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SCIENCE AND CULTURE IN JAPAN
– IN COMPARISON WITH THE TRADITION OF ART AND TECHNOLOGY

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Japanese scientific tradition has taken a multifaceted approach. It constitutes a carefully directed effort. The suggested changes include a move away from rote learning, the removal of the hierarchical order in school, changes in organizational structures of laboratories in favour of those promoting innovation, increases in funding, expanding links between industry and research and the careful cultivation of foreign scientists and foreign journals. A formidable attempt seems to be under way. The question we should pose is, will this succeed?

One of the elements for the lack of productivity and tradition of science in culturally dependent countries that has been identified is the incomplete and fragmentary nature of the mapping of "international" science. It has been documented that most of the time the different disciplines and subdisciplines are incompletely mapped through teaching programs, journals, reading material and laboratories in culturally dependent countries. In the case of Japan, however, this is not the case. The mapping is as complete as in any Western country and its science is fully integrated with that of the West. So this source of the lack of productivity does not exist in the case of Japan.

There is hardly any data on the functioning of the internal social system of Japanese labs in Japanese scientific centers compared to the considerable material on similar situations in the Western world, accumulated especially over the last decade and a half. Further, there are no significant writings on whether Japanese scientists have used intellectual approaches drawn from their culture in the articulation of their work. I had earlier identified these two facets, namely the effective working at the small group level of Japanese science; and the use of cultural inputs from Japan's indigenous store, as two vital approaches in removing

the cultural marginalisation of Western scientists increasing their productivity and traditions.

In the absence of direct data, I have to approach these two facts indirectly. The first, the social psychology dimension, by referring to the literature available on Japanese work organizations. This literature showed how the Japanese work situation has some flexible elements which could be favorable for tradition, albeit in a form different from the Western variety.

The Japanese work group, although it has stultifying aspects of conformity, also has the seeds of its opposite. The close discussions that the group indulges in the prolonged debates before decision-making and the importance for inputs from several members of the group allows for free exchange of views and acceptance of ideas. Mechanisms such as those represented by the *ringi* system allow for the raising of new perspectives and its acceptance, albeit in a form different from the West.

As for the acceptance of traditional elements from outside the immediate culture of the discipline, one has to again make an oblique approach by taking example from a field on more detailed empirical material. For this, two somewhat related intellectual areas outside science will be examined.

The two elements are (a) the arts and (b) technology. Science, it should be noted, stands as an intellectual endeavor half-way between these two. Not-so-free in conceptualization and more bounded than the fine arts, whilst freer and with more speculative possibilities than the direct use-oriented endeavors of technology. Are there examples of significant Japanese tradition in theses two realms?

Artificial Fusion

Critics and commentators in the theater, dance and music fields have recently observed significant elements of tradition in these fields, as Japan's tradition met with Western influences. It is useful to briefly overview these examples.

In Japan today, a dominant position is held by Western music. This is not only so in the case of pop music but is perhaps more so in serious music. Serious, classical music in current Japan, it appears, is not the music of its tradition but Western

music. (This, one should note in parentheses, is the opposite in India where its traditional classical music finds pride of place and a much wider audience than Western classical music.)

"The first landmark event in the history of contemporary music in Japan" was in 1952 when Matsudaira Yoritsune won the first prize for a composition "Theme and Variations for piano and Orchestra". This piece combined twelve tone techniques with a traditional genre of Japanese music, namely *gagaku*.

In late 1950s, Japanese felt that they had "caught up" with the standards of European music, as exemplified by Mayuzumi's *Niravana Symphony*. This composition, it should be noted, employed Buddhist temple bells and Buddhist chanting. In the 1960s and 1970s traditional Japanese musicians began to perform Western – style compositions using traditional instruments. The use of Japanese tradition in Japanese Western music began to increase. By 1985 a student of the Japanese music scene was to say that "the number of contemporary Japanese composers' works performed in Europe far outnumbered the works of modern European composers performed in Japan", signaling that Japanese music revitalized by merging its culture with that of the West had created something original and was exporting this.

The post-Meiji new theater *Shingeki* was strongly influenced by the European theatrical tradition. Yet, from the 1960s onwards there were Japanese dramatists creating new material in theater, arising partly through a renewed interest in traditional Japanese theater. Although they were initially attacked for these (*syogekijo undo*) attempts, they had an "enormous" influence. These groups experimented with new concepts of space in the theater, blurring the separation of theatrical space from everyday living space, actor from audience, etc. Here, then, was an example of creativity. In fact, the creativity had arisen precisely because elements of the tradition were spliced into the post-meiji, Western-influenced new tradition.

Any outsider to Japan would note the distinctive bodily movements in Kabuki and No as well as the distinctive rhythms of its popular dances in the many Japanese festivals. However, Western ballet, as well as the modern Western dance of the

Martha Graham variety, has pride of place in Japan. Yet, the imitative field of Japanese dance has recently shown remarkable creativity in one genre.

Butoh is this new genre that emerged in the 1960s. Hijikata, one of the leading exponents, holds a key position in its development. His inspiration for the new directions in dance was from the study of things Japanese. The Japanese body type, its size and shape, Hijikata has noted, was unsuitable for European classical ballet. He made new modern dance forms that were more suitable to the Japanese body type.

Hijikata's work and approach was also related to the Japanese haiku, which makes "incredible" combinations of disparate images. Whereas in Western styles of dance the emphasis is on rhythm, balance and the rational flow of "kinetic energy", Hijikata emphasized discontinuity and imbalance. The critical success and the influence of this innovation is another example of combining creatively cultural elements drawn from pre-Western culture and points to possibilities in other cultural fields, namely science.

If there are examples from the arts of the fusion of the traditional and the Western, to give a creative mix, what examples of successes of cultural fusions exist in the sphere of technology, the other intellectual endeavor which, together with the arts, sandwiches science as a cultural phenomenon?

Technological Fusion

There have been several important examples of such fusions. They are in those Japanese technologies which are identified with Japanese innovation, namely, robotics, biotechnology and the new ceramics.

This interdisciplinary technological strategy combines two existing areas of knowledge to give new products and new industries. The borders between the two disciplines are now blurred and many innovations emerge by combining the two. Here no fundamental creativity is required, but an imaginative application of existing knowledge at a higher level of integration. In this technological fusion, two basic technologies are combined into one to yield a new field of technology.

The classic example is the Japanese experience in mechatronics – a field vital for robots – which combined mechanics and electronics. Mechatronics is a Japanese innovation where mechanical technology was fused with electronic technology. Examples of mechatronics are in Numerically Controlled (NC) machine tools and robots. This category also includes technologies where the mechanical working part is either wholly or partly superseded by electronics. A mechatronized process it should be noted, was influenced by a MITI initiative resulting in a law in 1971 ("The Law on Temporary Measures for the Development of Specific Machinery and Electronic Industry") showing that direct legislation can have an influence on technological innovation.

The innovation sequence in technological fusion occurs with an industry having an interest in product fields other than its principal product line. In mechatronics, technological fusion commenced after 1971 with a crossflow of ordinary machinery industry and the electrical machinery industry. Later connections were created between precision instruments and communication and electronic equipment. With these four elements under fusion the new field was born.

In biotechnology, compared to the four-fold connections made in the mechatronics industry, a three-fold connection between different fields is made. In 1971, a two-way connection between food and drugs and medicines resulted in the appearance of fermentation technology, one leg of biotechnology. When industrial chemicals joined this duo, biotechnology came into being as a high technology field.

In the case of ceramics, the new ceramics emerged by initially fusing ceramics and ordinary machinery whence fine ceramics was born in 1980. In 1981, a connection was made between ceramics and industrial chemicals. By 1982, the three-fold connection between ceramics, ordinary machinery and industrial chemicals were made and the new ceramics were born.

The developments resulting from technological fusion was the result, among others, of good company-to-company relations operating in the two respective fields and resulting in a fusion of the technological culture of mechanics with that of electronics. Better fusion results are obtained when one company partly merges with another through a process of cross-investment resulting in closer fusion of the two subcultures. This type of development could also occur within the

organization. Clearly, what occurred was a merging and interpenetration of the knowledge cultures associated with the two fields giving rise to a synergistic result.

It was the mechanotronics revolution that spawned Japan's very successful innovations in robotics, making Japan the predominant power in this field. Other examples of successful technological fusion are biotechnology, and new ceramics. All three fields are front-line cutting edge technologies and the results of fusion show that cross-fertilization of cultures can indeed be very creative.

We have seen examples from two different fields, technology and fine arts that are on two opposite sides of science in their intellectual characteristics. The arts, although bounded, allows for more play of the imagination than does science, which is firmly rooted to reality. On the other hand, technology is much more grounded to reality and the everyday world than science is. In both these cases, we have seen that recent Japanese experiences show considerable tradition. This tradition is realized by essentially similar processes, by splicing – in elements drawn from Japan's past. In the case of technology, it was by merging two or more technological cultures.

If tradition is possible in Japan in the two opposite parts of a three-fold intellectual spectrum, clearly it is possible for the one sandwiched in between, namely science.

Scientific Fusion

Whilst having noted the possibilities for tradition that have been described in the pages above, one should remember that tradition, at least in science, had existed in Japan from the Meiji period onward. In spite of a perceived blanket of conformity, there have been several examples of Japanese tradition in science going back to the early period of its introduction. Thus, Kitasato Shibasaburo discovered natural immunity in medicine, although the 1901 Nobel Prize for this was given to Von Behring of Germany alone. Similarly, during World War I, Yamagiwa Katsusaburo of Tokyo University discovered a technique for inducing tumors into laboratory animals (although again the Nobel prize went to the Dane Johannes Fibiger). It is true that some of this work was done abroad – Shibasaburo did his work in collaboration with Von Bering. Yet on the other hand, Shiga Kiyoshi discovered the

dysentery bacillus on work done in Japan. Yamagiwa Katsusaburo demonstrated that he could produce tumors in laboratory animals and Nagaoka Hantaro proposed a model of the atomic nucleus. A more recent example of Japanese creativity would be Kimura's neutral theory of evolution which posits that evolution did not take place primarily through competition.

Kimura has suggested that evolution proceeds not only by competition but also by adaptively neutral mutations. This is a major departure from the "struggle for survival" model of evolution going back to Darwin. Yet as Darwin himself admitted, his ideas were influenced by Malthus' views on population and the struggle for resources, as well as other social ideas of competition prevalent in the 19th century. Although research has to be done before any firm statement can be made, it is perhaps suggestive that Kimura mapped – consciously or unconsciously – some elements of Japanese-type group relations and *wa* in his model as Darwin did the opposite in his model, illustrating the creative potential of cultural crossflows.

Conclusion

The Japanese attempts at scientific tradition are within a particular national level structure. This social structure had developed out of pre-Meiji origins under criteria, carefully laid down from to time, by members of the Japanese ruling elite. These efforts had given rise to a highly conformist, though very productive society. It had also attendant negative social facets like the delegation of women to a second-class status, and the spreading of a blanket of conformity.

The present search for scientific tradition with its slogans, and cries about "crazy" ideas, as well as the urging of "non-conformity" seems at first sight to be a challenge to this conservative society. However, it is very unlikely that exercises of "craziness" would take hold in the Japanese society at large, so as to shake it from its larger conformist mold. The demands for scientific tradition come from the ruling elite itself who saw limits to their markets in the existing products and now are searching for a new product array. It appears that "craziness" is being introduced today under an updated *Wakon Yosai* ("Japanese spirit, Western civilization") which would very probably still allow the society to remain socially conformist and conservative.

However, reforms in the educational system, if followed with zeal, and if they actually encourage a move-away from cramming and drilling into sameness – might lead to a more democratic, pleasanter and less conformist society. Such effects however, will take place to a great extent in the longer term.

The present cry of scientific tradition had being emphasized at the highest levels of the Japanese system. Theses levels which have close links with large-scale production and other organizations, have themselves contributed structurally to the perceived sterility of the Japanese mind. It is very unlikely, therefore, that these holders of power would allow the traditional slogan to go beyond defined bounds, so as to threaten the status quo.

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