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A Field Note on Damascus Steels
— In search of modernity in traditional technologies —

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1. Background

1.1 This is not a research paper but a field note. It aims to keep a good communication with our collaborators both in and out of Japan.

Discussions on "technology and development" have been in a state of disarray over decades, and a good many number of the third world intellectuals and policy makers were interested in the Japanese experience in the modern technology: her transformation from the status of importer to that of exporter. It is needed for solving their urgent problems of economic development though technology transfer. To develop mutual understanding and the mutual help with the nations of the developing world, we had to sum up the Japanese experience in certain theorized schemes and schemata.

Our response is the frame work of "5Ms" and "5 stages" matrix, to define a nation's state of affairs in reference to the "development and technology" problem, although it is not easy to theorize and difficult to apply to other society without a careful and in depth studies of internal and international setting and background. Saying so, what I have in mind is an intellectual legacy and illegacy in the developing society: an Euro-centric universalist approach and/or pan-logicianist stance for solving their national development problems, with indifference to the local conditions and to the international context. In their discussions, technology is handled as an universally operative system: a synonym of capital funds. Therefore, they came to realize the importance of man power to operate machines disappointing results of development by technology transfer. Transfer of plants does not mean transplanting of technology as manufacturing system. The author conceptualizes the modern technology with 5Ms of materials, including energies, machines, manpower, management, and market.

All Ms are integrated by capital funds on one hand, and by information on the other. But it is not practical to handle technology problems just to integrate in such a terms of abstraction. Each one of the 5 components of technology is interrelated with other four Ms and forms the techno-linkage which determines the level and scale of a national economy. When technology is to be transferred for national development, such a technology should be of the trunk of developments and to expand the inter-linkages horizontally and vertically. The process of developments in the national technological linkage formation among the key industrial sectors can be divided into 5 stages: (1) of proper operation, (2) of proper maintenance, (3) of repair and minor modification, (4) national/local design, and (5) domestic manufacturing which means the self-reliance technology.
1.2 This scheme of technological self-reliance of a nation draws attention to the preconditions for a national techno-linkage formation, in the forms of traditional technology. In other words, the modernity in the traditional technology should be carefully exploited. The majority of the developmentalists is naive in selection of technology for industrialization with a conviction of that the latest is the best, being indifferent to the existing techno-linkage.

The function of techno-linkage is well demonstrated by the fact that the lowest component of 5Ms reduces others’ level and scale to the lowest level and/or smallest scale, which means that the development of techno-linkage takes not a linear but a spiral course. And the latest technology requires the most sophisticated sets of technology network and services: this is the reason why the high technologies are trading almost among the industrially advanced nations only. Therefore, for the developing nations the most urgent task is to build a national linkage of technology at the minimal level and scale at first. When a minimal techno-linkage was established, it is not hard to absorb the latest technology in certain sectors of industry. In this manner, we had found the Damascus steels as the most typical case of traditional technology in handling the “technology and development”.

2. Damascus Steels

Steels from Damascus have been famous all over the world for several centuries. The Damascus swords were well known by their sharpness and the watered patterns on the blades, which sometimes were combined with designs incised with gold and silver in the surface to add elasticity by means of an elaborated fine art. Metallurgical analysts have proved a supertough and superplastic quality of the Damascus steels, which is specific to Ultrahigh carbon (UHC) one. UHC steels have a very large potential market due to their plasticity at intermediate temperature and ductility but strength at room temperature, which implies a good material for the manufactural handlings.

2.1 On Damascus steel, we have to avide to mix it with other types of UHC, which involves solid state welding of strips of different steels or irons. The original Damascus steels were forged from a single casting in use of a very specific manufacturing process that does not involve solid state welding. But the surface markings of the two types of UHC are different in their metallurgical origins and appearances according to Wadsworth and his group of scientist (J. Wadsworth, et al., 1986).

They describe the welded Damascus as “were made of low and high carbon steels.” And the other solid state welds were made between wrought iron and a low or medium carbon steel, for example the Merovingian blades. Points we have to confirm then is that there are two types of Damascus steels in view from metallurgy, instead of similarity in the appearance of watered or streaked marks on the blades. And the “origial” Damascus is made from steels, hard and soft, and not from welding of iron and steel.

It is an unsolved question whether the technology of Damascus steels was born in the Syrian city and its development was confined to the city alone. The Damascus steel, so it was called in the West, was one of the produces from various parts of the islamic world, according to an Arab historian of science and technology, Ahmad Y. al-Hassan. However, he
emphasises the appearance of the firind (watwered) on the native “white” steel (al-biith) blades. In this context, we have to satisfy to define the “Damascene” as a Arab-muslim original but Damascus is the most important centre of the technology for several centuries.

2.2 The field work we had conducted in the city of Damascus, in 1990, has proved that there is no remnants to reconstruct the real picture of traditional steel manufacturing technology. For instance, the Kaka Brothers who keep the family atelier is a dependant to the German steel for a long time. Therefore the key part of the technology had disappeared decades ago. The only swordsmith operating in Aleppo also could give us no information on the welding of steels and he also uses the German made steels as material.

The Western sources tell us that the Damascus steel is made from the wootz steels of India. However, as recent studies made clear, various types of steels were available in the muslim world, for instance Khurasan and Fars were well known not only manufacturing but also exporting. Then we start from an assumption that Damascus was supplied a good many types of steel from every corner of the islamic world, including India.

We have no intention to deny the value of wootz as a material for the Damascus steels, although not a single source. We conceive it is reasonable from the facts that the Syrian region was not well allocated the iron ore and the woods to make charcoal which was indispensable fuel. It is well known the Lebanon produced both of them for a long time. But we are not sure the real amount of their produce; probably very small. Of course it is an important but not well surveyed subject of historical ecology of the forests and trees in Syria and Lebanon. Thus our interests went to the problems of wootz in relation to the Damascus steels.

3. Wootz Steels

3.1 Several chemical analyses of Damascus swords record values of carbon content ranging from 1.20 to 1.80. However, the Indian wootz cakes used to contain around 3% C. Therefore wootz C was to be reduced to a level of around 1.6% in the final blades. A decarburization step was to be taken up prior to or during working. Detailed descriptions were given in the J.D. Verhoeven papers (1978).

One of the questions handled by scientists was the time and a maximum reasonable temperature for the decarburization process. This was a point of discussion in Europe whether a charcoal fire can heat the cake to melt or not. The charcoal problem is also of our concern but from a different reason for, albeit some types of charcoal fire can make enough heat for the treatment of steel cakes, as was the case of Japanese steels for swords.

In reference to the above mentioned 5Ms, we are paying attention to the local availability of the high quality charcoal to meet the needs of weldings in Damascus. It is reasonable to suppose that the most suitable source for the charcoal is of oaks, and then pine trees, as well as of cherry trees for the Japanese traditional steels. In this concern, we are skeptical to the conventional arguments on Damascus steels which never seriously touch to the sub- and/or supporting materials, apart from the ore. The impotence of such supporting resources has not been well understood in the third world in particular in discussions of technology problem. The natives gave us informations on the trees for charcoal, which is still in use for their daily
life. It was a good information but scale of consumption is quite different to the industrial use, far larger amounts were in need for the steel manufacturing. If our experience is applied here, more than the same amount of fuels is in need to that of the ore iron in terms of weight. In view of the 5% ores, more over 20 or 30 times of charcoal in various kinds is needed for final steel products. We have no reasonable information on the total amount of steel production in the city of Damascus and Syria proper, the production of steels was to be far larger than the level to keep the natural cycle of trees for charcoal.

In this sense, we conceive Damascus as the final station of manufacturing relying supply from various parts of India, Central Asia, Persia, and Arabia. Damascus was not the sole city which held the skills of traditional steel making in the Arab lands but sure to be a key city as was well demonstrated by the excellent products of the Asads’ atelier, which were now kept in the Army Museum of Damascus. The peak of Damascus steel making technology was very late against its fame in the West. The Asads was well known among natives since the later half of the 18th century, and many of their masterpiece were produce of the mid-19th century. The mid-19th century is on the other hand to be remembered as the time of decay to the wootz steels in India, due to the British policy of taxation to the ironmasters and for the forest preservation, which had wiped out the traditional Indian skills of steel making according to the India’s scholar Shri Dharampal of Madras. One of the most precious information given to as from him and his group was that charcoal from bamboo was in use in the south India to produce wootz.

Unfortunately the author could not identify the information in the field, because of remotness of the scattered settlements of wootz makers who are very defensive to the outsiders, said an informant.

3.2 Another point of wootz is of its convenient size for a long distance transportation by the pre-modern means. The steel is made in a small clay crucible and the steel ingot of around 1 lb in weight (454 g). Dimensions of a crucible are 8 in (203 mm) length x 2 in (50.8 mm) diameter x 0.25 in (6.35 mm) wall. A cake of wootz is around half a kilogramme and 100 cu in and not fragile, no need of package. The crucible charge consists of bloomery iron + wood chips (usually cassia auriculata) + fresh leaves (convolvulus). The crucibles were covered with charcoal and heated by combustion with air from bellows. This cake of wootz is a source of Damascus steels, although this is not the “true” Damascus according to a definition of it.

As referred before, however, Damasenes were welded from two types of steel: one of which was sure of wootz. The process of wootz requires the same weight of charcoal including of bamboo with the bloomery iron. Then a tremendous amount of charcoal is needed for manufacturing of steels from the beginning of the work to finalise to steels. This is the reason why we assumed Damascus as a final manufacturing site but not holding the whole process.

By the same token, the production site of wootz rotated its location in certain space of time, due to the shortage of charcoal supply and probably it is one of the reasons the British made a conservation policy of forestry to block floods.
3.3 Our interest here focused on the revival of traditional wootz technology in line with the modernization of steel industry of India. The reason behind our interests was a fact that the south Indian iron ores are not fit to the modern operation of iron and steel mills of the large scale production. But the small scale, widely scattered wootz artisans had been making such an excellent steel for long times. If their skills were restored, a tremendous amount of capital investment is to be saved.

This is our point to integrate the modernity in traditional technology with the modern operation. Unfortunate to us is no indepth information available, apart from some of the Britisch records. The situation surrounding artisans is the other factor which blocks us to make access to the reality of wootz production in India today.

4. Prospects

4.1 Our research are to be summed up in the followings: An extensive survey on the available informations of wootz technology in terms of 5Ms, in particular to the management of technology. We have in mind to conduct field-works in other parts of India and the Middle East: Peshawar in Pakistan, Yeman, and northern parts of Iran. The field work is basing on a methodological frame work of "triangle study; in search of a possibility and feasibility on transfer of traditional technology and its integration with the modern systems, three different societies will be carefully analysed at the same time. This an ambitious project which demands an international collaboration of researchers. This triangle approach is set up with an aim to avoid a trap of the over-simplified model of technology development which is based on Euro-centric universalism: dichotomy of the developed and the developing societies. It is impossible today for the developing nations to make full use of the merit of the late starters, because of tremendous gaps of technology level between the advanced societies and of the national network of techno-linkages. In this sense, the only way to break through is to build up a new mode of collective self-reliance with neighbouring nations being free from the classic European way of a national path and to find out a nation’s own way of development in a new international setting.

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