MARSBUGS:

The Electronic Exobiology Newsletter

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PREMIER ISSUE
By David Thomas and Julian Hiscox

Welcome to the premier issue of MARSBUGS: The Electronic Exobiology Newsletter. We would like to thank Carol Stoker of NASA Ames Research Center for her idea for a newsletter name (we modified it a little). The purpose of this newsletter is to provide a channel of information for scientists, educators and other persons interested in exobiology and related fields. This newsletter is not intended to replace peer-reviewed journals, but to supplement them. We, the editors, envision MARSBUGS as a medium in which people can informally present ideas for investigation, questions about exobiology, and announcements of upcoming events.

The life of this newsletter depends on its readers. We are in constant need of contributions of articles, essays, reviews, announcements, questions, etc. Please feel free to contribute, regardless of your field of expertise.

Exobiology is still a relatively young field, and new ideas may come out of the most unexpected places. Subjects may include, but are not limited to: exobiology proper (life on other planets), the search for extraterrestrial intelligence (SETI), ecopoeisis/terraforming, earth from space, planetary biology, primordial evolution, space physiology, biological life support systems, and human habitation of space and other planets. We hope that you, the readers, find this newsletter useful and informative, and we look forward to hearing from you.

IMAGINARY PLANETOLOGY AND EDUCATION
By Martyn Fogg

The edifice of science is now so vast and roomy that it is possible to spend one's time entirely within one of its myriad specialities, never raising one's head above the rut to explore the wider horizon. It is for this reason that new multi-disciplinary fields are so refreshing and invigorating for science as a whole, or at least until such time that they become semi-closed disciplines themselves. Specialization of sorts even extends down to school level--three of the "five basic sciences," physics, chemistry and biology being routinely taught as separate subjects. There are many practical reasons why this must be so and yet it is more than ever necessary for students to experience some taste of interdisciplinary study so as to integrate what they have learned in an enlightening and creative fashion.

One major reason for this is our growing appreciation of the interconnectedness of so many of the aspects of the planetary environment in which we live and the potential dangers of exploiting this environment without looking ahead to foresee the consequences. Aspects of environmental science therefore are increasingly entering into school curricula, focussing mainly on civilization's present dilemma vis-a-vis the biosphere. However, for the complete picture, it is also necessary to appreciate what contributes to making the Earth a habitable planet in the first place. In short, there is a need for students to be made aware of multidisciplinary science of planetology.

Disconnected aspects of earth-orientated planetology are of course being introduced to pupils within the context of traditional science education. However, planetology in a more flexible and holistic sense is also being taught within the medium of a creative game often called "World Building" or "Cultures of the Imagination," and has been pioneered within schools in the USA by the CONTACT organization. Students are encouraged to work as a team, combining their knowledge of the sciences to create an imaginary, but realistic planet, fully stocked with life forms. The advantages of this activity are considerable. Not only do participants gain experience of interdisciplinary work, but the intellectual experience is also very enjoyable and highly motivating.

It is not difficult to appreciate why world-building should be such an effective teaching method. There is something particularly appealing to the young (or the young at heart!) in its gigantic scale and somewhat offbeat nature, although it must be said that for any particular world-building session to be a success requires a teacher, or coordinator, knowledgeable enough to act as a guide to reality, but imaginative enough not to stifle the creativity of the students. World-building well conveys that spirit of adventure inherent in science that is often lacking in formal study; it demonstrates that the exhilaration and companionship to be experienced more commonly in sporting activities or other forms of play can also be found in purely intellectual and artistic discourse. If anything, this is its most valuable lesson and often leaves the most lasting impression on participants.

Student projects on terraforming are also exercises in world-building and thus have similar benefits. However, since they are founded on the premise of bringing terrestrial life to a world that actually exists, students are also required to research existing data and models. Moreover, a terraforming thought experiment must take in additional ingredients, as it commences with an inhospitable planet. For instance the process of rendering it Earthlike involves confronting the fundamental issues of planetary habitability, as well as questions as to the ethical "correctness" of the enterprise. In the academic year 1991-1992, this author was informed of a handful of university departments and schools, in both the UK and USA, that were using the concept of terraforming as just such a participatory teaching tool. In some cases this was triggered by the availability of the Maxis Software educational computer game "Sim Earth" which, as well as allowing a player to observe and direct the evolution of the Earth, also provides the qualitative challenge of terraforming Mars and Venus. It is however difficult to keep track of just how common this synergy between teaching and terraforming is, as such projects never receive publicity.

The role of world-building and terraforming in education at large is still minor; however its potential to inject a little fun into the teaching of serious issues that are relevant to the present habitability of the Earth is considerable. Perhaps, as formal research into terraforming becomes more widely known and the subject loses its residual science fictional image, its adoption by educators might become more widespread.

Information on the CONTACT organization can be obtained from Greg Barr on: elfhive@bix.com.

EXOBIOLOGY PROGRAM
From the NASA internet archives

The goal of NASA's Exobiology Program is to understand the origin, evolution, and distribution of life in the universe. Research is focused on achieving this goal by tracing the pathways taken by the biogenic elements, leading from the origin of the universe through the major epochs in the evolution of living systems and their precursors. These epochs (and the approximate percentage of exobiology research funding historically allocated to each) are: 1) The cosmic evolution of the biogenic compounds (16%); 2) prebiotic evolution (33%); 3) the early evolution of life (33%); and 4) the evolution of advanced life (16%).

The principal goal of research in the area of the cosmic evolution of the biogenic compounds is to determine the history of the biogenic elements (C, H, N, O, P, S) from their birth in stars to their incorporation into planetary bodies. Six stages in this history have been defined for study:
1) nucleo-synthesis and ejection into the interstellar medium; 2) chemical evolution in the interstellar medium; 3) protostellar collapse; 4) chemical evolution in the solar nebula; 5) growth of planetesimals from dust; and 6) accumulation and thermal processing of planetoids.

Research in the area of prebiotic evolution seeks to understand the pathways and processes leading from the origin of a planet to the origin of life. The strategy is to investigate the planetary and molecular processes that set the physical and chemical conditions within which living systems arose. Four major objectives are to:
1) determine constraints on prebiotic evolution imposed by the physical and chemical histories of planets; 2) develop models of active boundary regions in which chemical evolution could have occurred; 3) determine what chemical systems could have served as precursors of metabolic and replicating systems both on Earth and elsewhere; and 4) determine in what forms prebiotic organic matter has been preserved in planetary materials.

The goal of research into the early evolution of life is to determine the nature of the most primitive organisms, the environment in which they evolved, and the way in which they influenced that environment. As an approach to understanding life in the universe, the opportunity is taken to investigate two natural repositories of evolutionary history available on Earth: the molecular record in living organisms and the geological record in rocks. These paired records are used to: 1) determine when and in what setting life first appeared; 2) determine the characteristics of the first successful living organisms; 3) understand the phylogeny and physiology of microorganisms that inhabit hydrothermal areas now thought to be analogs of primitive environments; 4) determine the original nature of biotic energy transduction, membrane function, and information processing through study of extant microbes; and 5) elucidate the physical, chemical, and biotic forces operating on microbial evolution.

The research associated with the study of the evolution of advanced life seeks to determine the extrinsic factors influencing the development of advanced life and its potential distribution. This research includes an evaluation of the influence of extraterrestrial influences and planetary processes on the appearance and evolution of multicellular life, conducted by: 1) tracing the effects of major changes in the Earth's environment on the evolution of complex life, especially during mass extinction events; 2) determining the effects of global events and events originating in space on the production of environmental changes that affected the evolution of advanced life; and 3) searching for evidence of advanced life elsewhere in the galaxy.

The Exobiology Program interacts with other programs within the Solar System Exploration Division and elsewhere within NASA in an integrated effort to accomplish the goal of understanding life in the universe. Research within the program is integrative and interdisciplinary in nature, and is supported scientifically by work done in other NASA space and life science programs.

Proposals are sought for either new projects or the continuation of existing projects, which fall within the scope of the Exobiology Program. Proposers are reminded that programmatic balance requirements may limit the opportunities for funding in some areas.

Participation in the Exobiology Program is open to all individuals and all categories of organizations, both domestic and foreign, industry, educational institutions, other nonprofit organizations, NASA laboratories, and other Government agencies. Proposals may be submitted at any time during the period ending September 15, 1993. Proposals received before April 2, 1993, will be evaluated by scientific peer reviews during June/ July 1993; proposals received between April 2, 1993, and September 15, 1993, will be evaluated by scientific peer reviews during December 1993/January 1994.

Submit U.S. proposals to:
Exobiology Program, Solar System Exploration Division, Code SLC, NASA Headquarters, Washington, DC 20546

Submit foreign proposals to:
Mr. Albert Condes, NRA 93-OSSA-8, International Relations Division, Code IRD, NASA Headquarters, Washington, DC 20546 USA

EXOBIOLOGICAL STRATEGY FOR THE EXPLORATION OF MARS
Ames Research Center release

It is proposed to generate a detailed strategy for the acquisition of biologically important information during future exploration of Mars. The goal is to devise a strategy that the entire exobiological community can endorse. For that purpose, we propose to conduct two workshops: the first to provide a forum for transfer of information both to and from the exobiology community as a whole; the second to involve a subset of the community who will take the information generated by the first workshop and fashion it into a report. That report would then be circulated among the broader planetary-science community and would be presented at meetings such as the Lunar and Planetary Science Conference, the annual meeting of the Division of Planetary Science of the American Astronomical Society, and meetings of the American Geophysical Union, COSPAR, and the International Society for the Study of the Origin of Life, with the objective of promulgating to the broader community the relevance of exobiology to the history of the planet Mars.

We believe that the interconnectedness of exobiology and broad- based planetary science is not fully appreciated and that it is essential to the future of explorational exobiology to rectify this situation. Otherwise, exobiology will fail to stake a claim among the scientific objectives of future missions and will thus fail to share in their achievements.

The first workshop will be held at NASA's Ames Research Center on 27/28th April 1994, in association with the Exobiology PI's meeting, which will begin on 25th April. The Mars workshop is being organized jointly by Donald DeVincenzi and John Kerridge, the PI's meeting by Michael Meyer. It is hoped that as many PI's as possible will participate in the Mars workshop which will also include participation by representatives of relevant international organizations as well as by members of the broader-based US planetary-science community. This will be followed by a more restricted workshop, probably in September 1994, at which a writing team of about a dozen individuals will generate a report that will serve to define a scientifically based strategy for the future exobiological exploration of Mars.

In order to focus discussion at the first workshop, a paper generated last year by Harold P. Klein and Donald DeVincenzi will be distributed to PI's and other participants before the workshop and will be used as a strawman strategy. Participants will be asked to couch their contributions in terms of modification, elaboration, amplification or implementation of that
strawman strategy. That paper will also serve as the basis for two talks at the workshop: one dealing with scientific objectives, the other with implementation approaches.

Although all talks at the first workshop will be invited presentations, members of both the exobiological and planetary- science communities are urged to contribute poster presentations as well as to participate in the numerous discussion periods.

The writing team that will be responsible for drafting the individual sections of the final report will be identified in the near future. They will be charged with producing a draft document of somewhat less than 100 pages which will incorporate the conclusions reached during discussions at the meeting, using the Klein/DeVincenzi report as a provisional template. The draft document will be edited by Donald DeVincenzi, John Kerridge and Michael Meyer, who will also generate a 10 page executive summary.

Provisional schedule for first workshop and speakers/discussion leaders:

Session 1: Review of Current Knowledge about Mars

Why Mars? Carl Sagan
Mars as a planetary environment. Mike Carr
What can Mars tell us about the early Earth? Jim Kasting
Broad-based planetary-science objectives for future Mars exploration. Arden Albee
The Viking biology experiments. Chuck Klein
Mars-analog studies. Chris McKay
Exobiological objectives 1: The scientific basis. Michael Meyer

*Session 2: Future missions and programs, either approved or proposed.**

Overview: Mission from Planet Earth. Carl Pilcher
Mars Orbital Science. Arden Albee
MESUR Pathfinder & Mars surface science. Steve Squyres
Mars 94, 96. Alexander Zakharov
Mars Sample Return. Ben Clark

Discovery (review of program and proposed Mars missions). Henry Brinton
Ground-based observations. Ted Roush, Yvonne Pendleton

Session 3: Discussion of key questions that need to be addressed.

Exobiological objectives 2: Strawman strategy. Don DeVincenzi
What new missions will be needed? Chris McKay
What new flight instruments will be needed? Glenn Carle.
What new ground-based studies will be needed? Ted Roush, Yvonne Pendleton
What Mars surface sites would be preferred for which objectives? Jack Farmer
What have we overlooked? Geoff Briggs

* Details of session 2 tentative pending Elachi committee recommendations.

MARS FORUM III
CMEX release

Center for Mars Exploration, NASA Ames Research Center, Moffett Field, CA 94035-1000, USA.

Tentative Schedule

April 28, 1994

1:30 Introductions

2:00 Headquarters Perspective Carl Pilcher

3:00 Mars Program Planning Roger Bourke

3:45 Break

4:00 Mars Science Working Group Steve Squires/David Des Marais

6:00 Rickey's Hyatt - Banquet (Joint with exobiology workshop)

April 29, 1994

Human Factors and Long Duration Habitation

8:00 Biosphere II - Experience Mark Nelson

9:00 Antarctic Analog Carol Stoker

10:00 Break, Mars Info. Demo in Lobby Aaron Zent/Jeff Ota

10:30 Life on Other Worlds Dale Andersen

11:00 Mars Educational Outreach Project Fred Shair

12:00 Lunch

1:00 Mars '94/'96 Chris McKay

2:00 Mars Pathfinder Matt Golombek

3:00 Mars Surveyor Glenn Cunningham

4:00 Working with the Russians Carl Rising

SPACE COLONY DESIGN CONTEST
NASA release

The NASA Numerical Aerodynamic Simulation Division Applied Research Branch, the NASA Ames Research Center Educational Programs Office, and John Swett High School, Crockett are jointly sponsoring a space colony design contest for 6-12th grade students. Individuals and teams will design future orbital homes, competing for the opportunity to present their concepts to NASA engineers and scientists. In addition, prizes, tours of NASA Ames, and certificates of participation will be awarded to participants. The best submissions will be considered for display at NASA Ames.

Note: if you use the World Wide Web (e.g., Mosaic) you can find this information and more at URL: http://www.nas.nasa.gov/RNR/Visualization/AlGlobus/SpaceColonies/ spaceColonies.h

Space colonies are permanent communities in orbit, as opposed to living on the Moon or other planets. The pioneering work of the late Dr. Gerard O'Neill and others has shown that such colonies are technically feasible, although expensive. Settlers of this high frontier are expected to live inside large pressurized rotating structures holding hundreds, thousands, or even millions of people along with the animals, plants, and single celled organisms vital to comfort and survival. There are many advantages to living in orbit: terrific views, zero-g sports, plentiful solar energy, environmental independence, and variable (pseudo-)gravity to name a few. There's plenty of room for everyone who wants to go; the materials from a few asteroids are sufficient to make space colonies with living space equal to more than 1000 times the surface area of the Earth.

Individual submission are encouraged, and we hope that teachers will make this contest part of their lesson plan. While designing a space colony, students will have a chance to learn and integrate physics, mathematics, space science, chemistry, environmental science, biology, computer science, engineering and/or many other disciplines. We would like students outside the science classes to participate as well. Thus, contest submissions may include short stories, models, and artwork. Students can design entire colonies or focus on power, thermal, environmental, transportation, housing, recreation, economic, social, political, agricultural, or other systems. A class or group of classes can submit a joint project where small teams tackle different areas in a coordinated fashion. Thus, teams in the science class could design the basic structure and support systems, the art class could provide pictures of the interior and exterior, wood shop could build a scale model, and anyone could propose new low-g games. Each individual team, as well as the group as a whole, will be eligible to win the contest.

For information on how to submit and to get background material, contact Tug Sezen, 800 Sante Fe Court, Oakley, CA 94561, phone (510) 679-8121 or email tsezen@eis.calstate.edu on the Internet. Include a self addressed stamped envelope. If you include a Macintosh floppy disk, you will also receive copy of a Hypercard stack that teaches space colonization basics. To enter the contest, send a submission to Al Globus, MS T27-A, NASA Ames Research Center, Moffett Field, CA 94035-1000 by May 1, 1994 (email globus@nas.nasa.gov). The contest is open to all middle and high school students in the San Francisco Bay area. Submissions from outside this area will be considered for prizes, certificates, and display, but not for the grand prize or NASA Ames tours because transportation cannot be provided. We hope that this contest will provide an exciting educational and creative opportunity for students and begin training those who will build the first space colonies: the engineers, scientists, and poets who will start Life's expansion throughout the solar system.

Contest Details

General information:

- Two categories: 6-9 and 10-12 grade students.
- Individuals, teams of up to five, and groups of teams (where each team works on a particular design aspect) can participate.
- Cooperation between teams is encouraged.

Format:

- Focus: what part of space colonization does your speculative engineering focus on? (1 sentence).
- Summary (1 paragraph).
- Background materials used.
- Description and justification of design.
- Qualitative and quantitative analysis.
- Pictures, video, video of models, etc.

Suggested areas:

- Complete design
- Structure
- Recreation
- Agriculture
- Electrical power
- Environment
- Thermal
- Weather design
- Social system
- Government
- Internal transportation
- External transportation
- Mines
- Fiction
- Artwork
- Feasibility analysis
- Models (physical, computer, math)

Constraints:

- Population: size of your school or city/town.
- Size: not overcrowded.
- Minimal mass from Earth.
- Within two weeks travel time of Earth.
- Break no physical laws.
- Reasonable extrapolations of existing technology.
- Clean internal environment.
- Minimal leaks.
- Use metric units.

Judging criteria will be based on but not limited to:

- Creativity
- Thoroughness
- Accuracy
- Neatness
- Technical merit
- Attention to detail
- Organization
- Thoroughness of background research

Awards:

- Grand prize: Give a presentation of your project to NASA scientists and engineers at NASA Ames Research Center and a personal tour of NASA-Ames Space Encounter and Numerical Aerodynamic Simulation (NAS) division (transportation is not included). In addition, a visitor's tour of the research center will be arranged. To enter the Ames one must be a U.S. citizen under 18 years old.
- Other prizes for first, second, and third in each category.
- All participants will be recognized with a certificate of participation.

End *Marsbugs* Vol. 1, No. 1