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Karl Jansky: His Career at Bell Telephone Laboratories

Harald T. Friis

In 1928, 22-year-old Karl Jansky joined my group in our Cliffwood field laboratory and, because he had a chronic kidney ailment, it was requested that he be assigned to work which would not exert undue pressure on him. (Jansky was first rejected by the Medical Department but later was accepted through the intervention of his brother.)

Karl agreed to start work recording the static received at long wavelengths, using equipment already in existence. Later, he planned to record static at 14 meters' wavelength, using a 100-foot-long "Bruce" antenna which was to be mounted on a rotating platform such as we had used in 1924 to study long-wave static. He built an ultrasensitive shortwave receiver similar to the one I had used in 1928 to show that Johnson noise limits the sensitivity of radio receivers. He also modified Mutch's static recorder, which was an improved version of the one that had been used earlier to record long-wave static.

After working with his colleagues, especially Beck, Mutch, and Sharpless, to become thoroughly familiar with the then-existing techniques for accurate measurement, Karl began to assemble the equipment, but his work was interrupted by the relocation, in January 1930, of the whole Cliffwood field laboratory to Holmdel.

Karl had a new rotating platform built at Holmdel and reassembled his equipment. By the end of 1930 he was ready to record static at 14 meters' wavelength.

His recordings gave him lots of data, and he published the results in a paper, "Directional studies of atmospherics at high frequencies," in *Proceedings of the Institute of Radio Engineers* for December 1932. In this paper he classified static into three types: (i) that due to local thunderstorms, (ii) that due to distant thunderstorms, and (iii) "a steady hiss static, the origin of which is not known."

The hiss-type static, or hiss noise, fascinated Karl. The angle of arrival did not seem to check with anything pertaining to the earth or the solar system. Having collected thousands of records, he discussed the data with his colleague A. M. Skellet, who was familiar with astronomy. The conclusion was that the hiss noise came from the Milky Way.

Karl presented the findings before the International Scientific Radio Union (URSI) in April 1933, in Washington, and published a paper, "Electrical disturbances of extraterrestrial origin," in *Proceedings of the I.R.E.* for October 1933. He also published a short paper, "Radio waves from outside the solar system," in *Nature*. The Bell Telephone Laboratories publications department issued a press release, and the New York *Times* carried the story as front-page news.

As a result of this astounding and, to most people, unbelievable discovery, Karl was now a famous man. Karl was modest, and this adulation did not affect him. He wanted to continue his work and thought that it would be worth while to look for hiss noise at a shorter wavelength.

By 1931 Karl had built a new receiver that covered the wavelength range 4 to 20 meters, and he used it to observe static from local thunderstorms. A. C. Beck erected a 100-foot-long comb-type antenna on Karl's rotating platform and, in 1934, Karl connected his receiver to the comb antenna, but found no hiss noise at a wavelength of 4 meters. In retrospect, this is not surprising since the gain of the comb antenna is low (its directivity gain is high).

In July 1935 Karl presented a paper, "A note on the source of interstellar interference" (*Proceedings of the I.R.E.*, October 1935), in which he pointed out that the hiss noise was strongest when the antenna beam pointed toward the center of the Milky Way, and that the hiss noise sounded like thermal agitation noise. Karl had, in the meantime, made many measurements of the noise output of large fixed rhombic antennas; he always found hiss noise appearing at that time of the day when the antenna pointed

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toward the center of the Milky Way. These observations confirmed his earlier results, and he stopped making them at the end of 1936.

Karl had been an instructor at the University of Wisconsin for a year before he came to Bell, and he liked teaching. A. C. Beck had the same background at Rensselaer Polytechnic Institute, and he also liked teaching. Both he and Karl accepted gladly the additional job of teaching courses to our technical assistants and often talked about taking teaching jobs. Beck recalls discussing an opening at Iowa State College in 1936, but they both agreed that, in spite of the curtailment in research activity and their low pay due to the depression, they were better off at Bell Telephone Laboratories.

Karl consolidated his findings on hiss static, or what he was then calling "star noise," in a paper, "Minimum noise levels obtained on short wave receiving systems," which he presented before the April 1937 URSI meeting in Washington (*Proceedings of the I.R.E.*, December 1937). This paper also included a study of man-made diathermy interference. Karl had by now, as a sideline, become an expert on receiver sites; for example, he recommended the Manahawkin site for reception of transatlantic short waves.

Karl, being a good research man, then became interested in the characteristics of the several different kinds of noise, thermal noise included. He did some excellent experimental work and presented his results in a paper, "An experimental investigation of the characteristics of certain types of noise," at the April 1939 URSI meeting in Washington (*Proceedings of the I.R.E.*, December 1939).

In 1938, Karl dropped the study of star noise and, some 17 years later, I was criticized by people who thought that I had stopped him. This was not true. Karl was free to continue work on star noise if he had wanted to, but more than 5 years had passed since he made his epochal discovery, and not a word of encouragement to continue his work had appeared from scientists or astronomers. They evidently did not understand its significance. Also, Karl would have needed a large steerable antenna to continue his work, and such antennas were unknown to us at that time. Radio astronomy, as such, did not then exist, and neither Karl nor I had the foresight to see it coming some 10 years later.

What actually happened was that Karl, who had worked for 10 years on the angle of arrival of noise and interference, now expanded his work to measurement of the angles of arrival of transatlantic radio waves. He and a colleague, C. F. Edwards, studied the angle of arrival of 16-meter waves in 1938, and then began a special radio propagation experiment in January 1939, which resulted in a paper, "Measurements of the delay and direction of arrival of echoes from near-by short-wave transmitters," published in the *Proceedings of the I.R.E.* for June 1941. They also compared reception at the Manahawkin and Netcong receiving sites in 1940.

It was an outsider, Grote Reber, an ardent radio amateur, who took up studies of star noise after having read Jansky's original papers, and in 1941 he succeeded, with improved equipment and a 30-foot "mirror," in mapping the Milky Way at 3 meters' wavelength. Karl was delighted that somebody else had finally confirmed his early work. John Schelleng, who headed the Deal Laboratory, was greatly impressed by Reber's single-handed and successful effort. He recalls that he told Karl that it was too bad that he was not himself working in this field. To this Karl replied cheerfully that after all he had "skimmed the cream."

The United States was then getting into war, and all Holmdel personnel worked 50 percent overtime on war jobs (radars). Later, sensitive receivers and large paraboloids became available, but nobody in my group, Jansky included, could take time off from war work to study star noise. During the war, Karl made several valuable contributions in classified areas and received an Army-Navy citation for his work.

My group turned back to communication research after the war and, since microwave radio had looked promising even before the war, everyone concentrated his research on microwave transmission and microwave repeaters. Being familiar with the importance of minimum noise levels in receivers, Karl selected this phase of microwave repeater research and worked on intermediate frequency amplifiers in 1946 and 1947. Our work resulted in an important paper, "Microwave repeater research," by H. T. Friis in the *Bell System Technical Journal* for April 1948. Karl contributed the section on intermediate frequency amplifiers, edited the whole paper, and presented it before the Monmouth subsection of the Institute of Radio Engineers.

A chore that Karl did not mind was visiting his old alma mater, the University of Wisconsin, in 1947 and 1948, to recruit new employees.

I was made director of radio research in 1946. As a result of the reorganization this entailed, I asked Karl to join G. C. Southworth's group in January 1948. The era of transistors was just emerging, and Karl included them in his experiments with amplifiers. Karl, naturally, also showed interest in the new field of radio astronomy. He wrote, for example, a detailed report on a conference that he attended on this subject at the Naval Research Laboratory in May 1948.

Karl's health had in the meantime declined somewhat. He was out on extended sick leave in 1945 and 1946. He spent 4 days in the spring of 1948 at Durham, North Carolina, for medical tests, and went back in the fall for medical treatments. By the end of 1949 he was really sick. He died 14 February 1950, and I lost a close friend.

After the war, radio astronomy started throughout the world, especially in Australia, England, and Holland. Ewen and Purcell made their important contribution of the 1420-magacycle hydrogen line in 1951. After a conference in Washington in 1954, large-scale work started in the United States.

It is unfortunate that Karl did not live long enough to see the unbelievably important results of his early discovery. He is now recognized as the father of radio astronomy, and I am proud of having been associated with the man who deserved, but never got, the Nobel prize for his discovery.