Outline of a Proposal concerning the Gibbs Institute for Fundamental Theory at Yale University

I- Scientific Scope

a- An Institute devoted to the synthesis of theoretical models and methods

The idea of a Yale affiliated Institute for theoretical research cutting across different disciplines has gained momentum after many discussions among leading theoretical scientists at Yale. Such an Institute would not only go a long way in stimulating theoretical research at Yale but it would also initiate pioneering activities in gathering, coordinating and organizing various synthetic tendances and revolutionary methods that are already at work in all branches of theory such as the study of the classification and interaction of general structures as well as the investigation of the stability and development of systems.

b- The new structural approach encompasses recent theoretical work from mathematics to linguistics, including astrophysics, astronomy, physics, Engineering, Chemistry, geology, biology, ecology, economics, anthropology, sociology and political science.

b- The Institute develops a unified language for a unified treatment of all theories

One of the important functions of the new Institute would also be the codification or even the development of a common language used in all theoretical models that would enable theorists from

The language would be mainly based on modern mathematics whose task is the study of general and abstract structures. It would also include concepts from dynamics which is more directly concerned with stability and evolution of systems. A beautiful sample in this category is René Thom's pioneering book "Structural Stability and Morphogenesis" which deals with applications of topology chiefly to biology, physics and linguistics in a unified manner with the concept of field and catastrophe playing a universal role.

evolving hierarchical systems

different walks of science to communicate among themselves with greater ease in identifying common models and methods and borrowing ideas from each other.

c - unification of theories within each discipline

The unifying tendencies are active within each discipline as well as among various disciplines. As an example we may cite the recent abstract treatment of Quantum Field Theory and Statistical Mechanics that unifies both subjects in a single theoretical structure. This approach leads to a general theory of phase transitions that also includes the spontaneous breakdown of a symmetry of a system. On the other hand the fundamental theories of radioactivity, electromagnetism and even strong interaction physics are in the process of being unified in a single field theory. Other disciplines could furnish similar examples. Therefore, it would be fitting for the Gibbs Institute to focus also on unified theories for each discipline.

d - The threefold function of the institute: synthetic, creative and educational

The Institute would perform a unique role in the world of learning if it endeavours to accomplish three tasks simultaneously.

One of its functions would be to distill and synthetize all new theoretical work on concepts and models of general validity and codify the universal

language that goes with them. This would include a systematic amalgamation of specialized modern theoretical methods and ideas, such as theory of hierarchical systems, theories of genesis and development of forms, studies of symmetry, stability and evolution of systems, study of fluctuations around equilibrium states, emergence of cycles in stationary states, relations between background and individual systems, many-body relationships, phase transitions among different metastable regimes, bifurcation and catastrophes, general concepts of force and fields, elementary and composite, etc into a general theory of the classification, interaction, stability and evolution of hierarchical structures of universal validity.

The second function of the institute would be to make original contributions to this general theory of structures through the cooperation and discussion between theorists from different subjects or disciplines, and between young and old. Such activities would result in the organization of seminars and the production of papers.

The third function would be educational. The institute would offer graduate courses in the subjects mentioned above. These would finally lead to the writing of standard textbooks. Organization of summer schools and conferences would also help to disseminate the new theoretical science.

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