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Field Reports

Perspective on the Pyu Landscape†

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In January 1998, a small group of anthropologist, archaeologist, historian, ecologist, and soil scientist of international composition (from Japan, from Thailand, from Indonesia, from United States, and from Myanmar) visited six sites of the ancient Pyu in the Upper Ayeyarwady (Irrawaddy) Basin. Three of these sites had been known since the British time; Srikshetra (also spelled Sri Ksetra, and also known as Thare Khittara, located near Pyay or Prome), Beikthano (also spelled Peikthano, and also known as Vishnu City, or Panhtwa), and Halin-gyi, and the other three, Mongmao, Thegon, and Wadi, were identified more recently by U Aung Myint, who accompanied the group.

The Pyu cities are believed to have thrived nearly a millennium till around 9th century A.D., though this does not necessarily mean that any one individual city of the six existed throughout this time span. They are in the Dry Zone of the Upper Ayeyarwady Basin where annual rainfall ranges between 600 and 1,200 mm. The space within which the six Pyu cities distribute roughly overlap the sphere of the Bagan (Pagan).

The objective of our trip was to learn more about the man-environment interaction in this area and its changes over time in relation to the development and subsequent demise of the Pyu, similar to other cultures which developed also in the relatively drier areas of neighboring countries, namely, northeastern Thailand, northwestern Cambodia, central-eastern Java, northern Sri Lanka, and central Vietnam.

In this piece we summarize our impressions from the field survey and present a preliminary analysis of the findings.

I Two Access Routes from the Upper Ayeyarwady to the Sea

The Ayeyarwady Basin occupies the depressional portion of a geological unit called the West Burma Plate. It is clearly demarcated by Arakan Yoma on the west (an accretionary plism caused by collision of the Indian Plate to the West Burma Plate) and the Shan Plateau on the east (the boundary is the Sagain-Namyin strike-slip fault). The basin, mostly covered with Tertiary sediment, is divided into two parts, the western trough (interdeep) and the eastern trough (backdeep), by the now extinct Bago (Pegu) Yoma volcanic arc running north-south through the Jade Mine, Wuntho, Mt. Popa, and the Bago Yoma. The western trough is further subdivided into the Upper Chindwinn (Chindwin), the Central (or Ma-gway (Magwe)), and the Lower Ayeyarwady Basins. The Central and Lower Ayeyarwady Basins are separated by the Tayetmyo (Thayetmyo) Syntaxis. The eastern trough consists of the Monywa-Shwebo Alluvial Plain,

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the Sittaung (Sittang) Depression, and the Bago Alluvial Area.

The Ayeyarwady River flows down southward within the eastern trough until its makes an abrupt turn at Sagain toward the southwest. After crossing the volcanic arc around Pakkoku into the western trough, it flows down southward to the delta. Most probably, the Ayeyarwady used to flow straight to the south from Mandaley to the Mottama (Martaban) Bay through the Sittaung Depression. This depression becomes a narrow corridor (a few tens of km wide) between the Shan Plateau and the Bago Yoma. Presently the corridor is drained to the north to the Ayeyarwady and to the south to the Sittaung River. The divide is somewhere between Pyawbwe and Yamethin.

Thus, the Upper Ayeyarwady has two access routes to the sea ; the one along the Ayeyarwady directly to the sea, and the other through the corridor to Mottama. The former actually is part of the great distant route to Yunnan via Bhamo, and navigable most of it. The part downstream of Pyay along this route must have been only sparsely settled until the mid-19th century. The latter is mostly an overland route and passes through the fertile lowlands apparently densely populated since the early times. Kyaukse, Meiktila (Meikthila), and Toungoo are all located along the corridor, with Bago at the southern exit.

II Site Characteristics of the Pyu Ruins

Halin-gyi

The Shan Plateau and the eastern trough are demarcated by the north-south running Sagain (or Shan) fault as mentioned previously. There are many minor ridges running parallel to the Sagain fault within the trough. The most conspicuous of them is the one along the right bank of the Ayeyarwady north of Mandalay (the Meiktila Ridge[1]). In the Shwebo area, there spreads an extensive alluvial fan formed by the Mu River to the west of the ridge. It is said that this area is one of the centers of ancient irrigation. The Halin-gyi site is about 15 km southeast of the town of Shwebo, but located neither on this alluvial fan nor far from it (within a few km). The site itself is in the gentle hills of the Meiktila Ridge.

There are small streams with limited catchment in the ridge area, but lowland area suitable for rice cultivation is negligibly small. Salt fluorescence occurs on the soil surface of depressions during the dry season. It is collected, dissolved in water, filtered, and boiled to make salt. Subsurface mud flow belches on lower slopes (called *'nam duun'* in Northeast Thailand). There is a hot spring in the village. By crossing the Meiktila Ridge to the west, one is within 12 km of the Ayeyarwady.

Wadi

This site is on the erosional terrain with gentle undulation within the eastern trough near Nwahtou-gyi (Natogyi). The site is on a relative high point surrounded by local depressions. Inside the city wall the land is planted to dryland crops, such as sesame, pigeon peas, castor-oil plant and others, or used as pasture. The site is within the watershed of a minor intermittent river flowing to the west to the corridor of the Sittaung Depression.

Mongmao

This site is within the corridor bordered by the Shan Plataeu and the Meiktila Ridge. It is about

1) This is the naming in this paper since it extends to the south of Mandalay, and one of the largest ancient reservoirs at Meiktila is made by damming up a river flowing from the west to the east through a gap of this ridge.

25 km southeast of Kyaukse, and at the foot of the Shan Plateau. One of the two rivers supplying water to the ancient irrigation systems in the Kyaukse-Myittha area flows down from the Shan Plateau and forms a fan here. The site itself, however, is too close to the apex of the fan and too high to be suitable for rice cultivation. Though rice is grown inside the city wall presently, it appears not well irrigated. The Mongmao site can be connected to the Ayeyarwady by waterway via the Myitnge River.

Beiktano

This site is about 20 km west of the town of Taungdwingyi in the western trough. It is in a shallow intramontane basin developed at the western foothill of the northern Bago Yoma. The site itself, however, is located on a relative high point (apparently a remnant of a river terrace) protruding toward depressions. No rice is grown inside the city wall.

About 10 km west, the rivers from this shallow basin join the Yin River flowing down from the Mt. Popa area. The confluence of the Yin and the Ayeyarwady is further downstream about 30–40 km near Ma-gwe.

Srikshetra and Thegon

The Central and Lower Ayeyarwady Basins are separated by the Tayet-myo Syntaxis which forms a bottleneck of the Ayeyarwady River between Tayet-myo and Pyay. The site of Srikshetra is 8 km southeast of the present town of Pyay, and at the foot of a north-south elongated hill, which forms the southern margin of the Tayet-myo Syntaxis. The Ayeyarwady flows the western side of the hill while Srikshetra is on the opposite side. About one third to one fourth of the area inside the city wall is lowland and planted to rice. The rest is undulating and hilly land rising toward the hill to the west. An extensive lowland spreads to the east as far as the foot of the Bago Yoma, where Thegon is situated.

The Thegon site is on a fan formed by a minor river running down from the Bago Yoma. The site is surrounded mostly by paddy lands, but not far from hill slope to the east.

Today, the Nauin (Nawin) River from the Bago Yoma to the east joins the Ayeyarwady at the town of Pyay, crossing a gap of the elongated hill. It is said, however, it used to flow the eastern side of the hill to the south toward the Inma Wetland. Both of the Srikshetra and Thegon might have been connected to the Ayeyarwady by the old Nauin.

Some Common Features

All of the six Pyu sites are located on locally high grounds. Existence of lowland suitable for rice cultivation within the city wall does not appear to be a vital factor in choosing the site. Nonetheless, the sites are always close to lowland, indicating the importance of rice cultivation in the Pyu societies.

Preference of higher grounds might be explained by avoidance of flooding. But one must consider the whole material base of livelihood then. The sites are not only high enough to keep out of flooding, but also close to hills which might have been vital as the source of fuel woods, construction materials, animal feed, medicinal plants, game and so on. Upland fields may also have been indispensable for the economic crops they provided, e. g., fiber and oil crops, which most probably would have been cultivated in a system of shifting cultivation on hill slopes.

The Pyu cities are walled of bricks without exception. Area inside the wall is 14.2, 4.8, 8.5 sq. km for Srikshetra, Halin-gyi, and Beikthano, respectively. These sizes are much larger than those of the Bagan cities. Considering the probable size of population then, it is evident that the

Pyu walled cities were not merely for urban use. As stated above, however, the inside of the cities is not suitable for wet rice cultivation. Dryland crops could be grown, but the volume of production does not appear to warrant the construction of walls. One possible explanation for the large size of the Pyu cities is to accommodate the useful animals. Whether these were elephants and horses for military purpose, draft animal for rice cultivation, or dairy herds is not known.

If dairy farming is really the case, the city may have been most interested in safeguarding its livestock population within its walls during any attack by a hostile group. According to T. Itoh, some Bagan inscriptions give reference to the use of milk products such as curd (yogurt); this may be a clue to the importance of dairy cattle in this culture. Meiktila, where we were served this traditional product (rather like 'paneer', the coagulated milk solids of Indian cooking) in a local restaurant, may be carrying on a very old Pyu tradition.

In any case, the site characteristics of the Pyu cities suggest that each city must have been self-sufficient in every material needed for livelihood. In other words, the economy, if not cultural life, of the Pyu societies was 'closed', while that of the Bagan 'open' in the sense that the latter commanded different ecological zones from a single center.

Ⅲ Bricks

The walls and other structures of various kinds in the Pyu cities are all made of baked clay bricks. The bricks attracted our, particularly Donovan's, attention due to their great number and size. At nearly every site we encountered the remains of massive brick structures composed of large bricks (more than four times the size of present-day bricks). Some walls were more than 2.5 meter wide and are estimated to have been as much as 6 meter tall, if not more; often these walls were set a meter or more into the ground. Some cities had not one but a series of walls separated by moats protecting a particular approach to the city.

The bricks themselves were also very interesting and clearly have their own story to tell. They appeared to vary considerably in several aspects, not only in size but composition and quality, both in terms of texture as well as firing. Several bricks were measured at each stop. Of the intact bricks scaled many were found to be approximately 20 cm in width by 40 cm in length ranging from 5 to 10 cm thick with these large bricks weighing 8 kg or more. Based on tactile and visual examination it appeared that some bricks were clearly more sandy than others with different materials often used as binder or 'frog' (plant residues incorporated in the clay during the mixing process to improve cohesion and reduce shrinkage during firing). The various binders observed included rice husk, straw, and small twigs. Apparently the skill of the brick maker(s) varied too, as patterns noted both in the baked clay and in the form of the finished product indicated poor mixing and sloppy molding techniques in some instances.

Often the bricks were found to be imperfectly fired, as indicated by the uneven internal coloring shading from purple to black in color and by irregular form (swollen, twisted and cracked). This may be due to poor management of the fuel or the equipment used (probably an updraft, clamp kiln still used in many areas of Asia today). The uneven firing may be understandable given the large size of the brick. On average about 10 to 15 percent of the bricks from traditional kilns may be over-fired. It is difficult to know, however, if the bricks observed represent a fair sample of the total production. It could be that the craftsmen recognized the superior strength of the super-fired bricks and

reserved these for use at the base of the buildings where greater strength and durability are required. In most cases the foundation is all that remains for study.

While we might hypothesize that the brick making technology was not yet well-developed in the Pyu cities, it should be noted that the level of technology revealed by the other artifacts encountered was very well developed. Finely detailed terra-cotta vessels, votive plaques, and various items of jewelry, especially gold, indicated a high degree of skill among the Pyu crafters. Perhaps it could be concluded that the actual brick making was let out on contract.

It is notable that the rough measurements of several bricks are very conveniently one span (extended hand width) by two spans by about one finger length. In addition the bricks show regular markings (apparently made by the brick makers' fingers (2, 3, 4) in a variety of straight-line or crescent patterns). According to T. Itoh, a member of this group, these markings are peculiar to the Pyu period, and may indicate that the output was identified for some accounting or other recording purposes.

The series of finger marks and stamped inscriptions found on many bricks may not only be a tally of the number of bricks produced, but also suggests existence of a variety of kilns, or brick makers. An attempt to associate the various bricks with specific clay deposits in the vicinity (as identified by soil cores) might indicate the geographic extent of influence of the individual Pyu cities—the 'brick-shed', so to speak.

From the perspective of resource utilization one of the most interesting aspects of brick production is its fuel consumption. The primary source of energy for brick production and, indeed, all industry during this period, as well as domestic cooking and heating, would have been wood. A rough estimate, based on Donovan's previous work in Nepal with traditional brick kilns, would indicate that one cubic meter of bricks would have required at least the same if not twice that volume of wood, depending on the tree species used and the kiln. If a vast number of trees were cut to provide fuel for brick production, among other uses, the subsequent impact on local forest and consequently hydrological and meteorological conditions may have affected the fate of the Pyu civilization. Given the very dry climatic conditions in this area, one would expect vegetation growth to be relatively slow. It may have taken up to 60–100 years for fuel wood supplies to replenish themselves. Under the present conditions the natural forest vegetation occurs in sparsely wooded areas, in savanna-like in character, is dominated by drought-hardy tree species such as acacia. Given the relatively limited availability of fuel in this area, is it possible that the bricks were produced elsewhere and transported to the city sites ? Could one of the reasons the Pyu cities were located near foothills be to ensure good access to fuel and building materials (mainly wood, clay and bamboo), some or all of which may have been transported from the hill forests ?

Ⅳ Vegetation

The other aspect of the landscape that was of particular interest was the pattern of vegetation. Apart from reflecting climatic conditions, the pattern of vegetation clearly evidenced intensive human intervention. From the large size of the tree specimens (some as much as two meters in diameter) along the main roads it appears that the tradition of 'street' trees clearly dates back many decades if not longer (this is confirmed by similar patterns observed in the frescoes dating from the 19th century and earlier). The villages, a set of tightly grouped households, were distinctive on the landscape because of the especially large amount of greenery associated with them.

Trees, mainly for fruit but also clearly used for fuel including tamarind (*Tamarindus indicus*, a native of Africa), jujube (*Zizyphus jujuba*), various cassias acacias and *Albizia* sp., were abundant in the village and household compounds and village common areas. Trees were also common on field edges, the most frequent being the sugar, toddy, or palmyra palm (*Borassus flabellifer*). Many of these trees are common in India as well and may have been introduced in ancient times and become naturalized.

V Live Fences

The feature Donovan found most curious, however, was the widespread existence of live fences, that is, specific plant species (*Acacia, Euphorbia, Agave,* among others) planted in such a way as to create physical barrier to entry, especially for free-ranging livestock. The size, structure, extent and complexity suggest that this fencing may date from many years ago, especially given the current relatively low population of livestock and the management of these animals. In the areas visited we observed mostly working bullocks, approximately two per family, with only a few of what appeared to be dairy cattle breeds. These animals, for the most part appearing healthy and thriving, were generally tethered to a stake when grazing or fed from a trough in the farmyard. Occasionally goats and sheep were observed but not in any number that seemed to warrant the effort put into hedging. Thus, it may be that the vegetative fencing reflects past management practices and older traditions.

Around Meiktila, the situation was somewhat different. One could observe a greater population of grazing animals—dairy herds of cows plus calves and also small herds of goats and sheep, each herded by a young boy or old man, sometimes accompanied by a dog. Curiously, in this area the fences were in poor repair. It should be noted, however, that the canals in this very dry area also appeared poorly maintained. The animals too were skinny and in poor health. Perhaps these conditions of deteriorating environmental management reflect external factors affecting labor availability for communal projects or farm and household economics in this area.

VI Bamboo

One type of vegetation almost entirely absent from the environment in the areas we visited was bamboo. Only scattered and sickly looking clumps of bamboo were observed almost throughout the entire trip. Given the exceedingly dry conditions of this area, the absence of bamboo is not surprising, except that the primary construction material used in housing, in village fencing and for basketry is bamboo. Frescoes from the last century show that houses made of bamboo were equally popular then. Although brick structures covered by stucco were used for important government and religious buildings, the common people and lesser government functionaries were housed in bamboo or wooden structures. These are particularly well adapted to the climate providing a cool and comfortable living environment. Nowhere in the dry zone was there observed sufficient local reserves of bamboo to support the even relatively modest requirements of one of the ancient cities, much less today's population. The heavy use of bamboo by the household would indicate that bamboo is an important trade item, both presently and in the past when it was floated down from the foothills in rafts.

VII Environment Deterioration

It is difficult to ascertain whether the grazing

might be the cause or the result of the desiccation of the area visited. When the first settlers arrived, was the area in which the Pyu cities developed as dry as is currently observed ? Has the climate changed ? Did society's activities, especially brick making with its heavy demand for wood fuel, contribute to the desiccation of the area ? Were livestock a key element in the traditional economy ? If so, did overgrazing contribute to declining soil productivity and a dryer micro-climate ? Or perhaps the livestock were introduced only later, when crop production alone became insufficient to meet the needs of the populace ?

Overgrazing and destruction of forest with the subsequent hydrological changes could have led to increased erosion and sedimentation which would have blocked water channels used for irrigation, navigation and defensive barriers. Were the effects of environmental change exacerbated by a warming trend in the environment that existed in the northern hemisphere (at least as documented in Europe) in the period 800 to 1200 A.D. ? The landscape patterns observed could reflect the impact of ancient technology and institutions or of ideas introduced only last century, virtually yesterday.

We may get more clues if and when the Pyu inscriptions are decoded further. These queries may remain hypotheses, however, until more modern scientific techniques can be applied to develop the data required to answer questions as noted above. The first step may be to pursue an analysis of the clues stored in the bricks which were made of the very basis of Pyu civilization, namely, the clay soil. Sophisticated technology may be able to yield through microscopic analysis of soil samples and the baked clay important information regarding environmental change and adaptation during the Pyu period.

The lessons that can be learned from the man-environment interaction in the past should not be lost on today's scientists and policy makers ; we still face many of the same problems today. Will modern society let manmade environmental change push our civilization to the edge of extinction ?

Ⅷ Restoration of the Dry Area !?

Almost ten years have passed since T. Itoh visited some of the Pyu sites, apart from Thegon and Wadi, which he visited for the first time on this trip. Great changes which have occurred during the last decade were observed ; some brick mounds and sections of the city walls have been excavated, and new access roads to the sites constructed. But the most striking change is improvement of the economic conditions of villages near the sites.

At Halingyi, for example, population and the number of households increased significantly. The village has several shops selling everyday necessities, and even coffee shops. Some houses have TV sets, pickup cars, and motor cycles. Acreage of paddy fields increased, and double cropping of paddy was introduced together with rehabilitation and enlargement of old irrigation systems. Some peasants have power pumps to irrigate their own fields. These changes appear very much due to the change of government policies. Before 1988, remote areas in the Dry Zone such as Halingyi were out of the government's concern. The government encouraged production of only some exportable commodities, such as rice and some kind of beans with which it can earn hard currency. It distributed high-yielding varieties of rice and chemical fertilizers, but targeted to the Wet Zone in the Lower Ayeyarwady, and better-irrigated areas in the Dry Zone only. Even with these efforts, the government was not successful because it purchased the resulting products at fixed, low prices. This suppressed the income of

peasants, who, therefore, were not willing to follow the government policy. The decline of export prices in the mid-1980s worsened the situation. The government finance continued to deteriorate. It could not afford any development program for poorest areas in the Dry Zone.

In 1988, the government began to introduce a market economy. Peasants were allowed to sell most of their crops at market prices. Also, a new rice variety suited to the winter season was introduced, while old irrigation systems were renovated, and new cropping systems developed for the winter rice. The income of villagers was much raised.

Another change in the policy was emphasis on tourism as a means of earning foreign exchange. Historical and archaeological sites were developed as tourist attractions. The whole Bagan area was designated as the Archaeological Zone. Each foreign visitor is required to pay an admission fee in US dollar to visit Bagan. When the Pyu sites are restored and become the Archaeological Zones in future, we will be charged entry fees.

T. Itoh is rather pessimistic about the effectiveness of these policies, that is, rice and tourism, for sustainability of the peasants life in the Dry Zone. Tourism may create some local employment, but, under the present government policy, most of the profit would go to the central government. The historical and archaeological findings suggest the great diversity of farming system of the Dry Zone in the past, which included cultivation of, apart from rice, jowar, sesame, millet, pulses, and cotton, as well as animal husbandry. Concentrating efforts on the production of rice in monocultural systems for sale on the world market, which is out of control of the Myanmar government, cannot guarantee the sustainable livelihood for the peasants of the Dry Zone, either.

Report on International Co-Workshop on the Projects of "Inter-ethnic Relations in the Making of Mainland Southeast Asia (CSEAS, Kyoto University)" and "Social and Cultural History of the Tai Peoples (Chulalongkorn University)" at Chiang Mai Orchid Hotel, Chiang Mai, Thailand, March 28–29, 1998

By HAYASHI Yukio*

Conducting empirical field studies in mainland Southeast Asia was impossible until the middle of the 1980s except in Thailand. Due to the end of the Cold War, however, the region has entered into a new era. Foreigners are gradually being permitted to visit Thailand's neighboring socialist states that are opening their markets to the outside world. Academic networking has also begun especially among the countries along the Mekong, and inter-regional cooperation across national boundaries has been rapidly developing.

With this background, current research on Tai peoples and their neighbors across national

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