Prehistoric Man And His Environment
Evidence from the Ban Chiang Faunal Remains

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Deciduous vegetation during the dry season near Ban Chiang. This area is being cleared and dykes are being built for new paddy land.

Credits
All photographs by Joyce C. White except Fig. 8 by James S. Penny, Jr.

The excavations at Ban Chiang have opened a new chapter in our understanding of Southeast Asian prehistory, not only because of the richness of the material culture, but also because of the wealth of data on the environment and economy. Over five millennia of human occupation on the Khorat Plateau have transformed the landscape. Plant and animal communities as well as the flow of water and even the nature of some soils bear little resemblance to the situation when prehistoric man first settled there. Some species are now locally extinct, others have been successively introduced. Natural marshland has been converted to rice fields, and extensive tracts of woodland have been cut down.

WET AND DRY SEASONS

Some basic elements of the environment, however, are quite probably similar to those encountered by the prehistoric population. Thus the sharp distinction between the wet and dry seasons, which so affects the present adaptive behavior of plants and animals, probably obtained throughout the prehistoric period. This conclusion is based on the growth characteristics of prehistoric specimens of Pila ampullacea, a shellfish which adapts to the dry season by burrowing into soft soil and aestivating.

The vegetation best adapted to such marked seasonal fluctuations in rainfall is known as moist monsoon forest. The popular conception of tropical Southeast Asia as being covered by a dense canopied rain forest is quite incorrect. The moist monsoon forest comprises many tree species which lose their leaves during the long dry season (Fig. 1). Access of light to the forest floor promotes a thicker mat of herbaceous plants and grasses than is the case in adjacent regions, where more evenly distributed rainfall sustains canopied, evergreen forest. Consequently, many animals are specifically adapted to the deciduous form. We should not, however, view the Khorat Plateau as a relatively flat
The three terraces and the swamp grassland found on the perennially inundated flood plains. Swamp grassland, of course, have been much restricted in small, incised tributaries of the major rivers. Wild rice is one of the plants which was probably adapted to such areas. Indeed it is still found in parts of northeast Thailand.

The relationship between plant and animal communities was probably intimate. Such large herbivores as the rhinoceroses, elephant, water buffalo and Schomburgk's deer are historically recorded in the swampland plains habitat. Conversion of such areas to irrigated rice land through water control programs during the last 150 years, has practically eliminated all four. The Schomburgk's deer is now extinct.

A Thai woman collecting snails (Pila unguiculata) on the edge of a seasonal lake near Ban Chiang. This snail was also collected by the prehistoric inhabitants of the area.

While wild water buffalo survive only in remote parts of Uthai Thani province. The swamp land would also have sustained numerous species of fish, shellfish and amphibians. Rain tigers, for example, is a frog adapted specifically to the flood plain habitat.

The drier woodland on the low to high terraces would also have had its own faunal association. The largest species are the wild cattle and sambar deer. Pig, deer, wild pig and musk are found, and their predators were formerly the tiger, leopard and jackal.

It is self-evident, therefore, that we can obtain much information both from the location of sites like Ban Chiang, and from the animals exploited by their prehistoric inhabitants.

THE ENVIRONMENT WHEN FIRST SETTLED

During early 1960 we undertook an intensive site survey in the area southwest of Ban Chiang and found numerous prehistoric occupation sites (Fig. 3). Our analysis of the distribution of these sites revealed a significant affinity with small streams and low terrace soils. No such sites, however, were found near the flood plain soils of the large Phao River. When we turn specifically to Ban Chiang we see that the first occupants there chose proximity to three small tributary streams and an extensive tract of low terrace soils. The basal levels of Ban Chiang included...
The faunal spectrum of Ban Chiang, showing the relative frequencies of species identified with time. A cross indicates a trace only, a dot indicates absence.

A fish was caught along a lake near Ban Chiang. We have no direct evidence of fish traps in the archaeological record but if they were made of perishable materials, as they are today, they would not have survived. The prevalence of trapping today suggests that traps may have been used in prehistory.

Chiang are two species of the genus Pila. Modern specimens of Pila polli sought in the vicinity of Ban Chiang during 1979 were invariably associated with permanent, still water such as that found in lakes and swamps. The same applies to Pila ampullacea except that this species can survive by the process of estivation if surface water evaporates completely during the dry season. Its preferred habitat then, is in swamp margins or seasonally fugitive bodies of water. Density decreases markedly with distance from such areas.

The gastropod Filopsulina lives in still, or slowly moving, water while Trochotoma lives today in still ponds and lakes. Both occur in early shell middens at Ban Chiang. The small gastropod Bythinia lives in small, slow-moving streams, and was probably collected unintentionally when hand dredging for other species. Taken in conjunction, this range of shellfish suggests an environment containing bodies of permanent, still water and clear, slowly moving streams.

There were also some remains of land snails at Ban Chiang. Of these, Cyclorhaphus and Hemipecten are interesting because they are currently found in Dytrocorpus forest with a well-drained litter. This finding supports the conclusion that the low to high terraces were under a similar forest cover during the early part of the prehistoric sequence.

The faunal spectrum (Fig. 5) confirms the exploitation of species which adapted to permanent water. There are at least three varieties of fish, and probably many more were exploited. The three species represented have particular dura bones and it is surely likely that there were smaller, more fragile specimens which have not survived. Trionyx and Chiura are soft-backed turtles, and Renu is the small frog described already as one adapted to flood plains. It is currently found in paddy fields around Ban Chiang. There are also a few remains of the otter (Lutre). The lowest level at Ban Chiang is the only one to contain the bones of the squirrel. This animal is, of course, well adapted to woodland. Three other small mammals, the mongoose (Herpestes), small Indian civet (Viverricula) and hare (Lepus) are, by contrast, more often found in grassy forest clearings. Ground-dwelling mammals are numerically dominant in all phases at Ban Chiang. Pig remains are particularly numerous in the lowest layers, followed by those of cattle and deer.

Now the only site in northeast Thailand which is comparable with Ban Chiang in terms of area excavated is Non Nok Tha, where cattle and pig bones were found in association with the human burials. The cattle bones are demonstrably smaller than the modern, indigenous wild cattle of Thailand, and the shape of pigs' crania is distinct from the wild form. Both, it is felt, come from domestic animals. There are fewer complete pig or cattle bones from Ban Chiang, but the same conclusion arrived at for fish bones is justified on the basis of the size of the specimens available. The first settlers introduced domestic herds, but also hunted wild animals.

The deer bones come from three species, all of which are adapted to the dry deciduous forest. All large antelopes come from the Sambar rather than the Schomburgk's deer. The latter is of similar body size as the Sambar, but has a broader spread of antlers, reflecting its adaptation to an open habitat.

The dog is also abundantly represented from the first use of the site. It was of the same size as the modern village dog, and descended, according to the shape of its skull, from the wolf. This is particularly interesting, because the wolf is not indigenous to Southeast Asia. Indeed, China is the nearest area which sustains the wild wolf. The dog is the only exotic species found at Ban Chiang.

The scribing procedures at Ban Chiang ensured recovery of the smallest bone fragments, and so make feasible to consider not only species present but those which were not represented. There are no animals specifically adapted to the evergreen rain forest. Absent too are the large animals adapted to flood plain swamps; there are no remains of water buffalo, elephant or rhinoceros.

There is little doubt that the initial economy at Ban Chiang was wide-ranging. Apart from the introduced domesticates, a wide range of species was exploited. We may envisage such activities as fishing and shellfish collecting in the permanent lakes and of trapping in or near forest clearings.
Hunted animals included the huge wild cattle, known as the Casar and Banteng, as well as the deer and the tiger. Snails and tortoises were collected in the shaded forest, and the number of wild birds suggests that they, too, were sought. Only a handful of species was represented at Non Nok Tha, due to the hard nature of the soil there and lack of sieving procedures. Nearly Fifty different species come from early Ban Chiang, presenting a picture of a vigorous, broad spectrum economy.

**CHANGES DURING THE EARLY AND MIDDLE PERIODS**

There was little change during the Early Period. We can add as new species the rare and elusive fishing cat (Felis viverrina), the Bengal cat (Felis bengalensis), the Burmese ferret-badger (Molochos per- somata) and a spiny eel (Mosteimicus). These confirm an interest in aquatic and forest species. There are also a few bony scales from the crocodile, and one bone from the water buffalo.

A more pervasive change in the animals represented had come by the Middle Period. While these may seem of little note individually, in conjunction they present a coherent and very intriguing picture. In the first place, we find that the water buffalo became relatively abundant. Moreover, the bones come from an animal identical in size to the modern domestic breed in Thailand and much smaller than the wild type. It may well be that the narrow flood plains of the small streams which flow past Ban Chiang were not extensive enough to sustain wild water buffalo, and that a domestic form was introduced by the Middle Period (the later Om Ko era phase).

As the water buffalo became established, many of the aquatic species became increasingly rare, or ceased to be represented. Thus the otter was no longer found, while bones of fish diminished in frequency. The number of small mammals which prefer open terrain also diminished markedly. With the exception of the very latest layers, which may reflect access to firearms, bones of wild birds became rare. The domestic chicken, however, was relatively abundant throughout the sequence.

The bones described above reveal numerous instances of butchering and burning consistent with food processing. It may be that changes with time in the frequencies of animals are due only to sampling bias, for only a tiny fraction of Ban Chiang has been excavated and perhaps other parts of the site would present a different picture. On the other hand, the faunal spectra of two nearby sites, Ban Tong and Ban Phak Top, (Higham and Kijmang 1979) are very similar indeed to that described for Ban Chiang itself. This situation suggests that we are dealing with an economic pattern, and that we should seek to isolate possible reasons underlying it.

**RICE CULTIVATION**

At this juncture, it must be emphasized how unrealistic it would be to interpret the Ban Chiang faunal spectrum without incorporating other aspects of the culture responsible for it. For example, innovation in technology and the pressure created by any proposed population increase are critical factors which need consideration.

Of particular relevance is the nature of any rice cultivation which integrated with animal husbandry and acquisition of wild species.

The close association of all known sites like Ban Chiang with low terraces soils near tributary streams itself encourages the notion that the prehistoric occupants were concerned with the cultivation of rice (Fig. 10). Rice shaft is found as a temper in early pottery from Non Nok Tha and Ban Chiang (Yen 1977). For a study of the relationship between Ban Chiang pottery and rice, see the article by Douglas Yen, pages 51-64 of this issue of Excavation.

There are several methods of cultivating rice in northeast Thailand. One is to remove competing plants by cutting and dry-season burning along the margins of lakes and swamps, and planting out the seed in the cleared terrain. This is known as watercourses. This is achieved by building banks between fields. Where the land is flat, this is fairly straightforward, since soils are soft and easily worked. Increased slope, however, can involve considerable effort in restructuring the landscape. This 'wet rice' system (often known as paddy cultivation) is particularly productive when the soil is turned by the plow, because plowing ares the soil, kills competitive weeds by up-ending them, and helps create a hard pan of fine soil particles below plow level which retains water in the field. Again, the slow percolation of water dis- senniates blue-green algae which fix nitrogen, while upturned weed decaying under anaerobic conditions release valuable plant nutrients. In a word, plow wet rice cultivation allows annual cropping even on poor, sandy soils.

There is no evidence for wet rice cultivation...
FURTHER CHANGE IN THE MIDDLE PERIOD

With the Om Kaeo phase, however, the situation changed markedly. Following the introduction of the water buffalo, aquatic species and the small grassland mammals declined. It is tempting to view these changes as the reflection of a basic shift to wet rice cultivation, for conversion of forest to rice paddies plays havoc with the water regime. Water which formerly reached the water table and fed perennial streams remains on the surface, where evaporation is high. Where this occurs today, streams dry out for part of the year, ruling out the survival of many species of fish. The direct access of monsoon rainstorms introduces turbid water into streams and lakes, endangering filter feeding shellfish and those species which rely upon them. The availability of iron by this time would have expedited the process of forest clearance, due to its superior cutting qualities compared with bronze. Perhaps it was also used to tip plowshares.

SUMMARY

We clearly need more evidence before accepting this interpretation of the Ban Chiang faunal spectrum. It would be helpful to have, for example, prehistoric depictions of plowing, surviving plowshares, or datable fossil fields. Such evidence is found elsewhere, but there is none in northeast Thailand. There are, however, the bones of animals which may have been used for traction. Examination of modern Thai cattle and water buffalo bones reveals that draft animals develop large bony ridges at points of tendon attachment. Just the same growths are apparent on corresponding water buffalo bones from Ban Chiang. To this extent, there is supporting evidence for plowing there from the Om Kaeo phase.

But why should the prehistoric inhabitants have embarked on the labor intensive task of clearing forest and re-modelling the landscape? A transition from wet swidden to plow cultivation of rice in fixed fields among the Dyaks of Kalimantan (Borneo) has recently been studied by the geographer Seavoy (1973). He concluded that population pressure leading to demands for more rice was responsible. Documentation of population growth in prehistory is hard to demonstrate, but Piotrusewsky has argued that in fact, the population of Non Nok Tha did increase during the prehistoric period. There is no doubt that by the 1st millennium A.D., occupation sites up to fifty times larger than Ban Chiang existed.

Ban Chiang is located in a part of the Khorat Plateau which receives relatively high rainfall. South of the Dong Mun hills, the plateau becomes increasingly arid. Indeed, it may well be that occupation of the arid Mun-Chi valleys by rice cultivators became a practical possibility only after water control methods had been developed at sites like Ban Chiang. The data from this great site illuminate not only the population's changing relationship with its environment there, but also the broader perspective of Thai prehistory.

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Bibliography

Gorman, C. F. 1977

Higham, C. F. W. 1975

Higham, C. F. W., and A. Kijngam 1979

Lekagul, Boonsong, and Jeffrey A. McNeely, with a chapter on Muridae by Joe T. Marshall and a chapter on Sciridae by Robert Askins
Foreword by Harold Jefferson Coolidge 1977
Mammals of Thailand. Printed under the auspices of the Association for the Conservation of Wildlife. With numerous photographs, line drawings, maps and charts.

Seavoy, R. E. 1973

Yen, D. E. 1977