TITLE: The Missing Link Revealed

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THE MISSING LINK REVEALED

James D. Burke

At 0635 GMT on 9 November 1983, a 21-year-old intelligence problem was solved. Two Soviet spacecraft in orbit about the planet Venus on that day began transmitting at five-centimeter wavelength and for the first time we intercepted the signal.

The existence of a five-cm wideband planetary data downlink has been known for many years. In a previous article, "The Missing Link," published in the Winter 1978 issue of *Studies in Intelligence* (Volume 22, Number 4), I described the first 17 years of the search for this signal and indicated how we came to be confident that the missing link existed. Here I tell how that confidence was at last turned into proof.

Nature of the Search

In principle, finding an unknown radio signal is simple. One merely tunes a sensitive-enough receiver to the right carrier frequency and there the signal is. In practice, the problem can become enormously difficult because of the numbers involved. To send data over multi-million-mile planetary distances, a spacecraft must beam a powerful signal toward Earth (spacecraft transmitter power and antenna size are, of course, limited) and the receiver on Earth must be a supersensitive one with a huge antenna of the kind used by radio astronomers. Even then, finding an unknown signal remains impossible unless one knows when, in precisely what direction, and at what radio frequency to look. The usable radio spectrum is so enormous relative to the bandwidth of a typical planetary signal that a blind search, simply tuning across the dial as one might do with a car radio in a strange city, has essentially zero chance of success. And the problem is in this case compounded by the fact that Soviet planetary spacecraft, unlike those of the United States, transmit only briefly and only over their home territory.

Thus to have even a slight hope of finding the signal, we have had to build up knowledge of where in the sky, when, and in what wavelength or frequency band to look. The where and when problems were solved many years ago. Soviet planetary spacecraft radiate a housekeeping telemetry signal on a frequency of 928 MHz,* which can be routinely recorded using large antennas on Earth. By tracking this signal soon after launch, we can learn the spacecraft's trajectory well enough to forecast its position in the sky during the months of transit to a planet, and if the spacecraft then goes into planetary

*The unit of radio frequency is the hertz, one cycle per second. A megahertz (MHz) is a million hertz and a gigahertz (GHz) is a thousand million hertz. A radio wavelength of five centimeters corresponds to a frequency near six GHz.

orbit, we simply point at the planet from then on. [redacted] (b)(1) [redacted] Because the downlinks are usually commanded on only when the USSR is in view of the spacecraft, our deep-space downlink listening site must be in the eastern hemisphere, too.

We thus are left with the radio frequency dimension of the five-cm signal search, which (even assuming that we knew the where and when dimensions perfectly) has been an enormous block to progress. In the previous article, I recounted our efforts to narrow the search region using various weak collateral indicators such as Soviet announcements and exhibits. We were still left with a huge haystack in which our needle might be hidden.

Intelligence Priorities

In addition to its technical difficulties, there has always been a policy question affecting the search. The signals that we did intercept made it clear that the unknown link would be used primarily for sending high-rate science data, including planetary images from orbit. [redacted] (b)(1) [redacted] Apart from any skepticism as to the very existence of the latter, there was a legitimate concern over cost-benefit ratios. The required kind of searching is very costly: if not rigorously restrained, a single deployment could easily run up million-dollar bills. And the relation, if any, between Soviet planetary science and American national security is obscure. For these reasons, the search has always had low priority relative to other uses of the needed overseas facilities, equipment, secure communications, and personnel.

Nevertheless, it has proved possible to mount some sort of search operation at nearly every opportunity. Soviet planetary missions occur on the average every couple of years, and in one way or another we have covered most of them since 1962. During the late 1960s and early 1970s we had a high-quality intercept site at Asmara, Ethiopia. After we lost that, [redacted] (b)(1) [redacted] (b)(1) [redacted] which, though handicapped by their more westerly longitudes, did record some good data. Through these means we gradually built up a strong circumstantial case for the existence of the wideband downlink, and our continuing inability to find it became a well-known subject in the SIGINT community. Encouraged by the spreading conviction that the signal did exist and would be found somewhere in the five-cm wavelength region (i.e., near a frequency of six GHz), we continued stubbornly, year-by-year and using whatever means came to hand, to grind the problem down.

A New Element: SETI

Meanwhile, a related drama was opening upon a wider stage. Scientists in several countries were beginning to take seriously the idea that other civilizations may exist in the cosmos and that the best way to find one is to listen for its radio signals. This proposal came to be known as SETI—search for extraterrestrial intelligence.

Now the SETI problem is many orders of magnitude more difficult than that of finding a Soviet spacecraft signal. An alien civilization could be anywhere in the heavens and could be radiating, at completely unpredictable times, signals anywhere in the electromagnetic spectrum. Some scientists made the obvious calculations and dismissed the whole subject on the ground that even if contemporary civilizations do exist on planets of other stars, our chances of finding one are utterly negligible.

But other scientists, and some very clever engineers, were not so pessimistic. Realizing that developments in electronic data processing would soon make it possible to search a radio spectrum thousands or even millions of times faster and more sensitively than ever before, they set out to gain support for a serious SETI program.

There followed a classic American struggle between the conventional and the new: first, a modest National Aeronautics and Space Administration (NASA) project was approved and started. Then it won a Golden Fleece award from Senator William Proxmire and was stopped. Next it was started up again by private subscription; then the Senator relented and NASA funding was resumed. Today both public and private funds are available, and several small but healthy SETI projects are under way. Through all of these goings on, the search-system designers were quietly pursuing their goals. One product of [redacted] (b)(1) [redacted], exactly what is needed for SETI—and for finding unknown Soviet signals.

The 1983 Mission to Venus

Though rumors had been prevalent that the Soviets would launch radar mapping orbiters* to Venus in 1983, there was enough disbelief to prevent serious American SIGINT preparations until, on 2 and 7 June 1983, respectively,

*Radar must be used to map Venus because of the planet's permanent, total cloud cover.

Venera 15 and 16 were launched. Since the trip to Venus takes only three months, there was then no time to lose. NASA and National Security Agency (NSA) people quickly considered the available options [redacted] (b)(1) But some kind of collection and search was desirable, especially since the data might aid in planning the American Venus Radar Mapper mission which had just been budgeted for launch in 1988. It was decided [redacted] (b)(1)

Now our necks were a long way out. Hundreds of thousands of dollars had already been spent; and, an important American SETI project had been diverted from its plan. The prospects for discovery of the unknown Soviet link did not look very bright: during their three-month cruise to the planet, the two [redacted] (b)(1) Still, TASS had announced that Venera 15 and 16 would orbit Venus and did not carry landers. [redacted] (b)(1) So, with some apprehension but with good hope, we awaited the October encounters.

(b)(1) [redacted]

(b)(1)

(b)(1)

There followed a week of near-total frustration in the search. (b)(1) (b)(1) and during the coverage period the Soviets made no use of the unknown wideband downlink (b)(1) [redacted] Night after long, weary night, [redacted] personnel searched for the five-cm signal (b)(1) [redacted] watched the available time run out with no signal commanded on. When the operation ended without success, there was understandably some grumbling from people whose plans had been disrupted by it, and there was understandably a debate over whether to sink more money and time into the search.

Evidently intrigued by the problem, convinced of its seriousness, and aware of the major commitments and risks already undertaken [redacted] (b)(1) [redacted] sufficient to make the search worthwhile, could be expected.

We redoubled our efforts to understand [redacted] (b)(1) the Soviets' probable intentions for the mapping. On 19 October, TASS announced that on 16 October Venera 15 had transmitted its first radar picture: ". . . a high-resolution display of a region adjacent to the pole with an area of more than one million square kilometers." The announcement added that the first month in orbit would be used for adjusting the trajectory, after which systematic mapping would begin. Since Venera 15 had arrived at Venus on 10 October and (b)(1) [redacted]

(b)(1)

On 7 November the Soviets had released photos of the 1983 Venera spacecraft showing their large radar and telemetry antennas [redacted] (b)(1)

Meanwhile, some (b)(1) radio astronomers, who enjoyed cordial relations with Soviet colleagues, had for several months been discreetly digging for (b)(1) [redacted] might be found, and one of them came up with a frequency number: 5.9 GHz. We smiled at this, having heard a variety of such guesses over the years, but we were glad that it lay within the available search bandwidth, 5.6 to 6.3 GHz.•

Epiphany

(b)(1) [redacted] said:

"We have it (b)(1) [redacted]

— and the 21 years of silence ended.

Aftermath

(b)(1) [redacted]

(b)(1)

[redacted]

• • •

On 15 March 1984 in Houston, Soviet scientists displayed stunning radar imagery of the wrinkled, volcanic surface of Venus. (b)(1) [redacted]pening much of a strange new world to our eyes.

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Delight and contentment at the final discovery of the wideband planetary downlink can be f[redacted] (b)(1) [redacted] and that part of the American (b)(1) [redacted] scientific community with access to the intelligence data. Most of the people who became interested in the problem two decades ago, and contributed to the search over the years, are still active and some of them now are senior managers in their respective organizations. The writer is grateful for their sustained support in what at times may have appeared as a quixotic endeavor. The success of the search is clearly due to their lasting belief that it was worth doing despite its many uncertainties. But it is also due to the devoted work of the skilled and patient operators and analysts who ingeniously took advantage of every method and every opportunity to find the unknown signal, and at last have brought it to light.

This article is classified SECRET.