pioneering work that the potentialities of radio astronomy were demonstrated, and his work stimulated others and gave impetus to the whole field."

The acknowledgment of Reber's pioneering work in this new science is general among astronomers, both foreign and American.

Grote Reber (Plate II) was born December 22, 1911, in Chicago. He received his Bachelor degree in Electrical Engineering from the Illinois Institute of Technology in 1933. He was a radio engineer for Stewart Warner and Delmont Radio from 1933 to 1947 and was a staff member and later a Scientist at the National Bureau of Standards between 1947 and 1953.

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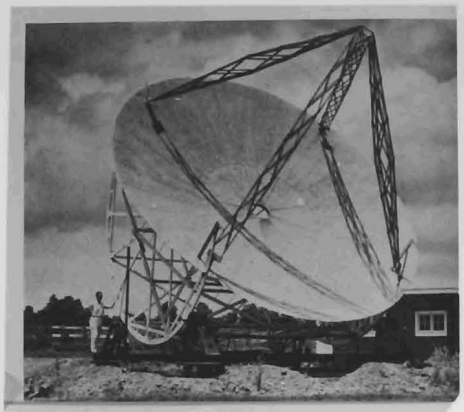
In consideration of his recognition of the significance of cosmic static as a new medium for astronomical investigation and for pioneering the field of Radio Astronomy with outstanding achievements in the construction of the first radio telescope and its use in the identification of the first radio star, THE FRANKLIN INSTITUTE awards its ELLIOTT CRESSON MEDAL to GROTE REBER, of Wailuku, Maui, Hawaii.

Wynn Laurence LePage
President.

Peter Geyelin
Secretary.

Charles H Topping
Chairman of the Committee on Science and the Arts.



S. & A. Case No. 3385,
Work of Grote Reber in Radio Astronomy.
Plate I.

PLATE I.

S. & A. Case No. 3385,
Work of Grote Reber in Radio Astronomy.
Plate II.
Grote Reber

PLATE II.

THE FRANKLIN INSTITUTE • PHILADELPHIA 3, PA. • LOcust 4-3600
OFFICE OF THE SECRETARY

October 18, 1962

Mr. Grote Reber
General Delivery
Wailuku, Maui
Hawaii

Dear Mr. Reber:

It is my pleasant duty to advise you that upon the recommendation of our Committee on Science and the Arts, the Board of Managers of The Franklin Institute, at its meeting on October 17, 1962, voted unanimously to award you an Elliott Cresson Medal. The citation reads as follows:

> "In consideration of his recognition of the significance of cosmic static as a new medium for astronomical investigation and for pioneering the field of Radio Astronomy with outstanding achievements in the construction of the first radio telescope and its use in the identification of the first radio star."

Medals of The Franklin Institute are awarded annually, and a dinner in honor of all recipients precedes the Medal Day exercises. We felt you might be interested in having a copy of the 1962 Medal Day Program, which is enclosed.

In 1963, the exercises will be held on Wednesday, October 16. You will hear from us further about this occasion. I hope you will hold the date open and will advise me that we will have the pleasure of your company on that evening. You might like to know that you will not be called upon to give a talk.

Sincerely yours,

William F. Jackson, Jr.
Secretary

WFJ/jmw
enc.

23rd November 1962
"Dennistoun"
Bothwell, Tasmania, Australia

Mr. William F. Jackson, Jr.
Franklin Institute
Philadelphia 3, Penna., U.S.A.

Dear Mr. Jackson:

Thank you for your fine letter of the 18th which found me here after much forwarding. I am delighted and indeed flattered to be nominated to receive an Elliot Cresson Medal 1963. My plans call for a trip to U.S.A. during October and November 1963. I am certain Wednesday the 16th October will be a highlight of the trip.

Looking forward to further information as plans develop, I am

Sincerely yours,

Grote Reber

Grote Reber