

PROFESSOR BERNHARD WUNDERLICH ON THE OCCASION OF HIS SIXTY-FIFTH BIRTHDAY



Bernhard Wunderlich's life story parallels the history of thermal analysis of macromolecules, and not by coincidence. Born in Brandenburg, Germany in 1931, he developed an early interest in chemistry, pursuing his high school and college studies among considerable obstacles during the tumultuous post-war years. From Humboldt University in Berlin to his first professional employment as an instructor of physical chemistry at Northwestern University, he became a pioneer in developing methods for thermal characterization of macromolecules.

To describe the early phase of Bernhard Wunderlich's scientific career, one cannot find a better source than the late Professor Malcolm Dole, his thesis advisor at Northwestern. "...On September 1, 1955, Bernhard Wunderlich came to Northwestern to study under me for his Ph.D. degree" wrote Professor Dole in his autobiography "My Life in the Golden Age of America" (Vantage Press, New York 1989). "Bernhard wrote a paper on the theory of cold crystallization of high polymers... I feel quite proud to have him as a student". This early and well deserved recognition has accompanied Bernhard throughout the subsequent four

decades, as has his wife Heidel, whom he met in high school and married while studying chemistry at the Goethe University in Frankfurt.

After accepting a teaching position at Cornell, he joined the faculty of Rensselaer Polytechnic Institute in 1963, where he became a full professor in 1965. Since 1988, Dr. Wunderlich has been Professor and Distinguished Scientist at the University of Tennessee and at the Oak Ridge National Laboratory. During sabbatical periods, he has also been visiting professor at the Universities of Mainz, Freiburg and Ulm, Germany.

This volume of the *Journal of Thermal Analysis* is dedicated to the occasion of Bernhard Wunderlich's 65th birthday because of the unique role he has played in the meteoric development of the theory and practice of thermal analysis. The lead article of this Special Issue is "Thermal Analysis of Macromolecules: A Personal Review" (by Bernhard Wunderlich). It is a concise, critical overview of the development of thermal analysis between 1955 and 1995.

Research activities

Bernhard Wunderlich's research activity started in the "Golden Age" of thermal analysis. Without commercially available instruments, the very few scientists interested in thermal analysis typically used home-made calorimeters to study thermal properties of materials. Polymer science itself was developing in that period at a rapid rate as a result of the revolutionary increase of plastics manufacturing. There were very few publications available on the thermal analysis of macromolecules. Thus, his research papers (numbering more than 400), his innumerable lectures and other contributions helped expand our knowledge to many areas not explored previously. Here is a brief and incomplete list of his major research areas and educational achievements:

1955–58 (Northwestern U.)

1. Adiabatic calorimetry of macromolecules

1958–63 (Cornell U.)

2. Crystallization and melting of macromolecules
3. Irreversible and equilibrium thermodynamics of heat capacity, melting and vitrification

1963–88 (Rensselaer)

4. Differential thermal analysis of organic and inorganic macromolecules
5. Superheating on melting
6. Properties of extended-chain crystals
7. Crystallization during polymerization
8. The theory of heat capacity

9. The solid state of macromolecules
10. The ATHAS Data Bank
11. Teaching *via* audio and computer courses
12. Thermotropic mesophases
- 1988– (*U. of Tennessee*)
13. Condis crystals
14. Molecular dynamics simulation of macromolecular crystals (with Dr. D. W. Noid)
15. The defect solid state of macromolecules
16. Temperature modulated calorimetry
17. Characterization of the structure and motion in macromolecules by calorimetry, solid state NMR, X-ray diffraction, and molecular dynamic simulation
18. Complete structure and mobility analysis of fibers
19. Heat capacities of proteins
20. Teaching graduate courses on the W W W

Other professional activities

Professor Wunderlich has been a prolific author of textbooks, monographs, audiotapes and other educational material. I mention here two out of his 13 books:

Macromolecular Physics (Academic Press; Volume 1, 1973; Volume 2, 1976; Volume 3, 1980). This 3-volume series is the definitive text for scientists interested in polymer physics.

Thermal Analysis (Academic Press, 1990). A fundamental textbook for students, teachers and researchers.

He is the author of audio courses on "Crystals of Linear Macromolecules" and on "Thermal Analysis" prepared for the American Chemical Society and for the Rensselaer Institute of Technology.

Professor Wunderlich has been invited to lecture at conferences, meetings and symposia all around the world. Among other societies and institutions, he has been a frequent lecturer at Gordon Research Conferences (15), IUPAC Meetings and Symposia (18), and ICTA Conferences (8), either in the USA or abroad. He has given some 500 lectures throughout the world.

The *Journal of Thermal Analysis* is particularly indebted to Professor Bernhard Wunderlich. Since its first issue more than 25 years ago, he has been a member of its Editorial Advisory Board. His active participation and frequent contributions as an author or referee have been instrumental in establishing and maintaining the high scientific level of this journal. Professor Wunderlich is also a board member of the *Journal of*

Polymer Science (Polymer Physics Edition), Macromolekulare Chemie, Macromolecules, Chemistry and Journal of Polymers for Advanced Technologies.

Recognitions

1. Named one of the outstanding educators of the United States, 1971
2. Mettler Award, North American Thermal Analysis Society, 1971
3. Doolittle Award of the Division of Organic Coatings and Plastics Chemistry of the American Chemical Society, 1975
4. Fellowship of the Japanese Society for the Promotion of Science, 1983
5. Humboldt US Senior Scientist Award for 1987/88 of the Alexander von Humboldt Gesellschaft of the Federal Republic of Germany
6. Prize for Applied Chemical Thermodynamics for 1993 of the Swiss Society for Thermal Analysis and Calorimetry (STK).

Personal reflections

I was of course well aware of Professor Wunderlich's fame long before I met him. I had listened to his lectures at many meetings. I remember one of them in particular from about 25 years ago: he presented the brilliant, innovative results of his studies on superheating. He not only demonstrated his persuasive knowledge of the area, but also told a revealing story. He submitted the paper on this subject to one of the scientific journals, only to have it repeatedly rejected. When he inquired why, the editor wrote him something to this effect: "young man, you will have to wait a long time until your ideas on this topic will be considered acceptable". The editor was wrong, Bernhard was right. Throughout his career, Bernhard has proved his points, and has led the way to having his innovative work accepted with enthusiasm and admiration.

My first personal meeting with Bernhard took place approximately 20 years ago. Academic Press asked me to edit a comprehensive book on Thermal Characterization of Polymeric Materials. I was looking for an author who would contribute one of the most important chapters of the planned volume: a monograph on the theoretical basis of thermal analysis. Naturally, my first thought was to invite Bernhard Wunderlich to write this chapter. He not only accepted the request, but volunteered to help me with all aspects of my plans. He invited my husband and me to visit him in his home at Troy, New York. It was a fine, sunny day when we

drove up to his house. Bernhard and his wife Heidel greeted us with warm hospitality. That day was the beginning of a close cooperation and a treasured friendship. Details we discussed there were later proven to be quite important. Bernhard delivered his elaborate, comprehensive, high quality chapter ahead of time (which was quite natural for him) and contributed greatly to the success of the book. He agreed to rewrite and update his chapter completely (and did) for the 2nd Edition that is scheduled to be published in 1996.

My second, long-term professional association with Bernhard began a few years later. I started a series of conference courses at the Polytechnic University of New York (at that time it was called the Polytechnic Institute of New York, formerly known as "Brooklyn Poly"). The course that has been offered annually since 1975 needed guest faculty, experts from other academic institutions and industry. We invited Bernhard to help out and teach at our course the basis of thermal analysis. He accepted and travelled year after year, first from Troy, NY and since 1988 from far away Knoxville, TN to give his lecture and participate in the evening consultation with the participants.

The third area of our cooperation has been the Education Committee of the International Confederation for Thermal Analysis and Calorimetry (ICTAC). I have chaired that committee since 1985 and Bernhard is its most productive and supportive member. He has written and lectured worldwide on the status of education of thermal analysis in and outside of academic institutions and in special courses held by local, national and international societies for thermal analysis. Using his own resources, he prepared a survey of how thermal analysis is taught in institutions of higher education throughout the USA and Canada. The Committee is working to extend that survey internationally. He has dedicated his life to teaching thermal analysis and wants to have many educators around the world who are professional thermal analysts.

Throughout the years, Bernhard has created a critically reviewed data bank of experimental heat capacities. His ATHAS (Advanced Thermal Analysis) laboratory is the focus of research for the members of the Wunderlich school: his students and postdoctoral fellows. He has earned worldwide recognition for his research contributions and for educating a generation of thermal analysts.

In addition to the over one hundred students who had the privilege of studying under him at various universities, in some respect all of us who practice thermal analysis are his students. As we approach his 65th birthday, it has been my honor to volunteer to be the guest editor of a Special Issue of the Journal of Thermal Analysis, solely devoted to the

celebration of this occasion. I have sent out letters to his former and present students and to some of his friends asking for their contributions to this volume. It was heartwarming to read the answers. Many of them agreed to submit original research articles in the area of thermal analysis; these papers are collected in this volume. Others are not working in this field any longer, or the nature of their work is confidential. These colleagues wrote moving stories of how they enjoyed Bernhard's classes, how much they respected him as a teacher and a person whom they considered a trusted friend.

Following the editorial policy of this journal, all papers were sent out to referees who themselves wanted to make a very much appreciated contribution by immediately reviewing the manuscripts and returning them with their critical comments and suggestions. The articles were placed in five groups in the volume by using the following criteria:

1. Papers on semicrystalline homopolymers and copolymers (starting with multiple analysis techniques, and followed by single analysis techniques)
2. Theoretical and technique oriented papers
3. Amorphous polymers and blends
4. Biological polymers and blends
5. Small organic and inorganic molecules

I am very pleased to present this collection of outstanding papers to the scientific community. I join his students and friends from all over the world in expressing our heartfelt gratitude to Professor Bernhard Wunderlich for all that he has done for us. We wish him on the happy occasion of his 65th birthday the best of health and continued success in his work.

Edith A. Turi
Guest Editor

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English, A. D., Wilmington, DE, USA
Flynn, J. H., Bethesda, MD, USA
Gallagher, P. K., Columbus, OH, USA
Liebovitch, L., Rocca Baton, FL, USA
Mark, J. E., Cincinnati, OH, USA
Matsuoka, S., Brooklyn, NY, USA
McGhie, A. R., Philadelphia, PA, USA
O'Reilly, J. M., Pittsford, NY, USA
Roe, R. J., Cincinnati, OH, USA
Sastri, S. B., Washington D. C., USA
Shushan, B., Concord, ON, Canada
Sircar, A. K., Dayton, OH, USA
Starkweather, H. W., Jr., Wilmington, DE, USA
Xenopoulos, A., Bedford, MA, USA