BIOLOGICAL SCIENCES COMMUNICATION PROJECT

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QUARTERLY REPORT - VOLUME I

April 1, to June 30, 1967

NSR 09 010 027

Dr. C. W. Shilling, M.D.
Director

FACILITY FORM

N67-32248 (ACCESSION NUMBER)
327 (PAGES)
CR-86650 (NASA CR OR TMX OR AD NUMBER)

N67-32255 (THRU)
1 (CODE)
04 (CATEGORY)

QUARTERLY REPORT

April 1, to June 30, 1967

NASA Contract

NSR 09 010 027

submitted by

BIOLOGICAL SCIENCES COMMUNICATION PROJECT

of

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PLANETARY QUARANTINE

SYNOPSIS

During this quarter the major portion of the Planetary Quarantine effort was spent on the preparation of a draft chapter for "Significant Achievements in Space Bioscience" entitled "Spacecraft Sterilization and Planetary Quarantine". This document (38 pages in length and complete with references) appears under tab number 15 of this report, Vol. II, Significant Achievements. This effort has been completed and the manuscript has been submitted to the Assistant Director of the Bioscience Programs Division for further editing by NASA Publications.

In addition to the above effort, the following activities describe the major efforts of the Planetary Quarantine portion of this contract.

1) A bibliography on the use of ethylene oxide gas as a sterilant was prepared and distributed to contractors of the Planetary Quarantine Program. One hundred and thirty seven references were included as well as the author and permuted title index. A brief bibliography on the general aspects of space bioscience was prepared for students who will attend the Bio-Space Technology Training Program at Wallops Island in August. These manuscripts appear in this report under tab numbers 2 and 3, respectively. A bibliography covering policies of the NASA sterilization program has been initiated.

2) The fifth short course in Environmental Microbiology was held June 12-16 at the Marshall Space Flight Center (MSFC), Huntsville. Attendance was limited to employees of MSFC and included one hundred auditors in addition to the thirty-five registrants. Preliminary surveys indicate an active interest in conducting the next course at Langley Research Center in the fall of 1967.

3) Work on the movie "Spacecraft Sterilization Technology" involved several trips to Atlanta for filming the host sequences and to the National Institutes of Health and NASA Headquarters. The BSCP has served as technical advisor for the Planetary Quarantine program. The film is presently undergoing editing.

4) Two hundred documents, representing over 4,000 pages have been abstracted and entered into the Termetrex and microfilm system, bringing the total film library to six magazines. At their request, three magazines have been duplicated for use by the Sandia Laboratory. Albuquerque, New Mexico.

5) A short article on the history of spacecraft sterilization in the U. S. has been revised and is nearing completion.

6) Numerous requests for information regarding Planetary Quarantine activities and literature have been received from space bioscientists from such diverse areas as the USSR and Australia. Two large demands were received, the Chief of the Human Research Branch of the NASA's Office of Aerospace Research and Technology received 107 pertinent references and Exotech, Inc. was provided with 94. Requests for hard copy reprints and abstracts amounted to almost 6,000 pages. These were provided to contractors of the Planetary Quarantine Program, U. S. Government agencies, universities, and NASA centers.

7) During this period, activities on the manuscript "Psychrophylic Microorganisms" has all but ceased due to the demands and priorities of the above activities. However, it is anticipated that during the next quarter a sizable amount of work on this project can be completed.

BIBLIOGRAPHY N67-32249

on

APPLICATIONS OF ETHYLENE OXIDE

by

DONALD E. WRIGHT

and

ANNE K. SERRELL

Manuscript

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Work performed under NASA contract

NSR-09-010-027

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I. Preface

PREFACE

This bibliography was compiled for the Office of Planetary Quarantine, NASA Headquarters, in order to provide scientists and engineers with background material on the uses and applications of ethylene oxide gas. Present plans call for a decontaminating cycle of ETO to be applied to spacecraft surfaces following environmental testing. For background information the reader is referred to the excellent reviews of Bruch (ref. 14), Opfell (ref. 75), Phillips and Kaye (ref. 89), and Phillips and Warshowsky (ref. 90). Interest in the sterilizing effects of ETO stems from the fact that it is effective against all types of organisms (slower sporocidal activity), has good penetration ability and diffusion rate, is easily removed through adequate ventilation, and is suitable for items that cannot be sterilized by heat. Its drawbacks include flammability, toxicity and a requirement for special equipment. The effectiveness of ETO as a sterilant is closely dependent on such factors as concentration, time of exposure, temperature, and relative humidity of the environment.

Most of the citations listed were drawn from the card files of the BSCP and from NASA contractor reports (32% of the citations were from NASA-sponsored research). Indicative of recent interest in gaseous sterilization is the fact that almost half of the citations included in this report were published within the past four years.

It is hoped that this bibliography will serve as a guide for future directed research as well as point out areas adequately covered in the past. In addition, it should be a means to identify individuals and laboratories most closely associated with the subject of ethylene oxide sterilization.

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III. Permuted Index

Key words in the title of each of the articles referenced in this work have been rotated to the beginning of the title and alphabetized.

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BIOSCIENCE COMMUNICATIONS

SYNOPSIS OF ACTIVITIES

Under the Bioscience Communications portion of this contract, major efforts were expended on 1) the preparation and publication of "Scientific Publications of the Bioscience Programs Division, National Aeronautics and Space Administration", 2) preparation of the BSCP draft document "Significant Achievements in Space Bioscience 1965-1966"; and 3) preparation of an outline and arrangements for writing the monographs of "Foundations of Space Biology and Medicine".

Volumes II to VI of "Scientific Publications of the Bioscience Programs Division, National Aeronautics and Space Administration" (Environmental Biology, Exobiology, Physical Biology, Planetary Quarantine, and Bioscience Communications, respectively) were completed and a copy of each issue was sent to contractors and grantees of Bioscience Programs, and to other NASA associated bioscientists. The 1,475 scientific papers and reports published by NASA Headquarters Bioscience grantees and contractors included in this work were scattered throughout more than 270 scientific and technical journals as well as other formal laboratory reporting media. This completes the publication of this series for this contractual period although work has already been initiated for an updated and revised report to be issued in 1968. Volume I, Behavioral Biology, has been included with the progress report of the preceding period. Volumes II to VI are included in Volume I of this report, see tabs 5 to 9 , respectively.

In late March, the BSCP had assumed the responsibility for writing "Significant Achievements in Space Bioscience, 1965-1966". During the past three months, the BSCP's final draft document has been prepared and delivered to the Assistant Director of Bioscience Programs in completion of this specific assignment for this contractual period. The document appears in Volume II of this report and chapters one through 11 are located at tabs 10 to 21, respectively Efforts are now underway to establish a repository of bioscience headquarter's and field center's progress reports and supported publications at the BSCP to provide more efficient support of this activity for the 1968 report. This undertaking will involve the collection, collation and recording of about 2,000 published papers widely scattered in almost 300 scientific and technical journals not including other papers appearing in various laboratory reporting media and an additional several thousand other progress reports.

The outline for "Foundations of Space Biology and Medicine" has been divided into nineteen monographs (see attached outline, tab 22) assigned to 23 authors. Letters have been written to each author asking if he is aggreable to writing the assigned section and requesting him to define his eligibility for an honorarium. To date, twelve authors (of nine monographs) have accepted and contracts or letters of committment (in case of government employees) have been sent to them. One author has indicated that it will

not be possible to accept his assignment at this time (monograph #5). Those authors (compilers) who have indicated their interest in writing the monographs are indicated by underlining; the encircled names are those of their designated collaborators. We are waiting to hear from the selected authors of the other monographs.

The following paragraphs describe the other activities undertaken by the Bioscience Communications portion of this contract during this quarter.

1) Bioscience Capsules numbers 13 and 14 (tabs 23 and 24, respectively) were issued during this period. Number 13 included a report on NASA's Behavioral Biology Program which, at the request of the Program Chief, was sent to various members of the American Psychological Association. This resulted in a number of requests from scientists interested in being placed on the mailing list, which is continuously subjected to revision and updating (see tab number 26). It was decided that their names would be added temporarily until 1968 when they would have to reassert their interest to remain on the list since the "Capsule" is meant primarily to serve scientists associated with the NASA's Bioscience Programs Division.

2) The BSCP is continuing to respond to queries for information concerning space biology from high school and college students, universities staff scientists, industrial scientists and government personnel. Many of these requests are made via telephone conversations, during informal conferences, etc., and records are not kept of these services. However, in those cases where written correspondence was maintained, as for example when NASA Program scientists provided outside requests that they received, the records of these correspondences have been included in this report under tab number 27 . The responses made by the Planetary Quarantine portion of this contract have been included there also.

3) A compilation of Bioscience's contract listings of publications resulting from support of the Physical Biology Program has been made. More than 120 references have been coded and collated. The material is ready for manuscript preparation.

4) The Space Biology Information Center has been subjected to constant expansion and updating. There are about 14,800 references pertaining to space bioscience on file, more than half of which have been processed into the Termetrex system. The directory of space bioscientists and laboratories participating in space related research is continuously maintained and updated. There are about 7,000 bioscientists with their complete addresses and 2,700 laboratories and their addresses in the directory.

5) In cooperation with the University of Virginia and Behavioral Biology Program at NASA, unedited rough transcriptions have been made of the presentations delivered at the Bio-Space Technology Institute held at Wallops Island in August of 1965 and 1966. A total of about forty transcriptions have been done. This material has been transmitted to the Program Chief of Behavioral Biology and this transaction completes the BSCP's committment in this regard to date.

6) The BSCP has obtained one critical review of Dr. J. P. Henry's manuscript, "The Role of Cultural Change in the Increase of Blood Pressure with Age". These comments have been forwarded to the Chief of Behavioral Biology.

N67-32251

SCIENTIFIC PUBLICATIONS OF THE BIOSCIENCE PROGRAM DIVISION

VOLUME II ENVIRONMENTAL BIOLOGY

by

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of the

Biological Sciences Communication Project

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sponsored by

The George Washington University

April 20, 1967

work performed under NASA Contract

NSR 09 010 027

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PREFACE

This bibliography was prepared to supplement the needs of various bioscience administrators at the National Aeronautics and Space Administration for maintaining a current awareness in their respective fields. When critically analyzed, bibliographies provide meaningful insight to the state of activities for scientific endeavors by defining areas of pursuit, providing records of accomplishment, identifying scientists and laboratories engaged in various scientific activities, revealing the direction of research and the areas of gradient emphasis in addition to listing the available literature in a particular subject field. For these reasons the importance of bibliographies is being increasingly recognized by both science administrators and research scientists.

The more than 1,400 citations in the total work represent the publication efforts of the grantees and contractors of the Bioscience Program Division since it was established. Letters were sent to the principal investigators requesting a list of publications resulting from research supported by grants or contracts from this division. The citations included in this bibliography were provided in response to this letter. Only those papers appearing in the serial literature and widely distributed report literature were considered. Theses and doctoral dissertations were omitted since such research would probably be published in scientific journals at a later date.

These citations have been collated into separate volumes for each program branch. A few citations predate the establishment of the branch offices under which they appear but are included because they resulted from efforts subsequently subsumed under these program offices. The volumes are enumerated as follows: Volume I, Behavioral Biology; Volume II, Environmental Biology; Volume III, Exobiology; Volume IV, Physical Biology; Volume V and VI, Planetary Quarantine and Bioscience Communications, respectively. Because of the brevity of the latter two bibliographies, they have been combined under one cover.

Each volume is divided into a number of sections beginning with the literature citations listed chronologically and according to the authors' surname. This arrangement reveals to some extent the growth and development of research under the direction of the program administrators. To provide access to these references both an author index and permuted title index are included.

An appendix is included which lists the journals in which these scientific publications appeared. This not only assists in identifying source material but indicates the wide range of scientific pursuit encompassed by the Bioscience Programs Division. It is interesting to note here that the publications have appeared in 268 scientific and technical journals.

Also in the appendix is a list of senior authors' affiliations which, when correlated with the directory of laboratory addresses, makes communication with a senior author possible. Copies or reprints of the citations embodied herein cannot be furnished by either NASA or BSCP but may be obtained by contacting the senior authors.

It should be noted that no practical means was available for verifying a few of the references given by the authors and, as a result, some citations are incomplete. This is especially true in cases where papers appeared in lesser known sources and/or were "in press".

The authors gratefully acknowledge the technical assistance of Miss Sheila Rollins and of the secretarial staff in the preparation of this report.

Leslie A. Kulp, Ph.D.

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The individuals listed below are those authors whose names appear as senior authors of a paper. They are in alphabetical order, with the laboratory or institution in which they performed their research designated in abbreviation. These abbreviations for the laboratories and universities are written out in full on pages 59 through 61 which is an alphabetical listing with the complete addresses given.

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ANALYSIS OF THE PUBLICATION SOURCES

Under the auspices of the Environmental Biology Program, 334 papers were published by NASA's Bioscience grantees and contractors. These papers were indexed under the various scientific pursuits listed in the table on page 63, some of which represent well recognized disciplines whereas others merely represent subject areas currently receiving notable attention. In those instances where reports might have been subsumed under more than one category, consideration was given to the scientific orientation of the author(s) or to the source of publication. Arbitrary decisions had to be made but these were not sufficient in quantity to significantly affect the data reported.

The figures on the following pages were constructed to represent, chronologically, the publication frequencies of the major subject fields. The frequency of publication for each area of study was derived by dividing the number of publications appearing in each given year by the total number for all the years considered. The publications appearing in 1960 and 1961 were combined with those of 1962 because of the small number of reports which were issued during these earlier years. The data used for the graphic illustration of 1966 included those citations listed as "in press" for that year. On the other hand, since the list of citations for 1967 was incomplete, it was omitted from the figures.

The figures derived from this study provide, to some extent, an indication of the activity and direction of research within this office. Figure 1 points out that the total publication effort has consistently risen each year although in the more recent years the increase was less pronounced. Studies on Environmental Extremes (Figure 4) have undergone the most rapid growth, from 3% in 1963 to 46% in 1966. Significant growth is also evident in the areas of Biochemistry (Figure 2), Gravity, Acceleration and Weightlessness (Figure 6) and Gaseous Environments (Figure 7). Publications on Radiobiology (Figure 3) and Bioinstrumentation and Techniques (Figure 5) have declined in recent years.

In this report, Gaseous Environments dealt with the tolerance of man and animals to various types of oxygen-mixed atmospheres and atmospheres of different pressures, whereas studies involving the effects of primitive atmospheres on the survival and growth of microorganism and plants were subsumed together with other studies under Extreme Environments.

										In Press			
	1960	1961	1962	1963	1964	1965	1966	No Date	1966	1967	No Date	TOTAL
Biochemistry			3	8	12	7	16		5	2	3	56
Radiobiology		2	4	12	17	11	4		2		2	54
Environmental Extremes			1	1	6	9	12	3	2		11	45
Bioinstrumentation and Techniques	1		3	7	13	6	2		1	1	4	38
Gravity, Acceleration and Weightlessness			1	8	4	13	8	1	2		1	38
Gaseous Environments			1	1	6	11	11		1		4	35
Photosynthesis		2		6	3	7			3			21
Physiology					4	9	2		2		4	21
Biomagnetism			3	3	3	2	1		1			13
Statistics				1		1	2		2			6
Biology			1		1		1			1	1	5
Histology					1		1					2
TOTAL	1	4	17	47	70	76	60	4	21	4	30	334

Table. Number of studies under the NASA Environmental Biology Program for the years 1960-1967 according to primary research areas.

Graphic Representation of the
Annual Distribution of Publications
in the Subdisciplines of Environmental Biology

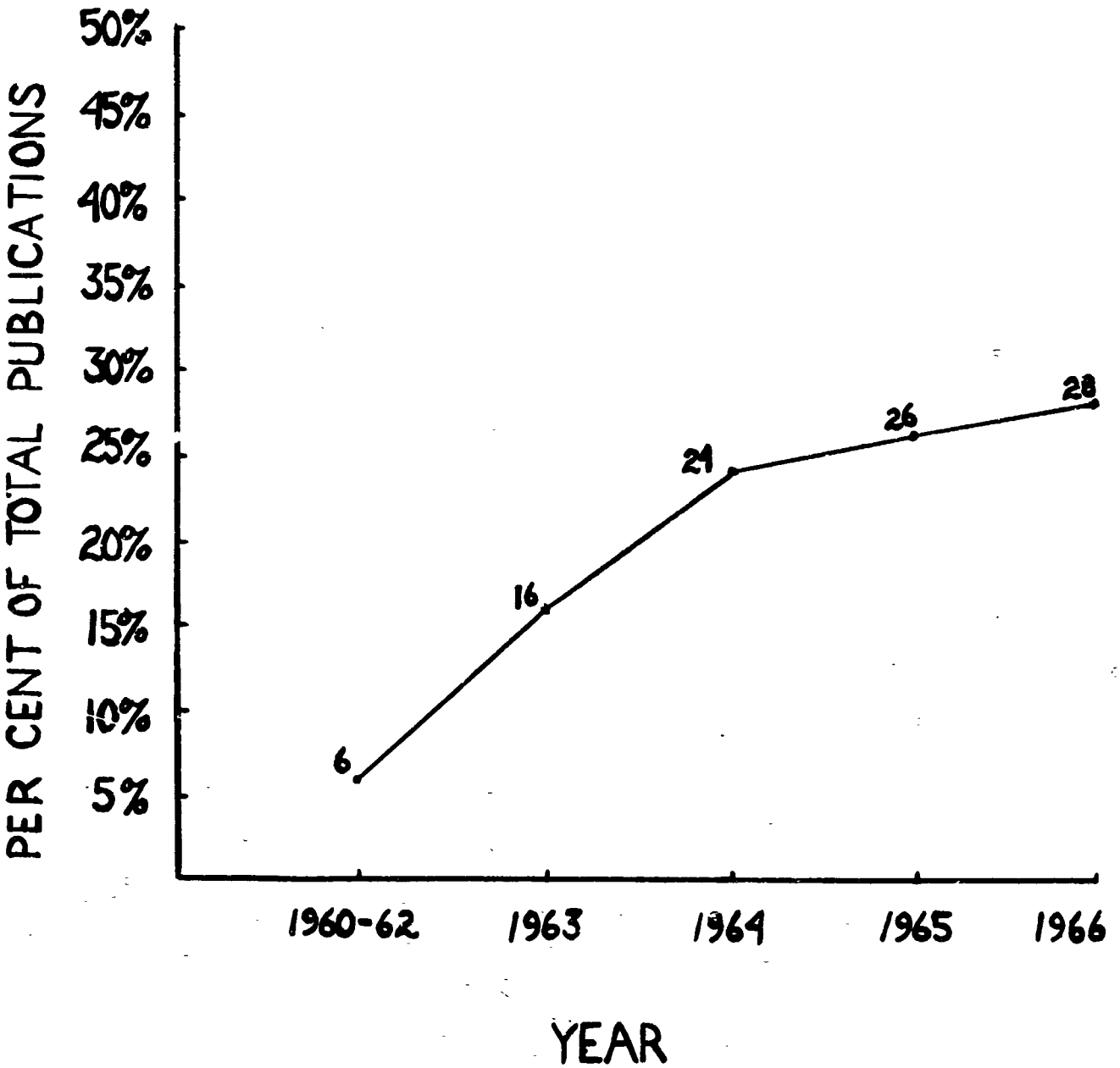

Figure 1. All Fields

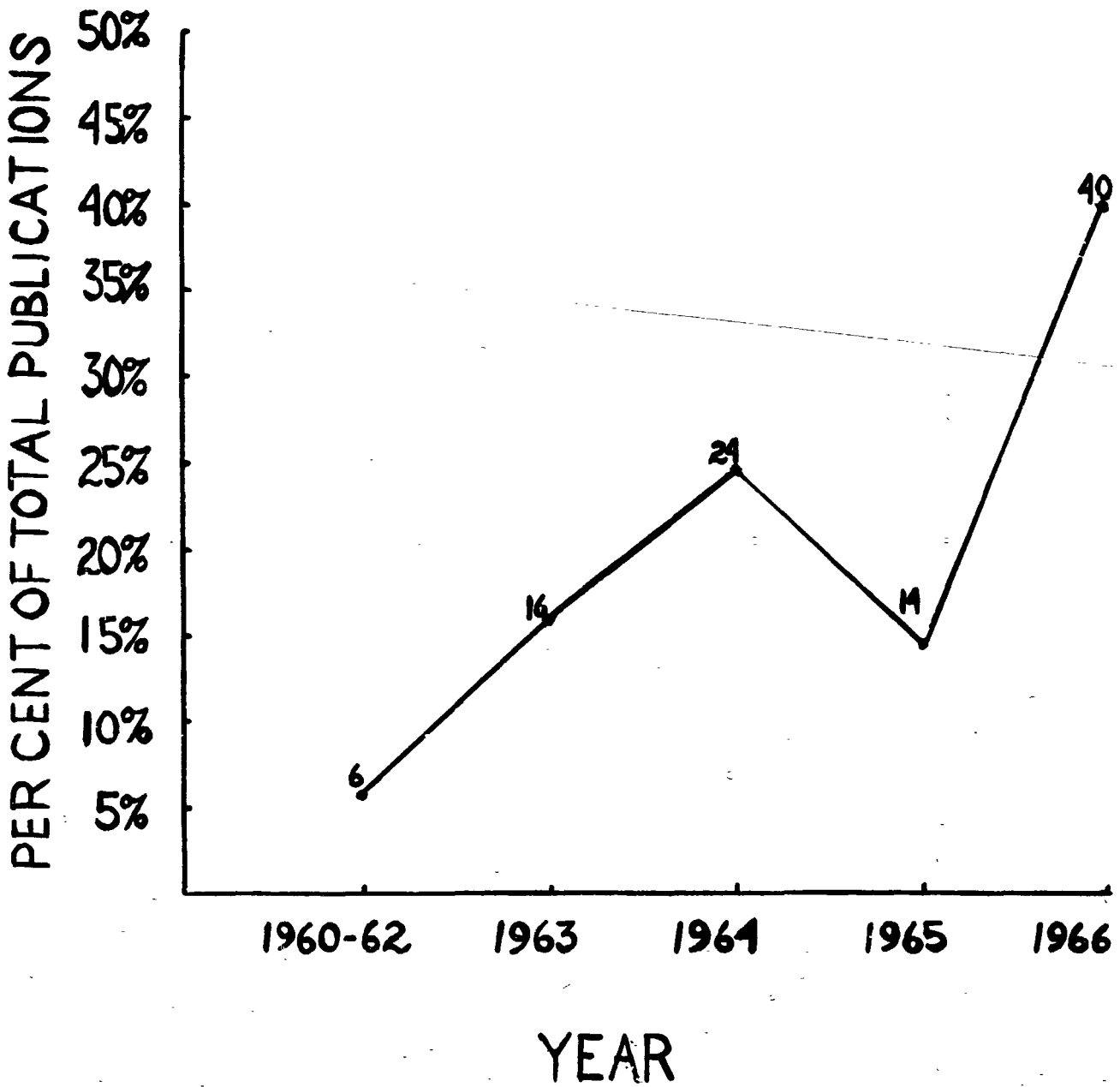

Figure 2. Biochemistry

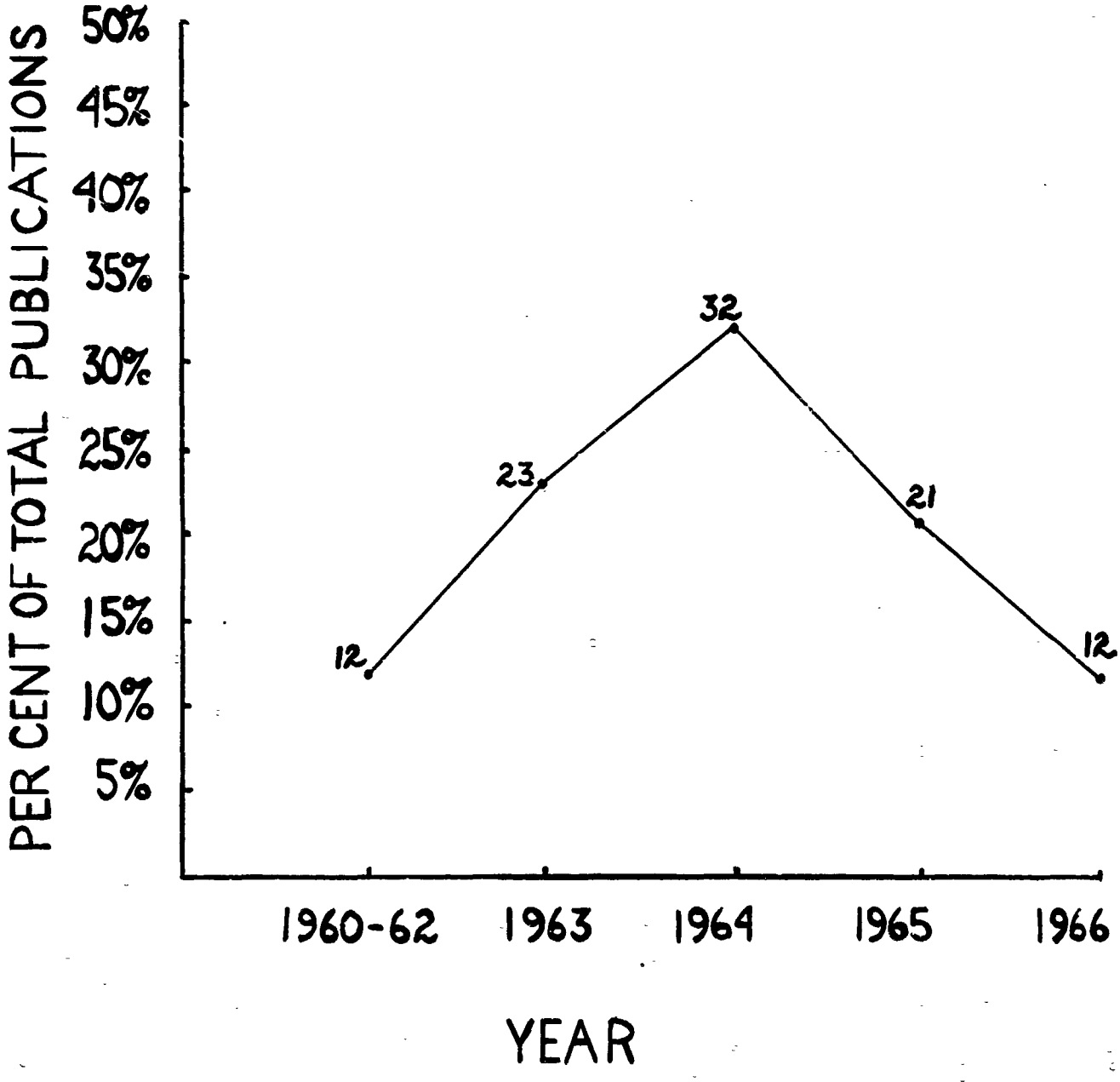

Figure 3. Radiobiology

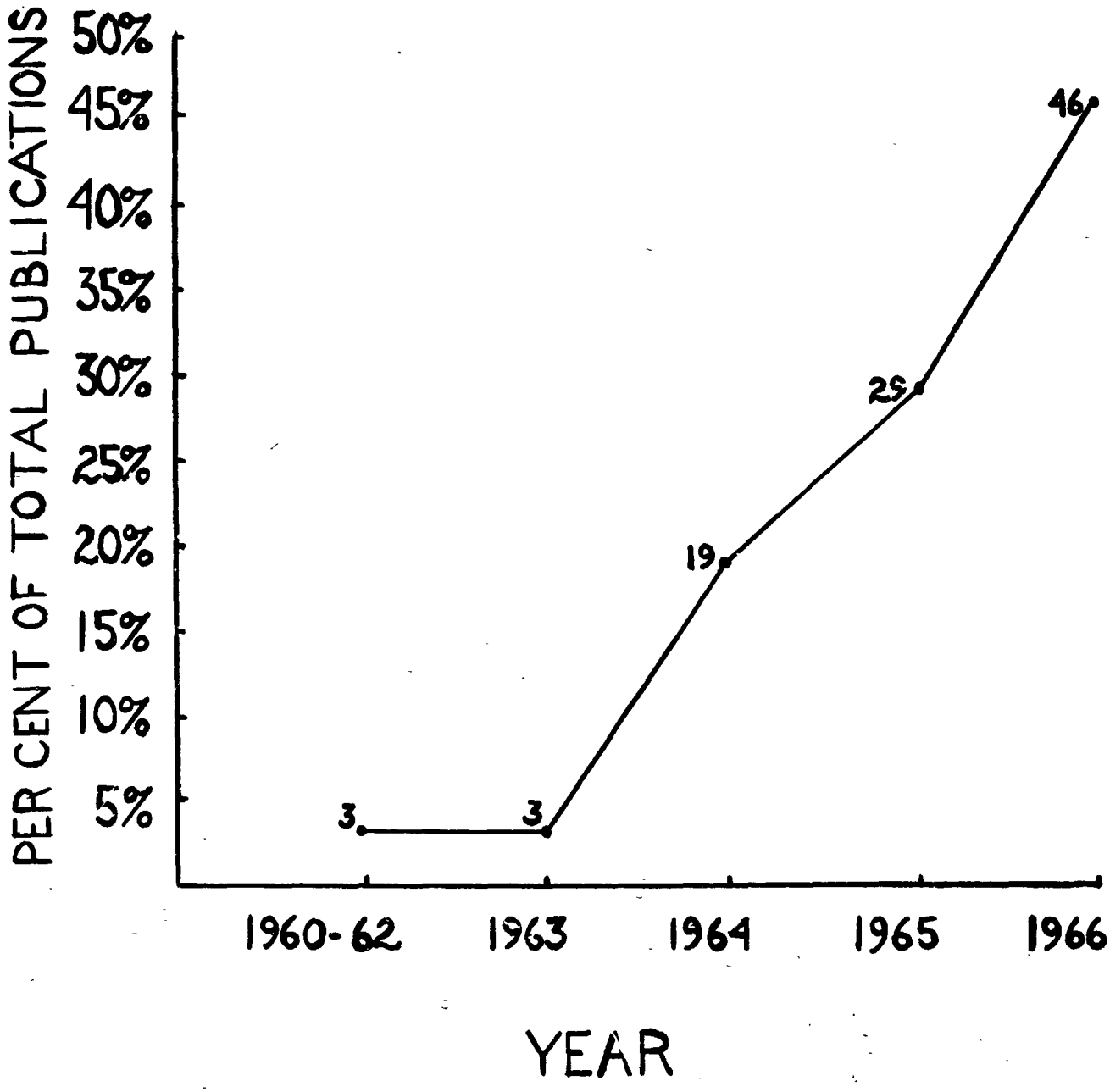

Figure 4. Environmental Extremes

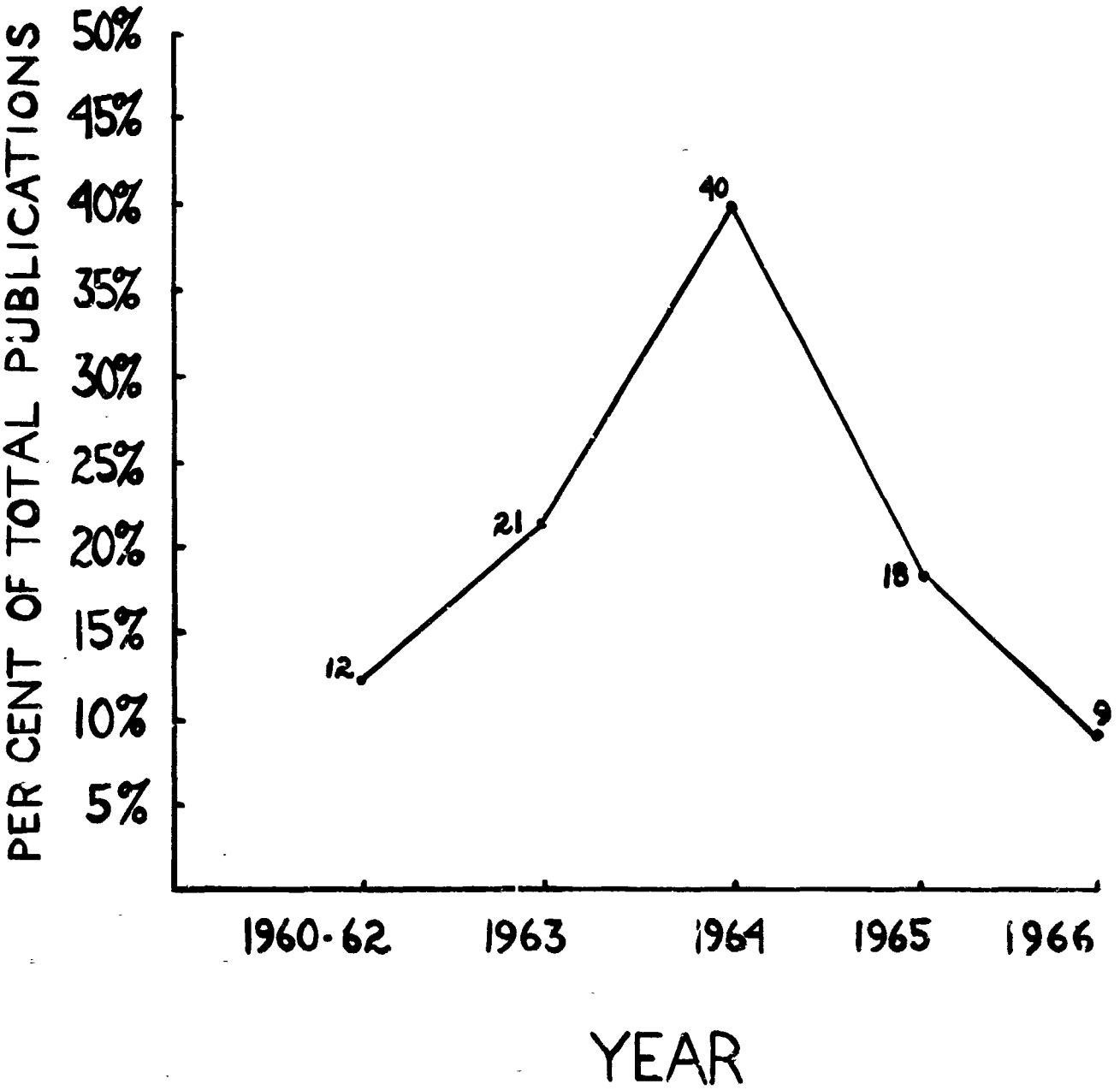

Figure 5. Bioinstrumentation and Techniques

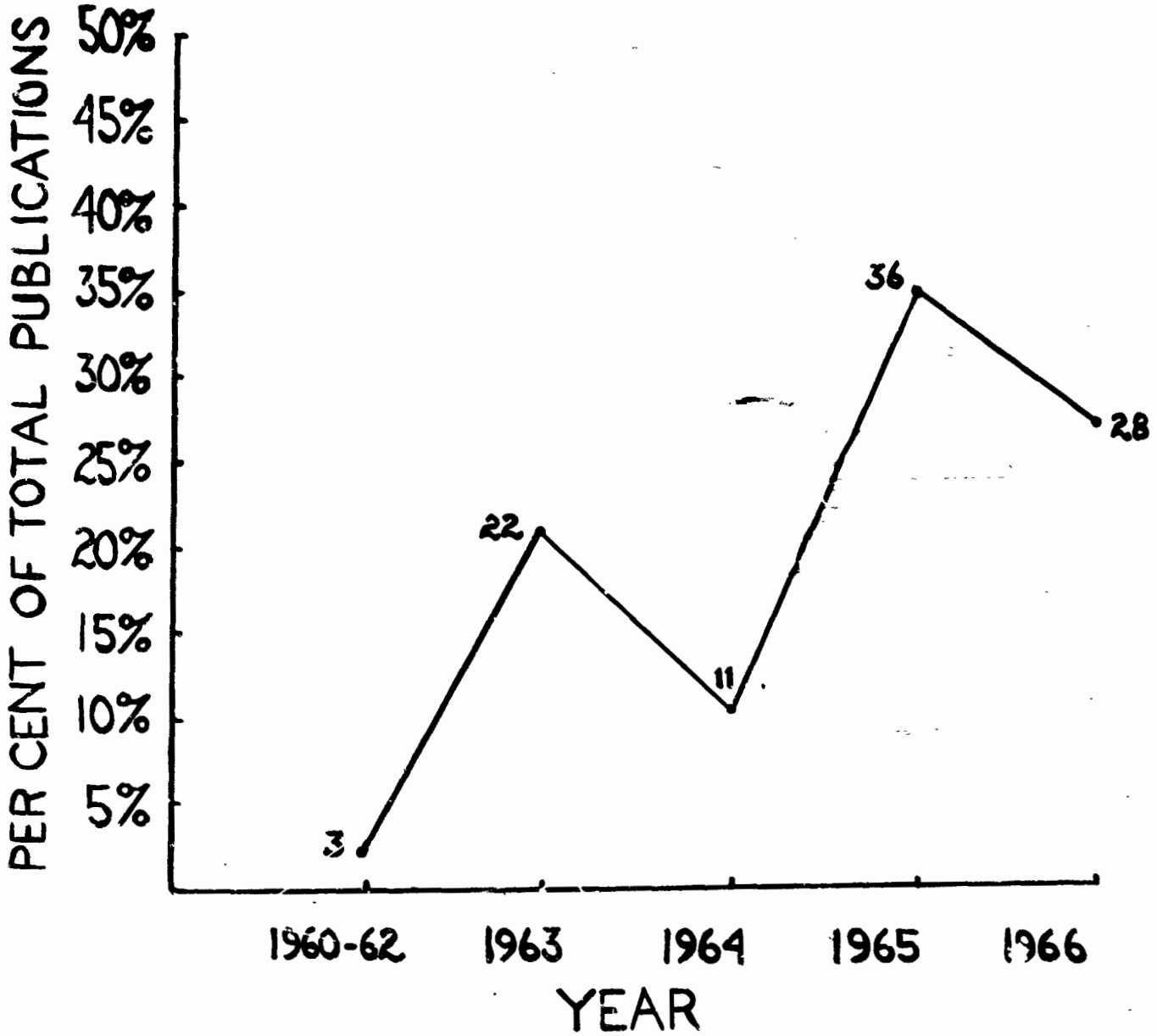

Figure 6. Gravity, Acceleration and Weightlessness

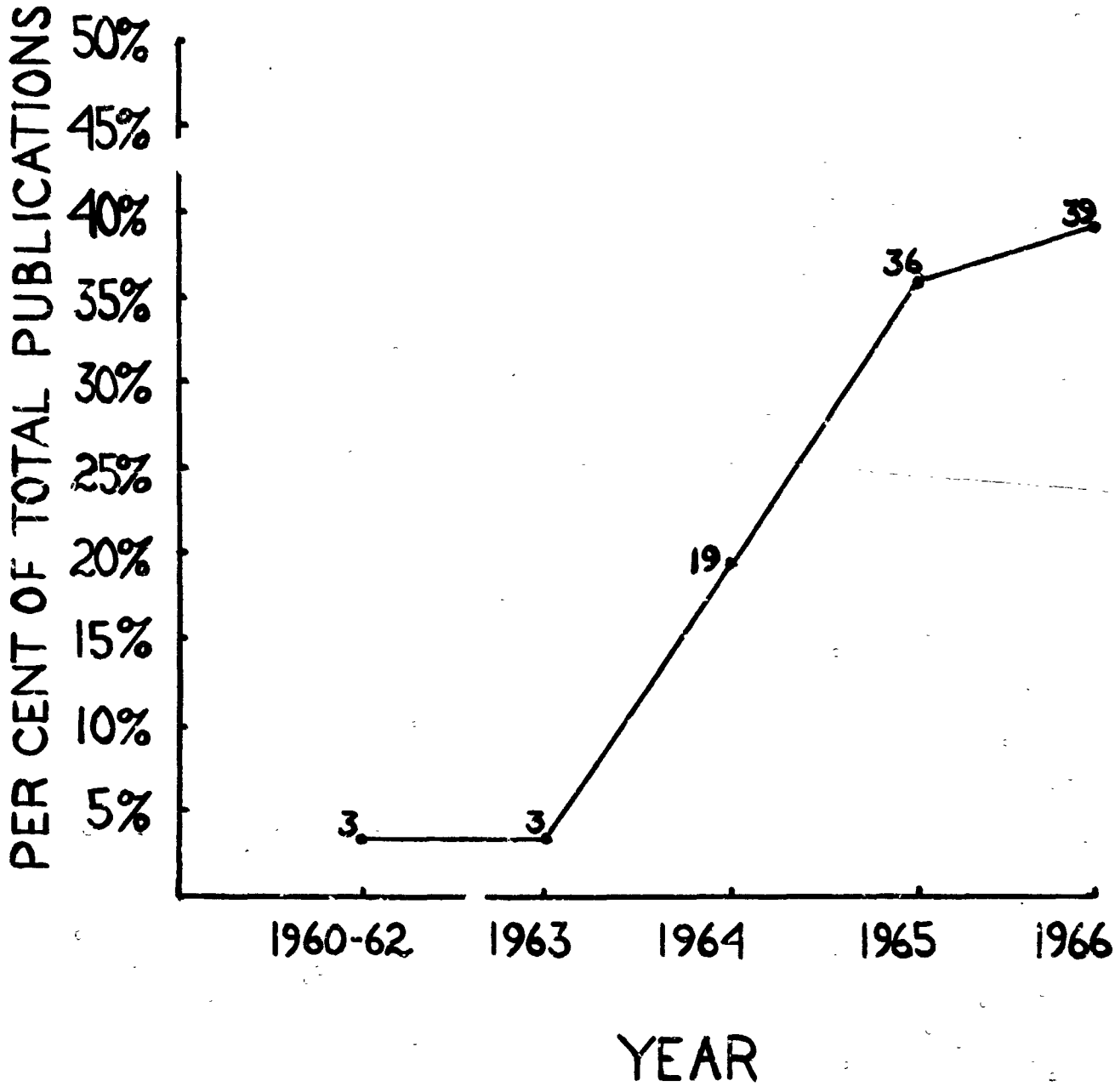

Figure 7. Gaseous Environments

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JOURNALS PUBLISHING ENVIRONMENTAL BIOLOGY ARTICLES

The following is an alphabetical list of journals in which some of the 344 articles appeared that resulted from research supported by the NASA Environmental Biology Program.

It is of particular interest to note the relatively large number of journals which have accepted one or more papers. The numbers in parentheses indicate the number of articles appearing in that journal.

Advances in the Astronautical Sciences (1)
Advances in Chemical Engineering (1)
Advances in Space Sciences and Technology (1)
Aerospace Medicine (18)
AIChE Journal (American Institute of Chemical Engineers) (1)
American Journal of Botany (4)
American Journal of Pathology (2)
American Journal of Physiology (8)
American Psychologist (1)
ARS Journal (American Rocket Society) (1)
Anatomical Record (2)
Annals of the New York Academy of Sciences (3)
Archiv fur Hydrobiologie (1)
Archiv fur Mikrobiologie (4)
Archives of Environmental Health (1)
Astronautics (presently Astronautics and Aeronautics) (1)

Bacteriological Proceedings (1)
Batelle Technical Review (1)
Biochimica et Biophysica Acta (4)
Biomedical Sciences Instrumentation (1)
Biophysical Journal (1)
Biotechnology and Bioengineering (1)
Botanical Gazette (3)
Bulletin of Mathematical Biophysics (1)
The Bulletin of Pathology (1)
Bulletin of the Torrey Botanical Club (1)

Canadian Journal of Microbiology (1)
Canadian Journal of Physiology and Pharmacology (1)
Canadian Journal of Zoology (1)
Cancer Research (4)
Comparative Biochemistry and Physiology (1)
Cryobiology (1)

Developments in Industrial Microbiology (6)

Experientia (2)
Experimental Cell Research (3)

Federation Proceedings (14)
Fertility and Sterility (1)
Folia Primatologica (1)

The Gerontologist (1)

Icarus (1)
I and E C Process Design and Development (Industrial and Engineering Chemistry) (2)
IRE Transactions on Medical Electronics (Institute of Radio Engineers) (presently IEEE Transactions on Biomedical Electronics) (1)
International Journal of Radiation Biology (and Related Studies in Physics, Chemistry and Medicine) (2)

Journal of the American Oil Chemists Society (1)
Journal of Applied Physiology (8)
Journal of the Arkansas Medical Society (1)
Journal of Bacteriology (4)
Journal of Cell Biology (2)
Journal of Cellular and Comparative Physiology (1)
Journal of Experimental Botany (1)
Journal of Fermentation Technology (1)
Journal of General Microbiology (1)
Journal of Phycology (1)
Journal de Physiologie (2)
Journal of the Royal Microscopical Society (1)
Journal of Surgical Research (1)
Journal of Theoretical Biology (2)

Laboratory Animal Care (1)
Laboratory Investigation (2)
Laboratory Primate Newsletter (1)
Life Sciences (1)

Memorie dell Instituto Italiano de Idrobiologia (Supplement) (1)
Microchemical Journal (4)

Nature (9)
Naturwissenschaft und Medizin (1)
Naval Research Reviews (1)

Physiologia Plantarum (1)
The Physiologist (17)
Plant and Cell Physiology (1)
Plant Physiology (18)
Planta (Berlin) (2)
Poultry Science (4)
Proceedings of the American Association for Cancer Research (2)
Proceedings of the Missouri Academy of Sciences (3)
Proceedings of the National Academy of Sciences (2)
Proceedings of the Society for Experimental Biology and Medicine (4)
Protoplasma (1)

Radiation Botany (1)
Radiation Research (3)
Record of Chemical Progress (1)

Science (7)

Texas Reports on Biology and Medici .e (2)

N67-32252

SCIENTIFIC PUBLICATIONS OF THE

BIOSCIENCE PROGRAMS DIVISION

VOLUME III EXOBIOLOGY

by

Frances Hong and L. A. Kulp

of the

Biological Sciences Communication Project

C. W. Shilling, M.D., Director

sponsored by

The George Washington University

work performed under NASA Contract

NSR 09 010 027

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PREFACE

This bibliography was prepared to supplement the needs of various bioscience administrators at the National Aeronautics and Space Administration for maintaining a current awareness in their respective fields. When critically analyzed, bibliographies provide meaningful insight to the state of activities for scientific endeavors by defining areas of pursuit, providing records of accomplishment, identifying scientists and laboratories engaged in various scientific activities, revealing the direction of research and the areas of gradient emphasis in addition to listing the available literature in a particular subject field. For these reasons the importance of bibliographies is being increasingly recognized by both science administrators and research scientists.

The more than 1,400 citations in the total work represent the publication efforts of the grantees and contractors of the Bioscience Programs Division since it was established. Letters were sent to the principal investigators requesting a list of publications resulting from research supported by grants or contracts from this division. The citations included in this bibliography were provided in response to this letter. Only those papers appearing in the serial literature and widely distributed report literature were considered. Theses and doctoral dissertations were omitted since such research would probably be published in scientific journals at a later date.

These citations have been collated into separate volumes for each program branch. A few citations predate the establishment of the branch offices under which they appear but are included because they resulted from efforts subsequently subsumed under these program offices. The volumes are enumerated as follows: Volume I, Behavioral Biology; Volume II, Environmental Biology; Volume III, Exobiology; Volume IV, Physical Biology; Volume V and VI, Planetary Quarantine and Bioscience Communications, respectively. Because of the brevity of the latter two bibliographies, they have been combined under one cover.

Each volume is divided into a number of sections beginning with the literature citations listed chronologically and according to the authors' surname. This arrangement reveals to some extent the growth and development of research under the direction of the program administrators. To provide access to these references both an author index and permuted title index are included.

An appendix is included which lists the journals in which these scientific publications appeared. This not only assists in identifying source material but indicates the wide range of scientific pursuit encompassed by the Bioscience Programs Division. It is interesting to note here that the publications have appeared in 268 scientific and technical journals.

Also in the appendix is a list of the senior authors' affiliations which, when correlated with the directory of laboratory addresses, makes communication with a senior author possible. Copies or reprints of the citations embodied herein cannot be furnished by either NASA or BSCP but may be obtained by contacting the senior authors.

It should be noted that no practical means was available for verifying a few of the references given by the authors and, as a result, a few citations are incomplete. This is especially true in cases where papers appeared in lesser known sources and/or were "in press".

The authors gratefully acknowledge the technical assistance of Miss Sheila Rollins and of the secretarial staff in the preparation of this report.

Leslie A. Kulp, Ph.D.

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Lundgren, D. A. (Appl. Sci.)
Lundstrom, J. (Stanford, Med. Cent.)
Mahler, I. (Brandeis, Grad. Dept. Biochem.)
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Mann, T. (U. Miami, Inst. Mol. Evol.)
Marmur, J. (Brandeis, Grad. Dept. Biochem.)
Matsumoto, K. (U. Miami, Inst. Mol. Evol.)
McCrosby, R. E. (Smithsonian)
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McMurray, W. J. (Yale, Sch. Med.)
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Menzel, M. Y. (U. Miami, Inst. Mol. Evol.)
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Morelli, F. (JPL)
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Vishniac, W. (U. Rochester)
Waehneldt, T. V. (U. Miami, Inst. Mol. Evol.)
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Wells, C. L. (Carnegie Inst. Tech.)
Westley, J. (Stanford, Med. Cent.)
Weston, C. R. (U. Rochester)
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Whitten, D. G. (JPL)
Wilhite, W. F. (JPL)
Wilska, A. P. (Arizona)
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Wolken, J. J. (Carnegie Inst. Tech.)
Young, R. S. (NASA, Ames)

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ANALYSIS OF THE PUBLICATION SOURCES

Under the auspices of the Exobiology Program, 442 papers were published by the NASA's bioscience grantees and contractors. The cross disciplinary aspects of this program is indicated by the widespread occurrence of these publications. These papers appeared in 98 different scientific and technical journals and in various laboratory report media. They were indexed under the scientific pursuits listed in the table on page 85, some of which represent well recognized disciplines whereas others merely represent subject areas which have received notable attention. In those instances where reports might have been subsumed under more than one category, consideration was given to the scientific orientation of the author(s) or to the source of publication. Arbitrary decisions had to be made occasionally but these were not sufficient in quantity to significantly affect the data reported.

The figures on the following pages were constructed to represent, chronologically, the publication frequencies of the major subject fields. The frequency of publication for each area of study was derived by dividing the number of subject publications appearing in each given year by the total number for all the years considered. The publications appearing in 1959 through 1961 were combined with those of 1962 because of the small number of reports which were issued during these early years. The data used for the graphic illustration of 1966 included those citations listed as "in press" for that year but since the list of citations for 1967 was incomplete, it was omitted from the figures.

The figures derived from this study provide, to some extent, an indication of the activity and direction of research within this office. Figure 1 points out that the total publication effort has consistently risen each year until 1966 when it dropped sharply. During this year none of the subject areas experienced an increase in publication output. Up to 1965, the publication effort in Organic Chemistry and Biochemistry, and Bioinstrumentation increased considerably and very small decreases occurred in only a few fields.

For the purposes of this report, those studies concerned with the exposure of organisms to stressful conditions such as simulated planetary environments were subsumed under Extreme Environments whereas the studies concerned with the physical environments of the planets and not involving the subjection of organisms to such conditions were subsumed under Planetary Environments.

Papers of the grantees and contractors of this program office appeared most frequently in Nature, which had 51 of the citations listed in this report. Science followed, having 37 citations and the Proceedings of the National Academy of Science and the Journal of the American Chemical Society were next, each with 10 references. Seventy-nine, or more than 80% of the journals had three or fewer publications over this nine year period.

	1959, 1960	1961	1962	1963	1964	1965	1966	No Date	In Press 1966, No 1967	Date	TOTAL
ORGANIC CHEMISTRY AND BIOCHEMISTRY											
Abiogenic Syntheses		2	5	21	25	20	9			6	88
Meteorbiology		1		11	8	8	8			2	38
Enzymology					5	7	5	2		4	23
Organogeochemistry					4	10	6		1,1	1	23
Other Studies		1		7	5	20	6	1	1	3	44
BIOINSTRUMENTATION											
Spectroscopy	1,2	1	3	5	15	20	5			1	53
Chromatography				5	3	7	7			2	22
Other Studies			1	8	8	7	6			2	32
EXOBIOLOGY, GENERAL	,2	3	3		4	9	7	1			36
REPRODUCTIVE MECHANISMS			7	3	2	3	1		1		17
SPACECRAFT STERILIZATION AND PLANETARY QUARANTINE	,2		2	3	3	4	1				15
SOIL MICROBIOLOGY			1	2		6	1			1	11
PLANETARY ENVIRONMENTS		1	2	1		3	3				10
EXTREME ENVIRONMENTS		1	2	2	3						8
COMPUTER AND INFORMATION SCIENCES					2	2	1				5
HIGH ALTITUDE SAMPLING						5					5
GENETICS					3				1,		4
IMMUNOLOGY						4					4
BIOLOGY, GENERAL				1			1		1,		3
BIOPHYSICS						1					1
TOTAL	1,6	10	26	76	87	136	66	4	4,1	20	442

Table. Number of studies under the NASA Exobiology Program for the years 1960-1967 according to primary research areas.

Graphic Representation of the
Annual Distribution of Publications
in the Subdisciplines of Exobiology

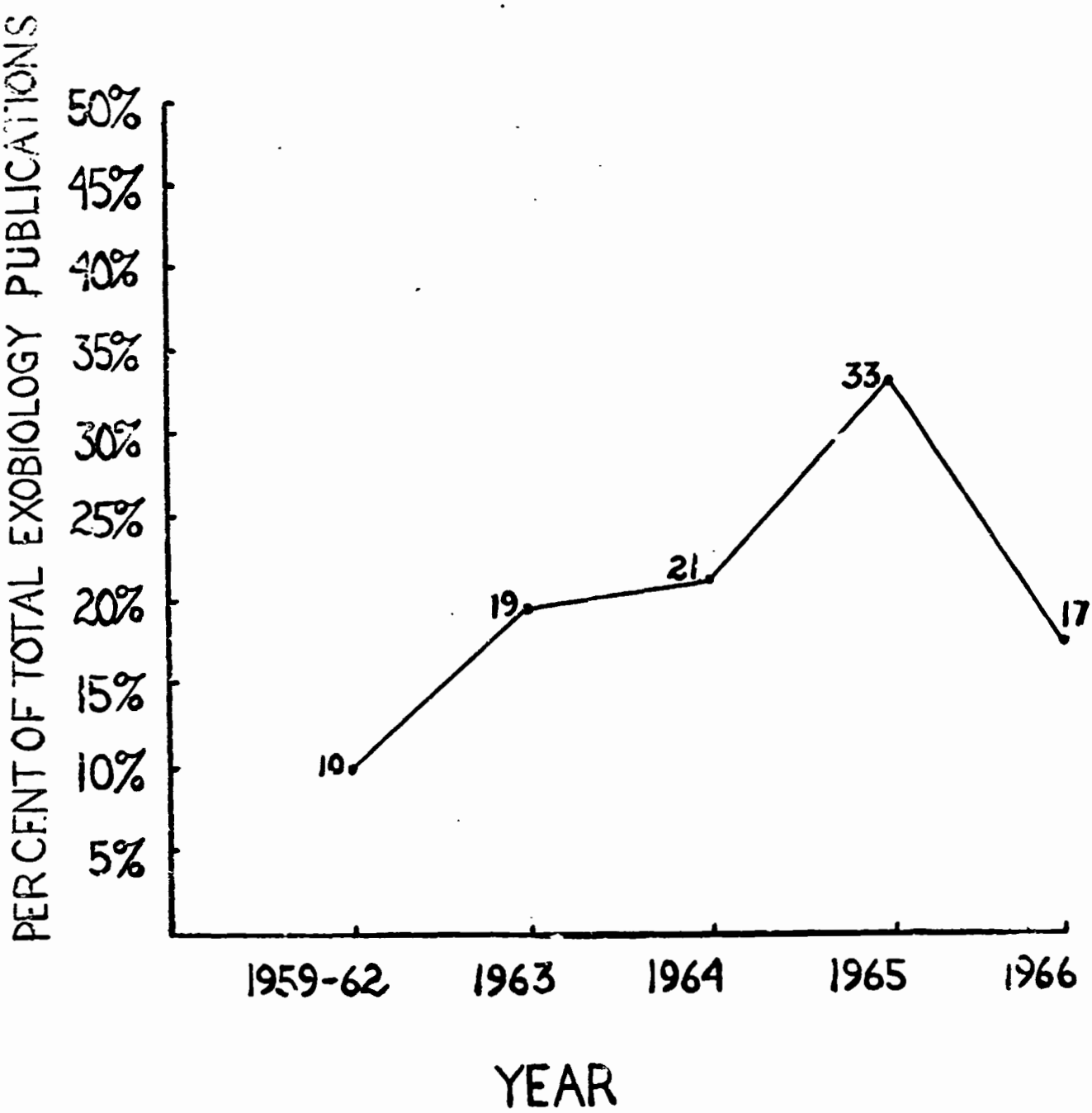

Figure 1. All Fields

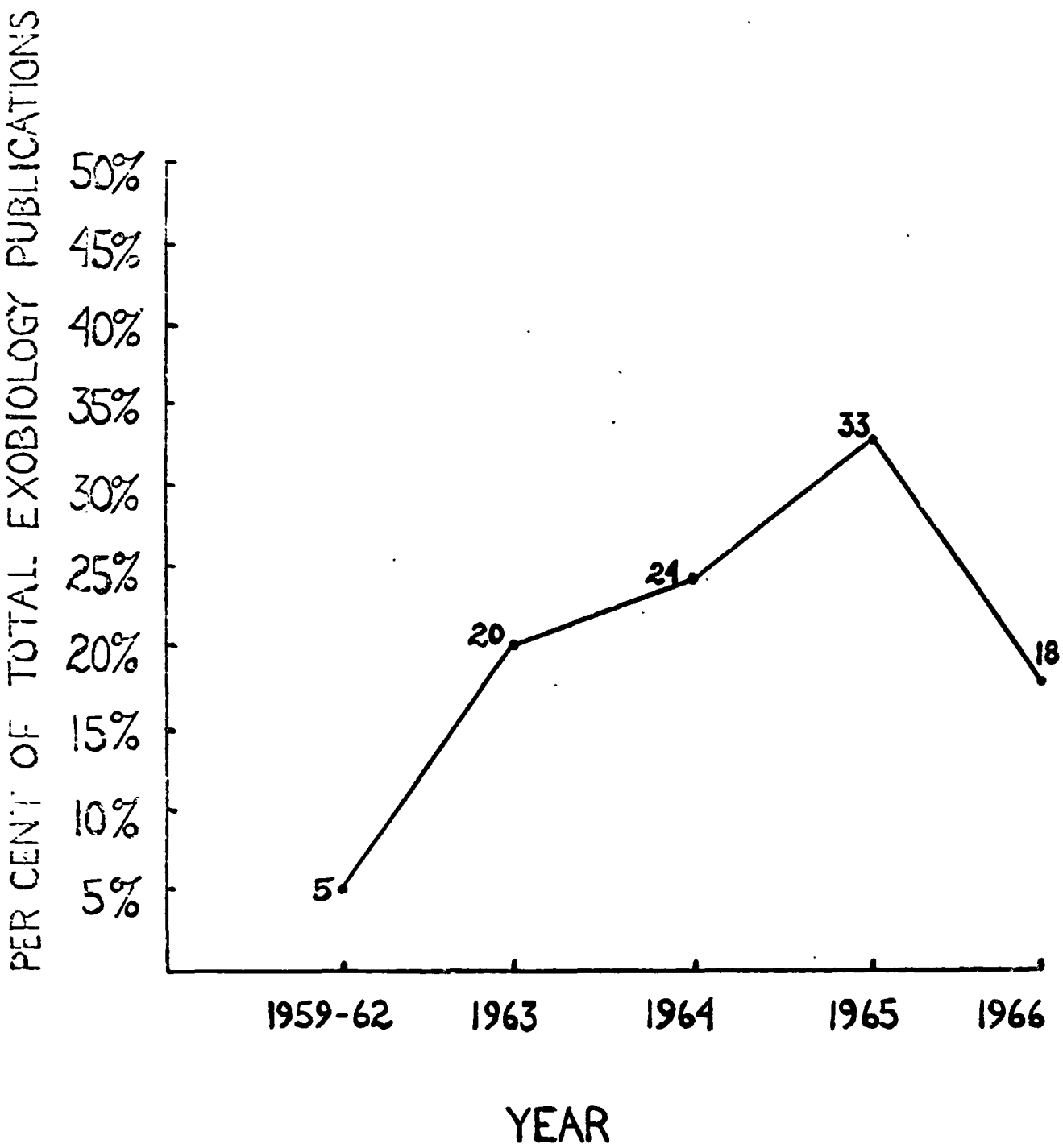

Figure 2. Organic Chemistry and Biochemistry

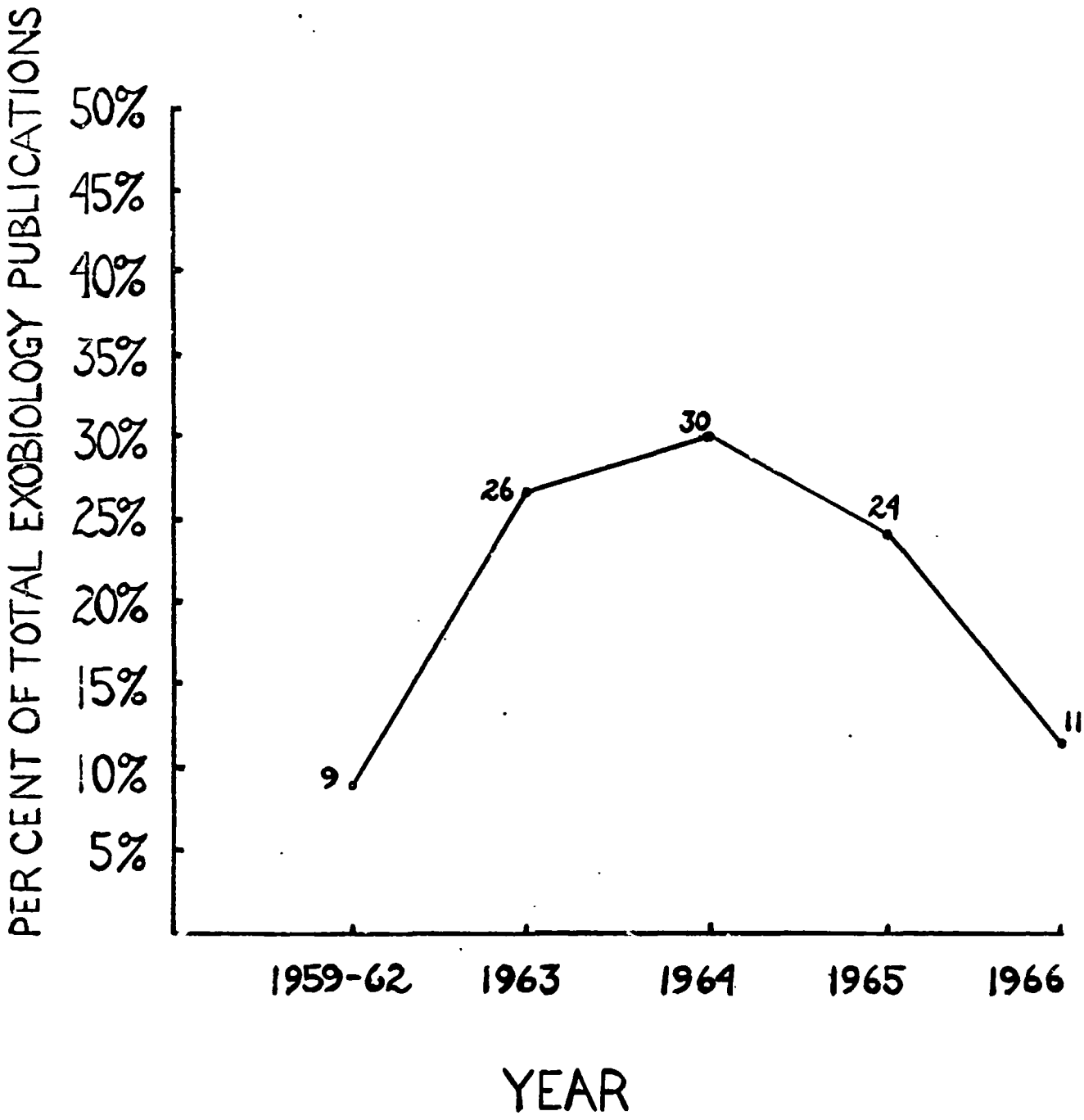

Figure 3. Abiogenic Syntheses

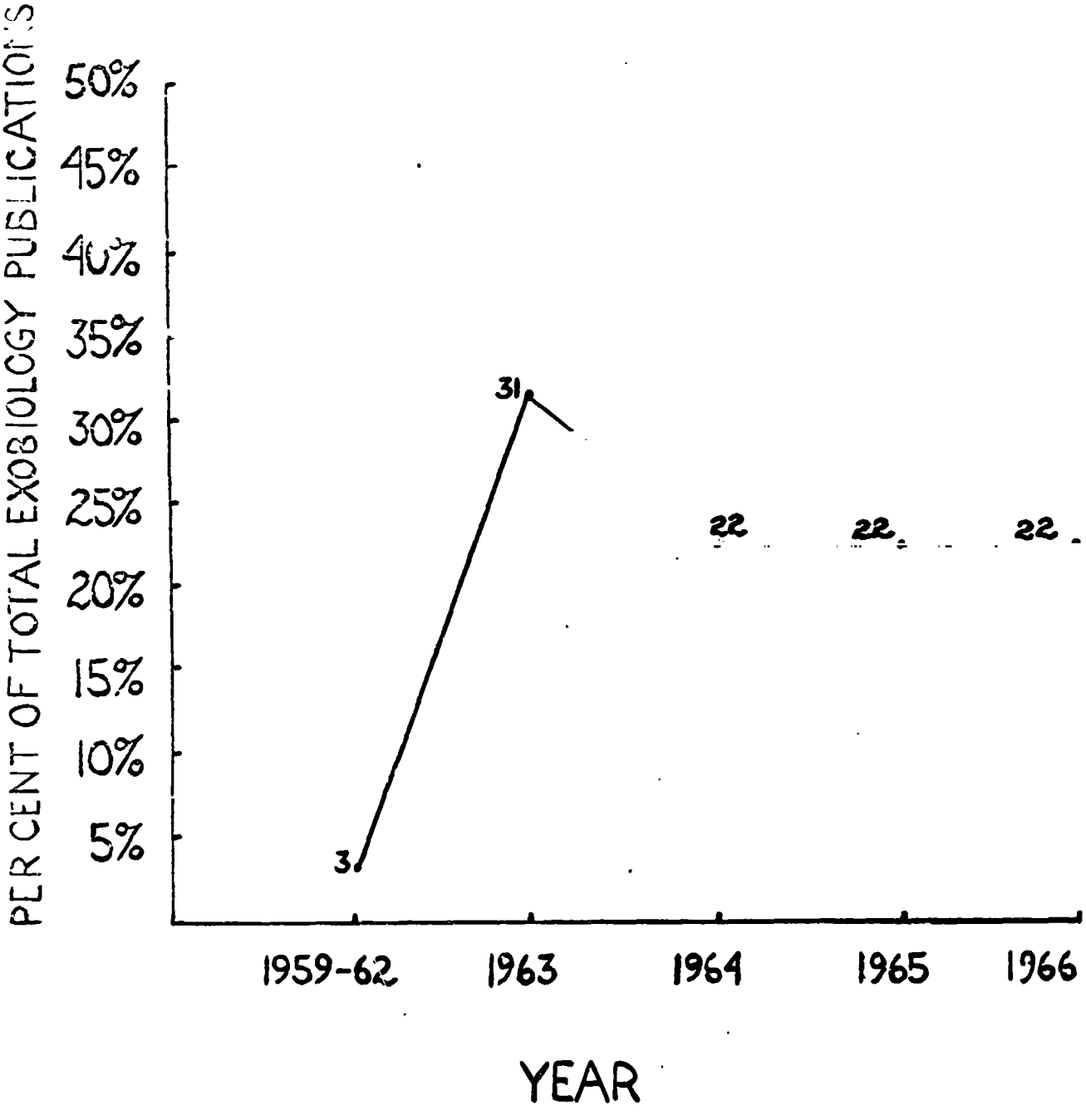

Figure 4. Meteorbiology

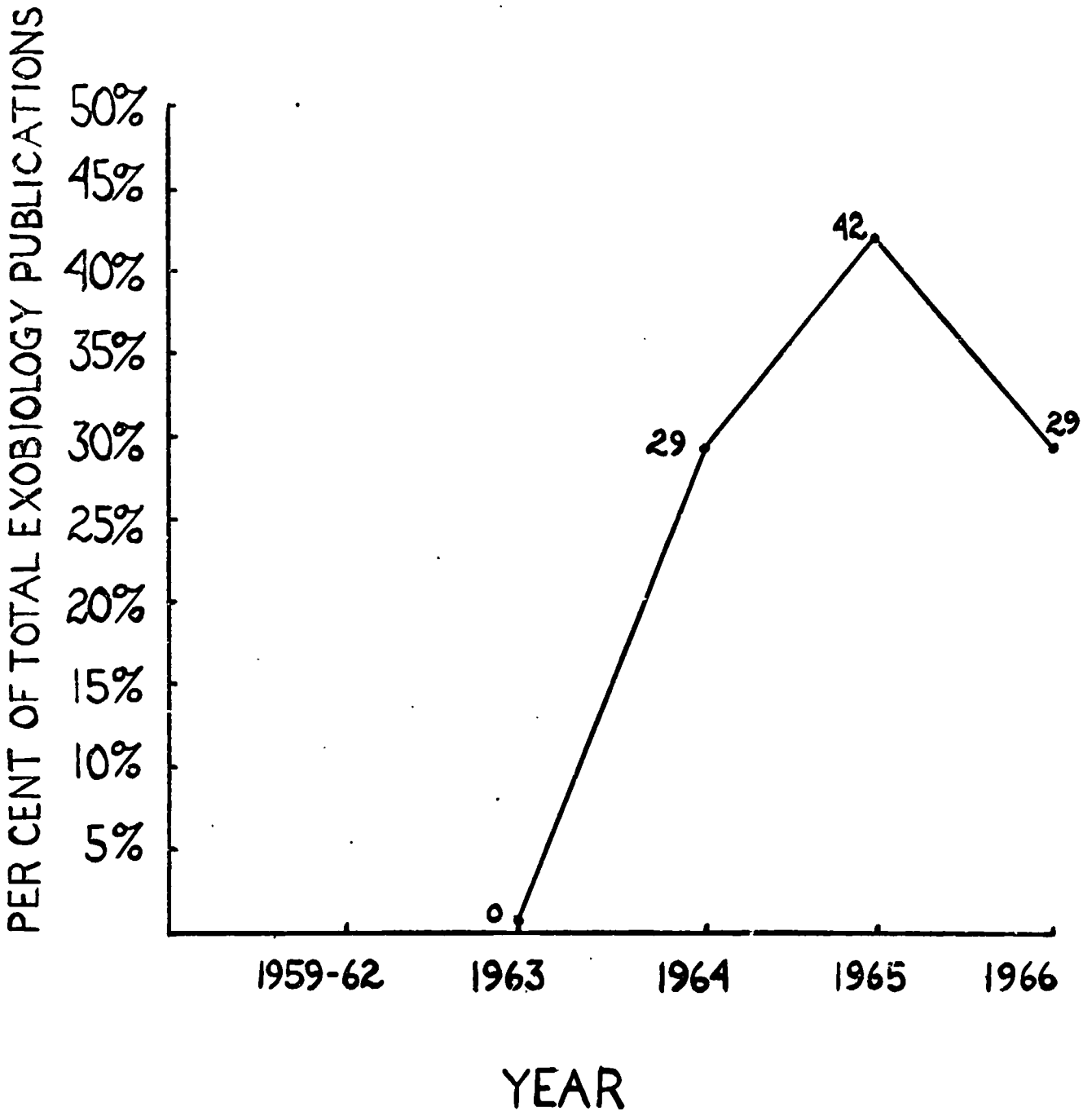

Figure 5. Enzymology

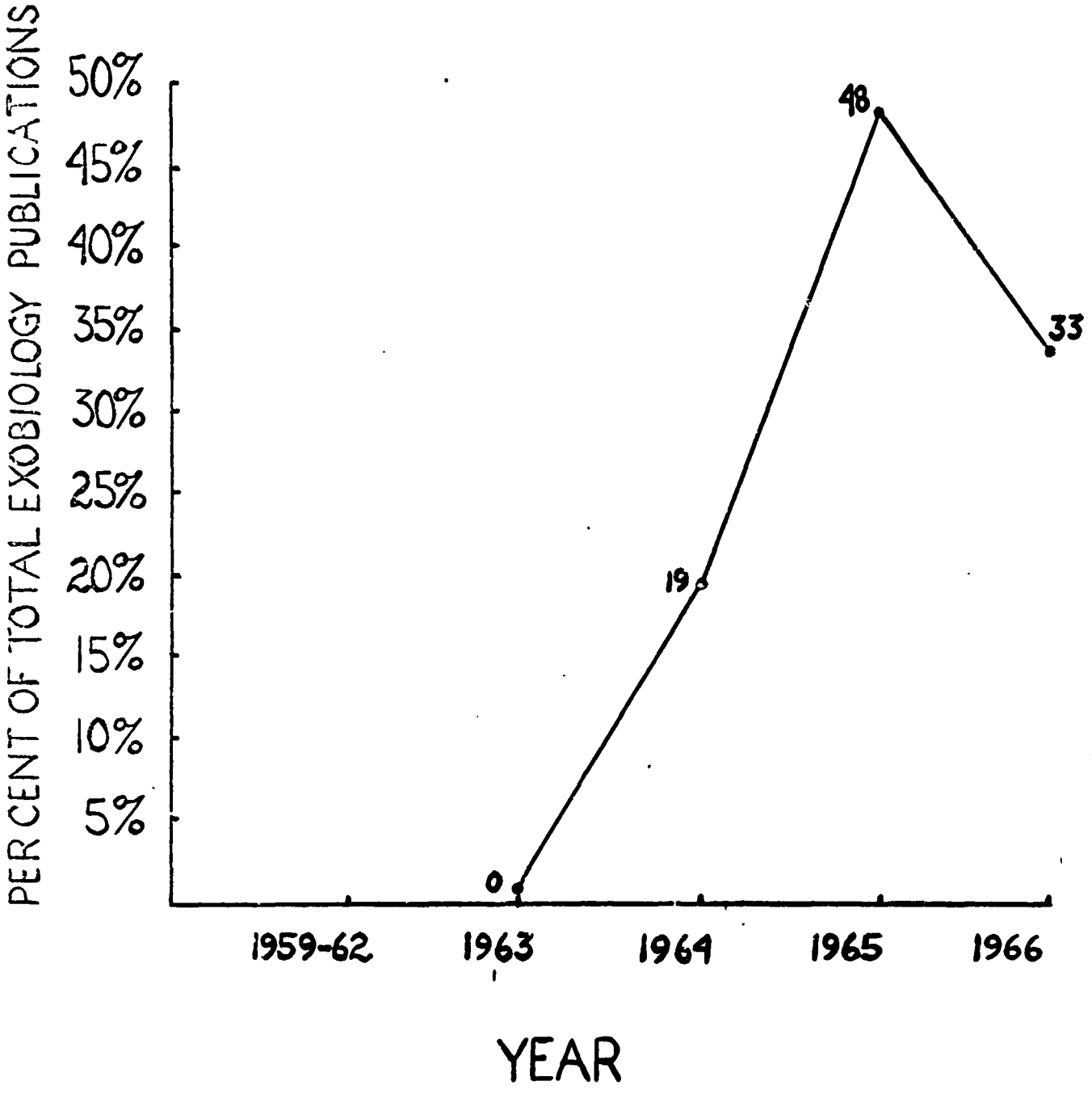

Figure 6. Organogeochemistry

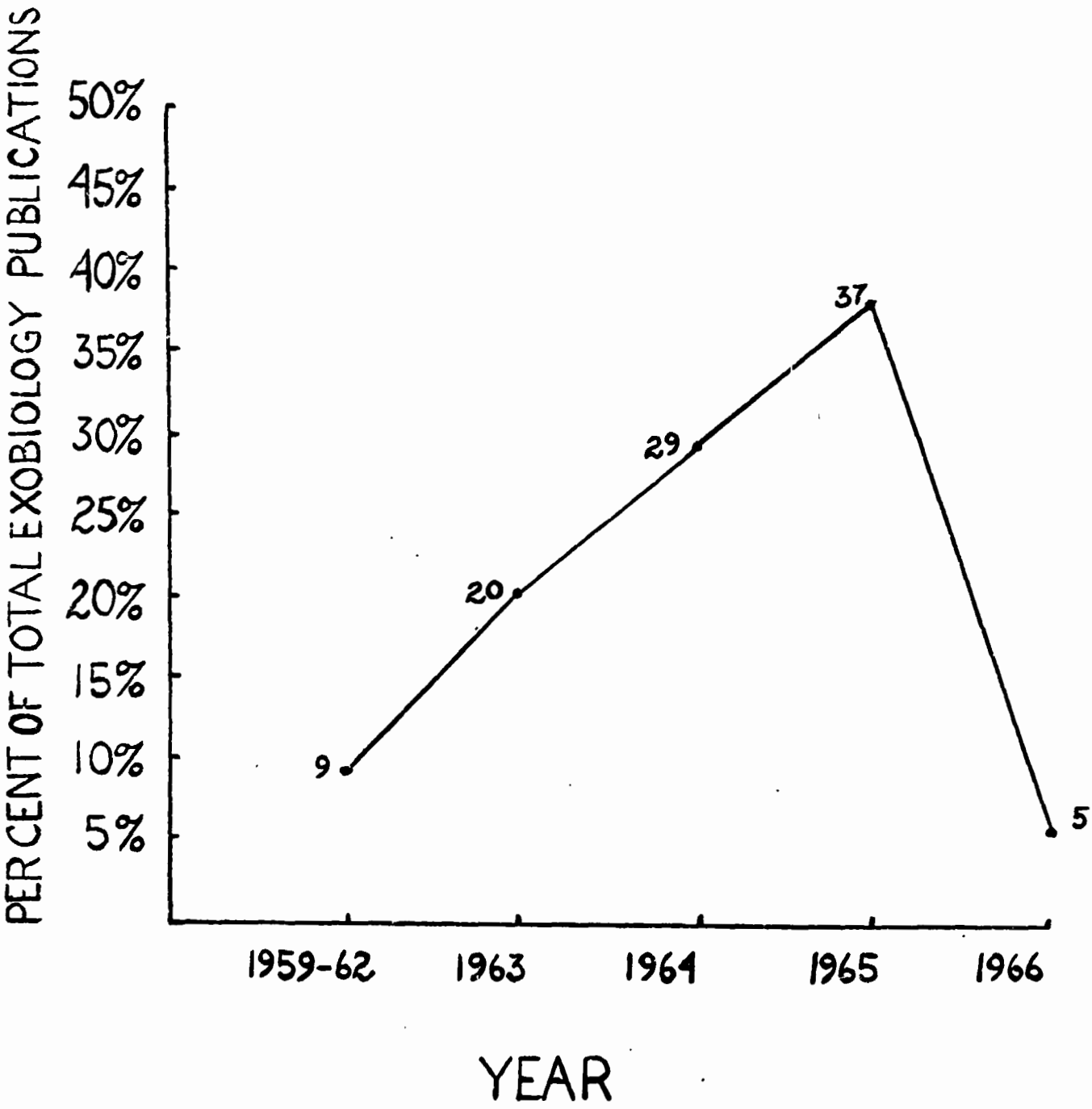

Figure 7. Bioinstrumentation

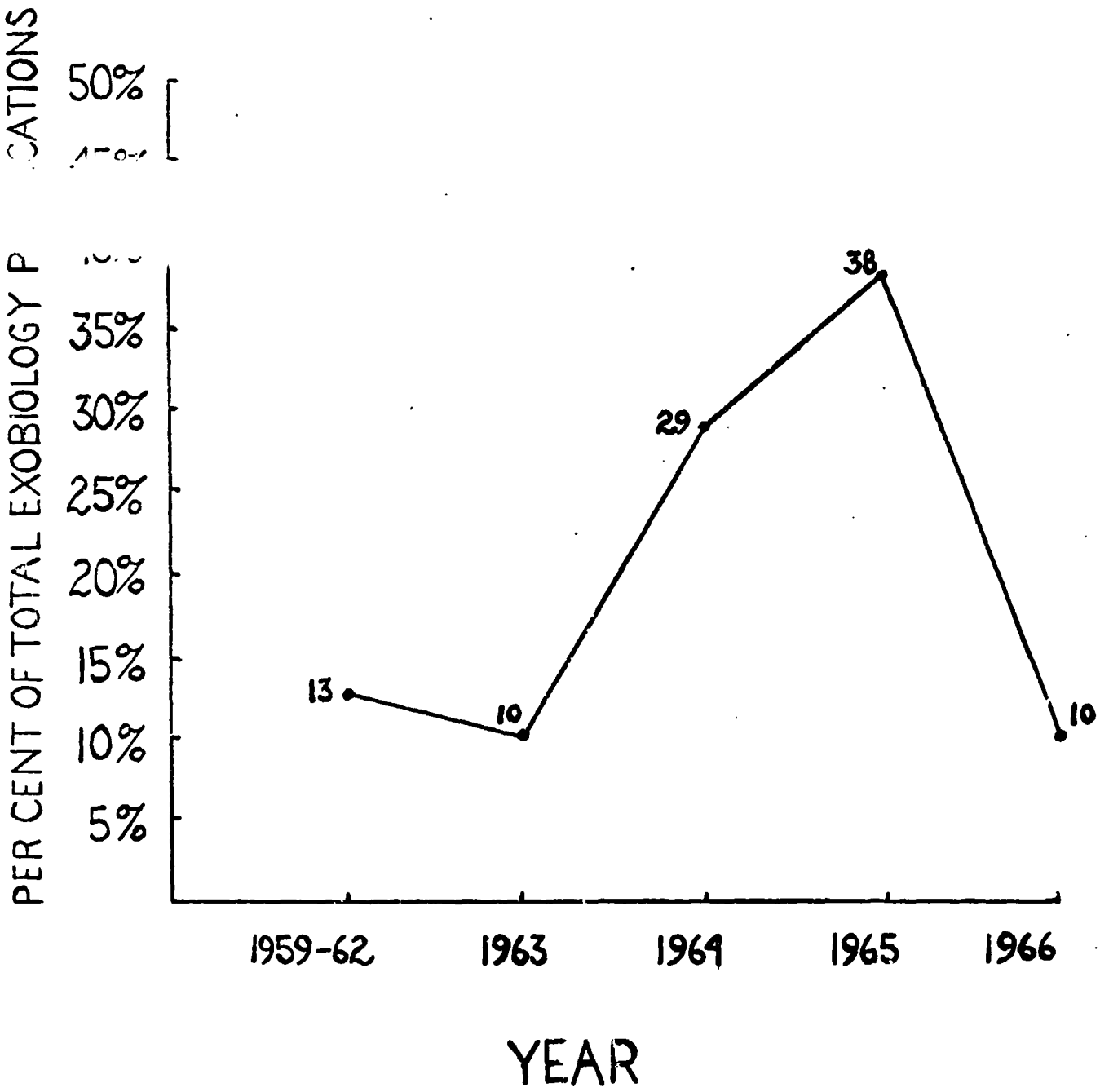

Figure 8. Spectroscopy

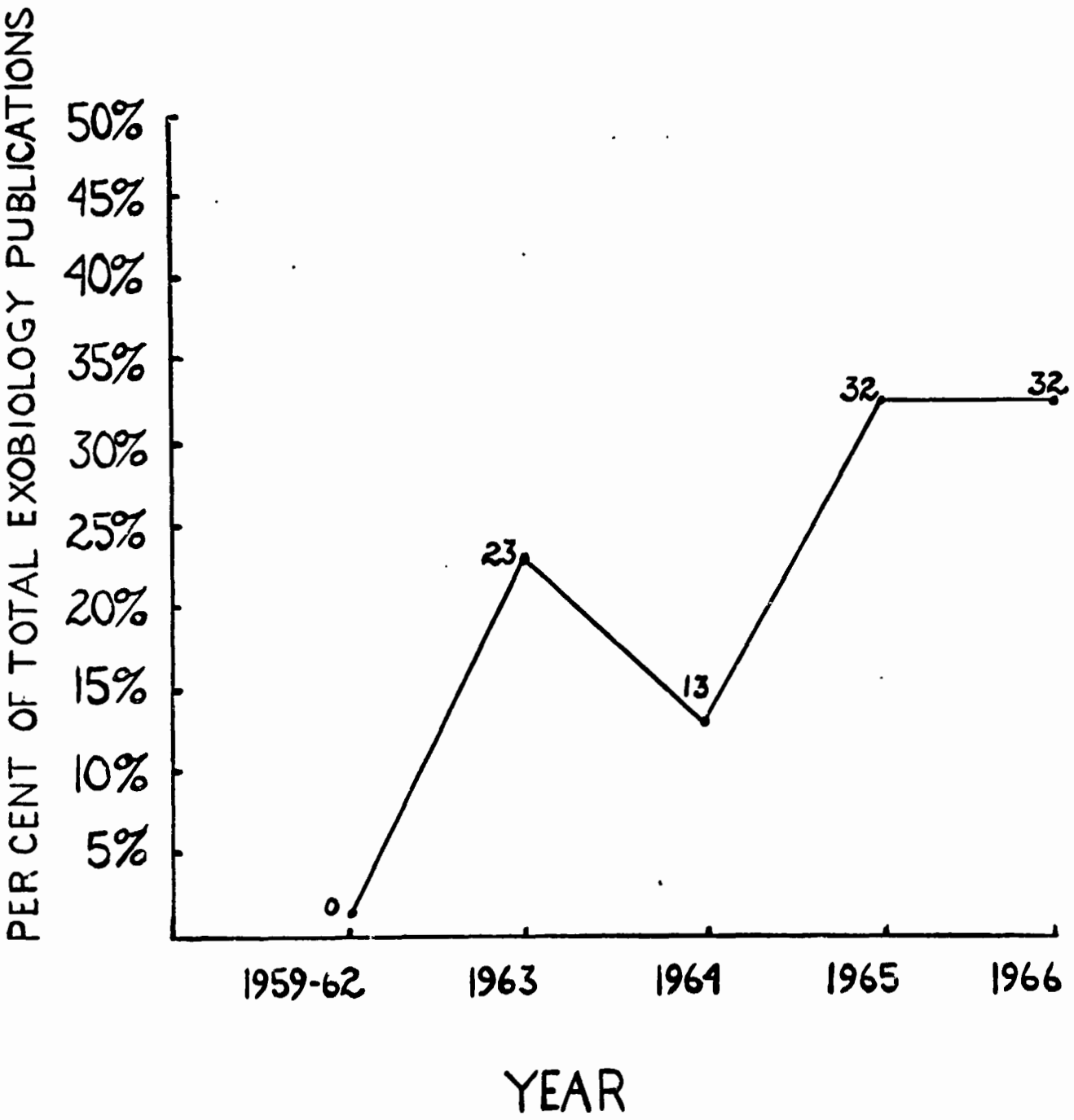

Figure 9. Chromatography

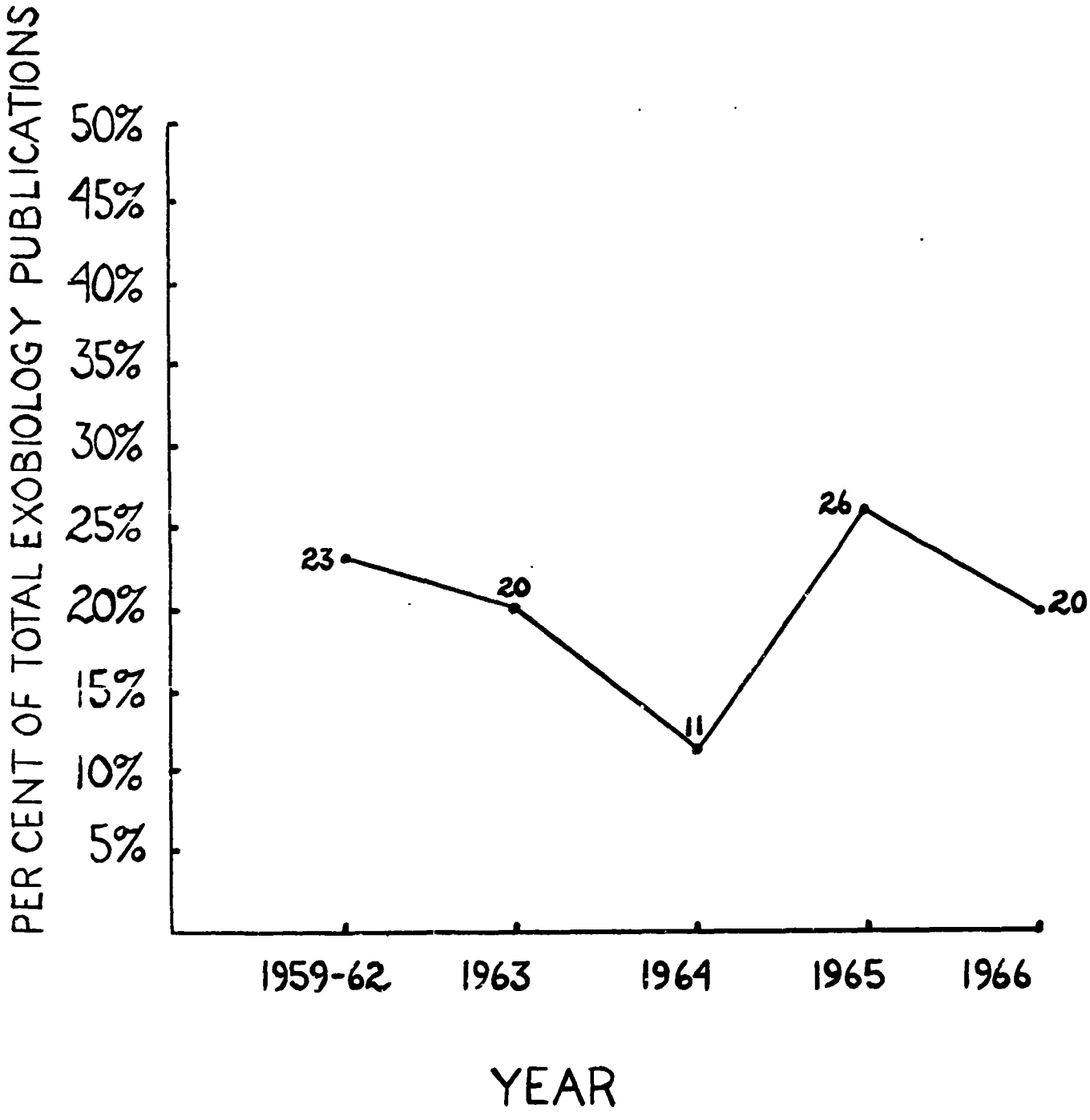

Figure 10. General Exobiology

JOURNALS PUBLISHING EXOBIOLOGY ARTICLES

The following is an alphabetical list of journals in which some of the 442 articles appeared that resulted from research supported by the NASA Exobiology Program.

It is of particular interest to note the relatively large number of journals which have accepted one or more papers. The numbers in parentheses indicate the number of articles appearing in that journal.

Advances in Applied Microbiology (2)
Advances in the Astronautical Sciences (1)
Advances in Organic Geochemistry, Proceedings (2)
Aerospace Medicine (1)
Air Engineering (1)
American Biology Teacher (1)
American Journal of Botany (1)
American Journal of the Diseases of Children (1)
American Mineralogists (1)
American Scientist (2)
Analytical Biochemistry (3)
Analytical Chemistry (5)
Annals of the New York Academy of Sciences (6)
Applied Optics (1)
Applied Microbiology (1)
Archives of Biochemistry and Biophysics (5)
Astronautics and Aeronautics (3)
Astronomical Journal (1)
Australian Journal of Chemistry (1)

Bacteriological Proceedings (1)
Biochemical and Biophysical Research Communications (4)
Biochemistry (2)
Biochimica et Biophysica Acta (2)
Biological Bulletin (7)
Biologie du Sol (1)
Bioscience (3)
Brookhaven Symposia in Biology (1)
Bulletin de l'Academie Royale de Medecine de Belgique (1)
Bulletin of the Chemical Society of Japan (6)
Bulletin of the Geological Society of America (1)

Carnegie Magazine (1)
Chemical Communications (2)
Cold Spring Harbor Symposia in Quantitative Biology (1)
Communications of the Lunar and Planetary Laboratory (2)
Comparative Biochemistry (1)
Comparative Biochemistry and Physiology (2)

Developments in Industrial Microbiology (1)

Enzymologia (2)
Evolution (1)
Experimental Cell Research (1)

Federation Proceedings (5)
Food Technology (1)

Genetics (1)
Geochimica et Cosmochimica Acta (7)
Geologiska föreningens i Stockholm förhandlingar (2)

Harvard Alumni Bulletin (1)
Helvetica Chimica Acta (1)

Icarus (4)
Immunochemistry (3)
Industrial Research (1)
IEEE Transactions on Circuit Theory (1)

Journal of the American Chemical Society (10)
Journal of the American Oil Chemists Society (2)
Journal of Bacteriology (6)
Journal of Biological Chemistry (4)
Journal of the British Interplanetary Society (1)
Journal of Cell Biology (1)
Journal of Chemical Physics (2)
Journal of the Chemical Society (1)
Journal of Chromatography (1)
Journal of Experimental Biology (1)
Journal of Gas Chromatography (2)
Journal of Geophysical Research (1)
Journal of Immunology (1)
Journal of Molecular Biology (3)
Journal of Organic Chemistry (2)
Journal of Physical Chemistry (4)
Journal of Protozoology (1)
Journal of Reproduction and Fertility (1)
Journal of Sedimentary Petrology (1)
Journal of Spacecraft and Rockets (1)
Journal of Ultrastructure Research (2)

Meteoritika (1)

Nature (51)
Naturwissenschaften (1)
Nucleonics (1)

Palaeontologische Zeitschrift (1)
Parasitology (1)
Photochemistry and Photobiology (2)
Phytochemistry (2)
Planetary and Space Science (2)
Plants (1)
Proceedings of the American Astronautical Society (1)
Proceedings of the Atmospheric Biology Conference (5)
Proceedings of the Lunar and Planetary Exploration Colloquium (5)
Proceedings of the National Academy of Sciences, U.S. (10)

Proceedings of the Royal Society, Series B (1)
Proceedings of the Society for Experimental Biology and Medicine (1)

Radiation Research (2)
Rochester Review (1)

Science (37)
Scientific American (1)
Space Science Reviews (5)

Tetrahedron (1)
Tetrahedron Letters (3)

Virology (1)

Yale Journal of Biology and Medicine (1)

Zeitschrift für Naturforschung (1)

Addendum

1966

A1. WESTLEY, J. W. Detection of optical activity as a sign of life. Stanford University School of Medicine, Instrum. Res. Lab., Palo Alto, Calif. Technical Rept. No. IRL-1047. Apr. 1966. 9 p.

N67-32253

SCIENTIFIC PUBLICATIONS OF THE BIOSCIENCE PROGRAMS DIVISION

VOLUME IV PHYSICAL BIOLOGY

by

Frances Hong and L. A. Kulp

of the

Biological Sciences Communication Project

C. W. Shilling, M.D., Director

sponsored by

The George Washington University

May 24, 1967

work performed under NASA Contract

NSR 09 010 027

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PREFACE

This bibliography was prepared to supplement the needs of various bioscience administrators at the National Aeronautics and Space Administration for maintaining a current awareness in their respective fields. When critically analyzed, bibliographies provide meaningful insight to the state of activities for scientific endeavors by defining areas of pursuit, providing records of accomplishment, identifying scientists and laboratories engaged in various scientific activities, revealing the direction of research and the areas of gradient emphasis in addition to listing the available literature in a particular subject field. For these reasons the importance of bibliographies is being increasingly recognized by both science administrators and research scientists.

The more than 1,400 citations in the total work represent the publication efforts of the grantees and contractors of the Bioscience Programs Division since it was established. Letters were sent to the principal investigators requesting a list of publications resulting from research supported by grants or contracts from this division. The citations included in this bibliography were provided in response to this letter. Only those papers appearing in the serial literature and widely distributed report literature were considered. Theses and doctoral dissertations were omitted since such research would probably be published in scientific journals at a later date.

These citations have been collated into separate volumes for each program branch. A few citations predate the establishment of the branch offices under which they appear but are included because they resulted from efforts subsequently subsumed under these program offices. The volumes are enumerated as follows: Volume I, Behavioral Biology; Volume II, Environmental Biology; Volume III, Exobiology; Volume IV, Physical Biology; Volume V and VI, Planetary Quarantine and Bioscience Communications, respectively. Because of the brevity of the latter two bibliographies, they have been combined under one cover.

Each volume is divided into a number of sections beginning with the literature citations listed chronologically and according to the authors' surname. This arrangement reveals to some extent the growth and development of research under the direction of the program administrators. To provide access to these references both an author index and permuted title index are included.

An appendix is included which lists the journals in which these scientific publications appeared. This not only assists in identifying source material but indicates the wide range of scientific pursuit encompassed by the Bioscience Programs Division. It is interesting to note here that the publications have appeared in 266 scientific and technical journals.

Also in the appendix is a list of the senior authors' affiliations which, when correlated with the directory of laboratory addresses, makes communication with a senior author possible. Copies or reprints of the citations embodied herein cannot be furnished by either NASA or BSCP but may be obtained by contacting the senior authors.

It should be noted that no practical means was available for verifying a few of the references given by the authors and, as a result, a few citations are incomplete. This is especially true in cases where papers appeared in lesser known sources and/or were "in press".

The authors gratefully acknowledge the technical assistance of Miss Sheila Rollins and of the secretarial staff in the preparation of this report.

Leslie A. Kulp, Ph.D.

SCIENTIFIC PUBLICATIONS OF THE PHYSICAL BIOLOGY PROGRAM,

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

1961

1226. BENZINGER, T. H. The diminution of thermoregulatory sweating during cold-reception at the skin. Proc. Nat. Acad. Sci. 47:1683. 1961.

1227. BENZINGER, T. H. The human thermostat. Sci. Amer. 204(1):134-147. Jan. 1961.

1228. BENZINGER, T. H. The quantitative mechanism and the sensory receptor organ of human temperature control in warm environment. Ann. Int. Med. 54:685. 1961.

1229. BENZINGER, T. H., PRATT, A. W., and KITZINGER, C. The thermostatic control of human metabolic heat production. Proc. Nat. Acad. Sci. 47:730. 1961.

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The individuals listed below are those authors whose names appear as senior authors of a paper. They are in alphabetical order, with the laboratory or institution in which they performed their research designated in abbreviation. These abbreviations for the laboratories and universities are written out in full on pages 28 through 29 which is an alphabetical listing with the complete addresses given.

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ANALYSIS OF THE PUBLICATION SOURCES

Under the auspices of the Physical Biology Program of NASA, 137 scientific and technical papers were published between 1961 and 1966. These papers were indexed under the thirteen scientific pursuits listed in the table on page 31, some of which represent well recognized disciplines whereas others represent subject areas which have received notable attention. In those instances where reports might have been subsumed under more than one category, consideration was given to the scientific orientation of the author(s) or to the source of publication.

The figures on the following pages were constructed to represent, chronologically, the publication frequencies of the major subject fields. The frequency of publication for each area of study was derived by dividing the number of subject publications appearing in each given year by the total number for all the years considered. The publications appearing in 1961 and 1962 were combined because of the small number of reports which were issued during these earlier years. The data used for the graphic illustration of 1966 included those citations listed as "in press" for that year.

The figures derived from this study provide, to some extent, an indication of the activity and direction of research within this office. Figure 1 points out that the total publication effort in 1965 and 1966 was four times greater than in 1963. Growth was especially rapid in the areas of Molecular Biology and Theoretical Biology, Figures 2 and 4, respectively.

Physical Biology's broad multidisciplinary approach to scientific research is reflected by the distribution of its supported publications. Only nine of the 43 journals in which these publications appeared had four or more of the cited papers. An average of less than one of these papers per year appeared in thirty-seven of these journals. The Proceedings of the National Academy of Sciences was the largest literature source of these publications although it contained less than 10% of the papers published under this program. Science was next with eleven papers and the Journal of Theoretical Biology followed with eight publications.

								IN PRESS		
	1961	1962	1963	1964	1965	1966	No Date	1966	No Date	TOTAL
MOLECULAR BIOLOGY		3	5	13	29	14		10	5	79
PHYSIOLOGY, GENERAL	4	2	4	3	2				2	17
THEORETICAL BIOLOGY				2	1	10	1	1		15
ELECTRON MICROSCOPY		1		2	2	1		1		7
BIOINSTRUMENTATION			1	1	2	1				5
CRYOBIOLOGY					2	2		1		5
PHYSIOLOGY, COMPARATIVE				1	2			1	1	5
BIOPHYSICS					2	1				3
BIOLOGY, GENERAL						1				1
TOTAL	4	6	10	22	42	30	1	14	8	137

Table. Number of studies under the NASA Physical Biology Program for the years 1961-1966 according to primary research areas.

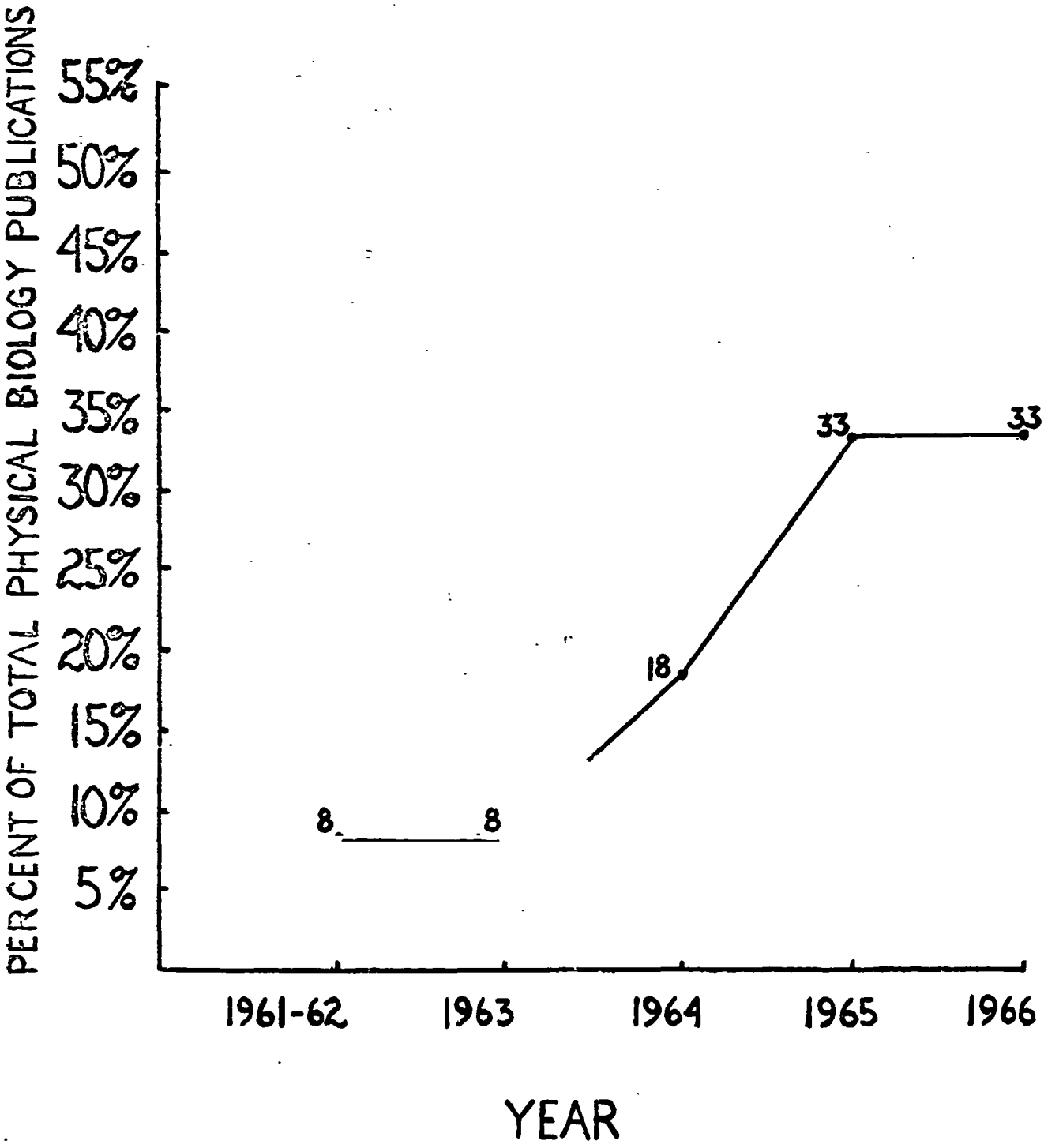

Figure 1. All Fields

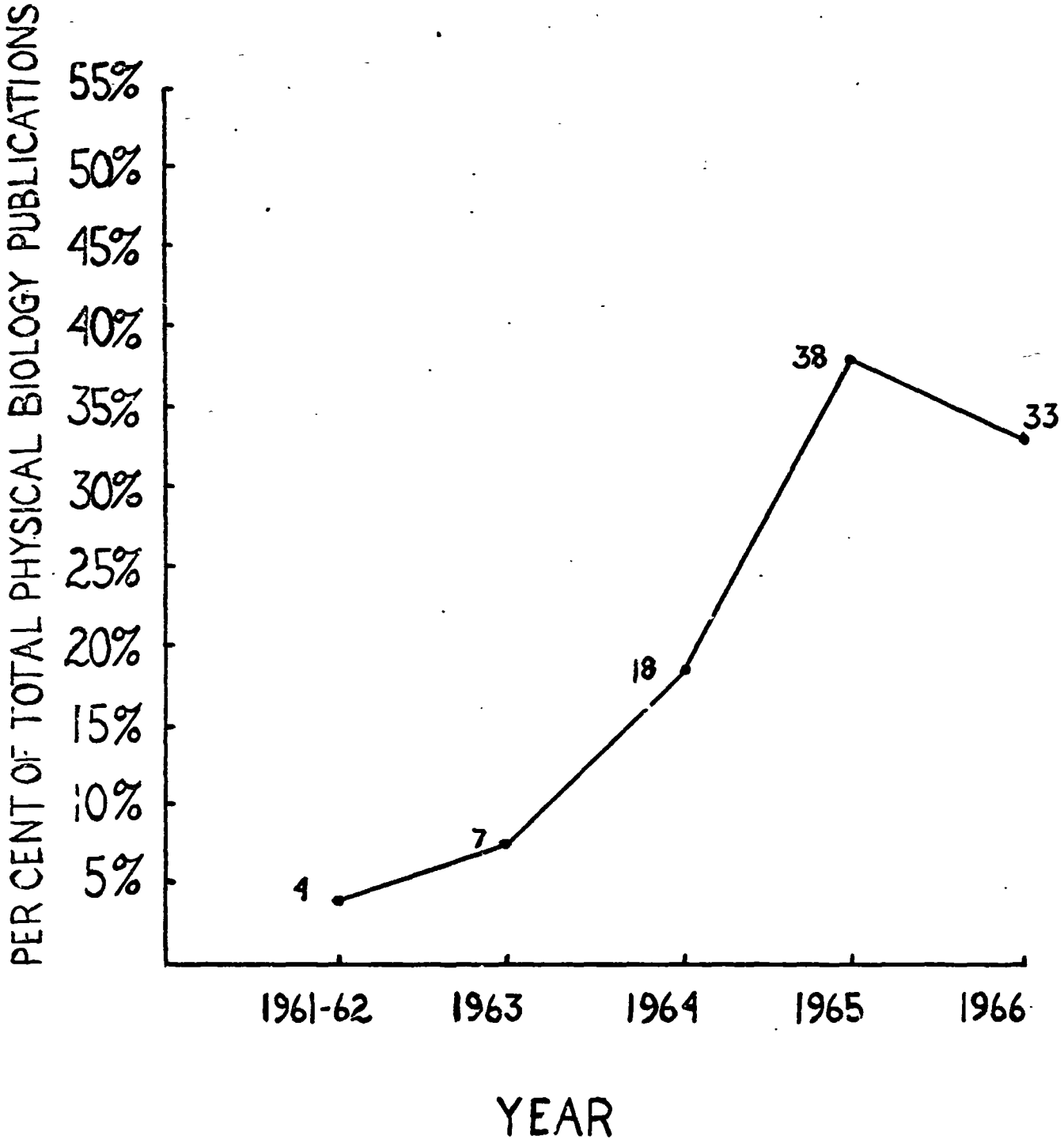

Figure 2. Molecular Biology

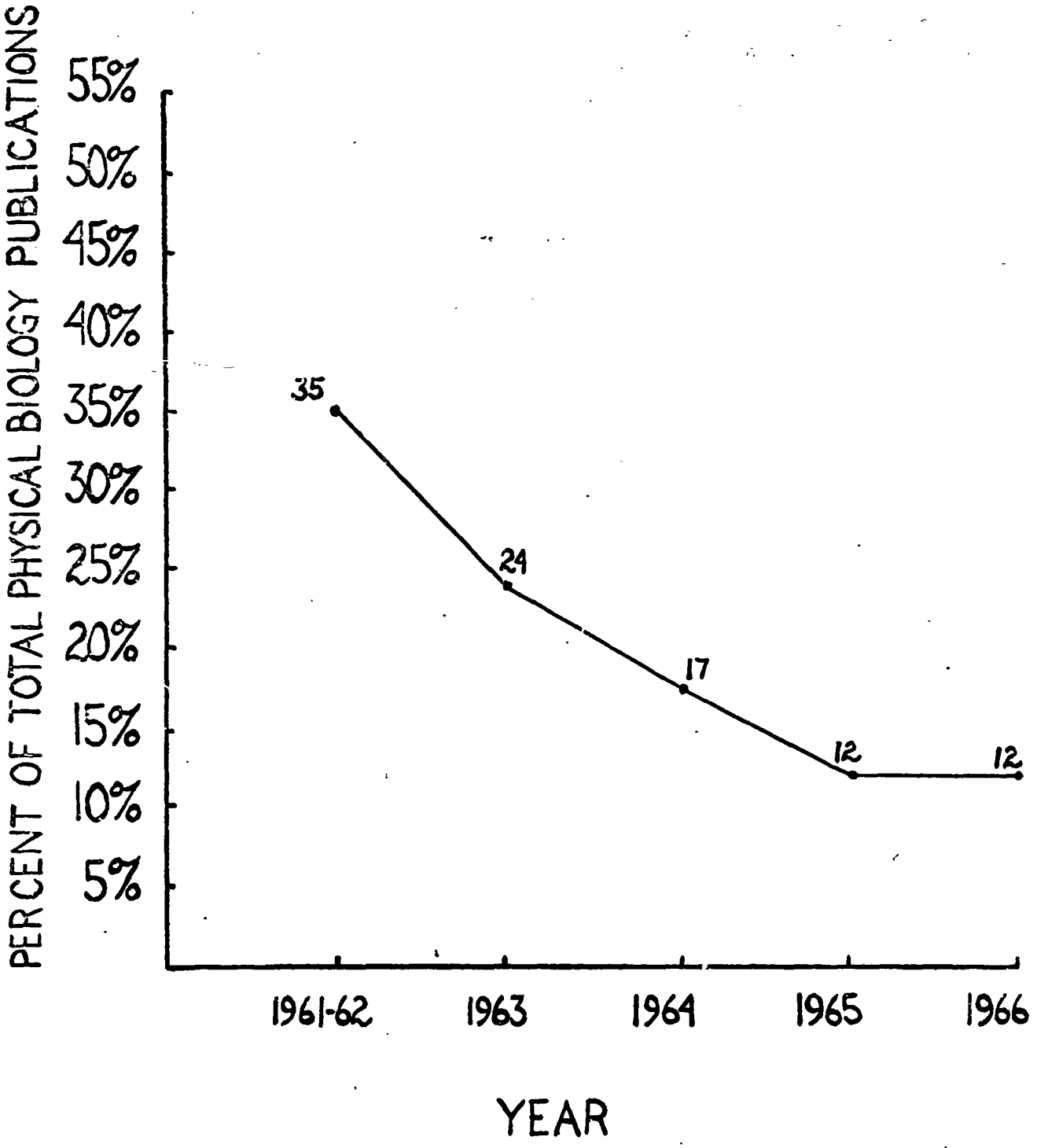

Figure 3. General Physiology

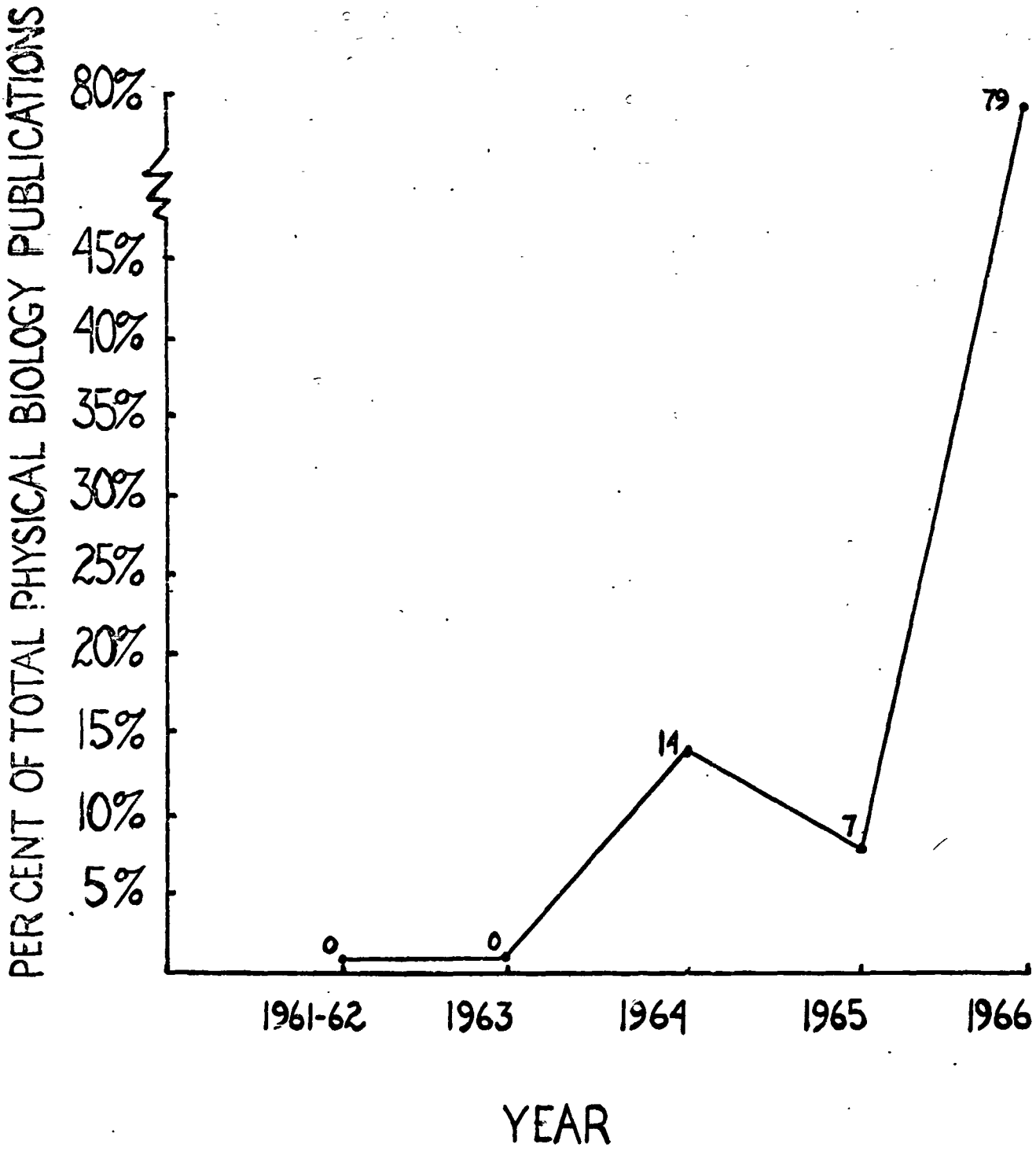

Figure 4. Theoretical Biology

JOURNALS PUBLISHING PHYSICAL BIOLOGY ARTICLES

The following is an alphabetical list of journals in which some of the 137 articles appeared that resulted from research supported by the NASA Physical Biology Program.

It is of particular interest to note the relatively large number of journals which have accepted one or more papers. The numbers in parentheses indicate the number of articles appearing in that journal.

Aerospace Medicine (1)
American Journal of Botany (1)
American Scientist (2)
Analytical Biochemistry (1)
Annals of Internal Medicine (1)
Annals of the New York Academy of Sciences (2)
Archives of Biochemistry (see also Archives of Biochemistry and Biophysics) (1)
Archives of Biochemistry and Biophysics (4)
Astrophysical Observatory Journal (1)

Bild der Wissenschaft (2)
Biochemical and Biophysical Research Communications (4)
Biochemical Journal (2)
Biochemistry (1)
Biochimica et Biophysica Acta (6)
Biophysical Journal (2)
Biopolymers (1)

Circulation (1)
Cold Spring Harbor Symposium of Quantitative Biology (1)
Cryobiology (2)

Ergebnisse der Physiologie (1)

Federation Proceedings (5)

Growth (1)

International Federation of Automatic Control Bulletin (2)

Journal of the American Dietetic Association (1)
Journal of the American Medical Association (1)
Journal of the American Society of Mechanical Engineers (1)
Journal of Biological Chemistry (1)
Journal of Cell Biology (1)
Journal of Chemical Physics (3)
Journal of Mammalogy (2)
Journal of Molecular Biology (6)
Journal of the Royal Microscopical Society (1)
Journal of Spacecraft and Rockets (1)
Journal of Theoretical Biology (8)

Mutation Research (2)

Nature (2)

Photochemistry and Photobiology (1)
Poultry Science (1)
Proceedings of the National Academy of Sciences (13)

Radiation Research (6)

Science (11)
Scientific American (1)

Virology (1)

N67-32254

SCIENTIFIC PUBLICATIONS OF THE BIOSCIENCE PROGRAMS DIVISION

VOLUME V PLANETARY QUARANTINE

by

Frances Hong, L. A. Kulp,
and D. F. Wright

of the

Biological Sciences Communication Project

C. W. Shilling, M.D., Director

manuscript by

The George Washington University

work performed under NASA Contract

NSR 09 010 027

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PREFACE

This bibliography was prepared to supplement the needs of various bioscience administrators at the National Aeronautics and Space Administration for maintaining a current awareness in their respective fields. When critically analyzed, bibliographies provide meaningful insight to the state of activities for scientific endeavors by defining areas of pursuit, providing records of accomplishment, identifying scientists and laboratories engaged in various scientific activities, revealing the direction of research and the a as of gradient emphasis in addition to listing the available literature in a particular subject field. For these reasons the importance of bibliographies is being increasingly recognized by both science administrators and research scientists.

The more than 1,400 citations in the total work represent the publication efforts of the grantees and contractors of the Bioscience Programs Division since it was established. Letters were sent to the principal investigators requesting a list of publications resulting from research supported by grants or contracts from this division. The citations included in this bibliography were provided in response to this letter. Only those papers appearing the serial literature and widely distributed report literature were considered. Theses and doctoral dissertations were omitted since such research would probably be published in scientific journals at a later date.

These citations have been collated into separate volumes for each program branch. A few citations predate the establishment of the branch offices under which they appear but are included because they resulted from efforts subsequently subsumed under these program offices. The volumes are enumerated as follows: Volume I, Behavioral Biology; Volume II, Environmental Biology; Volume III, Exobiology; Volume IV, Physical Biology; Volume V and VI, Planetary Quarantine and Bioscience Communications, respectively. Because of the brevity of the latter two bibliographies, they have been combined under one cover.

Each volume is divided into a number of sections beginning with the literature citations listed chronologically and according to the authors' surname. This arrangement reveals to some extent the growth and development of research under the direction of the program administrators. To provide access to these references both an author index and permuted title index are included.

An appendix is included which lists the journals in which these scientific publications appeared. This not only assists in identifying source material but indicates the wide range of scientific pursuit encompassed by the Bioscience Programs Division. It is interesting to note here that the publications have appeared in 268 scientific and technical journals.

Also in the appendix is a list of the senior authors' affiliations which, when correlated with the directory of laboratory addresses, makes communication with a senior author possible. Copies or reprints of the citations embodied herein cannot be furnished by either NASA or BSCP but may be obtained by contacting the senior authors.

It should be noted that no practical means was available for verifying a few of the references given by the authors and, as a result, a few citations are incomplete. This is especially true in cases where papers appeared in lesser known sources and/or were "in press".

The authors gratefully acknowledge the technical assistance of Miss Sheila Rollins and of the secretarial staff in the preparation of this report.

Leslie A. Kulp, Ph.D.

INTRODUCTION

The Office of Planetary Quarantine, Bioscience Programs, National Aeronautics and Space Administration, has the responsibility for preventing contamination of the several planets of biological interest. Of importance to the execution of these responsibilities is the dissemination of information through training programs, national and international conferences, committee meetings, and information exchange among contractors. The latter activity is handled through the Offices of the Biological Sciences Communication Project. Contractor reports are distributed among interested groups, abstracts of current literature are provided, bibliographies of specialized interest areas are prepared, and a microfilm file of all scientific reports bearing on the planetary quarantine problem is maintained. Upon request, hard copy reprints are produced from the microfilm file and distributed to organizations and individuals, current scientific and technical literature is reviewed weekly for items of interest. Thus, the development of spacecraft sterilization technology is directly aided through acquisition of information and its application to problem areas.

The publications listed in this bibliography were the result of work supported by the Office of Planetary Quarantine.

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The individuals listed below are those authors whose names appear as senior authors of a paper. They are in alphabetical order, with the laboratory or institution in which they performed their research designated in abbreviation. These abbreviations for the laboratories and universities are written out in full on pages 19 through 20 which is an alphabetical listing with the complete addresses given.

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JOURNALS PUBLISHING PLANETARY QUARANTINE ARTICLES

The following is an alphabetical list of journals in which some of the 66 articles appeared that resulted from research supported by the NASA Planetary Quarantine Program. The numbers in parentheses indicate the number of articles appearing in that journal.

Air Engineering (1)
Applied Microbiology (7)

Bacteriological Proceedings (1)
Biotechnology and Bioengineering (1)

Journal of Milk and Food Technology (1)

Nature (1)

Science (2)
Space Science (1)

Technometrics (1)

N67-32255

SCIENTIFIC PUBLICATIONS OF THE BIOSCIENCE PROGRAMS DIVISION

VOLUME VI BIOSCIENCE COMMUNICATIONS

by

Frances Hong and L. A. Kulp

of the

Biological Sciences Communication Project

C. W. Shilling, M.D., Director

manuscript by

The George Washington University

work performed under NASA Contract

NSR 09 010 027

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INTRODUCTION

The Bioscience Communications Program of the Bioscience Programs Division was established to meet the growing need for effective and timely communication between NASA program scientists and administrators, and scientists in universities, industry and other government agencies. Its activities are designed to meet the information needs of each of the Bioscience Programs in directing and coordinating their activities with a maximum of efficiency and foresight, and to provide the scientific community with access to information on the scientific products of these programs. Its functions are separate from the research oriented programs in a deliberate attempt to blur the lines which divide the scientific disciplines.

The Bioscience Communications Program provides 1) support of the Space Science Board of the National Academy of Science and its subcommittees (jointly with other Office of Space Science and Applications programs), 2) training of scientists through fellowship grants and summer institutes, 3) consultation to administrative program scientists, 4) supplemental cross disciplinary communication between various interfaces of the physical and biological sciences, 5) research literature and report analyses, current status reports, etc., 6) conferences, symposia, and informal meetings.

These activities illustrate the role of this office in supporting all Bioscience Programs. Its contribution is seen in supporting the preparation of all six volumes on "Scientific Publications of the Bioscience Programs Division". Thus, a small number of publications result solely from its sponsorship, although the program partially supported the publication of a large number of papers including more than sixty papers contained in the NAS-NRC publications, "Biology and the Exploration of Mars" and "Extraterrestrial Life" under a grant to the Space Science Board. Credit has been given, however, to these bioscience grantees and contractors under their respective research programs because their scientific papers resulted from research supported by these offices, and it would have been redundant to repeat the citations here. Only the literature resulting directly from the support of this program office has been included.

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