Harold F. Foerster

Microbiologist Professor

Biology Department

Sam Houston State University

Degrees Earned

Bachelors, Major: Biology/Secondary Education, Minor: Chemistry), Texas Lutheran College, 1950-1954.

M.A., Microbiology, University of Texas at Austin, 1961.

Ph D Microbiology, University of Texas at Austin, 1964.

Peer Review Publications

Germination Mutants of Bacillus megaterium QM B1551. Fall meeting of the American Society of Microbiology, Dallas, Texas. October 23-24, 1970.

Gamma amino butyric acid-requiring mutants of Bacillus megaterium QM 1551 and the role of endogenous glutamic acid in spore germination. Annual Meeting of the American Society for Microbiology, Minneapolis, Minnesota. May 2-7, 1971. Publish abstract G244.

Glutamic acid decarboxylase activities in parent and GABA-dependent mutant spores of Bacillus megateruim. Annual Meeting of the American Society for Microbiology, Philadelphia, Pennsylvania. April 23-20 1972. Published abstract G283.

The inhibition of germination of thermophilic actinomycete spores by L-argenine. Annual Meeting of the American Society for Microbiology, Las Vegas, Nevada. May 14-19, 1978. Published abstract I1114.

Spores of Thermoactinomyces: their activation and germination. Fall meeting of the American Society for Microbiology, Texas Branch. Houston, Texas. November 30-December 2, 1978.

Activation of Spores of Thermophilic Bacilli. Annual Meeting of the American Society for Microbiology. Atlanta, Georgia. March 17-12, 1982. San Antonio, Texas. Published abstract CCII14.

The effects of alterations in the suspending medium on low temperature activation of spores of Bacillus stearothermophilus NGB101. Fall meeting of the American Society for Microbiology. October 3-5., 1985. San Antonio, Texas.

Small acid-soluble spore proteins from the endospores of Bacillus cereus, Bacillus stearothermophilus and Thermoactinomyces thalpophilus. Fall meeting of the American Society for Microbiology. October 23-25, 1986. Temple, Texas.

Effects of low temperature and high temperature activation treatments on the germination properties of spores of Bacillus stearothermophilus NGB101. Spring Meeting of the American Society for Microbiology. Anaheim, California. May 12-14, 1990. Published abstract I-39.

Exhibition at Invited Seminars

Presented one of six invited papers in a seminar on the Biology of Actinomycetes at the 75th Annual Meeting of the American Society for Microbiology in New York City. April 30, 1975.

Department of Microbiology and Immunology, Baylor College of Medicine. April 3, 1979.

Department of Microbiology, University of Texas, Austin. April 25, 1979.

Departments of Medical Microbiology and Immunology/Medical Biochemistry. Texas A&M University College of Medicine, College Station, Texas. September 26, 1979.

Department of Microbiology, University of Georgia, Athens. July 29, 1980.

Department of Microbiology. Institut fur Allegemeine Botanik University of Hamburg. Hamburg, Germany. June 10, 1987.

Invited Papers Presented at International Spore Conferences

Germination characteristics of some thermophilic actinomycetes. Sixth International Spore Conference. East Lansing, Michigan, October 5-8, 1977*

L-Arginine inhibition of germination in spores of Thermoactinomyces thalpophilus. Eight International Spore Conference. Woods Hole, Massachusetts, October 9-12, 1980.

The effects of alterations in the suspending medium on low temperature activation of spores of Bacillus stearothermophilus NGB101. Ninth International Spore Conference. Asilomar Conference Center, Pacific Grove, California, September 3-6, 1984.

*Papers included in the published proceedings of the Spore Conference by the American Society for Microbiology. Volumes VI, VII, and VIII.

Research Monographs and Technical Reports

The following is a brief descriptive summary of the research activities of Harold F. Foerster:

A. Before Joining Faculty at SHSU.

Before joining the biology faculty at SHSU I received my B.S. degree from Texas Lutheran College In 1954 with a major in Biology and a minor in Chemistry. After teaching for two years in the High School program at Shreiner Institute, I entered graduate school at the University of Texas, Austin. At UT, I joined the spore group in the laboratory of Dr. Jackson W. Foster, In the Department of Microbiology

Bacterial endospores possess some unusual properties. Perhaps two of the most interesting are their extreme levels of metabolic rest of dormancy, and their remarkable resistance to high temperature. When I began spore research, it had been shown that spores contain large amounts of calcium which accumulate during late stages of sporulatioin and is rapidly lost during spore germination. These results suggested that spore dormancy and heat resistance were associated with or depended on spore calcium. A procedure identified as endotrophic sporulation had been developed in Foster's laboratory and I saw this procedure as a method for examining the role of calcium in spores. Endotrophic sporulation had been developed in Foster's laboratory and I saw this procedure as a method for examining the role of calcium in spores. Endotrophic sporulation involved the transfer of vegetative cells of a spore-forming bacterium from a complete growth medium to distilled water, and continuing the incubation in distilled water. Spores formed this way in distilled water were called endotrophic spores. Using this procedure I was able to show that sporulation in distilled water was highly variable and usually resulted in poor sporulation. However, the addition of only a few milligrams (1-20) of calcium per liter of distilled water resulted in excellent sporulation. It became immediately apparent that this procedure would allow me to examine the effect the substitution of other cations would have on sporulation. Particularly, other divalent cations such as Mg++, Sr++, and Ba++. Substitution studies showed that the requirement for Ca++ was unique and highly specific. That is, only solutions containing calcium gave high yields of spores that germinated normally. (See Foerster and Foster. 1966. J. Bacteriol. 91:1333-1345.)

Additional studies in Foster's laboratory involved comparisons of the germination properties of a collection of 46 different spore strains. This study demonstrated the heterogeneous nature of germination properties of different spore strains produced and germinated under similar (standardized) conditions. In addition. Several interesting anomalous germination patterns were identified. (See Foerster and Foster. 19696. J. Bateriol. 91:1168-1177)

B. After joining the faculty at SHSU.

Upon completion of my graduate studies, I joined the biology faculty at SHSU (spring, 1964). Research on bacterial spores continued here at SHSU. One of the bacterial strains that I had used in my research in Foster's laboratory was Bacillus megaterium QMB 1551. Spores of

QMB 1551 had the interesting property of germinating in a variety of different germinant solutions. Compounds that served as good initiators for the germination of QMB 1551 spores include the simple sugar glucose, or one of the amino acids, L-leucine, L-proline, or L-phenylalanine.

Because of these properties, QMB 1551 was chosen in studies to induce and isolate mutant spore strains with altered germination requirements. Germinated spores were irradiated with ultraviolet light and colonies of surviving cells isolated. Irradiated isolates were used to prepare spore crops and the latter examined for altered germination requirements. An interesting mutant spore type was observed. Mutant spores did not germinate in any of the solutions that germinated the parent spores, but germinated rapidly and completely in solutions that contained yeast extract. An intensive search that lasted for almost two years led to the isolation of the germinant required by the mutant spores, in crystalline form. With the help of Dr. James Johnson, then a member of the SHSU Chemistry faculty, the mutant spore germinant was identified as γ- aminobutryric acid. (See Foerster. 1971. J. Bacteriol. 108:817-823.)

Interest in this finding was considerably by a paper published by Nelson and Kornberg (Stanford University) which shoed what spores of QMB 1551 contained high levels of L-glutamic acid. This finding was of particular interest such the decarboxylation of glutamic acid yields γ - aminobutyric acid. These findings prompted research on the possible role of glutamic acid in spore germination.

Spore glutamic acid pools ere examined in dormant and germinating spores of OMB 1551 using colorimetric and ^{14}C analytical procedures. Glutamic acid pools in parent spores dropped rapidly with the onset of germination – dropping from 12ug of glutamic acid per mg dry spores to 7.7ug after 30 sec germination. On the other hand, glutamic acid pools of mutant spores remained unchanged. In addition, evidence supporting the rapid conversion of spore glutamic acid to γ – aminobutyric acid during the germination of parent spores was obtained. (See Foerster. 1972. J. Bacteriol. 111:437-442)

The rapid conversion of L-glutamic acid to γ–aminobutryic acid during the germination of parent spores provided evidence or the presence of L-glutamic acid decarboxylase (GAD) in these spores. Because this enzyme has not been demonstrated in bacterial spores, and because of its possible involvement in spore germination, studies on spore GAD were undertaken. These studies clearly demonstrated the presence of GAD in spores of QMB 1551 and provided strong experimental support for the involvement in this enzyme of spore germination. (See Foerster and Foerster. 1973. J.Bacteriol. 114:1090-1098.)

Research on bacterial endospores has been extended in our laboratory to include the endospores of thermophilic actinomycetes, an interesting and pervasive group of soil bacteria. Our work has concentrated on members of the genus Thermoactinomyces. A series of publication describe our work on these spores, and these provide a substantial source of new information and data on the endospores of this group of bacteria. Three of these papers were presented as invited papers at International Spore Conferences sponsored by the American Society for Microbiology (ASM), and published in the proceedings of these conferences. One of these papers was chosen as the Introductory Chapter (Spores VII) for one of the five sections comprising the published volume. This work also resulted in an invitation by Professor Jerry Ensign from the University of Wisconsin (Madison) to present one of six papers in a seminar on the Biology of the Actinomycetes at the 75th Annual Meeting of the ASM in New York City. .

One of the important "new" findings with the thermophilic actinomycete spores was low temperature activation. These reports represent the first documented evidence for low temperature activation in bacterial endospores. (See reprints from Spored VI, VII, VIII, and Foerster. 1978. Archives Microbiol. 118:257-264.)

These studies were extended to include the spores of thermophilic bacilli. Two papers published din the Archives of Microbiology describe these results, and show that low temperature activation is also a property of the spores of thermophilic strains of Bacillus. (See Foerster. 1983. Arch. Microbiol. 134:175; ibid, 1985. 142:182-189.)

The most recent research effort in our laboratory has been a collaborative project with Prof. Peter Setlow, a member of the biochemistry faculty at the University Of Connecticut Health Center. Professor Setlow and his group have studies some unusual spore proteins. These interesting and unique spore proteins were discovered in Setlow's laboratory in mesophilic Bacillus spores. The purpose of this study was to examine the spores of thermophilic bacteria for the presence of these proteins, and if present, to compare them with the mesophilic spore proteins. Because of my published research on and familiarity with the endospores of thermophilic bacteria, I was invited to collaborative in this project. The results of this study have been submitted to and accepted for publication in the Journal of Bacteriology later this year. (See Manuscript by Loshon, Fliss, Setlow, Foerster.) The results of this study are very interesting and will provide a major contribution to this area of sporology.

Funded External Grants and Faculty Development Activities

Participated in a one-week DNA sequencing workshop in the laboratory of Dr. Burr Furlong, Department of Biochemistry at the University of Texas Health Science Center in Houston, Texas. This workshop involved the nucleotide sequencing of a fragment and human DNA cloned in E. coli using nucleotide sequencing of a fragment of human DNA cloned in E. coli using the M13

virus as a vector. The sequencing method employed was the dideoxy analog procedure by Fred Sanger and associates. Attendance at the workshop was financially supported through the University. Summer 1984.

Took part in a collaborative research project with Professor Peter Fortnagel, Department of Microbiology, Institut fur Allegemeine Botanik, Hamburg, Germany. Research at the institute involved studies on the feasibility of using a plasmid, which had been successfully used in the transformation of thermophilic bacterium Bacillus subtillis for the transformation of the thermophilic bacterium Bacillus stearothermophilus. Work also involved developing improved methods for silver staining of proteins in two-dimensional polyacrylamide gels. This work was carried out during the summer of 1987. My trip to and from Hamburg was supported by a grant from the University of Hamburg. My stay in Hamburg was supported by a grant from Sam Houston State University.

While at the Institute, I presented an invited seminar to the Microbiology faculty and students describing recent research on the activation and germination properties of endospores of thermophilic bacteria.

Equipment Grant from the National Science Foundation

With Dr. Andrew Dewees, obtained a biotechnology equipment grant from the National Science Foundation to equip the Molecular Biology Laboratory here a Sam Houston State University. 1987.

Faculty Development Activities/Work or Professional Experiences

Army inductee April 1945. Completion of basic training at Fort Hood, Texas. Served with the occupational forces in Japan and was discharged in December, 1946.

High school science teacher at Schriener Institute, Kerrville, Texas for two years.

Research assistant in the laboratory of Dr. Roy V. Talmage at Rice University, Houston Texas, for two summers during high school teaching years. Studies conducted on parathyroid function using Sprague-Dawley rats as experimental animals.

Biology faculty at Sam Houston State University as an Assistant Professor 1966. Promoted to Professor in 1981.

A collaborated research project with Dr. Manley Mandel, Molecular Biology Department, M.D. Anderson Hospital and Tumor Institute, Houston, Texas, that involved the extraction of DNA from different strains of thermophilic actinomycetes and the determination of their Guanine-

Cytosine (GC) mole percent using cesium chloride (CsCl) density gradient centrifugation. Early 1980's.

Participated In a joint research project with Dr. Peter Setlow, Department of Biochemistry. University of Connecticut Health Center, Farmington. The research involved the cloning and nucleotide sequencing of genes fro small, acid-soluble spore proteins in mesophilic and thermophilic bacteria. The results of this study were published in the Journal of Bacteriology (see publications) and commented at scientific meetings (see scientific papers). 1985-86.

Master's Theses Supervised

Fred J. Boenig Jr., 1966, Studies on Endospores of Bacillus megaterium QMB – 1551.

Lyndon Dale Pinson, 1996, Ultraviolet Irradiation of a Bacillus Soil Isolate in an Attempt to Alter Requirements for Spore Germination.

Donald A. Wilkins, 1967, Growth Characteristics and the Paper Chromatographic Identification of Glucosamine in Mycoplasma hyoarthrinosa strain Eckert.

Joy Wen-huei Yueh, 1967, The Effect of p-Fluorophenylalanine on Spore Formation, Germination of Bacitracin Production in Bacillus licheniformis 10716.

James Hardy Mallery, 1968, The Effects of Ultraviolet Irradiation and Respiratory Inhibitors on Germination of Postgerminative Development of Spores of Bacillus megaterium 9885.

Mei-hsing Tang, 1969, The Use of Synthetic Medium for the Production of Spores Containing p-Flurophenylalanine With Altered Physiological Properties.

Helen Huay-yu Loh, 1970. Comparative Studies on Germination and Respiration of Spores of Three Strains of Bacillus.

Esther Hwei-ping Chou, 1970, Studies on the Germination Properties of Bacillus megaterium QM-1551 Spores and Some Mutant Strains With Altered Germination Requirements.

Charlene Wehe Foerster, 1972, Spore L-Glutamic Acid Decarboxylase and its Role in Germination.

Memberships Held

American Association for the Advancement of Science, Sigma Xi, The American Society for Microbiology, Texas Branch and the American Society for Microbiology.

Family

Married Charlene Wehe in 1956, they have 3 children, Cindi, Becky, and Melissa. Also, eight grandchildren.