Star Noise

The Galileo of radio astronomy

DAVE FINLEY/NRAO/AUI

The Karl G. Jansky Very Large Array

Even at 55 miles per hour, the desolate terrain seems to pass by in slow motion. Only an occasional stand of piñon pines on the side of a hill or, farther off, the stark profile of an erosion-sculpted mountain breaks the monotony.

But suddenly, after driving over a rise on Route 60, a few dozen miles west of Socorro, New Mexico, the weary traveler comes upon a spectacular sight: in the distance are twenty-seven dishlike antennas, lined up for miles over the flat, desert Plains of San Agustin. Airline pilots who fly over the ancient, mile-high lakebed have long called this gigantic Y-shaped installation "the mushroom patch." But ever since this facility was first dedicated in 1980, astronomers have simply referred to it as the VLA, for Very Large Array, one of radio astronomy's premier eyes on the universe.

Its majestic white dishes move in unison, like a mechanical version of the Rockettes, to gather the radio waves sent out by myriad celestial objects. On one day, the antennas might trace the wispy outlines of a gaseous nebula to see how its molecules tumble and collide, leading astronomers to the birthplace of new stars. The next day, the dishes could point toward a supernova and snap a "radio picture" of the debris racing away from the monstrous explosion.

The array's particular strength is acting like a giant zoom lens. For a few months at a time, the antennas are crowded close, each arm of the Y no more than half a mile long. This setup provides a sort of wide-angle view of the heavens, perhaps to trace the gas clouds in a nearby galaxy. But to get a closer look, the antennas are periodically transported along railroad tracks out to greater distances, up to thirteen miles along each arm. In the most extended arrangement, as the Earth sweeps the antennas around, the individual dishes collectively simulate the capability of a single antenna spanning some twenty-two miles, roughly the size of Dallas, Texas.

Over the array's three decades of service, more than 2,500 scientists from around the world have used the VLA to study the cosmos. Sometimes their focus is near—within our own solar neighborhood—and at other times out to the farthest reaches of space-time. On one occasion visitors from Hollywood even took their turn: in the 1997 movie *Contact*, a fictional astronomer played by actress Jodie Foster used the iconic scopes to find radio proof for the existence of intelligent extraterrestrials.

But by the 1990s the National Radio Astronomy Observatory (NRAO), which operates the New Mexico array, recognized that the facility was getting long in the tooth, hindered by its 1970s-vintage electronics. So, in partnership with Canada and Mexico, the NRAO spent the last decade upgrading the array's technology—from installing state-of-the-art receivers and fiber-optic transmission lines, to obtaining an innovative supercomputer to swiftly correlate its data. Upon completion this year, the new array will be able to detect signals more than ten times fainter than the original system could and will cover a radio-frequency range three times as wide, making it "by far the most sensitive such radio telescope in the world," says NRAO director Fred K. Y. Lo. Need to take a cellphone call from Jupiter, some half a billion miles away? The new array can do it.

Given this transforming reincarnation, the NRAO decided it was also time to update the VLA's humdrum name, and so, last fall, solicited suggestions via the Internet from both the public and the scientific community. Candidate names flooded in from 17,023 people in more than sixty-five countries. Sifting through some 16,000 unique names, NRAO officials at last chose

a new moniker that was eminently suitable. At a rededication ceremony that took place on March 31, 2012, the New Mexico facility was formally renamed the Karl G. Jansky Very Large Array.

Although hardly a household name, Karl Jansky is a pioneering giant to radio astronomers. He's the Galileo of radio astronomy. In the 1930s, Jansky set up a unique radio receiver amid central New Jersey's potato fields, and with it became the first to wrench astronomy away from its dependence on the optical spectrum, beyond the narrow band of electromagnetic radiation visible to the human eye. His first, provisional step ultimately led to a new and golden age of astronomy that thrives to this day. But, as is often the case in astronomical history, Jansky began his investigations for a totally different reason.

In 1928, fresh out of college with a degree in physics and newly hired by Bell Telephone Laboratories, the twenty-two-year-old was assigned to investigate long-radio-wave static that was disrupting transatlantic radio-telephone communications. To track down the sources, he eventually built a steerable antenna—a spindly network of brass pipes hung over a wooden frame that rolled around on Model-T Ford wheels. It was known around the lab as "Jansky's merry-go-round."

Setting up his antenna near Bell's Holmdel station, Jansky soon learned that thunderstorms were a major cause of the disruptive clicks and pops during a radio phone call. But there was a steady yet weaker hiss that he also kept receiving. After a year of detective work, in 1932 Jansky at last established that the disruptive 20-megahertz static (a frequency between the United States AM and FM bands) didn't originate in the Earth's atmosphere, or on the Sun, or from anywhere within our solar system. To his surprise, he saw that it was coming from the direction of the Sagittarius constellation, where the center of our home galaxy, the Milky Way, is located. Jansky affectionately dubbed the signal his "star noise." For Jansky it hinted at processes going on in the galactic core, some 27,000 light-years distant, that were not revealed by visible light rays emanating from that region. For unlike visible light, radio waves are able to cut through the intervening celestial gas and dust, in the manner of a radar signal passing through a fog.

Jansky's unexpected discovery made front-page headlines in *The New York Times* on May 5, 1933, with readers being reassured that the galactic radio waves were not the "result of some form of intelligence striving for intra-galactic communication." Ten days later NBC's public affairs–oriented Blue Network broadcast the signal across the United States for the radio audience to hear. One reporter said it "sounded like steam escaping from a radiator."

By 1935, Jansky speculated that the cosmic static was coming either from the huge number of stars in that region or from "some sort of thermal agitation of charged particles," which was closer to the truth. Years later, astronomers confirmed that the noise was being emitted by violent streams of electrons spiraling about in the magnetic fields of our galaxy. Just as an electric current, oscillating back and forth within an earthbound broadcast antenna, releases waves of radio energy into the air, these energetic particles broadcast radio waves out into the cosmos. And Jansky was the first to detect them. He was Earth's first eavesdropper on the universe.

Despite the worldwide publicity, however, few astronomers then appreciated Jansky's new ear on the universe. Most were more comfortable with lenses and mirrors than with radio receivers. It was not until after World War II, spurred by the military development of radar technology, that the infant field at last took off. During the subsequent decades, radio telescopes were mapping the locations of colossal clouds of gas over the breadth of the Milky Way, discovering the existence of neutron stars from their metronomic radio "beeping," and helping astronomers unmask quasars as the violent cores of newborn galaxies in the distant cosmos. The instruments' greatest coup? Capturing the fossil whisper of creation, the remnant radiation from the big bang, now cooled down to a uniform wash of microwaves that blankets the universe.

Jansky, alas, saw none of this happen. Long burdened with a chronic kidney ailment, he died in 1950 at the early age of forty-four. In his last experiments, he was trying out a newfangled gadget called a transistor to improve a radio amplifier.

Yet his legacy lives on with the new and improved Jansky Array in New Mexico, whose resolution and sensitivity are billions of times greater than those of the original merry-go-round. Even when the array is inevitably replaced or supplanted in the far future, Karl Jansky's name will still reverberate within the halls of radio astronomy. In 1973, the International Astronomical Union gave his name to a scientific unit. The *jansky* is a measure of the strength of an astronomical radio source.

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