Project OSCAR, Past, Present and Future

[by] W. W. Eitel [WA7LRU, W6UF; June 28, 1967]

The first concept of an amateur space satellite to appear in print came from Don Stoner, W6TNS, when he described a space satellite in the April 1959 issue of CQ and asked the humorous question: “Does anyone have a spare rocket for orbiting purposes?”

Looking back over thirteen years, little did Don realize the chain reaction he set off.

Fred Hicks, W6EJU, had been thinking along similar lines. When Fred read Don’s humorous quip in CQ, he decided there just might be a chance to get an amateur radio satellite aboard a space vehicle. Fred worked for an aerospace company and he hoped to obtain company support for the idea.

One of Fred’s first steps was to form a committee in June 1959. This committee consisted of a number of amateurs who were friends of Fred’s and were able to contribute ideas and hardware to an amateur satellite project. This dedicated group started to make plans for the construction and launch of an amateur radio satellite.

By 1960 it became apparent that it would be necessary to have a formal organization that would be responsible for project plans. By this time, radio amateurs (who were influential in professional and Government circles) had been contacted by the group and interest in the program was developing. Accordingly, in August of 1960 Project OSCAR was officially formed with Fred serving as Chairman. OSCAR stands for Orbiting Satellite Carrying Amateur Radio.

The next step was to seek the support of the ARRL for the OSCAR space program. The ARRL is the only official amateur radio organization in the United States. Its support would mean that Project OSCAR had the support of amateur radio as a whole and could rely on the ARRL to support the program when necessary. Official ARRL sponsorship of Project OSCAR was received in March of 1961.

Things were taking shape rapidly now, both in the construction of a satellite and the plans to launch and track it.

The final hurdle was overcome in November 1961 when the U.S. Air Force Space Systems Division in Los Angeles, California informed the Project that it approved the placing of an OSCAR package in orbit in conjunction with a DISCOVERER program launch on a space-available basis. In addition to the satellite construction and launch programs, there were other important programs that had to be worked out and coordinated to achieve the successful use of the OSCAR satellite by radio amateurs. It was necessary to set up a headquarters communication center to coordinate the world-wide amateur tracking and communication network.

In addition, a group had to be organized to gather data from these stations and other sources and process it for orbital predictions. This in itself was a large program for a group of volunteers to undertake.

On December 12, 1961, OSCAR I was successfully launched into orbit. OSCAR I was followed by two more successful launches, OSCARS II and III. The success of these three OSCARS was a milestone in amateur radio accomplishments comparable to the successful shortwave trans-atlantic

tests of December 1921. The 1921 tests proved that high frequency communication was possible with simple apparatus built by radio amateurs. The 1961 OSCAR tests demonstrated that radio amateurs could contribute to an international space communication program.

With the successful launch and international communication through OSCAR III, amateurs again demonstrated technical leadership. OSCAR III was the first satellite capable of repeating any mode of ground transmission falling within the receiver passband. In addition to the technical accomplishment, OSCAR III was the first free-access communication satellite. This capability was taken advantage of by radio amateurs on a world-wide basis. This event may go down in history as one of the more important steps in bringing about international understanding through people-to-people contacts.

With the launching of OSCAR III in March 1965, it was decided by Project OSCAR to devote more time to encouraging other radio amateur groups to participate in the program. Early in the program, Project OSCAR tried to broaden interest by urging other groups to participate through building flight hardware. This approach was beset by practical difficulties of coordination and it was not until OSCAR III was launched that a workable management technique was worked out. This was accomplished by appointing a local OSCAR member to serve as a liaison agent between OSCAR Headquarters and each participating group.

Following the decision to actively encourage others to participate in the OSCAR program, a very fortunate event took place. The TRW Amateur Radio Club of Los Angeles offered to design and build OSCAR IV. This was our first experience with a satellite program that was not handled completely within the OSCAR organization. Project OSCAR was

very fortunate in having a group like the TRW Radio Club to work with because the club members were familiar with all phases of satellite design and construction. Working with a group having this kind of experience called for very little technical supervision on the part of Project OSCAR and allowed concentration on the problems of mating the satellite to the launch vehicle and other launch details. The launch vehicle mounting frame for the satellites was constructed by the Martin Co. in Denver, Colorado, a distance of 1,000 miles from OSCAR Headquarters, located at Foothill College in Los Altos Hills, California. The TRW Radio Club is located in Los Angeles, a distance of 400 miles from OSCAR Headquarters. Coordination of the OSCAR IV program was carried out by telephone and visits to both locations.

The problem of mating the satellite to the launch vehicle mounting frame is a very critical one. In the case mentioned above, there were three other satellites carried on the TITAN IIIC launch vehicle. Each satellite had to be independently released from the mounting structure at the correct time and could not interfere, either mechanically or electrically, with the other satellites. In addition to these problems, Project OSCAR was required to demonstrate to the satisfaction of the launch agency that the satellite would withstand the vibration, shock and acoustic forces produced at lift off and at stage separation. These were difficult problems but experienced people were able to anticipate the forces and to design the satellite and its ejection apparatus accordingly. OSCAR IV was successfully launched from Cape Kennedy, Florida, December 21, 1965, even though the TITAN IIIC malfunctioned and did not go into planned orbit.

The failure of the TITAN IIIC to achieve the planned near-synchronous orbit was a bitter disappointment to all of the people involved in the OSCAR program. The near-synchronous orbit would have meant that OSCAR IV would have been accessible to any observer for a period of approximately 5 days. There would have been no requirements for rapid orbital predictions as demanded by our previous launches. OSCAR IV would have slowly drifted around the world at the equator allowing long periods of access and leisurely preparation and experimentation by those amateurs intending to communicate through it. Instead of this situation, the failure of the launch vehicle to achieve proper orbit forced the groups handling orbital predictions and communications to instantly change their plans and cope with a whole new set of circumstances. The third stage of the vehicle had not responded to commands to go into the near-synchronous orbit. Instead of a 24-day equatorial orbit, OSCAR IV was ejected into the 9 hour 50 minutes transfer orbit swinging north and south of the equator approximately 26°. Situations like this show one of amateur radio's most important characteristics - the ability to instantly respond to a new set of circumstances, be they earthquake, flood, or the change in orbit of a satellite.

In addition to the change in OSCAR IV's orbit caused by a failure of the third stage of the launch vehicle to achieve proper orbit, the satellite was ejected with random rotation because the stage was tumbling at the time of satellite ejection. The TRW Radio Club had done a splendid job of designing a simple but effective mechanism that would simultaneously eject and spin stabilize the satellite. But with the launch vehicle tumbling at the time of ejection, another

force had been added to the spin moment and the OSCAR satellite, was no longer spinning on the planned axis. As a result, the solar cells that supplied power to the equipment were oriented in a different relationship to the sun, and the antennas were oriented in a different relationship to the observer on earth. The elliptical orbit caused OSCAR to pass through the Van Allen radiation belt about 5 times in each 24 hours. No provision had been made to cope with the effects of radiation on the solar cells or other components. Because of these unexpected complications, the life of OSCAR IV was short and the operation marginal. Even so, the first satellite radio contact between the U.S. and the U.S.S.R. was established through OSCAR IV.

With the decision to encourage groups outside the OSCAR organization to design and build satellites, the Project may encounter delays in future launches because the groups may not have the experience or expertise necessary to meet the rigid requirements for space hardware delivered on schedule. Failure of a group to meet their schedule can cause many problems for Project OSCAR. OSCAR launches are on a space-available basis and we have no arrangements that will allow us to delay a launch. This means finding another space vehicle with the same characteristics, such as mounting frame, ejection system and orbit. This can prove to be very difficult.

In spite of the problems outlined above, Project OSCAR thinks it is in the best interest of international amateur radio and international good will to follow a program of encouraging other radio amateurs and amateur societies to participate in the free and peaceful use of space through participation at all levels in the OSCAR program.

As a result of this policy, Project OSCAR has been working for a year and a half with two overseas groups on the design and construction of their satellites. In April 1967, the first of these satellites was received from Germany by Project OSCAR. Built by Karl Meinzer, DJ4ZC, under the sponsorship of IARU, Region 1, this satellite is a battery-powered transponder with the receiver pass band centered at 144.1 Mc [= MHz]and the transmitter pass band centered at 145.9 Mc. The passband is about 40 kilocycles [= KHz]. You will recognize these characteristics as being similar to OSCAR III, and I might add they are more difficult to achieve than you would expect, as system gain is high frequency separation is small, and the receiving and transmitting antennas are both mounted on the satellite case which measures 6 by 12 by 17 inches. This satellite is presently undergoing test and evaluation.

On June 1, 1967, Richard Tonkin, Paul Dunn and Owen Mace of Australia arrived in San Francisco from the University of Melbourne. They are associated with Project Australis and are very active in the design and construction of the Australian satellite. Their satellite arrived in San Francisco on June 6 and they assisted the OSCAR coordinator in the preliminary test and evaluation of the satellite.

The Australian satellite contains two beacons transmitting on 29.45Mcand 144.050Mcand is battery powered. It will transmit telemetry information to observers on earth. Australia's radio amateur satellite incorporates a magnetic stabilizing system that should gradually dampen the tumbling produced by the ejection system of the space vehicle. Telemetry information transmitted by the satellite will indicate the amount of tumble. The telemetry frequency of 29.45 Mc was selected in order to allow

more observers to participate in these amateur radio space programs.

We hope to be able to announce the launch date of OSCAR V -which should be one of these two satellites - in the near future.

You are probably wondering now what comes after OSCAR V.

Let us briefly review what we have accomplished so far and consider what we may do in the future.

We at OSCAR believe that radio amateurs have demonstrated that they are capable of effectively participating in space programs. We have built and launched four successful satellites in a row. OSCAR III was the first free-access satellite and would respond to any mode of transmission. The first radio contact via satellite between the U.S.A. and the U.S.S.R. was achieved through OSCAR IV. The four OSCAR satellites that have been launched have resulted in hundreds of amateur observers participating in space experiments utilizing satellites having no accountability other than to the individual observer.

The OSCAR program, moreover, has provided the inspiration for students in many parts of the world to actively participate in space studies and experiments. The educational aspect of Project OSCAR is impressive and should not be discounted.

Through the medium of amateur radio, it is possible to carry on people-to-people contacts on an international basis without international agreements or treaties. The ITU regulations already in effect make it possible for a duly licensed radio amateur to participate in world-wide communication. Radio amateurs have built and orbited free-access satellites, proving their ability to construct space stations and simple ground equipment to use these space stations. Do not these facts point the way to the future for Project

OSCAR, charting the course for tomorrow? I think they do. OSCAR's future contribution lies in the field of education and experimentation, as exemplified by the Amateur Radio Service.

We realize that the age of space exploration and study is upon us, and that the space enthusiast and student of today will be the explorer and scientist of tomorrow. It should be possible to provide the means for these enthusiasts to pursue studies and experiments by means of satellites having open, free access, and bearing no accountability other than to the interested observer.

Today's communication satellites are strictly controlled, and experimentation and use are limited to a few individuals or organizations intimately connected with the particular communication program in question.

Looking ahead, I think it would be to our advantage to create and utilize a long-life, free-access satellite that radio amateurs and scientific-minded citizens can use for communication experiments and study. This would be in the best tradition of free and unrestricted communication between amateurs. Such a device would be of great benefit to radio amateurs, universities, and to the scientific community at large.

Within the proper context, a long-life, free-access communication satellite seems possible and desirable, and I suggest that such a satellite falls within the concept of the International Amateur Radio Service as defined by the International Telecommunications Union.

Amateur radio (by the ITU definition) is "a service of self-training, intercommunication and technical investigations carried on by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary

interest." Within this definition, and within the past decade, radio amateurs have designed, built and caused to be launched four space satellites.

The first four OSCAR satellites were designed and built by devoted groups of radio amateurs in California. The satellites were sophisticated devices, but represented the absolute minimum workable hardware that could be built on a volunteer basis. Satellite life and operational bandwidth were sacrificed in each instance to the hard limitations imposed by available funds and volunteer efforts. The returns on this modest investment were impressive, and those involved in the program were repaid many times over in satisfaction of a job well done.

In the long view, however, such a volunteer program, no matter how inexpensively conducted and worthy of execution, cannot sustain continued interest and participation of a majority of radio amateurs. Operating on this basis, Project OSCAR has provided a launch of about one satellite every two or three years, each satellite having a limited lifetime of weeks. Thus, even with the best intentions and unstinting labor of love of those intimately concerned with the program, the benefits of a long-life space experiment could not be achieved, nor do I foresee such experiments being possibly achieved in the immediate future while faced with limited facilities. The problems accompanying such an ambitious project simply cannot be overcome by a small volunteer group, no matter how high the degree of devotion to the task.

The ultimate goal, however, of a long-term useable radio amateur space satellite stands on its own merit, and I believe that the time has come to look for support for this concept, over and above the

voluntary support existing within our own ranks of radio amateurs. If, as I said, the program stands on its merit, it should be possible to obtain the necessary technical and financial assistance to realize a full-time radio amateur repeater satellite to be used for study and experiment.

A long-life, free-access radio amateur satellite, operating in a near-synchronous orbit would afford world-wide VHF communication between radio amateurs in an entire hemisphere, revolutionizing the long distance communication aspect of amateur radio. Being a satellite having no accountability other than to the users, the satellite could become a part of world-wide space study programs; and it could be utilized by universities and other students, as well as by radio amateurs. The only "key" to admission to the translator capability of the satellite would be a valid radio amateur license. Even this simple requirement would not, however, prohibit the use of the satellite for various passive studies and educational purposes. The satellite would be as available as any natural astronomical body for educational and scientific purposes, unencumbered by political or economic restrictions or reservations. Open to all, without specific invitation, the radio amateur space satellite would advance the cause of international amateur radio, would provide a reliable means of hemispheric, world-wide communication for radio amateurs, while simultaneously providing a source of study and investigation for scientific-minded persons irrespective of national boundaries. The point to remember here is that such a program can only be implemented through the medium of amateur radio because the necessary international regulations are already in effect.

In conclusion, then, amateur radio and Project OSCAR can serve themselves best by serving others. A free-access, long-life, semi-synchronous satellite can be our goal to stimulate and sustain international scientific and educational communication via the means of amateur radio. We will require impressive outside support in such an ambitious program, as the limited resources available to Project OSCAR at this moment, are insufficient to do the job.

Studies are underway within Project OSCAR to best determine the means of obtaining support necessary for such an ambitious program. Where will the design of such a satellite come from? Who will build it? These questions must be answered before OSCAR can proceed with plans for such a program.

But the aim is true and unswerving. Amateur radio has a purpose and a goal. Investigation of communication phenomena and self-education form the backbone of amateur radio, as they have for over 60 years. The next decade will surely further the cause of the Amateur Radio Service in this time-honored tradition.

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William Eitel
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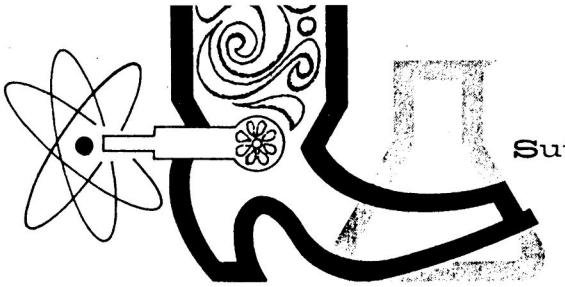

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September 24, 1972

AMATEUR SPACE ACTIVITIES - PAST, PRESENT, FUTURE, W.W. Eitel, WA7LRU
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A paper titled "Project OSCAR, Past, Present and Future" was given at the IARC Convention in Geneva, Switzerland in 1966. It was updated- and given at the 16th National ARRL Convention in Montreal, Canada on July 1, 1967. I have updated this paper again using the original material as it was presented.

Both previous presentations of the paper were presented for the purpose of explaining what had been done by amateurs in space communication and some suggestions were made regarding future action and benefits to be obtained. It was hoped that the amateur fraternity would realize the importance of space communication to its future. I believe the material presented in these two papers is still valid and the importance of amateur space communication has become crucial to our very existence.

Upon this premise, I am going to read the paper given at Montreal and then cover the events that have transpired since this paper was given in 1967.

William Eitel
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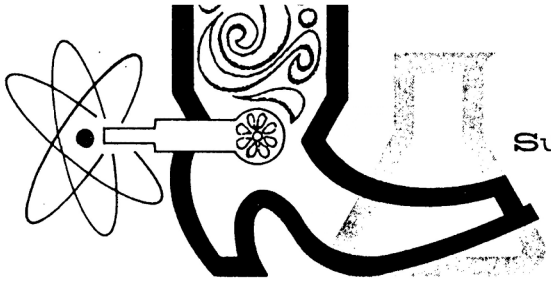

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Five of the ten years mentioned above have passed. Let's take a look at what has happened during this five-year period.

As previously mentioned, the conclusion had been reached that it was not possible for Project OSCAR to do the job that was necessary to provide the programs and satellites that would allow the amateur service to attain its objectives. The OSCAR organization was kept together for the purpose of making studies and developing plans that would provide the means to achieve the objectives mentioned in the Montreal paper.

Lady Luck has played a role as important in our space program as the sweat and tears of those volunteers who gave their all to the amateur radio service space communication programs.

Project OSCAR had shrunk to a small holding group that kept the organization together with the hope that somewhere in the amateur radio fraternity an awakening to the necessity for amateur space communication would take place.

On January 9, 1969, George Jacobs addressed the Communication Satellite Corp. Radio Club and reviewed the Project OSCAR programs. George suggested the formation of a similar group on the East Coast. This speech by George Jacobs inspired the group to marshall their talents and on March 3, 1969 AMSAT, the Radio Amateur Satellite Corp., was formed.

The formation of AMSAT preserved the work OSCAR had done and kept interest in Amateur Space Communication alive. One of the most

important things to come out of AMSAT's activities was that the Amateur Radio Space Communication had a continuous record of performance dating back to the launch of the first OSCAR. With this record the individuals who represented the amateur radio service at the last Space Frequency Allocation Conference were able to carve out a small window in the spectrum for amateur space communication.

The first satellite launched by AMSAT was built at the University of Melbourne in Australia. A satellite built by Paul Meinzer, DJ4ZC has been under development and test by AMSAT for some time.

AMSAT has made plans for a series of satellites to be launched over the next four to six years. The first in the series is known as AOC and when launched in October, it will be designated OSCAR 6.

OSCAR 6 will be launched in a Polar orbit and will have its input on the 144 Mhz band and the output on the 30 Mhz band.

On June 24, 1972 the Amateur Satellite Service Committee (ASSC) was formed. The Committee is made up of two members each from ARRL, AMSAT and OSCAR. The formation of ASSC provided the means for the three organizations to work together toward a common objective using the talents and resources of each group to the best advantage.

ASSC and OSCAR are working with AMSAT to provide support for their programs. The first step is to assure the launch of more satellites similar to AOC-OSCAR 6 on a continuing basis to maintain interest in amateur space communication activities.

Paralleling this effort is a joint program by ASSC-AMSAT and OSCAR to launch a satellite in 1976 in conjunction with our country's centennial celebration. This satellite would be launched in a near synchronous Polar orbit and would have the characteristics necessary to

allow the amateur radio service to provide education, public service, and international people-to-people communication.

These objectives are in keeping with those stated earlier in this paper. With the passing of time it becomes more important than ever that they be achieved. The Amateur Radio Service cannot survive if it continues to remain in the rut most of us have come to accept. It has been pointed out many times recently that we could be in jeopardy of losing our frequency assignments if we do not meet our license requirements to perform a public service that is in fact a public service. It is the goal of the three organizations working on the Amateur Space Communication program to help you provide this service.

This is a very ambitious program. The three groups involved have the imagination and talents to accomplish the objectives. The resources for the present programs are marginal and cannot begin to satisfy the needs for the larger programs that must be mounted in the future. Plans for support for our long range programs are being formulated. At the present we are being supported by substantial contributions from a few in the amateur ranks and the contributions of critical parts and services from certain segments of industry that appreciate the importance of the contributions amateur radio has made to a pool of self-trained experts in the field of electronics and communication. The individual amateur may have to contribute more to the space communication program if the program is to survive. In closing, let me emphasize once more that amateur radio may not survive if we do not have a space communication program that meets the objectives that I have outlined. (WWE/eh) [##]

Archivist's Note by Bart Lee, CHRS Archivist:

W. W. ("Bill") Eitel (and Jack McCullough) founded Eitel-McCullough, Inc. ("Eimac"). It did business in San Carlos, California and thrived for many decades. It asserted that it was "The World's largest Manufacturer of Transmitting Tubes." (https://worldradiohistory.com/Archive-Catalogs/EIMAC/Eimac-TubeManual-1965-Vol-1.pdf). It latterly specialized in high power klystrons.

A memorial biography of William Eitel, W6UF (b 1908, d 1989) appeared in *World Radio* in May, 1989. He was both a distinguished industrialist and a distinguished radio amateur. The biography may be found at: https://qrqcwhistory.wordpress.com/about/ .

IEEE published this photograph in 1965, when Eitel-McCullough merged into Varian Associates:

https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=6501041

This now PDF document was "Found in the Collections" in the CHRS Archives; it has been very lightly edited.

For a history of the successor AMSAT, see:

A Brief History of AMSAT by Keith Baker, KB1SF/VA3KSF and Dick Jansson, KD1K

https://www.amsat.org/amsat-history/

The wiki provides a photograph of OSCAR-1:

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