The Key to Innovation

Friedman, Jerome (1990 Nobel Laureate)

The development of Homo Sapiens has been a history of innovations, from the earliest crude tools to the modern technological society of today. The growth of science and technology has been exponential during the last century; and under the right circumstances, this rapid growth can be expected to continue.

The major innovations of the future - those that will shape the society of the future - will require a strong foundation of both basic and applied research. It is ironic that quantum mechanics, one of most abstruse conceptual frameworks in physics - one that was developed to explain atomic spectra and the structure of the atom, lies at the foundation of some of our most important technological developments, because it provided the understanding of semiconductors that was essential for the invention of the transistor.

Quantum mechanics thus contributed directly to the development of technologies that gave us world wide communication, computers with their applications to all phases of modern life, lasers with many diverse uses, consumers electronics, atomic clocks, and superconductors - just to mention a few. The internet and the world wide web, which are profoundly reshaping the way we communicate, learn, and engage in commerce, owe their origins in a deep sense to the physicists of the past who worked to understand the atom. In modern industrial nations, quantum mechanics probably lies at the basis of a sizable fraction of the gross national product. This is but one example, and there are many others in all areas of science that demonstrate this point.

It is clear that innovation is the key to the future and the human drive to understand nature is the key to future innovation. Society must do all that it can to preserve, nurture and encourage curiosity and the drive to understand.

Number and Organization of Primary Memory Objects in the Brain

De Gennes, Pierre-Gilles (1991 Nobel Laureate)

A memory area contains a large number ($N \sim 10^8$) of neurons, each of which is connected with many neighbors (number of efferents: $Z \sim 10^4$). But the connections are poor: the probability for one connection to be efficient is $p \sim 10^{-2}$. This is important: different memory objects must be independent.

We need to know how a definite memory object can be stored on a cluster of well connected neurons, and what is the statistics of these clusters. The average number M of neurons per cluster is contained within two limits: if M is too small, the memory is not faithful. If M is too large, the storage capacity is too small.

Various consequences of this picture have to be researched.