Teaching Physics in Relation to Cultural Backgrounds*

——A Japanese Response to *Project Physics*——

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Physics is, or is at least expected to be, valid for any person, regardless of his creed, ideology, or cultural background. Therefore, it can be taught in a manner totally unrelated to history or to cultural background. There seems to be no question about this. Moreover, it may naturally be presumed that the most efficient way of teaching physics is to ignore history and culture entirely.

As to this presumption, however, I have to point out that two very important aspects are completely overlooked. (1) It is true enough that a theory of physics, once established, is valid in any place, in any culture; but it is not true that such a theory could have been created in any place, in any culture. On the contrary, a certain cultural environment was, in fact, required for the birth and development of physics. This is a historical truth. Thus created, physics may be legitimate regardless of time, space, and person; but creativity in physics can in no way be independent of cultural backgrounds. (2) It is true enough again that, because it transcends cultural differences, physics can be of such a great power in any part of the world. However, the world in which we individuals actually live and in which we utilize physics is by no means unre-

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lated to cultural backgrounds, whether we do research in a scientific institute of a most advanced country or help a less developed country.

Consequently, physics taught independently of cultural background has, I am afraid, rather little relevance both to researchers and to educated citizens in general. It may serve to produce experts who play intellectual games in an ivory tower, or technicians who apply physics within a limited scope. But, to further physics to a not yet explored field or to apply physics to an unsolved problem in the actual world is a different story. For these reasons, namely from the point of view of creativity, productivity, and of relevance to general educated citizens, I seriously question teaching physics totally unrelated to cultural backgrounds.

This is not unassociated with a second and more serious doubt of mine concerning contemporary education, particularly in Japan. A high school student in Japan, for instance, has to take more than fifteen courses, such as classics (Japanese and Chinese), Japanese language and literature, English, Japanese history, world history, geography, ethics and society, politics and economics, mathematics, biology, physics, earth sciences, art, music, health, physical education, *etc*. These subjects are taught mostly according to the particular requirements of each discipline, quite indepedently of each other, thus adding more to the contemporary fragmentation of knowledge. A student who wants to enter a university of a high standard has to be very well versed in several of these subjects and be highly trained in answering those kinds of problems which are especially designed for entrance examinations. If he fails, he enrolls at a prep school, which is solely devoted to the training for the entrance examinations, and waits for the next opportunity. Even if he succeeds, he is not much cultivated in the inquiring mind, lacks a keen intellectual appetite, and is sometimes exhausted after the years of hard training for nothing but the entrance examinations.

This is the most problematic side, I think, of education in general in Japan. Could this still be called education? It does not help students develop genuine interest and understanding of science and learning, I am afraid. It can only produce an *élite* of split personalities or narrow autistic specialists on the one hand, and, on the other hand, a general public disinterested in learning and possessing an inferiority complex. Perhaps I may be too pessimistic. At any rate, this brief sketch will suffice to show how little room is made in Japan for physics to be taught in relation to humanistic aspects and to cultural backgrounds. If I had thought there still was some hope for it, I would have been even more desperate. Therefore, I had decided not to think of this hopeless problem too seriously.

But then, I was unexpectedly asked to join a seminar on physics education, held in Tokyo, and came to see the *Project Physics*[1] which had just come out. Frankly, I was fascinated with it. Although I had not had time to read it carefully, I could see that here physics is beautifully presented in relation to cultural background, and that the intellectual unity with other aspects of learning is also successfully achieved. This, I thought, may very well stimulate young students and help them understand physics in the broad perspectives of both history and the contemporary world. History of science and ideas permeates the volumes and serves to effectively display the humanistic aspect of physics. A passing glance of the *Readers*, for instance, will suffice to exhibit the richness of the material, which ranges from scientific writing of centuries ago to the most contemporary ones, from Galileo's discussion of projectile motion to the dynamics of a golf club and physics in athletic measurements, from history and philosophy of science to art, music and literature, and from critical essays to space travel and science fiction. Authors included are: Copernicus, Galileo, Kepler, Newton, Thomas Young, Maxwell, Tait, William Thomson, J. J. Thomson, Michelson,

1. James Rutherford, Gerald Holton & Fletcher G. Watson (diretors), *Project Physics*, New York & Toronto, 1970.

Einstein, Dirac, Schrödinger, Chadwick, Bridgman, Fermi, Feynman; Basil Willey (scholar of English literature), Herbert Butterfield (historian), George Gamow, C. P. Snow, Jacob Bronovski; Anatole France (French novelist), and Thomas Jefferson (the third President, U. S. A.). Illustrations are adequate and attractive at the same time. Famous paintings are sometimes used and, surprisingly enough, even Harunobu's woodcut print, *Windy Day Under Willow* (Figure 1), is shown under the item "Representation of Movement."

We now see why the *Project Physics* attracted so many high

Figure 1. *Windy Day Under Willow,* A Woodcut Print by Suzuki Harunobu.

school students in America and resulted in a remarkable rise in physics enrollment in the trial schools. Similar effect may be expected in Japanese high schools if it is taught by well trained teachers and with appropriate modifications to fit the Japanese cultural background.

For this, we have first to realize how the cultural background in Japan differs from that of the West. In the past, science developed very little in Japan. At least, it was not a dominant component in the Japanese culture until the Japanese people came to have close contacts with the Western peoples. Just think of the development of seismology as an example. In the Western countries it evolved slowly, primarily, perhaps, because earthquakes were rare. In Japan, on the contrary, people have been experiencing countless earthquakes for thousands of years. Yet, practically no systematic scientific study of them was ever carried out. It was only after Japan was opened to the Western world in the mid-nineteenth century and had Westerners live and experience earthquakes in Japan, that seismology was started there. The Japanese people, although they frequently suffered from natural disasters, did not try to conduct scientific studies of the phenomena in order to under-

Figure 2. *Landscape in Moonlight*, by NAGASAWA Rosetsu.

stand them and to avoid future misfortunes. Even though they were knocked down by typhoons, floods or by earthquakes, they were happy as soon as they realized in themselves that they were nestled in the bosom of nature. In this way, they were relieved and recovered without going further on to an objective clarification of the matter.

Such an attitude toward natural calamities of the Japanese people is not perhaps unrelated to their concept of nature in general. The Japanese people have been particularly appreciative of the beauty of nature, as is exemplified in their art (Figure 2), literature, and traditional culture in general. In his Nobel lecture entitled "Japan the Beautiful and Myself" (1968), Yasunari Kawabata first quoted a poem of the Zen priest Myōe (1173-1232):

> Winter moon, coming from the clouds to keep my company,
> Is the wind piercing, the snow cold?[1]

and then he commented on it saying:

> Winter moon, going behind the clouds and coming forth again, making bright my footsteps as I go to the meditation hall and descend again, making me unafraid of the wolf: does not the wind sink into you, does not the snow, are you not cold? I choose it as a poem of warm, deep, delicate compassion, a poem that has in it the deep quiet of the Japanese spirit.[2]

For the Japanese people, things in nature were their intimate companions. They did not view them as the objects of scientific investigation or of technological exploitation as did the Western people.

Since the nation itself has been so highly industrialized, the attitude of the people may be changing greatly. Basically, however, much of this attitude remains unaltered. A verse in one of the contemporary popular songs in Japan reads:

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2. Yasunari Kawabata, "Japan the Beautiful and Myself," translated by Edward G. Seidensticker.
3. *Ibid.*

Chimneys are so high that, you Moon,
Don't your eyes smart from the smoke?

After a day's work, Japanese workers are happy drinking *sake* wine, singing this song, and addressing it to the Moon. They are immersed in nature, forgetting themselves and even forgetting the dreadful destruction which the smoke is constantly inflicting upon nature and upon themselves. The too rapid growth of the gross national product of their country may be considered to be based on this kind of optimism of the people.

At any rate, Japan was a land of peace and beauty, until the four ugly "black ships" or battle ships of Commodore Perry steamed into Tokyo Bay in the mid-nineteenth century. What he brought to show the Japanese people were not the loop-films and transparencies of the *Project Physics* course, but a miniature steam locomotive and an electric telegraph. The Japanese people could not resist the power of steam and electricity, symbolic of Western science and technology (Figure 3), and they decided to open the doors to the Western countries, first to the United States of America, and then to others.

From this time on, the Japanese people started to purposively introduce and widely teach Western science, and this solely from the technical point of view and not from the cultural point of view at all. In this respect, Erwin Baelz's observation was exceptionally adequate and penetrating. He had been invited from Germany and taught at the Medical School of the University of Tokyo for as long as twenty-five years, beginning in 1876. "As a true and warm friend of the Japanese people" he set forth the following criticism, on the occasion celebrating his twenty-fifth year of service in Japan :

> ...So far as I see, a mistaken notion seems to be frequently prevalent in Japan concerning the origin and nature of Western science. The Japanese people regard science as a kind of machine which yearly performs a prescribed amount of work and can

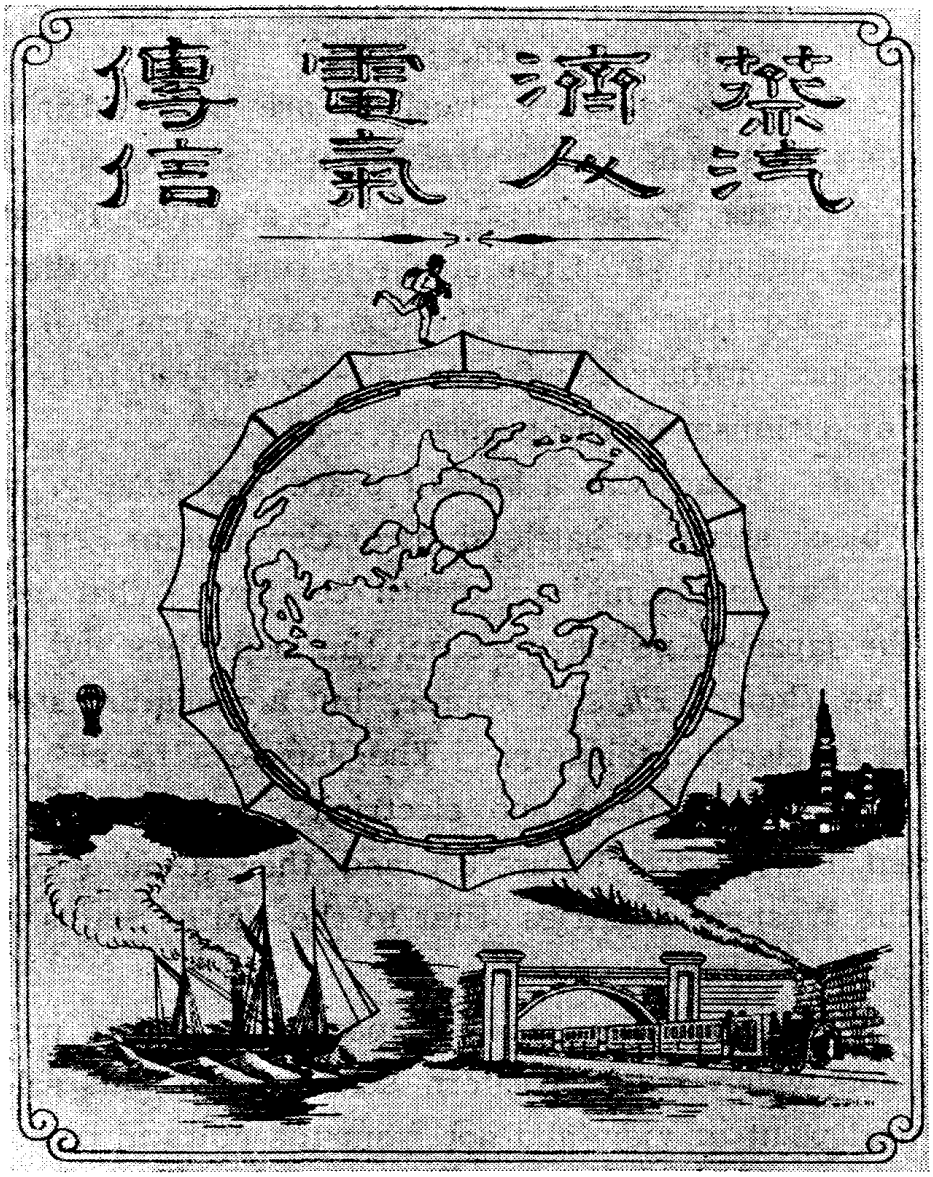

Figure 3. The frontpiece of *Seiyō Jijō* (Things in the West, 1866) by FUKUZAWA Yukichi, a leader and spokesman of the age of "Civilization and Enlightenment" in Japan. The eight Chinese characters above mean "steam ferries people, electricity carries message."

easily be transferred to any place to have it kept working there. This is a mistake. The Western scientific world is not a machine at all, but it is an organism, for the growth of which a certain climate and atmosphere are necessary as is true with the case of all other organisms....

...The Western countries sent many teachers to you, and with

> zeal did these teachers endeavor to transplant this spirit [of the West] in Japan and to make it adopted by the Japanese people. However, their mission was often misunderstood. They were looked upon as traders of scientific fruits who sell those fruits by the piece, although they were to be and they themselves intended to be the cultivators of the trees of science.... The Japanese people are content only with receiving the most recent developments and do not care to learn the basic spirit which has yielded these results.[4]

One can only regret that a course like *Project Physics* was not introduced and adapted at the time of Perry.

How natural science was born in the Western world; How it developed; What were its relations with and influences on other aspects of human life and world; How it has been transmitted to Japan; What kind of effects it has been producing there, where the entire cultural background is quite different: These types of questions and this kind of humanistic and cultural approach would have given deeper insight and a broader perspective to young people in Japan. It would have helped them get a better understanding of the scientific approach to nature inherent in the Western culture. It would have encouraged them to make an effort to integrate this Western component into their indigenous culture, which certainly would have resulted in more cultural productivity and harmony on the part of the Japanese people.

It may not be too late even now. I would like to see, therefore, science education in Japan, including general education at universities and colleges, revised along with the basic spirit of *Project Physics* which emphasizes cultural and humanistic aspects of learning.

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4. Translation by the present author from the Japanese edition, *Baelz no Nikki* (Tokyo: Iwanami Bunko), Part 1 (2), pp. 51-52.