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A Reminiscence of Project Ozma

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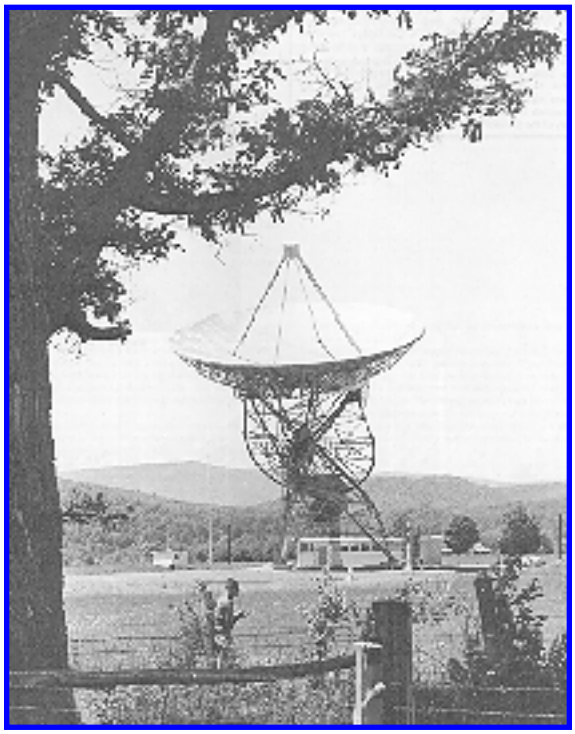


"The 85-foot telescope (was) a striking anachronism in those primitive mountains of West Virginia."

"We turned the telescope to Epsilon Eridani and then it happened — wham!"

Independently of Cocconi and Morrison, Frank D. Drake, an astronomer at the National Radio Astronomy Observatory, Green Bank, West Virginia, was formulating plans to conduct an actual search. Drake was 29 when, on April 8, 1960, he turned the 85-foot Howard Tatel telescope of the observatory toward the star Tau Ceti. Project "Ozma" had begun and for the first time man searched for signals of possible extraterrestrial intelligence. In this article Drake shares with you his feelings and emotions as the historic project progressed. It is a real-science thriller.—Eds.

Whenever I am reminded of Project Ozma, I recall how cold it is at Green Bank at four in the morning. I really have two quite vivid memories of those days — first, of the battle against the cold each morning as I would climb to the focus of the dish to tune the parametric amplifier, and then of that moment on the first day of the search when a strong unique pulsed signal came booming into the telescope just as soon as we had turned it towards the star Epsilon Eridani. But a lot of other

important things happened then, and the importance of some of them wasn't apparent until years later.

Green Bank was a very exciting place in 1959. We had been given the charter, and what amounted to unlimited funds, to build the best radio observatory in the world. We had started to build a very costly telescope, the 140-foot, completion of which was still years in the future, and we knew that we really should build a smaller telescope first to get the place into operation, to gain some experience and momentum. So a contract was made to build an 85-foot telescope, and by early 1959 it stood there, a striking anachronism in those primitive mountains of West Virginia.

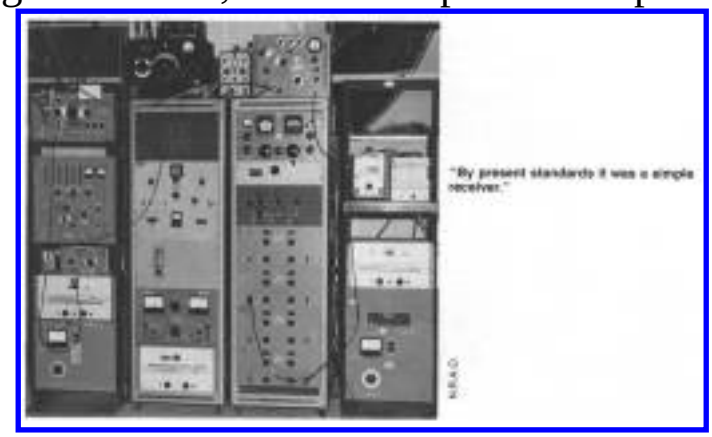
Ever since I was eight years old, I had wondered about the origins of people and whether there could be others elsewhere in the universe. So it was natural that one day at Green Bank I calculated just how far our new 85-foot telescope could detect radio signals from another world if they were equal to the strongest signals then generated on the earth. About ten light years, it turned out. And a few stars very much like the sun were within that distance.

The small group of scientists then at the Observatory used to have lunch together every few days at the closest thing to a restaurant, a roadside diner some five miles away which we had christened "Pierre's" or "Antoine's" although "The Greasy Spoon" was more appropriate. One snowy day in late winter we all drove down to this forlorn place and during lunch I mentioned my conclusion that we could possibly detect intelligent radio signals from some nearby stars with the new telescope. I suggested we put together some simple equipment to do the task — it took something we didn't usually use in radio astronomy, a narrow band radio receiver — and search some nearby stars for signals. At the time, the director of the National Radio Astronomy Observatory was Lloyd Berkner, a pioneer in ionospheric studies and something of a scientific gambler, and he was all for it. So as the last greasy french fry was washed down by the last drop of Coke, Project Ozma was born.

I decided we should build our equipment to operate at the 21-cm line frequency. The narrow band radio receivers to be used in Ozma would be just right to search for the Zeeman* effect in the 21-cm line of neutral hydrogen. Thus, if we set up the equipment for that wavelength, we could use it for that important experiment. In

addition, it would head off any criticism that we were putting resources into the equipment wastefully. In the end we spent only about $2000 for the unusual parts of the receiver, and no one ever complained.

About that time we received a visitor on a "sabbatical" from Slough in England. His name was Ross Meadows, and as an electronics expert he was given the task of doing all the dirty work of putting the Ozma receiver together. By present standards it was a simple receiver. It had only one signal channel, and the simplest of outputs — a chart recorder. We also planned to have an ordinary audio tape recorder connected to the system just in case something did come in from outer space! There were some other important special aspects of the receiver. It switched between two feed horns so as to allow us to distinguish a signal from space from a terrestrial signal coming in the side-lobes of the antennas. The same approach has been used in some form in just about all the searches since. Also, there was a reference channel to which the signal channel was compared; this was a standard technique in those days and now, and was used to eliminate receiver gain fluctuations and nonlinearities. Since our bandpass was to be 100 hertz, the oscillators used in the receiver had to be a bit more stable than usual, although nothing very challenging. After a while Kochu Menon, an old friend and colleague from Harvard, came to Green Bank and worked on the receiver also.


"By present standards it was a simple receiver."

We had been working on this system at a relaxed pace for about six months when an important event occurred. Giuseppe Cocconi and Phil Morrison of Cornell published their deservedly famous paper in *Nature* in September containing the same calculations I had made, pointing out that mankind could detect other civilizations with existing radio telescopes, and suggesting the 21-cm line as the most promising band to search for signals. For a good reason — the unique status of this fundamental spectral line of the most abundant and fundamental atom of our universe, and not for the practical reason which had influenced me. It made us feel good because now there were further arguments for what we were doing.

I did not know Phil Morrison then. As a student at Cornell I had been awed by

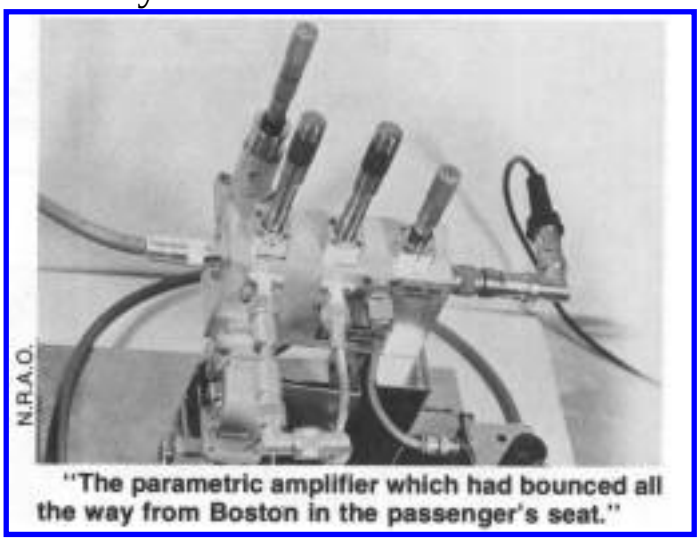
some superb lectures he gave, and he was a great help to one of my best friends, but I had never met him. He is still a superb lecturer, one of the very best, and of course one of the prime movers in SETI activities. I visited with Giuseppe Cocconi about a year ago in Geneva, where he is an active nuclear physicist at CERN.

By this time the world-renowned astrophysicist Otto Struve had become the director at Green Bank. Despite his conservative background, he was one of the few senior astronomers of that era who believed that intelligent life was abundant in the universe, and felt that everything possible should be done to support any feasible searches for signals of extraterrestrial intelligent life. So, he was for Ozma from the start, and was urging us to hurry with the project.

As an old timer in the real world of astronomy, Struve was also aware of the importance of getting credit for ideas, discoveries, and good research whenever possible. He knew it paid off in getting additional support for an institution. So, to our surprise he was very agitated and frustrated when the Cocconi-Morrison paper appeared. He was very worried that Green Bank was going to lose the credit for what he thought was an important idea. Actually, from the beginning of Ozma we had expected that any public announcement of it would bring a horde of reporters down on our heads, and so we had kept the whole thing as quiet as possible. Now Struve was very upset that we had done that. He did what he could — about a month later he was scheduled to give some prestigious lectures at MIT, and he used the occasion to ballyhoo all the activity at Green Bank in connection with the search for extraterrestrial life. The cat was out of the bag: looking back now, only good came from letting it out.

The first thing that happened was that we were offered the use of one of the first operative parametric amplifiers in the world. The realm of electronics had recently been turned topsy-turvy by two inventions — the solid-state maser,* and the parametric amplifier.* Both gave receiver sensitivities as much as ten times better than what had been in use. But both were laboratory devices, and could not be used in practice in the field on a moving radio telescope. So we were thrilled when a person who was simultaneously an avid radio ham, an intelligent life buff, and the president of one of the most sophisticated American electronic companies, Microwave Associates, offered us the use of a working parametric amplifier, probably the best in the world. This was Dana Atchley, Jr. Not only would he provide the amplifier, but he would send his chief engineer with it to install it.

On the appointed day, sure enough, I got a call in my office that the chief engineer of Microwave Associates had arrived with the amplifier. Going downstairs, I got a real jolt but kept my cool as I saw before me: 1) a British sports car, top down, made by Morgan; cars used to be made of wood and this was the last of them, you know, complete with leather straps to hold the hood down; 2) in the driver's seat, a fellow with a long flowing red beard, and wearing a red tam-o-shanter; and 3) in the passenger's seat, the parametric amplifier which had bounced all the way from Boston. The driver was Sam Harris, known to every radio ham as a radio amateur magazine editor, and known to many and soon to me as an electronics genius. He had designed the parametric amplifier, and was the only one in the world who could make it work, and it really worked. He proceeded to install it, make it do its magic, and then taught me how to tune it, the task which became my four-o'clock-in-the-morning pick-me-up for the day. When all was well, he climbed back in his Morgan and drove off. I never saw him again until one day in 1966, I met that red beard again; this time he was on the staff of my observatory at Arecibo (I had nothing to do with this improbable event), and he has been there ever since, doing his magic.



"The parametric amplifier which had bounced all the way from Boston in the passenger's seat."

With much urging from Struve and Dave Heeschen, who had also come to Green Bank, to get on with Ozma, because the press and the scientific community were now harrassing us, we finally had all the equipment built in the early Spring of 1960. In April we embarked on the actual observations.

On the first day of Project Ozma, I set the alarm clock for three, got up groggily, and went out into the fog and cold which was to be my regular morning greeting for about two months. At the 85-foot telescope, the operator would turn the telescope so that I could climb into the metal can, not much bigger than a garbage can, which was at the telescope's focus. There I would sit for about 45 minutes twiddling the micrometer adjustments on the parametric amplifier, talking to the telescope operator, as we set Sam Harris's gizmo so that it was doing the right thing. In the beginning we would have to do this several times a day as the changing temperature upset the tuning, but as time went on we found ways to

evade that problem. After the amplifier was all tuned, I climbed down from the focal point, went into the control building, and set up the Ozma receiver. It was built to tune slowly in frequency so that it shifted its frequency about 100 hertz every minute.

Then we pointed the telescope at our prime target, the nearby solar-type star Tau Ceti. Once the telescope was tracking the star's position, and the receiver was set on the starting frequency, we turned on the tuning motor, the chart recorder, and the tape recorder. Project Ozma was underway!

"A strong, unique pulsed signal came booming into the telescope just as soon as we had turned it towards the star Epsilon Eridani."

Whenever you search for extraterrestrial intelligent radio signals, you always feel at the beginning that the signal may pop up right away. And so the telescope operators and I spent a breathless morning peering at the wiggling pen on the chart recorder, thinking that every time the pen started to deflect up that this was IT. Only to see the pen go down again, obeying the universal law of gaussian noise statistics. And so it went until noon, when Tau Ceti set in the west.

Then we turned the telescope to point at our second subject, the solar-type star Epsilon Eridani. It was thought to be a single star then; recently there has been evidence that it has some companions; I wish we had known that then because it would have been more exciting. Again we pointed the telescope at the star, and set up the recorders. We had also added a loud speaker so that we could hear the receiver output. Again we started the chart and tape recorders, and settled back for more of what had already become routine.

A few minutes went by. And then it happened. Wham! Suddenly the chart recorder started banging off scale. We heard bursts of noise coming out of the loudspeaker eight times a second, and the chart recorder was banging against its pin eight times a second. We had never seen anything like this before in all the previous observing at Green Bank. We all looked at each other wide-eyed. Could it be this easy? Some people had even predicted that the most rational extraterrestrial signal would be a

slow series of pulses, as that would be evidence of intelligent origin. (No one had any idea about the existence of pulsars then.) Suddenly I realized that there had been a flaw in our planning. We had thought the detection of a signal so unlikely that we had never planned what to do if a clear signal was actually received. Almost simultaneously everyone in the room asked "What do we do now?" Change the frequency? Well, the most likely source of a spurious signal was the earth, and we could check that out by moving the telescope off the star and seeing if the signal went away. So we proceeded to do that, and as we moved off the star, sure enough the signal went away. So we pointed back at the star. The signal did not come back. Wow. Was it really from the star, or had it been from earth and had it turned off about the time we moved off the star? There was no way to know. And there was all that adrenaline flowing and no way to apply all that excitement and energy in a useful way.

What did we do? Day after day, as we turned to Epsilon Eridani, we tuned to the frequency on which the signal had been heard. We listened for a half hour or so, and then we would go back to our frequency scanning. We also connected a second receiver to a simple horn antenna which looked out of the control room and could pick up interference. A week went by and the signal didn't return. To our chagrin, one of our employees called up a friend in Ohio and told him about the signal. The word was passed to a newspaper reporter friend, and suddenly we were deluged with inquiries about the mysterious signal — "Had we really detected another civilization?" "No." "But you *have* received a strong signal with your equipment?" "We can't comment on that." And so, aha, we were hiding something. To this day many people believe falsely that we received signals from another world, and that some fiendish government agency has required us to keep this a deep dark secret.

We finally learned the truth about ten days after that BIG day. Suddenly the signals were there again, blasts of radio noise eight times a second, coming in the 85-foot telescope. But just as strongly, they were coming in the little horn we had poked out the window. The signals had to be man-made radio interference. As we watched them, we saw them grow and fade as though they were being transmitted from a high-flying passing airplane.

So we stopped listening as intently to that special frequency while the telescope was pointed at Epsilon Eridani.

The weeks went by, with hundreds of yards of chart paper and tape piling up, all with nothing but noise on them. We were now experts at scanning the records for signals. It even got dull, and I realized that as important and exciting as is a search for extraterrestrial signals, such searches should only be done in conjunction with regular astronomical research, so that there will be real results all the time to remind the searchers that there are, after all, strange and wonderful things in the sky. So they will keep looking.

"Only by doing the best we can with the very best that an era offers, do we find the way to do better in the future."

We had some special visitors at Green Bank during Proiect Ozma, visitors who are more remarkable in retrospect than they were at the time. One who came for several days was Theodore Hesburgh, then the very young president of Notre Dame University, and an up-and coming theologian. He felt that the search for extraterrestrial life was an inspiring and a very good thing to do. He has written the forward to the most recent SETI study.

Another was John Lear, then the science editor of the *Saturday Review of Literature*. He was a titan among science writers — had been the first to expose abuses in the drug industry, for example. He wanted to see history made, and knew that the detection of another civilization would be HISTORY if it really happened. So he came to Green Bank, and sat quietly in one corner of the control room, watching us go through our mysterious manipulations of cables and dials, for days on end, waiting for lightning to strike. Subsequently he published some of the best discussions of the nature and importance of the search for extraterrestrial life.

A third visitor was, of all people, the vice-president for research of the Hewlett-Packard Corporation, a company which made a lot of oscilloscopes and meters and other electronic gadgets which we and every other observatory used. Bernard M. Oliver dropped out of the sky one day in a chartered plane, full of enthusiasm, to watch the goings-on in the West Virginia wilderness. Actually, as it turned out, it was not at all surprising that he was there, because he too had thought about the means for detecting other civilizations for many years. A successful inventor,

electronics expert, and physicist, he already knew all about it, and was glad that someone had the opportunity at last to do something. Since then he has decided that a lot more should be done about it. Recently as the project director of the Project Cyclops Study, "Barney" Oliver has become the leader in the development of plans for enormously sophisticated systems for the detection of extraterrestrial intelligent radio signals. When he has his way, as he will some day, we will see radio telescopes ten thousand times larger than the 85-foot telescope scanning the sky, on not one, but perhaps billions of frequencies at once. Good.

After one month of searching, we took a break. Then another month, and the whole range of plausible hydrogen line frequencies had been scanned for both stars. We know that there was a chance that we had looked at the right star on the right frequency, but at a time when "Their" transmitter was turned off; so maybe a second look would hit pay-dirt. But no more telescope time could be committed to the project; there was a lot of astronomy to do. And so Project Ozma was over.

Today, with the Arecibo telescope and our 1008 channel receiver, we duplicate everything that was done in Project Ozma, actually do it better, in less than a second. And, everything is warm and cozy. But that does not mean in any way that the effort was wasted. Only by doing the best we can with the very best that an era offers, do we find the way to do better in the future. Just as Project Ozma contributed to the development of the much better systems of today, so the giant telescopes and computers of today will be replaced with even grander instruments in the future. A ladder doesn't work if some of its rungs are missing; they all have to be there, and you have to step on them all one at a time.

Frank D. Drake was born in Chicago in 1930. After service with the U.S. Navy and earning the Ph.D. degree in astronomy from Harvard University in 1958, he was scientist for 5 years at the National Radio Astronomy Observatory, Green Bank, West Virginia. It was during this period that he performed the historic "Ozma" experiment. In 1964 Drake joined the faculty of Cornell University where he is now [at the time the article was written] Goldwin Smith Professor of Astronomy and Director of the National Astronomy and

Ionosphere Center, which includes the Arecibo Observatory. He is author of many papers and a number of books including "Intelligent Life in Space" (1967). In 1978 he received the American Tentative Society Award for his Project Ozma. Drake is a member of many scientific societies including the National Academy of Sciences. He is a member of the Editorial Boards of the *Astrophysical Journal, Science Year* and COSMIC SEARCH.

* See Glossary (in a separate artticle entitled: "Miscellaneous Information from the Editors, Quotes & Graphics")

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