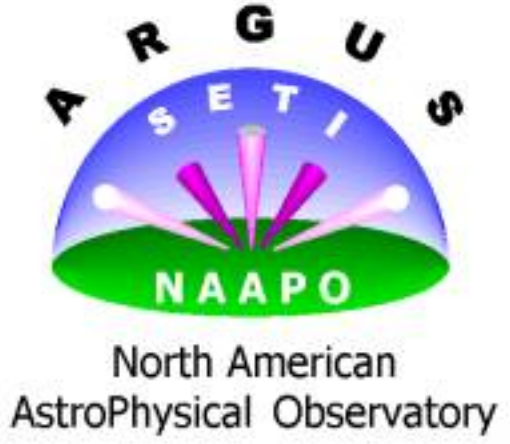

North American AstroPhysical Observatory (NAAPO)

Cosmic Search: Issue 11
(Volume 3 Number 3; Summer (July, Aug., Sept.) 1981)

[Article in magazine started on page 8]

The SEnTinel

By: Robert S. Dixon

Are We Listening for Machines or "People"?

Once again the gap between machine intelligence and biological intelligence has been narrowed. Researchers John Shoch and Jon Hupp at the Xerox Palo Alto Research Center in California have created a computer program that will migrate, reproduce and ultimately take over all the computers in a network. Their creation is called the WORM program, perhaps because it crawls through the wires interconnecting the various computers in a network, replicates itself in each one, and destroys whatever programs were originally running in the computers.

Shoch and Hupp have a network of 100 small computers connected together by the ***Ethernet*** technique. (***Ethernet*** is a relatively new method now being promoted by Xerox, Digital Equipment, and Intel corporations.) Their work was described in the February, 1981, issue of "Data Communications Magazine". One night they left the WORM running in a few computers, and returned the next morning to find that dozens of the computers had been taken over and were "dead." They tried to restart some of the dead ones, but they would only run briefly before they were invaded by a WORM from some other computer again.

Fortunately, Shoch and Hupp also have a special Antibody program that can stop the WORM from growing. However, the antibody cannot restore the afflicted computers, so they have to have their memories individually cleared out and reloaded with their normal programs to resume operation. Shoch and Hupp can observe the progress of the WORM with a WORM-Watcher program, that can also limit the WORM's growth or kill it completely.

This particular WORM program can only exist in the specific kind of computers and network used by Shoch and Hupp, but with future development could perhaps function with dissimilar computers and various types of networks. A practical application of such a program is to search through a computer network for some information or data whose exact location is unknown, and then return it to the seeker.

Another application is to search for previously undetected malfunctions and defects in the network and report their existence.

The WORM program is but one of many recent examples of artificial intelligence. How long will it be before some computer attains the theoretically "perfect" level — one in which a human conversing via a computer terminal cannot tell if it is a machine or another person at the other end of the circuit. And if we recognize the possibility of building such a machine, we will have another unknown to consider if and when we ever receive radio signals from other civilizations — Are we listening to machines or to "people"?

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A Russian SETI Experiment

Although several Russian SETI programs are believed to be in progress, very little detailed information about them has been published. A notable exception to this dearth of information is a recently published chapter in the book entitled ***Communication with Extraterrestrial Intelligence***, edited by John Billingham and Rudolf Pesek (Pergamon Press, 1979). This book is a special issue (Volume 6) of the ***Journal Acta Astronautica***, and contains many of the SETI papers given at the meetings of the International Astronautical Federation in the years 1975-77.

The experiment was actually carried out in 1972, by L.M. Gindilis (Sternberg State Astronomical Institute, Moscow), N.S. Kardashev, V.A. Soglasnov, E.E. Spangenberg, V. S. Etkin (all of the Institute of Space Research, Moscow), and V. G. Mirovskii (Lenin State Pedagogical Institute, Moscow).

Russian search strategies are generally the exact opposite of those used by most western experimenters. More precisely, they are the DUAL of western strategies. Whereas most searches seek narrowband, continuous signals, the Russian searches have concentrated on wideband, pulsed signals. The contrasts between these two approaches are shown in the table.

Parameter	**Western Strategy**	**Russian Strategy**
Limiting Signal Bandwidth	Zero	Infinite

Limiting Signal Time Duration	Infinite	Zero
Dimension which must be searched	Frequency	Time
Use of directional receiving antennas	Yes	No
Number of receiving sites required	1	2 or more, separated by thousands of kilometers
Effect of terrestrial interference	Blots out certain frequencies; can be identified by moving the antenna and by Doppler shift	Blots out certain times, can be identified by using multiple sites.
Method of determining transmitter distance	Parallax, over a period of time	Dispersion, immediately

Both strategies have their strengths and weaknesses, and since no one knows the form of extraterrestrial signals, both strategies are necessary. The relative disadvantages of the Russian strategy are less sensitivity (since very small antennas are used) and the necessity of operating several widely-separated receiving sites simultaneously. These sites, however, can use relatively small (even portable) equipment that is inexpensive to operate.

The Russian strategy makes use of the fact that radio pulses are distorted by the interstellar medium in such a way that they arrive here first at higher frequencies and later at lower frequencies. A pulse that was originally transmitted at the same time on all frequencies will be received as a pulse that sweeps downward in frequency, like a descending chirp. The rate of descent is slower for signals arriving from farther away. Thus the aproximate distance of an interstellar signal transmitter could be calculated from its apparent frequency sweep rate.

Gindilis and his co-workers used broadband receivers covering the frequency range 350-550 MHz, located at two sites separated by 3000 km. One was near the Black Sea in extreme southwestern Russia, and the other was in the Tadzhik Republic, near the southern tip of the Soviet Union. They recorded not only the output of these receivers, but the output of four 5 megahertz wide filters that selected portions of the total bandwidth near 371.5, 408, 458.5 and 535 megahertz. These

four frequencies were chosen to have equal time delay between them for a dispersion-caused sweeping signal. For example, a transmitter 3000 light years away would sweep from one filter to the next in 1/2 second. The experiment lasted for approximately one month.

They found many pulsed signals, most of which were blamed on local interference, since they occurred at only one or the other of the two sites. A number of the pulses did, however, occur simultaneously at both sites. Some of the signals agree even down to very small details, so they cannot have come from the surface of the earth. After careful analysis of all the signals received, Gindilis and his co-workers concluded that their extra-terrestrial signals came from three separate causes — artificial earth satellites, bursts from the Sun, and sporadic radiation from the Earth's ionosphere. None of the signals had a dispersion that would place it outside the solar system.

This experiment was valuable in that it demonstrated the capability of the method to detect potentially interesting signals, and to positively identify interfering signals. The authors recommend that further experiments of this type be conducted using improved receiving and recording equipment.

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