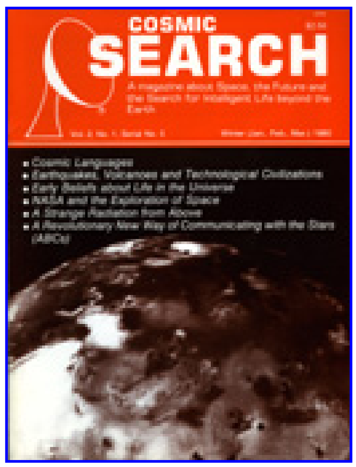
North American
AstroPhysical Observatory

North American AstroPhysical Observatory (NAAPO)



Cosmic Search: Issue 5
(Volume 2 Number 1; Winter (Jan., Feb., Mar.) 1980)

[Article in magazine started on page 24]

"Strategies for the Search for Life in the Universe"
A Joint Session of the International Astronomical Union

By: Michael D. Papagiannis

Michael Papagiannis (center) welcoming IAU members to the Montreal Joint Session on SETI. Philip Morrison (left) and Iosef Shklovsky (right) wave to the audience.

It was a happy moment, when on the morning of August 15, 1979, I stepped to the podium to welcome on behalf of the International Organizing Committee all the participants to our joint session. The large auditorium was full, creating a gratifying feeling after nearly two years of letter writing, telephone calls and telegrams to places all around the world. In my brief welcoming address, I said,

> "It is an important new step and a unique opportunity to hold a meeting on Life in the Universe during the General Assembly of the IAU when many of the best scientists in this field from around the world are gathered under the same roof. Our subject is a sensitive one that can easily lead to misunderstandings. It is our responsibility, therefore, to provide sensible leadership and to show that we can proceed in a scientific manner, without exaggerations and without premature headlines, toward the solution of this fundamental problem."

The **International Astronomical Union** (IAU) is an organization of the world's astronomers representing nearly fifty countries. The Unions purpose is to facilitate the exchange of scientific information and to foster international cooperation in astronomical activities. The Union is organized into about 50 commissions, each concerned with a specific area of astronomy. Every three years the Union holds a *General Assembly* at which all members and commissions may participate. The August 1979 meeting of the IAU in Montreal, Canada, was the Seventeenth General Assembly.

A special feature of the *General Assembly* was the one-day Joint Session of three of the IAU's Commissions (No. 16, *Physics of Planets*, No. 40. *Radio Astronomy* and No. 44. *Space Astronomy*) on Strategies for the Search for Life in the Universe" , as reported here by Michael D. Papagiannis, Chairman of the committee which organized the session. Professor Papagiannis is Chairman of the Astronomy Department of Boston University. Other members of the organizing committee were Frank Drake, Tobias Owen and Ben Zuckerman of the U.S.A., Nikolai Kardashev. Iosef Shklovsky and Vasevolod Triotsky of the U.S.S.R., J. C. Ribes of France. Sir Bernard Lovell and Martin Rees of the United Kingdom, George Marx of Hungary and Jun Jugaku of Japan.

Several of the members of the International Organizing Committee as well as several of the Section Chairman, namely Drake, Kardashev, Troitsky, Rees, Morrison, Oliver and von Hoemer, are also members of the Editorial Board of **COSMIC SEARCH**.

—Eds.

The topic of the first morning section was: **Alternative Views on the Value of N**, i. e., on the number of technologically advanced civilizations currently present in our galaxy. Iosef Shklovsky of the Academy of Sciences, Moscow, and Philip Morrison of M.I.T. were the Co-Chairmen of this section. Michael Hart, of Trinity University, who was the first speaker, supported the view that N is very small based on the lack of any evidence for extraterrestrial presence on earth. It is inconceivable, he said, that every one of millions of galactic civilizations has forbidden for billions of years interstellar travelling and this order has been obeyed without any exception by their trillions of inhabitants. Hence, he concluded, their absence from the earth is convincing evidence that they do not exist.

Thomas Kuiper of the Jet Propulsion Laboratory suggested that N is probably very large, because life seems to be able to operate an inverse 2nd law of thermodynamics, i.e., to use available energy to locally reduce entropy and thus progressively build organisms and societies of high complexity and sophistication. Frank Drake of Cornell University defended the view that N is neither very small nor very large based on the analysis that interstellar travelling would be prohibitively expensive. Using figures of energy consumption per head, he finds that the cost needed to send a few thousand people to another star in search of a better life would be equal to the cost needed to provide a high quality life for all the people on earth. Hence, he concluded, interstellar colonization would not be an appealing proposition to any civilization. It was pointed out by other participants, however, that man undertakes tasks not only for practical purposes, but, as in the case of climbing Mt. Everest or landing on the moon, for curiosity, glory, etc. Also that interstellar migration will never be used to offset the population problem of a planet, since it can involve only a minute fraction of its population, but rather to satisfy the spirit of seeking new worlds. Finally, the energy problem might not seem as severe after a few centuries in the light of future technological advances.

I supported the thesis that N is either very small or very large and that intermediate values are quite unlikely. I pointed out that life from the simplest to the most advanced forms has a natural tendency to expand like a gas to fill all available spaces. The slow biological evolution, which moved life from the waters to land and from land to air, has now been replaced by the explosive progress of technology which has allowed man to conquer the waters, the air and recently the outer space, the largest space of them all. Interstellar travelling and galactic colonization are not only technologically possible but also inevitable given this basic trait of life. It was generally agreed that the complete colonization of our galaxy can be achieved in about 10 million years, which is a very short interval when compared to the 10 billion, or so, year age of our galaxy. Hence, I concluded, either the colonization of our galaxy has already taken place and therefore every star must have been colonized, or it has not yet happened because nobody started it and therefore we must be one of the few if not the only technological civilization in our galaxy.

I also noted that in all probability colonizing civilizations could not come to live on planets, because they would be accustomed to living in space colonies, after their centuries-long interstellar journeys, and because it is highly unlikely that the conditions prevailing on any given planet would fit exactly their biological needs. They would continue, therefore, to live in their comfortable space colonies and their colonization of a solar system would amount to building more space colonies using the raw materials obtained from asteroids and small moons with low gravity. Consequently, their absence from the earth is not a proof of their absence from the solar system which we must search carefully and in particular the asteroid belt before we can conclude that the colonization of the galaxy has not yet taken place.

In addition to the above speakers Vasevolod Troitsky of the Radiophysical Scientific Research Institute of Gorky, U.S.S.R., presented an interesting paper dealing with the technological requirements of a radio antenna that could broadcast a beamed signal to a distance of 10,000 light years. He finds that these requirements are formidable, if not prohibitive. At the end of this section, Philip Morrison gave an articulate summary of the different views on the value of N and the directions we ought to proceed in the future in view of the alternatives discussed. These directions, he said, ought to include both the continuation of radio searches, as well as the further exploration of our solar system.

The topic for the second morning section was: **Strategies for SETI Through Radio Waves**. The Co-Chairmen were Bernard Oliver of the Hewlett-Packard Co. and Jun Jugaku of the Tokyo Astronomical Observatory. Oliver opened this section with a brief summary of the advantages of radio communications and the rapid progress that is being made in electronic support equipment, especially in the construction of multichannel analyzers. Analyzers with one million channels are within the capabilities of current technology, he said. Ben Zuckerman of the University of Maryland gave an extensive review of the six radio searches that have been performed up to now in the United States and Canada. The first one, Project OZMA by Frank Drake in 1960, looked only at 2 stars (Epsilon Eridani and Tau Ceti), while OZMA II by Palmer and Zuckerman looked at nearly 600 stars collecting data points 10 million times faster. Troitsky gave a similar, but less detailed summary of the several searches that have been going on in the Soviet Union and finally Samuel Gulkis of the Jet Propulsion Laboratory discussed different alternate possibilities, both small and large, for the future.

The topic of the first afternoon section was: **The Search for Early Forms of Life Both in Our Own Solar System and in Others**. The Co-Chairmen were Jesse Greenstein of the California Institute of Technology and Nikolai Kardashev of the Academy of Sciences, U.S.S.R. Gerald Soffen, the Director of Life Sciences of NASA, gave an exciting overview of the search for life in our solar system. He discussed the Viking mission to Mars and he noted that finding another independent origin of life would be of immense importance in our efforts to understand the mystery of life. He also pointed out that this is a multi-discipline task where experts from many different fields, including astronomers, geologists, biologists, chemists, physicists, etc. must work together. Tobias Owen of Stony Brook discussed how we hope some day to use spectroscopic observations, in particular those revealing the presence of water and oxygen, to search for life in other solar systems. Searching for life based on carbon, water and oxygen is not a projection of our chauvinistic bias because carbon, nitrogen and oxygen are the three most common heavy elements accounting for nearly 3/4 of all the heavy element atoms in the Cosmos. Carbon is unique for its ability to make complicated chemical compounds, while water is a superb solvent and medium for chemical reactions. In addition it can dissolve large quantities of carbon dioxide and can co-exist nicely with oxygen, which ammonia cannot.

Searching for signs of life in other solar systems, however, is still a task for the future because we have not yet been able to detect any planets even in the nearest stars. The problem is that the faint planets are so close to the extremely bright stars that it is like trying to see a firefly sitting at the edge of a powerful searchlight. Great progress, however, is being made in this area, and many new techniques were discussed by experts in the field. George Gatewood of Allegheny Observatory described the astronometric methods and said that the recent replacement of the photographic processes by photoelectric techniques has led to a dramatic improvement in the sensitivity of astrometric methods which are looking for minute changes (one to one-tenth milliarcseconds) in the position of a star produced by the rotation around it of one or more planets.

Douglas Currie of the University of Maryland described the interferometric methods where efforts are being made to develop a two aperture set-up, like a radio interferometer. Single aperture techniques, using speckle interferometry, have already made it possible to measure the diameters of some large red giant stars. Ian McLean, of the laboratory of Krzysztof Serkowski at the University of Arizona, described the progress being made in developing the sensitive spectroscopic techniques needed to measure the orbital velocity (10-20 m/sec) of a star about the common center of mass of the star and a large planet orbiting around it. William Baum of Lowell Observatory described the advantages the space telescope will have in this area since it will be able to detect objects as faint as 28th magnitude by avoiding the airglow and the smearing of a star's image by atmospheric seeing. It seems that the combination of the space telescope and the new photoelectric astrometric technique might be able to provide some impressive results in the next 5 to 10 years. Finally, David Black of NASA-Ames Research Center gave an excellent summary of the advantages and disadvantages of the different presently available methods for the detection of planets and their prospects for the future. He also discussed some direct methods that are currently being proposed, including occulting disks, apodized images and the infrared space interferometer proposed by Ronald Bracewell of Stanford University which might hold a great promise for the future.

The topic of the last section was: **The Different Manifestations of Advanced Cosmic Civilizations**. The Co-Chairmen were Sebastian von Hoerner of the National Radio Astronomy Observatory and Martin Rees of Cambridge University, England. Woodruff Sullivan of the University of Washington discussed the possibility of eavesdropping on other neighboring civilizations by considering what they could have learned by doing the same to the earth. Since strong narrow-band signals, such as the carrier frequencies of TV stations, come from discrete locations on the earth, it is possible from the Doppler effects to determine the rotation of the earth and its orbital period around the sun. From the mass of the sun, which one could figure out from its luminosity, one could then determine the distance of the earth from the sun and hence also its average temperature. Von Hoerner summarized different astroengineering projects that advanced civilizations might undertake, including the building of "Dyson spheres." Philip Morrison noted that it is uneconomical and therefore unrealistic to expect these civilizations to surround their stars completely with opaque spheres in order to absorb all of the star's radiation. It is more reasonable to expect them to deploy space colonies and solar energy satellites that would cover up to about 10 percent of the area around the star, so that such stars would appear to have a normal spectrum with an abnormally intensified infrared component. I proposed to name these "modified Dyson spheres" or better "Dyson-Morrison spheres".

Sebastian von Hoerner discussed also the possibilities for interstellar travelling. He noted that theoretical computations such as those performed by Freeman Dyson of Princeton University in project Orion, or by the group headed by Anthony Martin and Alan Bond of the British Interplanetary Society in *Project Daedalus*, have shown that it is possible to propel a spaceship over interstellar distances even with present day technology. These projects require the continuous explosion of nuclear bombs a certain distance behind the spaceship which provide the thrust needed to accelerate the spaceship to velocities in the range of one-hundredth to one-tenth of the speed of light. Von Hoerner noted that the undertaking of such a project today would wipe out completely all the nuclear stockpiles on earth. This remark brought glitters to the eyes of all the participants, because if sending a mission to another star would eliminate the threat of a nuclear holocaust on earth, what more could one ask for.

More than 300 astronomers attended the Joint Session and all four sections were followed by lively discussions. The next day the Executive Committee of the IAU had scheduled an Open Evening Session in which we were asked to summarize the discussions and the conclusions of our Joint Session for the general membership of the IAU. The large participation of the previous day necessitated the moving of the Open Evening Session to the main auditorium of the University of Montreal. Leo Goldberg, President of the IAU from 1973 to 1976, was the Chairman of this Evening Session and presented Frank Drake of Cornell University and myself. Drake reviewed the two morning sections and I reviewed the two afternoon sections. The attendance was probably the largest of all the meetings of the General Assembly, having many people standing in an auditorium with a seating capacity in excess of 1000 people. All in all it was an exciting meeting that brought together many distinguished workers in this field from around the world. It focused strongly on the controversy of the colonization of the galaxy and on the progress being made in the search for planets in other stars. The possibility of galactic colonization seems to call for a careful search inside our own solar system and for the parallel study with radio antennas of all nearby stars. These tasks, as well as the search for planets, can be comfortably woven into the current goals of space exploration and astronomical research for the 1980s. Thus, it seems that the proper strategy at this time is to amalgamate our Search for Life in the Universe into our normal scientific research and space exploration, keeping always a keen eye and an attentive ear for opportunities that might advance the cause for this exciting quest.

HOME

Designed by Jerry Ehman.
Last modified: January 11, 2006.