Signals from Outer Space

BY [redacted] (b)(3)-P.L. 86-36

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The radio signals transmitted by Sputniks I and II have been studied by various and diverse groups. The general assumption that these signals must contain the greater part of the intelligence to be acquired from such space satellites is not necessarily true. This article attempts to point out methods of data acquisition by other than telemetry techniques, without minimizing the possibility of telemetry on either the observed frequencies or frequencies not as yet demonstrated as emanating from the Sputniks.

The hand-keyed dots and dashes came in loud and clear—just a few groups off-and-on for three days—then they ceased, although operators, both amateur and commercial, sought to intercept them for weeks without success. Since these signals were received with about the same intensity at the various intercept points, the conclusion was quickly reached that they originated in outer space. A second factor that added substance to this theory was that the various combinations of dots and dashes could not be related to any known code.

Due to its proximity to earth at that time (1924), the planet Mars was given the credit for trying to establish a radio communications circuit with us.

Many receiving systems were modified to reach the radio spectrum—miles of magnet wire were wound on cardboard cylinders for use as loading coils, and unused sections of telephone lines were pressed into use as long-wave antennas. A high-powered transmitter sent out the call letters MARS at regular intervals over a period of several days. The French government developed grand plans for a battery of mirrors to be installed in the Sahara Desert for visual signaling. But lack of any identifiable response from Mars brought an end to further attempts by Earth to cooperate in a Mars-Earth communication link.

A generation or two later (4 Oct 1957), a third-stage rocket nosed over into a prescribed trajectory and delivered the final thrust necessary to launch an earth satellite into orbit. In rapid sequence the nose-cone separated from the rocket, thus releasing the 184-pound satellite to go hurtling around the earth at five miles per second; the swiveled antennas, freed by the jettisoned nose section, snapped back into position; the first space radio communication station was ready for operation—and began transmitting the now highly publicized beep-beep of *Sputnik I*.

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[1] This information is to be controlled because it is based on material not released by a cognizant organization.

Then, one month later, *Sputnik II*, weighing approximately 1100 pounds and purportedly containing both a live dog and extensive instrumentation, was successfully launched into orbit as the second earth satellite; and it too radiated radio signals for all to hear on the same frequencies as had *Sputnik I* (20.005 and 40.002 megacycles per second).

A brief review of the potential uses of earth satellites such as the *Sputniks* and our own satellites (*Explorer* and *Vanguard*) may aid us in estimating what intelligence may or may not be contained in the *Sputnik* Signals.

Our earth satellites, when properly instrumented, permit the following scientific objectives to be realized:

(a) Determination of outer atmospheric densities, (b) acquisition of geodetic data on the Earth's equatorial radius and oblateness, (c) long-term observations of solar ultraviolet radiation, (d) studies of the intensities of cosmic and other particle radiations impinging on the atmosphere, (e) determination of the density of hydrogen atoms and ions in interplanetary space, (f) observations of the Störmer current ring, (g) germination of the variations of mass in the Earth's crust under the orbital track, (h) observations of global meteorological conditions, (i) studies of radio wave propagation through the ionosphere, and (j) studies on the effect of meteor trails on radio wave propagation in the absence of the ionosphere.

The military potential of an earth satellite parallels that for the scientific field, with additional uses for surveillance and radio relay.

With the above points in mind, certain assessments of the intelligence to be gained from the signals from *Sputniks I* and *II* may be made. The first is the obvious one: that the rocketry program of the USSR had resulted in successfully launching into orbit the first instrumented man-made earth satellite. Other conclusions are not as easily deduced and fall into three groups: (a) those deduced from the behavior of the satellite itself, (b) those derived from the behavior of the radio signals without regard to message content, and (c) those resulting from analysis of the signals as to message content.

As to the first category: the formulae for phenomena controlling orbiting satellites have been developed to a high degree and any observed deviations from these formulae by a satellite in orbit may be ascribed to variations in such phenomena. Thus a deviation from the calculated path was expected, and noted, when *Sputnik I* passed over large geological upthrusts such as our own Rocky Mountains. Other path deviations have been ascribed to errors in geodetic data as to the Earth's equatorial radius and oblateness. Slow deviations, particularly in velocity, have been explained by density of ions, cosmic dust, or other matter giving rise to "air drag" on the satellite. The density of microscopic meteoric particles may be measured by using a polished surface on the satellite and optically measuring from a ground station the dulling of the surface. Collision with a large meteor has evidently not occurred, since such a collision would result in either destruction of the satellite or significant orbital deviation.

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As to the behavior of radio signals: a great deal of information has been collected about the path of propagation of the electro-magnetic radiations from *Sputniks I* and *II*. The spatial relationship between an Earth intercept site and the satellite can be calculated to a high degree of accuracy for any point in time, but opportunities for studies on radio wave propagation were lost to us by lack of preparation for observations on the radio frequencies used in *Sputniks I* and *II*. Particular observations have been made on certain long range intercepts, the explanations for which are in consonance with current theories of ionic rivers, jet streams, and tides in the ionosphere which give rise to "hot areas" capable of supporting long-haul radio communication circuits along specific bearings. Meteor trails above the orbital path would also give rise to observable variations in the characteristics of the received signal. There is every indication that the scientists of the U. S. S. R. have taken advantage of this opportunity to study the behavior of radio waves on a one-way pass through the ionospheric curtain above us. The choice of frequencies for the *Sputniks* was one favorable for such studies.

An inquiry as to what information may be contained in the composition of the signals does not proceed far before the following question arises: "What corroborative data do we have as to environmental conditions within and without *Sputniks I* and *II* at the time any particular sequence of signals was emitted?" We are aided in this direction by noting that all of the instrumentation proposed for *Vanguard* could have been contained in *Sputnik I* and much more in *Sputnik II* and the measurements planned for *Vanguard* could have been programmed in the *Sputniks* just as, to a limited extent, they have been successfully programmed in *Explorer*.

Transmissions identified as having originated from *Sputniks I* and *II* were characterized by the following features: bauds of variable length, amplitude modulation, bursts of frequency-modulation, sawtooth effect (FM), and amplitude variation in off-carrier backwave and full carrier conditions.

Signal characteristics observed on 20.005 and 40.002 megacycles could have supported the transmission of data. Evidences of high-speed complex telemetry were not observed. Unexplained variations

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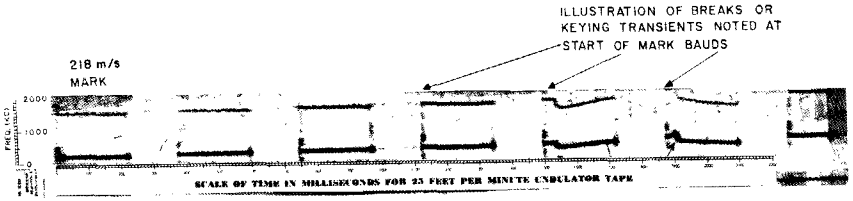

Fig. 1.

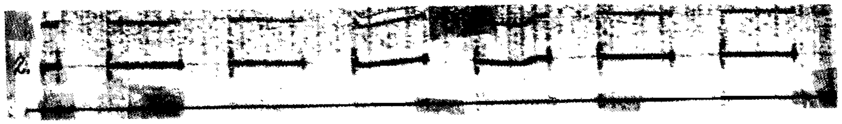

Fig. 2.

Fig. 3.

Fig. 4.

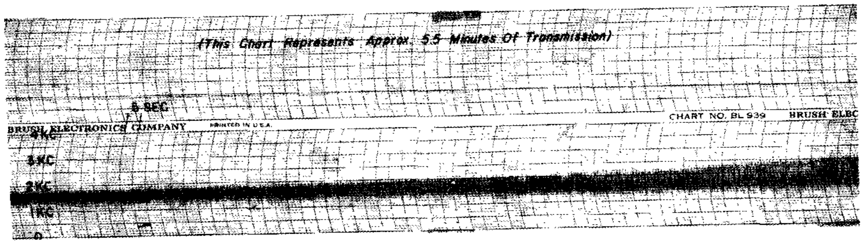

Fig. 5.

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IN ORDER to make *Sputnik I* signals perceptible to the ear, they first had to be translated into a suitable frequency and amplitude, since the frequencies of transmission (20 and 40 MCS) were considerably above the audio range, and the amplitude, after a trip to the earth from outer space, was extremely low.

Special antennas, cut to an optimum length for resonance at the transmission frequency and oriented to the oncoming wave, collected the radiations and directed them to communications receivers, where they passed progressively through radio-frequency, intermediate frequency, and audio-frequency stages, and were also suitably amplified. The resulting signal could then be changed from electromagnetic waves into sound waves by headphones or loud-speakers.

For purposes of examination and study, however, a visual presentation is obviously preferable. In order for a signal to convey information it must have components which vary in accordance with the information conveyed, the most natural of these being frequency, amplitude, and signal-element duration. An oscilloscope furnishes a characteristic visual pattern, changing from instant to instant as the signal varies, so that by photographing a series of these patterns and arranging them in order of occurrence from left to right a permanent record can be set up of the different parameters and their variations.

On the opposite page, Figs. 1 to 3 are spectrographs of this sort, showing time horizontally, frequency vertically, and amplitude by the degree of shading. Thus the dark horizontal lines represent the *on* time and the spaces between them the *off* time. By comparing Figs. 1 and 3 it may be noted that the mark durations are varied independently of the spacing; i. e., there is no fixed cycle length necessitating an elongation of the spaces to compensate for a shortening of the marks.

Figs. 1 and 2 illustrate instantaneous variations in frequency, as shown by the rising and falling pattern of the marks. Fig. 3 shows instantaneous variations of amplitude within the marks, by the variations in the shades of gray. Fig. 4 illustrates the Doppler effect; the frequency slowly rising and then falling as the satellite approaches and recedes from the point (near the horizon) where it is most rapidly approaching the observer. (The interruption on the right is irrelevant, being caused by a resetting of the machine.)

In Fig. 5 the graphic recording of the upper half shows amplitude (instead of frequency) on the vertical scale, and reveals a rhythmic undulation in amplitude fluctuations over a longer period of time. (The dark area to the right of center is not significant.) This effect could be due to the rolling of the satellite.

in signal characteristics suggest data stream transmission, encoding, or types of emission not yet clearly understood.

The unexplained frequency variations indicate that the signal is carrying intelligence. It is true that these variations have only appeared on a very small percentage of the tapes, but this is what could be expected if a transponder telemetering system was being used, and was occasionally accidentally triggered by noise.

"What data streams?" is of course the question. Cosmic ray measurements are very probable, since radio transmission may be the only possible method of data transfer. Mapping of cloud formations beneath the orbital tracks, by converting the output of photoelectric cells into digital information, as also density, pressure and temperature measurements inside the satellite and in the skin of the satellite, could have been telemetered to supplement the information derived from "air drop" observations. As to the heartbeat of the dog—only those present when the dog was sealed in can substantiate the claims of the U. S. S. R. in this regard. The list can be extended to cover measurements of other outer space phenomena. An analysis of the telemetry capabilities of the signals cannot be safely made at this time, since the possibility that techniques such as noise modulation are being used has not been evaluated.

Therefore, an assessment of the message content of *Sputnik* signals, as equated to identifiable phenomena, must be held in abeyance. (At the moment of writing we know no more as to the message content of *Sputnik* signals than we did the first day they were identified as such.) This statement is in no way intended to imply either that the correlation is impossible or that such a correlation has not been effected.

What is implied is that the various postulated correlations, as found in the open literature, cannot all be correct and must be treated as conjectures until such time as the notebooks of the responsible U. S. S. R. scientists are available, or until much more is known about outer space conditions, either through the results of our own rocketry programs or through more precise observations on the orbital behavior of *Sputniks* and X-type satellites. Telemetry data from *Explorer* may well be the key that will open up the message content of the *Sputnik* signals.

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