Speech given by the President

of the Max Planck Society for the Advancement of Science

Peter Gruss

on the occasion of the opening of the "Science Tunnel"

National Museum of Emerging Science and Innovation

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Dear Dr. Mamoru Mohri,
your Excellencies and High Representatives,
ladies and gentlemen,

It is a great pleasure for me to be here with you in Tokyo today to open the Science Tunnel of the Max Planck Society. I would like to express my sincere thanks to Dr. Mamoru Mohri and his staff for hosting our exhibition here in the National Museum of Emerging Science and Innovation. Thank you very much to all the people who helped to realize this exhibition: To the scientists in our institutes and their associates, who provided us with pictures, footage and exhibits, to the sponsors, who funded the updating, and most notably to the organizers of the exhibition!

"The pace of scientific progress today is so fast that somebody might be declaring that a thing cannot be done altogether, when he is already interrupted by somebody else, who has just done that very thing."

This statement was made by no other than Albert Einstein, possibly the most famous and most popular scientist of the 20th century. With his theories about space, time, and gravitation, Einstein himself in his time revolutionised the scientific image of the world, putting the previously unthinkable into a logical context.

In the 100 years that have passed since his breakthrough scientific discoveries, the rate of scientific progress has even accelerated. Indeed, there are estimates that on an average our knowledge has doubled every 15 years– and not only recently but since the 17th century. As a result of such exponential growth, 80 to 90 percent of all scientists who have ever lived are alive today.

Today, the results of scientific research are shaping our everyday life to an unprecedented degree. Whereas in earlier times many inventions were the result of simple trial and error experiments, scientists today establish cause and effect as exactly as possible before new technologies or substances are put into application. This is most clearly demonstrated in the field of medicine, which has an ever better understanding of the natural mechanisms taking place in the human body, and is thus able to treat diseases with increasingly greater accuracy.

But new insights pervade virtually all areas of our life: in new materials for clothes and packaging, in cars, trains, aeroplanes and ships, in the generation of heat and energy, in computers and mobile phones, in DVD players and computer games … And this list could be continued almost indefinitely.

Fresh knowledge, however, also has an effect on our actions: for example, only once we discover which substances damage the environment can we try and prevent their creation and release. The more research is done into what is good for our bodies, the more can we ensure our continued good health in terms of food, sport, or even sleep.

In the past few decades, human knowledge has not only advanced dramatically, but has achieved an unprecedented breadth and range. This is true for the smallest of areas, as well as for unimaginably large ones. At the beginning of the 20th century, scientific research moved in regions ranging from the size of individual atoms up to those of planets – expressed in figures between 10^{-10} to 10^{11} meters. Today, observations of the smallest phenomena are 5 decimal powers lower, and investigation of the largest dimensions 12 decimal powers higher.

Exactly this range is reflected in the Science Tunnel. It is divided in 12 topics ranging from the investigation of the smallest elementary particles, all the way to the exploration of the largest structures of the universe. The exhibit explores the frontiers of knowledge, showcasing the most recent discoveries of scientific research while simultaneously advancing questions raised by such discoveries. Because every new discovery reveals a new mystery. In some ways, knowledge is like a swelling orb – the more it grows, the more its surface expands, which represents the boundaries to what we do not know – thus, the area we recognise as unknown is growing too, and with it, our desire to keep exploring.

The Max Planck Society is committed to the very frontiers of such knowledge, that is, to the entire spectrum of science. This ranges from the classic areas of natural sciences and humanities, such as chemistry, physics, and history, to such specialised disciplines as foreign and international social law, iron or coal research and marine microbiology, up to highly interdisciplinary subjects, such as evolutionary anthropology, molecular cell biology and genetics, or biological cybernetics.

In 78 Max Planck Institutes, approximately 4,100 scientists and more than 10,000 junior and guest scientists from all over the world are involved in innovative research. We are in particular focused on those areas that have not yet been established at the universities, or those that do not have a place there due to their interdisciplinary character, or because they require major expenditure in terms of personnel and equipment. With its variety of topics from the most diverse areas, the Max Planck Institutes complement the activities of universities and other German research institutes in crucial areas of research. The research activities are primarily funded by the German federal and state governments, with the Max Planck Society enjoying absolute autonomy in the appointment of scientists and in the selection of research topics.

We do not take such a selection lightly. Because today it is important to ask questions such as: Which areas are the most interesting? Which questions have been neglected by the scientific community so far? Which problems are the most pressing? And what do we want to know first?

On the occasion of its 125th anniversary, the renowned scientific magazine Science picked out 125 scientific puzzles revealing critical knowledge gaps, highlighting 25 of these. The questions ranged from the origins of the universe via the origins of life up the maximum age that can be reached by man and the future possibilities of artificial intelligence. Many of the areas listed in Science are also the focus of research in our institutes.

Let us begin, for example, with the fundamental questions of the cosmos: Why do stable matter and unchanging natural constants exist? What is their relationship to one another? Is there a world formula that can unite previously contradicting theories of physics?

In particular, experiments with and the observation of particles in the nano region are a great source of amazement to scientific researchers. The magic word is self-assembly: in nature, atoms and molecules organise themselves into much more complex structures than in the classic chemical compounds which mankind has so far managed to produce artificially. Scientists are now trying to explore these structures in order to make use of the underlying principles of organisation.

Science is also delving ever more deeply into the secrets of life. The genetic code of many creatures has already been deciphered. Nevertheless scientists continue to be puzzled by the meaning and interplay of the individual components: How can an entire organism develop out of one single cell? How are the processes within one body cell controlled, and how do cells communicate with one another? What distinguishes a sick organism from a healthy one?

One special, even unique development of nature is the human brain.100 billion nerve cells, each with thousands of connections to others of its kind, control and direct the body, enabling perceptions and thoughts, feelings and memories but also movement, as well as communication with our surroundings. It is especially the ability to think about the past and the future and to exchange such thoughts with others by help of a complex language that makes us unique as human beings. We still know too little about how these abilities come into being.

At the same time, mankind is becoming a problem for our planet. We are increasingly disrupting the ecological system of the earth without having a real understanding of the contexts. One of this century's greatest challenges is to better understand the complex interplay of land, water and air in order to keep long-term damages as slight as possible. At the same time we have to find new possibilities to ensure that the more than 6 billion people currently living on earth are fed, kept healthy, and provided with energy.

It is part of the human drive for knowledge to look beyond our planet, even beyond our solar system. How does the activity of the sun influence our terrestrial globe? What does it look like on the other planets around us? How do stars come into being and die? And what is beyond the visible – what is the nature of the 96% of dark matter and energy which astronomers believe pervades the universe?

All these questions and issues reappear in the Science Tunnel. There are initial answers to some of them, and ideas and approaches for answers to others. In the light of the great variety of subjects presented, I am confident that there will be something of interest to everyone. In any case, you will be able to experience how fascinating it is to scientifically explore the world

Albert Einstein once said, "*There are only two ways to live your life: One is as though nothing is a miracle, the other is as though everything is a miracle.*" I would be delighted if many people – in particular young people – who take the opportunity to visit this exhibition will say afterwards: "Everything is a miracle".