MARSBUGS:

The Electronic Exobiology Newsletter

Volume 1, Number 4, October 1994

Co-editors:

David Thomas, Life Sciences Department, Belleville Area College, Belleville, IL 62221, USA, marsbugs@delphi.com.

Julian Hiscox, Department of Molecular Biology, I.A.H. Compton, Compton, Nr Newbury, Berkshire RG16 0NN, England, UK, hiscox@bbsrc.ac.uk.

CONTENTS

THE HUBES EXPERIMENT: A GROUND-BASED SIMULATION OF A 135-DAY MANNED SPACEFLIGHT
ESA press release

In the framework of the co-operation between the European Space Agency and Russia, a 135-day flight by a European astronaut on board the Russian orbital Mir complex is scheduled for 1995. This mission, EUROMIR 95, will follow EUROMIR 94, a shorter (30- day) mission scheduled to start on 3 October 1994.

In order to acquire knowledge needed for the EUROMIR 95 mission, the Institute for Biomedical Problems (IBMP) in Moscow, Russia, has been contracted by ESA to conduct a 135-day ground-based simulation (from 1 September 1994 to 14 January 1995) to study Human Behaviour in Extended Spaceflights (HUBES). On behalf of ESA, the Norwegian Underwater Technology Centre (NUTEC) of Bergen, Norway, is responsible for project management. The subjects of the experiment will be three Russian research volunteers.

The unique test-bench facilities, the varied equipment and the expertise accumulated by IBMP in the preparation of programme for biomedical investigation in space by developing appropriate methodologies and relevant equipment have helped to create the conditions that will enable HUBES to simulate real space missions on board the Mir station to the closest possible degree*.

The objectives of the HUBES simulation are:

- To compare and validate psychological methods and tools for use in crew selection, training, monitoring and in-orbit support flight;
- To select those most appropriate for possible application during a real long-duration spaceflight (e.g. EUROMIR 95);
- To improve knowledge about human requirements on extended space missions.

On the basis of an international competition, 31 studies were selected for the HUBES experiment, proposed by research groups from the Czech Republic, France, Germany, Italy, the Netherlands, Norway, Russia, Switzerland, the United Kingdom and the United States of America in the areas of: individual performance, group behaviour, chronobiology, physiology, neuro-immunology, nutrition and flight operations.

A press conference to mark the start of the HUBES experiment will take place on 1 September 1994 at 11:00 hrs at IBMP, 76-a Khoroshevskoye Shosse, Moscow, Russia. The research volunteers will enter the chamber at 12:00 hrs. If you wish to attend the press conference and witness the event, please contact IBMP directly: Prof. Dr. V. Gushin, Tel.: +7 095 195 2366, 195 1500 or 195 6335 Fax.: +7 095 195 2253

*Note:
When preparing for the HUBES experiment, the results of the previous experimental campaigns conducted by the ESA Long-Term Programme Office of the Directorate of Space Station and Microgravity were taken into account. These campaigns, ISEMSI-90 (Bergen, Norway, 6 men, duration: 28 days) and EXEMSI-92 (Cologne, Germany, 3 men and 1 woman, duration: 60 days), were performed in shore-based deep diving complexes (hyperbaric chambers). During these two experiments, the psychology of group dynamics and individual performance under isolation and confinement were studied amongst many other topics.

FULLERENES FOUND IN ROCK SAMPLES FROM IMPACT CRATER IN CANADA
By Diane Farrar, Ames Research Center
Release 94-35

Mountain View, Calif. -- Fullerenes thought to be of extraterrestrial origin have been found at a giant cosmic impact site in Ontario, Canada, by NASA and University of California scientists. The huge crater in Sudbury, formed almost two billion years ago by an asteroid or comet, contains the largest deposit of natural fullerenes found on Earth to date.

"For the first time, we can point to carbon in an impact crater and say that it is probably extraterrestrial," Theodore Bunch, a NASA Ames Research Center scientist said.

Fullerenes, usually made of 60 carbon atoms (sometime 70) arranged like a 'soccer ball cage', are the rarest form of elemental carbon occuring naturally on Earth. Diamond and graphite are the other forms.

Bunch collected rock samples from three sites in the crater which is 110 miles (164 kilometers) in diameter, twice the size of Rhode Island. The laser analysis, which he suggested, was performed by Luann Becker at the Argonne National Laboratories.

Bunch said the molecules, also known as buckyballs, probably formed during the impact by cannibalizing other carbon forms or organic compounds contained in the comet. According to Bunch, the heat from the impact may also have stripped carbon from the abundant carbon dioxide scientists think saturated Earth's early atmosphere. The object was a comet rather than an asteroid, Bunch suggests, because of the large amounts of carbon found in the impact deposits. He estimates that the comet was 10 miles (15 kilometers) in diameter and contained 20 to 30 percent carbon. This is much larger than the combined fragments of Comet Shoemaker- Levy that smashed into Jupiter, which Ames scientist Eric Asphaug estimated to be approximately 1 mile (1.5 kilometers) in diameter.

The fullerenes were present in rock samples from the crater site in a range between 1 and 10 parts per million. Sudbury site rocks contained no carbon before the impact.

"The startling thing is that not only were the fullerenes there, but they were there in an amount that is really extraordinary," said Jeff Bada, a professor at Scripps Institution of Oceanography. Scripps graduate student Luann Becker and Bada co- authored the paper, which appears in Science.

Bunch, with another research team, recently found fullerenes in a tiny crater on a NASA spacecraft that had orbited Earth for almost six years. It is unclear whether the fullerenes came from a carboneaceous micrometeorite or were formed by the high-speed collision creating the crater.

The large ball-shaped carbon molecules are thought to form in red giant or carbon stars that are nearing the end of their stellar lives. They were discovered in 1985 on Earth by accident when scientists heated carbon vapor to temperatures exceeding 14,000 degrees Farenheit. The first naturally occuring fullerenes on Earth were found in July 1992 in carbon-rich rock in ancient sediments in Russia. They have also been found in Colorado, formed in melted rock where vegetation (carbon) was present when lightning struck the ground. But the amounts previously detected on Earth are much smaller than these discovered at the Sudbury site.

The Sudbury impact crater is the second largest proven crater on Earth. Only the Chicxulub crater--formed by the comet that [may have] led to the extinction of the dinosaurs--in the Mexican state of Yucatan is larger. The fullerenes found there could have come from the impact or have been formed in the intense global fire storms the impact ignited.

A similar process, Bunch said, may have occured recently on Jupiter. It is posible, he said, that Comet Shoemaker-Levy's fiery plunge into Jupiter's stratosphere combusted the carbon compounds present in the jovian atmosphere. Carbon "freed" from the jovian atmosphere (and the comet) could have combined into "soot" and possibly some fullerenes, he said, forming the mysterious dark spots. A team of scientists at Ames is currently studying the origin of the dark spots remaining on Jupiter at Comet Shoemaker- Levy's impact sites.

NASA, NIH SIGN AGREEMENT ON BIOMEDICAL RESEARCH
By Michael Braukus, NASA Headquarters
Release 94-134

A unique process for growing tissue samples that could be used in AIDS research is about to be explored in depth by NASA and the National Institutes of Health (NIH).

The two agencies recently signed an agreement that will combine the unique talents and experience of both organizations by exploiting NASA's bioreactor technology to produce three- dimensional tissue cultures for laboratory research.

The goal of the agreement is to engineer a human lymph node model for AIDS research and then to extend the use of this technology to a broad spectrum of tissues available at the NIH. This collaborative effort will enable researchers to culture tissues previously deemed too complex for current tissue culturing technology.

Growing tissue samples under laboratory conditions "tissue culturing" is one of the basic tools of biomedical research. Researchers create specialized environments in laboratory vessels in order to grow or "culture" tissues for further study. For example, researchers might culture cancer tumors in the laboratory so that they can study the effects of anti-cancer drugs on the tumor.

Unfortunately, cells are highly sensitive to their growth environment and conventional tissue culturing techniques may not produce human tissue samples that closely resemble tissue structures found in the human body. As part of its ongoing program of research, NASA has developed an advanced cell culturing technology that produces improved tissue cultures that promise a superior three-dimensional structure.

"The NASA bioreactor is a very promising technology in tissue engineering," said Dr. Harry C. Holloway, Associate Administrator, NASA's Office of Life and Microgravity Sciences and Applications. "The primary thrust of this agreement will be the transfer of ground-based NASA bioreactor technology to NIH to support their cutting-edge research in complex tissue engineering."

This agreement will increase the capabilities of biomedical researchers throughout NIH by transferring NASA technology to NIH and establishing a center within the National Institute of Child Health and Human Development (NICHD). The center will teach this new technology to hundreds of neighboring NIH intramural laboratories that currently employ other tissue culture techniques as part of their ongoing research.

The total value of the NASA contribution is approximately $4.8 million over four and a half years. NICHD, through its Laboratory of Theoretical and Physical Biology, will provide laboratory space, scientific expertise and access to the advanced three-dimensional tissue imaging facility. Dr. Joshua Zimmerberg, chief of the NIH's Laboratory of Theoretical and Physical Biology, will direct the joint NASA/NIH biotechnology project.

EUROPE'S SPACE RESEARCH IN WEIGHTLESSNESS: ESA AND MICROGRAVITY

ESA press release

ESA's research in the field of microgravity is concerned with the exploration and later the exploitation of the "microgravity" environment in a low Earth orbit and with the challenge of being able to maintain man for long periods under orbital conditions.

Microgravity, literally vey low gravity, is the term given to the physical environment of an orbiting spacecraft. This environment is unique, and cannot be reproduced on Earth. It is characterised by minimal gravitation, an ultra-high vacuum, low temperatures, full solar radiation spectrum and cosmic proton and havey ion irradiation.

There are two main field of research performed in this microgravity environment, one dedicated to the life sciences, and the other to general physics, material and fluid sciences.

The life sciences look into many areas of biology, botany and physiology, including problems associated with the well being of astronauts in space. On Earth, every movement or action involves a reaction against gravity, the force that attracts bodies towards the centre of the Earth. In the microgravity environment of space, the effect of releasing this force on the functioning and reactions of organisms can be investigated. Such knowledge is required if permanent manned orbiting facilities and interplanetary space flight are to become reality.

Life science research also encompasses radiation biology, the study of the effect of cosmic ray particles on living matter (an important element in the evaluation of radiation hazards for prolonged space flight), and exobiology, the study of the origin of life. This field considers such questions as the likelihood of life having originated on other celestial bodies and the possibility of interplanetary (or interstellar) transfer of living organisms. Bioprocessing, a further field for the commercial exploitation of space, looks into the use of microgravity as a tool for separation process and techniques, and the production of medically valuable proteins like hormones, enzymes and vaccines.

In the human physiology domain, life science research has brought insights into specific gravity driven and gravity dependent processes, such as bodily equilibrium, blood volume control, and musculo-skeletal problems. The research has proved several previously accepted biological and physiological theories have to be reconsidered or are incomplete. For example, osteoporosis (a bone disease hampering many elderly people, mainly female) which is largely controlled by hormones, was found to be affected in space by lack of mechanical forces acting on the bone structure. Understanding of such functional mechanisms will have a direct impact on treatment strategies. "Ultimately it is believed that once a mechanism has been understood, a means to compensate for it can then be found," comments Heinz Oser, the senior life scientist in the ESA microgravity programme. It is hoped that drugs and countermeasures for people suffering from such problems as edema, hypertension and muscle wasting will result from life sciences research in microgravity.

The general physics, material and fluid science research looks into areas such as fluid physics, crystal growth, material processing, and fundamental physics. The study of some of these processes is particularly interesting in microgravity where the absence of gravitational forces provides favourable conditions which cannot be produced on Earth.

On Earth, the gravitational forces may be the cause of undesirable mechanisms, such as convection and sedimentation, which hinder perfection of such processes as crystal growth and material processing. In the absence of convection, better quality crystals with better structural properties may be grown. In the absence of sedimentation (which causes separation of components according to their densities) metals of different density can be mixed together without the heavier metals sinking before they solidify. This will enable the production of alloys of different composition and greater strength, and in the case of monotectic alloys much better bearing characteristics.

Fluid physics research investigates how the absence of gravity influences the behaviour of fluid. This may have important spin- offs in the storage and transfer of liquid propellants, and in material processing (since most material on Earth are processed when in their fluid state).

In the field of the fundamental physics, besides tests of general relativity, there are projects to develop an ultra precise atomic clock with long term perspective of application in Global Positioning System.

"The applications of microgravity research are very hard to quantify," explains Hannes Walter, chief scientist for fluid and material in the ESA microgravity programme, "however, it is clear today that these research activities have advanced the understanding of the influences of gravity on numerous physical and physico-chemical processes, and such understanding is the first step leading to the perfection of many technological and industrial processes on Earth."

An example of this, is the validation or correction of theories describing the formation of alloys and composite material, achieved by comparing results obtained in microgravity and those obtained on Earth, which have led to improvements in various metallurgical processes. One such improvement has led to new casting processes of aluminium alloys (with dispersion of bismuth or lead) for application in self lubrication bearings. Such bearings are employed in automotive engines and have a potentially large industrial market (see following note). Similarly, the identification of the relative influence of various transport processes on crystal perfection has led to improvements in ground based techniques, such as the application of magnetic fields to reduce gravity driven convection. This results in the growth of better quality crystals.

The actual processing of material in space is still subject to speculation. "It is at present unrealistic since the transportation costs are far too high," says Hannes Walter. "I do not see an industrial production in space in the next decade. There are some products being manufactured in space, like the famous latex spheres, but these are, and always will be, exceptions."

For the production of a material in space to be justifiable, it must have superior or unique properties compared to any competitor or replacement on Earth; it must be a key element in a system for advanced industrial, medical or other high technology applications; and it must have a high cost to weight (or volume) ratio.

There are many material about which we need to know more in order to optimise them and make them available for industrial application. Microgravity will help us learn more about the fundamental issues in material processing which is something which cannot be valued highly enough since materials are the key to technological progress.

How does Europe access microgravity?

In order to perform this research, access to a microgravity environment is needed. Ideally, this is provided by orbiting systems such as Spacelab and Get Away Specials on board the Shuttle, Biosatellites, the EURECA platform, and space stations. These provide from days (Spacelab) to years (space stations) of microgravity. Access is, however, also available using non- orbiting systems such as drop towers, drop tubes, parabolic flights and sounding rockets. These provide between 5 seconds (drop towers) and 15 minutes (sounding rockets) of microgravity. Details of these systems are given below:

Drop towers/tubes: These towers or tubes, which are evacuated so that an experiment capsule can free fall, provide 10 seconds of microgravity. They are used to verify the operation of devices, to check the feasibility of operations, and to perform short term studies. A 100 m drop tower is found at the University of Bremen in Germany, and a 50 m evacuated drop tube at Grenoble, France.

Parabolic flights: Aircraft flying parabolic trajectories provide up to 25 s of microgravity. The aircraft is flown in a 45 degree climb and then all engine thrust is reduced and it free falls on a parabolic trajectory during which experiments can be performed, before it is pulled out of the dive into level flight. Sequences of between 20 and 40 parabolas are normally flown on each mission, allowing repetition of experiments. Large pieces of apparatus can be carried and are operated by the experimenter on the flight. Parabolic flights are used for precursor experiments and equipment checkout in material and life sciences. ESA uses a reinforced Caravelle of the French National Space Agency (CNES) and the Russian IL-76 MDK aircraft. An Airbus A300 is also being considered as a new option.

Drop capsules: Up to one minute of microgravity is provided in these free falling capsules dropped from balloons. The payload is carried to an altitude of 40 to 45 km and then released to fall through the atmosphere.

Sounding rockets: When only a few minutes of microgravity are needed, these rockets work out cheaper than using a satellite or in-orbit laboratories. They include the German TEXUS and Swedish MASER sounding rockets, which provide between 6-7 minutes of microgravity, and the German/Swedish long duration sounding rocket, MAXUS, which provides 14 minutes of microgravity. The advantage of sounding rockets is the short lead time between experiment selection and flight, and the frequent flight opportunities. These sounding rockets are launched from ESRANGE in Kiruna, a space establishment in northern Sweden where complete launch and recovery services are provided.

Balloon flights: These do not provide a microgravity environment directly, but are used to expose samples to radiation conditions similar to those encountered in orbit. They provide information to complement results form orbiting experiments.

Spacelab: This laboratory, the European contribution to the American Space Shuttle programme, is flown in the Shuttle's cargo bay. Designed on a modular basis, Spacelab comprises a long or short pressurised cabin inside which astronauts can work on experiments in a shirt sleeve environment. To this laboratory are added one to three U-shaped 'pallets' on which experiments are exposed directly to the vacuum of space. Certain missions may use just these pallets, together with an 'igloo' services module. The first Spacelab mission took place in 1983. An average mission lasts 10 days. Facilities to perform experiments in the life, material and fluid sciences are carried on board. The designers of ESA experiments carried on Spacelab have real- time video and two-way audio contact with the astronauts and experiments on board, and can remotely operate some of their experiments. They can now partly make this communication from their research laboratories throughout Europe, via ESA's European Space Operations Centre (ESOC), which communicates with NASA at the Spacelab mission control centre at NASA Marshall Space Flight Center in Huntsville, Alabama.

Get Away Specials (GAS): These are self-contained payloads which are accommodated in standard containers installed in the Space Shuttle orbiter bay and exposed to the space environment. They provide a low cost access to space.

Biosatellites: Cooperation with Russia permits ESA experiments to be flown on their retrievable Foton type satellites. They offer 14 days in orbit, are unmanned and are principally reserved for biological experiments.

EURECA (EUropean REtrievable CArrier): This fully automatic instrument carrying platform is ideal for microgravity studies since microgravity levels are particularly low. It is launched by the Shuttle and then transferred to a 525 km orbit where it remains operational for a period of six to nine months before recovery by a subsequent Shuttle flight. EURECA's first mission, launched in 1992, was a great success. Eighty percent of its multi-disciplinary payload, was dedicated to microgravity research.

The Russian Mir space station: ESA microgravity opportunities are available on board this Russian Space Station. Such missions are considered as precursor flights for the International Space Station. During the first two EUROMIR missions planned for 1994 and 1995, ESA astronauts will spend 30 days and 135 days respectively in orbit conducting experiments from European scientists.

The future Columbus laboratory: This is European contribution to the International Space Station, and is being designed to have an operational life of 10 years. Experiments in the material, fluid and life sciences will take place. The Columbus Laboratory, one of the modules at the heart of the station, will be part of a permanently manned system in which astronauts will work in a shirt sleeve environment. A payload mass of up to 4,000 kg will be available.

European microgravity opportunities for 1994

In March this year, ESA carried out its 18th parabolic flight campaign with 10 experiments, following by the successful launches of four experiments in material sciences and fluid physics on board TEXUS 32 and Minitexus 2 sounding rockets in early May. On 14 June, six radiation biology experiments were launched from Plesetsk (Russia) on board Biopan, mounted onto the retrievable Russian capsule Foton-9. Landing should occur on 1 or 2 July.

Another ESA parabolic flight campaign (no. 19) is scheduled in early July on board the Russian Ilushin 76 aircraft. Training of the ESA astronauts preparing for the EUROMIR 95 mission will also be part of the activities during this campaign.

ESA is also heavily involved in the second International Microgravity Laboratory Mission (IML-2). This Spacelab mission is scheduled to be launched on 8 July 1994 on Space Shuttle Columbia. Like its predecessor, IML-1, this mission will be completely dedicated to research in microgravity. ESA is providing about 50% of the payload and four of the nineteen on board facilities: Biorack, for experiments in cell and developmental biology, and radiation physics; the Bubble Drop and Particle Unit (BDPU), dedicated to the study of bubbles, drops and particles in transparent liquids, the Critical Point Facility (CPF), designed to investigate phenomena occurring near the critical point in transparent fluid; and the Advanced Protein Crystallisation Facility (APCF), for the growth of proteins from crystals. Moreover, for the first time ESA will provide to the scientific community a means to communicate by remote operations directly with their experiments from five different User Centres in Europe.

Another microgravity opportunity on board a Russian retrievable satellite is offered in September with the flight of Biobox mounted onto Foton 10. EUROMIR 94, the first ESA mission on board the Russian Space Station MIR, is scheduled for launch on October 3, 1994. Thirty experiments in the fields of human physiology, material sciences and technology will be carried out by the ESA astronaut for a long duration mission of 30 days.

A further parabolic flight campaign (no. 20) is scheduled in October this year on board the Caravelle, during which 11 experiments should be carried out. Finally, three fluid physics experiments are planned to be flown on board the TEXUS 33 sounding rocket in November 1994.

SCIENCE ON EUROMIR 94
ESA press release

EUROMIR 94, the first of two ESA manned missions onboard the Russian space station Mir, is scheduled for launch on 3 October 1994. This mission, which is taking place within the framework of the Columbus Precursor Flights, will last 30 days and represents the longest western European manned space flight opportunity to date. Twenty three of the experiments to be flown are dedicated to human physiology, four to material science and three to technology.

The human physiology experiments will investigate the effects of microgravity on the human cardiovascular system, the human neurosensory system and the human muscle system. These investigations will give insight into the functioning of these body systems and their interaction with one another. This will lead to an increase in fundamental knowledge of the human body which will not only help in the support of manned space flight through provision of the necessary countermeasures, but may also have terrestrial applications on patients suffering from heart disease or with neurological, muscular, circulatory or bone disorders.

Past flights have shown that humans are remarkably tolerant to microgravity conditions, even for extended periods of time. Such tolerance is largely thanks to countermeasures-- mainly physical exercise--performed during the flight which prevents the body from fully adapting to the microgravity conditions. Although necessary for the health of the astronaut, such countermeasures make the science more difficult as it reduces the adaptation and associated changes within the body which scientist wants to measure. Long duration space flights are consequently particularly favourable to human physiological studies since they permit this small change to be measured over a longer period of time, thus increasing the validity of the results. Also, at the beginning of long duration flights, the astronauts are not obliged to work out with the intensity necessary during short missions. The less demanding exercise regime permits greater adaptation to microgravity and more marked and significant measurements.

Of particular interest in these human physiological studies is the investigation of the muscle system which will be measured before and after the one month flight. Due to the short length of previous European flights and the effective countermeasures taken, this system has not been studied systematically and in depth before on an ESA astronaut. It is however believed that the strength and mass of muscle fibres diminish in microgravity.

An important element of the human physiology experiment is the Baseline Data Collection (BDC), which comprises essentially carrying out the same experiment on the ground as in space, together with the collection and monitoring of urine, blood and saliva samples at regular intervals before and after space flight. This physiological reference data permits the impact of space flight on certain parameters to be evaluated.

The fact that 80% of the experiments come from within the human physiology domain is explained by the opportunity of having humans available as test subjects as well as the possibility of human intervention, both of which are available on Mir.

The four material science experiments to be flown concentrate on the areas of undercooled melts, metal matrix composite materials and glasses. The knowledge acquired about these materials and their processing in space may later be applied during their manufacturing on Earth. This could lead to improved industrial techniques and materials.

The technology experiments will investigate: the robustness of a lap-top PC in the space environment and its utility in crew support functions; the ability of special adhesive pads (aluminium plates coated with a non-setting adhesive) to retain small objects which would otherwise float around in the microgravity environment; and the long duration performance of the ion emitter of a mass spectrometer.

Due to the tight schedule for the preparation of the EUROMIR 94 mission, maximum use will be made of French, German, Austrian and Russian equipment already available onboard Mir. However, ESA is also providing a freezer, a centrifuge and passive cooling containers for the respective processing, storage and return of samples. The freezer will permit about 100 blood, urine and saliva samples to be stored, and returned in a frozen state back to Earth. It will be the first time that such a large amount of frozen samples is returned from a one month stay in orbit. ESA is also providing a photocamera and video equipment for scientific documentation of the experiments and for public relations use.

The payload activity flow from mission go-ahead, to payload selection, preparation, integration, in-flight operation and return to Earth. Approval for the EUROMIR missions was given by the ministers of the ESA participating states at the Granada Council meeting in November 1992, and actual implementation began in January 1993. This involved working out the legal framework with the Russian Space Agency (RKA), negotiating the industrial contract with the prime Russian contractor NPO Energia, and defining with the ESA user disciplines (microgravity, space science, Earth observation and technology) the guidelines for selection of experiment proposals for the mission.

The majority of the proposals received for the EUROMIR 94 mission came from the microgravity discipline and are based on experiments already flown on the French, German or Austrian bilaterial missions. Only a few proposals came from other disciplines due to the extremely short preparation time available before the launch, which did not permit design and development of new hardware and experiments. These other disciplines will however be more largely involved in the EUROMIR 95 mission. Reflying experiments has the advantage of confirming data from earlier shorter flights and increasing the statistical reliability of the results.

Typical payload selection and preparation

The selection of the experiments for space flights is a long and time consuming process. Initially, an announcement of opportunity is made to the scientists in states participating in the programme through scientific journals, and letters sent to universities, hospitals, commercial institutes, space orgranisations, etc.

For EUROMIR 94, due to the time constraints, no specific announcement of opportunity was made. Instead proposals came mainly from the Columbus announcement of opportunity pool.

The proposals, once received, are assessed with regard to their space relevance and scientific value--convincing arguments have to be put forward to show the experiments cannot be performed equally well on Earth, and to prove that their results will be of importance to science. Their technical feasibility in terms of mass, power and crew time is then considered and the validity of the methods and quality of the backup support evaulated. In order for an experiment to be selected, confirmation of its funding also has to be provided, since ESA, unlike NASA, cannot finance the development of experiments. Funding normally comes from national authorities such as national space organisations and research boards, universities, etc.

The screening is carried out by a scientific peer group and by a technical team. The scientific peer group, which is made up of experts in the fields of the scientific objectives of the mission, for example muscle physiologists and neuroscientists in the case of EUROMIR missions, who are not associated with ESA and are not necessarily involved with space projects, meet several times and discuss the ranking of the experiments with regard to the different selection criteria mentioned above. The technical team looks into the technical feasibility of the experiments and makes sure that they meet the required safety standards. The human physiology experiments are also assessed by a medical board who verifies the compatibility of the experiments and assures that there are no risks entailed for th astronaut.

Once passed the initial selection procedure the technical documentation describing the experiment and the necessary equipment is produced. Mockups of the experiments are then made for accomodation studies and astronaut training. Environmental, mechanical, thermal, acoustic, electrical, safety and reliability testes are carried out on the experiments to make sure that they meet all the specified requirements and will not harm the space station. Documentation giving details of these tests enables both ESA and the Russians to assess the results and standards met. Further documentation detailing the on-board operations procedures of each experiment down to the minute also have to be provided.

SETI CONFERENCE ANNOUNCEMENT AND OPTICAL SETI

By Stuart A. Kingsley, Director, The Columbus Optical SETI Observatory, ETI Photonics, 545 Northview Drive, Columbus, Ohio 43209-1051, USA.

The following papers are to be presented at the 45th International Astronautical Congress in Jerusalem in the 23rd Review Meeting of the Search for Extraterrestrial Intelligence (SETI). The congress, which is to be held at the ICC Jerusalem International Convention Center between October 9 to 14, will be opened in the presence of the President of the State of Israel, Mr. Ezer Weizman.

There are two sessions, "SETI: Science and Technology" being held on the Monday afternoon, and "SETI:

Interdisciplinary Connections" being held on the Wednesday morning.

The Congress is organized by the International Astronautical Federation (IAF), headquartered at:
3.5 Rue Mario-Nikis
75015 Paris
France
Tel: (33-1) 45.67.42.60
Fax: (33-1) 42.73.75.37
Telex: IAF 205917F

For more information in the United States contact: Dr. John Billingham
Chairman, IAA SETI Committee
SETI Institute
2035 Landings Drive
Mountain View
CA 94043
Tel: (415) 961-6633
Fax: (415) 961-7099

Here is the program, listing first authors only, for the Monday (October 10, 2.00 PM to 5.00 PM) afternoon session:

SETI I - SETI Science and Technology

Rudolph Pesek Lecture: Space Programs for SETI. -Kardashev.

Space-VLBI: A New Possibility to Complement Terrestrial Microwave Surveys. -Almar.

Results from the NASA HRMS Targeted Search. -Heilgman.

The Next Generation Berkeley SETI Machine: Serendip IV. -Malina.

META SETI in Argentina. -Colomb.

Circumstellar Habitable Zones. -Doyle.

Design of the Fast Fourier Transforms in SETI Detection Device. -Pardo.

Design for an Optical SETI Observatory. -Kingsley.

Radial-Velocity Search for Low Mass Companions of Nearby Stars. -Mazeh.

Here is the program, listing first authors only, for the Wednesday (October 12, 8:30 AM to 11:30 AM) morning session:

SETI II - SETI Interdisciplinary Connections

Challenge, Response, and SETI. -Michaud.

On the Applicability of Human Cultural Models to ETI Civilizations. -Ashkenazi.

How will the "Religious" React to a Signal/Message. -Gilkey.

The Nations United in the Scientific and Political Debate of the Search for Extraterrestrial Intelligence. -Reijnen.

SETI Analogies: Learning at a Distance from Ancient Terrestrial Civilizations. -Finney.

Public Opinion and SETI: a Mathematical Approach. -Strelnitskij.

Journalistic Culture and Space Communication Issues: Disseminating News of an ETI Discovery. -Harvey.

To Reply or Not to Reply. -Robbins.

Universals of Intelligence and Pre-Intelligence. -Krein/Zaretska-Tschukreyeva.

For more information on Optical SETI see:

COLUMBUS DISPATCH, November 18, 1990.
EJASA, Volume 3, Number 6, January 1992.
EJASA, Volume 4, Number 3, October 1992.
SKY & TELESCOPE, November 1992, p. 513.
LASER FOCUS WORLD, November 1992, p. 5.
PHOTONICS SPECTRA, December 1992, p. 10.
OE REPORTS, December 1992, pp. 1 & 3.
NEW SCIENTIST, December 12, 1992, p. 48.
COLUMBUS MONTHLY, January 1993, pp. 77-80.
EJASA, Volume 4, Number 6, January 1993.
BIOASTRONOMY NEWS, Volume 5, Number 3, Summer 1993.
BIOASTRONOMY NEWS, Volume 5, Number 4, Fall 1993.
COLUMBUS DISPATCH, October 16, 1993.
EJASA, Volume 5, Number 5, December 1993.
SETI NEWS, Volume 3, Number 1, First Quarter 1994.
COLUMBUS DISPATCH, July 24, 1994.
SETIQuest, Volume 1, Number 1, September 1994.
OE Reports, November 1994.
OMNI MAGAZINE. To be published.

DESIGN FOR AN OPTICAL SETI OBSERVATORY (ABSTRACT)

by Stuart A. Kingsley, Director, The Columbus Optical SETI Observatory, ETI Photonics, 545 Northview Drive, Columbus, Ohio 43209-1051, USA.

The paper describes the design and construction of the first Visible Optical SETI Observatory in North America. The rationale supporting both professional and amateur Optical SETI is also given. The Columbus Optical SETI Observatory is designed to detect ultra-fast pulsed laser beacon signals in the visible and near-infrared. The design and construction of the Columbus Optical SETI Observatory has been underway for two years and employs a Meade LX200 10" (25.4-cm) Schmidt-Cassegrain Telescope. Recently, this facility acquired a 240 sq. ft. control/conference room and a 10 ft. diameter fiber-glass dome.

With the basic observatory infrastructure now in place, we are now set to commence a low-sensitivity search for ETI signals. The targeted optical search will formally begin next year and examine the same stars in the northern hemisphere presently under investigation by Microwave SETI's Project Phoenix. In recent weeks, a series of shake-down stellar and sky background observations have been undertaken with a photon-counter. Eventually, the photon-counting system will be capable of detecting pulses as short as 1 ns. It is intended that each night's observations will be data-logged onto standard VHS video cassettes. The data-rate and data storage requirements will initially be kept very modest by setting a lower PMT or APD gain and higher discriminator threshold, in accordance with the rationale for AMOSETI (Amateur Optical

SETI). This rationale assumes that a typical ETI beacon pulse will consist of the near- simultaneous arrival of many photons.

The telescope control computer will be hard-wired to our Optical SETI Computer Bulletin Board (BBS). This will allow interested users to observe the control computer's screen in real-time, and the data being acquired. Internet access to this BBS should be available next year. Later, as more sophisticated computer hardware and signal processing becomes available, the signal and background noise detection threshold will be lowered. This will increase the data rate, storage requirements and sensitivity for a more professional approach to Optical SETI. The professional rationale assumes that a typical ETI beacon pulse is much weaker, and consists of only a few photons.

Fund-raising Appeal

After four years of self-funded Optical SETI activity, and coincident with the presentation at the Jerusalem conference, the author is in the process of launching an appeal to obtain private funding and hardware donations. This will allow The Columbus Optical SETI Observatory to be upgraded to undertake high- sensitivity professional Optical SETI.

MAGNETIC FIELD INFLUENCES EVOLUTION

Floyd Meyer reports he has built a machine that emulates the Earth's magnetic field as if it was not synchronised with the Earth's rotation. He suggests this ongoing non-reversing moving field effect may provide the energy for the origin of life and chirality.

He is now working on a computer model of the Earth as a multi layered gyroscope and proposes that when there is a mass extinction due to a comet impact, the crust slides around and loses some of its rotational velocity. This causes the magnetic field in the core to outrun the crust for a period of time. He suggests the free energy from the moving field should speed up evolution so that the present state could be reached in the three billion years allotted to science.

Anyone interested in further correspondence should contact Floyd at pefe@cup.portal.com

----

SCIENCE FICTION CONFERENCE ANNOUNCEMENT

53rd World Science Fiction Convention, SECC Glasgow, Scotland, U.K. 24-28th August, 1995. Science programme will include First Contact Simulations, Terraforming, Star-ship Design, Biosphere 2.

Contact intersection@smof.demon.co.uk for further details.

SETIQuest MAGAZINE
By Carl Helmers

Announcing a new quarterly magazine for amateur astronomers and SETI enthusiasts: *SETIQuest*. Published by Carl Helmers or Helmers Publications, Inc., and edited by Larry Klaes, former editor of EJASA. The first issues have extensive coverage of Optical SETI.

SETIQuest is a new quarterly print/electronic mail (E-mail) periodical containing news, technical information, and tutorials devoted to bioastronomy and its subset, SETI (Search for Extraterrestrial Intelligence).

SETIQuest is published for professionals, serious amateur astronomers, and individuals curious about this fascinating field of observation. *SETIQuest* fills the need for a specialized astronomical publication devoted exclusively to the on-going search for evidence of life in the Universe. Such evidence could be intentional or inadvertent signals of other civilizations. Such evidence could be found in spectral signatures of biological activity on extrasolar planets or in the interstellar medium.

SETIQuest is written and edited for the scientifically literate individual taking part in the progress of our technological civilization, with articles by amateur and professional scientists. *SETIQuest* includes information about hands-on observational programs that can be carried out by individuals and groups of amateur astronomers at radio and optical wavelengths.

SETIQuest is filled with articles covering topics such as:

- Tutorials about bioastronomy and SETI
- Microwave or optical SETI as practiced by amateurs
- "Do-it- yourself" participation in bioastronomy and SETI activities
- Book reviews
- Regular commentary on issues relevant to SETI and bioastronomy:
    - SETI and the political milieu
    - Philosophical issues regarding the prospects of success and failure in the search
    - SETI as a parable of science versus pseudo science

Publications Watch: Summaries of recent scientific/general publications relevant to SETI

For your FREE issue of *SETIQuest* (Volume 1, Number 1), send us your postal address by fax, E-mail, or conventional mail to:

SETIQuest Inquiries, Department EX, Helmers Publishing 174 Concord Street, Peterborough, NH 03458-0874, U.S.A. Telephone: (603) 924-9631 FAX (603) 924-7408 Internet E-mail: SQINQNET@pixelacres.mv.com

Carl Helmers, President & Editorial Director, Helmers Publishing, Inc. Publishers of Sensors, ID Systems and *SETIQuest* magazines. (what else do you do after starting BYTE?)
INTERNET: carl@pixelacres.mv.com
SNAILMAIL: 174 Concord Street, Peterborough, NH 03458
PHONE:
603-924-9631 FAX: 603-924-7408

CURRENT PUBLICATIONS IN EXOBIOLOGY
By Julian Hiscox

Allegre and Schneider, 1994. The evolution of the Earth. Scientific American Special Issue: Life in the Universe. October. Vol.271. no.4. pp. 44-51.

Binot, 1994: Biological air filters. Part 2-Advanced ecological regenerative concepts. Preparing for the Future. ESA's Technology Programme Quarterly. pp.10-11. (Stable microbial populations, membrane bio-reactors, water and air purification).

Burns, 1994: Mining the seams of our solar system. Nature. 371. pp.484. Book review of Resources of Near-Earth Space, Edited by J.Lewis, M.S. Matthews and M.L. Guerrieri. University of Arizona Press: 1993 Pp. 977. $85. (Mission profiles, planetary engineering, mining, utilization of space resources).

Chapman, 1994: Evidence, age and thickness of a frozen paleolake in Utopia Planitia, Mars. Icarus. Vol.109. No.2. pp.393-406. (Mapping and photoclinometric studies, exobiologic history of Mars).

Chown, 1994: The space molecule man. New Scientist. 10th September. pp.24-27. (Article about Fred Hoyle and organic molecules in space).

ESA, 1994: A Moon Programme: The European View. (ESA BR-101, May)-Prepared by Wubbo J. Ockels, published by ESA Publications Division, ESTEC, Noordwijk, The Netherlands. (Science on the Moon, technology, resources, observatory, human outpost).

ESA, 1994: Together to Mars. An initiative of the international Mars exploration working group. (ESA BR-105, July)-Authors A. Chicarro and S. Squyres, published by ESA Publications Division, ESTEC, Noordwijk, The Netherlands. (Science on the Moon, technology, resources, observatory, human outpost).

Field, 1994: Arctic chill for CO_2 uptake. Nature. Vol.371. pp.472-473. (CO_2 estimates, CO_2 fertilization, atmospheric CO_2).

Gould, 1994: The evolution of life on Earth. Scientific American Special Issue: Life in the Universe. October. Vol.271. no.4. pp. 62-69.

Hoyle, 1994: Home is where the wind blows. University Science Books, Mill Valley, California, and distributed by W H Freeman, Oxford ($32.50). (Autobiography of Sir Fred Hoyle).

James et al., 1994: The evolution of the universe. Scientific American Special Issue: Life in the Universe. October. Vol.271. no.4. pp. 28-33.

Kirshner, 1994: The earth's elements. Scientific American Special Issue: Life in the Universe. October. Vol.271. no.4. pp. 36-43.

Maddox, 1994: Origin of the first cell membrane. Nature. Vol. 371. pp.101. (Archeabacterium, RNA evolution).

Marco et al., 1994: Arthropod cuticle systems for studying complex biological processes in the space environment. Advances in Space Research. Vol.14. No.8. pp.215-227. (Biosatellite, Drosophila melanogaster, micro-gravity, aging).

Meerholz et al., 1994: A photorefractive polymer with high optical gain and diffraction efficiency near 100%. Nature. Vol.371. pp.497-500. (Photonic device, holographic storage). Possible use in solar mirrors?-Eds.

Mestel, 1994: Inflated ideas to end flops in space. New Scientist. 8th October. pp.8. (Inflatable antennas in space craft).

Orgel, 1994: The origin of life on Earth. Scientific American Special Issue: Life in the Universe. October. Vol.271. no.4. pp. 52-61.

Oechel, 1994: Transient nature of CO_2 fertilization in Arctic tundra. Nature. Vol.371. pp.500-503. (CO_2 in ecosystems, carbon sequestration, genetic limitation of plants). Possible use for planetary engineering data/estimates?-Eds.

Sagan, 1994: The search for extraterrestrial life. Scientific American Special Issue: Life in the Universe. October. Vol.271. no.4. pp. 70-77.

Scientific American, October-1994. Special issue on life in the universe. Articles relevant to exobiology are listed within this section.

Schiller, 1994: Confocal laser scanning microscope. Preparing for the Future. ESA's Technology Programme Quarterly. pp.8-9. (Optical microscopy for space missions to study cells).

Schneider, 1994: On the search for O_2 in extra-solar planets. Astrophysics and Space Science. Vol.212. No.1-2. pp.321-325. (Optical detection of O_2 in extrasolar planets by reflection or occultation, O_2 A-band).

Signorini, 1994: High efficiency solar cells for deep space missions. Preparing for the Future. ESA's Technology Programme Quarterly. pp.10-11. (Breakthrough in low temperature operation).

The Economist, 1994. Science and Technology-Reaching for the Stars. The Economist. September 10th-16th. Vol.332. No.7880. pp.105-106. (Inter-stellar travel, Robert Forward, particle beams).

Weinberg, 1994. Life in the universe. Scientific American-Special Issue-Life in the Universe. October. Vol.271. no.4. pp. 22-27.

End *Marsbugs* Vol. 1, No. 4.