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大来佐武郎：Higher Education in Technology
into the Twenty-first Century

日本工学アカデミー
THE ENGINEERING ACADEMY OF JAPAN

Higher Education in Technology into the Twenty-first Century

大来　佐武郎

1914年11月3日	中国、大連で生まれる
1937年3月	東京大学工学部電気工学科卒業
〃　9月	逓信省へ入省
	外務省を経て
1947年6月	経済安定本部調査課長
1952年4月	ECAFE事務局勤務
1957年8月	経済企画庁総合計画局長
1962年5月	経済企画庁総合開発局長
1964年4月	(社)日本経済研究センター理事長
1973年3月	海外経済協力基金総裁
1979年11月	外務大臣（第二次大平内閣）
1980年7月	対外経済関係担当政府代表
1981年3月	内外政策研究会会長（現職）
〃　12月	外務省顧問（現職）
1982年4月	国際大学学長
1987年4月	国際大学名誉学長（現職）
1988年4月	対外経済協力審議会会長（現職）

It is both a great honor and a vast privilege for me to have been asked to deliver a keynote speech before this distinguished audience on the occasion of the thirtieth anniversary of the Asian Institute of Technology (A.I.T.).

Before I begin, I would like to congratulate the A.I.T. on all that it has accomplished over the past thirty years and to express the hope that you will maintain these same high educational and research standards in meeting the region's future needs.

In 1952 and 1953, I worked with the United Nations ECAFE program (now ESCAP) here in Bangkok as the first Japanese UN Secretariat staff member since World War II. Since then, I have made many trips abroad. Recently, my secretary compiled a list of my postwar overseas trips so far and found that, to Asia alone, I have been to Thailand 42 times; the Philippines 31 times; Indonesia 23 times; China 20 times; India 19 times; Singapore 16 times; Hong Kong 14times; Malaysia 11 times; South Korea 10 times; Pakistan, Nepal, and Sri Lanka 3 times each; Bangladesh, Burma, and Fiji twice each; and Laos, Western Samoa, and Papua New Guinea once each.

I hope that this record of long involvement in the region and my own background as an engineer (having graduated from the University of Tokyo engineering faculty) will qualify me to speak, just as I hope my remarks will justify my selection as a keynote speaker.

I would like to begin today by discussing Japan's experience. From time to time, people ask me if Japan's development was successful because it was blessed with exceptionally favorable circumstances or if this success derived from some conscious Japanese strategy. Most of the people who ask this expect me to attribute Japan's success to some secret strategy, and they hope to learn the secret so that it can be applied elsewhere. While it is all very well and fine to want to learn from others' experience, it must be remembered that the lessons of history can be misleading or even counterproductive if the historical and other differences are not taken into consideration. In that sense, Japan is neither an ideal model case nor an irrelevant distraction for today's developing countries. Rather, the truth lies somewhere in between.

In fact, I suspect that both the traditional

factors indigenous to Japan and the international situation prevailing at the time were both important to Japan's development.

In 1960, the government of Japan announced its income-doubling plan—a plan that I was in charge of drafting as Director-General of the Economic Planning Agency's Planning Bureau. Disbanding the military, dissolving the zaibatsu, implementing agrarian land reform, rewriting the tax system, and reorganizing the bureaucracy, the postwar Allied Occupation policies had done much to change Japan's economic and political arrangements. At the same time, the priority production program and other measures adopted by Japanese policy-makers shortly after the end of the war made a start on economic recovery. Because all industrial sectors had been devastated and it was impossible to revitalize everything at once, the priority production program was devised to allocate resources to the most important sectors in the expectation that they would then lay the foundations for subsequent development by other sectors. The first priority sector was coal, and I believe that these policies contributed significantly to Japan's economic recovery from the wartime devastation. This was also helped by the change in Occupation policy from one of punishing Japan to one of assisting its recovery.

The postwar years were also a time of striking technological advances worldwide, and Japan, in its effort to catch up with the advanced Western nations, achieved very rapid advances with major impact on the economy. At the time, there was a dual structure to the Japanese economy as Japan had both the capital-intensive industries typical of an industrial country and the labor-intensive industries typical of a developing country. Thus another factor that contributed to Japan's rapid postwar growth was the existence of a large pool of low-cost and high-quality labor that was well-educated and capable of mastering sophisticated technology—a pool that was the direct result of the fact that Japan had sought to enhance universal education as early as the late 19th century. These factors were taken into account in drawing up the national income-doubling plan that was announced in 1960.

Under this plan, we hoped to double Japanese national income within a decade. In fact, this goal was achieved in only seven years. With this plan, Japan entered upon a period of very rapid growth, the growth rate averaging 10 percent a year for 15 years. As such, this plan played an important role in consolidating the foundations for Japan's postwar economic development.

Based upon market economic assumptions, this long-term plan was significant for the way it sought to avoid the tendency of policy planning and corporate management to make judgments on the basis of the short-term situation and tried instead to serve as part forecast and part guideline so that people could focus on the long-term outlook. By reaffirming the government's long-term intentions in such areas as public works and tax policy, the plan reduced the private sector's uncertainty and stimulated a surge of economic activity. Likewise, the plan also served as a forum for reconciling divergent interests and forging a national consensus on economic priorities. As such, the plan might well be characterized as a set of policy management directions.

In 1982, Professor Lester Thurow coordinated a symposium on Japan's postwar economic performance at the Massachusetts Insitute of Techonlogy, the results of which were later published by MIT as *The Management Challenge: Japanese Views*. Commenting on the five priorities that we had set in the 1960

income-doubling plan, Professor Thurow wrote:

> Consider the five elements in the Japanese economic strategy at the beginning of the income-doubling decade: strengthen social overhead capital, push growth industries, promote exports, develop human ability and technology, and secure social stability by mitigating the dual structure of the economy. This list could easily serve as strategic objectives for the American economy by the year 2000.

We recognized that the promotion of science and technology and the development of our human resources were indispensable to economic development. There was a special emphasis on training people in science and technology, and, in consultation and cooperation with the Ministry of Education, we drew up a plan for educating the necessary engineers and other technical people. Although it has been pointed out that Japan today graduates more engineers than the United States does, we were aware of the human aspect as an important element for Japan's industrialization even in the early years. In 1961, the year after the income-doubling plan was drawn up, a committee was formed within the Economic Council to study ways of enhancing human abilities. After extensive deliberation on how to develop people in the scientific and technological fields—everybody from university graduates to skilled workers—a report was drawn up on human resources development policy.

Until then, education had been seen as essentially different and divorced from economic issues, and economic planning had ignored these areas except in passing. Indeed, the tendency among teachers and other people interested in education was to argue that education should not be thought of in economic terms but should have some loftier objectives. However, there must be some connection between society's needs—the abilities the economy requires of people—and the educational process that gives people these abilities. Otherwise, the schools will end up turning out large numbers of highly educated, overqualified, and unemployed people. At the time, I emphasized that education and economic planning are like two circles which, while not concentric, do overlap to a considerable degree. This is especially true if, as was predicted, the pace of technological innovation picks up and the industrial structure is transformed. As new technology is incorporated into the economy, it is necessary for engineers and other workers alike to be continually learning and mastering the new technology. We were convinced that, as population growth slowed and the labor pool stopped expanding as fast, the nation's economic strength would depend upon how capable each individual worker was.

Once it is accepted that the economy works through the free activity of corporations and market mechanisms, it is clear that the private sector must be the driving force for the attainment of any national goals or targets. Indeed, problems can only be overcome and targets can only be achieved when the people in the private sector recognize how their actions interact on the nation's economy and they exercise their abilities to the fullest. It is the role of the government to create a climate in which the private sector can act, to remove any barriers that may arise, and to indicate general directions. I have long maintained that, while the government may want to assist these corporate efforts, to offer stimulation, and to encourage industry to work toward set goals, its economic role can only be complementary and indirect. In education and scientific research, however, we felt that the government could play an important role.

People are the ultimate resource. Once this

realized, the question becomes one of what policies are needed to develop these resources and to integrate them as a vital element in the economy without stifling them. At the time, we studied three specific points in keeping with Japan's economic traditions and the givens of our human resource reserves. The first point was to draft a program for human resources development that would give us people capable of responding and adapting to changing labor requirements as industry progressed and restructured. Second was to encourage the emergence of engineers able to promote the shift to a higher-value-added industrial structure. And third was a package of measures responsive to the changing industrial relations, employment practices, wage systems, and other elements as the economy modernized. Because all of these issues are so closely related to the society's personnel reserves, these policies demanded careful consideration of our situation and the historical currents. Yet regardless of the society's specific circumstances, I think it is a universal truth that people are the ultimate resource—and that human resources development must therefore be central to and underlie any development program.

The importance of human resources is also evident in light of the much-publicized finiteness of our other natural resources. The first work to have a global impact with its warning that the earth's resources are finite was the 1972 Club of Rome publication *The Limits to Growth*. Founded in 1968 at the initiative of the Italian industrialist Aurelio Peccei, the Club of Rome soon decided to undertake an ambitious Project on the Predicament of Mankind and to look for comprehensive solutions to the different parts of what was called the "world problematique." As a member of the Club's Executive Committee, I took an active part in the discussions and supported the decision to commission MIT's Professor Dennis Meadows and his team to do a study of the "world problematique." *The Limits to Growth* was result of this study. As noted in the study's conclusions:

> If the present growth trends in world population, industrialization, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probably result will be a rather sudden and uncontrollable decline in both population and industrial capacity.
>
> It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential.

More than a decade later, the United Nations World Commission on Environment and Development (WCED) was established in 1984 with Norway's Gro Harlem Brundtland as its chairwoman and Sudan's Mansour Khalid its vice chairman. I had the honor to a member of the Commission. After long and arduous deliberation, the WCED issued a report called *Our Common Future* (published by the Oxford University Press in April 1987)advocating the fundamental concept of sustainable development. As the report put it:

> Humanity has the ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits—not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth.
>
> In the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientations of technological development, and institutional change are made consistent with future as well as present needs.

From the conceptual understanding in *The*

Limits to Growth to the specifics of sustainable development in *Our Common Future*, international cooperation and technology are essential to the process of creating a viable world for present and future generations. The failure to manage the environment soundly and to achieve sustainable development today poses threat to the wellbeing of all nations. Thus it is that more and more people have come to realize that it is impossible to separate our concern for the environment and our desire for development. I do not see how we can possibly preserve the environment unless the costs of environmental protection are built into our economic growth, and we surely cannot sustain economic growth unless we also protect the environment. This is not a problem that distinguishes between the industrial countries and the developing countries. Neither is it an issue distinguishing among countries with different economic or political systems. Rather, it is an issue intrinsically common to all mankind and demanding international cooperation.

It should also be noted here that science and technology have the potential for altering the very structures and interworkings of society, culture, and the economy. While new technology does carry the danger of new risks, it also offers the promise of improved productivity, higher standards of living, enhanced health and medical care, more efficient resource utilization, the ability to preserve nature's bounty by using renewable resources, and much more. Indeed, if we are to overcome the environmental constraints on global industrialization and to achieve sustainable development, we need breakthroughs both in terms of our socioeconomic structures and in science and technology.

The needs are for promoting international cooperation and advancing science and technology, and it is only people who can do this. The earth's natural resources are finite. Environmental constraints impose their own limitations. Yet it is possible for us to enhance our human resources by gathering together and building upon mankind's accumulated wisdom and knowledge. Many of the difficulties facing the developing countries can be attributed at least in part to the fact that their human resources are, unfortunatmusstely, still in an undeveloped state. Some of these countries are trapped in a vicious spiral of population increases, poverty, environmental destruction, the depletion of natural resources, food shortages, and deteriorating health and nutrition. Food and nutrition are, if you will, the fuel the body needs to run on, and it is impossible for a person to be fully productive and creative unless there is a sustained and adequate supply of the right kinds of fuel. As the WCED report put it:

> People are also a creative resource, and this creativity is an asset society must tap. To nurture and enhance that asset, people's physical wellbeing must be improved through better nutrition, health care, and so on. And education must be provided to help them become more capable and creative, skillful, productive, and better able to deal with day-to-day problems. All this has to be achieved through access to and participation in the process of sustainable development.

I believe the Asian NIEs and the ASEAN countries are in a favorable position in this respect. Historically, geographically, and culturally close, the nations of East and Southeast Asia have seen consecutive waves of economic development. The first wave was in the 1960s, when Japan experienced its decade of rapid growth. The second wave was in the 1970s, when the Asian NIEs of the Republic of Korea, Taiwan, Hong Kong, and Singapore took off economically to achieve today's high growth rates. And the third wave is now building in Thailand, Malaysia, and the other ASEAN countries. In a very apt analogy, this pattern

of development has been called the flying geese pattern. Although the geese are now flying in a V-formation, there is a catch-up process at work that will ultimately result in a horizontal division of labor in the region.

The tremendous advances in information processing that have been achieved with microelectronics and computer technologies, the facility in telecommunications that new communications technologies have wrought, and the progress that has been made in process management and other production technologies have all fused together to improve productivity and resource utilization effectiveness, to radically alter industrial structures, and hence to eliminate the need to pursue economies of scale as a basic prerequisite to economic development. In many ways, the interaction of these new technologies can now offset the massive energy requirements of old. As a result, it is now possible to pursue small-scale industrialization with a high degree of specialization and dispersion, and this in turn means that it is possible to alleviate the environmental impact of industrialization. At the same time, advances in computer science have ramifications far beyond the industrial sphere, including the revolution in elementary education and the use of expert systems to make top-grade medical care available worldwide. Advances in biotechnology and genetic engineering should also contribute to improved medical care in the developing countries, as with the development of new medicines and vaccines to reduce the threat of infectious disease and the development of high-yield strains that will raise agricultural productivity and make it possible to engineer renewable bioenergy crops. The important thing about all of this technology is that it is very closely related to environmental conservation. Nor are computer sciences and biotechnology alone in this. A wide range of other technologies—everything from new materials and chemicals to energy technology, remote sensing, transport technology, habitat engineering, urban planning, macroengineering, resource management, effluent and emission processing technology, and much more—is also needed if we are to achieve sustainable development for all.

However, science and technology is a two-edged sword. While it is essential that these new technologies be developed, it is equally essential that we make progress in our risk assessment and crisis management capabilities to ensure that these technologies are safe for human consumption. It is also important that each country consider the social and economic infrastructure needed to make best use of these advanced technologies and concentrate on making sure that the social, economic, and industrial underpinnings are ready to bear the weight of these advanced technologies. Very often, even the laudable goals of energy and resource conservation demand a sophisticated capability in maintenance engineering, reliability engineering, and other support technologies.

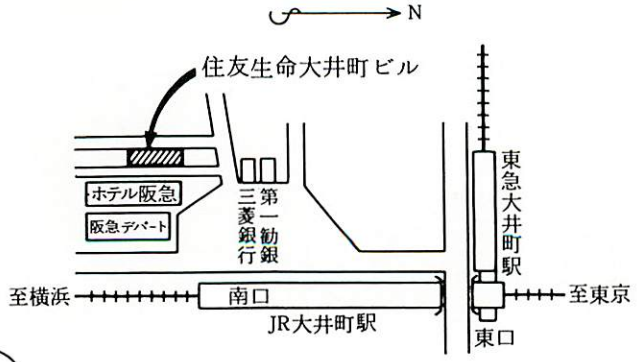
In fact, no country can do everything alone. The development of creative new technologies synthesizing advances in a number of fields requires a climate conducive to broad exchange of scientists and engineers both across national borders and among academic disciplines. In addition to the economic cooperation and technical cooperation that the Japanese government if now offering the developing countries, I have long advocated the creation of a new category called research cooperation and argued that the institutional and operational arrangements must be altered to make provision for this new need. Japan has become an economic power and ranks right alongside the United States in terms of total volume of

assistance to the developing countries, but Japanese assistance for the developing countries has focused too long and too much on roads, ports, bridges, electrical power plants, and other construction projects, and our technical cooperation has been subject to budget-term and procedural limitations that have made it difficult to do much to assist overseas research and training institutes. The developing countries are making an admirable effort to develop their own researchers and to strengthen their research capabilities, but they are very often strapped for funds. While it remains true that the local government and people must bear the primary responsibility for a country's economic development and that overseas assistance can no more than supplement these local efforts, I believe the importance of technology makes it imperative that Japan do more to promote research in the developing countries and scientific exchanges with experts in the industrial countries. In the same vein, Japan needs to do more—both in monetary terms and in personnel terms—to enhance its existing technical cooperation programs and improve the provisions made for foreign students in Japan.

While we obviously need policy-makers able to point out and rectify the institutional impediments to scientific and technological progress, we just as clearly need scientists and engineers aware of the potential and limitations inherent in our science and technology. I myself trained as an electrical engineer, but I found that my interest in social issues drew me into being an economist with a special concern for economic, development, environmental, and technology issues; and I was subsequently involved in foreign policy issues as Japan's Minister for Foreign Affairs. While this might be somewhat atypical, I am covinced that, like it or not, scientists and engineers will inevitably have to consider the socioeconomic implications of their work. Technological advances today not only impact in the economic and industrial fields but have the potential for dramatically changing our standard and style of living, radically altering our sense of values, and having a ripple effect that transcends national jurisdictions to transform the whole of our international cooperation.

People are crucial in all of this—the essential resource for conserving our planet and building better lives for all people everywhere.

案内図



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