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Singapore Government

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SPEECH BY DR TONY TAN KENG YAM, DEPUTY PRIME MINISTER AND MINISTER FOR DEFENCE AT THE INTERNATIONAL CONFERENCE ON FUNDAMENTAL SCIENCES HELD ON THURSDAY, 16 MARCH 2000 AT 7.10 PM AT GRAND BALLROOM, SHERATON TOWERS

Professor Lim Pin
Vice-Chancellor
National University of Singapore

Professor Keith Mofatt
Chairman
International Scientific Committee of the
International Conference on Fundamental Sciences

Professor Louis Chen and Dr K K Phua

Co-Chairmen of the Local Organising Committee

Ladies and Gentlemen

Thank you for inviting me to the conference dinner of the International Conference on Fundamental Sciences. I am very pleased that the university has launched such a conference that brings together leaders in the fundamental sciences to exchange ideas and promote their field.

Importance of Fundamental Sciences

About one hundred years ago, the physicist William Thomson Kelvin proclaimed that all was known about nature.Yet, within five decades after Kelvin's comment, the seeds of two major revolutions in physics were sown - the physics of the very small (quantum mechanics) and the physics of the very large (general relativity). At the same time, mathematics was moving relentlessly towards greater abstraction. In spite of many technological advances, the scientific world of the 20th century was faced with experimental data that undermined the foundations of classical physics.

Even the foundations of mathematics were not spared. The 21st century is likely to bring even greater challenges for the fundamental sciences.

In the past four days, you have cast a critical eye over the future for the fundamental sciences, and reaffirmed your conviction that the fundamental sciences have a major role in the development of science and technology in this new century.

Although the applied sciences and engineering often take the limelight, the fundamental sciences were the building blocks of the technological advancements in the last century and will continue to be the forces that bring about quantum leaps in technology in the future. Hence, while downstream applied research brings about faster outcomes and solves immediate and short-term problems, upstream basic research must not be neglected or applied research will soon hit a plateau.

History has shown that basic research plays a crucial role in the long-term development of science and technology. It often turns out that new theories on understanding natural phenomena or abstract ideas in the study of general mathematical structures regain prominence years later in solving problems in hitherto unrelated fields.

There is no shortage of examples to show that successful basic research in one specific field often leads to investigations and collaborations of a multidisciplinary nature. And multidisciplinary research inevitably results in the cross-fertilization of several fields, even those that may seem only remotely related.

Physicist Rosalyn Yalow, together with a medical researcher, applied her expertise in the physics of radioactivity to the problem of measuring minute quantities of hormones in the blood and developed the technique of radio-immunoassay. This collaboration earned her a Nobel prize for medicine in 1977.

It was a skilful application of Fourier analysis, a classical branch of mathematics concerned with periodic functions, that enabled Richard Ernst, the inventor of magnetic resonance imaging, to study the structure of complex molecules so crucial to biology and medicine.
This application of abstract mathematical theory to a chemical problem won him the Nobel prize for chemistry in 1991.

The mathematical concept of the Radon transform underlies the idea of computerized axial tomography (CAT) scanning. It was the pioneering work of physicist Allen Cormack and an engineer Godfrey Hounsfield, working independently of each another, that led to the development of CAT scan machines so indispensable in the non-invasive diagnosis of disease today. This marriage between mathematical software and engineering hardware earned the two inventors the Nobel prize for medicine in 1979.

As a final example, the ideas of stochastic analysis enabled Robert Merton and Myron Scholes to obtain the formula for calculating the value of stock options. The application of abstract mathematics to real-life financial

markets earned the two economists the Nobel prize for economic science in 1997.

No doubt, this conference has provided many other examples of basic research that have potential application in a variety of fields. Within Singapore, some of the work from such research has made an impact internationally. For instance, research by the wavelet group at the NUS Department of Mathematics has resulted in applications like picture and video compression and automatic fingerprint identification.

To further promote and foster research in and applications of the mathematical sciences, NUS is setting up the Institute for Mathematical Sciences, modeled after three successful international institutes -- the Isaac Newton Institute for Mathematical Sciences at Cambridge, the Institute for Mathematics and Its Applications (IMA) at Minneapolis, and the Mathematical Sciences Research Institute (MSRI) at Berkeley.

Funding of Basic Research

As it is more difficult to obtain industry funding for basic research than for applied research, the Singapore government will continue to ensure that a good balance exists for funding applied research and research that is more upstream and more fundamental in nature.
The Ministry of Education and the National Science and Technology Board have been working together to co-fund research with both academic and economic relevance.

There is scope for the two funding agencies to refine the system and to explore how projects with stronger links to the fundamental disciplines and yet have economic potential can be jointly funded, to build long-term capabilities for Singapore.

Training of the Mind

Beyond the role of the fundamental sciences in inventions and innovations, the study of the fundamental disciplines provides good training for the mind. Even as we encourage our young to pursue practical and useful courses in Engineering, Business and Info-communications Technology, we

should also encourage a fair share of our talent to pursue studies in Mathematics and the Sciences.

The discipline of thinking in more abstract terms is useful training in solving complex problems where it is often necessary to detect patterns and trends amidst chaos and noise.

Conclusion

The fundamental sciences have transformed society for the past three millenniums.

They will continue to play an indispensable role in transforming our way of life in the coming century and beyond.

I wish you every success in your scientific endeavours, and a very pleasant evening.

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