NASA SP-7015

# EXTRATERRESTRIAL LIFE A BIBLIOGRAPHY

## PART II: PUBLISHED LITERATURE

A selection of annotated references to journal articles and books

1900-1964

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# Introduction

Part II of NASA's bibliography *Extraterrestrial Life* (NASA SP–7015) is a comprehensive collection of annotated references to journal articles and books that were published during the period 1900–1964. A limited selection of significant references that have appeared in 1965 are also included. Part I, which has already been published, contains a listing of annotated references to domestic and foreign reports published between 1952 and July, 1964.

Although this bibliography is primarily concerned with the general subjects of extraterrestrial life and exobiology, its scope also makes provision for several particular topics that are directly pertinent to the search for extraterrestrial life. Included among these are the origin of life on earth, the suitability of other planets for the development of indigenous life, the possibility of intelligent extraterrestrial life forms, techniques and instrumentation for the detection of extraterrestrial life, the chemical basis of life including the synthesis of organic compounds from simple precursors, and terrestrial contamination of spacecraft. Several references, which describe the examination and analysis of meteorites and the relevance of such studies to the subject of extraterrestrial life, are also presented.

Each entry consists of a standard bibliographic citation and an annotation in the form of an abstract or a brief descriptive notation. Entries are listed in reverse chronological order, with the most recent references appearing first.

In addition to the abstract section, Part II of the bibliography contains a subject index and a personal author index. Each of these is a combined index for Parts I and II.

# Availability of Documents

Articles cited in this bibliography are available for examination in the designated issues of the original journals. Copies of particular issues may be borrowed from libraries maintaining sets of these journals. In some instances, reprints may be obtained by writing to the editorial office of the journal.

Copies of Part II of *Extraterrestrial Life* (NASA SP–7015) can be obtained from NASA (Code ATSS–A), without charge, by NASA offices and contractors, U. S. Government agencies and their contractors, and organizations that are working in direct support of NASA programs.

Other organizations and individuals can purchase copies of Part II of NASA SP–7015 from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

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# 1965

## 184

**DICYANDIAMIDE: POSSIBLE ROLE IN PEPTIDE SYNTHESIS DURING CHEMICAL EVOLUTION.**

Gary Steinman, Richard M. Lemmon, and Melvin Calvin (Lawrence Radiation Lab, Berkeley, Calif.)

*Science*, Vol. 147, Mar. 26, 1965. p. 1574–1575.
5 refs.
(AEC supported research)
(A65–80763)

A possible role of dicyandiamide in the peptide synthesis during chemical evolution was demonstrated by dehydration condensation of alanine. A dipeptide, alanine, was formed at room temperature, in the dark, and at low hydrogen ion concentration. The dipeptide was identified by the coincidence paper chromatography technique. Because the presence of dicyandiamide in the early geological environment was indicated by previous laboratory work, the action of dicyandiamide may be another indication of chemical abiogenesis under conditions prevailing on the primitive earth. (Aerospace Med.)

## 185

**PEPTIDE SYNTHESIS FROM AMINO ACIDS IN AQUEOUS SOLUTION.**

Cyril Ponnamperuma and Etta Peterson (NASA, Ames Research Center, Exobiology Div., Moffett Field, Calif.)

*Science*, Vol. 147, Mar. 26, 1965. p. 1572–1574. 14 refs.
(A65–80762).

When an aqueous solution of glycine and leucine was exposed to ultraviolet radiation (1800 Å), at room temperature and pH 5, in the presence of cyanamide, four dipeptides and a tripeptide were formed. These were identified by the coincidence paper chromatography technique and the elution method for hydrolysis products as glycyl-glycine, glycyl-glycyl-glycine. Formation of peptides under relatively abiological conditions by ultraviolet light alone, or with an addition of cyanamide, which appears to enhance the yield, lends support to the hypothesis of chemical evolution. (Aerospace Med.)

## 186

**METEORITES AND THE MOON.**

Harold C. Urey (U. of Calif., San Diego)

*Science*, 147:3663, Mar. 12, 1965. p. 1262–1265.

Considerable evidence of diverse kinds has accumulated during the last six years indicating that some or possibly most of the stone meteorites come from the Moon. Included in these may well be the carbonaceous chondrites of the Orgueil type and this indicates that contamination of the Moon with terrestrial water has occurred. This statement does not depend on the carbonaceous matter being of biotic origin. Models for the origin of the Moon are consistent with the hypothesis that some contamination of this kind occurred. This conclusion is possible regardless of whether the meteorites come from the Moon or not. (Author)

## 187

**ASTROCHEMISTRY—THE LONG-DISTANCE SCIENCE**

Francis O. Rice (Notre Dame U., Radiation Lab. and Dept. of Chemistry, Notre Dame, Ind.)

*Chem. Eng. News*, Vol. 43, Feb. 15, 1965. p. 88–94, 96–102.
(A65–16981)

General outline of conceivable chemical events in outer space, covering occurrence, state, and behavior of the elements on the planets and the Moon. Meteorites are discussed as a tangible source of astrochemical information, and the physical and astronomical characteristics of the planets, the escape speed of the constituent molecules of a planet's atmosphere, and some chemical figures for meteorites are tabulated. Free radicals are mentioned as a possible source of the colored zones on Jupiter. The atmospheric chemical and temperature profile, the atmosphere as a participant in life cycle, the Ranger pictures of the lunar surface, and extraterrestrial life are other topics. (V.Z.)

## 188

**THE MARTIAN ENVIRONMENT.**

Philip H. Abelson

*Science*, 147:3659, Feb. 12, 1965. p. 683.

Our present knowledge of Mars is incomplete, but the facts available provide little basis for thinking that life will be found there. Mars is arid. The total condensable water in a column from the surface of the planet to the top of the atmosphere is about 14 microns (0.00055 inch). White polar caps grow and shrink with the seasons. Considering the small amount to be vaporized and the aridity of the atmosphere, it seems unlikely that liquid water ever existed on the planet. (Author)

## 189

### DETECTING LIFE IN SPACE

William R. Corliss.

*Inter. Sci. Tech.*, Jan. 1965. p. 28–34.
(A65–16817)

Description of instruments and methods under development for the detection of chemical compounds generally associated with life on Earth, the products of metabolic processes, or direct visual evidence of extraterrestrial life forms. Most of the experiments are planned for Mars, involve the collection of dust particles by sticky, retractable tapes or "vacuum cleaners," and are concerned with the presence of micro-organisms. Macromolecules such as nucleic acids, proteins, and enzymes are to be identified through the use of mass spectrometers and gas chromatographs, which require the samples to be heated to provide a gaseous input, or through observations of the rotation of polarized light passed through a solution of Martian soil. A nearly ubiquitous enzyme, phosphatase, can be detected through the fluorescence of phosphate-bound fluorescein. One device, the Wolf Trap, measures two common properties of fluid cultures that contain multiplying bacteria—the increase in cloudiness or turbidity and the increase in acidity brought about by the accumulation of metabolic products—by means of a turbidometer and the well-known glass pH meter. Another, the Gulliver, collects a sample, feeds it with tagged food, and counts the radioactivity of the evolved $C^{14}O_2$ and $H_2S^{35}$. Microscopes coupled with TV cameras will permit measurements of the size, symmetry, and reactions to various biological strains of any Martian micro-organism. The basic tenet (and a recognized limitation) of all of the proposed experiments is the assumption that life, if it exists anywhere in the solar system, will be as we know it. (W.M.R.)

## 190

### NITROGEN OXIDES ON MARS

Carl Sagan (Harvard U., Harvard Coll. Observatory; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.), Philip L. Hanst (Avco Corp., Research and Advanced Development Div., Wilmington, Mass.), and Andrew T. Young (Harvard U., Harvard Coll. Observatory, Cambridge, Mass.).

*Planetary and Space Sci.*, Vol. 13, Jan. 1965. p. 73–88. 51 refs.
(A65–17992)

Comprehensive analysis of the case for the presence of nitrogen oxides on Mars. Analyses of observations at a variety of wavelengths place a firm upper limit on the Martian $NO_2$ abundance of 1 mm-atm. Nitrogen dioxide is a highly photolabile gas and will be photodissociated by visible and ultraviolet radiation on Mars. The photochemical equilibria of nitrogen oxides on Mars have been computed from the observational upper limits on the NO and $O_2$ abundances. The same procedure gives consistent results for the Earth, at locales free from urban pollution. The corresponding theoretical upper limit to the abundance of $NO_2$ on Mars is 1 mm-atm, when reactions with water are neglected. When reactions with water are considered, the $NO_2$ abundance is further diminished. These low abundances are regarded as inadequate to account for the Martian observables discussed by Kiess et al. The one Martian phenomenon in which it is suggested that nitrogen peroxide may play a role is the blue haze, where 1mm-atm may help to explain not only the general blue and violet opacity, but also the dependence of the opacity on time and position. The required abundance of NO must then be $>$ 50 cm-atm. (Author)

## 191

### BIOLOGY AND THE EXPLORATION OF MARS.

Summary and Conclusions of a Study by the NAS/NRC Space Science Board, Stanford U., June 1964.
Harry H. Hess (NAS/NRC Space Science Bd. Chm.), Colin S. Pittendrigh (Princeton U. and Chm. of the Study), et al.

Wash., D.C., National Academy of Sciences, 1965. 19 p.

Until recent years the origin of life and its possible occurrence elsewhere in the universe have been matters for speculation only. The rapid growth of molecular biology since 1940 has changed the discussion of life's origins into far more precise and explicit terms than were possible earlier. But the real transformation which the subject has undergone stems from the spectacular growth of space technology in the last decade. The possibility of life's origin and occurrence on planets other than ours is no longer limited to idle speculation: it has entered the realm of the testable, of science in the strict sense. Given the rockets now available and especially those available by 1969, it has become fully realistic to consider plans for the biological exploration of Mars.

The Study which this report seeks to interpret was convened in June 1964 by the Space Science Board of NAS at the request of NASA to examine this possibility. The task was to examine the scientific foundations and merits of the proposal to undertake a biological exploration of Mars. Overall purpose was to recommend to the Government through the Space Science Board whether or not a biological exploration of Mars should be included in the nation's space program over the next few decades; and further, to outline what that program should be.

The essence of the conclusion resulting from this meeting is that the exploration of Mars—motivated by biological questions—does indeed merit the highest scientific priority in the nation's space program over the next decade. It was concluded, further, that the favorable opportunities for exploration between 1969 and 1973 can and should be exploited as vigorously as possible. (J.W.)

# 1964

## 192

**DETECTION OF LIFE-RELATED COMPOUNDS ON PLANETARY SURFACES BY GAS CHROMATOGRAPHY—MASS SPECTROMETRY TECHNIQUES.**

K. E. Bentley, C. E. Griffin, D. G. Whitten, and W. F. Wilhite (California Institute of Technology, Jet Propulsion Laboratory, Space Sciences Div., Pasadena, Calif.).

Presented at the American Association for the Advancement of Science, Annual Meeting (131st), Montreal, Canada, Dec. 26–31, 1964. 6 refs.
(A65–15153)

Description of the program in progress at the Jet Propulsion Laboratory to develop a system, using a gas chromatograph and mass spectrometer in series, to analyze planetary soil for life-related compounds. To date, most experiments proposed to detect extraterrestrial life have made strong presuppositions about the nature of that life. Recent advances in the state of the art of combined gas-chromatography and mass-spectrometry techniques are considered to offer the possibility of detecting and identifying life-related compounds with minimum speculation (other than being based on organic chemistry) about the life itself. The relative merits of this approach are explored. Background information in the areas of pyrolysis, gas-chromatography miniaturization, sample enrichment devices, and mass-spectrometry miniaturization is presented. (Author)

## 193

**FREE ORGANIC RADICALS IN THE METEORITES MIGHEI AND NOGOYA (RADICAUX LIBRES ORGANIQUES DANS LES METEORITES MIGHEI ET NOGOYA).**

Jules Duchesne, Joseph Depireux, and Clotilde Litt (Liège, Université, Institut d'Astrophysique, Liège, Belgium).

*Compt. Rend.*, 259:25, Dec. 21, 1964. p. 4776–4778, 10 refs. (In French)
(A65–15884)

Investigation of the signals of electronic paramagnetic resonance connected with the free organic radicals present in the meteorites Mighéi and Nogoya. It is shown that these meteorites are characterized by a $g = 2.002$ altogether comparable to that of lignites and coals. It is stated that the discussion of the amplitude of the signals observed warrants the suggestion, in full agreement with the recent results of Schulz and Elofson, that carbonaceous chondrites have not been subjected to temperatures higher than 300 to 400° C. The generality of the analogy with the behavior of coals is discussed, and it is said to contribute an additional presumption in favor of an extraterrestrial biogenetic activity. (M.M.)

## 194

**ORGUEIL METEORITE—ORGANIC NITROGEN CONTENTS.**

Ryoichi Hayatsu (Chicago U., Enrico Fermi Institute for Nuclear Studies, Chicago, Ill.).

*Science*, Vol. 146, Dec. 4, 1964. p. 1291–1293. 21 refs.
(A65–12283)
(NASA–Grant NsG–366)

Investigation of the Orgueil meteorite. Purines, amino derivates of sym-triazine, and substituted guanidines are isolated from the meteorite and identified by chromatographic, spectroscopic, and other techniques. The presence of large amounts of sym-triazine derivatives is thought to be of particular interest since these compounds have no known biochemical significance. The analytical procedure is described in detail. The results are discussed in terms of their value as an evidence of extraterrestrial life. (V.Z.)

## 195

**HUMANOIDS ON OTHER PLANETS?**

R. Bieri (Antioch College)

*Amer. Scientist*, 52:4, Dec. 1964. p. 452–458.

If life has evolved on other planets in other solar systems, and if some population has reached the level of conceptual thought, it is highly probable that the organism so endowed will bear a strong resemblance to *homo sapiens*. Theory is based on the premise that the physical properties of the elements, the forms of energy available, and the environmental conditions which would allow life to arise and evolve are such that severe limitations are imposed on the number of routes available to evolving forms. The number of alternative possibilities is by no means infinite; on the contrary, the number is limited. This limited number of available routes has led to the innumerable cases of convergent evolution in plants and animals. Evidence shows that, again and again, animals and plants have independently evolved not only similar structures but also similar biochemical systems and similar behavioral patterns as solutions to the same fundamental problem. (Author)

## 196

**AN INSTRUMENTED SEARCH FOR EXTRATERRESTRIAL LIFE.**

E. A. Botan (Avco Corp., Research Center, Wilmington, Mass.).

*Space Science Reviews*, Vol. 3, Dec. 1964. p. 715–723. 16 refs.
(A65–16032)

Discussion of what to look for in the search for extraterrestrial life, and how to carry out nine suggested biological experiments. The suggested experiments are to demonstrate: (1) if life exists on Mars or elsewhere; (2) what forms, metabolisms, and ecology it has assumed; (3) what its origin was; (4) what the relationship is between extraterrestrial life and Earth's life; (5) what evolutionary pattern it has followed; (6) whether there are possible exotic life forms; (7) whether there are prebiotic forms; (8) what the seasonal variation of flora and fauna are; and (9) how to protect the environment from contamination by Earth organisms. Since one instrument could not obtain all the required answers, it is suggested that an extraterrestrial-life-detecting lander should have a payload of varied, integrated instruments so that the information obtained by one could be verified and expanded upon by others. Ways of carrying out suggested biological experiments, using devices and techniques available now, or being developed, are discusssd extensively. (F.R.L.)

## 197

**ORIGIN, AGE, AND COMPOSITION OF METEORITES.**

Edward Anders (Chicago U., Enrico Fermi Institute for Nuclear Studies, Chicago, Ill.; Bern, Universität, Physikalisches Institut, Bern, Switzerland).

*Space Sci. Rev.*, Vol. 3, Dec. 1964. p. 583–714. 369 refs.
(A65–16031)
(NASA Grant NsG–366; AEC Contract No. AT (11–1)382)

Collation and evaluation of all significant evidence on the origin of meteorites. The iron meteorites seem to have formed at low pressures. Several lines of evidence suggest that the irons come from perhaps as many as four parent bodies. The frequency of pallasites is considered to be consistent with an origin in the transition zone between core and mantle of the parent body. Ordinary chondrites definitely are equilibrium assemblages rather than chance conglomerates. The U-He and K-Ar ages of hypersthene chondrites are systematically shorter than those of bronzite chondrites, and evidence is considered to exist that most or all hypersthene chondrites come from the same parent body. Two distinct types of primordial gas occur in meteorites. Differentiated meteorites always contain unfractionated gas, while relatively undifferentiated meteorites contain fractionated gas. There is very little doubt that most, if not all, meteorites come from the asteroid belt rather than the Moon, and the most likely parent bodies are the 34 asteroids which cross the orbit of Mars. Various theories on the origin of the meteorites are reviewed, and Wood's theory, which postulates a high-temperature and a low-temperature variety of primordial matter, is considered to be in best accord with the evidence. (F.R.L.)

## 198

**CONTAMINATED METEORITE.**

Edward Anders, Eugene R. Dufresne, Ryoichi Hayatsu (Chicago U., Enrico Fermi Inst. for Nucl. Studies, Ill.) Albert Cavaille (Musée d'Histoire Naturelle, Montauban, France (Tarn-et-Garonne), Ann Dufresne (Georgetown U., Wash., D.C.) and Frank W. Fitch

*Science*, Vol. 146, Nov. 27, 1964. p. 1157–1161. 17 refs.
(A65–80081)
(NASA Grant NsG–366)

One stone (sample No. 9419) of the Orgueil meteorite shower contains an assortment of biogenic materials: coal fragments, seed capsules of the reed Juncus conglomeratus, other plant fragments, and an optically active, water-soluble protein material resembling collagen-derived glues. This sample seems to have been accidentally or deliberately contaminated shortly after the fall of the meteorite in 1864. It is emphasized that sample No. 9419 is the only stone of the Orgueil shower for which there is evidence of alteration by human intervention. There is no reason to believe that the Orgueil meteorite samples in which other investigators claimed to have found evidence of extraterrestrial life (biogenic hydrocarbons and "organized elements") were similarly altered and contaminated.

## 199

**PRIMORDIAL ORGANIC CHEMISTRY AND THE ORIGIN OF LIFE.**

Cyril Ponnamperuma (NASA, Ames Research Center, Moffett Field, Calif.)

Presented at the Southwest Research Institute and USAF, International Symposium on Bioastronautics and the Exploration of Space (3rd) San Antonio, Tex., Nov. 16–18, 1964. 8 p. 17 refs.
(A65–14529)

Consideration of the possibility of finding an answer to the question of the existence of life in our planetary system. Investigations were undertaken to synthesize the constituents of the nucleic acid molecule and the protein molecule, on the hypothesis that molecules that are fundamental now were fundamental at the time of the origin of life. The results are said to show that, under simulated primitive Earth conditions, molecules of biological significance can be synthesized. These results lend support to the hypothesis of chemical evolution since: (1) the conditions are aqueous, (2) the concentrations of materials used are very small, and (3) the sources of energy used are those that are most likely to have existed under primitive Earth conditions. It is stated that, as the laws of chemistry and physics are universal laws, these laboratory experiments point out that, wherever the right conditions exist, those molecules which can act as precursors of biological systems will arise anywhere in the universe. The laboratory experiments lend support to the Oparin-Haldane hypothesis of chemical evolution and possibility of the existence of extraterrestrial life. (M.M.)

## 200

ORGANIZED ELEMENT DISTRIBUTION IN RELATION TO SIZE IN THE ORGUEIL METEORITE.

George Claus and Eva A. Subac (U. of Calif., La Jolla)

*Nature*, Vol. 204, Oct. 10, 1964. p. 118–120. 21 refs.

(A65–80444)

(NASA Grant NsG–341)

The dimensional histogram obtained through the careful measurements of 303 types 1 and 2 organized elements would possibly suggest that even these most simple microstructures found in Wiik's four, type 1 carbonaceous chondrites do not represent just simple mineral grains as suggested by Fitch and Anders, or Mueller, but may be the remains of some kind of primitive life indigenous to the meteorites.

## 201

LIFE-FORMS IN METEORITES AND THE PROBLEM OF TERRESTRIAL CONTAMINATION—A STUDY IN METHODOLOGY.

Paul Tasch (Wichita, University, Dept. of Geology, Wichita, Kan.).

*N.Y. Acad. Sci. Ann.* Vol. 105, Sept. 9, 1964. p. 927–950. 20 refs.

Description of research designed to answer the question: can some, none, or all of the "organized objects" reported as found in meteorites be traced to terrestrial contamination introduced from the time of, and/or during, processing of samples? Slides were prepared of material taken from the Orgueil and Ivuna carbonaceous chondrites, and 27 control slides were also prepared. Each slide is described, and conclusions are drawn about the origin of the material seen. The methodological procedures are described in detail and it is concluded that, as of the time of writing, there are no universally accepted extraterrestrial organized objects of biogenic origin. (D.H.)

## 202

LOOKING FOR COSMIC MICROBES.

Oleg Kostko.

*Spaceflight*, 6:5, Sept. 1964. p. 168–169.

(Transl. from Novosti Press Agency—APN)

It is generally believed that the elements carbon, oxygen, hydrogen, iron, and some others are present in large quantities in outer space. The chemical evolution on other planets has apparently taken the same course as it has on earth to produce carbon- and nitrogen-bearing compounds which make quite possible the formation of simple micro-organisms. The different conditions prevailing on the various planets could give rise to different metabolisms. So there seems to be every ground for believing that life there can exist under temperatures and pressures greatly differing from those on earth. We are thus bound to find fundamentally different forms of life on other planets. (Author)

## 203

PLANETARY SYSTEMS ASSOCIATED WITH MAIN-SEQUENCE STARS.

A. H. Brown

*Science*, 145:3637, Sept. 1964. p. 1177–1181.

The luminosity function is used to estimate the number of invisible planet-like objects in the neighborhood of the sun taking into account the likely chemical composition of planets in relation to the composition of main-sequence stars. An attempt is made to estimate the distribution of these planet-like cold bodies in relation to stars. It is estimated that stars together with cold objects were formed in clusters of bodies of random size distribution. It is possible that every star should have a planetary system associated with it. The possible distribution of planets around such stars has been studied making use of the observed orbital characteristics of double star systems. It is concluded that favorable conditions for life processes may be far more abundant than has been generally thought possible. (Author)

## 204

SIGNIFICANCE AND STATUS OF EXOBIOLOGY.

Gilbert V. Levin (Hazelton Labs., Inc., Falls Church, Va.)

Presented at the A.I.B.S. Annual Meeting, Boulder, Colo., Aug. 26, 1964

*Bioscience*, Vol. 15, Jan. 1965. p. 17–20. 25 refs.

(A65–80508)

Although there are no direct data on extraterrestrial life, planetary observations and statistical considerations support the possibility of such life. The significance of the questions the "science" of exobiology may answer warrants its active pursuit. These questions range from whether life exists elsewhere to fundamental inquiries in all the sciences. (Author)

## 205

THE ORIGIN OF LIFE IN SPACE.

A. I. Oparin (U.S.S.R. Acad. of Sci., Inst. of Biochem., Moscow).

*Space Sci. Rev.*, Vol. 3, July 1964. p. 5–26. 53 refs.

(A64–80917, A64–25261)

The origin of life can be attributed to the evolution of carbon compounds. On earth three stages can be traced. First, formation of simple organic compounds, such as hydrocarbons and cyanides and their oxygen, nitrogen, sulfur, phosphorus, and other derivatives of low molecular weight. Second, polymerization and condensation of these compounds in "the primordial soup." Third, formation of multimolecular complexes, the precursors of the simplest organisms which later developed into all types of terrestrial life. The first step is universal. It takes place even on those extraterrestrial bodies that are essentially different from earth. The second step is very possible on those celestial bodies that are close to earth. This is indicated by the presence of organic polymers (carbonaceous chondrites) in the meteorites, and by seasonal periodicity of spots on Mars. However, the process of their formation may be different from that on earth. The final stage of formation of complex living organisms in space seems possible, but is still debatable.

## 206

PLANET MARS.

S. Tilson.

*Space/Aeronautics*, 42:1, July 1964. p. 46–53.

It has been said that the highest value in the exploration of Mars lies in the possibility of discovery of life there. The author asserts that such a claim places too high a premium on the con-

tinuing exploration of Mars over any equally important finds on other planets and sells that planet and the minds of men short. Life is after all just one part of the cosmic story. Its development is inevitable under certain circumstances, impossible under others. The answer to the existence of life on Mars might indeed revolutionize present scientific theories, but another question of whether Mars has a core or not is equally beguiling. The existence of a core would mean that Mars in all likelihood had a magnetic field and hence a Van Allen belt that could, among other things, shield any life on its surface from the deadly hail of energetic solar particles. (Author)

## 207

MICROBE SURVIVABILITY ON MARS SIMULATED.
W. C. Wetmore
*Aviation Wk. Space Tech.*, 80:26, Jun. 29, 1964. p. 75–76, 79.

Results are presented of experiments carried out by U.S. and Soviet scientists which indicate that terrestrial micro-organisms can survive a simulated Martian environment as well as that of outer space. These results have strong implications in the search for extraterrestrial life and the efforts to prevent contamination of other planets by spacecraft-borne microbic life from the earth. (S.T.L.)

## 208

CONCERNING THE DETECTION OF WATER IN THE ATMOSPHERE OF VENUS.
I. Ye Salomonovich
*In: Izv. Vysshikh Uchebn. Zavedeniy, Radiofizika* No. 1, 1964. Transl. into English by JPRS, June 19, 1964. p. 73–85. refs.
OTS: $4.00
(N64–27154)

In light of new data on the spectrum of the radio emission of the unilluminated side of Venus, the question is considered of the nature of the cloud layer of the planet and the possibility of observing water vapor in the atmosphere. (Author)

## 209

GENETIC RELATIONSHIPS BETWEEN THE ORGANIC MATTER IN METEORITES AND SEDIMENTS.
Egon T. Degens (California Inst. of Tech., Pasadena).
*Nature*, Vol. 202, June 13, 1964, p. 1092–1095. 28 refs.
(A64–80592)

Data supporting the abiotic nature of finely disseminated organic matter in carbonaceous chondrites are presented. Independent of whether biogenic or abiogenic organic molecules become incorporated into a rock, the final fossil organic residue will be chemically and structurally similar. Even organic compounds such as hydrocarbons generated during diagenesis from the finely disseminated organic debris will not yield information on the genetic nature of the precursor material. In analogy, abiotically synthesized extraterrestrial organic matter will chemically resemble the bulk of the ancient terrestrial organic compounds, with the exception of a few compounds, for example, mental-complexed porphyrins and possibly the bases of the purines and pyrimidines, which have so far been formed only here on Earth. It is concluded that fossil biogenic compounds differ from abiotic, meteoritic, and possibly primordial terrestrial organic matter only in a genetic, but not in a chemical, sense. This inference is supported by the lack of optical rotation in various organic fractions of meteorites and by stable isotope investigations.

## 210

IS MARS COVERED WITH ICE? (IST MARS MIT EIS BEDEKT?)
H. Strughold
*Intern. Sci. and Technol.*, No. 30, June 1964. p. 11–12.

A brief description is given of a theory revived and developed by Davydov which postulates the existence of a subsurface frozen hydrosphere on Mars. The possibility of a biosphere in this region is briefly considered. The entire matter is highly hypothetical, but it should not be ignored. (S.T.L.)

## 211

DO METEORITES REVEAL LIFE ON OTHER WORLDS?
T. Gaskell
*New Scientist*, 14:289, May 31, 1964. p. 458–460.

The discovery of microscopic organized elements in carbonaceous chondrites has stimulated a great deal of analysis and speculation about the possibility that they are fossil micro-organisms from another planet. Many questions are still unanswered. The principal observations and the attempts to explain them are reviewed. (A.H.F.)

## 212

SEARCH FOR LIFE; INSTRUMENT THAT WILL COLLECT AND ANALYZE A FEW GRAMS OF MARTIAN SOIL OR DUST FOR SIGNS OF MICROBIAL LIFE.
(No Author)
*Product Eng.*, Vol. 35, June 8, 1964. p. 41–42.

Detailed explanation of the operation of the Multivator—an instrument that will collect and analyze a few grams of Martian soil or dust for sizes of microbial life. The device will then code and transmit, with very little power, its findings back to earth 50 million miles away. (J.W.)

## 213

A STUDY OF AN INSTRUMENTED ANALYTICAL SYSTEM FOR EXTRATERRESTRIAL STUDY OF ATMOSPHERES, POSSIBLE LIFE FORMS, AND SOILS.
E. A. Botan, J. Phaneuf, and J. Lambert (Avco Res. Center, Wilmington, Mass.)
Presented at the Aerospace Medical Association, 35th Annual Scientific Meeting, Americana Hotel, Bal Harbour, Fla., May 11–14, 1964. Preprints of Scientific Program, p. 180–182.
(A64–80860)

A compact, lightweight instrument package is proposed that can be landed on an extraterrestrial body. This system will sample and analyze the environment by means of ultraviolet, visible, and infrared microspectroscopy, microscopy, and emission spectrometry. The data obtained will be converted to telemetry signals for transmission to earth. It consists of: (1) a device for sampling the

surface and reducing particles to dust by means of a diamond grit belt; (2) a vacuum cleaner type device for collecting abraded matter; (3) a conveyer belt to which the particles are attached by means of a static charge; (4) an absorption spectro-microscopy analytical station consisting of: (a) a microscope attached to sensors for passage of monochromatic light of various wavelengths and (b) a TV microscope for determination of size, shape, and structure; (5) an emission spectroscopy analytical station for further sample studies.

## 214

**BACTERIAL ECOLOGIES IN LIMONITE.**

W. Vishniac (Rochester U., Dept. of Biology, Rochester, N.Y.)

Presented at the COSPAR, Meeting (7th) and International Space Science Symposium (5th), Florence, Italy, May 8–20, 1964, 4 p.
(A64–18837)

Discussion of the influence of limonite on the ecology of Martian organisms. The studies made by Dollfus on the polarization of light reflected from Mars at different phase angles have led him to conjecture that the surface of Mars is covered with a layer of limonite. It is felt that iron may serve as a respiratory substrate for Martian micro-organisms. In this type of respiration process, the iron serves as the terminal respiratory electron acceptor. Organic matter is consumed, respired, and assimilated, and this series of processes is accompanied by the reduction of ferric iron to ferrous iron. In a balanced ecology, the net effect of respiration is counterbalanced by photosynthesis. It is stated that this latter process would be performed on Mars by photosynthetic bacteria. Experiments that explore the possible existence of terrestrial micro-organisms carrying out this type of metabolism are reported.

## 215

**CARBON COMPOUNDS IN TERRESTRIAL SAMPLES AND THE ORGUEIL METEORITE.**

W. G. Meinschein (Esso Research and Engineering Co., Linden, N. J.).

Presented at the COSPAR, Meeting (7th) and International Space Science Symposium (5th), Florence, Italy, May 8–20, 1964. 27 p. 63 refs.
(A64–18644)

Discussion of structural and isotopic determinations of carbon compounds in the Orgueil chondrite, which indicate that these compounds are primarily indigenous. It is stated that benzene-extractable carbonaceous materials from Orgueil fragments and terrestrial sediments have similar chromatographic properties. Infrared and ultraviolet spectra show that they contain compounds of the same functional types. Mass spectrometric analyses of the alkanes from the Orgueil meteorite, sediments, and organisms are statistically indistinguishable at the 95% confidence level. Theoretical considerations and experimental data are presented which support the view that alkanes are well-constituted to serve as indicators of former life. Complex alkanes in living things are structurally and isotopically analogous to hydrocarbons in petroleum. Pristane and phytane are constituents of a crude oil that is more than one billion years old. It is noted that the structures and abundances of many alkanes in various sedimentary environments attest to the source and stability of these compounds. Based on the characteristics and distributions of organic substances on Earth, alkanes may provide the clearest insight into the origin of some carbonaceous substances in chondrites. (I.A.A.)

## 216

**ON CREATION OF ARTIFICIAL CONDITIONS OF MARS FOR MICROBIOLOGICAL INVESTIGATIONS.**

A. I. Zhukova and I. I. Kondrat'yev (Academy of Sciences, Moscow, U.S.S.R.).

Presented at the COSPAR, Meeting (7th) and International Space Science Symposium (5th), Florence, Italy, May 8–20, 1964. 9 p.
(A64–18801)

Approach to the solution of problems regarding the character of life on Mars, by simulating Martian conditions by means of data obtained from astrophysics. Experiments are described in which pure cultures of fungi and bacteria have been used, as listed in a table. Short-time exposure has enabled conclusions on the viability of 22 strains of micro-organisms under chamber conditions when the insolation source is switched on. It is concluded that: (1) spores of mold fungi are more stable than spores of bacterial cells, and (2) not all tested forms of micro-organisms are capable of retaining viability under conditions imitated in the installation.

## 217

**GULLIVER AND DIOGENES—EXOBIOLOGICAL ANTITHESES.**

Gilbert V. Levin and Allen H. Heim (Hazelton Laboratories, Inc., Falls Church, Va.)

Presented at the COSPAR, Meeting (7th) and International Space Science Symposium (5th), Florence, Italy, May 8–20, 1964. 18 p. 7 refs.
(A64–18680)

Field testing of the Gulliver experiment's ability to detect life in severe natural environments. Three sites, differing sharply in climatology, geology, and pedology, were selected in topographically diverse parts of California. A fourth field test was conducted in Virginia on a hard clay soil containing approximately 15% iron oxides, rich in limonite. The results are stated to have been one or two orders of magnitude higher than those produced by the automated field instruments in a similar period. The second life detection system called Diogenes is said to be based on the firefly bioluminescent reaction and the ubiquity of adenosinetriphosphate (ATP) in terrestrial life. The light producing steps of the reaction are described. It is noted that the sensitivity, specificity, and rapidity of the test are adaptable to in-flight rocket soundings. As a result, a program has just been started to use the system to obtain microbial ATP profiles of the terrestrial atmosphere during non-recoverable rocket flights. It is stated that, in several aspects, the Gulliver and Diogenes projects are complementary and make good companion experiments.

## 218

METHODS AND SOME RESULTS OF MICROBIOLOGICAL INVESTIGATIONS OF METEORITES.

S. S. Abyzov and A. A. Imshenetskiy (Academy of Sciences, Moscow, U.S.S.R.)

Presented at the COSPAR, Meeting (7th) and International Space Science Symposium (5th), Florence, Italy, May 8–20, 1964. 12 p.
(A64–18628)

Discussion of three methods developed and used to study the origin of bacteria occasionally discovered in microbiological investigations of meteorites. The results obtained with various rock formations and with samples of the Sikhote-Alin iron octahedrite, the Chinge iron otoxite, the Kunashak and the Saratov stone chondrites indicate that, with the exception of the (extremely dense-structure) Chinge iron otoxite, soil bacteria were able to penetrate into the central regions of the meteorites investigated. It is concluded that only meteorites found soon after their fall, such having very dense structure, and possibly meteorites found in Arctic regions are suitable for microbiological analysis.

## 219

PROCEDURES NECESSARY FOR THE PREVENTION OF PLANETARY CONTAMINATION.

Lawrence B. Hall (NASA, Washington, D.C.) and Carl W. Bruch (NASA, Office of Space Science and Applications, Washington, D.C.).

Presented at the COSPAR, Meeting (7th) and International Space Science Symposium (5th), Florence, Italy, May 8–20, 1964. 26 p. 42 refs.
(A64–18827)

Presentation of some of the results of studies of microbial survival in simulated deep-space conditions. It is shown that these conditions will not sterilize contaminated spacecraft, and that many terrestrial microbes, particularly anaerobic spore formers, readily tolerate simulated Martian conditions. The theory and principles of sterilization and their application to the special problem of spacecraft sterilization are discussed and several procedures for the prevention of planetary contaminants are reviewed. It is found that the only processes that achieve both surface and interior sterilization are heat and radiation. If all parts of the spacecraft are assembled under the most rigorous conditions of cleanliness, the capsule can be brought to terminal sterilization containing a total of not more than $10^5$ viable organisms. These can be killed by exposure to 135° C for 24 hrs with a confidence of greater than $10^4$. The problems associated with designing spacecraft to withstand such heat sterilization without reduction of reliability are also considered.

## 220

REQUIREMENTS OF A MINIMUM FREE LIVING REPLICATING SYSTEM.

Harold J. Morowitz (Yale U., Dept. of Molecular Biology and Biophysics, New Haven, Conn.).

Presented at the COSPAR, Meeting (7th) and International Space Science Symposium (5th), Florence, Italy, May 8–20, 1964. 4 p.
(A64–18813)

Presentation of a partially inductive approach to the definition of a living system by formulating the features common to terrestrial living systems and seeking the minimum system showing these features. On the basis of ten generalizations, a minimum terrestrial biological system is postulated. It is stated that, in preliminary studies of various strains of living cells, it was found that there were violations of the ten generalizations postulated. The following conclusions are made: (1) extremely small free living cells exist; (2) these cells are capable of metabolizing synthesizing protein, DNA, and RNA, and replicating; and (3) any structure essential to the biological process of replication must be in these cells.

## 221

ULTRA-HIGH VACUUM AND MICRO-ORGANISMS.

A. A. Imshenetskiy and S. V. Lysenko (Academy of Sciences, Moscow, U.S.S.R.).

Presented at the COSPAR, Meeting (7th) and International Space Science Symposium (5th), Florence, Italy, May 8–20, 1964. 12 p.
(A64–18740)

Experimental investigation of the effects of ultra-high vacuum on micro-organisms. For 72 hours diverse bacteria and fungi were subjected to the action of ultra-high vacuum equal to $10^{-8}$ — $10^{-9}$ mm Hg. It is stated that seven species of sporogenic bacteria underwent ultra-high vacuum well. Of seven species of asporogenic bacteria, cells of three species perished completely. In four other species, a considerable number of cells died. Five species of fungi, among which there were both conidium-forming and nonconidium-forming specimens, were found to be very resistant to ultra-high vacuum. It is noted that, in some experiments, cells of microorganisms retained greater viability in ultra-high vacuum conditions than under laboratory conditions.

## 222

EXOBIOLOGY.

Frank B. Salisbury (Colorado State University, Dept. of Botany and Plant Pathology, Fort Collins, Colo.).

Grover J. D. Schock, ed. Annual Rocky Mountain Bioengineering Symposium, (1st), U. S. Air Force Academy, Colorado Springs, Colo., May 4–5, 1964. p. 75–83.
Symposium sponsored by the U.S. Air Force Academy and the Committee on Electrical Techniques in Medicine and Biology, Institute of Electrical and Electronics Engineers.
Colorado Springs, U. S. Air Force Academy, 1964. 10 refs.
(A65–10728)

Discussion of possible evidence for the existence of extraterrestrial life. Conditions imposed by current theories on the origin of life are noted. The possible detection of biological remains in meteorites is briefly reviewed. Observations of Mars are discussed, including those of seasonal color changes in surface markings, the "canal" network, the apparent uniqueness of some features of the Martian satellites, and the appearance of bright flares on the surface. The latter three cases are taken as possible indications of higher life forms on the planet. Possible implications of reported observations of extraterrestrial beings and vehicles are discussed. (P.K.)

## 223

**INSTRUMENTATION REQUIREMENTS FOR LIFE DETECTION SYSTEMS.**

Jerry L. Stuart (California Institute of Technology, Jet Propulsion Laboratory, Space Sciences Div., Pasadena, Calif.).

Grover J. D. Schock, ed. Annual Rocky Mountain Bioengineering Symposium, (1st) U. S. Air Force Academy, Colorado Springs, Colo., May 4–5, 1964. p. 88–97.
Symposium sponsored by the U. S. Air Force Academy and the Committee on Electrical Techniques in Medicine and Biology, Institute of Electrical and Electronics Engineers.
Colorado Springs, U. S. Air Force Academy, 1964.
(A65–10730)

Discussion of methods for analyzing planetary soil for various general and specific organic compounds, and for monitoring growth and metabolic processes, in the attempt to detect extraterrestrial life forms. The use of visual techniques, such as television and microscopy, for morphological information is noted, as are methods of chemical analysis. The problem of collecting samples is discussed, and several life-detection instruments being developed are described, including the Gulliver radio-isotope probe. The Minivator integrated system for chemical analyses is described, and would perform such functions as nephelometry, dye staining, polarization, and radio-isotope detection. It is suggested that an integrated instrumentation approach to the life-detection problem would be the most economical and reliable. (P.K.)

## 224

**PRINCIPLES OF OPTICAL MEASUREMENTS APPLIED TO BIOLOGICAL GROWTH IN THE WOLF TRAP.**

Charles R. Weston (Rochester U., Dept. of Biology, Rochester, N. Y.).

Grover J. D. Schock, ed. Annual Rocky Mountain Bioengineering Symposium, (1st) U. S. Air Force Academy, Colorado Springs, Colo., May 4–5, 1964. p. 99–109.
Symposium sponsored by the U. S. Air Force Academy and the Committee on Electrical Techniques in Medicine and Biology, Institute of Electrical and Electronics Engineers.
Colorado Springs, U. S. Air Force Academy, 1964.
NASA-supported research)
(A65–10731)

Description of the "Wolf Trap" for detecting and monitoring extraterrestrial microbial growth. In the device, the growth of micro-organisms is determined by measuring the intensity of light scattered by the organisms. With the present optics in the two chambers of an engineering breadboard, the Wolf Trap gives a reliable signal at $\sim 10^5$ bacteria/milliliter. The breadboard is controlled from a battery-operated portable console which supplies power, simulates spacecraft interface functions, and provides a convenient method of monitoring the data. The entire breadboard can be sterilized at 145° C for 24 hr, in line with the requirement for Martian landings. (P.K.)

## 225

**SYSTEMS CONSTRAINTS ON THE SEARCH FOR EXTRATERRESTRIAL LIFE.**

Dennis H. Le Croissette (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.).

Grover J. D. Schock, ed. Annual Rocky Mountain Bioengineering Symposium, (1st) U. S. Air Force Academy, Colorado Springs, Colo., May 4–5, 1964. p. 84–87.
Symposium sponsored by the U. S. Air Force Academy and the Committee on Electrical Techniques in Medicine and Biology, Institute of Electrical and Electronics Engineers.
Colorado Springs, U. S. Air Force Academy, 1964.
(A65–10729)

Review of constraints imposed by mission requirements on systems for detecting living organisms on the surface of Mars. The phases of a mission for landing a capsule on the Mars surface are reviewed. The severest constraints are found to be the limitation in data transmission rate to below 10 bits/sec (thus eliminating the possibility of picture transmission), relatively low scientific payload, and the severe impact which the capsule will suffer on reaching the surface. An additional problem is the need to sterilize the capsule to prevent contamination of Mars by terrestrial organisms. It is concluded that only a marginal possibility exists of landing a definitive life-detection system on Mars in this decade. (P.K.)

## 226

**A COINCIDENCE TECHNIQUE FOR PAPER CHROMATOGRAPHY.**

Cyril Ponnamperuma, Patricia Kirk, Ruth Mariner, and Bennett Tyson (NASA, Exobiology Div., Ames Research Center, Moffett Field, Calif.).

*Nature*, Vol. 202, Apr. 25, 1964. p. 393–394.
(A64–18658)

Brief description of a coincidence technique for paper chromatography which provides a reliable identification of compounds without the uncertainty involved in using $R_F$ values alone and often eliminating the need for extensive chemical analysis. This technique is used successfully for the identification of purines, pyramidines, amino acids, and sugars. It can be applied to any compound which can absorb ultraviolet or visible light.

## 227

**EVIDENCE FOR PORPHYRINS IN THE ORGUEIL METEORITE.**

G. W. Hodgson and B. L. Baker

*Nature* (London), 202:4928, Apr. 11, 1964. p. 125–131. 54 refs.
(A64–80348)

A class of organic compounds pertinent to the question of biogenicity is that of the porphyrins, since these or closely related compounds appear to be common to almost all living organisms.

Porphyrins are generally detected and measured by means of their characteristic light-absorption patterns, and several examinations of Orgueil samples in this work have shown responses which appear to be indistinguishable from those for porphyrin compounds existing in terrestrial sediments. The indicated level of concentration of these specific pigments, which appear to be similar to vanadyl porphyrins, is in the range found for terrestrial rocks. (Author)

## 228

OPTICAL ACTIVITY IN SAPONIFIED ORGANIC MATTER ISOLATED FROM THE INTERIOR OF THE ORGUEIL METEORITE.

B. Nagy, M. T. J. Murphy, V. E. Modzeleski, G. Rouser, G. Calus, D. J. Hennessy, U. Colombo, and F. Gazzarrini

*Nature* (London) 202:4929, Apr. 18, 1964. p. 228–233. 27 refs.

An optically active fraction was obtained by saponification of solvent extracts from a stone of the Orgueil carbonaceous meteorite. Thin-layer chromatograms showed that the composition of the Orgueil meteorite extracts was wholly different from the composition of saponified fractions which can be isolated by identical procedures from recent biological matter. It seems reasonable to connect optical rotation in Orgueil with biological activity, either of indigenous origin or perhaps still related to terrestrial contaminations. (Author)

## 229

WATER VAPOR IN THE ATMOSPHERE OF VENUS.

Murk Bottema, William Plummer, and John Strong (Johns Hopkins U., Laboratory of Astrophysics and Physical Meteorology, Baltimore, Md.)

*Astrophys. J.*, Vol. 139, Apr. 1, 1964. p. 1021–1022.

(USAF-supported research.)

(A64–18733)

Determination of the amount of water vapor present above the reflective cloud layer on the planet Venus, using an automatic daytime telescope of 30-cm aperture carried by balloon to 26.5 km. From 120 records it was determined that the modulation produced by the water absorption, when the line groups were scanned, was $(10.5 \pm 0.5)\%$. By calibration, this modulation is the same as that produced by $9.8 \times 10^{-3}$ g/cm$^2$ of water vapor at atmospheric pressure. Possible influence of water vapor in the Earth's atmosphere above the balloon was assessed. The influence of the Doppler shift on the recorded data was also determined.

## 230

EXTRATERRESTRIAL LIFE.

P. H. Abelson

*Proc. Nat. Acad. Sci.*, 47:4, Apr. 1964. p. 575–581.

This paper reviews some of the cogent limitations as we know them and examines some of the fundamental reasons why these limitations exist. Some of the important features of the planetary and lunar environments which contraindicate the presence of life on the Moon, Venus, or even Mars, are discussed. (J.P.L.)

## 231

THE LIMITS OF LIFE.

Peter H. A. Sneath (Med. Res. Council, Natl. Inst. for Med. Res., Mill Hill, London, England).

*Discovery*, Vol. 25, Apr. 1964. p. 20–24.

(A64–80354)

The possibility that micro-organisms could survive space travel and multiply on some other planet is discussed. The discussion includes possible effects of various temperatures, water supplies, energy supplies, acidity and alkalinity, and radiation on various organisms, including algae, bacteria, molds, and lichens. Evidence is presented suggesting that bacteria present in rockets would be protected by the cold, shielded from radiation, and not die in contaminated spaces in any reasonable time period. Possible planetary environments, including those of the Moon, Mars, Mercury, Jupiter, and Saturn, are described. Of these, Mars seems to be the most promising as a sustainer of life. Recent work has shown that many terrestrial bacteria can grow quite well in an environment similar to that of Mars. The bacteria grow when warmed, and become dormant when cooled. Terrestrial organisms most likely to be troublesome as planetary contaminants include: (1) sporing bacteria, which are long-lived and resistant to heat; (2) chemoautotrophic bacteria, which use unusual energy sources; (3) molds, which have small food requirements and are tolerant of desiccation; and (4) algae and lichens, which are hardy and versatile. The reverse danger of contaminating the earth with extraterrestrial organisms is also discussed, together with possible means of disinfecting rockets.

## 232

TRANSMISSION OF INFORMATION BY NONTERRESTRIAL CIVILIZATIONS (PEREDACHA INFORMATSII VNEZEMNYMI TSIVILIZATSIYAMI).

N. S. Kardashev (Gosudarstvennyy Astronomicheskiy Institut, Moscow, U.S.S.R.).

*Astron. Zh.*, Vol. 41, Mar.–Apr. 1964. p. 282–287. 17 refs. (In Russian). Translated into Eng. by JPRS, June 30, 1964.

(JPRS 25307 TT—64—31588; A64–19619)

Calculation of the optimum signal spectrum that will permit transmission of a maximum quantity of information in the presence of quantum fluctuations and cosmic radiation background. It is shown that by using modern methods of radioastronomy it is possible to detect, at any distance in the universe, a civilization capable of transforming power of the order of $4 \times 10^{38}$ erg/sec. Some distinguishing properties to be expected of artificial cosmic radiation are noted.

## 233

THE DARKENING WAVE ON MARS.

D. G. Rea (California, U., Space Sciences Laboratory, Berkeley, Calif.)

*Nature*, Vol. 201, Mar. 7, 1964. p. 1014–1015. 7 refs.

(A65–15140)

(NASA Grant NsG 101–61.)

Paper dealing with a recent communication of the author concerning the evidence for life on Mars and, in particular, the sea-

sonal wave of darkening and associated changes in the polarization of the dark areas. An improved rationale for a previous model (the principal feature of which is the seasonal transport of dust on and off the dark areas) explaining these phenomena is proposed. (V.P.)

## 234

**PHILCO LABS DEVELOPING PROTEIN DETECTOR TO PROBE FOR LIFE ON MARS.**
(No Author)
*Missiles and Rockets*, 14:9, Mar. 2, 1964. p. 26–27.

The protein life detector searches for molecules that are characteristic of all living material. This method does not involve growth, concentration, or separation of macromolecules. The instrument detects protein and similar macromolecules by the color change they cause in a carboncyanine dye. The color change in the dye, electro-optically detectable as increase in light absorption at certain wavelength, is thought to be caused by a change in the aggregation of dye molecules when they contact long chain molecules of the protein type. (M.G.)

## 235

**THE NONPREVALENCE OF HUMANOIDS.**
G. G. Simpson
*Science*, 143:3608, Feb. 21, 1964. p. 769–775. 25 refs.
(A64–15475)

Development of the theory that extraterrestrial life is a hypothesis the validity of which is based on negative assumptions, and which leads to speculation entirely free of earthly realities, is discussed. The possibility of a noncarbon-based biology is admitted with the observation that no tangible evidence for it exists. The questions of the origin of life and its possible existence outside the solar system are reviewed, with an examination of the subsequent evolution of postulated life forms. Both the course followed by evolution and its processes clearly show that evolution is not repeatable. Communications with other possible solar systems are considered so unlikely as to be impossible. It is suggested that expenditure on the further study of terrestrial life would be more fruitful than that for exploration of the possibility of nonterrene life.

## 236

**INFRARED EMISSION SPECTRA OF ORGANIC SOLIDS FROM 5–6.6 MICRONS.**
W. A. Hovis, Jr.
*Science*, 143:3606, Feb. 7, 1964. p. 587–589.

The emission spectra of thin layers of a number of organic solids from 5 to 6.6 $\mu$ in the infrared have been studied to determine if there are specific emission characteristics that would allow identification of such solids as organic. This was the case only for very thin films with strong absorption bands. (Author)

## 237

**GEOGRAPHICAL AND ASTRONOMICAL BASIS FOR LIFE ON THE PLANET EARTH: A SUMMARY: (BASES GEOGRAFICAS E. ASTRONOMICAS DA VIDA NO PLANETA TERRA: UM ENSAIO).**
Dulcidio Dibo
*Centro Estudos Cient. Rev.*, 11:2, Feb. 1964. p. 20–21. (In Portuguese)

This paper reports the geographic and astronomic conditions necessary to the existence of life on earth and considers these in relation to their presence or absence on Mercury, Venus, Mars, Jupiter, Saturn, Uranus, etc. Some of these conditions are: absence of temperature extremes, presence of water and free oxygen, photosynthesis, etc. (A.W.)

## 238

**MARS.**
W. W. Kellogg
*Intern. Sci. Technol.*, No. 26, Feb. 1964. p. 40–48.

Mars is the one planet in the solar system likely to support life something like the terrestrial kind. But if life exists there it must accommodate itself to an environment that is extremely harsh by earthly standards. Mean temperatures at the Martian equator, for example, are —35° to —45° C. Furthermore, the Martian atmosphere seems singularly lacking in oxygen (perhaps 0.1% by volume) and water vapor (Arizona's desert air is like a Turkish bath by comparison). Nevertheless, changes in color and polarization of Mars' dark areas that coincide with seasonal waxing and waning of the white (ice?) polar caps, persistence of the dark areas through the years, and recent discovery in them of spectral evidence of organic molecules combine to suggest that all of Mars is not as barren of life as its red dusty deserts of limonite seem to be. Fly-by space probes, ingeniously instrumented landing probes, and trained eyes at good telescopes—backed by brains soon may answer this and a host of equally important geophysical questions. (Author)

## 239

**NAMES FOR SPACE PLANTS.**
John Beckner
*Analog*, 72:6, Feb. 1964. p. 87–89. refs.

An article by Claus and Nagy in which they propose a system of nomenclature for extraterrestrial plants is discussed. Their three major proposals for codifying extraterrestrial plants are reviewed. (M.P.G.)

## 240

**LIFE: ORIGIN AND EVOLUTION.**
A. Szutka
*Science*, 143:3604, Jan. 24, 1964. p. 384–385.

Report of a meeting held in Wakulla Springs, Florida, on the origin of prebiological systems. Topics from small molecules through macromolecules to precellular organization were covered. (G.W.)

## 241

PLAN ADVANCED FOR LANDING PROBE ON MARS IN 1969 AS URGENT U. S. GOAL

H. M. David

*Missiles and Rockets*, 14:1, Jan. 6, 1964. p. 14–15.

There is a great urgency in preparing to land a space probe on Mars in 1969, according to Dr. Allan Brown, since then the surface could be sampled during spring and summer when there would be the best chance of detecting plantlife organisms. He holds that the chances of finding physiological evidence such as specific catalysts, autotrophy, catabolic $CO_2$ production, and growth are greater than the prospects for finding morphological evidence. He suggests that such a mission would lend itself to international cooperation and could be more easily achieved with greater scientific advantages than any other area in which both U. S. and Soviet space programs are involved. (M.P.G.)

## 242

IS THERE LIFE ON MARS?

J. A. Straiser

*Electronics*, Vol. 37, Jan. 3, 1964. p. 71–73.

Life detector systems on Mariner and Voyager may provide answer to question of extraterrestrial life. Of the eight candidates for the job, three are earmarked as possible experiments on Mariner B scheduled to launch in 1966 or 1968. The Voyager spacecraft will carry one of the other five devices in 1969, 1971, or 1973. Possible candidates for experiments on Mariner B are: Gulliver, Multivator, Vidicon Microscope. Possible candidates for experiments on Voyager are: Wolf Trap, Optical Rotary Dispersion, Ultra-high Viable Spectrophotometer, J-Band Life Detector, and Mass Spectrometer. (J.W.)

## 243

THE SEARCH FOR INTELLIGENT LIFE ON OTHER PLANETS.

J. Lear

*Saturday Rev.*, Vol. 43, Jan. 2, 1964. p. 39–40.

The realization of intelligent extraterrestrial life and methods and scope of detection of such life are discussed. The statistical probability of intelligent life is great within the total universe, but within the nearby areas of the sun the probability is extremely small. Among stars within 15 light years, seven have luminosity and lifetime similar to the sun. Assuming an advanced radio technology in a culture superior to ours, detection of beamed radio signals might be possible at the 1420 megacycle frequency of interstellar hydrogen, which would be of interest to any technological society. Project Ozma is the search for such signals from the stars Tau Ceti and Epsilon Eridani which are within the range of current receivers. (E.O.)

## 244

CIVILIZATION ON OTHER PLANETS?

*U.S.S.R.*, 1:88, Jan. 1964. p. 46–47.

In a series of four articles, V. Fesenkov, J. Shklovskiy, A. Pasynskiy, and B. Lyapunov discuss current theories and Soviet research in the field of exobiology. (E.C.)

## 245

THE CHEMICAL ORIGIN OF LIFE.

Alexander I. Oparin (USSR Acad. of Sci., Bach Inst. of Biochem., Moscow).

Springfield, Ill., Charles C. Thomas, 1964. 124 p. 170 refs.

(A64–80942)

Recent advances in many fields of science, supported by the development of precision systems capable of investigating objects on a microscopic and macroscopic scale, substantiate even more strongly the author's theory formulated forty years ago, that the origin of life is of a chemical nature. However, man still does not hold in his hands any direct factual evidence that would enable him to give a more or less accurate date of the origin of life on earth. On the basis of geological findings, it may be stated, however, with confidence that between the origin of the "primordial soup," containing minute particulate matter in a form of large organic and inorganic molecules and the development of most primitive organisms, a very extensive interval of time must have elapsed. The development proceeded through evolution from an elementary structure to more efficient combinations during a span of time when the earth environment was changing from an anoxygenic to an oxygenic state, which was not shorter or simpler than the path from amoeba to man. Duplicating the process in the laboratory, man may still hope to accomplish the artificial synthesis of life in the near future.

## 246

CONCEPTS FOR DETECTION OF EXTRATERRESTRIAL LIFE.

Freeman H. Quimby, ed.

Wash., D.C., NASA, 1964. 52 p. refs.

(N65–12268; NASA–SP–56) GPO: $0.50; OTS Price, MF $0.50.

The following subjects are presented: Evidence Relevant to Life on Mars; Mars Surface High-Resolution Near-Scan TV; The Vidicon Microscopes; The Gas Chromatograph; The Mass Spectrometer; The Ultraviolet Spectrophotometer; The J-Band Life Detector; Optical Rotation; The Radioisotope Biochemical Probe; Gulliver; The Wolf Trap; The Multivator Life-Detection System; and The Mars Mariners and Voyagers. (G.G.)

## 247

HAS THE ORGUEIL METEORITE FURNISHED EVIDENCE OF EXTRA-TERRESTRIAL LIFE? (LA METEORITE D'ORGUEIL A-T-ELLE APPORTÉ LES PREUVES D'UNE VIE EXTRA-TERRESTRE?)

Gaston Cohen

*Science Progress: La Nature*, No. 3345, Jan. 1964. p. 18–26. (In French)

(A64–80161)

A review is presented of laboratory studies and theories concerning the presence of extraterrestrial life forms in the meteorite that fell on Orgueil, France, in 1864. Infrared absorption analyses showed that the meteorite contained hydrocarbons similar to those formed on earth by the degradation of living molecules rather than by industrial "inorganic" processes. Microscopic

studies by Claus and Nagy revealed five types of "organized elements" that resembled certain microscopic algae, did not exhibit birefringence under polarized light, and reacted positively to organic staining tests. The conclusion that the organized elements represent the remains of extraterrestrial life forms have been rejected by many scientists, chiefly on the basis of studies suggesting contamination of the meteorite by terrestrial life.

## 248

LIFE IN SPACE.

A. A. Imshenetskiy.

*Akademiya Nauk SSSR, Vestnik*, No. 9, 1963. p. 23–29.

*NLL Translations Bulletin*, Vol. 6, Jan. 1964. p. 28–43.

(A64–16475)

Discussion of the possibility of life in space and of the problem of transmission to other planets of live bacteria from the Earth. Cosmic rockets and spacecraft leaving the Earth now receive special sterilization to prevent accidental transfer of bacteria. Considered are the microbiological analysis of meteorites; methods for the discovery of life at great altitudes, on other planets, and in cosmic space; and nephelometric, manometric, and pH measurements. It is noted that exobiological investigations cannot be limited to the search for micro-organisms. Of no less interest are chemical investigations capable of explaining the "evolutions" of various chemical substances related to the origin of life. The exploratory investigations involve the dispatching to the planets of various automatically operated instruments of chemical analysis. Particularly important will be the search on the planets for forms of life more primitive than the micro-organisms found on Earth. The discovery of precellular forms of life is not only an important, but also an extremely difficult problem, and before attempting to solve it, fuller information will be required on the distribution of the various chemical elements on the planet and planetary environmental conditions. It is stated that the attempts to discover the existence of precellular formations must precede the search for micro-organisms.

## 249

THE CONFLICT OF TWO WORLDS OF LIVING ORGANISMS (KONFLIKT ZYWYCH SWIATOW).

Mieczyslaw Markus.

*Astronautkya*, Vol. 7, 1964. p. 21–22. (In Polish)

(A64–81026)

Flights to other planets are connected with the possibility of meeting other living forms, especially micro-organisms, and with the probable development of diseases dangerous to human subjects. The development of diseases is dangerous only in cases of meeting extraterrestrial micro-organisms capable of being human parasites. Theoretically, such situations will seldom occur. The author gives a review of such possibilities and analyzes situations in which extraterrestrial micro-organisms might be dangerous to cosmonauts.

## 250

THE ENVIRONMENT OF THE PLANETS.

William W. Kellogg (RAND Corporation, Santa Monica, Calif.)

IN: Donald P. Le Galley and John W. McKee. eds. p. 83–96. Space Exploration.

New York, McGraw-Hill Book Company, 1964. 39 refs.

(A64–80787)

The author presents a summary of the state of knowledge of the planets pertaining to their environments and the possibility of the existence of life. The data include work done until the summer of 1962. Concentrating on Mars and Venus, the author summarizes environmental data gathered by visual, infrared, and radar observations. Observations indicating some form of plant life on Mars are cited. Data from studies of Venus indicate that life probably does not exist there. It is suggested that the one goal of planetary exploration should be to discover the history of the planets, and that only by close inspection shall the complete nature of these environments be determined. (Aerospace Med.)

## 251

HABITABLE PLANETS FOR MAN.

Stephen H. Dole (RAND Corp., Human Engineering Group, Santa Monica, Calif.).

New York, Blaisdell Publishing Co., 1964. 160 p.

$5.75.

(A64–17257)

The conditions necessary for planets to support human life, and the essential properties required of the stars that provide heat and light to such planets are studied in detail. The environmental needs of man are considered, including temperature, light, gravity, atmospheric composition and pressure, and water. The natural environments provided by other planets are considered, and hypothetical planets that could exist in orbits around other stars are discussed. The various classes of possible planets are analyzed, and a class of planets is described that would provide human beings with suitable environmental conditions. The probability of occurrence of habitable planets is analytically considered. In an appendix, data on the 25 principal bodies of the solar system of mass greater than $10^{23}$ gm are tabulated. A bibliography and subject index are also included. The book was prepared as part of the continuing program of research undertaken by the RAND Corporation for the U.S. Air Force.

## 252

MARINER C TO FLY BY MARS.

J. Oró.

*Space Aeron.* 41:1, 1964. p. 96.

Two Mariner C vehicles are to be launched in November, December or early 1965 to fly past Mars about eight months later. The main goal of Mariner C is to search for indications of life on Mars. Seasonal color changes provide hope for existence of life on Mars. In addition, balloon observations of Mars in the infrared have detected emissions characteristic of the carbon-hydrogen bond. The main Mars experiments on Mariner C will be a TV and possibly an infrared detector. (A.H.F.)

## 253

THE ORIGIN AND EVOLUTION OF ATMOSPHERES AND OCEANS.
(Proc. of a Conf. at NASA, Goddard Inst. for Space Studies, N.Y.C, Apr. 8–9, 1963)
Peter J. Brancazio and A. G. W. Cameron, eds.
N. Y., John Wiley & Sons, Inc., 1964. 314 p.
$12.50

Various aspects of the origin and evolution of planetary atmospheres and oceans are discussed. Included are the following: (1) geological history of sea water; (2) convection in the Earth's mantle; (3) degassing of argon and helium from the Earth; (4) comments on the outgassing of the Earth; (5) on the chemical evolution of the terrestrial and cytherean atmospheres; (6) the history of growth of oxygen in the Earth's atmosphere; (7) the escape of helium from the Earth's atmosphere; (8) primordial rare gases in meteorites; (9) isotopic analysis of xenon; (10) interpretation of xenon measurements; (11) outgassing processes on the Moon and Venus; (12) observations of water vapor on Mars and Venus; (13) the atmosphere of Mercury; (14) the atmosphere of Venus; (15) the atmosphere of Mars; (16) are the interiors of Jupiter and Saturn hot?; and (17) the atmosphere of Jupiter. A subject index is included. Pertinent articles are abstracted separately. (Aerospace Med.)

## 254

THE ORIGIN OF LIFE.
John Keosian (Newark Coll. of Arts and Sci., N. J.)
Reinhold Publishing Corp., 1964. 118 p.
(A65–80097)

Data on the origin of life on earth and on extraterrestrial bodies are reviewed. The following are included: (1) nature of the problem (including several approaches to the problem such as viralism, special creation, panspermia, mechanism, and materialism), (2) historical background, (3) Oparin hypothesis, (4) distribution of simple organic compounds, (5) composition of the primordial atmosphere, (6) primary synthesis of organic compounds, (7) some unsettled questions (hot dilute soup, asymmetric synthesis, origin of petroleum, energy considerations, reaction mechanisms, and origin of living things from discrete systems), and (8) review of evidence for and against neobiogenesis (origin of life anew). Selected rendings and a combined author and subject index are included. (Aerospace Med.)

## 255

PLANETS FOR MAN.
Stephen H. Doyle and Isaac Asimov
N.Y., Random House, 1964. 223 p.

Contents:

Chapter 1: The Coming Search; Chapter 2: Human Requirements; Chapter 3: The Properties of Planets; Chapter 4: Planetary Habitability; Chapter 5: Probability of Habitable Planets; Chapter 6: The Nearest Candidates; Chapter 7: Star Hopping; Chapter 8: An Appreciation of the Earth.

## 256

SOME CRITERIA OF LIVING SYSTEMS USEFUL IN THE SEARCH FOR EXTRATERRESTRIAL LIFE.
Freeman H. Quimby (Chief, Exobiology, Bioscience Programs, Office of Space Sciences, NASA)
*In:* Society for Industrial Microbiology. *Develop. Ind. Microbiol.* Vol. V. p. 224–234. Wash., D.C., Amer. Inst of Biological Sciences, 1964.

The possibility of the existence of extraterrestrial life, sentient or otherwise, has been a basic human curiosity since the beginning of man. Numerous developments have gradually added interest to this subject: the cosmic distribution of elements, the theory of evolution by natural selection, the recent ideas concerning the origin of the solar system, the classical Urey-Miller synthesis of organic compounds from reducing gases, knowledge of the structure and function of DNA, and new experiments which have closed the gap between living and nonliving matter. Sapient species on other planetary systems in our galaxy can be searched for by radio astronomy, but this idea is not popular. The search for life on Mars, or evidence of its earlier existence, can be detected by remote data relaying instruments. The latter approach is accepted and promoted by scientists in many disciplines, although there are some skeptics whose doubts are not without valid basis. But we are compelled to make the attempt because the possibility exists, and its consequences are too exciting to resist. If we succeed, it will revolutionize views concerning the universal distribution of life with the possibility that life is a cosmic force inherent in matter. The methods will consist of techniques for identifying those phenomena and substances usually associated with terrestrial living systems: growth, metabolism, enzymes, DNA, proteins, amino acids, and the optical activity of life associated molecules. The origin and nature of life, a great mystery, may be solved by the above experiments and their logical extensions. (Author)

## 257

SPACE EXPLORATION.
Donald P. LeGalley, ed. (Space Technol. Center, TRW Space Technol. Lab., Redondo Beach, Calif.) and John W. McKee (Gen. Elec. Co.—TEMPO, Santa Barbara, Calif.)
N.Y., McGraw-Hill Book Company, 1964. 467 p.
(A64–80786)

This book is based on a series of lectures given under the auspices of the University of California Engineering and Physical Sciences Extension Division. Each lecturer writes the corresponding chapter in the book. The chapters contain information in technology and physical and biological aspects of space. Technological subjects include information on design of reentry vehicles, nuclear propulsion, meteorological satellites, radiation shielding, space navigation, and economic implications. Studies in the physical sciences include chapters on cosmology and relativity, solar flares, astrodynamics, and meteoroids. Chapters of biological interest contain information on planetary environments, man-in-space, radiation shielding, and the origin of life. These chapters are abstracted separately.

258

THERMAL POLYMERIZATION OF AMINO-ACIDS AND PRODUCTION OF FORMED MICROPARTICLES ON LAVA.

S. Fox

*Nature*, 201:4917, 1964. p. 336–337.

Results of experiments to test the thermal polymerization of amino acids in a geological environment are reported. The amino acid mixture was run over a hot lava sample and microspherules resulted. Since there is a tremendous quantity of lava on the Earth's surface, thermal energy could have been significant in prebiological organic synthesis. These results may also be applied to meteorites and their formed elements, since carbonaceous chondrites during travel in the Earth's atmosphere were exposed to both thermal and water gradients. These experiments are considerd a demonstration that transformations from primordial gases to precellular forms could occur in a matter of hours. (A.H.F.)

259

THERMAL SYNTHESIS OF NATURAL AMINO-ACIDS FROM A POSTULATED PRIMITIVE TERRESTRIAL ATMOSPHERE.

R. Harada and S. Fox

*Nature*, 201:4917, 1964. p. 335–336.

Simple gases are thermally convertible to most of the amino acids common to protein in a way that is sequentially compatible with other aspects of the thermal theory of biochemical origins. A table of amino acid compositions produced thermally in the presence of silica and by electric discharge is included. (A.H.F.)

260

THIS VIEW OF LIFE.

George G. Simpson

N.Y., Harcourt, Brace, and World, 1964. 230 p.

Paleontology provides the keystone to a theory of evolution. The author draws a distinction between "historical" and "non-historical" events in the universe in relation to matter. (A.H.F.)

# 1963

## 261

THE SEARCH FOR EXTRATERRESTRIAL LIFE.

Allan H. Brown (Pennsylvania, University, Div. of Biology, Philadelphia, Pa.).

IN: William C. Kaufman, ed. BIOASTRONAUTICS—FUNDAMENTAL AND PRACTICAL PROBLEMS; PROCEEDINGS OF THE AMERICAN ASTRONAUTICAL SOCIETY SYMPOSIUM HELD AS PART OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, ANNUAL MEETING, 130TH, CLEVELAND, OHIO, DEC. 30, 1963. (ADVANCES IN THE ASTRONAUTICAL SCIENCES. VOLUME 17). North Hollywood, Western Periodicals Co., 1964. p. 41–60.
(A64–28342)

Discussion of methods of identifying any life which may exist beyond the limits of the terrestrial biosphere, especially with reference to Mars, and of the subsequent investigation of its chemical, physical, metabolic, and other properties. In general, life is assumed to consist of discrete organisms, to be essentially aqueous, to have a carbon-based chemistry, to exhibit a kind of genetic control of reproduction, to possess enzyme-like catalysts, and to exhibit both heterotrophy and autotrophy. Detection of Martian life can be achieved with unmanned probes which can aquire evidence of various kinds. Evidence of life collected by experiments landed on the Martian surface may be morphological, chemical, physical, or physiological. The Martian biota is expected to include micro-organisms and may consist of them exclusively. It is essential that all space probes sent to Mars be certified as sterile. International cooperation in exobiology is said to offer major scientific advantages and should be more easily achieved than in any other area of space research or exploration in which both US and USSR programs are involved. It is considered that there is urgency in being prepared to launch a space probe to Mars at the most propitious opportunity, which will come in 1969. That would make possible Martian surface sampling during the spring and summer when the best chance of detecting the proliferation of plant-like organisms would be expected. (F.R.L.)

## 262

ASYMMETRIC SYNTHESIS OF α-AMINO-ACIDS BY THE STRECKER SYNTHESIS.

Kaoru Harada (Florida State U., Tallahassee)

*Nature*, Vol. 200, Dec. 21, 1963. p. 1201.
(NASA Grant NsG–173–62)
(A64–13306)

A brief description of the asymmetric synthesis of L-analine is given. The general method of asymmetrically synthesizing α-amino acids in solution involves (1) the reaction of an aldehyde with hydrogen cyanide and D-(—)-α-methylbenzylamine in methanol, (2) the hydrolysis of the resulting amino nitrile to the N-(α-methylbenzyl) amino acid, and (3) catalytic hydrogenolysis to remove the methylbenzyl group. The production of 0.68 gram of pure N-(α-methylbenzyl) analine, and subsequent hydrogenolysis to 95% optically active L-analine, is outlined.

## 263

UPPER TEMPERATURE LIMIT OF LIFE.

E. S. Kempner

*Science*, 142:3597, Dec. 6, 1963. p. 1318–1319.
7 refs.

Possibilities for life in the universe are discussed. Thermonuclear reactions in the deep interior of the stars produce necessary elements for life and the energy for this process. It is concluded that without this energy released by the hydrogen chain in the sun, life on earth would be impossible. (S.T.L.)

## 264

USE OF GAS CHROMATOGRAPHY FOR THE DETECTION OF LIFE ON MARS.

Vance I. Oyama (NASA, Ames Research Center, Exobiology Div., Life Detection Systems Branch, Moffett Field, Calif.).

*Nature*, Vol. 200, Dec. 14, 1963. p. 1058–1059.
(NASA Contract NAS–7–100.)
(A64–13439)

Investigation which confirms, in part, the premise on which the technique of gas chromatography as applied to the identification of pyrolysis products of biological materials for life detection on Mars. This premise is based on the fact that terrestrial life is an aggregate of carbonaceous macromolecular structures as well as a lesser mass of monomeric organic substances. In the investigation, the simple technique of thermal degradation is applied to the analyses of chemical structure, using freshly isolated, but unidentified, micro-organisms grown in trypticase soy broth under aerobic conditions at 30° C.

## 265

**METEORITES AND MICROORGANISMS (METEORITY I MIKRO-ORGANIZMY).**

A. A. Yavnel'

*Priroda (Nature)*, No. 12, Dec. 1963. p. 92. ref.

(In Russian)

A critique is presented of an article by F. Yu. Zigel ("Life on Planets," *Znaniye i Sila*, No. 7, 1963). Opinions expressed by Zigel regarding the origin and composition of meteorites are erroneous. His assumption that the micro-organisms found in meteorites are remnants of organic life which existed on the hypothetical planet Phaeton is unfounded and misleading. (J.P.L.)

## 266

**BACTERIA UNDER SIMULATED MARTIAN CONDITIONS.**

Richard S. Young (NASA, Ames Research Center, Biochemical Evolution Branch, Moffett Field, Calif.).

*Space World*, Vol. A–2, Nov.–Dec. 1963. p. 36–39.

(A64–18258)

Discussion of a new technique for the simulation of known parameters of the Martian environment, along with possible biological implications. The response of bacteria to such simulation is demonstrated in terms of survival and growth, showing that certain bacteria will not only survive, but grow during simulated Martian freeze-thaw cycling if water is present. How water could be present on Mars although not detectable with current technology is demonstrated, and plans for future experimentation are discussed.

## 267

**AMES STUDY SUPPORTS MARS LIFE THEORY.**

H. D. Watkins

*Aviation Wk., Space Technol.*, 75:21, Nov. 18, 1963. p. 61, 65, 66, 71.

Work on the Martian environment at the Exobiology Division at the National Aeronautics and Space Administration's Ames Research Center has shown that under temperature conditions approximating those believed to exist on Mars, certain earth organisms not only survive, but will grow. (Author)

## 268

**ULTRA-VIOLET SPECTRA OF ORGANIZED ELEMENTS.**

B. Nagy, K. Fredriksson, J. Kudynowski and L. Carlson

*Nature* (London), 200:4906, Nov. 9, 1963. p. 565–566. 4 refs.

Ultraviolet absorption spectra of the acid-insoluble residues of individual "organized elements" of the Orgueil meteorite are reported. (A.H.F.)

## 269

**BIOLOGICAL CONTAMINATION OF MARS II. COLD AND ARIDITY AS CONSTRAINTS ON THE SURVIVAL OF TERRESTRIAL MICRO-ORGANISMS IN SIMULATED MARTIAN ENVIRONMENTS.**

E. Packer, S. Scher (California U., Berkeley Space Sciences Lab.) and C. Sagan (Harvard Coll. Obs.) *Icarus* 2:4, Nov. 1963. p. 293–316. refs.

(NASA Grant NsG–126–61)

(N64–19583)

Terrestrial micro-organisms were collected from a variety of environments, including regions of high alkalinity, low mean daily temperature, and low annual rainfall. The air-dried soils were then subjected in the presence of a desiccant to a simulated Martian environment involving 12-hour freeze-thaw cycles from about $-60°$ C to about $+20°$ C; atmospheres of 95% nitrogen, 5% carbon dioxide, and low moisture content: $\leq 0.1$ atm pressure; and a total ultraviolet dose at 2.537 A of $10^9$ erg $cm^{-2}$. Survivors were scored on supplemented agar. Preliminary results indicate a wide variety of survivors including obligate and facultative anaerobic spore-formers and nonspore-forming facultative anaerobic bacteria. Diurnal freezing and thawing were continued for 6 months. There was no significant loss of viability after the first freeze-thaw cycle. (Author)

## 270

**HYDROCARBONS IN TERRESTRIAL SAMPLES AND THE ORGUEIL METEORITE.**

W. G. Meinschein

*Space Sci. Revs.*, 2:5, Nov. 1963. p. 653–679. 79 refs.

Meteorites contain extraterrestrial carbonaceous materials. The Alais, Orgueil, Tonk, and Ivuna meteorites resemble in their carbon, free sulfur, and non-metamorphosed mineral contents, densities, and general appearances certain organic-rich terrestrial sediments. Structural and isotopic determinations of carbon compounds in the Orgueil chondrite indicate that these compounds are primarily indigenous. Physically and chemically the benzene extractable carbonaceous materials from the Orgueil and certain near surface terrestrial sediments are similar. Mass spectrometric type analyses of the alkanes from an Orgueil fragment, terrestrial sediments and organisms are statistically indistinguishable at the 95% confidence level. Theoretical considerations and experimental data are presented, and these permit an assessment of the potential and reliability of hydrocarbons as biologic indicators. Based on the production and preservation of organic substances in terrestrial environments, alkanes in the Alais, Orgueil, Tonk, and Ivuna (Type I) carbonaceous chondrites could retain the best evidence of organisms that may have lived on a parent body of meteorites. (Author)

## 271

LIFE IN THE UNIVERSE.

A. E. Slater

*Spaceflight* (London), 5:6, Nov. 1963. p. 198–201.

(A64–11388)

Factors associated with the existence of life elsewhere in the universe are briefly discussed. Considered are the fundamental characteristics of living processes, which involve energy transfers; the origin and development of life; the activities of DNA and RNA molecules; and possible evidence of extraterrestrial life—e.g., changes of color on the Martian surface.

## 272

THE ORIGINS OF PREBIOLOGICAL SYSTEMS AND OF THEIR MOLECULAR MATRICES.

Proc. of a Conf. at Wakulla Springs, Fla., Oct. 27–30, 1963, sponsored by NASA and Fla. State U.

Sidney W. Fox, ed. (Fla. State U. and Univ. of Miami) Introduction by Freeman H. Quimby (NASA Bioscience Programs, Exobiology) N.Y., Academic Press, 1965. 482 p.

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## 273

EVIDENCE FOR LIFE ON MARS.

D. G. Rea

*Nature*, 200:4902, Oct. 12, 1963. p. 114–116.

(NASA Grant NsG–101–61)

(N64–14741)

Observations are presented to illustrate the point that the evidence in support of the chance for the existence of life on Mars has been distorted and that a reexamination is required. The observational arguments for the existence of Martian life are the various colors, including green, exhibited by the dark areas, the seasonal changes in the visual albedo and the polarization of the dark areas; the ability of the dark areas to regenerate after an extensive dust storm; and the presence of 2700 to 3000 $cm^{-1}$ absorption bands, attributed to organic molecules. Aspects of Mars are given that defy the existence of life, and include the severity of the Martian climate. (C.L.W.)

## 274

STUDIES OF PARTICLES FOR EXTRATERRESTRIAL ORIGIN. I—CHEMICAL ANALYSES OF 118 PARTICLES.

Frances W. Wright and Paul W. Hodge (Smithsonian Astrophys. Obs., Cambridge, Mass.) and Chester C. Langway, Jr., (U.S. Army, Cold Regions Res. & Eng. Lab., Hanover, N.H.)

*J. Geophys. Res.*, Vol. 68, Oct. 1, 1963. p. 5575–5587. 30 refs.

(A63–23377)

The chemical and physical properties of dust particles of extraterrestrial origin were determined by electron-beam microanalyzer technique. These samples were collected in a wide variety of geographical locations, including the stratosphere, 750-year-old Greenland ice, 55-year-old antarctic ice, the antarctic atmosphere, a New Mexico mountaintop, glacial ice caves, and the place of fall of the Siberian Sikhote-Alin meteorite shower. The Fe/Ni ratios of five particles point undoubtedly to their meteoritic origin. From their high Fe/Si ratio some 35 others are thought to be extraterrestrial. A few objects are identified from their compositions as being of obvious terrestrial origin. The influx of cosmic dust onto the Earth's surface is computed to be more than $10^5$ tons per year.

## 275

ECOLOGICAL NECESSITY FOR SPACE EXPLORATION (NECESIDAD ECOLOGICA DE LA EXPLORACION DEL ESPACIO).

Luis Rodolfo Tello.

*Revista Nacional Aeronáutica y Espacial,* Vol. 23, Oct. 1963. p. 20–21.

(In Spanish)

(A64–13921)

Some reasons justifying space exploration are discussed. One objective is that of establishing contact with possible forms of extraterrestrial life. A brief investigation is made of the future energetic possibilities of the Sun, which makes life on Earth possible, and the phenomenon of solar decadence is examined. It is noted that the Sun, by a process of atomic fusion, transforms each second over 500 million tons of hydrogen into helium, of which only the 1/125th part is converted into energy radiated into space in nearly the entire extension of the spectrum. The Sun is likened to a celestial bonfire fed with its own fuel; this self-consumption reaches a value of 4 million tons of hydrogen of the solar mass per second. It is stated that this solar decadence constitutes a definite scientific and logical reason for initiating a systematic search for inhabitable extraterrestrial environments.

## 276

EFFECT OF DIURNAL FREEZE-THAWING ON SURVIVAL AND GROWTH OF SELECTED BACTERIA.

R. S. Young, P. Deal, J. Bell and J. L. Allen

*Nature,* 199:4898, Sep. 14, 1963. p. 1078–1079.

(A63–24113)

Experimental investigations are reviewed which demonstrate the ability of some organisms to survive and grow well under freeze-thaw cycles which are typical of day-night conditions in summer at the equator of the planet Mars. Martian conditions were simulated in terms of temperature extremes and time cycling. The temperature was cycled so that the organisms had only about 4.5 hr during which the temperature was above 0° C, with a maximum of 25° C. The remainder of the time was spent in a dry ice chamber at — 75° C. It was assumed that water is present on Mars, perhaps in some microenvironments.

## 277

EXTRATERRESTRIAL LIFE.

*Priroda* (Moscow), No. 2, 1963. 20 p. Transl. of two articles into English by JPRS, Sept. 11, 1963.

(JPRS–21026; OTS–63–3173b) OTS: $0.50

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1: Life In The Universe. A. I. Oparin p. 1–10 (See 290)

2: Mars And Organic Life. V. G. Fesenkov p. 11–17 (See 291)

## 278

LIFE IN THE UNIVERSE.

A. I. Oparin

*Priroda* (Moscow), No. 2, 1963. Transl. into English by JPRS, Sept. 11, 1963.

(JPRS–21026; OTS–63–3173B; N63–21489)

Three stages in the evolution of organic compounds—(1) the emergence of primitive organic compounds. (2) complication of these compounds which is linked with successive increase in their molecular size by polymerization and condensation of organic matter, and (3) formation in the terrestrial hydrosphere of high molecular-weight systems—are discussed. The principle of uniform development of matter allows an unambiguous solution to the problem of the spread of life in the universe. It cannot be said that earth is the only terrestrial body inhabited by life, since life must regularly emerge and develop on other heavenly bodies when the necessary conditions are established for life. Although the pathways of evolution of life are extremely diverse, it can be anticipated that, somewhere in the universe, living creatures capable of thought thrive. (P.V.E.)

## 279

MARS AND ORGANIC LIFE.

V. G. Fesenkov

*Priroda* (Moscow), No. 2, 1963. p. 11–17. Transl. into English by JPRS, Sept. 11, 1963.

(JPRS–21026; OTS–63–3173B; N63–21489)

Arguments for and against the existence of life on Mars are presented. The author feels that the existence on Mars of lower forms of life such as primitive algae and bacteria must not be taken as precluded. This does not contradict observed evidence of plants. However, higher forms of vegetation and animal life in all probability do not exist on the planet.

In the search for life on other planets and in outer space it must be decided which microbes are to be sought first. Controversy on which is earlier, auto- or heterotrophy, lost significance when the possibility of obtaining various organic substances abiogenically from simple compounds under the influence of such physical factors as electrical discharges and others was proved. The majority of biologists believe that heterotrophic bacteria, if not the first kind of life, in any case occurred before the autotrophs. Therefore, a search for micro-organisms on other planets should be begun with attempts to detect heterotrophic bacteria by creating in the instruments sent up conditions for the reproduction of as large a number as possible of species which utilize organic matter.

The second stage should be connected with a search for chemoautotrophic micro-organisms which oxidize hydrogen, methane, ammonia, sulfur, iron and others, because, according to existing data, these elements and compounds are quite frequently encountered in considerable quantities on various planets.

The third stage will consist of a search for photosynthesizing bacteria which carry out anaerobic photosynthesis. The absence of oxygen in the presence of carbon dioxide as well as water in the atmosphere of certain planets make the reproduction of these bacteria on the planets very likely.

Methods for detecting life, such as nephelometry and manometry are discussed. Investigations with simulated space environments are also reviewed.

## 280

**INTERPRETATION OF THE 3- to 4- MICRON INFRARED SPECTRUM OF MARS.**

D. G. Rea, T. Belsky and M. Calvin (Univ. of Calif., Berkeley)
*Science*, 141:3584, Sept. 6, 1963. p. 923–927.
(NASA Grant NsG–101–61)
(A63–21699)

IR reflection spectra recorded for a large number of inorganic and organic samples, including minerals and biological specimens are evaluated for the purpose of interpreting the 3-$\mu$ to 4-$\mu$ spectrum on Mars. A previous suggestion that the Martian bands indicated the presence of carbohydrates is shown not to be a required conclusion. However, no satisfactory explanation is advanced and the problem remains unresolved.

## 281

**DETECTING EXTRATERRESTRIAL LIFE.**

W. G. Meinschein
*Ind. Res.*, 5:8, Sept. 1963. p. 20–24.
(N63–23597)

Current methods for the detection of residues of extinct life in meteorites are discussed with particular reference to the investigation of the carbon compounds in chondrites. The inadequacy of available analytical instruments to precisely characterize and identify the carbon compounds found in meteorite fractions is noted. Comparisons of the infrared spectra of (1) crude oil, benzene extractable fractions of recent and ancient marine sediments, and the Orgueil meteorite; and (2) silica gel chromatographic fractions of the Orgueil meteorite benzene extracts. Considerable similarity is found between aromatic hydrocarbons from the Orgueil meteorite and recent marine sediments, suggesting that life existed centuries ago in a meteoritic parent body. (Star)

## 282

**LUNAR GAS CHROMATOGRAPH.**

W. F. Wilhite and M. R. Burnell
*ISAJ*, 10:9, Sept. 1963, p. 53–59. refs.

The Surveyor project gas chromatograph is described. An analysis of the data from this lunar chromatograph might determine the state of chemical equilibrium on the moon. Knowledge of the relative distribution of certain biologically important organic compounds might indicate the biologic history, if any, of the moon. This history might provide clues to the origin of life on earth. (S.T.L.)

## 283

**SPACE AND LIFE (KOSMOS I ZHIZN').**

A. A. Imshenetskiy
*Vestn. Akad. Nauk S.S.S.R.*, Vol. 33, Sept. 1963. p. 23–29.
(In Russian)
(A64–12279)

The theoretical background underlying exobiological investigations based on the use of automatic devices is surveyed. The suitability of a biological analysis of meteorites to the investigation of the vertical distribution of life (bacteria) in space, and the discovery of life on other planets are examined. Noted are laboratory results which indicate that solar radiation need not necessarily extinguish all life in cosmic space.

## 284

**ALLEGED BIOGENOUS SUBSTANCES IN METEORITES. (ANGEBLICH BIOGENE STOFFE IN METEORITEN).**

Kark Krejci-Graf (Frankfurt a. M.)
*Naturwiss.* (Berlin), 50:16, Aug. 1963. p. 539–541. 52 refs.
(In German)

Reports of various organic compounds found in meteorites are reviewed with respect to their alleged biological origin, *i.e.* the possibility of extraterrestrial life. Convincing arguments are presented for a nonorganic origin. Structural configurations within the meteorites cited often in support of extraterrestrial life are refuted similarly. The hygroscopic property of the meteorites renders them susceptible to decay as a result of the exposure to air and humidity. Thus the alleged organic structures could have arisen partly from contaminants or represent inorganic monoliths. (J.P.L.)

## 285

**HYPERSONIC CHEMOSYNTHESIS AND POSSIBLE FORMATION OF ORGANIC COMPOUNDS FROM IMPACT OF METEORITES ON WATER.**

A. R. Hochstim
Proc. Natl. Acad. Sci. U. S., 50:2, Aug. 1963. p. 200–208. 35 refs.

A new theory of formation of organic compounds by meteoritic impact on water is further developed in this paper. A new experiment is suggested and various implications of this theory are discussed. New methods of synthesizing a variety of complex chemical compounds are proposed. It is believed that an interplanetary vehicle sent to a planet on a crash landing may, on impact, produce complex chemical compounds which need to be discounted when searching for a sign of life afterwards in the vicinity of the impact. (Author)

## 286

**IS THERE LIFE ON MARS?**

Leonard H. Bongers (Martin-Marietta Corp., Martin Co., Space Systems Div., Baltimore, Md.)
*Space/Aeron.*, Vol. 40, Aug. 1963. p. 86–88.
(A63–23009)

Brief discussion of the forms of life which might be expected to be found on Mars, and of the sampling methods which could be used, from unmanned Mars vehicles, to establish the existence of these life forms. The possibility of life on Mars is discussed in terms of the Martian atmosphere and in terms of the hypothesis that the Martian surface markings are caused by vegetation. Among the possible sampling methods briefly described is the Gulliver system, which would detect the metabolic activity of Martian biota by measuring the radioactive carbon dioxide formed by organisms taken from the Martian surface and placed into a $C^{14}$-labeled nutrient broth.

## 287

**SOLAR SYSTEM SCIENCE: 1962 LITERATURE SURVEY. II.**
Edna O'Connell (RAND Corp., Santa Monica, Calif.)
*Icarus*, Vol. 2, Aug. 1963. p. 187–205
(NASA–USAF Supported Research)
(A63–23644)

Bibliography of 422 references, compiled from nine journals, concerning investigations of the solar system. Categories of literature listed are atmospheric physics; cosmogony; interplanetary physics; planetary biology, geodesy, geology, and physics; solar physics; solar-system dynamics; and solar-terrestrial relations.

## 288

**SYNTHESIS OF ADENOSINE TRIPHOSPHATE UNDER POSSIBLE PRIMITIVE EARTH CONDITIONS.**
C. Ponnamperuma, C. Sagan and R. Mariner
*Nature* (London), 199:4890, July 20, 1963. p. 222–226. 40 refs.

The results of an attempt to synthesize nucleoside phosphates by ultraviolet irradiation of dilute solutions of purine or pyrimidine bases, pentose sugars, and phosphorus compounds is reported. It is believed such syntheses were easily performed under primitive Earth conditions, and ultraviolet irradiation of dilute solutions of adenine and ribose has already produced the nucleoside adenosine. (Author)

## 289

**SYNTHESIS OF COMPLEX ORGANIC COMPOUNDS FROM SIMPLE PRECURSORS: FORMATION OF AMINO ACIDS, AMINO ACID POLYMERS, FATTY ACIDS AND PURINES FROM AMMONIUM CYANIDE.**
C. V. Lowe, M. W. Rees and R. Markham
*Nature* (London), 199:4890, July 20, 1963. p. 219–222. 22 refs.

Using a variety of methods, products formed when hydrocyanic acid reacts with aqueous ammonia at 90° for 10 hours were examined. Principal products along with adenine, glycine, alanine and aspartic acid were complex substances containing amino acids and unidentified compounds in a bound form which can be released by either acid or alkaline hydrolysis. After hydrolysis at least 75 ninhydrin reacting compounds appeared.

Observations indicate that heating aqueous ammonium cyanide produces a variety of ninhydrin reacting compounds as well as polymers containing these compounds. It is probable that the amino acids are a racemic mixture, since preliminary observations have failed to demonstrate optical activity. The experiments provide evidence for a consistent, if not exclusive, for primitive Earth synthesis of complex organic substances and macromolecules. A major problem on the primitive Earth concerns persistence of the original organisms. Not only was it necessary for survival and multiplication. If at any period in recent cosmic time appreciable quantities of ammonium cyanide existed in the Earth's atmosphere, it is obvious that there would have been ample supplies of organic components which would fulfill these functions. (Author)

## 290

**AUTOMATED LIFE DETECTION DEVICES.**
M. H. Briggs
*Spaceflight*, 5:4, July 1963. p. 128–133. 26 refs.

Current research in exobiology centers on two themes: (1) investigation of carbonaceous chondrites to determine whether these objects contain indigenous biological remains and (2) attempts at the detection of life on other members of our solar system. A brief summary of current results concerning the possible presence of life on other planets as derived from astronomical techniques is given. Automated life-detection devices to be used prior to manned exploration are discussed in detail. (S.T.L.)

## 291

**ORGANIC COMPOUNDS IN STONY METEORITES.**
I. R. Kaplan, T. T. Degens and J. H. Reuter
*Geochim. et Cosmochim. Acta*, 27:7, July 1963. p. 805–834. 46 refs.

Seven carbonaceous chondrites (Orgueil, Cold Bokkeveld, Mighei, Murray, Felix, Lance and Warrenton), five noncarbonaceous chondrites (Richardton, Bjurbole, Karoonda, Abee and Hvittis) and one achondrite (Norton County) were examined for organic constituents. Hydrocarbon-type organic matter was extracted from the samples with organic solvents (benzene-acetone and acetone-methanol) and studied by ultraviolet, visible and infrared absorption spectroscopy and by nuclear magnetic resonance spectroscopy. Both aliphatic and aromatic compounds were detected; in addition carbonyl groups appeared to be present as well as unsaturated groups of the vinyl or allylic type. The extractions also separated elemental sulphur in Orgueil, Cold Bokkeveld, Mighei and Richardton. Amino acids and sugars were encountered in all the meteorites studied. Chondrules were isolated from Mokoia, Bjurbole and Richardton; sugars were present and glycine was the only water-soluble amino acid found. In the acid hydrolyzate, alanine, serine, threonine, the leucines, glutamic acid and aspartic acid were also present. Acid hydrolyzates of carbonaceous chondrites contained 16 diazonium-sensitive compounds. In addition, fifteen unidentified, ultraviolet-absorbing and fluorescing compounds appeared on the chromatogram. No optical rotation could be detected in any of the extracts. The absence of rotation, the type and distribution pattern of amino compounds in chondrules and matrix, the lack of pigments, fatty acids and presumably nucleic acids, in addition to other biochemical criteria, suggest that the organic material has been synthesized by chemical rather than known biochemical processes. (Author)

## 292

**BENZENE EXTRACTS OF THE ORGUEIL METEORITE.**
W. G. Meinschein (Esso Res. and Eng. Co., Linden, N. J.)
*N. Y. Acad. Sci. Ann.*, 108:2, June 29, 1963. p. 553–579.

Chromatographic and spectroscopic analyses were made of benzene extracts of the hydrocarbon and organic nonhydrocarbon constituents of the Orgueil meteorite. Results indicate

that the constituents of this meteorite resemble those of some terrestrial sediments. IR- and UV-absorption spectra indicate that the benzene extracts of these fragments are not significantly contaminated by terrestrial organic matter. Also, it is indicated that mass spectroscopic analyses of alkanes that are extracted from Orgueil meteorite fragments, terrestrial sediments, and from living organisms are similar. (I.v.L.)

## 293

**ENVIRONMENTAL BIOPHYSICS AND MICROBIAL UBIQUITY.**
J. R. Vallentyne (Cornell U., Dept. of Zool., Ithaca, N. Y.)
*N. Y. Acad. of Sci. Ann.*, Vol. 108, June 29, 1963. p. 342–352. 57 refs.
(A64–81080)

The geocentric point of view limits the possibility of extraterrestrial life to conditions which are necessary for maintaining life on earth. Two assumptions seem to be involved: (1) complete knowledge of environmental limits beyond which life is impossible and (2) these geoenvironmental limits are not exceeded on a cosmic scale. Studies of micro-organism ecology show great variations of temperature, from —18° to 104° C. The range of environmental potentials varies from 850 mv. to —450 mv. The mean hydrogen concentration ranges between pH 1.0 and pH 10.2. Salinity tolerance may be as high as 25% NaCl. The range of hydrostatic pressure observed can be 0.1 atm. and reach 1400 atm. Water is the most important factor in the life process, yet micro-organisms can survive in a dehydrated state. There are various other factors, such as ionizing radiation, ultraviolet light, and partial pressure of various gases and of many chemical compounds, which may enhance or destroy growth and reproduction. As shown from the material presented, the degree of adaptability of living organisms is enormous. The question seems to be not so such one of adaptability of the living organism, as one concerning the origin of life itself.

## 294

**OBSERVATIONS ON THE NATURE OF THE "ORGANIZED ELEMENTS" IN CARBONACEOUS CHONDRITES.**
Frank W. Fitch (University of Chicago, Dept. of Pathology, Chicago, Ill.) and Edward Anders (University of Chicago, Enrico Fermi Institute for Nuclear Studies, Dept. of Chemistry and Geophysical Sciences, Chicago, Ill.).
*N. Y. Acad. of Sci., Ann.*, Vol. 108, Art. 2, June 29, 1963. p. 495–513. 21 refs.
(AEC-supported research.)
(A63–21215)

Experimental study of previous observations and composition of the organized elements. Properties of the elements are tabulated. The organized elements are classified into two types, those that have a highly structured morphology and those that have a much simpler appearance. The particles with highly structured morphology are less numerous than those of the simpler type and have not been seen in thin sections; many appear to have a strong resemblance to common terrestrial contaminants. Apparently of inorganic composition and origin are the particles of simple morphology which do not fluoresce, which either do not stain or stain atypically with biological stains, and which are soluble in acids. It is possible that life did exist in meteorites, but it is noted that the present evidence is inadequate to suggest an extraterrestrial biological origin for the particles found in the carbonaceous chondrites.

## 295

**ON THE ORIGIN OF CARBONACEOUS CHONDRITES.**
Edward Anders (U. of Chicago)
*N. Y. Acad. Sci., Ann.*, 108:2, Jun. 29, 1963. p. 514–533. 69 refs.
AEC-supported research
(A63–21216)

Study of theories and hypotheses concerning the origin of carbonaceous chondrites. The chondrites seem to have been produced by the action of liquid water on a more primitive source material, as implied by their mineralogy. Their high content of chalcophile trace elements and primordial noble gases suggests a source material more primitive than ordinary chondrites, yet the presence of high-temperature minerals implies that this source material passed through at least one high-temperature stage. The exposure to liquid water could have occurred in subsurface regions of an asteroid heated by extinct radioactivity or another internal energy source. It is noted that sunlight for photosynthesis would not reach these regions, but an appreciable amount of free energy would be available from the conversion of olivine to hydrated silicates. Although this source of energy is finite, it may have served as the basis for the evolution of a nonphotosynthetic life form. None of the isotopic data suggest the presence of life, however. Both the carbon and hydrocarbon data are inconclusive, since the degree of resemblance to biogenic hydrocarbons and the ability of nature to produce such a hydrocarbon distribution by purely abiotic reactions are open to dispute.

## 296

**PLANTS AT SUBATMOSPHERIC OXYGEN LEVELS.**
S. M. Siegel, L. A. Rosen and C. Giumarro
*Nature* (London), 198:4887, June 29, 1963. p. 1288–1290. 17 refs.

The continued investigation of low-oxygen environments has now disclosed a number of additional examples of favorable biological performances at subatmospheric oxygen levels. These experiments raise to 30 the number of species which have been examined for response to low-oxygen environments. Although it is a small sample of the vascular plants, the recurrence of good or even heightened performance attests to the importance of oxygen concentration as a significant variable in physiological and ecological research. (Author)

## 297

**STUDIES IN EXPERIMENTAL ORGANIC COSMOCHEMISTRY.**
J. Oro (Houston U.)
*N. Y. Acad. Sci. Ann.*, 108:2, June 29, 1963. p. 464–481. 182 refs.
(NASA Grant NsG–257 and NSF Grant G–13117)
(A63–21212)

The distribution of carbon compounds in the universe and related problems are investigated. Processes of organic synthesis

which may have occurred in the primitive Earth atmosphere, or which may occur in cosmic bodies such as comets, have been produced in the laboratory by the methods of electric discharges, UV light, and ionizing radiation. The tests warrant the statement that, if the Earth protoplanet had some of the simple organic constituents of comets, a large number of biochemical compounds would have been spontaneously synthesized during the development of this cosmic body. It is noted that space probes will confirm whether the more complex biochemical compounds described are present in cosmic bodies other than the Earth.

## 298

FORMATION OF ADENOSINE BY ULTRAVIOLET IRRADIATION OF A SOLUTION OF ADENINE AND RIBOSE.

C. Ponnamperuma, R. Mariner and C. Sagan

*Nature* (London), 198:4886, June 22, 1963. p. 1199–1200. 26 refs.

The possibility of synthesizing the nucleoside adenosine by ultraviolet irradiation of an aqueous solution of adenine and ribose is investigated. Experimental procedures are presented and preliminary results reported. (Authors)

## 299

MERCURY MISSIONS SEEN MORE USEFUL THAN MARS, VENUS PROBES.

D. M. Cole

*Missiles and Rockets*, 12:25, June 24, 1963. p. 37–38.

Mercury's dark side may represent the greatest storehouse of light elements in the solar system outside of Earth. The planet's environment is a good description of a prebiotic environment (atmosphere, solar energy, liquid water, moderate temperature), and could harbor an encapsulated, closed-cycle, symbiotic form of life. (S.T.L.)

## 300

PLANS FOR SEEKING LIFE ON MARS.

A. Croome

*New Scientist*, 18:344, June 20, 1963. p. 649–650.

Sterilization techniques and effectiveness for instrument carrying space vehicles are discussed. Two prototype microorganism detectors are described, as well as a Mars biological sampler now in production. (S.T.L.)

## 301

METALAW—REASSESSMENT IN THE LIGHT OF CERTAIN VIEWS EXPRESSED BY THE CHIEF JUSTICE OF THE UNITED STATES.

Andrew G. Haley (Haley, Bader and Potts, Washington, D. C.).

American Institute of Aeronautics and Astronautics, Summer Meeting, Los Angeles, Calif., June 17–20, 1963. 11 p. Members, $0.50; nonmembers, $1.00

(A63–18883)

General discussion of the principles and possible approaches to metalaw—the law which would be applicable to intelligent life on other planets. Emphasized is the fact that we cannot project our laws on other life forms. It is pointed out that, although it is impossible at this time to formulate detailed applications of metalaw, it is desirable to make certain assumptions in advance as to the nature of the extraterrestrial beings with whom space exploration may bring us in contact.

## 302

ORGANIZED ELEMENTS: POSSIBLE IDENTIFICATION IN ORGUEIL METEORITE.

Frank W. Fitch and Edward Anders (U. of Chicago)

*Science*, (Washington), 140:3571, June 7, 1963. p. 1097–1100. 11 refs.

Pollen of six species of false ragweed and ragweed were prepared and stained by the Gridley method (chromic acid followed by Schiff's reagent and aldehyde fuchsinmetanil yellow staining). Upon distortion by this method the pollen grains showed a definite resemblance in size, color, and morphology to the Orgueil meteorite preparation in which the original type-5 organized element was found. This element definitely was stained with the Gridley method. It is not now possible to say that this type of organized element is completely different from known terrestrial life forms. (Author)

## 303

LIFE ON OTHER PLANETS.

Sam Barnes

*Machine Design*, Vol. 35, June 6, 1963. p. 118–123.

(A63–20442)

Survey of current programs directed to the development of machines for detecting life on the planets, with Mars as the primary object. The following instruments are described: (1) a gas chromatograph designed for the Surveyor spacecraft, capable of performing 21 separate analyses, and its adaptation to the Mars mission; (2) a "Wolf trap" life-detecting machine, which uses a general-purpose culture medium (of yeast extract, or yeast extract plus glucose) to nourish alien cultures, while pH meters and photometers monitor the growth changes; (3) a paper chromatograph, capable of performing a complete organic and inorganic analysis of the soil; and (4) a life-detecting device, termed "Gulliver," based on the principle that animal life gives off $CO_2$ in metabolism.

## 304

BACTERIA UNDER SIMULATED MARTIAN CONDITIONS.

R. S. Young, P. H. Deal, J. Bell and J. L. Allen (NASA, Ames Research Center, Moffett Field, Calif.).

Presented at COSPAR, International Space Science Symposium, (4th), Warsaw, Poland, June 3–11, 1963. 11 p.

(A63–18972; A64–24948)

Discussion of a new technique for simulation of known parameters of the Martian environment. The response of bacteria to such simulation is demonstrated in terms of survival and growth, showing that certain bacteria not only will survive, but will grow during simulated Martian freeze-thaw cycling if water is present. This contradicts the usual assumption that the likelihood of contamination of Mars by Earth organisms is slight.

It is shown that water may be present on Mars, although it may not be detectable by current technology.

## 305

THE DESIGN OF MARTIAN BIOLOGICAL EXPERIMENTS.
N. H. Horowitz (California Inst. of Technology, Pasadena)
Presented at COSPAR, International Space Science Symposium (4th), Warsaw, Poland, June 3–11, 1963. 5 p. 14 refs.
(A63–18924)

Consideration of the biochemical characteristics of the life that would be found on Mars, in order to develop correct criteria in planning Martian biological experiments. It is assumed by the Gulliver and similar experiments designed to detect metabolism on Mars that, if life exists there, it is carbonaceous. This assumption is analyzed in terms of the uniqueness of the carbon atom, the uniformity of chemical composition in terrestrial life forms, and the mechanism of protein synthesis. The hypothesis that life in the universe has a common origin is briefly discussed. It is concluded that Martian life is likely to be similar, but not necessarily identical, to terrestrial life in chemical composition. This follows from the assumption that the primitive Martian atmosphere resembled that of the primitive Earth, that similar chemical reactions occurred in it, and that Martian life, like terrestrial life, was formed from the compounds available.

## 306

EFFECT OF ULTRAVIOLET RADIATION ON MICRO-ORGANISMS AS A PRINCIPAL EXTREMAL FACTOR OF SPACE ENVIRONMENT.
R. I. Fedorova (Acad. of Sci., Inst. of Microbiology, Moscow, USSR).
*In:* M. Florkin and A. Dollfus, eds. Life Sciences and Space Research II; International Space Science Symposium (4th), Warsaw, Poland, June 3–12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964. p. 305–310.
(A64–24973)

Discussion of the problem of the transport of viable germs through interplanetary space as related to the sterilization of spaceships. The following considerations are made: (1) Of all cosmic extremal factors, UV solar radiation is the most dangerous for micro-organisms. The intensity of the most bactericidal region of UV radiation at a distance of 1 astronomical unit from the Sun is $2 \times 10^5$ erg/cm$^2$. (2) The sensitivity of micro-organisms to UV rays varies in a large range. For the most resistant forms, the lethal dose is approximately 440 000 erg/cm$^2$. (3) The penetrating capacity of UV radiation is very low, and therefore, even insignificant amounts of organic or mineral substances may protect the bacterial cell. (4) Dust particles of terrestrial origin carrying on themselves bacterial spores exert upon the latter a protective effect against UV radiation.

## 307

EXOBIOLOGY—A CRITICAL REVIEW.
Carl Sagan (Harvard University; Smithsonian Institution, Smithsonian Astrophysical Observatory, Cambridge, Mass.).
*In:* M. Florkin and A. Dollfus, eds. Life Sciences and Space Research II; International Space Science Symposium (4th), Warsaw, Poland, June 3–12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 35–53. 63 refs.
(A64–24944)

Discussion of the possibility of existence of extraterrestrial life. The subjects considered include the origin of life, the likelihood of living systems in contemporary extraterrestrial environments, direct evidence of extraterrestrial life, and additional references. It is concluded that the issues on the existence of exobiologic life are largely unresolved, and that, perhaps, a definitive resolution will not be obtained until spacecraft are landed on the Martian surface. Experimental design of automatic instrumented biological landing packages is already under way.

## 308

EXPLORATION OF THE STRATOSPHERE FOR VIABLE MICRO-ORGANISMS.
V. W. Greene
*In:* Intern. Space Sci. Symp. (4th), Warsaw, 1963. 33 p. 7 refs.

Two balloon-borne flights to 19.8 km and 27.1 km were conducted in 1962 to sample air volumetrically through filters and to determine the existence and identity of viable micro-organisms in the stratosphere. Although a variety of bacteria, yeasts, and molds were recovered from filters exposed at high altitudes, malfunctions of the mechanical equipment and sterile controls limit the conclusions that can be drawn from these experiments. The feasibility of this type of exploration, and the precautions which must be taken are discussed. (Author)

## 309

EXPOSURE OF MICROORGANISMS TO SIMULATED EXTRATERRESTRIAL SPACE ECOLOGY.
G. S. Silverman, N. S. Davis and W. H. Keller
*In:* Intern. Space Sci. Symp. (4th), Warsaw, Jun. 3–12, 1963. 25 p., 12 refs.
(N63–21109)

The viability of spores of 5 test organisms (B. megaterium, B. subtilis var. niger, B. stearothermophilus, Clostridium sprogenes, and A. niger) after exposure to a wide range of temperatures, or to gamma radiation, while under ultrahigh vacuum was in-

vestigated. Appreciable percentages of all the test organisms were viable after exposure to temperature up to and including 60° C, and a small portion of the exposed spores were still viable after exposure to 107° C but not to 120° C. With the execption of B. subtilis var. niger, ultrahigh vacuum appeared to protect the spores, especially A. niger, subjected to prolonged exposure to elevated temperatures in the vicinity of 90° C. A sample of local soil and one obtained from the Mojave desert were also subjected to temperature-vacuum experiments. The soil samples were examined at various temperatures at ultrahigh vacuum. Local soil showed quantitative recovery of mesophilic aerobes, mesophilic anaerobes, and actinomycetes but no molds at temperatures up to 100° C; at higher temperatures, mesophilic aerobes, molds, and actinomycetes were recovered. Forty-three typical isolates were recovered from the Mojave desert soil after being subjected to 120° C for 4 to 5 days at $6 \times 10^{-9}$ torr. (Star)

## 310

GNOTOBIOTIC TECHNIQUES AND THEIR APPLICATION TO SPACECRAFT FABRICATION.

P. C. Trexler (Albert Einstein College of Medicine, Bronx, N.Y.)
Presented at COSPAR, International Space Science Symposium (4th), Warsaw, Poland, June 3—11, 1963. 4 p.
(A63—18970)

Brief consideration of the application of the "isolator" system (for the control of microbic contamination in gnotobiotics) to the sterilization of spacecraft. The isolator system involves the use of an impervious mechanical barrier to limit the migration of viable organisms. The barrier is modified to permit the observation and manipulation within the sterile area and the introduction and removal of materials without destroying its protective effect. Isolators described are those which are modifications of the familiar glove-box, and the split-seam transfer system, in which a flexible film package containing sterile supplies is cemented onto the wall of a plastic isolator. A typical procedure for sterilizing a spacecraft is outlined, and the problem of finding a meaningful index to the reliability of the sterilization process is noted.

## 311

"GULLIVER," AN EXPERIMENT FOR EXTRATERRESTRIAL LIFE DETECTION AND ANALYSIS.

Gilbert V. Levin, Allen H. Heim, M. F. Thompson, D. R. Beem (Resources Research Inc., Washington, D.C.) and N. H. Horowitz (California Institute of Technology, Pasadena)
Presented at COSPAR, International Space Symposium (4th), Warsaw, Poland, June 3—11, 1963. 14 p.
(A63—18574)

Proposed experiment for the detection of life of an aqueous, carbonaceous nature on Mars. It is assumed that the biochemistry at the cellular level of such life is similar to that on Earth. The use of radioisotopes, capable of probing metabolic reactions at the molecular level, is planned. Micro-organisms would be collected by a capsule landing on the Martian surface, and detected by collecting and counting $C^{14}O_2$ evolved by them from substrates containing $C^{14}$. The capsule has been tested in the laboratory and in the field. Modifications are planned to enable the equipment to distinguish photosynthetic activity.

## 312

INTERACTION OF COSMIC AND SOLAR FLARE RADIATIONS WITH THE MARTIAN ATMOSPHERE AND THEIR BIOLOGICAL IMPLICATIONS.

Herman Yagoda (USAF, Cambridge Research Labs., Bedford, Mass.)
Presented at COSPAR, International Space Science Symposium (4th), Warsaw, Poland, June 3—11, 1963. 4 p.
(A63—19734)

Brief review of studies of the intensity of the radiation falling on the Martian surface. Outlined are investigations concerning neutron production, capture of slow neutrons, particle star production, and galactic cosmic-ray intensities in terms of solar flares. A table shows the comparative surface radiation levels for Earth and Mars. It is noted that Mars, with its marginal environment for sustaining primitive life forms, is subjected periodically to comparatively intense radiation levels which may have profound effects on the mutation and evolution of Martian plant and animal life.

## 313

LIFE AND SPACE

A. A. Imshenetskiy (Acad. of Sci., Moscow, U.S.S.R.)
In: M. Florkin and A. Dollfus, eds. Life Sciences and Space Research II; International Space Science Symposium (4th), Warsaw, Poland, June 3—12, 1963.
Sponsored by the Committee on Space Research (COSPAR).
Amsterdam, North-Holland Publishing Co.; New York, Interscience Publishers, 1964, p. 25—34.
(A64—24943)

Discussion of methods to be used in space biology investigations. It is stated that the studies dealing with the detection of life on planets will have two stages. The first stage will be associated with the application of automatic devices, which will detect living creatures, whereas the second and later period will be concerned with the investigations provided by man himself. It is noted that, in these studies, one should proceed from the idea of life on Earth and, consequently, look for living creatures containing no water and no carbon dioxide only after obtaining negative results in searching for creatures similar to those living on Earth. The entire progress of "chemical evolution" on Earth proves the necessity of the detection on other planets of heterotrophic microorganisms at first, after which the search for specialized forms—i.e., chemo- and photoautotrophs—may be made. It is stated that the most perfect instrument for the detection of microorganisms will be a device which will record the multiplication rate of microbes in the liquid media simultaneously by means of different methods: manometry, nephelometry, potentiometry, and the determination of radioactive carbon dioxide, which is extracted during the breakdown of organic substances.

## 314

**MULTIVATOR: A BIOCHEMICAL LABORATORY FOR MARTIAN EXPERIMENTS.**

Elliott Levinthal, Lee Hundley and Joshua Lederberg (Stanford University, Instrumentation Research Laboratory, Genetics Dept., Stanford, Calif.)

Presented at COSPAR, International Space Science Symposium (4th), Warsaw, Poland, June 3–11, 1963. 17 p.
(A63–18968; A64–24949)
(NASA Grant NsG 81–60)

Discussion of the basic concepts underlying the Multivator, a system designed for detection of signs of life on Mars. The general criteria for noting signs of life on other planets are discussed, and a method for developing a matrix of the possible chemical and biological properties of living systems that must be analyzed is outlined. Described are the details of Multivator with which a wide range of biochemical experiments are possible, particularly studies in which a photomultiplier can be used as an output transducer. Recent investigations have centered on photometric assays of fluorescence, such as the determination of the widely distributed enzyme, phosphatase.

## 315

**ABIOTIC PRODUCTION OF PRIMITIVE PROTEIN AND FORMED MICROPARTICLES.**

S. W. Fox and S. Yuyama

*N.Y. Acad. Sci. Ann.*, Vol. 108, June 1963. p. 487–494.

A description is presented of the properties of microparticles formed by thermal copolymerization under carefully controlled aqueous conditions. Polymerization of amino acids to proteinoids is catalytically aided by phosphoric acid, polyphosphoric acid, or ATP. The effluence of water is important in the catalytic properties of proteinoids and the kind of morphogenicity from the polymerization of proteinoids also depends on the intrusion of water. The microparticles are formed in the shape of spherules which are the size and shape of cocci. Double boundaries, twinning, and aggregations into apparent colonies have been observed as the result of pH and pressure changes. The spherules may represent prebionta without the necessary apparatus for replication. (E.O.)

## 316

**AQUEOUS, LOW TEMPERATURE ENVIRONMENT OF THE ORGUEIL METEORITE PARENT BODY.**

B. Nagy, W. G. Meinschein and D. J. Hennessy

*N.Y. Acad. Sci. Ann.*, Vol. 108, June 1963. p. 534–552.

The nature of the Orgueil meteorite parent body is infrared from a mineral analysis of the Orgueil carbonaceous chondrite by electron microscopy, X-ray electron diffraction, and thermodravimetric studies. Trace element data in the meteorite appeared dissimilar to average abundance in terrestrial shales and igneous rocks which indicate either a definite extraterrestrial origin or a precrustal origin. The composition of the mineral suite which included hydrous layer lattice silicates, magnetite and magnesium sulfate prescribes an aqueous environment of the parent body in which the temperature was low to moderate. A slightly reduced environment and a slightly alkaline pH may have been present. A parent body of sufficient size to hold an atmosphere and external bodies of water is not precluded from the mineral evidence. (E.O.)

## 317

**ENVIRONMENTAL BIOPHYSICS AND MICROBIAL UBIQUITY.**

J. R. Vallentyne

*N.Y. Acad. Sci. Ann.*, Vol. 108, June 1963. p. 342–352.

Current knowledge regarding environmental boundaries that delimit the "stability field" of living matter is summarized. A complete body of information does not exist and it would be questionable to assume that these geoenvironmental limits of life are not exceeded on a cosmic scale. Examples are given of bacteria, fungi, and algae living in extremes of temperature, pH, salinity, pressure, available water, ultraviolet light, ionizing radiation, and various chemical environments. Sterile environments are either nonaqueous or noncirculatory aqueous. The question of extraterrestrial life on a planet such as Mars would depend on whether conditions were ever favorable for the origin of life and whether subsequent conditions have been favorable for the persistence of such life. (E.O.)

## 318

**ENVIRONMENT OF THE MOON.**

Paul A. Campbell (Aerospace Med. Div., Brooks AFB, Tex.)

*Arch. Environ. Health*, 6:6, June 1963. p. 724–729.

The lunar environment contains features thought to be extremely hostile to man and his machines. Principal among these are (1) the absence of an atmosphere with inherent protective characteristics and (2) the lunar temperature extremes and the rapidity with which they vary. The moon's surface has been suggested to have insulating characteristics. Thus, a solution for man's protection would be underground or subsurface dwellings. Since the problems involved in human lunar habitation are primarily logistical, lunar expeditions must use the materials at hand to the greatest possible extent. The possible existence of life on the moon is discussed. (Author)

## 319

**EVALUATION OF RADIATION EFFECTS IN SPACE.**

R. Berger

*N.Y. Acad. Sci. Ann.*, 108:2, June 1963. p. 482–486.

The role of radiation in the synthesis of complex organic compounds is discussed, and a review is made of laboratory syntheses of biologically important compounds under simulated primitive earth conditions. Electrical and coronal discharges, ultraviolet light, electron bombardment, high energy particle radiation, and X-rays were used as energy sources, in the syntheses. Unshielded organic compounds may be destroyed in space by electron bombardment. It is suggested that, initially, radiation may have been the agent which at least in part built up molecules to systems which could use light quanta in a controlled manner in photosynthesis. (E.O.)

## 320

**EVIDENCE IN METEORITES OF FORMER LIFE: THE ORGANIC COMPOUNDS IN CARBONACEOUS CHONDRITES ARE SIMILAR TO THOSE FOUND IN MARINE SEDIMENTS.**

W. G. Meinschein, B. Nagy and D. J. Hennessy

*N.Y. Acad. Sci. Ann.*, Vol. 108, June 1963. p. 553–579.

An analysis of hydrocarbons in the Orgueil and Murray meteorites by chromatography and light and mass spectroscopy is described. Saturated hydrocarbons isolated from these carbonaceous chondrites have infrared spectra, molecular weight ranges and cracking patterns in the mass spectrometer that resemble those of sedimental saturated hydrocarbons. The relative amounts of hydrocarbons and nonhydrocarbons, and the free sulfur contents of the benzene extracts of the Orgueil and terrestrial marine sediments are similar. Most of the meteoric extracts fall within the range of compositional variations observed in terrestrial sediment extracts of plant and animal hydrocarbons. It would seem that the amounts and composition of the benzene extracts from these carbonaceous chondrites are evidence for biological activity in the parent body. (E.O.)

## 321

**FOSSIL PROTOBIONTA AND THEIR OCCURRENCE.**

A. Papp

*N.Y. Acad. Sci. Ann.*, Vol. 108, June 1963. p. 461–463.

Protobionta with organic or inorganic shells, bacteria sporomorpha and spores are considered as some of the earliest organisms which can be traced. The similarity of organized material found in meteorites to certain spore shapes is noted. Sporomorpha and spores result from reduction division, and from tetrahedral reduction division trilete spores result. It would seem that organized meteoric elements with 3-sided symmetry could be classified under sporomorpha and might likewise result from reduction division. Residues of extraterrestrial organisms would depend on favorable conditions of fossilization which on Earth includes an aquatic medium. Also, organized elements with resistant oximes or organic material must have depended on the functions of protein molecules which would infer an environment similar to Earth's. (E.O.)

## 322

**FURTHER OBSERVATION ON THE PROPERTIES OF THE ORGANIZED ELEMENTS IN CARBONACEOUS CHONDRITES.**

G. Claus, B. Nagy and D. L. Europa

*N.Y. Acad. Sci. Ann.*, Vol. 108, June 1963. p. 580–605.

(A64–80452)

The application of biological stain and fluorescent microscopy to the organized elements found in carbonaceous chondrites is described. A short review of information previously ascertained about the organized element is presented. Of the 19 biological stains used, 18 gave positive results, although with different gradations—which was probably due to different degrees of mineralization. Fluorescence of the organized elements could be separated from the surrounding mineral fluorescence to reveal morphological features not related to terrestrial micro-organisms. The problems of quantities of organized element solubilities, and terrestrial contaminations are discussed. Considerations of fine morphology, physical and chemical tests and biological staining suggest that some carboneceous chondrites contain indigenous organic microstructures of possible biogenic origin. (E.O.)

## 323

**THE IDENTITY OF THE ORGANIZED ELEMENTS (PANEL DISCUSSION).**

H. C. Urey

*N.Y. Acad. Sci. Ann.*, Vol. 108, June 1963. p. 606–615.

Arguments for and against the possible extraterrestrial nature of organized meteoritic elements are reviewed. The classification, quantity, physical and chemical nature of the organized elements have not been settled conclusively. The problems of contamination or inorganic nature of the elements are primary before a biogenic extraterrestrial nature can be assigned to the organized elements. Organic material from the carbonaceous chondrites seems to be linked to a biogenic origin as in terrestrial sediments but an abiogenic origin of hydrocarbons must be considered as a possibility. (E.O.)

## 324

**METEORITES.**

John A. Wood (Smithsonian Inst. Astrophysical Observatory, Cambridge, Mass., and U. of Chicago, Enrico Fermi Inst. for Nuclear Studies, Chicago, Ill.

Presented at the International Union of Geodesy and Geophysics, Thirteenth General Assembly, United States National Report, 1960–1963.

*American Geophys. Union, Transactions*, Vol. 44, June 1963. p. 532–535. 44 refs.

(A63–19981)

Survey of some important advances in the understanding of meteorites and techniques for studying them. Noted are studies concerning the constancy of the cosmic-ray flux, the possibility of life in meteorites, the primordial noble gases in meteorites, chondrules, the parent meteorite planets, shock effects, meteorite craters, and tektitites.

## 325

**FORMATION OF RIBOSE AND DEOXYRIBOSE BY ULTRAVIOLET IRRADIATION OF FORMALDEHYDE IN WATER.**

Cyril Ponnamperuma, et al. (NASA, Ames Research Center, Moffett Field, Calif.)

Presented at the 11th Annual Meeting of the Radiation Research Soc., Milwaukee, Wis., May 27–29, 1963.

*Radiation Res.*, Vol. 19, 1963. p. 183–187.

When an aqueous solution of formaldehyde containing $3 \times 10^{-4}$ molecules per liter is exposed to a source of ultraviolet light, a large number of organic compounds is found. Among these, ribose and deoxyribose were identified. Paper chromotography and radioactive tracer techniques were used in the analysis. A similar but less significant result is produced by the use of cobalt —60$\gamma$ rays. Ribose and deoxyribose are the sugars in RNA and DNA. This formation by a simple biological process

has a possible bearing on the hypothesis that life originated on this earth by a gradual process of chemical evolution. (Author)

## 326

FORMATION OF ADENINE BY ELECTRON IRRADIATION OF METHANE, AMMONIA, AND WATER.

C. Ponnamperuma, R. M. Lemmon, R. Mariner and M. Calvin

Proc. Natl. Acad. Sci. U.S., 49:5, May 15, 1963. p. 737–740. 10 refs.

The primary object of the investigation was to examine the possibility of the synthesis of heterocyclic bases from mixtures of primitive gases. It has been established that: (1) adenine is indeed a product of electron irradiation of a mixture of methane, ammonia, and water; (2) there is an inverse relationship between the amount of adenine synthesis and the amount of hydrogen gas present; and (3) of the five nucleic acid bases, adenine is the one most readily synthesized under prebiotic conditions. (Author)

## 327

EXPERIMENTAL ORGANIC COSMOCHEMISTRY. THE FORMATION OF BIOCHEMICAL COMPOUNDS.

J. Oro

Proc. Lunar and Planet. Exploration Colloq., 3:2, May 5, 1963. p. 9–28. 34 refs.

(NAA Publ. 513–W–12; N63–19480)

Simple combinations of carbon, nitrogen, oxygen and hydrogen are important constituents of relatively cool star atmospheres, interstellar space, comets and cold planetary atmospheres. It is proposed that intercombination of these species in protoplanetary bodies leads to the formation of reactive organic compounds which are the precursors of more complex biochemical molecules. Model experiments involving the use of such simple compounds as water, ammonia, hydroxylamine, hydrazine, hydrogen cyanide, formaldehyde and acetaldehyde have led to the synthesis (in the University of Houston Laboratory) of hydroxy acids, amino acids and amino amides, including glycolic acid, lactic acid, glycine, glycinamide, alanine, $\beta$-alanine, aspartic acid, valine and lysine; monosaccharides, including ribose and 2-deoxyribose; purines and pyrimidines, including adenine, guanine and uracil; purine intermediates, including 4-aminoimidazole-5-carboxamide, 4-aminoimidazole-5-carboxamidine and formic acid; homo- and heteropolypeptides; and other compounds of biological significance. These experiments have been confirmed and extended recently in other laboratories. The paper is followed by an open-forum discussion. (Author)

## 328

MARS BIOLOGICAL ANALYSIS BY GAS CHROMOTOGRAPHY.

V. I. Oyama

Proc. Lunar and Planet. Exploration Colloq., 3:2, May 5, 1963. p. 29–36. 27 refs.

(NAA Publ. 513–W–12; N64–19481)

High sensitivity, relative simplicity, ruggedness, and rapid and wide analytical capability are the characteristics which especially qualify the gas chromatograph for analytical problems in space. It is proposed that the soil of the planet Mars be analyzed for organics by a simple adaption of the gas chromatograph. Volatiles produced by the controlled thermal degradation of orgainc aggregations are passed through a column, and the chromatogram (fingerprint) produced is indicative of the organic composition. The data suggest and some documentation is given to show that fingerprint patterns obtained from biological systems could be used as a basis for differentiating nonliving aggregates from living systems. The presentation of the paper is followed by an open-forum discussion. (Author)

## 329

THE POSSIBILITY OF LIFE ON MARS.

S. L. Miller

Proc. Lunar and Planet. Exploration Colloq., 3:2 May 5, 1963. p. 1–7. 8 refs.

(NAA Pub. 513–W–12; N63–19479)

The primitive earth is believed to have had a reducing atmosphere which was favorable for the evolution of simple organic life. As Mars was formed from the same cosmic dust cloud as the earth, similar conditions might be expected to have existed on that planet. Laboratory experiments demonstrate that certain basic organic compounds necessary to produce "living" matter can be formed in such a favorable environment. Although these data and the polarization and infrared measurements of the Martian surface are not conclusive evidence, the existence of life on Mars is highly probable. The presentation of the paper is followed by an open-forum discussion.

## 330

THE BIO-COURIER PROJECT: IMMUNOBIOLOGICAL SUPPORT FOR MANNED ORBITAL AND INTERPLANETARY EXPLORATIONS.

W. G. Glenn and W. E. Prather

*Aerospace Med.*, 34:5, May 1963. p. 409–413. 37 refs.

(A63–17324)

Discussion of the methods of analyzing the microbiological materials on other planets in order to solve aerospace immunobiological (IB) problems. Consideration of the IB approach includes examination of (1) the antigen-antibody reaction of a precipitin nature for exploring differences between molecules in solution, and (2) the gel-diffusion columns with only the antisera-agar mixture. It is emphasized that the antibody levels or the IB relationships will be determined by scientists stationed on Earth. Biotelescanner instrumentation is considered, and the Serum Agar Scanner, which is an automatic densitometer, specifically designed to scan and quantitate diffusion-column reactions, is described.

## 331

THE CARBONACEOUS CHONDRITES.

B. Mason

*Space Sci. Rev.*, 1:4, May 1963. p. 621–646.

The carbonaceous chondrites are a group of stony meteorites characterized by the presence of an appreciable amount of carbonaceous material other than free carbon (diamond and graphite). They have been divided into three subgroups known respectively as Type I, Type II, and Type III. Analyses of Type I meteorites

show about 3 to 5 percent of carbon and 20 percent of combined water; they consist largely of hydrated magnesium-iron silicate, magnetite, and magnesium sulfate, contain no chondrules and have a density of 2.2. Analyses of Type II meteorites show about 2 to 3 percent of carbon and 10 to 15 percent of combined water; they consist of groundmass of hydrated magnesium-iron silicate enclosing chondrules of olivine and pyroxene which are almost iron-free and have a density of 2.6—2.9. Analyses of Type III meteorites show about 0.5 to 2 percent of carbon and 2 percent combined water; they consist largely of olivine (often variable in composition, but averaging 30—40 mole % $Fe_2SiO_4$), with accessory pigeonite and sulfide minerals, and have a density about 3.4. The carbonaceous material and combined water in these meteorites are clearly of extraterrestrial origin, but their significance is not well understood. A biological origin has been claimed for some of the organic compounds on the basis of their composition, but this claim is the subject of considerable dispute. Microscopic objects with regular outline ("organized elements") have been recognized in some of these meteorites; investigators have claimed these to be extraterrestrial fossils, others have ascribed them to terrestrial contamination or considered them to be crystals or crystal aggregates of nonbiological origin. (Author)

## 332

COMBINED EFFECTS OF ULTRAHIGH VACUUM AND TEMPERATURE ON THE VIABILITY OF SOME SPORES AND SOIL ORGANISMS.

Gerald J. Silverman, Wayne H. Keller (Natl. Research Corp.) and Norman S. Davis

*Appl. Microbiol.*, 11:3, May 1963. p. 202—210. 18 refs.
(N63—19474)
(NASA Contract NASr—41)

Considerably fewer spores of *Basillus stearothermophilus*, *B. megaterium*, and *Clostridium sporogenes* were recovered than were spores of *B. subtilis* var. *niger* and *Aspergillus niger* after 4 to 5 days at 53° and 60° C in ultrahigh vacuum. There were no significant differences in the recoveries of these five organisms at 25° C and atmospheric pressure, and after exposure to 25° and —190° C in vacuum. At 60° C, a far greater decrease in viability was demonstrated for *B. stearothermophilus*, *B. megaterium*, and *C. sporogenes* in ultrahigh vacuum than at atmospheric pressure. Viable *B. subtilis* var. *niger* spores were not detected in an initial $10^7$ spores after retention at 90° C and ultrahigh vacuum, and $10^4$ spores were viable after 5 days at 90° C and atmospheric pressure from an initial $10^8$ spores. Molds and actinomycetes in soil were particularly resistant up to 69° C in vacuum. Actinomycetes were the only soil organisms recovered so far at 120° C. (Author)

## 333

DIRECT CONTACT AMONG GALACTIC CIVILIZATIONS BY RELATIVISTIC INTERSTELLAR SPACEFLIGHT.

Carl Sagan (U. of Calif., Berkeley)

*Planetary and Space Sci.*, 11:5, May 1963. p. 485—498. 41 refs.
(NASA Grant NsG—126—61)
(A63—17828)

Discussion is presented of possibilities of communication with advanced technical civilizations existing on other planets in this galaxy. An estimate of such civilizations, based on a number of poorly known parameters (such as the probabilities of the origins of life), is $10^6$. The most probable distance to the nearest such civilization is several hundred light-years. Interstellar spaceflight at relativistic velocities is found to have several advantages over electromagnetic communications with these communities. Some of the technical problems involved in the construction of starships with relativistic velocities are discussed. It is concluded that with nuclear staging, fusion reactors, and the Bussard interstellar ramjet, no fundamental energetic problems exist for relativistic interstellar spaceflight. It is shown to be a statistical likelihood that Earth was visited by an advanced extraterrestrial civilization at least once during historical times.

## 334

ORGANIC CONSTITUENTS OF THE CARBONACEOUS CHONDRITES.

M. H. Briggs and G. Mamikunian

*Space Sci. Rev.*, 1:4, May 1963. p. 647—682. 103 refs.

From a brief discussion of forms of meteorite carbon it is concluded that almost all the carbon in the carbonaceous chondrites is present as organic matter. Attempts to extract and identify this organic matter are then reviewed. It is shown that only 25% has been extracted and only about 5% chemically characterized. Of this 5% most is a complex mixture of hydroxylated aromatic acids together with various hydrocarbons of the paraffin, naphthene and aromatic series. The possible chemical nature of the major fraction is discussed. It is suggested to be a mixture of high-molecular-weight aromatic and hydrocarbon polymers. Possible sources of contamination of the meteorites are described and evidence indicating a general lack of organic contaminants is present. It is concluded that most of the organic constituents are indigenous to the meteorites and are extraterrestrial in origin. Synthtic processes for the compounds are mentioned and it is concluded that the organic material is probably of abiogenic origin. A brief review of studies of "organized elements" contained within the meteorites is presented. Difficulties of identification are discussed and photographs of some microstructures of several carbonaceous chondrites are presented. No final conclusion about the nature of these objects is possible, but some appear to be various indigenous organic and mineral structures, while others are terrestrial contaminants. (Author)

## 335

ARE WE ALONE IN SPACE?

C. Maxwell Cade (S. Smith & Sons, Ltd., Eng.)

*Discovery* (London), 24:4, Apr. 20, 1963. p. 27—29, 32—34.

Various theories of the origin of life on Earth are reviewed with reference to the possible development of similar life forms on other planets of other solar systems. It is calculated that of all the stars in the galaxy about 4000 million could have habitable systems of planets. Evidence for the occurrence of planets of these other systems is presented in relationship to the formation of stars and their physical properties such as mass, momentum, and angular velocity. The extraterrestrial origin of life on Earth (panspermia hypothesis) is discussed critically from the moment of a spore's escape from another planet to the arrival on the

Earth's surface. Life on Venus, Mars, and other planets is briefly discussed. These speculations conclude that intelligent life does exist in other parts of the universe. (E.O.)

## 336

**ELECTRON PROBE MICROANALYSIS OF ORGANIZED ELEMENTS IN THE ORGUEIL METEORITE.**

B. Nagy, K. Fredriksson, H. C. Urey, G. Claus, C. A. Anderson and J. Percy

*Nature* (London), 198:4876, April 13, 1963. p. 121–125. 21 ref.

Electron probe X-ray microanalysis of 28 organized elements from the Orgueil carbonaceous meteorite has revealed the presence of iron with smaller amounts of chlorine and/or nickel in a number of these objects. Morphologically less well-defined particles were found to be composed of silicates. Analysis of meteorite samples treated with 6N hydrochloric acid revealed particles with low average atomic number and no elements heavier than sodium. According to their shape these could be the remains of organized elements. Mineralization with iron (probably in the form of limonite), chlorine and/or nickel, and the occurrence of such particles in thin sections of undisturbed meteorite fragments seem practically to exclude the possibility that the 28 particles were terrestrial contaminants. (E.O.)

## 337

**80,587 CARBON ISOTOPE ABUNDANCE IN METEORITIC CARBONATES.**

R. N. Clayton

*Science*, Vol. 140, No. 3563, p. 102–193, Apr. 12, 1963

The $C^{13}/C^{12}$ ratio in the carbonate minerals of Orgueil is 6% greater than that of any known terrestrial carbon. The possible causes of this variation are considered. (Author)

## 338

**OBSERVATIONS OF WATER VAPOR ON MARS AND VENUS.**

A. Dollfus (Observatoire de Paris, Meudon, France)

*In:* Peter J. Brancazio and A. G. W. Cameron, eds. THE ORIGIN AND EVOLUTION OF ATMOSPHERES AND OCEANS. Proc. of a Conf., NASA, Goddard Inst. for Space Studies, N.Y.C., Apr. 8–9, 1963 p. 257–268. N.Y., John Wiley & Sons, Inc., 1964.

Descriptions of new measurements giving positive identification of water on both Venus and Mars are presented. Observations were made from balloons during flight and from high mountains. Data were obtained by making photometric comparisons of the observations on Venus and Mars with those on the sun or moon. A final value of $1.5 \times 10^{-2}$ g/cm.$^2$ of water vapor on Mars was obtained. For Venus, the amount of water vapor was calculated to be about $1 \times 10^{-2}$ g/cm$^2$, with a probable error of a factor of 2. Activities of an international program for photographing Venus in the ultraviolet are described. (Aerospace *Med.*)

## 339

**VENUS AN INFERNO.**

Angela Croome

*Discovery* (London), 24:4, Apr. 1963. p. 5.

A condensed report is given of the findings of the Mariner II flight to Venus. Aspects of the atmosphere of Venus such as temperature, cloud formation, ionosphere formation, hydrocarbon content, and the greenhouse effect are discussed. The surface temperature, about 800° F on both the daytime and nighttime sides, appears to rule out life's occurring on the planet's surface. However, life would still be possible in certain layers of the atmosphere. Methods of gathering the data are described, and the findings are compared to those previously made from Earth concerning the characteristics of the atmosphere and surface. (Author)

## 340

**WHICH STARS HAVE PLANETS?**

Stanley Leinwoll

*Analog*, 71:2, Apr. 1963. p. 9–16 and 91–93.

Relationships between the cyclic behavior of solar activity and the relative positions of the planets of the solar system are established as a basis for a suggested method of determining which other stars have planets. It is assumed that a plot of disturbance events of flare stars vs. time will in all liklihood display some kind of cyclical behavior; this, in turn, could indicate the kind of periodicity which would result from planets orbiting and making different angles with each other. The conditions necessary for life are considered in order to narrow the search to planets which may be inhabited. It is concluded that flare stars among the K and M stars on the main sequence should be monitored for flare activity, UV light intensity, and radio noise. Tau Ceti is considered the nearest likely star for such a program. (M.P.G.)

## 341

**EVIDENCE OF AN EXTRATERRESTRIAL ORIGIN FOR SOME ORGANIC CONSTITUENTS OF METEORITES.**

Michael H. Briggs (Jet Propulsion Lab., Pasadena, Calif., & Victoria U., Wellington, N.Z.)

*Nature* (London), Vol. 197:4874, Mar. 30, 1963. p. 1290. 8 refs. (A63–15565)

Results of experiments conducted to determine whether the isotopic composition of the meteorite organic matter affords any evidence regarding the origin of the compounds are presented. It is suggested that the isotopic composition of meteorite organic matter is quite unlike that of any terrestrial substances. The evidence presented is indicative of an extraterrestrial origin for a major fraction of the organic constituents of carbonaceous chondrites.

## 342

**SOME MICROSTRUCTURES OF COMPLEX MORPHOLOGY OBSERVED IN PREPARATIONS OF CARBONACEOUS CHONDRITES MADE UNDER STERILE CONDITIONS.**

G. Mamikunian and M. H. Briggs

*Nature* (London), 197:4874, Mar. 30, 1963. p. 1245–1248.

A selection of photographs is presented of some microstructures of complex morphology which were observed in sterile preparations of some carbonaceous chondrites. Efforts to culture microorganisms in ground meteorite samples are reported; no growth was detected after incubation for 7 days at 37° C in trypticase

medium. It is believed that most of the objects are unusual mineral grains or terrestrial minerals which have contaminated the meteorite during storage. However, conclusive identifications are not possible. (M.G.)

## 343

SYNTHESIS OF ORGANIC COMPOUNDS BY HIGH-ENERGY ELECTRONS.
J. Oro (Calif. U.)
*Nature*, 197:4871, Mar. 9, 1963. p. 971–974. refs.
(NASA Grant 257–62)
(N64–11117)

The results of experiments on the effects of ionizing radiation on the compounds, $^{14}C$-methane, ammonia, and water, have been compared with similar experiments, using electrical discharges, in an attempt to discover the means of formation of the first organic molecules on the primitive Earth. It is found that: (1) organic compounds are formed by the action of high-energy electron radiation on methane, ammonia, and water in both the solid phase and the gas phase: (2) the autoradiographic patterns of compounds so formed are similar to those obtained by electric discharges, but the products of solid-phase irradiation are less polar: and (3) since the compounds of carbon, nitrogen, and oxygen, especially the hydrides, are important in the universe, it is suggested that the radiation synthesis of organic and biochemical compounds is an important cosmic process. (D.E.R.)

## 344

SYNTHESIS OF ORGANIC COMPOUNDS BY ELECTRIC DISCHARGES.
J. Oro
*Nature* (London), 197:4870, Mar. 2, 1963. p. 862–867. 26 refs.

Further investigations on the synthesis of organic compounds under possible primitive Earth conditions have been carried out. In order to increase the probability of formation of new compounds, ethane was also included in the reaction mixture. Justification for the use of ethane is found through the spectroscopic detection of the $C_2$ species in star atmospheres, comets, and interstellar space. Results show that an appreciable number of organic compounds are formed by the action of electric discharges on mixtures consisting essentially of methane, ammonia and water. Products obtained include glycine, alanine, aspartic acid, asparagine, isoleucine (or isoasparagine), glycinamide and possibly proline; a yellowish oil, a highly insoluble polymer, and several ultraviolet-absorbing compounds. The formation of other products which give green, purple, and brown derivatives with ninhydrin, suggesting the presence of amines, amino-nitriles, amino-amides and peptides has also been observed. (Author)

## 345

BIOLOGICAL PROBLEMS OF METEORITES.
M. H. Briggs
*Spaceflight*, 5:2, March 1963. p. 45–52. 60 refs.

A review is made of the present controversy on whether meteorites contain biological materials. As yet no conclusion either way is possible. The issues raised by this problem seem to be of fundamental significance to the paleontologists, and also to proponents of a biological origin for petroleum. (S.T.L.)

## 346

A CLOSER LOOK AT "LIFE" IN METEORITES.
(No author)
*New Sci.*, 17:329, Mar. 1963. p. 534.

A note in which details of two investigations concerned with biotic indications in meteorites are briefly summarized. (A.H.F.)

## 347

ORGANIC MATTER FROM SPACE.
Brian Mason (Am. Mus. Nat. History, New York)
*Sci. Am.*, 208:3, Mar. 1963. p. 43–49.
(A63–13616)

The significance of recent finds of "organized elements" and hydrocarbons in meteorites is discussed. The meteorites in which organic compounds have been identified are carbonaceous chondrites. These are tabulated and classified in three groups, each group showing the content of all forms of carbon, the absorbed and combined water, the hydroxyl groups in minerals, and the hydrogen in organic compounds. Several hypotheses on the presence of complex organic material in meteorites are considered. The evidence of the relationship of hydrocarbons to life, the staining reactions of chondritic material, the morphological structure of the microfossils, and the possibilities of terrestrial contamination are discussed.

## 348

HOPES OF FINDING LIFE ON VENUS FADE.
Patrick Moore
*New Scientist*, 17:328, Feb. 28, 1963. p. 479

Reports of temperature measurements by Mariner 2 suggest that Venus is too hot to support life as we know it. The findings of the probe are summarized and discussed. (J.P.L.)

## 349

IMAGE OF VENUS: "GLOWING EARTH."
R. C. Toth
*New York Times* (West. Ed.), Vol. CXII:38385, Feb. 27, 1963. p. 1, 7.

Temperatures found by the Mariner 2 spacecraft could not rule out the possibility of a low form of life in the clouds around Venus, but the surface would be far too hot to support organisms. Surface temperatures of about 800° F were recorded by Mariner 2 on December 14, 1962 as it passed within 21000 miles of Venus. Cloud temperatures ranged from 200° F at the bottom to 30° F below zero at the top, according to NASA. The possible error in surface temperature readings is 15%. (Author)

## 350

ASTEROIDS STIR GROWING INTEREST.
Dandridge M. Cole (General Electric Co., Valley Forge, Pa.)
*Missiles and Rockets*, Vol. 12, Feb. 25, 1963. p. 43, 46, 48, 50, 52–54.
(A63–12973)

The current state of knowledge on the close-approach or cis-Martian group of asteroids is examined in view of the growing scientific interest in the minor planets. It is indicated that asteroids may hold the best record of the early history of the solar system. A number of scientific experiments which should be performed to give answers to such questions as the age, chemical composition, and biological conditions of the asteroids, are discussed. In addition, operational uses of the close-approach asteroids are suggested, such as the possibility of "hitch-hiking" on asteroids as a method of interplanetary travel. The materials of the asteroids could be used not only for radiation shielding but, after processing, for supplies and propellants. Most of what is known of representative members of the close-approach group is summarized in a table, and some illustrative orbits are graphically represented. (I.A.A.)

## 351

**ULTRAVIOLET-ABSORBING COMPOUND (S) REPORTED PRESENT IN THE MURRAY METEORITE.**

J. Oro (Calif. U.)

*Nature*, 197:4869, Feb. 23, 1963. p. 756–758. 11 refs.

(NASA Grant NsG–257–62)

(NASA CR–50299; N63–17157)

Investigations reported were undertaken to ascertain whether the compounds detected in meteorite extracts are indigenous to the meteorite or are the results of contamination by the ion exchange resin technique used. Investigation results show that the ultraviolet spectra obtained from meteorite extracts passed through Dowex 1 and the spectra given by blank eluates from Dowex 1 are essentially identical. It was concluded that the ultraviolet-absorbing compounds detected in water extracts of the Murray meteorite after treatment with Dowex 1 came from the resin and not from the meteorite. Observations concerning the presence of similar water-soluble ultraviolet-absorbing substances in Dowex 2 are also described. (N.E.A.)

## 352

**POSSIBLE ROLE OF METEORITES IN THE ORIGIN OF LIFE.**

J. J. Gilvarry and A. R. Hochstim

*Nature* (London), 197:4867, Feb. 9, 1963. p. 624–625.

A hypothesis is advanced which assumes that complex organic compounds originated in the Earth's primitive atmosphere, and were transferred to the hydrosphere. It is suggested that, as a meteoroid is traveling at high velocity through the primitive atmosphere of hydrogen, methane, ammonia and water, the temperatures behind the shock wave would produce monatomic and diatomic species of these compounds and some of the more complex products. The reversion to the original chemical composition would be prevented if the meteoroid carried through to impinge on the ocean's surface. Here a large cloud of hot water and steam, upon rising into the atmosphere (as in an atomic explosion), would engulf the descending remnants of the original wake. This would prevent further reversion, and the fallout would carry the organic material efficiently into the hydrosphere. If this hypothesis is true, it implies a profound importance of the effect of meteorite falls in biopoesis, and makes reasonable the presence of organic compounds on the moon. (Author)

## 353

**EFFECTS OF THE GRAM STAIN ON MICROSPHERES FROM THERMAL POLYAMINO ACIDS.**

Sidney W. Fox and Shuhei Yuyama (Fla. State U.)

*J. Bacteriol.*, 85:2, Feb. 1963. p. 279–283.

(N63–17687)

Microspheres produced from acid proteinoid accept the Gram stain. The stain is negative, but microspheres produced from mixtures containing a sufficient proportion of lysine proteinoid stain positive. Microspheres produced from mixtures containing the appropriate proportions contain individuals which stain positive and others which stain negative. (Author)

## 354

**LIFE ON UNSEEN PLANETS.**

H. Shapley

*Science Dig.*, 53:2, Feb. 1963. p. 59–64.

Small free-wandering bodies which are not parts of star-and-planet organizations exist in our universe. Only a few of the detected radio "sources" have been certainly identified with supernovae, nebulosities, and galaxy collisions, and it is speculated that these wanderers may produce such sources. Under favorable conditions life may occur on these wandering stars when the size is large enough for self-warming but not so large and hot that solid crusts are unable to form and persist. (Author)

## 355

**WHEN IS EXTRA-TERRESTRIAL LIFE INTERESTING?**

Solomon W. Golomb

(JPL, Calif. Inst. of Tech.)

*Eng. Sci.*, 26:5, Feb. 1963. p. 15–17.

Life is defined as a systems concept which is composed of organisms capable of growth and replication. The different components of the system may differ from one celestial body to another, but this will make it more possible for life to occur elsewhere. So it appears that future astronauts will have to look for other replicating systems based on chemicals other than the nucleic acids. The question of biological contamination of other planets is discussed, but it is thought that the biological contamination of the Earth by extraterrestrial organisms is more serious. If a foreign replicating system were introduced on Earth, and if it proved to be a better competitor for the molecular substrate need for growth and replication, then the nucleic acid system may become extinct. This problem is of considerable danger to life on Earth, and a great deal of thought should be given to it. (Author)

## 356

LIFE IN THE UNIVERSE.

A. I. Oparin (Inst. of Biochem., Acad. Sci. U.S.S.R., Moscow)

*Izv. Akad. Nauk. SSSR, Ser. Biol.* (Moscow), Vol. 1, Jan.—Feb. 1963. p. 3—8.
Transl. into English by JPRS, Apr. 4, 1963. p. 1—7.
(JPRS—18538; AD—63—21498) OTS: $0.50

Entering the era of the interplanetary voyages, we must be prepared for a practical study of life beyond the limits of our planet. Our judgments of the possibility of extraterrestrial life and of its concrete forms can be found only in the light of the study of the general process of the development of matter, an integral part of which is the origin of life. Three main stages of this process can be stated for Earth: (1) the appearance of the most primitive organic substances, (2) their complication, related to polymerization and condensation, and (3) the origin of multimolecular complexes and their transformation into primary living forms. The first stage is common to the most diverse bodies of the galaxy; the second one is more specific. It can be revealed on meteorites and is assumed to exist on the Moon and Mars. The third stage is also not ruled out on other planets of the Earth type. Life, having once originated, could have developed, adapting itself to severe conditions arising during the subsequent development. (Author's summary, modified)

## 357

MARTIAN BIOLOGY: THE EXPERIMENTALIST'S APPROACH.

S. M. Siegel, L. A. Halpern, C. Giumarro, R. Renwick and G. Davis (Union Carbide Res. Inst., Tarrytown, N.Y.)

*Nature*, Vol. 197, Jan. 26, 1963. p. 329—331.
(A63—12342)

A Salisbury model of Martian life forms and biogeochemical cycles in which such forms might participate is criticized. Although the Salisbury concepts are accepted generally, his reservations about the use of simulated environments are questioned. His distinction of higher plants as plants which "universally require oxygen," suggesting a divergence between the terrestrial model and its Martian counterpart, is believed to be invalid. Some experimental results are given showing that complex terrestrial organisms can survive and grow under conditions which constitute an extreme departure from normal terrestrial environment. It is concluded that the "plasticity" of organisms is far greater than the teachings of modern biology indicate. Thus, there is every prospect that environments such as those expected on Mars may well support forms of life that man could recognize readily.

## 358

ASTRONOMICAL ASPECTS OF THE EMERGENCE OF INTELLIGENCE.

S. S. Huang and R. H. Wilson

Presented at the Inst. Aerospace Sci. Ann. Meeting, New York, Jan. 1963. 8 p. p. 21—23.
(IAS Paper 63—48)
(A63—11515)

Discussion of the astronomical background which makes possible the emergence and development of intelligence in the universe. Stellar populations and life occurrence, criteria of the life-supporting ability of a star, and qualifications of habitable planets are briefly reviewed. If intelligent life should occur anywhere in space, it would depend upon solid matter for its support. It requires the existence of terrestrial-like planets, made of heavy elements. Therefore, the chance for both the formation of such planets in interstellar media and the emergence of life on these planets increases with the enrichment of heavy elements in the interstellar medium if the rate of star formation remains constant with time. In other words, Population I stars have a higher chance for supporting life than Population II stars. A consequence of this conclusion is that life phenomena in our galaxy are dominantly confined to the same galactic plane as Population I objects. (I.A.A.)

## 359

EXTRATERRESTRIAL INTELLIGENCE AND STELLAR EVOLUTION.

Lloyd Motz (Columbia University, Rutherford Observatory, New York, N.Y.)

Presented at the Institute of the Aerospace Sciences, Annual Meeting (31st) New York, N.Y., Jan. 21—23, 1963. 9 p.
(A63—11516)

Discussion of the existence of life of a high order of intelligence in our galaxy. An attempt is made to estimate the number of stars expected to have a retinue of planets, one or more of which can support life. The stellar luminosity function is used to obtain an order-of-magnitude estimate of the number of planets there are in the disk of our galaxy (the nucleus is excluded) that probably have life of a highly developed form. The influence that stellar evolution has on the way in which higher forms of life evolve is investigated. It is concluded that life of some sort is the rule rather than the exception in our galaxy. (I.A.A.)

## 360

SURVIVAL AND GROWTH OF ORGANISMS DURING LIFELONG EXPOSURE TO HIGH GRAVITY.

Charles C. Wunder, Lorenz O. Lutherer and Christopher H. Dodge (State U. of Iowa, Iowa City). Presented at the Aerospace Med. Assoc. Meeting, Atlantic City, N.J., Apr. 10, 1962.

*Aerospace Med.*, Vol. 34, Jan. 1963. p. 5—11. 20 refs. (Supported by NIH and Am. Cancer Soc.; Grants RG—5236, RG—8428, and SF—4756)
(A63—12138)

Studies concerned with the response of living forms to a chronically high gravity as simulated by continuous centrifugation are reviewed. Included are graphs and diagrams of the magnitude and duration of natural or artificial high-g fields which living organisms, such as bean and wheat seedings, fruit-fly larvae, turtles, chickens, turkeys, rats, mice, and hamsters are known to have survived. In some cases, life span decreases and growth decelerates; in other cases, growth is enhanced. The nature of the response is a function of the field intensity, age, size, and biological and physical characteristics of the organism, as well as other environmental factors. It is indicated that terrestrial forms of life could live and multiply at gravitational intensities differing from that of earth. However, there would undoubtedly be devel-

opmental alterations of a type which are at this time too complex to predict accurately.

## 361

A WORLD IN SPACE

Homer E. Newell (NASA, Office of Space Sciences, Washington, D.C.)

Presented at the IRE–NASA–AEC, International Symposium on Space Phenomena and Measurement, Detroit, Mich., Oct. 15–18, 1962.

*IEEE Transactions on Nuclear Science*, Vol. NS–10, Jan. 1963. p. 1–7.

(A63–11740)

Discussion of space research and exploration and of the importance of international cooperation in space. The overall setting in which the deliberations of the space symposium take place is revealed. Specifically surveyed are geophysics in space, the new astronomy, the universe, life in space, the environment of space, and measurement and detection techniques. The impact of space programs on all phases of life is noted.

## 362

ALONE IN THE UNIVERSE?

John W. MacVey

N. Y., Macmillan Co., 1963. 256 p.

(A64–80595)

The subject of this book is life in the universe, the chances for its existence, its probable forms, and the possibility of our communicating with it or even reaching some of its domains. (Author)

Contents:

Chap. 1: Across the Gulf. Chap. 2: Nature of a Star. Chap. 3: Worlds Around the Stars. Chap. 4: Lonely Sun. Chap. 5: Life on Far Worlds. Chap. 6: Stellar Communities. Chap. 7: Declining World. Chap. 8: Chemical Cauldron. Chap. 9: Beneath the Waters. Chap. 10: The Twilight World. Chap. 11: Back to the Reptiles. Chap. 12: Uncertain Sun. Chap. 13: Under Twin Suns. Chap. 14: Around the Galaxy. Chap. 15: Earth Visited? Chap. 16: Whispers from Space. Chap. 17: The Way to the Stars. Chap 18: Alpha and Omega.

## 363

AMINO ACID COMPOSITIONS OF PROTEINOIDS.

Sidney W. Fox, Kaoru Harada, Kenneth R. Woods and Charles Ray Windsor (Cornell U.)

*Arch. Biochem. Biophys.*, Vol. 102, 1963. p. 439–445.

(N64–12944)

Proteinoids prepared by thermal copolymerization of 18 common amino acids have been analyzed. Conditions for quantitative recovery of the total amino acids following hydrolysis have been established. The effects of various amino acid reaction mixtures upon the composition of the polymers obtained have been studied. (Author)

## 364

BIOLOGICAL CONTROL MECHANISMS.

Oscar Touster

*Science*, 139:3558, 1963. p. 926–928.

The concepts of repression (inhibition of the formation of one or more enzymes of a biosynthetic pathway by an end-product of the pathway) and negative feedback (end-product inhibition of an early reaction of a biosynthetic pathway) are discussed. Laboratory studies have indicated that an inducer for B-galactosidase in *E. coli* first stimulates the formation of messenger RNA, which in turn can then promote enzyme formation in the absence of the inducer. It was found that since both glycerol and fluorouracil are effective as repressors only during the 4-minute period when specific RNA is being formed, then induction and catabolite repression apparently affect the same step in enzyme biosynthesis. The concept of negative feedback is important in the biosynthesis of several amino acids that share portions of their biosynthetic pathways. In a clearly delineated system, namely, the phosphorylation of aspartic acid necessary for the production of both lysine and threonine, each of these two amino acid end-products is capable of only moderately inhibiting the required kinase. This limited inhibition occurs because there are two distinct kinases, one inhibited only by lysine, and the other inhibited only by threonine. (I.v.L.)

## 365

BIOLOGICAL EXPLORATION OF MARS.

C. Sagan

*In:* W. Morgenthaler, ed. ADVANCES IN THE ASTRONAUTICAL SCIENCES. Vol. 15, Pt. 7: Recent Astronomical Data on Mars and Evidences of Life. p. 571–581. Proc. of the AAS Symp. on the Exploration of Mars, Denver, Colo., June 6–7, 1963. North Hollywood, Calif., Western Periodicals Co., 1963.

The present evidence strongly suggests, but does not conclusively prove, that life exists on Mars. Only the landing of a biologist on Mars can provide the desired sophistication in detection and detailed characterization of Martian life forms. In preparation, a program of orbiters and unmanned landers is indicated. An orbiter has the intrinsic advantage that it provides information concerning large areas and long intervals of time, permitting observations of seasonal and secular changes in Martian surface features. Intercomparison of Martian and terrestrial organisms, both in the biochemical and on the morphological levels, can provide a general perspective which is currently lacking in biology, because all the life forms known to date have probably evolved from a single instance of the origin of life. (E.O.)

## 366

CHEMICAL EVOLUTION.

Melvin Calvin

*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATIONS, p. 33–77. N.Y., W. A. Benjamin, 1963.

(A64–10215)

From questions on the nature and characteristics of life, the author proceeds through chemical evolution with the establishment

of an environment conducive to the origin of self-replicating macromolecules. The primitive atmosphere, evolution of catalysts, molecular crystallization, and the formation of a cell are considered. The terrestrial occurrence of DNA and RNA are discussed in some detail. Life on other planets, life elsewhere in the solar system, and life in the galactic systems is followed by a discussion of man's place in the universe. Of the hundred million inhabitable planets in the visible universe, two areas selected for attempt at interstellar communication (Project Ozma) are Tau Ceti and Epsilon Eridani.

## 367

THE CHEMICAL ORIGINS OF LIFE.

M. H. Briggs (California Inst. of Tech., Space Sciences Div., Bioscience Group, Pasadena, Calif.)

*In:* K. W. Garland ed. SPACEFLIGHT TODAY, p. 228–238.

London, Iliffe Books, Ltd., 1963. 29 refs. $6.25.

(A64–80529)

Possible chemical mechanisms by which life could have developed from the inorganic environment of primitive Earth are discussed. One of the most striking discoveries of modern biochemistry is the close similarity between the chemistry of such simple organisms as bacteria, and that of the higher forms of life such as mammals. Before any organism, even the simplest, could have been formed, the following stages must have taken place: (1) the basic simpler substances must have been formed, (2) these must have been combined into the complex substances, and (3) the complex substances must have come together in aggregations and become organized and integrated into a system showing dynamic stability. Various aspects of these stages are discussed. It is concluded that life appears almost inevitably to be a consequence of certain atmospheric and geophysical properties of the planet Earth. If there are other planets with similar conditions, the same type of reactions must occur. Considerations of theories of planetary origins and the observed properties of some stars allow the prediction that life must be very widespread in the universe. (Author)

## 368

COHERENCE IN INTERSTELLAR SIGNALS.

M. J. E. Golay (Technische Hogeschool, Eindhoven, Netherlands).

*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION, p. 192–198.

N. Y., W. A. Benjamin, Inc., 1963. Also *in* IRE, Proceedings, Vol. 49, 1961. p. 958–959.

(A64–10229)

It is stated that it would appear that there may be four likely spectral regions within which a search should be made for coherent signals, before any intelligent messages can be received; at half or at twice the hydrogen frequency, and with or without correction for nebular drift. When factors such as easier power generation and greater space coverage are considered, the two half-frequency regions appear more favorable.

## 369

COMMENTS ON EXTRATERRESTRIAL TAXA.

F. L. Staplin (Imperial Oil Ltd., Calgary, Alberta, Canada)

*Taxon*, 12:1, 1963. p. 14–15.

It is still uncertain if there are truly extraterrestrial life-forms and those described are not either contamination or organic or mineral-organic complexes. The author is convinced that some meteoritic objects are fossils indigenous to the meteorite but believes that names should be given in accordance with the existing Code of Nomenclature. (J. McNeill)

## 370

COMMUNICATING WITH LIFE IN SPACE.

C. M. Cade

*Discovery* (London), 24:5, 1963. p. 36–41.

The methods of communication with intelligent extraterrestrial life and the implications of contact are considered. Optical communication by means of lasers does not yield enough range. The choice in the radio spectrum is the 21-cm line of interstellar hydrogen. Pulsed signals might be converted to pictorial representations by proper stacking. Project Ozma did not detect signals because of marginal sensitivity, but signal-relaying space probes appear feasible with present technology. Evidence of past visits is lacking although some unexplained objects such as Dr. Gurlt's Cube have been found in ancient geologic strata. The establishment of contact with a superior race could lead to extermination of the human race. It is probable that intelligent life would tend toward the center of the galaxy because of the higher probability of contacting life there. (E.O.)

## 371

CONDITIONS ON MARS.

C. A. Cross.

*In:* K. W. Gatland, ed. SPACEFLIGHT TODAY. p. 192–203.

London, Iliffe Books, Ltd., 1963. $6.25.

(A64–80527)

The manner through which knowledge of the planet Mars can be deduced from astronomical observations is described. Aspects included are Martian topography and meteorology. The possibilities of the existence of vegetation on the surface of Mars and of the survival of man in the Martian atmosphere are discussed. In spite of the application of all the resources of modern astronomical technique, Mars still remains more the subject of speculation than of established fact. Only when vehicles from the earth have carried men or machines out to Mars will this situation be substantially changed. (See also: Item No. 960).

## 372

DETECTION OF INTELLIGENT SIGNALS FROM SPACE.

J. S. Webb & W. H. Webb.

*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATIONS. p. 178–191. N.Y., W. A. Benjamin, 1963. Also *in:* Communication—Bridge or Barrier, IRE Seventh Natl. Commun. Sym. Record. p. 10–15. 6 refs. N.Y., Institute of Radio Engineers, 1961. 323 p.

(A64–10228)

It is suggested that present search protocols be altered to search the microwave portions of the electromagnetic spectrum for transmission not specifically beamed at Earth but intended for loal purposes, e. g., defense or normal commercial communications. The "odds" for finding intelligent life are good, from the statistical viewpoint.

## 373

**EVIDENCE OF THE EXISTENCE OF LIFE ON MARS.**

W. M. Sinton

*In:* W. Morgenthaler, ed. ADVANCES IN THE ASTRONAUTICAL SCIENCES, Vol. 15, pt. 7: Recent Astron. Data on Mars and Evidences of Life. p. 543–551. Proc. of the AAS Symp. on The Exploration of Mars, Denver, Colo., June 6–7, 1963.
(A64–10167)

The observational evidence that bears on the supposed existence of vegetation in the dark regions of the planet Mars is discussed. Perhaps the oldest evidence which is sometimes cited is that the dark areas are green. In truth, these areas may not be green. The oldest valid evidence is the marked seasonal intensity variation of the dark regions. Another line of evidence follows from the failure of the dark areas to be covered up as a result of the dust storms. Recently, it has been found that the polarization properties of the dark regions vary regularly with the season, and from this variation it is concluded that the microscopic character of the dark material varies. Recently, too, it was learned that the characteristic infrared absorptions of organic matter are present in the dark regions, which observation considerably strengthens the hypothesis of vegetation. The temperature measurements of Mars are presented because, although they do not give any direct support to the existence of vegetation, they do have a bearing on the nature of the vegetation, if such is present. From the temperature observations it is concluded that plants are likely to be like cactus.

## 374

**EXTRATERRESTRIAL INTELLIGENCE AND STELLAR EVOLUTION.**

L. Motz.

Presented at the annual meeting of the Institute of Aerospace Sciences (31st), N. Y., 1963. 9 p.
(Preprint paper 63–49.)
(A63–11576)

Discussion of the existence of life of a high order of intelligence in our galaxy. An attempt is made to estimate the number of stars expected to have a retinue of planets, one or more of which can support life. The stellar luminosity function is used to obtain an order of magnitude estimate of the number of planets there are in the disk of our galaxy (the nucleus is excluded) that probably have life of a highly developed form. The influence that stellar evolution has on the way in which higher forms of life evolve is investigated. It is concluded that life of some sort is the rule rather than the exception in our galaxy.

## 375

**EXTRATERRESTRIAL INTELLIGENT LIFE AND INTERSTELLAR COMMUNICATION: AN INFORMAL DISCUSSION.**

J. P. T. Pearman, National Academy of Sciences—National Research Council, Space Science Board, Wash., D. C.)

*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION, p. 287–293. N. Y., W. A. Benjamin, Inc., 1963.
(A64–10233)

From consideration of the prospects for the existence of other societies in our galaxy and the problems involved in establishing communication with them, it is concluded that, if the more optimistic values of communicative lifetime are chosen, the number of civilizations becomes $10^5$ to $10^9$ and the distance of the nearest civilization is estimated at ten to a few hundred light-years. The use of radio or other electromagnetic signals appears to be the only method accessible for interstellar communication. Straightforward detection of "intelligent" transmissions seems to hold more promise than establishing two-way communication. With respect to the selection of frequencies, the use of lasers does not appear to be advantageous over interstellar distances, and, in the radio spectrum, the region from 10 to 30 kMc seems to be preferable for maximizing the signal-to-noise ratio. The use of the hydrogen line, however, may ease the frequency search problem. (I.A.A.)

## 376

**EXTRATERRESTRIAL LIFE.**

A. I. Oparin

*Izv. Akad. Nauk SSSR, Ser. Biol.* (Moscow) 28:1, 1963. p. 3–8. Transl. by JPRS, Apr. 4, 1963.
(JPRS–18538; AD63–21498)

The possibility of extraterrestrial life on Mars is discussed. This discussion begins with the conjecture that Mars once had a hydrosphere and an atmosphere. Thus, the evoluton of organic matter and origin of life on this planet may have occurred in a similar fashion to that on Earth. However, the physical conditions on Mars gradually came to differ sharply from those on Earth. The physical conditions now prevailing on Mars suggest that the only living organisms may be anaerobic micro-organisms whose metabolism functions in the absence of free oxygen. Water vapor, which is clearly insufficient in the Martian atmosphere, may condense at night into liquid on top of the "Martian soil" and thus create a medium in which primitive organisms can survive.

## 377

**FUTURE RESEARCH OF INTERSTELLAR COMMUNICATION.**

A. G. W. Cameron (NASA, Goddard Space Flight Center, Goddard Inst. for Space Studies, New York, N. Y.)

*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION, p. 309–315. N.Y., W. A. Benjamin, Inc., 1963.
(A64–10241)

Fields of research that can contribute in a more direct way to guesses about the nature of extraterrestrial societies are discussed. The nearest communicative civilization should be expected to be about 87 parsecs away (284 light-years). For civilizations

on planets near the very faint stars, which have been proposed as likely to exist, the laser may be the obvious way of communicating, since the signal-to-noise ratio of their optical transmissions should be orders of magnitude better than that calculated for the sun by Schwartz and Townes.

## 378

THE HISTORY ON THE CONCEPTS ABOUT MARS.
W. Ley
*Adv. Astron. Sci.*, Vol. 15, 1963. p. 435—445. 11 refs.

The evolution of man's ideas and concepts about the planet Mars is traced from the time of the ancient Greeks to the present. The fanciful planetary trip concepts of early and 17th century chroniclers is followed. The astronomical writings which describe the controversies over the "canals" and the existence of life forms on Mars are also examined. (Author)

## 379

INTERSTELLAR COMMUNICATION.
Philip Morrison (Cornell U., Physics Dept., Ithaca, N.Y.)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 249—271. N.Y., W .A. Benjamin, Inc., 1963.
Also *in: Philosophical Soc. of Wash., Bulletin*, Vol. 16, 1962. p. 58.
(A64—10236)

Communication with interstellar societies more advanced than ours is discussed. It is suggested that signal beams be mounted at home, beams of a simple and unmistakable kind, directed preferentially toward those points where we think listeners may sooner or later arise. The beams should be of a kind best suited to attract attention, and to carry information over the distance of galactic space. The frequency suggested is the major spectral line in the radio band, the 21-cm emissions from neutral hydrogen atoms.

## 380

INTERSTELLAR COMMUNICATION.
B. M. Oliver (Hewlett-Packard Co., Palo Alto, Calif.)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 294—305. N.Y., W. A. Benjamin, Inc., 1963. 14 refs.
(A64—10239)

During this century, while the expectation of finding intelligent extraterrestrial life has vanished for the rest of our solar system, it has grown enormously for other stellar systems. It is stated that, if we can signal out to 1,000 light-years for an extremely long time, our chances of contact are, perhaps, 50%. The microwave region still seems the best at the present state of the art. It is suggested that we send a repeated series of messages which constitute a course of instruction—facts about our civilization, our language, our science, and ourselves. The other race can then respond with a much more sophisticated initial message, perhaps one which would indicate some more efficient means of communication. (I.A.A.)

## 381

IS COMMUNICATION POSSIBLE WITH INTELLIGENT BEINGS ON OTHER PLANETS?
I. S. Shklovskiy
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 5—16. N.Y., Benjamin Inc., 1963.

That there are other planetary systems and that their physical location may be conducive to life is established from a statistical viewpoint. Radio communication, nature of signal, signal strength, and interference are discussed. The question of direction of search is last to be given attention and is tentatively identified only as a "high galactic altitude." (G.W.)

## 382

LIFE ON OTHER PLANETS? (LEBEN AUF ANDEREN STERNEN?).
Joachim Herrmann.
Gütersloh, Germany, C. Bertelsmann Verlag, 1963. 190 p. (In German)
(A64—80238)

This is a popular review of man's endeavor to satisfy his curiosity about his extraterrestrial environment. The author covers the historical background, speculations on extraterrestrial life, origin of life, environment on other planets, the moon, other galaxies, space travel in the future, current status of space flight, etc. Hazards of space flight are discussed in some detail, e.g., weightlessness, cosmic radiation, cabin atmosphere, need for repairs in space, extreme loneliness, etc. Projecting into the future suggests the planning of cities on the Moon or Mars, space travel across galaxies, photon rockets, etc. (Author)

## 383

IS THERE LIFE ON OTHER WORLDS?
P. Anderson
N.Y., Crowell-Collier Press, 1963. 216 p.

This book includes not only a sober consideration of what scientists believe to be fact but also carefully culled specimens of speculation beyond the actual fact by men who have been thinking hard about the problem of other-life for decades as well as stimulating speculation by the author himself. (From Foreword by I. Asimov)

Contents:

Chapt. 1: Stage Setting. Chapt. 2: Life on Earth. Chapt. 3: Sisters Under the Sun. Chapt. 4: Beyond the Sun. Chapt. 5: Life As We Do Not Know It. Chapt. 6: The Appearance of Intelligence. Chapt. 7: Other Minds. Chapt. 8: On the Nature and Origin of Science. Chapt. 9: Voices from the Stars. Chapt. 10: Tomorrow's Argosies. Chapt. 11: New Earth.

## 384

LIFE—A TERRESTRIAL OR COSMIC PRINCIPLE (EIN IRDISCHES ODER EIN KOSMISCHES PRINZIP).
W. Pons
*Weltraumfahrt*, 11:4, 1960—1963. p. 109—110. (In German)

## 385

**LIFE IN THE GALAXY.**

R. N. Bracewell

*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 232–242. N.Y., W. A. Benjamin, Inc., 1963.

The author establishes the concept that other stars and star systems have planets and that some of these planets are inhabitable. He postulates that life thereon is less advanced than that of Earth. Radio communication in "the galactic club" is a fact, but not from intelligent source; however, we should be alert for signals. Out of a discussion of the life phenomenon, it is speculated that sufficiently highly developed stellar communities are common but that contacting them, or its reverse, will be a matter of chance. (Author)

## 386

**LONG CHAIN FATTY ACIDS FROM THE ORGUEIL METEORITE.**

B. Nagy and M. C. Bitz

*Archiv. Biochem. Biophys.*, 101:2, 1963. p. 240–248.

Long-chain fatty acids were found in two Orgueil meteorite samples investigated. The carboxylic acids and their esters were identified by infrared spectroscopy and vapor phase chromatography. Since these samples were not contaminated during analysis, three possible explanations are proposed for their presence. (1) They could be terrestrial contaminations acquired when meteorites passed through the atmosphere, when they hit the ground, or during museum storage. Holbrook and Orgueil meteorites contain the same average number of contaminants, yet Orgueil contains not only even chain fatty acids representing recent contamination, but odd chain fatty acids possibly of biogenic origin from ancient sediments. (2) It is possible that the fatty acids are indigenous to the meteorite and are the result of abiological processes. However, it seems unlikely that purely inorganic reactions would produce an array of carboxylic acids which contain a relative abundance of straight chain compounds. (3) It is possible that these compounds are the result of biological activity on the meteorite body or bodies. The exact origin of the fatty acids in the Orgueil meteorite is not known. (A.H.F.)

## 387

**MARS.**

N. P. Barbashov

Moscow, 1963. 63 p. (In Russian)

## 388

**MICROSCOPIC EXTRATERRESTRIAL PARTICLES FROM THE ANTARCTIC PENINSULA.**

Richard A. Schmidt (NASA Ames Res. Center)

Presented at the Cosmic Dust Conf., N.Y., Nov. 21–22, 1963.

(Supported by NSF)

NASA–TM–X–51131; N64–22778) OTS $2.60 ph.

While several types of particles were recognized, black, metallic spherules and yellowish, glassy spherules were most common. The metallic spherules ranged from 10 to 170 microns in diameter, had physical properties generally similar to magnetite, and were rich in iron. The glassy spherules ranged from 10 to 300 microns in diameter, had physical properties similar to various forms of silica glass, and were rich in silica. A few glassy spherules appeared to be akin to tektites. Direct relations of frequency of spherule occurrence and annual snow deposit were suggested by the data, while an inverse relation between snow accumulation and mean spherule size was discovered. Exceptions to these relations were attributable to local and regional topographical and meteorological effects. The cumulative rate of deposition of metallic spherules was found to be essentially uniform for the area of the Antarctic Peninsula Traverse, although at individual stations the rates were divergent because of local factors. (Author)

## 389

**MULTIVATOR: A BIOCHEMICAL LABORATORY FOR MARTIAN EXPERIMENTS.**

E. Levinthal, L. Hundley and J. Lederberg

Presented at the Intern. Space Sci. Symp. (4th) Warsaw, 1963. 17 p.

(A63–18968)

Discussion of the basic concepts underlying the Multivator, a system designed for the detection of signs of life on Mars. The general criteria for noting signs of life on other planets are discussed, and a method for developing a matrix of the possible chemical and biological properties of living systems that must be analyzed is outlined. Described are details of the Multivator with which a wide range of biochemical experiments are possible, particularly studies in which a photomultiplier can be used as an output transducer. Recent investigations have centered on photometric assays of fluorescence, such as the determination of the widely distributed enzyme, phosphatase.

## 390

**NEGENTROPY AND LIVING SYSTEMS.**

H. F. Blum

*Science*, Vol. 139, 1963. p. 398.

The question of a deterministic point of view toward life emergence in current literature is discussed. It is hypothesized that the origin and evolution of living systems, or even the evolution of organic compounds, must have entailed the accumulation of a vast amount of negentropy. (A.H.F.)

## 391

**NEW EVIDENCE OF MARTIAN LIFE.**

M. H. Briggs (California Inst. of Tech., Space Sciences Div., Bioscience Group, Pasadena)

*In:* K. W. Gatland, ed. SPACEFLIGHT TODAY.

London, Iliffe Books, Ltd., 1963, p. 223–227. 27 refs. $6.25.

(A64–80565)

Studies of the infrared spectra of Mars demonstrated the presence of absorption bands probably due to organic compounds. These absorptions are characteristic of the spectra from the dark areas of the surface. This evidence points to the existence of complex organic substances in these areas of Mars. Absorptions which are typical of carbohydrate molecules were found in the

spetrum of a lichen and algae. The presence of this type of plants on Mars would provide an explanation of the negative results of chlorophyll. Although these studies do not demonstrate conclusively the existence of life on the surface of Mars, they make it appear very likely.

## 392

ORGANIC EXTRACTS OF SOME CARBONACEOUS METEORITES.
M. H. Briggs
*In:* LIFE SCIENCES, Vol. 1, 1963. p. 63–68.

Three approaches have been taken to determine whether materials of biological yet extraterrestrial origin can be detected in meteorites: (1) examination of the morphology of organic microstructures contained within meteorites, which has not produced any conclusive evidence either way; (2) culturing of viable micro-organisms within sterile meteorite samples, for which the reported successes can probably be explained by terrestrial contamination; and (3) chemical analysis of organic substances extracted from carbonaceous chondrites, which has revealed the presence of many compounds typical of terrestrial organisms but not necessarily of biogenic origin. Polarimetric studies failed to detect any optical activity; this result is indicative of an abiogenic origin for the organic compounds. (A.H.F.)

## 393

OUR GAMBLE IN SPACE—THE SEARCH FOR LIFE.
N. J. Berrill
*Atlantic*, 212:2, 1963. p. 135–50.

NASA is developing a program to search for extraterrestrial life, which includes instrumentation of planetary probes and also a small recoverable satellite for conducting bioscience space experiments. The scientific question at stake is the most challenging in western thought for 300 years, leading to new levels of discussion on the meaning and nature of life. Are we the inevitable consequence of chemical development on Earth? Martian microbes would suffice to prove the point. Life, as we know it, is based on carbon and can exist in an active state only when incorporated in liquid $H_2O$. The Earth, Venus, and Mars lie in the zone of the solar system where liquid $H_2O$ may exist. Evidence from Mariner II, however, indicates that the Venus environment is out of bounds for any kind of life. Mars shows seasonal changes suggestive of life. Will life on Mars, if present, follow the evolutionary sequences of Earth with the same chemical patterns, genetic codes, and sex development? Gulliver will be our first life probe intended to determine if there are microbes on Mars. Moon dust sampling may reveal evidences of former life preserved unchanged. We look for communications from outer space and look to Mars for further signs of life. (A.H.F.)

## 394

OUTLOOK REGARDING INTERSTELLAR COMMUNICATION.
Philip Morrison (Cornell U., Ithaca, N.Y.)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 316–317. N. Y., W. A. Benjamin, Inc., 1963.
(A64–10242)

The first success can be looked to within the years 1964–1966, when a Mars soft-landed instrument probe should be able to settle the issue of whether life exists on that planet. If the answer is yes, the next stage is to see whether or not that form of life has independent origin from that of the Earth. If this answer is also affirmative, it will transform the opinion that life is probable from a mere opinion to a statistic. Analogous work directed at the other uncertain factors, from searches for dark stellar companions to historical investigations of the drive to technical competency, ought to replace the speculative nature of current investigations of the field. (I.A.A.)

## 395

PERSPECTIVES FOR THE DEVELOPMENT OF EXOBIOLOGY.
A. A. Imshenetskiy
*In:* LIFE SCIENCES AND SPACE RESEARCH
Intern. Space Sci. Symp. (3rd), Wash., D.C., 1962 p. 1–15. Amsterdam, North-Holland Pub. Co., 1963. 20 refs.
(A63–23080)

A general discussion of the methods used and assumptions made in exobiology is presented. The problems involved in detecting extraterrestrial life are considered in terms of biochemical analyses, microbiological studies of meteorites, the possible physiology of extraterrestrial organisms, and the methods of detection of such organisms. The effects of cosmic factors on microorganisms are outlined, including low and high temperatures, vacuum, and radiation. The necessity of sterilizing space vehicles is briefly considered.

## 396

THE PROBLEM OF LIFE IN THE UNIVERSE AND THE MODE OF STAR FORMATION.
Su-Shu Huang (NASA, Goddard Space Flight Center, Greenbelt, Md.)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 89–92.
N.Y., W. A. Benjamin, Inc., 1963.
Also *In: Astron. Soc. of the Pacific Meeting*
San Francisco, Calif., Jun. 1959.
(A64–10216)

General conclusions concerning the occurrence of life in the universe are presented. The prediction is warranted that, out of 42 known stars (including the Sun) within 5 parsecs from us, only three stars have a good chance for supporting advanced living beings on their planets, if such planets exist. The problem of the occurrence of life in the universe reduces to the problem of discovering whether simple main sequence F, G, and K stars possess planets. Three arguments are presented for believing that the formation of planets around stars is a common phenomenon. It is predicted that nearly all single stars of the main sequence below F5 and, perhaps, above K5, have a fair chance of supporting life on their planets; therefore life should be a common phenomenon in the universe.

## 397

PROBLEMS OF TRANSMISSION IN INTERSTELLAR COMMUNICATION.
SU-SHU HUANG (NASA, Goddard Space Flight Center, Greenbelt, Maryland)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 201–206.
N. Y., W. A. Benjamin, Inc., 1963.
(A64–10231)

It is stated that beings who are transmitting signals to other worlds, in order to increase their chances of contacting civilizations in other worlds, must divide the antenna time and beam the signals successively to all stars which are within their reach and which are believed to be able to support life of an advanced form. Since our present technology is perhaps inferior to that of others who can communicate with us, it is suggested that our transmitting station should be used solely, at least for the next hundred years or so, for making responses to some intelligent messages from interstellar space that have been detected. (I.A.A.)

## 398

PROBLEMS IN THE DESIGN OF UNMANNED SPACECRAFT FOR PLANETARY AND INTERPLANETARY EXPLORATION.
James R. Miles, Sr. (N. Y., Inst. of the Aerospace Sciences)
Presented at the IAS 31st Annual Meeting, New York, Jan. 21–23, 1963.
(IAS Paper–63–36) IAS: $0.50 members, $1.00 nonmembers
(N63–12890)

Problems in the design of spacecraft for interplanetary journeys, for making scientific observations en route and at the destinations, are discussed in relation to the present technology and advances needed. Topics mentioned include: biological sterilization and its effects upon spacecraft hardware; midcourse maneuvers; capsule ejection, entry, landing, and deployment; power requirements, thermal control, and communications. (Author)

## 399

PROJECT OZMA.
Frank D. Drake (Natl. Radio Astron. Obs., Green Bank, W. Va.)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 176–177.
N.Y., W. A. Benjamin, Inc., 1963.

The first systematic, high-sensitivity search for manifestations of extraterrestrial intelligent life are described. Tau Ceti and Epsilon Eridani were chosen as subjects because they are the nearest single sunlike stars observable from the telescope site. Preliminary observations discovered no signals of extraterrestrial origin, but radio frequencies still appear to offer the greatest hope for success. (Author)

## 400

RADIO SIGNALS FROM OTHER PLANETS.
R. N. Bracewell (Stanford U.)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 199–200.
N.Y., W. A. Benjamin, Inc., 1963.
Also *In: IRE Proc.*, Vol. 50, 1962. p 135.
(A64–10230)

The most suitable microwave frequency to be searched for intelligent signals from other planets is considered. No case has been made for avoiding 1,420 Mc. There are, however, reasons for not using 1,420 Mc or other microwave frequencies, if the distance to the nearest community more advanced than our own is 100 light-years rather than the 10 light-years investigated by Project Ozma.

## 401

RADIOASTRONOMY AND COMMUNICATION THROUGH SPACE.
E. Purcell
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATIONS. p. 121–143.
N.Y., W. A. Benjamin, Inc., 1963.

The contributions to knowledge of distant galaxies by radioastronomy are reviewed and followed by a discussion of modes of travel beyond the solar system. After accepting that there are other habitable non-solar planets, the author discusses transmission of coded messages and the analysis of messages received, and suggests that a sequence of prime numbers be both sent and listened for over the period of centuries, not fiscal years. (Author)

## 402

SEARCHING FOR INTERSTELLAR COMMUNICATIONS.
G. Cocconi and P. Morrison
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATIONS. p. 160–164.
N.Y., W. A. Benjamin, Inc., 1963.

The optimum channels on which to receive interstellar messages are given as that radio band from 1 to $10^4$ mc, with 1420 mc/sec as the most promising. Power demands of the source and signal location and bandwidth are seen as presenting no real problem. It is postulated that any signal will be pulse-modulated, will continue for 10 years or more and will then repeat. Four systems are suggested as possible sources : Tau Ceti, 02 Eridani, Epsilon Eridani, and Epsilon Indi. (J.W.)

## 403

THE SIZE OF HABITABLE PLANETS.
Su-Shu Huang (NASA, Goddard Space Flight Center, Greenbelt, Md.)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 102–106.
N.Y., W. A. Benjamin, Inc., 1963.
Also *In: Publ. Astron, Soc. of the Pacific*, Vol. 72, 1960. p. 489.
(A64–10219)

The conditions for habitability and size of planets are discussed. The tentative conclusion is reached that a habitable planet will have a radius lying between 1000 and 20 000 km. This is a generous estimate, as this range includes the Moon and Mercury, both of which are known to be uninhabitable. The suggestion has recently been advanced that the rate of biological evolution on a planet may increase with its surface area, if other conditions are equal.

## 404

SOME RESULTS OF COMPARISON OF CARBONACEOUS CHONDRITE BITUMENS WITH BITUMENS OF TERRESTRIAL ROCKS. (NEKOTORYYE RESUL'TATY SRAVNENIYA BITUMOV UGLISTYKH KHONDRITOV S BITUMAMI GORNYKH POROD).

G. P. Vdovykin

*Meteoritika, Akad. Nauk S.S.S.R.*, No. 23, 1963. p. 56–61. 21 refs. (In Russian)

Specimens of the chondrites Groznaya and Mighei, as well as samples of serpentinite, ozocerite, and clay shale were analyzed, and their chemical compositions determined and compared. It was established that the composition of chondrite bitumens strikingly resembles that of serpentinite and, to a lesser degree, that of ozocerite and clay shale. The results confirm the findings of other authors and appear to prove that under conditions of low temperature (below 400° C) and increased pressure (300 atm), organic compounds containing oxygen can be obtained. It is possible that the primordial organic compounds of our planet originated in a similar way and later evolved into complex organic groups. (S.T.L.)

## 405

THE SOLAR SYSTEM AND EXTRATERRESTRIAL LIFE.

R. Berger

*In:* ADVANCES IN THE ASTRONAUTICAL SCIENCES, Vol. 13. p. 649–665.

North Hollywood, Calif., Western Periodicals Co., 1963.

Paper presented at A.A.S. 9th Ann. Meet., Interplanet. Missions Conf., Los Angeles, Calif. Jan. 15–17, 1963.

(63–23877)

A discussion is presented of the current experimental results, opinion and speculation in research on the problem of extraterrestrial life. Ideas on chemical and prebiological evolution in space are connected with the origin of life. The planets are examined for a potential environment of life forms. Also, the evidence in meteorites is analyzed. In addition, such areas as environmental limitations of extraterrestrial life, panspermia and life detectors are included. (S.T.L.)

## 406

SPACE CHEMISTRY.

Paul W. Merrill

Ann Arbor, Univ. of Mich. Press, 1963. 163 p.

Some chemical evidence supporting a positive view of the existence of some form of life on Mars has been obtained. Spectroscopic observations reveal bands of a CH radical of organic molecules. This would support the view that organic molecules are produced in localized regions and that some sort of life—vegetation or even possibly bacteria would be capable of doing this. (E.C.)

## 407

SPACEFLIGHT TODAY.

K. W. Gatland, ed.

London, Iliffe Books, Ltd., 1963. 254 p. $6.25.

(A64–80532)

The monograph contains several articles treating various problems affecting astronautical development. Articles pertinent to aerospace medicine and space exploration (e.g., weightlessness, radiation, meteoroids, extraterrestrial life) are abstracted separately.

## 408

STELLAR LIFE ZONES.

A. G. W. Cameron (NASA. Goddard Space Flight Center, Goddard Inst. for Space Studies, New York, N.Y.)

*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION, p. 107–110.

N.Y., W. A. Benjamin, Inc., 1963.

(A64–10220)

A discussion is presented of the invalidity for the solar system of Huang's assumption that the probability of finding a planet in any position near a star is proportional either to the element of area on the orbital plane or to the element of volume in space. The conclusion is reached that all single stars in space (except those with very low heavy-element contents) have a life zone containing an average of about 1.4 planets of undetermined size. Huang suggested that the best probability for finding life in a stellar system within 5 parsecs would be in the Epsilon Eridani and Tau Ceti systems. But there are about 26 other single stars of smaller mass within this distance, each of which should have a comparable probability of having a life-supporting planet according to the present analysis.

## 409

STERILIZING UNMANNED SPACECRAFT.

L. D. Jaffe

*Astronautics Aerospace Eng.*, 1:7, 1963. p. 22–29. 22 refs.

(A63–20266)

The engineering problems involved in spacecraft sterilization for unmanned space exploration are examined in terms of the contamination of another planet with Earth organisms. Various aspects of sterilization are discussed, including ablation, impact on the planetary surface, use of the space environment (radiation and temperature), gas and liquid sterilization, and heat. Aseptic procedures for the assembly of previously sterilized spacecraft components or subassemblies are suggested, as are the possibilities of subsequent recontamination. Conflicts with the sterility requirement, such as the need for late calibration and adjustment of equipment, are explained. The probability of introducing a viable organism into the atmosphere of Venus or Mars should be held to $10^{-4}$, and techniques for accomplishing this are discussed. The following general propositions are made: (1) for Mars orbiters, sterilization should be required; (2) for Mars and Venus flyby spacecraft, Venus orbiters, and the last stage of launch vehicles, sterilization should be used, or trajectories should be controlled to ensure not over $10^{-4}$ probability of hitting Mars and $10^{-1}$ probability of hitting Venus; and (3) lunar-flight sterilization does not appear to be essential.

## 410

THE STRUCTURE AND FUNCTION OF LIVING MATTER.

R. S. Karpinskaya

Transl. by JPRS of *Vopr. Filosofii* (Problems of Philosophy), 17:8, 1963. p. 104–114. *In:* PHILOSOPHICAL ASPECTS OF LIFE ON THE MOLECULAR LEVEL, Nov. 8, 1963. 31 p.

(JPRS–21806; OTS–41107; $1.00; N64–12069)

In order to cast light on the essence of life, discover basic biological principles, and develop methods of controlling vital processes, the "entire complex of biological sciences must be developed in every possible way." One of the most important problems in this complex is that of the physical properties, chemical structure, and physiological functions of proteins, nucleic acids, and other biologically important compounds. The structure, evolution, and function of these compounds are discussed. (Author)

## 411

WHAT IS ASTROBOTANY?

G. A. Tikhov.

IN: K. W. Gatland, ed., SPACEFLIGHT TODAY. p. 215–222.

London, Iliffe Books, Ltd., 1963. $6.25.

(A64–80528)

Astrobotany is a combination of planetary astronomy and spectral analysis as applied to the study of plants on earth and on other planets. Various studies in this area are discussed, including those on the possibility of vegetable life on Mars and Venus, and on the newly discovered optic properties of plants. The discovery was made that flowers possess the property of emitting radiation or fluorescence as do plants. Moreover it was found that the fluorescence of plants increases rapidly with rise in temperature of the air and does not disappear even when the temperature drops to several tens of degrees below zero. In all probability fluorescence enables the plant to generate surplus warmth and emit it to the environment. On the other hand it enables the plant in early spring to thaw the snow around it and emerge onto the surface. The possibility is not excluded that with the perfection of methods of observation, areas of vegetation will be discovered on Mars possessing the property of emitting radiation in red and infrared rays, which permits them to withstand the sharp changes of temperature during the Martian day and night. Astrobotanical research suggests that vegetable life must be fairly widespread throughout the universe and in addition, possibly animal life, as in principle there is no difference between plants and animals.

## 412

STUDIES WITH A SIMULATED MARTIAN ENVIRONMENT.

Thomas L. Roberts (Aerospace Med. Div., Brooks AFB, Tex.)

*J. Astronautical Sci.*, 10:3, Fall 1963. p. 65–74. 56 refs.

(A64–10147)

Hypothetical models of the planet Mars, constructed on the basis of observations and indirect experiments are presented. The models are used to investigate problems pertaining to atmospheric and surface features in determining whether Mars offers a hospitable environment for terrestrial life. Experiments with these models indicate that bacteria are able to survive and multiply in a simulated Martian environment, and thus the view is encouraged that life exists on Mars.

## 413

TERRESTRIAL AND EXTRATERRESTRIAL LIFE.

M. H. Briggs (Calif. Inst. of Tech., Bioscience Group, Pasadena Calif.)

IN: K. W. Gatland, ed. SPACEFLIGHT TODAY.

London, Life Books, Ltd., 1963. 12 refs. $6.25.

(A64–30530)

The alien intelligences hypothesis for the origin of life on Earth is discussed. This hypothesis makes the following three basic assumptions: (1) that intelligent life existed elsewhere in the universe prior to the beginning of life on earth, (2) that interplanetary flight (travel between two planets) is possible and that the intelligent life of the first assumption was capable of making such journeys, and (3) that lifeless earth was visited by such extraterrestrial intelligences who either deliberately or accidentally left microbes behind them when they departed. The random forces of natural selection are all that is required for these organisms to evolve into the known terrestrial forms of biological complexity. Evidence for and against this hypothesis is discussed. At the moment, the chemical origin of life is the most favored; but this is largely because it is capable of being investigated experimentally in the laboratory while others are not. It may be that, if life in the universe is considered as a whole, life could have arisen on some planets by chemical evolution and then transferred to other planets by meteorites and intelligent races. All three hypotheses may be correct for the universe, but only one of them can be correct for a particular planet such as Earth. *(Aerospace Med.)*

## 414

THE TERRESTRIAL PLANETS.

C. Sagan and W. W. Kellogg

*In:* L. Goldberg, ed. ANNUAL REV. OF ASTRONOMY AND ASTROPHYSICS, Vol. 1. p. 235–266.

Palo Alto, Calif., Annual Review, Inc., 1963.

The most widely accepted interpretation of the wave of darkening on Mars is the response of vegetation to the increased availability of atmospheric water vapor. The demonstration of the survival or replication of terrestrial micro-organisms in simulated Martian environments is not taken as proof of the existence of life on Mars but it allows a reasonable assumption that, if terrestrial micro-organisms can survive on Mars, then indigenous organisms, evolved on Mars, may be even more efficient in dealing with the apparent rigors of the environment. (E.C.)

## 415

WHY LAND ON THE MOON?

R. Jastrow and H. Newell

*Atlantic*, 212:2, 1963. p. 41–45.

Moon exploration may help solve one of the classic problems of science, the origin of the solar system. The moon with no oceans or atmosphere to destroy the surface may still hold the key to the origin of life and the probability of other living

organisms in the universe. If the moon and planets were formed in the near collision of two stars, then life must be very unusual, possibly unique because space is very empty and collision between stars extremely rare. If planets were formed as a natural condensation process in which our sun was born, the creation of planets must have accompanied the formation of nearly every star in the universe. Since most of these stars are expected to have planets around them, there must be many cases in which size of one of the planets and its distance from the star are suitable for the development of life in a form somewhat as we know it. These are the fundamental questions involving the physical origin of our solar system and its living organisms, on which a powerful attack can now be made with the aid of lunar and planetary exploration. (A.H.F.)

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## 416

**SEARCH FOR ORGANIZED ELEMENTS IN CARBONACEOUS CHONDRITES.**

E. Anders, F. W. Fitch

*Science*, 138:3548, Dec. 28, 1962. p. 1392–1399.

By means of a systematic search of Orgueil stone, an attempt is made to confirm previous reports of occurrence of life forms in meteorites. This effort is based on the following generic properties of the organized elements: (1) fluorescence in ultraviolet light, (2) biological staining, (3) insolubility in hydrofluoric acid, and (4) density less than 2.4 g/cm$^3$. (J.P.L.)

## 417

**INTERPRETATION OF MICRO-STRUCTURES IN CARBONACEOUS METEORITES.**

G. Mueller (U. of Concepcio, Concepcio, Chile)

*Nature*, 196:4858, Dec. 8, 1962. p. 929–932.

An attempt to clarify the controversy concerning the origin of the microscopic objects within the Orgueil and several other arbonaceous stones is presented. Additional evidence is provided from observations under the polarizing microscope of 15 previously recognized and five new stones with a carbonaceous phase. It is found that the majority of the structures claimed to be of organic origin could be readily and quite unequivocally identified as mineral grains. (E.O.)

## 418

**NEW DATA ON THE NATURE OF ORGANIC COMPOUNDS OF CARBONACEOUS CHONDRITES (NOVYYE DANNYYE O PRIRODE ORGANICHESKIKH SOYEDINENII UGLISTYKH KHONDRITOV).**

G. P. Vdovykin and N. V. Pomortseva

*Geokhimiya*, No. 12, Dec. 1962. p. 1106–1107. 9 refs.

(In Russian)

Oxidizing bacteria were introduced into a nutrient solution consisting of water and $(NH_4)_2$ $SO_4$, $Na_2HPO_4$ $KH_2PO_4$, $MgSO_4$, and NaCl. Specimens of the chondrites Groznaya and Mighei were used in the experiments. The results obtained demonstrate that the organic matter extracted from carbonaceous chondrites is of primordial nature and was not generated during the extraction process or produced as a result of the destruction of biogenous elements. (Author)

## 419

**ON THE AMOUNT OF WATER AVAILABLE IN A FREE STATE ON MARS.**

A. I. Lebedinskiy and G. I. Salona

*Soviet Astron. (AJ)*, 6:3, Nov.–Dec. 1962. p. 390–397. 11 refs.

Discussed is the amount of water available in the free state on the planet Mars. The estimate was arrived at through two different approaches: 1) from the degree of turbidity of the atmosphere, 2) from the rate of evaporation of the polar ice caps. Both approaches produced closely agreeing estimates. The thickness of the snow or cloud layer in the polar ice caps is 0.01 g/cm$^2$, and the total quantity of water in the free state on Mars is $2 \times 10^{15}$ g. Errors are pointed out in the calculations by de Vaucouleurs and Janesley. (S.T.L.)

## 420

**THE DISTRIBUTION OF LIFE IN THE SOLAR SYSTEM: AN EVALUATION OF THE PRESENT EVIDENCE. APPENDIX—RECENT STUDIES OF LIFE-FORMS IN METEORITES.**

Michael H. Briggs (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.)

*Brit. Interplanet. Soc., J.*, Vol. 18, Sept.–Oct., Nov.–Dec. 1962. p. 431–437. 156 refs.

(NASA supported research.)

(A63–12358)

Assessment of the current information on the present distribution of life in the solar system, considered before any possible transfer of terrrestrial forms by space exploration. From a study of 156 references it is concluded that Mars is the only other planet likely to have life. On Venus the surface temperature is probably too high for life, but some primitive organic compounds may possibly be found in the dense clouds. On the Moon it is impossible to decide whether any of the terrestrial types of life could exist. The temperatures are too low on the planets beyond Mars to give rise to Earth-type polymers, though some radiation-formed hydrocarbon polymers may occur there.

## 421

AN HISTORIC REPORT ON LIFE IN SPACE: TESLA, MARCONI, TODD.

C. D. Jackson and R. E. Hohmann

Presented at the 17th Ann. Meeting and Space Flight Exposition, Los Angeles, Nov. 13–18, 1962.

*N.Y. Am. Rocket Soc.*, 1962. 7 p. 23 refs.

During the years 1899 to 1924, three experimental scientists—Nikola Tesla, Guglielmo Marconi, and David Todd (each working independently)—observed laboratory data and related phenomena which suggested the possibility that they were monitoring interplanetary communications. During the same period, the Russian theorist Konstantin Tsiolkovsky deduced a model of an intelligence existing independently of terrestrial influence. Tesla, Marconi, and Todd did not know that they were working with identical data, nor did they know that these data corroborated, in a quantitative manner, the theoretical model built by Tsiolkovsky. The investigations and experimental data of Tesla, Marconi, and Todd are presented. These data are first assembled in an historical model (1899 to 1924), then shown to be the natural complement of a current theoretical model (1959 to 1962), and finally recommended for assembly into a quantitative model according to the theoretical outline described by Tsiolkovsky. (J.P.L.)

## 422

WHAT WE WANT TO KNOW ABOUT MARS.

P. Moore

*New Scientist*, 16:312, Nov. 8, 1962. p. 309–311.

Mars presents many problems which remain to be solved. Some of them can hardly be cleared up without the use of probe vehicles. Present impressions, based on visual and spectroscopic studies, indicate an arid world which nevertheless probably supports life of some kind. (Aerospace Med.)

## 423

BIOASTRONAUTICS.

George B. Smith, Jr., Siegfried J. Gerathewohl, Bo E. Gernandt, Richard S. Johnston, and Richard S. Young

Presented at Session L of the NASA-University Conf. on the Science and Technol. of Space Exploration, Chicago, Nov. 1–3, 1962. 36 p. 60 refs.

(NASA–SP–18; N63–11508) GPO: $0.30.

Contents:

1: Environmental Biology. G. B. Smith, Jr. (NASA. Manned Spacecraft Center) 4 p.; 2: Physiological and Behavioral Sciences. S. J. Gerathewohl and B. E. Gernandt. (NASA. Ames Research Center) 15 p. 43 refs.; 3: Bioengineering. Richard S. Johnston (NASA. Manned Spacecraft Center) 8 p. 1 ref.; 4: Exobiology. Richard S. Young (NASA. Ames Research Center) 7 p. 16 refs.

## 424

EXOBIOLOGY.

R. S. Young.

*In:* NASA-Univ. Conference on the Science & Technology of Space Exploration (1st), Chicago, Nov. 1–3, 1962. Proc., Vol. 1, Wash., D. C., 1962. p. 423–429. 16 refs.

(NASA–SP–11)

Exobiology is concerned with the detection and study of extraterrestrial life, and its impact on the origin and evolution of life on Earth and elsewhere in the universe. Three phases of the exobiology program of the National Aeronautics and Space Administration (NASA) are described and discussed. These include: (1) studies on the chemistry of formation of biologically signicant molecules under conditions that may have prevailed on the primitive Earth or some other likely planet; (2) the detection and study of extraterrestrial life, with the first object of study being the planet Mars, although the Moon, Venus, and Jupiter are not without biological significance; and (3) laboratory studies on Earth in which extraterrestrial and primitive environments are simulated. The NASA program requires highly specialized laboratory facilities and personnel particularly in biology, biochemistry, and organic chemistry. Some of the work is being done in NASA Laboratories in industry, and in universities throughout the country.

## 425

EXOBIOLOGY—A NEW FIELD OF SCIENTIFIC RESEARCH (EKZOBIOLOGIYA—NOVAYA OBLAST' NAUCHNYKH ISSLEDOVANII.

A. A. Imshenetskiy

*Akademiya Nauk SSSR, Vestnik*, Vol. 32, Nov. 1962. p. 58–63. (In Russian)

(A63–11283)

Discussion of some problems associated with the development of experimental techniques suitable for the investigation of the existence of life on other planets. Particular attention is given to possible methods of life detection, and to the effects of space environment upon living cells.

## 426

LIFE IN A METEORITE.

D. F. Zigel

*Ogonek*, No. 47, Nov. 1962. p. 28–29. Transl. into English by JPRS.

(JPRS–17326; AD–407201; N63–12190)

Micro-organisms have been cultured from a specimen of the Sikhote-Alin' meteorite (the Soviets claiming this is the first time a living culture has been isolated from a meteorite). The culture of "meteoritic rods" is similar to cultures of bacteria obtained from the terrestrial mineral ozocerite. (E.O.)

## 427

MARINER B TO TEST FOR LIFE ON MARS.

W. Beller

*Missiles and Rockets*, 11:15, Oct. 8, 1962. p. 24–25.

NASA scientists have chosen Mars as the target for the Mariner B experiment, a radioisotope biochemical probe for extraterrestrial life. The detection apparatus is described, as well as the method to be used for data collection and analysis once the unmanned probe soft lands on Mars. (S.T.L.)

## 428

SPACE BIOSCIENCES.
Orr E. Reynolds
*A.I.B.S. Bull.*, 12:5, Oct. 5, 1962. p. 49–51.
(N63–12836)

The biologist's task in space is considered to fall into three categories: (1) the search for extraterrestrial life; (2) the attempt to put man into space adequately protected from space hazards and sustained by a good simulation of his terrestrial environment; and (3) the exploitation of special features of the space environment for the general analysis of organism–environment relationships. The first objective is considered to be the most important because of its philosophical implications concerning the meaning of life and man's place in nature. Major developments required for carrying out these objectives include: the design of highly reliable flight systems adapted to biological experiments; the integration of experimental biologists with physicists and engineers to achieve the maximum collection of reliable data; and the rapid development of biological theory and concept so that experimental design for space biology will be more certain of answering the pertinent questions. (M.P.G.)

## 429

THE ENVIRONMENT OF THE PLANETS.
William W. Kellogg
Presented at the Space Exploration lecture series, Calif. U., Oct. 1–4, 1962 and at Moffett Field, Anaheim, Los Angeles, and San Diego. 13 p. 5 refs.
(P–2640; N63–19338)

This review discusses the solar system and the limitation of observations from earth optical telescopes, radio telescopes, and space probes. Also included are studies of Mars and Venus atmospheres and surfaces and the possibilities of the existence of life forms on these planets. (N.E.A.)

## 430

COMMUNICATION: FROM MOLECULES TO MARS.
M. Calvin
*A.I.B.S. Bull.*, 12:5, Oct. 1962. p. 29–44. 75 refs.

Biochemical evolution on earth and the generation of molecular compounds which may give rise to terrestrial and extraterrestrial organisms are discussed. A definition of a living system is attempted. Materials known to make a living system, time factors, starting material, energy sources, initial transformations, polymerization, generation of order and new information, and the development of cellular structure are discussed. Various detecting devices for future assessment of organic matter on the Moon, Venus, and Mars are described. In the meantime, meteorite observations serve as a source of such information. Life in other galactic systems can be explored only statistically. It is suggested that there must be several terrestrial-type planets upon which living systems could have evolved. (A.H.F.)

## 431

LIFE ON MARS.
G. V. Levin and A. W. Carriker
*Nucleonics*, 20:10, Oct. 1962. p. 71–72.

Experiment Gulliver, which will detect presence of microorganisms on the surface of Mars with radioactive tracer techniques, is described. Samples of Martian soil are injected into a radioactive nutrient broth. Detection of radioactive gas evolved from the broth will constitute evidence of life. The method of sampling and detection of particles is given. (J.P.L.)

## 432

RADIO SEARCH FOR DISTANT RACES; A SEARCH OF THE ELECTROMAGNETIC SPECTRUM FOR SIGNALS FROM EXTRATERRESTRIAL INTELLIGENCE CAN NOW BE SERIOUSLY CONSIDERED ON A PRACTICAL ENGINEERING BASIS.
B. M. Oliver
*Intern. Sci. Technol.* Vol. 10, Oct. 1962. p. 55–60.

It is now considered unlikely that intelligent life exists elsewhere in our solar system. But within some 16 light years are three stars which might have the kind of planetary systems that should support life long enough for intelligent races to emerge. Within 1000 light years there are hundreds of thousands of such stars. Terrestrial technology has reached the stage where an attempt to find and contact intelligent extraterrestrials can be undertaken with a reasonable hope for success. If we can use the optimum transmission frequencies and modes (as any intelligent race would), and if we can reach out far enough for a long enough time, our chances might be as high as 50%. Among technically sophisticated races (those with radio telescopes) scientific semantics should not raise an insurmountable problem. But the whole thing depends on the longevity and effectiveness of the effort at both ends. (Author)

## 433

SAILING IN NEW AND OLD OCEANS.
R. Revelle
*A.I.B.S. Bull.*, Oct. 1962. p. 45–47.

It is reasonably certain that, within our own solar system, primitive forms of life can exist on Mars, and probably Venus. But the conditions on these and other planets of our solar system are probably too difficult for intelligent, highly developed life such as is known on Earth. If modern theories about the formation of stars are correct, probably the great majority of stars have planets around them. There is a chance that, on at least some of these planets, life began as it did on the Earth, perhaps two billion years ago. If so, it may have evolved in a beneficent realm of light and liquid water, and in an atmosphere of oxygen and nitrogen, to a level perhaps as high, perhaps much higher, than the highest life as known on Earth. However, even if intelligent beings exist on the planets of other stars, communication is almost impossible, because of the distances involved. A radio message to one of the planets of Betelgeuse or Rigel, which are among Earth's nearest stellar neighbors, would take several hundred years to get there, and the reply would require an

equal time. In the present state of civilization, by the time a reply was received, no one on Earth would known what was said in the first place. A radio message from one side of our galaxy to the other would require 200 thousand years before a reply could be heard. Also, the biological and sociological problems involved in sending out a manned spacecraft, which could not return to earth for 2000 years, are discussed. (I.v.L.)

## 434

SOLAR SYSTEM SCIENCE: 1961 LITERATURE SURVEY, PART III BOOK NOTES: A SELECTED LIST.

Donna Wilson

*Icarus*, 1:3, Oct. 1962. p. 286–295. 40 refs.

(NASA Contract NASr–21 (04))

(N63–12581)

Included in this survey are annotated listings of books on solar system science published in 1961. (I.v.L.)

## 435

PROPERTIES OF THE ORGANIC MICROSTRUCTURES OF SOME CARBONACEOUS CHONDRITES.

M. H. Briggs

*Nature* (London), 195:4846. Sept. 15, 1962. p. 1076–1077. 10 refs.

A report is presented on the results of an examination to determine the nature of organic microstructures in three carbonaceous chondrites (Mokoia, Murray, and Orgueil). It is concluded that the meteorite samples examined did not contain anything identifiable as "organized elements." On the other hand, all these meteorites do contain a variety of microstructures which in certain features resemble the "organized elements." However, it would seem that these microstructures are of several types: (a) various mineral grains; (b) droplets of organic solvent-soluble carbon compounds, possibly associated with elemental sulfur; and (c) organic solvent-soluble carbon compounds that perhaps could be high molecular weight hydrocarbon polymers. At present there is certainly no convincing evidence for the existence of any material within carbonaceous chondrites of extraterrestrial, biological origin. (S.T.L.)

## 436

INTERPPRETATION OF MICRO-STRUCTURES IN CARBONACEOUS METEORITES.

G. Mueller (Concepción University, Concepción, Chile)

*In:* Umberto Colombo and G. D. Hobson, eds. Advances in Organic Geochemistry; Proceedings of the First International Meeting of the Geochemical Society, Organic Geochemical Group, Milan, Italy, Sept. 10–12, 1962.

Meeting sponsored by the Lombard Branch of the Società Chimica Italiana, Montecatini—Società Generale per l'Industria Mineraria e Chimica, and Ente Nazionale Idrocarburi.

Oxford, Pergamon Press, Ltd., 1964. p. 119–140. 16 refs.

(A64–27533)

Discussion of the possible cosmological histories of carbonaceous meteorites, by analyzing the properties of, and microstructures in, these meteorites. Evidence for the possible existence of life on these bodies is discussed briefly in terms of work on the chemistry and petrography of their organic and inorganic phases, and in further detail based on studies with a polarizing microscope on the microstructures in samples of 20 carbonaceous chondrites. The distribution of euhedral crystals, globular or rounded grains, veinlet fillings and concreting structures, and microfossil-like structures in these chondrites is examined, and the possible history of formation of such chondrites is discussed. The results are used to consider the possibility of biogenesis in carbonaceous chondrites. (P.K.)

## 437

MINERALIZED MICROSTRUCTURES IN CARBONACEOUS METEORITES.

Bartholomew Nagy (Fordham University, Dept. of Chemistry, New York, N.Y.) and George Claus (New York University, Medical Center, New York, N.Y.).

*In:* Umberto Colombo and G. D. Hobson, ed. Advances in Organic Geochemistry; Proceedings of the First International Meeting of the Geochemical Society, Organic Geochemical Group, Milan, Italy. Sept 10–12, 1962.

Meeting sponsored by the Lombard Branch of the Società Chimica Italiana, Montecatini—Società Generale per l'Industria Mineraria e Chimica, and Ente Nazionale Idrocarburi.

Oxford, Pergamon Press, Ltd., 1964. p. 109–114. 32 refs.

(A64–27531)

Analysis of partially mineralized microstructures present in carbonaceous chondrites, which seem to have carbonaceous residues exhibiting elaborate morphologies resembling the morphology of certain terrestrial unicellular organisms. Earlier studies on carbonaceous meteorites to determine possible extraterrestrial life are briefly reviewed. A microbiological investigation on "organized" organic microstructures in these meteorites, to determine the possibility that they might be remnants of once-living extraterrestrial organisms, is discussed. The results neither rule out nor definitely confirm this possibility. (P.K.)

## 438

BIOLOGY AND FLIGHTS TO OUTER SPACE.

V. Ya. Kop'yev

Nauka I. Zhizn', No. 9, Sept. 1962. p. 13–22. Transl. by JPRS.

(JPRS–16766)

A brief description of bacteriological experiments in space is followed by a discussion of terrestrial contamination possible from returning probes. Some of the problems mentioned are microbial parasitism, adaptation, toxin production, and specialization. The author tacitly assumes that there is no question of extraterrestrial life forms in those regions subject to exploration. (E.O.)

## 439

EXTRATERRESTRIAL LIFE.

R. R. Austin

*Spaceflight*, Vol. 4, Sept. 1962. p. 176.

The existence of life within the solar system may be inferred from the gaseous composition of the planetary atmospheres. Organic molecules but not life would exist on planets with primi-

tive type atmospheres. The fact that Mars possesses some $O_2$ and more $CO_2$ argues that some vegetation probably exists and that the $CO_2$ represents the existence of previous life. However, life on Venus may be in the formative stage since cloud cover would prevent the formation of oxygen by the mechanism of chlorophyll usage. Out of $10^{12}$ possible planets, $10^3$ planets probably have life. (E.O.)

## 440

**MICROENVIRONMENTS FOR LIFE ON MARS.**

Joshua Lederberg and Carl Sagan (Stanford U. School of Med., Calif.)

*Proc. Natl. Acad. of Sci., 48:9*, Sept. 1962. p. 1473–1475. 22 refs.
(NASA Grants NsG–81–60 and NsG–126–61)
(N63–15275)

It has been fairly well determined that some terrestrial microorganisms can survive in purported simulations of the Martian environment. Surface temperatures vary from — 200° K to 310° K. Seasonal changes in the polar ice cap imply a variation in the availability of atmospheric water vapor. Substantial moisture may be frozen in the subsoil. Also, moisture and warmth may be available through localized geothermal activity. A search for favorable microhabitats can be made from planetary flyby vehicles such as the Mariner series. (J.A.J.)

## 441

**SPACECRAFT STERILIZATION: PART II.**

A. M. Nowitzky

*Missiles and Space*, 10:9, Sept. 1962. p. 16–18.

Part II gives examples of specific sterilization techniques and procedures.

## 442

**METEORITIC HYDROCARBONS AND EXTRATERRESTRIAL LIFE.**

E. Anders

*N. Y. Acad. Sci. Ann.*, 93:14, Aug. 29, 1962. p. 649–664.

A critical analysis is given of previous work which states that extraterrestrial life and biogenic processes exist in the universe. This statement based on the analyses of mass spectrometric studies of hydrocarbons found in the Orgueil meteorite is refuted. The author compares the peak heights of the mass spectra of butter, recent earthy sediments, and hydrocarbons of the Orgueil meteorite, and find little resemblance in general. Other criticisms concerning changes in the hydrocarbons of the meteorites by radiation, dehydrogenation by sulfur, replication, and nebular formation are pointed out. These criticisms make it impossible to state affirmatively that life exists outside the Earth. (E.O.)

## 443

**MOON MAY NOW BE CONTAMINATED.**

W. Beller

*Missiles and Rockets*, 11:9, Aug. 27, 1962. p. 24–27.

Man may already have contaminated the Moon, since sterilization of Lunik 2 and Ranger 4 was incomplete. Hitchhiking microorganisms in rocket fuel and sealed components may have been released alive onto the lunar surface and may be proliferating there in the lunar subsurface—possibly ruining man's hope of exploring a virgin Moon. Other subjects covered include: (1) theories of lunar origin, development, and characteristics; (2) four theories of possible life on the Moon; (3) the possibility that Apollo astronauts may become carriers of lunar micro-organisms; and (4) data expected to be furnished by Ranger 5 and Surveyor flights. (Author)

## 444

**LIFELIKE FORMS IN METEORITES.**

H. C. Urey

*Science*, 137:3530, Aug. 24, 1962. p. 623–624, 626, and 628.

At a meeting held May 1, 1962 at the New York Academy of Sciences a group of papers were presented dealing with the organized elements which were observed in carbonaceous chondrites. It is doubtful that a conclusion that these compounds and fossil-like objects either are, or are not, valid evidence for extraterrestrial life can be drawn at the present time, although the evidence for extraterrestrial life is better now than it was before. The opinions expressed by the microbiologists and micropaleontologists are indeed very impressive. If it can be shown that these hydrocarbons and the "organized elements" are the residue of living organisms indigenous to the carbonaceous chondrites, this would be the most interesting and indeed astounding fact of all scientific study in recent years. (A.H.F.)

## 445

**CONSIDERATIONS ON COMMUNICATION WITH INTELLIGENT LIFE IN OUTER SPACE.**

Morris Handelsman. 1962. 16 p. 42 refs.

Presented at the Western Electronic Show and Conv., Los Angeles, Aug. 21–24, 1962. Sponsored by Western Electronic Manufacturers Assoc. and Inst. of Radio Engineers.

(WESCON Paper 4.4 Available from Western Periodicals Co., 13000 Raymer St., N. Hollywood, Calif.
(N62–17801)

The subject of communication with intelligent life in outer space is examined for the technical and economic aspects of a continuing search for electromagnetic signals of this type. The criteria established for the kinds of stars most likely to have life-bearing planets is reviewed along with the probabilities involved. An estimate is made of the instrumentation and facilities required for a search program with variable parameters such as star range, number of stars searched, equipment sensitivity, monitored frequency bands, and search time. It is assumed that the most likely star classes are examined starting first with those within a nearby radius of 10 light years and progressively increasing the range to thousands of light years. The recommended frequency band for search from earth is from 1000 to 10 000 mc/s depending on the background noise and atmospheric limitations. However, use of space platforms affords possibilities for search in frequency bands normally denied to Earth-based sensors. (Author)

## 446

COMMUNICATION WITH EXTRATERRESTRIAL INTELLIGENCE.
P. Rosenberg
*Aerospace Eng.*, 21:8, Aug. 1962. p. 68–69.

A general statement of the purposes, possible techniques, and problems of interstellar communications is presented. The probable existence of other planets with suitable environmental conditions for life has been determined statistically. Frequencies between 1000 and 10 000 mc/sec would seem to be optimum carrés of extraterrestrial signals because of minimum noise from galactic or terrestrial sources. Project Ozma is presently seeking signals from Soltype stars. The recognition of extraterrestrial signals and time lag between propagation and reception are major problems, as well as actual communication between our civilization and other more highly developed civilizations. The necessity of this project has not yet been universally recognized and accepted by scientists. (E.O.)

## 447

IS THERE LIFE ELSEWHERE IN THE UNIVERSE?
J. D. Bernal
*Sci. Cult.* (Calcutta), 28:8, Aug. 1962. p. 356–357.

Claims have been made that small bodies buried in meteorites similar in size and shape to simple algae were actual remains of organisms that evolved on some object in outer space. Some scientists maintain that these are not organic bodies but small concretions of minerals such as iron oxide or sulfur. Others say that the objects are contaminants, terrestrial organisms that entered the meteorites after they fell. Upon analysis the socalled carbonaceous meteorites showed a 10% water content, an unusual fact since no asteroid between Mars and Jupiter is considered large enough to hold liquid water on its surface. It is postulated that the water is beneath the surface, but no one has accepted the idea of an underground origin of life. An alternative hypothesis is that these organisms actually originated on the Earth, were carried to the Moon along with the water stirred up by the attraction when the Moon joined the Earth, and then were knocked off at a later date and returned to Earth. (Author)

## 448

THE NATURE AND ORIGIN OF METEORITE ORGANIC MATTER.
M. H. Briggs
*Sci. Cult.* (Calcutta), 28:8, Aug. 1962. p. 357–360. Also in: Victoria U., Wellington, New Zealand. 9 p. 31 refs.
(N62–15487)

The presence of organic compounds of extraterrestrial origin in some meteorites is now well established. However, neither the mere presence of these compounds nor their chemical nature is sufficient evidence of a biological origin. The small organic microstructures of the meteorites, while showing some features in common with microfossils, are probably also abiogenic. Their definite identification, however, presents an extremely complex problem. (Author)

## 449

SPACECRAFT STERILIZATION: PART I.
A. M. Nowitzky
*Missiles and Space*, 10:9, Aug. 1962. p. 16–17, 20 refs.

Spacecraft biological sterility for extraterrestrial-impact vehicles is discussed. Procedures and mission compatibility are tested. J.P.L.)

## 450

BIOLOGY IN SPACE.
N. H. Horowitz
*Federation Proc.*, 21:4, July–Aug. 1962. p. 687–691.

Biology is involved in the national space program in three principal areas: (1) in the man-in-space effort; (2) in the investigation of the biological effects of the space environment; and (3) in the search for extraterrestrial life. Mars, and possibly Venus, is sufficiently similar to the Earth to provide a test of the idea that life arises wherever conditions exist for the synthesis and evolution of organic compounds. Experiments (ultraviolet and infrared spectroscopy of surface atmospheres, landing vehicle experiments with television photography, microscopy, etc.) currently considered for investigating the biology of Mars are discussed. Sterilization of all spacecraft landing on the Moon or planets and the possibility of back-contamination are reviewed, along with the evidence for possible life in meteorites.

## 451

PROCEEDINGS OF THE CONFERENCE ON SPACECRAFT STERILIZATION. HELD UNDER THE AUSPICES OF THE NASA BIOSCIENCES PROGRAM, WASHINGTON, D.C., July 9, 1962.
F. H. Quimby, ed.
NASA, Wash., D.C., Dec. 1962. 101 p.
(NASA–TN–D–1357; N63–10793) OTS: $2.50

The information presented is essentially a transcript of the discussions, with editing kept to a minimum in the interest of preserving the individual contributions of the participants. Recommendations of the participants for research and development are appended.

## 452

ALONE IN THE UNIVERSE?
John W. MacVey
*Spaceflight*, 4:4, July 1962. p. 125–127.

On Earth, life is based essentially on the common elements oxygen and carbon, but this need not necessarily be the case on alien planets orbiting remote stars. We might envisualize, for example, a world where the air is predominantly hydrogen peroxide vapor which breathed by animals could be reduced to oxygen and water—or one with fluorine being inhaled by living creatures with leathery, unpleasant skin. Nightmarish perhaps—but possible. (J.W.)

## 453

THE CHALLENGE OF THE UNIVERSE.
A. Hyneck, and N. Anderson
N.Y., *Scholastic Book Services*, July 1962. 144 p.

A general astronomy of the universe, solar systems, galaxies, satellites, orbits, space station, gravity and light is presented. The moon's gravitational force, 0.16 that of Earth, is much too feeble to keep an atmosphere; without an atmosphere there can only be a lifeless world. In regard to the planets, the mass of the original material determines its surface gravity and thus its ability to hold atmospheric gases, and the distance from the sun determines the amount of radiant energy the planet receives. These two factors determine the kind of chemical reactions that can take place, whereas the chemistry of the planet determines whether or not life is possible. Venus and Earth, similar in original chemical composition, have developed along separate pathways. Since Venus receives more ultraviolet light than Earth, no life has developed there. Mars, smaller than Earth, can hold only a thin atmosphere and has an average temperature slightly above freezing, yet organic material and probably elementary life forms exist there. This leads to the belief that life may exist elsewhere. The evidence is overwhelming that such life is based on the same physical and chemical conditions as life on Earth. (A.H.F.)

## 454

CORRESPONDENCE: ETHICS AND SPACE TRAVEL.
E. C. Miller
*Spaceflight*, Vol. 4, July 1962. p. 139.

With the a priori assumption that intelligent extraterrestrial life may exist, three statements of ethical conduct are urged for discussion and adoption. No contact would be made with intelligent life not possessing spaceflight capability. No sectarian or belligerent views or acts would be made without common understanding. No artifact or specimen not within the technical competence of both parties would be exchanged. (E.O.)

## 455

FEASIBILITY OF LABORATORY STUDIES CONCERNING LIFE ON VENUS.
C. A. Schindler, T. L. Roberts and E. S. Wynne
*Aerospace Med.*, Vol. 33, July 1962. p. 859–861.

Studies on the survival of terrestrial forms of life under simulated Venusian conditions appear unfeasible and untimely. Present knowledge is based on astronomic observations, and distortions and obscurations introduced by the amtosphere of Venus handicap acquisition of accurate information. Prior to any Earth-bound laboratory experiment, it is essential to obtain probably by probe, a three-dimensional map of temperature and moisture on or about Venus, as well as a characterization of chemical compounds on the surface. Such information would indicate zones where life such as known on Earth, might exist. It is possible that forms of life completely unlike those on Earth do exist on Venus; but present day microbiological methodology would not disclose such life. The very occurrence of such life would necessitate a redefinition of the term. Therefore, if the environment of Venus (when it becomes known) effectively eliminates organisms similar to those on Earth, then samples from the planet should be subjected to simulated Venusian conditions. (I.v.L.)

## 456

MICROFOSSILS FROM THE ORGUEIL METEORITE.
F. L. Staplin
*Micropaleontology*, 8:3, July 1962, p. 343–346.

Palynological treatment of a sample from the Orgueil meteorite, a black carbonaceous chondrite, yielded new acid-resistant microfossils. The assemblage does not compare with any of Cambrian to Recent age. Most of the fossils have some similarity to unicellular algae with acid-resistant pellicles. *Caelestites sexangulatus* n. gen., n. sp. and *Clausisphaera fissa* n. gen., n. sp. are described. Recent contaminants, and a very few Cretaceous ones, were noted in the residue. (J.P.L.)

## 457

THE CHEMICAL BASIS FOR EVOLUTION.
D. Paretsky
*Univ. Kansas Sci. Bull.*, 42 (Suppl.) June 28, 1962. p. 81–97.

As the development of a self-replicating system is the base of the evolution of relatively permanent, living organisms, a review is presented of some physical properties of living system. Proteins, enzymes, nucleic acid and coding, and energy systems are discussed. The conditions found on the primitive Earth about 3000 million years ago were: moderate temperature, a reducing atmosphere of water vapor, methane, ammonia, and carbon monoxide among others; no free oxygen; and different types of energies including ultraviolet light. The production of organic compounds under these conditions would include formaldehyde, urea, and amino acids among others. The possible mechanisms for producing purine, adenine, and pyrimidines as the bases in nucleic acids are discussed. The origins of the iron-porphyrin pigments as an electron transfer system are described in relation to chlorophyll and the release of free oxygen through photosynthesis. Many of the unanswered questions of evolution are posed as guides to further work and understanding of the chemical basis for evolution. (Aerospace Med.)

## 458

FURTHER LIFE-FORMS IN THE ORGUEIL METEORITE.
R. Palik
*Nature* (London), 194:4833, June 16, 1962. p. 1065.

Crushed, sterile, powdered material from the Orgueil meteorite revealed under the microscope 6 different filamentous formations which appear similar in form to algae. The various filaments are briefly described, but the author warns that these structures may possibly be indigenous to the meteorite. (Author)

## 459

IDENTITY OF ORGANIZED ELEMENTS FROM METEORITES.
P. H. Gregory
*Nature* (London), 194:4833, June 16, 1962. p. 1065.

From the publication of illustrations of organized structures from the Orgueil and Ivuna meteorites the author identifies some of the unknown forms. These appear to be similar to ascospores and pollen grains. The author urges that the illustrations be published so that a larger group of specialists can attempt to identify the structures. (Aerospace Med.)

## 460

LIFE FORMS IN CARBONACEOUS CHONDRITES.
R. Pearson
*Nature* (London), 194:4833, June 16, 1962. p. 1064—1065.

A discussion is presented giving a critical analysis of the identification and interpretation of pollen-like structures found by previous workers in meteorites. It is advised that it would be preferable to prove or disprove the explanation that these forms are of an earthly origin before postulating more elaborate theories. (Aerospace Med.)

## 461

LIFE ON MARS SEEN POSSIBLE.
(No Author)
*Sci. News Letter*, 81:24, June 16, 1962. p. 378—379.

It is the belief of Dr. Frank Salisbury, Colorado State University, that the only explanation for many of the observed changes on Mars is the existence of life. Dr. William Sinton, Johns Hopkins University, Baltimore, used the 200-inch telescope on top of Mt. Palomar to look at Mars in the light given off by the infrared and found absorption bands characteristic of organic molecules in living organisms on Earth. Dr. Salisbury sets forth 5 requirements for any potential life on Mars, including visibility, ability to withstand great daily fluctuations in temperature, and conformity to certain fundamental principles of ecology, such as the cycling of elements.

## 462

PRIMORDIAL ORGANIC CHEMISTRY. 1. COMPOUNDS RESULTING FROM ELECTRON IRRADIATION OF $C^{14}H_4$.
C. Palm and M. Calvin
*J. Am. Chem. Soc.*, 84:11, July 5, 1962. p. 2115—2121. 32 refs.

$C^{14}$ labeled methane, together with a number of other presumed primordial gases of the Earth's atmosphere, has been subjected to electron bombardments. The products formed have been examined by paper chromatography, ion exchange chromatography, mass spectrometry and ultraviolet light spectrophotometry. A number of minor molecules have been specifically identified, and urea has been found as a major component in the absence of added phosphine; the formation of urea is inhibited by added phosphine. Most of the products can be accounted for as discrete molecules, even though they are as yet unidentified. (Author)

## 463

COSMIC MICROBIOLOGY.
N. N. Zhukov-Verezhnikov, I. N. Mayskiy, A. P. Pekhov and N. P. Nefed'yeva
*Mikrobiologiya* (Moskva), Vol. 30, Jan—June 1962.
p. 665—670. (In Russian; English Summary)

The problems of extraterrestrial microbiology are discussed in four areas: The activity of terrestrial micro-organisms under spacial conditions, the genetic consequences of spacial exposure to micro-organism, the simplest forms of extraterrestrial life, and contamination both by terrestrial and extraterrestrial micro-organisms. Since it is known that terrestrial micro-organisms can survive under very unfavorable conditions of temperature, pressure, water supply, etc., it may be possible to find life under more unfavorable conditions. Microbial adaptation to the action of radiant energy beyond the atmosphere appears probable. The inherent hardness of micro-organisms emphasizes the need for the decontamination of spacial probes. (E.O.)

## 464

EXPERIMENTAL ORGANIC COSMOCHEMISTRY: THE FORMATION OF BIOCHEMICAL COMPOUNDS.
J. Oró
*In:* North American Aviation, Inc., Downey, Calif. Proc. of the Lunar and Planetary Exploration Colloq., Santa Monica, Calif. May 23—24, 1962. p. 9—28. 23 refs. (See N63—19478 19—16)
(NASA Grant NsG—257—62 and NSF Grant G—13117)
(N63—19480)

Simple combinations of carbon, nitrogen, oxygen and hydrogen are important constituents of relatively cool star atmospheres, interstellar space, comets and cold planetary atmospheres. It is proposed that intercombination of these species in protoplanetary bodies leads to the formation of reactive organic compounds which are the procursors of more complex biochemical molecules. Model experiments involving the use of such simple compounds as water, ammonia, hydroxylamine, hydrazine, hydrogen cyanide, formaldehyde and acetaldehyde have led to the synthesis of hydroxy acids, amino acids and amino amides, including glycolic acid, lactic acid, glycine, glycinamide, alanine, $\beta$-alanime, aspartic acid, valine and lysine: monosaccharides, including ribose and 2-deoxyibose; purines and pyrimidines, including adenine, guanine and uracil; purine intermediates, including 4-aminoimidazole-5-carboxamide. 4-aminoimidazole-5-carboxamidine and formic acid: homo-and heteropolypeptides; and other compounds of biological significance. (Author)

## 465

SIMPLE VIDICON MICROSCOPY.
G. A. Soffen
*In:* North American Aviation, Inc., Downey, Calif. Proc. of the Lunar and Planetary Exploration Colloq., Santa Monica, Calif., May 23—24, 1962. p. 47—48.
(N63—19478 19—16)
(N63—19483)

While specimens of the Martian soil may be collected by means of a string probe, for example, there are still problems of enrich-

ing the sample, transporting it to a microscope slide and transmitting what is actually observed. A special instrument is being developed that includes a microscope with an aerosol medium of transportation and vidicon transmission. (Author)

## 466

LIFE BEYOND THE EARTH.

Carl Sagan

*In:* USIA Voice of Am. Forum Ser. on Space Sci., Jan. 8–May 21, 1962. p. 297–310.

(See N63–23436 24–01) (Lecture 20)

(N63–23454)

The interrelated questions of extraterrestrial life and the origin of life on Earth are considered. A theory of the origin of life in the primitive oceans is reviewed, and the laboratory recreation of life is regarded as a likely possibility. The primitive environments of the other planets are expected to have been similar to the primitive environment of the Earth. Information on the present atmospheric and surface conditions of Venus, Mars, the Moon, and the Jovian planets is reviewed and related to the possibility of existence of life based on organic matter. The existence of life based on some other kind of chemistry is beyond comprehension at present. Speculation on extraterrestrial life has been popular over the years, but the prospect of actual experimentation to solve this question belongs to this generation. The importance of sterilizing the interiors of all space probes in order to prevent contamination of extraterrestrial areas with terrestrial micro-organisms is stressed. (M.P.G.)

## 467

EFFECTS OF REDUCED OXYGEN TENSION ON VASCULAR PLANTS IV. WINTER RYE GERMINATION UNDER NEAR-MARTIAN CONDITIONS AND IN OTHER NONTERRESTRIAL ENVIRONMENTS.

S. M. Siegel, L. A. Rosen and C. Guimarro

*Proc. Nat. Acad. Sci. U.S.*, 48:5, May 15, 1962. p. 725–728. 10 refs.

The germination and early seedling growth of Winter rye can be supported in a variety of experimental conditions including a near-Martian atmospheric and temperature condition. This species requires at most traces of oxygen in its early stages, and can germinate in atmospheres consisting of argon, $CO_2$, or methane. Normal-appearing green coleoptiles are produced in argon, CO, $N_2O$, and "Martian" atmospheres. Exobiological implications are considered, and it is concluded that complex life forms can be sustained in planetary environments at least as different as those associated with Mars. (Author)

## 468

CRITICAL REMARKS ON THE ALLEGED PRESENCE OF EXTRATERRESTRIAL MICROORGANISMS IN METEORITES (REMARQUES CRITIQUES SUR LA PRÉSENCE SUPPOSÉE DE MICROORGANISMES D'ORIGINE EXTRATERRESTRE DANS LES METEORITES).

G. Deflandre

*Compt. Rend.*, 254:19, May 7, 1962. p. 3405–3407. 4 refs. (in French)

Claus and Nagy have written about the remains of microscopic organisms found in stony meteorites. They have established a special classification system for them on the assumption that the organisms are of extraterrestrial origin. A critical examination of several of their preparations, made by crushing, contradicts their opinion. Only rigorous methods applied to the making of thin sections will be able to demonstrate the existence of organized elements belonging to extraterrestrial organisms.

## 469

LIFE IN THE UNIVERSE.

A. E. Slater

*Spaceflight*, Vol. 4, May 1962. p. 88.

An argument is presented against the theory of life being a biological and cosmic phenomenon. It is suggested that the simplest imaginable living molecule must be so large and complicated that its spontaneous appearance is highly improbable even on a planet where conditions are suitable for life. Statistically, the chance of the correct form of nucleic and molecule needed for life protein synthesis is only one in $10^{80}$, which is infinitesimal. However, it is not certain if this would be a rare event or not and the possibility exists of creating a man-made nucleic acid molecule. (E.O.)

## 470

MARINER TO TEST MARS LIFE THEORIES.

W. Beller

*Missiles and Rockets*, 10:16, Apr. 16, 1962. p. 31–32.

The schedule and plans of the Mariner A, B, and R projects for the fly-by of Venus and Mars are discussed. The theories concerning the properties of life to be found on Mars are reviewed. The types of plants and certain aspects of metabolism of Martian life are discussed, as well as the role of the Mariner projects in the verification of these theories. (Author)

## 471

METEORITE RESEARCH.

(No Author)

*Eng. and Sci.* (Calif. Inst. of Tech.), 25:7, Apr. 1962. p. 15–16.

Analyses of the chondrites Bruderheim and Murray suggests that both meteorites represent an excellent environment for the growth of micro-organisms. Apparently the peculiar chemistry of meteorites, in terms of sulphur content, high iron concentration, or the various oxidation states of heavy metals, stimulates the activity of certain terrestrial microbes, and even accelerates the production and accumulation of terrestrial biogenic organic matter. The organic spectrum of chondrites strikingly resembles the one of oxidizing recent marine sediments, but differs considerably from any other spectrum obtained from any ancient or recent rocks. The present facts indicate simple terrestrial contamination of these chondrites—not biogenic indications of extraterrestrial life. (S.T.L.)

## 472

PLANETARY STUDIES PART IV.

Carl Sagan, K. M. Siegel, M. Eimer, J. L. Kulp, R. S. Pogrund, and G. P. Kuiper

*The Spectrum*, 1:7, Apr. 1962. p. 8–9, 18, 20.

Some of the discussions presented during the Ninth Lunar and Planetary Exploration Colloquium in Downey, Calif., on Nov. 2,

1960 are reprinted. The evolution and life-support capabilities of Venus, Mars, and Jupiter are discussed. (J.P.L.)

## 473

POSSIBILITIES FOR LIFE IN THE UNIVERSE.
J. Kleczek.
*In:* Intern. Cong. The Man and Technology in the Nuclear and Space Age Proc., Milan, Apr. 1962. p. 135–138.
Rome, Associazione Internationale Uomo nello Spazio, 1963.
(A64–11415)

The possibility of the existence of life in the universe is discussed. Included in the discussion are the thermonuclear reactions that take place deep in the interior of the stars which produce both the energy and the materials necessary for the formation of life. The discussion concludes that life cannot exist without the energy production of the stars.

## 474

INTERSTELLAR COMMUNICATION.
B. M. Oliver (Hewlett-Packard Co., Palo Alto, Calif.)
Presented at the Institute of Radio Engineers, International Convention, New York, N. Y., Mar. 26–29, 1962.
1962 IRE International Convention Record. Part 8—Communications Systems; Vehicular Communications, Vol. 10, p. 34–39.
Price of entire volume (170 p.): nonmembers, $5.00.
(A63–12483)

Brief discussion of the problems of interstellar communication. It is pointed out that the ultimate range of a communication system is determined by three factors: (1) the energy radiated per symbol; (2) the directive gain of the antennas; and (3) the cosmic and thermal noise. The two likely regions of communication are believed to be the IR and the optical part of the spectrum, and a much quieter section in the microwave region. The acquisition problem involves the difficulties encountered in the time dimension. Possibilities of communication languages are considered.

## 475

COMMENTS.
J. D. Bernal
*Nature* (London), 193:4821, Mar. 24, 1962. p. 1127–1129. 8 refs.

The implications of the observation by Claus and Nagy of what appeared to be organisms in carbonaceous meteorites are extremely far-reaching, and we are faced with very serious difficulties in their interpretation. Difficulties realized by Urey (*Nature*, London, Vol. 193, No. 4821, Mar. 24, 62, p. 1119–1123) are by no means the only difficulties; other problems that arise are investigated. It is concluded that either "life" is a complex of phenomena which only follow for intrinsic necessity a very narrow range of chemical reactions, or there is only one sequence of evolution of life and the forms observed on the meteorites and on earth are genetically related. The first alternative seems inherently improbable but the second strains the imagination as to how these transfers may have been effected. (S.T.L.)

## 476

COMPLEX ORGANIC MICROSTRUCTURES IN THE MOKOIA METEORITE.
M. H. Briggs and G. B. Kitto
*Nature*, Vol. 193, Mar. 24, 1962. p. 1126–1127.
(Comments J. D. Bernal, p. 1147–1149, 19 refs.).
(62–6051)

Results of an experimental investigation of possible life forms occurring in a carbonaceous chondrite are presented. The meteorite is shown to be uncontaminated with terrestrial microorganisms, and from the results of experiments similar to those of Claus and Nagy, it is concluded that the organic components of the meteorite are of extraterrestrial origin.

## 477

ORGANIC PARTICLES EMBEDDED IN MINERALS IN THE ORGUEIL AND IVUNA CARBONACEOUS CHONDRITES.
B. Nagy, G. Claus and D. J. Hennessy
*Nature* (London), 193:4821, Mar. 24, 1962. p. 1129–1133. 11 refs.

Four types of experiments are described which offer additional data regarding the nature and formation of the organized elements, although, undoubtedly, additional experiments must yet be performed. The experiments seem to indicate that these microscopic particles are fossilized, organic, organized structures, which are not likely to be minerals, organic artifacts or terrestrial, microbiological contaminations. It is believed that the organized elements are microfossils apparently indigenous to the meteorite parent body. (Author)

## 478

"ORGANIZED ELEMENTS" in CARBONACEOUS CHONDRITES.
F. Fitch, H. P. Schwarcz and E. Anders
*Nature* (London), 193:4821, Mar. 24, 1962. p. 1123–1125. 7 refs.

An examination has been made of Orgueil and Ivuna meteorite samples which showed spherical and oval particles quite similar to those illustrated and described by Claus and Nagy, 452, (*Nature* (London), Vol. 192, No. 4803, Nov. 18, 61, pp. 594–596). Several new observations have been made. It is concluded that the organized elements of Claus and Nagy are either identical with troilite globules, sulphur droplets, or hydrocarbon droplets, or that they are so scarce in the specimens investigated that they lie below the threshold of detection. (E.O.)

## 479

ORIGIN OF LIFE-LIKE FORMS IN CARBONACEOUS CHONDRITES.
H. C. Urey
*Nature*, 193:4821, Mar. 24, 1962. p. 1119–1123.
(62–6053)

Possible extraterrestrial origins for such life forms as may exist in carbonaceous chondrites are discussed. It is concluded that the most probable origin would seem to be that the moon became contaminated temporarily with water and life-forms from earth early in its history, that these forms have been preserved there, and that they are now returning to earth. (I.A.A.)

## 480

**NUCLEAR CLUES TO THE EARLY HISTORY OF THE SOLAR SYSTEM.**
W. A. Fowler
*Science*, 135:3508, Mar. 23, 1962. p. 1037—1045. 14 refs.
Condensed version publ. as *Astron. Soc. Pac. Leaflet* No. 411, Sept. 63.

The present implication of the observed abundances of $D^2$, $Li^6$, $Li^7$, $Be^9$, $B^{10}$, and $B^{11}$ in terrestrial and meteoritic matter is discussed. The abundances indicate that the synthesis of these light nuclei occurred during an intermediate stage in the early history of the solar system. It is contended that the major planets, with mass 200 times that of the terrestrial planets, were not appreciably affected by the irradiation during the process of formation, and thus, they should contain deuterium, lithium, beryllium, and boron only in abundances comparable to those in the material of the sun when it first formed and in the material which then constituted and still constitutes the interstellar medium. It is believed these abundances are considerably smaller than those observed in the earth and the meteorites and considerably smaller than those expected in the minor planets. Predicted upper limits for the abundances in the interstellar medium and the major planets relative to the abundances in the terrestrial planets and the meteorites are $\leq$50% for deuterium and $\leq$10% for lithium, beryllium, and boron.

It is speculated that after the initial reducing conditions for formation of planetesimals, oxidizing conditions replaced the reducing conditions. Thus prebiotic or even biotic materials could have been formed in the planetesimals prior to the formation of the earth. (Author)

## 481

**INTERSTELLAR COMMUNICATION AND HUMAN EVOLUTION.**
R. Ascher, M. Ascher
*Nature*, 193:4819, Mar. 10, 1962. p. 940—941.
(A64—10240)

Using extraterrestrial data and models founded on human evolution, the probability of the existence of extraterrestrial technical civilizations is studied. (Author)

## 482

**OXYGEN PRODUCTION DURING THE EVOLUTION OF THE EARTH'S ATMOSPHERE.**
Hubertus Strughold and O. L. Ritter
*Aerospace Med.*, Vol. 33, Mar. 1962. p. 275—278.

The physiological and biological processes of oxygen production in the Earth's primordial atmosphere are discussed. During the early stages of the Earth's formation, the protoatmosphere contained no oxygen. The initial stock of oxygen appeared in this protoatmosphere by a photolytic process in which the parent molecule was water and the effective agent was solar radiation. Later on, a biological process, photosynthetic in nature, became important. It required water and carbon dioxide as parent molecules. Carbon dioxide originated in the protoatmosphere through the oxidation of methane as soon as some photolytically produced oxygen was available. The photosynthetic process required light energy and chlorophyll as an enzyme. Chlorophyll apparently existed 1.5 to 2 billion years in the past, perhaps at first in other forms or as precursors of bacterial chlorophyll and protochlorophyll as they are known today. The outer planets still have atmospheres of the primordial type. The atmospheres of the inner planets, Venus and Mars, went through the process of oxidation similarly to that of the Earth; however, with different results due to different solar radiation intensities and different gravities. Whether or not biological processes have been involved in their atmospheric transformations remains to be explored on the spot by means of astronautical operations. (I.v.L.)

## 483

**ON THE POSSIBLE EXISTENCE OF INTELLIGENT LIVING BEINGS ON OTHER PLANETS.**
R. Margaria
*Riv. Med. Aeronaut. e Sp.* (Rome), 25:1, Jan.—Mar. 1962. p. 24—35. 8 refs. (In English)
Also *in:* R. M. L. Baker, Jr., and M. W. Makemson, eds. PROC. XIIth INTERN. ASTRONAUT. CONGRESS, Vol. 11., Washington, D.C., Oct. 1—7, 1961. Vienna, Springer-Verlag, 1963. p. 556—563.

The possibility of any form of life similar to that on Earth developing on other planets is extremely rare; it would mean that identical chemical reactions, in the same order as on earth, took place, giving rise to the most elementary form of life. The possibility that, from this, superior forms of life developed to living beings with the same type of intelligence as man, and with whom we might communicate, is ruled out statistically. Evolution of living beings such as takes place on the earth is the result of innumerable mutations that are governed mainly by chance. The probability of an exact replica of such an event in the history of evolution anywhere else in the universe is infinitely small. (Author)

## 484

**CARBONACEOUS "SNOWFLAKES" AND THE ORIGIN OF LIFE.**
P. Morrison
*Science*, 135:3504, Feb. 23, 1962. p. 663.

The possibility that the intricate "organized elements" found in some carbonaceous chondrites are to be interpreted, not as microfossils of once-living cells, but as organic-chemical analogues of similarly intricate snow crystals is raised; tests and implications are discussed. (E.O.)

## 485

**METEORITES ARE A UNIQUE SOURCE OF EXTRATERRESTRIAL SUBSTANCES.**
S. D. Gossner
*Natural History*, 72:9, Feb. 1962. p. 40—41.

A brief, nontechnical description of meteorites, as yet the only extraterrestrial substances available for analysis in the laboratory, is presented. (S.T.L.)

## 486

AF LECTURES COVER HOST OF LUNAR PROBLEMS.
H. M. David
*Missiles and Rockets*, 10:4, Jan. 22, 1962. p. 28.

Several problems associated with the exploration of the moon are reviewed. These lectures cover radiation hazards, environmental conditions to be faced by astronauts on the lunar surface, and the possibilities of finding certain types of life on the moon and other planets. (J.P.L.)

## 487

AN AMMONIA-BASED LIFE.
V. A. Firsoff
*Discovery* (London), 23:1, Jan. 1962. p. 36—42. 7 refs.

The development of inorganic polymers which bear a resemblance to organic compounds but have, wholly or partly, a different chemical basis has led to speculations of various alternative life schemes. The presence of ammonia in the atmosphere of the giant planets has prompted interest in one scheme where liquid ammonia replaces water as a universal solvent. It is shown that our processes of digestion rely on hydrolysis and so can be replaced by ammonolysis of the analogue compounds in an ammono-organic chemistry, and that the same reactions of chemical degradation which yield energy by oxidation in our system would be performed in that of ammonia through the agency of nitrogen. Instead of water and carbon dioxide as final products, ammonia and cyanogen $C_2N_2$, which is the ammonia analogue of $CO_2$, would be produced. Equivalent organic compounds in a nitrogen based life system are given. (Author)

## 488

LIFE ON MARS.
Clyde Tombaugh
*Space World*, 2:2, Jan. 1962. p. 36—37, 58, and 61—62.

The controversial question of whether or not life exists on Mars is discussed. Observations and theories concerning the planet's atmosphere, surface features, and natural satellites are related. (J.P.L.)

## 489

SOME PROBLEMS OF SPACE BIOLOGY (NEKOTORYYE PROBLEMY KOSMICHESKOY BIOLOGII).
O. G. Gazenko
*Vestn. Akad. Nauk S.S.S.R.* (Moskva), 32:1, Jan. 1962. p. 30—34. (In Russian)

Reports on problems of space biology presented at the meeting of the Department of Biological Sciences, Academy of Science, USSR, in Moscow on October 3—5, 1961, are reviewed. Biotelemetry is discussed in view of its importance in space biology. (Aerospace Med.)

## 490

AMINO ACIDS AND SUGARS IN THE BRUDERHEIM AND MURRAY METEORITE.
E. T. Degens, Matthias Bajor
*Naturwiss.*, Issue 24, 1962. p. 605—606. (Supported by Am. Chem. Soc.)

Previously published data encouraged the analysis of a chondrite (Bruderheim fall of 1960) and a carbonaceous chondrite (Murray, fall of 1950) for their sugar and amino acid spectrum by means of paper chromatography. In view of the thermal instability of amino acids and sugars, the occurrence of these compounds in the high temperature chondrites suggests that they apparently have been introduced after the high temperature stage. Furthermore, the sugar and amino acid spectrum is in many ways different from that observed in recent and ancient sediment, and there seems to exist no relationship between total organic carbon and total amount of amino acids and sugars in the meteorites. All the listed geochemical criteria in addition to the age of the chondrites (4.5 billion years) make extraterrestrial organisms rather unlikely as a source for the identified organic compounds. More reasonable seems to be an biogenic origin or perhaps a terrestrial contamination or both factors to account for the presence of amino acids and sugars in the studied meteorites. (Author)

## 491

APPLICATION OF GAS CHROMATOGRAPHY TO THE ANALYSES OF ORGANIC WATER AND ABSORBED GASES IN THE LUNAR CRUST.
V. I. Oyama, S. P. Vango and E. M. Wilson
*ARS J.*, 32:3, 1962. p. 354—360.

It has been hypothesized that the origin of living systems must necessarily obtain from preformed substances. These preformed substances, which are essential for biological processes, would make the probability of polymerization and subsequent organelle formation much greater. The organic composition of Earth is directly associated with life systems, making it difficult to establish the abiogenic synthesis of our organic deposits. The moon on the other hand, is a body in which organic residues formed by an originally reducing atmosphere could well be preserved by fortuitous loss of hydrosphere and atmosphere and by a protective layer of meteoric infall. The data obtained by controlled heating of biogenic material with mineral mixtures is presented. The application of this technique to a gas chromatograph apparatus being fabricated is discussed. (Author)

## 492

ASTROBIOLOGY.
F. I. Ordway, III, J. P. Gardner and M. R. Sharpe, Jr.
*In:* BASIC ASTRONAUTICS, p. 244—305. 178 refs.
Englewood Cliffs, N. J., Prentice-Hall, 1962. 587 p.

Since early in 1957 the climate of interest has changed and the new science of astrobiology has been created. The authors see several research paths being followed at this time, with emphasis on a deeper understanding of life on Earth as essential

for study on extraterrestrial life. Current research involves: (1) investigations into life's beginnings on Earth to determine what the terrestrial environment was like at various stages of life's development; (2) theoretical studies of life processes and experimental studies of life's reactions to abnormal environmental conditions are being coordinated in the hope of shedding light on evolutionary causes and consequences; (3) physical, chemical and environmental studies of other planets are being made coupled with investigations of the interactions of the planets and their atmospheres with space radiations, particles and fields, to determine what the current conditions are, and what the past conditions must have been; (4) instrumentation is being developed to search for life forms on other bodies of the Solar System; and (5) theoretical work is being conducted on the intriguing question of intelligent life beyond the confines of the Solar System. (Author)

## 493

**ATMOSPHERE AND SURFACE PROPERTIES OF MARS AND VENUS.**
E. J. Opik
*Progress in the Astronautical Sciences*, Vol. 1, 1962. p. 261–342. 97 refs.

Observations of the surface formation on Mars are: orange-red continents, dark gray maria and polar caps of water, hoarfrost or snow, which vary with the season. A common interpretation of the maria is the occurrence of a primitive, nonchlorophyll, type vegetation. Mountain ranges have not been observed near the Martian terminator. The Martian atmosphere may consist mainly of nitrogen and argon. Carbon dioxide has been observed spectroscopically. Oxygen is practically absent. Water surfaces are absent except seasonally at the poles.

Optical properties of the surface of Venus are consistent with a relatively thin scattering gaseous atmosphere, overlying a continuous layer of clouds. Observed amount of water vapor is too small to be condensable. Water is not present on Venus. The clouds most likely are solid dust, possibly containing surface carbonates. The bands in the upper haze level correspond to climactic zones. By spectroscopic observation, hydrocarbons are not present in large quantities. (E.C.)

## 494

**BIOASTRONOMY.**
F. P. Andrews
*Southern Stars*, Vol. 19, 1962. p. 155–160.

Factors which influence the creation and development of life in the universe are outlined. Stellar energy is a prime requirement but there is a very limited area around any star in which the amounts of light, heat, and other radiation are suitable for the formation of organic molecules. Within the solar system, Venus and Mars delineate the limits of this zone and may be capable of supporting primitive life. The time factor is very important since it appears the evolution of life require millions of years, and therefore stable stellar sources of energy to maintain the biozone. Stars of type F to K and possibly M-type dwarfs fulfill this requirement. Multiple star systems are not favorable because of eccentricty of planetary orbits. Intelligent life may only have appeared on a few thousand planets but it is possible that primitive life is quite extensively distributed. (E.O.)

## 495

**CERTAIN PROBLEMS OF STUDYING AND MASTERING COSMIC SPACE.**
N. M. Sisakyan, V. V. Parin, V. N. Chernigovskiy and V. I. Yazdovskiy
*In:* PROBLEMY KOSMICHESKOY BIOLOGII (Problems of Space Biology), Vol. 1. p. 3–15. Moscow, Acad. Sci. USSR, 1962. Transl. by NASA, Wash., D.C., Nov. 1963.
(NASA–TT–F–174; N64–11665)

The principal problems of space biology, stages of biological experiments performed in space, and prospects of further space researches are described. The importance of fundamental aspects of space biology relating to the origin of life and transplanting of various forms of life from one celestial body to another are discussed.

## 496

**THE CHEMISTRY OF THE LUNAR SURFACE.**
M. H. Briggs
*J. Brit. Interplane. Soc.*, Vol. 18, 1962, p. 386–389.

The author suggests that the primitive moon possessed an extensive reducing atmosphere which was slowly lost and replaced by a secondary atmosphere of gases which leaked from the interior. Organic syntheses occurred in the primitive atmosphere and quantities of fairly complex compounds were deposited on the surface. After $10^9$ years the atmosphere and hydrosphere were lost and exposed organic matter was charred and incorporated into sediments. Some organic matter may have been buried by dust infall and may still survive. It is possible that simple life forms arose but their survival to the present is unlikely. Tektites may represent samples of fused lunar sediments.

## 497

**COMPARATIVE CYTOLOGY AND THE EVOLUTION OF LIFE.**
Lawrence S. Dillon (A. and M. Coll. Tex.)
*Evolution*, 16:1, 1962. p. 102–117.

The structure of the principal organelles of the cell might provide clues to the evolutionary history of the cell and some stages in the development might still be represented among extant organisms. On these premises a possible history of the nucleus is outlined, commencing with the strandular chromatin mass of the blue-green algae, passing through increasingly more complex endosomes, and continuing through simpler nuclei to the advanced ones of the seed-plants and Eumetazoa. This provides a long line of ascent, diverging in two directions at the top. Brief synopses of other organelles, including the chloroplast, flagellum, and mitochondrion, show similar patterns and sequence of organisms representing the successive stadia, so that no conflict of evidence between cellular constituents is found. Synopses of phylogenies among groups of similar cytological structure suggest that all living things form a single tree and kingdom, to which the name Plant Kingdom is applied. The Eumetazoa, to which alone the term animal is confined, is placed as a secondary

branch closely akin to the brown seaweeds (Phaeophyta). (Author)

## 498

A CONTRIBUTION TO THE GENETIC BASIS OF QUANTUM EVOLUTION. (EIN BEITRAG ZUR GENETISCHEN BASIS DER QUANTEN-EVOLUTION).

Th. Dobzhansky and W. Drescher

*In:* Gottfried Durth, ed. EVOLUTION UND HOMINISATION. Stuttgart, Germany, Gustav Fischer Verlag, 1962. p. 64–73.

Various experiments with *Drosophila* are referred to, which show that wild-living populations carry many recessive lethal or sub-lethal genes, and that "normal" phenotypes may have quite different basic genetic combinations. Every population has a very considerable potential variability. There is no one typical, normal, optimal genotype for each species, as "typological" thinking assumes. Rapidity of evolution does not depend upon frequency rate of mutations. Although there would be no evolution without mutations, changes in a given population depend chiefly upon recombination and natural selection, by which new genetic systems come into being and gradually replace less favorable ones. In human evolution, the ability to make and use tools and symbols was favored by selection and became self-accelerating. This represents "quantum evolution," when entrance into a new adaptive zone means that transitional forms cease to occur. (A. K. Winner.)

## 499

CURRENT THEORIES ON THE ORIGIN OF LIFE.

N. H. Horowitz and S. L. Miller

*Fortschr. Chem. Org. Naturstoffe*, Vol. 20, 1962. p. 423–455.

The nature of living organism is discussed and speculations are presented on the origin of life on earth and the presence of extraterrestrial biologically important compounds, and life itself. The central problem in the origin of terrestrial life is to account for the origin of material combining the properties of self-duplication and mutation. The chemistry and conditions possibly prevalent on the primitive earth are described and experiments are detailed which have produced biologically interesting compounds under primitive earth conditions. In space research the fundamental problem is whether a form of living matter is possible that is not based on nucleic acids and proteins. Even if life is not found, the origin of life on earth may be enlightened by examining repositories of prebiological organic compounds on other planets. (E.O.)

## 500

CYTOLOGICAL RESEARCH AND COSMIC BIOLOGY.

L. K. Lozina-Lozinskiy

*In:* N. M. Sisakyan and V. I. Yazdovskiy, eds. PROBLEMS IN SPACE BIOLOGY. Moscow, 1962. p. 46–47.

Since the study of life in other worlds is very complex, biologists have to employ at present indirect methods. First of all they include the study of physical and chemical environmental conditions on other planets and attempts to investigate the growth, multiplication and state of various organisms under conditions imitating the medium of this or that planet. It is also very important to extend our knowledge of potential properties of terrestrial organisms in relation to adaptation and resistence to the environmental factors considerably differing from those on the Earth. In this respect studies on comparative and ecological cytology are of keen interest. The main line in these studies is the investigation of cell resistance and adaptation to extremal and unusual medium factors. The paper gives, in short, the results of these investigations. The phenomena of adaptation and resistance to low and extremely low temperatures, rarefied atmosphere, ionizing and ultraviolet irradiation were studied on various biological objects. (Author)

## 501

ECOLOGICAL ASPECTS OF PLANETARY ATMOSPHERES WITH SPECIAL REFERENCE TO MARS.

Hubertus Strughold

*J. Aviation Med.*, 23:2, 1962. p. 130–140.

The study is confined to two environmental factors: temperature and oxygen. Mars and possibly Venus are the only planets, aside from Earth, possessing the temperature requirements for life. However, because of an absence of oxygen, apart from carbon, it is not probable that man-like creatures are present on Mars, but only some form of plant life. The same problem exists in connection with Venus. (M.G.)

## 502

EFFECT OF ULTRA-HIGH VACUUM ON BACILLUS SUBTILIS VAR. NIGER.

F. A. Morelli, F. P. Fehlner and C. H. Stembridge

*Nature*, Vol. 196, 1962. p. 4850.

(NASA Contract NAS7–100)

Spores of *Bacillus subtilis var. Niger* will survive exposure to an ultrahigh vacuum ($10^{-8}$mm Hg) for a period of 35 days. (A.H.F.)

## 503

EVOLUTIONARY POSSIBILITIES FOR PHOTOSYNTHESIS AND QUANTUM CONVERSION.

Melvin Calvin (Univ. Calif., Berkeley)

*Horizons in Biochem.*, 1962. p. 23–57.

Evolution of the photosynthetic mechanism follows from the chemical evolution of basic organic molecules under the influence of both terrestrial and cosmic radiation. The structural aspect has a common origin with any form of life. The light-capturing mechanism was dependent on development of porphyrin into the efficient chlorophyll molecule. This was probably preceded by the development of the iron-containing heme molecule. Heme demonstrates an increased catalytic activity after it joins a protein to form catalase which breaks down peroxide. It is shown how this can supply the oxidizing potential for the formation of pyrophosphate from orthophosphate. The paleontological record may supply futher details on the development of porphyrin compounds.

## 504

**EXOBIOLOGY-NEW AREA FOR SCIENTIFIC RESEARCH (EKZOBIOLOGIYA NOVAYA OBLAST' NAUCHNYKH ISSLEDOVANIY).**

A. A. Imshenetskiy

Vestn., Akad. Nauk S.S.S.R. (Moscow), No. 11, 1962. p. 58–63. In Russian

(N63–20611; NAS–TT–F–166)

A new area for scientific research, exobiology, is discussed. This new discipline is concerned with the explanation of the existence and expansion of life in the cosmos on the one hand, and on the other, with investigations of the effect of cosmic conditions on living organisms. (Author)

## 505

**THE EXPLORATION OF OUTER SPACE.**

Bernard Lovell

N.Y., Harper & Row, 1962. p. 70–81.

Only about 5 or less percent of all stars are in a condition where one of their planets is able to sustain some form of organic evolution. It is assumed that life does exist on Mars; but our failure to see the Venusian surface keeps us from making any such assumption about Venus. Space probes and interstellar communication by radio signals are means of determining the existence of life on other planets. (A.W.)

## 506

**FOSSILS IN METEORITES.**

H. Welsh

*J. Brit. Astron. Assoc.*, 72:7, 1962. p. 353.

A note is presented expressing doubt that the "organized elements" in certain meteorites are microfossils indigenous to meteorites. The chances of a tiny portion of the thin and comparatively scarce fossilbearing crust of some presumably disintegrated planet reaching the earth are considered infinitesimally small. (Author)

## 507

**THE GENERAL LIMITS OF SPACE TRAVEL.**

S. Von Hoerner (Astron. Rech. Inst., Heidelberg)

Science, 137:3523, 1962. p. 18–23. 5 refs.

The physical possibility of interstellar space travel by residents of earth is discussed. Space travel, even in the most distant future, will be confined completely to our own planetary system; a similar conclusion will hold for any other civilization no matter how advanced it may be. The only means of communication between different civilizations, thus seems to be electromagnetic signals. We may never visit neighbors in space, but we should start listening and talking to them. (M.G.)

## 508

**GULLIVER—A QUEST FOR LIFE ON MARS.**

G. V. Levin, A. H. Heim, J. R. Clendenning and M. F. Thompson

Science, 138:3537, 1962. p. 114–121.

A Martian life probe sensitive to a small number of organisms and responsive to a broad spectrum of species is described. Gulliver is also simple and capable of heat sterilization. This system uses the highly sensitive radioisotope technique to detect the evolution of a gas as a common product of metabolism. In essence, Gulliver detects the evolution of radioactive gases as end products derived from labeled substrates metabolized by micro-organisms. A positive response would be strong grounds for concluding that life exists on Mars; on the other hand, a negative result would not rule out the possibility of life, but barring equipment failure, would lead one to suspect that, if organisms exist on Mars, they are very different from any on earth. (E.O.)

## 509

**HISTORY, NATURE, AND THEORY OF ASTROBIOLOGY.**

K. A. Lyubarskiy

*In: Ocherki po Astrobiologii* (Moscow), 1962. (Essays on Astrobiology) p. 5–11, 104–111.

Translated by Joint Publications Research Service, Washington, D. C., Apr. 16, 1963.

(JPRS–18724; OTS 63–21584; N64–10643)

The possibility of extraterrestrial life and the multiplicity of inhabited worlds are discussed. The history and nature of the problems are studied, including a review of the hypotheses pertaining to extraterrestrial life formulated through the work of various investigators, and followed by some general theoretical questions. (STAR)

## 510

**IDENTIFICATION OF SOME ORGANIZED ELEMENTS IN CARBONACEOUS CHONDRITES.**

F. Fitch, H. P. Schwartz and E. Anders

*J. Geophys. Res.*, Vol. 67, 1962. p. 3557–3558.

To verify reports of organized elements resembling fossil algae in the Orgueil and Ivuna carbonaceous chondrites (Claus and Nagy, 1961), density-separated fractions of these meteorites were examined microscopically. In the unfractionated meteorites, the most abundant particles of circular outlines were identified as globules and platelets of troilite. In concentrates prepared by means of heavy organic liquids, two other classes of particles were found that matched the organized elements in color, transparency, size, shape, and ultraviolet fluorescence. These particles were identified as supercooled droplets of liquid sulfur and aromatic hydrocarbons, extracted from the meteorite during density separation and reprecipitated during evaporation of the solvent. The only other particles of vaguely spheroidal shape had all the visual and chemical characteristics of silicate grains; neither their behavior toward biological stains nor their UV-fluorescence properties were consistent with a biogenic origin. A few particles of more striking morphology were found only on the slides of Claus and Nagy, but not on slides of the same meteorite prepared in Chicago. Most of these particles bear a strong resemblance to terrestrial components, such as starch grains, pollen, and other airborne contaminants. On the basis of these findings, it does not seem necessary to invoke extraterrestrial life to account for the organized elements. (Authors)

## 511

INTELLIGENT LIFE IN SPACE.
F. D. Drake
N.Y., Macmillan, 1962. 113 p.

A description of the facts that seem to point to the existence of many civilizations in space and the ways in which we might contact such civilizations is presented. (Author)

CONTENTS:

Chapter 1: Our Real Home. Chapter 2: The Making of a Star. Chapter 3: Where Can Life Originate? Chapter 4: The Creatures of the Earth. Chapter 5: The Most Difficult Problem. Chapter 6: Reaching to the Stars. Chapter 7: The Search Begins.

## 512

IS ANYBODY OUT THERE?
J. Rublowsky
N.Y., Walker & Co., 1962. 118 p.

CONTENTS:

Chapt. 1: The Way of Science. Chapt. 2: Life On Earth. Chapt. 3: On the Way. Chapt. 4: Man In The Moon? Chapt. 5: Mars The Unknown. Chapt. 6: Behind the Veil. Chapt. 7: Beyond The Lifebelt. Chapt. 8: The Sun. Chapt. 9: The Universe Around Us. Chapt. 10: Project Ozma.

## 513

LECTURE BEFORE THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY.
N. H. Horowitz (Calif. Inst. of Tech.)
*A.I.B.S. Bull.*, 12:5, 1962. p. 74.

The discovery of life on another planet would be one of the momentous events of human history. It would not only satisfy human curiosity, but would also enlarge our view of nature and add much to our understanding of how life originated on earth. Although Mars offers the most exciting prospects for biologists, the moon may be of considerable biological interest, since it may contain beneath its surface deposits of organic materials formed during its very early history. Such deposits would provide invaluable indications of the kind of organic matter that existed on the earth before life arose. (A.H.F.)

## 514

LIFE BEYOND OUR PLANET.
D. W. Posin
N.Y., McGraw-Hill Book Co., Inc., 1962. 126 p.

CONTENTS:

Chapt. 1: A Search for the Land of Oz. Chapt. 2: Communication With Planets of Other Solar Systems. Chapt. 3: Communicating Across Space. How? Chapt. 4: Other Worlds. Chapt. 5: A Tiny Bit of the Universe. Chapt. 6: Mars. Was Professor Lowell Right? Chapt. 7: Venus. Is It Likely to Have Life? Chapt. 8: Mercury and the Moon. Are They Completely Dead Worlds? Chapt. 9: Other Planets, Other Chemistries, Other Beings, and Unusual Forces and Energies. Chapt. 10: The Inhabitants of Space.

## 515

LIFE IN THE UNIVERSE.
F. Jackson, and P. Moore
New York, Norton, 1962. 140 p.

The planets of our solar system are considered to offer unfavorable environments for the kind of life that we know on earth. The idea that life, even intelligent life, may exist in other parts of the universe is entertained. The idea that life has been seeded about from some unknown source is rejected. (M.G.)

The book attempts an examination of the whole question of life in the universe, and summarizes conclusions which can be drawn from available evidence.

Contents:

I: The Universe Around Us: II: The Nature and Origin of Living Organisms on the Earth: 1. Historical Introduction: 2. The Constitution of Living Organisms: 3. Pathways to Life: III: Myths or Men? IV: The Moon: V: Mars: VI: Venus: VII: Other Worlds of The Solar System: VIII: Planets of Other Stars: IX: Alien Life? X: Summary of Present Position.

## 516

LIFE IN THE UNIVERSE.
M. W. Overden
N.Y., Anchor Books, Doubleday, 1962. 160 p.

Recent discoveries in biology, chemistry, and phsyics that provide clues to possibilities of life in the universe are presented. Environments of Mars, Venus, Jupiter, and Saturn are specifically discussed, as well as the possibility of similar conditions existing on planets of other stars. (E.O.)

Contents: 1: life and the Universe: 2: The Earth as an Abode of Life: 3: The Solar System: 4: The Planet Mars: 5: Are There Other Planetary Systems? 6: What is Life? 7: Molecules and Life: 8: The Evolution of Life on Earth: 9: The Adaptability of Life: 10: Life on Other Planets: 11: The Chemistry of the Universe: 12: The Evolution of the Universe: Subject Index.

## 517

LIFE ON MARS.
L. C. Cole
*Science*, 138:3545, 1962. p. 1198—1199.

A plea to NASA for cessation of the biological space probe program until a man can accompany the probe is presented. The danger of contamination with terrestrial organisms will otherwise leave us in doubt about the nature or even the existence of Martian life. (A.H.F.)

## 518

LIFE ON THE PLANETS (LA VIE SUR LES PLANETES).
Robert Tocquet
N.Y., Grove Press, Inc., 1962. 191 p.

MERCURY: Mercury is a world without any appreciable atmosphere. Conditions on this planet are incompatible with life development or survival. Lower microbes might possibly exist.

ATMOSPHERE AND LIFE ON VENUS: Because of high temperature and an atmosphere containing carbon dioxide and oxygen only elemental vegetal life is possible on Venus. Animal life is unlikely. MARTIAN LIFE: Basic conditions for life do exist on Mars. Low forms of plant life are plausible on Mars. Lichens seem very likely due to their adaptation to environmental extremes. Animal life is possible, but no observations support the existence of intelligent life. LIFE ON JUPITER: No life can exist in the atmosphere of Jupiter. LIFE IN THE UNIVERSE: When we consider in our solar system of nine major planets there are two or three capable of supporting life, then we may expect many other probable life supporting abodes in our galaxy. (E.C.)

## 519

LIFE: ORIGIN AND DEVELOPMENT.
G. Ehrensvard
Univ. of Chicago Press, Chicago, 1962. 164 p.

A deterministic approach to the emergence of life as a necessary outcome of the accumulation of molecular species is presented. This predominantly biochemical treatment emphasizes the seemingly continuous evolution of the kinds of molecular species that characterize life, from the nonliving primordial environment on through the evolution of living organisms themselves. Emphasis is placed upon the apparent continuity of this record. (A.H.F.)

## 520

LIFE-FORMS IN METEORITES (COMMENTS ON A SYMPOSIUM).
J. D. Bernal
*Nature*, Vol. 193, 1962. p. 1127–1129.

If, as the writer believes, the 'organized elements' of Nagy et al. (*Nature*, Vol. 189, p. 967) are biogenic, one must recognize the possibilities that life developed elsewhere and populated the Earth, and vice versa. Life could have developed inside a planetary body. If such a body has a hot interior and a surface temperature below O° C, a zone between O° C and 100° C would exist in which, using radioactive energy, life could be synthesized. The required volatile materials would be sealed in by a frozen surface. (J.P.L.)

## 521

MARS BIOLOGICAL ANALYSIS BY GAS CHROMATOGRAPHY.
V. I. Oyama
Lunar & Planetary Exploration Colloquium, Santa Monica, Proc., 3:2, 1962. p. 29–36. 29 refs.

High sensitivity, relative simplicity, ruggedness, rapid and wide analytical capability are the characteristics which especially qualify the gas chromatograph for analytical problems in space. It is proposed that the soil of the planet Mars be analyzed for organics by a simple adaption of the gas chromatograph. Volatiles produced by the controlled thermal degradation of organic aggregations are passed through a column, and the chromatogram produced (fingerprint) is indicative of the organic composition. The data suggest and some documentation is given to show that fingerprint patterns obtained from biological systems could be used as a basis for differentiating nonliving aggregates from living systems. (Author)

## 522

MARTIAN BIOLOGY: ACCUMULATING EVIDENCE FAVORS THE THEORY OF LIFE ON MARS, BUT WE CAN EXPECT SURPRISES.
Frank B. Salisbury (Colorado State U.)
*Science*, 136:3510, 1962. p. 17–26.

Of all the proposals put forth to account for the observed Martian phenomena, the idea of life on Mars seems to be the most tenable. And if this idea is accepted, we are immediately drawn to the conclusion that this life is a very well-adapted and flourishing one. The suggested criteria seem to eliminate all the known terrestrial life forms, but of all these forms, a higher plant would require the least modification in order to meet the criteria. The basic shape of the leaf of a higher plant seems suited to conditions on Mars, but the lower gravity might well result in some interesting modifications in morphology. Some life forms on Mars might resemble our own higher plants, but we should be prepared to encounter some interesting surprises in biochemistry. In light of the thriving nature of the Martian organisms, we should expect to see the operation of many principles of dynamic ecology among them, surely, food chains and elemental cycles. A succession in the development of life forms must occur (was the new area in 1954 an example of plant succession in the desert or of an organized reclamation project?). What about intelligence? If in place of struggling lichens we assume a thriving vegetational cover, then it is easy to add other members of the biotic community. If plantlike organisms have solved the problem of growth in the Martian environment so well, one might surely expect to find mobile forms comparable to our animals that feed on plants. And from there it is but one more step (granted, a big one) to intelligent beings. In view of the evidence, we should at least try to keep our minds open so that we could survive the initial shock of encountering them. A manned landing could solve all the problems posed in this article, but even telescopic observations from a satellite, especially one orbiting Mars, could provide us with extremely valuable data. (*Aerospace Med.*)

## 523

MARTIAN LIFE.
R. V. Rice
*Science*, 138:3545, 1962. p. 1197–1198.

It is suggested that a medium suitable for D-forms as well as L-forms of amino acid be included in the Gulliver experiment. (A.H.F.)

## 524

MICRO-ORGANISMS UNDER A SIMULATED MARTIAN ENVIRONMENT.
E. J. Hawrylewicz, B. Gowdy and R. Ehrlich
*Nature*, Vol. 193, 1962. p. 497–498.

The results show that an encapsulated, facultative anaerobic organism such as *K. pneumoniae* will survive under Martian conditions for a few months and that it will be less virulent than the

freshly isolated organism. Spores of anerobic organisms such as *Cl. botulinum* and perhaps the tetanus and gangrene organisms will survive the Martian atmosphere. (A.H.F.)

## 525

MICROPALEONTOLOGIE DES METEORITES.

G. Deflandre

*Compt. Rend. Acad. Sci.* Paris, Vol. 254, 1962. p. 3405–3407

The author takes exception to the work of Claus and Nagy who have described organic bodies in stony meteorites, and have even suggested systematic nomenclature for the organisms observed. It is suggested that the techniques employed were conducive to the incorporation of contaminants on the slides of the investigators. In each instance a terrestrial life form is identified. Even the chemical analysis data from Claus and Nagy is also doubted, since organic matter might have been incorporated in the meteorite under unclean museum conditions. This leaves in doubt the question of fossil extraterrestrial organisms incorporated in meteorites. (E.O.)

## 526

THE MIND AND TIME AND SPACE.

Dan Tassi

Philadelphia, Dorrance & Co., 1962.

Following introductory chapters on the thesis of extrasensory perception and description of distant planets, application of this theory to controlled experimentation, general and specific methods and techniques, limitations, and examples of verified experiments. A presentation is made of several unverified experiments in which subjects describe their impressions of present and past conditions of the solar system planets. (M.P.G.)

## 527

ON THE CHEMICAL EVOLUTION OF THE CARBONACEOUS CHONDRITES.

E. R. DuFresne and E. Anders

*Geochim. Cosmochim. Acta*, Vol. 26, 1962. p. 1085–1114.

The mineral compositions of nine carbonaceous chondrites have been determined by X-ray diffraction. $MgSO_4$, free sulphur, a magnetic spinel, dolomite (newly reported) and pentlandite are present. Hydrous alteration products of olivine are present in several varieties which are distinct from known chlorites and serpentines. These minerals can be accounted for by preterrestrial action of water on olivine, troilite, and iron. In view of the crystal perfection of dolomite, the aqueous phase was active for longer than 1000 years. The prolonged presence of water does not necessitate origin of meteorites in bodies of planetary size. In small bodies at asteroidal distances from the sun, a surface ice layer could hold in an internal atmosphere for several million years or more. (E.O.)

## 528

ON THE POSSIBLE EXISTENCE OF INTELLIGENT LIVING BEINGS ON OTHER PLANETS.

Rodolfo Margaria

*Revi. Med. Aeron. Spaziale (Roma)*, 25:1, 1962. p.24–35.

The probability that in 3 billion years geological, physical, and chemical evolution took place on other planets in the same sequence and intensity as on Earth is infinitely small. The most optimistic hypothesis may consider that living beings exist on other planets; however, such forms of life may be so different from those on Earth as to be inconceivable. Even if intelligent beings inhabited the planets, it would be by coincidence that they lived in the same time cycle as found on Earth. Possible communications with the inhabitants of planets, although appealing to scientists, are unlikely.

## 529

ON THE POSSIBILITIES OF THE EXISTENCE OF EXTRA-TERRESTRIAL INTELLIGENCE.

R. A. MacGowan.

*In:* F. I. Ordway, ed. ADVANCES IN SPACE SCIENCE AND TECHNOLOGY Vol. 4, p. 39–111. N.Y., Academic Press, 1962.

(A63–17568)

Theories of planetary systems formation, evolution of life, the thinking process, and the development of intelligent mechanical automata are examined. The high probability of the frequent occurrence of planetary systems is strongly supported by empirical evidence. Life of increasing intelligence by natural selection is expected in appropriate planetary systems. Life at our level of intelligence should be capable of developing super-intelligent automata, and therefore, it is very likely that extraterrestrial intelligence may be mechanical or inorganic in make up. The effort to detect extraterrestrial communications is fully justified, although the results of such communications may have highly adverse effects upon our society. (E.O.)

## 530

ON THE PROBLEMS OF EVOLUTION AND BIOCHEMICAL INFORMATION TRANSFER.

A. Rich

*In:* M. Kasha and B. Pullman, eds. HORIZONS IN BIOCHEMISTRY. p. 124–125. N.Y., Academic Press, 1962.

If life exists on other planets, it is possible that it may exist in quite a different form from our own. It is likely, however, that there would be one major feature in common with terrestrial life, and that is the use of polymer molecules to store the large amount of information needed to define adequately the complexity of events that go on in a system we call "living." (E.W.)

## 531

THE ORIGIN OF LIFE.
George Wald
*In:* G. B. Moment, ed. FRONTIERS OF MODERN BIOLOGY. Boston, Houghton Mifflin, 1962. p. 185–192. Also *in: Sci. Ann.*, 121:2, Aug. 1954. p. 45–53.

The theories and accounts of the origin of life, from Genesis to Abelson are briefly delineated. Van Helmont, Redi, Spallanzani, Needham, Pasteur, Mohler, Darwin, Haldane, Oparin, Miller and Urey are cited as contributors to the development of the present state of knowledge. Author concludes with idea that life has originated and evolved elsewhere and that life has a physical status in the universe, and that as men, we are "matter that has begun to contemplate itself." (G.W.)

## 532

THE ORIGIN OF PETROLEUM AND THE NATURE OF THE LUNAR MARIA.
A. T. Wilson
*Nature*, Vol. 196, 1962. p. 11–13.

Since a "petroleum-like" product has been produced by the destructive distillation of a portion of the Orgueil Meteorite, it is hypothesized that petroleum could occur on the moon. Such petroleum would be of abiogenic hydrocarbon composition (unless life has flourished on the moon.). (A.H.F.)

## 533

OUR VIEW OF SPACE BIOLOGY WIDENS.
C. Tobias and J. Slater
*Astronautics*, Vol. 7:1, 1962. p. 20–22, 47–52.

Space observations by remote control will be made in the quest for life on other planets. Many organisms exist with environmental requirements and tolerances different from those of man. Experiments on living organisms under varying conditions of gravity and radiation are discussed. Information derived from these experiments are of use not only in problems of the physiological and psychological aspects of human space flight, but are of interest in the study of any life processes and developments on other planets. (A.H.F.)

## 534

POSSIBILITIES AND METHODS OF DETECTION OF EXTRATERRESTRIAL LIFE FORMS.
A. A. Imshenetskiy
*Problemy Kosmicheskoy Biologii (Moskva)*, Vol. 1, 1962. p. 144. (In Russian; English Summary)

Detection of extraterrestrial life forms would have a profound significance upon our understanding of fundamental biological processes. Micro-organisms are possibly a most wide-spread form of life due to their great adaptability. Absence of oxygen in itself may not be an obstacle to the existence of life. In view of the possibility that primitive life forms may be spread throughout space, the construction and use of microbial traps may lead to the detection of extraterrestrial life. (J.P.L.)

## 535

THE POSSIBILITY OF EXISTENCE AND METHODS OF DETECTING EXTRATERRESTRIAL LIFE.
A. A. Imshenetskiy
*In:* PROBLEMY KOSMICHESKOY BIOLOGII (Problems of Space Biology), Vol. 1, p. 153–160 Moscow, Acad. Sci., U.S.S.R., 1962. Transl. by NASA, Wash., D. C., Nov. 1963.
(NASA–TT–F–164; N64–11665) OTS: $7.00

Micro-organisms represent a most suitable object to solve problems of life forms distribution in outer space. Their negligible mass and resistance to the influence of various physical and chemical factors suggest the possibility of spores being carried along great distances in cosmic space and the probability of micro-organisms existing in diverse and complicated ecological conditions.

Discussed are various methods proposed to automatically record existence of life forms from a space probe which has landed on a planet.

## 536

THE POSSIBILITY OF LIFE ON MARS.
S. L. Miller
*In:* Proc. Lunar and Planetary Exploration Colloquium, Santa Monica, Calif., 3:2, 1962. p. 1–7. 10 refs.

The primitive earth is believed to have had a reducing atmosphere which was favorable for the evolution of simple organic life. As Mars was formed from the same cosmic dust cloud as the Earth, similar conditions might be expected to have existed on that planet. Laboratory experiments demonstrate that certain basic organic compounds necessary to produce "living" matter can be formed in such a favorable environment. Although these data and the polarization and infrared measurements of the Martian surface are not conclusive evidence, the existence of life on Mars is highly probable. (Author)

## 537

PROBLEMS OF SPACE BIOLOGY.
N. M. Sisakyan, O. G. Gazenko and A. M. Genin
*Prob. Kosmich. Biol.* (Moscow), Vol. 1, 1962. p. 17–26. (In Russian; English Summary)
(JPRS–12097)

The basic problems of space biology are briefly these: the influence of extraneous cosmic factors on living terrestrial organisms, biological criteria for safe space flights and existence on other planets, and the question of extraterrestrial life forms and life conditions. A variety of methods are possible in the solution of these problems. Hypotheses of the ecosphere of the sun and interstellar migration of micro-organisms are discussed in relation to evidence suggested by meteorite analyses. (Author)

## 538

PROBLEMS OF SPACE BIOLOGY.

N. M. Sisakyan, O. G. Gazenko, and A. M. Genin

*In:* PROBLEMY KOSMICHESKOY BIOLOGII (Problems of Space Biology), Vol. 1. p. 17–27. Moscow, Acad. Sci., U.S.S.R., 1962. Transl. by NASA, Wash., D. C., Nov. 1963.
(NASA–TT–F–174; N64–11665) OTS: $7.00

The main objectives of space biology are formulated. Biological characteristics of experimental factors of space flight are given, and methods for the development of special protectors against their influence are determined.

Principal problems of exobiology, achievements and investigations in this field are discussed. The significance of exobiology from the aspect of fundamental biology and methodology is presented.

## 539

PROBLEMS OF SPACE MICROBIOLOGY AND CYTOLOGY.

N. N. Zhukhov-Verezhnikov, I. N. Mayskiy, V. I. Yazdovskiy, et al.

*In:* PROBLEMY KOSMICHESKOY BIOLOGII (Problems of Space Biology), Vol. 1, p. 133–149. Moscow, Acad. Sci., U.S.S.R., 1962. 28 refs. Transl. by NASA, Wash., D. C., Nov. 1963.
(NASA–TT–F–164; N64–11665) OTS: $1.00

Microbiological and cytological investigations realized on the second and subsequent space ships, Vostok–1 and Vostok–2 included, were aimed at the solution of two principal problems of fundamental biology: 1) study of life conditions in outer space (viability of micro-organisms and somatic cells and possibilities of their multiplication) and 2) investigation of genetic consequencies caused by cosmic space factors.

The investigations indicated that microbiological and cytological objects used in cosmic flights showed no essential changes in comparison to control ones. Thus space ship conditions exerted no unfavourable effect either upon highly organized multicellular organisms of higher animals or upon living cells directly.

It was found in one experiment only (Vostok–2) that induced phage production of lysogenic bacteria as well as dissociative phenomena in *E. coli* KK–12 culture somewhat increased. There is a great necessity in experiments to study biological characteristics of cosmic space and in improvement of experimental techniques, particularly wide application of such biological indices of high sensitivity as induced phage producton of lysogenic bacteria.

Possibilities of life existence in outer space and methods of its detection are considered from the viewpoint of fundamental biology. The necessity of taking preventive measures against the implantation of terrestrial micro-organisms on heavenly bodies and the converse, the contamination of the Earth by unusual (probably harmful) organisms from outer space is discussed.

## 540

RADIOISOTOPIC METABOLIC DETECTION OF POSSIBLE MARTIAN LIFE-FORMS.

A. H. Heim.

*In:* Lunar and Planetary Exploration Colloquium, Proc. Santa Monica, Calif., 3:2, p. 37–46. 1962.

The feasibility of radioisotopic biochemical experiment for extraterrestrial life detection has been established. A medium has been developed which supports the evolution of detectable levels of $C^{14}O_2$ by pure cultures of representative bacteria, streptomycetes, fungi and algae within a period ranging from minutes to several hours. Mixed populations in soils also respond in less than one hour. An instrument weighing 1.5 pounds has been developed and field tested. In operation, a soil sample is obtained by ejection of two 25-foot lengths of adhesive-impregnated strings which are reeled back, with collected soil particles, into a culture chamber. Here a radioactive medium is supplied, and a solid-state radiation detector monitors metabolically evolved radioactive gases. (Author)

## 541

RECENT ADVANCES IN THE INVESTIGATION OF METEORITES.

M. H. Briggs

*Sci. Progress* (London), Vol. 50, 1962. p. 376–387.

A discussion is presented on recent advances in the chemistry of meteorites on the possible relationships of meteorites to comets and meteors, and the probable origin of meteorites. Organized elements in meteorites are also discussed. Biogenic materials in meteorites point to a planetary origin. The presence of life or even of complex organic compounds implies an atmosphere and a hydrosphere on an object of planetary size. If the organized elements are not contaminants or artifacts, they are also an argument for a hydrosphere since they resemble terrestrial aquatic micro-organisms. To account for the constitutions and relative abundances of the various meteorite groups, it is suggested that localized reduction, melting and segregation of metal and silicate occurred in the parent bodies. (E.O.)

## 542

REPORT OF THE GENERAL MEETING OF THE BRITISH ASTRONOMICAL ASSOCIATION.

(No Author)

*J. Brit. Astron. Assoc.*, Vol. 72, 1962. p. 205–211.

A discussion on extraterrestrial life and the danger of contaminating other planets with terrestrial organisms carried on probes is reported.

## 543

SEASONAL EVOLUTION OF THE FINE STRUCTURE OF THE DARK AREAS OF MARS.

J. H. Focas

*Planetary Space Sci.*, Vol. 9, 1962. p. 371–381.

The seasonal darkening of the dusky areas of Mars starts with maximum thickness of the winter polar clouds. The regional brightness of the polar caps is connected with the profile of the relief. The average intensity of the dark areas increases from the poles towards the equator; the amplitude of the darkening waves decreases from the poles towards the equator. The combined action of the two darkening waves shows that the action of the darkening generating element is constant for all areographic latitudes during the martian year. The distribution of the total intensity of the dark areas, the sizes and frequency in areographic attitude of dark blocks or nuclei composing the dark

areas of the planet, depend on the duration of the action of the darkening generating element. (Author)

## 544

**SOME COSMIC ASPECTS OF ORGANIC EVOLUTION.**

George G. Simpson (Harvard U.)

*In:* Gottfried Kurth, Ed. EVOLUTION UND HOMINSATION. p. 6–20. Stuttgart, Germany, Gustav Fischer Verlag, 1962.

This is a general discussion of the possible answer to the question "To what extent and in what way were the species of organisms that actually exist, and most particularly the species *homo sapiens*, inevitable or necessitated results of evolution?" Topics discussed fall under the headings: immanent and evolutionary causation; limitations on organic evolution; causation, convergence, and irrevocability; divergence and some environmental relationships; life in other worlds; a final remark on infinity. It is pointed out particularly that organisms result from an extremely long series of historical events, in which the environmental changes, although they determined to some extent the changes in the populations, were in themselves affected by the reactions of the organisms involved. If some form of life originated elsewhere, the history would be different from that on earth, therefore probably no solar planets other than earth have any species, at least above the bacterial level, that resemble terrestrial species. If the universe is "infinite," earthly conditions could theoretically be duplicated, but if the universe holds only some billions of billions of planets, the chances that any evolved life forms similar to terrestrial species exist anywhere else at all are "effectively nil." (A.K.W.)

## 545

**SPECTROPHOTOMETRIC STUDY OF THE REFLECTIVITY OF THE CENTER OF THE MARTIAN DISK AT OPPOSITION, AND THE NATURE OF THE VIOLET LAYER.**

P. Guerin

*Planetary Space Sci.*, Vol. 9, 1962. p. 81–87.

Spectra of the center of the Martian disk (Arabia region) were compared, wavelength by wavelength, with those of a GO v star. The Martian reflectivity curve was obtained by taking account of the visible and ultraviolet gradients of this star relative to the sun. Mars is red from 6100Å to 3850Å, and 'grey' on the average from 3850Å to 3100Å, but in this region of the spectrum the reflectivity curve presents undulations which perhaps, if real, may be due to packets of absorption bands produced by some organic compound ejected by Martian 'vegetation'. (Author)

## 546

**STERILIZATION OF ELECTRONIC COMPONENTS OF SPACECRAFT.**

J. T. Cordaro

*In:* Trans. 7th Symp. on Ballistic Missile and Space Technology, U. S. Air Force Acad., Colorado, 1962. Vol. 1: Space vehicles and system design, hypersonics and reentry techniques, propulsion, structures and materials, mathematical reliability techniques. p. 73–82.

Contamination of celestial bodies with earth micro-organisms might make studies of any extraterrestrial life impossible. Sterilization of heat-and/or radiation-sensitive electronic components presents a special problem. Using a flexible film germ-free isolator, internal contamination was demonstrated in only 11 of 166 components, including 9 of 101 capacitors. Moreover, the level of natural contamination is low and destruction of micro-organisms is assessed in terms of probability. Therefore, development of adequate sterilization procedures is being approached by deliberate contamination, during manufacture, with bacterial spores of high resistance to heat and irradiation. The results obtained with some types of resistors and diodes are presented. (Author)

## 547

**STERILIZATION OF SPACECRAFT.**

G. L. Hobby

*In:* Lunar and Planetary Exploration Colloquium, Santa Monica, Calif., 1962. Proc. 3:2, 1962. p. 49–52.

The actual damage from biological contamination of the moon would appear to be extremely low but can be fully evaluated only after data are obtained from soft-landed probes. Moreover, the strongest argument in favor of spacecraft sterilization is the uncertainty of any current predictions regarding the lunar environment. Therefore, vigorous sterilization techniques have been and are being developed for all lunar and planetary exploration vehicles. The methods employed for decontaminating lunar spacecraft include dry-heat sterilization of components and subassemblies whenever possible and the use of sterile assembly procedures. Ethylene oxide is employed for decontamination of the surface of the spacecraft, which is enveloped in a specially designed shroud. Although these procedures are considered effective for lunar missions, more stringent methods are contemplated for Mars spacecraft. (Author)

## 548

**SURFACE PROPERTIES OF THE MOON.**

E. J. Opik

*Progress in the Astron. Sci.*, Vol. 1, 1962. p. 215–260.

A survey of lunar surface characteristics is presented with an estimate of the density of the lunar atmosphere. The dynamical shape of the Moon is described and features an uncompensated bulge of 1.1 km. directed towards the earth. A dust layer of 20–100 cm. probably covers the plains and there should be adequate support for any lunar landings. Vegetation has been ascribed to certain dark spots which appear near full Moon, but the increase in contrast of the bright rays and dark spots can be attributed to a greater or smaller degree of roughness of the markings as compared with the average surface. Moreover, with the known extreme tenuity of the lunar atmosphere and even considering local effusions of gas, there would be insufficient pressure to prevent the instantaneous evaporation of organic liquids at local high temperatures. The probable origin and structure of the moon are discussed from the standpoint of accretion from solid fragments. (E.O.)

## 549

**SYNTHESIS OF PURINES UNDER POSSIBLE PRIMITIVE EARTH CONDITIONS.**

J. Oro and A. P. Kimball

*Arch. Biochem. Biophys.*, Vol. 96, 1962. p. 293–313.

In addition to adenine the supernatant solution from the product of the base-catalized condensation of hydrogen cyanide in aqueous ammonia contains several purine precursors, other amino acids and a large number of unidentified ultraviolet-absorbing and fluorescing compounds. A probable mechanism for the synthesis of adenine is proposed. These results are considered significant in relation to the formation of imidazoles and other heterocyclic compounds on the abiotic earth. The fact that not only adenine, but also amino acids and polypeptides can be synthesized under similar conditions strongly supports the geochemical models proposed by Oparin, by Urey, and more recently by Oro for the formation of biochemical compounds on the primitive earth. (Author)

## 550

**"THE TWINS"—MOST HOSPITABLE OF OUTER PLANETS?**

R. L. Forward

*Missiles and Rockets*, 60:4, 1962. p. 34–36, and 45.

The possibilities for probes and manned travel to Uranus and Neptune are discussed. The author predicts the use of ion rockets or other methods of long-duration thrust to decrease radically the time needed to complete a round trip. He also proposes the use of a bathyscaphe to explore Uranus, and the use of methane on Triton to refuel. He cites Sagan's production of organic molecules by bombarding a simulated Jupiter atmosphere with ultra-violet rays as the basis for life on the outer planets. He expects "reasonable" temperatures in the interior because the four gaseous planets are hotter than solar-heating equilibrium temperature. (Author)

## 551

**THE UNIVERSE IN ACTION.**

Donald H. Menzel (Harvard Coll. Obs., Cambridge, Mass.)

The Rushton Lectures Foundation, Birmingham, Ala., 1962.

A discussion is presented of the universe as it was, as it is now, and as it will be in the far distant future when evolution has nearly run its course. The belief that life, even human or superhuman life, may exist in millions of places in the universe is expressed, based on the plurality of planets that follows from the theory of planetary origins. (M.P.G.)

## 552

**VISUAL COLORIMETRY OF THE LUNAR SURFACE.**

V. V. Sharonov

*Soviet Astron.-AJ*, Vol. 6, 1962. p. 62–66. (In English)

The colors of 115 lunar surface features have been measured. The most extreme color differences on the moon are barely above the limit of resolution: they can be detected on the maria with difficulty and are most indiscernible on the continents. (J.P.L.)

# 1961

## 553

EFFECT OF ULTRAHIGH VACUUM ON VIABILITY OF MICRO-ORGANISMS.

Dorothy M. Portner, David R. Spiner, Robert K. Hoffman, and Charles R. Phillips

Repr. from *Science*, 134:3495, Dec. 22, 1961. p. 2047.

(NASA Order R–35)

(N62–11134)

Three species of resistant micro-organisms were exposed for 5 days to an ultrahigh vacuum approaching that of interplanetary space. Since no lethal effect was observed, there is no indication that the vacuum of outer space would prevent transport of viable micro-organisms on unsterilized space vehicles. (Author)

## 554

SEARCH FOR SIGNALS FROM OTHER CIVILIZATIONS.

Sebastian von Hoerner (Astronomisches Rechen-Institut, Heidelberg, Germany).

*In:* A.G.W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 272–286.

N.Y., W. A. Benjamin, Inc., 1963.

Also *In:* *Science*, Vol. 134, Dec. 8, 1961, p. 1839–1843.

(A64–10237)

Emphasis is placed on the distances involved. The basic assumption is made that our planetary system and our civilization are about average, and that life and intelligence will develop by the same rules of natural selection wherever the proper surroundings and the needed time are given. It is also assumed that a state of mind not too different from our own will have developed at many places but will have only a limited longevity. It is suggested that use be made of exactly twice the frequency of the 21-cm line. If this should fail, we will have to look for more sophisticated methods of producing contacting signals. The design is recommended of a receiving system which can be used for ordinary astronomy as well, since, because of the size and sensitivity needed for its prime task, it will be extremely powerful. The observing time should be allocated in equal parts between the two projects assigned to the instrument.

## 555

STELLAR EVOLUTION AND THE ORIGIN OF THE CHEMICAL ELEMENTS.

J. L. Greenstein

*Am. Scientist*, 49:4, Dec. 1961. p. 449–473. 19 refs.

The processes of stellar evolution are reviewed in the light of current astronomical knowledge, including nuclear reactions in stars and elements detected in various types of stars. The appearance of these elements in planets or in meteorites is discussed. (S.T.L.)

## 556

THE COSMOS SEEN BY THE SOVIET SCIENTISTS: LIFE AND ITS ORIGIN, PT. 2. (LE COSMOS VU PAR LES SAVANTS SOVIETIQUES: LA VIE ET SON APPARITION, PT. 2.)

A. I. Oparin and V. G. Fesenkov

*l'Homme et l'Espace*, Vol. 8–9, Nov.–Dec. 1961. p. 16–23.

A review of the biological character of compounds formed by numerous mineral elements shows that the formation of organic substances must be considered as the first stage of the development of matter leading to the appearance of life. The authors stress the question of nonbiological formation of organic substance in a natural medium. It is shown that the first important stage of development toward life on earth is the formation of hydrocarbons, a process that is widely prevalent in the universe and present in a large number of celestial bodies. The second stage, which on the earth consisted in the formation of complex organic compounds, particularly albumenoids, is investigated in detail. This investigation shows that light must necessarily take part in the synthesis of the earth's complex organic substances. The laboratory synthesis of albumenoids and other complex organic substances is foreseen. Finally, the conditions required for the development of similar processes on other planets are examined, together with the possible obstacles to this development. (A.V.S.)

## 557

ON THE ORIGIN AND EVOLUTION OF LIVING MACHINES.

H. H. Blum

*Am. Sci.*, 49:4, 1961. p. 474–501.

The process of self-replication of living machines is considered in a framework which attempts to unite both the chemical and the biological aspects of biogenesis and evolution. An analogy is drawn between a living system and a complex man-made machine, and a distinction is made between the origin of a replicating machine and the duplication of such a machine once it exists. Topics discussed include chemical evolution, replication

of living systems, origin and evolution, and viruses and genes as templates. The question of the origin and existence of life on other worlds is considered, and it is concluded the origin of life and its evolution by natural selection requires a whole series of rare events. Such thinking should perhaps not dampen our enthusiasm for exploring the possibility of life on other planets, but it might temper our expectations of what we may find and affect planning in regard to what to look for. (M.P.G.)

## 558

THE PROBLEM OF NITROGEN PEROXIDE IN THE ATMOSPHERES OF PLANETS.

Su-Shu Huang

*Publ. Astronom. Soc. Pacific*, 73:435, Dec. 1961. p. 446–451.

A discussion is presented on the occurrence and origin of nitrogen peroxide in the atmospheres of Jupiter, Mars, and Venus. The stability of nitrogen peroxide is shown by a discussion of thermal requirements for decompositions and the rate of reaction. As long as only thermal collision is available as an activation mechanism, it is believed that nitrogen peroxide will stay indefinitely in the atmosphere of Mars. The temperature in the lower atmosphere of Venus may cause the breakdown of peroxide. The origin of nitrogen peroxide in these planets' atmospheres may be from the early periods when the temperature was high, or there may have been special methods of activation such as ultraviolet light or high-energy particles from the sun. (Author)

## 559

THE PROBLEM OF STERILIZATION.

E. S. Wynne

*Space World*, Dec. 1961. p. 28–31, 59.

The necessity of sterilizing space probes to prevent contamination, methods of sterilization, and sterility tests are discussed. Lunar micro-organisms which evolved in the distant past may be preserved beneath the surface and the possibility of life on Mars is strong. Probe sterilty may be accomplished by sterile assembly, built-in sterilization, and terminal sterilization by heat radiation, or chemicals, especially gaseous alkylating agents which appear most promising against bacteria and viruses. Ethylene oxide is considered as a good sterilizing agent. Sealed components may present special problems. (E.O.)

## 560

A MICROBIOLOGICAL EXAMINATION OF SOME CARBONACEOUS CHONDRITES.

G. Claus and B. Nagy

*Nature* (London), 192:4803, Nov. 18, 1961. p. 594–596. 13 refs.

Microscopic-sized particles, resembling fossil algae, were to be present in relatively large quantities in the Orgueil and Ivuna carbonaceous meteorites. No such particles were found in two ordinary stony meteorites (Holbrook and Bruderheim). The Orgueil meteorite samples contained each of the five organized element types found. Types 1 and 2 were by far the most abundant in both meteorites. Several of the organized elements appeared to undergo "cell divisions" and several showed distortion and rupture of the walls. Often the interior seemed to be spilling out through the walls. The organized elements found in Orgueil and Ivuna may be micro-fossils indigenous to the meteorites. (J.P.L.)

## 561

HYDROCARBONS IN THE ORGUEIL METEORITE.

W. G. Meinschein

*Proc. Lunar and Planet. Exploration Colloq.*, 2:4, Nov. 15, 1961. p. 65–73. 2 refs.

(NAA Publ. 913–W–10)

The basis for the interpretation of the data collected for the Orgueil meteorite and the procedures used at the National Institute of Health's Germfree Laboratory in the extraction of micro-organisms from the Murray meteorite are discussed. Theories of the origin of organic matter in meteorites are considered. (E.D.)

## 562

ORGANIC MATTER AND LIFE IN METEORITES.

W. G. Meinschein, C. Sagan, and P. D. Sisler

*Proc. Lunar and Planet. Exploration Colloq.*, 2:4, Nov. 15, 1961. p. 49–65. 3 refs.

(NAA Publ. 913–W–10)

The object of the study is to develop polarimetric methods to detect the presence of optically active materials, particularly DNA or its congeners in soil suspensions. Provided such methods can be developed, the determination of the existence of life (as known terrestrially) on other planets may be accomplished by remote instrumentation. The cotton region of the spectrum associated with optically active biological compounds is of principal interest because of the intensely high activity in the absorption bands of such materials.

The design and development of a spectrophotometer which permits premeasurement of optical rotation in media which exhibit absorption, scattering and circular dichroism is discussed. Optical rotary dispersion measurements have been obtained on pure water, 0.15N HCl, 0.15N NaOH, and 0.5N NaOH soluble extracts of soil. The data presented indicate that the theoretical development of the electronic simple ratio for obtaining optical rotary dispersion measurements is valid. (Author)

## 563

UNCHANGING MOON.

J. W. MacVey

*Spaceflight*, Vol. 3, Nov. 1961. p. 210–212.

Descriptions of unexplained changes occurring within a series of lunar craters are given. Variations in the shape and intensity of markings are recorded as well as the appearance and disappearance of certain spots. Various suggestions have been put forward to account for these changes such as gases or mists, seismic disturbances, volcanic ejections, or possibly vegetation. Final analysis must await lunar exploration. (E.O.)

## 564

**IS THERE LIFE ON THE MOON?**

J. Rublowsky

*Space World*, Nov. 1961. p. 12–15, 49–50.

The environment of the Moon is described and the possibility of life on it is considered. Markings of variable size and color have been observed in certain areas of the Moon such as Mare Tranquillitatis and the crater Eratosthenes and may be due to low order vegetation gathered around cracks in the surface from which gases and vapor escape. Adaptation to rigorous conditions is exhibited by certain terrestrial plants and adaptation by lunar plants may be much more complex, involving structural and chemical changes. The lunar surface may cover a honeycomb of caves and crevases in which conditions for life may be much more favorable. Chemautotrophic life may exist there, deriving its energy from inorganic substances. (E.O.)

## 565

**PROSPECTS AND PHYSICAL CONDITIONS FOR LIFE ON VENUS AND MARS.**

N. A. Barricelli

*Scienta*, (Milano), 96:11, Nov. 1961. p. 337–343. (In English)

A review is given of the physical conditions including density, size, surface temperature, and atmospheric properties including water content on Mars and Venus. It is thought that conditions for developing organisms with properties of living beings do not need to be similar to conditions on Earth. The evidence for life on Mars and Venus is reviewed and analyzed, and generalized speculation as to types and properties of any organisms already present is made. (Author)

## 566

**ON THE POSSIBLE EXISTENCE OF INTELLIGENT LIVING BEINGS ON OTHER PLANETS.**

Rodolfo Margaria (University of Milan, Institute of Human Physiology, Milan, Italy).

*In:* 12th INTERNATIONAL ASTRONAUTICAL CONGRESS, PROCEEDINGS, Vol. 2. Washington, D.C., Oct. 1–7, 1961. New York and London, Academic Press, Inc., 1963, p. 556–563. (A63–21274)

Brief consideration of the possibility that necessary conditions for life similar to that on Earth have developed on other planets. Basic ecological conditions necessary for its development are briefly considered in terms of geochemical and biological evolution. The probability of a replica of these evolutions is discussed, and the possible forms of life in other worlds is considered in terms of the appearance of the ATP molecule (adenyltriphosphoric acid).

## 567

**LIFE FORMS TO BE EXPECTED ELSEWHERE THAN ON EARTH.**

H. J. Muller

*Am. Biol. Teacher*, 23:6, Oct. 1961. p. 331–346.

Also *In: Spaceflight*, 5:3, May 1963. p. 74–85.

After a brief discussion of cosmic and chemical evolution, the known evidence concerning the origin of terrestrial life is recapitulated. Mars is described as not only being habitable, but also probably inhabited, based on spectroscopic evidence. The possibility of life based on materials other than carbon and the question of intelligent life elsewhere are discussed at length. The point is made that, if extraterrstrial life is more advanced, why have they not discovered us? (A.H.F.)

## 568

**RECORD OF COSMIC RAY INTENSITY IN THE METEORITES.**

J. R. Arnold, M. Honda and D. Lal (Tata Inst. for Fundamental Res., Bombay, India)

*J. Geophys. Res.*, 66:10, Oct. 1961. p. 3519–3531.

Extensive data now exist on the abundance of radioactive and stable nuclides produced by cosmic rays in iron meteorites. Halflives of radioactive species range from 16 days to $1.2 \times 10^6$ years. In this paper these data are compared with calculated production rates based on derived energy spectra of nuclear-active particles in meteorites and experimental excitation functions. Both relative and absolute amounts of the various species are in approximate agreement if the flux of cosmic rays is assumed not to have varied. The variation, averaged over the halflife of each species, does not appear to exceed a factor of 2 in any case, except possibly $K^{40}$, for which the data are still insufficient. It is concluded that the cosmic ray intensity has been constant, in this sense, at least over millions of years. (Author)

## 569

**THE VIABILITY OF MICRO-ORGANISMS IN ULTRA-HIGH VACUUM.**

E. E. Brueschke, R. H. Suess, and M. Willard

*Planetary Space Sci.*, 8:1, Oct. 1961. p. 30–34. 6 refs.

Studies were conducted on the resistance of common micro-organisms to vacuum from $1 \times 10^{-5}$ to $6 \times 10^{-9}$ mm Hg. Some of the organisms remained viable after exposure to $8 \times 10^{-5}$ mm Hg. All were killed by prolonged exposure to pressures of $1.2 \times 10^{-8}$ mm Hg and lower. (Author)

## 570

**SPACE MICROBIOLOGY.**

N. N. Zhukov-Verezhnikov, I. N. Mayskiy, A. P. Pekhov, N. P. Nefedeva

*Mikrobiologiya, Moscow*, 30:5, Sep.–Oct. 1961. p. 809–817. (JPRS–11308; OTS–62–13396)

Areas currently under investigation in the field of space microbiology include (1) the vital activity of terrestrial micro-organisms when exposed to outer space, (2) the genetic consequences of the exposure of micro-organisms to outer space, (3) the simplest forms of life existing beyond the confines of the earth, and (4) the possible migration of terrestrial micro-organisms to the surface of other planets. (J.P.L.)

## 571

**MECHANISM OF SYNTHESIS OF ADENINE FROM HYDROGEN CYANIDE UNDER POSSIBLE PRIMITIVE EARTH CONDITIONS.**

J. Oró

*Nature* (London), 191:4794, Sep. 16,1961. p. 1193–1194. 7 refs.

The various steps in the synthesis of adenine from hydrogen

cyanide are outlined, and direct experimental evidence for the last step is given. (S.T.L.)

## 572

THE PROTON IRRADIATION OF METHANE, AMMONIA, AND WATER AT 77° K.

R. Berger

*Proc. Natl. Acad. Sci. U.S.*, 47:9, Sep. 15, 1961. p. 1434–1436. 17 refs.

It has been shown that significant amounts of organic compounds such as amino acids could have been formed on the primitive earth by electric discharges passing through gas mixtures. The question arises as to whether the synthesis of organic material could have occurred even before the earth existed, and if organic molecules are presently being synthesized in space on comets, icy meteors, and interstellar dust. Experiments were performed to see if more complex organic compounds could be synthesized in frozen mixtures of gases using Whipple's comet model. Urea, acetamide and acetone were obtained by radiation synthesis under conditions likely to be encountered in space. The number of proton impacts per $cm^2$ in the experiment approaches the order of magnitude of those sustained by a comet of the age of the solar system. (E.O.)

## 573

IDENTIFICATION OF ALDEHYDE IN MARS VEGETATION REGION.

N. B. Colthup

*Science*, 134:3478, Aug. 25, 1961. p. 529.

It is suggested that bands indicating the presence of the aldehyde acetaldehyde on Mars may be an end product of certain anaerobic metabolic processes. An organism can use fermentation as a source of energy when oxygen is not available, as might be the case on Mars. (S.T.L.)

## 574

PLANETARY STUDIES.

G. P. Kuiper

*Proc. Lunar and Planetary Exploration Colloq.*, 2:3, Aug. 15, 1961. p. 17–41.

Phenomena of the planets Mars and Venus are discussed. Planetary models are reviewed, and speculations made as to existence of organic life on these planets. (S.T.L.)

## 575

LA CONQUISTA DI PIANETI.

Rodolfo Margaria

*Missili*, Vol. 4, Aug. 1961. p. 49–52. (In Italian)

(61–10529)

A brief discussion of the possibility of there being life on other planets is given. The biochemical foundations of life are surveyed, probable conditions on other planets are noted, and the possibilities of our discovering such life in space are considered. (I.A.A.)

## 576

ON THE ORIGIN AND PLANETARY DISTRIBUTION OF LIFE.

Carl Sagan

*Radiation Res.*, 15:7, Aug. 1961. p. 174–192.

Processes by which ultraviolet radiation or lightning could have produced organic matter and life in the Earth's primevial atmosphere of water, methane, nitrogen, and ammonia are discussed and the effects of hazards such as radiation are evaluated. The early physical conditions of the Earth were similar to the other planets, especially Mars and Venus. It is suggested that biological evolution may have taken place on these planets in a manner similar to that on Earth. Evidence, including changing polarization, color changes, and absorption in the 3.4 to 3.7 micron range in the spectra of the dark areas is given for the existence of life on Mars. Suggestions are made for probe instrumentation to detect life forms. The possibility that life has existed on Venus is considered remote. The atmospheres of the giant planets are compositionally similar to that of the early Earth and organic material is undoubtedly forming there. It is suggested that a greenhouse effect, coupled with convection cells, may warm the lower atmospheres of these planets enough to permit seas of water or ammonia to concentrate the organic molecules. It is concluded that life at 400° K or higher temperatures is unlikely. (J.P.L.)

## 577

SYNTHESIS OF PURINES UNDER POSSIBLE PRIMITIVE EARTH CONDITIONS. I. ADENINE FROM HYDROGEN CYANIDE.

J. Oró and A. P. Kimball

*Arch. Biochem. Biophys.*, 49:2, Aug. 1961. p. 217–227. 45 refs.

Adenine has been synthesized in substantial amounts by heating a solution of hydrogen cyanide (1 to 5 M) in aqueous ammonia for one or several days at moderate temperatures. The insoluble black polymer of hydrogen cyanide was removed and adenine was isolated from the red-brown supernatant. From a 11.1 M hydrogen cyanide reaction mixture at 70°, a yield of 110 mg of adenine per liter of original reaction was obtained which could be increased to 685 mg by evaporation of the supernatant to dryness and treatment of the residue with hydrochloric acid. Since adenine is an essential building block of nucleic acids and most of the important coenzymes, and since hydrogen cyanide, ammonia and water are common natural constituents of the solar system, these experiments are considered of significance in relation to the problem of the origin of life. (Author)

## 578

XENOBIOLOGY.

R. Heinlein and H. Wooster

*Science* (Washington), 134:3473, July 21, 1961. p. 223–225.

The authors of this letter suggest the use of the term "xenobiology" (and adjectives derived from its prefix) instead of "exobiology" or "astrobiology," for all references to extraterrestrial biology. In addition to being novel, "xeno-" terminology is free of most of the semantic conflicts which are associated with "exo-" or "astro-biology" and their associated adjectives.

Dr. Wooster endorses the use of "xeno-", "xenio-" and "xen" in an added note. (Author)

## 579

THE UNIVERSE AND LIFE.

A. I. Oparin

*Priroda*, No. 7, July 1961. p. 5–12.

The development thought on extraterrestrial life is given from the Greek philosophers to the present. The origin of life represents a long irreversible process of a gradual complication of organic substances and complex systems leading to the formation of organisms. Since the early stages of life on Earth are absent, we can only judge about the forms of life by: (1) synthesis of life; (2) the discovery of life forms beyond our planet where the evolution of life is at an earlier stage of development. Until interplanetary travel can bring scientific proof of living organisms, meteorites are the only non-earthly objects which can be studied. However, mineralogical study of meteorites shows that they were formed under conditions which utterly rule out life. Conditions on the moon preclude life there. The first organic-chemical stages could proceed on Venus. There are diverse views on the possibility of life on Mars; the author believes that different, more primitive forms of organization exist on Mars than on Earth. The problem of life on another world should not be approached only by determining the possibility of the existence of organisms under various conditions, but also by the study of the course of evolution of matter on the various objects in the universe. (A.H.F.)

## 580

SYNTHESIS OF URACIL UNDER CONDITIONS OF A THERMAL MODEL OF PREBIOLOGICAL CHEMISTRY.

Sidney W. Fox and Kaoru Harada (Florida State U., Tallahassee)

*Science*, 133:3468, Jun. 16, 1961. p. 1923–1924. 13 refs.

(NASA Grant NsG–105–61; NIH Grant C–3971; PHS Grant G–4566)

(N62–11742)

Uracil has been formed under thermal conditions which yield other materials of theoretical prebiochemical significance. The chemical evidence for the identity of uracil rests on chromatography, spectrography, color tests, and melting points and analyses of isolated material. The place of uracil in a scheme of biochemical origins, including carbon dioxide as an intermediate, is discussed. (Author)

## 581

MASS SPECTROSCOPIC ANALYSIS OF THE ORGUEIL METEORITE: EVIDENCE FOR BIOGENIC HYDROCARBONS.

B. Nagy, W. G. Meinschein and D. J. Hennessy (Fordham U.)

*N.Y. Acad. Sci., Ann.*, 93:2, June 5, 1961. p. 25–35. 14 refs.

A sample of the meteorite was subjected to solvent extraction, infrared and ultraviolet analyses, and to mass spectrometric analysis of fragments and distillates as well as to thermal balance and X-ray diffraction studies. Although the distillates analyzed probably did not contain all the high molecular weight hydrocarbons in the meteorite and the distillates were not subjected to further fractionation, the mass spectrometric analyses reveal that hydrocarbons in the Orgueil meteorite resemble in many important respects the hydrocarbons in the products of living things and sediments on earth. Based on these preliminary studies, it appears that biogenic processes occur and that living forms exist in regions of the universe beyond the earth.

## 582

CHALLENGES TO BIOLOGY.

Aaron Novick and J. Lederberg

*Bull. Atomic Scientists*, 17:5–6, May–June 1961. p. 203–206.

The most important consequences to biology from the exploration of space will be the opportunity to see if extraterrestrial life exists on other planets and to gain an insight on the origin of life on Earth. Biology will have the chance to test hypotheses such as panspermia. The discovery of other chemical systems used in extraterrestrial life can help us to understand our system better. An evaluation of the planets most likely to have life is given. The possibility of detecting extraterrestrial life by remote photographic-chemical means is discussed. Although of secondary importance to biology, the problem of space contamination either from the Earth to the planets or vice versa will be the important responsibility of the biologist. (Author)

## 583

EXTRATERRESTRIAL LINGUISTICS.

S. W. Golomb

*Astronautics*, Vol. 6, Jan.–June 1961. p. 46–47, 96.

An examination is made of communication attempts with extraterrestrial intelligence. Objections are advanced against the choice of the 21 cm hydrogen line as the best of all possible frequencies, the use of *pi* as an identification symbol and the makeup of artificial "cosmic" languages since they are all based on terrestrial logic. Prime number sequences or arithmetic progressions are advocated as identification symbols. The problems of communicating on the levels of our own intelligence, semantics, and the choice of subject matter in 2-way communication, are discussed. Governmental control, secrecy, and possible danger to our civilization from extraterrestrial contact must be resolved. (E.O.)

## 584

THE U. S. PLANETARY EXPLORATION PROGRAM.

R. J. Parks

*Astronautics*, Vol. 6, Jan.–June 1961. p. 22–24, 92–96.

The program objectives, scientific goals, probe mechanisms, and technological problems of the planetary exploration program are described. The primary goals are the determination of the distribution of life and the origin and evolution of the solar system. Since the changing character of the Martian surface indicates some form of life, the first Mars mission will seek evidence of organic molecules and knowledge of the atmosphere composition of Mars. (E.O.)

## 585

THE EVOLUTION OF HUMANS ON OTHER PLANETS.
W. Howells
*Discovery*, 22:6, June 1961. p. 237–241.

The author expresses his thoughts on what intelligent beings would probably be like on other planets. (J.P.L.)

## 586

LIFE ON VENUS.
(No Author)
*The Airman*, 5:6, June 1961. p. 44.

Some of the information which has been uncovered concerning the physical and chemical properties of Venus is reviewed. (E.O.)

## 587

MICRO-ORGANISMS IN SPACE (MIKROORGANIZMY V KOSMOSE)
N. I. Rybakov
*Nauka i Zhizn* (Moscow), 28:6, June 1961. p. 8–9. (In Russian)

The use of unicellular organisms in preparation for manned space flight is explained in a popular way. Bacteria sensitive to large doses of radiation (*Bacterium coli*, *Staphyloccus*, butyic-fermentation bacillus, etc.) were used to observe the effects of cosmic radiation on mutation rate and cellular metabolism. Lysogenic bacteria were included because of their high sensitivity to small doses of radiation to indicate genetic consequences of radiation absorbed in small doses throughout the flight. Human cancer cell cultures occupied an intermediate position in the radiation sensitivity scale. (Aerospace Med.)

## 588

SOME ASTRONOMICAL ASPECTS OF LIFE IN THE UNIVERSE.
S. S. Huang
*Sky and Telescope*, 21:6, June 1961. p. 312–316.

The evolution of stars is discussed in terms of present knowledge of the gravitational, nuclear, and chemical interactions of matter, and the conclusion is reached that intelligent life has the best chance of being found in the vicinities of stars of medium temperature, like the sun. The qualifications of a planet for the support of life are considered, and the assumption is made, based on recent experiments in prebiological chemistry, that life everywhere in the universe depends upon carbon compounds. Supporting evidence is presented for the following conclusions: (1) Other planets in our solar system could support only very primitive forms of life; and (2) Intelligent life could appear around a few thousand stars within 1000 light years from earth, or around two other stars (Epsilon Eridani and Tau Ceti) within 16.3 light years of our sun. The possibility of radio communication with intelligent life existing elsewhere in space. (Author)

## 589

CHEMISTRY OF LIFE: HOW LIFE ORIGINATED ON EARTH AND IN THE WORLD BEYOND.
Melvin Calvin
*Chem. and Eng. News*, 39:21, May 22, 1961. p. 96–104.

The stages of chemical evolution are discussed as follows: (1) conversion of simple compounds into more complex ones in random fashion; (2) autoselection leading to the formation of certain compounds from precursors which themselves have some autocatalytic function; (3) the beginnings of energy conversion and storage processes; (4) emergence of structurally organized macromolecules proteins and nucleic acids; and (5) the formation of a primitive organism. This same sequence of events could occur anywhere outside of earth where earthlike conditions exist. Evidence for the extraterrestrial existence of organic compounds has been found in meteorites and comets. Recent experimental syntheses under primitive conditions indicate that the two apparently distinct evolutionary processes—the development of the catalytic function of proteins and the code development of the polynucleotides were initiated by the same chemistry and grew simultaneously. (M.P.G.)

## 590

POLYPEPTIDE FORMATION FROM ASPARAGINE UNDER HYPOTHETICALLY PRIMITIVE CONDITIONS.
J. Kovacs and H. Nagy
*Nature* (London), 190:4775, May 6, 1961. p. 531–532. 6 refs.

A report is given of the formation of polyaspartic acid from asparagine in aqueous solution under conditions which satisfy suggested primitive terrestrial conditions better than thermal polycondensation. It is assumed that the polymerization of asparagine involves an intermolecular nonenzymatic transamidation reaction. (A.H.F.)

## 591

SPECTROPHOTOMETER TO INVESTIGATE EXISTENCE OF VEGETATION OF MARS.
(No Author)
*Aviation Wk. Space Technol.*, 74:18, May 1, 1961, p. 139.

A description is given of an infrared spectrophotometer, built by Perkins-Elmer Corporation, to be used in an attempt to determine the existence of vegetative life on Mars. The device is to be used during a 1964 flyby. (S.T.L.)

## 592

THE ORIGINS OF LIFE ON EARTH AND ELSEWHERE.
M. Calvin
*Ann. Intern. Med.* 54:5:954–976, May, 1961.

A description is given of the random syntheses of amino acids, formic and acetic acid, purines, pyrimidines, and other organic molecules from methane, ammonia, water, and hydrogen through the use of high energy ionizing radiation, ultraviolet light, or electrical discharges. It is shown that the molecules which tend to be formed under such random conditions are the very ones which today are the common building blocks in the

biological reconstruction of living matter. The appearance of order among such random molecules is induced by two forces: autocatalysis and crystallization. Points of agreement between laboratory findings and theories of the construction of macromolecules are discussed. Studies in colloid surface chemistry are needed to elucidate cell construction. A description is given of the organic constituents of meteorites and comets and of experiments designed to detect the presence of prebiotic organic synthesis on other planets. (E.O.)

## 593

**SUPERIOR GALACTIC COMMUNITIES.**

M. H. Briggs

*Spaceflight*, 3:3, May 1961. p. 109–110. 8 refs.

The possibility of the existence of intelligent extraterrestrial life should lead to an examination of methods by which contact might be made. Artificial radio signals have been sought at the 21-centimeter line of interstellar hydrogen which might be identified by Doppler shifts, narrow bandwidth, or a repeated pattern of impulses. A search should be initiated for signals from artificial probes within our solar system and for artificial sources of infrared radiation. Since the likelihood of intelligent life greatly increases toward the center of the galaxy a long term experiment of beaming radio signals at the nearest accumulations of stars should be undertaken. (E.O.)

## 594

**AMINO-ACID SYNTHESIS FROM HYDROGEN CYANIDE UNDER POSSIBLE PRIMITIVE EARTH CONDITIONS.**

J. Oro and S. S. Kamat

*Nature*, 190:4774, Apr. 29, 1961. p. 442–443.

The direct formation of amino acids from hydrogen cyanide under possible primitive earth conditions is investigated. Almost all the amino acids may be present. On the basis of chromatographic evidence the amino acids alamine, glycene, and aspartic acid were tentatively identified among the products formed by the condensation of hydrogen cyanide in aqueous ammonia. (A.H.F.)

## 595

**COMETS AND THE FORMATION OF BIOCHEMICAL COMPOUNDS ON THE PRIMITIVE EARTH.**

J. Oro

*Nature*, 190:4774, Apr. 29, 1961. p. 389–390.

The basis for the hypothesis of the cometary origin of biochemical compounds on the primitive earth is discussed. It is known from work on cometary spectra that comets contain large amounts of hydrogen, carbon, nitrogen, and oxygen compounds, as indicated by the fluorescence emission bands of diatomic and triatomic radicals or molecules such as CN, CH, $CH_2$, $C_2$, $C_3$, NH, $NH_2$, and OH, and ions such as $CH^+$, $OH^+$, $CO^+$, $N_2^+$, and $CO_2^+$, observed in the heads or tails of comets. In addition, the following products have been produced in the laboratory from chemical mixtures approaching cometary composition: adenine, 4-aminoimidazole-5-carboxamide, 4-aminoimidazole-5-carboxamidine, formamidine, glycinamide, glycine, alanine, aliphatic acids, polypeptides, and deoxyribose. It is of interest that the predominant elementary composition of comets, and for that matter, of the universe as a whole, if the inert gases are excluded, is precisely identical to the elementary composition of proteins, that is hydrogen, carbon, nitrogen, and oxygen. The corollary is that given appropriate planetary conditions, the phenomenon of biopoiesis should be a probable event in the universe rather than a very improbable one. (I.v.L.)

## 596

**THE MOON AS A COLLECTOR OF BIOLOGICAL MATERIAL.**

E. Anders

Science (Washington), 133:3459, Apr. 14, 1961. p. 1115–1116. 12 refs.

The mathematical probability is considered of terrestrial organisms reaching the moon in detectable amounts (1 organism/m.$^2$ of the moon surface). Using the optimistic value of $10^{11}$ as the number of life-bearing planets in our galaxy and the approximate mass of the earth's biosphere as typical for them, the approximate total mass of galactic biospheres is determined. Meteor impact seems to be the most likely way that organisms could escape from their parent planets. An impact capable of imparting escape velocity to terrestrial biota may be expected at $10^3$–$10^6$ year intervals. Considering the solid angle subtended to the earth by the moon it seems quite possible that terrestrial organisms might reach the moon. However, the probability of organisms foreign to our solar system reaching the moon in detectable numbers is overwhelmingly small. (Author)

## 597

**STERILIZATION OF INTERPLANETARY VEHICLES.**

Charles R. Phillips and Robert K. Hoffman

*In:* Research II (Intern. Space Sci. Symp. (2nd) Florence, Apr. 10–14, 1961)

N.Y., Interscience, 1961. p. 661–672.

Reasons for concern among biologists that man may contaminate extraterrestrial bodies with earth micro-organisms are (1) that earth micro-organisms may not only survive but propagate on other planets, upsetting the biological balance of the planet; and (2) that an opportunity to obtain information on the origin of life may be jeopardized. For these reasons, spacecraft should be sterilized before leaving earth. Since a large percentage of the small electronic components of spacecraft have been shown to be internally contaminated, techniques which can be used to sterilize an entire spacecraft are discussed. These include sterile assembly or heat or radiation sterilization of hermetically sealed components and plastics, followed by sterilization of the spacecraft surfaces by ethylene oxide at the last possible moment before launch. The nose cone would protect the spacecraft from recontamination during its flight through the earth atmosphere. (M.P.G.)

## 598

**SIGNIFICANCE OF CARBONACEOUS METEORITES IN THEORIES ON THE ORIGIN OF LIFE.**

J. D. Bernal

*Nature* (London), 190:4771, Apr. 8, 1961. p. 129–131.

The conclusions of Meinschein and Hennessy after finding paraffinoid hydrocarbons in the Orgeuil meteorite are "that biogenic processes occur and that living forms exist in regions of the universe beyond the earth." However, these results indicate that the meteorite material *may* be of organismal origin and not that it *must* be so. It is possible that these hydrocarbons could have arisen from inorganic condensations of smaller carbon-containing molecules. Experiments with high-energy radiation on the synthesis of complex hydrocarbons may justify a theory that these molecules were formed as the planets themselves were formed and that they are not necessarily the end products of chemical evolution.

## 599

PROJECT OZMA.
F. D. Drake
*Phys. Today*, 14:4, Apr. 1961. p. 40—46.

The process of natural selection led, after some five billion years of chemical and biological evolution, to our present civilization. Since it takes something like 5 billion years to produce an intelligent form of life, this means that the radiation from the star about which a planet orbits must stay nearly constant in intensity over that period. Single stars of near-solar luminosity are the most likely abodes of intelligent life. Types of radio transmitters are described as means of detecting extraterrestrial life. The probabilities of success for Project Ozma (the search for radio communications from outer space) are discussed. (M.P.G.)

## 600

THE PLANET VENUS.
Carl Sagan
*Science*, 133:3456, Mar. 24, 1961. p. 849—858.

After an exhaustive review of past and present Venus research, evidence is introduced to show that the clouds are composed of ice crystals. Because of the high surface temperature (600° K), no liquid water is expected on Venus. The surface should be hot, arid, calm, and overcast. (J.P.L.)

## 601

THE OPERATIONAL PROBLEMS OF STERILIZATION.
N. F. Jacobson
Presented at ARS Missile and Space Vehicle Testing Conf., Los Angeles, Calif., Mar. 13—16, 1961. 5 p.
(ARS Paper 1671—61)

Sterilization procedures proposed for use in the sterilization of the Ranger spacecraft are described. It is concluded that sterilization can be accomplished and that proper consideration early in a program can greatly mitigate difficulties that are presently encountered. (S.T.L.)

## 602

HOW RANGER PAYLOAD IS STERILIZED.
H. M. David
*Missiles and Rockets*, 8:13, Mar. 1961. p. 27—28.

The sterilization process for the Ranger payload is described. The separation will take place at altitudes high enough to prevent atmospheric contamination of the payload which was previously sterilized.

## 603

IS THERE LIFE ON OTHER PLANETS?
N. Horowitz
*Eng. and Sci.* (Calif. Inst. of Tech.) 24:6, Mar. 1961. p. 11—15.
Also *in: Calif. Inst. of Tech. Quart.*, 2:3, Summer 1961. p. 12—17.

Knowledge of life on other planets is important in that it would tell us whether our particular form of living matter, based on proteins and nucleic acids, is the only possible kind of life, or whether some other kind of material is capable of showing the attributes of living matter. Current theory holds that life will arise where conditions are favorable, and that microbial life is the most ubiquitous and tenacious. The possibility of this type of life existing on Mars and Venus is discussed. (Author)

## 604

EXTRATERRESTRIAL LIFE (ESTRATERRESTRISCHES LEBEN)
F. Drawert
*Naturw.* Rundschau (Stuttgart), 14:2, Feb. 1961. p. 68—70. (In German)

The author reviews a report on organic constituents found in the chemical analysis of the meteorite Murray by M. Calvin and S. Vaughn. Various theories on the origin of life are discussed. (J.P.L.)

## 605

BRIEF INTRODUCTION TO EXOBIOLOGY.
L. R. Tello
*Rev. Nacl. Aeron. Espacial*, 21:14, Jan. 1961. p. 15. (In Spanish)

Brief discussions are presented of inorganic and organic evolution, the possibilities of extraterrestrial life, and the contributions which may be made to both areas by means of space research and exploration. (J.P.L.)

## 606

LA CONQUISTA DE LOS GRANDES PLANETAS.
R. A. Quiroga
*Rev. Nacl. Aeron. Espacial*, 21:14, Jan. 1961. p. 8—9. (In Spanish)
(A62—2842)

Discussion of the atmospheric and other characteristics of Mars and Venus which are of importance with respect to their habitability. The "population explosion" on the Earth is noted, and the possibility of colonizing the planets is considered briefly, as is the possible existence there of living beings resembling man. (I.A.A.)

## 607

ADVANCING FRONTIERS OF LIFE SCIENCES.
B. Mukerji
*A.I.B.S. Bull.*, 11:2, 1961. p. 21—24, 32.

When man visits other planets he may be confronted with primordial conditions, strange forms of life, and perhaps the extinction of ancient life. Biologists are now studying the relation of penetrating and solar electromagnetic radiation to the generation of biological materials and to the mutation and evolution of species. No doubt the interplay of these factors during the last two billion years of our own history has been a decisive influence in the development of living systems. No matter how far we carry earth-based investigations, it seems certain that space travel will bring surprises to the biologist and physiologist. Much new knowledge of cellular and organic adaptation of plant and animal life to very different conditions of temperature, pressure, humidity, and radioactivity will be available. (A.H.F.)

## 608

AFTER THE ORIGIN OF LIFE.
Singo Nakazawa (Yamagata U., Japan)
*Acta Biotheroret.*, 14:1–2, 1961. p. 29–42.

Two conditions concerning the primary morphogenesis which occurred after the origin of life are considered. (a) It must be a non-specific pattern. (b) It must be one of the simplest patterns. The above conditions are satisfied by morphogenetic polarity. Actually, the simplest polar pattern is divided into two classes. The first of these is represented by a regional inversion. The first morphogenesis might therefore have occurred in two directions: regional protrusion and regional inversion of the globular organism. Both might be conditioned by the appearance of protoplasmic polarity. (Author)

## 609

ATMOSPHERES OF MARS AND VENUS.
W. W. Kellogg and C. Sagan
*Natl. Acad. of Sci., Natl. Res. Council*, Wash., D.C. 1961. 151 p.

Section F of Chapter III discusses the question of life on Mars. The evidence, taken as a whole, is suggestive of life; in particular, the response to the availability of water vapor is just what is to be expected on a planet which is now relatively arid but which once probably had much more surface water. The direct evidence summarized is directly relevant only to the presence of micro-organisms. There are no valid data for or against the existence of larger organisms and motile animals. Categories of life detection experiments are listed. In Appendix 5, an agnostic position is taken based on the possible existence of life as we do not know it. (M.P.G.)

## 610

BIOLOGY OF SPACE TRAVEL.
N. W. Pirie, ed. (London Institute of Biology)
N.Y., Hafner Publishing Co., 1961. 120 p.

Published as the Symposia of the Institute of Biology No. 10, the book contains an introduction and the following chapters by different contributors: Biological Effects of Partial and of Complete Weightlessness: Maintenance of Life in Space Ships—Thermal Environment: Maintenance of Life in Space Ships—Synthesis, Recycling and the Step Towards a Microcosm: Maintenance of Life in Space Ships—the Food Problem: Radiation in Space and its Effects on Man: Psychological Problems of Solitude and Confinement: The Problems of Astronaut Selection: The Human Brain in Space Time: Dangers of Contamination of Planets and the Earth: and the Probable Environment on Other Planets and its Suitability for Some Forms of Life. (Author)

## 611

CAPTIVES OF THE SUN.
James S. Pickering (Hayden Planetarium)
N.Y., Dodd, Mead & Co., 1961. 319 p.

In 1959 a report of definite traces of water vapor and free oxygen in the atmosphere of Venus was made. If this is correct, then we may speculate on the existence of life—at least in the form of vegetation.

The environment, topography, and rotation of Mars is presented. Apart from the gleaming white polar caps, the Martian surface is either reddish-brown or green. These green areas vary with the seasons and have been interpreted as vegetation. More recently, theories of the dark areas have been presented as being either soluble salts or an optical illusion where gray areas adjacent to orange-red areas appear green. The possibility of human life has been ruled out and only the possibility of primitive vegetation and bacterial life persists. (E.C.)

## 612

DIRECT SYNTHESIS OF POLYPEPTIDES. 1. POLYCONDENSATION OF GLYCINE IN AQUEOUS AMMONIA.
J. Oro & C. L. Guidry
*Arch. of Biochem. & Biophys.*, Vol. 93, 1961. p. 166–171.

Polyglycines with average degrees of polymerization up to 18 were synthesized by heating glycine in aqueous ammonium hydroxide solutions. The rate of the reaction increased with the ammonium hydroxide concentration, and the optimum temperature of synthesis was found at about 140° C. The polymer yield glycine upon acid hydrolysis. The infrared spectra in KBr disks has shown that the polymers have the configuration of polyglycine II. The significance of these findings in relation to the formation of polypeptides on the primitive earth according to the theory of Akaboric is briefly discussed. (E.O.)

## 613

THE EXPLORATION OF MERCURY, THE ASTEROIDS, THE MAJOR PLANETS AND THEIR SATELLITE SYSTEMS AND PLUTO.
R. L. Newburn, Jr. (JPL, Pasadena, Calif.)
*In:* Frederick I. Ordway, III, ed. ADVANCES IN SPACE SCIENCE AND TECHNOLOGY, Vol. 3.
N.Y., Academic Press, 1961. p. 196–266.

A review of the known facts about Mercury and Jupiter indicates that a search for organic molecules or prelife forms on these planets is warranted. (M.P.G.)

## 614

GENETIC NUCLEIC ACID: KEY MATERIAL IN THE ORIGIN OF LIFE.

H. J. Muller

*Perspectives Biol. Med.*, 5:1, Autumn 1961. p. 1–23.

A review and discussion are presented of the chemical bases of living organisms. The structure of desoxyribose nucleic acid (DNA) and ribose nucleic acid (RNA) is discussed, and their importance in biologic replication and genetics is stressed. What is known of evolution from nucleotide chains to the synthesis of proteins and the development of protoplasm is reviewed and discussed. The conditions for life on the Moon, Venus, and Mars and the evidence for life occurring on these celestial bodies are reviewed and speculated upon.

## 615

A HISTORY OF ASTRONOMY.

A. Pannekoek

N.Y., Interscience Publ., Inc., 1961. 521 p.

Observations of Mars have revealed yellow or ruddy parts and dark, mostly greenish parts. Scientists agree on calling the latter vegetation. It is concluded that life-conditions on Mars are not greatly different from those on earth, and it is, therefore, possible that some form of life did and can exist there. The French astronomer, Flammarion, in 1892 even postulated "The inhabitation of Mars by a race superior to ours". However, it is now generally conceded that Martian life is, at best, only some primitive form of vegetation, and that other planets are not suitable at all for human habitation. (E.C.)

Contents:

Pt. 1: Astronomy in the ancient world. Pt. 2: Astronomy in revolution. Pt. 3: Astronomy surveying the universe.

## 616

INTERNATIONAL CONTROL OF INVESTIGATIONS OF RARE METEORITES.

(No Author)

*Nature*, Vol. 189, 1961. p. 967

Carbonaceous meteorites, unlike other meteorites, have never been subjected to high temperatures; therefore, they might well contain samples of the raw materials from which life may have been formed on larger planets. The work of Nagy, Meinschein and Hennessey provided presumed proof for the existence of life on the meteorite parent bodies. Scientific investigators by their immediate demand for meteorite samples may exhaust the stock of meteoritic material. The Committee on Space Research of the International Council of Scientific Unions should be placed in control of meteoritic material to obtain the maximum information from them with the minimum of destruction. (A.H.F.)

## 617

INTERSTELLAR AND INTERPLANETARY COMMUNICATION BY OPTICAL MASERS.

R. N. Schwartz and C. H. Townes

*Nature*, 190:4, 1961. p. 205–208

Long-range communication by radio waves is already well known, and the possibility of interstellar communication by radio waves in the microwave region has been suggested to search for signals from intelligent beings on planets associated with nearby stars. However, maser oscillators and other appropriate apparatus operating in or near the optical region are being developed. These will allow detectable light signals to be beamed between planets of 2 stars separated by a number of light years. Two different systems of optical masers are described, and the detectability of maser signals is discussed at length. Other possible methods of communication are mentioned. (A.H.F.)

## 618

INTRODUCTION TO ASTRONOMY.

Dean B. McLaughlin

Boston, Houghton Mifflin Co., 1961.

The large daily temperature range, extreme scarcity of water, practically complete lack of oxygen, and very low atmospheric pressure impose severe limitations on the types of organism that might exist on Mars. No terrestrial warm-blooded creatures could survive. Most higher plants would find the climate too rigorous. Lichens and some algae and mosses probably could endure the extreme conditions. The lack of chlorophyll-rich plants is indicated by the low reflectivity of the maria in the infrared but, as noted, lichens and algae may be present. (A.W.)

## 619

LIFE, ITS NATURE, ORIGIN, AND DEVELOPMENT

A. I. Oparin

N.Y., Academic Press, 1961. 207 p. 30 refs.

(Transl. from the Russian by A. Synge)

A review of the nature of life and theories regarding its origin is followed by discussions of those physiological activities of probable origin outside a living system and the mechanisms by whch they contribute to the origin of life. The nature of competition for substrate is emphasized. The author predicts life forms elsewhere in the universe with different pathways to complexity. Concludes that biological evolution for man has slowed, further change is in the societal sphere. (G.W.)

## 620

A LITHOLOGICAL INTERPRETATION OF THE PHOTOMETRIC AND COLORIMETRIC STUDIES OF MARS.

V. V. Sharanov

*Soviet Astron. A. J.*, Vol. 5, 1961. p. 199–202. (In English)

Results of visual photometric and colorimetric observations of the surface of Mars were compared with data from a study of terrestrial rocks. The mean values of the albedo and the color excess obtained for sand, desert coverings, red Permian rocks, and dense varieties of limonite are not similar to the values obtained for Mars. Only the earthly varieties of limonite approximate the more saturated color of Mars. It is proposed that the surface of the Martian continents is covered with silt of limonite particles. The orange haze is caused by these particles ascending into the atmosphere. (M.G.)

## 621

**MAN AND SPACE.**
R. E. Lapp
*The Next Decade*, N. Y., Harper & Bros., 1961. p. 183.

Presents an educated guess, based on peripheral experience in the field of astronautics, as to where space flight is leading mankind, and what new discoveries will be made as lunar and planetary flight become realities. Attention is given to current projects. Chapters deal with such topics as the US space programs, peaceful uses of satellites, military space vehicles, the possibilities of life beyond the Solar System, the origin of life on Earth, and the possibilities of communicating with other intelligent communities within the Milky Way galaxy.

## 622

**MARS AS AN ASTRONAUTICAL OBJECTIVE.**
L. Hess (Fla. State U., Tallahassee)
*In:* Frederick I. Ordway, III, ed. ADVANCES IN SPACE SCIENCE AND TECHNOLOGY, Vol. 3, p. 151–192.
N.Y., Academic Press, 1961.

Investigation of life on Mars may have a vast impact of a practical as well as an intellectual nature. It is impossible to predict the consequences to biology of detailed study of a life form which has evolved and lives in an environment so different from our own. Yet it is likewise impossible to set limits on the effect such observations may well have. We find ourselves faced with the necessity of pursuing these investigations, regardless of their difficulty and expense, for our very nature demands it and our practical self-interest will most likely be well-served in the process. (Author)

## 623

**THE MECHANISM OF SYNTHESIS OF ADENINE FROM HYDROGEN CYANIDE UNDER POSSIBLE PRIMITIVE EARTH CONDITIONS.**
J. Oro
*Nature*, 191:1193 (3b), 1961.

The research supports the imidazole pathway as a mechanism for the synthesis of adenine from hydrogen cyanide under possible primitive Earth conditions. (A.H.F.)

## 624

**MINERALOGICAL AND CHEMICAL PROPERTIES OF THE CARBONACEOUS METEORITE FROM KABA, HUNGARY.**
K. I. Sztrokay, V. Tolnay and M. Foldvari-Vogl
*Acta Geol. Acad. Sci. Hung.*, Vol. 7, 1961. p. 100–103.

The carbonaceous meteorite that fell in 1857 near the village of Kaba in Hungary was reinvestigated. This meteorite is an olivine-pyroxene chondrite. "Organic matter" impregnated the fine-grained ground mass between the chondrules. This matter consisted of aliphatic hydrocarbons containing some sulfur. It exhibited no luminescence in ultraviolet light and contained no halogens. A mineralogical novelty, spinel, occured in separated nodes of centimeter size and in association with enstatite. Magnetite was the most important of the opaque minerals. Metallic iron occurred only in small and rare grains. Traces of carbon and hydrocarbons found in "common" stony meteorites suggest that the hydrocarbon content has been gradually lost, and that this process went hand in hand with a reduction and alloy formation of the metals. "Organic" chondrites represent some of the phases and arrested stages of this process. It is assumed that, compared with large celestial bodies, meteorites represent a "less mature" (initial) stage of development. This retardation of development postulates a smaller mass of the celestial bodies involved. (I.v.L.)

## 625

**NOTE ON THE PROBABLE CHARACTER OF INTELLIGENT RADIO SIGNALS FROM OTHER PLANETARY SYSTEMS.**
J. E. Golay
Proc. IRE, 49:5, 1961. p. 959.

The character and spectral location of possible extraterrestrial signals is speculated upon. The 1421 Mc line of hydrogen seems to be a reasonable starting point, but since this line is located in a relatively noisy level of the cosmic radio spectrum, a location at either half or twice the frequency appears probable. Each of these bands may be corrected for nebular drift; therefore four bands should be searched. Coherent signals may be identified as such by special search procedures. (E.O.)

## 626

**ON THE GEOGENOUS EVOLUTION OF SELF-REPRODUCING SYSTEMS AND MACROMOLECULES.**
H. S. Anker
*Perspectives Biol. Med.*, Vol. 5, 1961. p. 86–88.

The possible steps leading to the formation of self-reproducing protein or ribonucleic acid macromolecules are enumerated. It is statistically almost impossible that "able" macromolecules could have been formed by random assembly or chemical selection, so that they must be regarded as the products rather than the beginning of life on Earth. Simple self-reproducing molecules could have been formed by the action of ultraviolet energy on the organic broth under autocatalytic conditions, evolving to the complex macromolecules. The possibility exists that the light-absorbing components of the first self-reproducing system were related to the purines and pyrimidines. (A.H.F.)

## 627

**ORGANIC CONSTITUENTS OF METEORITES.**
M. H. Briggs
*Nature*, Vol. 191, 1961. p. 1137–1140.

The author demonstrates that the Mokoia meteorite contains a variety of quite complex organic compounds. The problem of the origin of these compounds remains complex and unsolved.

## 628

**PEACETIME USES OF OUTER SPACE.**
S. Ramo, ed.
N.Y., McGraw-Hill Book Co., 1961. 279 p.

The principal reason for space exploration is to gain knowledge. It is the author's belief that existence on Mars would be a

little off-beat as compared to living in Antarctica, due to temperature extremes, little gravitational pull, and little oxygen. The main interest for space exploration for us is to find out whether there is life on the moon or planets. The moon seems dead and probably is. Color changes on Mars are suspicious of life. Spectroscopic observations indicate lines characteristic of the carbon-hydrogen bond, and may be due to life. The author predicts that life on Mars will be so strange, so unusual in appearance, that the first observer will not recognize it as life at all. Life as we know it is based on amino acids. Are the Martians also made up of amino acids? (E.C.)

## 629

PHOTOCHEMICAL SYNTHESIS OF AMINO ACIDS AND A NEW TRANSAMINATION PROCESS BY TRANSFER OF FREE AMINO-RADICALS.

G. Ferrari and R. Cultrera

*Nature*, 190, 1961. p. 326–8.

Investigations show that it is possible to synthesize amino acids by UV irradiation of solutions containing a ternary organic compound together with a nitrogen compound such as potassium nitrate, sodium nitrite, hydroxylamine and ammonium hydroxide. All the various steps of the photochemical process are elucidated. The action mechanism of each of them is established, and a rational coordinated interpretation is deduced. (A.H.F.)

## 630

POLARIZATION STUDIES OF THE PLANETS.

A. Dollfus (Observatoire de Paris, Meudon)

*In:* G. P. Kuiper and M. B. Middlehurst, eds. PLANETS AND SATELLITES. Vol. III. p. 343–398. The Solar System. U. of Chicago Press, 1961.

After a description of the methods used in polarimetric analysis, the polarization characteristics of the Martian surface, the bright and dark regions, the polar caps, and the different types of clouds are discussed. Vegetation is suggested as a possible interpretation of the dark markings and the changing tints on Mars. The white spots at the poles of Mars are compatible with a deposit of hoarfrost which sublimates under the sun's radiation. Polarimetric observations also suggest the presence of water vapor in the Martian atmosphere. (M.P.G.)

## 631

THE PROBABLE ENVIRONMENT ON OTHER PLANETS.

H. Shapley

*In:* THE BIOLOGY OF SPACE TRAVEL, Symposia of the Institute of Biology, 10, p. 107–116. London, 1961.

A discussion is presented on the physical environmental conditions primarily on the Moon, Venus, and Mars (other planets and stars are also mentioned). The greenhouse effect of the atmosphere of Venus and the earth is related to the temperature of the planets and the occurrence of life there. The presence of ozone in the Earth's atmosphere appears to be unique, and the effects of this shielding on the evolution of life is discussed. (Aerospace Med.)

## 632

RADIO EMISSION FROM THE PLANETS.

F. D. Drake

*Phys. Today*, 14:4, 1961. p. 30–34.

Results of radio emission observations of the planets are discussed with some references to their biological significance. The temperature of Venus is much too high for carbon-based life forms to survive. Therefore, it seems likely that any life forms that previously existed on Venus have been destroyed and that no living forms exist on the surface at the present time. The use of radar astronomy to detect living things on another planet is suggested. Since most living things have vertical sides, a radar analysis that suggests a large abundance of objects having vertical sides would be good evidence for the existence of life. (M.P.G.)

## 633

SCIENCE IN SPACE.

L. V. Berkner and H. Odishaw

New York, McGraw-Hill, 1961. 458 p.

This volume presents a review of the new scientific opportunities offered by space science and suggests what now appear to be major areas of emphasis for the national space effort. Among the topics covered are results of experiments in space, the nature of gravitation, knowledge of the earth from space, aspects of geodesy, meteorology, upper atmospheric rocket research, satellite research of the upper atmosphere, the moon and planets, physics of fields and energetic particles, interplanetary gases and magnetic fields, the acceleration and propagation of particles within the solar system, the sun, galactic and extragalactic astronomy, and exobiology.

## 634

SETTLING TIME OF A FIXED AMOUNT OF OXYGEN IN THE ATMOSPHERES OF PLANETS CONTAINING WATER VAPOR (O VREMENI USTANOVLENIYA STATSIONARNOGO KOLICHESTVA KISLORODA V ATMOSFERAKH PLANET SODERZHASHCHIKH VODYANOY PAR).

E. K. Byutner

*Dokl. Akad. Nauk SSSR*, 138:5, 1961. p. 1050–1053.

Transl. by NASA Wash., D.C. 7 p.

(NASA TTF–86; N64–10522) OTS: $0.50

A theoretical appraisal is made concerning whether the accumulation of a significant quantity of free oxygen in the terrestrial atmosphere as a result of water vapor photodissociation was possible prior to the appearance of organic life. This appraisal is made by estimating the time necessary for the accumulation of the given quantity of oxygen in the terrestrial atmosphere at the expense of $H_2O$ photodissociation, with losses due to surface oxidation.

## 635

SOME ASTRONOMICAL ASPECTS OF LIFE IN THE UNIVERSE.

Su-Shu Huang

*Smithsonian Inst., Ann. Rept.*, 1961. p. 239–249.

The concepts of planetary formation, zones of acceptable environment around stars, the development of life within the solar system and the rest of the universe are outlined. From theories of the conservation of angular momentum and thermal stability over the long time periods necessary for biological evolution, stars between spectral types $F_5$ and $K_5$ very probably have planetary systems capable of supporting life. Intelligent life may be possible around 1 or 2% of all stars. Carbon-based life in an oxidizing atmosphere is considered most feasible on the basis of necessary biochemical complexity. Life seems improbable on Venus because of the high surface temperatures but the conditions on Mars are not impossibly hostile to low order vegetation. Radio communication with extraterrestrial life might be initiated by the use of pulses representing simple numbers. Attempts have been made to detail signals at the 21-centimeter line of neutral hydrogen. (E.O.)

## 636

SOME PROBLEMS OF COSMIC BIOLOGY.

N. M. Sisakyan, O. G. Gazenko, and A. M. Genin

*Zh. Obshchey Biol.*, 22:5, 1961. p. 325–332.

Also *In: Ref. Zh. Biol.*, No. 9A99, 1962.

In discussion of the problem, Forms and Conditions of Extraterrestrial Life, perspectives were indicated for the study of the existence and characteristics of living matter and organic substances in space and on other planets. Since organic life based on carbon compounds is possible at temperatures from +80 to −70° C, pertinent investigations of Mars (average annual temperature approximately −50°) and Venus (approximately +50°), and the comparison of forms of life or biogenic products found there with those of earth are of interest. Related to the exobiological investigations mentioned above, the necessity is particularly stressed of precluding the uncontrolled transport of earthly forms of life and organic material to other heavenly bodies as well as transport of unusual forms of life to earth.

## 637

SPACE FLIGHT AND SCIENCE.

L. V. Berkner

*Astronautics*, 6:10, 1961. p. 46–47, 138–150.

The achievements of present satellite experiments and the rationale and goals of lunar and planetary exploration are outlined. The advancement of scientific knowledge and the progress of technology have been the immediate fruits. The role of the detection of extraterrestrial life as a prime scientific goal is discussed. Evidence is available for possible life on Mars and perhaps even on the Moon. The study of different ecological environments even if no life is found, will have relevance to understanding terrestrial evolution. The problem of contamination is extremely serious both on Earth and other planets. International cooperation will be required in the problem of contamination and in the preserving of vital evidence. (E.O.)

## 638

SPACE MICROBES.

Paula Foxzy

*Bull. Atomic Sci.*, Vol. 17, 1961. p. 249.

Rod-shaped microbes found in the Murray meteorite are unlike any terrestrial organisms. These were grown for the first time in the laboratory at the National Institutes of Health. Dr. Frederick D. Sisler, who has been working on the cultures of the "space" micro-organisms, said that the only way that one can be certain of the extraterrestrial origin of the organisms is to trap some meteorites in space before they have been contaminated in an Earth environment. (M.G.)

## 639

TIME IN WHICH A STEADY AMOUNT OF OXYGEN IS ESTABLISHED IN THE ATMOSPHERE OF PLANETS CONTAINING WATER VAPOR.

E. K. Bystner

*Dokl. Akad. Nauk SSSR*, 138:5, 1961. p. 1050.

It is suggested that the photodissociation of water vapor was the source of oxygen in the Earth's atmosphere until the origin of organic life on Earth. Although the presence of a highly developed biosphere makes it impossible to directly examine the balance of oxygen due to nonbiologic processes, calculations are presented of the time necessary for accumulating oxygen from the photodissociation of water vapor in the presence of losses from surface oxidation. These calculations lead to an estimate of conditions immediately preceding the origin of life on Earth. (M.P.G.)

## 640

AN UPPER LIMIT TO THE CONCENTRATIOIN OF $NO_2$ AND $N_2O_4$ IN THE MARTIAN ATMOSPHERE.

W. M. Sinton

*Publ. Astron. Soc. Pacific*, Vol. 73, 1961. p. 125–128.

Spectrographic studies of the Martian atmosphere are presented as evidence against substantial amounts of $NO_2$ and $N_2O_4$ in the atmosphere. It was previously theorized that the surface features and atmospheric phenomena could be explained by a surplus of oxides of nitrogen in equilibrium with each other. Yellow clouds cannot be local concentrations of $NO_2$ since their intrinsic brightness could not be produced by increasing the concentration of the absorbing gas. In infrared spectra, absorbtion bands indicative of $NO_2$ and $N_2O_4$ are missing at 8 and 13 microns. Using the band at 3.43 microns, the maximum possible concentration of $NO_2$ in the atmosphere is 1.2 parts per million, quite insufficient to cause the assumed effects. (E.O.)

## 641

VENUS AS AN ASTRONAUTICAL OBJECTIVE.

P. Moore (Brit. Astron. Assoc.) and S. W. Greenwood (Brit. Interplan. Soc.)

*In:* Frederick I. Ordway, III, ed. ADVANCES IN SPACE SCIENCE AND TECHNOLOGY, Vol. 3. p. 113–147.

N.Y. Academic Press, 1961.

Speculations on the possibility of life on Venus are included in a general review of the planet. If the dust bowl hypothesis is correct, then no life is possible. If, however, the planet is mainly ocean covered, it may resemble Earth in the Precambrian or Cambrian era when primitive marine life existed in the oceans. Should this be the case, there seems to be no reason why this life should not develop over the ages with a gradual change to an oxygen atmosphere following the evolution of photosynthesis. (M.P.G.)

# 1960

## 642

**THE ABUNDANCE OF WATER VAPOR ON MARS.**

C. Sagan

*Astron J.*, 66:2, Mar. 1961. p. 52.

Presented at A.A.S. 107th Meet., New York, Dec. 29–31, 1960.

To date, all spectroscopic searches for water vapor on Mars have been negative. A resulting rigid upper limit on the water vapor abundance is $3.5 \times 10^{-2}$ g/cm$^{-2}$. A lower limit to the water-vapor abundance follows from the discrepancy of about 30° K between the theoretical radiation temperatures and the observed thermocouple temperatures of Mars. The water vapor required in addition to the Martian $CO_2$ to explain this greenhouse effect is determined as a function of the mean infrared surface emissivity, $\epsilon$. If $\epsilon < 0.82$ no water vapor is required; since observations of the polar ice caps indicate water vapor must be present, $\epsilon$ must exceed 0.82. The emissivity of Mars in the 3.5 $\mu$ surface absorption bands is 0.94. One minus the visual albedo is 0.85. The true infrared emissivity should fall between these values, as is characteristic of many common minerals. The resulting water-vapor abundance is between $2 \times 10^{-2}$ and $2 \times 10^{-3}$ g/cm$^{-2}$. The $H_2O$ abundance can also be determined from the vapor pressure above the sublimating edge of the polar ice cap, if the temperature of the edge is known. Considering an increase over the theoretical temperature of the edge due to $CO^2$ alone, a water-vapor abundance is derived. A new temperature is derived from the $CO_2$ — $H_2O$ greenhouse effect. Successive approximations converge near $10^{-2}$ g/cm$^{-2}$ for $\epsilon \simeq 0.90$. We conclude the water-vapor abundance is within an order of magnitude of existing spectroscopic tolerances. The corresponding thickness of the polar caps at maximum extent is about 1 mm. With $10^{-2}$ g/cm$^{-2}$ of water vapor on Mars, there are few infrared wavelength intervals of complete transparency; with $10^{-3}$ g/cm$^{-2}$, the 5- to 8-$\mu$ interval where characteristic organic bond resonances lie is almost completely transparent. Observations of this interval from high altitudes should give a firm water-vapor abundance determination. These low water-vapor abundances do not argue against life on Mars; obligate halophiles are known which obtain their entire water requirements from the water absorbed on a crystal of salt, and other organisms are known which produce all water requirements metabolically. (Author)

## 643

**SYNTHESIS OF MACROMOLECULES UNDER POSSIBLE PRIMEVAL EARTH CONDITIONS.**

A. T. Wilson

*Nature*, 188:4755, Dec. 17, 1960. p. 1007–1009. 7 refs.

An experiment is discussed in which a high molecular weight polymer was produced from methane, water, and ammonia under the influence of an electrical discharge. The combustion results, infrared spectra, and general properties suggest that this polymer is essentially hydrocarbon in nature and that its surface is covered with polar groups which enable it to be dyed and impart its hydrophilic character. If it is assumed that the primeval atmosphere of the Earth consisted largely of methane with smaller amounts of ammonia, it is reasonable to suggest on the basis of this experiment that large quantities of hydrocarbons of high molecular weight, with surface polar groups, could have been synthesized during electrical disturbances on the surface of the primeval ocean and even perhaps on cloud and rain droplets caught in the corona discharge of thunderstorms. Perhaps some of these groupings might be of the proper kind and of the proper geometrical orientation to endow the macromolecule with "enzymatic" activity. Thus, it is suggested that the early steps in the chemical evolution of life may have been based on catalysts or 'protoenzymes' in which the catalytic groupings were supported on hydrocarbon-type material. This "hydrocarbon life" would then have evolved until it was sufficiently developed to synthesize its own macromolecules, namely protein, thus producing the beginning of the present-day "protein life" where the catalytic groups of the enzymes are supported on protein material. (I.v.L.)

## 644

**ORIGIN AND NATURE OF LUNAR SURFACE FEATURES.**

J. J. Gilvarry

*Nature* (London), 188:4754, Dec. 10, 1960. p. 886–891.

The former presence of a lunar hydrosphere is postulated to explain the origin and nature of major surface features on the moon. By deciding on the types of secondary atmosphere and hydrosphere formed by leakage of fluid through the surface of the moon, the lifetime of the lunar hydrosphere is estimated to be at least of the order of $10^9$ years. This theory explains the progression of relative dimensions of the craters in the various classes,

the origin of the maria, and the nature of the mare floors. The dark color of the maria provides a positive clue that life once existed in the lunar hydrosphere.

## 645

**AN INTRODUCTION TO ASTROBIOLOGY.**
Hubertus Strughold
*Astronautics*, 5:12, Dec. 1960. p. 20, 21, 86, 88–90.
(61–1123)

Questions of indigenous life on other celestial bodies are discussed. The development history of the terrestrial atmosphere is considered, and the chemistry of the atmospheres of other planets is studied. Taking chemical, thermal, and light environmental conditions into account, it is concluded that in additon to Earth, only Mars and possibly Venus qualify as bioplanets. Theories concerning the dark green areas on Mars are discussed, including comparison of observation results with the theories, research results in Russia, and experimental results obtained in laboratories.

## 646

**THE CHEMISTRY OF MARS. II—THE SURFACE.**
M. H. Briggs and J. P. Revill.
*J. Brit. Interplanet. Soc.*, 17:12, Nov.–Dec. 1960. p. 459–461. 31 refs.

The physical conditions at the Martian surface are reviewed and the various hypotheses as to its chemical nature are discussed. Night temperatures on Mars are in the region of — 70° C; daylight temperatures at the equator on the sunlight side are around 20° C; and 33° C has been recorded for the dark areas. Polarization studies have shown Mars to be dusty with a surface of crumbled rock. Polar ice caps melt and reform seasonally, and are presumed to be frost. Reddish deserts may be of (1) hydrated ferric oxide, indicating a past history of oxidizing atmosphere, or (2) felsitic rhyolite, which provides no clue to the Martian atmosphere. Dark surface markings or maria change seasonally from green and blue to brown and red, probably indicating vegetation consisting of simple plants with low oxygen output. Infrared analyses show absorptions similar to carbon-hydrogen bonds which may or may not be of biotic origin. The possibility that the maria are of volcanic origin is considered as a secondary hypothesis. (Author)

## 647

**STERILIZATION OF INTERPLANETARY VEHICLES.**
Charles R. Phillips and Robert K. Hoffman
*Science*, 132:3433, Oct. 14, 1960. p. 991–995.
(NASA Order R–35)
(N62–11133)

Sterilization of interplanetary vehicles was investigated to find out primarily whether: (1) contamination should be avoided; (2) all life forms would be automatically killed in passage because of the rigor of interplanetary space; and (3) sterilization can be accomplished without adding crippling restrictions to the space exploration program. Results were as follows: (1) contamination should be avoided to enable man to examine native habitat life forms other than those which arose on earth; (2) since micro-organisms could probably well withstand spaceflights, space vehicles should be sterilized before leaving the earth to avoid living earth forms from being transported to other celestial bodies; and (3) design consideration and laboratory experiments indicated that chemical sterilization with ethylene oxide promises a good solution. Should some component prove sensitive to ethylene oxide, it could be sterilized prior to assembly by another technique and shielded from further exposure by building a gas-tight barrier around it. (L.L.)

## 648

**COMMUNICATION FROM MOLECULES TO MARS.**
M. Calvin
*A.I.B.S. Bull.*, Vol. 12, Oct. 1960. p. 29–44.

Chemical evolution on the Earth, the generation of molecular communities which rise to terrestrial organisms, and the possibility of corresponding organisms elsewhere are discussed. Energy sources including light radioactivity, electric discharges, and cosmic radiation operating on the primeval molecules of the earth's surface can and do produce simple organic materials including new c-c bonds from which polymeric materials may ultimately be derived. Macromolecules (proteins, nucleic acids) have an intrinsic ability to arrange themselves in highly ordered array. Increasing levels of organization are detailed. Mars, Venus, and the Moon are reviewed as possible sites of life. Organic constituency of certain meteorites shows promise as evidence for extraterrestrial life. Life in other galactic systems is speculated upon by means of statistical evidence. (E.O.)

## 649

**NEW EVIDENCE ON MARTIAN LIFE.**
M. H. Briggs
*Spaceflight*, 2:8, Oct. 1960. p. 237–238, 259. 27 refs.

Studies of the infrared spectra of Mars have shown the presence of absorption bands probably due to organic compounds. These absorptions are characteristic of the spectra from the dark areas of the surface. This evidence points to the existence of complex organic substances in these areas of Mars. The absorptions typical of carbohydrate molecules were found in the spectrum of a lichen. The presence of plants of this type would provide an explanation of the negative results for chlorophyll. (S.T.L.)

## 650

**THE NEW SCIENCE OF ASTRO-BOTANY.**
V. Bazykene.
*African J. Sci.*, 56:10, Oct. 1960. p. 229–231.

Observations of the optical properties of the surface of Mars have led to new theories concerning planetary vegetation, climate, and atmosphere. Although the dark lines indicative of chlorophyll were not observed in spectral analysis of the dark, greyish-blue areas of the Martian surface, observers have suggested that Martian plants have adapted themselves to the harsh climate and that, as a result, their optical properties have also changed. Russian scientists have demonstrated that, at very low temperatures, terrestrial plants absorb solar energy not only in the in-

frared range but also in the red and yellow-green range. The possibility that plants on Mars absorb all rays but reflect only violet and blue is therefore suggested. Further investigations into spectral similarities between terrestrial and Martian plant life, seasonal changes in the size and color of Martian polar icecaps, the presence of oxygen in the red Martian "deserts", and the possibilities of some form of life on Venus, Jupiter, and Mars have been initiated. (Author)

## 651

**THE ORIGIN OF LIFE ON THE EARTH: A REVIEW OF THE EXPERIMENTAL EVIDENCE.**

M. H. Briggs

*Sci. Cult.* (Calcutta), 26:4, Oct. 1960. p. 160–170. 78 refs.

At the present time it is impossible to definitely decide on the mechanism of the origin of life on the Earth. Despite gaps in our knowledge, the hypothesis of chemical evolution is highly attractive and there can be little doubt that, given sufficient time, it could account for the origin of terrestrial organisms. However, it is impossible to be certain that life arose this way for an extraterrestrial contact might have occurred. If future research on the planets fails to reveal any organism that can be dated prior to the probable origin of life on the earth, then it is likely that the contact hypotheses will be ruled out. Yet the discovery of even dead organisms on other planets, or in meteorites, would be of great interest, for the transference of just a few molecules of alien active enzymes or nucleic acids might have altered the whole course of terrestrial chemical evolution. There can be little doubt that the detailed study of lunar and planetary surfaces at first hand is going to radically affect our knowledge of the origins of terrestrial life. (Author)

## 652

**VEGETATION ON MARS.**

R. H. Garstang

*J. Brit. Astron. Assoc.*, Vol. 70, Jan–Oct. 1960. p. 195.

A further explanation is given of the discovery of spectrographic absorption lines probably due to vegetation-related organic molecules on Mars. Three absorption bands at 3.43$\mu$, 3.56$\mu$, and 3.67$\mu$ were found which appear to be peculiar to the dark regions of Mars. The first two bands are well known in plants, but only recently the band at 3.67$\mu$ has been found in the alga *Cladophora* and appears to be produced by carbohydrate molecules in the plant. The longer wavelength is due to the attachment of both oxygen and hydrogen atoms to the same carbon atom. (E.O.)

## 653

**ASTRONOMERS IN TURMOIL.**

Otto Struve

*Phys. Today*, 13:9, Sept. 1960. p. 18–23.

The purpose of Project Ozma is to sweep over radio spectra of a few nearby solar-type stars in order to search for variable sources of radio emission connected with such stars. The total number of planets in the observable part of the universe must be of the order of $10^{20}$ or $10^{21}$. Since the intervals of time during which a solar-type star remains essentially at a constant surface temperature and at a constant size are sufficient to permit living organisms to develop on these planets, then it is possible that some form of life may exist there. (M.G.)

## 654

**MOLECULAR SYNTHESIS IN SIMULATED REDUCING PLANETARY ATMOSPHERES.**

C. Sagan and S. L. Miller

*Astron J.*, 65:9, Nov. 1960. p. 499.

Presented at A.A.S. 106th Meet., Mexico City, Aug. 22–25, 1960.

Corona discharges have been applied to simulated reducing planetary atmospheres in an attempt to identify the most abundant stable compounds produced in the gas phase at room temperature. One mixture contained approximately equal amounts of hydrogen, methane, ammonia, and water vapor, and was intended to roughly reproduce the primitive atmospheres of the terrestrial planets. A second mixture contained hydrogen, methane, and ammonia in the proportions 30:3:1, and was intended to roughly reproduce the present Jovian atmosphere above the cloud layer. Extracted gas samples were analyzed by infrared and mass spectrography. Among the molecules which have been tentatively identified as being produced in both mixtures are ethane, ethylene, acetylene, hydrogen cyanide, and acetonitrile. In addition formaldehyde was produced in the experiment when water vapor was present. The production of these molecules in the simulated Jovian atmosphere disproves the assertion frequently encountered in the astronomical literature that more complex molecules cannot be produced from methane and ammonia in an excess of hydrogen. The possible presence of acetylene on Jupiter is exceptionally interesting because acetylene is known to explosively polymerize in the conditions of the Jovian atmosphere, forming a variety of compounds of high molecular weight, many of them brightly colored. The possibility of chemical reactions contributing to the Jupiter radio noise and of organic molecules explaining the coloration of the Jovian cloud layer are discussed. Pyrroles, purines, and pyrimidines, compounds of considerable biological interest, can under suitable conditions be synthesized from the products of these experiments. It has previously been shown that amino acids are produced by sparking a mixture of methane, ammonia, and water. (Author)

## 655

**THE PRODUCTION OF ORGANIC MOLECULES IN PLANETARY ATMOSPHERES.**

C. Sagan

*Astron J.*, 65:9, Nov. 1960. p. 499.

Paper presented at A.A.S. 106th Meet., Mexico City, Aug. 22–25, 1960.

It is now well known that when energy is supplied to a mixture of hydrogen, methane, and ammonia, or of hydrogen, methane, ammonia, and water vapor, organic molecules are produced. Both electric corona discharge and ultraviolet light, which have been successful as laboratory energy sources, are available in planetary atmospheres. Since hydrogen, methane, ammonia, and water vapor are the four most abundant reactive molecules in cold nondiffuse astronomical objects, it is probable that organic molecules are being produced in the solar system today. Rates

have been estimated for the net production of organic compounds in the contemporary atmospheres of the Jovian planets, and in the primitive reducing atmospheres of the terrestrial planets. The total surface densities of synthesized molecules during the lifetimes of these atmospheres are of the order of 1000 g/cm$^{-2}$. Applications are made to the origin of life on earth, the reduced carbon fraction of the terrestrial crust, Sinton's identification of hydrocarbons and aldehydes on Mars, the discovery of complex organic matter in carbonaceous chondrites, and the composition of comets. The spectra of some of the more abundant synthesized molecules are described. An infrared spectrophotometric tracing of Jupiter by Kuiper shows a feature near 1.53$\mu$ which is tentatively attributed to HCN. (Author)

## 656

EXPERIMENTAL APPROACHES TO LIFE BEYOND THE EARTH.

J. Lederberg

*Science* (Wash.), 132:3424, Aug. 12, 1960. p. 393—400.

Also *In:* SCIENCE IN SPACE. Chap. IX: THE BIOLOGICAL SCIENCES AND SPACE RESEARCH. p. 4—19.

Wash., D.C., Natl. Acad. Sci.—Natl. Res. Council, 1960.

Also *In:* L. V. Berkner and H. Odishaw, eds. SCIENCE IN SPACE. Chap. 20, p. 407—425.

N.Y., McGraw-Hill, 1961.

Also *In:* H. K. Bijl, ed. Space Research Proc. 1st. Intern. Space Sci. Symp., Nice, France, Jan. 11—16, 1960. p. 393—400.

N.Y., Interscience, 1960.

The detection of life beyond the earth is one of the most exciting challenges of space science. The problems of exobiology have important implications for the development of theoretical biology and the understanding of mechanism of the evolution of life, as well as for general philosophical conceptions of man's place in the universe. The critical techniques of actual exobiological experimentation are believed to be those of microbiology, since micro-organisms for several reasons have a most important place in our consideration of program policy and in the solution of basic biochemical problems. Among the most important of these is the role of nucleic acids and proteins in the functioning of any organisms that may have evolved on other sites. The rapid growth of micro-organisms and the variety of their adaptations to different environments, dictate the most rigorous care to prevent the unwanted transfer of contaminants from one planet to another. (Author)

## 657

EXTRATERRESTRIAL MICROBIOLOGY.

Wolf Vishniac

*Aerospace Med.*, Vol. 31, Aug. 1960. p. 678—680.

Presented at the Aerospace Med. Assoc. Meeting, Miami, Fla., May 10, 1960.

(NASA Grant NsG—19—59)

(N63—14434)

Mars shall be considered as a gigantic enrichment culture and a few predictions are offered concerning the microflora which exist there. These predictions deal only with those activities which such an organism would have to carry on to flourish in such an environment. Absence of oxygen from the Martian atmosphere means that photosynthesis cannot be of the oxygen-evolving type and it is assumed that it resembles photosynthesis as carried out by terrestrial photosynthetic bacteria. Concomitant with a light-dependent reduction of carbon dioxide, there must, therefore, be oxidation of some external substrate. As an example, reduced sulfur compounds such as hydrogen sulfide would be oxidized to sulfuric acid. The Martian counterpart of respiration which will balance photosynthesis therefore cannot be oxygen-dependent. It must be assumed that anaerobic types of respiration exist, such as sulfate reduction. Other anaerobic respirations which may take place on Mars, and which are known among terrestrial organisms, would be the use of carbon dioxide as a terminal respiratory substrate with the resultant formation of methane or nitrate which would give rise to free nitrogen. Photosynthetic organisms in light can frequently carry out oxidations of the type usually associated with strictly aerobic processes. It is therefore possible that in such an anaerobic environment one might find photosynthetic bacteria oxidizing ammonia. The reduction of nitrate and nitrogen fixation is also known to occur under anaerobic conditions. Similarly, methane might be oxidized by certain photosynthetic bacteria. The exploration of life on Mars may be carried out by a device which is in principle a culture tube, provided with a suitable medium which can be monitored for changes in acidity and turbidity. (I.v.L.)

## 658

A NEW INTERPRETATION OF MARTIAN PHENOMENA.

C. C. Kiess, S. Karrer and H. K. Kiess

*Publ. Astron. Soc. Pacific*, 72:427, Aug. 1960. p. 256—267.

The assumed presence of oxides of nitrogen in the Martian atmosphere is used to explain many observed phenomena, including the polar caps and their colors, the various haze and cloud formations in the atmosphere, the seasonal changes of color in the dark areas, the monochromatic albedos, and other effects. If this explanation of the Martian atmosphere is correct, then life cannot exist on Mars. (M.P.G.)

## 659

HOW TO CONTACT "PEOPLE" IN SPACE.

W. Beller

*Missiles and Rockets*, 7:4, July 25, 1960. p. 42—44.

Although scientists may agree there is intelligent extraterrestrial life, there are two schools of thought as to how to get in touch with these "people". The first group believes the intelligent beings are passively attending to about one thousand transmitters which are beaming electromagnetic signals into likely areas of the universe. The second group is of the opinion that the extraterrestrial beings have sent out probes and satellites to every solar system within their reach, and are transmitting signals from the probes. Methods and justifications for search for signals by each faction are presented. (S.T.L.)

## 660

HOW DID LIFE BEGIN?

S. W. Fox

*Science*, 132:3421, July 22, 1960. p. 200—208. 54 refs.

Experiments in synthesizing life, or the basis of life, are discussed. These experiments have demonstrated the way in

which isolated chemical aspects of life might have arisen spontaneously. From a thermal model there has been a gain in the discovery of methods for easily producing a variety of peptides, the discovery of convenient methods for synthesizing some amino acids, and contributions to processes of microencapsulation. (Author)

## 661

THE THERMAL COPOLYMERIZATION OF AMINO ACIDS COMMON TO PROTEIN.

S. W. Fox and K. Harada

*J. Am. Chem. Soc.*, 82:14, July 20, 1960. p. 3745–3751. 34 refs.

By use of an excess of the dicarboxylic amino acids, the dry, eighteen amino acids common to proteins can be simultaneously copolymerized in a few hours at temperatures above 150°. Changes in the constitution of the polymers are described for variations in the conditions of reaction. The properties of the synthetic products are compared with known properties of natural proteins. (Author)

## 662

THE EXPLORATION OF OUTER SPACE.

A. C. B. Lovell

*Spaceflight* (London), 2:7, July 1960. p. 194–203.

The author reviews and evaluates some of the information which has been obtained and suggests lines of investigation which may be followed to extend our knowledge of outer space. Consideration is given to the limitations of the earth's physical environment, including the great radiation belt; the dust particles and radiations of the interplanetary medium; the distance, atmospheric constitution, and geophysical environment of the moon and the planets; possibilities for extraterrestrial life; the cosmologic problems of time and space; and radio-astronomic studies of the universe. (Aerospace Med.)

## 663

PROCEEDINGS OF MEETING ON PROBLEMS AND TECHNIQUES ASSOCIATED WITH THE DECONTAMINATION AND STERILIZATION OF SPACECRAFT, Washington, D.C., June 29, 1960.

J. Posner, ed.

NASA, Wash., D.C., Jan. 1961. 57 p. 16 refs.

(NASA TN D-771; AD–248765; N62–71345)

A meeting was held of representatives of agencies concerned with the development of space vehicles and those investigating decontamination and sterilization procedures. Recommendations resulting from the deliberations include: (1) a body of related information be accumulated, (2) standard operating procedures be established, (3) acceptable limits of contamination be determined, (4) NASA policy be clarified, (5) new sterilizing agents be developed, (6) compatibility studies be pursued, (7) sterile manufacture of parts be investigated, and (8) a working level group should be formed to implement recommendations and procedures. (Star)

## 664

SEARCH FOR ARTIFICIAL STELLAR SOURCES OF INFRARED RADIATION.

F. J. Dyson

*Science*, 131:3414, June 3, 1960. p. 1667. 3 refs.

If extraterrestrial intelligent beings exist and have reached a high level of technical development, one byproduct of their energy metabolism is likely to be the large-scale conversion of starlight into far-infrared radiation. It is proposed that a search for sources of infrared radiation should accompany the recently initiated search for interstellar communications. (M.G.)

## 665

FIRST PLANNING CONFERENCE ON BIOMEDICAL EXPERIMENTS IN EXTRATERRESTRIAL ENVIRONMENTS.

Held under the auspices of the NASA, Washington, D.C., June, 1960.

Feb. 1961. 85 p. OTS price $2.25.

(NASA TN D–781)

(N62–71355)

Thirty of the nation's leading experimental biologists conferred with the staff of the NASA Office of Life Science Programs for the purpose of establishing the objectives, important areas of inquiry, and program priorities for space environment biomedical experiments. The group recommended emphasis on the following: detection and study of extraterrestrial life, studies of the effects of simulated extreme environments, cellular and biological system studies in space conditions, ways and means of decontaminating space probes and vehicles, effects of space on biological rhythms and animal orientation, and photosynthesis in ecosystems. It was urged that space related work be carried out in earth-bound laboratories as well as in simulated environments and in upper atmospheric balloons.

## 666

PROPOSED EXPLANATION OF MARITIAN PHENOMENA.

C. C. Kiess, H. K. Kiess and S. Karrer

*Sky & Telescope*, Vol. 19, June 1960. p. 469.

Oxides of nitrogen are proposed as the principal agents for the surface and atmospheric phenomena observed on Mars. The polar caps may be solid $N_2O_4$ and the spreading of the heavy gas as the poles melt would cause the seasonal changes in the dark areas. Absorption of light by gaseous $NO_2$ and $N_2O_7$ may be responsible for the low albedo, the blue clearing caused by polymerization of $NO_2$ to $N_2O_7$ and the yellow clouds caused by increases in $NO_2$ concentration. This view of Mars would make the presence of life very unlikely because of the toxicity of the oxides of nitrogen. (E.O.)

## 667

SYNTHESIS OF ADENINE FROM AMMONIUM CYANIDE.

J. Oro

*Biochem. and Biophys. Res. Commun.*, Vol. 2, June 1960. p. 407–412.

The synthesis of purines and pyrimidines under possible primitive Earth conditions is regarded as a major problem for the

understanding of the origin of life. Evidence is presented for the synthesis of adenine from aqueous solutions of ammonium cyanide at temperatures below 100° C. Chromatograms were used to identify the adenine product. Preliminary evidence for the formation of glycine and 4-aminoimidazole-5-carbonimide as products of the reactions indicates the synthesis of adenine under the present conditions follows a parallelism with the known pathway of biochemical synthesis of purines. (E.O.)

## 668

ARTIFICIAL STELLAR SOURCES OF INFRARED RADIATION.
F. J. Dawson
*Sci. Am.*, 202:6, June 1960. p. 61—69.

The means by which an advanced extraterrestrial culture might utilize the greatest possible amount of available stellar energy is discussed. The expansion of a technically advanced species depends upon the supply of matter and energy. A spherical shell of matter around a star would intercept the useful energy and in turn would reradiate nonuseful energy in the far infrared, probably near 10$\mu$. It is suggested that searches be initiated for point sources of infrared radiation either above or with visible stars which might be evidence of such a concept in use by intelligent extraterrestrial life and which would compliment the search for artificial radio signals. (E.O.)

## 669

ORGANIC MOLECULES FROM SPACE.
(No Author)
*Sci. Digest*, Vol. 47, Jan.—June 1960. p. 25.

A brief statement is made of a stony meteorite analysis which indicates the presence of organic molecules, possibly intermediate in the evolution of chemical forms from inert to living material. The findings indicate organic molecules formed outside of earth by prebiological processes. (E.O.)

## 670

COMMUNICATIONS FROM SUPERIOR GALACTIC COMMUNITIES.
R. N. Bracewell
*Nature* (London), 186:4726, May 28, 1960. p. 670—671. 6 refs.

If intelligent life did develop on other likely systems at the same tempo as ours has developed, and if some superior community has not made contact with us, it may simply be that the mortality rate for advanced civilizations is too high for them to become abundant in the Galaxy. It is rather striking that there would be a thousand superior communities present in the Galaxy at any given time even though it takes as long as five thousand million years to produce a technological community that is viable, on the average, for only 500 years beyond the point we have reached. Even in the event of technology being rare, there is, however, the possibility of a chain existing. Thus, in a Galaxy supporting 103 superior communities with brief expectation of life, there may be some communities that have achieved durability, even quasi-permanence, perhaps by gaining control of the circumstances that lead to short average lifetimes. Aided by accidental proximity due to random spacing, some of these could be in contact. Presumably such an ancient association would be very able indeed technically and might seek us out by special means that we cannot guess. Whether they would be interested in rudimentary societies which, in their experience, would usually have burnt themselves out before they could be located and reached, is difficult to say. (I.v.L.)

## 671

THE EXPLORATION OF THE MOON.
R. Jastrow
*Sci. Am.*, 202:5, May 1960. p. 61—69.

The importance of lunar exploration is increased by the fact that the surface of the moon, lacking an erosive atmosphere, has preserved a record of the history of the solar system. (Author)

## 672

INDIGENOUS ORGANIC MATTER ON THE MOON.
C. Sagan
*Proc. Natl. Acad. Sci., U.S.*, 46:4, Apr. 15, 1960. p. 393—396. 17 refs.

Studies of the early history of the solar system indicate that for some period after its formation the moon possessed a reducing atmosphere of secondary origin, composed largely of $CH_4$, $NH_3$ and $H_2O$, with smaller amounts of $H_2$ and the interaction products of these molecules. The effect of solar ultraviolet light and electric discharge, on such an atmosphere is well known; organic molecules of fair complexity—up to molecular weight $\sim$ 100—are produced almost independently of the relative proportions of precursors. Amino and other organic acids, pyrroles, pyridines, and simple hydrocarbons and their polymers are among the synthesized molecules. The paper estimates the quantity of organic matter which formed in the primitive lunar atmosphere, diffused to the surface, and survived to the present day. It is concluded that a sample of appropriate lunar subsurface material should have an organic fraction easily detectable by simple chemical techniques. (Author)

## 673

A NOVEL SYNTHESIS OF POLYPEPTIDES.
J. Oro and C. L. Guidry
*Nature*, 186:4719, Apr. 9, 1960. p. 156—157.

On the basis of these experiments (those described in the article) and assuming that most of the alpha amino acid amides can polymerize under similar liquid-phase or vapor-phase conditions, a simple mechanism for the formation of polypeptides on the primitive Earth can be visualized. It requires temperatures accepted by geochemical evidence and uses as reactants logical intermediates in primordial syntheses of amino acids. (Author)

## 674

BIOLOGICAL CONTAMINATION OF THE MOON.
Carl Sagan
*Proc. Nat. Acad. Sci., U.S.*, 46:4, Apr. 1960. p. 396—402.

Four possible circumstances under which the moon may be biologically contaminated via lunar probes are discussed and evaluated. The moon may contain no indigenous living or-

ganisms and may be incapable of supporting terrestrial organisms, but, there may be relics of primitive indigenous organisms and deposited cosmobiota at or near the surface which would be indistinguishable from the terrestrial biological contaminants distributed by hard-landing vehicles. Or subsurface prebiological organic matter may exist which would be indistinguishable from deposited terrestrial organic matter, either biological or abiological in origin. The moon may contain no indigenous living organisms but may be capable of supporting some terrestrial organisms; it is possible that a deposited terrestrial micro-organism will multiply at a geometric rate and in a short time destroy large quantities of organic matter produced in the early history of the moon. The moon may contain indigenous living organisms which may have their ecology seriously disturbed by competition with or parasitization by deposited terrestrial micro-organisms. The probable survival times of terrestrial living organisms and non-living organic matter in the potentially hazardous lunar environment are computed. It is concluded that the probability is very low that deposited terrestrial micro-organisms and organic matter will be confused with indigenous lunar organisms or organic matter, but that the explosive reproduction of terrestrial micro-organisms in indigenous lunar organic matter, and the disruption of the ecologies of hypothetical lunar organisms are remote but non-negligible possibilities. (Author)

## 675

DOES LIFE EXIST IN SPACE?
(No Author)
*Spaceflight*, Vol. 2, Apr. 1960. p. 180.

A short report is given of a Russian proposal that experiments be made to determine if outer space is free from micro-organisms. This would settle two opposing theories of microbiology: the Weisman-Morgan theory which holds that the chemical composition of extraterrestrial micro-organisms would differ basically from the protein and nucleic acid composition of terrestrial micro-organisms, and the Michurn theory which holds that structural compositions will be basically similar since the laws governing living matter are the same for Earth and the other planets. (E.O.)

## 676

EXTRATERRESTRIAL LIFE.
H. Shapley
*Astronautics*, 5:4, Apr. 1960. p. 321–333, 350.

Conditions necessary for the persistence of life on a planet are discussed, with emphasis on the diversity of types of protoplasmic life that can occur. It is concluded that man as a species may be unique, but that we may expect to find habitable planets with higher forms of life in other solar systems. (B.N.)

## 677

LIFE OUTSIDE THE SOLAR SYSTEM.
Su-Shu Huang
*Sci. Am.*, 202:4, Apr. 1960. p. 55–63.

The evolution of living organisms is represented as one outcome of stellar evolution. The characteristics and life history of stars are discussed. On the basis of their lifetimes and the depth of their habitable zones, stars of the late-F, -G and early-K types seem to offer the most favorable environments for life. The further necessity for maintenance of stable planetary orbits eliminates all but 1 or 2% of all double or multiple stars. Evidence for the presence of planets of other stars is presented, and an estimate is given that 3 to 5% of all stars in our galaxy possess habitable planets. Although the chance that advanced civilizations might be flourishing at the present time on the planets of one or two nearby stars is excessively small, the intriguing possibility of establishing radio contact and the choice of signals are discussed. (M.P.G.)

## 678

LIFE-SUPPORTING REGIONS IN THE VICINITY OF BINARY SYSTEMS.
Su-Shu Huang (NASA. Goddard Space Flight Center, Greenbelt, Md.)
*Publ. Astron. Soc. Pacific*, 72:425, Apr. 1960. p. 106.
(A64–10218)

A quantitative study is made of the statement that, if a life-supporting planet exists in a binary system, it must be an interior planet in the case of a distant binary, and an exterior planet in the case of a close binary. Considered are the habitable zone of a binary system, the dynamical stability of the orbit of a third body in a binary system, and the life-supporting ability of a binary system in terms of the separation between the components. It is stated that many binaries have as good a chance to support life as do single stars. However, it is emphasized that this may be true only for distant binaries having nearly circular orbits. The situation is not so favorable if the binary has a highly eccentric orbit.

## 679

METEORITES YIELD CLUE TO LIFE IN SPACE.
Melvin Calvin and S. K. Vaughn
*Chem. and Eng. News*, Vol. 38, Mar. 14, 1960. p. 38.

The analysis of a Kentucky meteorite containing 2% carbon by ultraviolet, infrared, and mass spectography and chromatography has revealed the presence of prebiotic compounds notably similar to the spectrum of cytosine, a pyrimidine that is part of the nucleic acid structure. No trace of amino acids was found. The studies show that prebiotic forms can exist on bodies other than earth and that the formation of heterocyclic compounds seems to take place more readily than that of amino acids under conditions that existed in the meteorites. (E.O.)

## 680

EXTRATERRESTRIAL LIFE.
H. Shapley
*Astronautics*, 5:4, Mar. 1960. p. 32–33, 50–52.

The probability of the existence of life on other planets is based on the premises that (1) under certain conditions, such as were present on earth at one time, the development of life is spontaneous, and (2) that the common origin of the earth and other planets of the universe and the law of probability make the existence of these conditions on other planets very likely. The possibility of life in a different physiochemical form and

adapted to different environmental conditions must not be discounted. However, certain conditions may be considered to be essential to the existence of life as we know it. These conditions are a relative stability of environmental conditions, a fairly circular planetary orbit, availability of water or possibly some other solvent, a suitable chemical nature, and the development of organisms either incapable or unwilling to destroy themselves or their planet. (Aerospace Med.)

## 681

ON THE ORIGIN OF LIFE.
John Keosian
*Science*, 131:3399, Feb. 19, 1960. p. 479—482.

Arguments for neobiogenesis are presented in reference to various problems of evolution and the origin of life. Repetitive neobiogenesis was and is possible from the organic milieu, and actually may take a relatively short time if given the proper combination of substances and circumstances. A new organism may be compatible or symbiotic with existing organisms in its environment which invalidates the concept of overpowering competition. The question is raised as to whether some resolution of racemic mixtures could already have taken place or optical activity could have already occurred before the emergence of life. Repetitive neobiogenesis would establish organisms similar in metabolism to known forms. Neobiogenesis is a possible explanation for the occurrence of present-day viruses and also bacteria. Some of the discontinuities in paleontological evidence can be viewed as the result of separate cases of neobiogenesis. This may also be said of discontinuities in the taxonomic arrangement of existing organisms. (E.C.)

## 682

THE SEARCH FOR LIFE BEYOND THE EARTH.
J. Lederberg
*New Scientist* (London), 7:170, Feb. 18, 1960. p. 386—388.

Seaching of future space territories for the presence of living organisms will be an essential requirement, because the knowledge of the type of organic matter encountered may forestall the danger of contamination of our planet by involuntary space transportation of such organisms to earth. Spontaneous development of life on other planets under conditions similar to those found on earth, or even under dissimilar conditions, is considered strongly possible. All living cells on earth share a generally common chemical structure, including nucleic acids, proteins, amino acids, and smaller molecules such as the B vitamins. It is of interest in the study of evolutionary processes to know whether these structures may have developed spontaneously on other worlds, and if so, under what conditions. Rigid measures must be utilized to prevent the contamination of this potential source of knowledge by earth organisms. It is suggested, therefore, that initial studies be made by unmanned sterile space vehicles equipped with automatic microscopes and other recording instruments. (Aerospace Med.)

## 683

HOW WE CAN DETECT RADIO TRANSMISSIONS FROM DISTANT PLANETARY SYSTEMS?
F. D. Drake
*Sky and Telescope*, 19:3, Feb. 1960. p. 140—143.

Optimal ranges for detecting radio transmissions over interstellar distances are discussed. It appears that strong intelligent radio transmissions may emanate from the vicinities of, at best, 25% of the stars in a million; making good the possibility that at least one of the 10 000 stars soon to be within reach has a civilization using radio techniques. Search frequencies to use, and the nature of signals that might be heard are discussed. Justifications for Project Ozma which will go into operation in early 1960, and a description of the receiver that will be used to detect radio transmissions are given. (Author)

## 684

A VIEW OF GENETICS.
J. Lederberg
*Science*, 131:3396, Jan. 29, 1960. p. 269—276.

The mutualism of DNA, RNA, and proteins as reviewed is considered to be fundamental to all contemporary life. The least requirements of a primeval organism for progressive replication of DNA include: (1) DNA; (2) the four deoxyribotide pyrophosphates in abundance; (3) one molecule of the protein DNA polymerase; (4) ribotide phosphates as precursors for RNA; (5) one molecule of the protein RNA polymerase; (6) a supply of the 20 aminoacyl nucleotidates or, alternatively, each of the 20 enzymes which catalyze the condensation of an amino acid and the corresponding RNA fragments together with sources of these components; and (7) one molecule of the protein aminoacyl-RNA polymerase. The most plausible theory for the origin of DNA is considered to be evolution from a simpler, spontaneously condensing polymer. Although nucleoproteins are the only known self-replicating polymers, the basic requirements for other such polymers are discussed. Since the hydrogen bonding of nuclein molecules constrained on a rigid helical backbone (the DNA mechanism) would be difficult to imitate, the construction of a self-replicating assembly based, perhaps, on the attraction between ionic groups of opposite charge such as $NH_3^+$ and $COOH^-$ is proposed. The construction of an artificial molecule having the essential function of primitive life is considered to be within the grasp of current organic chemistry. (M.P.G.)

## 685

BASIC RESEARCH IN ASTROBIOLOGY.
R. S. Young
*In:* Advances in the Astronautical Science, Vol. 6, Proc. of the 6th Ann. Mtg. A.A.S., N.Y., Jan. 18—21, 1960. p. 317—327.
N.Y., Macmillan, 1961. 898 p.

The effect of spacial environmental conditions on man and other organisms, both plant and animal, is discussed. Radiation and weightlessness are considered and experiments testing the effect of weightlessness on fertilization and cell division are described. The need for the investigation of possible extrater-

restrial life is cited as a basic consideration, both for the problems of reciprocal contamination and the origin and nature of life. The study of elementary life or protolife on other planets will need detailed experimental design derived from knowledge presently known on infrared. (E.O.)

## 686

**LIFE ON MARS?**
(No Author)
*Missiles and Rockets*, 6:3, Jan. 18, 1960. p. 32–33

According to N. I. Kucherov, the observed color of the dark spots or "seas" changes according to the time of the year; blue-green in the spring, brown or grey-brown in the fall; also they change outline and size. G. A. Tikov demonstrated that the spectral curves of the "seas" of Mars coincide with the same curves for Earth plants growing in severe climatic conditions. The Soviets plan further study of Mars at the new Planetary Div. to be opened at the Pulkovo Observatory. (A.H.F.)

## 687

**LIFE ON THE PLANET MARS (LA VIE SUR LA PLANÈTE MARS).**
A. Dollfus
*Compt. Rend.*, 250:2, Jan. 18, 1960. p. 463–465. (in French)

Analysis of polarized light has revealed the existence on Mars of small elements which bloom seasonally with the arrival of water. (J.P.L.)

## 688

**EXTRATERRESTRIAL LIFE: SOME ORGANIC CONSTITUENTS OF METEORITES AND THEIR SIGNIFICANCE FOR POSSIBLE EXTRA-TERRESTRIAL BIOLOGICAL EVOLUTION**
M. Calvin and S. K. Vaughn
*In:* H. K. Bijl, ed. SPACE RESEARCH, Proc. First Intern. Space Sci. Symp., Nice, France, Jan. 11–16, 1960. p. 1171–1190 19 refs. New York, Interscience, 1960. 1195 p.

In order to decide the value and type of information to be obtained from outer space with regard to its pertinence for the evolution of life, a brief review is presented of currrent theories on the origin of life on Earth. Particular kinds of chemicals, whose presence or absence on other astral bodies might be significant, are indicated.

The only data available is telescopic spectroscopy. Information indicating the presence in meteorites of complex organic materials, some of them apparently uniquely pertinent to life processes, is presented. (Author)

## 689

**RESEARCH RELATING TO LIFE ON THE PLANETS (RECHERCHES CONCERNANT LA VIE SUR LES PLANETES).**
A. Dollfus
*In:* H. K. Bijl, ed. SPACE RESEARCH, Proc. First Intern. Space Sci. Symp., Nice, France, Jan. 11–16, 1960. p. 1146–1152. 18 refs. New York, Interscience, 1960. 1195 p.

1. Observations indicating life on Mars: The dark patches on the ground polarize light in the same manner as a deposit of opaque grains. The polarization varies seasonally and is observed at the same time when the contrast changes are observed by the telescope, at the moment when the content of water vapor is increased in the air. It is therefore asumed that small organisms, capable of blooming in the spring, are present on the ground.

2. A study of the atmosphere of Venus: The conditions of life depend on the presence of water in the atmosphere. The water vapor observations are made by means of spectroscopes carried into the stratosphere by balloons.

The device consists of a metallic cabin surmounted by a telescope of 50-centimeter diameter and of a spectrophotometer, which gives the intensity of the 1.4 micron water vapor band from Venus and from the Moon. The cabin and the observer are carried into the atmosphere by a group of 100 big sounding balloons which are attached to a cable. In France, the author has already made an ascent which lasted for five hours. (Author)

## 690

**HOW CAN WE DETECT RADIO TRANSMISSIONS FROM DISTANT PLANETARY SYSTEMS?**
F. D. Drake
*Sky and Telescope*, Vol. 19, Jan. 1960. p. 140–143.

The probability of extraterrestrial life is considered and also the radio methods for detecting intelligent signals. Complex organic molecules can form on any planet with conditions similar to earth. These planets would probably revolve around stars of spectral types F, G, K, and possible M. It is estimated that at best 25 percent of stars might have intelligent life. Technical perfection of radio is likely in at least one stellar system within 100 light years. The choice of wavebands lies between the frequency of galactic noise and terrestrial atmospheric radiation, probably at the frequency of interstellar hydrogen which might be expected as a mutual frequency of scientific interest. The characteristics of an intelligent signal may be deduced from narrow waveband, Doppler shift, or variation over time. (E.O.)

## 691

**SPACIOUS TALK.**
(No Author)
*Sci. Am.* 202:1, Jan. 1960. p. 74, 76, 79.

Cocconi and Morrison's theory on the possibility of intelligent extraterrestrial life trying to contact earth is reviewed. Project Ozma is mentioned as a means of "listening" for contacting signals. (S.T.L.)

## 692

**ARTIFICIAL BIOSPHERE.**
E. Sloane
*Science*, 132:3421, 1960. p. 252.

The author agrees with Dyson's suggestion for investigating solar far-infrared radiations as one way to detect extraterrestrial intelligence, sounds, and proposes that intelligent beings most possibly have detected us. (A.H.F.)

## 693

**ARTIFICIAL BIOSPHERE.**
F. J. Dyson
*Science*, 132:3421, 1960. p. 252–253.

In reply to criticism, the author adds the following points to his theory of how intelligent beings might survive after reaching the population limits set by Malthusian principles: (1) the biosphere consists of a collection of objects travelling in independent orbits around a star; (2) a stabilization of population and industry is likely to occur close to the Malthusian limit rather than far below it; and (3) the discovery of an intense point source of infrared radiation would not itself imply that extraterrestrial intelligence had been found. On the contrary, one of the strongest reasons for conducting a search for such sources is that many new types of natural astronomical objects might be discovered. (A.H.F.)

## 694

**ARTIFICIAL BIOSPHERE.**
J. Maddox
*Science*, 132:3421, 1960. p. 250–251.

The author suggests, in response to Dyson's theory of an artificial biosphere shell around the sun, that the dispersal of Jupiter into a thin shell about the sun would not be an effective means of escaping the consequences of continued population growth. It might, however, be an experiment with an important bearing on various theories of the origin of the solar system. (A.H.F.)

## 695

**ASTROBOTANY.**
(No Author)
*Research* (London), Vol. 13, 1960. p. 374.

A short review is presented of current astrobotanical knowledge which is based on the comparison of the properties of terrestrial planets. Spectra of the Martian maria show similarities to spectra of terrestrial plants living in severely cold climates. Plants on Mars absorb all rays but reflect violet and blue ones. Infrared absorption of certain wavelengths appears common to plants on Earth and Mars. Life may also be possible on Jupiter and Saturn since there are spectral similarities from plants and the spectrum of methane produced by the decay of organic matter. (E.O.)

## 696

**CELESTIAL WORLD LIVING OR DEAD?**
**(LES MONDES DU CIEL TERRES VIVANTES OU CIMETIÈRES?).**
Pierre Gauroy
Paris, Libraire Artheme Fayard, 1960. 298 p.

## 697

**THE ENVIRONMENTS OF THE MOON AND PLANETS.**
G. P. Kuiper
*In*: O. O. Benson, Jr., and H. Stroghold, eds. PHYSICS AND MEDICINE OF THE ATMOSPHERE AND SPACE. p. 577–583.
N. Y., Wiley & Sons, Inc., 1960.

The moon is devoid of an atmosphere. Principal surface features of the moon—well known maria and large craters, the rills, ridges extinct volcanoes, faults and graben—cannot be explained from the present lunar environment. The moon's formation appears to have been that Earth and moon formed together from one protoplanet. There is possibly primitive vegetation on Mars (E.C.)

## 698

**EVIDENCE FOR OXIDES OF NITROGEN IN THE ATMOSPHERE O MARS.**
C. C. Kiess, H. K. Kiess and C. H. Corliss
*Science*, Vol. 131, 1960. p. 1319.

A microphotometric comparison of the spectra of Mars an the moon is given. The curve showing the general decline i intensity of the Martian spectrum with wavelength closely re sembles the absorption curve of $NO_2$. Observations at high dis persion of the absorption spectrum of $NO_2$ provide agreemen between Martian and laboratory results. It is concluded tho the oxides of nitrogen are present in the atmosphere of Mar and explain observed features of the Martian spectrum. Th toxicity of these gases is evidence for the nonexistence of life o Mars. (A.H.F.)

## 699

**EXPERIMENTAL UTILIZATION OF STAY IN SPACE.**
*In*: J. Dvorak, P. K. Isakov and J. Hospodar, eds. MAN IN INTE PLANETARY SPACE—A SMALL MODERN ENCYLOPEDIA. p. 231–23
Prague, 1960.

The exploration in space will assist in explanation of the origi of life. The discovery of extraterrestrial life will accelerate th solution to the general question of the "rules" of biologic evolution. The space voyager will be able to investigate presen of life on Mars and Venus, the two most likely sites for it. Oth questions which may be solved are: (1) the relation of livi matter to carbon; (2) the conditions for different evolutiona pathways; (3) the question of aging; (4) relationships betwe body and mental functions; and, (5) adaptation of terrestrial for under extraterrestrial conditions. The strong point is made th the planets and their satellites must be protected against co tamination by terrestrial forms. (Micro-organisms).

## 700

**THE EXPLORATION OF OUTER SPACE.**
A. C. Lovell, et al.
*Spaceflight*, 2:7, 1960. p. 194–203.

Man is now technically able to explore two issues of importan to humanity, the uniqueness of life, and the origin of the u verse. Technical problems are discussed in terms of the boundari of outer space, the interplanetary medium, the moon and t planets, and the cosmological problem. In the search f extraterrestrial life it is stated that the possible existence intelligent life on other planets has been the domain of specul tive writers. With the abandonment of the theory that the ea and planets were torn from the sun by a passing star and t adoption of the belief that the earth and planets were form

from a dust cloud, the possibility of biotic accretions at an early earth stage is now considered feasible, as well as the existence of organic material, and indeed of living organisms in other parts of the solar system. The planets Mars and Venus are crucial in biological investigation, the presence of plant life on Mars being strongly suspected. An infrared spectrometer sensitive to a few microns is being developed which will investigate the spectral region where molecules of biological origin have definite characteristics. Another instrument is a microscope with an automatic collecting device for atmospheres or soils associated with a device for transmitting information back to earth. Organic meteorite material has been determined to contain cytosine, one of the bases of nucleic acid, by means of refined spectra analysis. This seems to be a definite indication of the existence of life from outer space. (A.H.F.)

## 701

EXPLORATION OF THE SOLAR SYSTEM.
F. Godwin
N.Y., Plenum Press, 1960. 200 p.

A brief review of the Martian vegetation hypothesis is included in section 26 of part D of this book. Evidence supporting both sides of the controversy is presented. (M.P.G.)

## 702

THE EXPLORATION OF SPACE.
R. Jastrow
N. Y., Macmillan Co., 1960.

From spectroscopic comparisons of terrestrial planets with the spectra of Mars, the best explanation of the variation in intensity of the dark regions of Mars is the existence of plant life. The dark patches have been noted to come back after a dust storm. This has been interpreted as indicating the presence of organic matter which has the power to regenerate or rejuvenate itself. (E.C.)

## 703

ISSUES IN EVOLUTION.
H. J. Muller
*In:* S. Fox and C. Collender, eds. EVOLUTION AFTER DARWIN, Vol. III. p. 69—105.
Chicago, Univ. of Chicago Press, 1960. (Univ. of Chicago Centennial Discussion)

In this volume, the origin of life is discussed by several noted scientists. It is concluded that the conditions on Mars are such that low forms of life could exist. It is thought that there would not be much plant life on Venus since there is very little oxygen. It is assumed that only in stars of what are called "third generation" or later would there be enough heavy elements to support life as we know it. (E.C.)

## 704

MESSAGES FROM THE OUTER SPACE.
M. Gyorgy
*Pizikai Szemle,* 10:11, 1960. p. 335—337. Transl. by AF Foreign Tech. Div., Wright-Patterson AFB, Ohio, Dec. 20, 1961. 10 p. (MCL—1360/1 + 2; AD—270779)

Conditions necessary for the appearance of intelligent life elsewhere in the universe are discussed. Various star systems are examined for possibility of human-type life. Methods of contacting such people, assuming they exist, are presented. (E.O.)

## 705

MOLECULAR SYNTHESIS IN SIMULATED REDUCING PLANETARY ATMOSPHERES.
Carl Sagan and S. L. Miller
*Astron. J.,* Vol. 65, 1960. p. 499.

Corona discharges have been applied to simulated reducing planetary atmospheres in an attempt to identify the most abundant stable compounds produced in the gas phase at room temperature. A mixture of hydrogen methane, ammonia, and water vapor represented the primitive atmospheres of the terrestrial planets. A second mixture of different proportions and without the water vapor represented the present Jovian atmosphere above the cloud layer. Extracted gas samples were analyzed by infrared and mass spectroscopy and included ethane, ethylene, acetylene, hydrogen cyanide and acetonitrite and in addition formaldehyde produced in the presence of water vapor. Any acetylene in the Jovian atmosphere could explosively polymerize, contributing to Jupiter radio noise and cloud layer color. Pyrroles, purines, and pyrimidines can under suitable conditions be synthesized from the products of the experiments. (Author, ed.)

## 706

THE MOON AND ITS NATURE.
V. V. Sharonov
*Priroda (Nature),* No. 1, 1960. p. 9—19. (In Russian)

Existing information about the moon is reviewed, including its topography, the origin of its mountains, the moon's atmosphere, the luminescence of its rocky formations, the coloration of the moon's landscape, the temperature prevailing at different times and on different parts of the moon's surface, and the structure of the moon's surface. All new facts established by science during the last few years are discussed. (J.P.L.)

## 707

ORIGIN OF CHONDRULES AND CHONDRITIC METEORITES.
Brian Mason
*Nature,* 186:4720, 1960. p. 230—231.

An hypothesis concerning the origin of chondrules and chondritic meteorites is presented. This hypothesis suggests that the structure of chondritic meteorites is the result of the reaction and recrystallization of preexisting material essentially in the solid state, and that many, if not all, chondritic meteorites, instead of being fragments of a disrupted planet or asteroid, have always been independent and individual objects. The preexisting material is believed to be represented by the carbonaceous chondrites, a small group quite distinct from all other meteorites in chemical composition. They all contain carbon, organic compounds, water-soluble compounds, and much combined water. The mineralogical composition is largely chlorite, a hydrated magnesium-iron silicate. Chlorite decomposes on heating above 600° C to give

olivine and orthopyroxene. The presence of carbon causes a natural smelting, reducing some of the combined iron to metallic iron, thereby increasing the magnesium content of the silicates. These reactions will produce the mineralogical composition of the usual chondritic meteorites, an aggregate of olivine and/or orthopyroxene, with some metallic iron. It is suggested that carbonaceous chondrites represent aggregates of primitive cosmic dust, and that most of them have, during the course of geological time, approached sufficiently close to the sun to be heated enough to setoff the reactions converting them to olivine-pyroxene chondrites. (I.v.L.)

## 708

A NEW EXPLANATION OF MARTIAN PHENOMENA.
C. C. Kiess, S. Karrer and H. K. Kiess
*Astron. J.*, Vol. 65, 1960. p. 348.

The existence of water vapor and oxygen in the atmosphere of Mars in amounts too small for spectroscopic detection justifies the assumption that the observed Martian phenomena may be due to the oxides of nitrogen. The polar caps would seem to be solid $N_2O_4$ and the spread of heavy gaseous $N_2O_4$ over the dark areas toward the equator would account for the seasonal changes of color. The oxides of nitrogen may exist in both solid and gaseous phases, which could account for the haze and for blue, white, and yellow clouds. Mars may be considered as a gigantic photochemical nitrogen-fixation process. Further, the well known toxic effects of these oxides argue against the existence of living organisms on the planet. (E.O.)

## 709

NINE PLANETS.
A. E. Nourse
N.Y., Harper & Bros., 1960. 291 p.

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Chapter 1: The Threshold of Space. Chapter 2: The Sun and Its Planets. Chapter 3: Mercury. Chapter 4: Venus. Chapter 5: The Moon Of Earth. Chapter 6: Mars. Chapter 7: The Asteroids. Chapter 8: The Gas Giants. Chapter 9: The Outer Satellites. Chapter 10: Pluto and the Outer Reaches. Chapter 11: Solar Systems Beyond the Sun.

## 710

ON THE ORIGIN OF LIFE. (LETTER).
J. L. Kavanau (Dept. of Zoology, Univ. of California)
*Science*, 131:3414, 1960. p. 1682.

The author reasons that the greatly increased rate of discovery of facts pertaining to the chemistry of hereditary mechanisms and the relationships of enzyme constitution to genotype had led to a distortion of the basic problem. He is concerned with the increasing tendency, especially among biochemists, to identify the event of the origin of life.

## 711

ORIGIN AND NATURE OF LUNAR SURFACE FEATURES.
J. J. Gilvarry
*Nature*, 188:4754, 1960. p. 886–891.

The origin and nature of lunar surface features are explained on the basis of the presence of a lunar hydrosphere. The dark color of the lunar mare is explained by the postulation that a primitive form of life existed in the lunar hydrosphere. All requirements for biopoesis were once met on the Moon in view of the existence, for an extended period of time, of an atmosphere and a hydrosphere. This atmosphere and hydrosphere are believed to have been formed by exudation from the Moon's interior in a process analogous to the formation of the terrestrial atmosphere and hydrosphere by exudation from the Earth's interior. The presence of a lunar atmosphere and hydrosphere would reduce the daily range of temperature below that observed at present; if the albedo of the primitive atmosphere on the Moon were comparable with that of the Earth, the mean surface temperatures would be the same. The time scale is also favorable to the postulation. Thus, it can be speculated that life originated on the Moon through the process postulated by Oparin. The original steps were the formation of fairly complex organic molecules through the action of solar ultraviolet radiation and lightning discharges on atmospheric gases. A positive clue does exist that life once existed in the lunar hydrosphere. As this hydrosphere dissipated, the dark coloration in the maria of the Imbrian type tended to recede from the bases of the encircling mountains, as is evident in the pattern of light and dark coloring in the mare basins. It is characteristic of living matter to follow the retreat of its habitat in this manner. Also, the origin of tekites is discussed. Erosion explains the presence of quartz particles in the lunar sediments, required to yield the lechatelierite observed in tektites. (I.v.L.)

## 712

THE ORIGIN OF LIFE.
H. Gaffron
*Perspectives Biol. Med.*, Vol. 3, 1960. p. 163 (3a).

The author is not optimistic about life existing on other planets as we know it on earth. On Mars, biopoesis may have run relatively quickly through its first phase up to the time when lack of water and hydrogen prevented any further development. On Venus, no photosynthesis of the type displayed by the green plants has had a chance to convert the excess carbon dioxide into organic matter of presently living or fossil organisms. (E.O.)

## 713

THE OSCILLATING UNIVERSE.
E. J. Opik
N.Y., New American Library, 1960. 144 p.

If life exists on Mars, it must be adapted to extreme conditions unlike any on Earth. Any type of Martian plant would have to be hygroscopic. It is felt that the dark areas or Maria are covered by vegetation that defies the sand drifts and feeds on the dust, but it is also thought that if there really are plants on Mars, they will be found thinly scattered all over its surface and only thickest on the Maria. It is extremely improbable that there is any type of intelligent life on Mars such as we know on Earth. (E.C.)

## 714

**OTHER ASTRONOMERS IN THE UNIVERSE?**
M. H. Briggs
*Southern Stars*, Vol. 18, 1960. p. 147–151.

The possible detection of intelligent extraterrestrial life by means of radio signals is discussed. Evidence for some sort of life on Mars has been derived from spectrographic observation. Indirect evidence for planetary systems around 61 Cygni and 70 Ophiuchi has been obtained and various theories of planetary formation indicate a high number of planetary systems in the universe. Present signals from earth could be detected at the distance of Sirius. Radio receivers now planned could detect other signals over a distance of 100 light years. The frequency of the 21-cm line of interstellar hydrogen would have been detected first by any astronomical receiver and so would probably be used as the wavelength of intelligent signals. (E.O.)

## 715

**THE PHYSICAL ENVIRONMENT ON MARS.**
Gerard de Vaucouleurs
*In:* O. O. Benson Jr., and H. Strughold, eds. PHYSICS AND MEDICINE OF THE ATMOSPHERE AND SPACE. p. 584–605.
N.Y., Wiley & Sons, inc., 1960.

The presence of a tenuous atmosphere on Mars is well established. Water vapor and oxygen remain so far undetected spectroscopically. The near-infrared absorption bands of carbon dioxide have been detected. Nitrogen must be the main constituent of the atmosphere, but is undetectable spectroscopically. Three main cloud types are recognized—white, blue and yellow. There is an extreme diurnal temperature variation and a seasonal variation. The present status of the vegetative hypothesis of the dark regions on Mars is more that of a philosophical speculation than of a scientific hypothesis. McLaughlin hypothesizes that the dark areas may be due to volcanic action. (E.C.)

## 716

**THE PLANETS.**
H. C. Urey
*In:* SCIENCE IN SPACE. Chap. 5, p. 1–13. National Research Council. Space Science Board.
Washington, Natl. Acad. of Sci., 1960.

Environmental characteristics of planets are discussed. The possibility of life occurring on Mars and Venus is speculated upon in relation to the environment. High temperatures on Venus may prohibit the existence of life. On the basis of seasonal color changes, it has been supposed that some kind of plant life exists on Mars. Sinton's spectroscopic studies are the best evidence for life on Mars.

## 717

**THE PROBLEM OF STAGES IN BIOPOESIS.**
J. D. Bernal (Birkbeck Coll., Univ. London, Eng.)
*Aspects of the Origin of Life*, 1960. p. 30–45.

The two chief tasks in the elaboration by many workers of a complete scheme of biopoesis are first the establishment of more or less plausible connected areas of development, those for instance of the origins of proteins or of photosynthesis, and second the reasonable linking of these areas of knowledge into a coherent whole. At the present, study of biopoesis is limited to the one form of life known on Earth. Where life exists on other planets, it is most likely that it will be incompatible with ours although we may suspect striking biochemical and structural parallels.

## 718

**PROBLEMS OF THE MOON.**
P. Moore
*Advan. of Sci.*, Vol. 17, 1960. p. 33–41.

Minor alterations on the moon's surface have been a subject of controversy. The crater Alphonsus has been a point of suspect gas discharges, which were investigated spectroscopically at the Crimean Astrophysical Observatory. The crater Linnie seems to be reduced in size with new surrounding white markings. Chain arrangements of craters may be interpreted as lines of weakness in the original crust. The non-random distribution of crater groups seems to have been internally caused. Occultation of a radio source by the moon suggests an atmospheric density $10^{-13}$ that of Earth. Except for previous theories that minor features inside Eratosthenes or craters of the Aristarchus type may be vegetation, the moon is entirely lifeless. (E.O.)

## 719

**THE QUANTITY OF MICRO-ORGANISMS IN THE UPPER STRATA OF THE ATMOSPHERE (KIL'KISNYI VMIST MIKROORHANIZMIV U VYSOKYKH SHARAKH ATMOSFERY).**
Ya. H. Kishko
*Mikrobiol. Zh. Akad. Nauk Ukr. SSR*, 22:6, 1960. p. 77–81. (Ukrainian; Russian Summary)
(Also in Referat. Zh. Viol., 1962, No. 4B321)
(21672)

The decrease in the quantity of micro-organisms with increasing height is noted. The surface stratum (up to 500m) is most densely populated with micro-organisms. (E.O.)

## 720

**RESEARCH INTO LIFE ON OTHER PLANETS (RECHERCHES CONCERNANT LA VIE SUR LES PLANÈTES).**
A. Dollfus
*In:* H. K. Bijl, ed. SPACE RESEARCH. p. 1146–1152.
N.Y., Interscience Inc., 1960. (Proc. of the Intern. Space Sci. Symp., 1st, Nice ,1960).
(English and Russian Summaries)

1. Observations indicating life on Mars. The dark patches on the ground polarize light in the same manner as deposit of opaque grains. The polarization varies seasonably and is observed at the same time when the contrast changes are observed by the telescope, at the moment when the content of water vapor is increased in the air. It is therefore assumed, that small organisms, capable of blooming in the spring, are present on the ground. 2. A study of the atmosphere of Venus. The conditions of life depend on the presence of water in the atmosphere. The

water vapor observations are made by means of spectroscopes, carried into the stratosphere by balloons. The device consists of metallic cabin surmounted by a telescope of 50-cm diameter and of a spectrophotometer, which gives the intensity of the 1.4 microns water vapor band from Venus and from the Moon. The cabin and the observer are carried into the atmosphere by a group of 100 big sounding balloons, which are attached to a cable. In France, the author has already made an ascent which lasted for five hours. (Author)

## 721

THE SEARCH FOR LIFE BEYOND THE EARTH.

J. Lederberg

*The New Scientist*, 7:170, 1960. p. 386—388.

The possibilities of life on Mars and Venus are considered and a means of detection is proposed. The Martian environment permits the maintenance of a biochemistry compatible with the life and for the survival and spread of terrestrial micro-organisms. The high apparent temperature of Venus does not preclude the presence of a layer where a temperate environment is available. Many organic compounds are shared by terrestrial organisms and any extraterrestrial life might show analogous use of such compounds as nucleic acids. The formation of life on earth is reviewed in the light of present theories but the main problem is the appearance of a replicating polymer. A design for a microscope to detect extraterrestrial micro-organisms is discussed. The need for absolute sterilization of planetary probes is stressed because of the possible adverse effects on our environment and the environment of other planets. (E.O.)

## 722

SOME NOTES ON THE ORIGIN OF THE COLOUR OF THE MARTIAN DESERTS.

H. French

*J. Brit. Astron. Assoc.*, Vol. 70, 1960. p. 136—138.

Ferrous oxide is black; therefore, in order to produce the Martian deserts, there must have been sufficient oxygen in the Martian atmosphere to oxidize it to ferric oxide, which is brick-red. Sufficient water vapor to hydrate some of this to yellow limonite must also have been present.

## 723

SOME ORGANIC CONSTITUENTS OF METEORITES AND THEIR SIGNIFICANCE FOR POSSIBLE EXTRATERRESTRIAL BIOLOGICAL EVOLUTION.

M. Calvin and S. K. (Himes) Vaughn.

*In:* H. Kallman, ed. SPACE RESEARCH. p. 1171—1191. Amsterdam, North-Holland Publ. Co., 1960.

In order to decide the value and type of information to be obtained from outer space with regard to its pertinence for the evolution of life, a brief review is presented of the current status of our thinking on the origin of life on earth. This points up the particular kinds of chemicals whose presence, or absence, on other astral bodies might be significant.

Heretofore, the only data available are the result of telescopic spectroscopy. We report here information indicating the presence in meteorites of complex organic materials, some of them apparently uniquely pertinent to life processes.

## 724

SPACE AGE MICROBIOLOGY.

A. E. Prince (Wright-Patterson AFB, Ohio) et al.

*In:* Developments in Industrial Microbiology, Vol. 1, p. 13—20. N.Y., Plenum Press, 1960. (Proc. General Meeting Soc. Ind. Microbiol., 16th, State College, Penn., Aug. 30,—Sept. 3, 1959)

Speculations are made on what will be found by space travellers to other planets. A prolonged space voyage will require a much greater insight into bioecology than we now possess and the design of a probe will require a reexamination of the fundamental properties of living matter. Gnotobiotics, i.e., organisms grown by themselves or in association with known kinds of organisms, is one of the many disciplines of biology that can contribute to space exploration. There is a danger of irretrievably losing the opportunity to investigate forms of life that may exist on the moon or the planets. Some experience with gnotobiotes may be of value in this consideration. Organisms ordinarily living in one environment may when introduced as a pure culture into another environment cause problems. A single contaminant from Earth could overrun and destroy life forms on another planet. It is not unlikely that organisms evolved in the harsh environment of Mars may provide a useful crop in the cold and arid regions of Earth. Sterilization of returning space probes to avoid contamination of Earth by extraterrestrial life is discussed.

Since fossil evidence indicates that morphology of micro-organisms has not changed obviously, it is believed that no new environments will be found on this planet, Mars, or perhaps, even Venus, that will entirely prohibit growth of all micro-organisms as we know them. Since the surface of Venus has never been seen, all theories have to be discounted considerably. However, the author prefers the theory that Venus is in a kind of carboniferous era, and is covered with jungles with all sorts of unknown fungi.

In the opinion of Strughold, low forms of both plants and cold-blooded animals could exist on Mars. The atmosphere is mostly nitrogen with some carbon dioxide and possibly a trace of oxygen and water. Summer temperatures on Mars in tropical regions are believed to go as high as $+20^\circ$ C. While higher plants and animals as we know them could not exist on Mars, one can agree with Strughold that at least the lower forms of plants, namely the fungi and algae could do reasonably well. (E.C.)

## 725

SPACIOUS TALK.

(No Author)

*Sci. Am.*, 202:1, 1960. p. 74, 76, 79.

Intelligent beings in other solar planets might be signalling us. Possible frequency for communication lies between one and 10 000 megacycles per sec. The frequency of the 21-centimeter line emitted by interstellar hydrogen is considered best. Depending on the distance, a two-way communication would be subject to a delay of 10 years or more between 2 and A. The passage, possibly pulse-coded, may go on a few years before repeating as

recognition symbols; it might contain a sequence of small prime numbers or simple arithmetical sums. (A.H.F.)

## 726

SPECULATION ON THE RELATIONSHIP BETWEEN ORGANIC AND ATMOSPHERIC EVOLUTION.

D. L. Gilbert

*Perspectives in Biol. Med.*, Vol. 4, 1960. p. 58–71.

Living organisms on Earth represent metastable chemical forms which can exist for periods of time during the evolution of the Earth's atmosphere. Energy for maintaining living organisms on Earth is derived from solar energy and is stored in the forms of molecular oxygen and hydrogen pool. For life to exist on a planet, there must be an energy supply, and the atmospheric transition period from the initial reducing atmosphere to its oxidized atmosphere must exist for a sufficient time to permit the formation and maintenance of living organisms. Because the atmosphere of Mars contains little, if any, water and oxygen and measurable amounts of carbon dioxide, it would seem that the "life stage" is ending on that planet. (E.C.)

## 727

SURFACE CONDITIONS ON THE NEAREST PLANETS.

E. J. Opik

*Am. J. Phys.*, 28:7, 1960. p. 618–622.

Atmosphere, temperature and topography of the moon, Mars, and Venus are discussed. Spectral absorption bands in the far infrared, characteristic of organic molecules, were found in the spectrum of the Martian dark area. The huge amounts of carbon dioxide, practically no oxygen, and very little water point to the absence of plant life on Venus. (E.C.)

## 728

SURVIVAL OF TERRESTRIAL MICRO-ORGANISMS UNDER SIMULATED MARTIAN CONDITIONS.

J. D. Fulton

*In:* O. O. Benson, Jr. and H. Strughold, eds. PHYSICS AND MEDICINE OF THE ATMOSPHERE AND SPACE. p. 606–613.
N.Y., Wiley & Sons, Inc., 1960. 17 refs.

Reviews sources of information on Martian environment and establishes conditions of 65mm Hg atmospheric pressure, moisture content of 1% or less, atmospheric composition of commercial nitrogen gas, soil type of red sandstone (lava soil), and a temperature range of +25° to —25° C (diurnal-nocturnal) in small scale Brewer anaerobic jars. Organisms investigated were mixed populations of soil micro-organisms and times involved were up to ten months. Survivors reapportioned themselves into three groups and growth occurred. Implications for closed ecological systems are discussed. (G.W.)

## 729

THE THERMAL COPOLYMERIZATION OF AMINO ACIDS COMMON TO PROTEIN.

Sidney W. Fox and Kaoru Harada (Fla. State U.)

*J. Am. Chem. Soc.*, Vol. 82, 1960. p. 3745.

By use of an excess of the dicarboxylic amino acids, the dry eighteen amino acids common to proteins can be simultaneously copolymerized in a few hours of temperatures above 150°C. Changes in the constitution of the polymers are described for variations in the conditions of reaction. The properties of the synthetic products are compared with known properties of natural proteins. (Author.)

## 730

THE WELLSPRINGS OF LIFE.

I. Asimov

N.Y., Abelard-Schuman, 1960. 233 p.

In so vast a universe it is possible that there are billions of "earth-type" planets. Mars is the only observable planet which may provide a habitat suitable for life.

Contents:

Pt. 1: Life and the species. Pt. 2: Life and the cell. Pt. 3: Life and the molecule. Pt. 4: Life.

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## 731

**HOW DID LIFE BEGIN?**

S. Fox

*Science*, 32:3421, Dec. 26, 1959. p. 200–208. 54 refs.

Presented at the AAAS Meeting, Chicago, Dec. 26, 1959.

A large portion of this report deals with the laboratory production of amino acids and proteinoids. Amino acids have been produced by electrical discharge in a mixture of methane, hydrogen, ammonia, and water. They have also been produced from formaldehyde and nitrate under the action of sunlight. Aspartic acid, alanine, glutamic acid and glycine have been produced thermally from malic acid, aspartic acid, alpha-hydroxyglutaric acid and glucose plus urea, respectively. Trace amounts of the peptides, glycylglycine and glycylalanine have been produced by the action of ultraviolet light on aqueous solutions of amino acids. Mixtures of genuine peptides have been produced when two or more amino acids, one being aspartic acid, glutamic acid, or lysine, are heated together. Linear peptides (polymers) containing eighteen amino acids have been obtained by the thermal copolymerization of excess aspartic acid, excess glutamic acid plus sixteen common amino acids. These polymers have many properties in common with natural proteins. Of particular interest is the production of a nucleic acid biointermediate, ureidosuccinic acid. This acid is essentially the only experimental demonstration yet published dealing with the prebiological origin of nucleic acid. Also, the morphogenicity of various polymers and copolymers of amino acids is discussed. (I.v.L.)

## 732

**LUNIK II IMPACT MAY HAVE CONTAMINATED THE MOON.**

(No Author)

*Missiles and Rockets*, Dec. 21, 1959. p. 41.

The final-stage carrier of Lunik II apparently was not decontaminated, although the instrument package was reportedly sterilized. Contamination of the moon by terrestrial micro-organisms could seriously hamper detection of indigenous organisms of extraterrestrial origin.

## 733

**FURTHER EVIDENCE OF VEGETATION ON MARS.**

W. M. Sinton

*Science*, Vol. 130, Oct.–Dec. 1959. p. 1234–1237.

The presence of absorption bands near 3.5$\mu$ in the infrared spectra of Mars is confirmed with the use of more sensitive records with the 200-inch telescope. The bands are most probably due to organic molecules although carbonate molecules may produce similar absorptions. The observed spectra resemble those of organic compounds, particularly plants. An absorption band at 3.67$\mu$ is indicative of carbohydrate molecules present in plants and its relative strength may be due to significant differences in the proposed Martian vegetation. The carbohydrate absorption band at 3.67$\mu$ has been identified as a characteristic of certain terrestrial lichens and algae. (E.O.)

## 734

**COULD THE SATELLITES OF MARS BE ARTIFICIAL?**

C. W. Tombaugh

*Astronautics*, Vol. 4, July–Dec. 1959. p. 38–39, 52, 54.

The hypothesis has been advanced by I. S. Shklovskiy that the satellites of Mars are artificial on the basis of their small size, the fact that the period of revolution of Phobos is shorter than the rotation period of Mars, and the inward deviation of the orbit of Phobos. Possible forces causing this deviation on a satellite of normal mass are insignificant. It would seem then that the density of Phobos may be explained only by a hollow, artificial structure. A rebuttal is made that the geophysical structure of Mars precludes any previous civilization capable of creating artificial satellites. The existence of similar small satellites is found associated with Jupiter and the deviation of the orbit of Phobos is probably caused by elastic collisions with asteroids, resulting in a loss in orbital kinetic energy and a decreasing orbital size. Phobos would then no longer be required to have a low unnatural density. (E.O.)

## 735

**VEGETATION ON MARS.**

(No Author)

*Nature* (London), 184:4699, Nov. 21, 1959. p. 1612.

Sinton's test for the presence of vegetation on Mars is discussed. This test is based on the fact that all organic molecules possess strong absorption bands at wavelengths near 3.4$\mu$, the wavelength of the carbon-hydrogen bond resonance. Tests were carried out at the oppositions of 1956 and 1958. A lead sulfide cell cooled in liquid nitrogen was the detector and was preceded

by a monochromator equipped with a lithium fluoride prism. The radiation received from Mars was analyzed theoretically into thermal radiation and reflected solar radiation. The latter showed three absorption bands at 3.43$\mu$, 3.56$\mu$ and 3.67$\mu$. These appeared to be peculiar to the dark regions of Mars. The bands were weak or absent in the bright regions, and are therefore formed neither in the atmosphere nor in the bright regions of the planet. No new absorptions were found. The observed spectrum fitted very closely that of organic compounds and plants. The first two bands are easily observed in plants. The 3.67$\mu$ band seemed at first to be an enigma; however, it has been found in alga Cladophora and appears to be produced by carbohydrate molecules in the plant. Sinton's results are the best evidence yet produced for the existence of vegetation on Mars. (I.v.L.)

## 736

FURTHER EVIDENCE OF VEGETATION ON MARS.
W. M. Sinton
*Science*, 130:3384, Nov. 6, 1959. p. 1234—1237. 8 refs.

New tests for the presence of organic molecules on Mars were made during 1956 and 1958 oppositions. A band present at 3.67$\mu$ has also been found in the alga Cladophora, and is apparently produced by carbohydrate molecules present in the plant. The strength of the band at 3.67$\mu$ compared to its weakness or absence in plants may indicate a significant difference in plants that may be present on Mars. (E.O.)

## 737

THE PROBLEM LIFE IN THE UNIVERSE AND THE MODE OF STAR FORMATION.
S.-S. Huang
*Publs. Astron. Soc. Pacific*, 71:422, Oct. 1959. p. 421—424. 7 refs.
Also *in: Am. Scientist*, 47:3, Sept. 1959. p. 397—402.

General conclusions concerning the occurrence of life in the universe are presented. Habitable zones around a star and methods of detecting planets belonging to stars other than the sun are discussed. Three indirect arguments for believing that formation of planets around stars is a common phenomenon are given. (S.T.L.)

## 738

TERRESTRIAL AND EXTRATERRESTRIAL LIFE.
M. H. Briggs
*Spaceflight*, 2:4, Oct. 1959. p. 120—121. 12 refs.

Accidental deposition of bacterial spores by extraterrestrial intelligences not actually landing on Earth, but visiting it beginning about 2 billion years ago, is presented as a third theory accounting for the origin of life. Objections to this theory are given. Author indicates insufficiency of data to form any conclusions. (N.G.)

## 739

SEARCHING FOR INTERSTELLAR COMMUNICATIONS.
G. Cocconi and P. Morrison
*Nature* (London), 184:4690, Sept. 19, 1959. p. 844—846.

Interstellar communication across the galactic plasma without dispersion in direction and flight time is practical, so far as we know, only with electromagnetic waves. An optimum channel which might be used by an intelligent extraterrestrial civilization to contact Earth is discussed. The most promising radio emission line to search for would be at 1—20 mc/s ($\lambda = 21$ cm) of neutral hydrogen; it is reasonable to assume that sensitive receivers for this frequency will be made at an early stage of the development of radio astronomy. Power demands for the signal source, signal location and bandwidth, the nature of the signal sent and its possible locations are discussed. (Author)

## 740

ROUND TRIP FROM SPACE.
M. Calvin
*Evolution*, 13:3, Sept. 8, 1959. p. 362—377

The author traces the origin and development of life on Earth as prologue to his affirmative discussion of the probabilities for cellular life (as we know it) to exist on other planets. Despite at least 15 different hypotheses on the origin of the Earth and the solar system, one prerequisite for life has been agreed on, namely that the atmosphere itself must have been made up of relatively simple molecules.

## 741

THE STERILIZATION OF SPACE VEHICLES TO PREVENT EXTRA-TERRESTRIAL BIOLOGICAL CONTAMINATION.
M. G. Comuntzis
*In:* Proc. of the 10th Intern. Astronautic Congress, London, Aug. 30,—Sept. 5, 1959. p. 495—504.
Springer-Verlag, 1960. 94 p.

Present knowledge of the planets Mars and Venus is compatible with the possibility both of an indigenous life and of the maintenance and rapid spread of terrestrial micro-organisms. The introduction of terrestrial organisms as contaminants on planetary probes might so distort the biology of either planet as to constitute a scientific catastrophe. Extraterrestrial contamination has not received sufficient international attention. Two reports have been put out by the Committee on Contamination by Extraterrestrial Exploration (CETEX) representing the International Scientific Unions. These reports attempted to set a tone for developing a code of conduct in space research, but did not offer any specific suggestions as to how probes should be sterilized. Four phases of payload sterilization are recommended. They are: (1) sterile assembly, (2) built-in or intrinsic sterilization, (3) terminal sterilization, and (4) maintaining sterilization. In order to minimize chemical contamination of a kind that might confuse later investigators, it is recommended that a careful molecular inventory be made of each mission together with a replica of each package. It is also recommended that a microbiological survey be made of the launching site area. (Author)

## 742

THE ORIGINATION OF LIFE.
A. E. Needham
*Quart. Rev. Biol.*, 34:2, Sept. 1959. p. 189—209.

A formal solution of the main problems concerning the origination of life is attempted, adopting as the fundamental axiom the plausible assumption that it was a spontaneous natural sequence of "most probable" events. Survival by natural selection is a particular example of a most probable event, and therefore operated at all stages of the origination. True evolutionary novelties have been most probable responses to new environmental conditions, and may have become rarer as the rate of exchange of the casual conditions decreased. (M.P.G.)

## 743

**ORGANIC COMPOUND SYNTHESIS ON THE PRIMITIVE EARTH.**
S. L. Miller and H. C. Urey
*Science*, 130:3370, July 31, 1959. p. 245–251.

The chemical history and the synthesis of organic compounds on primitive Earth are reviewed. Emphasis is placed on the laboratory synthesis of organic compounds in order to extrapolate the results obtained to the synthesis of organic compounds on primitive Earth. Among the syntheses discussed are: formaldehyde polyhydroxy compounds, thiourea, thioacetamide, N-methyl urea, peptides, formic acid, various amino acids, imino aliphatic acids, hydroxy acids, acetic acid, propionic acid, malonic acid, malic acid, citric acid, lactic acid, and ureidosuccinic acid. The energy sources for the above syntheses are given. Also, the possibility of extraterrestrial life is discussed. Venus is perhaps too hot to support life. The changing colors of Mars, bluish or green in the spring and brown and reddish in autumn, and the 3.5$\mu$ absorption band, which corresponds to the C-H stretching frequency of most organic compounds, are the best, yet weak, evidence for the existence of life on this planet. (I.v.L.)

## 744

**THE CHEMICAL ORIGINS OF LIFE.**
M. H. Briggs
*Spaceflight*, Vol. 2, July 1959. p. 69–73. 27 refs.

A general survey of theories on the origin of life is presented. Experimental studies on the synthesis of basic organic compounds from simple inorganic processes are reviewed. Although it can be agreed that simple inorganic reactions could have given rise on the primeval earth to a mixture of the basic units of proteins, nucleic acids, etc., it remains to provide an explanation of how the simple units combined to form the large molecules. (S.T.L.)

## 745

**WHAT IS ASTROBOTANY?**
G. A. Tikhov
*Spaceflight*, 2:3, July 1959. p. 74–77.

Infrared investigations of possible plant life on Mars are described. Differences between spectral qualities of presumed Martian plant zones and those of terrestrial coordinate zones are noted. The prediction is made that plant and animal life is widespread in the universe. (M.F.G.)

## 746

**PRODUCTION OF SPHERULES FROM SYNTHETIC PROTEINOID AND HOT WATER.**
S. W. Fox, K. Harada and J. Kendrick
*Science*, 129:3357, May 1, 1959. p. 1221–1223. 11 refs.

When hot saturated solutions of thermal copolymers containing the 18 common amino acids are allowed to cool, huge numbers of uniform, microscopic, relatively firm, and elastic spherules separate. The place of this phenomenon in a comprehensive theory of original thermal generation of primordial living units is considered. (Author)

## 747

**EXOTIC ATMOSPHERES ON EARTH.**
H. Strughold
*J. Aviation Med.*, Vol. 30, May 1959. p. 311–314.

The need for the investigation of exotic atmospheres for their ecological and physiological effects is outlined. Spacial exploration will be affected by foreign environment. Protoatmospheres exist on the outer planets similar to the supposed reducing atmospheres on the primitive Earth. Venus and Mars present dense and thin versions of Earth's oxidizing atmosphere. The behavior of terrestrial micro-organisms under simulated Martian conditions may provide knowledge of indigenous life. Areas of coal mines may show similar atmospheres to Jupiter and Venus. Within the pores of soil a methane and ammonia atmosphere may result from bacterial action similar to the protoatmosphere. Areas of concentrated $CO_2$ are known on Earth which are toxic to animal life. (E.O.)

## 748

**TRANSPORT OF LIFE IN THE FROZEN OR DRIED STATE.**
A. S. Parkes and A. U. Smith
*Brit. Med. J.*, Vol. 1, May 1959. p. 1295–1297.

Effects of temperature extremes—dessication and freezing—of seeds, spores and animals is discussed with relation to transporting and possibly establishing Earthly organisms on the outer planets. Vegetation on Mars, if similar to anything found on Earth, has likely evolved along the lines of lichens. At the temperatures prevailing, however, any life based on biochemical reactions will be rather sluggish, particularly on the outer planets, and it is to be doubted if evolution can have proceeded very far. (A.H.F.)

## 749

**OXYGEN AS A PREREQUISITE TO THE ORIGIN OF THE METAZOA.**
J. R. Nursall
*Nature* (London), Vol. 193, Apr.—May 1959. p. 1170–1172.

The presence of fossils is hypothesized to be a function of an oxidative metabolism in the oxidizing atmosphere which replaced the supposed reducing atmosphere of the primitive Earth. The first organisms may have appeared as heterotrophic colloidal aggregates which existed upon organic substances dissolved in seas in which they lived. The gradual appearance of photosynthetic autotrophes added oxygen to the air which in turn pro-

vided the energy for the evolution of more complex organisms. The fact that animals developed into complex forms earlier than plants indicates the importance of oxygen in the environment as a developmental factor. (E.O.)

## 750

ADVANCES IN ASTROBIOLOGY.
Hubertus Strughold
*In:* Lunar and Planetary Exploration Colloquium, Proc., 1:6, Apr. 1959. p. 1—7. 42 refs.

Gives brief review of the advances made recently in astrobiology. They are based on theoretical considerations, visual observations, spectrographic analysis, and experimentation in the laboratory. (G.W.)

## 751

THE DETECTION OF PLANETS AT INTERSTELLAR DISTANCES.
M. H. Briggs
*J. Brit. Interplan. Soc.*, 17:2, Mar.—Apr. 1959. p. 59—60. 11 refs.

From recent developments in the theory of planetary origins and the probable relationship between the rate of stellar rotation and the presence of planets, it is suggested that the observed rate of rotation and hence the spectral type of a star, can serve as criterion for the existence of a planetary system. A survey of stellar rotations and spectral types of the nearest stars is given and the probable existence of life on the planets around these stars is discussed. (Author)

## 752

METEORITES AND THE ORIGIN OF LIFE.
M. H. Briggs
*Spaceflight*, 2:2, Apr. 1959. p. 39—44. 12 refs.

Life on Earth began, as indicated by recent studies of sulfur ratios, approximately 800 million years ago. It has been suggested that the "origin" of life on Earth was caused by the arrival of spore-bearing meteorites, the original source of the spores being open to speculation. The discovery of spores in meteorites would support this theory and would possibly indicate that life on Mars is of a similar type to terrestrial life. On the other hand, the lack of oxygen in the Martian atmosphere might be explained as being due to the arrival on Mars of a terrestrial spore only a relatively short time ago. However, it might also mean that life on Earth was a different variety of a basic form which began on Mars. A most thorough and careful study of the interior of meteorites for the presence of spores needs to be done. (S.T.L.)

## 753

CONTAMINATION OF THE MOON.
J. D. Hughes (Brookhaven Natl. Lab.)
*Science*, 130:3371, Mar. 9—10, 1959. p. 340—342. Presented at the CETEX Meeting (2nd), The Hague, 9—10 Mar. 1959.

There is a real possibility that exploration experiments could contaminate the moon or the planets in such a way that other experiments, particularly biological, would be made impossible. The dangers of such contamination and steps to avoid them were pointed out in the report of CETEX. General principles for conducting space research and the correct sequence of experiments were outlined. (E.C.)

## 754

THE CLOUDS OF VENUS.
M. H. Briggs
*Observatory*, Vol. 79, Feb. 1959. p. 20—22.

The composition of the clouds of Venus is suggested to be of an organic rather than inorganic basis. Previous theories of cloud composition include water vapor, formaldehyde and its polymers, and carbon suboxide which must be discounted because of a lack of spectroscopic corroboration. Another theory holds that the clouds are oil droplets. However, this is unlikely since a biological origin is suggested and the known physicochemical environment does not warrant it. The observed variations and alterations in the clouds point to a changeable organic chemical system. Organic synthesis has probably occurred on Venus, and in the absence of utilization as food by life forms, the more stable compounds remain as the clouds. (E.O.)

## 755

LIFE ON OTHER WORLDS.
H. S. Jones
*New Scientist*, 5:112, Jan. 8, 1959. p. 65—67.

Various theories concerning the origin of life on earth are reviewed. Conditions essential to well-developed life are discussed, and each of the planets is examined for the possibility of life existing there. Mars is considered the only possible planet to harbor life forms, and those would be extremely primitive types. (S.T.L.)

## 756

MARS A WORLD FOR EXPLORATION.
C. W. Tombaugh
*Astronautics*, 4:1, Jan. 1959. p. 30—31, 86—93.

The atmosphere and climate of Mars is discussed. The shrinking and reforming of the polar caps is cited as evidence of an atmosphere which is estimated at one tenth that of Earth. Spectrographic observation has failed to disclose free oxygen; $CO_2$ and some argon are present. The solar radiation received on Mars is only from $53^2$ to 36% of that received on Earth. Mars' seasons are of unequal length, and the highest noon temperatures are only a few degrees above freezing with a diurnal variation of over 200° F. The southern marias exhibit the fullest range of seasonal color change. New spectrographic evidence indicates that organic matter exists on Mars, but water would be required in the atmosphere for this matter to have life. No ozone or sulfur dioxide layer, which would protect the surface from ultraviolet radiation, has been discovered. However, vegetation may shield itself by changing color. The canals (asteroid scars) and the oases (impact craters) may be havens for vegetation. Martian geology shows a lack of sedimentary rock, erosion carving, and metamorphic rocks. (A.H.F.)

## 757

**BIOLOGICAL OVERTONES OF THE THERMAL THEORY OF BIOCHEMICAL ORIGINS.**
S. Fox
*A.I.B.S. Bull.*, 9:1, 1959. p. 20–23.

The thermal synthesis of protein is discussed. This synthesis, which began with the thermal conversion of malic acid to aspartic acid, indicated that: (1) numerous linked reactions arose spontaneously; (2) enzymic protein was generated in the presence of the continuous reaction products; and (3) genic nucleic acid (on the basis of finding ureidosuccinic acid) helped to fix a record of chemical occurrences up to the moment of its own synthesis. The main theme which can be seen to be running through the entire thermal synthesis picture is a biogenetic one. This picture contains not only the same micromolecules as are found in nature, but also shows that the sequences by which these arise thermally are in the same order as such reactions occur in a generalized biosynthesis. If the biogenetic principle stating that the development of an organism reflects its evolution is correct, a naturalist should then expect the law to be reducible to the chemical level. When the thermal pathways are regarded as prebiological pathways, the biogenetic law is reduced to the chemical level and the prebiological and biological eras are spanned in an essentially Darwinian continuum. Interpretations of the thermal theory lead to the concept of a memory mechanism at the chemical level. This is consistent with biogenetic thinking. The individual cell can be considered to be reenacting the chemical history by which it came into existence, because the final fruit of this development was a chemical memory mechanism, i.e., a system for detailed reproduction of biochemical events. Also discussed is the production of a complex polymer closely resembling protein of current organisms and possibly virtually identical with primordial protein. (I.v.L.)

## 758

**CHEMICAL DIVERSITY AND THE ORIGINS OF LIFE.**
N. W. Pirie.
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Ser., Vol.1, p. 76–83.
N.Y., Pergamon Press, 1959. 17 refs.

Chemical diversity argues strongly for the logical evolution of life. As complexity and time increase, metabolism may become simpler. A strong case is made to avoid any form of dogmatism about the processes involved in the origins of life. (Author)

## 759

**A CHEMICAL THEORY OF SPONTANEOUS GENERATION.**
S. W. Fox
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Ser., Vol. 1, p. 256–262.
N.Y., Pergamon Press, 1959. 17 refs.

Treats the problem of primordial nitrogen fixation, origin of optical activity, membrane formation, and conversion to the aqueous state from an anhydrous one in purely chemical terms. Points out that life must have begun without the aid of such special apparatus as can now be assembled. (G.W.)

## 760

**CONDITIONS ON MARS.**
C. A. Cross
*Spaceflight*, 2:1, 1959. p. 25–29.

In spite of the application of all the resources of modern astronomical technique, Mars remains more the subject of speculation than of established fact. Mars' polar caps are presumed to be ice, but water cannot be detected spectroscopically. Temperature measurements show that the atmosphere and surface are too cold to provide enough water vapor for detection by present techniques. Polar caps show temperatures around —50° C, and evaporate by sublimation twice a year. Reddish areas or deserts with dust storms appear to be present. Dark areas in bands north and south of the equator with temperatures of 20° C show seasonal changes in color. A vegetation hypothesis is favored for these dark areas, especially since studies of Siberian vegetation indicate increased absorption coefficients in the long wave region by plants growing at very low temperatures. The constituents of the Martian atmosphere identified by spectroscopic technique register 1.5% $CO_2$, and water vapor and oxygen, if present, not in excess of .01% and 1.5%, respectively. (Author)

## 761

**CONTAMINATION BY EXTRATERRESTRIAL EXPLORATION.**
(No Author)
*Nature*, 183:4666, 1959. p. 925–928.

There is no reasonable possibility by which the introduction of cells such as spores or bacteria might give rise to life of the same type on the Moon (that is, containing deoxyribonucleic acid) as on Earth which might later confuse investigators. There are no cells on Earth which grow or multiply in the absence of water, and at the high vacuum of the Moon no water can exist on its surface. However, it is possible that some "pre-life" processes may be occurring on the Moon which may be similar to or different from those which have taken place on Earth. Macromolecules from the Earth might, under lunar conditions, act as templates and provide new foci for "pre-life" growth. There is a possibility of biological contamination of Mars, since there is a reasonable probability that the conditions on Mars are such that some terrestrial organisms might grow. Carbon compounds, light for photosynthesis, and probably water and nitrogen are all available. It is therefore of the greatest importance that space vehicles should not land on Mars (and possibly Venus) unless all precautions have been taken to exclude living organisms from them. The pattern of development of macromolecules on these planets could become distorted by terrestrial contamination. Also discussed is terrestrial contamination, which might endanger physical and chemical studies. (I.v.L.)

## 762

**DATING THE ORIGIN OF LIFE ON EARTH.**
Michael H. Briggs
*Evolution*, 13:3, 1959. p. 416–418.

The earliest reported fossils, or traces of biological material, are in excess of 2 billion years old. The present oxidizing atmos-

phere of the Earth appears to have a similar age and this can be taken as an estimate of the age of photosynthetic life. Although it is not possible to fix an exact date for the origin of life, complex chemical systems appear to have been present on Earth for more than 2 billion years. (Author)

## 763

A DISCUSSION.
E. N. Pavlovskiy
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 369–370.
N.Y., Pergamon Press, 1959.

Life, as we know it, could exist outside Earth only if there had been an exact repetition of all the spatial, temporal, and qualitative conditions of the evolution of the Earth in the solar system. But there is nothing improbable in the idea that, in some planets in the universe, organic material may have arisen. If the concept of "being" is substituted for that of "life", there is nothing improbable in the idea of the possibility of the "being" of such organic material even outside the Earth. (A.H.F.)

## 764

ON DEFINING LIFE.
N. H. Horowitz
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Ser., Vol. 1, Session 1: Discussion. 106 p.
N.Y., Pergamon Press, 1959.

To the property of self-duplication the author suggests that one must add the ability to mutate randomly and to reproduce in the new form. It involves a copying mechanism which insures that mutations occurring in the parents will be faithfully reproduced in the offspring, evolution becoming inevitable. With the ability to influence the environment in such a way as to insure a supply of the materials necessary for the perpetuation of the system we add a final element. Thus life has three properties: (1) mutability; (2) self-duplication; (3) heterocatalysis. Life arose as individual molecules in a polymolecular environment. (A.H.F.)

## 765

EVOLUTION OF ENZYMES AND THE PHOTOSYNTHETIC APPARATUS.
M. Calvin
*Science*, Vol. 130, 1959. p. 1170.

The evolution of enzymes and the photosynthetic apparatus are reviewed. The enzyme, iron protoporphyrin, is produced in the following manner. The starting materials are laboratory-synthesized succinic acid and glycine. From these an $\alpha$-amino-$\beta$-keto acid is formed, followed by decarboxylation to $\delta$-aminolevulinic acid. Two of these acid molecules then condense to form a pyrrole nucleus, porphobilinogen. This molecule then passes through a series of steps, involving a number of oxidations. Iron is introduced into the protoporphyrin forming iron protoporphyrin. Once the latter is formed, it will accelerate its own synthesis from such precursors as succinic acid and glycine. It is believed that the photosynthetic apparatus evolved from this iron-containing enzyme, since its structure is very similar to the structures of chlorophyll A and B. It is unlikely that rudimentary prebiotic enzymatic systems will be found on Earth. However, in exploring the Moon, Venus, and Mars, the possibility of finding pertinent rudimentary materials in an evolutionary stage, which might correspond to the early stages of terrestrial evolution, is real and finite. Therefore, terrestrial contamination, which would jeopardize, or even destroy, the possibility of distinguishing organisms or prebiotic chemical forms which might be discovered, particularly on Mars, must be avoided. (I.v.L.)

## 766

THE FORMATION OF THE EARTH FROM COLD MATERIAL AND THE PROBLEM OF THE FORMATION OF THE SIMPLEST ORGANIC SUBSTANCES.
B. Yu Levin (U.S.S.R.)
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series Vol. 1 p. 67–75.
N.Y., Pergamon Press, 1959.

The problem of the origin of life must answer the question of how and under what conditions abiogenic synthesis took place, and how it lead to the appearance on our Earth, of organisms which later became the synthesizers of these compounds. The question of the time and place of the original formation of the organic compounds which is closely associated with the formation of the Earth is discussed in the light of theories advanced by several scientists. Spectroscopic observations have shown that the simplest organic compounds exist both within our planetary system and far beyond its bounds. The chemistry of its atmospheres is discussed. Evidence concerning the organic compounds of the planetary system is provided by a study of one type of meteorite, the carbonaceous chondrites. The abiogenic origin of the meteoritic hydrocarbons is not open to the least doubt. There are two conclusions important for the problem of the origin of life: (1) Organic compounds of varying degrees of complexity existed in the preplanetary material, and, with it entered into the composition of the Earth through its whole depth; (2) The emission of gases and vapors from the interior, leading to the formation of the hydrosphere and atmosphere, was accompanied by the carrying out of organic compounds which underwent further changes in the course of it. (A.H.F.)

## 767

HOW CAN WE DETECT RADIO TRANSMISSIONS FROM DISTANT PLANETARY SYSTEMS?
Frank D. Drake (National Radio Astronomy Observatory, Green Bank, W. Va.).
*Sky and Telescope*, Vol. 19, 1959. p. 140.
Also *in:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 165–175.
N.Y., W. A. Benjamin, Inc., 1963.
(A64–10226)

Discussion of the means for detecting intelligent radio transmissions which may emanate from the vicinities of, at best, 25% of the stars and, at worst, perhaps one star in a million. Only in a relatively narrow range of radio frequencies is there a reasonable chance of receiving transmissions from extraterrestrial beings. It is stated that the search should be confined to the band between

1000 and 10 000 Mc, and that frequencies around 1420 Mc may offer the best chance for success. Specifications are given for a receiver designed to detect interstellar radio signals at the surface of the Earth.

## 768

MANNED SPACE CABIN SYSTEMS.
E. B. Konecci.
*In:* ADVANCES IN SPACE SCIENCES, Vol. 1.
N.Y., Academic Press, 1959.

There is a reasonable possibility that spores or bacteria might live on the moon. It might be possible to contaminate Mars and Venus since carbon, light for photosynthesis, nitrogen and water are probably all available. (A.F.)

## 769

MARS REVISITED.
D. L. Cyr
Philadelphia, Dorrance, 1959. 120 p.

CONTENTS:

Chapter 1: Mysterious Mars. Chapter 2: Crater Oases of Mars. Chapter 3: The Mystery of "Canals." Chapter 4. The Evidence for Marsitrons. Chapter 5: Missions of Marsitrons. Chapter 6: Is There Really Life on Mars? Chapter 7: The Natural History of Mars.

## 770

MARTIAN VEGETATION.
(No Author)
*Sky & Telescope*, 18:5, 1959. p. 252.

A summary is given of Linton's experiment in which an infrared spectrographic analysis was made of the dark Martian maria. Absorption bands at 3.43, 3.56 and 3.67 microns were found which are due to the C-H bond of organic molecules. Terrestrial plants show absorptions at 3.41 and 3.51 microns and the third Martian band may indicate a significant difference in the complexity of the Martian organic molecule. The presence of organic molecules produced over large areas within short time spans is most simply explained by the growth of vegetation. (E.O.)

## 771

THE MICROBIOLOGICAL CHALLENGE IN SPACE.
W. M. Bejuki
*Develop. Ind. Microbiol.*, Vol. 1, 1959. p. 45–55.

A general estimation is presented of the problems involved with spatial environmental factors on bacteria and fungi, the development of closed ecological systems, and the nature of extraterrestrial biospheres. In space, chemical, radiation-associated, gravity-associated, and planetary factors will have to be examined for effects on micro-organisms. Closed ecological systems will include gas exchange, waste disposal, food production, and psychobiological support. The extent of the biosphere presents special problems. Since on Earth it appears that biological development went from molecules to micro-organisms, it is reasonable to anticipate a similar pathway on other habitable planets. Natural and induced adaptability of micro-organisms to varied environments will have to be investigated. (E.O.)

## 772

NEWS AND COMMENTS: FURTHER EVIDENCE OF VEGETATION ON MARS AND THE COMPOSITION OF THE MARTIAN ATMOSPHERE.
E. J. Opik
*Irish Astron. J.*, Vol. 5, 1959. p. 137–139.

Spectrographic studies of the Martian maria with the 200-in. telescope show absorption bands at about 3.43, 3.56, and 3.67 microns. Since terrestrial plants show absorptions at 3.42 and 3.51 microns, organic matter is very likely present on Mars. The slight differences in wavelengths is probably due to a different complexity of the hydrocarbon structure. Further spectrographic studies of the atmosphere reveal little $CH_4$. The scarcity of $O_2$ is attributed to a breakup of the molecule under ultraviolet radiation and consequent escape of atomic oxygen. Water vapor is trapped by ice particle formation and so forms the polar caps. CO may be present in the atmosphere in some quantity and so be a negative factor for human toleration. (E.O.)

## 773

NEXT QUESTION.
G. DuShane
*Science*, Vol. 130, 1959. p. 1733.

Discussions on the possible existence of intelligent beings in the "radio" stage of civilization in other planetary systems are reviewed, and a number of signals for interplanetary communication are suggested. (A.H.F.)

## 774

OCCURRENCE OF LIFE IN THE UNIVERSE.
Su-Shu Huang (NASA, Goddard Space Flight Center, Greenbelt, Md.)
*Am. Scientist*, Vol. 47, 1959. p. 397.
(A64–10216)

The requirements for the occurrence of life in the universe are discussed, based on the present knowledge of the stars and their evolution. Considered are time scales of biological and stellar evolution, and the habitable zone of a star. It is stated that faint dwarf stars in our galaxy and, perhaps, in other galaxies, may possess planets with living beings. Our Sun does support life abundantly on at least one of its planets. The stars in the solar neighborhood which are binary and multiple systems have a damaging effect on the development of life on their planets. (I.A.A.)

## 775

ORIGIN OF LIFE.
Sidney W. Fox
*Science*, 130:3389, 1959. p. 1622.

A discussion and critique of a review by Miller and Urey which discounted the work by Calvin et al. with relation to the low yields recorded in 1951 for the conversion of carbon dioxide and water to formaldehyde and formic acid is presented. However, the fact

that highest possible yields may be an appropriate objective in some situations does not necessarily have meaning in the context under discussion. For life to begin, no more is required conceptually than an infinitesimal pinch of organic stuff of the proper sort and organization; this pinch would need the ability to replicate itself from carbon compounds in the environment and to adapt. By the same reasoning, small proportions of carbon dioxide are adequate as Calvin's inorganic intermediates. As intermediates for amino acids, Miller and Urey also seem to prefer aminotriles, which have no known biological counterpart, to Krebs-cycle acids which are both biological and thermal precursors. (N.P.G.)

## 776

THE ORIGIN OF LIFE ON EARTH.

V. V. Alpatov

*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 115–116.
N.Y., Pergamon Press, 1959.

The optical activity of protoplasm and its components is discussed in connection with the origin of life on Earth. Pasteur demonstrated a fundamental molecular difference between living and nonliving matter and the inequality of the dextro and levo forms in materials derived from organisms. This disymmetry of life is not only expressed at the molecular level, but manifests itself in the structure of the bodies of plants and animals. In plants it appears that the nearer we get to the equator the greater is the proportion of racemic populations. (A.H.F.)

## 777

THE ORIGIN OF LIFE ON EARTH.

I. S. Shklovskiy

*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 113–114.
N.Y., Pergamon Press, 1959.

In considering the hypothesis that the primaeval organic compounds were synthesized under the influence of the nearer ultraviolet part of the spectrum, we must make due allowance for the absorption of the ultraviolet rays by the various components of the atmosphere at that time. A high level of cosmic radiation during particular epochs in the history of Earth has a definite advantage as against such mechanisms as ultraviolet radiation from the sun or electrical discharges as agents for the development of life. Developments in physics and chemistry lead to the conclusion that there certainly must have been epochs in the past when the intensity of cosmic rays was hundreds of times greater than it is today. They enter the atmosphere and penetrate water. Advances in radiation biology show that this factor can hardly have failed to produce an effect on organic substances. (A.H.F.)

## 778

THE ORIGINAL FORMATION OF AMINO ACIDS UNDER THE ACTION OF ULTRAVIOLET RAYS AND ELECTRIC DISCHARGES.

T. E. Pavlovskaya and A. G. Pasynskiy

*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 151–157.
N.Y., Pergamon Press, 1959.

A study is made on the action of ultraviolet rays as an important source of energy under primaeval Earth conditions upon the solutions of mixtures of formaldehyde and ammonium chloride or nitrate, and the formation of amino acids under these conditions is demonstrated. Miller's experiments are repeated using gaseous mixtures of somewhat different composition. (A.H.F.)

## 779

OXYGEN AS A PREREQUISITE TO THE ORIGIN OF THE METAZOA.

J. R. Nursall

*Nature*, 183:4669, 1959. p. 1170–1172.

Advances in the biochemistry of photosynthesis have demonstrated how chlorophyll molecules could have been built up from inorganic substances through organic substances such as glycine and succinic acid to protoporphyrins and finally complex porphyrin compounds. Photosynthetic reactions could originate anaerobically, with oxygen being produced by photolysis. It is suggested that primitive forms of life were heterotrophes, absorbing as their nutrients organic substances dissolved in the seas in which they lived. The next step was the development of protochlorophylls, by certain types of organisms (autotrophes), which would allow the utilization of the energy of sunlight for the reduction of carbon dioxide and its fixation in the form of carbohydrates. Not until the concentration of oxygen in the hydrosphere and atmosphere reached a level at which it became a constant part of the environment did it exert a significant effect on the evolution of the heterotrophes. A variety of primitive forms of heterotrophes and autotrophes could respond to the altered environment by using the new, more efficient method of extracting energy from their food (oxidative metabolism). The consequence of such metabolic improvement was the development of metazoan and metaphytic forms through tissue differentiation. (I.v.L.)

## 780

THE PART PLAYED BY ACOUSTIC ENERGY IN THE INITIATION OF THE CHEMICAL PROCESSES UNDER NATURAL CONDITIONS.

I. E. El'pier and A. V. Sokol'skaya (U.S.S.R.)

*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 172–173.
N.Y., Pergamon Press, 1959.

The authors have demonstrated that some gases are activated (dissociated) when acted on by supersonic vibrations in water. It was found that ammonia is formed when hydrogen and nitrogen in water are submitted to sonic vibrations. (A.H.F.)

## 781

PHOTOSYNTHESIS IN THE SHORTEST ULTRAVIOLET.

A. N. Terenin

*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 136–139.
N.Y., Pergamon Press, 1959.

It is proved that aldehydes and amino acids could be formed from the gases of the primitive Earth atmosphere under the action of the shortest ultraviolet radiation of the sun. (A.H.F.)

## 782

**THE PHYSICAL NATURE OF THE PLANETS AND THEIR PROBABLE COURSE OF EVOLUTION.**

J. F. Heard

*Can. Aeron. J.*, 5:5, 1959. p. 184–186.

Similar characteristics of the inner four planets and of the giant planets are discussed, as well as the origin of the system and the question of life. The densities of the inner and outer planets fall into two groups and may be explained by the fact that the outer planets, receiving minimal amounts of solar radiation, could hold on to the masses of lighter elements by their own gravitation. If the origin of the solar system was due to condensations within the nebula that formed the sun, then statistically, millions of other planetary systems are also possible. Venus and Mars have some capability for the existence of life. However, the present physical and chemical differences between Venus and Earth can be attributed to the failure of Venus to produce oceans and a similar lack of water vapor and oxygen on Mars point to a general lack of validity for life development on either Venus or Mars despite controversial markings on the latter. (E.O.)

## 783

**POLYCONDENSATION OF THERMAL PRECURSORS OF ASPARTIC ACID.**

K. Harada

*J. Org. Chem.*, Vol. 24, 1959. p. 1662–1666.

Anhydropolyaspartic acid has been synthesized by heating unsubstituted aspartic acid. It is found that the anhydropolyaspartic acid may be prepared by heating monoammonium malate, maleamic acid, and combinations of asparagine and malic acid, maleamic acid and malic acid. Postulated pathways to form anhydropolyaspartic acid are discussed and the resulting polymers are characterized. (Author)

## 784

**THE POSSIBLE INFLUENCE OF COSMIC RAYS ON THE ORIGIN AND EVOLUTION OF LIFE ON EARTH.**

V. I. Krasovskiy and I. S. Shklovskiy (U.S.S.R.)

*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 107–108.
N.Y., Pergamon Press, 1959.

Supernovae bursting out in our galaxy have been the source of hard radiations to elements of our solar system. At times in the past these cosmic rays may have been several tens of times greater than the normal for some thousands of years. This could have had serious biological and, above all, genetic consequences. Until recently it was held that the process of evolution of living things was brought about by the influence of natural selection and the various physical conditions of the surrounding medium. Among these, however, no consideration has ever been given to the important factor of the general level of hard radiations. At some stages of evolution, this latter factor must have been of great, if not of decisive significance in the formation of life itself from primitive organic compounds, in the disappearance of large plant and animal groups from the Earth, and the emergence of other groups. (A.H.F.)

## 785

**PRIMITIVE PLANETARY ATMOSPHERES AND THE ORIGIN OF LIFE.**

H. C. Urey

*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 16–22. 26 refs.
N.Y., Pergamon Press, 1959.

Atmospheres of Earth, Venus, and Mars are compared. It is postulated that each possessed substantial amounts of surface water early in development, but that these conditions are not now likely on Venus and Mars; however, temperatures are not such to prohibit evolution and maintenance of life. (G.W.)

## 786

**THE REACTIONS OF TERRESTRIAL MICROORGANISMS TO SIMULATED MARTIAN CONDITIONS.**

I. Davis and J. D. Fulton

*In: Intern. Astron. Congr., Proc., 10th*, London, 1959.
Wien, Springer, 1960. Vol. 2, p. 778–785. 17 refs.

The existence of life on the planet Mars has been hypothesized by several authors. It is generally stated that the Martian planet would probably be the most likely in our solar system, other than Earth, capable of supporting "life." The nature of such possible Martian life has been suggested to be similar to certain simple forms of terrestrial life. Laboratory studies have demonstrated the ability of certain of the indigenous bacteria of soil to survive and multiply during exposure to an environment closely simulating that presumed to be present on the planet Mars. Recent experimentation has been directed towards an understanding of the relation of temperature, moisture, and other factors to the survival and multiplication of homogenous cultures of bacteria in soil under these simulated Martian environmental conditions. Several generalities regarding the simulated Martian environment may be stated: (1) Soil bacteria, selectively adapted to a simulated Martian environment, survive and multiply; (2) Spore-forming bacteria appear to have a higher rate of cell multiplication than strictly vegetative cells; (3) The factor of temperature cycling (+25° C, diurnal, to minus 25° C, nocturnal) appear to yield greater numbers of viable cells than room temperature conditions; (4) Recoverable moisture in the soil-bacteria specimens in the Mars jars held under conditions of temperature cycling appears consistently less than that found under room temperature conditions. The practical applications of such studies are discussed. (Author)

## 787

**REMARKS ON MARS AND VENUS.**

G. deVaucouleurs

*J. Geophys. Res.* 64:11, 1959. p. 1739–1744.

Available astronomical, astrophysical, and geophysical data on Mars and Venus are reviewed. The discovery by Sinton of bands in the infrared reflection spectrum of the dark areas of Mars which can be tentatively identified with bands observed in the reflection spectrum of terrestrial vegetation is discussed. Since these bands are due to vibration of the C-H bonds in ter-

restrial vegetation, this observation is very suggestive of the presence of organic molecules and come close to offering proof of the existence of plant life on Mars. (M.P.G.)

## 788

THE SCALE OF STRUCTURAL UNITS IN BIOPOESIS.
J. D. Bernal
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 136–139.
N.Y., Pergamon Press, 1959.

In the evolution of material systems two processes must be kept in mind—the dynamic and the static. The probability of formation of a highly complex structure from its elements is increased, or the number of possible ways of doing it diminished, if the structure in question can be broken down into a finite series of successively inclusive substructures. The author attempts to demonstrate that such substructures can be formed from atoms related by the known laws of physics and chemistry. He also shows that each kind of substructural unit corresponds to a definite and limited range of absolute sizes and shapes and that at each level the laws of association of the units are qualitatively different. None of this depends on biological analysis; it would hold for all combinations consisting mainly of the four elements hydrogen, carbon, nitrogen and oxygen. (A.H.F.)

## 789

SEARCH FOR ARTIFICIAL STELLAR SOURCES OF INFRARED RADIATION.
Freeman J. Dyson (Inst. for Advanced Study, Princeton, N. J.)
*In:* A. G. W. Cameron, ed. INTERSTELLAR COMMUNICATION. p. 111–114.
N.Y., W. A. Benjamin, Inc., 1963.
Also *in: Science*, vol. 131, 1959. p. 1667.
(A64–10221)

Consideration of additional possibilities to be considered in planning a serious search for evidence of extraterrestrial intelligent beings. The expectation is expressed that, within a few thousand years of its entering the stage of industrial development, any intelligent species should be found occupying an artificial biosphere completely surrounding its parent star. It is stated that the discovery of an intense point source of infrared radiation would not by itself imply that extraterrestrial intelligence had been found. On the contrary, one of the strongest reasons for conducting a search for such sources is that many new types of natural astronomical objects might be discovered.

## 790

SOME CONDITIONS FOR THE APPEARANCE OF LIFE ON EARTH.
R. L. Berg
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 169–181.
N.Y., Pergamon Press, 1959.

Life came into being in the triphasic system of a porous solid substrate permeated by air and water. Arguments supporting a theory of multiple biopoesis are discussed and rejected. The author supports the theory that life came into being in the solid substrate of dry land, shielded from the ultraviolet rays of the sun, yet accessible to its heat. The living organisms then produced free oxygen and only then did they colonize the open dry land and open water. $CO_2$ could have acted as an ultraviolet radiation screen as the ozone does today. Water could only act as a screen for deep-living forms of life. The surface of the land, the weathered superficial layers of the crust of the Earth, and shallow continental basins and lagoons of the ocean were the areas in which life developed in the form of a multifarious host of germs. (A.H.F.)

## 791

SPACE HANDBOOK: ASTRONAUTICS AND ITS APPLICATION.
Robert W. Bucheim (Rand Corp.)
N.Y., Random House, 1959. p. 18–26.

The possibility of some form of life—most probably vegetation—as suggested by seasonal color change on Mars is conceded. General description of the other terrestrial planets presents no evidence for life (E.C.)

## 792

SPECTROSCOPIC EVIDENCE OF VEGETATION ON MARS.
E. J. Opik
*Irish Astron. J.*, Vol. 5, 1958–1959. p. 12–13.

Theories of the dark areas of Mars are reviewed, as well as the latest far-infrared spectroscopic evidence. That the dark areas might be due to volcanic ash or to exposed rock of higher altitude than the light areas is not acceptable as fitting all the observed facts for Martian surface features. The vegetation theory is still favored because terrestrial plants are known to exist such as algae and lichens, which do not show spectrographic absorption or infrared reflection characteristics of chlorophyll-bearing plants. Recent spectroscopic studies of Mars show an absorption band in the far infrared at 3.46 microns which is due to the C-H bond of large molecules which are usually known to be of organic origin. This observation seems to point to the presence of organic material on Mars, most probably of vegetable origin. (E.O.)

## 793

STRANGE WORLD OF THE MOON.
V. A. Firsoff
New York, Basic Books, 1959. 226 p.

The main subject of the entire volume is the present condition of the moon, with special reference to the atmosphere, surface, and subsurface, as well as the possibility of life there. Specifically, chapter sixteen proposes the existence of underground water and gas as well as living beings equipped with a husklike covering to survive evaporation in a near vacuum. (M.P.G.)

## 794

THERMAL FACTORS IN ARCHEOMETABOLISM.
S. Scher
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 650–651.
N.Y., Pergamon Press, 1959.

The first enzymes in primitive biological systems are difficult to determine in present complex organic systems since the primitive pattern of metabolism has been masked by a superstructure of alternate pathways. If we postulate that life arose in the waters and that evolution from heterotrophy to autotrophy was paralled by a gradual decrease in environmental temperature, then thermal factors may provide clues to the nature of primitive metabolic systems. Enzymes may have developed to replace heat in the thermal reaction sequence when the Earth cooled. The thermal limit of present day blue-green algae and bacteria suggests that early enzymes may have developed at temperatures above 85° C. Heightened temperature studies on algae, bacteria, protozoa and yeast bring to light otherwise poorly accessible metabolic chains. Thus, temperature factors appear to provide clues to archeometabolism if we assume a thermal origin of life and an early evolutionary tendency from heterotrophy to autotrophy. (A.H.F.)

## 795

THERMAL POLYMERIZATION OF AMINO ACIDS AND A THEORY OF BIOCHEMICAL ORIGINS.
Sidney W. Fox, Kaoru Harada and A. Vegotsky
*Experientia*, 15:2, 1959. p. 81–84.

A review of earlier experiments on the copolymerization of 18 amino acids into a proteinoid with the use of aspartic and glutamic acid. A unique feature of thermal polymerization of aspartic acid is that it yields a polyimide which can be split to a true peptide. All of the common amino acids can be copolymerized under selected thermal conditions into a single product suggestive of protein. At the most the picture which has been inferred represents essentially the way in which biochemical systems originated. At the least, it presents in relatively complete outline an internally and externally consistent picture of how biochemical systems, and by self-directed extrapolation, life could have originated, when one invokes a modulation from a hypohydrous magma to an aqueous system. (M.P.G.)

## 796

WOULD OTHER HUMANS LOOK LIKE US?
W. Howells
*In:* MANKIND IN THE MAKING.
N.Y., Doubleday & Co., 1959.
Also *In: Sci. Digest*, Vol. 43, Feb. 1960. p. 53–58.

Speculations are made on the probable form of extraterrestrial intelligent life. Although one in a trillion planets might be habitable the plurality of planets make intelligent life very probable. This life would be similar to man in many respects: a supporting structure, a liquid nutrient system, a nervous system, a large brain. The number of sexes is open but two seems most likely. The beings would be land-dwelling since water is far less promising as a medium for creation and communication. Symmetry and coordination dictate a choice of two arms each with multiple fingers, but the number of legs may differ at four since this minimized the troubles of bipeds. If man himself were eradicated, it is likely that intelligent life would have to evolve all over again since present animals have passed the point of differentiation. (E.O.)

## 797

(NO TITLE)
A. S. Komikova (U.S.S.R.).
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 116–117.
N.Y., Pergamon Press, 1959.

With the emergence of life, the factor of self-development of matter does not manifest itself in the material world in general in the form of a process of creation of more and more new substances, but within the confines of particular chemical substances. In a scheme of biopoesis by Bernal a correct and consistent materialistic picture of the form of the development of nature is provided, but it does not reflect the transition of chemistry to biology, i.e., the essential dissimilarity—the boundary between these two forms of the motion of matter. (A.H.F.)

## 798

(NO TITLE)
A. I. Lebedinskiy (U.S.S.R.).
*In:* A. I. Oparin et al., eds. THE ORIGIN OF LIFE ON EARTH. I.U.B. Symp. Series, Vol. 1. p. 113.
N.Y., Pergamon Press, 1959.

The successful solution of the problem of the origin of life on Earth may be made easier by a study of the conditions under which life exists on Mars. The hypothesis that life exists on Mars rests on the fact that we can observe seasonal changes in the coloring of the various parts of the planet which we call seas and canals. The form in which life exists on Mars is very different from that on Earth, being anaerobic in nature. A lack of oxygen and water mark the Martian biosphere. Both formed by the gradual acquisition of cold bodies falling on their surfaces, interior pressurized heat produced water and gases in volcanic eruptions on both planets. However the biospheres of both developed differently because of climate, Martian mean soil temperatures below O° C and polar ice caps. Martian biosphere which has developed on Mars has not yet produced oxygen. The wavelength of light which can pass through the Martian atmosphere is about 1900 A or the wavelength of mitogenic rays. It is suggested that the ability of organisms to reflect and absorb mitogenic rays is a relic from the time when there was neither oxygen nor ozone in the atmosphere of the Earth. (A.H.F.)

# 1958

## 799

**ATMOSPHERES OF OTHER PLANETS.**

S. L. Hess

*Science*, 128:3328, Oct. 1958. p. 809–814. 19 refs.

A study of the planetary atmospheres of Venus, Mars, and Jupiter is reported. Previous studies identified $CO_2$ on Venus. The $O_2$, $H_2O$, $N_2$ studies are inconclusive. Thermal data reveal that clouds cannot be $H_2O$. Cloud composition may be dust or polymers of carbon suboxide. The clouds exhibit poorly-understood ultraviolet markings. Life is improbable. The atmosphere of Mars exhibits $CO_2$, minute $H_2O$, and probably Argon and $N_2$. Equatorial temperatures may range from $+30°$ to $-100°$ C and they probably promote atmospheric circulation. Thin clouds may be dust or water vapor; blue haze seems to be atmospheric ice crystals; elementary life is not an impossibility. The atmosphere of Jupiter consists largely of $H_2$ and He, with $CH_4$ and $NH_3$ as minor constituents. Solar heating appears dominant in atmospheric temperatures. Cloud motions are zonal and light and dark bands are produced by ascending and descending cloud masses of different temperature. The Great Red Spot remains an unsolved phenomenon. (E.O.)

## 800

**THE CONTEMPORARY STATUS OF THE PROBLEM OF THE ORIGIN OF LIFE.**

A. I. Oparin

*Usp. Sovrem. Biol.*, Second ed., 44:5, p. 158–172. Sept.–Oct. 1958. Transl. by JPRS Oct. 29, 1958. 20 p. 53 refs.

(JPRS–L468) OTS: $0.50

Theories on the origin of life are reviewed, including current research. Synthesis of organic compounds on the primitive earth, and the emergence of structures peculiar to living organisms are discussed. (S.T.L.)

## 801

**THE PHYSICAL CONDITIONS ON THE PLANET MARS.**

A. J. M. Wanders

*In:* F. Hecht, ed. PROC. INTERN. ASTRONAUT. CONGRESS, Vol. 1, p. 394–404.

Amsterdam, Aug. 25–30, 1958.

Vienna, Springer-Verlag, 1959. 506 p.

A survey is presented of current knowledge on the planet Mars as revealed by visual and astrophysical observations. The various points discussed are the constitution of the atmosphere and some of its implications, the nature and behavior of the snow caps at the poles, the bright desert regions and the dark markings that occur mainly on the southern hemisphere, some of which are of variable extent. Attempts that have been made to interpret the latter, among which the hypothesis of vegetation is the most intriguing, are discussed. (Author)

## 802

**POTENTIALITIES AND RAMIFICATIONS OF LIFE UNDER EXTREME ENVIRONMENTAL CONDITIONS.**

Dietrich E. Beischer

*J. Aviation Med.*, 29:7, 1958. p. 500–503.

Essential factors for life are: a temperature range from zero degrees to 50° C; magnetic, electric, and gravitational forces; time; chemical environment; water; carbon. There is the possibility that during the biochemical period of evolution other molecules than DNA and RNA were preponderant. If so, extraterrestrial living matter would have different appearances from man and other potentialities. (M.G.)

## 803

**SPECULATION ON EXTRATERRESTRIAL LIFE.**

S. S. Kind

*Spaceflight*, 1:8, July 1958. p. 288–290.

The nature of life as a chemical system based on carbon is discussed. The possibility of suitable environments for native and terrestrial life on Mars and Venus is considered. Thermal considerations necessary for liquid water rule out the other planets of the solar system. The temperatures of Mars exhibit a wide range and the lack of oxygen and water demand high adaptation from any Martian vegetation. The low atmospheric pressure would also necessitate artificial pressure environments for humans. Venus contains a great deal of $CO_2$ in the atmosphere, but the lower levels may contain oxygen and water vapor so that Venus may represent a very primitive earth before the advent of life. Seeding the planet with oxygen-producing bacteria may convert the atmosphere in a relatively short time. (E.O.)

## 804

MOONDUST.
J. Lederberg and D. B. Cowie
*Science*, 127:3313, June 27, 1958. p. 1473—1475. 15 refs.

Astronomers suppose the moon is covered with a layer of dust of great antiquity. This dust is cosmic material captured by the moon's gravitational field and presumably left undisturbed by atmospheric and biological alteration. It should therefore contain a continuing record of cosmic history as informative with respect to the biochemical origins of life as the fossil-bearing sediments of the earth's crust have been in the study of its later evolution. Discussed are (1) prebiotic synthesis of organic molecules, (2) interstellar and interplanetary dust, and (3) the theory of panspermia. (Author)

## 805

PROBLEMS COMMON TO THE FIELDS OF ASTRONOMY AND BIOLOGY: A SYMPOSIUM.
A. T. Wilson
*Publ. Astron. Soc. Pacific*, 70:412, Feb. 1958. p. 41—78.

The symposium consists of six papers concerned with Astrobiology. Planetary ecological considerations and methods of gathering and analyzing data are presented.
Contents:

Wilson, A. T.; Introduction. Strughold, H., General Review. Sinton, W. M.; Spectroscopic Evidence of Vegetation on Mars. Dollfus, A.; The Nature of the Surface of Mars. Kooistra, J. A., Jr.; R. B. Mitchell, and H. Strughold; The Behavior of Micro-organisms Under Simulated Martian Environmental Conditions. Simons, D. G.; Manned Balloon Capabilities for Astronomical Observations. Schmidt, I.; Application of Recent Advances in Physiological Optics to Astronomy. (E.O.)

## 806

THE BEHAVIOR OF MICRO-ORGANISMS UNDER SIMULATED MARTIAN ENVIRONMENTAL CONDITIONS.
J. A. Kooistra, R. B. Mitchell and H. Strughold
*Publ. Astron. Soc. Pacific*, Vol. 70, 1958. p. 64—68.

Preliminary testing has been accomplished of terrestrial microorganisms under individual and combinations of conditions believed present on Mars. Bacteria have been isolated which can survive individual factors such as oxygen lack, high $CO_2$ levels, a mean temperature of —20° C to —30° C, 0.4% moisture content. Four types of soil exposed to a combination of simulated Martian environmental conditions of high altitude, low temperature, and low moisture showed a trend for the micropopulation of the samples to change to accommodate organisms capable of surviving and multiplying under the conditions. The majority of isolates made from the population growing at simulated altitude are facultative anaerobes of a gram-negative nature. Yeast or yeastlike organisms have gradually disappeared from the population. Future studies of the isolates will be made under similar conditions including simulated radiation. (E.O.)

## 807

THE CHALLENGE OF SPACE BIOLOGY.
W. O. Fenn
*A.I.B.S. Bull.* 8:2, 1958. p. 15.

The design of biological space experiments, the search for life in space and on the moon, and the development of a suitable environment for man in space are regarded as major points of interest for the biologist. The panspermia theory of Arrhenius should be examined. Spores may be found in space, even though not viable. Contamination of the moon by space probes must be avoided. (E.O.)

## 808

DEVELOPMENTS OF INTERNATIONAL EFFORTS TO AVOID CONTAMINATION OF EXTRATERRESTRIAL BODIES.
(No Author)
*Science*, Vol. 128, 1958. p. 887—889.

A major scientific problem under investigation is how to explore, and yet preserve for study, the physical and chemical structures that obtain on the moon and other celestial bodies. Biological or radioactive contamination of extraterrestrial objects is to be avoided. To meet this problem, *CETEX* was formed in 1938. The first findings released information on the moon's atmosphere indicating that it could be easily disrupted by explosions for marking purposes, or chemical markers, or chemical propellants. The chemical composition of dust on the moon's surface is of greatest interest, and it should not be disturbed or contaminated. Nuclear explosions constitute the greatest hazard. Also, some "pre-life" processes may be occurring on the moon, and these may be similar to or different from those which had taken place on earth. Earth macromolecules under lunar conditions may act as templates and provide new foci for "pre-life" growth. Conditions on Mars are such that some terrestrial organisms might grow. Water, nitrogen, carbon oxides and light for photosynthesis are all available. The most challenging of all planetary studies, extraterrestrial life, would be put in jeopardy if precautions against biological contamination are not undertaken. (A.H.F.)

## 809

EVIDENCE FOR VEGETATION ON MARS.
R. H. Garstang
*J. Brit. Astron. Assoc.*, Vol. 68, 1958. p. 196.

A short summary is given of a test by Harvard Observatory carried out for the presence of vegetation on Mars. Terrestrial plants show an absorption band at about 3.4 $\mu$ due to the C-H band of organic molecules. The radiation received from Mars was analyzed theoretically into two parts, one being the thermal radiation from the planet, the other the reflected solar radiation. The reflected radiation shows an absorption band at the wavelength of the organic band and so provides further evidence for some kind of vegetation on Mars. (E.O.)

## 810

THE EVOLUTION OF LIVING THINGS.
Graham H. Cannon
Springfield, Illinois, Charles C. Thomas, Publishers. 1958.

The history of the idea of evolution and resumés of various evolutionary theories are presented.

The final chapter, on "Balanced Evolution," points out that some mechanism for evolution must have existed in the simpler, earlier forms of life, before forms with chromosomes appeared, and that any living thing which was incapable of homeostatic adjustment to its environment would have ceased to be a living thing and become simply a collection of chemicals. If changes in the environment were too great, extinction by natural selection would have occurred. Each major step in evolution, such as development of the power to live in air as well as in water, and the ability to maintain a constant body temperature, represents a homeostatic reaction occurring in the organism which leads to a greater and greater emancipation from the environment. The author believes that the Mendelian mechanism evolved in connection with sexual reproduction as a means for keeping separate the nascent species and that the effects of natural selection on chance mutations cannot account for evolution. He believes that evolution "has taken place not by virtue of a succession of lucky chances but as the result of something central, which is inherent in all living things—an expression of an inexorable physico-chemical law."

## 811

GENERAL REVIEW OF PROBLEMS COMMON TO THE FIELDS OF ASTRONOMY AND BIOLOGY.
H. Strughold
*Publ. Astron. Soc. Pacific*, Vol. 70, 1958. p. 43–50.

The study of general planetary ecology, physiological problems connected with space exploration and the human factor involved in astronomical observations are discussed. The question of life from the viewpoint of physical ecology leads to zonal considerations. Earth possesses a favorable intensity of illumination, biotemperature, liquid water and oxygen; Mars and Venus lie in the fringe areas of this ecological belt. In the hydrogen belt planets, micro-organisms such as hydrogen bacteria, ammonia, methane, and iron bacteria are conceivable provided the temperatures are suitable. Mars offers an environment for highly adaptive plants and micro-organisms. The bluish tint of the green areas of Mars may represent a plant mechanism for high absorption of infrared light and a shift in reflecting power toward the blue as a means of temperature control and ultraviolet light protection. Experimentation should be done with simulated Martian enviroments for behavioral studies of micro-organisms. (E.O.)

## 812

THE INHABITANTS OF MARS.
F. B. Salisbury
*In:* E. Hutchings, Jr., ed. FRONTIERS IN SCIENCE. p. 168–179.
N.Y., Basic Books, 1958.

Observational evidence supporting a vegetative cover on the surface of Mars is presented; however, it is hypothesized that this vegetation is based on nitrogen rather than oxygen for energy transfer and that water acts as a growth regulator rather than as a primary solvent. This hypothesis would also allow animallike organisms having locomotion and even, possibly, intelligence. (M.P.G.)

## 813

LIFE AND THE COSMOS.
L. J. Henderson
*In:* The FITNESS OF THE ENVIRONMENT, p. 274–312.
Boston, Beacon Press. 1958.

Life in relation to its environment is discussed. Properties of the environment, biologically considered, present the same fitness as the properties of life. Life based on chemical elements other than carbon would produce organisms radically different from those we know, and, therefore, life may be probable on other planets. (E.C.)

## 814

LIFE ON OTHER STARS: PART I.
E. Stuhlinger
*Space J.*, 1:2, Spring 1958. p. 10–16.

The probability of life existing on other celestial bodies is discussed. Astronomical aspects of such investigation are presented. It is assumed there exist within our galaxy about 100 000 planets probably similar to Earth. That part of our universe which can be observed with current means contains no less than ten thousand billion planets on which, at some time, conditions were favorable for the development of life. (J.F.)

## 815

LIFE ON OTHER STARS: PART II.
E. Stuhlinger
*Space J.*, 1:3, Summer 1958. p. 21–30.

Conditions favorable for the development of life are discussed, and each of the planets examined as to its capabilities for bearing life. (S.T.L.)

## 816

MARS IN LIGHT OF THE NEWEST INVESTIGATIONS (MARS W SWIETLE NAJNOWSZYCH BADAN).
A. Wroblewski
*Postepy Astronomii*, 6–7:3, 1958. p. 71–91.

The vegetation hypothesis is the best explanation of observed characteristics on the surface of Mars. The vegetation is most likely a primitive type. However, according to G. A. Tichow, there is a possibility of the occurrence of higher forms of plant life. Sinton's spectroscopic studies are supportive evidence for the presence of vegetation on Mars similar to terrestrial vegetation. (E.C.)

## 817

THE NATURE OF THE SURFACE OF MARS.
Audouin Dollfus
*Publ. Astron. Soc. Pacific*, Vol. 70, 1958. p. 56—64.

Polarimetric and photometric studies of the light and dark areas of Mars were made to provide new information about the nature and changes of the surface. Polarization curves of the light areas are very similar to comparison curves produced by pulverized limonite. The Martian dark areas would also seem to have a powdery or pulverized surface but the polarization curves vary seasonally. Animated micro-organisms are very likely present on the powdery surface. The organisms must be pulverulent and very absorbent. Examples are given of terrestrial organisms of high adaptivity which possess a superficial colored pigment that offers protection against cold or excessive radiation by proper selective absorption of light. Chromogenic bacteria and highly colored elementary cryptogams are possible answers to explain the observational results. (E.O.)

## 818

NEWS AND COMMENTS: MARS.
E. J. Opik
*Irish Astron. J.*, Vol. 5, 1958. p. 110—111.

A summary is given of recent polarimetric studies of Mars and also the growth of micro-organisms under simulated Martian conditions. The surface of Mars may be covered chiefly with a powder of iron oxides. Among the grains of limonite, especially in the maria, are dark grains which could be living organisms such as certain algae, lichens or mushrooms which show a polarization curve similar to Martian curves. Flowering plants do not show this similarity. Under simulated Martian conditions, populations of micro-organisms increased in 3 samples and decreased in 1 sample. Yeast and yeast-like organisms gradually disappeared. (E.O.)

## 819

ORIGIN OF LIFE.
S. Fox
*Science*, 127:3294, 1958. p. 346—347.

A report of the international symposium on the Origin of Life on Earth held in Moscow, U.S.S.R., August 19—24, 1957 is presented. The topics discussed included: (1) Various ideas concerning the primitive atmosphere, hydrosphere, and lithosphere; (2) The formation of amino acids from assumedly primitive gases; (3) The origin of proteins, nucleoproteins, and enzymes; (4) Origin of structure and metabolism; (5) Evolution of metabolism; and (6) Concept of thermal orgins. (M.P.G.)

## 820

THE ORIGIN OF LIFE.
N. H. Horowitz
*In:* E. Hutchings, ed. FRONTIERS OF SCIENCE. p. 19—27.
N.Y., Basic Books, 1958.

A colorful account is presented of the studies man has made in his attempt to discover the fundamental characteristics of living matter. (A.H.F.)

## 821

PRINCIPLES OF HISTORICAL GEOLOGY APPLIED TO NEIGHBORING PLANETS AND LIFE ON MARS.
A. H. Carpenter
*Popular Astronomy*, Vol. 56, 1958. p. 233—246.

A comparison of geologic formation on Earth is made with the known and theorized geologic formation of the Moon and Mars. Geology should have an important influence on the initiation and evolution of life forms. On Earth life formed by a circumstance of reasonable temperature and a variety of chemical combinations, the most important of which was the hydrosphere. The Moon shows the effects of great volcanic activity, but an atmosphere and hydrosphere are lacking which indicates a sterile development in time. Mars may contain some water but again evidence for a hydrosphere is lacking. The atmosphere is full of colloidal particles and the presence of substantial vegetation seems to be contraindicated by the lack of oxygen in the air. The surface of Mars is relatively smooth because of erosion and the lack of mountains formed from the upheaval of sediments. The environment seems to have been constant and so any forms of vegetation could not have been forced to evolve into higher forms. (E.O.)

## 822

THE PROBABILITY OF INTELLIGENT LIFE EVOLVING ON A PLANET.
A. E. Slater
*In:* F. Hecht, ed. *Proc. of the VIII Intern. Astronaut. Congr.*, Barcelona, p. 395—402. Oct. 6—12, 1957.
Wien, Springer, 1958. 607 p. 9 refs.

In order to estimate the likelihood of intelligent life evolving on a planet on which life has started, this paper traces briefly the line of evolution of the human species from primitive life forms, and, taking examples from animal groups at different stages along this sequence, shows that, as each group differentiated along various evolutionary paths, the particular one which eventually led to man was far from inevitable and, in fact, the chances were often against it starting at all. It therefore seems improbable that other forms of intelligent life will be found by voyagers through space. (Author)

## 823

SPECTROSCOPIC EVIDENCE OF VEGETATION ON MARS.
W. M. Sinton
*Publ. Astron. Soc. Pacific*, 70:412, 1958. p. 50—56.

The results of a new spectrographic test involving C-H absorption at 3.46 $\mu$ for organic plant material on Mars are given. Previous visual studies have shown a wave of darkening following a seasonal decrease in the size of the polar cap which is assumed to be moisture-controlled growth of vegetation. A lack of reflectivity $\lambda$ 9000 has been cited as an objection to a vegetation theory, but plant dyes other than chlorophyll may be present which absorb at this wavelength. Spectra of terrestrial lichens and mosses show an absorption by the C-H band at 3.46 $\mu$. Reduction of Mars observational data by statistical analysis reveals spectroscope absorption near 3.46 $\mu$. Contributions to the curve from reflections by rocks and dust on

the Martian surface and thermal emission are not enough to override strong evidence for the presence of organic matter of some kind. (E.O.)

## 824

**OF STARS AND MEN: THE HUMAN RESPONSE TO AN EXPANDING UNIVERSE.**

H. Shapley

Boston, Beacon Hill Press, 1958. 157 p.

Gives contemporary information on man's place and function in the cosmos, the Earth in the physical universe and problems affecting the future. Particular attention is given to the possibility of intelligent life on other planets. (G.W.)

## 825

**THE SYNTHESIS OF ORGANIC SUBSTANCES ON THE PRIMORDIAL EARTH (O SINTEZE ORGANICHESKIKH VESHCHESTV NA PERVICHNO ZEMLE).**

Stanley L. Miller

*Priroda* (Moscow), Vol. 5, 1958. p. 44–48.

Also *In: Referat. Zhur., Biol.*, No. 60670, 1958. (Translation)

The article gives a description of the conditions for artificial synthesis of amino acids and other organic compounds. The problem of creating life artifically is reduced to the synthesis of polypeptides possessing enzymatic properties. According to the author, the first organism looked like a strip of DNA with associated enzymes, encased in a membrane. The properties of multiplication and mutation are the basic signs of life. In order to understand the early stages of evolution, it is essential to study the mechanism of enzyme synthesis and the self-reproduction of genes in present-day organisms. (A.S.F.)

## 826

**THERMAL COPOLYMERIZATION OF AMINO ACIDS TO A PRODUCT RESEMBLING PROTEIN.**

S. Fox and K. Harada

*Science*, 128:333, 1958. p. 1214.

The thermal synthesis of a proteinoid from all the common amino acids has been accomplished by the use of considerable molar excess of dicarboxylic amino acid. The polypeptide nature of the polymer is substantiated by biuret tests and infrared analysis. Possibilities of bacterial contamination, trapped amino acids, and the presence of difficulty-soluble diketopiperazines have been eliminated. The percentage of basic and neutral amino acids can be increased. The findings may be significant in helping to explain primitive protein formation and should enlarge the scope for the synthesis of peptides from the copolymerization of amino acids. (E.O.)

# 1957

## 827

**SPACE FLIGHT IN A COSMIC PERSPECTIVE.**
Heinrich Faust
*Naturw. Rundschau* (Stuttgart), 10:12, Dec. 1957. p. 445–448. (In German)

The author discusses the possible development of forms of life on other planets. The statistical probability of life having occurred is extremely high. Particular consideration is given to the highly advantageous conditions on Earth for the appearance of life; these include its orbit, its rotation, and its ecliptical inclination. (M.G.)

## 828

**THE ORIGINS OF LIFE.**
N. W. Pirie
*Nature*, Vol. 180, Nov. 2, 1957. p. 886–888.

Theories of biopoesis and papers presented at the symposium are discussed. The theories are (1) life has always pervaded space and apparent origin is simply a transfer from place to place; (2) creation by divine intervention; (3) evolution on Earth by the action of inevitable, normal processes; (4) repeated coordination of eobionts or subvital units; and (5) the classical and medieval idea that life appeared whenever there was a suitable environment. Theory (1) will soon become amenable to experimental test when astronauts set out to look for what Haldane calls "astroplankton." A few papers were on the chemical nature of Earth's probiotic atmosphere and surface; they demonstrated that there is no basis for dogmatism. Of particular interest was the revival by P. K. Kropotkin of the idea that petroleum could have a nonbiological origin. There were several papers on the types of synthesis that proceed when mixtures of the various substances that have been postulated in the primitive environment are exposed, in the laboratory, to energy sources as diverse as heat, electromagnetic radiation, and radioactivity. These papers demonstrated that there is no difficulty in postulating a chemically complex "probiotic soup." The greater part of the symposium was taken up with papers whose relevance depended on the assumption that life can only exist as a result of the activities of protein, nucleic acids, high-energy phosphates, etc. (I.v.L.)

## 829

**"BIOSPHERIC INDEX" A CONTRIBUTION TO THE PROBLEM OF DETERMINATION OF THE EXISTENCE OF EXTRA-SOLAR PLANETARY BIOSPHERES.**
T. P. Bun and F. A. Pereira
*In:* F. Hecht, ed. *Proc. VIIIth Intern. Astronaut. Congr.*, Barcelona, p. 63. Oct. 6–12, 1957.
Vienna, Springer-Verlag, 1958. 607 p.

The comparative examination of the different regions of the "Solar Ecosphere" (H. Strughold, *J. Aviation Med.*, Vol. 23, No. 2, Apr. 1952, p. 130–140), allows the classification of the planets of the solar system in three groups as concerns the presence of life: (1) Biosphere improbable—Mercury, Moon, Pluto; (2) Possibility of formation of a biosphere—giant planets; (3) Biosphere probable—Venus, Earth, Mars.

The distinction of these three groups corresponds to the distinction among three types of planetary atmospheres: (1) No or insufficient atmosphere; (2) Gases as $NH_3$ and $CH_4$ where proteic molecules might be formed under the action of radiation as proved by experimental evidence; (3) Atmospheres chemically adequate for subsistence of organisms maintaining a metabolism.

Comparison of spectroscopic absorption lines permits the establishment of a "Biospheric Index" for the classification of a given planet within the indicated scale of groups. (Author)

## 830

**THE STELLAR ECOSPHERES WITHIN A RADIUS OF 17 LIGHT YEARS AROUND THE SUN (DIE STERNENOKOSPHAREN IN RADIUM VON 17 LICHTJAHREN UM DIE SONNE).**
J. Gadomski
*In:* F. Hecht, ed. *Proc. VIIIth Intern. Astronaut. Congr.*, Barcelona, p. 127–136. Oct. 6–12, 1957.
Vienna, Springer-Verlag, 1958. 607 p.

The range of the ecospheres is calculated for those stars which are situated in the neighborhood of the sun within a radius of 17 light years. Using certain formulae and Van de Kamp's catalogue the author has listed 59 star ecospheres. Values of the calculated radii and of the masses of the stars are rounded off.

It follows that only 16 stars which are similar to the sun show broad ecospheres (about $200 \times 10^6$ km), whereas the ecospheres around the other 43 sub-dwarfs are very narrow (about $10 \times 10^6$

km) and can possess only planets with stopped rotation periods, that is, with very limited ecological possibilities. (Author)

## 831

SPECTROSCOPIC EVIDENCE FOR VEGETATION ON MARS.
W. M. Sinton
*Astrophys. J.*, 126:2, Sept. 1957. p. 231–239. 8 refs.

A new test for the presence of vegetation on Mars depends on the fact that all organic molecules have absorption bands in the vicinity of 3.4 $\mu$. These bands have been studied in the reflection spectrum of terrestrial plants, and it is found that for most plants a doublet band appears which has a separation of about 0.1 $\mu$ and is centered about 3.46 $\mu$. Spectra of Mars taken during the 1956 opposition indicate the probable presence of this band. This evidence and the well known seasonal changes of the dark areas make it extremely probable that vegetation in some form is present. (Author)

## 832

THE FORMATION OF ORGANIC COMPOUNDS ON THE PRIMITIVE EARTH.
S. L. Miller
*N.Y. Acad. Sci., Ann.*, 69:2, Aug. 1957. p. 260–275. 34 refs.

By either silent or spark-type electrical discharges in a mixture of hydrogen, ammonia, methane, and water there are produced hydroxy, aliphatic, and amino acids. With the silent discharge the yield is one-fourth less of the same products than with sparks. Hydrogen cyanide and aldehydes, both direct products of the electrical discharge, react to produce aminonitrides which in turn would be hydrolyzed to an amino acid. It is suggested that ultraviolet light could be the energy source in the absence of an electric spark for the synthesis of organic compounds in the Earth's beginnings. These compounds would have been synthesized in the presence of a reducing atmosphere, but their origin in an oxidizing atmosphere is doubted.

## 833

LIFE ON OTHER PLANETS.
M. H. Briggs
*The Humanist* (London), 72:8, Aug. 1957. p. 18–20.

The conditions necessary for life, the likelihood of life on either Venus or Mars and the probability of life in the known universe are examined. Temperature, pressure, radiation, and the presence of certain chemical compounds are all necessary for life. Since Venus contains little free oxygen or water, there is little chance of life. Mars presents conditions well within the limits of certain types of life. American and Russian observations have detected similarities between reflected light from the Martian dark areas and from certain terrestrial plants which can grow in cold climates. There is speculation that the canals and satellites of Mars may possibly be of artificial construction. It is estimated that there are $10^{19}$ planets in the known universe on which life can and may exist. (E.O.)

## 834

PHOSPHORUS AND THE ORIGIN OF LIFE.
A. Gulick
*N.Y. Acad. Sci., Ann.*, 69:2, Aug. 1957. p. 309–313. 25 refs.

The importance of phosphorus as a means of transferring cellular energy and as a contributor to the formation of the nucleic acids necessary for self-replicating molecules is discussed. Assuming that self-replication was the same in the beginning as now, the question arises as to the source of phosphorus that was readily available to the first living organisms. Although phosphorus is plentiful in nature, it is not freely available to organisms. The phosphates, being a more common form found in cells, are fully oxidized forms of phosphorus and are highly insoluble in water. Hence, these were probably not the forms that were first available. The author suggests that some type of hypophosphite, a highly soluble and less oxidized form, was the first assimilable phosphorus compound found in the seas. These hypophosphites were possibly derived from the oxidation of phosphides found in the rock crust. The environment that would allow these less oxidized forms of phosphorus to become widely distributed is discussed. It is possible that sulfur or iron was playing the role of phosphorus in the beginning of organic life. (Aerospace Med.)

## 835

THE ATMOSPHERE OF MARS.
R. M. Goody
*J. Brit. Interplanet. Soc.* (London), 16:2, Apr.–June 1957. p. 69–83.

A detailed discussion, with photographs and figures, is presented of the Martian atmosphere, dealing with topography, clouds and violet layer, temperature and winds, composition, the vertical structure of the atmosphere, and interpretation of cloud forms and movements. The Martian year is less than twice the Earth's, but the seasonal cycle of insolation is thought to be similar on the two planets. The length of the Martian day is 24 hours, 37 minutes. (Aerospace Med.)

## 836

PROBABLE ROLE OF GAMMA IRRADIATION IN ORIGIN OF LIFE.
R. Paschke, R. W. H. Chang and D. Young
*Science*, 125:3253, May 3, 1957. p. 881.

By irradiating ammonium carbonate with gamma rays at dosages of about 500 Mrep, the first known production of amino acids (glycine and possibly alanine) in the absence of free hydrogen is reported. Gamma irradiation, whether a massive dose as used here is necessary or not, is a more probable agent than sunlight or lightning in generating complex organic molecules. It is postulated that once these amino acids were formed they could have been protected from radioactive destruction by being immersed in the oceans where further molecular complexes could have developed. (Aerospace, Med.)

## 837

**GULLIVER'S MOONS.**

D. Malcolm

*Spaceflight*, Vol. 1, Apr. 1957. p. 107—108.

An account of the discovery of the two moons of Mars is presented. Curiously, before the telescopic discovery by Hall in 1877 they were mentioned in Swift's *Gulliver's Travels* of 1726. Swift may have chanced on the number of moons by a comparison of the number of moons circling other planets. The Martian moons may be captured asteroids but a suggestion that they are artificial satellites is apparently untenable. There has never been evidence for any intelligent life on Mars. Putting such large satellites into orbit would require astronomical complexity and energy sources. The actual orbits of the moons also do not fit the concept of artificiality, since polar orbits, not equatorial, would be desirable for scientific and observational purposes. (E.O.)

## 838

**RADIATION AND THE ORIGIN OF THE GENE.**

Carl Sagan

*Evolution*, 11:1, Mar. 1957. p. 40—55.

It is suggested that solar ultraviolet radiation penetrated through the primitive terrestrial atmosphere to the surface of the waters. The existence of loci of phosphorous-organic concentration is likely, and ultraviolet-activated ring structures may have transferred their energy to synthesize high-energy phosphate bonds. Small amounts of proteins produced by pyrosynthesis or by radiation-induced polymerization would have provided the enzymatic priming required for utilization of ATP, and the large-scale production of bio-molecules. The differential survival of polymers over nonpolymers is indicated in polymeric resistance to ultraviolet photolysis. It is proposed that nucleic acids and proteins possess certain unique properties which were ideally suited for biogenesis. The origin of polynucleotides (proto-DNA) was a major turning point, since reproduction and biological evolution were now possible. Hydrogen bond lysis and proto-DNA reproduction may have been radiation-induced. The resulting, evolving nucleoprotein, situated in a dilute medium of organic matter, is suggested to be the first living thing, a free-living naked gene. (G.W.)

## 839

**REFLEXIVE CATALYSIS: A POSSIBLE MECHANISM OF MOLECULAR DUPLICATION IN PREBIOLOGICAL EVOLUTION.**

G. Allen

*Am. Naturalist*, 91:857, Mar. 1957. p. 65—78.

A critique of Oparin's hypothesis of the origin of life is presented, based on principles of natural selection. A mechanism proposed and mathematically demonstrated whereby any molecule that catalyzed the synthesis of one of its precursors, in a system where these precursors eventually formed, more of the same molecule, would be reproducing itself in the sense required by natural selection. Molecular reproduction by reflexive catalysis would generally have a high probability of mutation, resulting in new molecules capable of catalyzing steps in their own synthesis. Inefficient or uncatalyzed competing reactions would be gradually extinguished. Using this mechanism, Oparin's hypothesis becomes reasonable. (E.O.)

## 840

**VISUAL OBSERVATIONS OF MARS.**

G. P. Kuiper

*Astrophys. J.*, 125:2, Mar. 1957. p. 307—317. 4 refs.

Visual observations of Mars, made with an 82-in. telescope during one month of nearly continuous observation centered around the time of closest approach in 1956 (September 7), are reported. Emphasis was placed on obtaining dependable determinations of the colors of the Martian dark areas and on the general appearance of the planet, including fine detail. The colors, expected to be green at this season (Martian spring), were found to be neutral gray, with a mere touch of moss-green in some of the equatorial regions and a touch of brown in the dark border surrounding the South Polar Cap. A spectacular system of dust storms was observed to develop, eventually enveloping the entire observable planet except the polar zones. Between Sept. 6 and 9 a dense cloud cap formed over the South Pole. This cloud cap had cleared away by September 14, but it had deposited a new polar cap that has remained largely intact since. It is remarkable that this event occurred shortly before the summer solstice. The bearing of the surface studies on the vegetation hypothesis is discussed (Author)

## 841

**ATMOSPHERIC PRESSURE AND BIOLOGICAL ADAPTATION.**

Jean Giaja

*Acta Physiol. Pharmacol. Neerl.*, Vol. 6, 1957. p. 479—486.

A comparative study of $O_2$ consumption per kg body weight by various homeothermic and poikilothermic animals under normal and reduced $O_2$ pressures showed that biological oxidations are influenced by such a reduction only below a certain limit which varies within a narrow range. It follows that the relation between $O_2$ consumption and limit tension is higher, the smaller the animal. The surface law, however, is unable to explain the differences in oxidative yield which can be observed in one and the same animal under different physiological conditions. (E. Taschdjian)

## 842

**CONDITIONS ON THE MOON AND NEARER PLANETS.**

Patrick Moore

*Space Res. Tech.* 1957. p. 182—194.

The author concludes that the Moon is a dead world insofar as even low forms of plant life are considered improbable. Conditions on Venus are not favorable for the development of life. Mars has been regarded as the one planet other than Earth where intelligent life might exist though the idea of Martian men and animals such as are on Earth or similar thereto is now discounted. The outer planets are unlikely to be favorable to the evolution and survival of life. Only the Moon, Mars

and Venus would be practicable for manned landings and of these three Mars is by far the least hostile. (E.C.)

## 843

THE DAWN OF LIFE.
Joseph H. Rush
N.Y., Hanover House, 1957. 218 p.

Contents:

Chapter 1: What is Life? Chapter 2: About Beginnings. Chapter 3: The Earth Before Life Began. Chapter 4: Where Did Life Come From? Chapter 5: The Chemistry of Living Things. Chapter 6: The Beginning of Life. Chapter 7: Breakthrough. Chapter 8: Life in the Universe. Chapter 9: The Emergence of Mind.

## 844

A DISCUSSION OF SOME CURRENT THEORIES REGARDING THE MARKINGS ON MARS.
F. Salisbury
*Publ. Astron. Soc. Pacific*, Vol. 69, 1957. p. 396–397.

Arguments are advanced against theories of vegetation on Mars composed of earth-like crustose lichens. Lichens do not exhibit seasonal color changes, are very slow growing, would not appear quickly after dust storms, and could hardly be expected to cover large areas without adequate water. The ecological aspects of Mars would be very inimical to earth-like lichens. Gaseous exchange mechanisms with the limited $O_2$ available present another problem. Two biological possibilities remain: Life as we know it has become adapted somehow to the conditions on Mars or that another form of life unknown to us—a parabiology—accounts for the markings on Mars. (E.O.)

## 845

INHABITED UNIVERSE.
K. W. Gatland and D. D. Dempster
N.Y., David McKay Co., Inc., 1957. 182 p.
Contents:

Chapter 1: Worlds in Creation. Chapter 2: The Dawn of Life. Chapter 3: Our Neighbor Worlds. Chapter 4: The Expanding Universe. Chapter 5: Out of the Cosmic Void. Chapter 6: The Strange Duality of Light. Chapter 7: The Time Paradox. Chapter 8: Other Universes. Chapter 9: The Forbidden Frontier. Chapter 10: In Search of God. Chapter 11: The Last Freedom. Chapter 12: The End—or the Beginning?

## 846

INTERPRETATION OF THE OBSERVATIONS OF MARS AFTER THE DRAWINGS MADE BY G. A. TIKHOV IN 1918, 1920 and 1948.
K. I. Kozlova
*Tr. Sektora Astrobotan. Akad. Nauk (Alma-Ata)*, Vol. 5, 1957. p. 83–94.

From G. A. Tikhov's drawings of Mars, made during its opposition in 1918, 1920, and 1948 on the basis of visual and spectrographic observations, the following may be concluded: (1) The appearance of clouds, solid sediments and mist on Mars is a relatively common phenomenon; (2) A white zone along the northern coast of southern seas was observed; (3) The transparency of the atmosphere varied greatly, and dark spots were often visible on the surface of the planet; (4) From the 1920 observation it was evident that the seas were of different colors, brown in the northern hemisphere and green in the southern hemisphere; (5) In the 1948 observation, the seas were gray toward the center of the disc, acquiring a greenish hue toward the edge; and (6) In the 1948 observation, a dark border was very distinct around the northern polar cap, and was, on some days, the darkest spot on Mars. (Aerospace Med.)

## 847

MAN AMONG THE STARS.
Wolfgang D. Muller
N.Y., Criterion Books, Inc., 1957.

Chapter 12, Creatures That May Await Us, discusses the lack of a final answer to the question of the existence of extraterrestrial life. The conditions necessary for life are considered, the possibilities of life on other solar system planets (particularly Mars) are discussed, and the possibility of other habitable and/or inhabited planets in the universe is examined. The following chapter discusses the religious and philosophical implications that pertain to the possible discovery of manlike beings endowed with reason on other worlds. (M.P.G.)

## 848

THE MECHANISM OF SYNTHESIS OF AMINO ACIDS BY ELECTRIC DISCHARGE.
S. L. Miller
*Bioch. Biophys. Acta.*, Vol. 23, 1957. p. 480–489.

The mechanism of the electric discharge synthesis of amino and hydroxy acids from $CH_4$, $NH_3$, $H_2O$, and $H_2$ was investigated. This mixture of gases has been proposed as the composition of the primitive Earth atmosphere. Hydrogen cyanide and aldehydes produced by the discharge react to form amino and hydroxynitriles. Amino acids are formed from hydrolysis of the aminonitriles. No purines or pyrimidines could be detected. The experiments indicate that the synthesis of amino acids does not require special conditions. Electric discharges are not critical and the same results could be expected from ultraviolet light. (E.O.)

## 849

MODEL INVESTIGATIONS FOR FORMING ORGANIC COMPOUNDS IN THE ATMOSPHERE OF SIMPLE GASES BY ELECTRICAL DISCHARGES (MODELLUNTERSUCHUGEN ZUR BILDUNG ORGANISCHER VERBINDUNGEN IN ATMOSPHAREN EINFACHER GASE DURCH ELEKTRISCHE ENTALDUGEN).
K. Heyns, W. Walter and E. Meyer
*Naturwiss.*, Vol. 44, 1957. p. 385. (In German)

The synthesis of amino acids from simple gas mixtures under the action of electrical discharges, is used as a model reaction for problems concerning the composition of the Earth's atmosphere, during its early stages, in conjunction with the "primordial synthesis" of biochemical building blocks. Ammonium thiocyanate

was synthesized, in a hydrogen sulfide-containing atmosphere, from two unidentified sulfur-containing compounds. The amino acid synthesis was not noticeably affected by the presence of the hydrogen sulfide. Compounds with guanidino groups (e.g. glycocyamine) were synthesized, under certain conditions, at higher reaction temperatures. In the absence of oxygen and with a suitable energy supply, the volatile reaction products of the thermal decomposition of amino acids can be used in the resynthesis of the simplest amino acids. (I.v.L.)

## 850

ON N. A. KOZREV'S ARTICLE "EXPLANATION OF THE COLOR OF MARS BY SPECTRAL PROPERTIES OF ITS ATMOSPHERE" (PO POVODU STAT'I N. A. KOZREVA "OB'YASNENIYE TSVETA MARSA SPEKTRAL'NYMI SVOYISTVAMI YEGO ATMOSFERY").

G. A. Tikhov

*Tr. Sektora Astrobotan. Akad. Nauk Kaz. SSR (Alma-Ata)*, Vol. 5, 1957. p. 3–5. (In Russian)

The author criticizes the article on the color of Mars by N. A. Kozyrev. The fallacy of the article is obvious from several statements and logarithmical curves and tables supplied by Kozyrev. The dispute arises as to the coloring of the seas and the areas of vegetation. It is improbable that the color of Mars is derived from its own atmosphere. (Aerospace Med.)

## 851

THE ORIGIN OF LIFE ON THE EARTH.

A. I. Oparin

N.Y., Academic Press, 1957. 495 p.

Oparin concludes that the primal seas contained a wide variety of "organic" compounds which had been abiotically synthesized. By the process of coacervation these organic compounds became organized into a multitude of different types of systems. These did not exhibit the phenomenon of life but, rather, set the stage for the development of even more complex coacervate systems. The theory of the dynamics of "open" systems operative within enclosing (and often selective) membranes is developed. The final stage, extending over a vast stretch of geologic time, was the development of coordinated enzyme systems within the coacervates, at first randomized but later "directed" by the selective forces existing within the abiotic but chemically complex environment. When various of these enzyme systems had been stabilized the most primitive types of what might be called life could then come into being. Oparin holds that the first living things were both heterotrophic and anaerobic, deriving their sustenance and energy from the organic substances in which their environment then abounded. He also holds that the chemoautotrophic and photoautotrophic organisms were derived later from heterotrophs. (Aerospace Med.)

## 852

ORIGIN OF THE SOLAR SYSTEM.

A. W. Titherley

Wykeham Press, Warren & Son, Ltd. Winchester, England, 1957.

The developmental components of the atmosphere of Mars are discussed. Kuiper found no free oxygen. Mars could retain oxygen, but since there was none in the original Ur-cloud after cooling, it must have at one time made its own. Photosynthesis is the only way we know a planet can acquire free oxygen. Speculation of Mars having considerable vegetation at one time is made and the seasonal color changes strongly suggest vestigial plant life. This vegetation is most likely primitive similar to lichens and mosses. (E.C.)

## 853

PHILOSOPHICAL BASIS FOR THE POSSIBILITY OF EXTRATERRESTRIAL LIFE.

A. K. Suslov

*Tr. Sektora Astrobotan. Akad. Nauk Kaz. SSR (Alma-Ata)*, Vol. 5, 1957. p. 207–211.

Materialistic and idealistic points of view on the problem of life on Mars are discussed. The theories of Weissman, Morgan, and Mendel are rejected, and only the theory explaining the origin of the solar system in terms of evolution of the planets and of life on them is considered acceptable. While some theorists claim that there is no clear evidence of a martian biosphere, the author does not agree with them. On the basis of astrobiological studies and spectrophotometric observations of Mars it is to be concluded that vegetal life forms on that planet are possible. (Aerospace Med.)

## 854

PHOTOCHEMICAL FUSION OF AMINO ACIDS FROM MIXTURE OF SIMPLE GASES (PHOTOCHEMISCHE BIDUNG VON AMINOSAUREN AUS MISCHUGEN EIFACHER GASE).

W. Groth and H. Von Weyssenhoff

*Naturwiss.*, Vol. 44, 1957. p. 510. (In German)

Sensitized reactions were conducted using a mercury-resonance lamp with mercury vapor serving as the sensitizer. Mixtures of methane, ammonia, hydrogen, and water vapor produced no reaction products because the effective cross section of the methane molecule is extremely small compared to that of the excited mercury atoms and as a result the hydrogen atoms and/or free radicals have little effect on the molecule. When methane was replaced by ethane, with or without a mercury-vapor sensitizer, a large number of organic compounds were formed. These included a number of amines, amino acids such as glycine and alanine, and higher amino acids. Direct photochemical reactions using the resonance wavelengths of xenon and krypton, between methane, ammonia, and water vapor gave few products. Among those, only glycine and alanine could be positively identified. These results show that the definite tendency, observed by Miller who used an electrial discharge, toward the synthesis of amino acids from gas mixtures also holds true for the photolysis of mixtures of methane, ammonia, and water vapor. In addition, the results give further support to the assumption that the atmosphere of the earth during its early stages was a reducing one. (I.v.L.)

## 855

**A PHOTOMETRIC STUDY OF THE DARK SIDE OF THE SURFACE OF THE PLANET MARS.**

Audouin Dollfus

*Compt. Rend. Acad. Sci.*, Paris, Vol. 244, 1957. p. 1458–1460. (In French)

The phenomena of seasonal variations by spectroscopic observations of Mars cannot be explained simply by the presence of water vapor. Photometric studies suggest that a solar dust composed of living micro-organisms makes possible variations in light and dark and polarization. (A.W.)

## 856

**THE PLANET MARS.**

Patrick Moore

*In:* L. J. Carter, ed. REALITIES OF SPACE TRAVEL, p. 313–334. London, Putnam, 1957.

(This is a reprint of an article which appeared in: *J. Brit. Interplan. Soc.* (London), 14 (2): 65–84. March–April 1955.) A review is presented of the main features of Mars: its polar caps, canals, dark areas, ochre dust deserts, tracts of vegetation, clouds, meteors, aurorae, and icy polar snows circled by two dwarf moons. The Martian atmosphere, although oxygen-deficient, contains carbon dioxide, argon, and nitrogen. Atmospheric density and pressure are lower than that found on Earth.

## 857

**THE POSSIBILITIES OF AN INHABITABLE EXTRATERRESTRIAL ENVIRONMENT REACHABLE FROM THE EARTH.**

Hubertus Strughold

*J. Aviat. Med.*, Vol. 28, 1957. p. 507–512.

Ecological necessities for life on other planets as now predominant on Earth are present only on Venus and Mars. (A.H.F.)

## 858

**PROBLEMS OF ORGANIC EVOLUTION IN THE LIGHT OF RECENT STUDIES OF THE PLANETS.**

N. I. Suvorov

*Tr. Sektora Astrobotan. Akad. Nauk Kaz. SSR (Alma-Ata)*, Vol. 5, 1957. p. 118–125.

We possess a considerable amount of reliable information pertaining to the physical and chemical conditions on the planets of the solar system but not many data on the evolution of these planets, their lithospheres, hydrospheres, and atmospheres. The study of organic evolution being the task of general biology, it is imperative that this branch of science should solve the problems of cosmic life. According to present theories, life on Earth has existed for some 3–4 billion years. Jupiter and Saturn manifest a state of evolution corresponding to the precellular and unicellular evolutionary periods of the Earth, while Venus is now in its Paleozoic period. Mars shows high organic life forms capable of surviving severe conditions. It is highly improbable that the Moon sustains any life, although the possibility cannot be excluded. Mars, being the best known planet, may have also animated life, if one may draw analogies to the evolutionary laws on Earth. Yet the possibility of animated life on Mars is disputed among the authors; from the point of view of evolution it is to be assumed that only vegetal life exists there. Since energy is needed to sustain life and since energy is stored by plants, two types of nutrition are possible, autotrophic and heterotrophic. This presupposes the existence of photosynthetic organisms (plants). Spectrographic and, more recently, isotope studies reveal that not all plants have the same ability to develop chlorophyll. It was shown experimentally that corn will grow under climatic conditions similar to those existing on Mars. (Aerospace Med.)

## 859

**RADIOMETRIC MEASUREMENTS ON THE PLANET MARS.**

W. W. Coblentz and C. O. Lampland

*Phys. Rev.*, Vol. 29, 1957. p. 372–376.

Measurements with vacuum thermocouples interrupting only 0.01 of the area of Mars' image show that the southern (summer) hemisphere is warmer than the northern hemisphere, the dark areas are hotter than the adjacent bright areas and the forenoon side is cooler than the afternoon side. Estimates of temperatures as viewed on the central meridian: south polar region 10° to —10° C, south temperate zone 20° to 25° C, center of disk 20° to 30° C, north temperate zone 0° to 20° C, north polar region —25° to —40° C. (E.O.)

## 860

**REACHING FOR THE STARS.**

G. A. Tikhov

Moscow, Foreign Languages Publ. House, 1957.

A wealth of material on the optical properties of terrestrial plants growing in rigorous climates is presented, and comparisons are drawn between these observations and those of Martian areas believed to be patches of vegetation. The probable presence of micro-organisms on Venus and even some of the outer planets is suggested on the basis of the environmental extremes to which bacteria have adapted themselves. (M.P.G.)

## 861

**REALITIES OF SPACE TRAVEL.**

P. Moore

London, Putnam, 1957. 273 p.

There is no intelligent organism capable of existing on the moon since it has no water, virtually no air, and temperatures over 100 degrees on either side of zero. There may be some low form of vegetation. Mars has a marked resemblance to Earth—it is a solid body with a certain amount of moisture; there is an atmosphere, and there is probably plant life. The main difference is that Mars is smaller. There is a seasonal shrinking of polar caps. The Martian atmosphere is thin and oxygen-poor. The temperature range is extreme. We can imagine forms of life which could survive under the very rigorous Martian conditions. It appears from the environmental conditions almost certain that plant life does exist on Mars. (E.C.)

## 862

**RECENT OBSERVATIONS OF RADIO SIGNALS FROM VENUS AT 11 METERS WAVE LENGTH.**

J. D. Kraus

*Astron. J.*, Vol. 62, 1957. p. 21.

Two types of radio signals have been observed emanating from Venus at 11 meters wave length. Class I signals are burst-like and are similar to terrestrial thunderstorm static. Class II signals are of a coherent and more sustained type, often lasting for 1 sec. or more, and appear to be modulated at an audio frequency rate. Occasionally quite uniform spacing intervals have been observed. No explanation is given for the coherency of Class II signals. (E.O.)

## 863

**THE RED PLANET.**

J. Gustavson

*Jet Propulsion*, Vol. 27, 1957. p. 706–708.

Astronomical, physical, and chemical data on Mars is summarized, with a discussion of atmospheric and surface features and the logistics of an expedition to Mars. The atmospheric composition has not been accurately determined. There are traces of oxygen and water vapor from spectroscopic observations, and polar caps of wide extent indicate a substantial amount of ice. The dark areas of the surface are attributed to lava flows, volcanic dust, or hydroscopic minerals or to vegetative life. Since the "canals" appear to be natural features, the theory of intelligent life is discarded. Low vegetative life, however, is possible and might resemble lichens capable of surviving environmental extremes. Resinous structures would absorb infrared energy and would be suitable for low temperatures and pressures. (E.O.)

## 864

**RESULTS OF PHOTOGRAPHIC OBSERVATIONS OF MARS AT THE KHARKOV ASTRONOMICAL OBSERVATORY DURING 1954.**

I. K. Koval

*Soviet Astron.*, Vol. 1, 1957. p. 404–410.

Observations of Mars made in four spectral regions during 1954 resulted in the following conclusions: The slope of the brightness distribution curves in the spectral region 560–660 $\mu$ decreases with increasing meridian altitude of the sun. The reflection of light from the surface of the maria does not follow Lambert's law. The atmosphere above the Martian maria is more transparent than over the continent. The south polar cap is reddish in comparison to a white screen. Near the date of opposition the color of the maria differs little from the color of the continent. The maria at low southern latitudes change their color with variation of the meridian altitude of the sun. With the approach of summer it is suggested that the maria are moistened by the thawing of the polar cap and that in some of them are regions of vegetation. (E.O.)

## 865

**SPONTANEOUS GENERATION OF ANABOLIC PATHWAYS, PROTEIN AND NUCLEIC ACID.**

S. W. Fox, A. Vegotsky, K. Harada and P. D. Hoagland

*N.Y. Acad. Sci., Ann.*, Vol. 69, 1957. p. 328–337.

The problem of spontaneous generation of materials and pathways of chemical reactions necessary for life is studied. Protein molecules show a great similarity which reflects an exceedingly small rate of molecular evolution. The peptide bond could be formed at reasonable terrestrial temperatures. Spontaneous generation and simple organic experiments almost necessarily would begin with some of the same compounds derived from a primitive atmosphere. Thermal production of proteinlike polymer from amino acids has been accomplished experimentally. Nucleic acids show a similar origin. Thermal reactions could occur in the presence of enzyme protein which is formed simultaneously so that each reaction is impressed on the material of the enzyme. The enzyme thus formed is trapped by nucleic acid until it is subsequently released by some trigger for further reactions. (E.O.)

## 866

**VENUS THE NEAREST PLANET.**

P. Moore

*New Scientist*, 2:52, 1957. p. 12–14.

Various theoretical studies of the planet Venus—its surface, atmosphere, rotation period and temperature—are discussed. Conflicting theories exist concerning the presence of water. One thing is certain: Venus is a thoroughly unfriendly world and the existence of advanced life there seems to be utterly out of the question. But, we can not predict what the first space travellers are likely to find.

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## 867

**OUR NEIGHBOUR MARS.**
**Zdenek Kopal**
*New Scientist* (London), Vol. 1, Nov. 22, 1956. p. 41–43.

Although nitrogen appears to be the principal constituent of the Martian atmosphere, the only gas whose presence has been established by its power to absorb infrared is carbon dioxide. Evidence for oxygen and water vapor is so far absent. Measurements indicate that the overall Martian temperature is 30–40° C cooler than that of the Earth. White, blue, or yellow clouds hover near the surface of the planet. Three-quarters of the surface itself consists of reddish or yellow expanses, probably exposed solid rocks but mostly covered with dust or sand (so-called monotonous deserts). The remaining quarter consists of "dark spots," faint and ill-defined during winter but turning dark with advent of spring. The probable existence of vegetation is also discussed. (Aerospace Med.)

## 868

**AMINO ACIDS FORMED IN "PRIMITIVE ATMOSPHERES."**
**P. H. Abelson**
*Science*, 124:3228, Nov. 9, 1956. p. 935. Presented at the NAS Autumn Meeting, Nov. 9–10, 1956.

Simulating atmospheric conditions that might have been present early in the history of the Earth, amino acids such as alanine, beta-alanine, glycine, and sarcosine have been synthesized employing a variety of compositions. Combinations of gases, including $CO_2$–$N_2$–$H_2$–$H_2O$, $CO$–$N_2$–$H_2$–$H_2O$, $CO_2$–$NH_3$–$H_2$–$H_2O$, were subjected to electric discharges, and in each case amino acids were formed. The earlier work of S. Miller (J. Am. Chem. Soc. 77:2351, 1955) employing $CH_4$–$NH_3$–$H_2O$ has been confirmed. (G.W.)

## 869

**ON BIOCHEMICAL ORIGINS AND OPTICAL ACTIVITY.**
**S. W. Fox, J. E. Johnson and A. Vegotsky**
*Science*, 124:3228, Nov. 9, 1956. p. 923–925. 35 refs.

The findings of ureidosuccinic acid as a principal product of the thermal reaction of malic acid and urea under hot-springs conditions is pertinent to the origins of biological chemistry in that ureidosuccinic acid has been shown to be a key intermediate in the biosynthesis of nucleic acids. The accumulated data reveal a pathway of thermal synthesis, with reactions which also represent some of the early steps in biosynthesis. The presumption that thermal reactions imitate prebiological chemistry is supported by the deduction that the most primitive algae are thermophilic, by the inference that the current biochemical world is not greatly different from the primordial biochemical world, and by additional evidence from thermal experiments described in this paper. (Author)

## 870

**VEGETATION ON MARS.**
**(No Author)**
*Sky and Telescope*, Vol. 16, Oct.–Nov. 1956. p. 275.

The presence of the 3.45$\mu$ absorption band in the infrared spectrum of Mars was detected by a statistical analysis of spectra and indicates the presence of organic molecules on Mars. Comparisons of spectra of terrestrial plants show a double absorption band due to the organic molecules at 3.45$\mu$ which is less evident in mosses and lichens. The limited amount of reflected energy from Mars precluded the assignment of the infrared absorption to any specific area on Mars. It is assumed that the presence of organic molecules is indicative of vegetative life. (E.O.)

## 871

**THE COLOURS OF MARTIAN "VEGETATION."**
**A. E. Slater**
*Spaceflight*, 1:1, Oct. 1956. p. 35–39.

Color changes on Mars are discussed as evidence for the existence of vegetation on the planet. Spectroscopic evidence is presented in support of this theory. (S.T.L.)

## 872

**EVOLUTION OF PROTEIN MOLECULES AND THERMAL SYNTHESIS OF BIOCHEMICAL SUBSTANCES.**
**S. W. Fox**
*Am. Scientist*, Vol. 44, Oct. 1956. p. 347–359.

A sequence of thermal reactions simulating prebiological chemistry is described and their essential "orderliness" is defined. The relationships suggested in the thermal studies are

reminiscent of the biological approximation that ontogeny recapitulates phylogeny. In the flowsheet we see a second chemical generalization analogous to a biological parallel. This can be expressed, with the appropriate qualifications, as biochemistry recapitulates pyrochemistry. The thermal thesis, in conjunction with the interpretations of evolution of protein in the biological era, makes it possible to visualize an outline of how the complex system of which we are a part might have originated from simple chemical beginnings. (E.O.)

## 873

MARS OPPOSITION AND MARS CLIMATE.
J. Hoppe
*Urania* (Leipzig), 19:10, Oct. 1956. p. 374–377.

Astronomical research on conditions on the planet Mars is summarized. The essential difference between Earth and Mars lies in the lower density of Martian atmosphere and the scarce supply of water and oxygen. Thermal conditions are presumably similar to Earth.

## 874

THE ECOSPHERE IN THE SOLAR PLANETARY SYSTEM.
H. Strughold
*In:* Proc. VII Intern. Astronaut. Congr., Rome, Sept. 17–22, 1956. p. 277–288. 12 refs.

The ecosphere in the solar planetary system is a biologically defined concept concerning the possibility of life on planets. It refers to a zone surrounding the Sun, in which solar radiation on the one hand does not exceed the ecological maximum, and on the other hand does not fall below the ecological minimum.

Within these limits we recognize in the planetary system a biotemperature belt, a liquid water belt, and an oxygen belt. These belts all lie in about the same area around the Sun. To cover all of the ecological factors by a general concept, the term ecosphere of the Sun has been suggested.

The decisive factor is the distance from the Sun. In our planetary system the ecosphere evidently extends from the orbit of Venus to beyond Mars, roughly a distance of about 50 to 150 million miles or 80 to 240 million kilometers from the Sun. The zone itself is therefore about 100 million miles or 160 million kilometers in width. This is less than 5 percent of the total expanse from the Sun to Pluto. The solar ecosphere is, therefore, a relatively narrow zone within our planetary area. The concept of ecosphere may also be applied to other suns in the universe. (Author)

## 875

THE EVOLUTIONARY UNIVERSE.
George Gamow
*Sci. Am.*, 195:3, Sept. 1956. p. 145–154.

Most cosmologists believe that the universe began as a dense kernel of matter and radiant energy which started to expand about 5 billion years ago and later coalesced into galaxies.

## 876

CHEMICAL EVOLUTION AND THE ORIGIN OF LIFE.
M. Calvin
*Am. Scientist*, 44:3, July 1956. p. 248–263. 10 refs.
(Also issued as Univ. of Calif. Radiation Lab., UCRL–2124, rev. Aug. 11, 1955.).

A discussion is presented of the elements, or at least most of the elements, that are usually thought of as required and characteristic of living materials. A continuous evolutionary process is conceived, beginning with a bare earth and leading to the random formation of more or less complex molecules from simple ones, and gradually, by the processes of random variation, autocatalysis, and selection, to more complex systems and the ordered array of desoxynucleic acid molecules which are the units that carry the continuity and order of present-day living systems. (Author)

## 877

THE SURFACE CONDITIONS ON VENUS.
E. J. Opik
*Irish Astron. J.*, Vol. 4, June 1956. p. 37–47.

A review is made of conditions within the atmosphere of Venus from photographic, spectrographic, and radiometric observations. The clouds are believed not to be water vapor but dust from a desert surface. The amount of $CO_2$ in the atmosphere, which may range from 40–100%, and the lack of water vapor indicates the absence of plants and organic life. The absence of water could be the chief cause which prevented the development of life. A rotational period equal to 10 days is inferred from rates of nocturnal cooling. Dark bands observed on the cloud surface are probably due to crests of the cloud surface where the scattered light of the atmosphere is decreased. A yellow color to the clouds indicates a suspension of very fine dust particles at high altitudes. (E.O.)

## 878

THE VOLCANIC-AEOLIAN HYPOTHESIS OF MARTIAN FEATURES.
D. B. McLaughlin
*Publ. Astron. Soc. Pacific*, 68:402, June 1956. p. 211–218. 15 refs.

Arguments both for and against volcanism on Mars are presented. The author feels the vegetation hypothesis and the volcanic hypothesis are not mutually exclusive; the volcanic-aeolian hypothesis was developed expressly to account for the forms of the markings which the growth of vegetation by itself does not. (S.T.L.)

## 879

THE SURFACE-TEMPERATURE CLIMATE OF MARS.
F. Gifford
*Astrophys. J.*, 123:1, Jan. 1956. p. 154–161

The radiometric measurements of Martian surface temperatures obtained by Lampland between 1926 and 1941 were analyzed by the "method of water-cell transmissions." The data indicate an extreme diurnal temperature variation of 50° C, and a rigorous climate. However, it appears that midday temperatures

exceed 0° C. The average date of the summer temperature curve lags 60 days behind the southern-hemisphere summer solstice, and that of the fall curve about 20 days behind the autumnal equinox. (Aerospace Med.)

## 880

THE ECOSPHERE IN THE SOLAR PLANETARY SYSTEM (HELIO-ECOSPHERE).

*In:* Hubertus Strughold, ed. Proc. 7th Intern. Astronaut. Congr., Rome, Roma, Associazione Italiana Razzi, p. 277–288. 1956. 12 refs.

The ecosphere in the solar planetary system is a biologically defined concept concerning the possibility of life on planets. It refers to a zone surrounding the Sun, in which solar radiation on the one hand does not exceed the ecological maximum, and on the other hand does not fall below the ecological minimum. Within these limits we recognize in the planetary system a biotemperature belt, a "liquid water belt" (H. Shapely) and an oxygen belt. These belts all lie in about the same area around the Sun. To cover all these ecological factors by a general concept, the term ecosphere of the Sun has been suggested. The decisive factor is the distance from the Sun. In our own planetary system the ecosphere evidently extends from the orbit of Venus to beyond Mars, roughly, a distance of about 50 to 150 million miles or 80 to 240 million kilometers from the Sun. The zone itself is therefore about 100 million miles or 160 million kilometers in width. This is less than 5 percent of the total expanse from the Sun to Pluto. The solar ecosphere is, therefore, a relatively narrow zone within our planetary area. The concept of ecosphere may also be applied to other suns in the universe. (Author)

## 881

GUIDE TO MARS.

P. Moore

London, F. Muller, 1956. 124 p.

Prominent theories and observations of the movements, polar caps, deserts, atmosphere, surface conditions, canals and satellites of Mars are reviewed. From a brief discussion of the possibility of life on Mars, it is concluded that there is no conclusive evidence against the existence of low forms of vegetation, and considerable evidence to support the presence of life. (Aerospace Med.)

## 882

MARS, THE NEW FRONTIER. LOWELL'S HYPOTHESIS. DOES ANALYSIS OF THE NETWORK OF CANALS ON MARS INDICATE INTELLIGENT DESIGN?

W. A. Webb

San Francisco, Calif. Fearson Publ., 1965. 123 p.

Contents:

Chapter 1: Science and Controversy. Chapter 2: Science and the Personal Factor. Chapter 3: Astrobiology. Chapter 4: The Martian Researches of Percival Lowell. Chapter 5: Criticisms of Lowell's Hypothesis. Chapter 6: Evidence for Martian Life of a Low Order. Chapter 7: Evidence for Martian Life of High Order. Chapter 8: Correlation of the Martian Canal System. Chapter 9: A Hypothetical History of Mars. Chapter 10: Strange Sightings.

## 883

MYSTERY OF MARS.

H. P. Wilkins

*In:* Annual Report of the Board of Regents of the Smithsonian Inst. p. 229–244. Wash., D.C., GPO, 1956. (Publ. 4272)

It is now generally admitted that there is life of some sort on Mars. The seasonal changes in the dark markings suggest the presence of vegetation. The question is whether this consists merely of vegetation, possibly with some elementary animal life, or whether there are or ever have been creatures somewhat resembling man. Discussion of this question, pro and con, is set forth.

## 884

ON THE ESCAPE OF WATER FROM MARS.

H. C. Urey

*Publ. Astron. Soc. Pacific*, Vol. 68, 1956. p. 220–222.

A rebuttal is made to arguments by Kuiper that water cannot escape rapidly from Mars and that volcanoes on Mars are impossible because they would produce more water than that observed on Mars. The evidence and rate of water loss from the terrestrial atmosphere has not yet been accurately established and, therefore, no conclusion can be drawn about Mars. It is probable that $O_2$ molecules as well as $H_2O$ molecules can rapidly escape from the Martian atmosphere because of lower energy requirements. Since evidence of life is indicated on Mars, and such life must have required a liquid environment to evolve, the absence of water on Mars would indicate either the escape of $O_2$ and $H_2$ from Mars or the absorption of $O_2$ by minerals. Possibly water in quantity may now be brought into being by volcanic action. (E.O.)

## 885

PHYSICAL CONDITIONS ON MARS.

A. E. Lebedinskiy

*Akad. Nauk SSSR*, 108:5, 1956. p. 795–798.

The presence of oxygen within carbon dioxide, as well as water and certain acids, together with not unreasonable temperature ranges (200° K–300° K) make life on the planet Mars possible, although unlike that on Earth. (A.H.F.)

## 886

THE PLANET VENUS.

P. Moore

London, Faber and Faber, 1956. 132 p. 155 refs.

The physical characteristics of Venus derived from telescopic, photographic, and spectroscopic data are described, including the orbit, velocity, atmosphere, period of rotation, and surface of the planet. It is concluded that, although reasonable temperature and atmospheric conditions probably are present on Venus, spectroscopic observations showing a lack of atmospheric mo-

lecular oxygen indicate an absence of life. The possibility is suggested that Venus may be in a Cambrian-equivalent stage in which primitive organisms capable of development into more advanced forms of life are present in oceans covering the surface of the planet. (Aerospace Med.)

## 887

THE PROBLEM OF LIFE ON MARS.
B. G. Fesenhoff
*Astron. Zh.*, Vol. 53, 1956. p. 440–443. (In Russian; English Abstract)

It is shown that the statement about the complete correspondence of the thermal and reflecting properties of the "continents" and "seas" on Mars has no relation to the laws of radiation and does not depend on any analytical hypothesis. This close correspondence is strong evidence against vegetative life on Mars. The same conclusion may be drawn by the evidence showing an absence of any sensible change in the contrast between the "continents" and the "seas" as the edge of the planetary disk is approached. (Author)

## 888

SPACE TRAVELER'S GUIDE TO MARS.
I. M. Levitt
N.Y., Henry Holt Co., Inc., 1956. 175 p.

MARS: The growth of the dark areas on Mars is associated with the shrinking of the polar caps and led us to the belief that vegetation flourishes as the meager water supply is released by melting of the polar caps in summer. This vegetation is assumed to be a primitive type similar to our lichens which have adapted to the ultraviolet radiation and scarcity of oxygen. These lichens are probably different from terrestrial lichens in view of the different conditions in which they have developed. There is no evidence that animal life can exist on Mars, and, if it does, it would not have evolved along the same pattern as on Earth.

MERCURY: Mercury has been ruled out as a possible life-bearing planet.

VENUS: Venus may possibly have life which has adapted to the rigorous environment of very high temperatures and an atmosphere containing only carbon dioxide.

JUPITER: Jupiter, because of its extreme cold temperature would make evolution of life impossible.

SUN: It is possible that there are many stars like our own sun surrounded by planetary systems identical to ours. Stars which are slightly older than the sun may be scattered through space and, therefore, there may be life around these stars which is farther advanced than life on Earth. (E.C.)

## 889

THE VOLCANIC-AEOLIAN HYPOTHESIS OF MARTIAN FEATURES.
D. B. McLaughlin
*Publ. Astron. Soc. Pacific*, Vol. 68, 1956. p. 211–218.

Arguments that the form of the Martian maria are due to windblown deposits of volcanic ash from an extensive series of active volcanoes are presented. Although vegetation is usually considered the explanation for the dark maria, the volcanic theory and vegetation theory are not mutually exclusive, since the seasonal variation in hue may be due to vegetation growing on areas of deposited volcanic ash and associated moisture. Although the scarcity of water would seem to indicate a similar lack of volcanism, no reliable estimate is yet to be had of the actual available water on Mars. Maps of Mars are very consistent with the concept of flow patterns originating from point sources and curved because of the Coriolis effect. Trade winds carrying ash would produce the dark patterns over large areas of relatively undisturbed flow. (E.O.)

## 890

THE WORLDS AROUND US.
Patrick Moore
N.Y., Abelard-Schuman, 1956. 151 p.

This book systematically rules out the possibility of intelligent life existing on any other body in the solar system, although the dark areas on Mars are believed to represent some low form of vegetation. (M.B.G.)

Contents:

Chapter 1: Are There Other Men? Chapter 2: Other Worlds. Chapter 3: Where Can Life Exist? Chapter 4: Men in the Moon. Chapter 5: Airless World. Chapter 6: Cold Worlds. Chapter 7: Scorched Worlds. Chapter 8: Life on Venus. Chapter 9: The Martians. Chapter 10: Signaling to Other Worlds. Chapter 11: Visitors from Other Worlds. Chapter 12: Colonies on Other Worlds.

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## 891

THE VOLCANIC THEORY OF MARTIAN GREEN AREAS.
A. E. Slater
*J. Brit. Interplanet. Soc.*, Vol. 14, Nov. 1955. p. 319–323.

A review of the volcanic theory proposed by McLaughlin for the dark areas of Mars is presented. A trade wind system on Mars seems plausible, although observers have not noticed certain convergence zones of heavy cloud formation, as is the case on Earth. Some parts of the descriptions of the dark areas seem consistent with the idea of a point source and occasional limited changes in wind direction. However, in areas of weak winds there should be a greater concentration of matter around each major source, and again there is no observational evidence for this. It is suggested that the seasonal change in intensity of the dark areas may be due to a combination of factors: volcanism, which ejects moisture and ash; and the seasonal growth of vegetation, which depends on moisture from volcanoes and the melting polar cap. (E.O.)

## 892

PERSPECTIVES IN EVOLUTION.
H. F. Blum
*Am. Scientist*, 43:4, Oct. 1955. p. 595–610.

The panorama of evolution—chemical, prebiological, protobiological and biological—is presented from an introduction to thermodynamics and the concept of entropy. The author summarizes by concluding that future earthly evolution for man is in the realm of his thought processes. He concludes that it is not unlikely that life exists on planets of other stars and that extraterrestrial evolution may have a pattern quite similar to our own.

## 893

ON THE MARTIAN SURFACE FEATURES.
G. P. Kuiper
*Publ. Astron. Soc. Pacific*, Vol. 67, Oct. 1955. p. 271–282.

A description of the surface markings on Mars, their change in form and color, and their probable nature is presented. The historical observations of the canals of Mars are reviewed. The present consensus relegates them to natural surface features. The apparent colors of the Martian maria, which are usually greenish, deteriorate as the seeing improves, often yielding almost the same color as the surrounding deserts. Although volcanic ash deposited by presently active volcanoes has been suggested as the cause of the dark markings, the lack of water on Mars contradicts excessive volcanic action. Plant life still appears to be the most satisfactory explanation for the shades of the markings and their seasonal and secular changes. (E.O.)

## 894

THE LIMITS OF LIFE.
P. F. James
*J. Brit. Interplanet. Soc.*, 14:5, Sept. 1955. p. 265–266.

The extremes of temperature, pressure, and lack of oxygen in which low order forms of life can survive are demonstrated. Desiccated rotifers can live at temporary temperature ranges from — 272° C. Less extreme ranges are tolerated by lichens, tardigrates and protozoa. An important factor for survival seems to be that most of these organisms have less than 30% water in their tissues compared to 80% in normal muscle. Life is demonstrated on the ocean floor at 1000 atm., and snails can remain active indefinitely at an oxygen partial pressure of 2 mm. It is suggested that, within the environmental conditions on Mars, there may exist quite complex small plants served by small animals of the tardigrate type developed along the lines of an ant colony. (E.O.)

## 895

GEOLOGIC EVIDENCE OF CHEMICAL COMPOSITION OF THE PRE-CAMBRIAN ATMOSPHERE.
K. Rankama (U. of Helsinki, Finland)
*In:* Arie Poldervaart, ed. CRUST OF THE EARTH. p. 631–650.
Baltimore, Waverly Press, July 15, 1955.

It is shown that the presence of a reducing atmosphere in early Precambrian time appears thoroughly possible geologically and is not contradicted by such evidence as can be collected from rocks. (Author)

## 896

PHOSPHORUS AS A FACTOR IN THE ORIGIN OF LIFE.
A. Gulick
*Am. Scientist*, 43:3, July 1955. p. 479–489. 15 refs.

It is now recognized that practically every form of energy

exchange inside the living cell involves the making and breaking of what are called the "high energy bonds" that link oxides of phosphorus to carbon compounds or carbon-nitrogen compounds. Every biological or physiological event involves gain or loss of energy, and accordingly we may infer that these energy-rich phosphorus bonds have always played a crucial role, even from the very start of the most primitive manifestation of life.

The availability of phosphorus for emerging life forms is discussed, and theories of primitive Earth conditions at that time presented. (Author)

## 897

### PRODUCTION OF SOME ORGANIC COMPOUNDS UNDER POSSIBLE PRIMITIVE EARTH CONDITIONS.

S. L. Miller

*J. Am. Chem. Soc.*, 77:9, May 12, 1955. p. 2351—2361. 47 refs.

A mixture of gases, $CH_4$, $NH_3$, $H_2O$ and $H_2$, which possibly made up the atmosphere of the Earth in its early stages, has been subjected to spark and silent discharges, for times of the order of a week, to determine which organic compounds would be synthesized. Several designs of apparatus and reasons for their construction are described. Analyses of the remaining gases were made and CO, $CO_2$, $N_2$ and the initial gases were found. A red compound that seems to be associated with the trace metals is formed, as well as yellow compounds (probably polymers) which have acidic, basic and ampholytic properties. The mixture of compounds is separated into acidic, basic and ampholytic fractions with ion exchange resins. The amino acids are chromatographed on Dowex-50 and the acids on silica. Glycine, d,l-alanine, $\beta$-alanine, sarcosine, d,l-$\alpha$-amino-n-butyric acid and $\alpha$-amino-isobutyric acid have been identified by paper chromatography and by melting points of derivatives. Substantial quantities of several unidentified amino acids and small amounts of about 25 amino acids are produced, while glycolic, d,l-lactic, formic, acetic and propionic acids make up most of the acid fractions. Quantitative estimates of these compounds are given. Evidence is presented that polyhydroxy compounds of unknown composition are present. HCN and aldehydes are direct products of the discharge. Although there is insufficient evidence, the synthesis of the hydroxy and amino acids may be through the hydroxy and amino nitriles in the solution. The relation of these experiments to the formation of the Earth and the origin of life is briefly discussed. (Author)

## 898

### THE INHABITANTS OF MARS.

F. Salisbury (Calif. Inst. of Tech.)

*Eng. Sci.*, Vol. 18, Apr. 1955. p. 23—32.

Evidence for life on Mars is reviewed and the nature of this life is speculated upon. The descent of a green wave from the polar caps as they melt has been interpreted as vegetation, since no known chemical undergoes such a color change under the influence of a small change in atmospheric water vapor content. The canals are still enigmatic and a volcanic ash theory proposed for both canals and dark areas does not fit all the facts. Spectra in the infrared of Earth lichens resemble somewhat infrared spectra of the Martian dark areas. However, the apparent completeness of cover of the areas on Mars and the rate of size, shape and color change show no similarity to the known characteristics of Earth lichens. Martian biochemistry may be slightly or radically different from Earth biochemistry. It is probable that some type of plant sucession, photosynthesis and natural selection occurs in Martian vegetation. Animal life may also show patterns based on environment and community structure, but conditions governing life on Mars can only be inferred. (E.O.)

## 899

### THE CONCENTRATION OF CARBON DIOXIDE IN THE ATMOSPHERE OF MARS.

J. Grandjean and R. M. Goody

*Astrophys. J.*, 121:2, Mar. 1955. p. 548—552.

From observations made by G. P. Kuiper of carbon dioxide bands in the spectrum of Mars, we have redetermined the fraction by volume of this gas in the planet's atmosphere, taking into account the fine structure of the band and the shape of the rotation lines. If the ground-level pressure on Mars is 100 mb, we find that the fraction by volume of carbon dioxide is 50 times greater than in the Earth's atmosphere. (Author)

## 900

### LIFE ON THE MOON.

P. Moore

*Irish Astron. J.*, 3:5, Mar. 1955. p. 133—137.

Conditions on the Moon are summarized to indicate the probable barrenness of the lunar surface. However in certain favored localities such as Eratosthenes, Grimaldi, Endymion, and Aristarchus, variable bands and patches have been observed by Pickering and others and may indicate the presence of vegetative life. This life may be centered around lunar cracks from which gas and water vapor escape. The lunar atmosphere is too tenuous to support any life and the collection of pockets of gas would be the only way in which low vegetative life might survive. (E.O.)

## 901

### LIFE ON OTHER WORLDS.

Otto Struve

*Sky and Telescope*, 14:4, Feb. 1955. p. 4, 137—140, 146.

Statements are presented that the basic facts of life on Earth are still vague and uncertain and that knowledge of physical features on Mars and Venus is insufficient to give reliable background for answering the question as to whether life exists or has ever existed on these planets. The view is taken that life is an intrinsic and inseparable property of certain aggregates of very complex organic molecules, formed in the medium of the necessary kinds of atoms. It is proposed that life may be on the verge of coming into existence on Venus and declining on Mars. Since there is no proof one way or the other, the most logical assumption is that most dwarf stars of the solar type have planetary systems and that the total number of planets with some form of life could be in the billions. (M.G.)

## 902

**ANABIOSIS.**
**P. Schmidt**
**Moscow, 1955. (In Russian)**

The survival of various organisms under conditions even more severe than those of Mars are described. It is assumed, therefore, that life can exist in some form on more than one planet. (A.F.)

## 903

**ANALYSIS OF THE MARTIAN CANAL NETWORK.**
**W. A. Webb**
***Publ. Astron. Soc. Pacific*, Vol. 67, 1955. p. 283–292.**

A mathematical statistical analysis was performed upon the intersections of the Martian canal network and the results compared to studies of microscopic cracks of inanimate nature, networks constructed by high order intelligence, and networks constructed by low order intelligence. Trumpler's map of the Martian canals was used. In natural cracks the majority of rays emerge from points having three rays; in spider webs, most rays emerge from points having four rays; and in man's communication networks, a substantial portion of the rays emerge from points having four rays, and many points in the pattern have more than four rays. In the Martian network, as defined by Trumpler, 43% of the canals pass out of junctions of four canals and about 38% of the canals pass out of junctions of more than four canals. The similarity between the Martian network and our communication network does not yet warrant conclusions until further evidence is obtained. (E.O.)

## 904

**THE ASH THEORY OF MARTIAN FEATURES.**
**R. Barker**
***J. Brit. Astron. Assoc.*, Vol. 65, 1955. p. 235–236.**

On the basis of visual observations, objections to the volcanic ash theory of Martian dark areas are raised. Marked parallelisms exist on the Moon but lunar volcanism would seem very improbable. The maria of Mars have distinctly shaped outlines and the thin atmosphere on Mars would seem to contraindicate patterns of ash laid down by trade winds. The wave of darkness sweeping towards the equator as the polar caps melt can be attributed only to vegetation. Weak points in the Martian crust may hold volcanoes, but any ash deposits would soon be covered by windblown dust from the desert. The volcanic theory would seem to be untenable in the light of available evidence for vegetation's causing the dark areas of Mars. (E.O.)

## 905

**BENEATH THE CLOUDS OF VENUS.**
**P. A. Moore**
***J. Astronaut.*, 2:1, 1955. p. 7–8.**

The known facts about Venus are summarized, and theories concerning the nature of the surface are presented. The atmosphere apparently hides any surface markings although Lowell believed he had detected straight hard lines on the surface similar to Mars. Vague polar caps seem to be an atmospheric phenomenon. Since carbon dioxide is plentiful, the concept of advanced life is very improbable. The surface may either be a completely dry dust bowl or be covered completely with carbon dioxide-impregnated water. A curious brightening of the dark side may be due to intense auroral displays in the upper atmosphere. (E.O.)

## 906

**THE CELL AS A STRUCTURAL UNIT.**
**G. A. Bartsell**
***Am. Scientist*, 43:1, 1955. p. 133–147.**

It is now apparent that the plan of organization exhibited in the living world, with the cell as a basic unit, does not differ intrinsically from that exhibited by inorganic materials. The difference is only in degree of complexity. The phenomena characteristic of life are possible only when a tremendously complex association of certain elements is present, but the materials used are the same nonliving materials. There is a generally continuous interchange of materials from the inorganic to the organic and back, but the structure and behavior of any atom is not changed when it is temporarily built into protoplasm. The complexity of living materials is maintained by utilization of radiant energy and other phenomena which are beyond, and different from, any known nonliving association of elements. Nothing definite can be said about how, when, or where life originated. Studies of molecular biology, which may elucidate these processes, are discussed. (A.H.F.)

## 907

**CHANGES ON MARS AS EVIDENCE OF WIND DEPOSITION AND VOLCANISM.**
**D. B. McLaughlin**
***Astron. J.*, Vol. 60, 1955. p. 261–270.**

A counter argument is presented for the formation and appearance of the Martian dark areas by volcanic ash deposits rather than by vegetation. Evidence from moving clouds seems to indicate extensive monsoon type winds on Mars. The volcanic hypothesis was developed to explain the greatest temporary changes observed historically. Shifting boundaries of maria are interpreted as due to aeolian deposition of light-colored desert dust or dark volcanic ash accompanied by variable volcanic activity and changes of wind direction. The amounts of ash required for any of the temporary markings are only a few cubic kilometers comparable to the output of major terrestrial eruptions. The patterns of the maria, especially the vertices of the pointed bays, do not support a vegetation theory, since if these points were sources of moisture or fertile dust the concept of volcanoes at these points is strengthened. (E.O.)

## 908

**DEVELOPMENT OF THE HYDROSPHERE AND ATMOSPHERE.**
**W. W. Rubey (Geological Survey, Wash., D. C.)**
***Geol. Soc. Am., Spec. Paper*, Vol. 62, 1955. p. 631–650.**

Evidence is presented for the conclusion that the Earth's atmosphere, even very early in Earth history, must have contained at least a small amount of free oxygen. This conclusion does not

negate the current Oparin-Horowitz theory of the origin of life, however, since there were then, as now, local environments in the ocean and in mud pools where free oxygen was absent. The first organisms may have come into existence in just such local reducing environments. (M.P.G.)

## 909

THE IMPORTANCE OF TRACE ELEMENTS IN BIOLOGICAL ACTIVITY.
D. Baudisch
*Am. Scientist*, Vol. 31, 1955. p. 211–240.

The general outline of the anaerobic theory of the primitive atmosphere is accepted, but the presence of easily available oxygen from oxide sources is assumed. Oxygen being absent, no ozone would be in the atmosphere, hence ultraviolet light could penetrate further and have greater effects than we observe today. This could supply the energy for the original photochemical synthesis of biological materials. The starting point for the formation of protein substances might be $_2H_2CO + N_2O + H_2O + {}_2HOCH = NOH$. (A.H.F.)

## 910

IS LIFE POSSIBLE ON OTHER PLANETS?
G. A. Tikhov
*J. Brit. Astron. Assoc.*, 65:5, 1955. p. 193–204.

The author reviews the known characteristics of Mars and Venus, and points out that terrestrial life forms are known to survive under equally extreme environmental conditions. Russian experiments concerning infrared emissivity of plants are reviewed, and hypotheses concerning the paleobotany of the planets are discussed. From the adaptability of micro-organisms, the author concludes that life forms are present on Mars and may be present on Saturn, Venus, Neptune, and Jupiter. The conclusion is also drawn that life is a persistent phenomenon. (M.F.G.)

## 911

MERCURY—THE BARREN PLANET.
P. A. Moore
*J. Astronaut.*, 2:4, 1955. p. 145–148.

The physical conditions on Mercury are reviewed. By indirect polarimetric methods, an atmosphere has been detected by Dollfus on the order of 1 mm of Hg. Temperatures range from 700° F on the sunlit side to a low on the dark side which must be as low as anywhere in the solar system. Surface features are ill-defined and no evidence of high mountains has been discovered. Any form of life on Mercury seems to be out of the question due to the extreme conditions, although the twilight zone may have a less rigorous temperature range. (E.O.)

## 912

THE NATURE OF THE PHYSICAL WORLD.
A. S. Eddington
London, Dent & Sons, Ltd., 1955. 341 p.

The author assumes that the required conditions for life on other worlds are similar to those on the Earth, and, if such conditions appear that life will automatically follow. Of the planets of the solar system, only Venus and Mars are eligible, and Mars is discussed as the more likely. Seasonal changes support the Martian vegetation theory. Mars has every appearance of being a planet long past its prime; and, in any case, it is improbable that two such different planets as Mars and the Earth would be in the zenith of biological development concurrently. (E.C.)

## 913

ON THE QUESTION OF EXTRATERRESTRIAL LIFE (ZUR FRAGE AUSSERIRDISCHEN LEBENS).
Heinrich Faust
*Weltraumfahrt* (Germany), Vol. 6–9, 1955–1958. p. 23–24. (In German)

## 914

PYROSYNTHESIS OF ASPARTIC ACID AND ALANINE FROM CITRIC ACID CYCLE INTERMEDIATES.
S. W. Fox, J. E. Johnson and M. Middlebrook
*J. Am. Chem. Soc.*, Vol. 77, 1955. p. 1048–1049.

A thermal origin of biochemistry is speculated upon from the synthesis of aspartic acid and alanine from two ammonium salts of acids in the citric acid cycle. Ammonium fumarate and malate were heated for three hours at 200° F., and chromatographed before and after hydrolysis. The amino acids were more easily observed after hydrolysis. The conditions under which these amino acids were formed can lead to the formation of one or more additional amino acids and can result in a proteinoid polymer from which these amino acids are recovered following hydrolysis. (E.O.)

# 1954

## 915

**SOME COMMENTS ON STRUGHOLD'S IDEAS ON MARTIAN VEGETATION.**

A. E. Slater

*J. Brit. Interplanet. Soc.*, Vol. 13, Nov. 1954. p. 334–336.

Several objections are offered to the theory of vegetation on Mars proposed by Strughold. The lack of oxygen in the Martian atmosphere has been explained by a storage mechanism within the plant which conserves unutilized oxygen. However, decay of dead plants is an oxidation process and it must be explained how surplus oxygen stored in the growing plants can be transferred to the dying ones to help make them decay. The seasonal color change which occurs on Mars cannot be attributed to vegetation unless it can be shown that organisms containing green chlorophyll must necessarily change color in this way. Also, the spectrum of earth lichens in the infrared which apparently is almost a straight line cannot be applied to similar straight line spectra of Mars unless specific and equal absorption bands are shown by both earth and Martian spectra. (E.O.)

## 916

**FURTHER NOTES ON MARTIAN FEATURES.**

D. B. McLaughlin

*Publ. Astron. Soc. Pacific*, 66:392. Oct. 1954. p. 221–229. 21 refs.

In this paper an account is given of numerous Martian features in terms of well-known terrestrial processes such as volcanism. Morphology of the markings is the crucial evidence. Many facts of orientation and form have been neglected; even the color of the maria and the seasonal changes, long attributed to vegetation, appear consistent with the hypothesis. (S.T.L.)

## 917

**INTERPRETATION OF SOME MARTIAN FEATURES.**

D. B. McLaughlin

*Publ. Astron. Soc. Pacific*, 66:391, Aug. 1954. p. 161–170. 11 refs.

Numerous dark markings of the Martian surface can be rationally explained in terms of natural mechanisms that are familiar to the inhabitants of the Earth. Primarily the agencies appear to be volcanism and aeolian transportation and sedimentation. This hypothesis accounts for most of the maria and some of the canals. (S.T.L.)

## 918

**ANHYDROCOPOLYMERIZATION OF AMINO ACIDS UNDER THE INFLUENCE OF HYPOTHETICALLY PRIMITIVE TERRESTRIAL CONDITIONS.**

S. W. Fox and M. Middlebrook

*Federation Proc.* Vol. 13, Mar. 1954. p. 211.

Extrapolation of concepts of molecular evolution in regard to proteins may be accomplished by anhydrocopolymerization of amino acids under primitive earth conditions. Equimolar combinations from DL forms of aspartic acid, leucine, valine, and phenylalanine heated at 200° for ½ to 3 hours yielded appreciable portions of acetone-soluble tars and polymers which gave assayable amino acids upon hydrolysis. Leucine was found in greater proportion than valine and seems to be related to the results of experimental comparisons of leucine and valine in enzymic synthesis of anilides and to the known composition of protein. (Author)

## 919

**THE BIOCHEMISTRY OF THE TERRESTRIAL ATMOSPHERE.**

G. E. Hutchinson (Yale U.)

*In:* G. P. Kuiper, ed. THE SOLAR SYSTEM. Univ. of Chicago Press, 1954. 751 p.

Chemical reactions occurring at low levels of the Earth's atmosphere due either directly or indirectly to living matter at the surface of the Earth are discussed, and the possibility of like phenomena occurring on Mars is considered. The infrared spectrum of the green areas on Mars is similar to that of xerophytic lower plants. Three major difficulties in proposing a flora of the general complexity of lichens are discussed. The possibility of nitrite-nitrate oxygen acceptor system in the organisms is considered. This hypothesis is supported by considerations of the past history of the planet. It is just possible that magnesium nitrate may be involved in lowering the freezing point of the liquid contents of the organisms. (M.P.G.)

## 920

**COSMOCHEMICAL CONSIDERATIONS.**

G. E. Hutchinson

*In:* Gerard P. Kuiper, ed. THE SOLAR SYSTEM, Vol. 2—*The Earth As a Planet;* p. 422–427.

Univ. of Chicago Press, 1954.

Objections to the occurrence of a lichenlike flora on Mars are discussed. (1) Water source appears to be precipitated ice; (2) difficulty in development of life unprotected by a layer of oxygen or water in the ultraviolet radiation that reaches the planet. The ultraviolet radiation would disrupt any nucleic acids present; (3) difficulty in carrying on metabolism at the very low temperatures present. It is possible that in an earlier stage water and oxygen were more abundant, and the oxygen which did not leave the planet became nitrified. It is speculated that an ultra-xerophytic flora depends on the nitrate for its oxygen by night and that magnesium nitrate is responsible for lowering the freezing point of liquid contents of the organism. (E.C.)

## 921

EXPLORING MARS.
R. S. Richardson
N. Y., McGraw-Hill Book Co., Inc., 1954. 261 p.

Low forms of animal and plant life may exist on Mars. Scarcity of oxygen would probably prevent the development of intelligent life. Seasonal color changes indicate the presence of vegetation on Mars. Because of environmental extremes lichens appear to be the most likely type of vegetation. Postulation is made of the possibility of an entirely new type of life on Mars. (E.C.)

## 922

FACT AND FANCY IN DISCUSSIONS ABOUT THE ORIGINS OF LIFE.
N. W. Pirie
*Sci. Cult.*, Vol. 20, 1954. p. 261–265.

Available theories on the origin of life on Earth are outlined: The theory of panspermia is briefly reviewed but rejected since the theory conveniently leaves the origin of life to a distant part of the universe. Controversy still arises over the composition of the primitive atmosphere. Ultraviolet light provided energy for chemical synthesis. Certain reactions produce characteristic metabolic products in a cyclic fashion which almost satisfy the criteria for a living system. The protobiotic "soup" developed some method of selection and evolution using available energy sources. Although present day organisms have a uniformity of chemical composition, this is probably the result of the most successful metabolic chain and not the only chain. Protein-based biology appears to be the most effective since a great variety of substances can be produced with relatively few bases. (E.O.)

## 923

LIFE ON THE MOON?
P. Moore
*Irish Astron. J.*, Vol. 3, 1954–55. p. 133–137.

The possibility of plant life on the Moon is considered in relation to certain craters and some vague and unexplained markings. The hostile environment for life on the Moon is discussed. The crater Eratosthenes shows dark areas which "spread" with the coming of day, and these areas Pickering believed to be vegetation. Aristarchus shows dark bands which apparently have become more prominent in the last century. Any plants which existed on the Moon could only exist around fissures from which needed gases or water vapor might issue, but the likelihood of this is very small. (E.O.)

## 924

MAN AND THE PLANETS.
R. S. Richardson (Palomar Obs., Calif.)
London, Muller, 1954. 188 p.

Chapters 6 and 7 discuss possible forms of vegetable and perhaps animal life on Mars on the basis of Martian surface and atmospheric observations. The interpretations that have been ascribed to the canals by various observers are reviewed. In Chapter 10, observations of Venus are interpreted as making life unlikely, but not impossible, on that planet. (M.P.G.)

## 925

MARS, PLANET OF MYSTERY.
N. J. Bowman
*J. Space Flight*, 6:1, 1954. p. 1–7.

The physical characteristics of Mars are reviewed and the theory of the development and adapting of life to Martian conditions is discussed. The question of whether Mars has a massive core or is composed of homogeneous material has a direct bearing on the probability of life. Oblateness measurements do not indicate such a core. Core formation is probably responsible for the abundance of oxygen and water on Earth. Vegetation may exist, but higher type plants are supposedly excluded because the spectrographic absorption bands are not the same as those from chlorophyll found in vascular plant life on Earth. Assuming that once conditions were favorable for the development of life, and that Mars represents a degenerate state rather than an undeveloped state, animal life of higher intelligence could have evolved and adapted itself to the present vigorous conditions. The increase in cosmic radiation from atmosphere loss may either have aided mutation and adaption or promoted extinction. The possibilities of life will increase if better measurements revise the oxygen content upwards and give a positive answer to the question of a Martian core. (E.O.)

## 926

MARTIAN JUVENATION: THE EFFECTS ON PLANETARY CONDITIONS.
W. Proell
*J. Space Flight*, 6:5, 1954. p. 1–5.

A scheme is proposed to manufacture a habitable environment on Mars by the deliverance of some $10^{20}$ grams of water with a thermonuclear energy source. Normal photodissociation and hydrogen loss would give Mars an oxygeniferous atmosphere of about 30 mm pressure within 300 years of delivering the water in the form of ice to the planet. Since kinetic energy of the ice mass would have to be dissipated, the crashing of the ice mass would result thermally in great geographic and climatic changes on Mars. Mars is presumed to have a moderately varied life and perhaps intelligent life. Juvenation would certainly have an adverse effect by the shock and induced changes. Although the scheme is now impractical it may someday be necessary and practical. (E.O.)

927

OUR MOON.
H. P. Wilkins
London, Muller, Ltd., 1954.

Certain lunar observers are of the opinion that dusky bands seen on the moon are presumably individual clumps of vegetation and the plots where they grow. It would seem obvious that no high form of life can exist on the moon because of the virtual vacuum and temperature variations. Since there has been a failure to detect any certain effects due to the impact of meteors, the existence is suggested of at least a trace of atmosphere, and, if this is so, life of some kind may have come into being and may still exist clinging to cracks and pits from which gas and moisture ooze. (A.W.)

928

PHYSICS OF THE PLANET MARS.
G. deVaucouleurs
N.Y., Macmillan Co., 1954. 365 p.

Martian atmosphere, climatology, polar caps and the problem of water, surface and internal constitution are discussed. The nature of the dark area is still unknown. It is provisionally concluded that the balance of the new evidence afforded by recent astrophysical research, while pointing to the extreme severity of the conditions for life on Mars, supports rather than disproves the hypothesis of life on Mars. (M.P.G.)

929

VARIATION IN ATMOSPHERIC TRANSPARENCY OF MARS IN 1939.
E. P. Martz
*Publ. Astron. Soc. Pacific*, Vol. 66, 1954. p. 45–51.

Photographs of Mars taken in 1939 are discussed in relation to theories concerning the occasional clearing of the Martian atmosphere to blue light. Some correlation has been established between color changes occurring in supposed vegetation, and a greater influx of ultraviolet radiation at times of clearing. A relationship between time of planetary opposition and clearing has also been established. The possibility of the blue haze being due to $CO_2$ or $H_2O$ crystals or to scattering by dust or a fluorescent effect, is discussed. Examination of the photographs leads to a reciprocal relationship between atmospheric transparency and the presence of equatorial haze and limb light. (E.O.)

# 1953

## 930

LIFE ON OTHER PLANETS.
Harlow Shapley
*Atlantic Monthly*, Vol. 192, Nov. 1953. p. 29–32.

The probability of extraterrestrial life is calculated by determining the probability of the existence of other planets having environments similar to earth. If one star in a million has planets and one planet in a million has started life in a suitable environment, then there are probably $10^6$ life bearing planets in the metagalaxy. Within our solar system, the existence of Martian life has not been definitely proved, the Moon could hardly support life and Venus is still an enigma. Positional astronomy has already demonstrated a large planet around 61 Cygnus from perturbation studies, and it is likely that many other planetary systems will be found for adjacent stars. (E.O.)

## 931

IS MAN ALONE IN SPACE?
L. C. Eiseley
*Sci. Am.*, 189:1, July 1953. p. 80–82.

The probability of man's arising on another planet in the universe is examined in the light of contemporary concepts on evolution. Although other planets may harbor life of some kind, man as an event is unique. (S.T.L.)

## 932

A PRODUCTION OF AMINO ACIDS UNDER PRIMITIVE EARTH CONDITIONS.
S. L. Miller
*Science*, Vol. 117, May 15, 1953. p. 528–529.

In order to test the hypothesis that the organic compounds which serve as the basis of life were formed when the earth had an atmosphere of methane, ammonia, water, and hydrogen, an apparatus was built to circulate these gases past an electric discharge. The resulting mixture was tested for amino acids by chromatography. Glycine, $\alpha$-alanine, and $\beta$-alanine were obtained.

## 933

ASTROBIOLOGY
G. A. Tikhov
Moscow, 1953. 367 p. (In Russian)

Claims are made for the possibility of higher forms of life in extraterrestrial space, especially on Mars. Spectroscopic investigation appears to substantiate this possibility from the author's viewpoint. An evolutionary chart of life forms in relation to temperature extremes is given. (E.W.)

## 934

COMPARATIVE ECOLOGICAL STUDY OF THE CHEMISTRY OF THE PLANETARY ATMOSPHERE.
H. Strughold
*J. Aviation Med.*, Vol. 24, 1953. p. 393–399.

The chemistry of the planetary atmospheres is examined from a biological point of view in order to make a differentiation between certain characteristic ecological types of atmospheres. The atmosphere of Neptune, Uranus, Saturn, and Jupiter consists of hydrogen, helium, methane, ammonia, and probably water. The similarity of this composition to that of the protoatmosphere of earth is striking. The Martian atmosphere is qualitatively similar to earth; it is an oxidized atmosphere with low potential oxidizing power, and this may be sufficient to permit the existence of vegetation of lower order. Venus has no water or oxygen, and, therefore, could not support any kind of life, although this point is still a matter of astronomical dispute. Except for the Earth, all planetary atmospheres are anoxic or hypoxic. The larger planets are primarily anoxic; Mars and Venus may be already secondarily hypoxic or anoxic. (M.G.)

## 935

EVOLUTION OF LIFE.
J. D. Bernal
*Sci. Cult.* (Calcutta), Vol. 19, 1953. p. 228–234.

A theory of organic evolution is presented from the primitive Earth to the point of oxygen production by photosynthesis. The chemical substances in the atmosphere were exposed to ultraviolet light after the condensation of water vapor. Regenerative reactions probably occurred slowly, without catalysts, within a series of reaction chains. The source of reaction energy shifted from the ultraviolet to the visual upon dehydrogenation of cyclic compounds, a future aid to photosynthesis. The evolution of protein polymers was slow until a process initiated by the size of the molecule aided protein formation. Essential molecules associated with life processes evolved and became contributors to life

with the formation of the fatty membrane around the protocell. The decisive division in life forms came with the ability of colored catalysts such as chlorophyll to absorb long wave radiation, producing oxygen from water and finally ozone, which closed the door to the original photochemical synthesis of organic matter. (E.O.)

## 936

THE EVOLUTION OF LIFE IN THE UNIVERSE.
A. E. Slater
*J. Brit. Interplanet. Soc.*, Vol. 12, 1953. p. 114–118.

A report is given of a discussion of the evolution of life on Earth and on other planets or planetary systems. The formation of the primitive atmosphere and hydrosphere and the relation of life to the hydrosphere is traced. Life on Earth probably began by the adsorption of organic molecules on wet clay. Complex compounds resulted which with the aid of catalysts were able to reproduce themselves. However, the chemistry of life on other planets may be completely incompatible with our own. Life based on silicon atoms instead of carbon is not probable since these atoms are stable at only relatively high temperatures. Water apparently limits life to temperatures not greater than 50° C. Radioactivity may be important in producing variety through mutations. A planet within the mean temperature range of 0–33° C should be capable of producing life. (E.O.)

## 937

THE GREEN AND RED PLANET: A PHYSIOLOGICAL STUDY OF THE POSSIBILITY OF LIFE ON MARS.
Hubertus Strughold and G. Payton
*Albuquerque U., New Mexico Press*, 1953. 107 p. 74 refs.

The possibility of the existence of life on Mars is investigated in terms of biological criteria. Environmental factors essential to life, as we conceive it (such as temperature, atmospheric pressure, light, humidity, supply of oxygen, chemical constituents of the soil, etc.) are analyzed in detail. From comparisons with analogous factors encountered on Earth, it is deduced that a lower form of life on Mars in conceivable. There is evidence of the existence of a primitive type of plants, similar to the lichens growing on our desert rocks and in Arctic tundras, and there is a chance that the "animal kingdom" is represented by such lower forms as bacteria. But any higher form of animal or plant life must be discounted. While the authors' attention is focused on Mars, other planets are studied with regard to their comparative fitness as a biological environment. This leads towards an entirely new field of biological investigation which may be called "planetary biology." (G.W.)

## 938

IS MAN ALONE IN SPACE?
L. C. Eiseley
*Sci. Am.*, Vol. 189, 1953. p. 80–86.

A generally negative view on the possibility of extraterrestrial life is presented. It would be possible with an infinite temporal period and spacial extent to expect duplicates of man. However, since cosmological theory holds that the universe began some four to ten billion years ago, a temporal limitation is imposed. It would seem that evolutionary paths are largely the result of isolated accident. Although life has been postulated to exist on Mars, it is doubtful that any major life form could have evolved upon it. (E.O.)

## 939

LIFE AND THE UNIVERSE.
Earl Nelson.
London, Staples Press, 1953. 223 p.

Chapter 1: Discussion of the universe, the solar system, the possibility of life on Mars and Venus, the Martian canals, and other solar systems. Chapter 2: The Sun and Other Stars, includes a discussion of the possibility of life on other worlds. Chapter 4: Discussion of the origin of living matter. (M.P.G.)

## 940

LIFE ON MARS (DAS LEBEN AUF DEM MARS).
H. Strughold
*Weltraumfahrt*, Vol. 4, 1953. p. 24–26.

## 941

MARS
G. de Vaucouleurs
*Sci. Am.*, 188:5, 1953. p. 65–73.

Observations of the main features of the Martian surface and atmosphere are assembled. The review includes discussions of the polar caps, deserts, atmosphere, clouds, climate, dark areas, and canals. The plant-life hypothesis is considered to provide the most likely explanation of the seasonal variation of the dark areas. However, the characteristic reflection spectrum of chlorophyll is absent. This does not exclude the possibility that lower forms of plant-life such as lichens, mosses, and algae may exist. (M.P.G.)

## 942

ON CLIMATE AND LIFE.
H. Shapley (Harvard U.)
*In:* CLIMATIC CHANGE—EVIDENCE—CAUSES AND EFFECTS. p. 3–7. Cambridge, Harvard U. Press, 1953.

Speculation is made on the number of planets on which life may occur. Color variations of Mars do not necessarily mean that vegetation is present. Comparison of the climates of Mars and Earth is made. The Moon is lifeless. It is assured that terrestrial type life is nonexistent on Venus, if, indeed, any life form.

## 943

THE ORGANISM AND ITS ORIGIN.
K. M. Madison
*Evolution*, Vol. 7, 1953. p. 211–227.

A discussion involving the definitions of life and organism, the environmental conditions necessary for life, energy processes adaptation and evolution is presented. We recognize life by the manifestations of the organic organism. The energy for the organism could be derived from radioactivity, inorganic oxida-

tions or dehydrogenations, photolysis or organic oxidations, either aerobic or anaerobic. Radioactivity sources seem improbable for physical reasons. The evolution of more complex molecules utilizing these energy sources is theorized. The storage of energy by adenosine phosphate and the ability to duplicate needed organic molecules in a closed system formed the foundation required in the evolution of all subsequent living forms. (E.O.)

## 944

**PRESENTATION OF POLYASPARTIC ACIDS BY THERMAL AUTO-CONDENSATION—PRODUCTS OF ASPARTIC ACID (DARSTELLUNG VON POLYASPARAGINSAUREN AUS DEM THERMISCHEN AUTO-KODENSATIONS—PRODUKT DER ASPARAGINSAURE).**

J. Kovacs, I. Konyves and A. Pusztai

*Experientia*, Vol. 2, 1953. p. 459–460. (In German)

Aspartic acid changes on being heated without solvents to a not completely uniform substance of anhydride character. This appears to have a structure different from that assigned to it by earlier investigators. Mild hydrolysis produces a mixture of polyaspartic acids which has been freed by dialysis from constituents of low molecular weight leaving a polypeptide with the approximate molecular weight of 8200. It is presumed that this polyaspartic acid, differing from the known synthetic α-polyaspartic acid, closely approximates a β-polyaspartic acid. (Author)

## 945

**THE PROPERTIES AND THEORY OF GENESIS OF THE CARBONACEOUS COMPLEX WITHIN THE COLD BOKKEVELT METEORITE.**

G. Mueller

*Geochim. Cosmochim. Acta*, Vol. 4, 1953. p. 1–10.

The carbonaceous substances within the Cold Bokkevelt meteorite show uniform distribution. Analyses indicate a relatively high proportion of carbonaceous matter. The extracts consist mainly of complex organic acids, including some organically bound chlorine, an element so far undetected in terrestrial bitumens. The fact that the extracts are optically neutral indicates that the organic material may have been condensed from the atmosphere of the parent body through nonbiological processes of polymerization or other means. A low decomposition temperature of the finely divided carbonaceous substances indicates that the meteorite may have condensed under low temperature conditions. (E.O.)

## 946

**SPECULATION ON THE COSMIC FUNCTION OF LIFE.**

A. A. Williamson

*J. Wash. Acad. Sci.*, Baltimore, Md., 43:10, 1953. p. 305–311.

This is an outline of a schematic concept of the origin and evolution of life. The author proposes what he calls "the master biological phenomenon of this planet," namely, "the pyramid of life", which exhibits the following characteristics: (1) the law of territorial dominion; (2) the law that lower levels must precede higher; (3) the diminution of number, level by level; (4) the necessity for each level to have world wide dominion; (5) and the increased individual territorial dominion in inverse proportion to diminution of number. From these, the author argues for the probability of extraterrestrial life. (M.G.)

# 1952

## 947

**OPARIN'S HYPOTHESIS AND THE EVOLUTION OF NUCLEOPROTEINS.**

U. N. Lanham

*Am. Naturalist*, 16:829, July 1952. p. 213–218.

Oparin's theory of biopoesis and biogenesis from compounds such as iron carbide, metallic nitrides and water on primitive earth is reviewed as a basis for further hypothesis. Relatively large cell-like systems (coacervates) were the first self-producing structures; growth and division of whole systems represented biological growth and reproduction. Nucleoprotein centers, (self-duplicating or proteo-synthetic or both), are derived secondary structures and their reproduction is only ancillary to basic biological growth. This implies that animal viruses and bacteriophages are not representative of the most primitive organisms, but are either parasitic micro-organisms, which have lost most cytoplasmic functions, or are infectious fragments of the nuclear apparatus of cells, or both. (E.O.)

## 948

**OUR NEIGHBOR MARS.**

T. R. Cave

*Sky & Telescope*, Vol. 11, Aug. 1952. p. 252–254.

A general description of Mars is presented for the amateur astronomer. The detection of the Martian "canals" is reviewed historically including Lowell's theory of intelligent construction. The surface features and the possible relation of the maria to areas of vegetation are described. Meteorology of Mars is covered briefly. (E.O.)

## 949

**APROPOS OF THE PAPER BY O. V. TROITSKAYA, "ON THE POSSIBLE EXISTENCE OF PLANT LIFE ON MARS".**

G. A. Tikhov, N. I. Kucherov, S. V. Tikhomirov, et al.

*Astron. Zh.*, Vol. 29, 1952. p. 738–744.

(Translated by G. Belkov for the Canada National Research Council. TT–429. 1954. 11 p.)

O. V. Troitskaya's stand—that there can be no life on Mars—is refuted. Her reasons are: (1) the absence of water bodies and the very small quantity of water vapor in the atmosphere; (2) the absence or very small quantity of oxygen in the atmosphere; (3) the low temperature of the planet; (4) a rarified atmosphere which causes severe cooling of the planet and exposes the planet to detrimental effect of ultraviolet rays of the sun. The authors compare her statements to known life conditions at the Pamir Biological Station which show: (1) Plants can survive drought periods with precipitation as low as 200 mm per year, developing little water in the tissues. (2) Oxygen may be stored by plants in roots or intercellular spaces for respiration. (3) The lowest temperature on Mars is about —70° C which corresponds to lowest temperature on Earth where 200 plant species have been recorded. Extremes of day-night temperature contribute to thermal hardening; some Earth plants bloom in snow and ice, sleeping at night. The Martian year is about twice as long as that on Earth, allowing vegetation time to seed and prepare for a severe winter. (4) The violet layer of the Martian atmosphere absorbs ultraviolet rays even more than the Earth's ozone, but plants would exist on Earth without the ozone layer in our atmosphere. (M.F.G.)

## 950

**ABOUT THE POSSIBILITIES OF PLANT LIFE ON MARS.**

O. V. Troitskaya

*Astron. Zh.*, 29:1, 1952. 13 p. 12 refs.

Trans. by J. L. Zygielbaum, Feb. 16, 1960.

(JPL–TRANS–8)

A. I. Oparin's theory on the origin of life is reviewed in light of knowledge about the physical conditions on Mars. The type of plant life that might exist on Mars is discussed. (S.T.L.)

## 951

**ASTRAGOLOSSA OR FIRST STEPS IN CELESTIAL SYNTAX.**

L. Hogben

*J. Brit. Interplanet. Soc.*, Vol. 11, 1952. p. 258–274.

The possibility of initiating long-distance communication with intelligent beings within or without the solar system provided such beings exist and have means of recognizing signals transmitted in some region of the complete wave spectrum, is investigated. A common framework for reciprocal understanding will be by the number concept and the knowledge of celestial occurrences. If extraterrestrial neighbors have advanced to our level of astronomical science, it will be possible to enlarge the radio lexicon successively by symbols for mass, temperature and distance, identification of elements by their spectra, and from there the

composition of the crust of the respective planets. The most formidable problem, antecedent to any exchange of biological information, will be how to introduce the Ego-concept. The paper concludes with a conceivable solution and its implications. (E.O.)

## 952

ENERGY FIXATION AND INTELLIGENT LIFE.
S. S. Kind
*J. Brit. Interplanet. Soc.*, Vol. 11, 1952. p. 168–172.

A general survey is made of the basic principles of life as found on the Earth's surface and to consider how far these principles may be applied to other unspecified planetary surfaces. Any extraterrestrial life similar to life as we know it must live by energy utilization, self reproduce, have its constituent units small, and have its nature ingrained into it in a relatively stable fashion (e.g., genes). Intelligent life on other planets must be a motile member of an energy dissipating group. The supply of fixed energy must not be limiting, hence requiring a synthesizing population comparable with the vegetation of Earth. (E.O.)

## 953

THE EXPLORATION.
F. L. Whipple and W. von Braun
*Collier's* 1952. p. 38–40, 42, 44–46, 48.

The exploration of the Moon's surface is discussed, including the investigation of a possible atmosphere and methods of examining its crust and core to determine its origin. (Author)

## 954

IS THERE LIFE ON THE PLANET MARS? (¿HAY VIDA EN EL PLANETA MARTE?)
R. Compte-Porta
*Urania*, Vol. 37, 1952. p. 56–59.

## 955

LIFE AND ITS EVOLUTION FROM AN ASTRONOMICAL VIEWPOINT.
E. J. Opik
*Irish Astron. J.*, Vol. 2, 1952. p. 9–20.

The nature of life is considered in its physical and philosophical sense and the method of evolution by mutation is discussed. Natural selection would seem to play a secondary role in the evolution of species but might play an important role in favoring one of several possible patterns of evolution. Statistical probabilities are given for mutations within species. The time required to produce new genera or families is of the same order of magnitude as required for new species. Approximately 200–300 million years is necessary for the full development of organic life. From considerations of the time scale involved in the degeneration of the sun, life on earth would not be again possible in the event of a preliminary extinction by a solar catastrophe. (E.O.)

## 956

ON THE EARLY CHEMICAL HISTORY OF THE EARTH AND THE ORIGIN OF LIFE.
H. C. Urey
*Proc. Nat. Acad. Sci.*, 38:4, 1952. p. 351–363. 18 refs.

Theories on the origin of life are discussed in relation to the early chemical composition of the Earth. Support for Oparin's theory of spontaneous generation of life from organic compounds formed in the reducing atmosphere of the primitive Earth is presented. During this period, organic compounds as complex as porphyrins occurred, and photosynthesis evolved. The time and conditions of the period of transition to an oxidizing atmosphere are discussed with numerous references and some suggestions for experimental investigations. (M.P.G.)

## 957

ON THE POSSIBLE NATURE OF EXTRATERRESTRIAL LIFE.
J. England
*J. Space Flight*, 4:2, 1952. p. 1–3.

The problem of the nature of extraterrestrial life is approached by analytical reasoning based on existing knowledge of the properties of the elements and also by analogy with known life forms. It is doubtful that life based on silicon chemistry would be sufficiently complex and of sufficiently diversified properties. Life, which could respire with gases other than oxygen, such as ammonia, would certainly not be in a high position on the evolutionary scale. Of course, metabolic systems are possible where the body-building and energy-producing functions are derived from foodstuffs without the necessity of atmospheric respiration. Another possibility lies in the direct use of energy, as in photosynthesis, as a basis for life. Knowledge of present and previous life forms on earth may be used as a basis of speculation for similar or related forms on other planets. A telepathic sense would probably be highly developed in advanced life forms. (E.O.)

## 958

OUR NEIGHBOUR WORLDS.
V. A. Firsoff
London, Hutchinson's Scientific and Techn. Publications, 1952. 336 p.

From an introduction of astronomy and cosmogony, the author considers rockets and propulsion as means of exploring the solar system. There is a discussion about space travel, its hazards and other characteristics. The major portion of the work is a discussion of the planets and their natural satellites, primarily a recapitulation of the known. (G.W.)

## 959

THE PLANETS—THEIR ORIGIN AND DEVELOPMENT.
H. C. Urey
New Haven, Conn., Yale U. Press, 1952. 237 p.

Postulation of possible life on Venus in its early history is made based on the theory that Venus in the beginning had an atmosphere similar to that of the newly formed Earth. Early environmental condition on Venus, Mars, and Earth are discussed with relation to the origin and evolution of life. Lichen-like life is the best explanation for seasonal color changes on Mars.
Contents:
Chap. 1: The origin of the solar system; Chap. 2: The moon; Chap. 3: The terrestrial planets; Chap. 4: Chemical processes

during the formation of the planets; Chap. 5: The heat balance of the Earth; Chap. 6: The abundances of the elements and the chemical composition of the solar system; Chap. 7: Summary and conclusions.

## 960

**WHAT DO WE KNOW ABOUT THE MOON?**

P. A. Moore

*J. Brit. Interplanet. Soc.*, Vol. 11, 1952. p. 19–40.

The moon, as our nearest neighbor in space, will necessarily be the first goal in interplanetary travel, but will prove an inhospitable world. Water is certainly absent, and the temperature range unpleasantly great. A very tenuous atmosphere may, however, persist. Some evidence of it is seen from time to time in the mists that cover the floors and walls of craters, and meteor trails have been strongly suspected. Higher forms of life are almost definitely out of the question, but the curious radial bands in a dozen or more craters may perhaps be due to a very low form of vegetation; and there are several cases of probable alterations in the surface features over the past hundred and fifty years. The popular belief that the moon is a dead changeless world may have to be modified in view of recent investigations. (Author)

# 1951

## 961

LIFE ON MARS IN VIEW OF PHYSIOLOGICAL PRINCIPLES.
Hubertus Strughold
*Cado Tech. Data Digest*, Vol. 16, Nov. 1951. p. 15–19.

A study of the possibility of life on other planets under aspects of physical ecology, such as the principles of limiting factors and adaptive processes, is discussed. Comparing the scale of biotemperatures with the temperatures found on the surfaces and within the atmospheres of the planets, it was found that only Mars and possibly Venus are left as ecological spaces since their range of temperatures partially covers the "thermo band of active life." The ecological properties of the Martian atmosphere are discussed in relation to minimum pressure of $O_2$ required for life. Emphasis is given to the importance of certain adaptations of the microscopic structure of plant tissue, such as intercellular air spaces, which by providing an internal atmosphere would facilitate plant life on Mars. (Author)

## 962

GEOLOGICAL INTERPRETATIONS OF THE MARKINGS OF MARS.
C. W. Tombaugh
*Astron. J.*, Vol. 55, Dec. 1949–Feb. 1951. p. 184.

The formation of the various markings on Mars by geological processes, asteroid impact, and association with hardy seasonal vegetation is discussed. Low temperatures would greatly retard oxidation of surface minerals. The deserts may consist of relatively unaltered rhyolitic igneous rock due to a lack of water erosion and minimal sand erosion. The round oases are sites of impact craters caused by collisions of small asteroids, filled by vegetation similar to lichens which find a favorable environment in the pulverized igneous rock and shelter offered by the crater. Previous civilizations capable of building the canals are ruled out by consideration of available natural resources. The canals may be fracture zones caused by asteroid impact which give haven to vegetation capable of absorbing slight atmospheric moisture. (E.O.)

## 963

THE AIR OF OTHER WORLDS.
V. A. Firsoff
*J. Brit. Interplanet. Soc.*, Vol. 10, 1951. p. 197–210.

The known planetary and moon atmospheres are discussed, as well as the possibility of atmospheric detection around solar system bodies. The methods of detection of atmospheres are reviewed. Evidence for the Moon points to a tenuous layer of gas corresponding to ½–1 mm of Hg. Greenish patches of changeable outline have been attributed to the spread and decay of vegetation in the brief cycle of the lunar day. Likewise, Mercury probably has a tenuous atmosphere. Minute ice crystals are probably present in the upper Martian atmosphere. The green areas of Mars are most satisfactorily explained as vegetation. The scarcity of oxygen constitutes no bar to the existence of animals, as chemical reactions whereby oxygen can be obtained from carbon dioxide present no biological difficulty. (E.O.)

## 964

ON THE BIOLOGICAL BASIS OF ADAPTEDNESS.
E. Caspari
*Am. Scientist*, 39:2, 1951. p. 441–451.

One of the outstanding features of organisms is the way in which they are adapted in their structures and in their behavior to the environmental conditions in which they live. The origin of this adaptedness has constituted a problem of primary importance for the theory of evolution. Various experiments as described serve as models for the origin of some evolutionary situations. The discussions show that the genetic theory of evolution by natural selection is able to explain rather complicated cases of adaptation. The statistical genetic basis of the origin of species is at present well understood, but a problem remains: the analysis of the biochemical and developmental action of genes leading to adaptation of organisms to new environments and new functions. Investigation of actual cases will lead to a closer integration of the different disciplines and techniques of biology. (A.H.F.)

## 965

THE EXPLORATION OF SPACE.
A. C. Clarke
N.Y., Harper & Bro., 1951. 199 p.

Although this volume is concerned primarily with manned space travel to other planets of the solar system and to planets of other stars in our galaxy, the possibility of finding life already existing at each of these destinations is evaluated. (M.P.G.)

CONTENTS:

Chap. 1: The Shaping of the Dream; Chap. 2: The Earth and

Its Neighbors; Chap. 3: The Rocket; Chap. 4: Escaping from Earth; Chap. 5: The Road to the Planets; Chap. 6: The Spaceship; Chap. 7: The Journey to the Moon; Chap. 8: Navigation and Communication in Space; Chap. 9: Life in the Spaceship; Chap. 10: The Moon; Chap. 11: The Lunar Base; Chap. 12: The Inner Planets; Chap. 13: The Outer Planets; Chap. 14: Exploring the Planets; Chap. 15: Stations in Space; Chap. 16: Other Suns Than Ours; Chap. 17: To the Stars; Chap. 18: Concerning Means and Ends.

## 966

GENERAL ASTRONOMY.

H. S. Jones

London, Edward Arnold & Co., 1951. 445 p.

A comparison is made of the planets Mars and Earth with relation to environment, topography, and rotation. Seasonal changes on Mars are attributed to changes in vegetation coloring. Vegetation may resemble mosses and lichens of the Arctic area of the Earth. Absence of oxygen makes the existence of animal life improbable. (E.C.)

Contents:

Chap. 1: The celestial sphere; Chap. 2: The earth; Chap. 3: The earth in relation to the sun; Chap. 4: Astronomical instruments; Chap. 5: Astronomical observations; Chap. 6: The moon; Chap. 7: The sun; Chap. 8: Eclipses and occultations; Chap. 9: The planetary motions; Chap. 10: The planets; Chap. 11: Comets and meteors; Chap. 12: The stars; Chap. 13: Double and variable stars; Chap. 14: The galactic system; Chap. 15: Extra-galactic systems; Chap. 16: Stellar constitution and evolution.

## 967

ON THE NATURE OF PLUTO AND TRITON (SUR LA NATURE DE PLUTON ET DE TRITON).

M. A. Dauvillier

*Compt. Rend., Acad. Sci.,* Paris, Vol. 233, 1951. p. 901—903. (In French)

The author suggests that Pluto and Triton were in all probability terrestrial planets: large planets with a mass on the order of Earth that was reduced by evaporation, and that they are very similar to the moon and, therefore, not likely to support life because of an absence of the proper atmosphere. (A.W.)

## 968

THE PHYSICAL BASIS OF LIFE.

J. D. Bernal

*London, Routledge and Kegan Paul,* 1951. 80 p.

The author establishes, in an orderly fashion, the concept of chemical evolution and its continuum with biological evolution. Considerable attention is given the physical environment in which molecules of biological importance can arise. (E.O.)

## 969

PHYSIOLOGICAL CONSIDERATIONS ON THE POSSIBILITY OF LIFE UNDER EXTRATERRESTRIAL CONDITIONS.

H. Strughold

*In:* J. P. Marbarger, ed. SPACE MEDICINE, p. 31—48. 12 refs. Urbana, Ill., Univ. of Ill. Press, 1951. 83 p.

Life as we know it can exist only under specified environmental conditions. Two of these factors, temperature and oxygen, are discussed in terms of terrestrial life and the possibility of life on Mars and Venus. (S.T.L.)

## 970

THE PROBLEM OF THE ORIGIN OF LIFE.

A. I. Oparin

*Mod. Quart.,* Vol. 6, 1951. p. 135—146.

The qualities inherent in life are described and a theoretical sequence of the formation and evolution of life on the primitive Earth is given. What is specific for living matter is the organization of metabolic reactions in time in a certain way and their integration into a single system, which leads to a dynamic stability. Coacervate droplets probably formed in the primal hydrosphere and only those survived in which synthesis exceeded degradation. Qualitative changes within the droplets acquired direction by "natural selection." Coordinated repetitive synthesis became the basis for self-propagation, and only those organisms which possessed the dynamic stability could survive and develop further in the primal ocean. (E.O.)

## 971

REDUCTION OF CARBON DIOXIDE IN AQUEOUS SOLUTIONS BY IONIZING RADIATION.

W. M. Garrison, D. C. Morrison, J. G. Hamilton, A. A. Benson and M. Calvin

*Science,* Vol. 114, 1951. p. 416—418.

Experiments supporting the current conception that life originated in an organic milieu are described. The results indicate that conditions can be found in which high energy radiations could induce the reduction with water of carbon dioxide, leading to the ultimate creation of polyatomic molecules of carbon, oxygen, hydrogen, and nitrogen. (A.H.F.)

## 972

TIME'S ARROW AND EVOLUTION.

H. F. Blum

Princeton U. Press, 1951. 219 p.

The author uses "time's arrow", the second law of thermodynamics, as a key concept to show how the nature and evolution of the nonliving world place limits upon the nature and evolution of life. He seeks to show that, from the beginning of the universe, physical and chemical laws have inexorably channeled the course of evolution so that possibilities were already limited when life first emerged. (A.H.F.)

## 973

A TRANSITIONAL HYPOTHESIS CONCERNING LIFE ON INTERSTELLAR BODIES.

G. L. Chaikin

*Popular Astronomy,* 59:1, Jan. 1951. p. 50—51.

The relationship of life zones within the solar system to a slowly cooling sun is discussed. Life as we know it depends upon

temperature, oxygen, water, and the photosynthetic or similar process for storing energy. It is assumed that Mars represents a planet which once held life or still does but is in a stage of worsening habitable environment. Venus on the other hand would seem to be a planet primed for the appearance of life once the solar temperature has decreased sufficiently. Earth represents the intermediate stage. If this view is maintained, life may be said to be a transitional phenomenon that tends to flourish most easily under conditions of least stress on habitable bodies. (E.O.)

# 1950

## 974

**THE POSSIBILITY OF POTENTIALLY PATHOGENIC ORGANISMS OCCURRING ON ANOTHER PLANET.**

E. R. Nye

*J. Brit. Interplanet. Soc.*, Vol. 9, March 1950. p. 62–63.

The amount and variety of bacteria and members of slightly higher orders, who present a serious threat to man's health on Earth may very well be complimented by similar life forms that are encountered on other planets. Bacteria on the Moon might be spore forming and highly adaptable to changes in temperature. On Mars the bacteria might be inured to extremes of cold but not to heat, and the thermal death point may well be below human body temperature. Anaerobic bacteria are possible on Venus but in this case human body temperature might be too low for active reproduction. Precautions against exposure are absolutely necessary and remote testing for dangerous forms of bacteria will have to be developed. (E.O.)

## 975

**DUST AND THE PLANETS: MARS.**

E. J. Opik

*Irish Astron. J.*, Vol. 1, June 1950. p. 44–47.

The composition of the Martian atmosphere, the physical appearance of the surface and the nature of the dark areas on the surface are the major problems associated with Mars. The polar caps are most likely snow or hoarfrost, and since $CO_2$ has definitely been detected and a biologically suitable temperature range occurs, the prerequisites for life certainly exist on Mars. There are apparently no mountain ranges on Mars and wind-blown dust would have provided a featureless pattern if vegetation did not exist. It is likely that the dark areas are somewhat lower and therefore warmer and are also areas of liquid water drainage where vegetation can survive. (E.O.)

## 976

**THE PLANET MARS.**

G. de Vaucouleurs

London, Faber & Faber, Ltd., 1950. p. 88. (Transl. of *LE PROBLÈME MARTIEN*).

An objective view is presented of the problem posed by Mars, the only planet whose phenomena cannot easily be interpreted by the sole use of the physical and chemical laws applied to inorganic matter. Theories advanced to account for the problems that have not yet been solved are presented impartially. (E.O.)

CONTENTS:

Chap. 1: Generalities; Chap. 2: The Polar Caps; Chap. 3: The Bright Regions of Mars; Chap. 4: The Atmosphere; Chap. 5: Climates; Chap. 6: The Dark Regions on Mars; Chap. 7: The Canals; Chap. 8: Life on Mars?

## 977

**THE PRESERVATION OF LIVE SPORES IN ABSOLUTE ZERO.**

P. Becquerel

*Compt. Rend. Acad. Sci.*, Paris, Vol. 231, Dec. 1950. p. 1392–1394.

The author kept the spores of certain bacilli alive at temperatures approaching absolute zero. If these spores can be protected against radiation, their reproductive power seems unlimited; there are then possibilities for the conservation and dissemination of life throughout the universe. (E.O.)

# 1940–1949

## 978

THE PLANET MERCURY.

S. M. Mather

*J. Brit. Interplanet. Soc.*, Vol. 8, May 1949. p. 119–120.

A review is made of the known conditions on Mercury, which apparently provide an inimical environment for any sort of life. The temperature of the subsolar point is about 770° F. and the temperature of the dark side approaches absolute zero since the period of rotation is equal to the orbital period. No atmosphere has definitely been observed and theoretical studies of Mercury's escape velocity would seem to preclude any but the most tenuous atmosphere. However, some obscurations of surface features have been observed which may be dust clouds hanging in a thin atmosphere. It has been theorized that Mercury is a lost moon of Venus since physically it greatly resembles our moon. (E.O.)

## 979

THE HISTORY OF OXYGEN.

Malcolm Dole (Dept. of Chem., Northwestern U.)

*Science*, Vol. 109, Jan. 28, 1949. p. 77–81.

Isotopic evidence is presented indicating either that the oxygen in the Earth's atmosphere is not of photosynthetic origin, or that the photosynthetic oxygen must have changed its composition by isotopic exchange. References are made to: (1) D. ter Haar's modified theory of the origin of the solar system, which relates the density of planets, their proximity to the Sun, and the atomic weight of the elements of which they are composed; (2) Oparin's theory of the origin of life in a reducing atmosphere; and (3) Tammann's thermal dissociation of water theory of the origin of atmospheric oxygen. All of the oxygen-producing processes, whether photochemical or ionic, that are believed to exist or are thought capable of existing in the stratosphere or ionosphere are tabulated and critically examined. The abundance and transport of oxygen-18 in the atmosphere warrants further examination to determine the possibility of isotopic exchange. (M.P.G.)

## 980

POSSIBILITY OF PHOTOSYNTHESIS ON MARS.

James Franck

*In:* Gerard P. Kuiper, ed. THE ATMOSPHERES OF THE EARTH AND PLANETS. p. 355–356.

U. of Chicago Press, 1949.

Paper presented at 15th Symp. of Yerkes Obs., Sept. 1947

Photosynthesis is considered unlikely to occur on Mars. This conclusion is supported by the absence of chlorophyll bands in the Martian spectrum. Photosynthesis is not impossible, however, since bacteria and photosynthesizing plants that are not green exist on earth. Photoreduction is suggested as an alternate metabolic energy route, especially if the Mars atmosphere contains little or no oxygen. If plants exist on Mars, they are probably more similar to lichens than mosses, since the mosses depend on taking nitrogen from the soil, and this cannot occur in the absence of water. It is concluded that the existence of plant life on Mars does not constitute a unique explanation of the green color since many other nonbiological explanations exist. (M.P.G.)

## 981

SURVEY OF PLANETARY ATMOSPHERES.

James Franck

*In:* Gerard P. Kuiper, ed. THE ATMOSPHERES OF THE EARTH AND PLANETS. p. 304–354.

Univ. of Chicago Press, 1949.

(Papers presented at 15th Symp. of Yerkes Obs., Sept. 1947.)

The reflection curves of lichens and certain dry mosses are consistent with the results obtained for the reflective properties of the green areas of Mars. It is premature to conclude that the green areas are covered with lichens and mosses, however, because different forms of life may well have developed under the very different conditions existing on Mars. (M.P.G.)

## 982

A METEOROLOGICAL APPROACH TO THE QUESTION OF WATER VAPOR ON MARS AND THE MASS OF THE MARTIAN ATMOSPHERE.

S. L. Hess (Lowell Observatory, Flagstaff, Ariz.)

*Publ. Astron. Soc. Pacific*, 60:356, Oct. 1948. p. 290–302.

It has been suggested that the Martian polar caps are frozen $CO_2$ instead of frozen water vapor. The $CO_2$ hypothesis requires a summer polar temperature of about $-100°$ C, while the ice hypothesis would require that temperature to be 0° C. In 1926 the temperature was determined to be $-7°$ C at the south cap, a temperature far from the sublimation point of $CO_2$. Thus water vapor may be present on Mars. The spectroscopic picture is somewhat confused, since both positive and negative results have been reported. Water vapor on Mars must undergo a seasonal variation. A total water vapor content of 0.4 mm, or less, in the

Martian atmosphere will suffice to explain the sunrise limb clouds as aqueous condensation products due to radiation cooling. On the basis of reasonable meteorological calculations, the amount of water vapor on Mars is at or below the limits of spectroscopic measurement. (A.H.F.)

## 983

INTERPLANETARY MAN.
O. Stapleton
*J. Brit. Interplanet. Soc.*, Vol. 7, 1948. p. 213–233.

A discussion is given of man's future when travel outside of earth is accomplished. The possibility of life in the solar system is considered, and the sociological, philosophical and moral implications of meeting with extraterrestrial civilizations. Any extraterrestrial life which was not based on carbon would have a very restricted scope of biological evolution since carbon compounds offer a unique diversity. If life is not encountered elsewhere, man will still face problems of adaptation to local environments. The philosophy, ethics, spiritual values, and interrelationships of cosmic man are discussed at length. (E.O.)

## 984

THE NATURE AND DEVELOPMENT OF LIFE AND OF OUR IDEAS ABOUT IT.
N. W. Pirie
*Mod. Quart.*, Vol. 3, 1948. p. 82–93.

A general discussion of historical and present considerations of life is made as well as an attempt to partially trace the formation of life on the primitive Earth. The nature of life may be traced by its manifestations in a metastable environment. A distinction is not always made between the what and how of life historically. Biochemical theories of the formation of life are still very speculative, but present-day biochemistry has relevance more toward the interrelationships of organisms rather than the origin and essential nature of life. (E.O.)

## 985

THE CLIMATE OF MARS.
J. R. Randolph
*ARS J.*, Vol. 70, June 1947. p. 16–19.

From theoretical computations of blackbody radiation from Mars, the average temperature at the equator is — 30° F and the average for the planet is — 55° F. The effect of this range of temperatures on possible vegetation is discussed. The growth of Martian vegetation may be dependent not only on melting polar caps for water, but also for the water vapor in the atmosphere to trap enough heat for a minimal surface temperature suitable for growth. Earth plants are known which can survive minimal temperatures and sunlight. It is assumed that Martian plants would be similarly adaptable. The straightness of the canals is an indication of artificiality, but it is much more probable that water is obtained for Martian vegetation by less elaborate, natural means. (E.O.)

## 986

SOME PHYSICO-CHEMICAL ASPECTS OF LIFE AND EVOLUTION IN RELATION TO THE LIVING STATE.
J. L. Kavanau
*Am. Naturalist*, 81:798, May 1947. 161–183.

The conditions required for the attainment of the living state are postulated. Organization of molecules may have occurred in membrane-type bounded systems as a result of factors introduced by oscillating temperatures caused by the Earth's rotation. Carbon-nitrogen molecule complexes evolved in response to environmental conditions. The role of specific protein-type constituents in living forms is probably associated with the origin of their characteristic functions rather than with the basic factors leading to the origin of the primordial systems that have evolved to the living state. Life may continually rise *de novo*. The behavior of material aggregates and the influence of radiant or kinetic energy should be investigated. It is reasonable to expect like phenomena to take place upon other planets where similar conditions arise. (E.O.)

## 987

CONDITIONS ON THE SURFACE OF MARS.
M. W. Wholey
*J. Brit. Interplanet. Soc.*, 7:1, 1947. p. 2–20.

The historical accumulation of knowledge of Mars and present knowledge and theories are discussed. The green belts of Mars are presumed to be the remnants of a once abundant cloak of vegetation. As oxygen and water vapor were dissipated from the atmosphere the low sea beds only were capable of supporting vegetation. Mars may still be in a stage of planetary decay, and any vegetation is most probably of a degenerate character. The growth of Martian plants may be so finely balanced that the variation of a small amount of water vapor in the atmosphere is sufficient to retard or stimulate it. It is suggested that any life forms on Mars, plant or animal, will have made physiological adaptations. Low temperatures indicate low metabolic rates. It is conjectured that any intelligent life on Mars would have sought a more suitable environment within the Martian crust and would not be especially fitted for or curious about extra-Mars affairs. (E.O.)

## 988

THE FUNCTIONS OF IRON IN THE EVOLUTION OF LIFE.
W. D. Francis
*Trans. Roy. Soc. Can.*, Vol. 41, 1947. p. 19–28.

The hypothesis is given that life may have originated or may originate with metallic iron or some of its compounds such as ferrous hydroxide. The importance of iron as a basis of respiration in certain bacteria and as a catalyst in other modes of respiration is described. Iron displays a remarkable affinity for the elements of protein. Protein itself has been produced from inorganic nutrient solution surrounding an iron wire. It appears that the protein produced is similar to chromatin, a nucleoprotein. Primitive life may have developed in conjunction with particles of rust, since some mesobiotic forms evidently arise through the interaction of iron compounds and their environment. (E.O.)

## 989

**ON THE VARIABILITY OF MARTIAN SEAS.**

N. P. Barabashov

*Astron. Zh.*, 24:3, 1947. p. 138–144. (In Russian; English summary).

It is shown that the observed colour variations of some seas, gulfs, lakes, and canals on Mars depend on the year's season and much resemble the colour variations of the vegetable colour of the Earth. In the southern hemisphere of Mars the green colour of the seas, gulfs, and canals is observed at h752°. In the northern hemisphere the blue-green colour for the seas, gulfs, lakes and canals is observed at h753°. Apparently the blue for the seas, gulfs, lakes and canals can be observed at all values of h. This might be an indication of the fact that if the coniferous vegetables exist on Mars, they appear to us as grey-blue, grey-green and grey (and not green, green-blue or blue), since for these colours h apparently is not fixed, as in the case for the brown colour. On the graph for these colours $h > 26°$. From the above we can conclude that very probably the variability of the colours of many dark regions on Mars is due to the existence of a vegetation cover. (Auth)

## 990

**ASTRONOMY 1. THE SOLAR SYSTEM.**

H. N. Russell, R. S. Dugan and J. Stewart

Boston, Ginn and Co., 1945.

In Chapter XI, "The Terrestrial and Minor Planets," the statement is made that attributing the seasonal changes on Mars to the presence of vegetation appears to be an entirely reasonable hypothesis, though not proved. The extraordinary divergencies in the accounts of the Martian canals by trained and experienced observers is noted. (M.P.G.)

## 991

**ON THE EVOLUTION OF BIOCHEMICAL SYNTHESIS.**

N. H. Horowitz

*Proc. Natl. Acad. Sci. U.S.*, 31:6, 1945. p. 153–157. 11 refs.

The hypothesis presented here suggests that the first living entity was a completely heterotropic unit, reproducing itself at the expense of prefabricated organic molecules in its environment. A depletion of the environment resulted until a point was reached where the supply of specific substrates limited further multiplication. By a process of mutation a means was eventually discovered for utilizing other available substances. With this event the evolution of biosyntheses began. The conditions necessary for the operation of the mechanism ceased to exist with the ultimate destruction of the organic environment. Further evolution was probably based on the chance combination of genes, resulting to a large extent in the development of short reaction chains utilizing substances whose synthesis had been previously acquired. (Author)

## 992

**THE ORIGIN OF THE SOLAR SYSTEM.**

A. C. Banerji

*Sci. Cult.* (Calcutta), 10:8, 1945. p. 317–323.

Various theories on the origin of the solar systems are described, as well as the frequency of other planetary systems and the possibility of life on Venus or Mars. The theories of planet formation range from condensation in large dust clouds to the ejection of mass from an unstable sun or by the influence of another star. A main problem is to account for the angular momentum existing in the system. Planetary systems have also been discovered around 61 Cygni and 70 Opiuch and statistically many more systems are possible. Venus appears unlikely as an abode of life because of the absence of oxygen, but Mars has an environment which could support at least vegetative life. The abundance of planets in the universe makes the possibility of advanced life very definite. (E.O.)

## 993

**NON-SOLAR PLANETS AND THE ORIGIN OF THE SOLAR SYSTEM.**

H. Alfvén

*Nature*, 152:3868, Dec. 18, 1943. p. 721.

The probability that all other stars are surrounded by more or less massive planetary systems of the same structure as ours is presented. This conclusion is based on an extension of a theory of solar system origin which states that the planets were formed of matter falling in from interstellar space towards the sun and stopped by the action of the sun's magnetic field as soon as it became ionized by the heating due to gravitation. The invading matter probably originated from a gas cloud once surrounding the stars. According to this theory, for a given cloud density, the larger component will have the more massive planetary system. (M.P.G.)

## 994

**ON THE ORIGIN OF LIFE.**

N. Rashevsky

*Bull. Math. Biophy.*, Vol. 5, 1943. p. 165–169.

On the basis of the recently proposed new fundamental equation of mathematical biophysics, a suggestion is made for a theory of the formation of a primitive cell from nonliving material. The discussion includes a suggestion for a quantitative formulation of the degree of biological organization. It is shown that according to the fundamental equation of mathematical biophysics, organization of the nonliving material may spontaneously increase under certain conditions, leading to the formation of a primitive organism. This process, however, is a very slow one requiring time intervals of several years or even decades. This may account for the failure in observing or artificially producing spontaneous generation. (Author)

## 995

**THE PHYSICAL CHEMISTRY OF A COOLING PLANET.**

P. G. Nutting

*J. Wash. Acad. Sci.*, Vol. 33, 1943. p. 121–125.

An analysis is given of the various steps a planet such as the Earth would undergo upon cooling from a mass of vapor. At 5000° A, there are no compounds and the planetary mass would have a photosphere. Between 4000° and 1500° A, a core is formed of heavy metals, water vapor and carbon dioxide appear, and compounds of the heavier elements appear. The fall of

temperature below 370° C marks the beginning of hydration, solution, and sedimentation. Living matter became possible when temperatures were not above 50° C and since the polar regions probably reached this temperature first, life probably originated there. (E.O.)

## 996

**VEGETATION ON MARS.**
A. P. Maude
*J. Brit. Astron. Assoc.*, Vol. 52, Sept. 1942. p. 264–265.

The relationship of available water to the growth of vegetation on Mars is given by analogy on Earth. Mars resembles Earth in many respects such as tilt of axis, rotational period, polar caps and atmospheric circulation. Although there is much less water on Mars, the distance for clouds to bring moisture from the polar caps is much less. On Earth, Lake Chad supports a great deal of vegetation in a belt even where the ground appears dry. The vegetation on Mars could be supported by a few central marshy areas and large amounts of water would not be necessary. Also the thin atmosphere might be more favorable to plant than to animal life. (E.O.)

## 997

**CLIMATE AND VEGETATION OF MARS COMPARED WITH THE EARTH'S.**
R. E. Pressman
*J. Brit. Astron. Assoc.*, Vol. 52, July 1942. p. 193–197.

Knowledge of Mars obtained by observation is summarized in respect to physical conditions, meteorology, and variable surface markings. In the absence of mountain ranges, atmospheric circulation should be relatively constant on Mars bringing evaporated moisture from the poles to the equator. However, anomalous winds may cause the observed dust storms. The existence of artificial canals to aid moisture transfer from the poles is not sound from an engineering point of view since any intelligent life would be capable of more efficient methods of transfer. If vegetation exists in the equatorial zone on Mars, it must be accompanied by a considerable body of water and how that body of water is maintained by non-artificial means remains unresolved. (E.O.)

## 998

**DOES ANYTHING EVER HAPPEN ON THE MOON?**
W. H. Haas
*J. Roy. Astron. Soc. Canada*, 36:7, 1942. p. 237–272.

A summary of lunar observations is presented which deal with unexplained and variable areas of darkness and light colors, and the possibility of a lunar atmosphere. Pickering's theory is reviewed, in which the dark areas are believed to be vegetation and the light areas snow or ice. Since the variation of temperature on the moon is so great, any lunar vegetation must be capable of withstanding great extremes, and experimentation should be carried out to determine any terrestrial plants which could flourish under these extremes. The effects of libration and various sun altitudes are discussed in relationship to the markings. (E.O.)

## 999

**THE GEOCHEMISTRY OF THE ATMOSPHERE AND THE CONSTITUTION OF THE TERRESTRIAL PLANETS.**
R. Wildt
*Rev. Mod. Physics*, Vol. 14, 1942. p. 151.

A review of the geochemistry of the atmosphere in relation to the constitution of the planets. The astrophysical data on which Oparin has based his speculations are largely obsolete and often incorrectly interpreted. Notwithstanding that, every new advance in the fields of geochemistry and planetary constitution will undoubtedly reveal more clearly the possible unique concatenation of circumstances to which we owe the spectacle of life. (E.C.)

## 1000

**IS THERE LIFE ON THE OTHER WORLDS?**
J. Jeans
*Smithsonian Inst., Ann. Rept.*, 1942 p. 145–150.

Historical and contemporary speculation on the existence of extraterrestrial life is reviewed. Claims of observed lunar habitations are negated by the fact that impossibly large telescopes would be needed to resolve such details. The apparent geometricity of the Martian canals is probably a psychological phenomenon. In a survey of the environmental conditions of the solar system planets, Venus and Mars at the outside might be capable of supporting life although life itself may be capable of adaptation to the worst environmental conditions. If theories of planetary formation are correct, 2 billion planetary systems may be in existence, and, since there seems to be an equal qualitative distribution of elements in the universe, life-evolving processes may be working on a great many planets having Earth-like physical conditions. (E.O.)

## 1001

**THEORIES AS TO THE ORIGIN AND NATURE OF LIFE.**
J. Alexander
*Science*, 96:2489, Sept. 11, 1942. p. 252–253.

Criteria which establish the existence of a living unit are discussed in relation to theories on the origin of life. Life involves three criteria: (1) self-duplication; (2) the ability to direct chemical change by catalysis; and (3) the ability to undergo heritable changes. Although various chemical artifacts may simulate many forms and activities of truly living units, none of them has been shown to exhibit these criteria which are characteristic of even the smallest known bionts (genes, viruses, and bacteriophages). Since the same physico-chemical forces and principles dominate both living and nonliving units, it seems reasonable that life originated by the chance formation of an autocatalytic unit of molecular dimensions; the smaller its size, the greater the probability of its formation. Conditions existing when life first emerged allowed the survival of such small units. (A.H.F.)

## 1002

**THE ORIGIN OF LIFE.**

C. F. Pantin

*Nature*, Vol. 148, July 12, 1941.

The geological record suggests the existence of organic matter at a very early period under physical conditions not wholly different from those of the present day, except that there may have been a change from anaerobic to aerobic conditions during the pre-Cambrian period. It is known that the larger planets have developed enormous atmospheres of hydrocarbons and ammonia from the solar material of which they are composed. The overwhelming reducing character of this material thus leads to the development of an anaerobic organic medium on a planet. In a planet such as Venus, there has been further atmospheric evolution through the inability of the gravitational field to retain hydrogen, so that carbon dioxide has been produced. Venus and the Earth are very close in size. A similar condition must once have prevailed on Earth, and would rapidly do so again if photosynthesis ceased. It is not known how complex would be the organic molecules formed in the original medium. Molecules of the kinds utilizable by bacteria would fairly certainly be produced. (I.v.L.)

## 1003

**VENUS—THE VEILED MYSTERY.**

W. E. Duckwall

*Popular Astronomy*, Vol. 48, 1940. p. 100–103.

The planet Venus is described in the light of present observation and theory, and the possibility of life is discussed briefly. The controversy over the rotational period of Venus has not yet been resolved although a very long period of rotation is favored. Spectrographic studies reveal no water vapor or oxygen but this may be due to high altitude reflection. It is expected that the cloud cover will have stabilized temperatures around the planet. Venus may well be a drab, flat, featureless planet, since any mountainous areas or patches of vegetation should have been visible at some point. However, it is likely that life may once have developed on Venus because of its similarity to Earth in size, density, and probable chemical composition, although a planet-wide catastrophe may have resulted in its extinction. (E.O.)

# 1930–1939

## 1004

**IS THERE VEGETATION ON MARS?**
**P. M. Millman**
*Sky*, Vol. 3, Aug. 1939. p. 10–11.

Studies of reflection characteristics from the Martian maria are compared to the reflection characteristics of terrestrial vegetation. Since the green color of the Martian maria has been attributed to vegetation, a search for chlorophyll was undertaken. Photographs of the maria sensitive to different colors confirm the greenish color of the seas, but also negate the existence of chlorophyll as an agent in producing the green color because of the lack of intensity of yellow and yellow-green light from the maria. Photographs of terrestrial vegetation show this characteristic reflection. It would seem that if vegetation does exist on Mars, other tests than color characteristics must be used. (E.O.)

## 1005

**THE PLANET MARS.**
**E. M. Antoncadi**
*Sky*, Vol. 3, July 1939. p. 6–7, and 22.

The surface of Mars is described in terms of the various colors of the desert areas and the changes in form and color of the maria. Certain areas of maria have irregular changes not associated with the seasons. Investigation of the canals does not reveal linearity or special configuration, but rather diffuse, disconnected shapes. The meteorology on Mars may be deduced from a study of clouds and their motions, which also indicates the presence and distribution of water vapor in the atmosphere. The atmosphere probably tends to produce reasonable temperatures on the surface. Vegetation could exist under the conditions on Mars and is the best explanation for the maria. It is suggested that animal life may also be present on Mars if vegetation is actually present. (E.O.)

## 1006

**LIFE ON THE MOON.**
**W. E. Duckwall**
*Popular Astronomy*, Vol. 47, 1939. p. 517–518.

Changes on the surface of the Moon are thought not to be due to any form of life. Organic life would depend on water, which has been long dissipated from the Moon. It is more likely that the observed changes are due to thermal action or direct reflection from unweathered surfaces. Moreover, although life can exist at low barometric pressures on high points on the earth, and therefore might exist under the low atmospheric pressure on Mars, the Moon is considered airless and barren of life. (E.O.)

## 1007

**THE PLANET MARS AND LIFE (LA PLANETE MARS ET LA VIE).**
**G. Fournier**
*Soc. Astron. France*, Vol. 53, 1939. p. 348–352. (In French)

## 1008

**MEN FROM MARS.**
**D. A. Bennett**
*Sky*, Vol. 3, Dec. 1938. p. 8–9.

A description of Mars and a generally negative attitude toward possible life there is presented in response to the Welles broadcast of a fictional Martian attack upon earth. Life on earth requires air to breathe, water, and temperatures within certain specified limits. Mars has an extremely thin atmosphere, little water and, in general, an extreme environment which at best might support scattered vegetation. The greenish color of the Martian maria does not seem to be related to chlorophyll from spectroscopic studies, and the seasonal variation of hue spreads from pole to equator, opposite the direction of vegetation propagation on earth. Martian canals exist as irregular markings, but no geometrical nature has been established. (E.O.)

## 1009

**CONCERNING BACTERIA IN METEORITES.**
**H. N. Nininger**
*Popular Astronomy*, Vol. 41, 1938. p. 214–215.

A rebuttal is presented to the experiments of Lipman which seemed to indicate the presence of nonterrestrial bacteria within certain meteorites. The technique of culturing the bacteria would seem to be faulty and could have introduced contaminants. However, the most probable source of bacteria was the absorption of air containing desiccated bacteria within the pores of the meteorite as it made its adjustments to terrestrial conditions. (E.O.)

## 1010

LUNAR CHANGES IN ARISTARCHUS.
W. H. Haas
*Popular Astronomy*, Vol. 46, 1938. p. 135–137.

A description of unexplained dark bands in the crater Aristarchus is presented. These bands darken as the lunar day progresses and cannot be attributed to shadows. The angle of incidence of sunlight also apparently plays no part since the maximum darkening is not reached at the lunar noon. Although many objections have been raised to the possibility of vegetation, clouds, or snow, it is suggested that the Moon may not be so dead as generally thought. (E.O.)

## 1011

ADDITIONAL NOTES ON THE QUESTION OF LIVING BACTERIA IN STONEY METEORITES.
S. K. Roy
*Popular Astronomy*, Vol. 45, 1937. p. 499–504.

A defense is presented of criticism leveled against the experiments and theory of Lipman, who held that nonterrestrial micro-organisms were present in certain stoney meteorites. Similar experiments by Roy yielded only identifiable terrestrial bacteria which probably entered by contamination when the meteorite lay on the earth. All the meteorites examined by Lipman and Roy were exposed to contamination from 8 to 65 years, and so any results obtained from the meteorites could be regarded as only inconclusive. Previously, Pasteur had searched for micro-organisms in a carbonaceous chondrite (the Orgueil meteorite) with negative results. (E.O.)

## 1012

COLOR CHANGES ON THE MOON.
W. H. Haas
*Popular Astronomy*, Vol. 45, 1937. p. 337–341.

A series of observations of color changes within lunar craters is presented. Three categories are given: colors seen in shadows which deviate from jet black, colors seen on crater floors at sunrise or sunset, and colors seen on crater floors under a high sun. Abnormal shadows are also recorded in some cases. There is objective confirmation of these changes from independent observers. It is suggested that abnormal shadows may be due to a twilight effect of some kind and that the color changes within the craters are due to low or abnormal types of vegetation, flourishing at irregular periods. (E.O.)

## 1013

LIFE ON THE MOON.
W. H. Pickering
*Popular Astronomy*, Vol. 45, 1937. p. 317–319.

The presence of vegetation on the Moon has been theorized from the unexplained observations of variable dark bands, spots, and color changes. A series of these color changes presented would not seem to be due to any known mineral or geological causes. It is predicted that any vegetation would flourish between lunar latitudes plus and minus 50° since the temperature of the Moon is too low to grow vegetation except in its torrid zone and the polar regions are subject to barren conditions. Experiments should be undertaken to subject low terrestrial plants to simulated lunar conditions, especially to great temperature variations, to determine survivability. (E.O.)

## 1014

BACTERIA IN METEORITES.
C. B. Lipman
*Popular Astronomy*, Vol. 44, 1936. p. 442–446.

A rebuttal of criticism is presented by the author, whose experiments with meteorites apparently revealed viable micro-organisms which may not have been native to earth. Similar experiments by Roy which were negative are criticized for the size of the sample used. Since bacteria have been shown viable in corrosive solutions, it is possible that bacteria in spore form might survive within meteorites over long periods. The question of contamination by water seepage on earth is not applicable since water may penetrate many materials which remain impenetrable to things carried in suspension or solution. The high temperatures caused by passage of the meteorite through the atmosphere would not be fatal to deeply inbedded spores surrounded by poor heat-conductive material. Extraterrestrial life still remains a probability. (E.O.)

## 1015

NORMAL VIABILITY OF SEEDS AND BACTERIAL SPORES AFTER EXPOSURE TO TEMPERATURES NEAR THE ABSOLUTE ZERO.
C. B. Lipman
*Plant Physiol.*, Vol. 11, 1936. p. 201–205.

The ability of seeds of higher plants and the spores of bacteria to survive temperatures as low as 1.35° K is demonstrated. The seeds and spores were first desiccated for a period of 2 weeks before the low-temperature application for about 44 hours. The seeds germinated normally upon removal and the spores were also cultured successfully, both in comparison to controls. It would seem that the life pattern can be maintained without respiration and that the power to develop into vegetative forms under proper environmental conditions is retained. (E.O.)

## 1016

THE QUESTION OF LIVING BACTERIA IN STONY METEORITES.
S. K. Roy
*Fieldiana, Geol.*, Vol. 6, Dec. 1935. p. 179–198.

The experiments of Lipman which indicated the presence of nonterrestrial bacteria in stony meteorites are reviewed and compared to similar but negative experiments. Culturing of crushed meteoric material yielded bacterial growth in only 3 of 12 tubes and the bacteria were identified as definite terrestrial types. The presence of extraterrestrial bacteria is strongly contraindicated since the amount of organic material in stony meteorites is inadequate to support bacteria, and the mode of igneous formation of the meteorites would preclude extraterrestrial contamination. The meteorites used by Lipman were exposed to terrestrial contamination for substantial periods of time and could be expected to produce bacterial growth. (E.O.)

## 1017

**A CONSIDERATION OF EVOLUTION FROM A THERMODYNAMIC VIEWPOINT.**

H. F. Blum

*Am. Naturalist*, 69:723, July 1935. p. 354–369.

Evolution of the environment and of living systems is considered by the analogy of generally irreversible reactions leading to an increase of entropy. Major changes in the environment would seem to be necessary for evolution by chance mutation and natural selection. The reaction rate of $H_2$ with $O_2$ exceeds that of $H_2$ and $N_2$ and is responsible for oceans of water and not ammonia. An ammonia environment is not inimical to life on other planets lacking in $O_2$. Living systems, especially by photosynthesis, have decreased the rate of entropy increase. Autotrophic bacteria would seem to be the precursors of both photosynthetic and nonphotosynthetic organisms. (E.O.)

## 1018

**THE ATMOSPHERES OF THE PLANETS.**

H. N. Russell

*Science*, 81:2088, 1935. p. 1–9.

From a discussion of the physical nature of the atmospheres of selected planets, the author concludes that there is probably little or no life on Venus and only slight life of any kind on Mars. (A.H.F.)

## 1019

**THE FRONTIERS OF PHYSICS AND BIOLOGY (LES FRONTIÉRES DE LA PHYSIQUE ET DE LA BIOLOGIE).**

E. Guye

*Arch. Sci. Phys. Biol.*, 17:5, 1935. p. 5–33. (In French)

Extraterrestrial life is probable in some primitive form but because of extreme temperatures on planets other than Earth, it is not considered possible that life, as we know it, exists or ever existed. (A.W.)

## 1020

**THE SOLAR SYSTEM AND ITS ORIGIN.**

H. N. Russell

N.Y., Macmillan Co., 1935. 144 p.

In Chapter Two the author discusses the possibility of vegetation on Mars based on the presence of dark areas and the seasonal changes noted in these areas. Intelligent life, as we know it, might have survived the change from an environment with free oxygen to one devoid of it. Venus is considered a lifeless planet because of the absence of water and oxygen and the abundance of carbon dioxide. (E.C.)

## 1021

**EXTRATERRESTRIAL LIFE.**

P. E. Cleator

*J. Brit. Interplanet. Soc.*, Vol. 1, Oct. 1934. p. 3–4.

An argument is made against attitudes which tend to exclude the possibility of extraterrestrial life on the basis of planetary conditions which are hostile to human life. The laying down of conditions necessary for life is valueless because of the mystery of life itself, and the fact that nonterrestrial life could not be other than nonterrestrial by nature. The conditions on Earth may be deemed unsuitable for life from an extraterrestrial point of view. (E.O.)

## 1022

**VENUS AND LIFE.**

E. P. Martz, Jr.

*Popular Astronomy*, Vol. 42, 1934. p. 165–167.

The environment on Venus is discussed in relation to its ability to produce and sustain life. Spectrographic studies have so far revealed a paucity of $H_2O$ and $O_2$. However, the light received may be reflected from the very high atmosphere and would not show low-lying $H_2O$ and $O_2$. Likewise, the high albedo and probable rotation period of 30 days or more would tend to stabilize temperatures to reasonable levels. The definite presence of $CO_2$ in the atmosphere may be compatible with life processes which produce both $CO_2$ and $O_2$. It is reasonable to assume a similar formation for both Venus and Earth which would indicate similar chemical and physical composition and the same tendency toward the development of life. (E.O.)

## 1023

**VENUS, THE EARTH'S TWIN PLANET.**

Robert G. Aitken (Lick Obs., Mt. Hamilton, Calif.)

*In: Astron. Soc. Pacific, Leaflets* 1:48. p. 195–198. Jan. 1933.

The orbit of Venus is discussed. From ultraviolet photographs it is almost certain we have not seen the solid surface of Venus, but only the upper surface of the dense clouds in its atmosphere. Below the cloud layer the temperature may be higher than it is at the surface of the Earth. If the rotation period is as long as a month, it would seem possible that life might exist on Venus, for it has extensive atmosphere and receives heat and light from the sun. Absorption bands in the infrared region of the spectrum indicate the presence of carbon dioxide. Attempts to detect water vapor or oxygen in the atmosphere have failed. From this it is doubtful life does exist on Venus. (M.G.)

## 1024

**LIFE ON OTHER WORLDS.**

F. C. Leonard

*Popular Astronomy*, Vol. 41, 1933. p. 260–263.

The conditions on the planets of the solar system are discussed in relation to the possibility of life. The Moon and Mercury show too great a range in temperature to be suitable, as well as an absence of atmosphere. The giant planets and Pluto have unfavorably low temperatures unless they have stores of internal heat. Venus appears to have no free oxygen and therefore no plant life. Mars has the best possibility for life, since temperatures and atmospheric oxygen and water vapor indicate a severe but not impossible habitat. Owell is cited for his theory of intelligent life on Mars which could construct irrigation canals. (E.O.)

## 1025

THE LIVING UNIVERSE.

Francis Younghusband

N.Y., Dutton, 1933. 252 p.

Boodin's "cosmic evolution" is considered as evidence for universal life. Life need not be the same on all planets. In other parts of the universe life may have developed from many other primordial germs than protoplasmic forms. (E.C.)

## 1026

ARE THERE LIVING BACTERIA IN STONY METEORITES?

C. B. Lipman

*Am. Museum Novitates*, No. 588, Dec. 31, 1932. p. 1–19.

Samples of ten aerolites were surficially sterilized, crushed in a sterile mortar, and the resulting powder introduced into culture flasks containing various sterile media. Detailed descriptions of experimental procedure and precautions taken to assure sterility are given. Bacterial growth was noted in a number of the cultures —primarily rods and coccus forms. Especially interesting are the autotrophic forms isolated from the Johnston and Pultusk meteorites. While the development of occasional organisms observed during the course of research may have been due to contamination, most of those described cannot have been, in view of the rigorous precautions taken to assure sterility. Arguments for and against the extraterrestrial nature of the described organisms are presented. (M.P.G.)

## 1027

LIFE IN OTHER WORLDS—A STUDY IN THE HISTORY OF OPINION.

R. V. Chamberlin.

*Bull. of the U. of Utah*, 22:3, Feb. 1932. (Biological Series, 1:6).

Among the more strictly scientific men, opinions have differed as available evidence and accepted interpretations have affected the probability of other planets' or celestial bodies' affording suitable environments for life as we know it. It is the purpose of the present paper to review beliefs as to this ever-interesting subject held from the days of the Greeks to the present and to indicate the prepossessions, points of view and types of thought that have led men to assume a negative, a positive, or an agnostic position. No attention will be given to the varied but generally vague beliefs and legends relative to extra-mundane life held at present or in the past by other than European peoples. For convenience the paper is divided into sections dealing with periods as here indicated. I. The period previous to Copernicus. II. The period from the establishment of the Copernican theory to the enunciation of the nebular hypothesis by La Place (cir. 1800). III. From 1800 to the introduction of spectrum analysis (cir. 1850). IV. From 1850 to the enunciation of the planet-esimal hypothesis (cir. 1905). V. From 1905 to the present. (Author)

## 1028

CAN MAN EXIST ON OTHER PLANETS?

N. Schachner

*Astronautics*, No. 15, 1932. p. 3–10.

The environments of the Moon and the extraterrestrial planets of the solar system are considered in view of possible future human habitation, and the extremes of environment which the human is capable of withstanding are discussed. The range of temperature, pressure and vacuum, and gravity which man can survive is fairly wide above and below the normal quantities, but apparently conditions on all the planets except Mars and Venus are beyond the limits. The Moon may contain some low vegetation in some craters but man could not survive without special equipment. Venus remains a mystery, but conditions may not be impossible once more information is known. Mars remains the best possibility for man since it is assumed to possess life already, Micro-organisms may be a potent danger on any habitable planet man may approach. (E.O.)

## 1029

COSMOGONY.

Sir J. H. Jeans

*In:* MYSTERIOUS UNIVERSE, Chap. 1. N.Y., Dutton, 1931. 163 p.

The physical conditions under which life is possible form only a tiny fraction of the range of physical conditions which prevail in the universe as a whole. The very concept of life implies duration in time; there can be no life where the atoms change their makeup millions of times a second and no pairs of atoms can ever be joined together. It also implies a certain mobility in space, and these two implications restrict life to the small range of physical conditions in which the liquid state is possible. Survey of the universe has shown how small this range is in comparison with the range of the whole universe. Primeval matter must go on transforming itself into radiation for millions of millions of years to produce an infinitesimal amount of the inert ash on which life can exist. Even then this residue of ash must not be too hot or too cold, or life will be impossible. (Author)

## 1030

HAS LIFE ANY COSMIC SIGNIFICANCE?

H. T. Stetson

*In:* MAN AND THE STARS. N.Y., McGraw-Hill, 1930. 221 p.

To attempt to maintain that life exists only on this Earth seems the height of absurdity. On some hypothetical planet revolving about some distant sun there may very well be a race of beings much like ourselves, perhaps far more intelligent. With telescopes grander than any we have constructed, they may penetrate into the deepest recesses of their sky, map stars and nebulae, and in sober reflection wonder as we wonder: "Can there be intelligent life anywhere else in the universe?" (Author)

## 1031

INTERPLANETARY COMMUNICATION.

C. J. Fitch

*Astronautics*, No. 4, Oct. 1930. p. 1–2, 5–7.

Various regions of the electromagnetic spectrum are investigated for their feasibility in communicating with intelligent life on Mars or Venus. A practical aspect of such an investigation would be in the maintenance of communication with space probes from earth. Ultrashort wavelength radio waves appear most promising in the radio spectrum since longer wavelengths

are absorbed or reflected in the atmosphere. In the optical portions, transmission by infrared can be blocked by water vapor to some extent and special receiving equipment would have to be postulated for any intelligent life. Visible light beams seem promising, both as a means of gaining attention and as carriers for superimposed telephonic and television transmissions. Reception by Venus would be doubtful because of its opaque atmosphere but Mars should offer little difficulty. (E.O.)

## 1032

**THE NEW PLANET PLUTO.**

Frederic C. Leonard (U. of Calif., L.A.,)

*In Astron. Soc. Pacific, Leaflets*, 1:30, Aug. 1930. p. 121–124.

Because of the extreme low temperature and absence of air, anything even remotely analogous to life as we know it would be impossible, as indeed it would be also on Jupiter, Saturn, Uranus and Neptune. (E.C.)

# 1920–1929

## 1033

**LIFE ON MARS.**

**P. Lowell**

*In:* Harlow Shapley and Helen E. Howarth, eds. A SOURCE BOOK IN ASTRONOMY. p. 388–393.
N.Y., McGraw-Hill Book Co., 1929.

The broad physical conditions of the planet Mars are not antagonistic to some form of life. However, the dearth of water is a factor in the kind of life that would be found. What manner of beings may be on Mars we lack the data to decide at this point. (E.C.)

## 1034

**LIFE IN THE UNIVERSE.**

**Sir J. H. Jeans**

*In:* THE UNIVERSE AROUND US, N.Y., Macmillan, 1929. 351 p.

It is difficult to imagine life of any high order except on planets warmed by a sun, and, even after a star has lived its life of millions of years, the chance, so far as we can calculate it, is still about a hundred thousand to one against its being a sun surrounded by planets. In every respect—space, time, physical conditions—life is limited to an almost inconceivably small corner of the universe. (Author)

## 1035

**THE PLANET JUPITER.**

**E. C. Slipher (Lowell Obs., Flagstaff, Ariz.)**

*In: Astron. Soc. Pacific, Leaflets,* 1:12, Sep. 1927. p. 47–50.

Jupiter is probably in an early stage in its evolution: it possesses an enormous gaseous atmosphere which is in rapid circulation both along and perpendicular to its surface; and possibly the energy of its internal fires gives rise to violent motions which are reflected by changes in its belts. In this and other senses, it appears as a body somewhat more than halfway in life's journey from sun to world. Thus it is evident that no life, as we know it, can exist there. (E.C.)

## 1036

**A CHEMICAL CONCEPT OF THE ORIGIN AND DEVELOPMENT OF LIFE.**

**V. C. Vaughan**

*Chem. Rev.,* Vol. 4, 1927. p. 167–187.

The nature and function of life is considered and life as it appeared on earth is traced from origin in the inorganic atmosphere through species formation and evolution. Formaldehyde may have been the first organic compound synthesized from carbon dioxide and moisture under the influence of ultraviolet rays. The tendency of the protein molecule or molecules to establish thermodynamic equilibrium would result in viscous protein shell or membrane and the action of some chemicals could render this membrane insoluble. Bacteria do not represent the simplest form of life because of their complicated chemical structure. The role of environment in the development of complicated and intelligent life forms is discussed at length. (E.O.)

## 1037

**LIFE IN THE STARS.**

**F. Younghusband**

London, John Murray, 1927. 222 p.

Contents:

Chap. 1: The astronomical view; Chap. 2: The view of biology; Chap. 3: The view of philosophy; Chap. 4: Boodin's Conception; Chap. 5: The genius of the whole; Chap. 6: The main inference; Chap. 7: Poets and the stars; Chap. 8: The view of religion; Chap. 9: Higher being; Chap. 10: The higher esprit de corps; Chap. 11: The world-leader; Chap. 12: Influences from the stars; Chap. 13: Transmission of influence; Chap. 14: Recapitulation and conclusions.

## 1038

**VISUAL AND PHOTOGRAPHIC OBSERVATIONS OF MARS MADE AT THE OPPOSITION OF 1926.**

**R. J. Trumpler**

*In: Publ. Astron. Soc. Pacific,* Vol. 39, 1927. p. 103–111.

Visual studies and photographs in red light of the planet Mars were made with a 36-in. refractor. The north polar cap appeared to be a low-atmospheric phenomenon in contrast to the south polar cap as a surface feature. Principle characteristics of observed "canals" are given. The canals vary in width, appear as diffuse hazy shadings with irregular breaks, and cross the dark areas as even darker markings. No impression of artificiality is produced. Seasonal changes in the dark areas are discussed as being a possible vegetation-water relationship. (E.O.)

## 1039

**A CLOSE-UP OF THE MOON.**
Isabel M. Lewis (Naval Obs., Wash., D. C.)
*In: Publ. Astron. Soc. Pacific, Leaflets*, 1:5, Mar. 1926. p. 15–18.

The topography of the lunar surface is discussed in detail. Observations tended to show that visible changes have taken place in some of the crater cones and spots on the floor of Plato. Some observers are inclined to believe the Moon is not quite as dead a world as we have been inclined to believe. However, if there is any lunar activity it would likely be confined to minor eruptions from small volcanic vents on the floors or walls of craters or upon the maria. The harshness of lunar shadows and the absence of cloud signs or vegetational changes furnish sufficient proof that it is devoid of any appreciable air or water vapor. (E.C.)

## 1040

**EVOLUTION AND CREATION.**
Oliver Lodge
London, Hodder and Stoughton, 1926. 164 p.

After stating the order of creation (ether, electric charges, atoms, nebulae, stars, planets, life, and then the resolution of the stars again into ether and radiation) he discusses briefly the materialistic explanation (noting that science does not deal with ultimate origins), reason, inspiration, the composition of the universe (protons, electrons, radiation), ultimate existence (the primary fundamental essence, whether the molecular process or life) and cosmic evolution, and proceeds to "speculate" upon time, beginning or end, the pressure of light and its effects, and personality. The last third of the book treats very broadly the evolution of plants and animals as to the method of their creation, the evolution of man, the perfecting of man through free will and cooperation and assistance form the Creative Power, the two epochs (first of law and judgment and then of brotherly love). The final chapter discusses the worth of man. The little volume deals not with science but with the philosophy underlying and permeating all science. (M.M.M.)

## 1041

**CLIMATIC CONDITIONS ON MARS.**
W. W. Coblentz
*Popular Astronomy*, Vol. 33, 1925. p. 310–316, 363–382.

A review of environmental conditions on Mars is given from the results of direct observation and from radiographic and spectrographic studies. Visual observation of seasonal changes in color and the polar caps and most recent radiometric studies indicate temperatures above 0° C, especially in the dark maria. Since vegetation is known on Earth which can survive at low temperatures, it is assumed that low vegetation exists in the maria. A scarcity of vegetation in the northern hemisphere may be due to temperatures below the minimum necessary for growth. Any plant life may be in the form of tussocks which have high absorbtivity of solar radiation on the surface and a low thermal conductivity underneath. (E.O.)

## 1042

**WHY POPULAR INTEREST IN MARS?**
Dr. Robert G. Aitken (Lick Obs.)
*In: Astron. Soc. Pacific, Leaflets*, 1:2, July 1925. p. 3–6.

The chief reason for popular interest in Mars is that it has become associated in our minds, more than any other planet, with the question of the possibility of life's existing in some form on other planets. Astronomers agree on the seasons, the length of the Martian day, the presence of an atmosphere which contains water, polar caps which vary in size and the absence of permanent bodies of water. From Lowell's observations of the surface color's varying with the Martian season, it is assumed that the dark areas are vegetation, and, therefore, low forms of animal life probably exist. Majority of astronomers believe this hypothesis. However, there is no evidence for the existence of intelligent life. There is no hope at all of discovering evidence for the existence of intelligent life on other planets in the solar system, but there may be planets in the universe capable of sustaining life—even intelligent life. (E.C.)

## 1043

**RADIO MESSAGES FROM MARS?**
David Todd (Amherst College)
*Lit. Digest*, 82:10, Sept. 6, 1924.

While it is hardly probable that a message could be sent to Mars, it is entirely within bounds of reason to assume that Mars could communicate with the Earth. That life on Mars is possible is a virtual certainty according to the opinion of some noted biologists and astronomers. Thus it is logical to assume that the people are far in advance of us in scientific knowledge by reason of the fact that intelligent life was possible on Mars long before it was on Earth. (J.W.)

## 1044

**ARE THE PLANETS INHABITED?**
Maynard Shipley
Girard, Kan. Haldeman-Julius Co., 1924.

A review of the solar system planets and the possibilities of life on each is presented with numerous excerpts from the works of others writing in this field. (M.P.G.)

## 1045

**BITUMEN IN METEORITES.**
P. E. Spielman
*Nature*, 114:2858, 1924. p. 276.

The statement that is currently repeated as to the existence of bitumen in meteorites does not bear examination. There has been obtained a hydrocarbon (possibly containing sulphur and oxygen), melting at about 114° to 120° C., accompanied by free sulphur and graphite; this is the material, present in an extraterrestrial body, that is quoted as evidence for the inorganic origin of terrestrial petroleum. The suggestion now made is that the presence of the hydrocarbon is due to the action of water on carbide after the arrival of the meteorite on the earth. The evidence for this is the following: (1) Iron-nickel carbide is found

in meteorites. (2) Water poured onto powdered meteorite causes the production of "an alliaceous odor." (3) Phosphide is also present. (4) The water that is usually found in meteorites is considered by authorities not to be original, but to have been taken up at some subsequent time. (5) Soluble carbon compounds have been stated to be completely removed by solvents without preliminary pulverization of the meteorite sample; that is, they exist in cracks and pores which are just the positions into which water could percolate. (6) Solid hydrocarbons are formed by the action of water on carbides of metals of high valency. The carbides and hydrocarbons are actually present, though in small quantities and not often. This explanation, if correct, dissipates the present contradictory evidence of the presence of: (a) graphite, suggesting crystallization for an iron magma; (b) carbide and phosphide, suggesting high temperatures of formation; (c) an outer skin, indicating the attainment of a high temperature on reaching the Earth's atmosphere; and (d) a hydrocarbon of low melting point, absolutely precluding the possibility of a high temperature after its formation. (Author)

## 1046

**DOES LIFE ON EARTH EXIST IN ANOTHER WORLD? (LA VIE TERRESTRE PROVIENT—ELLE D'UN AUTRE MONDE?).**
P. Becquerel
*Astronomie*, Vol. 38, 1924. p. 393–417.

## 1047

**MARS.**
J. Gallo
*Publ. Astron. Soc. Pacific*, Vol. 36, 1924. p. 332–335.

Observations of Mars with a 38-cm telescope are discussed. The polar caps would seem to be made of snow, and therefore some canals become visible only when filled with an adequate amount of melted snow. These canals are merely natural depressions of the soil and occur at different levels. The deepest areas of Mars—Sinus Sabeus and the northern part of Cimmeruim—represent transient seas whose water is replaced by seasonal vegetation which is responsible for changes of the surface and coloration. The formation of the polar caps is apparently due to the continuous fall of snow at night. Visibility of the canals may be due in some respect to the light received from the sun, as in the marks in some craters of the Moon. (E.O.)

## 1048

**SPECTRUM OBSERVATION OF MARS.**
V. M. Slipher
*Publ. Astron. Soc. Pacific*, Vol. 36, 1924. p. 261–262.

Spectra of Mars made in the deep red and infrared reveal a strong gain in intensity for reflected light. The polar cap remains strong in the blue portion of the spectrum. The detection of chlorophyll on Mars is presently negative and is complicated by the fact that the reflection spectrum of chlorophyll is much more difficult to recognize than the lambda 6600 absorption band found in solutions of chlorophyll on earth. The amount and types of vegetation required to make the effect noticeable will be investigated by suitable terrestrial exposures. (E.O.)

## 1049

**RESEARCHES INTO THE PRESENCE OF LIVING ORGANISMS IN METEORITES AND VOLCANIC ASH AND THE POSSIBILITY OF THEIR REVIVAL (RECHERCHES SUR LA PRÉSENCE DANS LES METEORITES, LES PIERRES DURES, LES MINERAIS, LE QUARTZ, LE GRANITE, LE BASULTE, LES CENDRES ET LES LAVES VOLCANIQUES, D'ORGANITES SUCEPTIBLES DE REVIVISCENCE ET SUR LEUR RÉSISTANCE AUX HAUTES TEMPERATURES).**
V. Gallipe & G. Souffland
*Compte Rend. Acad. Sci.* (Paris), Vol. 172, Jan.–June 1921. p. 1252–1254. (In French).

## 1050

**LIFE IN OTHER WORLDS.**
W. D. Matthew
*Science*, 54:1394, 1921. p. 241–289.

The author states that the probability of the occurrence of life on another planet besides Earth is so slight as to be practically reducible to zero. On the other hand, because of possible favorable environmental conditions on other planets, there is a reasonable chance that life has existed or will exist elsewhere on the universe. However, the probability that this was or would be intelligent life or a civilization similar to Earth's is negligible. Probabilities of intelligent life on Mars, Venus or elsewhere in our system similar to our own appear to be zero. (E.O.)

## 1051

**MARS.**
W. H. Pickering (Harvard Astron. Station, Jamaica) Boston, Gorham Press, 1921. 173 p.

There is little doubt that surface markings are an indication for the presence of vegetation on Mars. Possibly animal life exists there too. But, there is still the question of intelligent life. Canals (irrigation ditches) have been the only argument favoring the existence of intelligent beings on Mars. However, there are other theories explaining the occurrence of canals, such as volcanic cracks lying between craterlets. Vegetation growing on the sides is visible by telescope. (E.C.)

## 1052

**ARE MARTIANS PEOPLE?**
C. Fitzhugh Salmon
*Sci. Am.*, 122:12, Mar. 20, 1920. p. 301.

Nothing we know of the evolutionary process warrants assumption that there are intelligent beings on Mars or on any other planet than Earth. Plant life only exists on Mars, and since it is commonly assumed that Mars supported life longer than the Earth, plant forms would presumably have reached a high stage of development, to such a degree that our highest plants are simple and rudimentary in comparison. If life has been produced at all upon other planets than our own, it has assumed forms of which we know nothing: forms which may be neither animal nor vegetal, transcending our experience. Even if we actually perform a journey to Mars, it is not likely that we

should be able to communicate with its inhabitants, and if we found existing there a great number of life forms, we should probably have difficulty in deciding to which of them, if any, the designation "people" should be applied. (J.W.)

## 1053

HABITABILITY OF VENUS, MARS AND OTHER WORLDS.
C. G. Abbott
Rept. of the Smithsonian Inst., 1920. p. 165–171.

It seems evident that while life on Mars appears to be possible, it must be of a kind that can withstand prolonged drought and intense cold. With much of the surface at frigid temperatures it is reasonable to assume that if vegetable life can exist on Mars it must be like the mosses and lichens which can thrive in cool weather. Similarly animal life must be troglodytic, able to burrow deep and hibernate, or able to withstand the intense cold in a benumbed state, as do, for example, the torpid gråsshoppers, wasps and ants one finds on warm days in winter. Apparently life on the equatorial region of Mars must be a continuous process of thawing out and limbering up in the forenoon and a reversal of the process in the afternoon. (Author)

## 1054

WHAT SHALL WE SAY TO MARS?
H. W. Nieman and C. Wells Nieman
*Sci. Am.*, 122:12, Mar. 20, 1920. p. 298–312.

The authors present an original solution to the question "How might we proceed to establish the interplanetary vocabulary?" granted the physical means of communication. When a practical method of signaling is devised, a plan of building up a common language with our new correspondents is discussed. (J.W.)

# 1900–1919

## 1055

THE DESTINIES OF THE STARS.
S. A. Arrhenius
N.Y., G. P. Putnam's Sons, 1918.

Early historical accounts of theories of the environmental conditions, surface characteristics and the possible existence of life on Mars are presented. Arguments for intelligent life on Mars were based on Slipher's photographic studies. Low forms of vegetation may exist at the poles. The climate of Venus is compared to Earth's, during its hottest period. Vegetation, on Venus, is likely. Higher organisms should have developed near the poles since the temperature is probably lower. Speculations are made that more advanced life may possibly exist on undiscovered planets. (E.C.)

CONTENTS:

Chapter 1: Origin of Star-Worship; Chapter 2: The Mystery of the Milky Way; Chapter 3: The Climatic Importance of Water Vapour; Chapter 4: Atmosphere and Physics of the Stellar Bodies; Chapter 5: The Chemistry of the Atmosphere; Chapter 6: The Planet Mars; Chapter 7: Mercury, The Moon, and Venus.

## 1056

THE PROBLEM OF MARS.
W. W. Campbell
*Publ. Astron. Soc. Pacific*, Vol. 30, 1918. p. 133–147.

The controversy over the canal systems of Mars is reviewed in the form of a series of quotations by Pickering and Lowell. Lowell supports the visual detection of fine, regular systems, possibly artificial. Pickering describes the canals in terms of broadness, haziness and mixed regularity and irregularity. The canals, as observed by two capable astronomers, differ completely and it is suggested that in view of the limited diameters of the telescopes employed, the features of the canals might be beyond visual acuity. (E.O.)

## 1057

LUNAR CHANGES.
W. H. Pickering
*Memoirs Brit. Astron. Assoc.*, Vol. 20, Part II, 1916. p. 110–112.

The existence of vegetation on the Moon is postulated in certain craters such as Eratosthenes or Aristillus which show dark spots variable in shape and intensity not due to any shadow formation. Similarly, variable white spots in Tycho, Hell, or on Piton are regarded as snow or ice formations. Although there is a general unfounded belief that the moon is a completely dead unchanging world, critical observations over long time periods indicate some atmospheric and vegetative activity. (E.O.)

## 1058

ARE THE PLANETS INHABITED?
E. W. Maunder
London, Harper, 1913. 166 p.

CONTENTS:

Chapter 1: The Question Stated; Chapter 2 : The Living Organism; Chapter 3: The Sun; Chapter 4: The Distribution of the Elements in Space; Chapter 5: The Moon; Chapter 6: The Canals of Mars; Chapter 7: The Condition of Mars; Chapter 8: The Illusions of Mars; Chapter 9: Venus, Mercury and the Asteroids; Chapter 10: The Major Planets; Chapter 11: When the Major Planets Cool; Chapter 12: The Final Question.

## 1059

LIFE IN OTHER WORLDS.
F. W. Henkel.
*Sci. Am.*, 67:174, May 15, 1909. p. 136–139.

Although little scientific evidence, one way or another, exists as to habitability of other worlds, the very variety of conditions under which we know life to be possible, should of itself preclude the assertion that life can exist only in our solar system. Nothing seems to prevent the existence of totally different beings on every one of the planets (with the possible exception of the Moon), organized and just as fitted for the condition of their existence as we are for our own. As for their "fixed" stars, though their intense heat seems to preclude existence of life, yet, as they are in all probability surrounded by revolving planets not unlike those in our own system, there is no doubt that, on some of them, conditions prevail more or less akin to those existing here. (J.W.)

## 1060

DIFFERENT EXPLANATION OF THE CANALS OF MARS.
W. H. Pickering (Harvard Obs.)
*Harper's*, 116:692, 1908. p. 192–196.

Physical conditions on Mars are in many ways intermediate between those found upon the Earth and the Moon, and it seems plausible that the life existing upon it should similarly be of a higher type than that found on the Moon, and of a lower type than that found at present on the surface of the Earth. Even if the physical conditions were equally favorable with those on the Earth, civilization would by no means be a necessary consequence. (Author)

## 1061

MARS AS THE ABODE OF LIFE.
P. Lowell
N.Y., Macmillan, 1908. 280 p.

A comprehensive compilation of investigations, observations and reasoning is presented which indicates that the inhabitants of Mars are carrying on a system of irrigations for agricultural purposes on a much larger scale than has ever been attempted on Earth; and, that they possess a high degree of agricultural and mechanical intelligence. (M.P.G.)

CONTENTS

Chapter 1: The Genesis of A World; Chapter 2: The Evolution of Life; Chapter 3: The Sun Dominant; Chapter 4: Mars and the Future of the Earth; Chapter 5: The Canals and Oases of Mars; Chapter 6: Proofs of Life on Mars.

## 1062

PROOFS OF LIFE ON MARS.
Percival Lowell (Lowell Obs., Flagstaff, Ariz.)
*Century*, 76:2, 1908. p. 292–303.

Not only do observations thus far scanned lead to the conclusion that Mars at this moment is inhabited, but they lead us to the further one, that these denizens are of an order whose acquaintance is worth making—whether we ever shall come to converse with them is a question upon which science at present has no date to decide. More important is the fact that they exist, made all the more interesting by their precedence before us in the path of evolution. Their presence certainly ousts us from any unique or self-centered position in the solar system. To all who have a cosmopolitan breadth of view, it cannot but be pregnant to contemplate extra-mundane life and to realize that we have warrant for believing that such life now inhabits the planet Mars. (Author)

## 1063

ATMOSPHERIC AND SURFACE PHENOMENA ON MARS.
E. C. Slipher
*Publ. Astron. Soc. Pacific*, Vol. 39, 1907. p. 209–216.

Descriptions are given of cloud and haze formations in the Martian atmosphere and the changes in form and color of the surface maria. The meteorology of the atmosphere shows a sluggish circulation, although apparently changes can occur quickly in atmospheric clearing over extremely wide areas. Photographs show an extensive atmosphere, and spectrographic confirmation of oxygen and water vapor has been obtained. From the extent of the polar caps a temperature fairly similar to Earth's is inferred. It is apparent that the dark markings on Mars are all due to the same cause and obey the same law of change. Seasonal variation, color and appearance of the dark area all obey the law of change expected of vegetation. (E.O.)

## 1064

INTERPRETATION OF THE SO-CALLED CANALS OF MARS.
S. Newcomb
*Astrophys. J.*, Vol. 26, 1907. p. 1–17.

The author contends that not only does life, but also intelligence flourish on this globe under a great variety of conditions as regards temperature and surroundings. No sound reason can be shown why, under certain conditions which are frequent in the universe, intelligent beings should not acquire the highest development. It is therefore perfectly reasonable to suppose that beings, not only animated but also endowed with reason, inhabit countless worlds in space. (Author)

## 1065

MARS AND ITS CANALS.
Percival Lowell
N.Y., Macmillan, 1907. 393 p.

The phenomenon of a highly complicated system of lines (channels or canals) on the planet Mars forming a network over its surface was first detected by Schiaparelli in 1877. In this book, Prof. Lowell presents the interpretation of the phenomenon as representing bands of vegetation along primary irrigation canals, appearing thus in the spring, first near the melting ice caps and following the flow of water toward the equator. The evidence presented is that here is a dry planet, and an intelligence of some kind, that survives only by utilizing the few remaining sources of water supply. The author is certain that Mars is inhabited by some form of beings. The theory of the existence of intelligent life on Mars may be likened to the atomic theory in chemistry; in both we are led to the belief in units which we are similarly unable to define. (J.W.)

## 1066

ARE THE PLANETS INHABITED?
Charles Coupe, S.J. (Bournemouth, England)
*Am. Cath. Qtly.*, 31:124, 1906. p. 699–720.

The author argues against the materialistic evolutionists, stating that there is no proof that Mars is inhabited by man nor do we even have any title evidence that Mars is habitable by man. In his reply to the argument that the outer planets are cooling down for habitability, the author asserts that it is obvious that habitability requires many other vital conditions besides cooling down. Man, on this Earth, is consequently the crown and climax of the Universe. All other planets are uninhabitable. (J.W.)

## 1067

MARS AND ITS MYSTERY.
E. S. Morse
Boston, Little Brown, 1906. 16 p.

Only on Mars, writes the author, do we have what appears to many like direct evidence of the existence of intelligent life. Though considerably smaller than Earth with the cooling of its mass, Mars is very like our world, and its history must have

presented conditions as favorable to the development of life as those on Earth. It is a world with sunsets and sunrises, with seasonal changes, and most important of all, the melting of ice caps, with rivulets and torrents, temporary arctic seas and frozen pools, great expanses of vegetation and sterile plains. (J.W.)

## 1068

**MARTIAN METEOROLOGY.**

**W. H. Pickering**

*Ann. Harvard. Coll. Astron. Obs.* Vol. 53, 1904–1905. p. 155–171.

A study of the Martian clouds and circulation system is presented. A series of plates reveals a high percentage of clouds forming in the center of the disk and also an equatorial cloud band. Another cloud band is seen near the north pole. This indicates evidence of an effective atmospheric circulation of moisture on Mars, which would seem sufficient to account for the observed transfer of precipitation from pole to pole during the Martian year, and the incidental development and growth of the vegetation forming the maria and canal system. (E.O.)

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