The Guardian Office
Manchester

28 December 1950

Mr.Grote Reber,
212 W.Seminary Ave.,
Wheaton, Illinois,
U.S.A.

Dear Sir,

Perhaps you may be interested to have the text of the article to which you refer in your letter of December 17.

Yours very truly,

The Ed.

The Manchester Guardian.
25 NOV 1950

RADIO STARS IN THE UNIVERSE

A Discovery at Jodrell Bank

By A. C. B. Lovell

This week's issue of the scientific journal "Nature" contains a short communication from two members of the Physical Laboratories of the University of Manchester describing new results of great astronomical interest. At the Jodrell Bank Experimental Station in Cheshire R. Hanbury Brown and C. Hazard have recently been able to detect and measure radio waves emanating from the great nebula in Andromeda. This discovery, together with other recent work in radio astronomy, now presents us with such a new view of the universe that a short appraisal of the situation seems appropriate.

The great telescopes reveal the universe as consisting of stars distributed in galaxies throughout space. Our local galaxy contains some hundred thousand million stars. This galaxy, although localised in space, is of immense size and appears to be a disk-like system about a hundred thousand light years in diameter and twenty thousand light years thick at the centre. (A light year is the distance travelled by light in one year—that is, 5.8 million million miles.) The sun, which is an average star, is situated well to one side of this system—about thirty thousand light years from the centre. When we see the Milky Way we are looking along the disk at vast numbers of distant stars, but in other directions we are looking out of the thinner parts of the disk and see fewer stars. This huge assembly of stars is now regarded as being merely a localised system in the universe.

THE NEBULAE

A small diffused patch of light in Andromeda, which can just be seen by the naked eye, is another great star system external to our own galaxy. This Andromeda Nebula (M.31) is the nearest of the spiral nebulae and is 750,000 light years distant from us. Such nebulae appear to be fairly uniformly scattered throughout space—there are more than a hundred million within the limits of view of the big telescopes.

These details of the universe have been obtained by astronomers because the light from the stars is able to penetrate the earth's atmosphere. Although the atmosphere blankets all incoming radiation which lies much beyond the visible limits of the spectrum, until recently this did not seem to be a fundamental drawback to the study of the universe. The distribution of the energy in the radiation from a hot body, such as a star, was well known and it seemed unlikely that the ability to investigate the universe in another quite different discovery was that the position of these radio stars did not coincide with any of the bright visual stars. After two years' work Ryle and Bolton have been able to discover and position nearly a hundred of these radio stars; but they do not coincide with any prominent visible stars, or seem to be related in any way to types of stars which have so far been catalogued from visual observations.

THE UNSEEN STARS

The question arises immediately whether all the radio emissions received on the earth originate in radio stars—of which only the nearest hundred can be detected by our present radio telescopes—or whether there is some other source in the interstellar gas. All the most recent experimental and theoretical work indicates the former to be the case. In fact it is possible to estimate that all the radio emissions can be explained if the hundred known radio stars are merely the nearest of a vast number of radio stars distributed throughout our galaxy in a manner, and with a population, similar to the visual stars. We are thus faced with the surprising prospect that our galaxy is constituted not only of a hundred thousand million stars of types already known to astronomers but of a similarly vast number of radio stars, which cannot be seen visually, of a type and constitution hitherto unknown.

Is our galaxy unique in its content of these radio stars? Or are they common objects throughout the whole universe? The answer to these questions has been sought without success until the last few months. It has long been realised that the great nebula in Andromeda probably held the key to this answer, since the visual information indicates that it is very similar to our local galaxy. But even if it contained radio stars similar to the local galaxy the total radiation from the whole nebula received on the earth would be only about one-thousandth of that received from one of our local radio stars.

Since the power received from the most intense of these radio stars is measured in units of a million-million-million-millionth of a watt, it will be appreciated that the experiment is one of the utmost difficulty. Nevertheless, Hanbury Brown and Hazard have now succeeded in detecting and measuring the radio emissions from the nebula. Their measurements show that the nebula behaves very similarly to our own galaxy as far as radio emission in concerned, and they estimate that it must contain some thousand million radio stars.

Photocopy from original clipping made by F Bolton Nov 1950

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Even the famous discovery, made by Jansky in 1932, that radio waves were being received on the earth from outer space did not seem likely to affect this belief. For many years after Jansky's discovery it was generally believed that these radio emissions were either being generated by some special process in the visible stars or in the rarefied gas which permeates interstellar space. But since 1945 a striking sequence of refined experiments made in England and Australia has shown that the situation is far more dramatic and puzzling.

Until 1948 the radio techniques were too crude to distinguish any special features of this radiation from particular directions. It was known that the radiation was most intense from the direction of the Milky Way, but although many observers had directed their aerials towards the bright stars no increase in signal strength was observed. Then Bolton in Australia and Ryle in England almost simultaneously devised a new technique—a somewhat analogous method in radio to that which Michelson used for measuring stellar diameters in light. They both discovered that at least some of the radio waves were coming from very localised sources in space. The astonishing feature of the mental and theoretical work indicates the former to be the case. In fact it is possible to estimate that all the radio emissions can be explained if the hundred known radio stars are merely the nearest of a vast number of radio stars distributed throughout our galaxy in a manner, and with a population, similar to the visual stars. We are thus faced with the surprising prospect that our galaxy is constituted not only of a hundred thousand million stars of types already known to astronomers but of a similarly vast number of radio stars, which cannot be seen visually, of a type and constitution hitherto unknown.

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Various circumstances have combined to make possible this very remarkable measurement. Jodrell Bank possesses the biggest radio telescope in the world—220 feet in diameter. It was designed by Dr J. A. Clegg, and built by the workers at Jodrell Bank in 1947 and 1948. This instrument normally receives the radiation in a very narrow beam from the vertical direction, but in the spring of this year Hanbury Brown pointed out that if we were prepared to risk tilting the main tower 14 degrees from the vertical it would be possible to look at the Andromeda nebula. By the summer he had refined his receiving apparatus to such an extent that—on the assumption that Andromeda behaved in a similar manner to our galaxy—the experiment seemed to have even chances of success. The subsequent tilting of the tower and progress of the experiment during August and September have been watched with incredulity by those privileged to be at Jodrell Bank during these recent weeks. Although experiments in radio astronomy are not normally affected by weather, these were of such delicacy that rain and wind would ruin a measurement which could only be made for a short period

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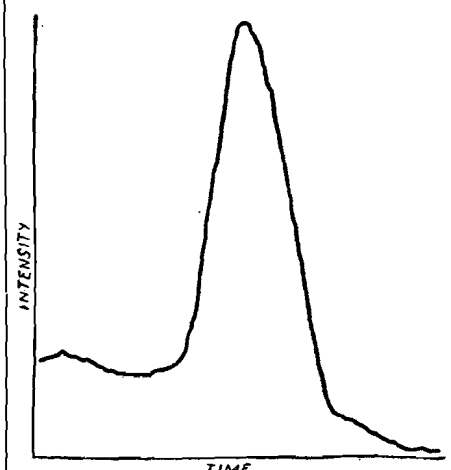
in the depths of the night. In spite of the prevailing cyclonic conditions it became evident after a few weeks that radio waves which left the nebula 750,000 years ago, and had been travelling through space for more than the whole span of human existence, were being received on the earth.

Previous to this work we believed that the dark radio stars were as common in our galaxy as the visible stars. Now we believe that they are equally common in the Andromeda nebula. Since these are two typical galaxies we must now presume that the radio stars in the whole universe are as immeasurable as the visible stars. What are these radio stars? Are they stars in the process of being born? Or dying? Or a new type of stellar object lying outside the normal stellar sequence? The paradox of their existence is such that the solution will mark an event of supreme scientific importance.



a.

b.

A radio star (a) and the Andromeda nebula (b) as seen by the radio astronomer.

The rotation of the earth sweeps the narrow beam of the radio telescope across the sky. When this passes over a source emitting radio waves the increase in intensity of the received signal is recorded on a chart: (a) is the record of one of the intense radio stars in our local galaxy; (b) of the nebula in Andromeda (M. 31). The strengths of the two signals are several hundred to one, and the sensitivity of the equipment had to be decreased thirty times in order to keep the signal from the radio star (a) on the chart.