

The Gibbs conference on biothermodynamics: Origins and evolution

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Abstract

The Gibbs conference on biothermodynamics arose in the late 1980's as a 'self-organized' endeavor by researchers at eleven institutions of the US. Over a period of 10 years these annual conferences have grown steadily in size. They have fostered the development of new thermodynamic approaches and their applications in biochemistry. By emphasizing participation by students and postdoctoral fellows they have contributed significantly to the career development of young scientists in this field. © 1997 Elsevier Science B.V. All rights reserved.

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In the mid 1980s, the role of thermodynamics in biochemistry was widely perceived as essentially an 'energy book-keeping system' (e.g. counting the number of ATP hydrolyses that pay for each biochemical synthesis). A relatively small number of researchers in the US held the view that thermodynamics was equally important as a 'logic tool,' as exemplified by Wyman's theory of linked functions (cf. [1,2]), and that new approaches should be promoted to foster and develop this broader vision of what thermodynamics has to offer in the study of biological systems. The prevailing opinion of many biochemists at the time was that the new tools of molecular biology, in combination with x-ray structure analyses, could provide all the elements of

molecular logic and functional reactivity that were needed. A widespread view of thermodynamics was that:

(1) Thermodynamic approaches were archaic, and, at best, ancillary to the central problems of biochemistry, as reinforced by the commonly-heard slogan 'thermodynamics can tell us nothing about mechanisms.'

(2) The subject was usually taught poorly or not at all in departments of chemistry and biochemistry.

(3) A long-standing tradition of equating thermodynamics with only a single technique (i.e., calorimetry) had contributed to the narrow and insular perception of the field and its potential.

(4) Thermodynamics had seldom been fused with modern developments of structural analysis and computational chemistry.

With this backdrop, a small group of people gathered at a retreat in Vail, Colorado to determine

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where the discipline of thermodynamics in biological systems was headed, and to decide what might be done to promote more innovative uses of thermodynamics, uses which would exploit the power and unique ability of this discipline to reveal the functional energetics of biological systems¹. Following two meetings to discuss these issues (one in the Fall of 1986 and the second in February, 1987), it was decided that a means of addressing them would be to establish an annual conference among laboratory groups, whose research and training interests intersected critically with the above issues.

A major consideration was that the conference should be especially useful to students and postdoctorals. Since these are the people most likely to carry on the development and use of thermodynamics in biology, it was felt that they should be featured prominently in the scientific program². A focus on student and postdoctoral development required choosing an inexpensive conference site so that essentially all members of the research groups could attend without compromising limited travel budgets. A conference site that more than met these needs was 'Touch of Nature.' The site is located in Southern Illinois, about a two hour drive from St. Louis. Touch of Nature is affiliated with Southern Illinois University (famous in part for Buckminster Fuller, its most noted professor). The conference facilities, offering lodging, meals and meeting rooms, are located in a rustic and pleasant wooded area, situated on a large lake. The facilities and accommodations

are very good, considering their price, and the weather in Southern Illinois for the early October meetings of the Gibbs Conference has been marvelous, with warm sunny days and cool nights. The session format of the meeting is much like that of a Gordon Conference, with afternoons available for hiking, canoeing, volleyball, etc. Two traditions that were established and continued since the initial conference are the lake-side campfire sessions running from 10:00 p.m. until early morning, and the 'Buffalo Tro,' a unique experience in outdoor dining³ which is provided by the Touch of Nature staff.

The central geographic location of Touch of Nature has permitted laboratories to rent a university van, fill it with students, postdoctorals, and mentors and reach the conference in one hellacious drive. Some laboratories have regularly performed this ritual from Texas, Colorado, Maryland, Wisconsin, Mississippi, and other states, while more sedate conferees have flown into St. Louis for the two hour drive to Carbondale. The camaraderie which comes from the informal 'summer camp' atmosphere, in conjunction with top-notch science and professionalism demanded in oral and poster sessions, have resulted in a unique conference which students and faculty alike look forward to every year.

The emphasis on participation of students and postdoctorals over the 10 years of Gibbs Conferences has significantly influenced the careers of many young scientists. A number of these individuals first attended as graduate students, then as postdoctorals, assistant professors or scientists in industry, and more recently as associate professors. They are now the scientists who organize the annual Conference⁴ and carry on the traditions they began. This newer generation of faculty and researchers have contributed significantly to the field, and now bring their own students and postdoctorals to enrich the development of thermodynamics as an essential discipline in biology.

¹ Specific gatherings to discuss this issue occurred at Vail, CO in the Fall of 1986 (G. Ackers, W. Bolen, E. Freire, S. Gill, and J. Lee) and in New Orleans, LA in February, 1987 (G. Ackers, N. Allewell, W. Bolen, K. Breslauer, K. Dill, E. Freire, S. Gill, and J. Lee). The first conference was held September, 1987 with 44 attendees from eleven institutions (Brandeis U., U.C., San Francisco, Southern Illinois U., Johns Hopkins U., Northeast Regional USDA Laboratory, Rutgers U., St. Louis U., Texas A and M U., U. Virginia, and Wesleyan U.). Attendance has grown steadily to a level of 133 participants in 1995.

² Initial rules allowed only students or postdoctorals to give oral presentations while faculty presentations were restricted to posters. To avoid the semblance of an 'oral exam' the faculty were not allowed to ask questions after a talk until at least one question had been asked by a student or postdoc. These idealistic rules were followed in the initial meetings, but were found to have serious downsides which led to their abandonment.

³ Buffalo tro was allegedly a food staple for an ancient race of people who mysteriously disappeared some two thousand years ago. Most who dine on 'tro' are spared from mystical experiences. If you ask the old time Gibbs attendees, they will tell you that it tastes like chicken.

⁴ Each annual Conference is organized by two co-organizers who are elected by those in attendance at the preceding meeting.

The initial decade of Gibbs conferences has also witnessed a maturation and amalgamation among disciplines and technologies that were once perceived to be remote from thermodynamic consideration: The routine usages of site-directed mutagenesis for designing and modifying protein structures has provided fascinating new models and questions for thermodynamic investigation (cf. [3]). Modern techniques of macromolecular structure determination are increasingly coupled with thermodynamic analyses and computational modeling; and continuing developments in molecular and cell biology have revealed numerous macromolecular machines (and

sub-machines) whose mechanochemical properties demand thermodynamic treatment. A recent compendium of these and other examples [4] has emphasized the currently accelerating interest in thermodynamic aspects of biology.

References

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